Appendix E2

Monterey Peninsula Water Supply Project Groundwater Modeling and Analysis

Monterey Peninsula Water Supply Project Groundwater Modeling and Analysis

DRAFT

Prepared for: California American Water and Environmental Science Associates

April 17, 2015

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www.gssiwater.com

GEOSCIENCE Support Services, Inc.

P (909) 451-6650 | F (909) 451-6638

620 W. Arrow Highway, Suite 2000, La Verne, CA 91750

Mailing: P.O. Box 220, Claremont, CA 91711

THIS MODELING REPORT HAS BEEN PREPARED FOR CALIFORNIA AMERICAN WATER BY OR UNDER THE DIRECTION OF THE FOLLOWING PROFESSIONALS LICENSED BY THE STATE OF CALIFORNIA.

Dennis E. Williams, PhD, PG, CHG
Principal Hydrologist
CHG No. 139

Johnson Yeh, PhD, PG, CHG
Senior Geohydrologist
CHG No. 422

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MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

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Ltr.	Description
Attached	
A	Hydrologic Modeling of the Monterey Peninsula Water Supply Project Using the Salinas Valley Integrated Ground and Surface Water Model. Prepared by Luhdorff and Scalmanini, Consulting Engineers

ABBREVIATIONS AND DEFINITIONS

acre-ft/yr	acre-feet per year.
Alluvial	A geologic term describing beds of sand, gravel, silt, and clay deposited by flowing water.
amsl	above mean sea level
Aquifer	A geologic formation or group of formations which store, transmit, and yield significant quantities of water to wells and springs.
Aquitard	A geologic formation whose permeability is so low that is cannot transmit any significant quantities of water.
Dispersivity	A geometric property of a porous medium which determines the dispersion characteristics of the medium by relating the components of pore velocity to the dispersion coefficient.
Drawdown	The change in hydraulic head or water level relative to a background condition.
DWR	California Department of Water Resources
Effective Porosity	A fraction of the void spaces which forms part of the interconnected flow paths through the medium, per unit volume of porous medium (excluding void space in isolated or dead-end pores).
Fault	A fracture in the earth's crust, with displacement of one side of the fracture with respect to the other.
Formation	A geologic term that designates a body of rock or rock/sediment strata of similar lithologic type or combination of types.
ft	feet, foot
ft/day	feet per day
gpd	gallons per day
Groundwater	Water contained in interconnected pores located below the water table in an unconfined aquifer or located in a confined aquifer.
Head	Energy, produced by elevation, pressure, or velocity, contained in a water mass.

Holocene	An epoch of the Quaternary period extending from the end of the Pleistocene, approximately 11,000 years ago, to the present time.
Hydraulic Conductivity	The measure of the ability of the soil to transmit water, dependent upon both the properties of the soil and those of the fluid.
in.	inch
Leakage	The vertical movement (either downward or upward) of groundwater from one aquifer to another.
MGD	million gallons per day
mg/L	milligrams per liter
MODFLOW	A modular finite-difference flow model developed by the United States Geologic Survey (USGS) to solve the groundwater flow equation.
MT3DMS	A modular three-dimensional solute transport model for simulation of advection, dispersion and chemical reactions of contaminants in groundwater systems.
PEST	Parameter ESTimation software
Pleistocene	An epoch of the Tertiary period extending from approximately 2.6 million years ago to 11,000 years ago.
Quaternary	The second period of the Cenozoic era extending from approximately 2.6 million years ago to 5,000 years ago.
SEAWAT	Developed by the USGS to simulate three-dimensional, variable density, groundwater flow and solute transport in porous media. The source code for SEAWAT was developed by combining MODFLOW and MT3DMS into a single program that solves the coupled flow and solute transport equations
Specific Yield	Ratio of the volume of water that drains from a saturated soil or rock due to gravity to the total volume of soil or rock, stated in a percentage.
Storativity	The volume of water that an aquifer releases or takes into storage per unit change in hydraulic head.
TDS	total dissolved solids
Tertiary	The second period of the Cenozoic era extending from approximately 65 to 2.6 million years ago.

USGS	United States Geological Survey
yr(s)	year or years

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

1.0 EXECUTIVE SUMMARY

California American Water (CalAm) is proposing the Monterey Peninsula Water Supply Project (MPWSP or Project) for the purpose of developing water supplies to replace those portions of CalAm's existing supplies that have been constrained by legal decisions regarding CalAm's diversions from the Carmel River and pumping from the Seaside Groundwater Basin. The proposed project will also help meet CalAm's long-term regional water demands, improve groundwater quality in the seawater-intruded Salinas Basin, and expand agricultural water deliveries. The MPWSP would include construction of a subsurface Seawater Intake System and a desalination plant with a rated capacity of 9.6 MGD or 6.4 MGD. The corresponding feedwater supply is estimated to be approximately 24.1 or 15.5 MGD and is proposed be obtained through a subsurface intake system located at either the CEMEX Project area or Potrero Road in the Moss Landing Project area (see Figure 1) consisting of low angled wells (i.e., slant wells) arranged in slant well pods and constructed beneath the ocean floor. The full-scale subsurface intake system is proposed to consist of either 10 slant wells (eight wells operating and two wells standby) for a feedwater supply of 24.1 MGD or seven slant wells (five wells operating and two wells standby) for a feedwater supply of 15.5 MGD. This report summarizes results from modeling the MPWSP well pumping impacts.

During this project, the Salinas Valley Integrated Ground and Surface Water Model (SVIGSM) was updated and recalibrated by Luhdorff and Scalmanini Consulting Engineers (LSCE). In addition, updates were made as part of this current modeling effort to land use and water use data. The updated and recalibrated SVIGSM was used to evaluate the MPWSP impacts and provide boundary conditions and flux terms for the North Marina Groundwater Model (NMGWM). See Appendix A for detailed model description and modeling results from the SVIGSM.

The NMGWM was successfully updated and calibrated from water year 1980 through water year 2011 (October, 1979 through September, 2011) using monthly stress periods. The acceptable model calibration is reflected in the distribution of water level residuals, the ability of the model-calculated hydrographs to capture the long- and short-term temporal trends in observed groundwater levels, and in a relative error of 9.5% for the flow model and 9.9% for the solute transport model, both of which are below the recommended modeling error of 10%.

Thirteen predictive model runs were made using the calibrated NMGWM to evaluate and predict the

water level and seawater intrusion impacts during long-term pumping from the proposed slant wells. The model runs were simulated for a period of 63 years (water years 2012-2074 for Project model runs and water years 2075-2137 for Post Project rebound model runs) with a monthly stress period. Each scenario has a different set of assumptions regarding the land use, water demand, Salinas Valley Water Project (SVWP) conditions, and location and amount of feedwater supply from the slant wells.

Results from the modeling scenarios are summarized as the following.

1.1 No Project Conditions

- Groundwater level fluctuations over 40 ft are caused by changes in hydrological conditions (e.g., wet and dry cycles) in both the Dune Sand and 180-FT/180-FTE Aquifers.
- SVWP Phase II tends to increase water levels in both aquifers in the Salinas River Valley from southwest to northeast, except in Salinas River area in the southeast model corner. Water levels in this northeast model area increase up to approximately 25 and 45 feet in the Dune Sand and 180-FT/180-FTE Aquifers, respectively.
- Decreases along the Salinas River in the southeast a maximum of 20 feet in the Dune Sand Aquifer (Figure 93) and from 5 to 25 feet in the 180-FT/180-FTE Aquifer (Figure 94). The decreased water levels in the southeast model boundary area under SVWP Phase II are caused by changes in SVWP water delivery amounts and locations (refer to Appendix A).

1.2 CEMEX Site Project Conditions

1.2.1 Groundwater Levels

- Groundwater level fluctuations are caused by changes in hydrological conditions (e.g., wet and dry cycles) in both the Dune Sand and 180-FT/180-FTE Aquifers.
- The maximum change in groundwater elevations occurs at the center of the CEMEX Site Wellfield.
- CEMEX Site Project pumping under 24.1 MGD feedwater conditions (Configuration A) is expected to cause a maximum decrease in groundwater levels at the Project site of 10 ft to 15 ft in the Dune Sand Aquifer, and of roughly 30 ft in the 180-FTE Aquifer.
- CEMEX Site Project pumping under 15.5 MGD feedwater conditions (Configuration B) is expected to cause a maximum decrease in groundwater levels at the Project site of 5 ft to 10 ft in the Dune Sand Aquifer, and of 15 ft to 20 ft in the 180-FTE Aquifer.
- The farthest distance from the CEMEX Site Project wellfield where water levels are expected to decline by one foot in the Dune Sand Aquifer occurs at approximately 5.1 miles southeast along

the Salinas River Valley under Model Run 4f conditions in September 2034 (i.e., moderate period following a prolonged dry period). This distance will be reduced to 1.7 miles in the Dune Sand Aquifer if the feedwater supply decreases from 24.1 MGD to 15.5 MGD (Model Run 5f).

- The farthest distance for a water level decline of one foot in the 180-FT/180-FTE Aquifer occurs at the model boundary (located at approximately 7.0 miles southeast along the Salinas Valley) in September 2034 under Model Run 3n, 3ncb and 3nc conditions. This maximum distance will be reduced to about 1.4 to 1.7 miles in the 180-FT/180-FTE Aquifer in the same time period if the feedwater supply decreases to 15.5 MGD (Model Runs 5n, 5ncb, and 5nc).
- The Post Project scenario indicates that groundwater levels in the Dune Sand the 180-FT/180-FTE Aquifers will recover to the same levels seen under No Project conditions within five and three months, respectively.

1.2.2 Seawater Intrusion

- Forward particle tracking from the coastline under No Project conditions shows water from the coast migrating inland. Under Model Run 2f conditions with MCWD pumping, some of this seawater intrusion in the vicinity of the MCWD desalination wells is captured. In addition, the particle tracks under Model Run 2f (2060 land use) conditions reach distances slightly farther inland than under Model Run 1n (2012 land use) conditions.
- Reverse particle tracking under Project conditions shows that the slant wells at the CEMEX Site capture water primarily from off the coast. Some water is also captured from inland areas within roughly 2 miles of the coast that would have experienced seawater intrusion under No Project conditions. Therefore, the particle tracks illustrate one of the possible benefits that slant well pumping along the coast can provide; protection against seawater intrusion.

1.2.3 Percent Ocean Water in Project Wells

- In general, TDS concentrations in the slant well feedwater supply peaks after the prolonged dry season, approaching the assumed ocean water TDS of 33,500 mg/L. This likely corresponds with a steeper hydraulic gradient inland due to the dry conditions, resulting in a high distribution of ocean recharge. The subsequent prolonged wet season will produce a flat hydraulic gradient inland and a seaward flow direction, resulting in more inland groundwater being pumped and therefore lowering the TDS concentration of the extracted feedwater.
- Results from the CM show an average TDS concentration in the CEMEX slant wells of between 31,300 and 32,020 mg/L, indicating that the percentage of ocean water in the feedwater will average approximately 93 to 96 percent.

- The percentage of inland water, or return percentage, begins at approximately 7 percent under 2012 land use conditions (Run 3n) shortly after the system is fully operational and prior to the initiation of the MCWD desalination plant, and decreases with time to approximately 4 percent under 2060 land use conditions (Run 4f) long after the system is fully operational and with MCWD desalination.

1.2.4 Effects at Prunedale

- Comparisons between No Project and Project model runs show that there is no change in the particle tracks, indicating that slant well pumping at the CEMEX Site will not have an effect on water levels or groundwater movement in the northeast model area.
- The nonexistence of Project impacts in the Prunedale area is further supported by a lack of change in particle track flow directions and rates under CEMEX feedwater supply pumping conditions of 24.1 and 15.5 MGD.

1.2.5 Effects of Returning Basin Water

- The modeling results show that returning basin water by injection at either the Charles Benson Road Site or CEMEX Site during Project pumping reduces the Project impacts inland.
- Returning basin water at the Charles Benson Road Site reduces the maximum distance inland from the Project site that experiences a decline in water levels of one foot by approximately 0.3 to 0.8 miles.
- Returning basin water at the CEMEX Site reduces the maximum distance inland from the Project site that experiences a decline in water levels of one foot by approximately 0.1 to 0.5 miles. In addition, the drawdowns at the slant well location are slightly reduced.

1.2.6 Water Balance Analysis

- Operation of the slant wells as feedwater for the desalination plant generally increases the amount of ocean water flowing into the model and reduces the amount of groundwater flowing into the ocean. The increase in ocean water inflow ranges from 10,548 acre-ft/yr (Model Run 5nc) to 22, 830 acre-ft/yr (Model Run 4f).
- Along the inland model boundaries (i.e., general head boundary), it is expected that Project pumping for a feedwater supply of 24.1 MGD will generally cause the amount of water flowing into the model area from inland areas to increase (or the amount of water flowing out of the model area inland to decrease). The increased underflow inflow under 24.1 MGD feedwater conditions ranges from 481 acre-ft/yr (Model Run 3ncb) to 989 acre-ft/yr (Model Run 4f).

- A feedwater supply of 15.5 MGD is expected to cause a decrease in inflow across the inland model boundaries due to the effect from the Ground Water Replenishment (GWR) Project with additional CSIP Water deliveries. The decreased underflow inflow under 15.5 MGD feedwater conditions ranges from 68 acre-ft/yr (Model Run 5n) to 611 acre-ft/yr (Model Run 5f). The underflow inflow across the inland model boundaries from inland is expected to be reduced by a greater degree under MPWSP returning basin water recharging conditions than without the additional recharge (Model Runs 5ncb and 5nc vs. Model Run 5n).
- The amount of streambed percolation and deep percolation from precipitation and applied water is also generally expected to increase under 24.1 MGD Project pumping conditions, while aquifer losses to streams will decrease. The increase in streambed percolation and deep percolation from precipitation and applied water ranges from 539 acre-ft/yr (Model Run 4f) to 562 acre-ft/yr (Model Runs 3n, 3ncb and 3nc). The decrease in aquifer losses to streams ranges from 100 acre-ft/yr (Model Run 4f) to 183 acre-ft/yr (Model Runs 3n, 3ncb and 3nc).
- Under 15.5 MGD Project pumping conditions, the amount of streambed percolation and deep percolation from precipitation and applied water is expected to decrease while aquifer losses to streams are generally expected to increase due to effects from the GWR Project with additional CSIP Water deliveries. The decrease in streambed percolation and deep percolation from precipitation and applied water ranges from 29 acre-ft/yr (Model Run 5f) to 298 acre-ft/yr (Model Runs 5n, 5ncb and 5nc). The increase in aquifer losses to streams ranges from 21 acre-ft/yr (Model Run 5f) to 65 acre-ft/yr (Model Run Model Runs 5n, 5ncb and 5nc).
- Under Post Project conditions (Model Run 4rf), the recharge and discharge values are approximately the same as the values under No Project conditions (Model Run 2f).

1.3 Potrero Road Site Project Conditions

1.3.1 Groundwater Levels

- Groundwater level fluctuations are caused by changes in hydrological conditions (e.g., wet and dry cycles) in both the Dune Sand and 180-FT/180-FTE Aquifers.
- The maximum change in 180-FT/180-FTE Aquifer groundwater elevations occurs approximately 0.8 miles east of the wellfield for the model runs. This is most likely caused by the pinching out of the SVA to the east of the Potrero Road Site and the induced leakage upward from the 180-FT/180-FTE Aquifer in response to pumping in the Dune Sand Aquifer.
- Potrero Road Site Project pumping under 24.1 MGD feedwater conditions (Configuration A) is expected to cause a maximum decrease in groundwater levels at the Project site of 30 ft to 35 ft in the Dune Sand Aquifer, and of roughly 4 to 6 ft in the 180-FT Aquifer.

- Potrero Road Site Project pumping under 15.5 MGD feedwater conditions (Configuration B) is expected to cause a maximum decrease in groundwater levels at the Project site of 20 ft in the Dune Sand Aquifer, and of roughly 1 to 5 ft in the 180-FT Aquifer.
- The farthest measurable distance from the Project wellfield where water levels are expected to decline by one foot in the Dune Sand Aquifer occurs at approximately 4.8 miles southeast along the Salinas Valley under Model Run 6sn and Model Run 7sf conditions. This maximum distance will be reduced to 3.0-3.2 miles and 3.2 miles in the Dune Sand Aquifer for Model Runs 6sn and 7sf, respectively, if the feedwater supply decreases from 24.1 MGD to 15.5 MGD (Model Runs 8sn and 8sf).
- The farthest distance where water levels are expected to decline by one foot in the 180-FT/180-FTE Aquifer occurs at a distance of approximately 4.5 miles under Model Run 7sf conditions in September 2050 (i.e., moderate period following a prolonged wet period). This maximum distance will be reduced to about 2.5 miles in the 180-FT/180-FTE Aquifer if the feedwater supply decreases from 24.1 MGD to 15.5 MGD (Model Run 8sf).
- The Post Project scenario indicates that groundwater levels in the Dune Sand the 180-FT/180-FTE Aquifers will recover to the same levels seen under No Project conditions within twelve and five months, respectively.

1.3.2 Seawater Intrusion

- Forward particle tracking from the coastline under No Project conditions shows water from the coast migrating inland. Under Model Run 2f conditions (2060 land use) particle tracks reach distances slightly farther inland than under Model Run 1n (2012 land use) conditions and have a strictly southeasterly flow direction. Under Model Run 1n conditions, some of the particle tracks tend to have a more easterly travel path direction than under Model Run 2f, and some of the tracks in the northern portion have a northeastern component of flow.
- Reverse particle tracking under Project conditions shows that the slant wells at the Potrero Road Site capture water primarily from off the coast. A split in particle paths is observed offshore of the Elkhorn Slough and is a product of the Monterey Canyon and bathymetry. Some water is also captured from inland areas within roughly 2 miles of the coast; some of which would have experienced seawater intrusion under No Project conditions.

1.3.3 Percent Ocean Water in Project Wells

- In general, TDS concentrations in the slant well feedwater supply peaks after the prolonged dry season. This likely corresponds with a steeper hydraulic gradient inland due to the dry conditions, resulting in a high distribution of ocean recharge. The subsequent prolonged wet

season will produce a flat hydraulic gradient inland and a seaward flow direction, resulting in more inland groundwater being pumped and therefore lowering the TDS concentration of the extracted feedwater.

- Results from the NMGWM show an average TDS concentration in the Potrero Road slant wells of between 27,840 and 28,760 mg/L, indicating that the percentage of ocean water in the feedwater will average approximately 83 to 86 percent.
- The percentage of inland water, or return percentage, begins at approximately 17 percent under 2012 land use conditions (Run 6sn) shortly after the system is fully operational and prior to the initiation of the MCWD desalination plant, and decreases with time to approximately 14 percent under 2060 land use conditions (Run 7sf) long after the system is fully operational and with MCWD desalination.

1.3.4 Effects at Prunedale

- Comparisons between No Project and Project model runs show that there is no change in the particle tracks, indicating that slant well pumping at the Potrero Road Site will not have an effect on water levels or groundwater movement in the northeast model area.
- The nonexistence of Project impacts in the Prunedale area is further supported by a lack of change in particle track flow directions and rates under Potrero Road feedwater supply pumping conditions of 24.1 and 15.5 MGD.

1.3.5 Water Balance Analysis

- Operation of the slant wells as feedwater for the desalination plant is expected to increase the amount of ocean water flowing into the model and reduce the amount of groundwater flowing into the ocean. The increase in ocean water inflow ranges from 9,044 acre-ft/yr (Model Run 8sn) to 19,104 acre-ft/yr (Model Run 7sf).
- Along the inland model boundaries (i.e., general head boundary), it is expected that Project pumping under 24.1 and 15.5 MGD feedwater supply conditions will generally cause the amount of water flowing into the model area from inland areas to increase (or the amount of water flowing out of the model area inland to decrease). The increased underflow inflow ranges from 1,749 acre-ft/yr (Model Run 8sf) to 5,136 acre-ft/yr (Model Run 6sn).
- Under Post Project conditions (Model Run 7srf), the recharge and discharge values are approximately the same as the values under No Project conditions (Model Run 2f).

2.0 INTRODUCTION

2.1 Background

California American Water (CalAm) is proposing the Monterey Peninsula Water Supply Project (MPWSP or Project) for the purpose of developing water supplies to replace those portions of CalAm's existing supplies that have been constrained by legal decisions regarding CalAm's diversions from the Carmel River and pumping from the Seaside Groundwater Basin. The proposed Project will also help meet CalAm's long-term regional water demands, improve groundwater quality in the seawater-intruded Salinas Basin, and expand agricultural water deliveries. The MPWSP would include construction of a subsurface Seawater Intake System and a desalination plant with a rated capacity of 9.6 MGD or 6.4 MGD. The corresponding feedwater supply is estimated to be approximately 24.1 or 15.5 MGD and is proposed be obtained through a subsurface intake system located at either the CEMEX Project area or Potrero Road in the Moss Landing Project area (see Figure 1), consisting of low angled wells (i.e., slant wells) arranged in slant well pods and constructed beneath the ocean floor. The full-scale subsurface intake system is proposed to consist of either 10 slant wells (eight wells operating and two wells standby) for a feedwater supply of 24.1 MGD or seven slant wells (five wells operating and two wells standby) for a feedwater supply of 15.5 MGD. This report summarizes results from modeling the MPWSP slant well pumping impacts.

2.2 Purpose and Scope

The purpose of this study was to evaluate the impacts of the proposed MPWSP on the Salinas Valley Groundwater Basin. Groundwater modeling was conducted to assess the impacts of MPWSP on the groundwater levels and the seawater intrusion.

The scope of work included:

- Collecting and analyzing historical geohydrologic data,
- Updating and recalibrating the North Marina Groundwater Model (NMGWM), including data gathered during the exploratory borehole work (GEOSCIENCE, 2014),
- Updating and recalibrating the Salinas Valley Integrated Ground and Surface Water Model (SVIGSM; see Appendix A)
- Developing a focused CEMEX Model for the CEMEX Site,
- Developing and running various MPWSP scenarios, and
- Preparing the modeling report.

The Salinas Valley Integrated Ground and Surface Water Model (SVIGSM) was updated and recalibrated by Luhdorff and Scalmanini Consulting Engineers (LSCE) to provide the boundary conditions and flux terms for the recalibration of the NMGWM. Similarly, various MPWSP runs were made using the SVIGSM to provide boundary conditions and flux terms for the NMGWM's MPWSP runs. Modeling of the MPWSP using the SVIGSM is included as Appendix A.

3.0 GEOHYDROLOGIC SETTING

The groundwater modeling effort undertaken for the MPWSP included updated geologic and hydrologic information obtained from the exploratory boreholes. The general location of the project area is shown on Figure 1. Groundwater is present in multiple aquifer systems in several subbasins in this project area. A more detailed description of these subbasins is provided in the Borehole Technical Memorandum (GEOSCIENCE, 2014). A brief description of the regional and local hydrogeology is provided below.

3.1 Regional Geologic Setting

A regional geologic map of the project area is provided as Figure 2a (see Figure 2b for legend). The locations of geologic and hydrogeologic cross-sections of the area are shown on Figure 3 and are provided as Figures 4a through 13. In general, the geologic units mapped at the surface in the study area include, from oldest to youngest:

- Aromas Sand
- Quaternary Marine Terrace Deposits
- Quaternary Terrace Deposits/ Older Dune Sand
- Older Alluvium
- Younger Dune Deposits
- Quaternary Basin Fill Alluvium and Floodplain Deposits

The individual geologic units are discussed in the following sections.

3.1.1 Aromas Sand (Qar, Qae, and Qaf)

The Aromas Sand designated as Qar (undifferentiated Aromas Sand), Qae (eolian lithofacies of the Aromas Sand) and Qaf (fluvial lithofacies of the Aromas Sand) is present near the study area. The Aromas Sand is early Pleistocene in age and crops out north of the Salinas Valley proper on southwest facing slopes above Castroville. The Aromas Sand in this area is overlain by Older Dune Sand deposits, terrace deposits, the Antioch Alluvial Fan, and the Chualar Alluvial Fan (see Figure 2a). Due to the current uncertainty associated with the location and/or extent of the Aromas Sand in the CEMEX area and the regional dune highlands, the USGS (Tinsley, 2014) recommends using a question mark (?) following the name Aromas to denote that a type section for the units formally designated as the Aromas Sand in the Moss Landing and Watsonville areas has not been established in the area south of the Salinas River and the Aromas (?) unit south of the Salinas River is likely an equivalent unit. The Aromas Sand (?) crops out in the eastern part of the Ford Ord area. The unit in this area is underlain by

the Paso Robles Formation and overlain by Older Dune Sand deposits. Overall, the outcrops of the Aromas Sand form an arcuate shape from south of the Salinas River to the north. The unit has been eroded in the Salinas Valley during lowering of sea levels to elevations between -200 and -300 ft amsl (Kennedy/Jenks, 2004). With sea level rise in the Holocene (11,000 years bp), the Salinas River Valley was backfilled with Valley Fill deposits.

3.1.2 Quaternary Marine Terrace Deposits (Qmt)

According to Dupré (1990), marine terraces flank both the northern and southern margins of Monterey Bay. They formed in response to glacioeustatic fluctuations in sea level. The youngest terraces in the Santa Cruz area were formed during the Sangamon sea level highstands (at 102,000 and 118,000 years bp; Dupré, 1990). Quaternary Marine Terraces are mapped near Moss Landing (see Figure 2a and Figure 5) and north of Elkhorn Slough.

3.1.3 Quaternary Terrace Deposits (Qt)

Terrace deposits are present along and elevated above the Salinas River floodplain. The terrace deposits represent former alluvial fan and river floodplain surfaces, and range in age from early to mid Pleistocene. Terrace surfaces and their relative stratigraphic positions were mapped by Tinsley (1975) using soil stratigraphic methods. The stratigraphic positions of the terraces associated with the alluvial fans in the northern Salinas Valley were used to interpret the stratigraphic relationships shown on Figure 5.

3.1.4 Older Dune Sand (Qod)

The Older Dune Sand (late Pleistocene) is also present in the project area. These deposits are much more extensive in the project area south of the Salinas River Valley, extending inland as far as the East Garrison of former Fort Ord (approximately 5 miles inland). However, north of the Salinas River, the Older Dune Sand is limited in extent and crops out in small non-contiguous areas. Further north, nearing the Watsonville area, Older Dune Sand deposits are again extensive, occupying much of the coastal areas. The Older Dune Sand deposits in the Fort Ord area are reported to be as much as 250 ft thick (HLA, 2001). The Dupré work (1975 and 1990) has shown that the Older Dune Sand deposits rest on top of terrace deposits (Santa Cruz Terrace).

3.1.5 Older Alluvium (Qo)

Older alluvial deposits are not mapped at the surface in the study area, but underlie the Holocene deposits in the Salinas River Valley. These deposits are late Pleistocene and are likely in erosional contact with terrace deposits. The Older Alluvium contains organic “blue clay” horizons located beneath the Holocene floodplain of the Salinas River, and is typically referred to as the Salinas Valley Aquitard

(SVA). According to Tinsley (1975), the presence of this "blue clay" indicates that shallow marine to brackish water estuarine environments prevailed during the deposition of the horizons.

3.1.6 Younger Dune Deposits (Qd)

Younger dune and beach sand deposits extend along the shoreline of Monterey Bay from the southern end of the Bay, northward to Moss Landing. The deposits are absent in the immediate vicinity of the mouth of the Salinas River (Langenheim et al., 2002). The dune sand deposits extend landward approximately 0.1 to 0.5 miles inland. The Younger Dune Sand is Holocene in age and overlies older Dune Sand south of the Salinas River and older alluvial deposits along the mouth of the Salinas River Valley. It is likely that the recent dune sand rests over fluvial deposits (which form a shallow aquifer) in the area where the Salinas River Valley meets the ocean. However, to the south of the Salinas River Valley near the community of Marina and Fort Ord, the recent dune sand directly overlies older dune sand deposits.

3.1.7 Quaternary Basin Fill (Qb), Alluvium (Q) and Floodplain Deposits (Qfl)

The Quaternary basin fill, alluvium, and floodplain deposits are Holocene in age, consisting of sedimentary material deposited by the Salinas River and/or its tributaries. These units are mapped within the central portion of the Salinas Valley.

3.2 Local Geology

3.2.1 CEMEX Area

In the CEMEX area, younger and older dune deposits overlie Quaternary terrace deposits. The area is within the western edge of the Older Dune Complex, which is bounded by the Salinas River Valley to the north and extends from the coast to a maximum distance of five miles inland (see Figure 2a). The CEMEX area has been dominated by eolian (wind blown) depositional processes, while the Salinas River Valley is dominated by riverine fluvial depositional processes. The CEMEX area represents a distinct geomorphic area from the Salinas River Valley.

The concept of the formation of coastal dunes during the lowering of sea level as reported by Dupré (1975) suggests that the Older Dune deposits are either equivalent in age or older than the sand, silt, and gravel which form the 180-Foot (180-FT) Aquifer in the Salinas Valley to the north. These fluvial deposits which make up the 180-FT Aquifer deposits were laid down as the Salinas River Valley degraded its channel during Wisconsinan time. The 180-FT Aquifer was subsequently capped as sea levels rose at the beginning of the Holocene, forming an estuary and the SVA. The geologic units which form the 180-FT Aquifer are stratigraphically equivalent but chronologically younger than the terrace deposits which underlie the Older Dune deposits at the CEMEX site.

DWR (2003) notes the "180-Foot Aquifer may in part be correlative to older portions of Quaternary terrace deposits or the upper Aromas Sand". Cross-section 1-1' (Figure 4a) depicts the relationship between the geologic units that make up the 180-Foot Aquifer present beneath the Salinas Valley and the stratigraphic units encountered in the CEMEX boreholes. The degree of hydraulic connection was evaluated using the CM and the NMGWM, and will be field investigated with the test slant well program.

3.2.2 Moss Landing Area

The investigation at Moss Landing is inclusive of the area from the Salinas River State Beach Molera Road Parking Lot at Monterey Dunes Way (Boring MDW-1) to the Monterey Bay Aquarium Research Institute (MBARI) located at the northern terminal end of Sandholt Road (Boring ML-6). The geologic units include Younger Dune Deposits (Qd), recent alluvium (Qal), and basin fill deposits (Qb) near the coast. The area around the Highway 1 is underlain by Older Dune Deposits (Qod) and Quaternary Marine Terrace Deposits (Qmt). Further to the northeast, as land surface elevation increases, the alluvial fan deposits (Qfa) predominate and are underlain by the Aromas Sand (Qar) which crops out near Elkhorn Slough and Prunedale. The distribution of surface geologic units is shown on Figure 2a.

3.3 Hydrostratigraphy

Traditionally, aquifers in the Salinas Valley Groundwater Basin have been named for the average depth at which they occur (e.g., 180-Foot Aquifer). Water-bearing materials in the area, from oldest to youngest, consist of the Pliocene marine Purisima Formation, Plio-Pleistocene Paso Robles Formation, Pleistocene Aromas Sands, and Holocene Valley Fill materials (Greene, 1970).

Tables 3.1 and 3.2 below summarize the surface mapped geologic units shown on Figure 2a and the hydrostratigraphic unit associated with the geologic unit. These units helped define the model layers in the NMGWM and CM, as discussed in Section 4.3.

Table 3.1 –Geologic and Hydrostratigraphic Units – 180/400-FT Aquifer Subbasin

Age	Geologic Unit	Geologic Unit Map Symbol	Hydrostratigraphic Unit
Holocene	Benthic Zone	--	Benthic Zone
	Alluvium	Qal[1]	Perched "A" Aquifer
Pleistocene	Older Alluvium	Qo	Salinas Valley Aquitard
			180-FT Aquifer
	Older Alluvium/ Marine Terrace	Qo/Qmt	
	Older Alluvium/ Older Alluvial Fan – Antioch	Qo/Qfa	
	Older Alluvial Fan – Placentia	Qfp	
	Aromas Sand (undifferentiated)	Qar	180/400-FT Aquitard
			400-FT Aquifer
	Aromas Sand – Eolian/Fluvial Lithofacies	Qae/Qaf	
Pliocene	Paso Robles Formation	QT	400/900-FT Aquitard
			900-FT Aquifer

[1] Subsurface Holocene geologic unit not mapped at surface.

Table 3.2 –Geologic and Hydrostratigraphic Units – CEMEX Area

Age	Geologic Unit	Geologic Unit Map Symbol	Hydrostratigraphic Unit
Holocene	Benthic Zone	--	Benthic Zone
	Dune Sand	Qd	Dune Sand Aquifer
Pleistocene	Older Dune Sand	Qod	
	Older Terrace/ Marine Terrace	Qt (Qmt?)	180-FTE Aquifer[1]
	Aromas Sand (undifferentiated) (?)	Qar (?)	180/400-FT Aquitard
			400-FT Aquifer
Pliocene	Paso Robles Formation	QT	400/900-FT Aquitard
			900-FT Aquifer

[1] See Section 3.3.4.

3.3.1 900-Foot Aquifer

The 900-Foot (900-FT) Aquifer is contained within the Plio-Pleistocene Paso Robles Formation. HLA (2001) notes that the 900-Foot Aquifer is part of a "Deep" aquifer system, which also includes what has been called the 800-Foot, 1,000-Foot, and 1,500-Foot Aquifers. For purposes of groundwater modeling, these aquifers will be collectively termed and simulated as the 900-FT Aquifer.

3.3.2 400-Foot Aquifer

Within the project area, the 400-Foot (400-FT) Aquifer is the aquifer unit which is contained in the upper and lower portions of the Aromas Sand (USGS, 2003). The thickness of the unit has been reported to be approximately 200 ft (HLA, 2001) but may be as thick as 500 ft (USGS, 2003). The unit is separated from the overlying 180-Foot (180-FT) Aquifer by zones of discontinuous aquifers and aquitards which are approximately 10 to 70 ft thick. The aquitards in this area have been designated as the 180/400-Foot Aquitard.

3.3.3 180-Foot Aquifer

The 180-FT Aquifer has various reported thicknesses ranging from 50 to 250 ft. The aquifer is separated from the overlying Perched "A" Aquifer by the SVA. DWR (2003) states that the 180-FT Aquifer may, in part, be correlative to older portions of Quaternary Terrace Deposits or the upper Aromas Sand. Work completed during the borehole investigation suggests that the 180-FT Aquifer is correlative with terrace deposits of Quaternary age that are older but in erosional contact with younger Salinas River fluvial deposits containing the 180-FT Aquifer in the Salinas Valley.

3.3.4 180-Foot Equivalent Aquifer (Terrace Deposits)

The terrace deposits are water bearing materials beneath the Dune Sand Aquifer in the CEMEX area. The terrace deposits are approximately 160 ft thick at the CEMEX site, thinning seaward. Hydraulic conductivity values are lower than those attributed to the 180-FT Aquifer. Based on the data collected during the borehole investigation, the terrace deposits are interpreted to be stratigraphically equivalent to the 180-FT Aquifer of the Salinas Valley, and may likely be in hydraulic continuity with the 180-FT Aquifer. Therefore, for the purposes of this investigation, the aquifer interval within the terrace deposits is referred to as 180-Foot Equivalent (180-FTE) Aquifer. The 180-FTE Aquifer is believed to be in hydraulic continuity with the overlying Dune Sand Aquifer; both units extend seaward beneath Monterey Bay and have similar water quality.

3.3.5 Salinas Valley Aquitard

The SVA consists of discontinuous layers of clays ranging in thickness from 0 to 100 ft. It defines the Pressure Area from Chualar to the coast. In the inland areas, the SVA is generally present overlying the

180-FT Aquifer, separating the 180-FT Aquifer from the Perched "A" Aquifer (discussed below). The SVA is present beneath the Moss Landing area but not beneath the CEMEX site.

3.3.6 Dune Sand Aquifer

The Dune Sand Aquifer is present beneath the CEMEX site and represents the water bearing units of both the Younger and Older Dune Sand. Based on groundwater quality data collected at the CEMEX site, and the absence of the SVA, the groundwater in the Dune Sand Aquifer is believed to be hydraulically connected to the underlying 180-FTE Aquifer (terrace deposits). The high salinity suggests that the Dune Sand Aquifer is also connected to the ocean. According to HLA (2001), the Dune Sand Aquifer is hydrostratigraphically equivalent to the Perched "A" Aquifer. Work completed by Emcon (1991) for the Marina Peninsula Class III Landfill suggests that there are multiple perched aquifers within the Older Dune Sand. The aquifer designated as the -2 Foot Aquifer at the landfill appears to correlate with the Perched "A" Aquifer of the Salinas Valley.

3.3.7 Perched "A" Aquifer

The Perched "A" Aquifer is found within the Salinas Valley overlying the SVA. According to HLA (2001), an equivalent unit designated as the "A-aquifer" is found exclusively in the Older Dune Sand beneath the former Fort Ord. This relationship further suggests that groundwater within the Perched "A" Aquifer in the Salinas Valley may be hydraulically connected to the groundwater found in the Older Dune Sand.

4.0 GROUNDWATER MODELS

4.1 Model Descriptions

The groundwater modeling exercise included running several models, each successively more focused and refined. Update and refinement of the models was achieved primarily through newly acquired geologic and hydrogeologic data collected during a recent drilling and sampling program (GEOSCIENCE, 2014). The following sections describe the models used for the MPWSP.

4.1.1 Salinas Valley Integrated Ground and Surface Water Model (SVIGSM)

The largest model, referred to as the Salinas Valley Integrated Ground and Surface Water Model (SVIGSM), covers the entire Salinas Valley and was originally developed in February 1994 (Montgomery Watson, 1994) to analyze the groundwater resources of the Salinas Valley. It is a three layer (with an aquitard and aquifer for each layer) regional model that encompasses an area of approximately 650 square miles (see Figure 14). A major refinement occurred in 1996-1997 when the model was used to assist the Salinas Valley Water Project (SVWP) planning and Environmental Impact Report/Environmental Impact Statement (EIR/EIS). During this update and recalibration process, model assumptions and input data were evaluated, updated, and revised by LSCE. In addition, updates were made as part of this current modeling effort to land use and water use data. Output from the updated and recalibrated SVIGSM was used to evaluate the MPWSP impacts by providing boundary conditions and flux terms for the North Marina Groundwater Model (NMGWM). See Appendix A for detailed model description and modeling results from the SVIGSM.

4.1.2 North Marina Groundwater Model (NMGWM)

In 2008, GEOSCIENCE developed the NMGWM, which covers the region in the current project area and is located within the larger SVIGSM. It is a coastal model covering part of the Pacific Ocean and approximately seven miles inland from the coastline with an area of approximately 149 square miles (see Figure 14). The NMGWM was constructed by integrating the SVISGM aquifer parameters, recharge and discharge terms, boundary conditions and predictive scenarios to ensure consistency between the two models. It has been used previously to evaluate several proposed projects in the region and contains a water quality component that the SVIGSM does not have. The model was developed using MODFLOW[1] and MT3DMS[2] computer codes. The NMGWM does not use the SEAWAT[3] code. In general,

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[1] MODFLOW is a block-centered, finite-difference groundwater flow code developed by the United States Geologic Survey (USGS) (Harbaugh et al., 2000).

[2] MT3DMS is a Modular three-dimensional Multi-Species Transport model, is the second generation of the MT3D developed with funding from the U.S. Army Engineer Research and Development Center (Zheng and Wang, 1998).

MODFLOW and MT3DMS yield a very similar result compared to SEAWAT with slight differences in water level elevation (approximately one foot). More recent work (GEOSCIENCE, 2013) has included updating the model layers using additional geologic data. However, a considerable amount of new data was generated from the field investigations resulting from exploratory boreholes work (GEOSCIENCE, 2014). The additional data from the exploratory boreholes was used to update and refine the NMGWM. The updated NMGWM is an eight-layer model and consists of 300 cells in the i-direction (northeast-to-southwest along rows) and 345 cells in the j-direction (northwest-to-southeast along columns) with a uniform cell size of 200 ft by 200 ft (see Figure 15). The model grid is rotated 16 degrees clockwise from horizontal. The updated and recalibrated NMGWM was used to evaluate the MPWSP impacts and provide boundary conditions and flux terms for the CM.

4.1.3 CEMEX Model (CM)

In order to accurately model local effects of slant well pumping, a focused model, designated as the CEMEX Model (CM), was constructed. The CM is located within the NMGWM, and is centered at the CEMEX site and surrounding areas with an area of four square miles (see Figure 14). It was constructed using the SEAWAT computer code. It is a 12-layer model and consists of 540 cells in the i-direction (northeast-to-southwest along rows) and 540 cells in the j-direction (northwest-to-southeast along columns) with a uniform cell size of 20 ft by 20 ft (see Figure 16). The model grid is also rotated 16 degrees clockwise from horizontal. The CM was used to predict the TDS concentrations extracted from the slant wells under MPWSP conditions at the CEMEX Site.

4.2 Integration of SVIGSM, NMGWM and CM

The SVIGSM encompasses the entire NMGWM. The calibrated SVIGSM data, including the aquifer parameters, recharge and discharge terms, and boundary conditions in the model area, were used to develop boundary conditions for the NMGWM. For example, the eastern, northern and southern boundaries of the NMGWM represent locations of subsurface underflow. The underflow at these locations was simulated using the general-head boundary package in MODFLOW with a time varying specified head based on the model simulated groundwater elevation from the SVIGSM. This procedure is similar to the telescopic mesh refinement method (Anderson and Woessner, 1992). The NMGWM in turn was run and provided boundary conditions and aquifer parameters such as recharge and discharge terms for the focused CM.

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[3] The SEAWAT program was developed by the USGS (Guo and Langevin, 2002) to simulate three-dimensional, variable-density, groundwater flow and solute transport in porous media. The source code for SEAWAT was developed by combining MODFLOW and MT3DMS into a single program that solves the coupled flow and solute transport equations.

In addition, the model layers in the SVIGSM were updated in the vicinity of the NMGWM to reflect the geohydrologic conditions encountered during the borehole exploratory work (see GEOSCIENCE, 2014 and Appendix A for additional information). The revised layer configuration allowed the model layers of each individual model to line up with and correspond to the relative layers from the other models. For example, the SVIGSM model layer 1, representing the 180-FT/180-FTE Aquifer corresponds to NMGWM layer 4 for the same aquifer, which in turn corresponds to CM model layers 6, 7 and 8. A diagram of how the model layers of the different models align is provided as Figure 17.

4.3 Conceptual Model

The conceptual model of the NMGWM was developed based on the geologic and hydrostratigraphic units of the area. The correlation of geologic and hydrostratigraphic units with the regional and local models is summarized in Table 4.1 below. As shown, the NMGWM was further refined in the CM through the addition of model layers. The NMGWM layers 2 and 4 were each modeled by three layers in the CM (i.e., layers 2 through 4 and layers 6 through 8, respectively). By adding additional layers to the CM, aquifer parameters in this key area could be refined even further to more accurately reflect the different geologic layers present in these hydrostratigraphic units. In addition, the extra layers allow for the improved simulation of vertical flow and solute transport components.

Table 4.1 – Correlation of Hydrostratigraphic Units with SVIGSM, NMGWM, and CM Layers

Hydro-stratigraphic Units	SVIGSM Layer[1]	NMGWM Layer	CM Layer
Benthic Zone	Constant Head	1	1
Perched "A" Aquifer / Dune Sand Aquifer	1a	2	2
			3
			4
Salinas Valley Aquitard	1a	3	5
180-FT/ 180-FTE Aquifer	1	4	6
			7
			8
180/400-FT Aquitard	2a	5	9
400-FT Aquifer	2	6	10
400/900-FT Aquitard	3a	7	11
900-FT Aquifer	3	8	12

Notes:
180-FTE Aquifer represents "180-Foot Equivalent Aquifer"
[1] SVIGSM considers "a" layers to be aquitards (vertical hydraulic conductivity and thickness are input).

For purposes of this document, the alluvial materials encountered near the coast (in the CEMEX area) are based solely on analyses of borehole samples (and geophysical borehole logs). As of yet, no direct correlation can be made between these coastal alluvial deposits and the standard naming convention found further inland (e.g., 180-FT Aquifer, 400-FT Aquifer, and SVA, etc.). Therefore, in this document, the upper materials in the CEMEX Site area have been classified as the Dune Sand Aquifer and the alluvial materials below have been referred to as stratigraphically equivalent to the inland 180-FT Aquifer (or 180-FTE Aquifer).

Although 12 model layers are delineated in the CM, the ones of interest include layers 2, 3, and 4 (Dune Sand Aquifer), and Layers 6, 7, and 8 (180-FTE Aquifer). Layer 5 is a model layer placeholder for the SVA

which does not exist at the coast but is present farther inland within the domain of the NMGWM. In this case, a thickness of one foot was assigned for model layer 5 with a hydraulic conductivity value from the Dune Sand Aquifer.

5.0 NORTH MARINA AND CEMEX GROUNDWATER MODELS

The conceptual model and model cell size for the NMGWM and CM were provided in Section 4. This Section provides the boundary conditions, model codes, model layers, model parameters, recharge and discharge terms and model calibration for the NMGWM and CM.

5.1 North Marina Groundwater Model

5.1.1 Boundary Conditions

By definition, a boundary condition is any external influence or effect that either acts as a source or sink, adding to or removing water from the groundwater flow system. The boundary conditions used in the NMGWM are no flow, constant head and general head boundary (see Figure 18). No flow cells were assigned to non-alluvial and bedrock portions off the coast in the Pacific Ocean as well as to areas excluded from the specific layers. The constant head boundary for model layer 1 is used to represent the surface of the ocean[4]. A constant total dissolved solids (TDS) concentration of 33,500 mg/L was specified for the constant head boundary. The eastern, northern, and southern edges of the active model areas in the NMGWM represent areas of subsurface underflow and were simulated using the general head boundary (GHB) package with a specified head based on the model simulated groundwater elevations from the SVIGSM.

5.1.2 Description of Model Codes

MODFLOW and MT3DMS are the model computer codes used for the NMGWM. MODFLOW is a block-centered, three-dimensional, finite difference groundwater flow model developed by the USGS for the purpose of modeling groundwater flow. MT3DMS is a modular three-dimensional multi-species transport model for simulation of advection, dispersion, and chemical reactions of contaminants in groundwater systems (Zheng and Wang, 1998).

5.1.3 Model Layers

The newly collected exploratory boring information provided valuable data needed to determine the thickness and extent of the Dune Sand Aquifer, Perched “A” Aquifer, and the 180-FT/180-FTE Aquifer, in addition to hydraulic conductivity data and initial TDS concentrations for model input. The model layers representing the Dune Sand Aquifer, Perched “A” Aquifer, Salinas Valley Aquitard, and 180-FT/180-FTE Aquifer were refined using the new data (GEOSCIENCE, 2014).

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[4] For the NMGWM, the equivalent freshwater head was used.

Model layer boundaries and layer extents were defined using the cross-sections prepared from borehole data (see Figures 4a through 13) prepared using lithologic logs and wells from Kennedy/Jenks (2004), DWR (2003) and Hanson et al. (2001). The refinement process used ninety one (91) control points to develop the thickness of each model layer (GEOSCIENCE, 2014). The points were contoured to provide the rest of the model layer surface. The individual bottom layer elevations for the NMGWM are shown on Figure 19. Model layer thicknesses are shown on Figures 20 through 26. The elevation of each model layer is taken as the top elevation minus the determined thickness. For example, the bottom elevation of model layer 1 is the surface elevation; the bottom elevation of model layer 2 is the bottom elevation of model layer 1 minus the thickness of model layer 2; and so on.

5.1.4 Model Parameters

The parameters of the NMGWM were developed based on the calibrated SVIGSM (WRIME, 2008), as well as updated geohydrologic data from the exploratory borehole work (GEOSCIENCE, 2014). Aquifer parameters used in the model will be updated, as appropriate, to reflect water level changes occurring in the aquifers during the test slant well pumping. Table 5.1 below summarizes aquifer parameters used in the NMGWM.

5.1.4.1 Hydraulic Conductivity

Horizontal and vertical hydraulic conductivity values were determined through model calibration. Initial values for the refinement of horizontal and vertical hydraulic conductivities were estimated based on the descriptions of borehole samples and a series of curves developed to show the relationship between sediment texture and hydraulic conductivity (refer to GEOSCIENCE, 2014). These curves, representing maximum and minimum horizontal and vertical hydraulic conductivity values, were constructed using the following equation (Durbin, 2013; Faunt ed., 2009):

$$K_i = \left(K_c{}^p\, F_{c,i} + K_f{}^p F_{f,i}\right)^{1/p}$$

where:

K_i	=	Hydraulic conductivity for cell i [ft/day]
K_c	=	Horizontal hydraulic conductivity for coarse-grained material [ft/day]
K_f	=	Horizontal hydraulic conductivity for fine-grained material [ft/day]
$F_{c,i}$	=	Fraction of coarse-grained material in cell i [unitless]
$F_{f,i}$	=	Fraction of fine-grained material in cell i [unitless]

p = Empirical parameter

Lithologic log intervals from the borings were classified as either being "coarse-grained" or "fine-grained" based on the sediment texture described in the logs and texture classification procedures observed in the USGS Professional Paper 1766 (Faunt ed., 2009). Coarse-grained sediment was defined as having a grain size of fine sand or greater (i.e., sand, gravel, pebbles, and cobbles). Fine-grained material was defined as any texture that consisted predominately (greater than 50%) of silt or clay.

To determine the K_c and K_f, the individual lithologic intervals for each borehole were first assigned a maximum or minimum hydraulic conductivity value based on the soil classification for that interval and the estimates of horizontal conductivity made from borehole sample grain size distribution curves. The methods used to estimate the sample hydraulic conductivities are described in greater detail in exploratory borehole summary report (GEOSCIENCE, 2014). The weighted K_c and K_f were then calculated for each borehole and each model layer using both the minimum and maximum hydraulic conductivities in order to provide a possible range of K_c and K_f that could be expected for each area (i.e., CEMEX area and Moss Landing area).

The empirical parameter shown in the equation above imparts a particular textural structure to help approximate flow in a heterogeneous anisotropic groundwater system. P values of 0.93 and -0.62 were used for calculating horizontal and vertical hydraulic conductivity, respectively, based on numerical experiments conducted by Durbin (2013).

Figures 27 through 30 show the different curves for the calculation of hydraulic conductivity, and the ranges shown represent the initial values for horizontal and vertical hydraulic conductivity which were used for the refinement of model aquifer parameters. These values were then modified during model calibration. Calibrated horizontal and vertical hydraulic conductivity values for the NMGWM are shown on Figures 31 and 32, respectively.

5.1.4.2 Effective Porosity and Storativity

Effective porosity and storativity are important parameters in simulating flow through hydrologic systems. Porosity is presented as a percentage and refers to the amount of void spaces in a material compared to the overall volume. Effective porosity is defined as the total porosity minus the specific retention (in unconfined aquifers) or storativity (in confined aquifers) (Sara, 2003). More specifically, it is used to correct the total porosity to account for the dead-end and isolated pore spaces in which velocity is zero.

Some column test studies have shown that effective porosity is essentially the same as total porosity, especially in coarse grained sediments (Kim et al., 1997 and Sevee, 2010). However, using total porosity in flow rate calculations, particularly for fine grained sediments like clays, has also been found to yield travel times that differ from observed data or tracer tests (Zheng and Bennett, 2002; Zheng and Wang, 1999; Sevee, 2010). For example, commonly suggested values for the total porosity of a gravel ranges from 0.25 to 0.38 while the effective porosity ranges from 0.20 to 0.35 (Sara, 2003). On the other hand, the suggested total porosity for clay ranges from 0.34 to 0.60 with a much lower estimated effective porosity of 0.01 to 0.20. In addition, Martin Sara (2003) stresses that effective porosity should not be confused with total porosity, specific yield, or gravity drainage; although, in some cases (e.g., coarse grained soils), the substitution of one of these variables may be acceptable. In fine grained materials however, the departure of the effective porosity from the specific yield is especially important.

The MT3DMS model code used for the NMGWM uses equations based on effective porosity (Zheng and Bennett, 2002). In this case, the effective porosity represents the porosity that is required to achieve agreement between observed and model-calculated travel times. It is not a value that can be measured readily in the field, so it is determined through model calibration (Zheng and Bennett, 2002; Zheng and Wang, 1999; Sara, 2003). The initial storativity and effective porosity values used for the NMGWM and CM were based on published data by Staal, Gardner and Dunne, Inc. (1991) as well as calibrated SVIGSM values. Calibrated values for storativity and effective porosity are shown on Figures 33 and 34, respectively.

5.1.4.3 Dispersivity

Longitudinal dispersivity was estimated initially from the relationship between longitudinal dispersivity and the scale of observation (Zheng and Bennett, 2002). These values were adjusted during the NMGWM model calibration. A longitudinal dispersivity of 20 ft results in a good match between model-calculated and the observed seawater intrusion front. The ratio of horizontal transverse dispersivity to longitudinal dispersivity was assumed to be 0.1, while the ratio of vertical transverse dispersivity to longitudinal dispersivity was assumed to be 0.01.

Table 5.1 – Summary of Aquifer Parameters Used in the NMGWM

Model Layer	Horizontal Hydraulic Conductivity [ft/day]	Vertical Hydraulic Conductivity [ft/day]	Storativity*	Effective Porosity	Dispersivity		
					Horizontal		Vertical
					Longitudinal [ft]	Transverse [ft]	Transverse [ft]
1 (Benthic Zone)	-	-	-	-	-	-	-
2 (Dune Sand Aquifer)	20 - 340	0.01 - 10.02	0.065 - 0.1	0.065 - 0.1	20	2	0.2
3 (Variable Layer**)	5 - 340	0.01 - 10.02	$1x10^{-5}$ - $5x10^{-3}$	0.02 - 0.1	20	2	0.2
4 (180-FT/180-FTE Aquifer)	20 - 340	0.01 – 0.93	$1x10^{-4}$ - $5x10^{-3}$	0.065 - 0.1	20	2	0.2
5 (180/400-FT Aquitard)	3 - 100	0.01 – 0.94	$1x10^{-5}$ - $1x10^{-4}$	0.02 - 0.1	20	2	0.2
6 (400-FT Aquifer)	3 - 100	0.05 - 0.93	$1x10^{-4}$ - $5x10^{-3}$	0.1	20	2	0.2
7 (400/900-FT Aquitard)	3.6	0.01 – 0.2	$1x10^{-5}$ - $1x10^{-4}$	0.02	20	2	0.2
8 (900-FT Aquifer)	35	0.01 – 0.2	$1x10^{-4}$ - $5x10^{-3}$	0.06	20	2	0.2

Notes:
Model input variables are spatially variable and will be modified based on the results of the test slant well.
*All aquifers have a storativity value, even unconfined aquifers. However, in unconfined aquifers, the storativity is the sum of the effective porosity (specific yield) and an unconfined storativity. Since the unconfined storativity is so much lower than the effective porosity, it dominates the term.
**Variable layer ranges from Salinas Valley Aquitard to Dune Sand Aquifer; however, the Salinas Valley Aquitard is present only within a small area in the northern model domain.

5.1.5 Recharge and Discharge

Recharge and discharge components in the NMGWM as well as the MODFLOW Package used for each term are presented in Table 5.2 below.

Table 5.2 – NMGWM Recharge and Discharge Terms

Terms		MODFLOW Package Used
Recharge	Deep Percolation from Precipitation and Applied Water (Irrigation)	Recharge Package
	Underflow Inflow from Northern, Southern and Eastern Model Boundaries	General Head Boundary Package
	Streambed Percolation	Recharge Package
	Ocean Inflow	Constant Head Boundary
Discharge	Groundwater Pumping	Well Package
	Ocean Outflow	Constant Head Boundary
	Aquifer Loss to Streams	Recharge Package

Monthly data for deep percolation from precipitation, stream recharge and groundwater pumping in the NMGWM area as well as the water levels assigned for the general head boundaries during the calibration period were obtained from the SVIGSM.

5.1.6 Model Calibration

The NMGWM was originally calibrated for the period from October 1979 through September 1994 (GEOSCIENCE, 2008). The models have been recently updated with the data from the exploratory borehole work (GEOSCIENCE, 2014), and were recalibrated through September 2011.

5.1.6.1 Calibration Methodology

Model calibration was performed in order to compare model-simulated water levels and TDS concentrations to field-measured values. The method of calibration used by the groundwater model was the industry standard “history matching” technique. In this method, a transient calibration period from water year 1980 through water year 2011 (October, 1979 through September, 2011) was used. The model calibration was simulated with a monthly stress period, for a total of 384 stress periods (i.e., 32 years).

The calibration process involved adjusting model parameters until the model provided a reasonable match between the simulated and measured parameters. These aquifer parameters included horizontal hydraulic conductivity, vertical hydraulic conductivity, effective porosity, and the storage coefficient.

5.1.6.2 Initial Conditions

Initial conditions for the transient calibration of the NMGWM include groundwater elevations and TDS concentrations for October 1979. Groundwater elevation in October 1979 generated from the SVIGSM was provided by LSCE and was imported into the model using Groundwater Vistas. The initial TDS concentrations were based primarily on measured TDS concentrations in wells in October 1979. The TDS concentration of seawater was assumed to be 33,500 mg/L based on the measured data. Initial TDS concentrations are shown on Figure 35.

5.1.6.3 Flow Model Calibration Results

The model calibration was based on 5,273 water level measurements from 17 wells. The NMGWM flow model target wells are shown on Figure 36. Figure 37 shows a scatter plot of measured versus model-calculated water levels. As can be seen, most of the points are clustered around a diagonal line (representing where measured water levels match model-calculated water levels). This reflects a good match between measured and model-calculated water levels. Also, as shown on the Figure, the 400-FT Aquifer (NMGWM layer 6) has the most spread, with a significant amount of over-estimation. This may be due to the inclusion of pumping water level data in the observed water level data set.

Statistical tests on these residuals can also help describe the model calibration. These are provided on Figure 37 as well. Relative error is an easy way to check whether the calibration provides a good match between the model-calculated and observed values. It is the standard deviation of the residuals divided by the range in observed values. A residual is the difference between the model-calculated and the observed value. Common modeling practice is to consider a good fit between measured and model-calculated water levels if the relative error is below 10% (Spitz and Moreno, 1996 and Environmental Simulations, Inc., 1999). As can be seen in Figure 37, the calibrated NMGWM does a good job at modeling observed water level changes, with a relative error of 9.5%.

Figure 38 shows a histogram of water level residuals of the 5,273 water level measurements from 17 wells. The frequency distribution of water level residuals represents a bell curve with the majority of the residuals (71.9%) found in the range of plus or minus ten feet. This is another indication of an acceptable model calibration.

Figures 39, 40 and 41 show hydrographs for the final model calibration for the 180-FT/180-FTE, 400-FT and 900-FT Aquifers, respectively. In general, the pattern of the model-calculated and measured water

levels are similar in that the model appears to capture the long- and short-term temporal trends in groundwater levels in most parts of the NMGWM area.

5.1.6.4 Transport Model Calibration Results

Target wells used for the transport model calibration portion of the NMGWM are shown on Figure 42. The calibration was based on 323 TDS concentration measurements from 21 wells and has a relative error of 9.9%. Transient calibration chemographs of TDS concentrations are shown on Figures 43, 44 and 45 for the 180-FT/180-FTE, 400-FT and 900-FT Aquifers, respectively. In general, the model-calculated TDS concentrations agree with the observed data. However, as with the flow model calibration, the 400-FT Aquifer (NMGWM layer 6) did not match as well (model overestimates in some locations). This is possibly the result of a well or wells (e.g., 13S/02E-32A02 and 14S/02E-08M02 on Figure 25) being screened in a different aquifer or layer.

5.2 CEMEX Model

The CM is located within the NMGWM, and is centered at the CEMEX site. It was constructed using the SEAWAT computer code (SEAWAT is a generic MODFLOW/MT3DMS-based computer program designed to simulate three-dimensional variable-density ground water flow coupled with solute transport) to allow the simulation of seawater intrusion. The CM model consists of 540 rows and columns with a uniform cell size of 20 feet to a side, which is a significant refinement over the uniform grid size of 200 ft by 200 ft in the NMGWM. The decreased model cell size will allow for a very accurate calibration by matching groundwater levels and quality data to be collected during the long-term test slant well pumping test.

As with the NMGWM, the boundary conditions used in the CM are no flow, constant head and general head boundary. The eastern, northern, and southern edges of the active model areas in the CM represent areas of subsurface underflow and were simulated using the general head boundary package with a specified head based on the model simulated groundwater elevations from the NMGWM. Additional model layers were added to the CM, as compared to the NMGWM, to allow for the refinement of aquifer parameters in key areas (see Section 4.3 and inset Table 4.1). The model parameters (e.g., hydraulic conductivity, effective porosity and storativity, and dispersivity) and recharge/discharge terms of the CM were based on those used in the NMGWM.

6.0 ASSUMPTIONS FOR PREDICTIVE MODEL SCENARIOS

Seventeen (17) predictive model runs were made using the calibrated NMGWM to evaluate and predict the water level and water quality impacts during long-term pumping from the proposed slant wells, including:

- Three No Project Scenarios (i.e., Model Runs 1n, 2f and 2af),
- Eight CEMEX Site Project Scenarios (i.e., Model Runs 3n, 3ncb, 3nc, 4f, 5n, 5ncb, 5nc, and 5f),
- Four Potrero Road Project Scenarios (i.e., Model Runs 6sn, 7sf, 8sn and 8sf), and
- Two Post Project Scenarios (i.e., Model Runs 4rf and 7srf).

The CM developed from the calibrated NMGWM was also used to run MPWSP conditions at the CEMEX Site. The model runs were simulated for a period of 63 years (water years 2012-2074 for Project model runs and water years 2075-2137 for Post Project model runs) with a monthly stress period. Each scenario has a different set of assumptions regarding the land use, water demand, Salinas Valley Water Project (SVWP) conditions, and location and amount of feedwater supply from the slant wells. These scenarios are summarized in attached Table 1 and a detailed discussion of the assumptions for each of the Project model scenario runs are provided in the following sections.

6.1 Hydrologic Base Period

Selection of a forecast period that represents long-term hydrologic conditions is necessary prior to running future model scenarios. Historical precipitation was available from 1949 through the model calibration period, while evapotranspiration was available since 1984. Due to the lack of evapotranspiration data prior to 1984, a 63-year hydrologic base period was synthesized for future conditions rather than selected from the historical record (see Section 6.1 of Appendix A). This future hydrology includes a prolonged dry period, a prolonged wet period, and an overall long-term average period with moderate hydrology years separating the sequences. Figure 46 shows a plot of the cumulative departure from mean annual precipitation during the model scenario hydrologic base period for three locations in the Salinas Valley. On the figure, a downwards trend represents a dry period while an upward trend indicates a wet period.

The overall average precipitation for the simulation period (14.0, 12.2 and 11.3 inches for Salinas, King City and Soledad, respectively) is comparable to the long-term observed average precipitation from 1949-2011 (12.8, 11.3 and 10.7 inches for Salinas, King City and Soledad, respectively). This hydrologic base period was assumed to represent future conditions for the 63-year period from October 2011 through September 2074 for both No Project and Project model predictive runs, and from October 2074

through September 2137 for Post Project model runs, and was applied to the model runs through the monthly stress periods.

6.2 MPWSP Project Pumping and Slant Wells

6.2.1 Project Pumping and Wellfield Configuration

Two wellfield configurations were used at both the CEMEX and Potrero Road Sites in the predictive model runs. Configuration A consists of 10 slant wells (eight operating wells and two standby) with a total feedwater supply of 24.1 MGD. Configuration B includes 7 slant wells (five operating wells and two standby) with a total feedwater supply of 15.5 MGD. Figures 47 and 48 show the locations of the slant wells at the CEMEX Site under Configuration A and B, respectively. Well locations for Configuration A and B at the Potrero Road Site are shown on Figures 49 and 50, respectively.

Table 6.1 below summarizes the assumptions used for the two wellfield configurations and their corresponding model runs:

Table 6.1 – Model Scenario Wellfield Configuration

Wellfield Configuration	Predictive Model Runs	Feedwater Supply	
		MGD	Acre-ft/yr
No Project/Post Project	1n, 2f, 2af, 4rf and 7srf	0	0
A (CEMEX Site, see Figure 47)	3n, 3ncb, 3nc and 4f	24.1	27,000
B (CEMEX Site, see Figure 48)	5n, 5ncb, 5nc and 5f	15.5	17,400
A (Potrero Road Site, See Figure 49)	6sn and 7sf	24.1	27,000
B (Potrero Road Site, see Figure 50)	8sn and 8sf	15.5	17,400

6.2.2 Well Cross-Sections

Figures 51 through 60 show the cross-sections for the 10 slant wells used at the CEMEX Site under Configuration A. The slant wells here are screened in the Dune Sand Aquifer and 180-FTE Aquifer with a total screen length ranging from 535 ft (CS-A-2; Figure 52) to 822 ft (CS-A-7; Figure 57). All of the slant wells are situated at an angle of 14 degrees below horizontal, except for CS-A-2 which is at an angle of 19 degrees below horizontal.

Cross-sections for the 7 slant wells used at the CEMEX Site under Configuration B are depicted on Figures 61 through 67. For the CEMEX Site Configuration B, all slant wells pump feedwater from both the Dune Sand Aquifer and the 180-FTE Aquifer, and the total screen length ranges from 535 ft (CS-B-1;

Figure 61) to 822 ft (CS-B-5; Figure 65). Slant Well CS-B-1 situated at an angle of 19 degrees below horizontal, while the others are at an angle of 14 degrees below horizontal.

Figures 68 through 77 and Figures 78 through 84 show the cross-sections of slant wells used at the Potrero Road Site for Configuration A and Configuration B, respectively. For both Potrero Road Site configurations, the slant wells are screened only in the Dune Sand Aquifer. The total screen length ranges from 620 ft (PRS-A-4; Figure 71) to 741 ft (PRS-A-10; Figure 77) for Configuration A, and from 620 ft (PRS-B-3; Figure 80) to 675 ft (PRS-B-7; Figure 88) for Configuration B. All of the modeled slant wells at the Potrero Road Site are situated at 9 degrees below horizontal for both Configuration A and B.

6.3 Land Use

Each of the predictive model runs were operated under different land use conditions, as summarized in Table 6.2 below (see also attached Table 1). The type of land use affects the amount of surface runoff and deep infiltration of precipitation (refer to Figures 3a and 3b from Appendix A of this report for 2012 and 2060 land use maps, respectively). For scenarios run under the 2060 land use assumptions, the model area will experience less pumping compared to 2012 pumping conditions, and receive less recharge from deep percolation due to urbanization.

Table 6.2 – Model Scenario Land Use Assumptions

Model Run		Land Use Conditions
No Project	1n	2012
	2f	2060
	2af	2060
CEMEX Site	3n	2012
	3ncb	2012
	3nc	2012
	4f	2060
	4rf	2060
	5n	2012
	5ncb	2012
	5nc	2012
	5f	2060
Potrero Road Site	6sn	2012
	7sf	2060
	7srf	2060
	8sn	2012
	8sf	2060

6.4 Salinas Valley Water Project

The SVWP was developed to help address the water resource management issues within the Salinas Valley. Two SVWP phases were accounted for in the groundwater modeling and scenario development. Phase I allows for maximum annual surface water diversions from the Salinas River of up to approximately 14,500 acre-ft/yr. In addition, average annual recycled water delivery to the Castroville Seawater Intrusion Project (CSIP) area of approximately 12,500 acre-ft/yr was also included. Phase II allows for a maximum surface water diversion of approximately 120,500 acre-ft/yr from the Salinas River in addition to the SVWP Phase I deliveries (refer to Section 6.2.4 of Appendix A).

SVWP Phase II effects were analyzed with the NMGWM. Model Run 2af is run under Phase II conditions and compared to Run 2f in order to determine impacts from Phase II. All of the other scenarios with the exception of Run 2af are run under Phase I conditions only. Under SVWP Phase II conditions (as

compared to Phase I conditions), the model area will experience less pumping due to reduced demand and more discharge to the ocean due to an increase in water levels.

6.5 Marina Coast Water District Desalination Project

The Marina Coast Water District (MCWD) desalination project was also included in the predictive scenarios using future land use conditions. These are the model runs denoted with an "f"; model runs that do not include MCWD desalination pumping are marked with an "n". Modeling of the MCWD project assumed pumping from two vertical wells screened in 180-FT Aquifer to provide a feedwater supply of 3.8 MGD (1.5 MGD of product water). These wells are located in the vicinity of the current MCWD headquarters (see Figure 85).

6.6 Returning Basin Water

Model runs were also made that include returning basin water at proposed injection sites to help reduce potential effects from Project pumping at the CEMEX Site. Under these scenarios, MPWSP water is injected into the 180-FT/180-FTE aquifer in wells at Charles Benson Road Site (Model Runs 3ncb and 5ncb) or at the CEMEX Site (Model Runs 3nc and 5nc). The propose injection locations are shown on Figure 86. For CEMEX slant well Configurations A and B, 1,080 acre-ft/yr and 700 acre-ft of recharge is assumed, respectively, which represents approximately 4% of the feedwater supply. This recharge volume was based on the modeling results from the CM, which showed that approximately 4% of the feedwater is expected to come from basin water.

6.7 Sea Level Rise

Potential rise in future sea level was included in all model runs by using a constant head for the 2047 sea level, which is the mean predicted sea level for the period from 2012 through 2074 (ESA PWA, 2013). The sea level rise is predicted to be an average of 8 inches by 2047. The Project coast line occurring in 2047 was also incorporated into all the NMGWM and CM model runs.

6.8 Initial Conditions

The model-calculated water levels at the end of the transient model calibration (i.e., September 2011) were used as the initial water levels for the No Project baseline runs (Model Runs 1n, 2f and 2af), and Project runs (Model Runs 3n, 3ncb, 3nc, 4f, 5n, 5ncb, 5nc, 5f, 6sn, 7sf, 8sn and 8sf). The model-calculated TDS concentrations at the end of transient model calibration (i.e., September 2011) were updated with data from the exploratory borehole work (GEOSCIENCE, 2014) and were used as the initial water levels and initial TDS concentrations for the above various model runs. In addition, the initial water levels and TDS concentrations used for Model Run 4rf and Model Run 7srf (i.e., Post Project runs)

were obtained from the results at the end of Project Runs 4f and 7sf (i.e., September 2074), respectively.

7.0 MODEL RESULTS – NO PROJECT CONDITIONS

7.1 Groundwater Elevations

Model-predicted groundwater elevations for the Dune Sand and 180-FT/180-FTE Aquifers under Model Run 1n, Model Run 2f, and Model Run 2af (i.e., No Project model runs) are shown on Figures 87 through 92. In general, groundwater elevations and flow directions change corresponding to the hydrologic conditions. As shown on Figures 87 through 92, groundwater flows inland (east/southeast) in September 2027 under prolonged dry conditions. In September 2046 under prolonged wet conditions, groundwater flows northwest towards the ocean in the area south of Salinas River, while groundwater typically flows inland and east/northeast north of the Salinas River. Groundwater level fluctuations over 40 ft are caused by changes in hydrological conditions (e.g., wet and dry cycles) in both the Dune Sand and 180-FT/180-FTE Aquifers.

7.2 Effects of SVWP Phase II

The effects of SVWP Phase II were evaluated by comparing the groundwater levels produced under SVWP Phase II conditions (Model Run 2af) to those produced under Phase I conditions (Model Run 2f). Figures 93 and 94 show the change in water levels from Model Run 2af, as compared to Model Run 2f, in the Dune Sand and 180-FT/180-FTE Aquifers, respectively. As shown, there is very little change, if any, after prolonged dry hydrologic conditions in September, 2027. Under the other hydrologic conditions, SVWP Phase II tends to increase water levels in both aquifers in the Salinas River Valley from southwest to northeast, except in Salinas River area in the southeast model corner. Water levels in this northeast model area increase up to approximately 25 and 45 feet in the Dune Sand and 180-FT/180-FTE Aquifers, respectively. Decreases along the Salinas River in the southeast a maximum of 20 feet in the Dune Sand Aquifer (Figure 93) and from 5 to 25 feet in the 180-FT/180-FTE Aquifer (Figure 94). The decreased water levels in the southeast model boundary area under SVWP Phase II are caused by changes in SVWP water delivery amounts and locations (refer to Appendix A).

7.3 Water Balance Analysis

The overall water budgets for No Project model runs were compiled. The inflow terms for the NMGWM include underflow inflow through northern, eastern and southern model boundaries, stream recharge, deep percolation from precipitation and applied water (i.e., irrigation), and inflow from the ocean. The outflow terms are comprised of non-Project groundwater pumping, MCWD desalination pumping (Model Runs 2f and 2af only), aquifer losses to streams, and outflow to the ocean. The difference between the total inflow and total outflow represents the change in groundwater storage. The annual water budget tables for the No Project predictive model runs are presented in attached Tables 2 through 4.

8.0 MODEL RESULTS – CEMEX SITE

After the predictive model runs were performed, comparisons were made between the results from No Project model runs and Project model runs at the CEMEX Site during each hydrologic period in order to analyze the impacts from the operation of the proposed slant wells. This includes impacts on groundwater elevations in the Dune Sand and 180-FT/180-FTE Aquifers, particle tracking, and water budgets. In addition, the TDS concentrations for each of the slant wells were obtained from Model Run 4f using the CM. A field investigation was also performed by GEOSCIENCE in 2014 in order to locate the active and potentially active wells near the CEMEX Site. These wells were incorporated into the slant well impact analysis (see Figures 95 and 96).

The groundwater elevation results from the No Project model runs were used as a comparison for those from Project model runs in order to evaluate the Project's incremental impact. Table 8.1 below lists what No Project model run was used in the comparison of each of the Project model runs at the CEMEX Site.

Table 8.1 – Comparisons Made between No Project Runs and CEMEX Site Project Runs

No Project Model Run	Project Model Runs Used for Comparison	Post Project Model Run Used for Comparison
1n	3n, 3ncb, 3nc, 5n, 5ncb and 5nc	-
2f	4f and 5f	4rf

A detailed discussion of the results for each Project model run is provided in the following sections.

8.1 Changes in Groundwater Levels

The predicted change in groundwater levels from slant well pumping was calculated as the difference between model-predicted water level elevations under No Project conditions and model-predicted water level elevations under Project conditions. Figures 97 through 104 depict the changes in groundwater elevations for the Dune Sand and 180-FT/180-FTE Aquifers during different hydrologic periods with slant wells operating under CEMEX Site feedwater supply of 24.1 MGD (Configuration A) conditions. Changes in groundwater elevations for the Dune Sand and 180-FT/180-FTE Aquifers with slant wells operating under CEMEX Site feedwater supply of 15.5 MGD (Configuration B) conditions are shown on Figures 105 through 112.

Results from the CEMEX Site Project model runs indicate that changes in groundwater elevations in the vicinity of wellfield will vary only slightly with different hydrologic conditions. Also, the maximum

change in groundwater elevations occurs at the center of the wellfield. Under 24.1 MGD feedwater supply conditions, groundwater levels at the Project site will decrease approximately 10 ft to 15 ft in the Dune Sand Aquifer, and will decrease roughly 30 ft in the 180-FTE Aquifer. Under 15.5 MGD feedwater supply conditions, water level declines will be about 5 ft to 10 ft in the Dune Sand Aquifer, and 15 ft to 20 ft in the 180-FTE Aquifer. Table 8.2 below summarizes the predicted changes in groundwater elevations at the CEMEX Project wellfield.

Table 8.2 – Summary of Changes in Groundwater Elevations in the Vicinity of the CEMEX Wellfield

Project Model Run	No Project Comparison	Aquifer	Changes in Groundwater Elevations in the Vicinity of the CEMEX Wellfield [ft]
3n	1n	Dune Sand	10 – 15
		180-FTE	30
3ncb	1n	Dune Sand	10 – 15
		180-FTE	30
3nc	1n	Dune Sand	10 – 15
		180-FTE	25 – 30
4f	2f	Dune Sand	10 – 15
		180-FTE	30
5n	1n	Dune Sand	5 – 10
		180-FTE	15 – 20
5ncb	1n	Dune Sand	5 – 10
		180-FTE	15 – 20
5nc	1n	Dune Sand	5 – 10
		180-FTE	15 – 20
5f	2f	Dune Sand	5 – 10
		180-FTE	15 – 20

Contours representing expected groundwater declines of one foot can fluctuate depending on the hydrologic conditions (e.g., wet, dry, etc.). The approximate maximum distances inland from the Project wellfield and southeast along the Salinas River Valley where groundwater levels are expected to decline by one foot due to pumping are summarized in Table 8.3 below.

Table 8.3 – Summary of the Maximum Distance Inland from the CEMEX Site with Water Level Decline of One Foot

Project Model Run	No Project Comparison	Aquifer	Maximum Distance Inland from the CEMEX Site with Water Level Decline of One Foot				
			Sept. 2027 (Prolonged Dry)	Sept. 2034 (Moderate Period)	Sept. 2046 (Prolonged Wet)	Sept. 2050 (Moderate Period)	Sept. 2074 (End of Model Simulation)
			[miles]				
3n	1n	Dune Sand	4.7	5.0	3.3	3.8	4.2
		180-FT/180-FTE	4.9	7.0	3.6	3.7	4.2
3ncb	1n	Dune Sand	4.3	4.5	3.0	3.3	3.7
		180-FT/180-FTE	4.1	7.0	3.0	3.3	3.5
3nc	1n	Dune Sand	4.6	5.0	3.3	3.6	4.2
		180-FT/180-FTE	4.5	7.0	3.4	3.5	3.9
4f	2f	Dune Sand	4.8	5.1	3.5	4.0	4.8
		180-FT/180-FTE	5.0	5.8	3.8	4.3	4.5
5n	1n	Dune Sand	1.6	1.7	1.8	2.2	2.0
		180-FT/180-FTE	1.6	1.7	2.0	2.2	2.1
5ncb	1n	Dune Sand	1.3	1.4	1.5	1.7	1.6
		180-FT/180-FTE	1.4	1.4	1.6	1.8	1.7
5nc	1n	Dune Sand	1.5	1.5	1.6	2.0	1.8
		180-FT/180-FTE	1.4	1.5	1.8	2.0	1.9
5f	2f	Dune Sand	1.6	1.7	2.0	2.3	2.2
		180-FT/180-FTE	1.6	1.8	2.2	2.5	2.3

The farthest measurable distance from the Project wellfield where water levels are expected to decline by one foot in the Dune Sand Aquifer occurs at approximately 5.1 miles southeast along the Salinas Valley under Model Run 4f conditions. This maximum distance will be reduced to 1.7 miles in the Dune Sand Aquifer in the same time period if the feedwater supply decreases to 15.5 MGD (i.e., Model Run 5f). The farthest distance where water levels are expected to decline by one foot in the 180-FT/180-FTE Aquifer occurs at the model boundary (located at approximately 7.0 miles southeast along the Salinas Valley). This water level change is produced under Model Runs 3n, 3ncb and 3nc conditions in September 2034 (i.e., moderate period following a prolonged dry period). This maximum distance will

be reduced to about 1.4 to 1.7 miles in the 180-FT/180-FTE Aquifer in the same time period if the feedwater supply decreases to 15.5 MGD (i.e., Model Runs 5n, 5ncb and 5nc).

Hydrographs for selected wells under each of the CEMEX Site Project model runs, along with the corresponding No Project model runs, are shown on Figures 113 through 136 for the 180-FT/180-FTE, 400-FT and 900-FT Aquifers.

8.2 Seawater Intrusion

The slant wells were designed to pull feedwater for the proposed desalination plant from the ocean and to have as little impact on inland waters as possible. Particle tracking was used in the vicinity of the CEMEX Site to demonstrate where the feedwater supply from slant well pumping is expected to come from. These particle tracks are shown on Figures 137 through 144 for the 180-FT/180-FTE Aquifer.

As shown on the figures, the forward particle tracking from the coastline under No Project conditions (i.e., Model Run 1n or 2f) have similar patterns showing water from the coast migrating inland. Under Model Run 2f conditions with MCWD pumping, some of this seawater intrusion in the vicinity of the MCWD desalination wells is captured. In addition, the particle tracks under Model Run 2f (2060 land use) conditions reach distances slightly farther inland than under Model Run 1n (2012 land use) conditions.

Reverse particle tracking under Project conditions shows that the slant wells at the CEMEX Site capture water primarily from off the coast. Some water is also captured from inland areas within roughly 2 miles of the coast that would have experienced seawater intrusion under No Project conditions. Therefore, the particle tracks illustrate one of the possible benefits that slant well pumping along the coast can provide; protection against seawater intrusion. In addition, the particle tracks show that the distance inland affected by pumping at the CEMEX Site is less under future land use conditions (e.g., Model Run 4f; Figure 140) than under current land use conditions (e.g., Model Run 3n; Figure 137), even with the additional pumping from the MCWD desalination wells.

8.3 Percent Ocean Water in Project Wells

The predicted TDS concentrations for the slant wells at the CEMEX Site in Model Runs 3n and 4f during the 50-year Project life are shown on Figures 145 and 146, respectively. In general, TDS concentration peaks after the prolonged dry season approaching the assumed ocean water TDS of 33,500 mg/L. This likely corresponds with a steeper hydraulic gradient inland due to the dry conditions, resulting in a high distribution of ocean recharge. The subsequent prolonged wet season will produce a flat hydraulic gradient inland and a seaward flow direction, resulting in more inland groundwater being pumped and therefore lowering the TDS concentration of the extracted feedwater. The average TDS concentration

from the slant wells was predicted to be 31,300 mg/L under Run 3n conditions, and 32,020 mg/L under Run 4f conditions.

The percentage of ocean water in the feedwater was calculated using the following equation (MCWD, MCWRA and Cal-Am, 2010):

$$OWP = (FS – IS) / (OWS – IS) * 100$$

where :

OWP= Ocean Water Percentage, %
FS = Feedwater Salinity, mg/L
IS = Inland Water Salinity (TDS = 440 mg/L)
OWS = Ocean Water Salinity (TDS = 33,500 mg/L)

Since the average feedwater was estimated to range between 31,300 mg/L under Run 3n conditions and 32,020 mg/L under Run 4f conditions, the percentage of ocean water in the feedwater will average approximately 93 percent under Run 3n conditions (93% = (31,300 - 440) / (33,500 - 440) * 100%) to 96 percent under Run 4f conditions (96% = (32,020 - 440) / (33,500 - 440) * 100%).

The percentage of inland water, or return percentage, is therefore equal to 100 percent minus the percentage of ocean water. This begins at approximately 7 percent (100% - 93% = 7%) under 2012 land use conditions (Run 3n) shortly after the system is fully operational and prior to the initiation of the MCWD desalination plant, and decreases with time to approximately 4 percent (100% - 96% = 4%) under 2060 land use conditions (Run 4f) long after the system is fully operational and with MCWD desalination.

8.4 Effects at Prunedale

Forward particle tracking was used to assess Project impacts in the northeast model area in the vicinity of Prunedale, California. Six locations along State Highway 156 and U.S. Highway 101 were chosen as particle tracking release points. Particle track paths under Project slant well pumping conditions at the CEMEX Site are compared to No Project condition particle paths in the 180-FT/180-FTE Aquifer on Figures 147 through 154.

The comparison of 2012 land use No Project model runs to Project model runs produces the same flow paths (see Figures 147, 148, 149, 151, 152 and 153). For example, as shown on Figure 147, which compares Model Run 1n (No Project) to Model Run 3n (CEMEX Project pumping of 24.1 MGD), particle paths originating at 156-C, 156-D and 101-B travel to the southeast, roughly parallel to the northeast model boundary. Particle paths originating at 156-A, 156-B and 101-A travel northeast towards the

confluence of Highways 156 and 101. These flow paths reflect the groundwater elevations and groundwater flow directions present in the area under 2012 land use conditions. As seen from the comparisons of Model Run 1n and 3n, there is no change in the particle tracks between Project and No Project conditions. Therefore, slant well pumping at the CEMEX Site will not have an effect on water levels or groundwater movement in the northeast model area.

Similarly, the comparison of 2060 land use No Project model runs to Project model runs also produces the same flow patterns (see Figures 150 and 154), but these vary from those seen under 2012 land use conditions. For example, Figure 150 shows the comparison between Model Run 2f (No Project) and Model Run 4f (CEMEX Project pumping of 24.1 MGD) under 2060 land use conditions. The particle tracks under these conditions show uniform northeast travel paths and greater rates of movement, as compared to particle tracks under 2012 land use conditions (e.g., Model Run 1n vs. Model Run 3n; Figure 147). This is in response to land use changes which cause a lowering of water levels in the East Side Subarea and a corresponding change in groundwater flow directions and hydraulic gradients.

The nonexistence of Project impacts in the Prunedale area is further supported by a lack of change in particle track flow directions and rates under CEMEX feedwater supply pumping conditions of 24.1 and 15.5 MGD (e.g., Figures 147 vs. Figure 151, respectively).

8.5 Effects of Returning Basin Water

8.5.1 Charles Benson Road Site

Changes in water level comparisons between Model Run 3n (no returning basin water; Figures 97 and 98) and Model Run 3ncb (returning basin water at Charles Benson Road Site; Figures 99 and 100) shows that by injecting water at the Charles Benson Road Site during Project pumping at the CEMEX Site, the maximum distance inland from the Project site that experiences a decline in water levels of one foot is reduced by approximately 0.3 to 0.8 miles (refer to inset Table 8.3). This means that returning basin water at this site reduces the Project impacts inland. This was also reflected in the increased time or reduced distance for particle track travel under Model Run 3ncb conditions, as compared to Model Run 3n conditions (refer to Section 8.2).

8.5.2 CEMEX Site

Similar comparisons were made between the changes in water levels between Model Run 3n and Model Run 3nc (returning basin water at the CEMEX Site; Figures 101 and 102). While injecting water at the CEMEX Site reduces the maximum distance inland that experiences a decline in water levels of 1 ft by a lesser amount than at the Charles Benson Road Site (0.1 to 0.5 miles; refer to inset Tables 8.3), the drawdowns at the slant well location are slightly less. Returning water at the CEMEX Site under Model Run 3nc conditions produces drawdowns at the slant wells of between 25 and 30 ft in the 180-FTE

Aquifer, compared to 30 ft with returning basin water at the Charles Benson Road Site (refer to inset Table 8.2). In addition, returning basin water at the CEMEX site also resulted in increased time or reduced distance for particle track travel under Model Run 3nc conditions, as compared to Model Run 3n conditions (refer to Section 8.2).

8.6 Post Project

In order to assess the Post Project conditions and responses to Project pumping in the vicinity of the CEMEX Site, a Post Project model run was conducted. Model Run 4rf was simulated for the 63-year period following Project pumping under Model Run 4f conditions; from October 2074 through September 2137. The hydrology from the base period was also used for this scenario. Changes in groundwater elevations relative to No Project Model Run 2f in the Dune Sand and 180-FTE Aquifers are shown on Figures 155 and 156, respectively. Results from Model Run 4rf show that groundwater levels in the Dune Sand and the 180-FT/180-FTE Aquifers will recover to the same levels seen under No Project conditions for each corresponding hydrologic period after a period of approximately five months and three months, respectively.

Hydrographs showing Post Project Model Run 4rf versus No Project Model Run 2f for selected wells in the 180/180-FTE, 400-FT, and 900-FT Aquifers are shown on Figures 157, 158, and 159, respectively.

8.7 Water Balance Analysis

The overall water budgets for the CEMEX Site predictive model runs were compiled. The inflow terms for the NMGWM include underflow inflow through northern, eastern and southern model boundaries, stream recharge, deep percolation from precipitation and applied water (i.e., irrigation), recharge from returning basin water, and inflow from the ocean. The outflow terms are comprised of non-Project groundwater pumping, MCWD desalination pumping, MPWSP slant well pumping, aquifer losses to streams, and outflow to the ocean. The difference between the total inflow and total outflow represents the change in groundwater storage. The annual water budget tables for all of the CEMEX Site predictive model runs are presented in attached Tables 5 through 13. Attached Table 14 summarizes the average annual water budgets for each of the model runs.

The differences between CEMEX Site Project model runs and No Project model runs for selected flux terms are summarized in Table 8.4 below in order to assess slant well operation effects on the water budgets.

Table 8.4 – Summary of the Average Annual Changes in Selected Flux Terms (CEMEX Site Project Runs vs. No Project Runs)

Model Run	Land Use	Feedwater Amount [MGD]	No Project Comparison (Land Use)	Average Annual Changes from No Project Conditions [AFY]				
				Ocean Inflow	Underflow from Northern, Eastern, and Southern Model Boundaries	Streambed Percolation, Deep Percolation from Precipitation and Applied Water	Aquifer Loss to Streams	Outflow to Ocean
3n	2012	24.1	1n (2012)	20,824	979	562	-183	-3,671
3ncb	2012	24.1	1n (2012)	20,381	481	562	-183	-3,540
3nc	2012	24.1	1n (2012)	20,098	738	562	-183	-3,562
4f	2060	24.1	2f (2060)	22,830	989	539	-100	-1,814
4rf	2060	0	2f (2060)	-174	-115	4	0	9
5n	2012	15.5	1n (2012)	10,992	-68	-298	65	-2,159
5ncb	2012	15.5	1n (2012)	10,727	-391	-298	65	-2,053
5nc	2012	15.5	1n (2012)	10,548	-225	-298	65	-2,063
5f	2060	15.5	2f (2060)	12,596	-611	-29	21	-849

Note: A positive sign represents an increase over No Project conditions, and a negative sign indicates a decrease.

As can be seen in the table, operation of the slant wells as feedwater for the desalination plant generally increases the amount of ocean water flowing into the model and reduces the amount of groundwater flowing into the ocean. However, these effects are reduced under no MCWD Desalination pumping conditions (Model Runs 3n and 5n) and conditions with returning basin water (Model Runs 3ncb, 3nc, 5ncb and 5nc). The increase in ocean water inflow ranges from 10,548 acre-ft/yr (Model Run 5nc) to 22,830 acre-ft/yr (Model Run 4f). It has also been shown that much of the additional inflow produced by Project pumping is captured by the slant wells (refer to Section 8.2 and Figures 141 through 150).

Along the inland model boundaries (i.e., general head boundary), it is expected that Project pumping for a feedwater supply of 24.1 MGD will generally cause the amount of water flowing into the model area

from inland areas to increase (or the amount of water flowing out of the model area inland to decrease). Conversely, a feedwater supply of 15.5 MGD is expected to cause a decrease in inflow across the general head boundary due to the effect from the Ground Water Replenishment (GWR) Project with additional CSIP Water deliveries. The increased underflow inflow under 24.1 MGD feedwater conditions ranges from 481 acre-ft/yr (Model Run 3ncb) to 989 acre-ft/yr (Model Run 4f). The decreased underflow inflow under 15.5 MGD feedwater conditions ranges from 68 acre-ft/yr (Model Run 5n) to 611 acre-ft/yr (Model Run 5f). The underflow inflow across the inland model boundaries from inland is expected to be reduced to a greater degree under MPWSP returning basin water recharging conditions than without the additional recharge (Model Runs 5ncb and 5nc vs. Model Run 5n). The reduced underflow inflow across the eastern model boundary and increased seawater intrusion seen under Model Run 5f conditions is in response to the lowering of water levels in the Eastside Subarea due to changes in future land use.

The amount of streambed percolation and deep percolation from precipitation and applied water is also generally expected to increase under 24.1 MGD Project pumping conditions, while aquifer losses to streams will decrease. The increase in streambed percolation and deep percolation from precipitation and applied water ranges from 539 acre-ft/yr (Model Run 4f) to 562 acre-ft/yr (Model Runs 3n, 3ncb and 3nc). The decrease in aquifer losses to streams ranges from 100 acre-ft/yr (Model Run 4f) to 183 acre-ft/yr (Model Runs 3n, 3ncb and 3nc). Under 15.5 MGD Project pumping conditions, the amount of streambed percolation and deep percolation from precipitation and applied water is expected to decrease while aquifer losses to streams are generally expected to increase due to effects from the GWR Project with additional CSIP Water deliveries. The decrease in streambed percolation and deep percolation from precipitation and applied water ranges from 29 acre-ft/yr (Model Run 5f) to 298 acre-ft/yr (Model Runs 5n, 5ncb and 5nc). The increase in aquifer losses to streams ranges from 21 acre-ft/yr (Model Run 5f) to 65 acre-ft/yr (Model Run Model Runs 5n, 5ncb and 5nc). Therefore, MPWSP returning basin water recharge will not have much of an impact on these two flux terms.

Under Post Project conditions (Model Run 4rf), the recharge and discharge values are approximately the same as the values under No Project conditions (Model Run 2f).

9.0 MODEL RESULTS – POTRERO ROAD SITE

After the predictive model runs were performed, comparisons were also made between the results from No Project model runs and Project model runs at the Potrero Road Site during each hydrologic period in order to analyze the impacts from the operation of the proposed slant wells. This includes impacts on groundwater elevations in the Dune Sand and 180-FT/180-FTE Aquifers, particle tracking, and water budgets. A field investigation was also performed by GEOSCIENCE in 2014 in order to locate the active and potentially active wells near the Potrero Road Site. These wells were incorporated into the slant well impact analysis (see Figure 160).

The groundwater elevation results from the No Project model runs were used as a comparison for those from Project model runs in order to evaluate the Project's incremental impact. Table 9.1 below lists what No Project model run was used in the comparison of each of the Project model runs at the Potrero Road Site.

Table 9.1 – Comparisons Made between No Project Runs and Potrero Road Site Project Runs

No Project Model Run	Project Model Runs Used for Comparison	Post Project Model Run Used for Comparison
1n	6sn and 8sn	-
2f	7sf and 8sf	7srf

A detailed discussion of the results for each Project model run is provided in the following sections.

9.1 Changes in Groundwater Levels

The predicted change in groundwater levels from slant well pumping was calculated as the difference between model-predicted water level elevations under No Project conditions and model-predicted water level elevations under Project conditions. Figures 161 through 164 depict the changes in groundwater elevations for the Dune Sand and 180-FT/180-FTE Aquifers during different hydrologic periods with slant wells operating under Potrero Road Site feedwater supply of 24.1 MGD (Configuration A) conditions.

Changes in groundwater elevations for the Dune Sand and 180-FT/180-FTE Aquifers with slant wells operating under Potrero Road Site feedwater supply of 15.5 MGD (Configuration B) conditions are shown on Figures 165 through 168.

Results from the Potrero Road Site model runs indicate that the changes in groundwater elevations at the Project site, as well as the farthest distance from the Project wellfield that groundwater levels are expected to decrease by one foot, are relatively stable despite the different hydrologic conditions and configurations. In addition, the maximum change in 180-FT/180-FTE Aquifer groundwater elevations occurs approximately 0.8 miles east of the wellfield for the model runs. This is most likely caused by the pinching out of the SVA to the east of the Potrero Road Site and the induced leakage upward from the 180-FT/180-FTE Aquifer in response to pumping in the Dune Sand Aquifer (see Figure 5). Impacts on groundwater levels from slant well pumping are summarized in Table 9.2 below.

Table 9.2 – Summary of Changes in Groundwater Elevations in the Vicinity of the Potrero Road Wellfield

Project Model Run	No Project Comparison	Aquifer	Changes in Groundwater Elevations in the Vicinity of the Potrero Road Wellfield [ft]
6sn	1n	Dune Sand	30 – 35
		180-FT	4 – 5
7sf	2f	Dune Sand	30 – 35
		180-FT	4 – 5
8sn	1n	Dune Sand	20
		180-FT	1 – 3
8sf	2f	Dune Sand	20
		180-FT	2 – 3

As shown in Table 9.2, groundwater levels at the Project site will decrease by as much as 35 ft in the Dune Sand Aquifer under Model Runs 7sn and 7sf conditions, while there will be only slight decrease in groundwater levels in the 180-FT/180-FTE Aquifer. This is due to the presence of the Salinas Valley Aquitard beneath the Project site.

Contours representing expected groundwater declines of one foot can fluctuate depending on hydrologic conditions (e.g., wet, dry, etc.). The approximate maximum distances inland from the Project wellfield and southeast along the Salinas River Valley where groundwater levels are expected to decline by one foot due to pumping are summarized in Table 9.3.

Table 9.3 – Summary of the Maximum Distance Inland from the Potrero Road Site with Water Level Decline of One Foot

Project Model Run	No Project Comparison	Aquifer	Maximum Distance Inland from the Potrero Road Site with Water Level Decline of One Foot				
			Sept. 2027 (Prolonged Dry)	Sept. 2034 (Moderate Period)	Sept. 2046 (Prolonged Wet)	Sept. 2050 (Moderate Period)	Sept. 2074 (End of Model Simulation)
			[miles]				
6sn	1n	Dune Sand	4.4	4.4	4.8	4.8	4.5
		180-FT/180-FTE	3.7	3.6	4.3	4.1	4.0
7sf	2f	Dune Sand	4.6	4.5	4.8	4.7	3.3
		180-FT/180-FTE	3.9	3.9	4.3	4.5	2.6
8sn	1n	Dune Sand	2.7	2.7	3.0	3.2	2.6
		180-FT/180-FTE	1.1	1.3	1.7	2.1	1.5
8sf	2f	Dune Sand	2.8	2.7	3.2	3.3	3.2
		180-FT/180-FTE	1.1	1.2	2.1	2.5	2.3

The farthest measurable distance from the Project wellfield where water levels are expected to decline by one foot in the Dune Sand Aquifer occurs at approximately 4.8 miles southeast along the Salinas Valley under Model Run 6sn and Model Run 7sf conditions. This maximum distance will be reduced to 3.0-3.2 miles and 3.2 miles in the Dune Sand Aquifer for Model Runs 6sn and 7sf, respectively, in the same time period if the feedwater supply decreases to 15.5 MGD (i.e., Model Runs 8sn and 8sf). The farthest distance where water levels are expected to decline by one foot in the 180-FT/180-FTE Aquifer occurs at a distance of approximately 4.5 miles. This water level change is produced under Model Run 7sf conditions in September 2050 (i.e., moderate period following a prolonged wet period). This maximum distance will be reduced to about 2.5 miles in the 180-FT/180-FTE Aquifer in the same time period if the feedwater supply decreases to 15.5 MGD (i.e., Model Run 8sf).

Hydrographs for selected wells under each of the Potrero Road Site Project model runs, along with its corresponding No Project model run, are shown on Figures 169 through 180 for the 180-FT/180-FTE, 400-FT and 900-FT Aquifers.

9.2 Seawater Intrusion

The slant wells were designed to pull feedwater for the proposed desalination plant from the ocean and to have as little impact on inland waters as possible. Particle tracking was used in the vicinity of the

Potrero Road Site to demonstrate where the feedwater supply from slant well pumping is expected to come from. These particle tracks are shown on Figures 181 through 184 for the Dune Sand Aquifer.

As shown on the figures, the forward particle tracking from the coastline under No Project conditions (i.e., Model Run 1n or 2f) have similar patterns showing water from the coast migrating inland. Under Model Run 2f conditions (2060 land use) particle tracks reach distances slightly farther inland than under Model Run 1n (2012 land use) conditions and have a strictly southeasterly flow direction. Under Model Run 1n conditions, some of the particle tracks tend to have a more easterly travel path direction than under Model Run 2f, and some of the tracks in the northern portion have a northeastern component of flow.

Reverse particle tracking under Project conditions shows that the slant wells at the Potrero Road Site capture water primarily from off the coast. The split in particle paths offshore of the Elkhorn Slough is a product of the Monterey Canyon and bathymetry. Some water is also captured from inland areas within roughly 2 miles of the coast; some of which would have experienced seawater intrusion under No Project conditions. Therefore, the particle tracks illustrate one of the possible benefits that slant well pumping along the coast can provide; protection against seawater intrusion. In addition, the particle tracks show that the distance inland affected by pumping at the Potrero Road Site is slightly less under future land use conditions (e.g., Model Run 7sf; Figure 182) than under current land use conditions (e.g., Model Run 6sn; Figure 181).

9.3 Percent Ocean Water in Project Wells

The predicted TDS concentrations for the slant wells at the Potrero Road Site in Model Runs 6sn and 7sf during the 50-year Project life are shown on Figures 185 and 186, respectively. In general, TDS concentration peaks after the prolonged dry season. This likely corresponds with a steeper hydraulic gradient inland due to the dry conditions, resulting in a high distribution of ocean recharge. The subsequent prolonged wet season will produce a flat hydraulic gradient inland and a seaward flow direction, resulting in more inland groundwater being pumped and therefore lowering the TDS concentration of the extracted feedwater. The average TDS concentration from the slant wells was predicted to be 27,840 mg/L under Run 6sn conditions, and 28,760 mg/L under Run 7sf conditions.

The percentage of ocean water in the feedwater was calculated using the following equation (MCWD, MCWRA and Cal-Am, 2010):

$$OWP = (FS - IS) / (OWS - IS) * 100$$

where :

OWP= Ocean Water Percentage, %
FS = Feedwater Salinity, mg/L
IS = Inland Water Salinity (TDS = 440 mg/L)
OWS = Ocean Water Salinity (TDS = 33,500 mg/L)

Since the average feedwater was estimated to range between 27,840 mg/L under Run 6sn conditions and 28,760 mg/L under Run 7sf conditions, the percentage of ocean water in the feedwater will average approximately 83 percent under Run 6sn conditions (83% = (27,840 - 440) / (33,500 - 440) * 100%) to 86 percent under Run 7sf conditions (86% = (28,760 - 440) / (33,500 - 440) * 100%).

The percentage of inland water, or return percentage, is therefore equal to 100 percent minus the percentage of ocean water. This begins at approximately 17 percent (100% - 83% = 17%) under 2012 land use conditions (Run 6sn) shortly after the system is fully operational and prior to the initiation of the MCWD desalination plant, and decreases with time to approximately 14 percent (100% - 86% = 14%) under 2060 land use conditions (Run 7sf) long after the system is fully operational and with MCWD desalination.

9.4 Effects at Prunedale

Forward particle tracking was used to assess Project impacts in the northeast model area in the vicinity of Prunedale, California. Six locations along State Highway 156 and U.S. Highway 101 were chosen as particle tracking release points. Particle track paths under Project slant well pumping conditions at the Potrero Road Site are compared to No Project condition particle paths in the 180-FT/180-FTE Aquifer on Figures 187 through 190.

The comparison of 2012 land use No Project model runs to Project model runs produces the same flow patterns (see Figures 187 and 189). For example, as shown on Figure 187, which compares Model Run 1n (No Project) to Model Run 6sn (Potrero Road Project pumping of 24.1 MGD), particle paths originating at 156-C, 156-D and 101-B travel to the southeast, roughly parallel to the northeast model boundary. Particle paths originating at 156-A, 156-B and 101-A travel northeast towards the confluence of Highways 156 and 101. These flow paths reflect the groundwater elevations and groundwater flow directions present in the area under 2012 land use conditions. As seen from the comparisons of Model Run 1n and 6sn, there is no change in the particle tracks between Project and No Project conditions. Therefore, slant well pumping at the Potrero Road Site will not have an effect on water levels or groundwater movement in the northeast model area.

Similarly, the comparison of 2060 land use No Project model runs to Project model runs also produces the same flow patterns (see Figures 188 and 190), but these vary from those seen under 2012 land use

conditions. For example, Figure 188 shows the comparison between Model Run 2f (No Project) and Model Run 7sf (Potrero Road Project pumping of 24.1 MGD) under 2060 land use conditions. The particle tracks under these conditions show uniform northeast travel paths and greater rates of movement, as compared to particle tracks under 2012 land use conditions (e.g., Model Run 1n vs. Model Run 6sn; Figure 187). This is in response to land use changes which cause a lowering of water levels in the East Side Subarea and a corresponding change in groundwater flow directions and hydraulic gradients.

The lack of Project impacts in the Prunedale area is further supported by a lack of change in particle track flow directions and rates under Potrero Road feedwater supply pumping conditions of 24.1 and 15.5 MGD (e.g., Figures 187 vs. Figure 189, respectively).

9.5 Post Project

In order to assess the Post Project conditions and responses to Project pumping in the vicinity of the Potrero Road Site, a Post Project model run was conducted. Model Run 7srf was simulated for the 63-year period following Project pumping under Model Run 7sf conditions; from October 2074 through September 2137. The hydrology from the base period was also used for this scenario. Changes in groundwater elevations relative to No Project Model Run 2f in the Dune Sand and 180-FT Aquifers are shown on Figures 191 and 192, respectively. Results from Model Run 7srf show that groundwater levels in the Dune Sand and the 180-FT/180-FTE Aquifers will recover to the same levels seen under No Project conditions for each corresponding hydrologic period after a period of approximately twelve months and five months, respectively.

Hydrographs showing Post Project Model Run 7srf versus No Project Model Run 2f for selected wells in the 180/180-FTE, 400-FT, and 900-FT Aquifers are shown on Figures 193, 194, and 195, respectively.

9.6 Water Balance Analysis

The overall water budgets for the predictive model runs were compiled. The inflow terms for the NMGWM include underflow inflow through northern, eastern and southern model boundaries, stream recharge, deep percolation from precipitation and applied water (i.e., irrigation), recharge from returning basin water, and inflow from the ocean. The outflow terms are comprised of non-Project groundwater pumping, MCWD desalination pumping, MPWSP slant well pumping, aquifer losses to streams, and outflow to the ocean. The difference between the total inflow and total outflow represents the change in groundwater storage. The annual water budget tables for all of the Potrero Road Site predictive model runs are presented in attached Tables 15 through 19. Attached Table 20 summarizes the average annual water budgets for each of the model runs.

The differences between Potrero Road Site Project model runs and No Project model runs for selected flux terms are summarized in Table 9.4 below in order to assess slant well operation effects on the water budgets.

Table 9.4 – Summary of the Average Annual Changes in Selected Flux Terms (Potrero Road Site Project Runs vs. No Project Runs)

Model Run	Land Use	Feedwater Amount [MGD]	No Project Comparison (Land Use)	Average Annual Changes from No Project Conditions [AFY]				
				Ocean Inflow	Underflow from Northern, Eastern, and Southern Model Boundaries	Streambed Percolation, Deep Percolation from Precipitation and Applied Water	Aquifer Loss to Streams	Outflow to Ocean
6sn	2012	24.1	1n (2012)	17,833	5,136	-260	57	-3,558
7sf	2060	24.1	2f (2060)	19,104	4,602	-37	-7	-2,585
7srf	2060	0	2f (2060)	-172	-97	-1	0	2
8sn	2012	15.5	1n (2012)	9,044	2,300	-725	233	-2,371
8sf	2060	15.5	2f (2060)	9,801	1,749	-422	95	-1,793

Note: A positive sign represents an increase over No Project conditions, and a negative sign indicates a decrease.

As can be seen in the table, operation of the slant wells as feedwater for the desalination plant is expected to increase the amount of ocean water flowing into the model and reduce the amount of groundwater flowing into the ocean. The increase in ocean water inflow ranges from 9,044 acre-ft/yr (Model Run 8sn) to 19,104 acre-ft/yr (Model Run 7sf).

Along the inland model boundaries (i.e., GHB), it is expected that Project pumping under 24.1 and 15.5 MGD feedwater supply conditions will generally cause the amount of water flowing into the model area from inland areas to increase (or the amount of water flowing out of the model area inland to decrease). The increased underflow inflow ranges from 1,749 acre-ft/yr (Model Run 8sf) to 5,136 acre-ft/yr (Model Run 6sn).

Under Post Project conditions (Model Run 7srf), the recharge and discharge values are approximately the same as the values under No Project conditions (Model Run 2f).

10.0 FINDINGS

The NMGWM was successfully updated and calibrated from water year 1980 through water year 2011 (October, 1979 through September, 2011) using monthly stress periods. The acceptable model calibration is reflected in the distribution of water level residuals, the ability of the model-calculated hydrographs to capture the long- and short-term temporal trends in observed groundwater levels, and in a relative error of 9.5% for the flow model and 9.9% for the solute transport model, both of which are below the recommended modeling error of 10%. Model scenario results from the calibrated NMGWM and CM are summarized in the following sections. Refer to Appendix A for the SVIGSM results.

10.1 No Project Conditions

- Groundwater level fluctuations over 40 ft are caused by changes in hydrological conditions (e.g., wet and dry cycles) in both the Dune Sand and 180-FT/180-FTE Aquifers.
- SVWP Phase II tends to increase water levels in both aquifers in the Salinas River Valley from southwest to northeast, except in Salinas River area in the southeast model corner. Water levels in this northeast model area increase up to approximately 25 and 45 feet in the Dune Sand and 180-FT/180-FTE Aquifers, respectively.
- Decreases along the Salinas River in the southeast a maximum of 20 feet in the Dune Sand Aquifer (Figure 93) and from 5 to 25 feet in the 180-FT/180-FTE Aquifer (Figure 94). The decreased water levels in the southeast model boundary area under SVWP Phase II are caused by changes in SVWP water delivery amounts and locations (refer to Appendix A).

10.2 CEMEX Site Project Conditions

10.2.1 Groundwater Levels

- Groundwater level fluctuations are caused by changes in hydrological conditions (e.g., wet and dry cycles) in both the Dune Sand and 180-FT/180-FTE Aquifers.
- The maximum change in groundwater elevations occurs at the center of the CEMEX Site Wellfield.
- CEMEX Site Project pumping under 24.1 MGD feedwater conditions (Configuration A) is expected to cause a maximum decrease in groundwater levels at the Project site of 10 ft to 15 ft in the Dune Sand Aquifer, and of roughly 30 ft in the 180-FTE Aquifer.
- CEMEX Site Project pumping under 15.5 MGD feedwater conditions (Configuration B) is expected to cause a maximum decrease in groundwater levels at the Project site of 5 ft to 10 ft in the Dune Sand Aquifer, and of 15 ft to 20 ft in the 180-FTE Aquifer.

- The farthest distance from the CEMEX Site Project wellfield where water levels are expected to decline by one foot in the Dune Sand Aquifer occurs at approximately 5.1 miles southeast along the Salinas River Valley under Model Run 4f conditions in September 2034 (i.e., moderate period following a prolonged dry period). This distance will be reduced to 1.7 miles in the Dune Sand Aquifer if the feedwater supply decreases from 24.1 MGD to 15.5 MGD (Model Run 5f).
- The farthest distance for a water level decline of one foot in the 180-FT/180-FTE Aquifer occurs at the model boundary (located at approximately 7.0 miles southeast along the Salinas Valley) in September 2034 under Model Run 3n, 3ncb and 3nc conditions. This maximum distance will be reduced to about 1.4 to 1.7 miles in the 180-FT/180-FTE Aquifer in the same time period if the feedwater supply decreases to 15.5 MGD (Model Runs 5n, 5ncb, and 5nc).
- The Post Project scenario indicates that groundwater levels in the Dune Sand the 180-FT/180-FTE Aquifers will recover to the same levels seen under No Project conditions within five and three months, respectively.

10.2.2 Seawater Intrusion

- Forward particle tracking from the coastline under No Project conditions shows water from the coast migrating inland. Under Model Run 2f conditions with MCWD pumping, some of this seawater intrusion in the vicinity of the MCWD desalination wells is captured. In addition, the particle tracks under Model Run 2f (2060 land use) conditions reach distances slightly farther inland than under Model Run 1n (2012 land use) conditions.
- Reverse particle tracking under Project conditions shows that the slant wells at the CEMEX Site capture water primarily from off the coast. Some water is also captured from inland areas within roughly 2 miles of the coast that would have experienced seawater intrusion under No Project conditions. Therefore, the particle tracks illustrate one of the possible benefits that slant well pumping along the coast can provide; protection against seawater intrusion.

10.2.3 Percent Ocean Water in Project Wells

- In general, TDS concentrations in the slant well feedwater supply peaks after the prolonged dry season, approaching the assumed ocean water TDS of 33,500 mg/L. This likely corresponds with a steeper hydraulic gradient inland due to the dry conditions, resulting in a high distribution of ocean recharge. The subsequent prolonged wet season will produce a flat hydraulic gradient inland and a seaward flow direction, resulting in more inland groundwater being pumped and therefore lowering the TDS concentration of the extracted feedwater.

- Results from the CM show an average TDS concentration in the CEMEX slant wells of between 31,300 and 32,020 mg/L, indicating that the percentage of ocean water in the feedwater will average approximately 93 to 96 percent.
- The percentage of inland water, or return percentage, begins at approximately 7 percent under 2012 land use conditions (Run 3n) shortly after the system is fully operational and prior to the initiation of the MCWD desalination plant, and decreases with time to approximately 4 percent under 2060 land use conditions (Run 4f) long after the system is fully operational and with MCWD desalination.

10.2.4 Effects at Prunedale

- Comparisons between No Project and Project model runs show that there is no change in the particle tracks, indicating that slant well pumping at the CEMEX Site will not have an effect on water levels or groundwater movement in the northeast model area.
- The nonexistence of Project impacts in the Prunedale area is further supported by a lack of change in particle track flow directions and rates under CEMEX feedwater supply pumping conditions of 24.1 and 15.5 MGD.

10.2.5 Effects of Returning Basin Water

- The modeling results show that returning basin water by injection at either the Charles Benson Road Site or CEMEX Site during Project pumping reduces the Project impacts inland.
- Returning basin water at the Charles Benson Road Site reduces the maximum distance inland from the Project site that experiences a decline in water levels of one foot by approximately 0.3 to 0.8 miles.
- Returning basin water at the CEMEX Site reduces the maximum distance inland from the Project site that experiences a decline in water levels of one foot by approximately 0.1 to 0.5 miles. In addition, the drawdowns at the slant well location are slightly reduced.

10.2.6 Water Balance Analysis

- Operation of the slant wells as feedwater for the desalination plant generally increases the amount of ocean water flowing into the model and reduces the amount of groundwater flowing into the ocean. The increase in ocean water inflow ranges from 10,548 acre-ft/yr (Model Run 5nc) to 22, 830 acre-ft/yr (Model Run 4f).
- Along the inland model boundaries (i.e., general head boundary), it is expected that Project pumping for a feedwater supply of 24.1 MGD will generally cause the amount of water flowing

into the model area from inland areas to increase (or the amount of water flowing out of the model area inland to decrease). The increased underflow inflow under 24.1 MGD feedwater conditions ranges from 481 acre-ft/yr (Model Run 3ncb) to 989 acre-ft/yr (Model Run 4f).

- A feedwater supply of 15.5 MGD is expected to cause a decrease in inflow across the inland model boundaries due to the effect from the Ground Water Replenishment (GWR) Project with additional CSIP Water deliveries. The decreased underflow inflow under 15.5 MGD feedwater conditions ranges from 68 acre-ft/yr (Model Run 5n) to 611 acre-ft/yr (Model Run 5f). The underflow inflow across the inland model boundaries from inland is expected to be reduced to a greater degree under MPWSP returning basin water recharging conditions than without the additional recharge (Model Runs 5ncb and 5nc vs. Model Run 5n).
- The amount of streambed percolation and deep percolation from precipitation and applied water is also generally expected to increase under 24.1 MGD Project pumping conditions, while aquifer losses to streams will decrease. The increase in streambed percolation and deep percolation from precipitation and applied water ranges from 539 acre-ft/yr (Model Run 4f) to 562 acre-ft/yr (Model Runs 3n, 3ncb and 3nc). The decrease in aquifer losses to streams ranges from 100 acre-ft/yr (Model Run 4f) to 183 acre-ft/yr (Model Runs 3n, 3ncb and 3nc).
- Under 15.5 MGD Project pumping conditions, the amount of streambed percolation and deep percolation from precipitation and applied water is expected to decrease while aquifer losses to streams are generally expected to increase due to effects from the GWR Project with additional CSIP Water deliveries. The decrease in streambed percolation and deep percolation from precipitation and applied water ranges from 29 acre-ft/yr (Model Run 5f) to 298 acre-ft/yr (Model Runs 5n, 5ncb and 5nc). The increase in aquifer losses to streams ranges from 21 acre-ft/yr (Model Run 5f) to 65 acre-ft/yr (Model Run Model Runs 5n, 5ncb and 5nc).
- Under Post Project conditions (Model Run 4rf), the recharge and discharge values are approximately the same as the values under No Project conditions (Model Run 2f).

10.3 Potrero Road Site Project Conditions

10.3.1 Groundwater Levels

- Groundwater level fluctuations are caused by changes in hydrological conditions (e.g., wet and dry cycles) in both the Dune Sand and 180-FT/180-FTE Aquifers.
- The maximum change in 180-FT/180-FTE Aquifer groundwater elevations occurs approximately 0.8 miles east of the wellfield for the model runs. This is most likely caused by the pinching out of the SVA to the east of the Potrero Road Site and the induced leakage upward from the 180-FT/180-FTE Aquifer in response to pumping in the Dune Sand Aquifer.

- Potrero Road Site Project pumping under 24.1 MGD feedwater conditions (Configuration A) is expected to cause a maximum decrease in groundwater levels at the Project site of 30 ft to 35 ft in the Dune Sand Aquifer, and of roughly 4 to 6 ft in the 180-FT Aquifer.
- Potrero Road Site Project pumping under 15.5 MGD feedwater conditions (Configuration B) is expected to cause a maximum decrease in groundwater levels at the Project site of 20 ft in the Dune Sand Aquifer, and of roughly 1 to 5 ft in the 180-FT Aquifer.
- The farthest measurable distance from the Project wellfield where water levels are expected to decline by one foot in the Dune Sand Aquifer occurs at approximately 4.8 miles southeast along the Salinas Valley under Model Run 6sn and Model Run 7sf conditions. This maximum distance will be reduced to 3.0-3.2 miles and 3.2 miles in the Dune Sand Aquifer for Model Runs 6sn and 7sf, respectively, if the feedwater supply decreases from 24.1 MGD to 15.5 MGD (Model Runs 8sn and 8sf).
- The farthest distance where water levels are expected to decline by one foot in the 180-FT/180-FTE Aquifer occurs at a distance of approximately 4.5 miles under Model Run 7sf conditions in September 2050 (i.e., moderate period following a prolonged wet period). This maximum distance will be reduced to about 2.5 miles in the 180-FT/180-FTE Aquifer if the feedwater supply decreases from 24.1 MGD to 15.5 MGD (Model Run 8sf).
- The Post Project scenario indicates that groundwater levels in the Dune Sand the 180-FT/180-FTE Aquifers will recover to the same levels seen under No Project conditions within twelve and five months, respectively.

10.3.2 Seawater Intrusion

- Forward particle tracking from the coastline under No Project conditions shows water from the coast migrating inland. Under Model Run 2f conditions (2060 land use) particle tracks reach distances slightly farther inland than under Model Run 1n (2012 land use) conditions and have a strictly southeasterly flow direction. Under Model Run 1n conditions, some of the particle tracks tend to have a more easterly travel path direction than under Model Run 2f, and some of the tracks in the northern portion have a northeastern component of flow.
- Reverse particle tracking under Project conditions shows that the slant wells at the Potrero Road Site capture water primarily from off the coast. A split in particle paths is observed offshore of the Elkhorn Slough and is a product of the Monterey Canyon and bathymetry. Some water is also captured from inland areas within roughly 2 miles of the coast; some of which would have experienced seawater intrusion under No Project conditions.

10.3.3 Percent Ocean Water in Project Wells

- In general, TDS concentrations in the slant well feedwater supply peaks after the prolonged dry season. This likely corresponds with a steeper hydraulic gradient inland due to the dry conditions, resulting in a high distribution of ocean recharge. The subsequent prolonged wet season will produce a flat hydraulic gradient inland and a seaward flow direction, resulting in more inland groundwater being pumped and therefore lowering the TDS concentration of the extracted feedwater.
- Results from the NMGWM show an average TDS concentration in the Potrero Road slant wells of between 27,840 and 28,760 mg/L, indicating that the percentage of ocean water in the feedwater will average approximately 83 to 86 percent.
- The percentage of inland water, or return percentage, begins at approximately 17 percent under 2012 land use conditions (Run 6sn) shortly after the system is fully operational and prior to the initiation of the MCWD desalination plant, and decreases with time to approximately 14 percent under 2060 land use conditions (Run 7sf) long after the system is fully operational and with MCWD desalination.

10.3.4 Effects at Prunedale

- Comparisons between No Project and Project model runs show that there is no change in the particle tracks, indicating that slant well pumping at the Potrero Road Site will not have an effect on water levels or groundwater movement in the northeast model area.
- The nonexistence of Project impacts in the Prunedale area is further supported by a lack of change in particle track flow directions and rates under Potrero Road feedwater supply pumping conditions of 24.1 and 15.5 MGD.

10.3.5 Water Balance Analysis

- Operation of the slant wells as feedwater for the desalination plant is expected to increase the amount of ocean water flowing into the model and reduce the amount of groundwater flowing into the ocean. The increase in ocean water inflow ranges from 9,044 acre-ft/yr (Model Run 8sn) to 19,104 acre-ft/yr (Model Run 7sf).
- Along the inland model boundaries (i.e., general head boundary), it is expected that Project pumping under 24.1 and 15.5 MGD feedwater supply conditions will generally cause the amount of water flowing into the model area from inland areas to increase (or the amount of water flowing out of the model area inland to decrease). The increased underflow inflow ranges from 1,749 acre-ft/yr (Model Run 8sf) to 5,136 acre-ft/yr (Model Run 6sn).

- Under Post Project conditions (Model Run 7srf), the recharge and discharge values are approximately the same as the values under No Project conditions (Model Run 2f).

11.0 MODEL LIMITATIONS AND UNCERTAINTY

The NMGWM is a useful tool for evaluating water levels and water quality of the aquifer systems, as the model calibration exceeds industry standards. In addition, the confidence in using the predictive model runs is increased through the reasonable results from the Project Scenario runs. However, it should be noted that the model is a simplified approximation of a complex geohydrologic system. The accuracy of model predictions is dependent on the simplifying assumptions used due to limited hydrogeologic data. As an example, the hydraulic conductivity values at the CEMEX and Potrero Road Sites was estimated based on lithologic data collected from boreholes. Results from the Test Well pumping test can significantly enhance the capability of the model to predict water level and water quality impacts from Project pumping. It is anticipated that the NMGWM and CM will be updated when additional hydrogeologic data from the pumping test become available.

12.0 REFERENCES

Anderson, Mary P., and Woessner, William W., 1992. *Applied Groundwater Modeling – Simulation of Flow and Advective Transport*. New York: Academic Press, 1992.

California Department of Water Resources (DWR), 2003. California's Groundwater - Bulletin 118, Update 2003. Dated October, 1, 2003.

Dupré, William R., 1975. *Quaternary History of the Watsonville Lowlands North-Central Monterey Bay Region, California*.

Dupré, William R., 1990. *Quaternary Geology of the Monterey Bay Region California*. AAPG Pacific Section, 2009 – Geology and Tectonics of the Central California Coast Region.

Durbin, T., 2013, *Conaway Ranch Groundwater Model – Power-Law Averaging of Hydraulic Conductivity*. Draft Technical Memorandum, November 2013.

Emcon, 1991. Monterey Regional Waste Management District, Marina Class III Landfill Geologic and Hydrogeologic Study, Monterey County, California.

Environmental Simulations, Inc., 1999. *Groundwater Vistas*, version 2.1.Dupré, William R., 1975. *Quaternary History of the Watsonville Lowlands North-Central Monterey Bay Region, California*.

ESA PWA, 2013. Monterey Peninsula Water Supply Project: Coastal Water Elevations and Sea Level Rise Scenarios. Memorandum, 2-Apr-2013.

Faunt, C.C., ed., 2009, Groundwater Availability of the Central Valley Aquifer, California: U.S. Geological Survey Professional Paper 1766, 225 p.

GEOSCIENCE Support Services, Inc., 2008. *North Marina Groundwater Model Evaluation of Potential Projects*. Prepared for California American Water. September 2008.

GEOSCIENCE Support Services, Inc., 2013. *Monterey Peninsula Water Supply Project Hydrogeologic Investigation Work Plan*. Prepared for California American Water and RBF Consulting. December 2013.

GEOSCIENCE Support Services, Inc., 2014. *Monterey Peninsula Water Supply Project Hydrogeologic Investigation Technical Memorandum (TM-1) – Summary of Results – Exploratory Boreholes*. Prepared for California American Water and RBF Consulting. July 2014.

Greene, Gary H., 1970. *Geology of Southern Monterey Bay and its Relationship to Ground Water Basin and Sea Water Intrusion*. U.S. Geologic Survey Open-File Report.

Guo, W., and Langevin, C.D., 2002. *User's Guide to SEAWAT: A Computer Program for Simulation of Three-Dimensional Variable-Density Ground-Water Flow.* U.S. Geological Survey Techniques of Water-Resources Investigations 6-A7.

Hanson, R.T., Everett, R.R., Newhouse, M.W., Crawford, S.M., Pimentel, M.I., and Smith, G.A., 2001. *Geohydrology of a Deep-Aquifer Monitoring-Well Site at Marina, Monterey County, California.* Prepared in cooperation with the Monterey County Water Resources Agency. USGS Water-Resources Investigations Report (WRIR) 02-4003.

Harbaugh, A.W., E.R. Banta, M.C. Hill, and M.G. McDonald. 2000. *MODFLOW-2000, the U.S. Geological Survey modular ground-water model—User guide to modularization concepts and the Ground-Water Flow Process*. USGS Open-File Report 00-92. Reston, Virginia: U.S. Geological Survey.

Harding Lawson Associates (HLA), 2001. *Final Report: Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina, Salinas Valley, California.*

Kennedy-Jenks Consultants, 2004. *Hydrostratigraphic Analysis of the Northern Salinas Valley*.

Kim, J.Y., Edil, T.B., and Park, J.K., 1997. *Effective Porosity and Seepage Velocity in Column Tests on Compacted Clay.* Journal of Geotechnical and Geoenvironmental Engineering. December 1997.

Langenheim, V.E., Stiles, S.R., and Jachens, R.C., 2002. *Isostatic Gravity Map of the Monterey 30' x 60' Quadrangle and Adjacent Areas, California*. U.S. Geological Survey Open-File Report 02-373.

Ludorff and Scalmanini, Consulting Engineers (LSCE), 2015. *Hydrologic Modeling of the Monterey Peninsula Water Supply Project using the Salinas Valley Integrated Ground and Surface Water Model*. Prepared for GEOSCIENCE Support Services, Inc.

MACTEC, 2005. Operable Unit Carbon Tetrachloride Plume Groundwater Remedial Investigation/Feasibility Study – Former Fort Ord, CA. Volume I – Remedial Investigation. Draft prepared for United States Army Corps of Engineers. April 29, 2005.

Marina Coast Water District (MCWD), Monterey County Water Resources Agency (MCWRA), and California-American Water Company (Cal-Am), 2010. *Water Purchase Agreement.* Dated April 6, 2010.

Montgomery Watson, 1994. *Salinas River Basin Water Resources Management Plan Task 1.09 Salinas Valley Ground Water Flow and Quality Model Report*. Prepared for Monterey County Water Resources Agency. Dated February 1994.

Rosenberg, L.I., and Clark, J.C., 2009. *Map of Rinconada and Reliz Fault Zones, Salinas River Valley, California*. U.S. Geological Survey Scientific Investigations Map 3059.

Sara, M., 2003. *Site Assessment and Remediation Handbook, 2nd ed.* Lewis Publishers, Florida. 944 p.

Sevee, J.E., 2010. *Effective Porosity Measurement of Marine Clay.* Journal of Environmental Engineering. July 2010.

Spitz, K., and Moreno, J., 1996. *A Practical Guide to Groundwater and Solute Transport Modeling*. Wiley-Interscience. April 1996.

Staal, Gardner, and Dunne, Inc., 1991. *Feasibility Study-Seawater Intake Wells Marina County Water District Wastewater Treatment Facility, Marina, California.*

Tinsley, John III, 1975. *Quaternary Geology of the Northern Salinas Valley, Monterey County, California*.

Tinsley, John III, 2014. Personal Communication.

United States Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), and National Geodetic Survey (NGS), 2011. Continually Updated Shoreline Product. Shapefile.

USGS, 2003. Geohydrologic Framework of Recharge and Seawater Intrusion in the Pajaro Valley, Santa Cruz and Monterey Counties, California. U.S.G.S. Water-Resources Investigations. Report 03-4096.

WRIME, 2008. *Groundwater Modeling Simulation of Impacts for Monterey Regional Water Supply Project (Draft)*. Prepared for RMC. Dated May 30, 2008.

Zheng, C., and Bennett, G., 2002. *Applied Contaminant Transport Modeling, Second Edition.* New York: John Wiley & Sons, 2002.

Zheng, C., and Wang, P., 1998. *MT3DMS, A modular three-dimensional multispecies transport model for simulation of advection, dispersion and chemical reactions of contaminants in groundwater systems*: Vicksburg, Miss., Waterways Experiment Station, U.S. Army Corps of Engineers.

FIGURES

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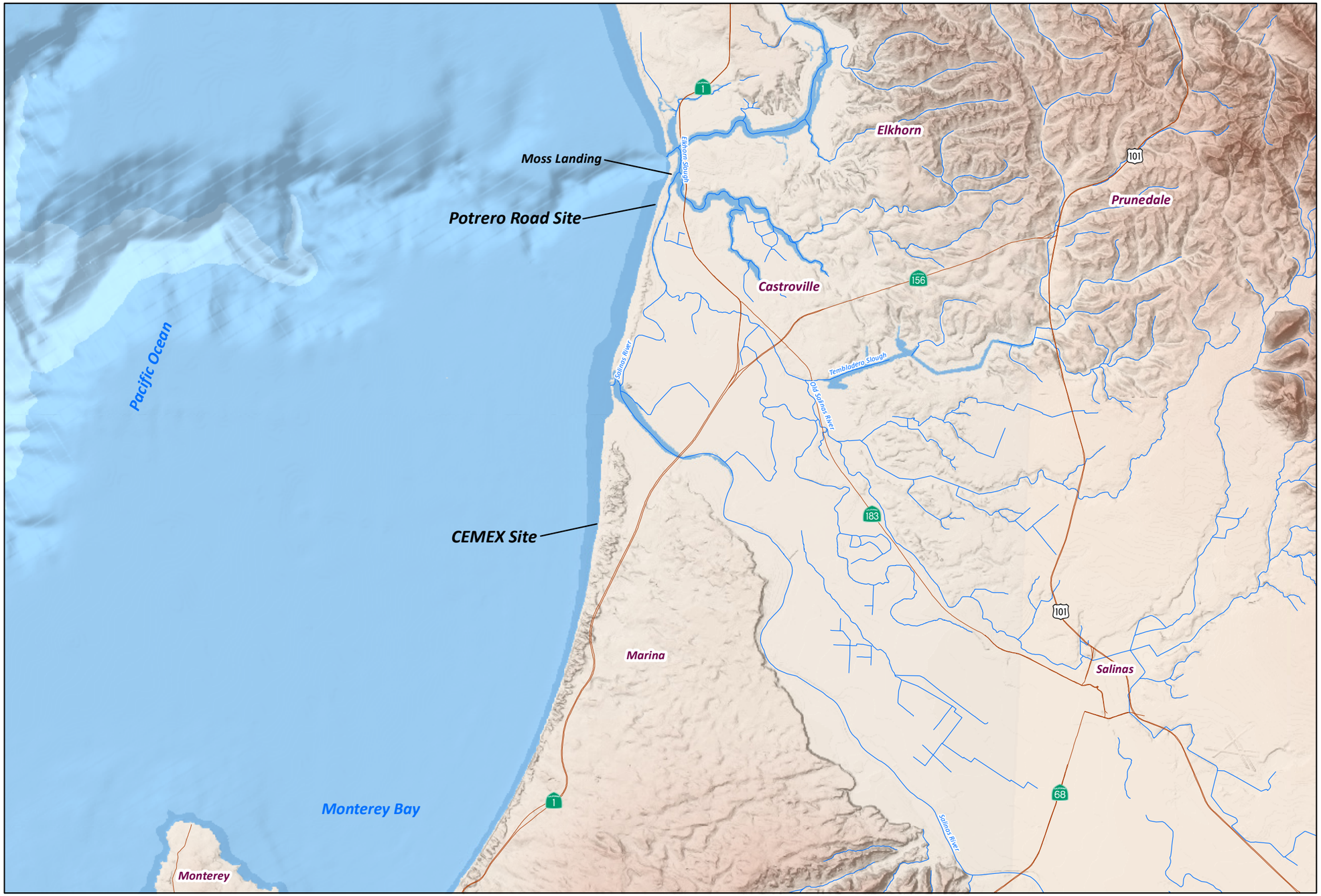
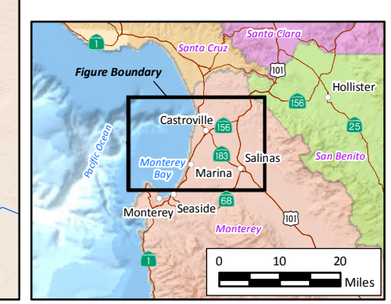
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

GENERAL LOCATION OF PROJECT AREA





17-Apr-15

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NORTH

0 0.5 1 1.5 2 2.5 5 Miles

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Figure 1

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_1_general_loc_11x17_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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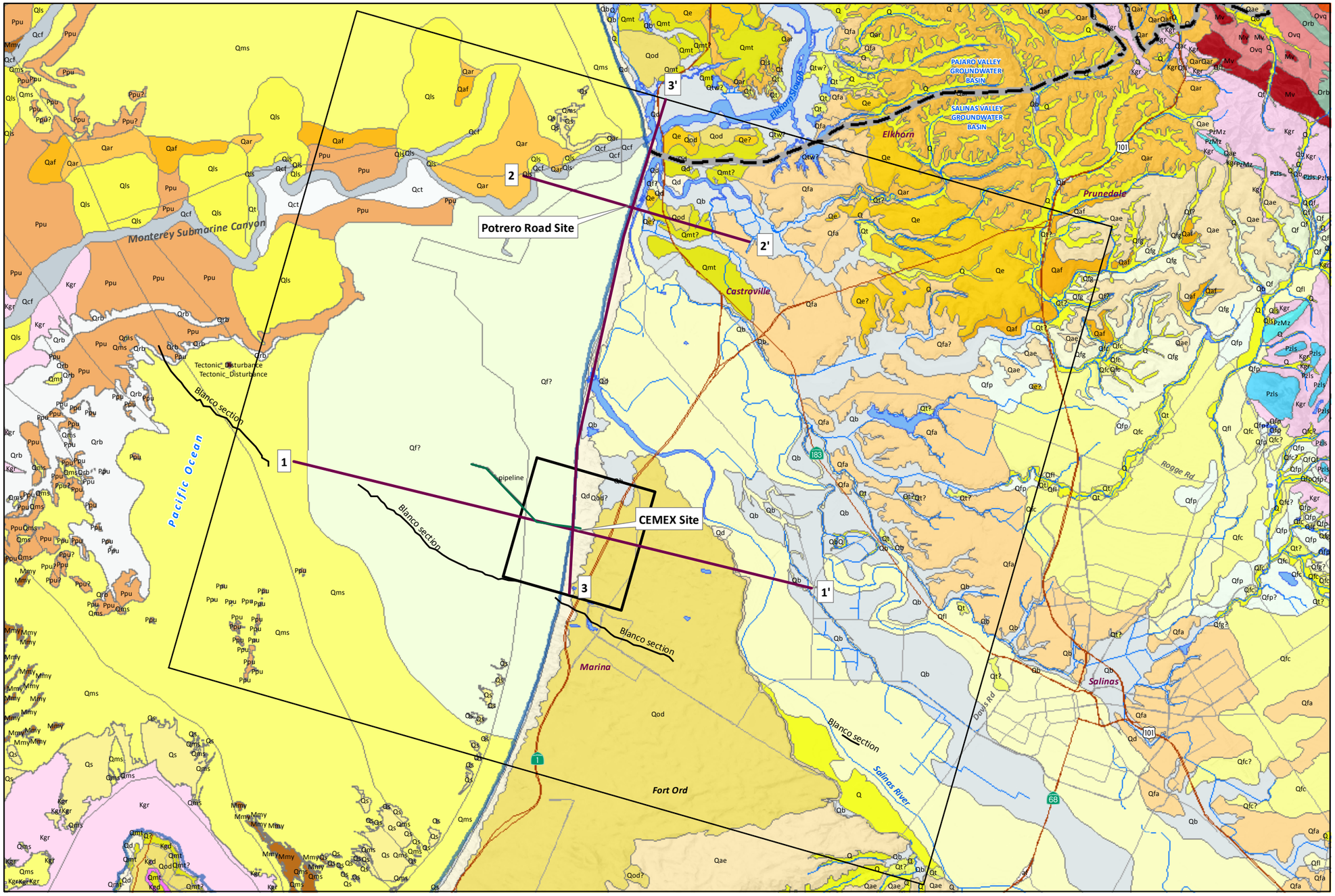
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

GEOLOGIC SETTING



EXPLANATION

- Fault - Blanco Section of the Reliz Fault Source (Rosenberg and Clark, 2009)
- Pipeline Outfall
- Groundwater Basin Boundary (DWR, 2003)
- North Marina Groundwater Model (NMGWM) Boundary
- CEMEX Groundwater Model Boundary
- 1 1' Cross-Section Location
- Coastline

Geology from: (Langenheim et al., 2002) Isostatic Gravity Map Monterey 30 X 60)
See Figure 2b for Geologic Legend

17-Apr-15

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Figure 2a

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/11_Fig_2a_geology_modified_3-15.mxd

Langenheim, V.E., Stiles, S.R., and Jachens, R.C. 2002.
Isostatic Gravity Map of the Monterey 30'x60' Quadrangle and Adjacent Areas, California.
U.S. Geological Survey Open-File Report 02-373.

af - Artificial Fill

Holocene

- Q - Alluvium
- Qfl - Flood Plain Deposits
- Qb - Basin Deposits
- Qs - Sand
- Qe - Eolian Sand
- Qd - Dune Sand
- Qcf - Canyon Fill (offshore)
- Qo - Older Alluvium
- Qls - Landslide Deposits
- Qms - Marine Sediments
- Qt - Terrace Deposits
- Qod - Older Dune Sand
- Qmt - Marine Terrace Deposits
- Qrb - Relict Beach Deposits (offshore)
- Qf - Alluvial Fan Deposits
- Qtw - Terrace Deposits of Watsonville Terrace
- Qct - Submarine Canyon Terrace

Pleistocene

- Qfa - Fan Deposits of Antioch
- Qfc - Fan Deposits of Chular
- Qfp - Fan Deposits of Placentia
- Qfg - Fan Deposits of Gloria
- Qar - Aromas Sand (undivided)
  - Qae - Eolian Facies
  - Qaf - Fluvial Facies

Pliocene

- QT - Plio-Pleistocene Continental Deposits
- Ppu - Purisma Formation

Miocene

- MPe - Etchegoin Formation
- Mv - Unnamed Miocene Volcanic Rocks
- Mmy - Monterey Formation
- Tv - Tertiary Volcanic Rocks
- Mus - Unnamed Miocene Sandstone

Oligocene

- Orb - Red Beds
- Ovq - Vaqueros Sandstone

Paleocene-Eocene

- EOsj - San Juan Bautista Formation
- Ebu - Unnamed Eocene Sedimentary Rocks
- Ec - Carmelo Formation

Cretaceous

- Kgr - Granitic Rocks
- Kqm - Quartz Monzonite
- Kgd - Granodiorite

Jurassic

- PzMz - Prebatholithic Metasedimentary Rocks
- Pzls - Carbonate Rocks

Tectonic Disturbance

Pipeline

water

GEOLOGIC MAP LEGEND

17-Apr-15

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Figure 2b

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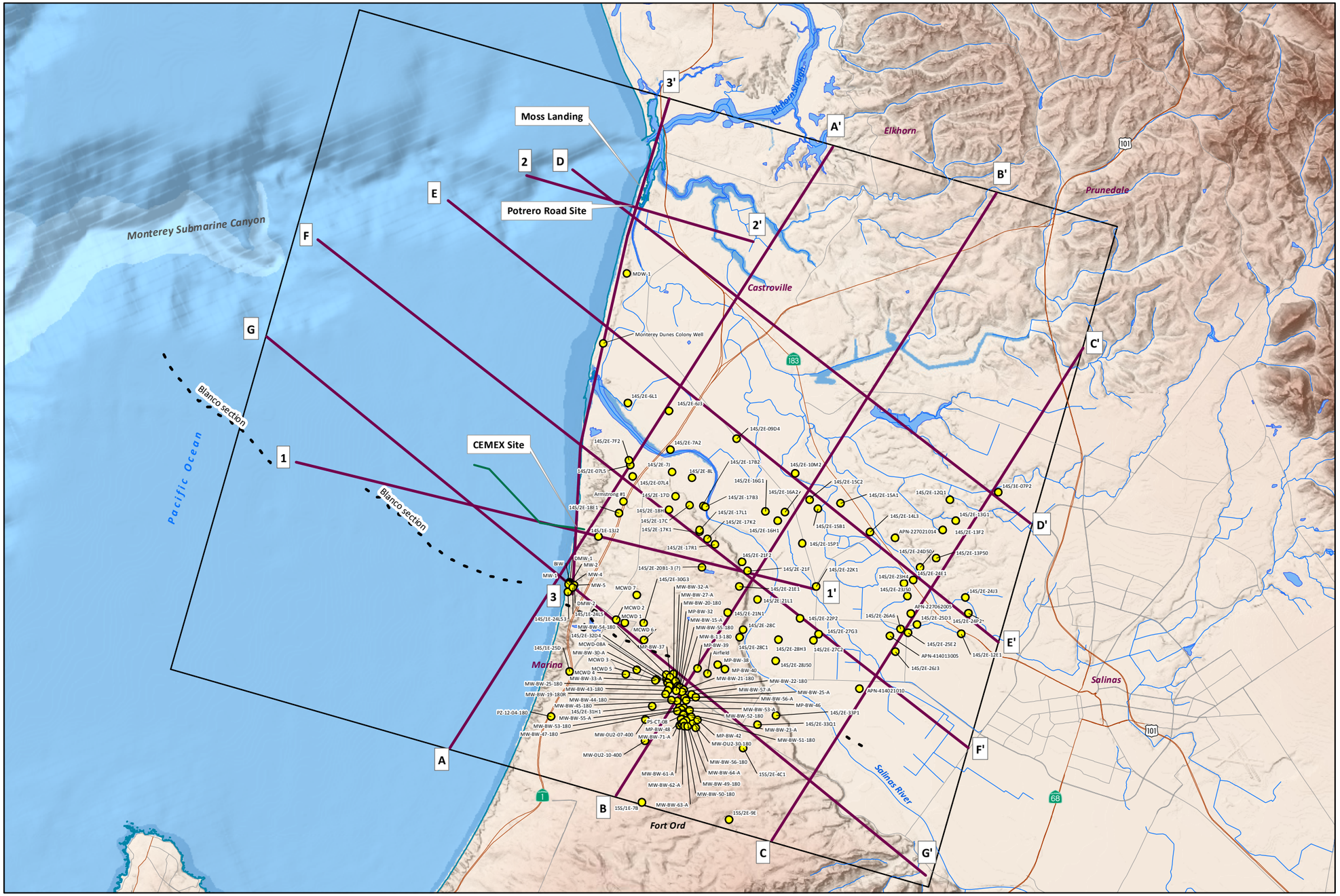
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



WELL AND CROSS-SECTION LOCATIONS

EXPLANATION

- Well Location
- 1 — 1' Cross-Section Location
- Fault - Blanco Section of the Reliz Fault Source (Rosenberg and Clark, 2009)
- Pipeline Outfall
- North Marina Groundwater Model Boundary
- Mean High Tide (DOC, NOAA et al., 2011)

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Figure 3

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/11_Fig_3_wells_and_x-secs_3-15.mxd

Source: Kennedy Jenks, 2004.

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GEOLOGIC CROSS-SECTION 1-1'

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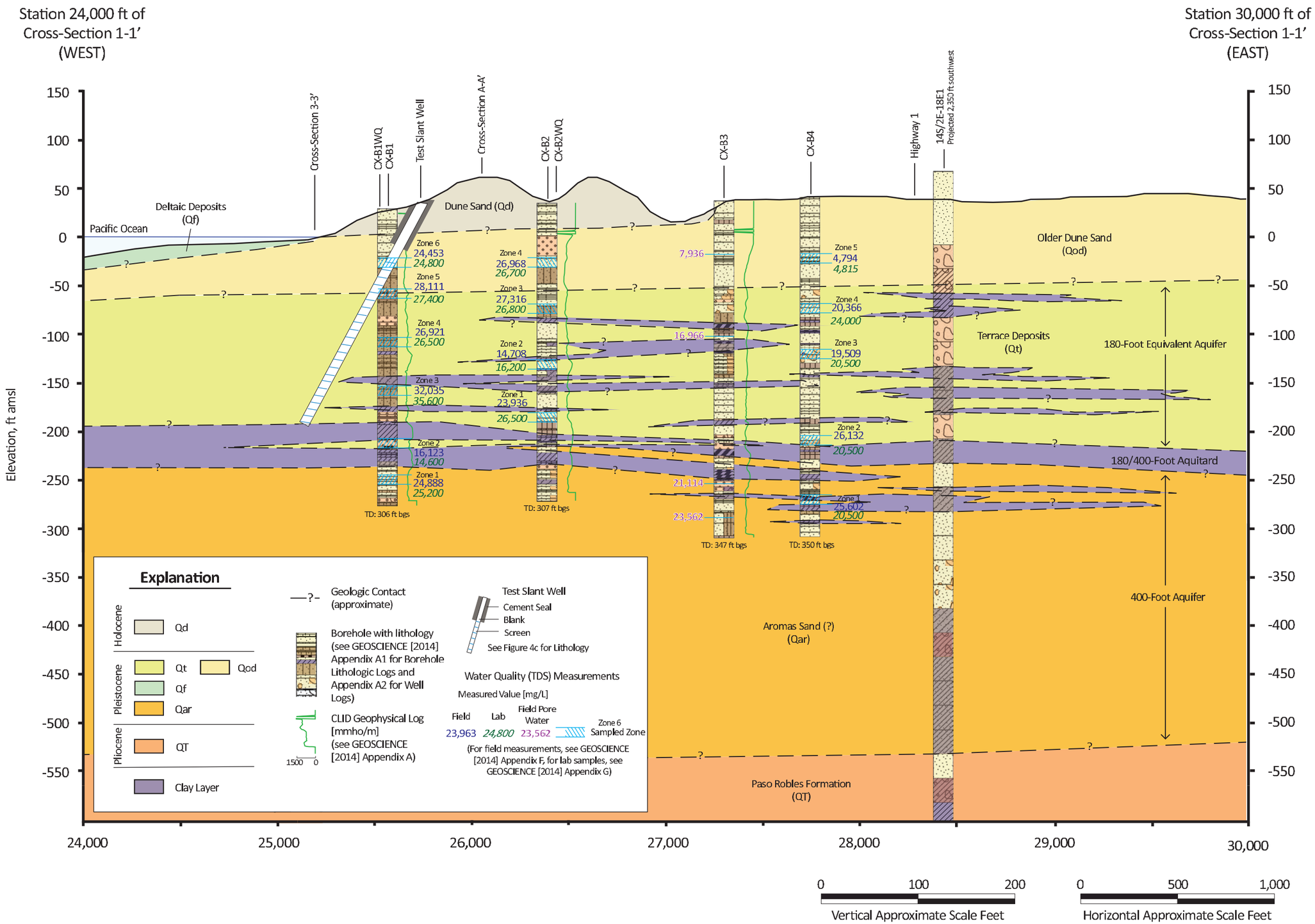
Figure 4a



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CEMEX AREA PORTION OF GEOLOGIC CROSS-SECTION 1-1'

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Figure 4b

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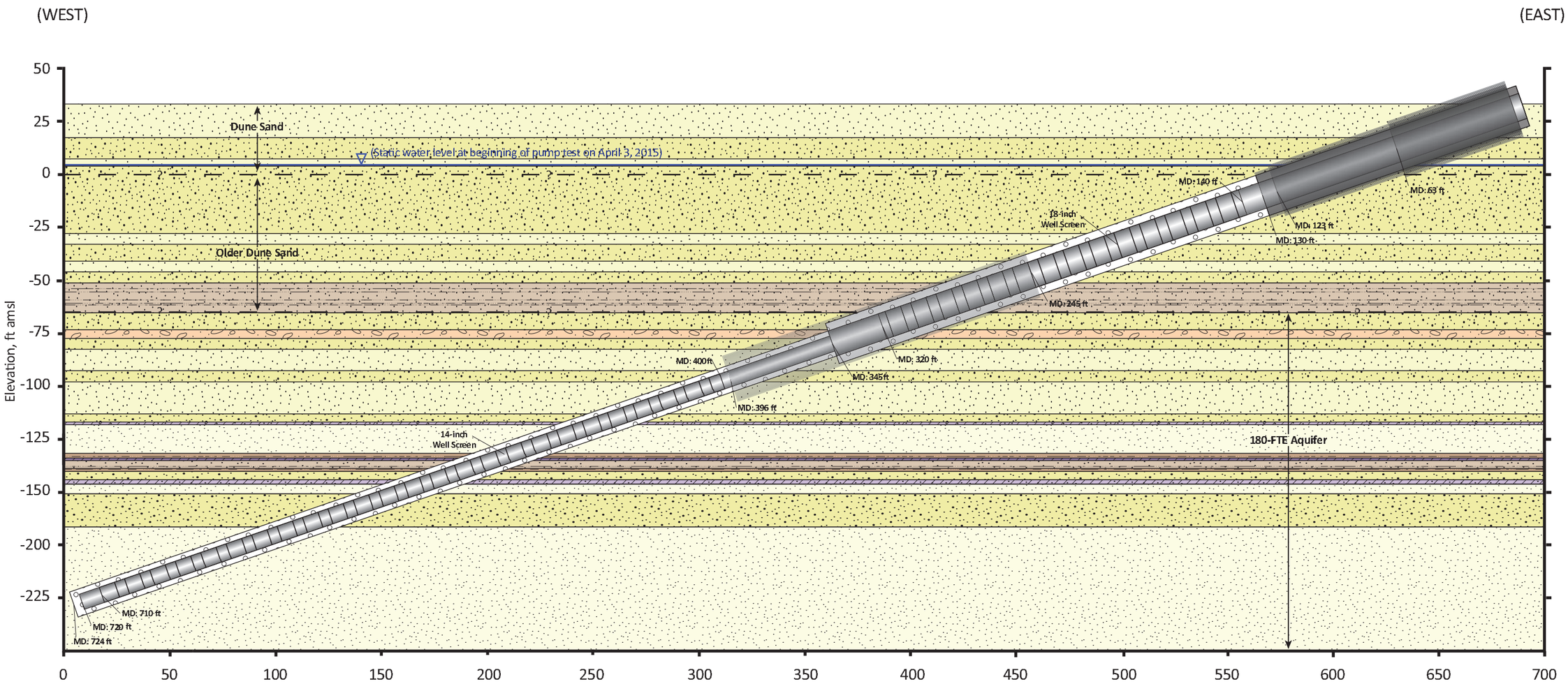
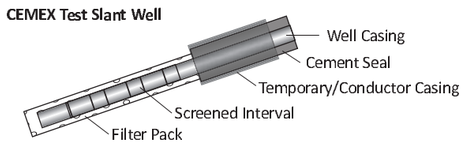


Explanation

- Sand with Gravel (SP)
- Fine to Coarse Grained Sand (SP)
- Fine to Medium Grained Sand (SP)
- Fine Grained Sand (SP)
- Sand with Silt (SP-SM)
- Silt or Silt with Sand (ML/SM)
- Clayey Sand (SC)
- Clay (CL)
- — ? — Geologic Contact (approximate)

CEMEX Test Slant Well



MD = Measured (Lineal) Depth

0 50 100
Approximate Scale Feet

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CEMEX TEST SLANT WELL LITHOLOGY

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Figure 4c

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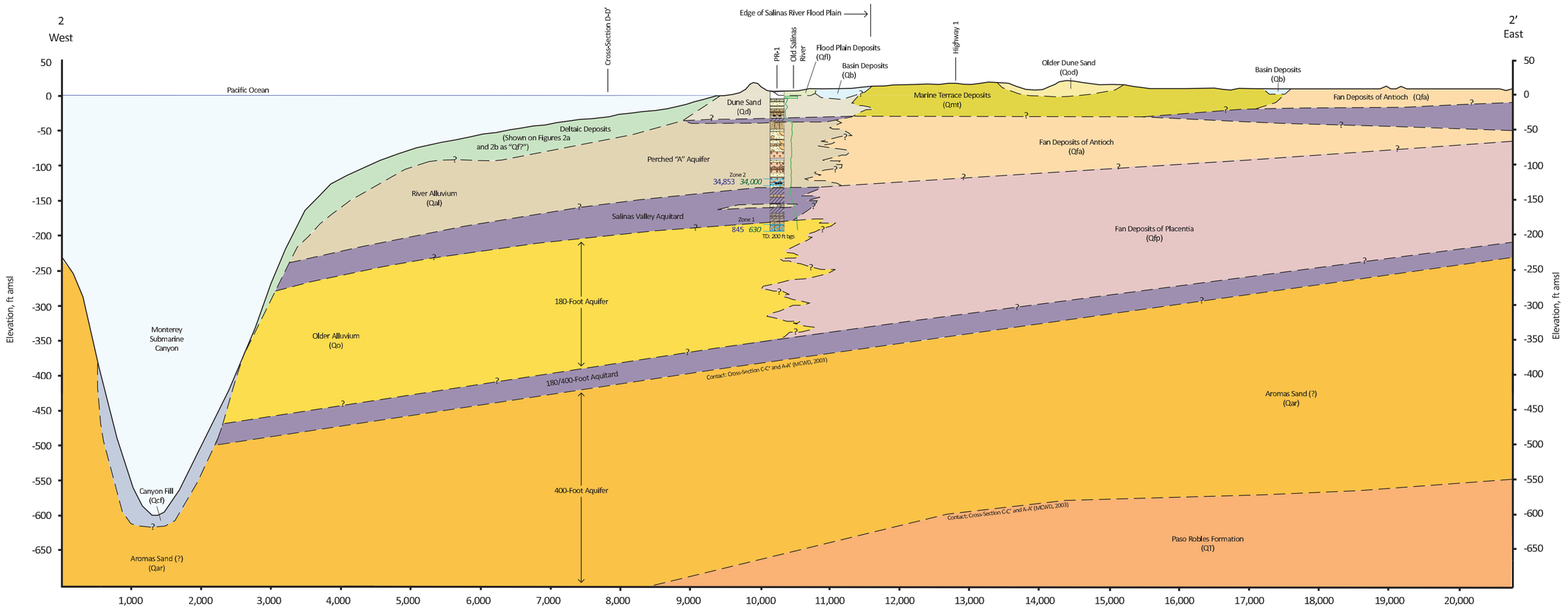

Explanation

Holocene
- Qfl
- Qd
- Qal
- Qb
- Qcf

Pleistocene
- Qo
- Qod
- Qmt
- Qf
- Qfa
- Qfp
- Qar

Pliocene
- QT

- Clay Layer
- Silt Layer
- ?– Geologic Contact (approximate)
- Borehole/Well with lithology (see GEOSCIENCE [2014] Appendix A1 for Borehole Lithologic Logs and Appendix A2 for Well Logs)
- CLID Geophysical Log [mmho/m] (see GEOSCIENCE [2014] Appendix A1) — 1500 0

Water Quality (TDS) Measurements

Measured Value [mg/L]
Field Lab
23,963 *24,800*
Zone 6 Sampled Zone

(For field measurements, see GEOSCIENCE [2014] Appendix F, for lab samples, see GEOSCIENCE [2014] Appendix G)

0 100 200
Vertical Approximate Scale Feet

0 1,000 2,000
Horizontal Approximate Scale Feet

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GEOLOGIC CROSS-SECTION 2-2'

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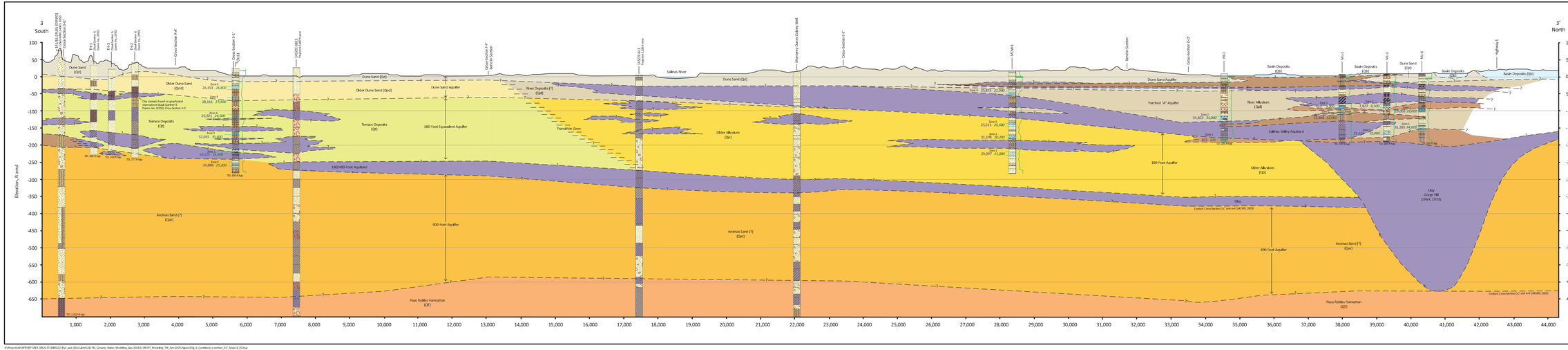
Figure 5



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GEOLOGIC CROSS-SECTION 3-3'

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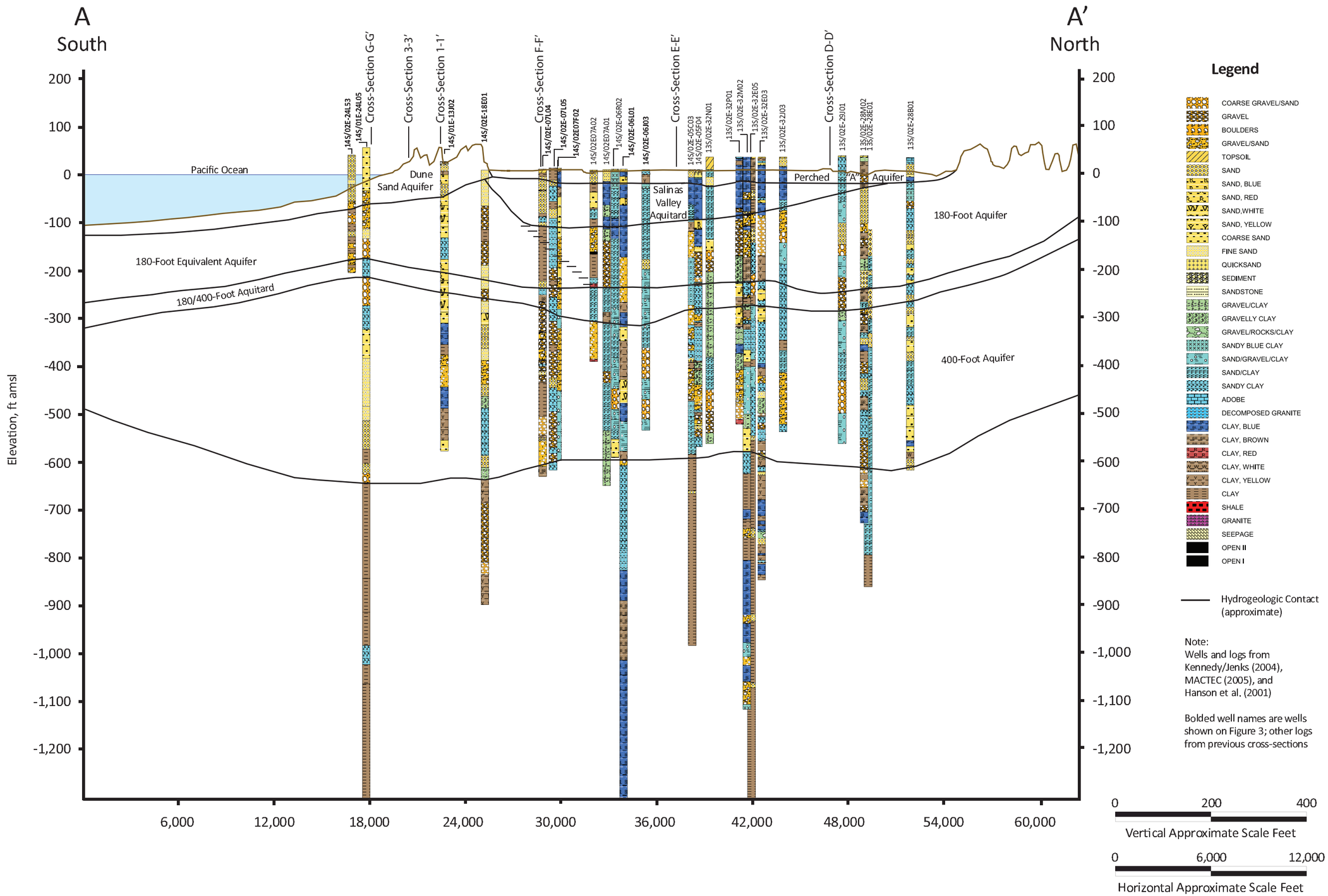
Figure 6



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HYDROGEOLOGIC CROSS-SECTION A-A'

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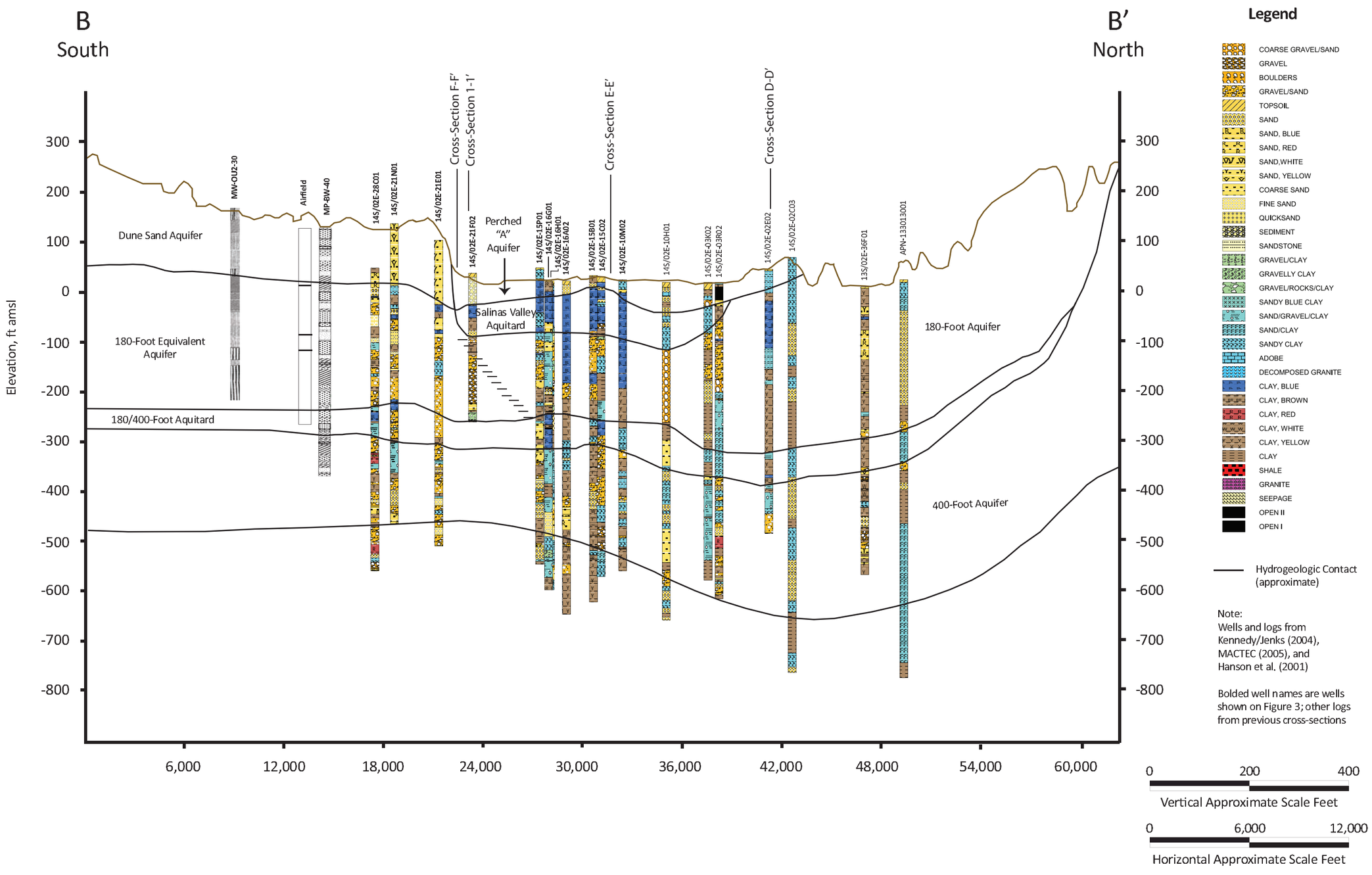
Date: 17-Apr-15

Figure 7

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_7_x-section_A-A'_rev.ai



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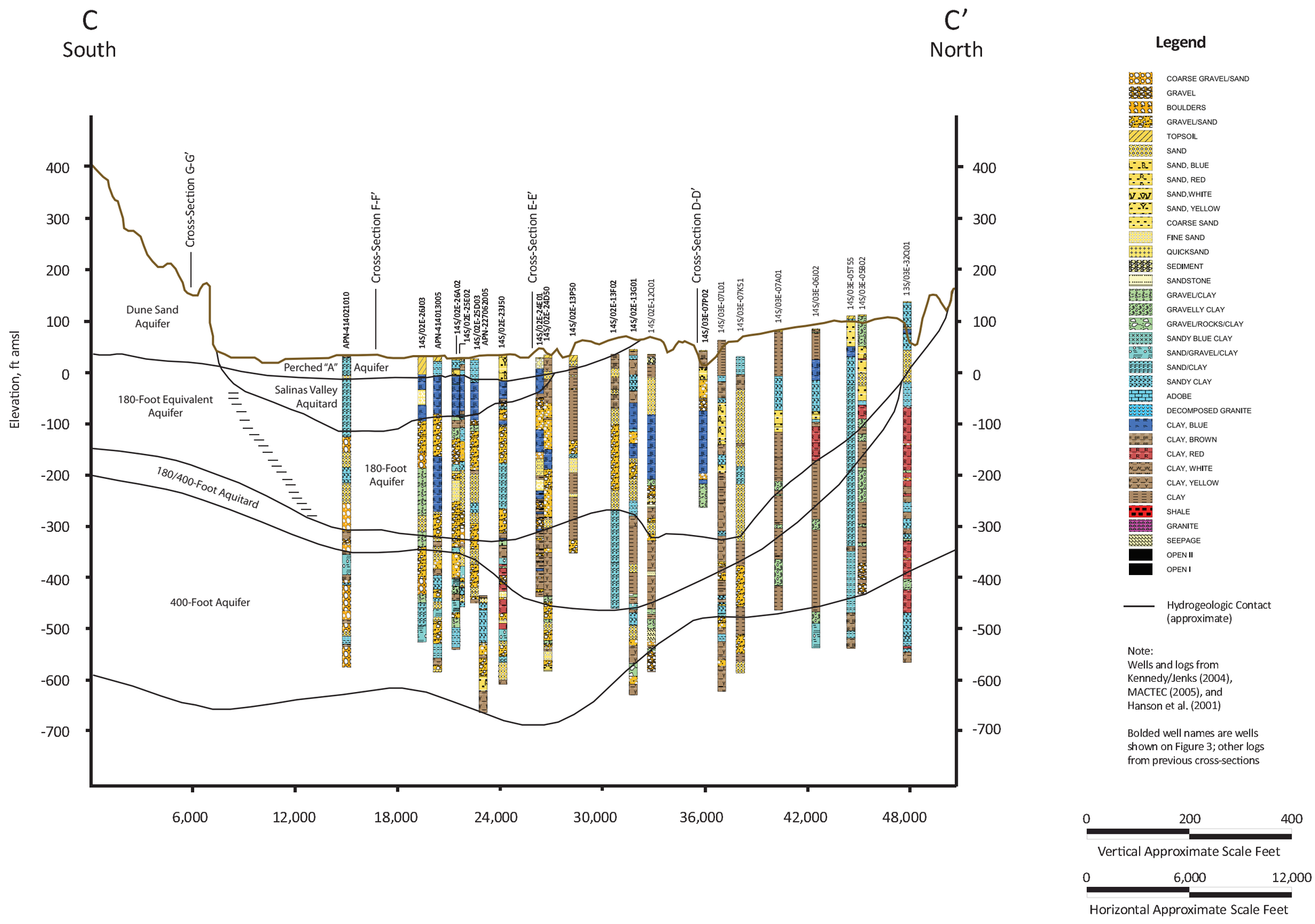
HYDROGEOLOGIC CROSS-SECTION B-B'

Drawn: TC
Checked:
Approved:
Date: 17-Apr-15

Figure 8

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_8_x-section_B-B'_rev.ai



Legend

- COARSE GRAVEL/SAND
- GRAVEL
- BOULDERS
- GRAVEL/SAND
- TOPSOIL
- SAND
- SAND, BLUE
- SAND, RED
- SAND,WHITE
- SAND, YELLOW
- COARSE SAND
- FINE SAND
- QUICKSAND
- SEDIMENT
- SANDSTONE
- GRAVEL/CLAY
- GRAVELLY CLAY
- GRAVEL/ROCKS/CLAY
- SANDY BLUE CLAY
- SAND/GRAVEL/CLAY
- SAND/CLAY
- SANDY CLAY
- ADOBE
- DECOMPOSED GRANITE
- CLAY, BLUE
- CLAY, BROWN
- CLAY, RED
- CLAY, WHITE
- CLAY, YELLOW
- CLAY
- SHALE
- GRANITE
- SEEPAGE
- OPEN II
- OPEN I

Hydrogeologic Contact (approximate)

Note:
Wells and logs from Kennedy/Jenks (2004), MACTEC (2005), and Hanson et al. (2001)

Bolded well names are wells shown on Figure 3; other logs from previous cross-sections

0 200 400
Vertical Approximate Scale Feet

0 6,000 12,000
Horizontal Approximate Scale Feet

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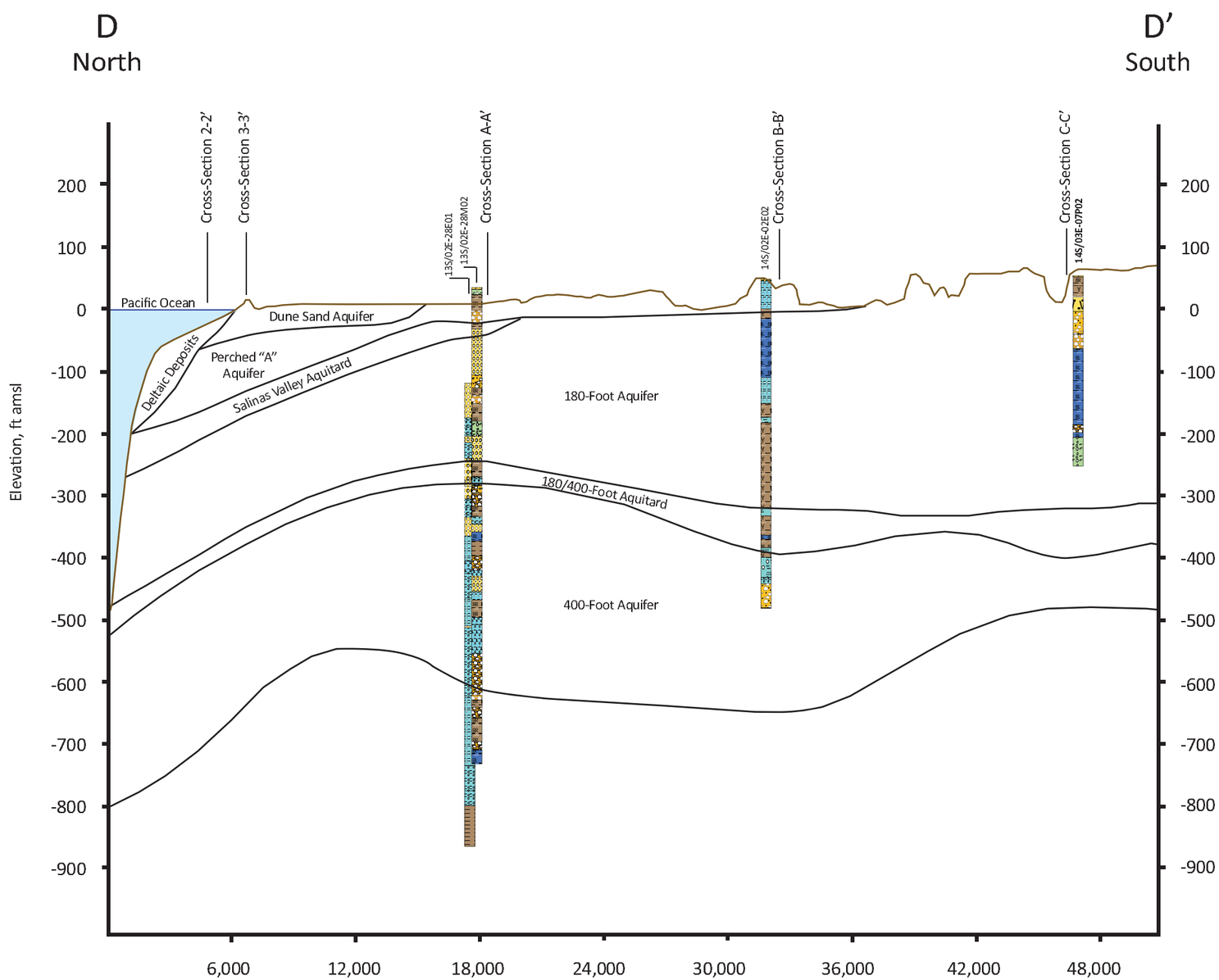
HYDROGEOLOGIC CROSS-SECTION C-C'

Drawn: TC
Checked:
Approved:
Date: 17-Apr-15

Figure 9

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_9_x-section_C-C'_rev.ai



Legend

- COARSE GRAVEL/SAND
- GRAVEL
- BOULDERS
- GRAVEL/SAND
- TOPSOIL
- SAND
- SAND, BLUE
- SAND, RED
- SAND,WHITE
- SAND, YELLOW
- COARSE SAND
- FINE SAND
- QUICKSAND
- SEDIMENT
- SANDSTONE
- GRAVEL/CLAY
- GRAVELLY CLAY
- GRAVEL/ROCKS/CLAY
- SANDY BLUE CLAY
- SAND/GRAVEL/CLAY
- SAND/CLAY
- SANDY CLAY
- ADOBE
- DECOMPOSED GRANITE
- CLAY, BLUE
- CLAY, BROWN
- CLAY, RED
- CLAY, WHITE
- CLAY, YELLOW
- CLAY
- SHALE
- GRANITE
- SEEPAGE
- OPEN II
- OPEN I

Hydrogeologic Contact (approximate)

Note:
Wells and logs from Kennedy/Jenks (2004), MACTEC (2005), and Hanson et al. (2001)

Bolded well names are wells shown on Figure 3; other logs from previous cross-sections

0 200 400
Vertical Approximate Scale Feet

0 6,000 12,000
Horizontal Approximate Scale Feet

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HYDROGEOLOGIC CROSS-SECTION D-D'

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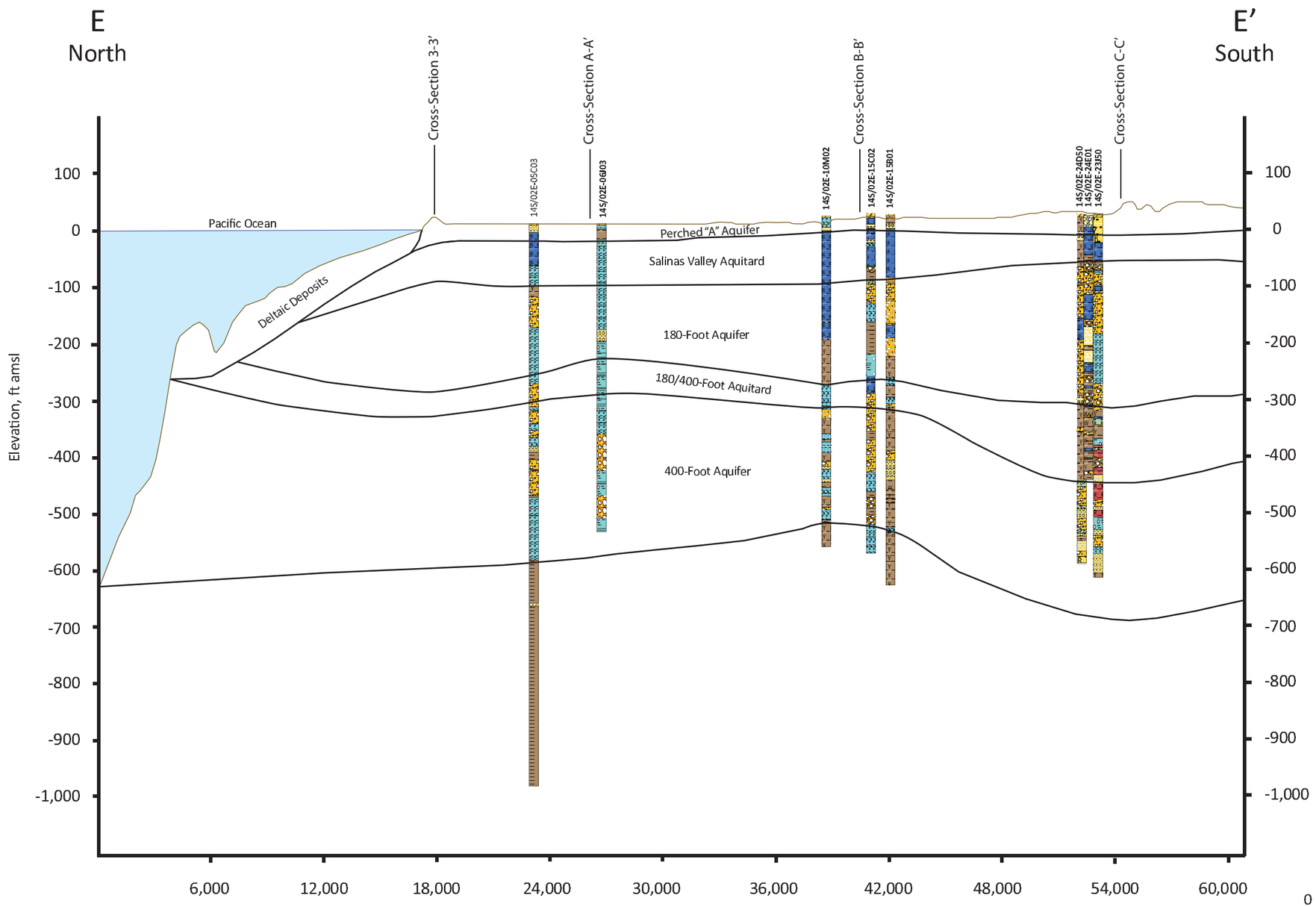
Approved:
Date: 17-Apr-15

Figure 10

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_10_x-section_D-D'_rev.ai



Legend

- COARSE GRAVEL/SAND
- GRAVEL
- BOULDERS
- GRAVEL/SAND
- TOPSOIL
- SAND
- SAND, BLUE
- SAND, RED
- SAND,WHITE
- SAND, YELLOW
- COARSE SAND
- FINE SAND
- QUICKSAND
- SEDIMENT
- SANDSTONE
- GRAVEL/CLAY
- GRAVELLY CLAY
- GRAVEL/ROCKS/CLAY
- SANDY BLUE CLAY
- SAND/GRAVEL/CLAY
- SAND/CLAY
- SANDY CLAY
- ADOBE
- DECOMPOSED GRANITE
- CLAY, BLUE
- CLAY, BROWN
- CLAY, RED
- CLAY, WHITE
- CLAY, YELLOW
- CLAY
- SHALE
- GRANITE
- SEEPAGE
- OPEN II
- OPEN I

Hydrogeologic Contact (approximate)

Note:
Wells and logs from Kennedy/Jenks (2004), MACTEC (2005), and Hanson et al. (2001)

Bolded well names are wells shown on Figure 3; other logs from previous cross-sections

0 200 400
Vertical Approximate Scale Feet

0 6,000 12,000
Horizontal Approximate Scale Feet

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HYDROGEOLOGIC CROSS-SECTION E-E'

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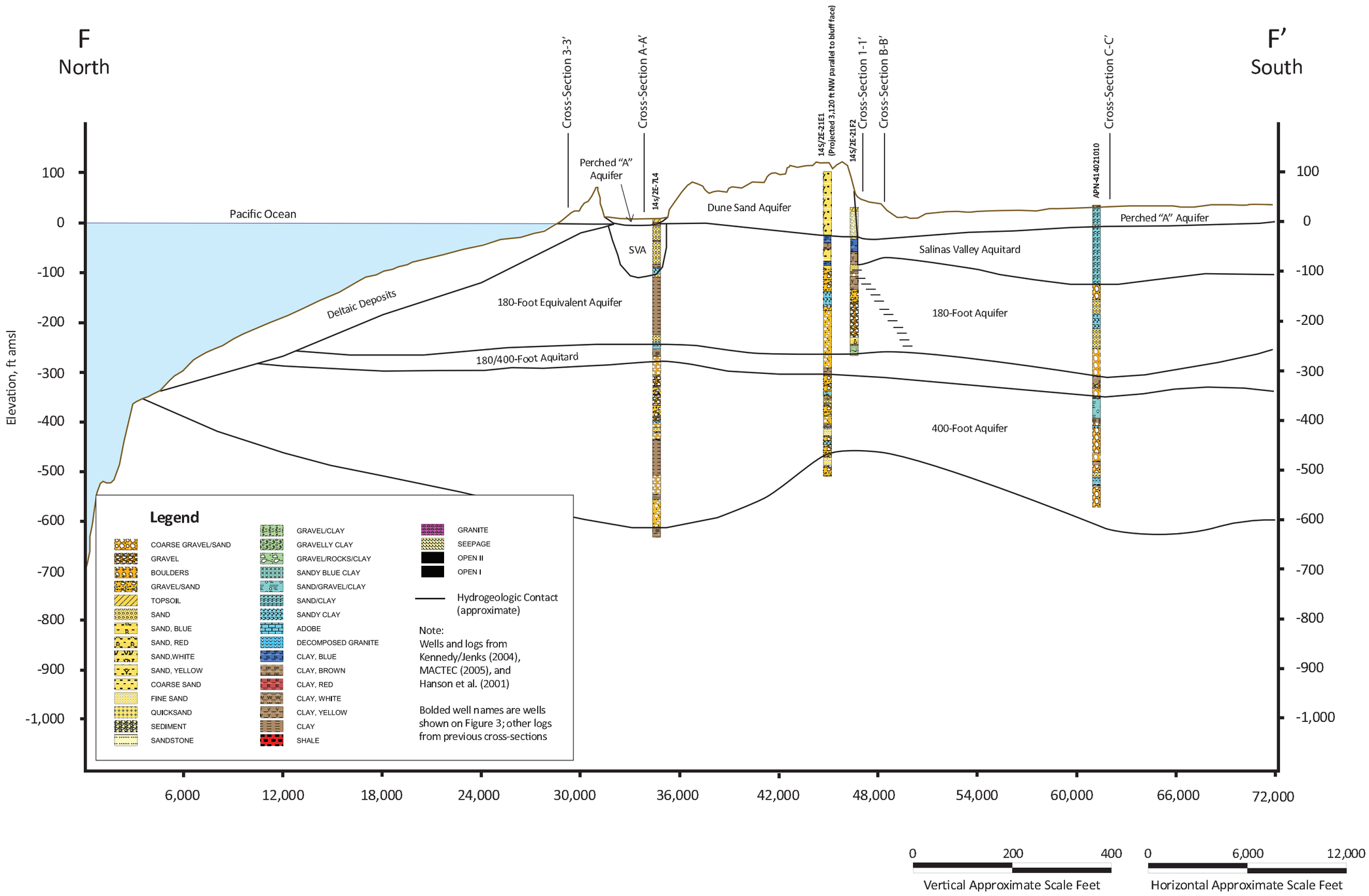
Date: 17-Apr-15

Figure 11

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_11_x-section_E-E'_rev.ai



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HYDROGEOLOGIC CROSS-SECTION F-F'

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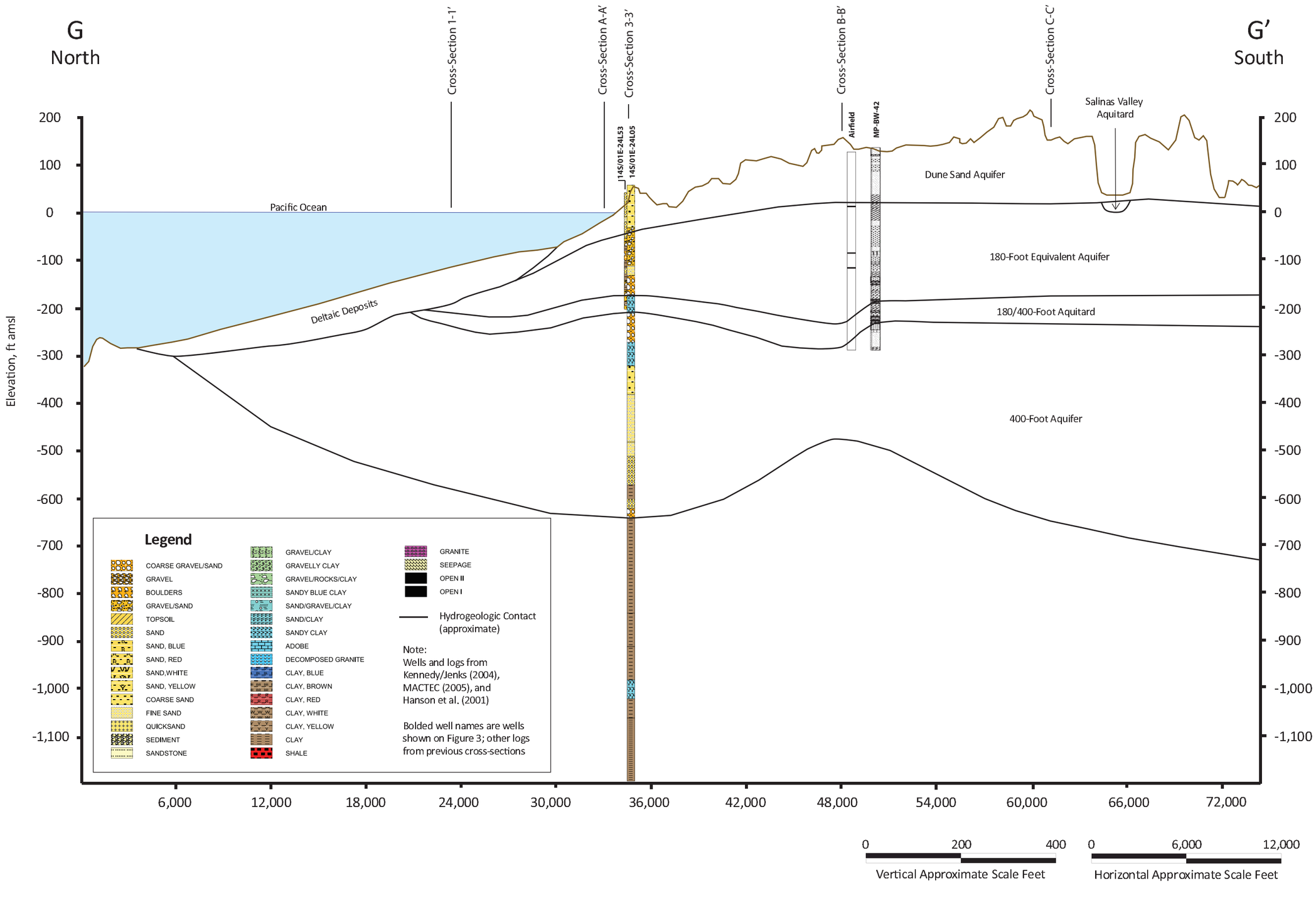
Approved:
Date: 17-Apr-15

Figure 12

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_12_x-section_F-F'_rev.ai



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HYDROGEOLOGIC CROSS-SECTION G-G'

Drawn: TC
Checked:
Approved:
Date: 17-Apr-15

Figure 13

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_13_x-section_G-G'_rev.ai

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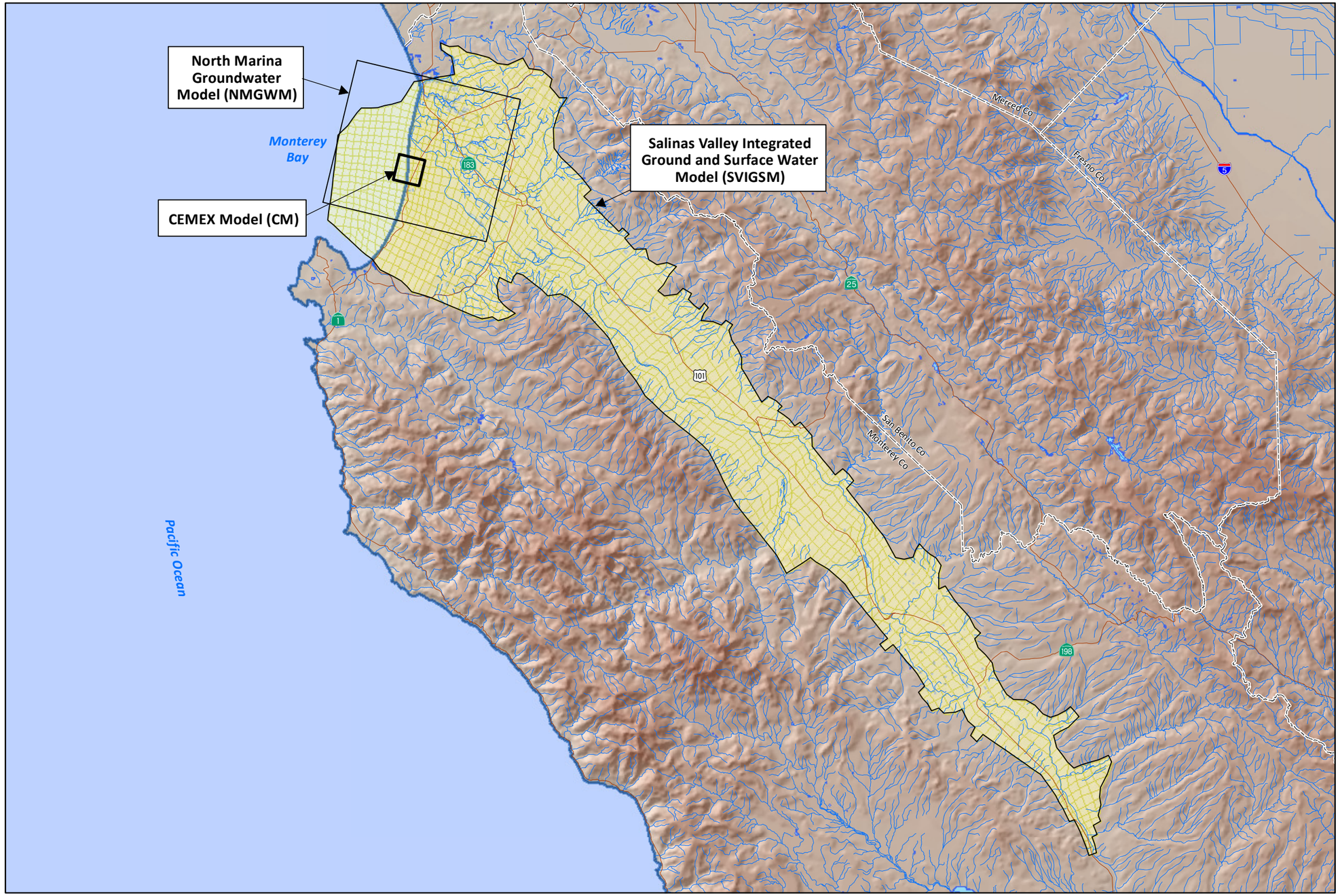
GROUNDWATER MODELING AND ANALYSIS

GROUNDWATER MODEL BOUNDARIES



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NORTH

0 2 4 6 8 10 20 Miles

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Figure 14

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_14_gw_model_bndys_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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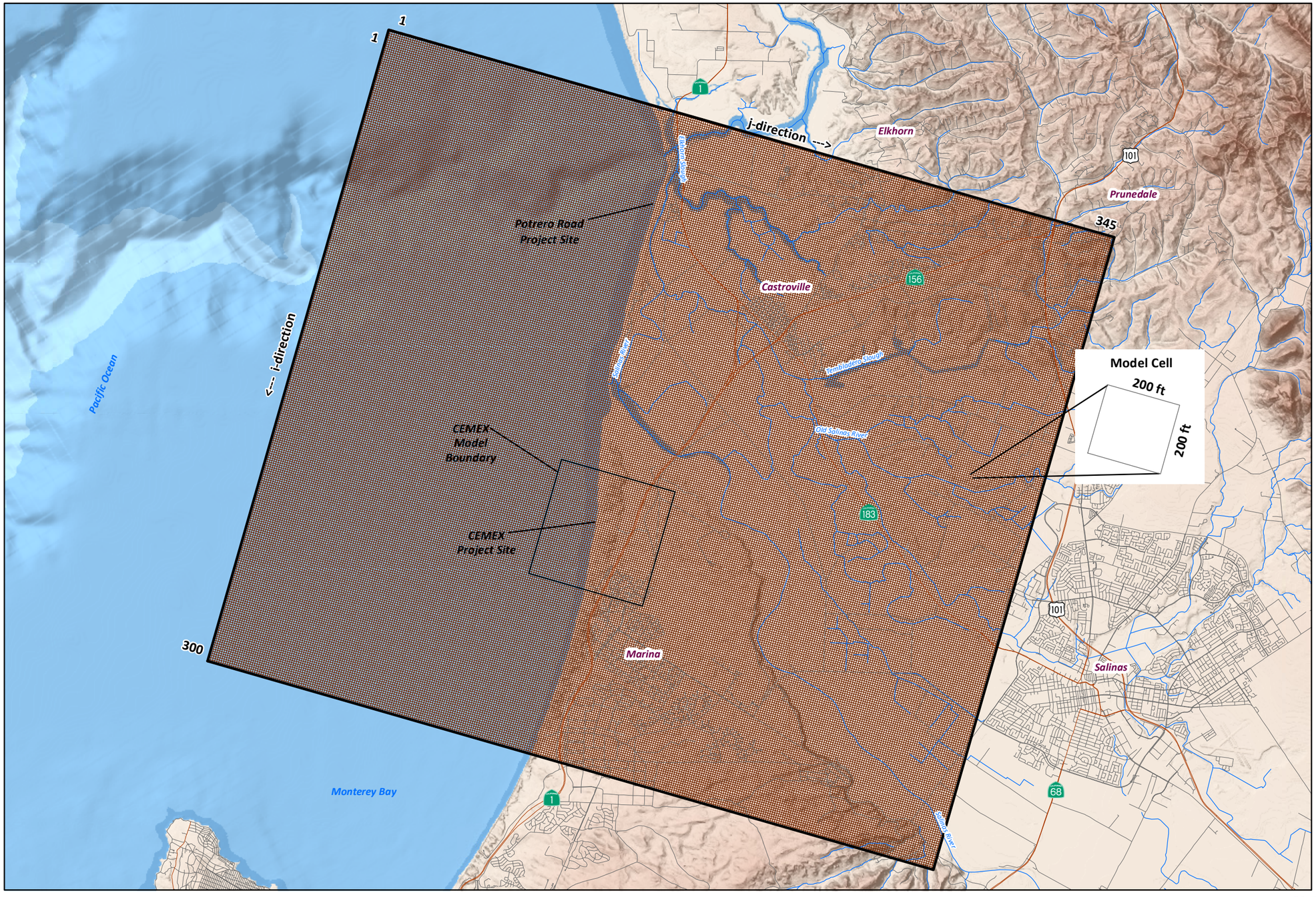
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

NORTH MARINA GROUNDWATER MODEL GRID



EXPLANATION

North Marina Groundwater Model Boundary

CEMEX Model Boundary

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0 1.5 3 6 Miles

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Figure 15

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_15_NMGWM_model_grid_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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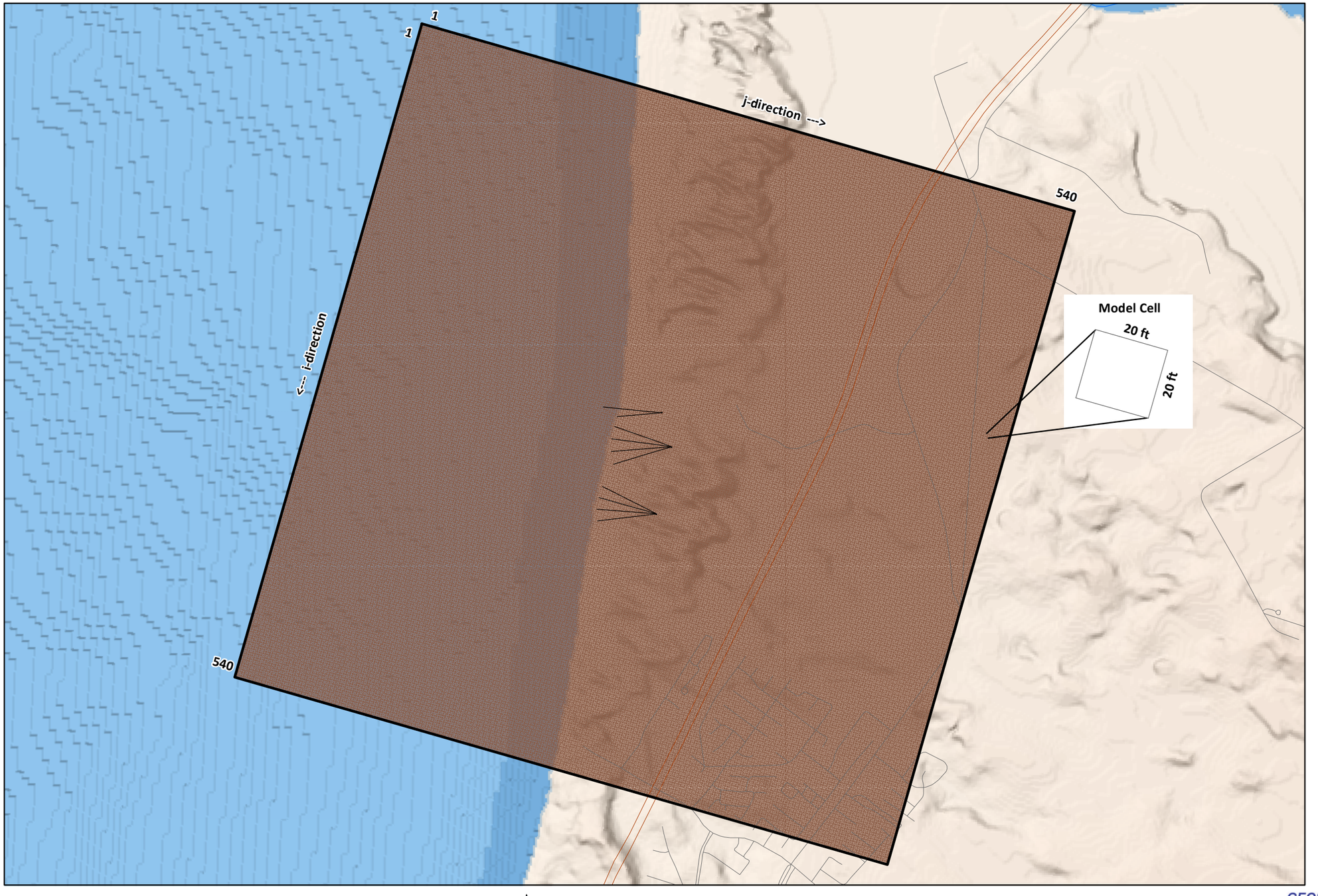
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

CEMEX MODEL GRID



EXPLANATION

CEMEX Model Boundary

CEMEX Slant Wells
Configuration A
Feedwater Supply of 24.1 MGD

17-Apr-15

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NORTH

0 1,000 2,000 4,000 Feet

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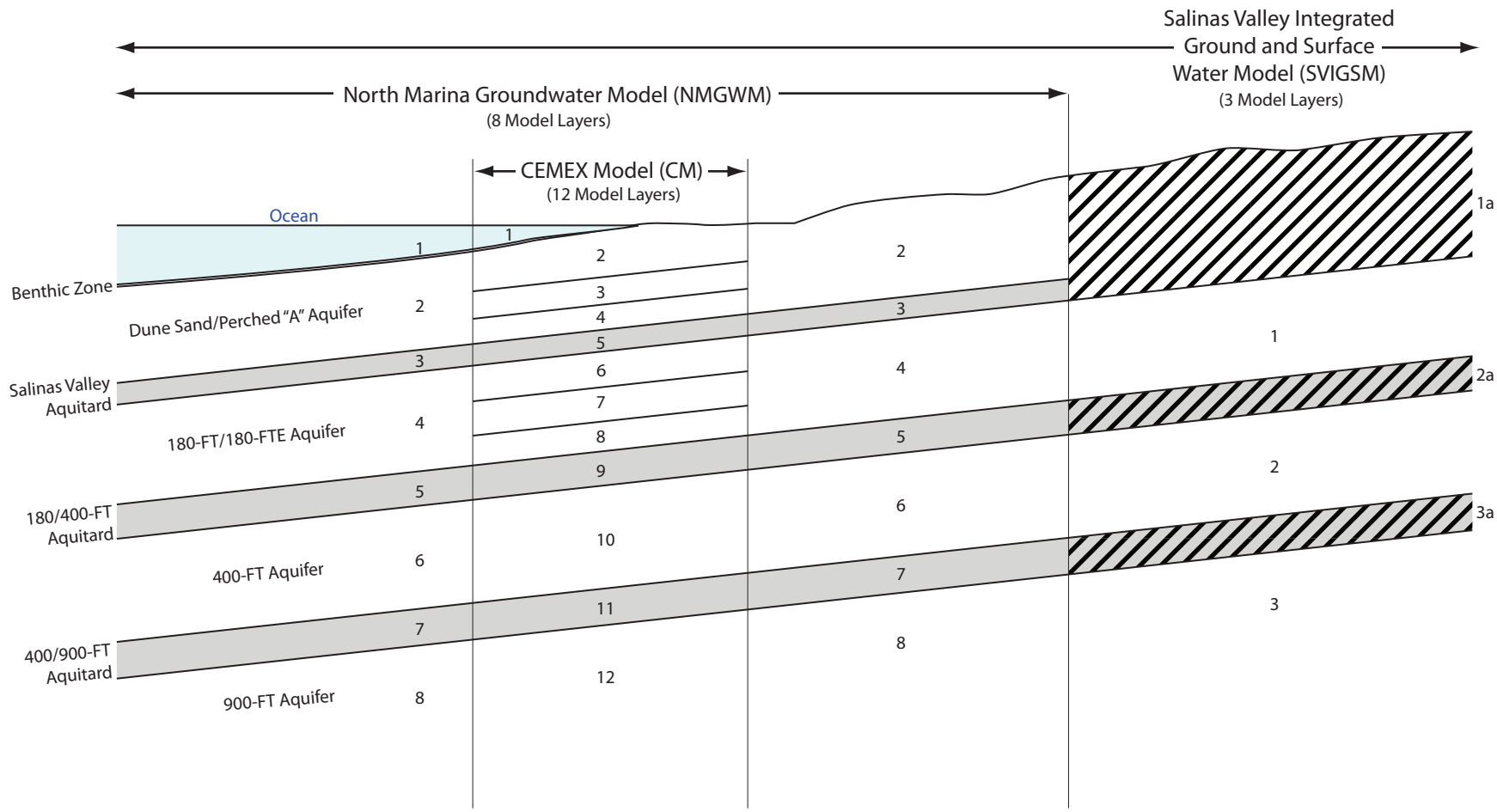
Figure 16

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_16_CEMEX_model_grid_4-15.mxd



Note : Numbers indicate model layer.
SVIGSM "a" model layers have the vertical hydraulic conductivity and thickness input into the model
Not drawn to scale

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	Checked:	MODEL INTEGRATION	GEOSCIENCE Support Services, Inc. P.O. Box 220, Claremont, CA 91711 Tel: (909) 920-0707 Fax: (909) 920-0403 E-mail: email@geoscience-water.com
	Approved:		
	Date: 17-Apr-15		

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_17_model_integration.ai

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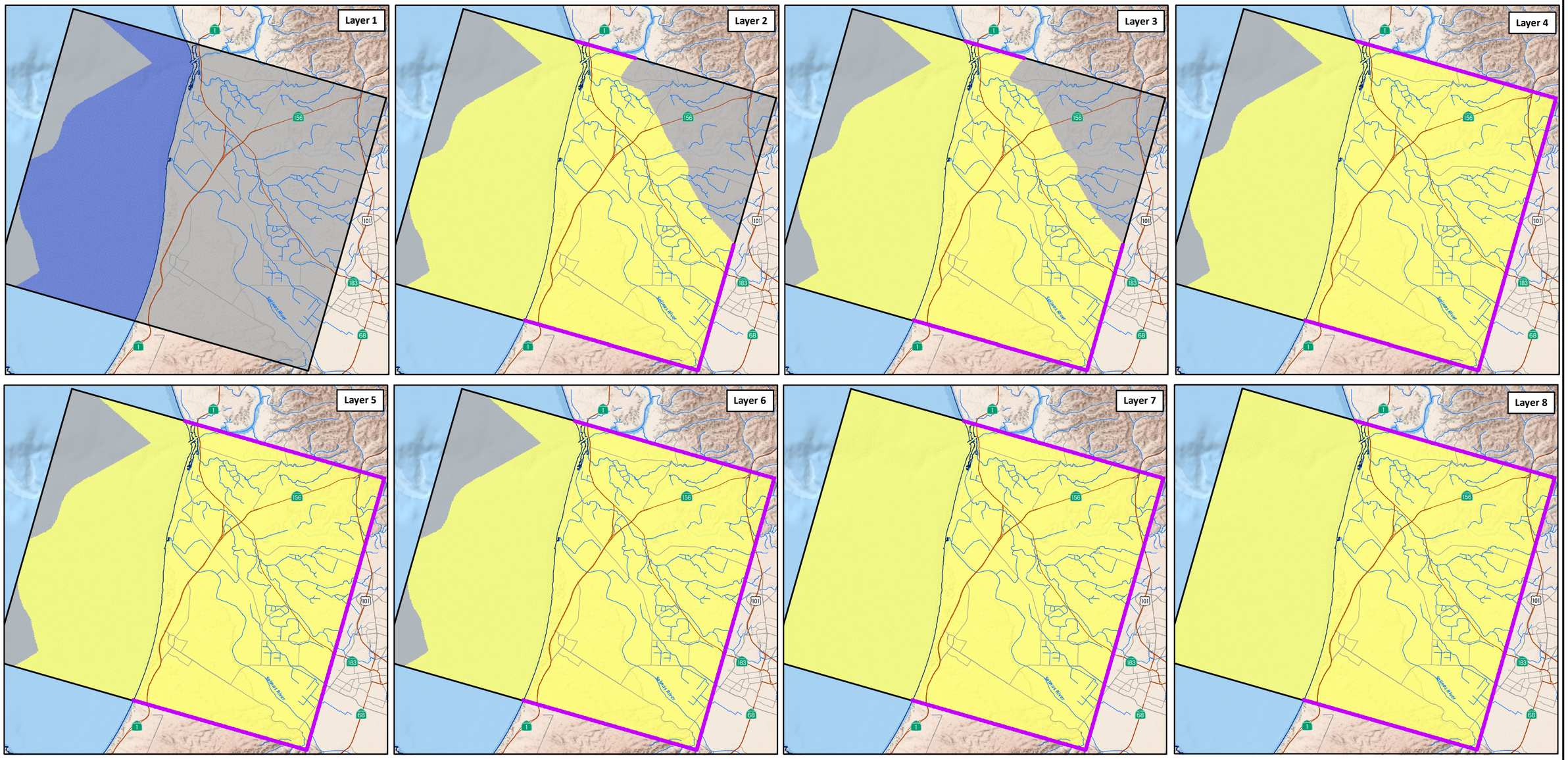
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

Mean High Tide (DOC, NOAA et al., 2011)

Boundary Conditions

Active Model Cell

Constant Head

General Head Boundary

No Flow Cell

NORTH

0 2 4 8 Miles

BOUNDARY CONDITIONS OF THE NMGWM

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Figure 18

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_18_bndy_cond_4-15.mxd

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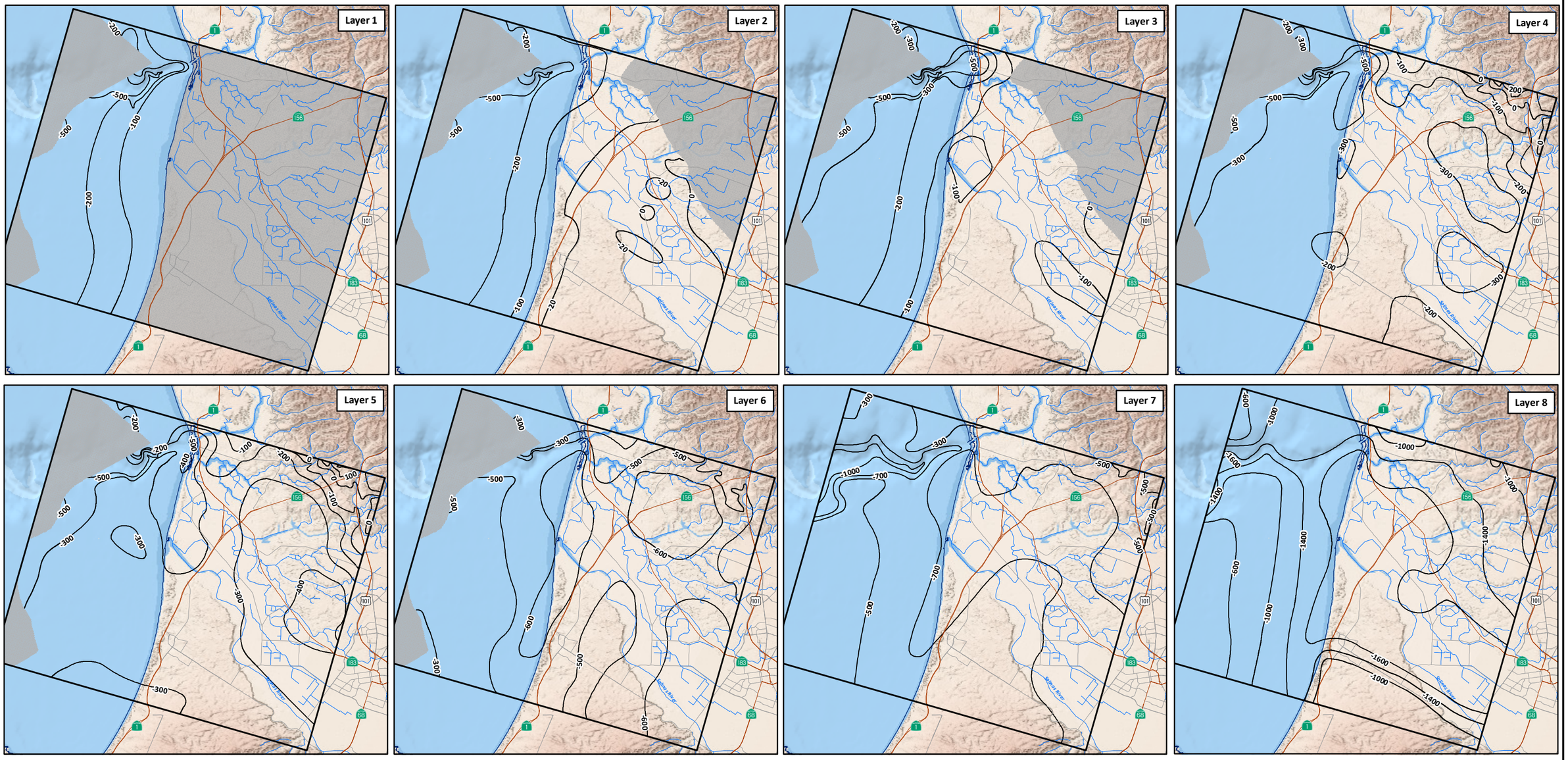
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

— -100 — Bottom Layer Elevations (ft amsl)

BOTTOM LAYER ELEVATIONS OF THE NMGWM

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Figure 19

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_19_bottom_layer_elev_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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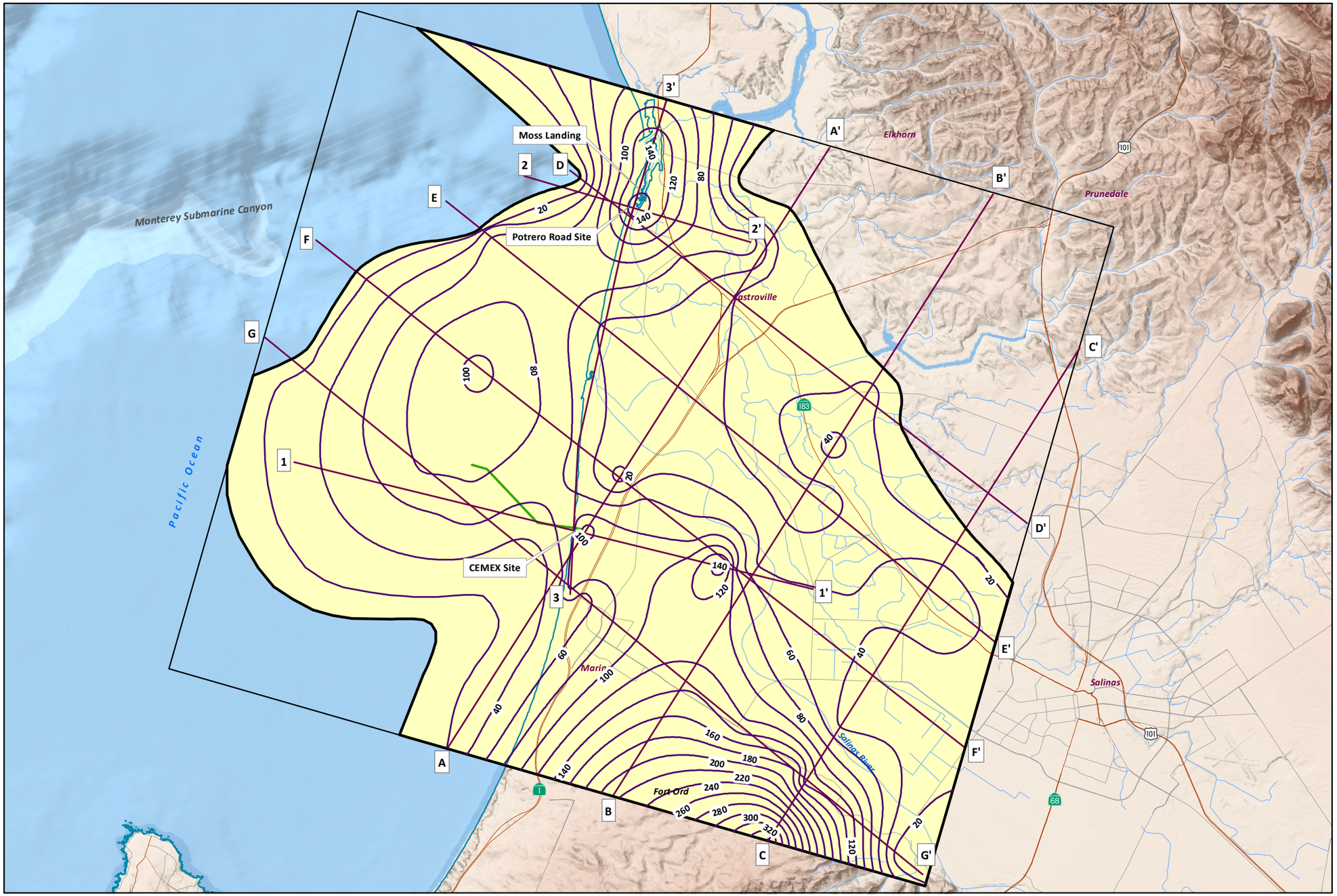
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

THICKNESS OF DUNE SAND, PERCHED "A", AND DELTAIC DEPOSIT AQUIFERS (MODEL LAYER 2)



EXPLANATION

- Boundary of Dune Sand, Perched "A", and Deltaic Deposit Aquifers
- 20 — Aquifer Thickness (ft)
- 1 — 1' Cross-Section Location
- Pipeline Outfall
- North Marina Groundwater Model Boundary
- Mean High Tide (DOC, NOAA et al., 2011)

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Figure 20

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_20_layer2_Thickness_4-15.mxd

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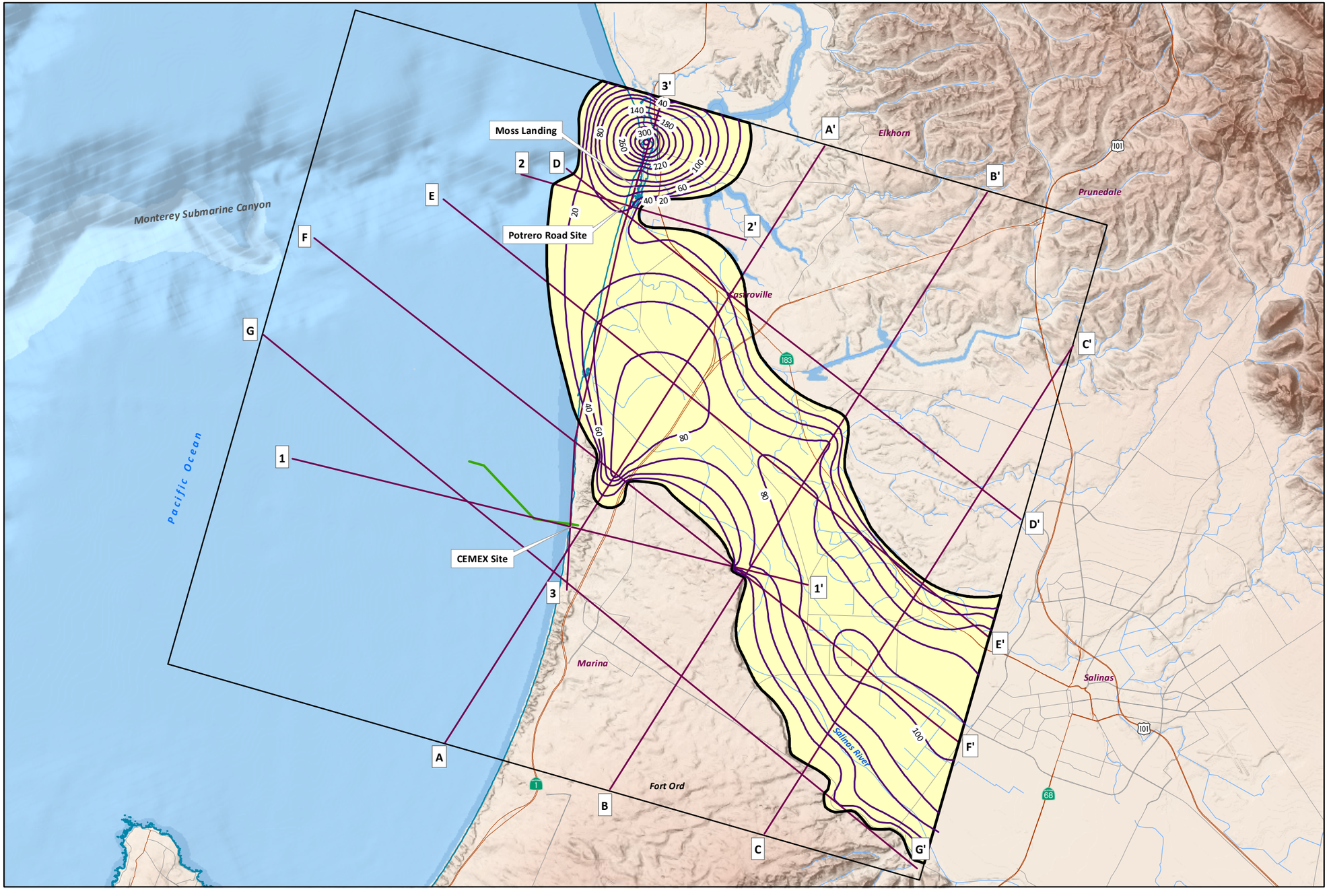
GROUNDWATER MODELING AND ANALYSIS

THICKNESS OF SALINAS VALLEY AQUITARD (MODEL LAYER 3)



EXPLANATION

- Boundary of Salinas Valley Aquitard
- 20 — Aquitard Thickness (ft)
- 1 1' — Cross-Section Location
- Pipeline Outfall
- North Marina Groundwater Model Boundary
- Mean High Tide (DOC, NOAA et al., 2011)

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Figure 21

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_21_layer3_Thickness_4-15.mxd

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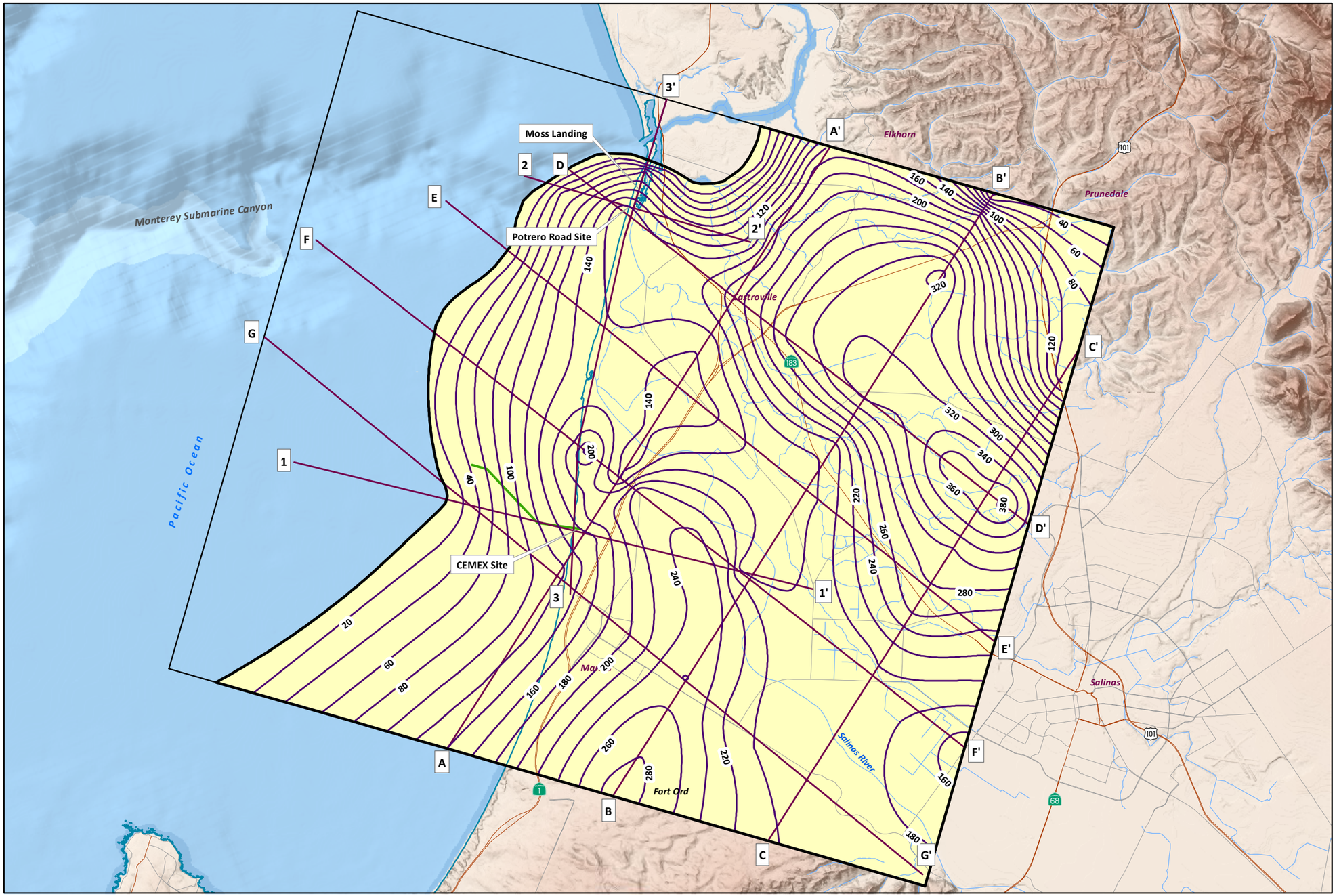
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

THICKNESS OF 180-FT/180-FTE AQUIFER (MODEL LAYER 4)



EXPLANATION

Boundary of 180-FT/180-FTE Aquifer

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

20 — Aquifer Thickness (ft)

1 1' — Cross-Section Location

Pipeline Outfall

North Marina Groundwater Model Boundary

Mean High Tide (DOC, NOAA et al., 2011)

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Figure 22

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_22_layer4_Thickness_4-15.mxd

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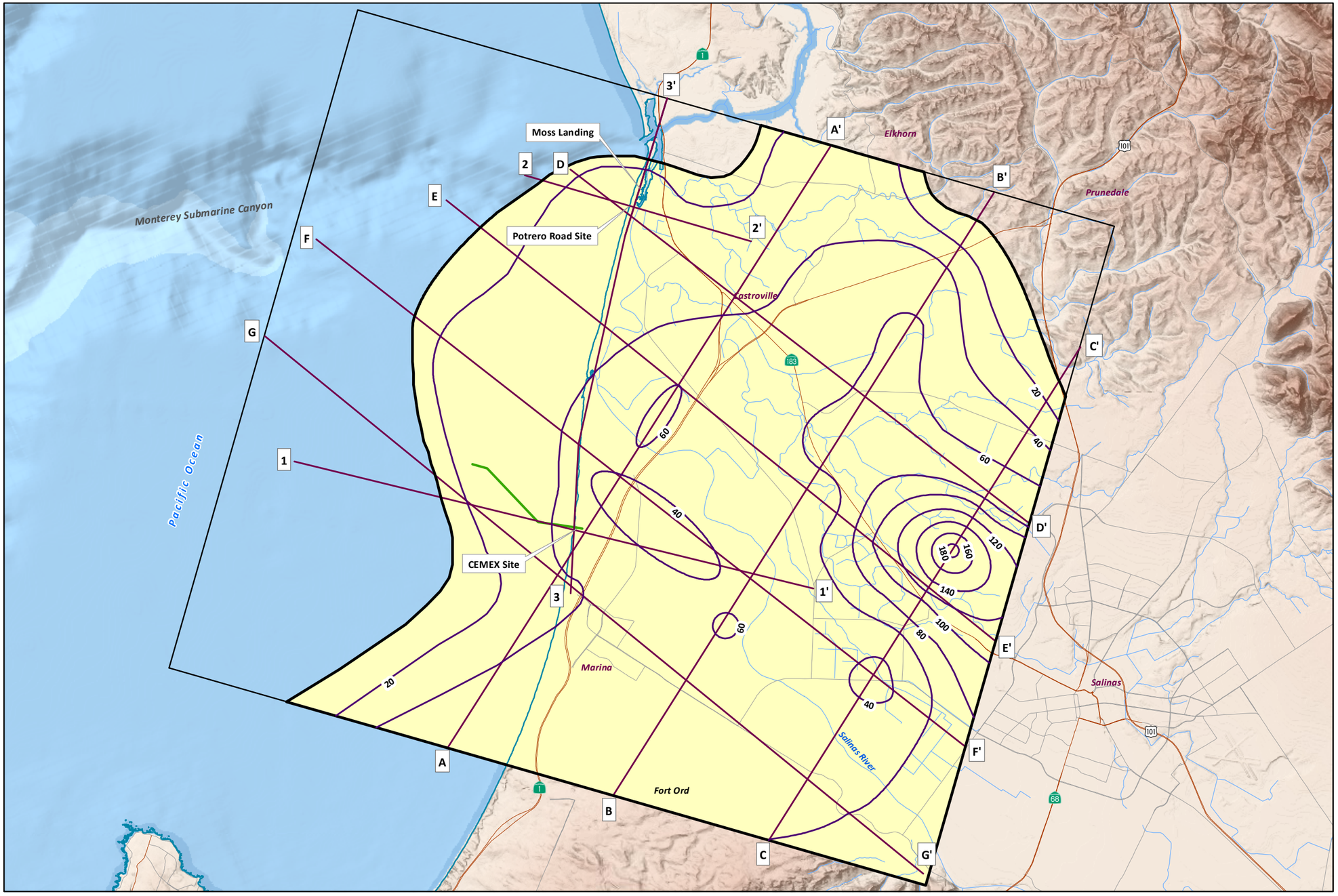
GROUNDWATER MODELING AND ANALYSIS

THICKNESS OF 180/400-FT AQUITARD (MODEL LAYER 5)



EXPLANATION

- Boundary of 180/400-FT Aquitard
- 20 — Aquitard Thickness (ft)
- 1 1' — Cross-Section Location
- Pipeline Outfall
- North Marina Groundwater Model Boundary
- Mean High Tide (DOC, NOAA et al., 2011)

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Figure 23

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_23_layer5_Thickness_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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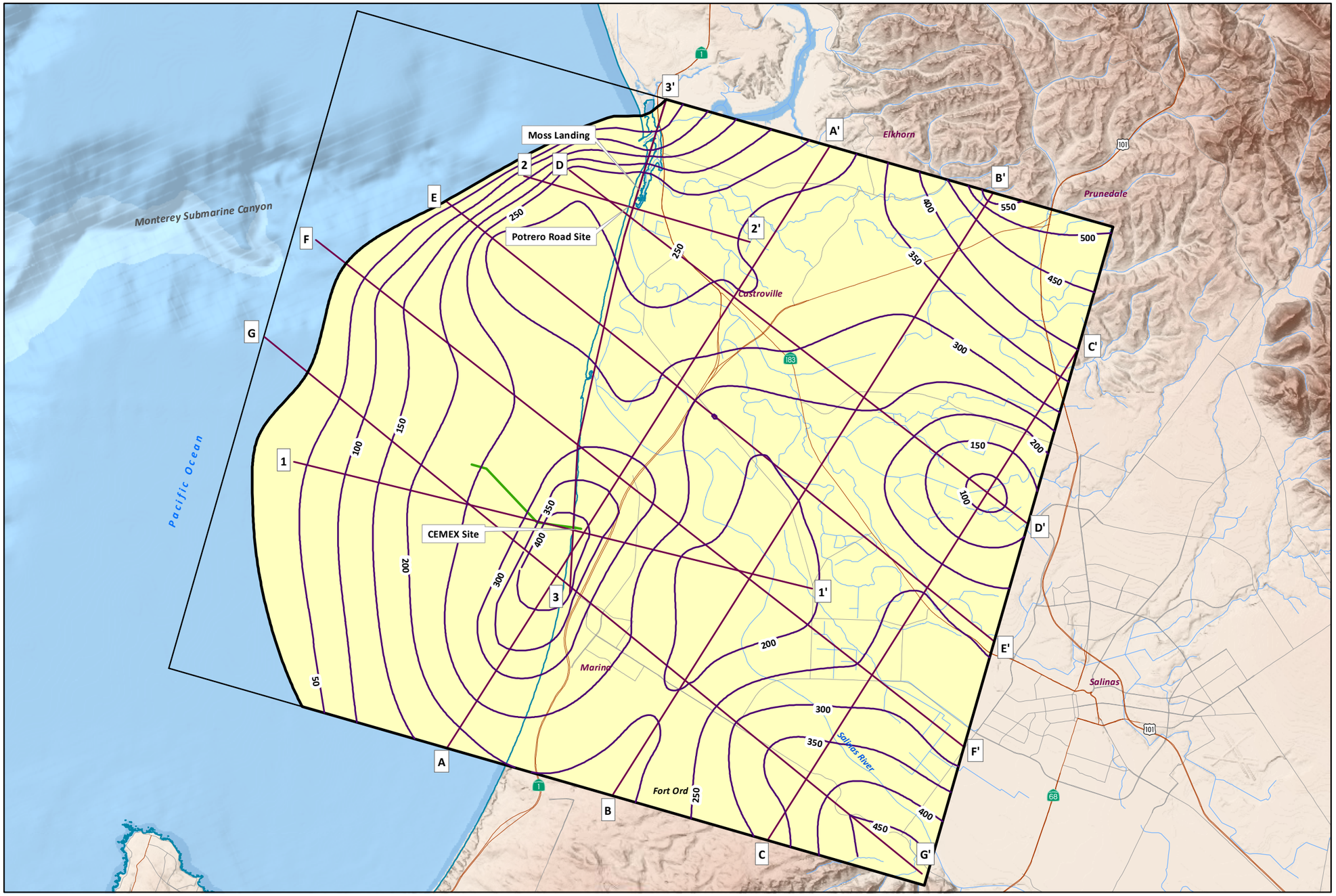
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

THICKNESS OF 400-FT AQUIFER (MODEL LAYER 6)



EXPLANATION

- Boundary of 400-FT Aquifer
- 20 — Aquifer Thickness (ft)
- 1 1' — Cross-Section Location
- Pipeline Outfall
- North Marina Groundwater Model Boundary
- Mean High Tide (DOC, NOAA et al., 2011)

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Figure 24

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_24_layer6_Thickness_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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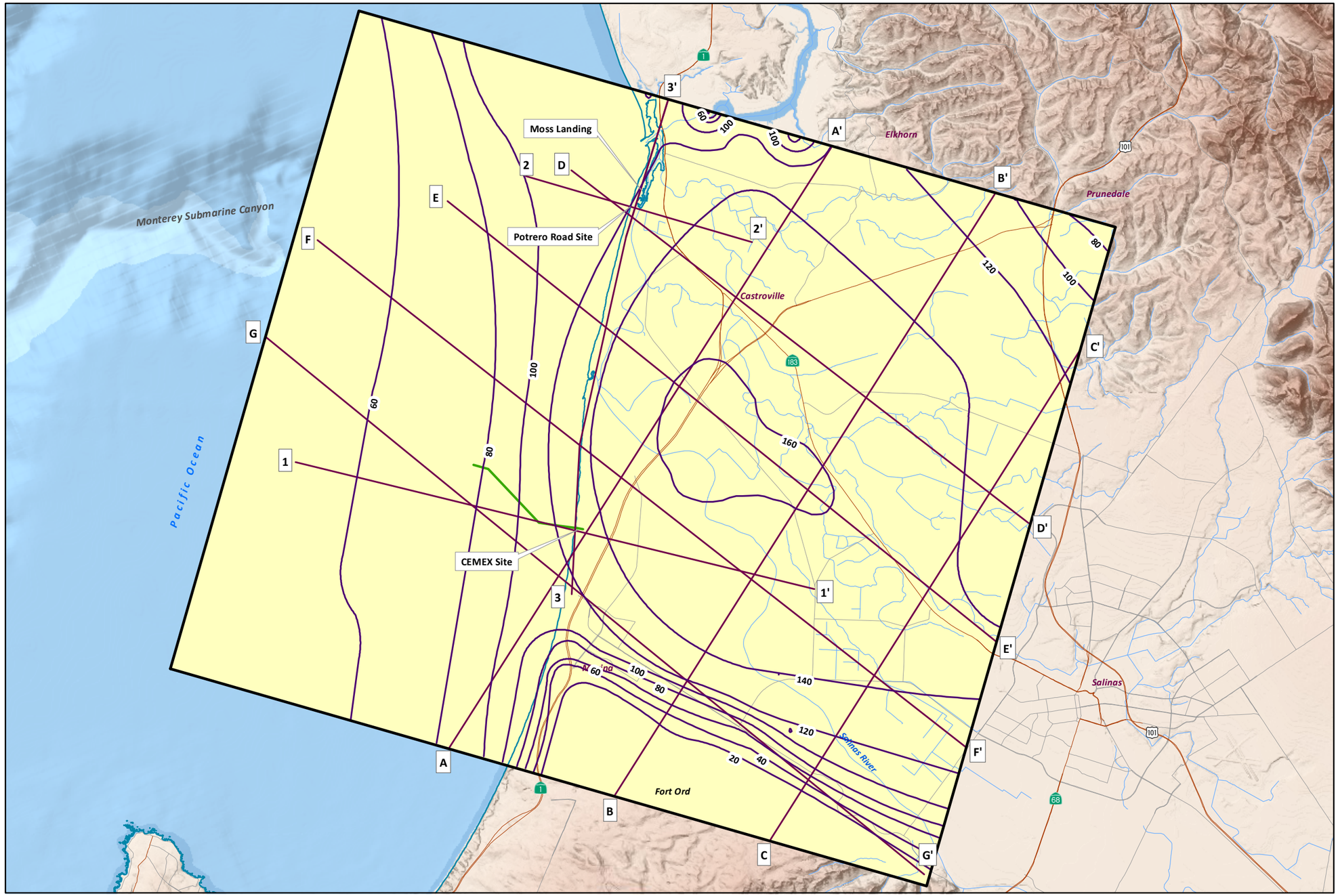
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

THICKNESS OF 400/900-FT AQUITARD (MODEL LAYER 7)



EXPLANATION

- Boundary of 400/900-FT Aquitard and North Marina Groundwater Model Boundary
- 20 — Aquitard Thickness (ft)
- 1 1' — Cross-Section Location
- Pipeline Outfall
- Mean High Tide (DOC, NOAA et al., 2011)

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Figure 25

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_25_layer7_Thickness_4-15.mxd

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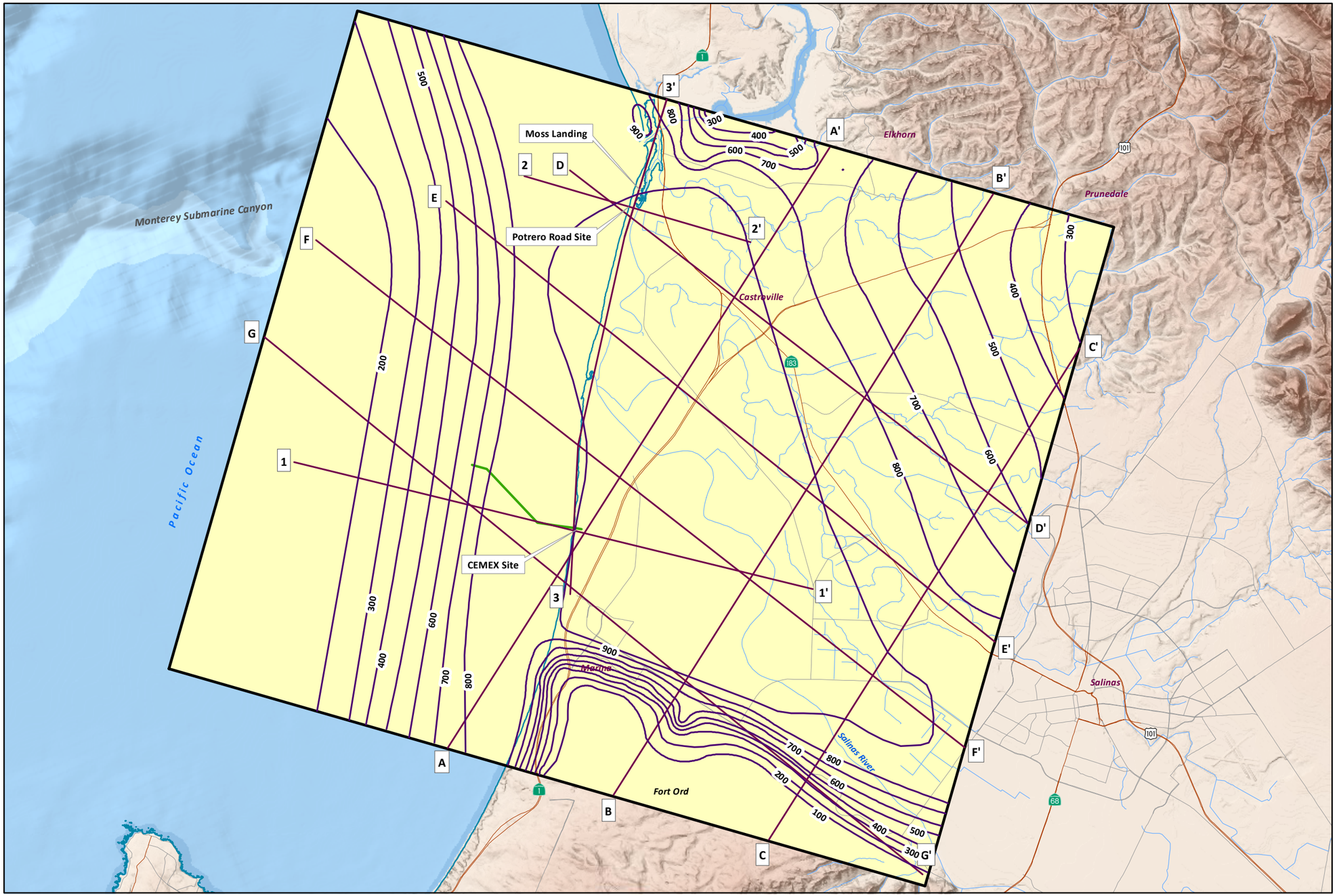
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

THICKNESS OF 900-FT AQUIFER (MODEL LAYER 8)



EXPLANATION

- Boundary of 900-FT Aquifer and North Marina Groundater Model Boundary
- 20 — Aquifer Thickness (ft)
- 1 1' — Cross-Section Location
- Pipeline Outfall
- Mean High Tide (DOC, NOAA et al., 2011)

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Figure 26

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_26_layer8_Thickness_4-15.mxd

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Sediment Texture versus Horizontal and Vertical Hydraulic Conductivity Values
Dune Sand Aquifer near CEMEX Site

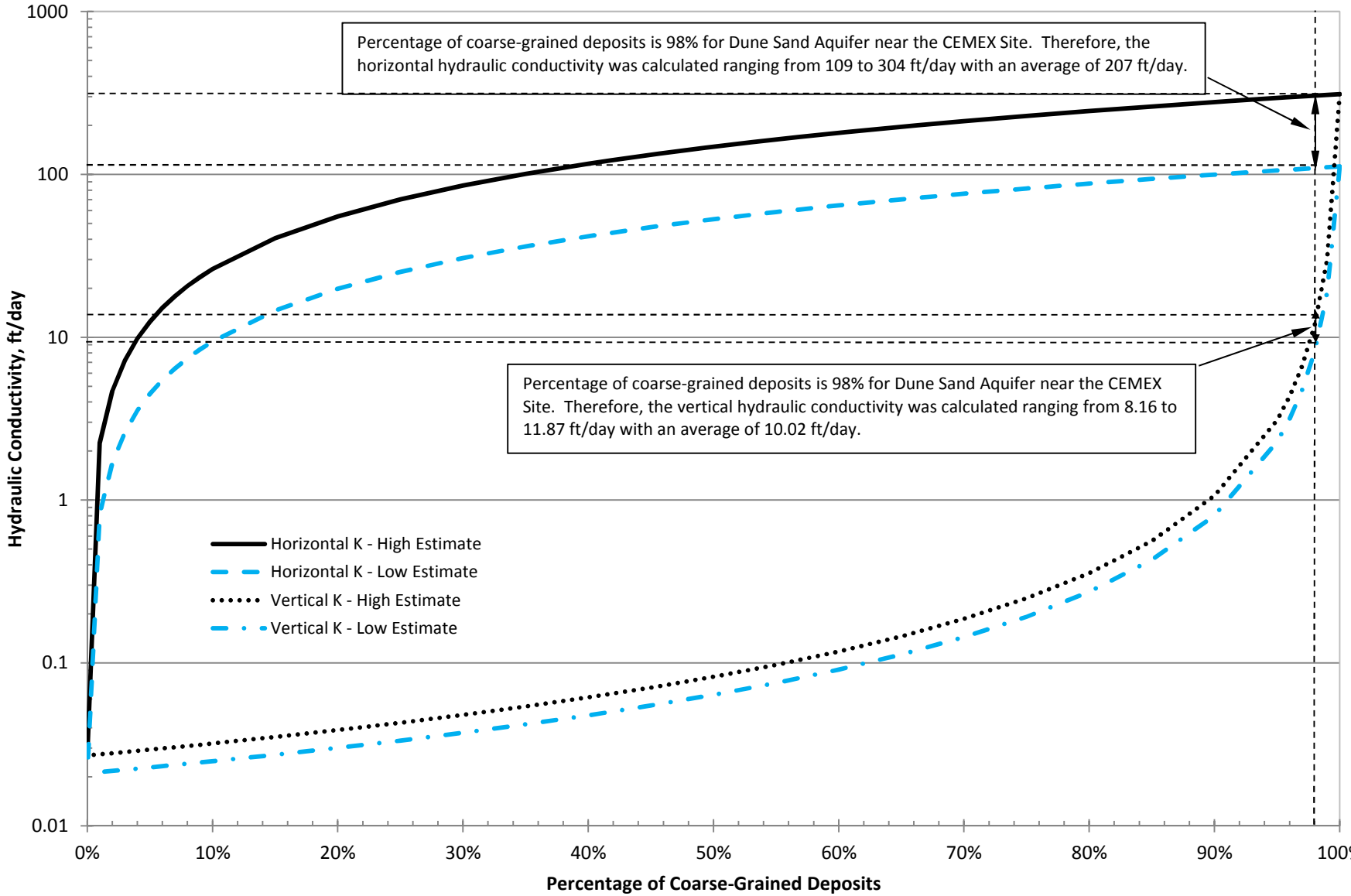

Figure 27

DRAFT

Sediment Texture versus Horizontal and Vertical Hydraulic Conductivity Values
180-FT/180-FTE Aquifer near CEMEX Site

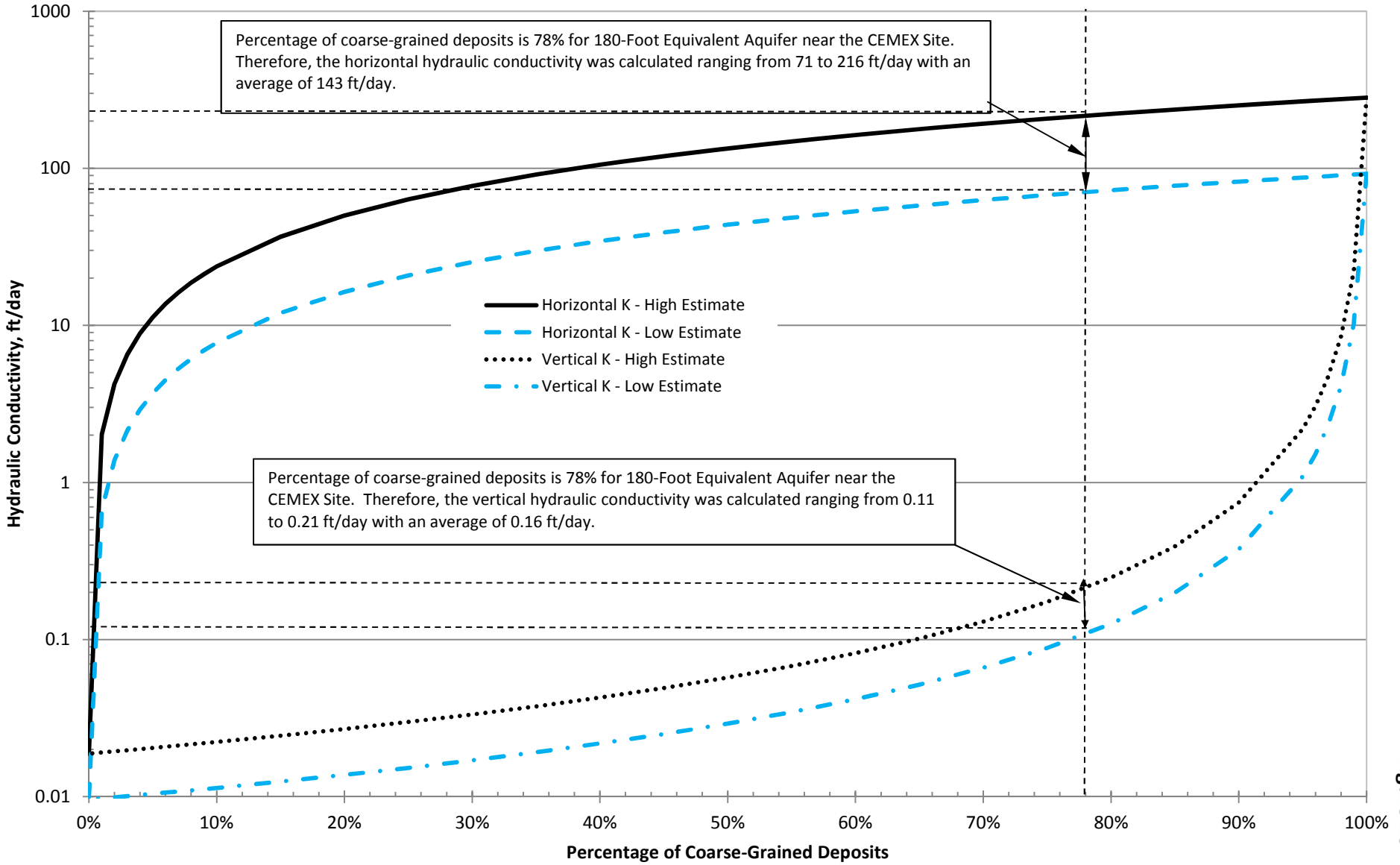

Figure 28

Sediment Texture versus Horizontal and Vertical Hydraulic Conductivity Values
Dune Sand/Perched "A" Aquifer near Moss Landing Site

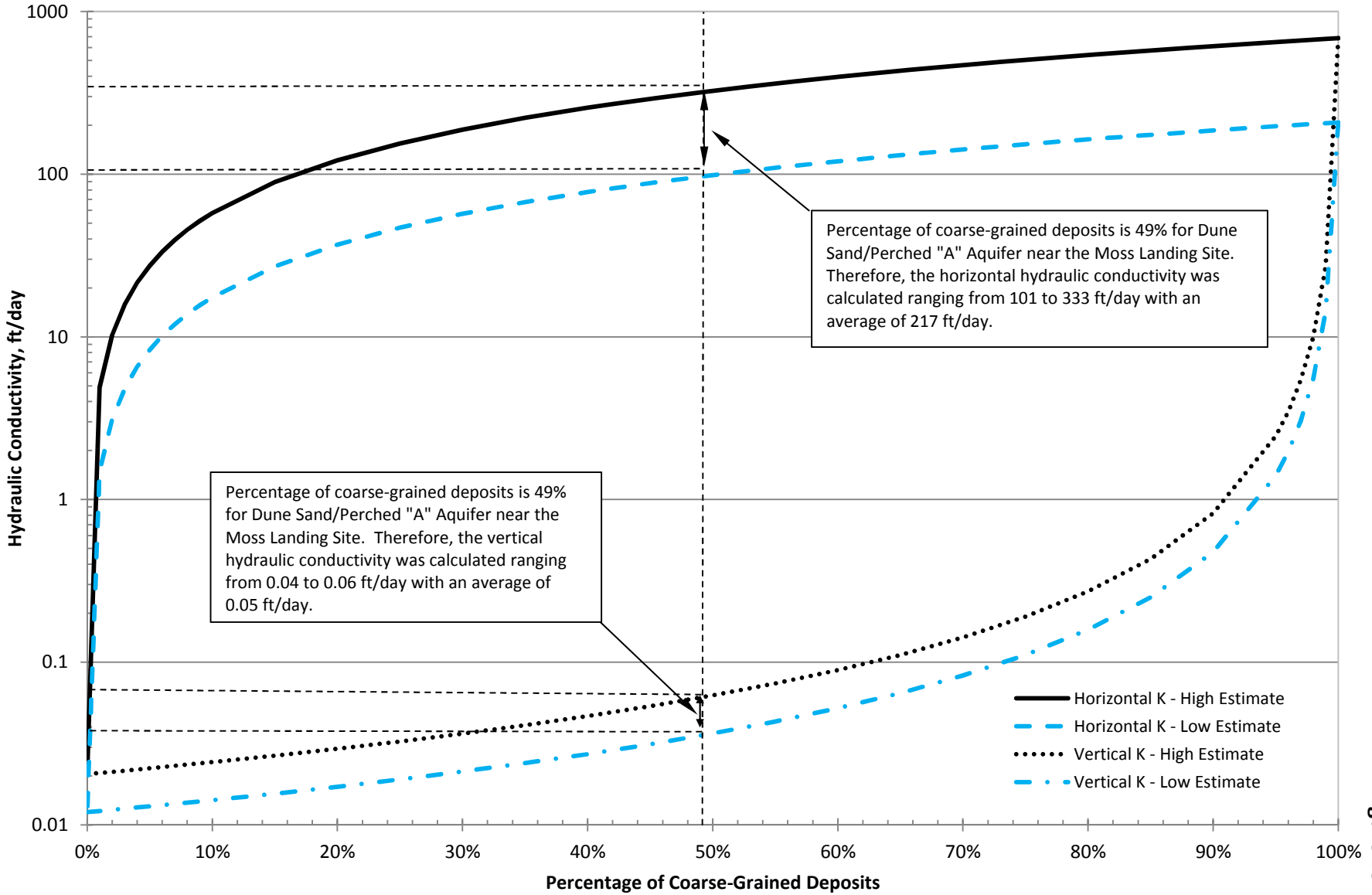

Figure 29

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Sediment Texture versus Horizontal and Vertical Hydraulic Conductivity Values
Dune Sand/Perched "A" Aquifer near Potrero Road Site

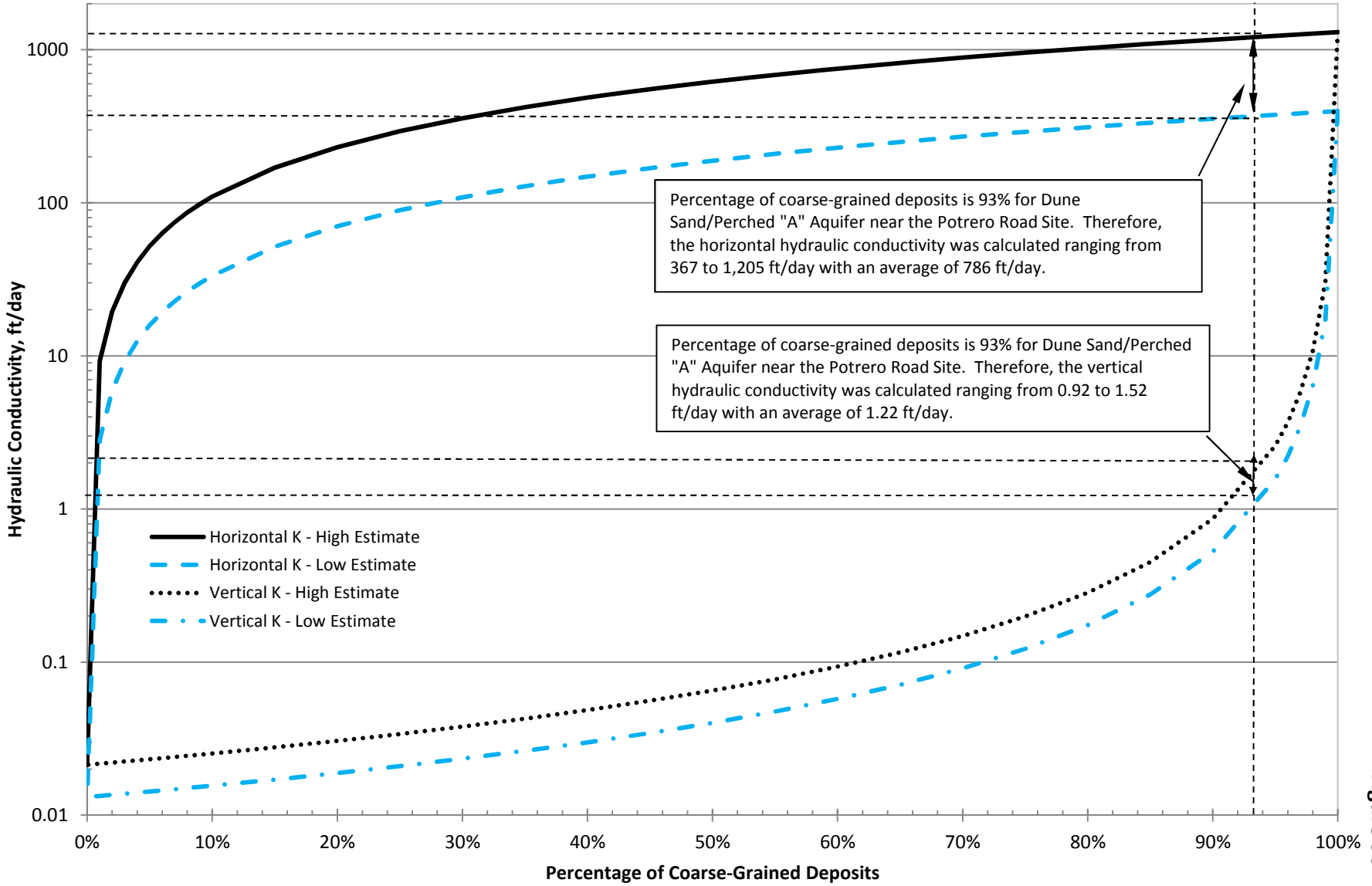

Figure 30

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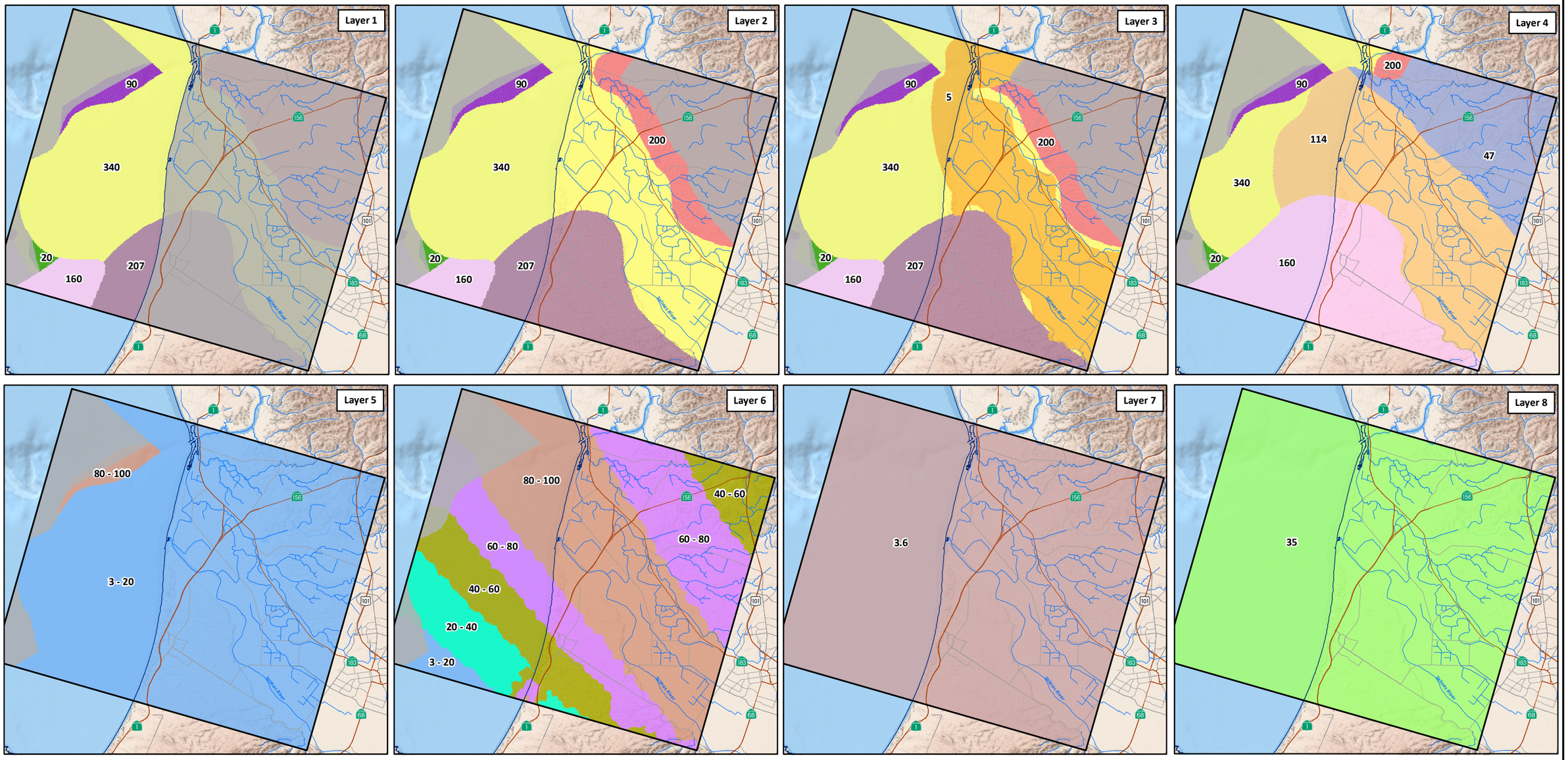
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

Horizontal Hydraulic Conductivity Values (ft/day)

3.6	114	3 - 20
5	160	20 - 40
20	200	40 - 60
35	207	60 - 80
47	340	80 - 100
90		

17-Apr-15

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NORTH

0 2 4 8 Miles

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HORIZONTAL HYDRAULIC CONDUCTIVITY OF THE NMGWM

DRAFT

Figure 31

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_31_horiz_hy_cond_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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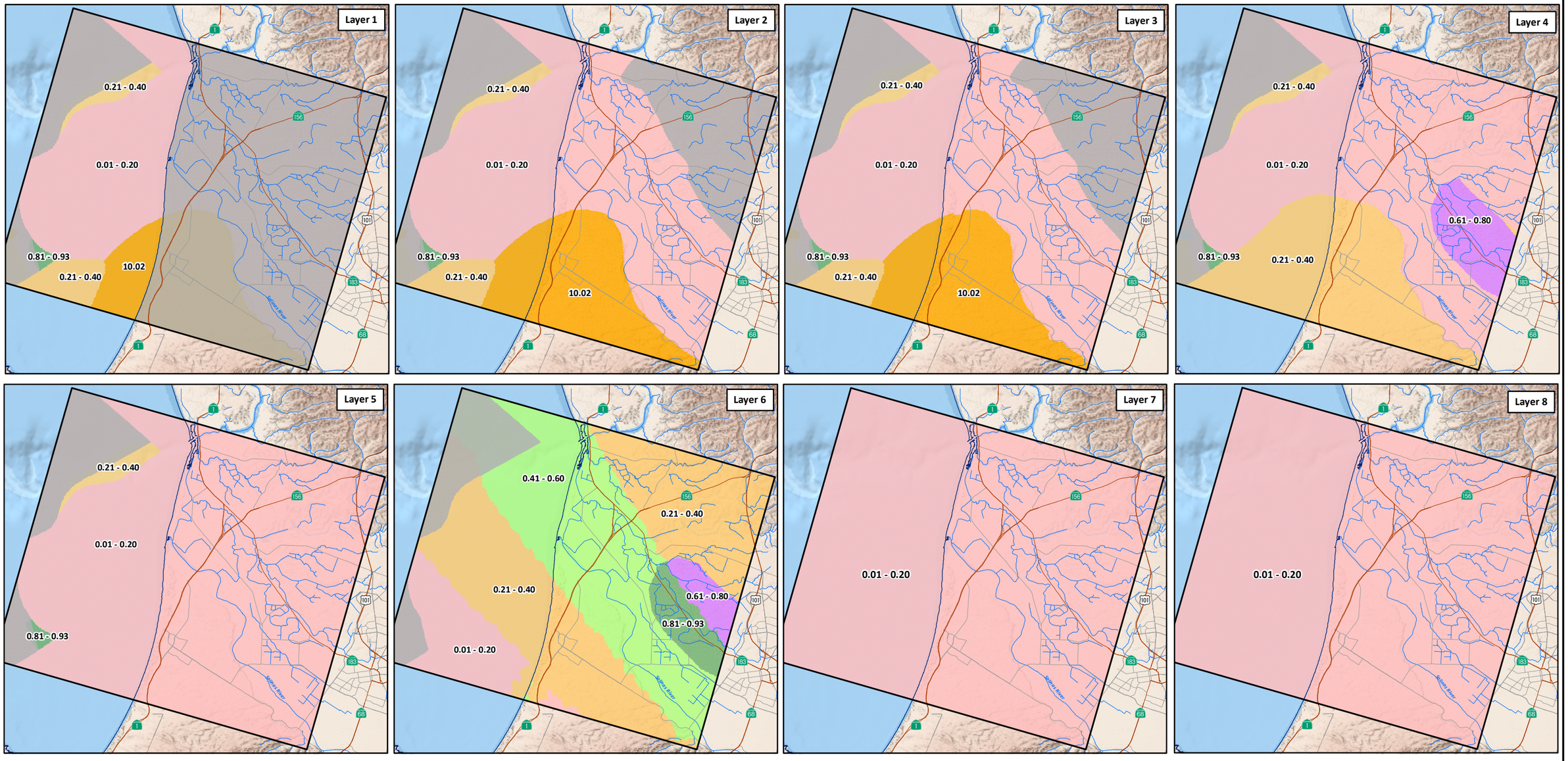
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

Vertical Hydraulic Conductivity Values (ft/day)

- 0.01 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 0.93
- 10.02

VERTICAL HYDRAULIC CONDUCTIVITY OF THE NMGWM

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Figure 32

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_32_vert_hy_cond_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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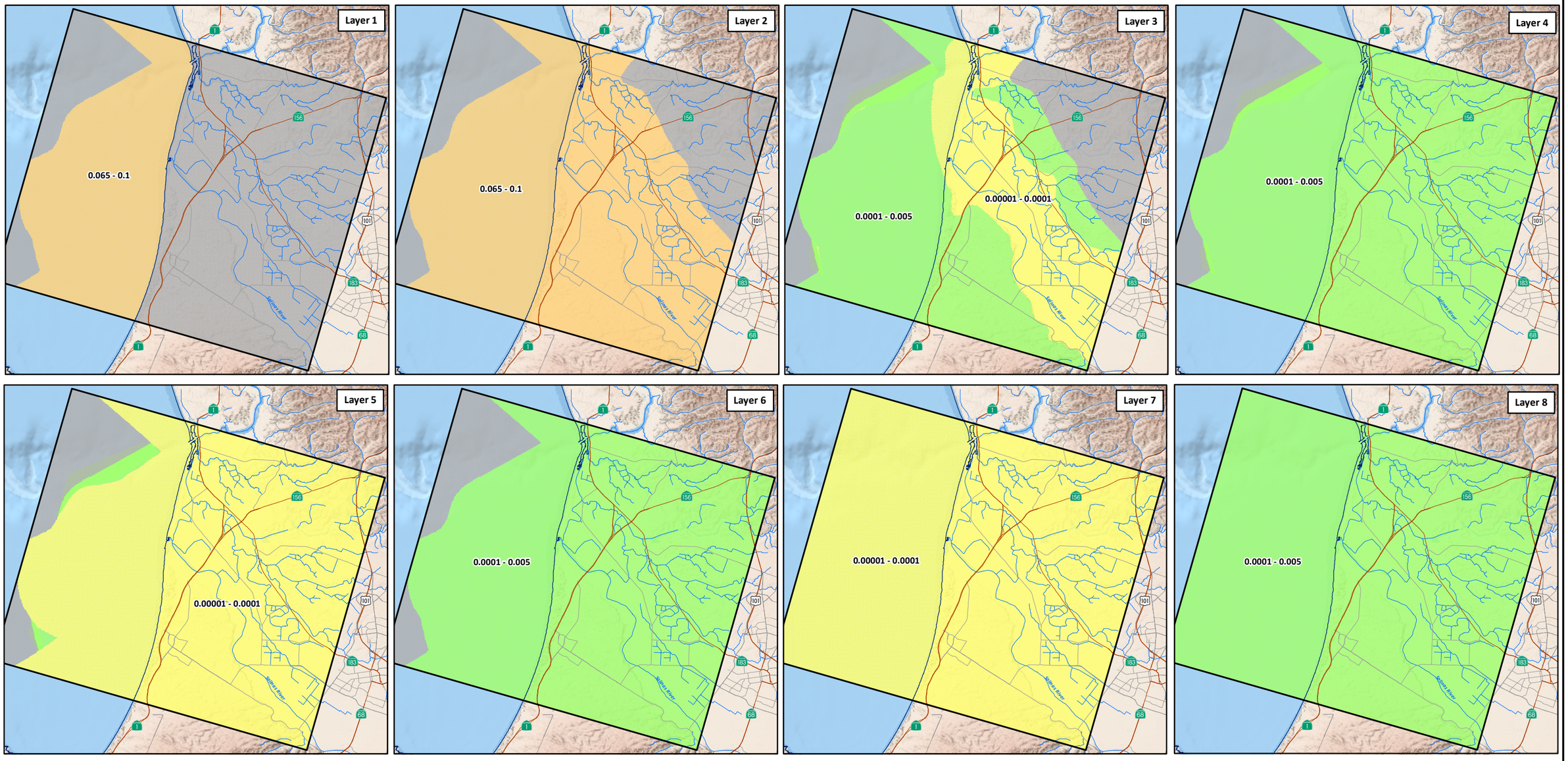
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

Storativity

0.00001 - 0.0001

0.0001 - 0.005

0.065 - 0.1

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STORATIVITY
OF THE NMGWM

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Figure 33

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_33_storativity_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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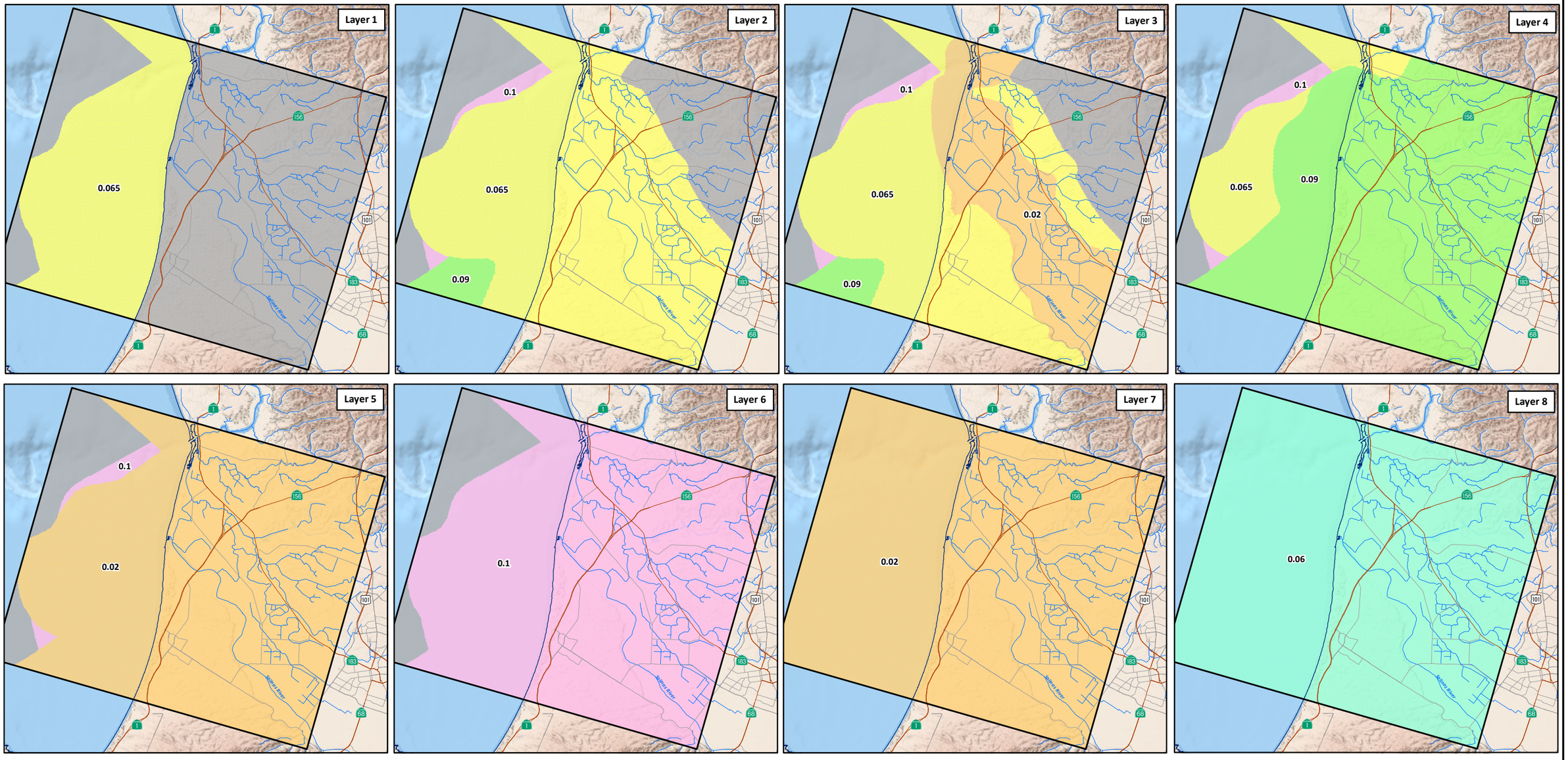
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

Effective Porosity

- 0.02
- 0.06
- 0.065
- 0.09
- 0.1

NORTH

0 2 4 8 Miles

EFFECTIVE POROSITY OF THE NMGWM

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Figure 34

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_34_effective_porosity_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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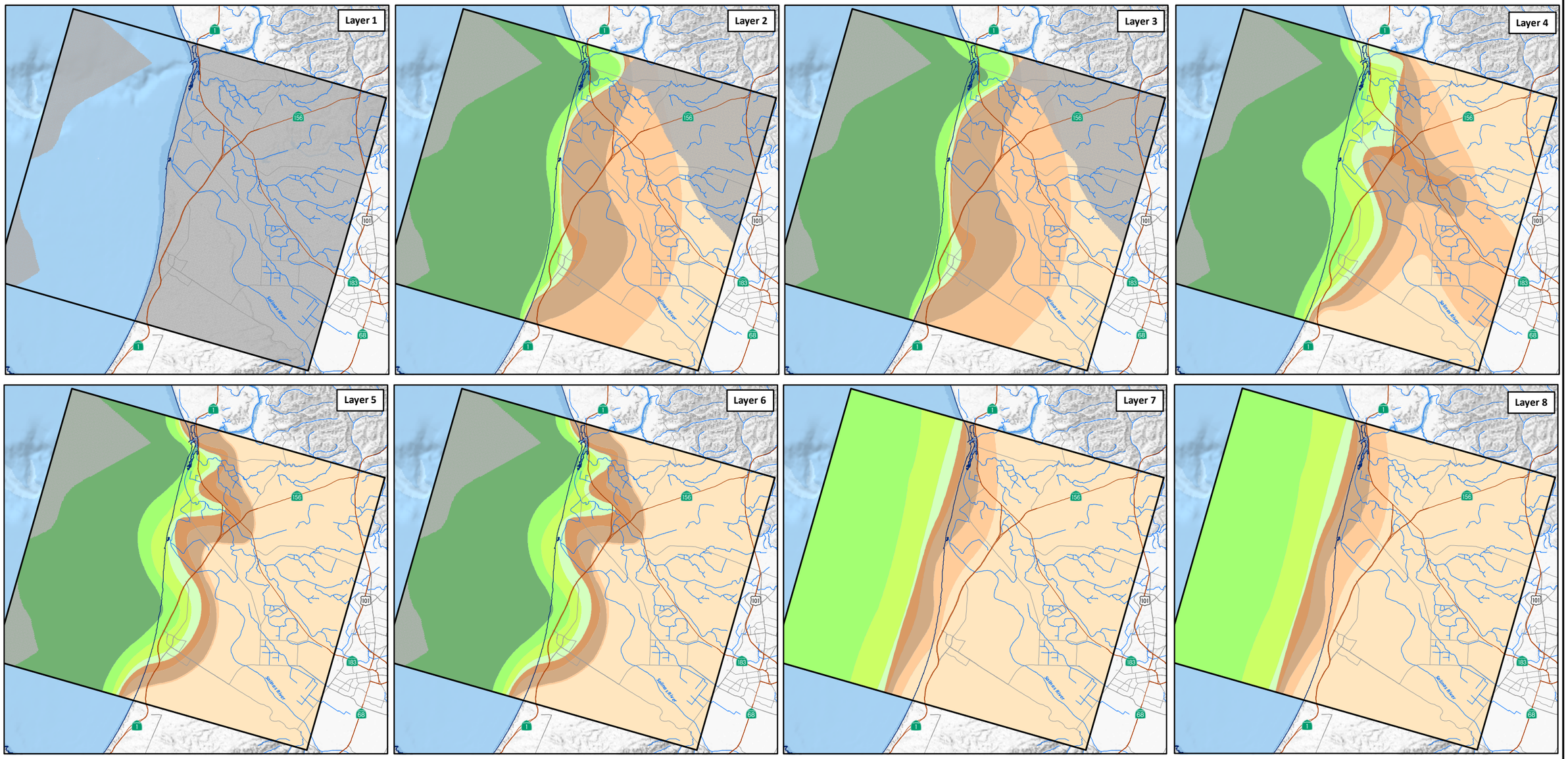
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

Initial TDS Concentrations (mg/L)

400 - 500	5,000 - 10,000
500 - 1,000	10,000 - 20,000
1,000 - 3,000	20,000 - 30,000
3,000 - 5,000	30,000 - 33,500

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INITIAL TDS CONCENTRATIONS (OCTOBER 1979)

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Figure 35

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_35_initial_TDS_concentrations_COLORFLOOD_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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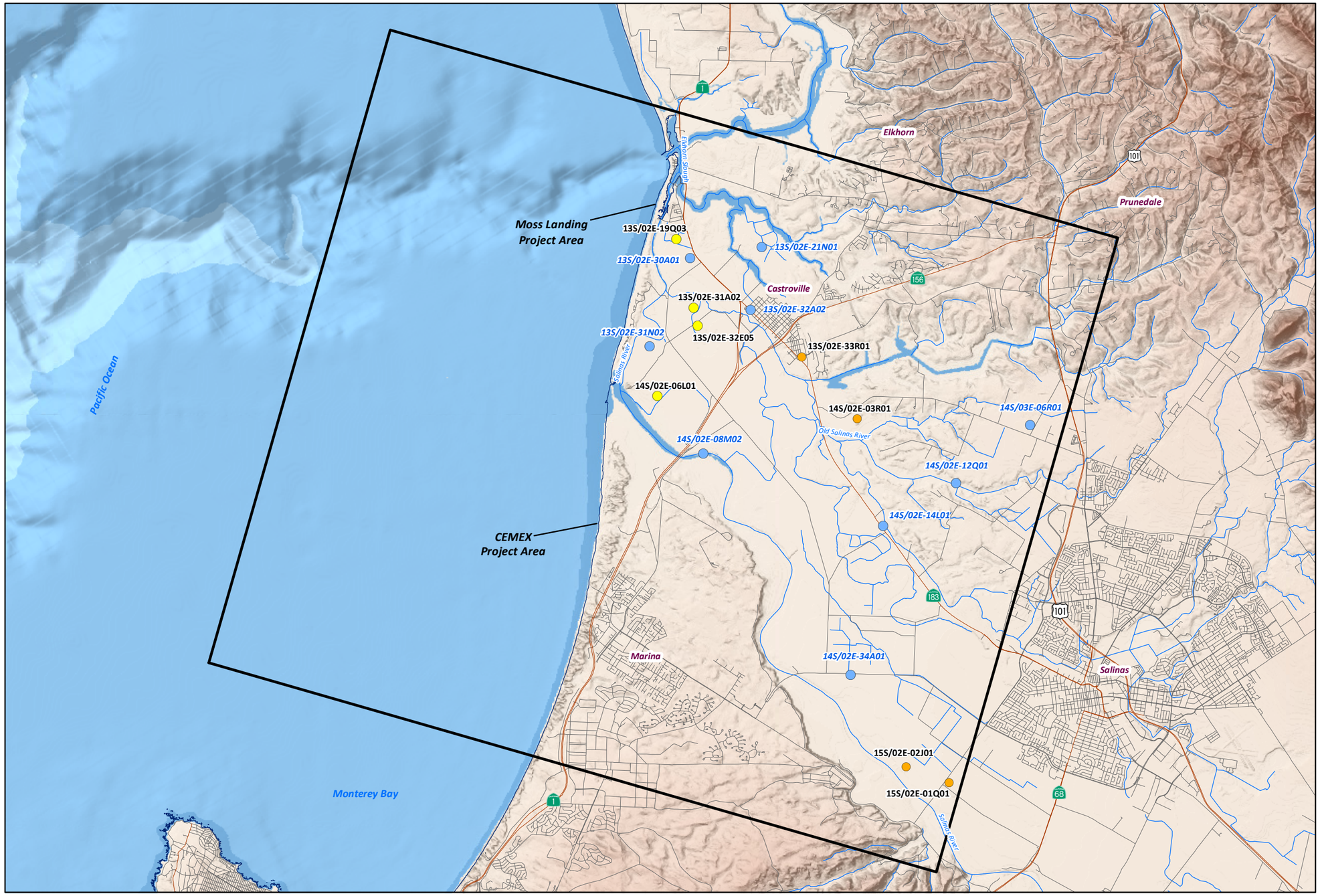
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

NMGWM FLOW MODEL CALIBRATION TARGET WELLS



EXPLANATION

North Marina Groundwater Model Boundary

Flow Model Calibration Target Well Location and Screened Aquifer

- 180-FT/180-FTE
- 400-FT
- 900-FT

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

Mean High Tide (DOC, NOAA et al., 2011)

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NORTH

0 0.5 1 1.5 2 2.5 3 6 Miles

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Figure 36

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_36_NMGWM_calibration_wells_4-15.mxd

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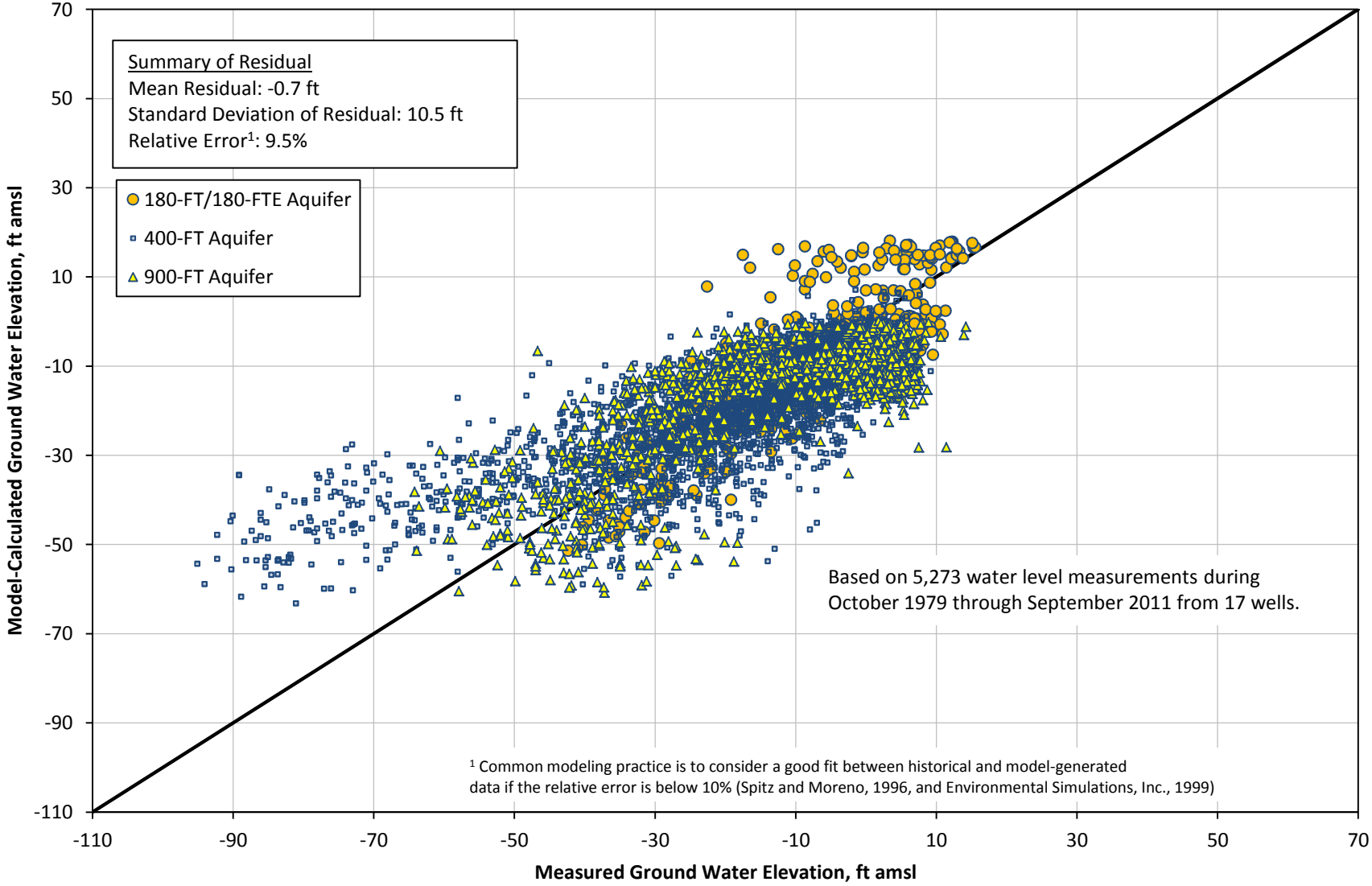
Comparison of Measured Versus Model-Calculated Groundwater Elevations
Transient Model Calibration (Water Years 1980-2011)



[1] Common modeling practice is to consider a good fit between historical and model-generated data if the relative error is below 10% (Spitz and Moreno, 1996, and Environmental Simulations, Inc., 1999)

Figure 37

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Histogram of Water Level Residuals
Transient Model Calibration (Water Years 1980-2011)

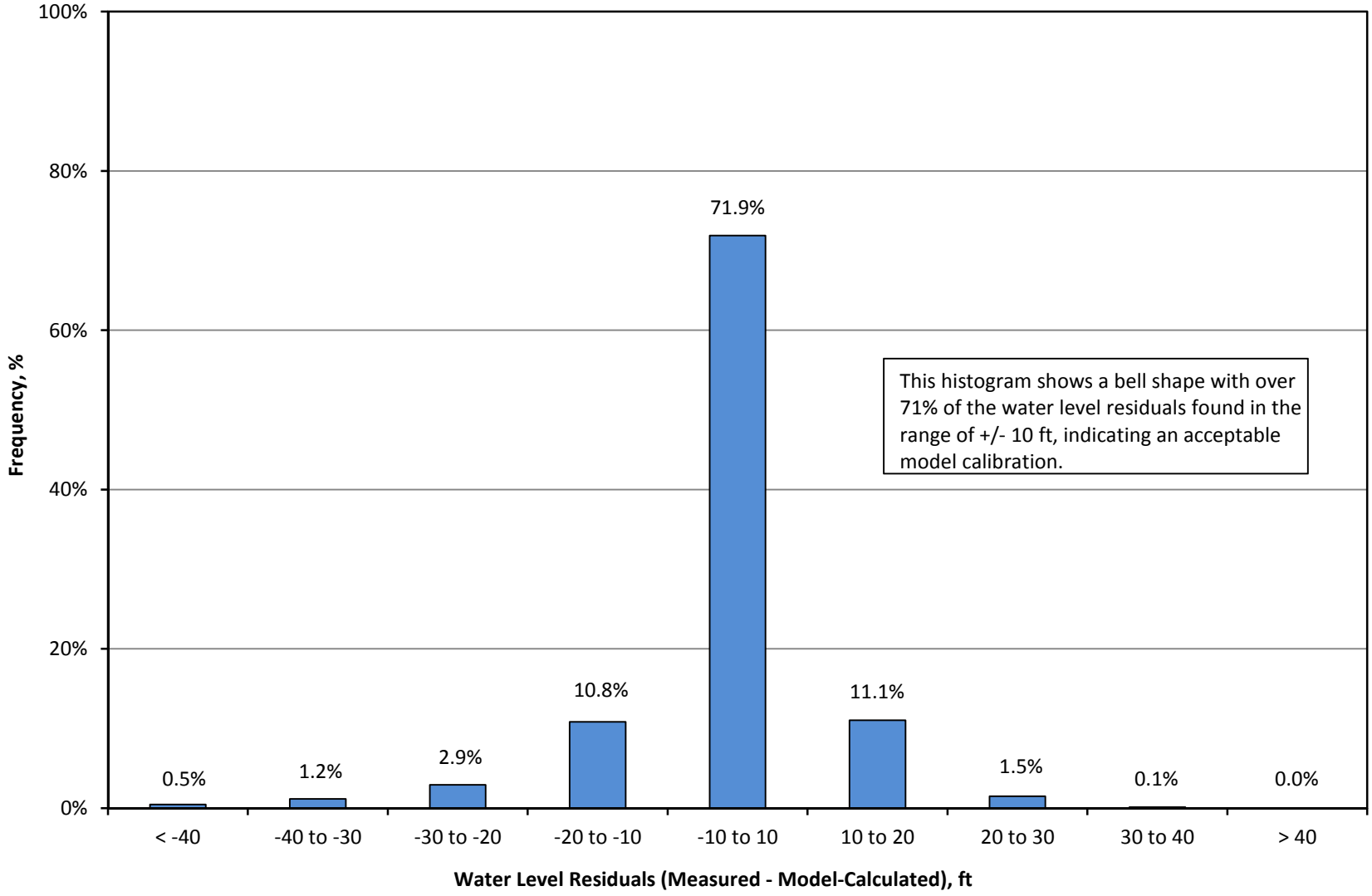

Figure 38

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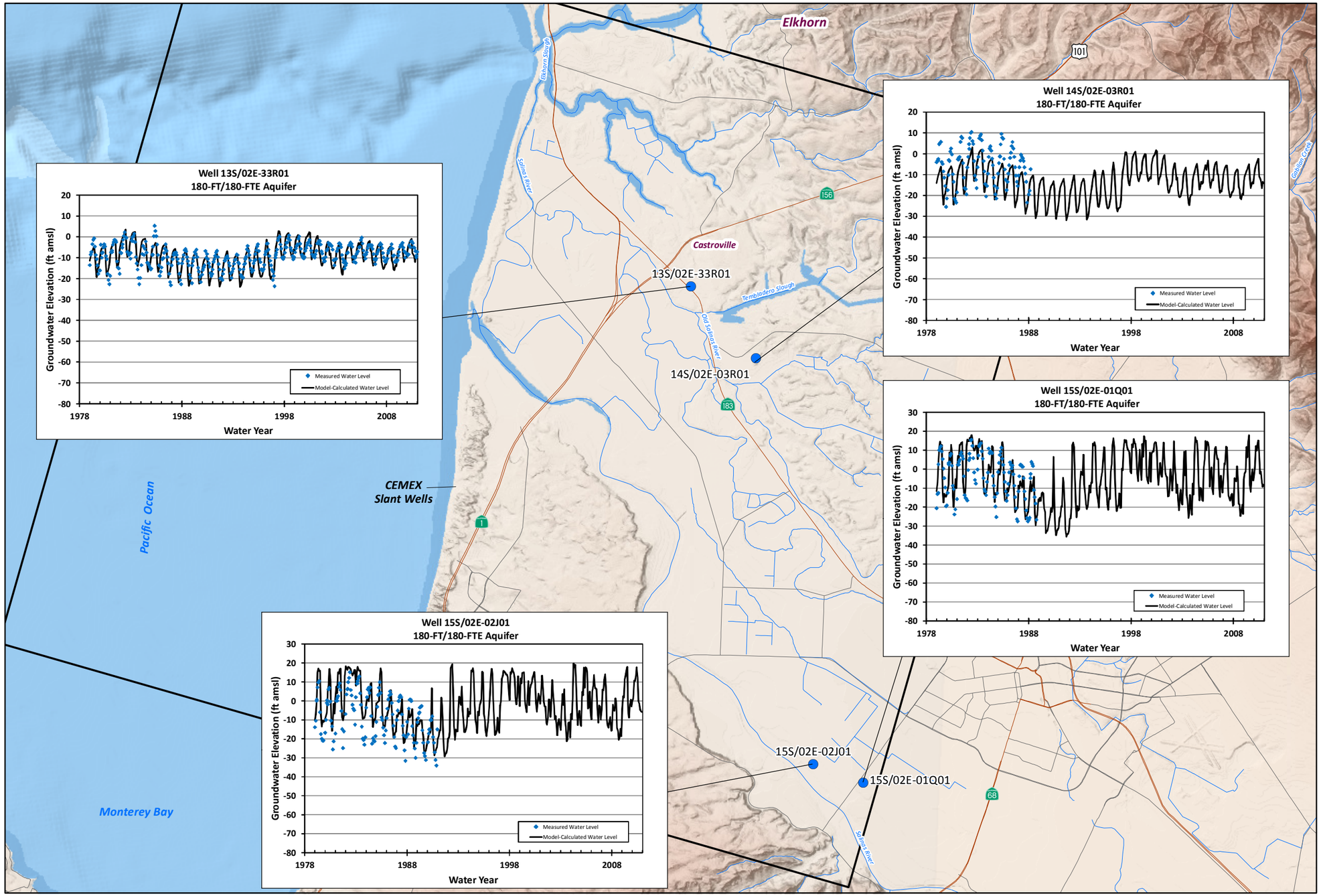
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

TRANSIENT CALIBRATION HYDROGRAPHS OF SELECTED WELLS 180-FT/180-FTE AQUIFER



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

NOTE: 180-FTE =
180-Foot Equivalent Aquifer

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NORTH

0 1 2 4 Miles

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Figure 39

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_39_Calib_Hydrograph_180FT-180FTE_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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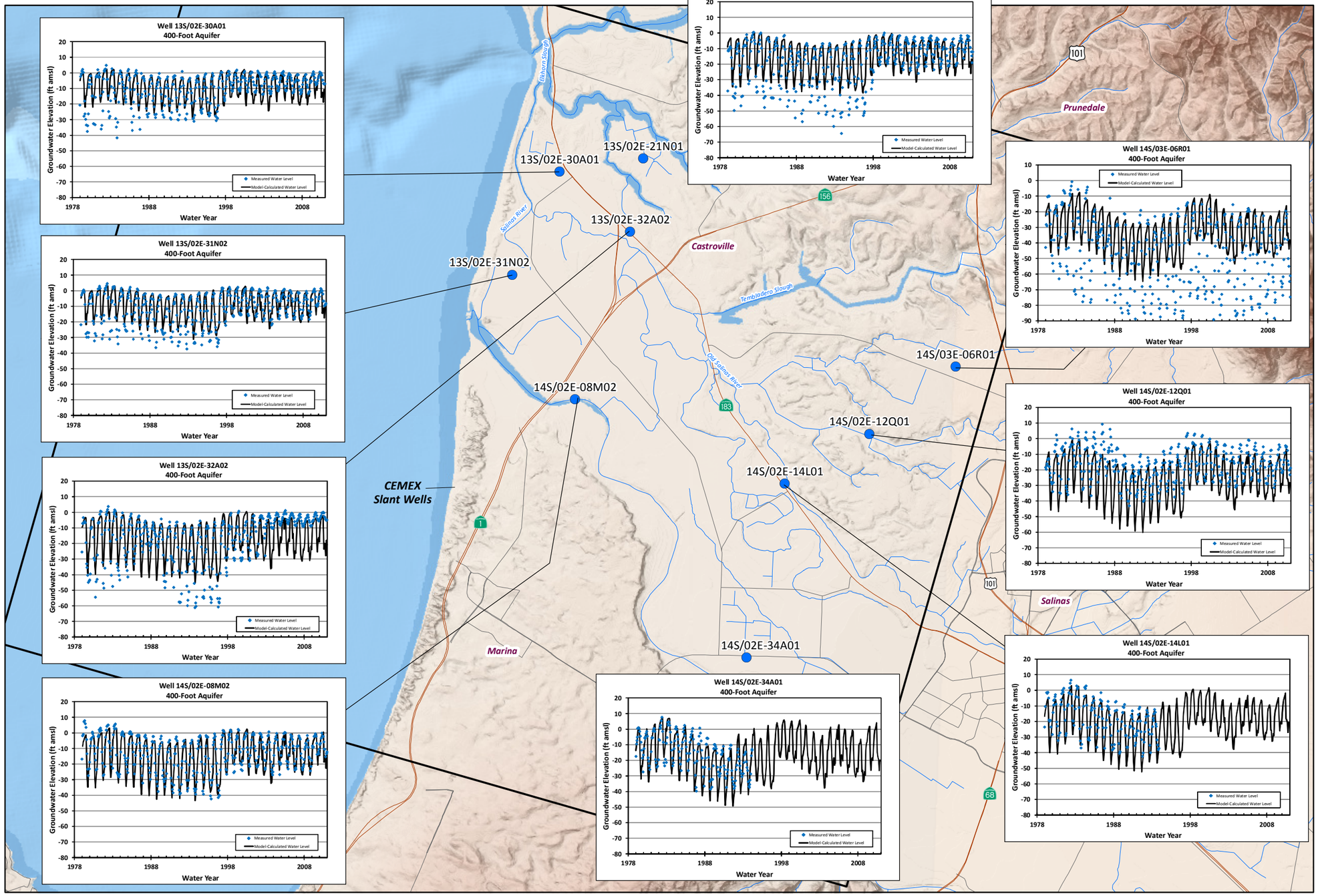
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

TRANSIENT CALIBRATION HYDROGRAPHS OF SELECTED WELLS 400-FT AQUIFER



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

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Figure 40

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_40_Calib_Hydrograph_400FT_4-15.mxd

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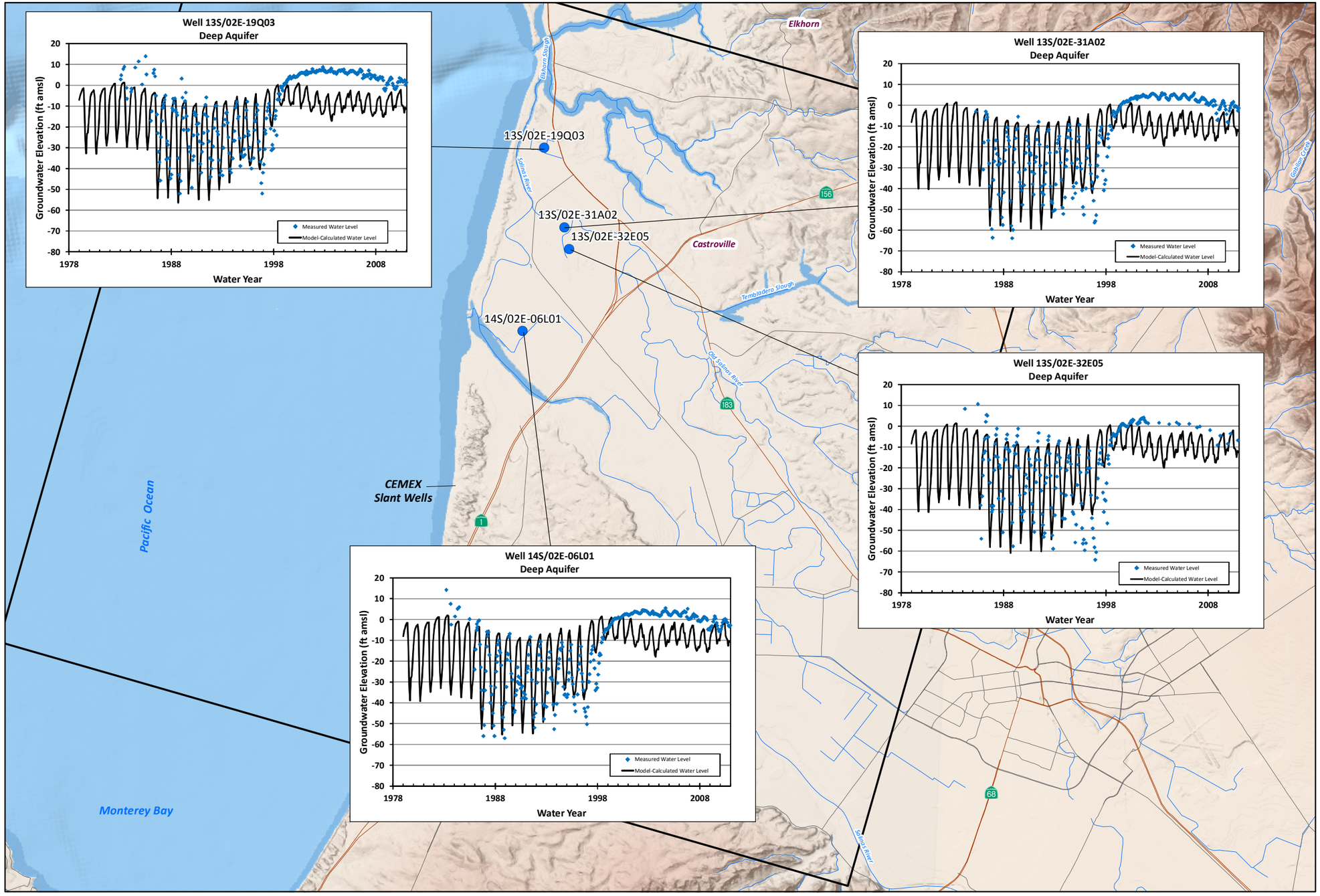
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

TRANSIENT CALIBRATION HYDROGRAPHS OF SELECTED WELLS 900-FT AQUIFER



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

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NORTH

0 1 2 4 Miles

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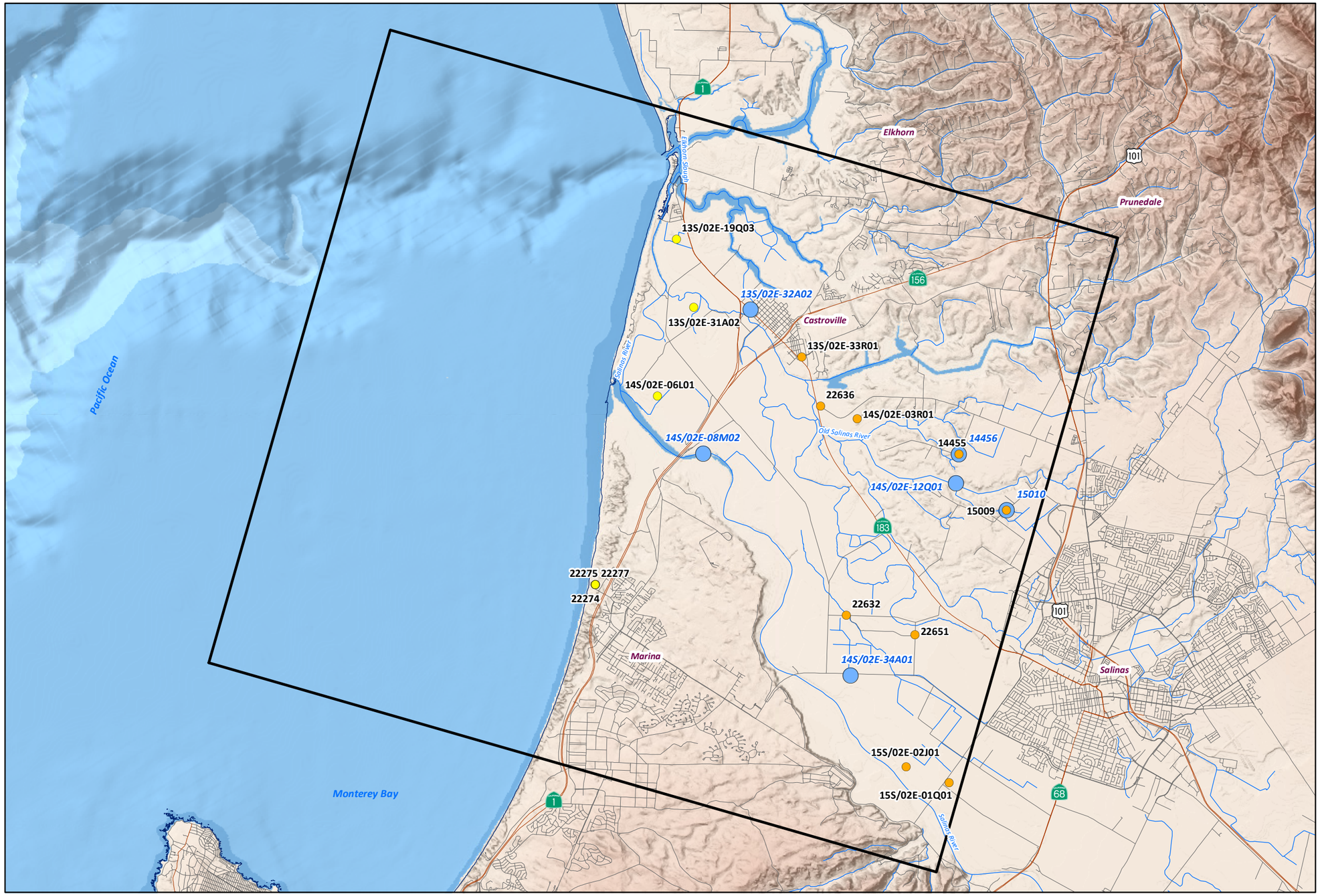
Figure 41

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_41_Calib_Hydrograph_900FT_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

NMGWM SOLUTE TRANSPORT MODEL CALIBRATION TARGET WELLS



EXPLANATION

North Marina Groundwater Model Boundary

Solute Transport Model Calibration Target Well Location and Screened Aquifer

- 180-FT/180-FTE
- *400-FT*
- 900-FT

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

Mean High Tide (DOC, NOAA et al., 2011)

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NORTH

0 0.5 1 1.5 2 2.5 3 6 Miles

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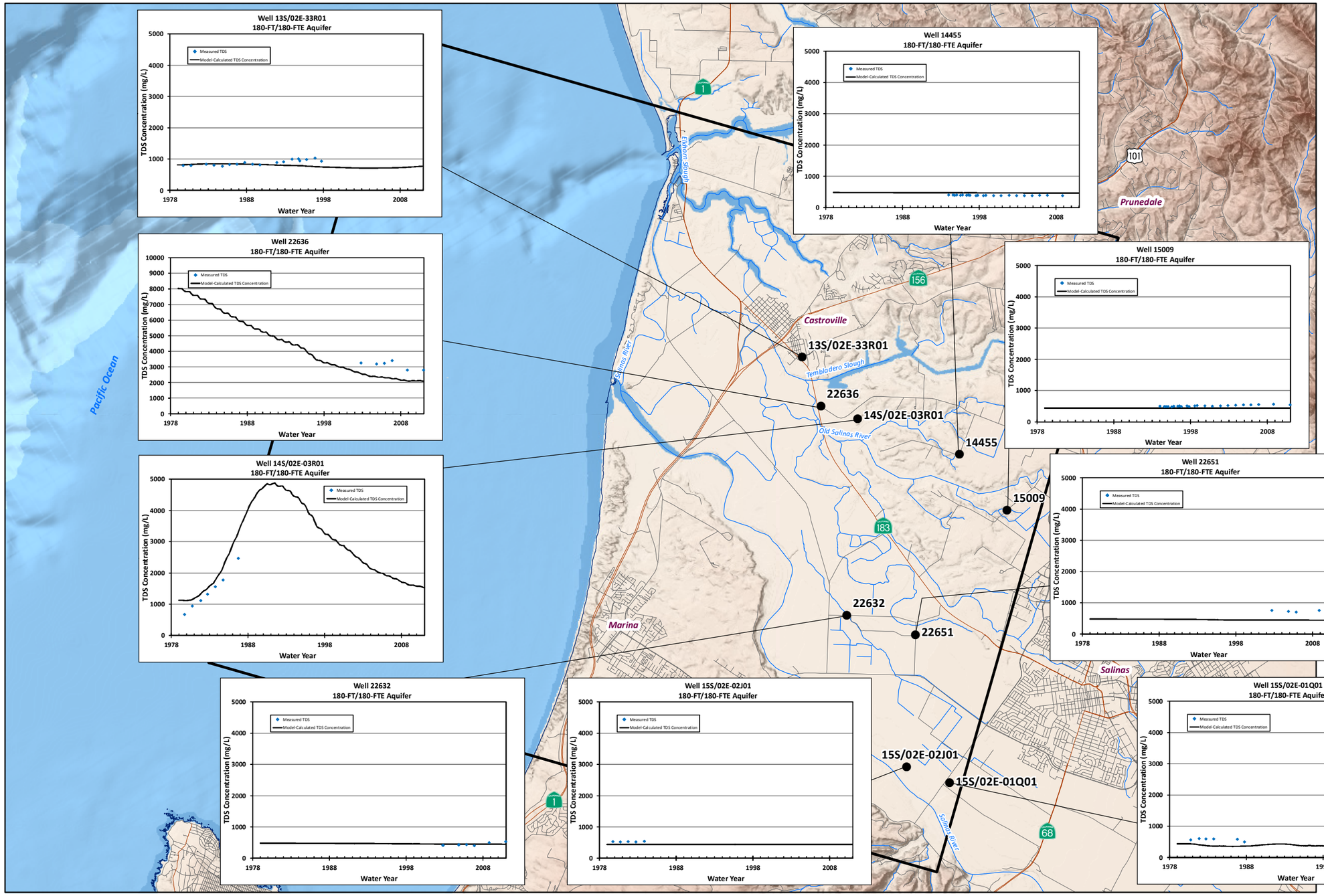
Figure 42

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_42_NMGWM_TDS_calibration_wells_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

TRANSIENT CALIBRATION TDS CHEMOGRAPHS OF SELECTED WELLS 180-FT/180-FTE AQUIFER



EXPLANATION

North Marina Groundwater Model Boundary

Solute Transport Model Calibration Target Well Location

Mean High Tide (DOC, NOAA et al., 2011)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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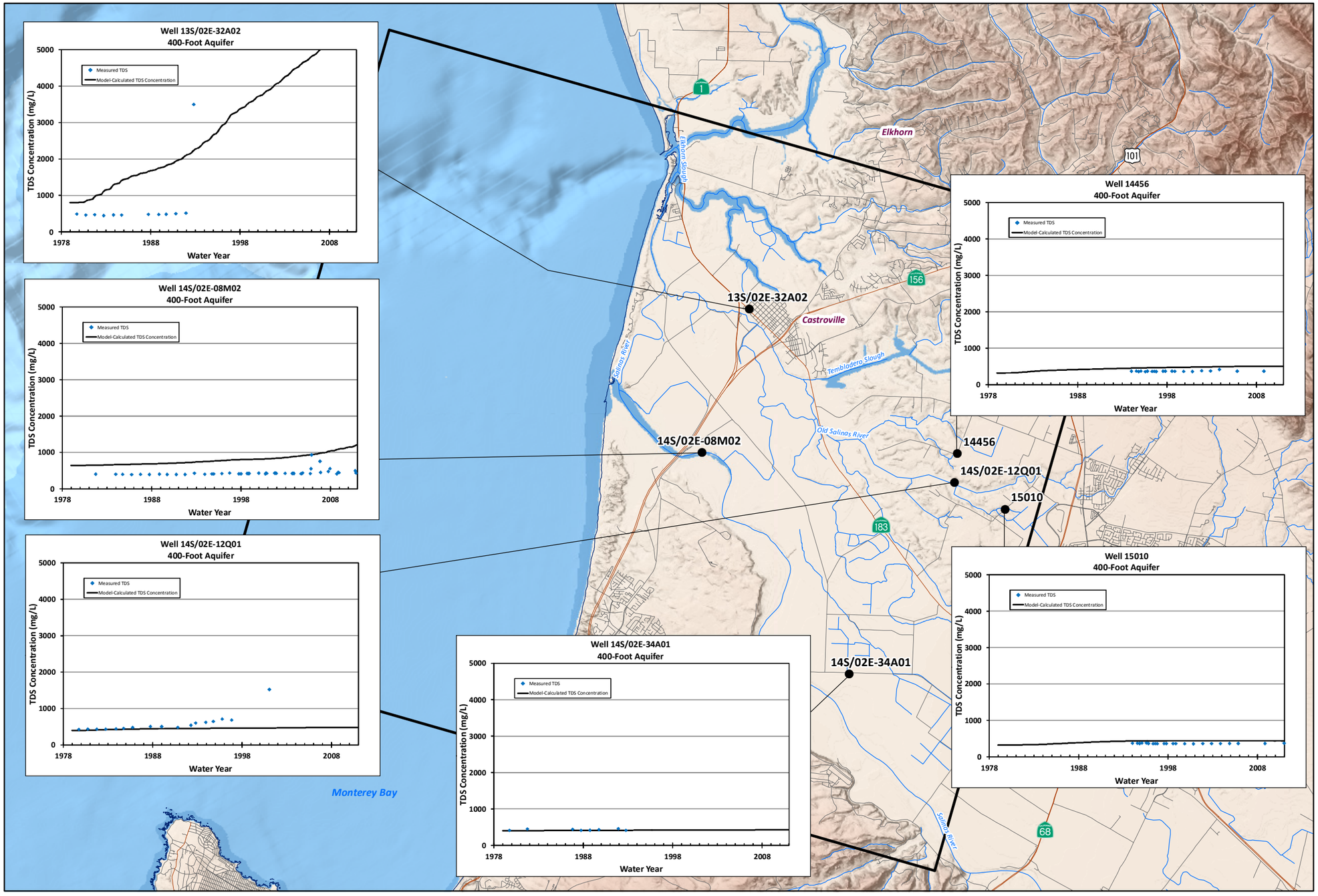
Figure 43

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_43_TDS_Calib_Chemograph_180FT-180FTE_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

TRANSIENT CALIBRATION TDS CHEMOGRAPHS OF SELECTED WELLS 400-FT AQUIFER



EXPLANATION

North Marina Groundwater Model Boundary

Solute Transport Model Calibration Target Well Location

Mean High Tide (DOC, NOAA et al., 2011)

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Figure 44

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_44_TDS_Calib_Chemograph_400FT_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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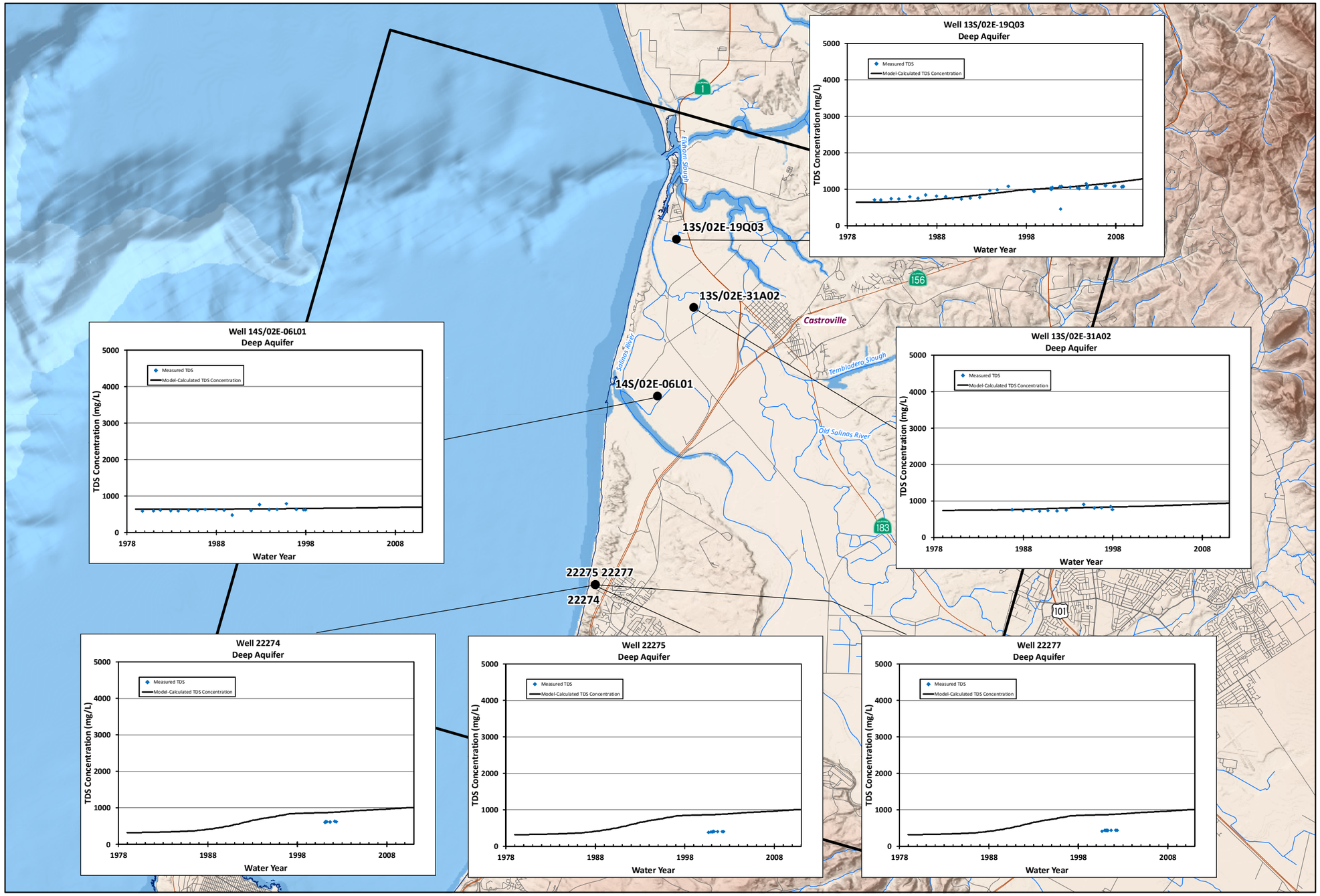
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

TRANSIENT CALIBRATION TDS CHEMOGRAPHS OF SELECTED WELLS 900-FT AQUIFER



EXPLANATION

North Marina Groundwater Model Boundary

Solute Transport Model Calibration Target Well Location

Mean High Tide (DOC, NOAA et al., 2011)

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NORTH

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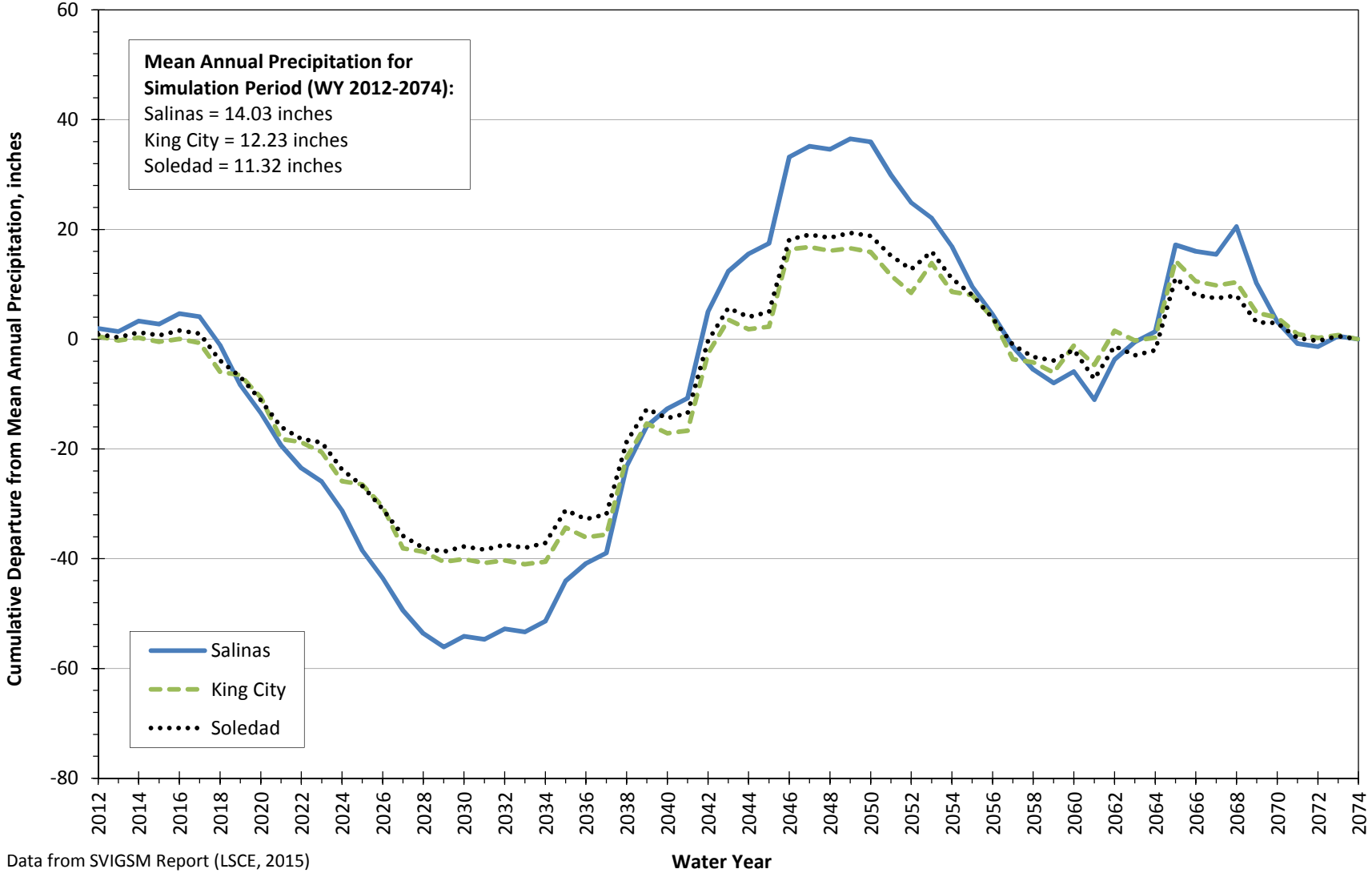
Figure 45

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_45_TDS_Calib_Chemograph_900FT_4-15.mxd

Hydrologic Base Period Cumulative Departure from Mean Precipitation



Data from SVIGSM Report (LSCE, 2015)

Figure 46

CALIFORNIA AMERICAN WATER AND
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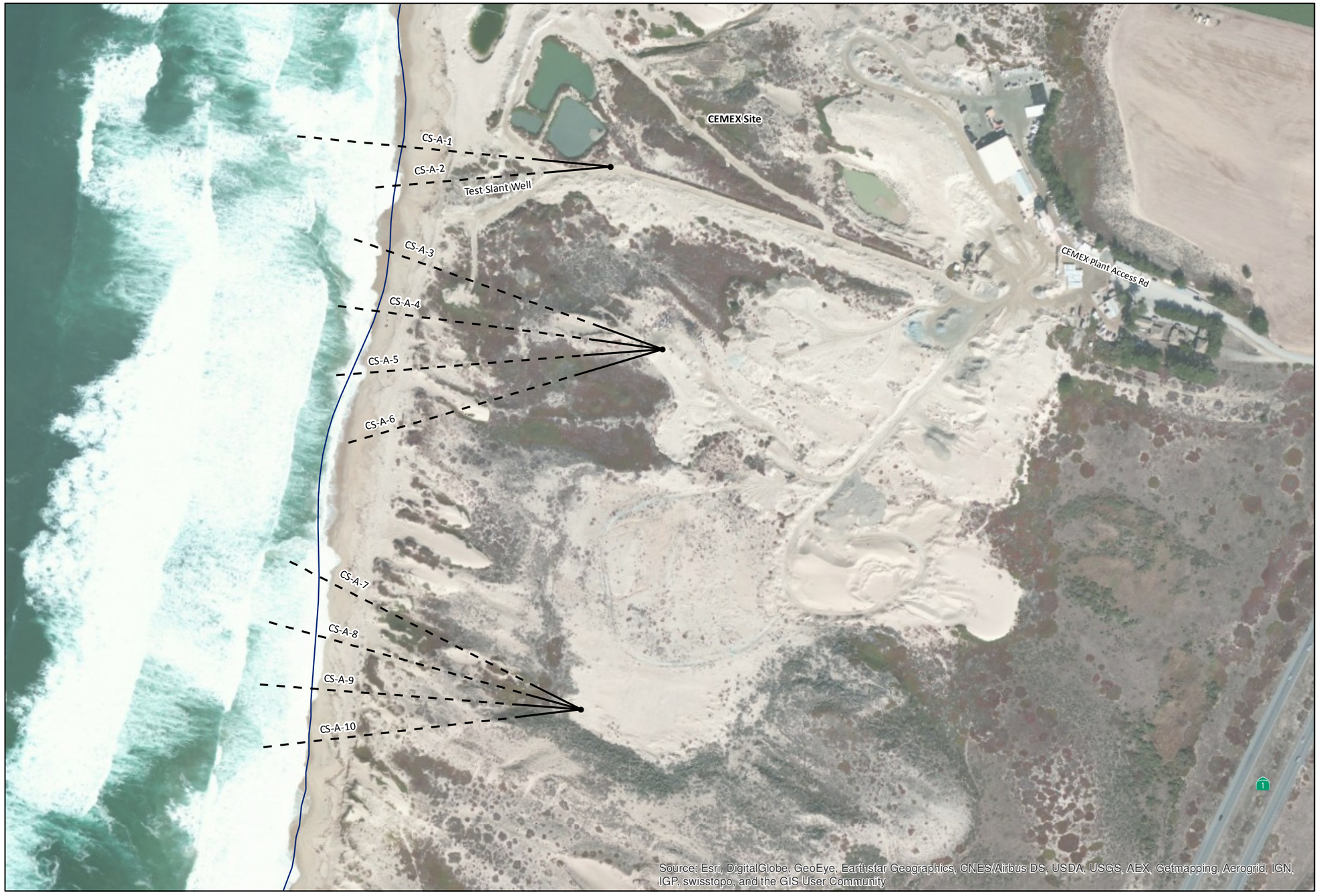
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

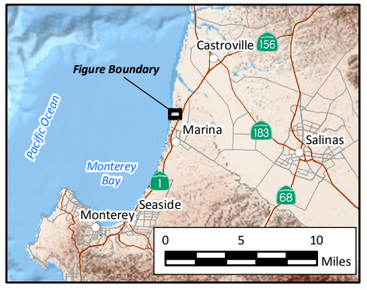
CEMEX SITE SLANT WELL CONFIGURATION A (FEEDWATER SUPPLY OF 24.1 MGD)



EXPLANATION

Test Slant Wellhead
Blank Casing
Well Screen

Mean High Tide
(DOC, NOAA et al., 2011)



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NORTH

0 100 200 300 400 500 1,000 Feet

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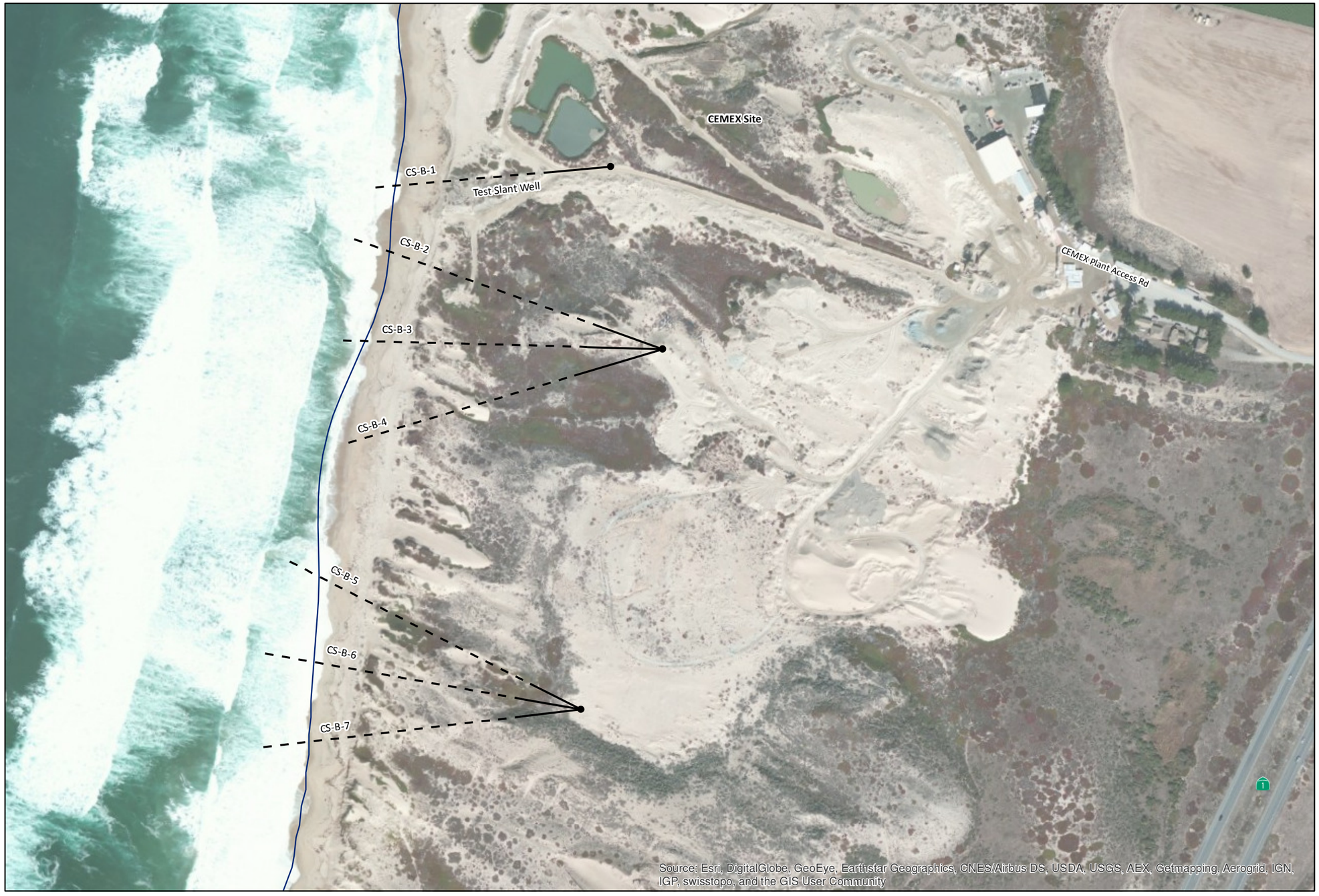
Figure 47

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_47_CEMEX_Config_A_slant_well_4-15.mxd

CALIFORNIA AMERICAN WATER

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

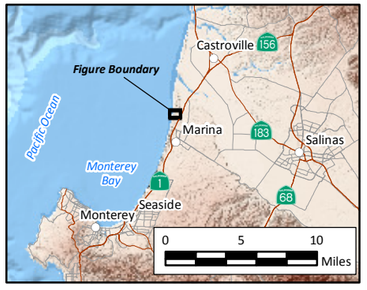
CEMEX SITE SLANT WELL CONFIGURATION B (FEEDWATER SUPPLY OF 15.5 MGD)



EXPLANATION

Test Slant Wellhead
Blank Casing
Well Screen

Mean High Tide
(DOC, NOAA et al., 2011)



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NORTH

0 100 200 300 400 500 1,000 Feet

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Figure 48

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_48_CEMEX_Config_B_slant_well_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

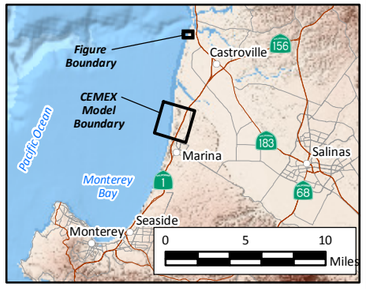
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SITE SLANT WELL CONFIGURATION A (FEEDWATER SUPPLY OF 24.1 MGD)

EXPLANATION

Slant Wellhead
Blank Casing
Well Screen

Mean High Tide
(DOC, NOAA et al., 2011)



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NORTH

0 50 100 150 200 250 500
Feet

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Figure 49

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_49_Potrero_Config_A_slant_well_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

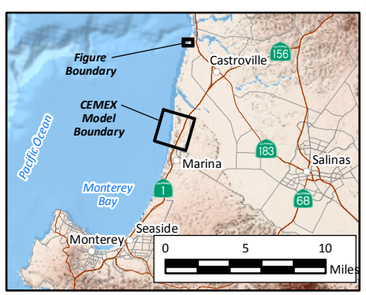
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SITE SLANT WELL CONFIGURATION B (FEEDWATER SUPPLY OF 15.5 MGD)

EXPLANATION

Slant Wellhead
Blank Casing
Well Screen

Mean High Tide
(DOC, NOAA et al., 2011)



17-Apr-15

Prepared by: DB. Map Projection: State Plane 1983, Zone IV.

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NORTH

0 50 100 150 200 250 500
Feet

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Figure 50

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_50_Potrero_Config_B_slant_well_4-15.mxd

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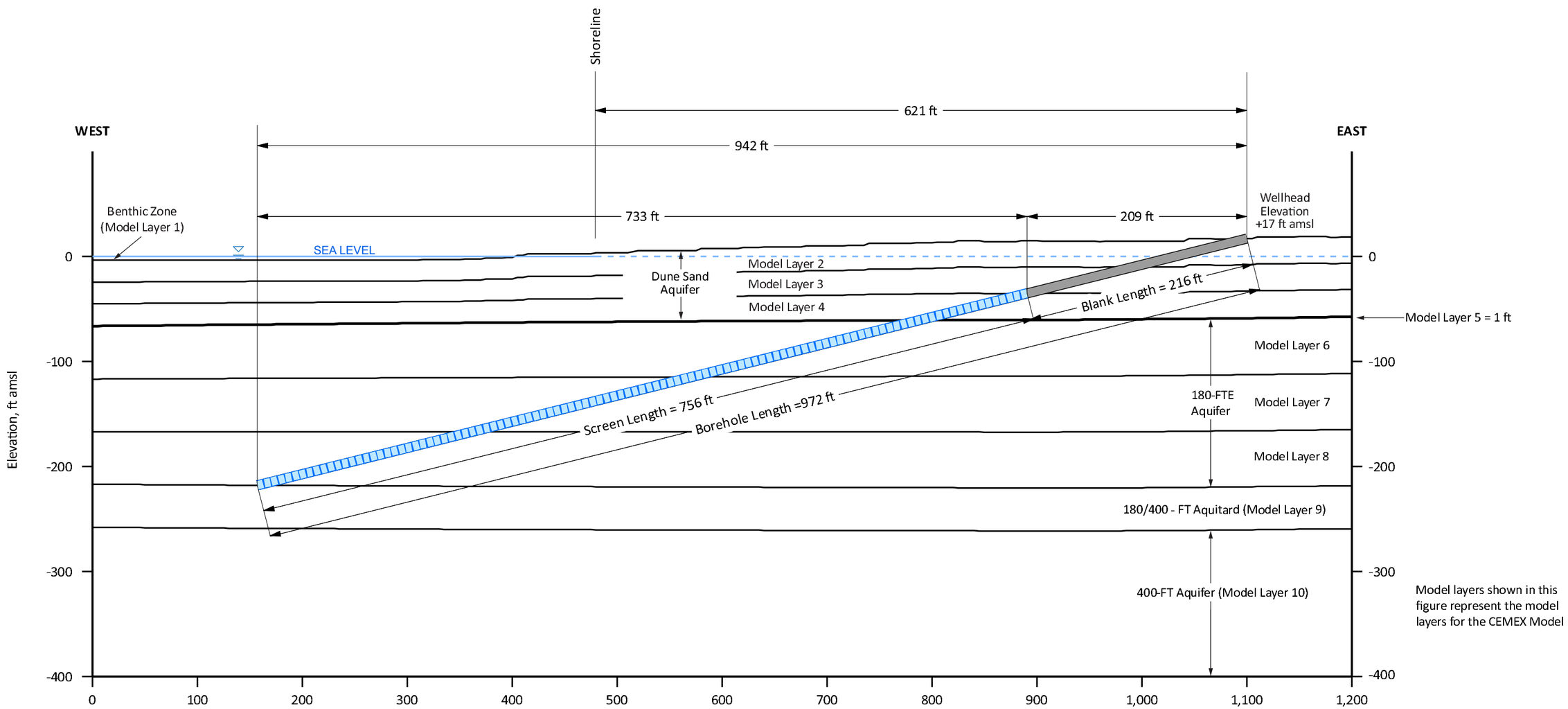
GROUNDWATER MODELING AND ANALYSIS

CEMEX
SLANT WELL CS-A-1
PROFILE
CONFIGURATION A



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	0
	Layer 4	108
180-FTE Aquifer	Layer 6	221
	Layer 7	217
	Layer 8	210
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 51

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_51_CEMEX_CS-A-1_12-14.ai

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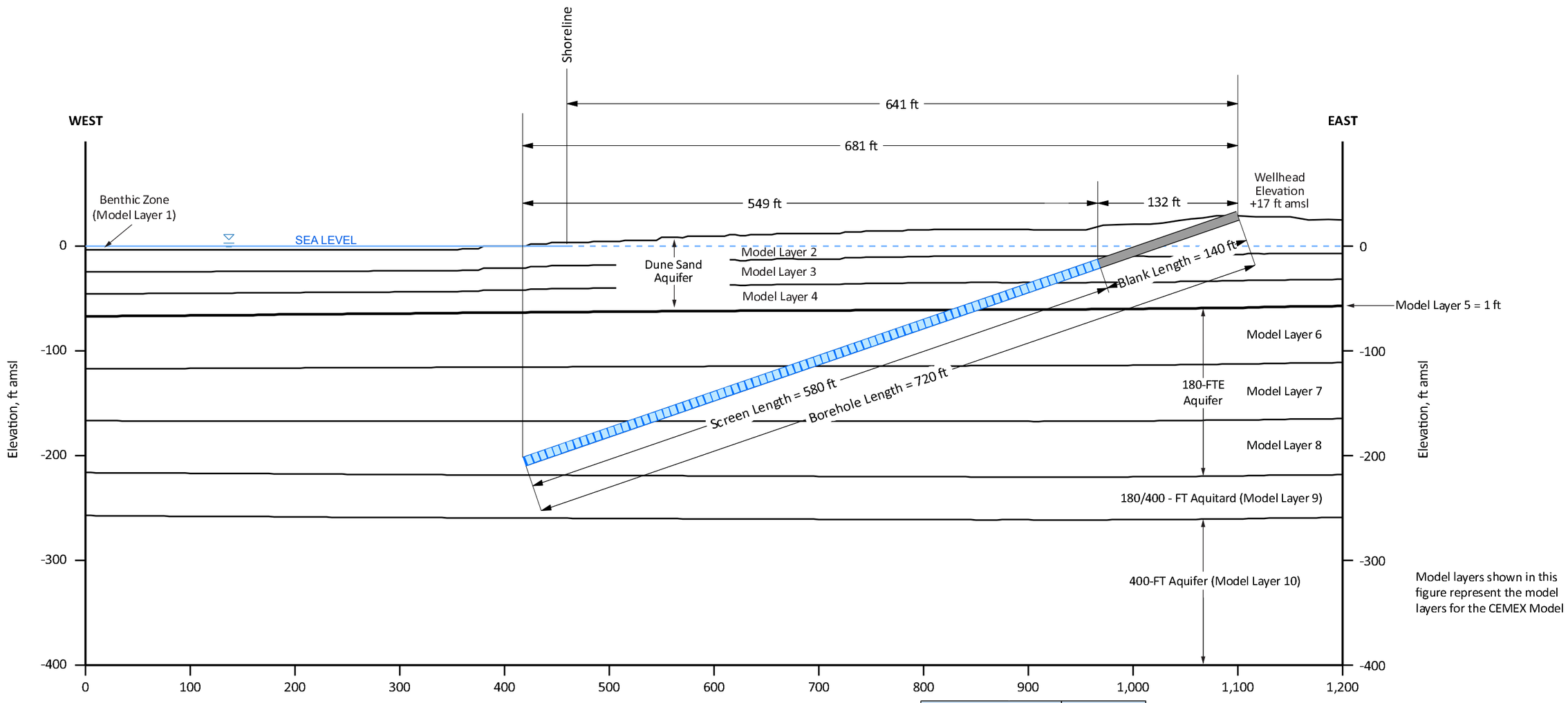
GROUNDWATER MODELING AND ANALYSIS

CEMEX SLANT WELL CS-A-2 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 19 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	68
	Layer 4	79
180-FTE Aquifer	Layer 6	166
	Layer 7	161
	Layer 8	106
* Benthic zone in seabed.		

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

Note: 180-FTE represents 180-Foot Equivalent Aquifer

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Figure 52

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_52_CEMEX_CS-A-2_12-14.ai

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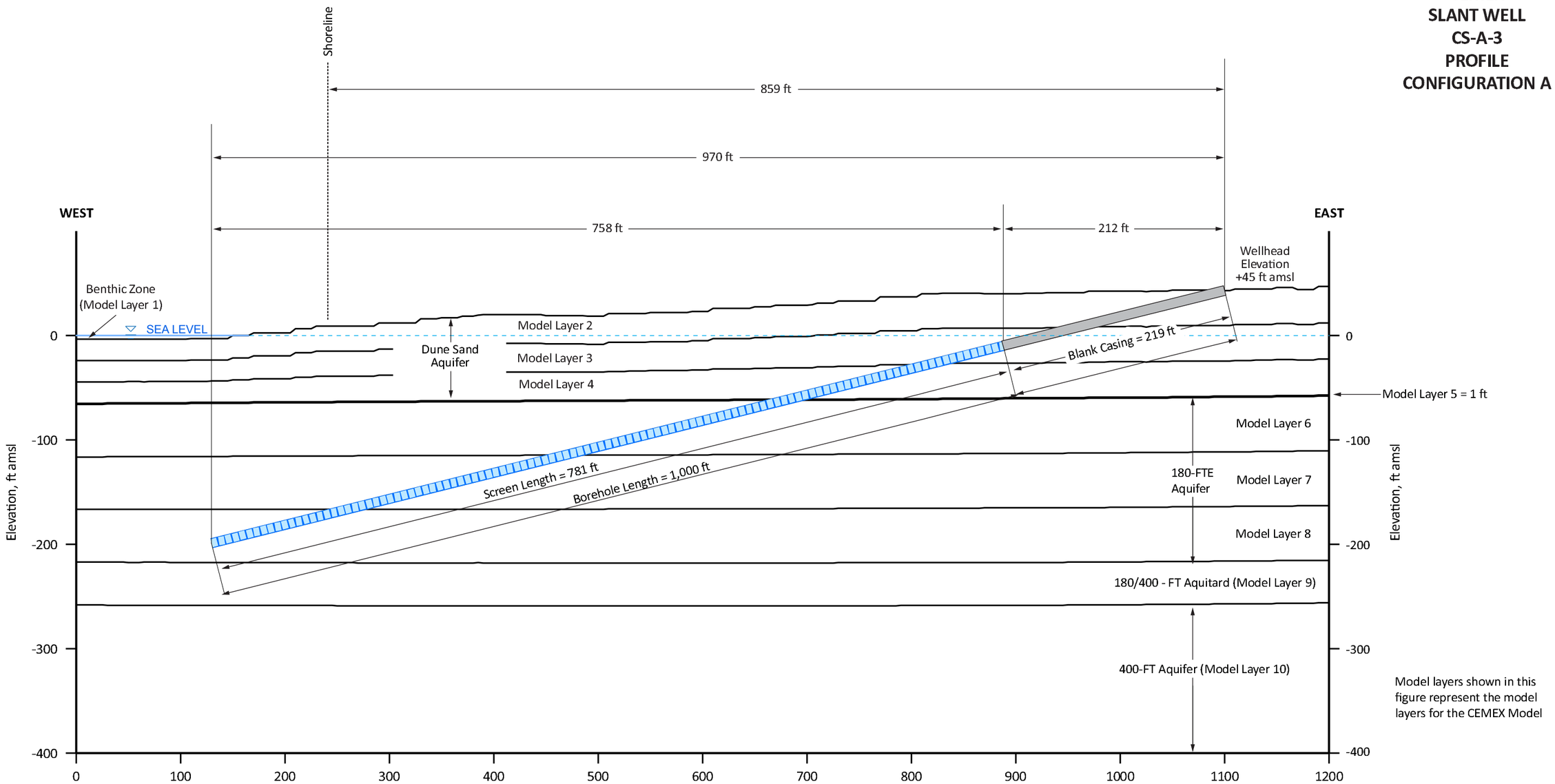
GROUNDWATER MODELING AND ANALYSI

CEMEX SLANT WELL CS-A-3 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	71
	Layer 4	145
180-FTE Aquifer	Layer 6	218
	Layer 7	214
	Layer 8	133
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 53

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_53_CEMEX_CS-A-3_12-14.ai

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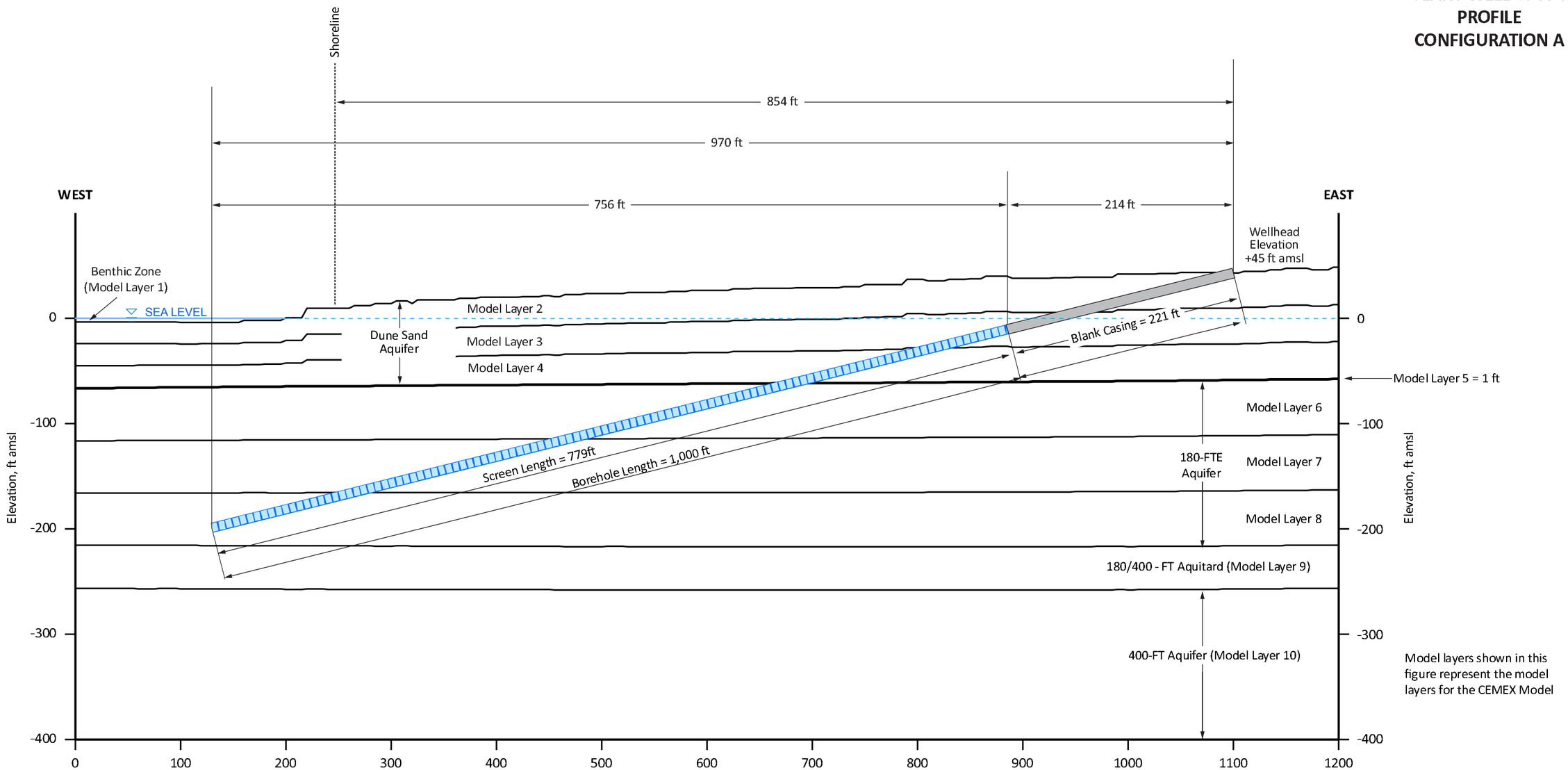
CEMEX
SLANT WELL CS-A-4
PROFILE
CONFIGURATION A



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	75
	Layer 4	135
180-FTE Aquifer	Layer 6	220
	Layer 7	212
	Layer 8	137
* Benthic zone in seabed.		

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

Note: 180-FTE represents 180-Foot Equivalent Aquifer

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Figure 54

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_54_CEMEX_CS-A-4_12-14.ai

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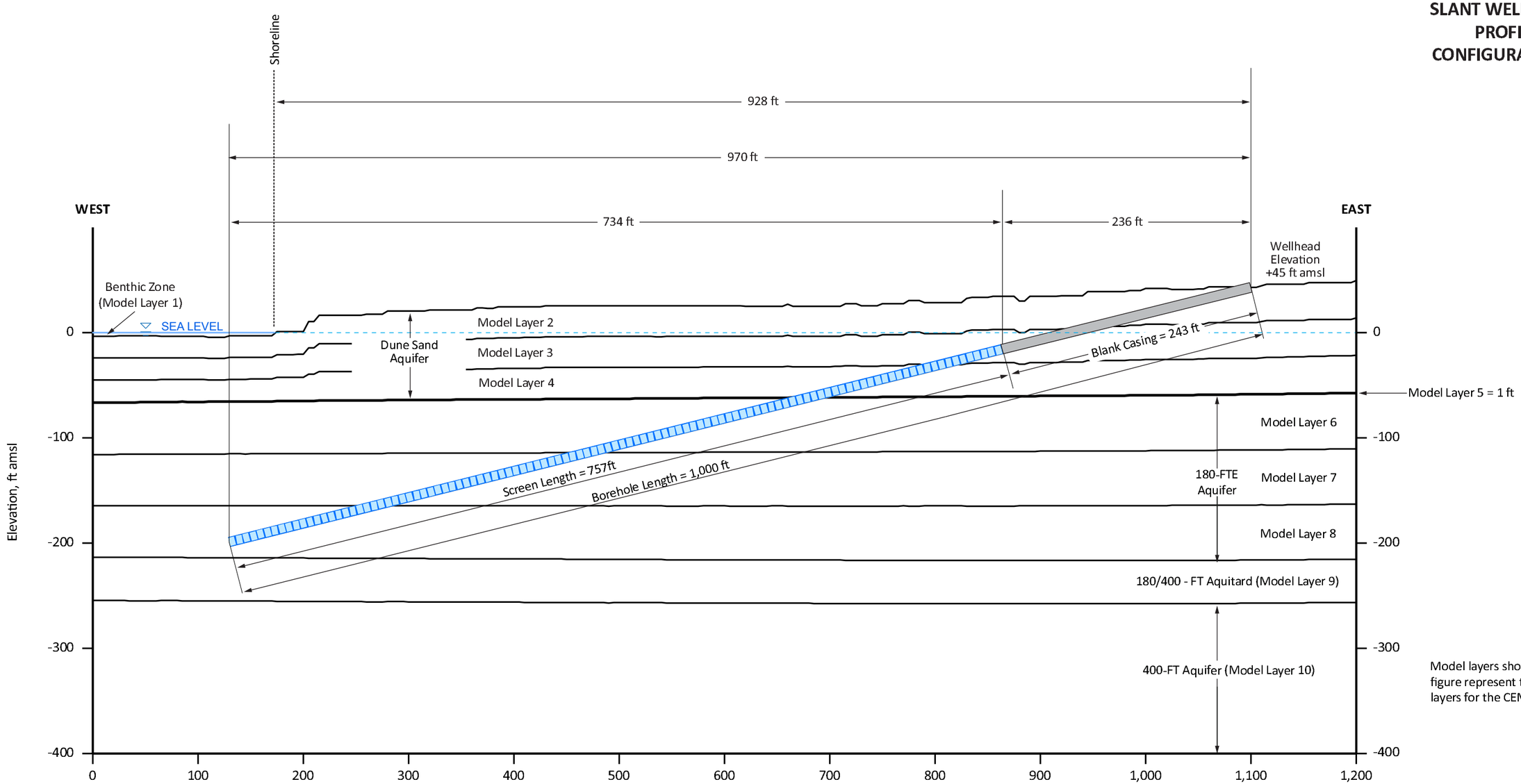
GROUNDWATER MODELING AND ANALYSIS

CEMEX
SLANT WELL CS-A-5
PROFILE
CONFIGURATION A



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	62
	Layer 4	125
180-FTE Aquifer	Layer 6	219
	Layer 7	210
	Layer 8	141
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 55

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_55_CEMEX_CS-A-5_12-14.ai

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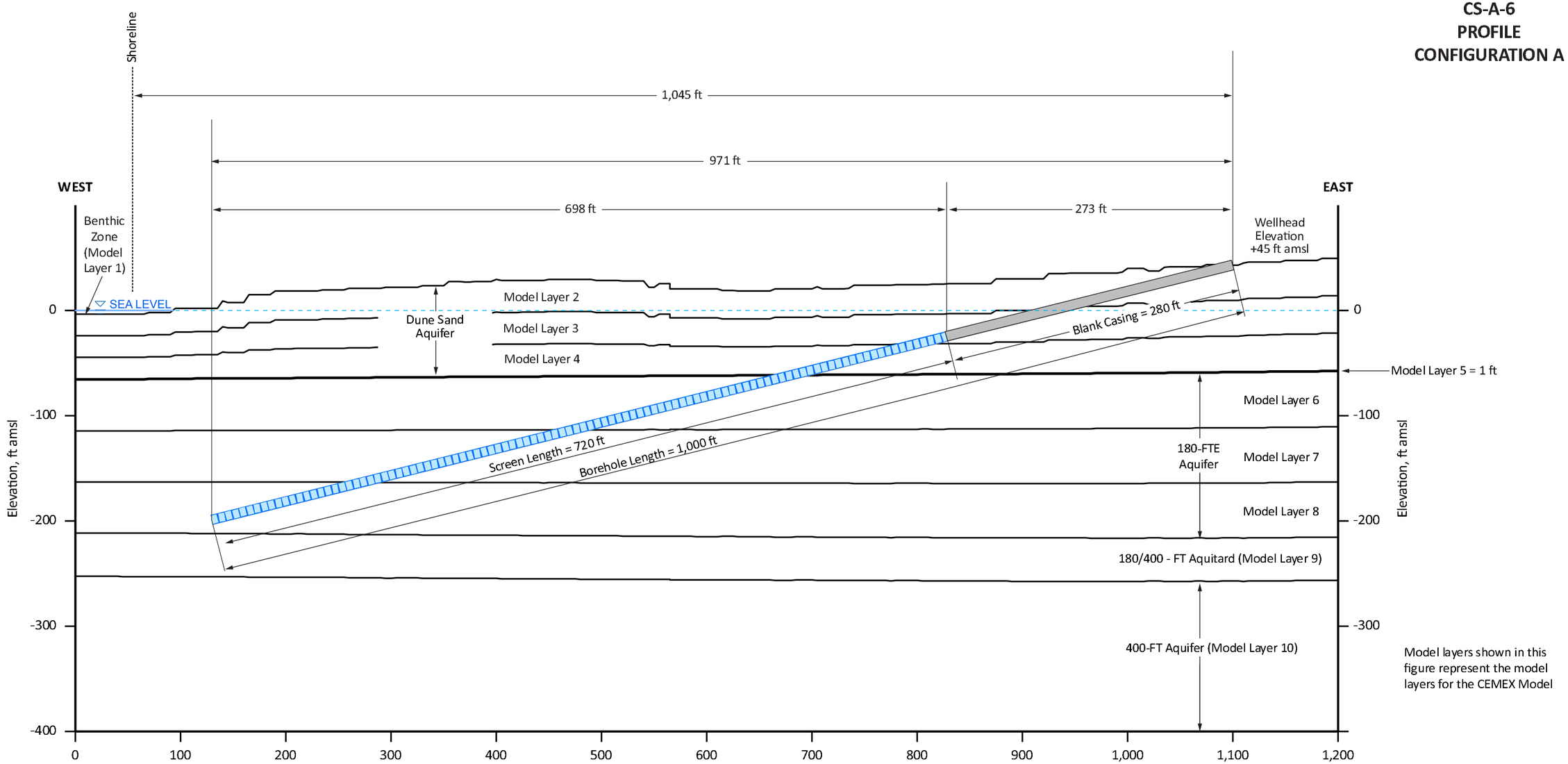
GROUNDWATER MODELING AND ANALYSIS

CEMEX SLANT WELL CS-A-6 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	30
	Layer 4	119
180-FTE Aquifer	Layer 6	217
	Layer 7	207
	Layer 8	147
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 56

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_56_CEMEX_CS-A-6_12-14.ai

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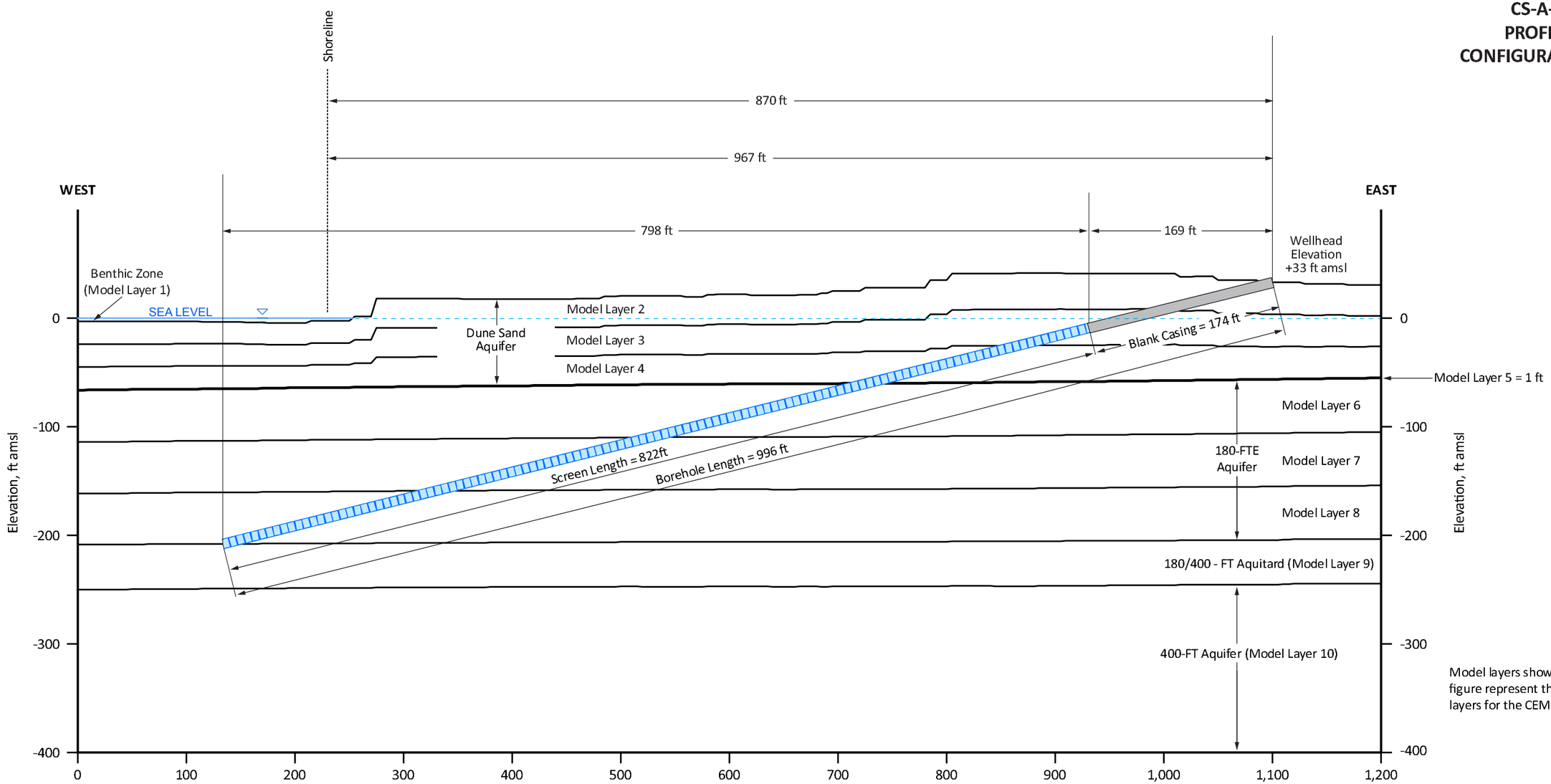
GROUNDWATER MODELING AND ANALYSIS

CEMEX SLANT WELL CS-A-7 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	66
	Layer 4	142
180-FTE Aquifer	Layer 6	208
	Layer 7	204
	Layer 8	202
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 57

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_57_CEMEX_CS-A-7_12-14.ai

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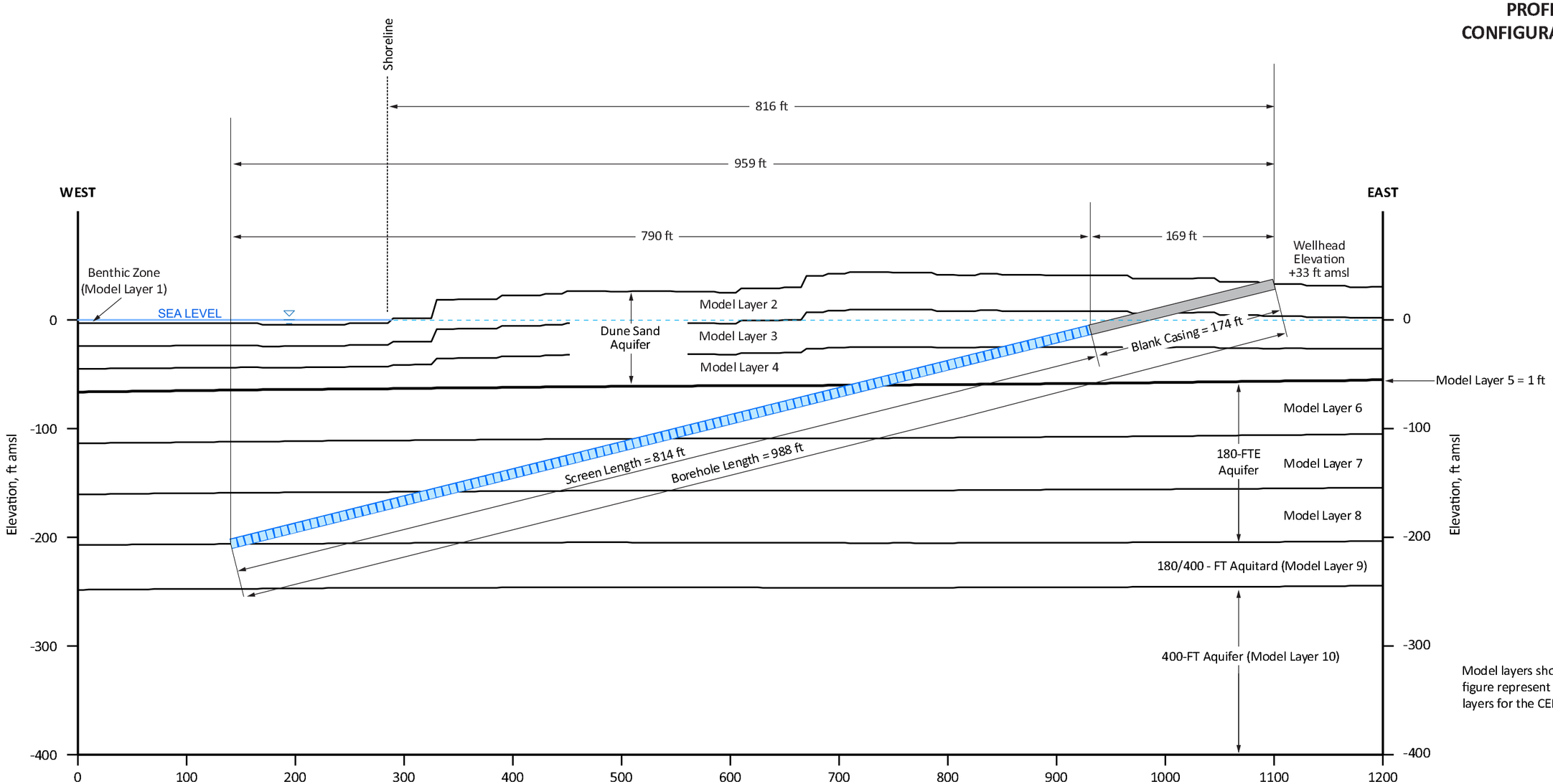
CEMEX
SLANT WELL CS-A-8
PROFILE
CONFIGURATION A



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	66
	Layer 4	142
180-FTE Aquifer	Layer 6	205
	Layer 7	201
	Layer 8	200
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 58

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_58_CEMEX_CS-A-8_12-14.ai

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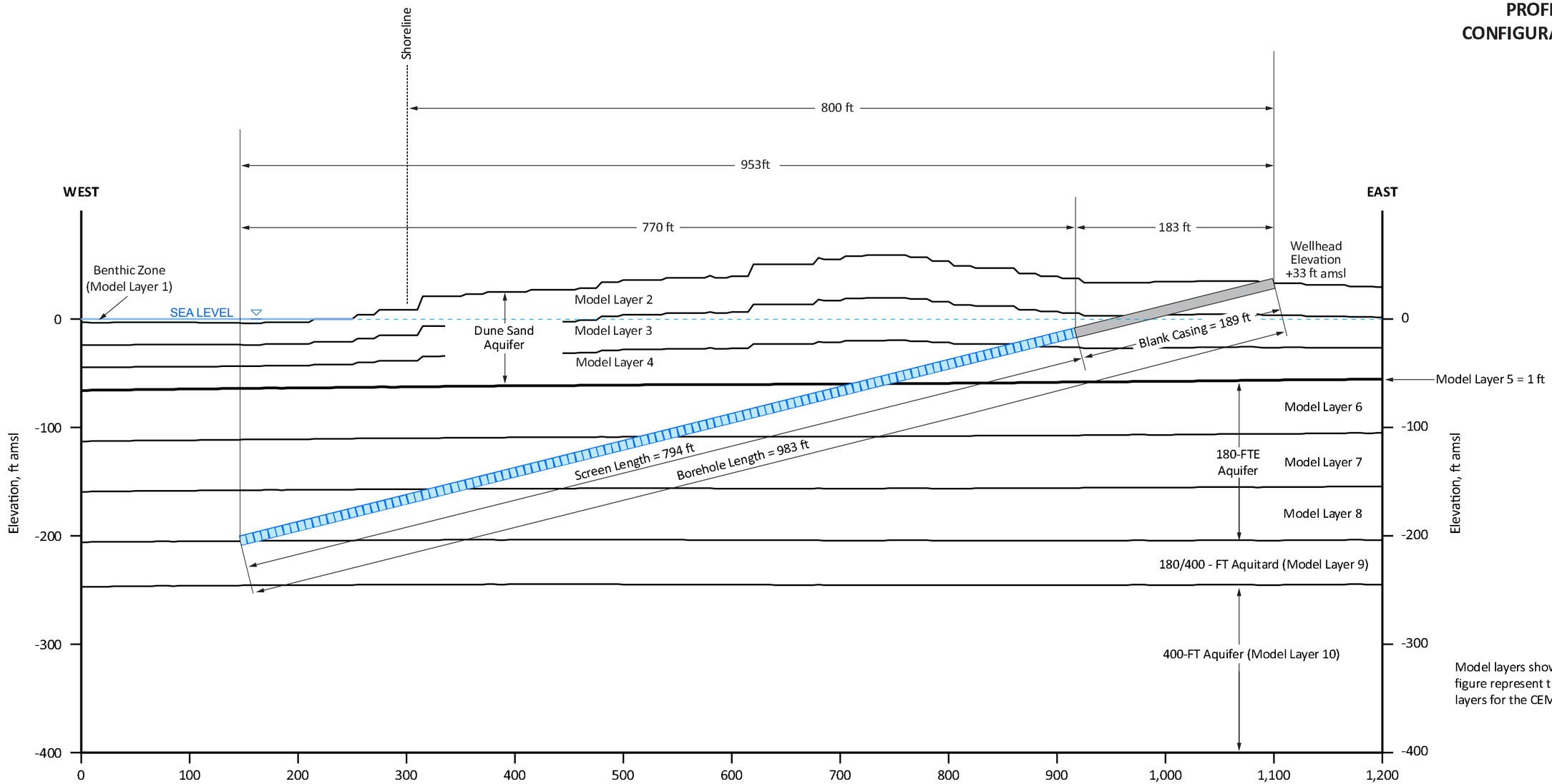
GROUNDWATER MODELING AND ANALYSIS

CEMEX
SLANT WELL CS-A-9
PROFILE
CONFIGURATION A



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	50
	Layer 4	143
180-FTE Aquifer	Layer 6	204
	Layer 7	198
	Layer 8	199
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 59

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_59_CEMEX_CS-A-9_12-14.ai

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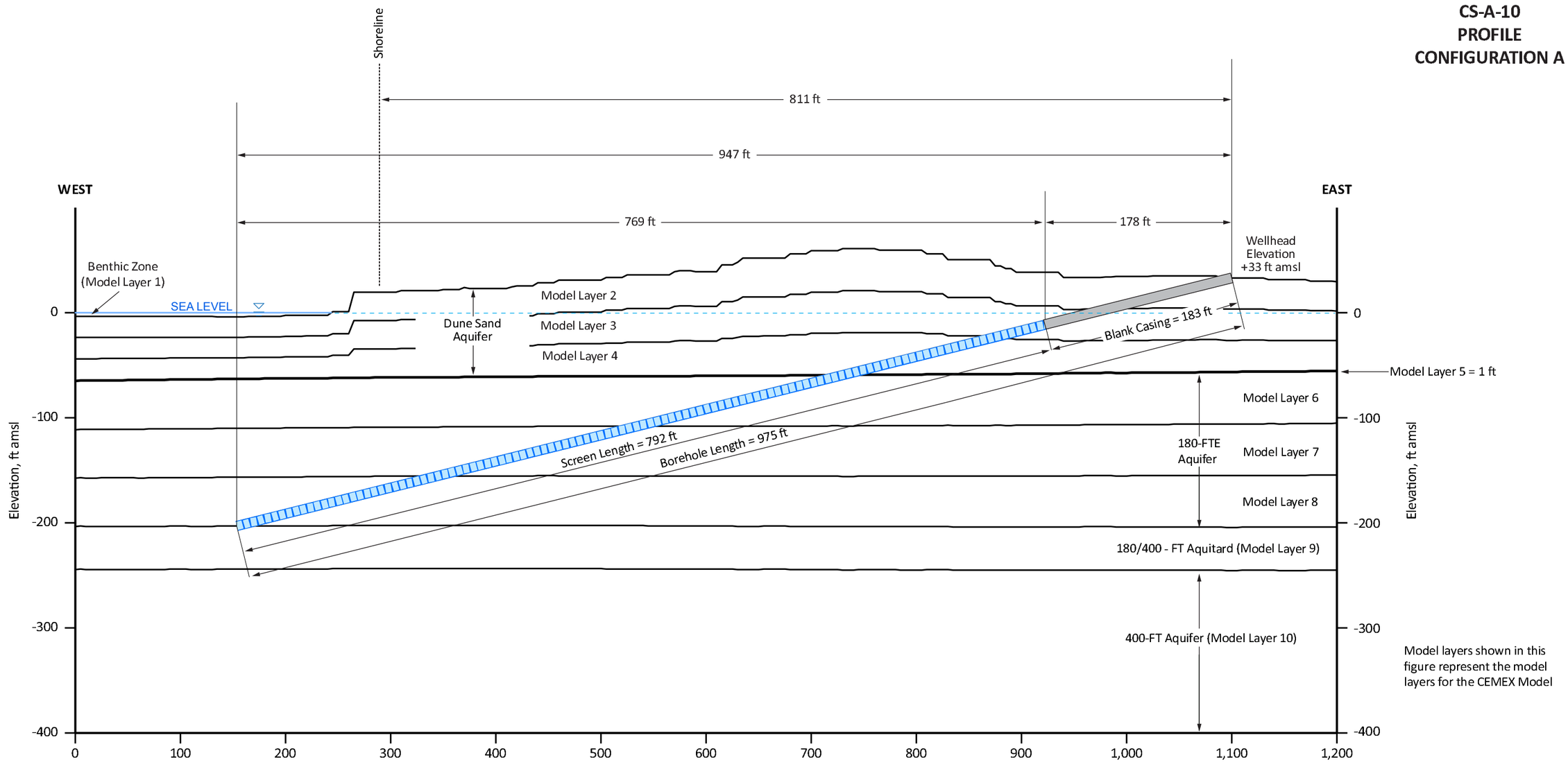
GROUNDWATER MODELING AND ANALYSIS

CEMEX SLANT WELL CS-A-10 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	50
	Layer 4	147
180-FTE Aquifer	Layer 6	203
	Layer 7	196
	Layer 8	196
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 60

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_60_CEMEX_CS-A-10_12-14.ai

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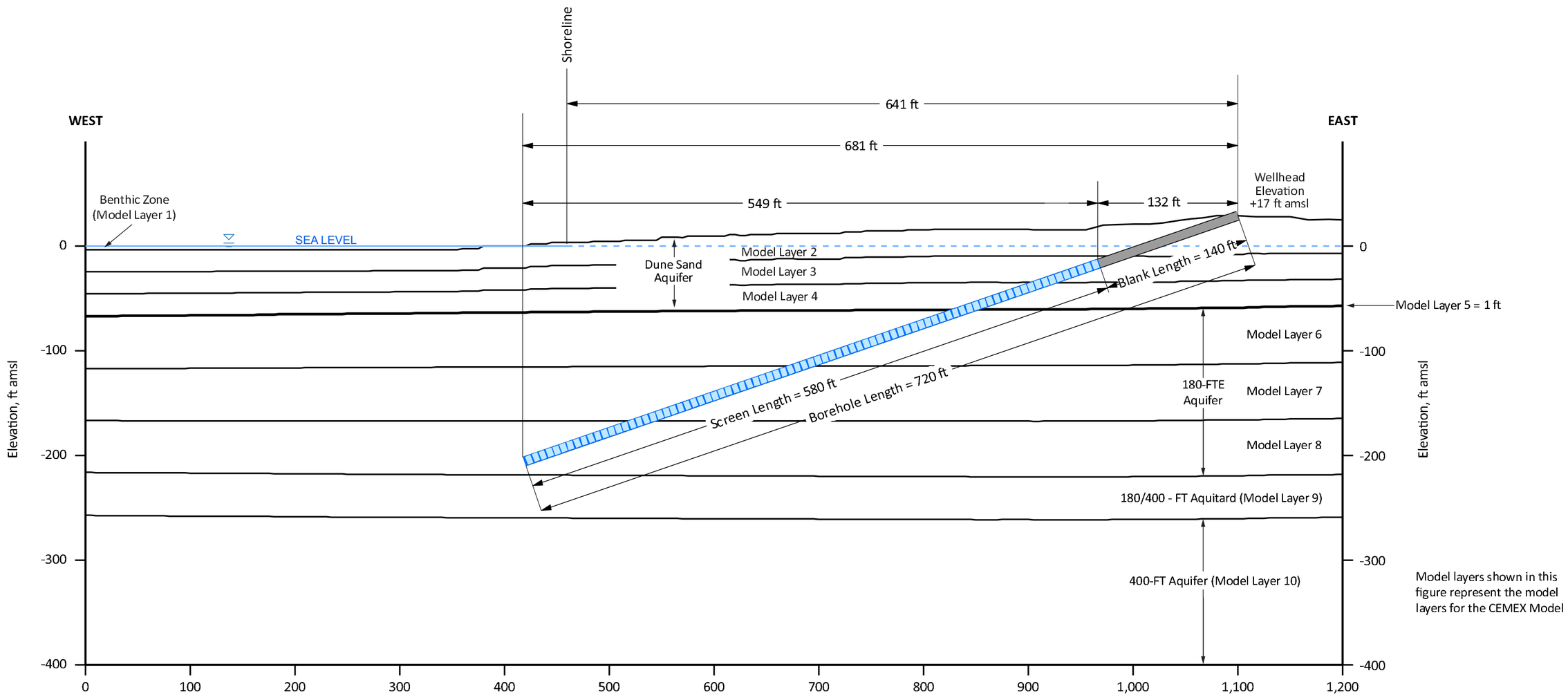
GROUNDWATER MODELING AND ANALYSIS

CEMEX SLANT WELL CS-B-1 PROFILE CONFIGURATION B



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 19 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	68
	Layer 4	79
180-FTE Aquifer	Layer 6	166
	Layer 7	161
	Layer 8	106
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 61

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_61_CEMEX_CS-B-1_12-14.ai

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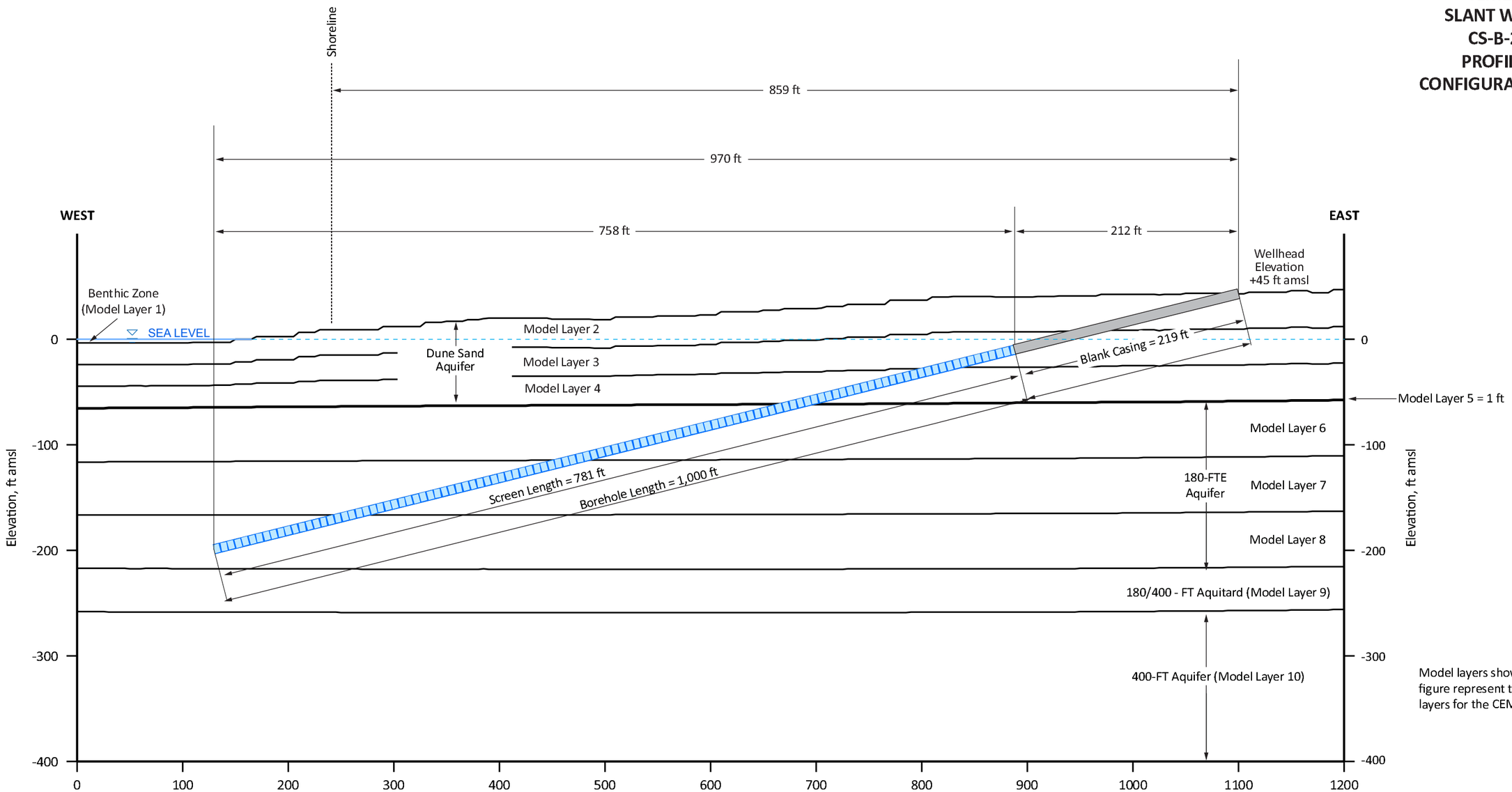
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

CEMEX SLANT WELL CS-B-2 PROFILE CONFIGURATION B



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	71
	Layer 4	145
180-FTE Aquifer	Layer 6	218
	Layer 7	214
	Layer 8	133
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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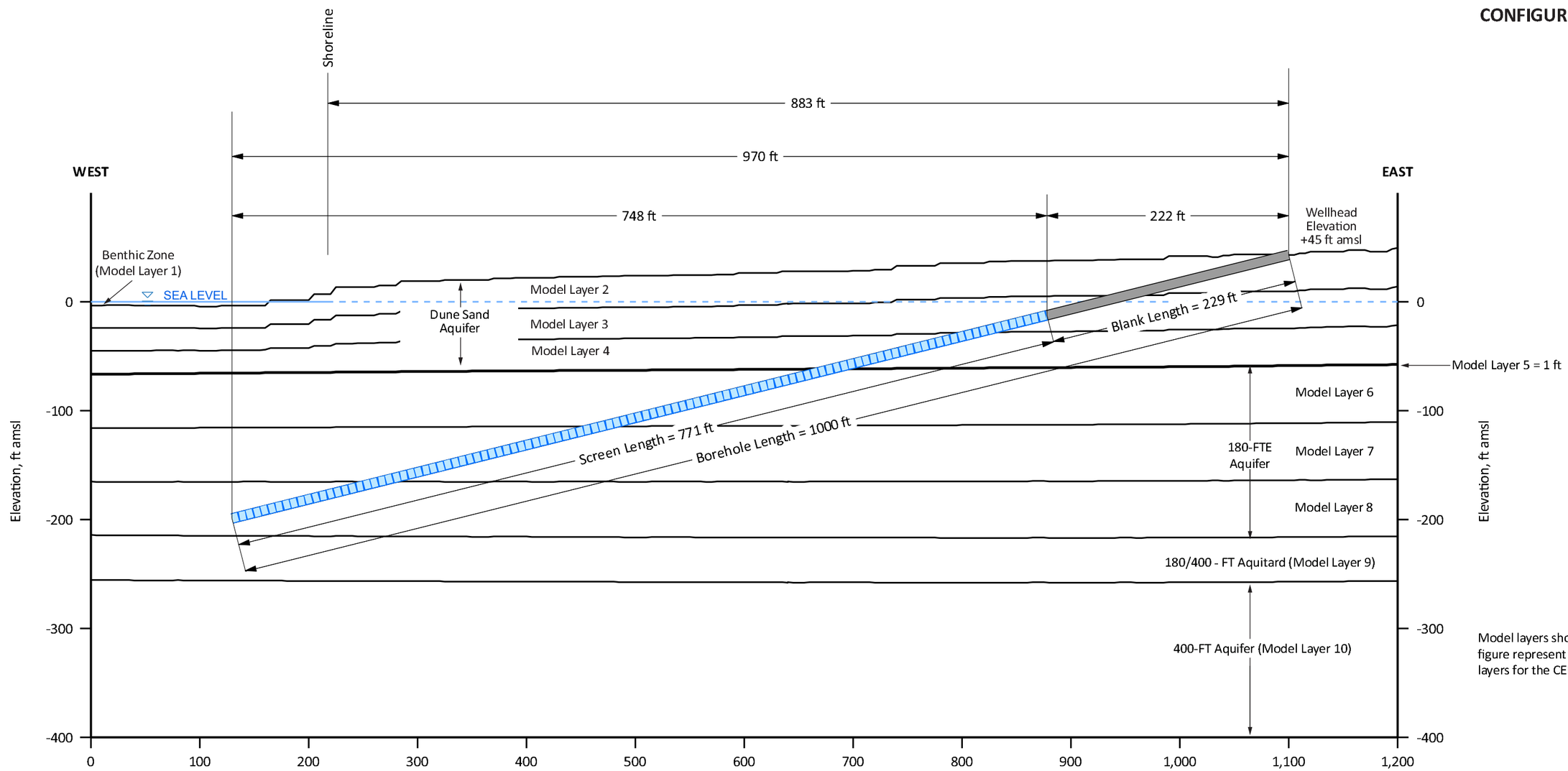
Figure 62

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_62_CEMEX_CS-B-2_12-14.ai

CEMEX
SLANT WELL CS-B-3
PROFILE
CONFIGURATION B



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	67
	Layer 4	135
180-FTE Aquifer	Layer 6	220
	Layer 7	211
	Layer 8	138
* Benthic zone in seabed.		

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

Note: 180-FTE represents 180-Foot Equivalent Aquifer

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Figure 63

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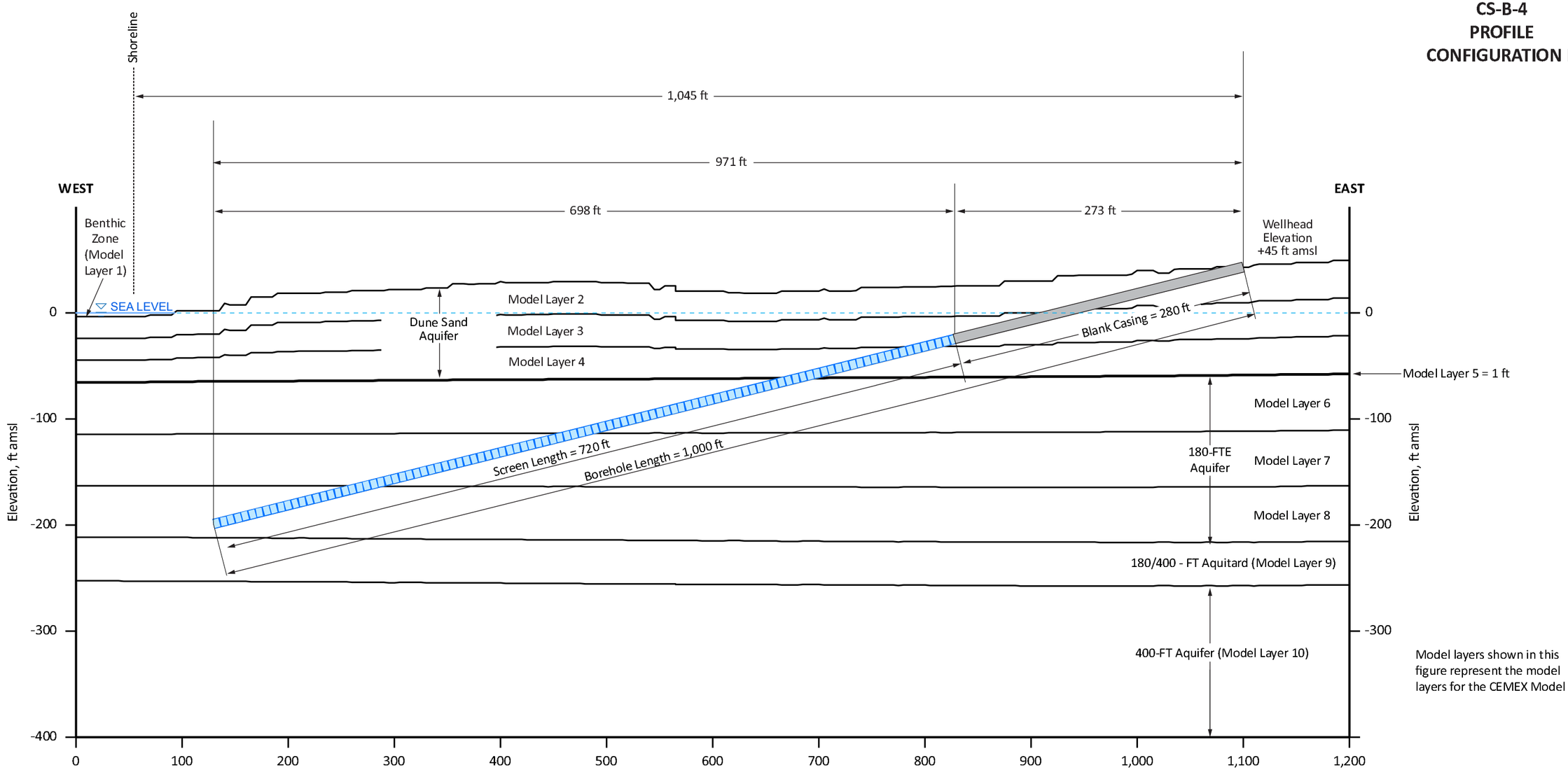
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

CEMEX SLANT WELL CS-B-4 PROFILE CONFIGURATION B



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	30
	Layer 4	119
180-FTE Aquifer	Layer 6	217
	Layer 7	207
	Layer 8	147
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 64

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_64_CEMEX_CS-B-4_12-14.ai

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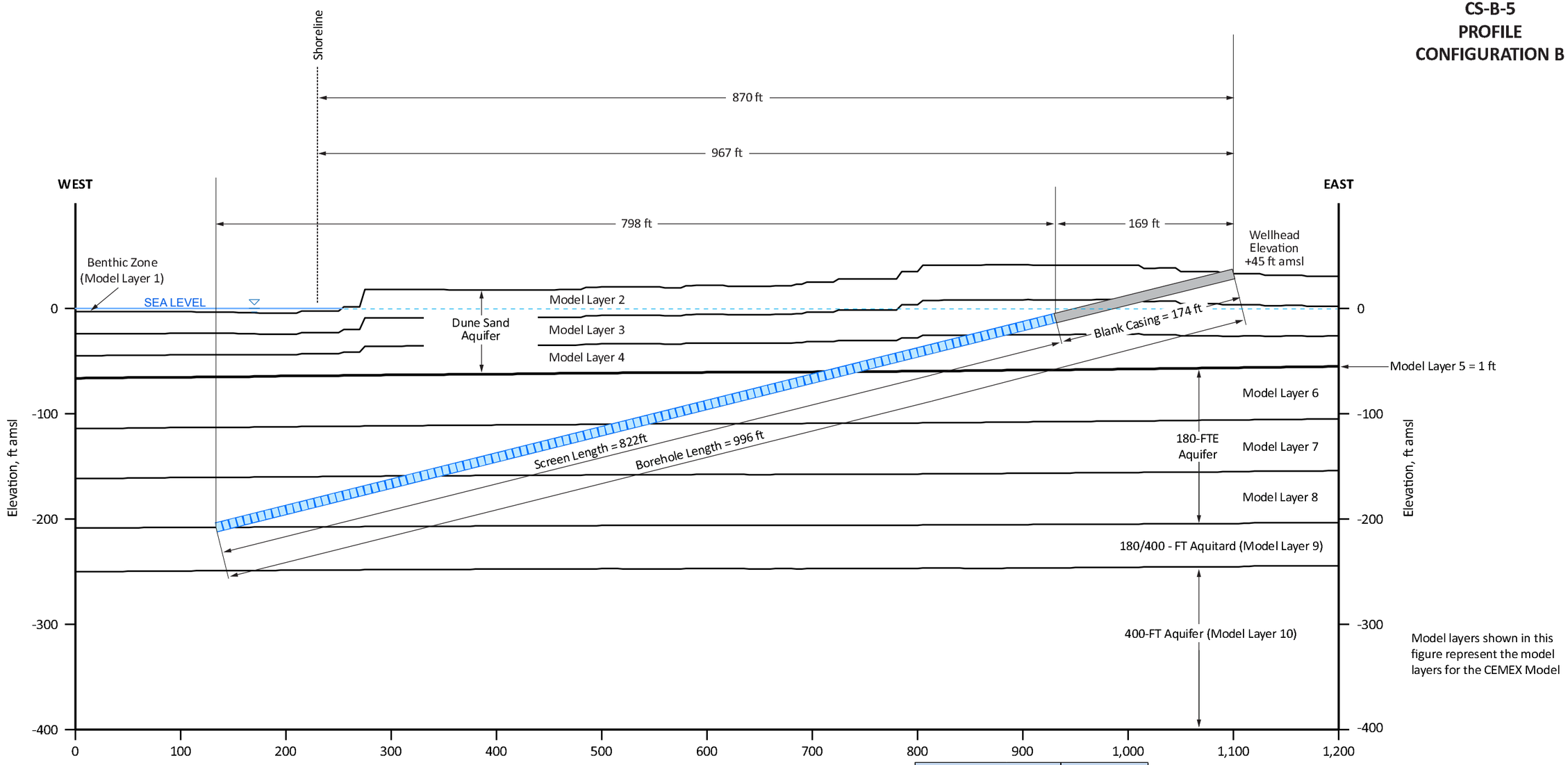
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

CEMEX SLANT WELL CS-B-5 PROFILE CONFIGURATION B



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	66
	Layer 4	142
180-FTE Aquifer	Layer 6	208
	Layer 7	204
	Layer 8	202
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 65

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_65_CEMEX_CS-B-5_12-14.ai

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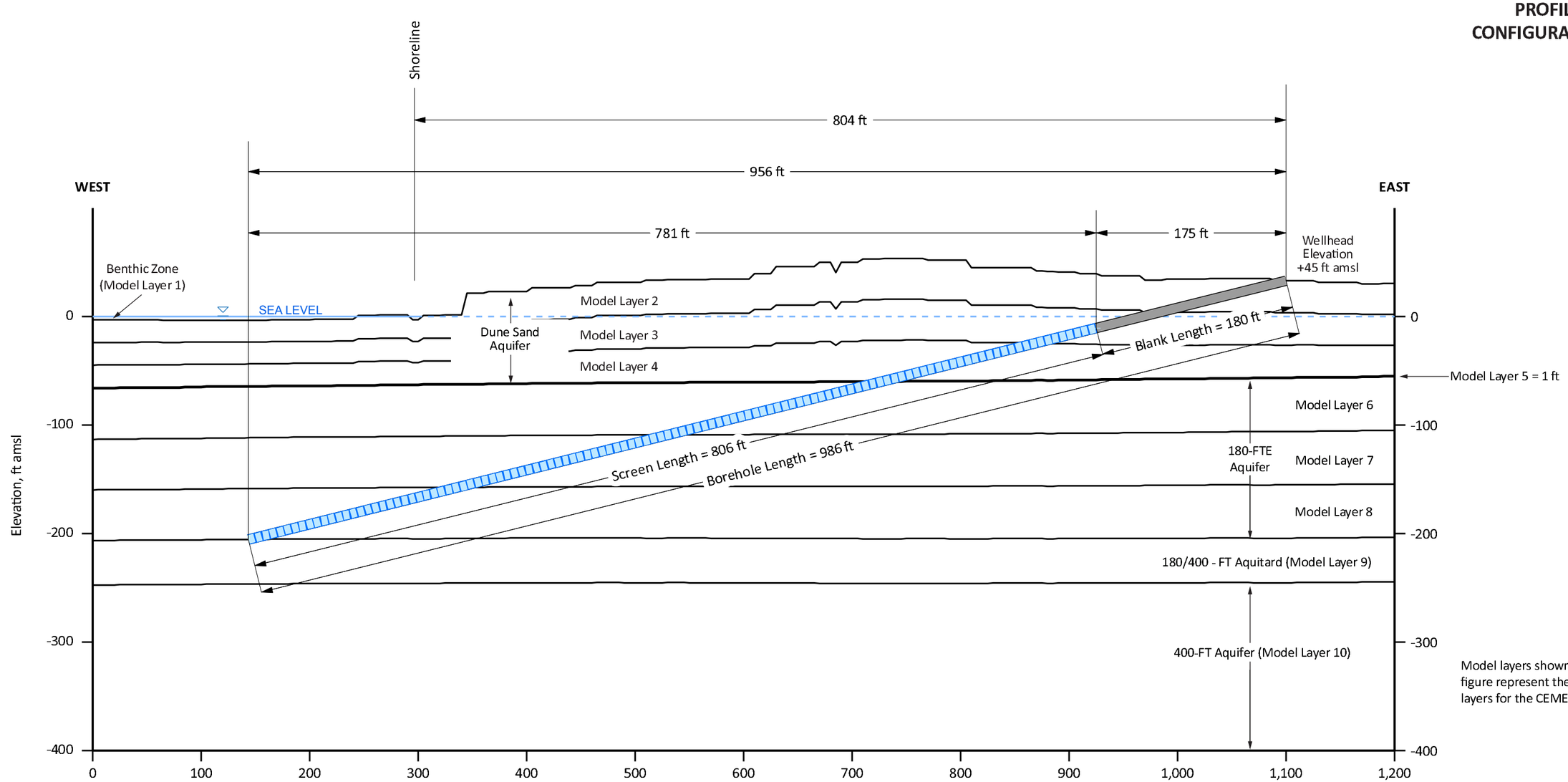
GROUNDWATER MODELING AND ANALYSIS

CEMEX
SLANT WELL CS-B-6
PROFILE
CONFIGURATION B



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	58
	Layer 4	144
180-FTE Aquifer	Layer 6	205
	Layer 7	200
	Layer 8	199
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 66

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_66_CEMEX_CS-B-7_12-14.ai

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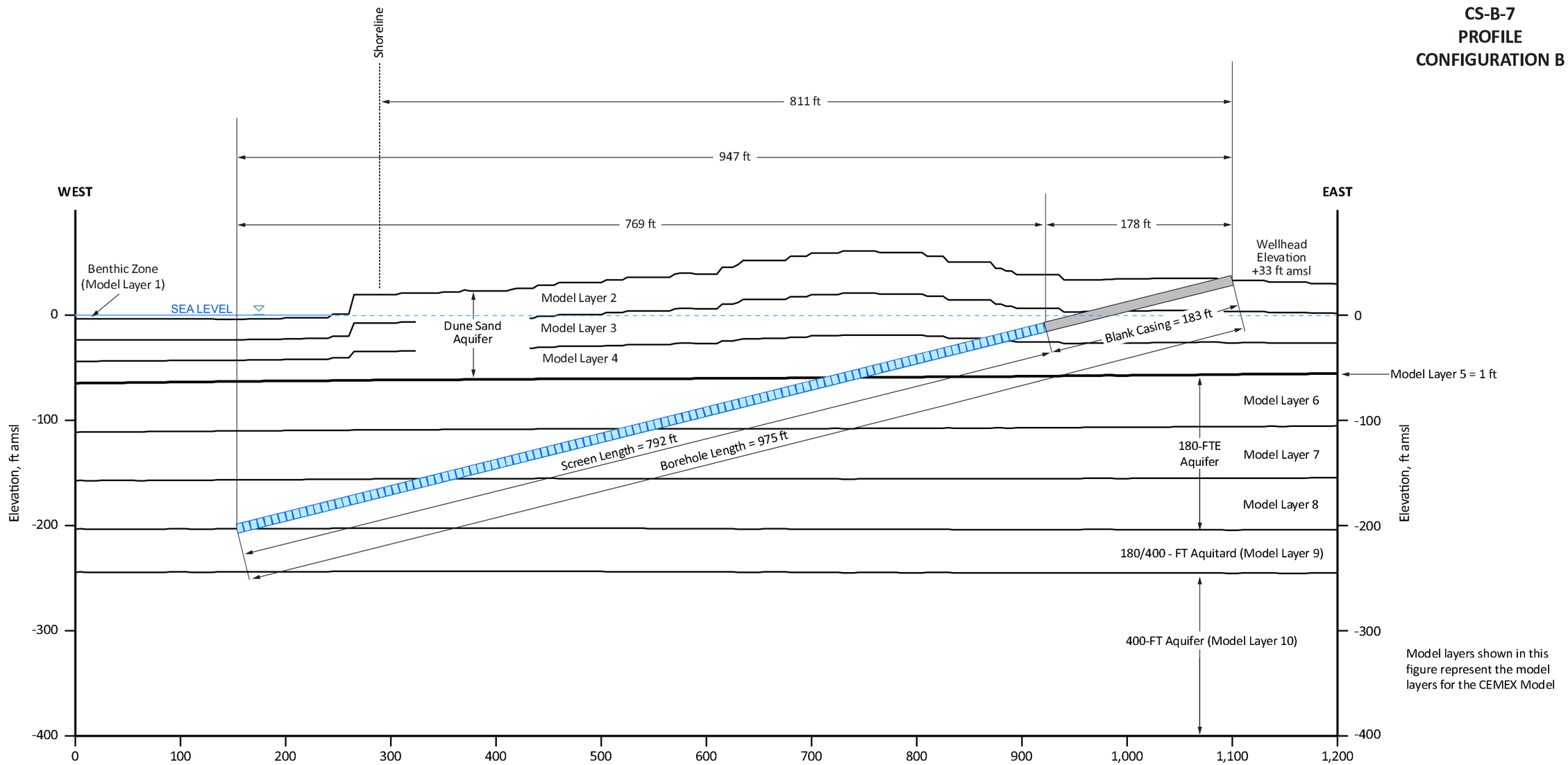
GROUNDWATER MODELING AND ANALYSIS

CEMEX SLANT WELL CS-B-7 PROFILE CONFIGURATION B



Model layers shown in this figure represent the model layers for the CEMEX Model

Angle Below Horizontal = 14 deg		Screen Length in Layer, ft
Benthic Zone	Layer 1*	0
Dune Sand Aquifer	Layer 2	0
	Layer 3	50
	Layer 4	147
180-FTE Aquifer	Layer 6	203
	Layer 7	196
	Layer 8	196
* Benthic zone in seabed.		

Note: 180-FTE represents 180-Foot Equivalent Aquifer

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 67

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_67_CEMEX_CS-B-7_12-14.ai

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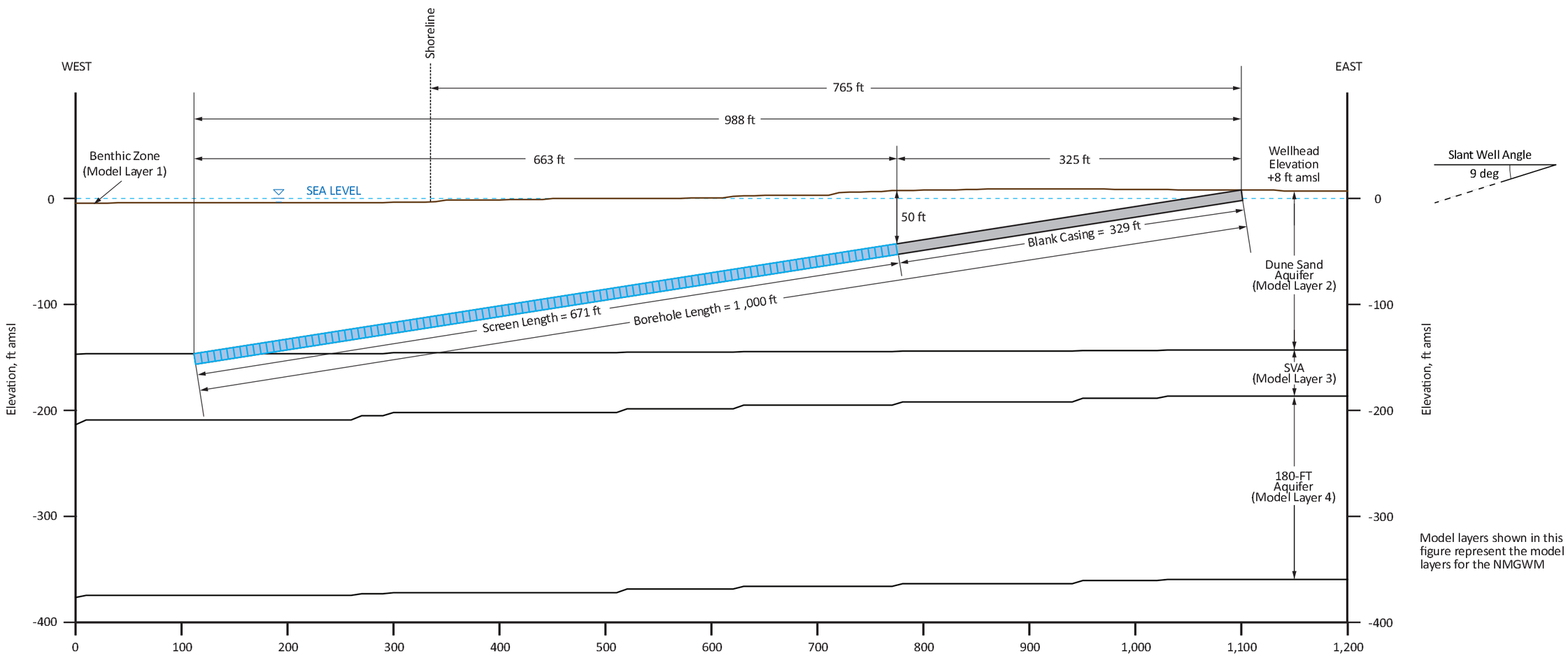
GROUNDWATER MODELING ANALYSIS

POTRERO ROAD SLANT WELL PRS-A-1 PROFILE CONFIGURATION A



Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 68

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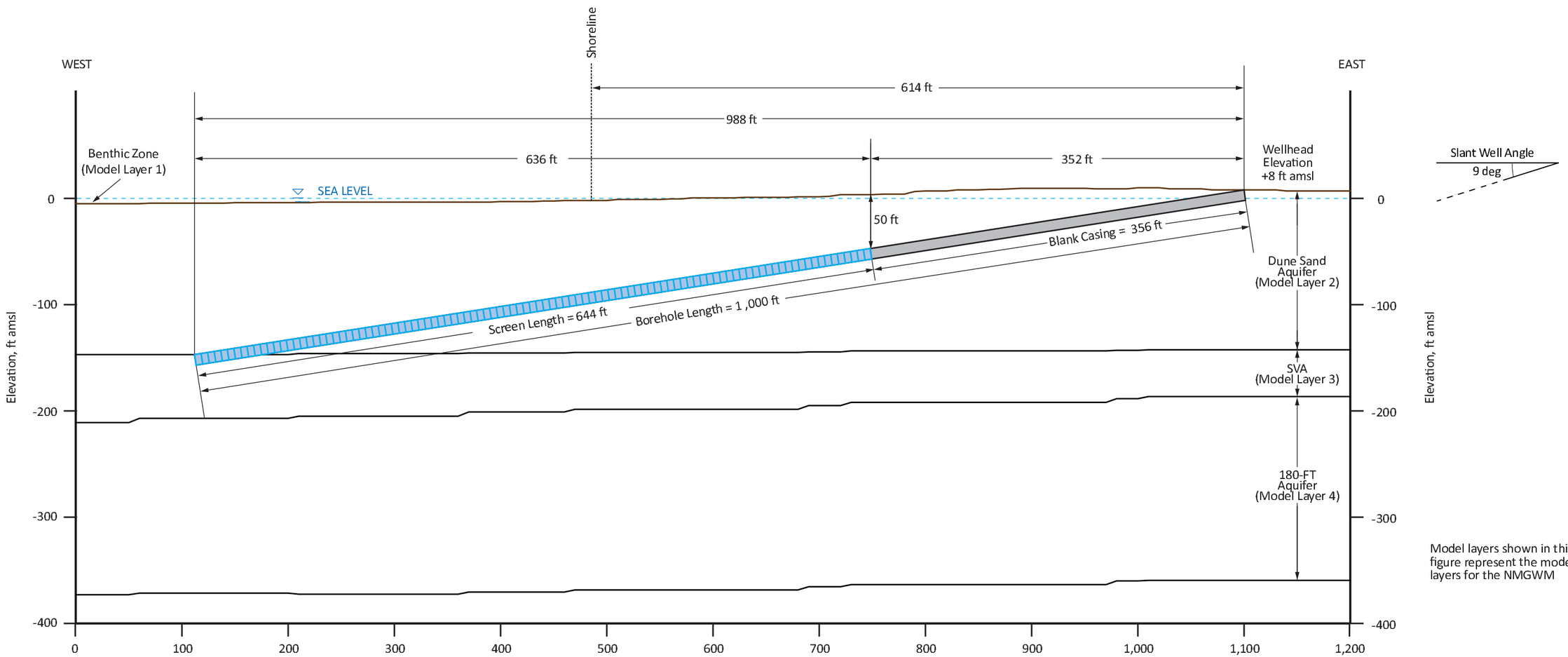
GROUNDWATER MODELING ANALYSIS

POTRERO ROAD SLANT WELL PRS-A-2 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 69

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_69_Potrero_PRS-A-2_12-14.ai

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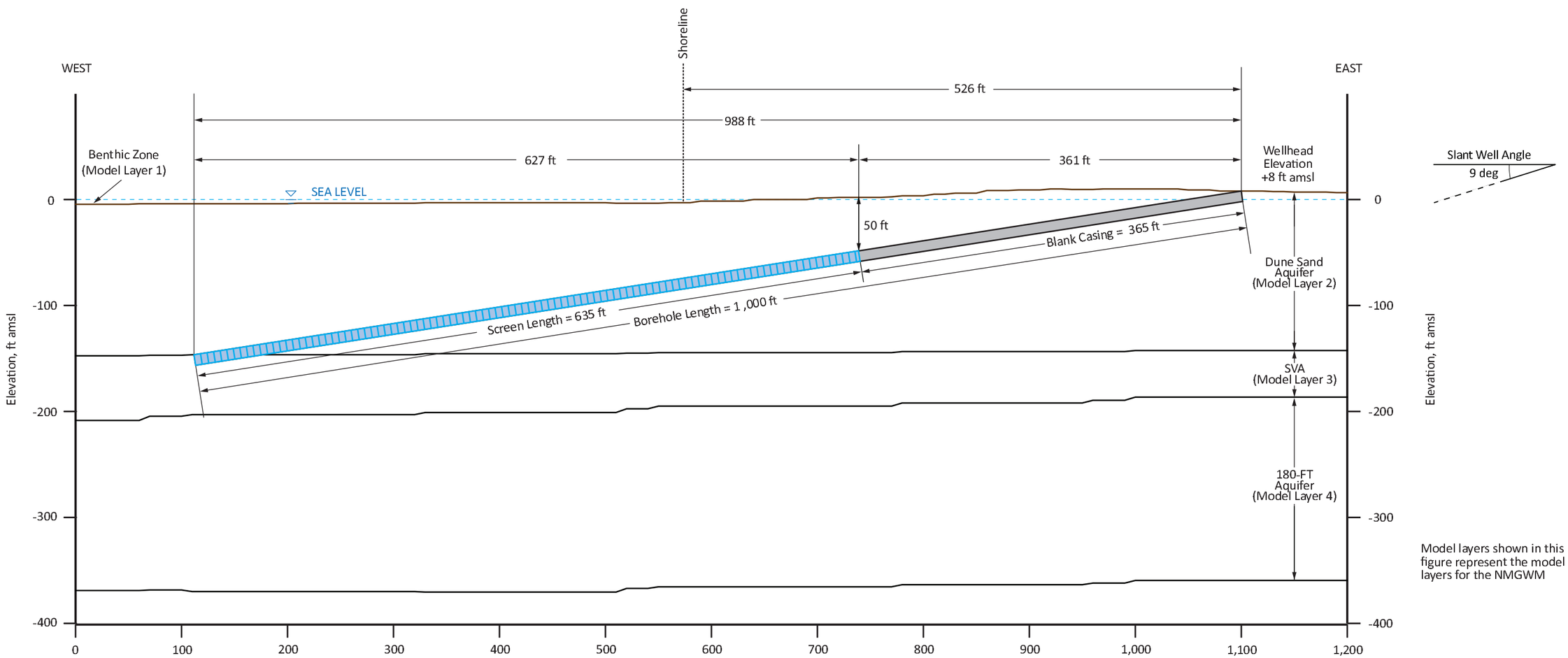
POTRERO ROAD SLANT WELL PRS-A-3 PROFILE CONFIGURATION A



Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 70

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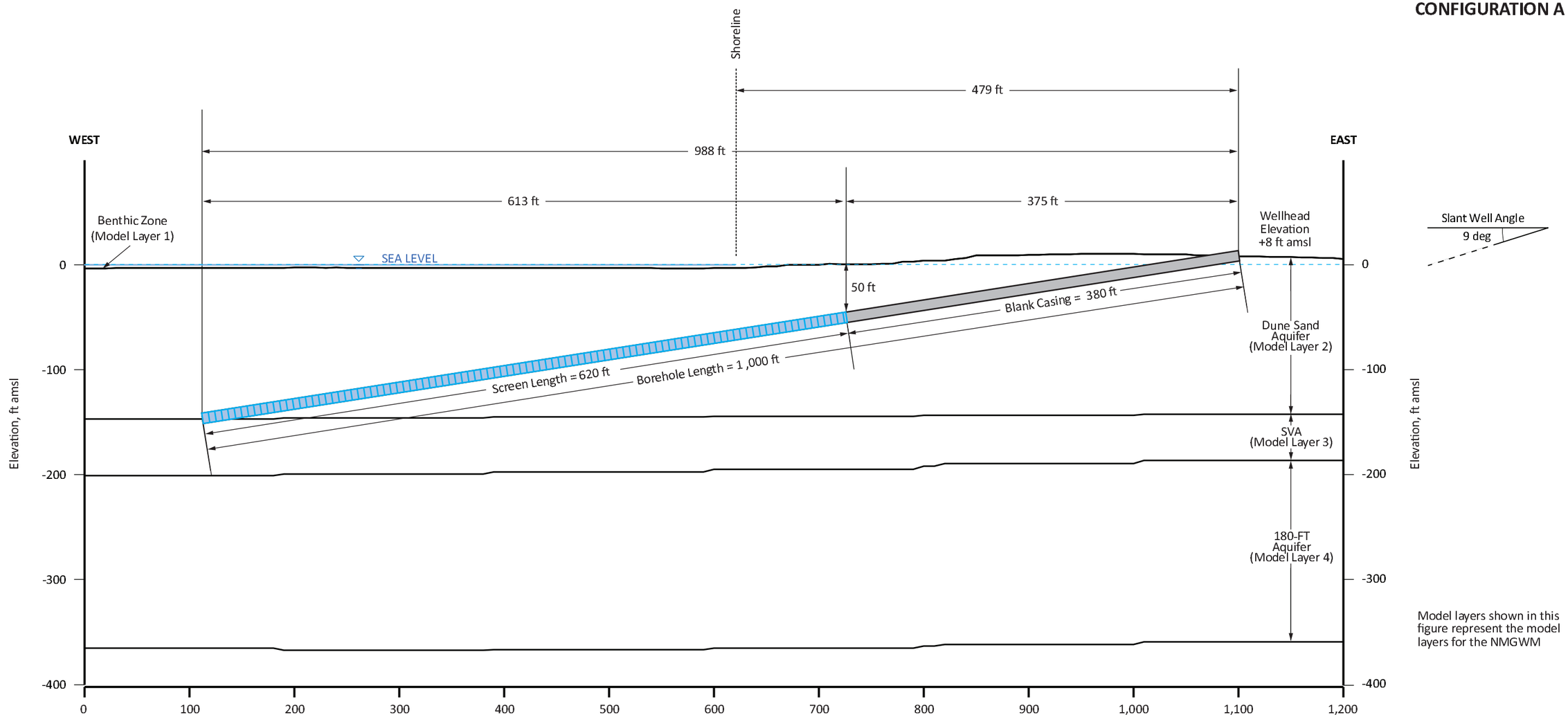
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-A-4 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 71

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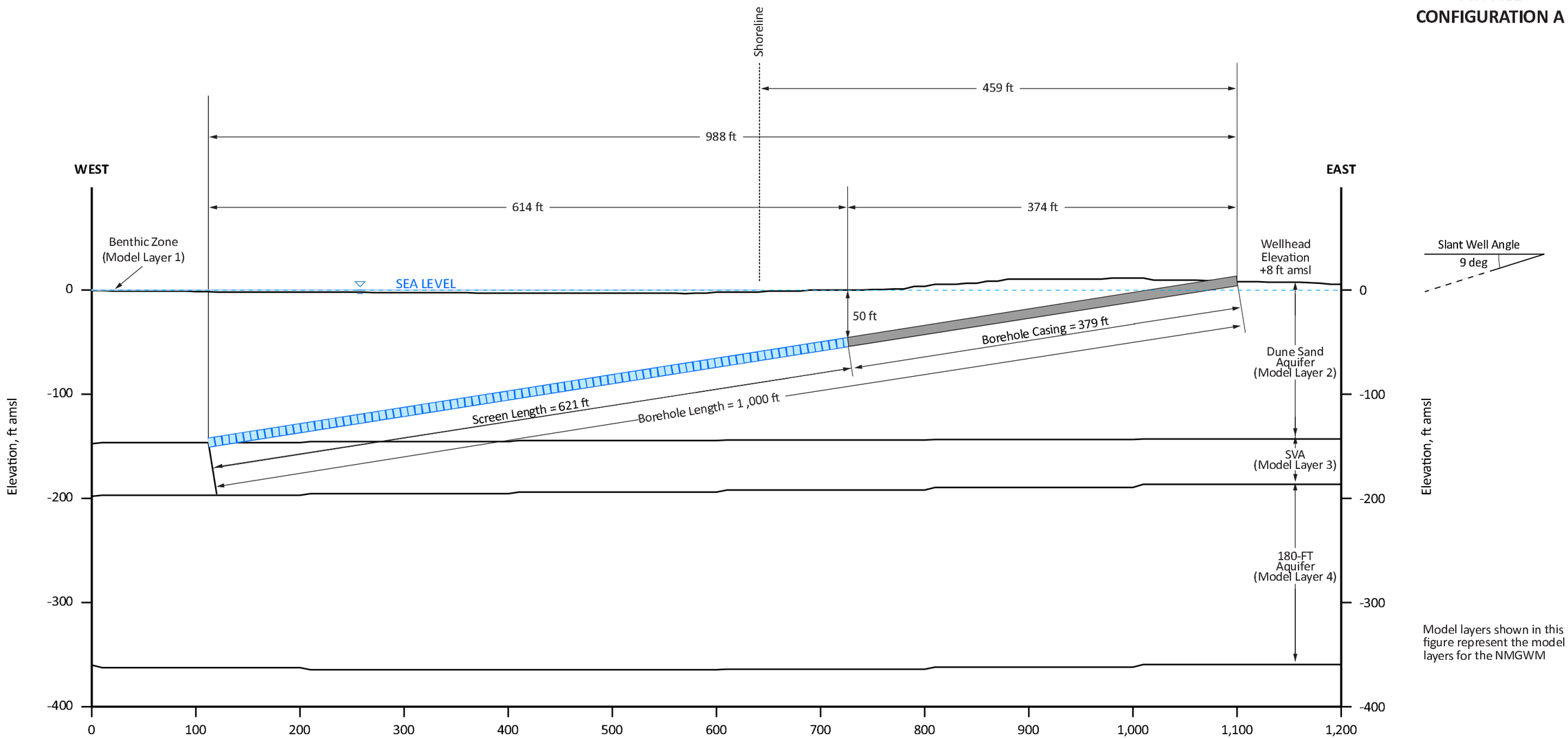
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-A-5 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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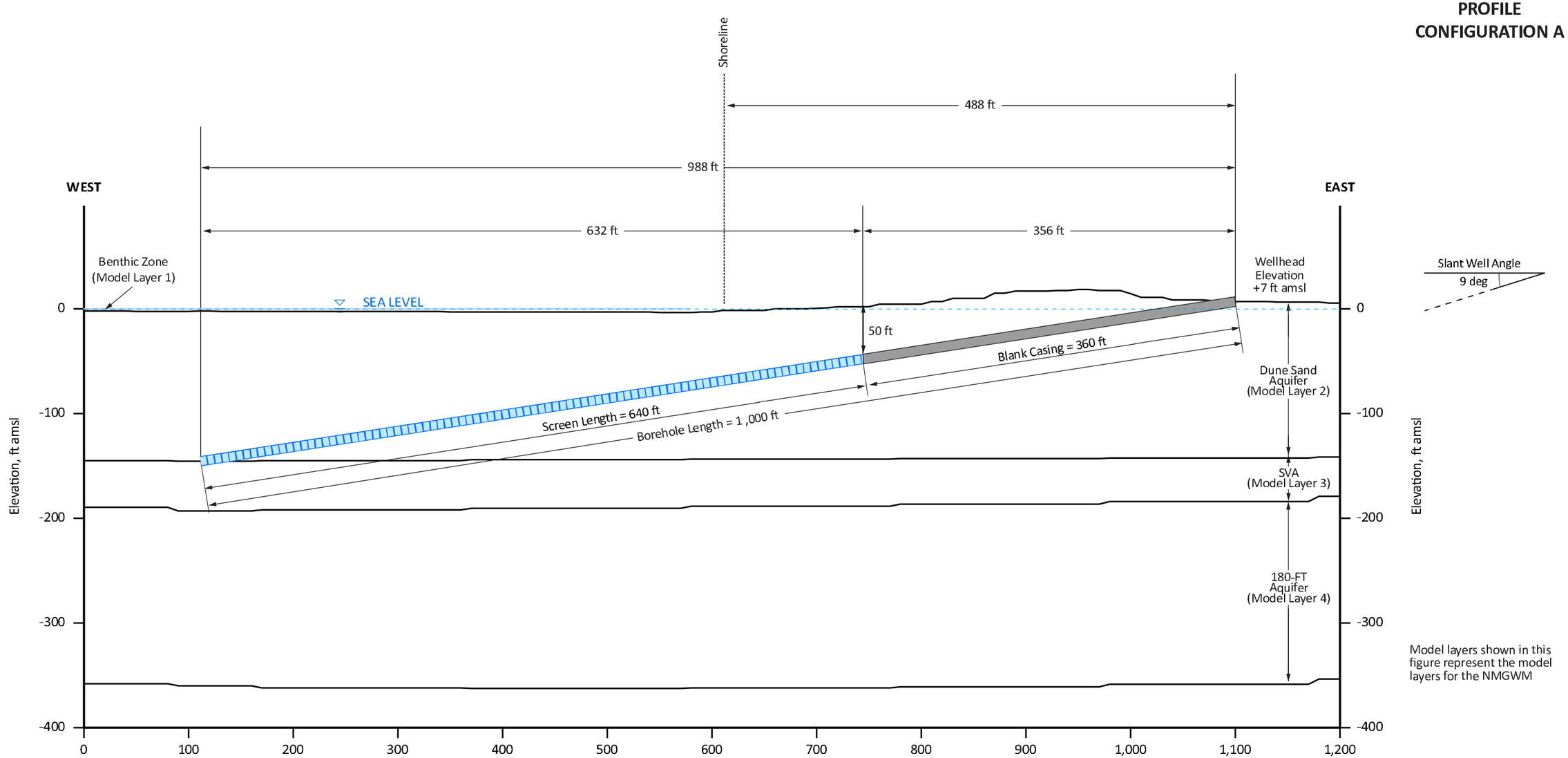
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-A-6 PROFILE CONFIGURATION A



Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 73

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GROUNDWATER MODELING AND ANALYSIS

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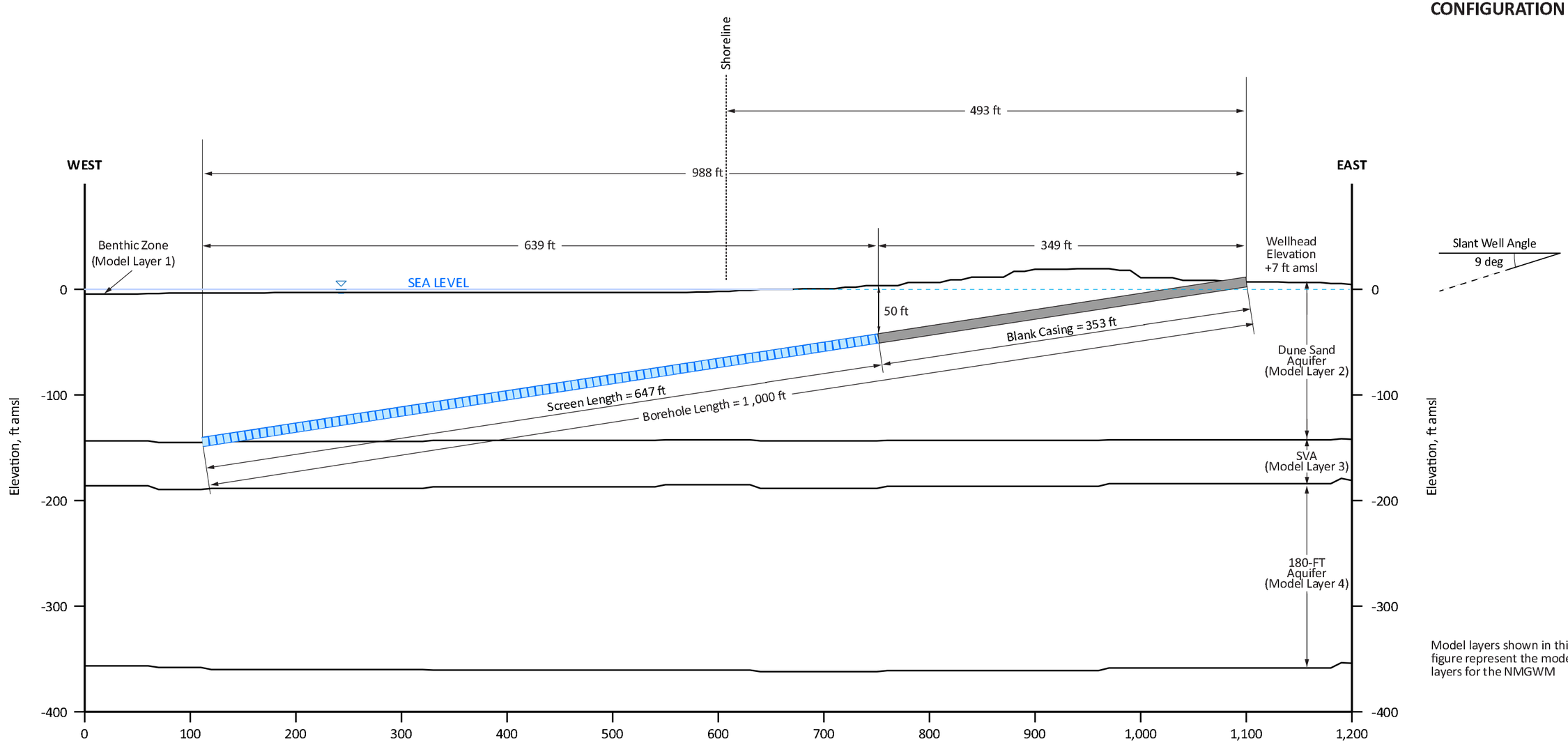

Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 74

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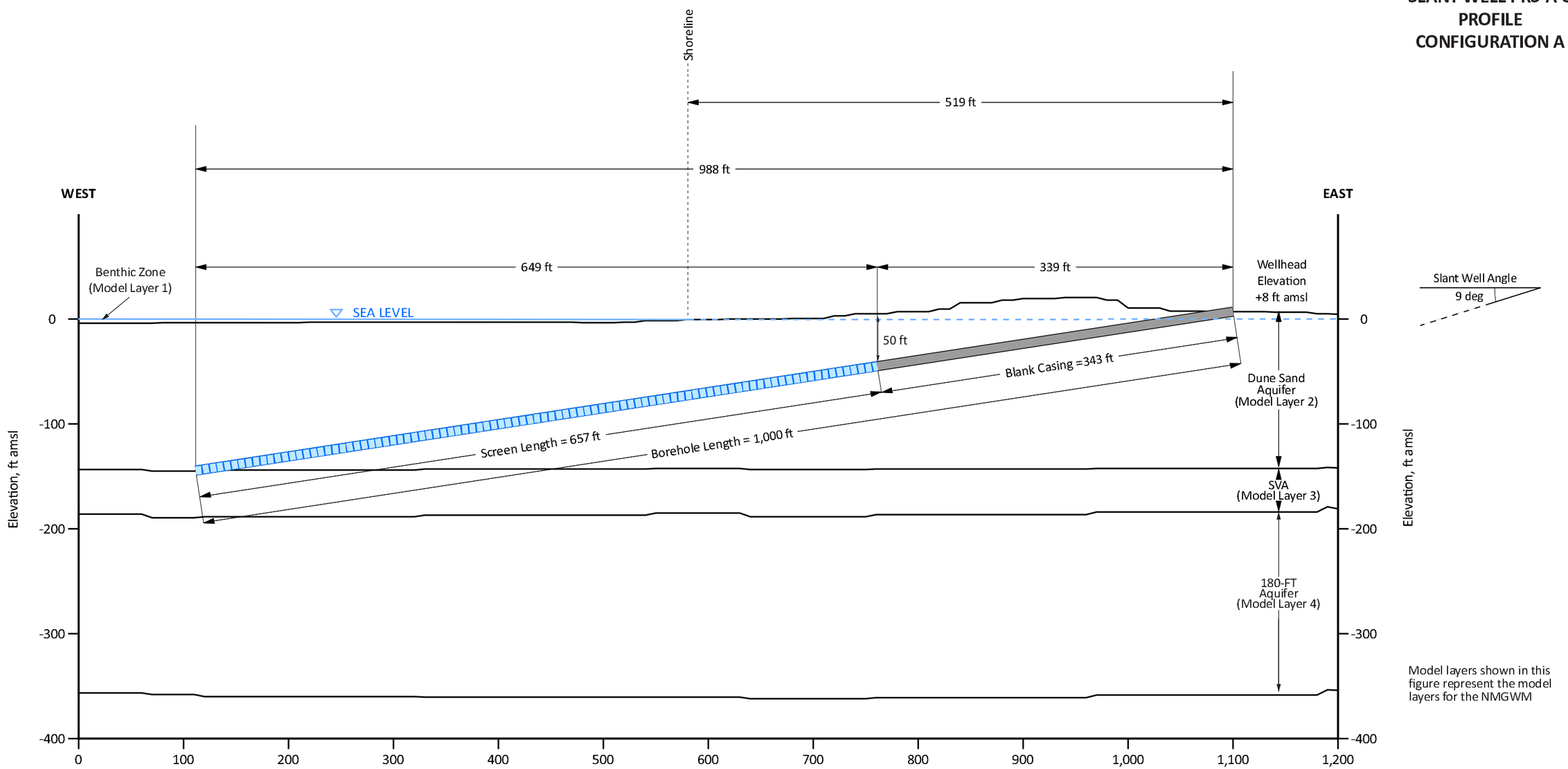
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-A-8 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200 Feet
Horizontal Scale, feet

0 100 200 Feet
Vertical Scale, feet

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Figure 75

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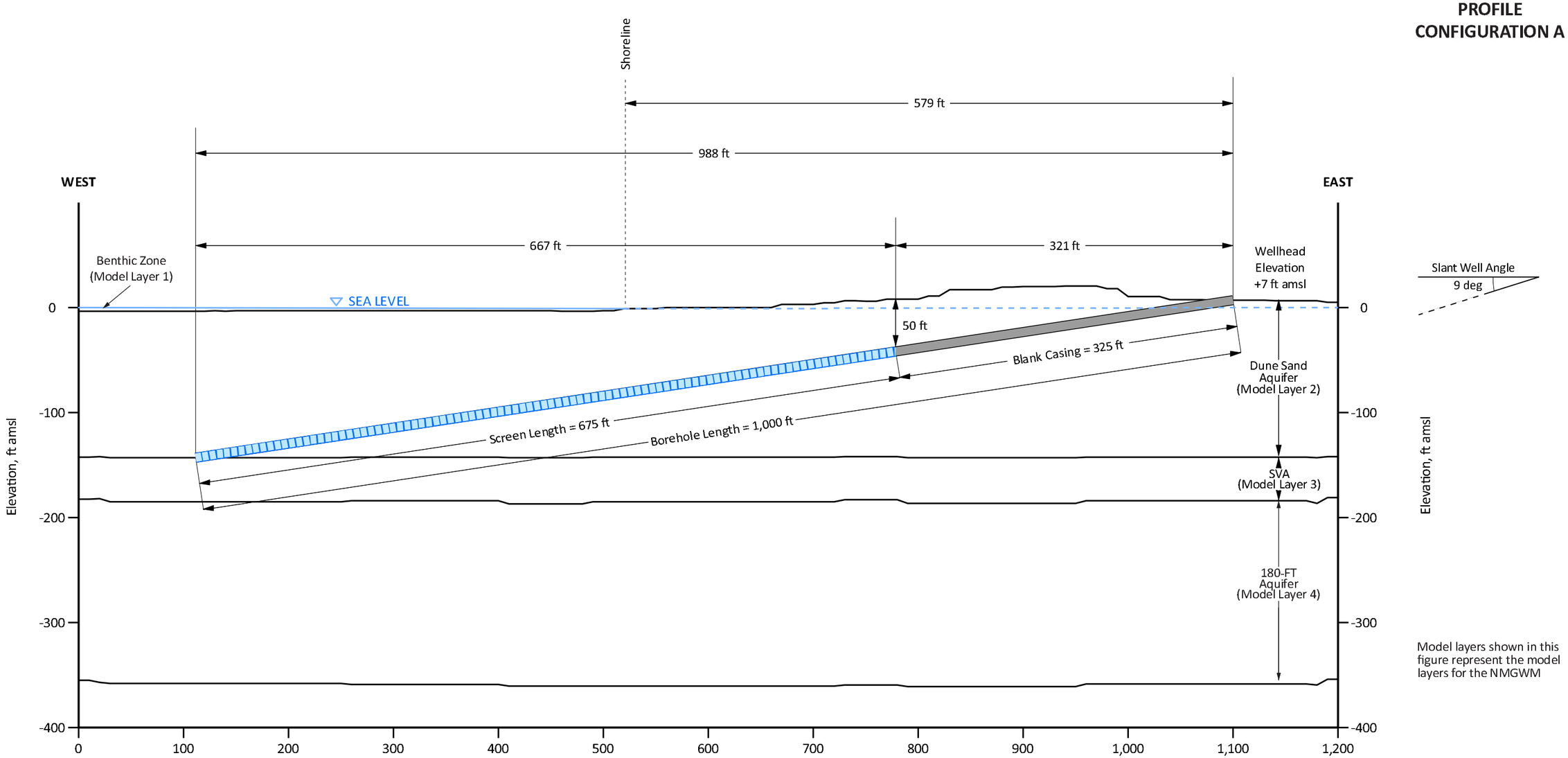
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-A-9 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200 Feet
Horizontal Scale, feet

0 100 200 Feet
Vertical Scale, feet

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Figure 76

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2014\Figures\Fig_76_Potrero_PRS-A-9_12-14.ai

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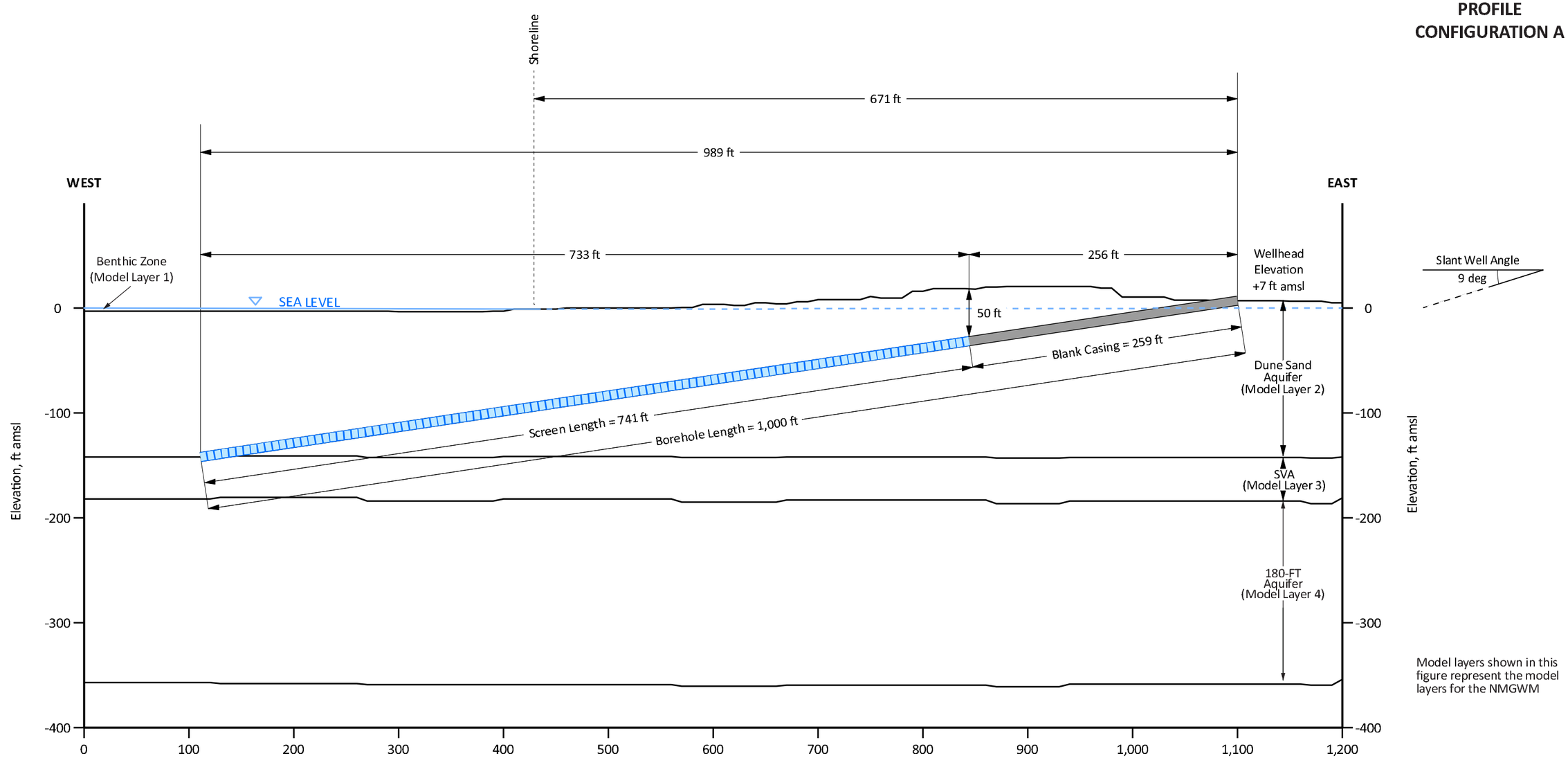
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-A-10 PROFILE CONFIGURATION A



Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200 Feet
Horizontal Scale, feet

0 100 200 Feet
Vertical Scale, feet

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Figure 77

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_77_Potrero_PRS-A-10_12-14.ai

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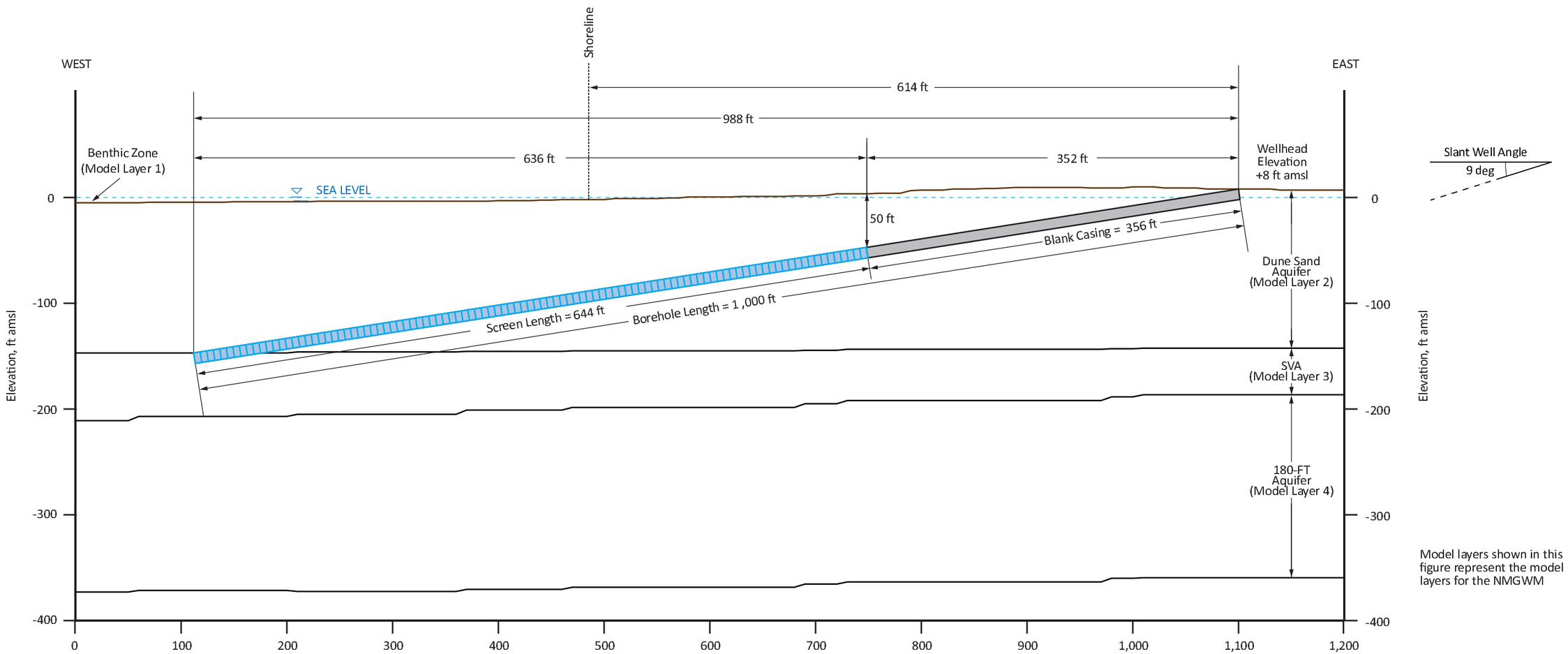
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-B-1 PROFILE CONFIGURATION B



Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 78

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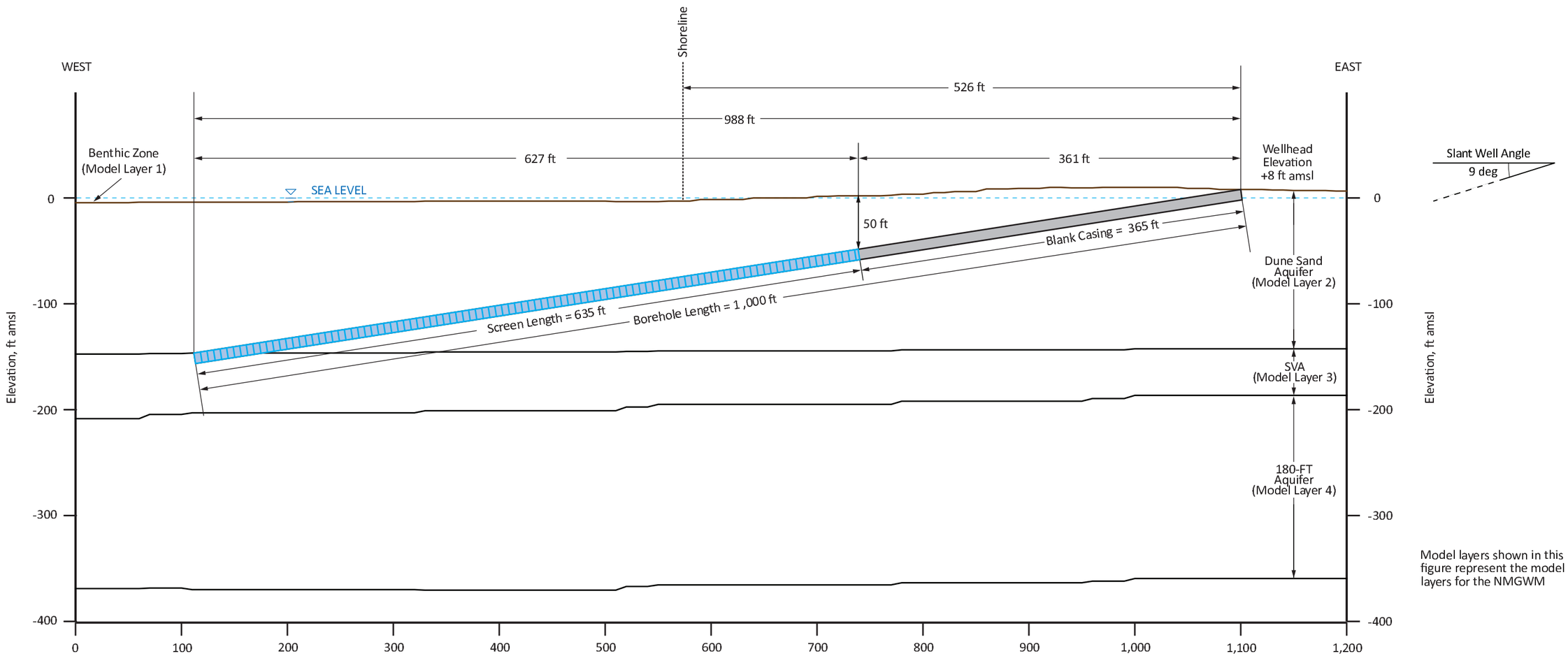
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-B-2 PROFILE CONFIGURATION B



Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 79

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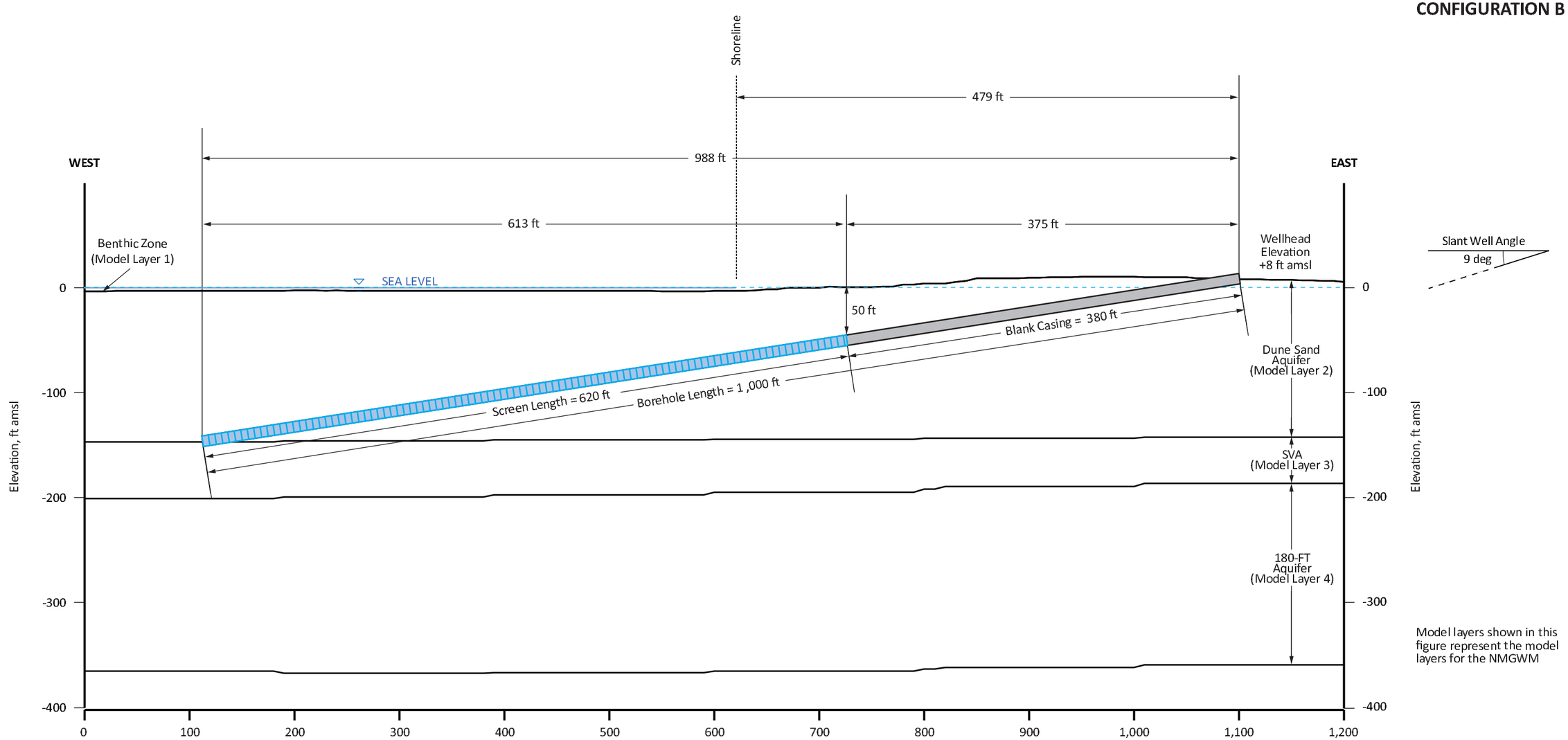
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-B-3 PROFILE CONFIGURATION B



Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 80

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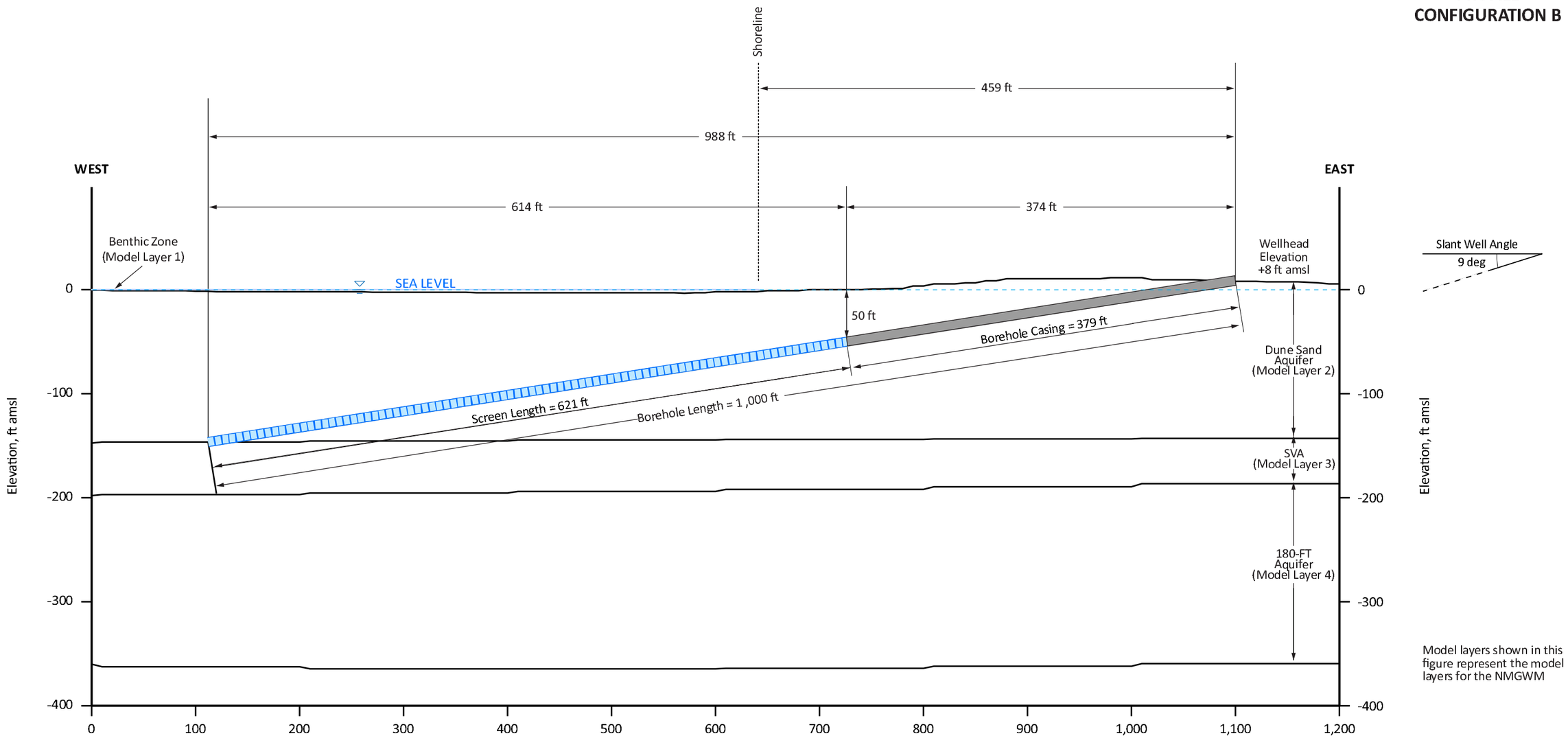
GROUNDWATER PRODUCTION AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-B-4 PROFILE CONFIGURATION B



Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 81

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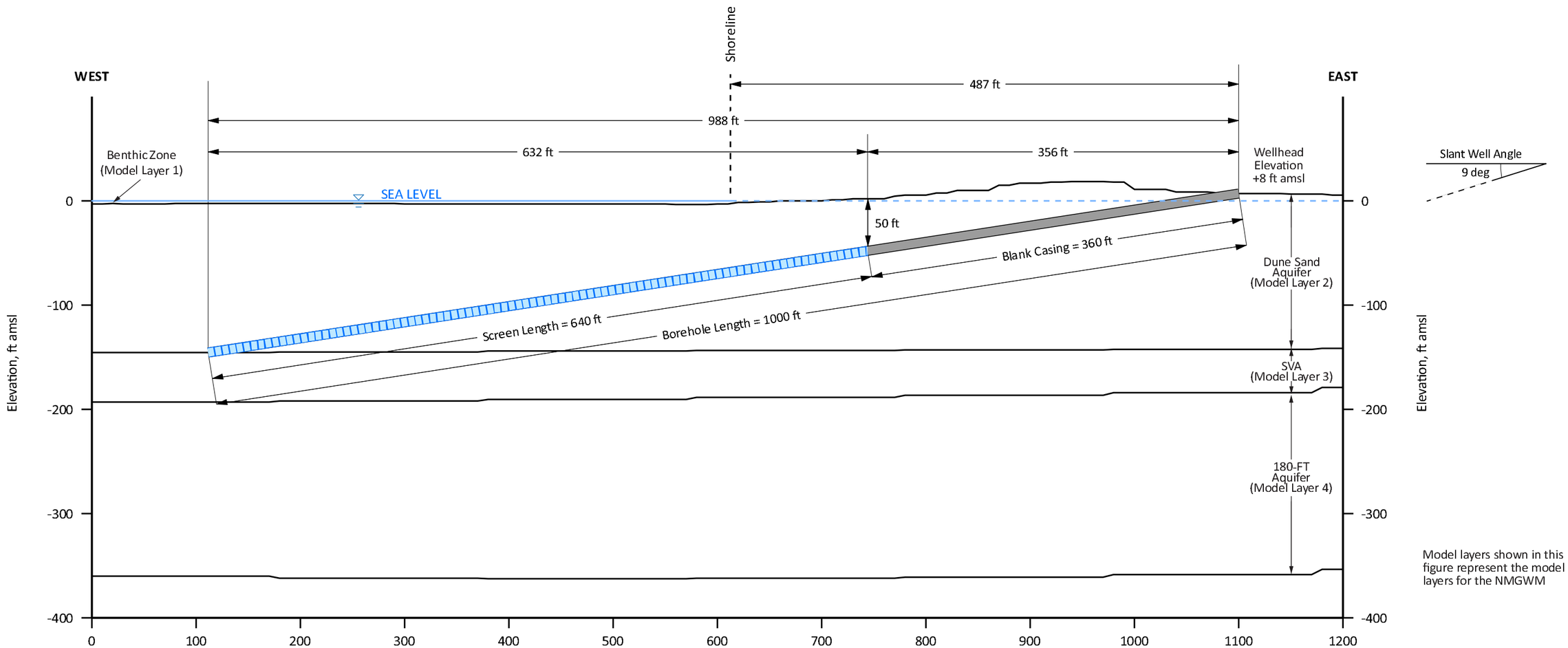
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-B-5 PROFILE CONFIGURATION B



Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 82

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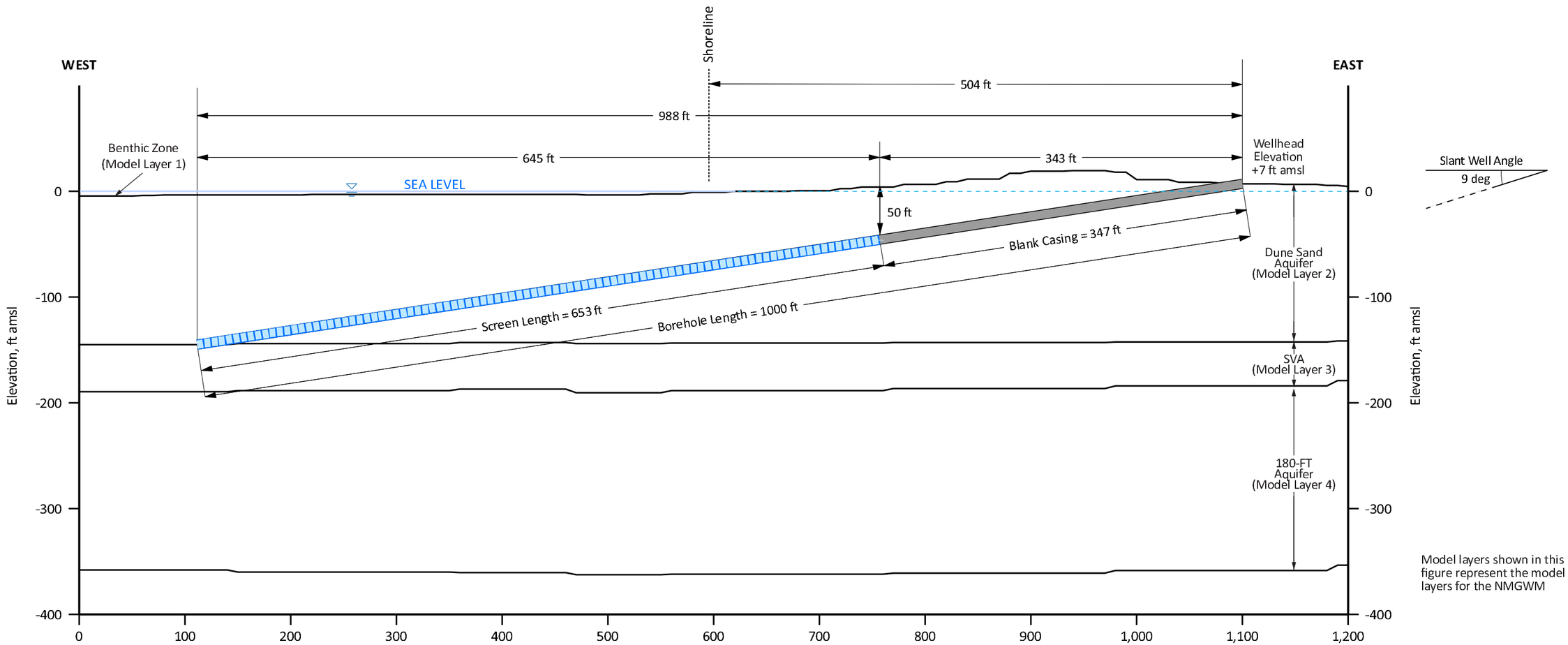
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-B-6 PROFILE CONFIGURATION B



Note: SVA represents the Salinas Valley Aquitard

0 100 200
Horizontal Scale, feet

0 100 200
Vertical Scale, feet

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Figure 83

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_83_Potrero_PRS-B-6_12-14.ai

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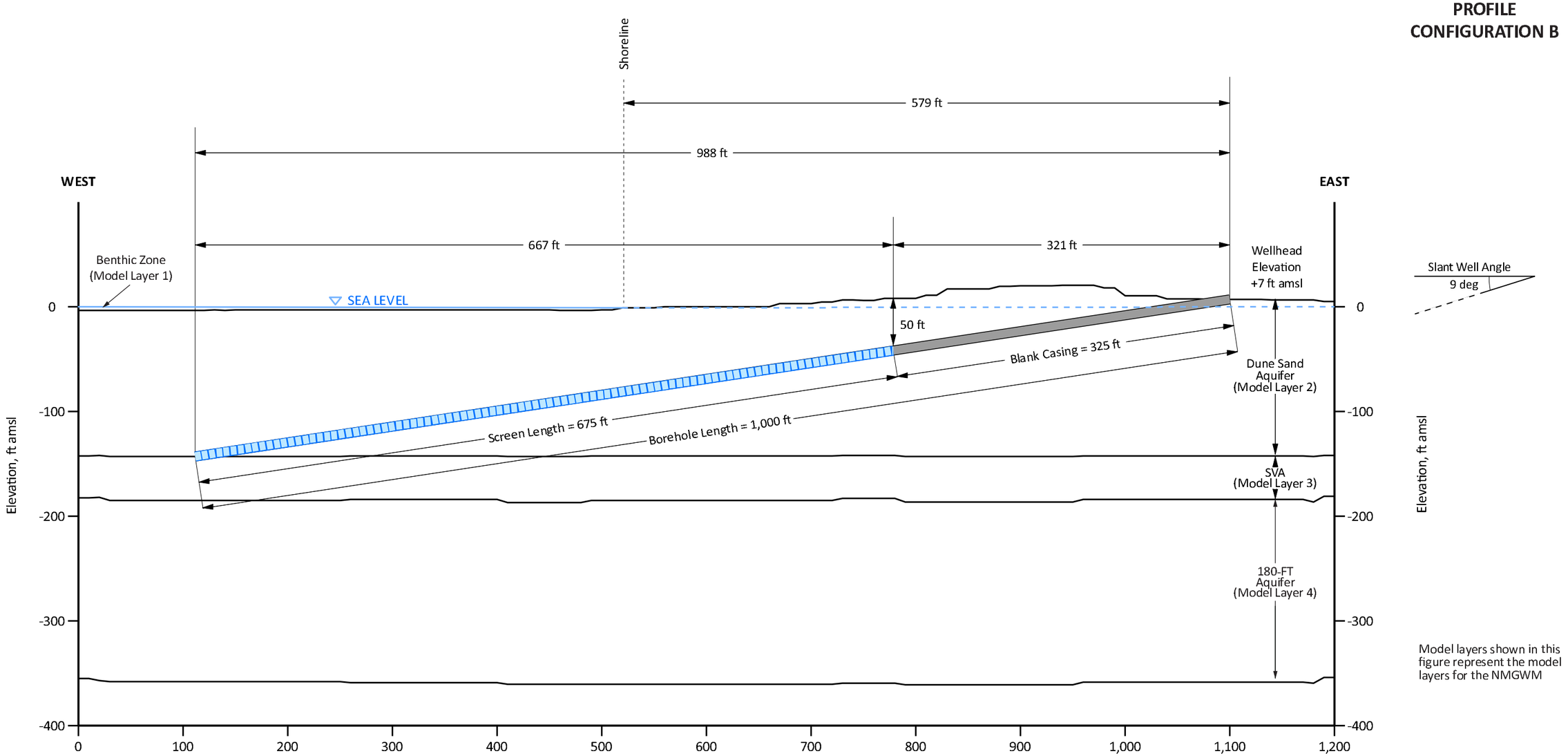
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

POTRERO ROAD SLANT WELL PRS-B-7 PROFILE CONFIGURATION B



Model layers shown in this figure represent the model layers for the NMGWM

Note: SVA represents the Salinas Valley Aquitard

0 100 200 Feet
Horizontal Scale, feet

0 100 200 Feet
Vertical Scale, feet

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17-Apr-15

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Figure 84

X:\Projects\MONTEREY AREA DESAL STUDIES\02) ESA_and_ESA-CalAm\34) TM_Ground_Water_Modeling_Sep-2014\5) DRAFT_Modeling_TM_Apr-2015\Figures\Fig_84_Potrero_PRS-B-7_12-14.ai

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MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

MARINA COAST WATER DISTRICT DESALINATION PROJECT WELLS

EXPLANATION

Proposed Marina Coast Water District Desalination Well

CEMEX Slant Wells Configuration A (Feedwater Supply of 24.1 MGD)

17-Apr-15

Prepared by: DB. Map Projection: State Plane 1983, Zone IV.

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NORTH

0 1,000 2,000 4,000 Feet

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Figure 85

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_85_MCWD_desal_wells_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

LOCATIONS FOR RETURNING BASIN WATER

EXPLANATION

- Injection Well at CEMEX Site
- Injection Well at Charles Benson Site
- CEMEX Slant Wells Configuration A (Feedwater Supply of 24.1 MGD)

17-Apr-15

Prepared by: DB. Map Projection: State Plane 1983, Zone IV.

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NORTH

0 1,000 2,000 4,000 Feet

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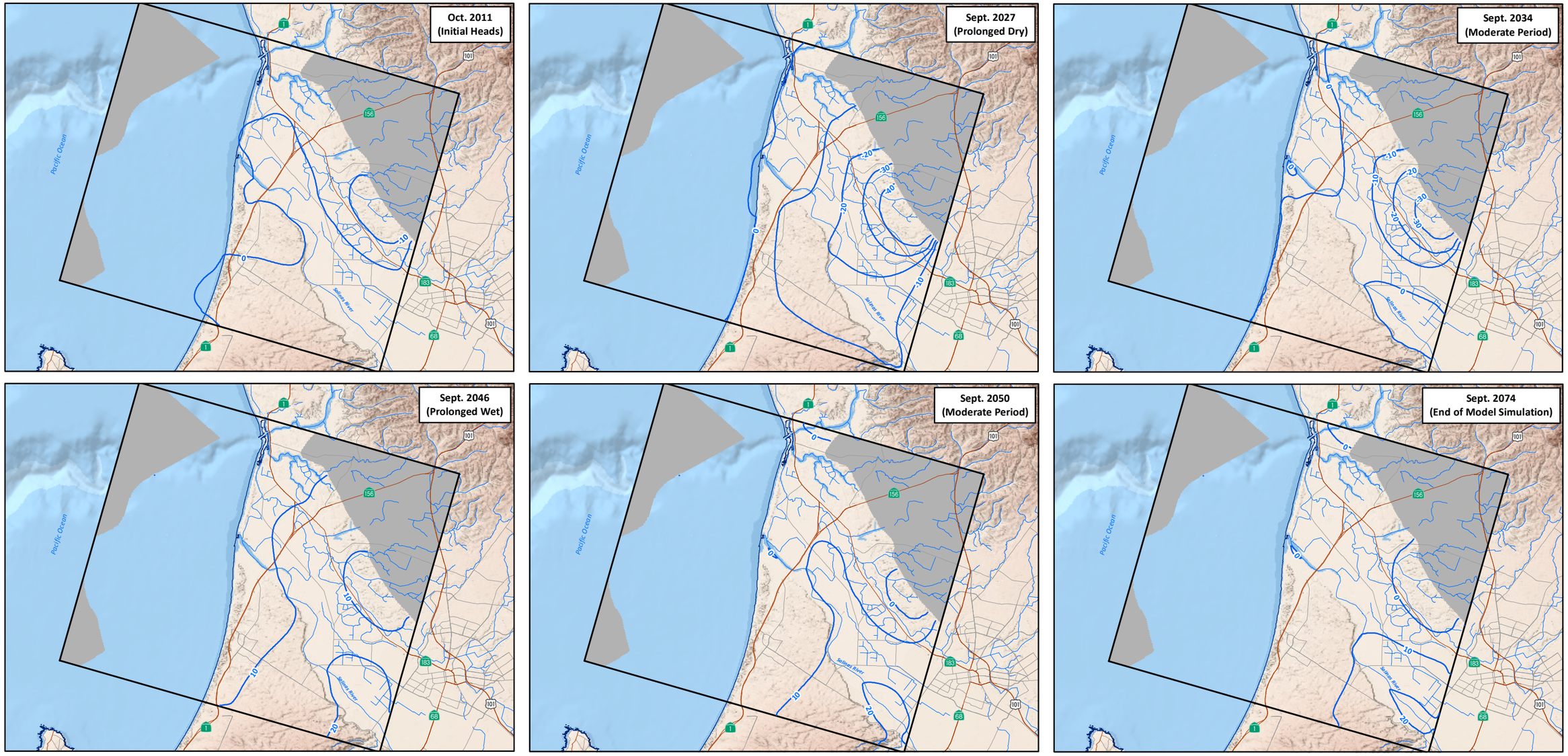
Figure 86

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_86_returning_basin_water_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

—5— Groundwater Elevation (ft amsl)

MODEL-CALCULATED GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS NMGWM RUN 1n

17-Apr-15

Prepared by: DB. Map Projection: State Plane 1983, Zone IV.

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NORTH

0 2 4 8 Miles

Run 1n - Baseline (No Project)
2012 Land Use

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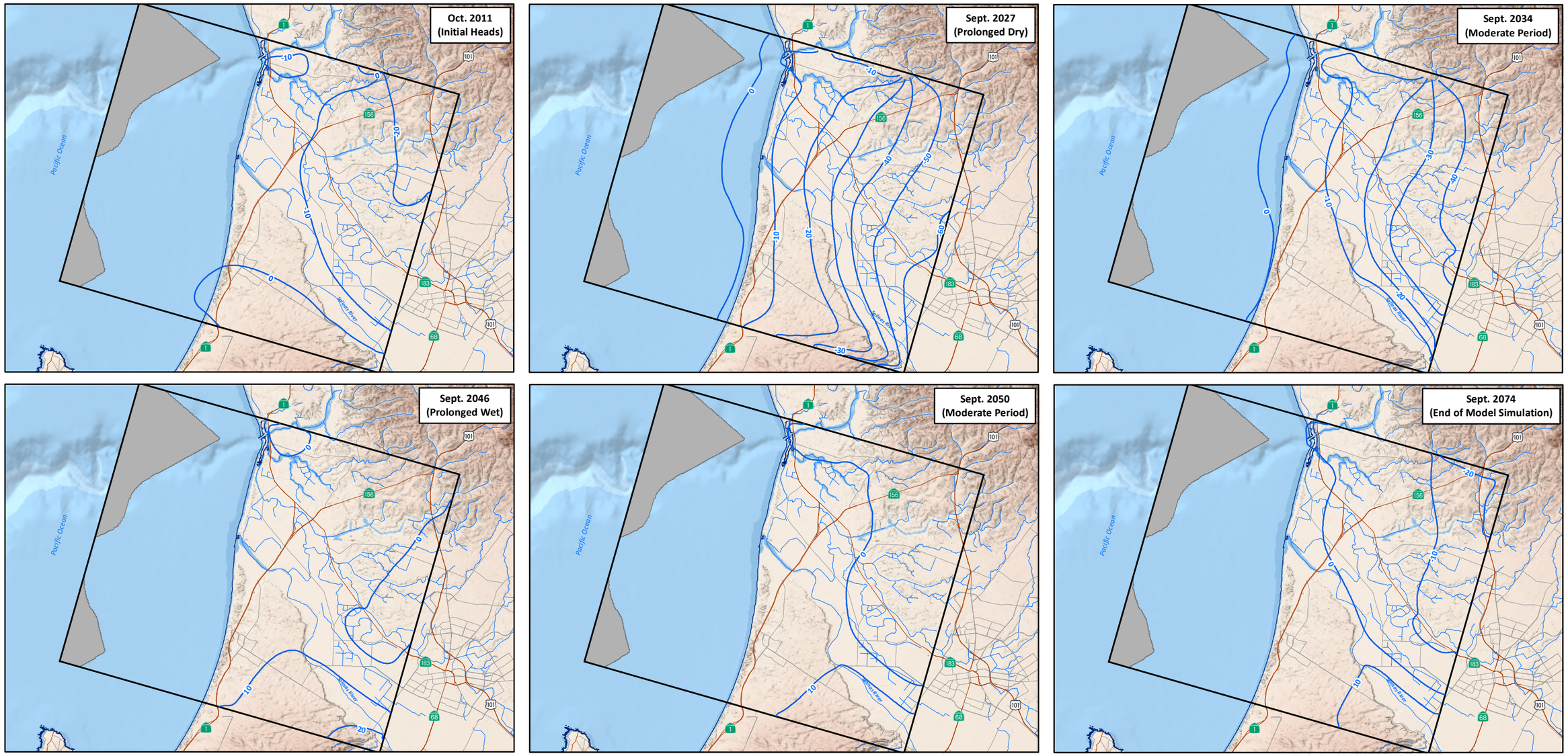
Figure 87

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_87_wl_dunesand_Run1n_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

5 Groundwater Elevation (ft amsl)

Note: 180-FTE = 180-Foot Equivalent Aquifer

MODEL-CALCULATED GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS NMGWM RUN 1n

17-Apr-15

Prepared by: DB. Map Projection: State Plane 1983, Zone IV.

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NORTH

0 2 4 8 Miles

Run 1n - Baseline (No Project)
2012 Land Use

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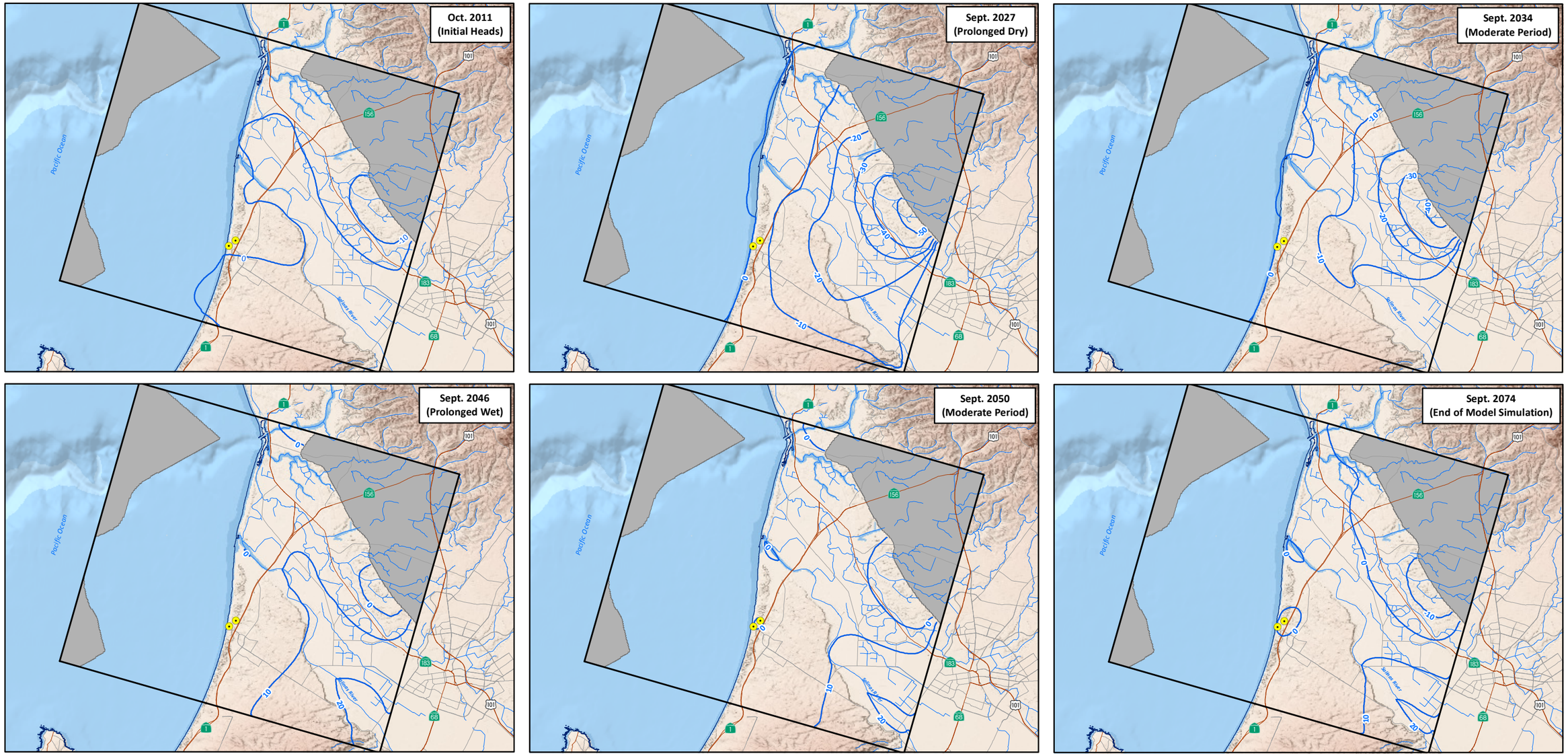
Figure 88

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_88_wl_180FT-180FTE_Run1n_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-10 Groundwater Elevation (ft amsl)

Proposed Marina Coast Water District Desalination Well

NORTH

0 2 4 8 Miles

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

MODEL-CALCULATED GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS NMGWM RUN 2f

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Figure 89

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GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_89_wl_dunesand_Run2f_6panel_4-15.mxd

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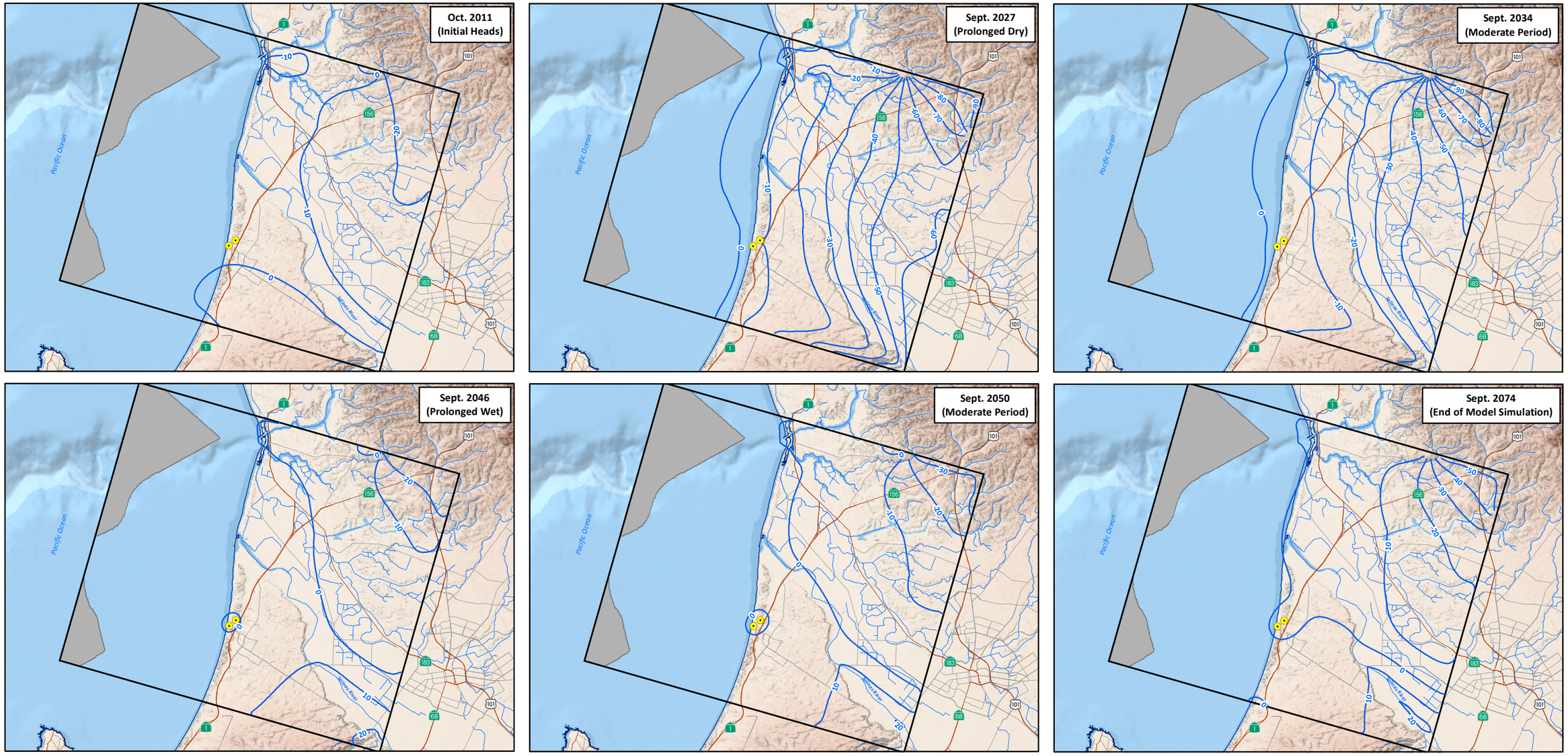
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-10 Groundwater Elevation (ft amsl)

Proposed Marina Coast Water District Desalination Well

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2 4 8 Miles

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

MODEL-CALCULATED GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS NMGWM RUN 2f

17-Apr-15

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Figure 90

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_90_wl_180FT_Run2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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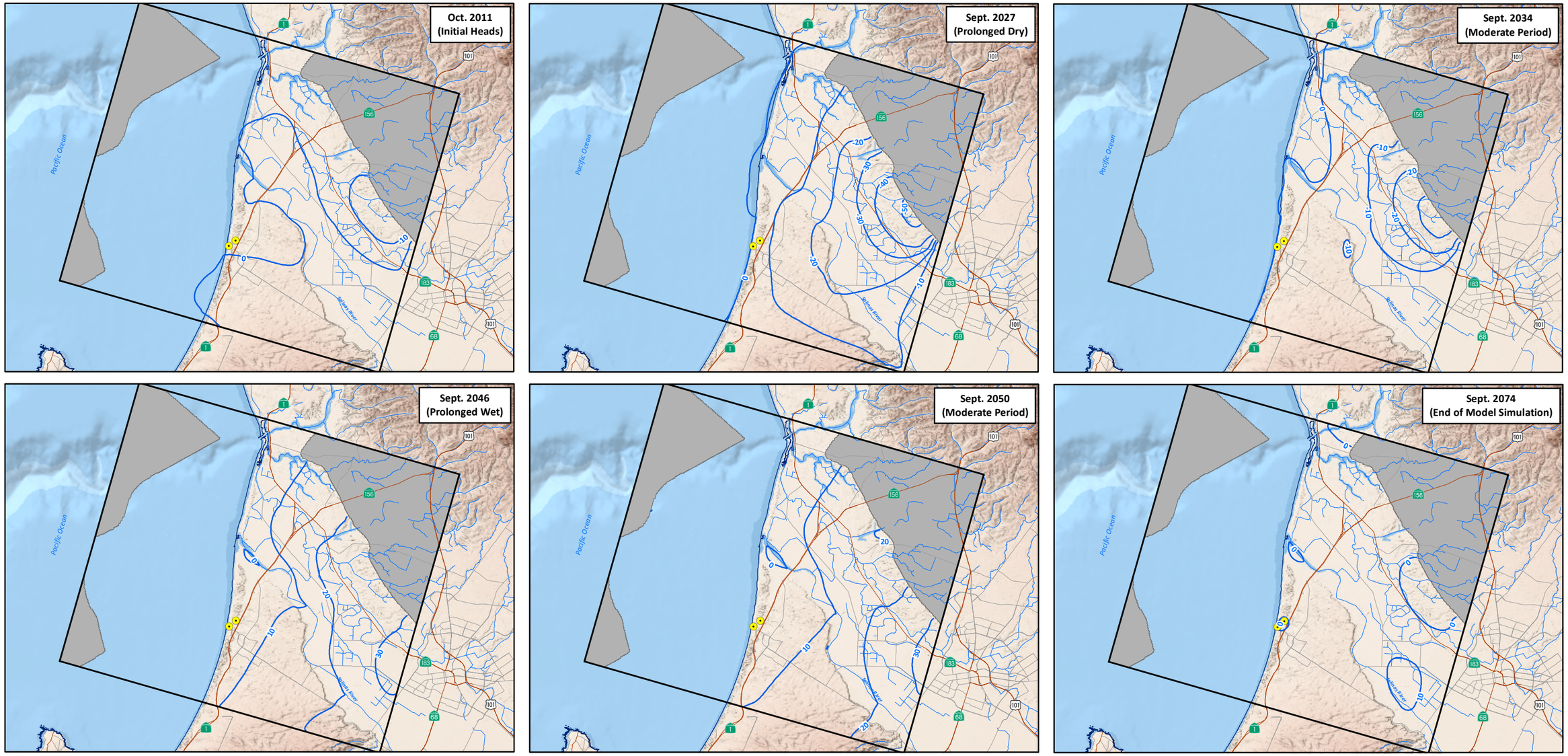
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-10 Groundwater Elevation (ft amsl)

Proposed Marina Coast Water District Desalination Well

MODEL-CALCULATED GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELELECTED YEARS NMGWM RUN 2af

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NORTH

0 2 4 8 Miles

Run 2af - Cumulative with SVWP II and MCWD (No Project)
2060 Land Use

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Figure 91

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_91_wl_dunesand_Run2af_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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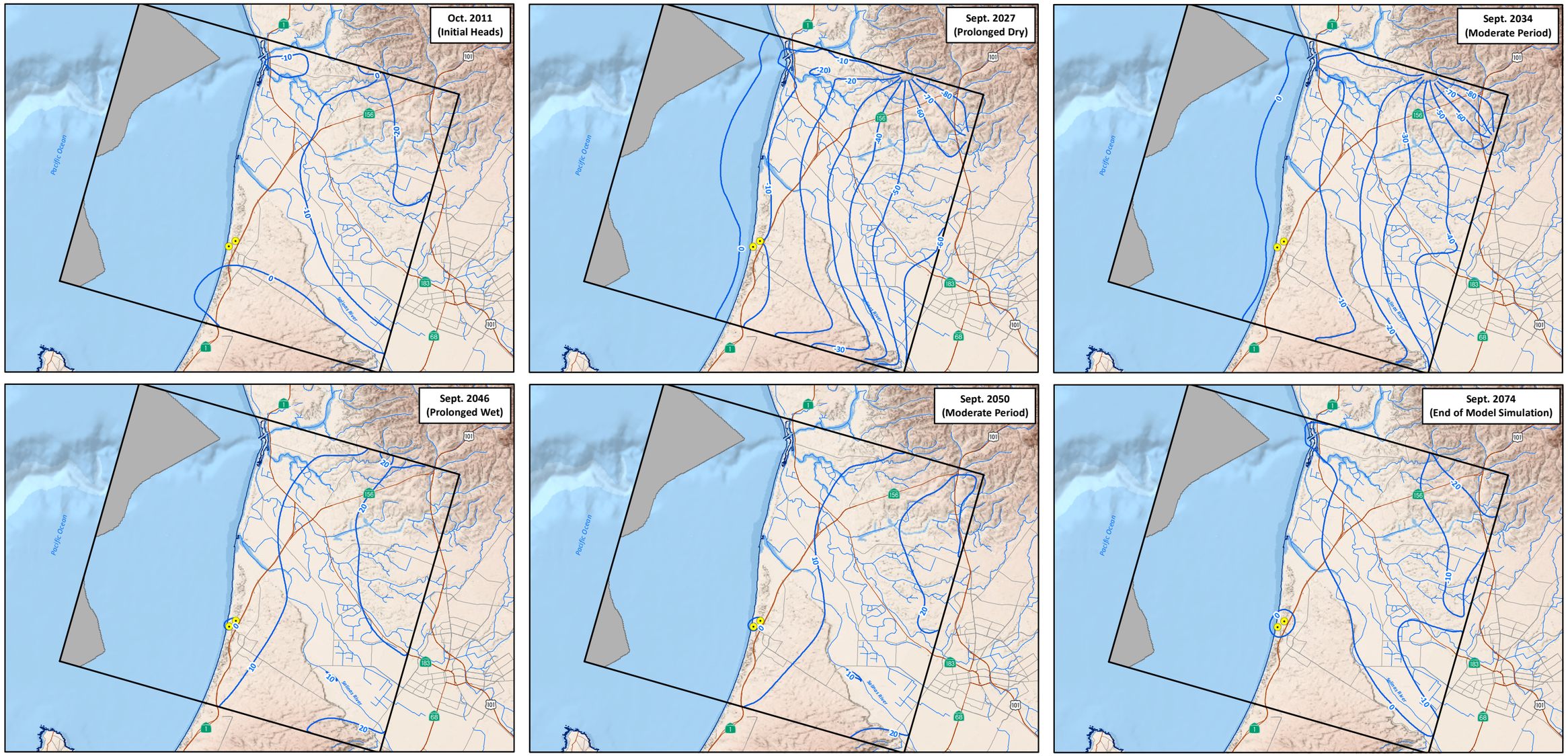
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-10 Groundwater Elevation (ft amsl)

Proposed Marina Coast Water District Desalination Well

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2 4 8 Miles

MODEL-CALCULATED GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS NMGWM RUN 2af

Run 2af - Cumulative with SVWP II and MCWD (No Project)
2060 Land Use

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Figure 92

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_92_wl_180FT_Run2af_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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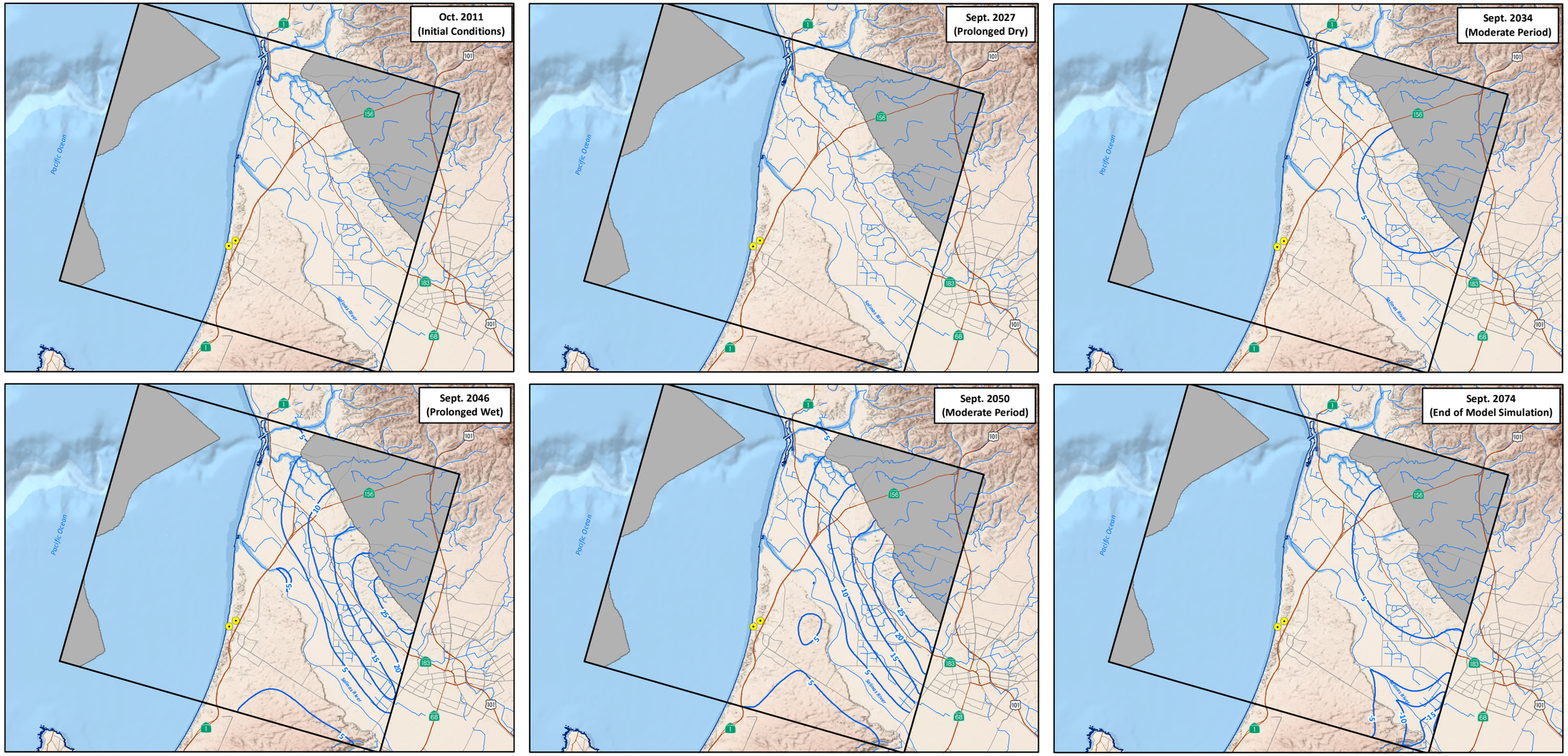
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

NORTH

0 2 4 8 Miles

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 2af - Cumulative with SVWP II and MCWD (No Project)
2060 Land Use

CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 2af (RUN 2af MINUS RUN 2f)

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Figure 93

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_93_wlchange_dunesand_Run2afminus2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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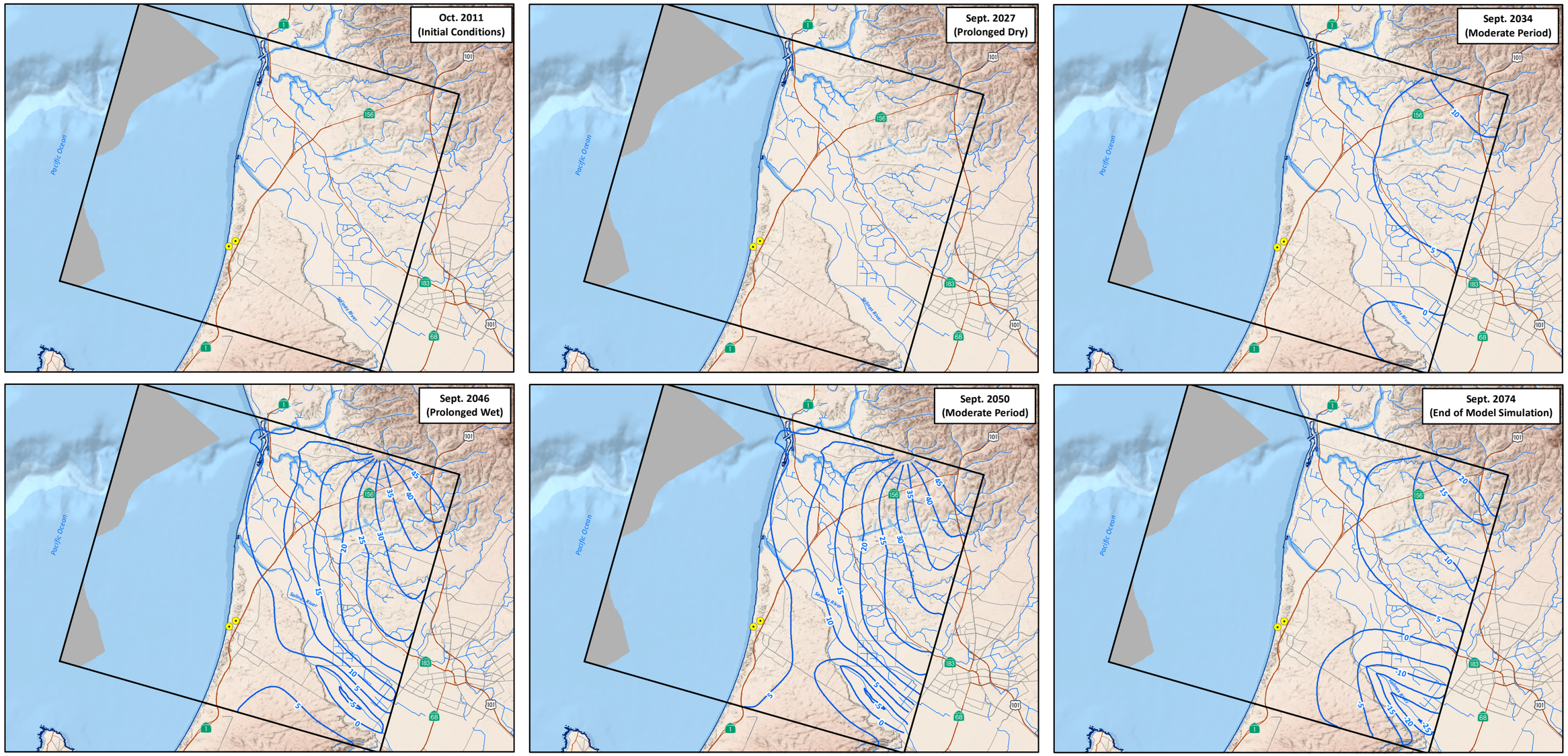
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2 4 8 Miles

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 2af - Cumulative with SVWP II and MCWD (No Project)
2060 Land Use

CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 2af (RUN 2af MINUS RUN 2f)

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Figure 94

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_94_wlchange_180FT-180FTE_Run2afminus2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

ACTIVE OR POTENTIALLY ACTIVE WELLS WITHIN 2 MILES OF THE CEMEX SLANT WELL SITE

EXPLANATION

Active Well (Aquifer Screened)

- 400-FT
- Unknown

Potentially Active Well (Aquifer Screened)

- 400-FT
- Unknown

CEMEX Slant Wells Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)

17-Apr-15

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NORTH

0 1,250 2,500 5,000 Feet

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Figure 95

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_95_well_loc_2milebuffer_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

WELLS SCREENED IN THE DUNE SAND, 180-FTE OR 400-FT AQUIFERS WITHIN 2 MILES OF THE CEMEX SLANT WELL SITE

EXPLANATION

Dune Sand Aquifer
(Type of Well)

- △ Monitoring
- ○ Unknown

180-FTE Aquifer
(Type of Well)

- ▲ Monitoring (DMW-1 and DMW-2)
- ● Active
- ● Inactive
- ◐ Well Screened in Dune Sand and 180-FTE Aquifer

400-FT Aquifer
(Type of Well)

- ● Active
- ● Potentially Active
- ● Unknown

— CEMEX Slant Wells Configuration A (Feedwater Supply of 24.1 MGD)

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NORTH

0 1,250 2,500 5,000 Feet

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Figure 96

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_96_well_screened_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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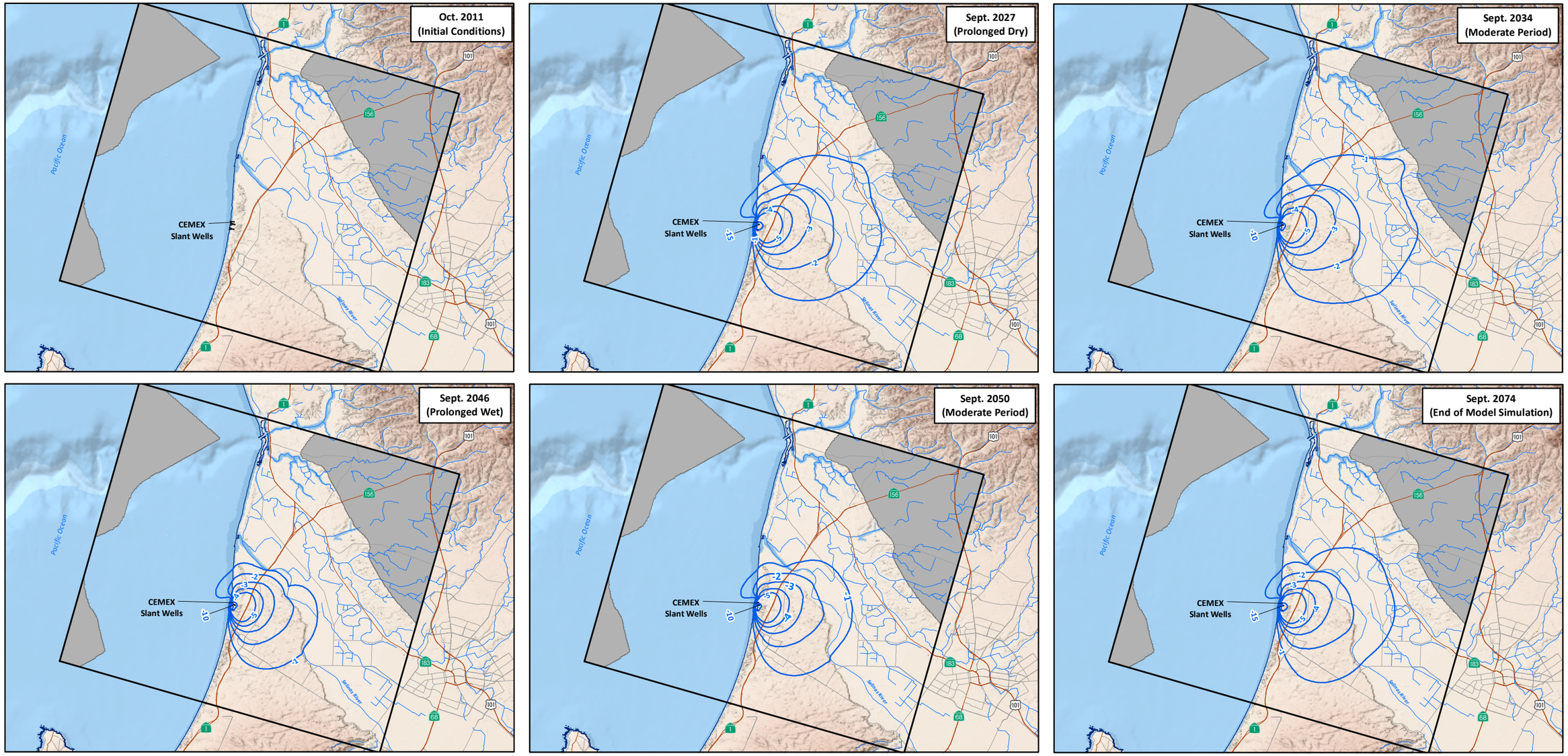
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 3n - Project 2012 Land Use
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

17-Apr-15

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 3n (RUN 3n MINUS RUN 1n)

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Figure 97

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_97_wlchange_dunesand_Run3nminus1n_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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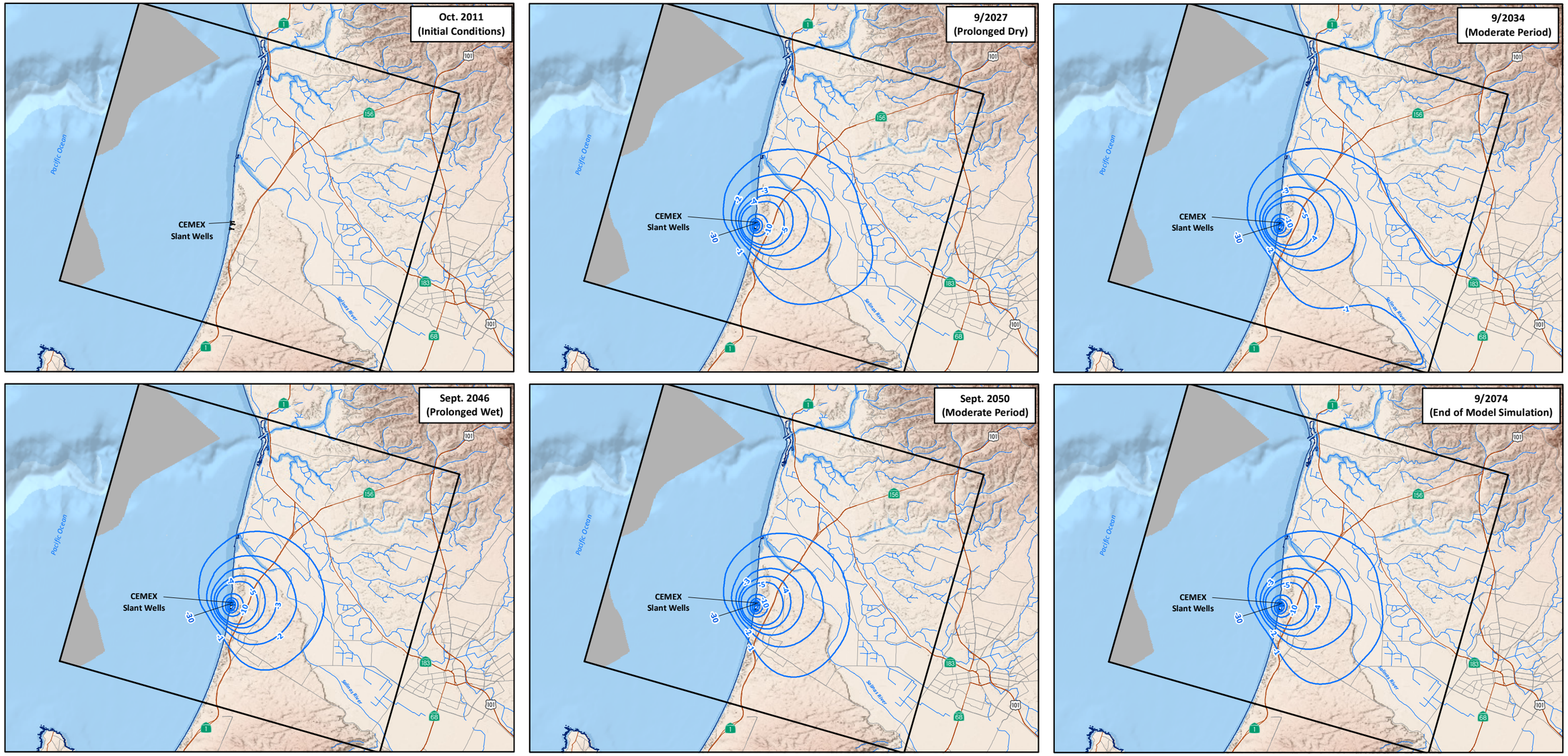
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Note: 180-FTE = 180-Foot Equivalent Aquifer

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 3n - Project 2012 Land Use
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 3n (RUN 3n MINUS RUN 1n)

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Figure 98

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_98_wlchange_180FT-180FTE_Run3nminus1n_6panel_4-15.mxd

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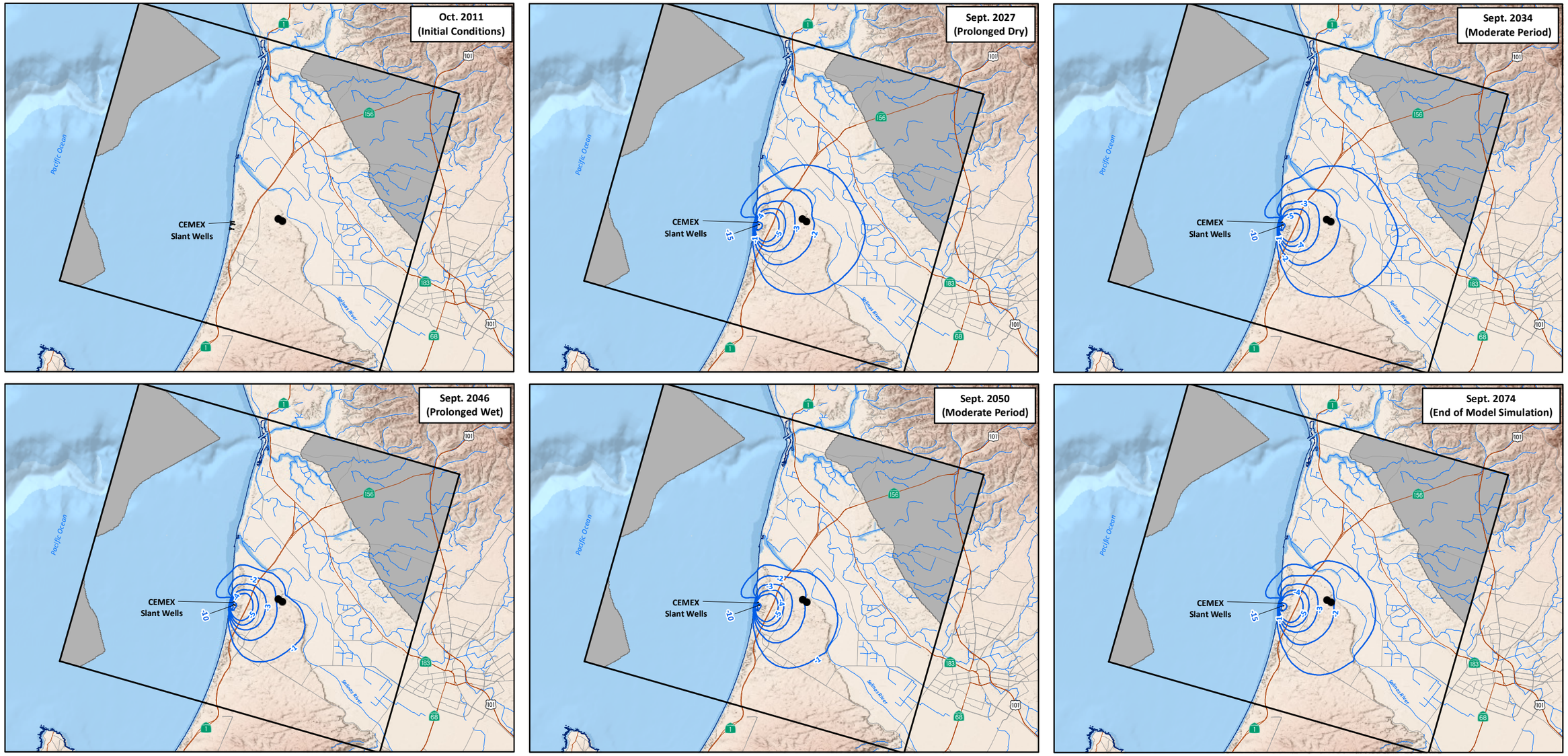
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide
(DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Injection Well at Charles Benson Site for Returning Basin Water

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 3ncb - Project 2012 Land Use with Returning Basin Water
at Charles Benson Rd. Site
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

17-Apr-15

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 3ncb (RUN 3ncb MINUS RUN 1n)

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Figure 99

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CALIFORNIA AMERICAN WATER AND
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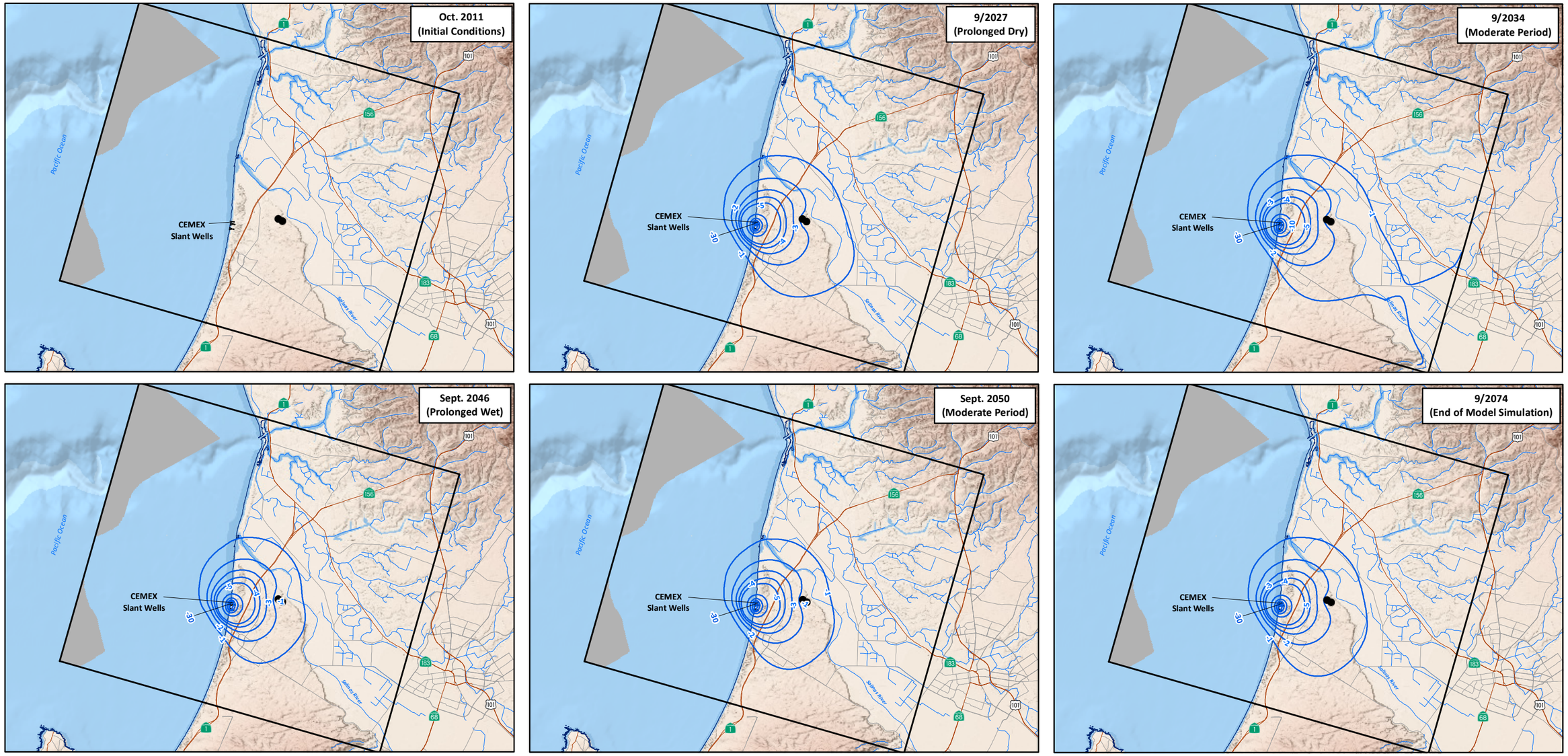
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Injection Well at Charles Benson Site for Returning Basin Water

Note: 180-FTE = 180-Foot Equivalent Aquifer

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 3ncb - Project 2012 Land Use with Returning Basin Water
at Charles Benson Rd. Site
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

17-Apr-15

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CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 3ncb (RUN 3ncb MINUS RUN 1n)

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Figure 100

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_100_wlchange_180FT-180FTE_Run3ncbminus1n_6panel_4-15.mxd

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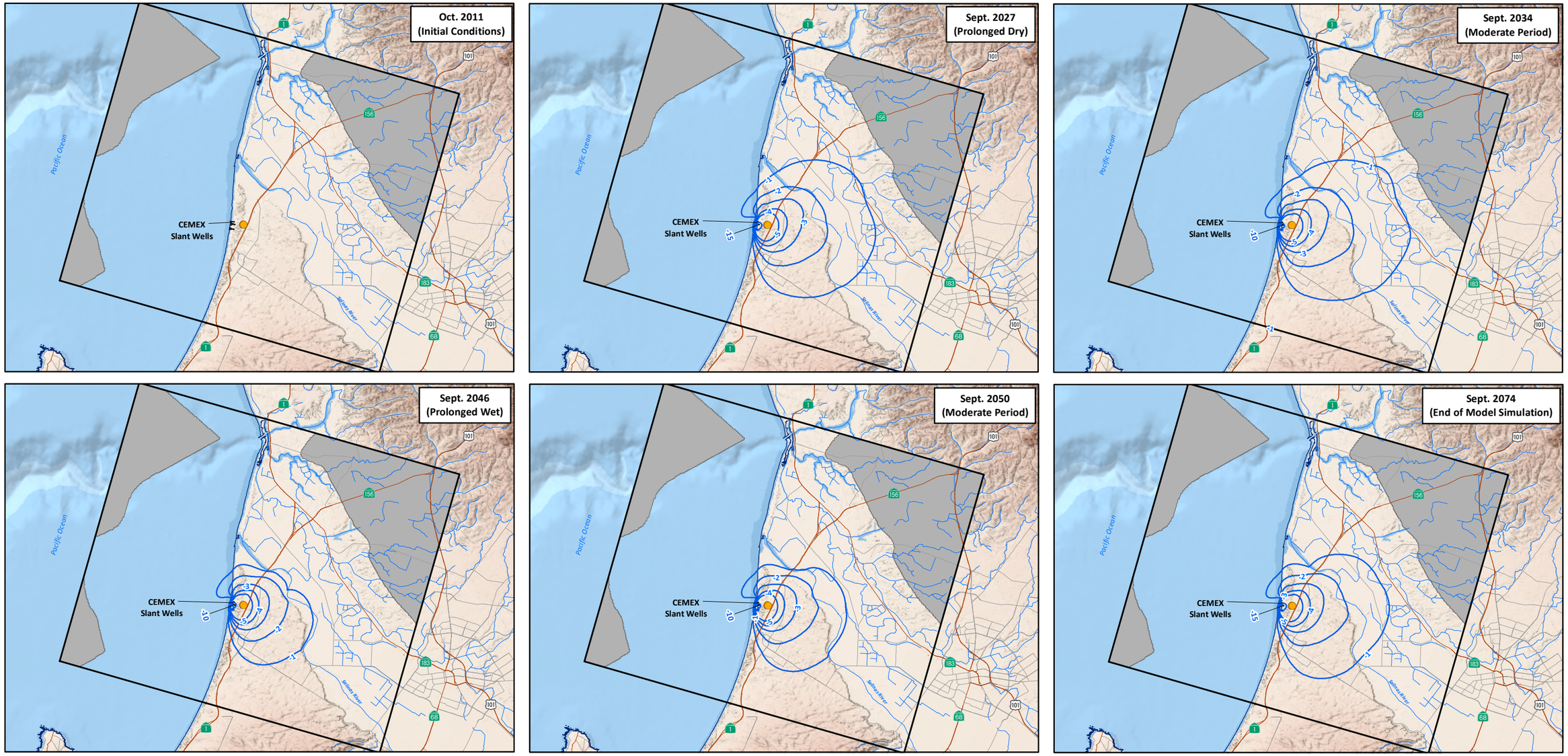
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Injection Well at CEMEX Site for Returning Basin Water

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 3nc - Project 2012 Land Use with Returning Basin Water
at CEMEX Site
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

17-Apr-15

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 3nc (RUN 3nc MINUS RUN 1n)

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Figure 101

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_101_wlchange_dunesand_Run3ncminus1n_6panel_4-15.mxd

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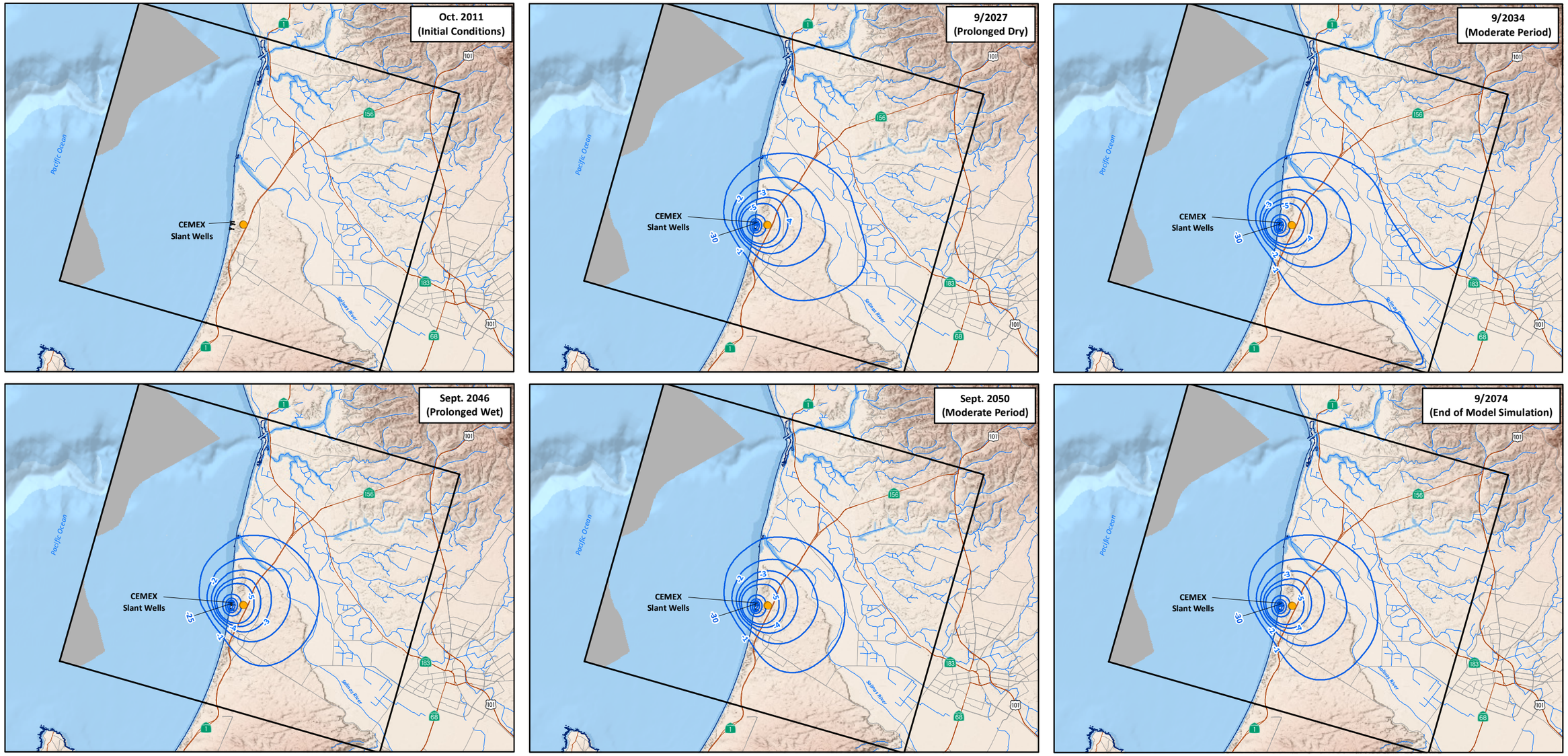

EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Injection Well at CEMEX Site for Returning Basin Water

Note: 180-FTE = 180-Foot Equivalent Aquifer

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 3nc - Project 2012 Land Use with Returning Basin Water
at CEMEX Site
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 3nc (RUN 3nc MINUS RUN 1n)

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Figure 102

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_102_wlchange_180FT-180FTE_Run3ncminus1n_6panel_4-15.mxd

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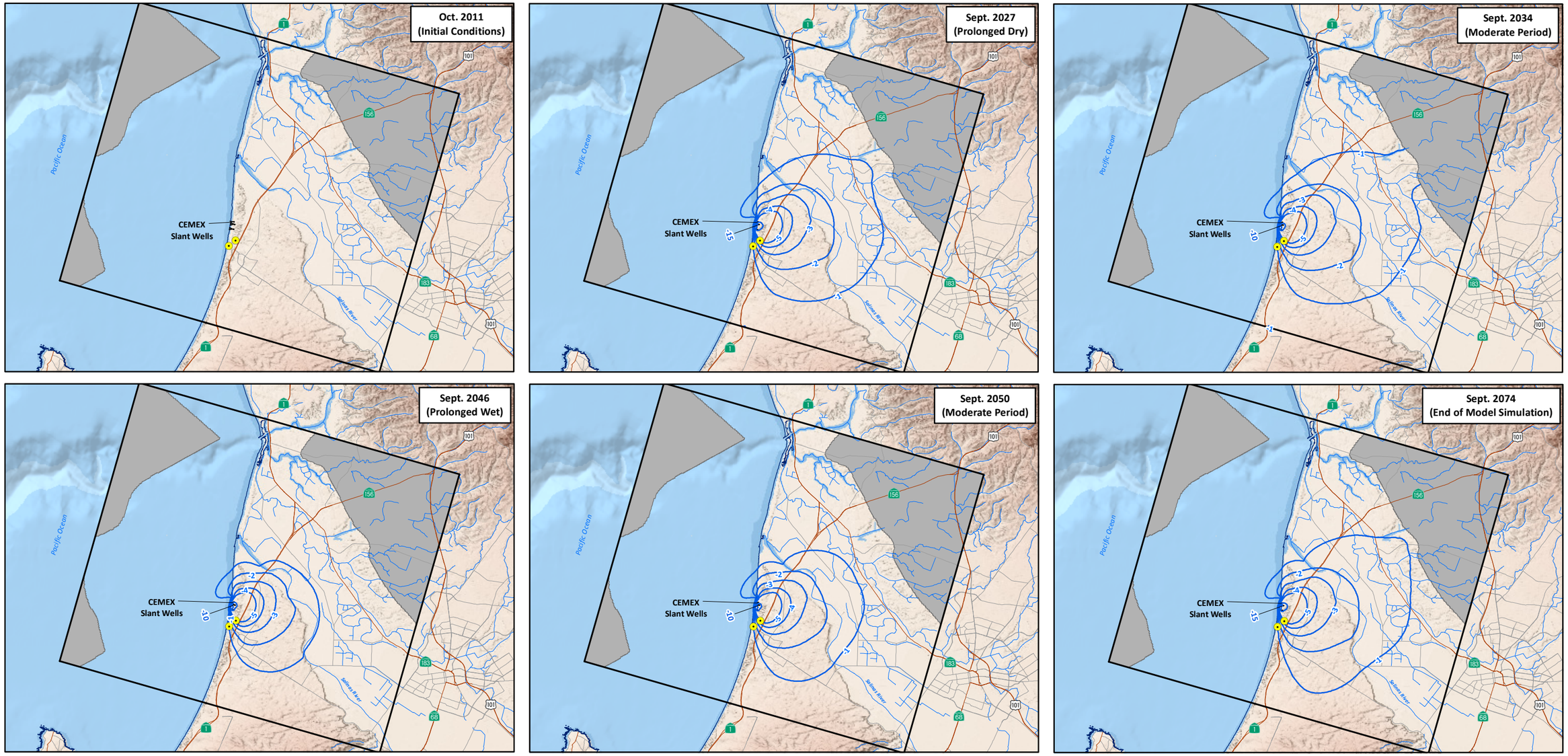
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 4f - Project 2060 Land Use with MCWD
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 4f (RUN 4f MINUS RUN 2f)

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Figure 103

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_103_wlchange_dunesand_Run4fminus2f_6panel_4-15.mxd

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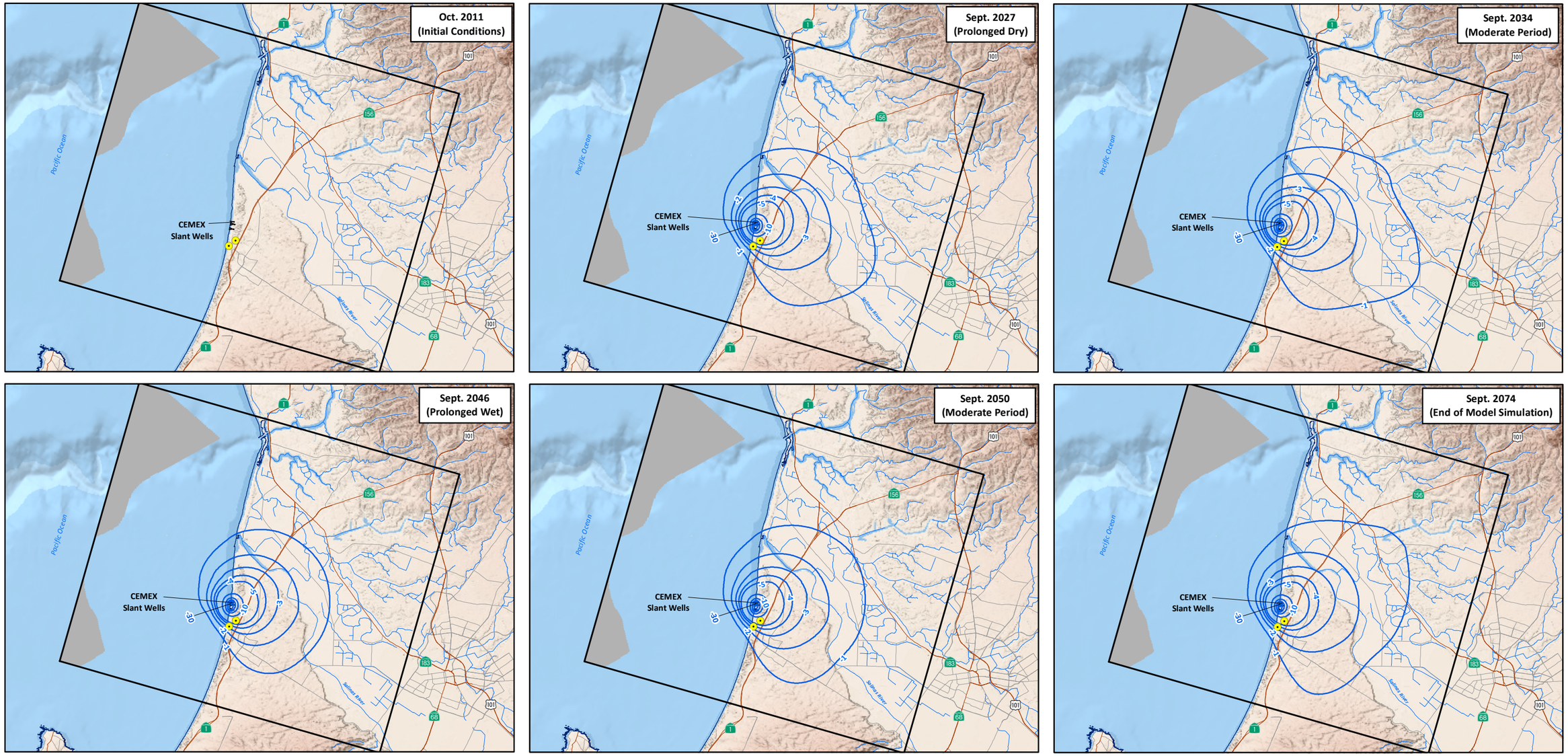
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2 4 8 Miles

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 4f - Project 2060 Land Use with MCWD
(Dune Sand & 180-FTE)

CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 4f (RUN 4f MINUS RUN 2f)

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Figure 104

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_104_wlchange_180FT-180FTE_Run4fminus2f_6panel_4-15.mxd

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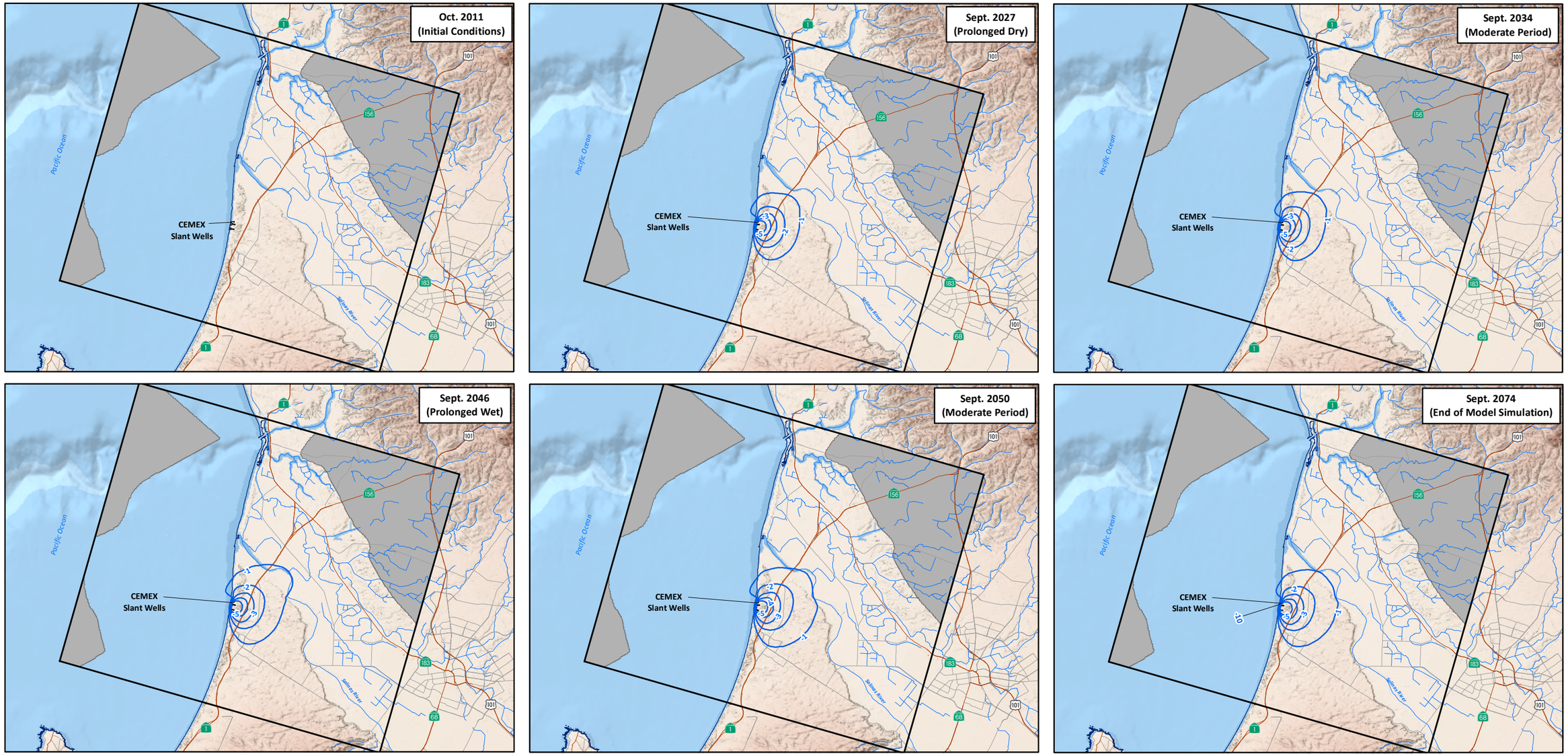
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

CEMEX Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 48 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 5n - Variant 2012 Land Use
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 5n (RUN 5n MINUS RUN 1n)

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Figure 105

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_105_wlchange_dunesand_Run5nminus1n_6panel_4-15.mxd

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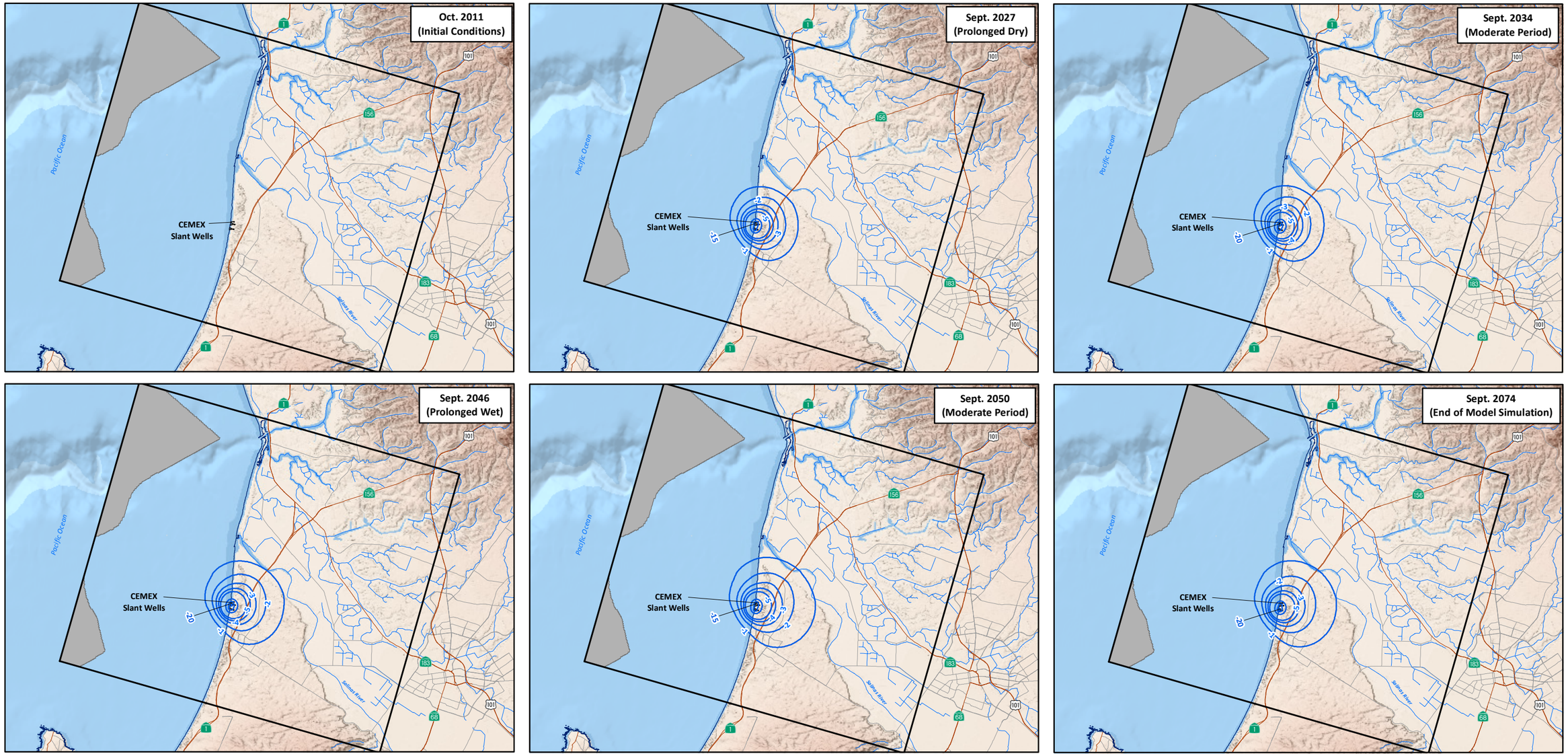

EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Note: 180-FTE = 180-Foot Equivalent Aquifer

CEMEX Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 48 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 5n - Variant 2012 Land Use
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 5n (RUN 5n MINUS RUN 1n)

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Figure 106

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/11_Fig_106_wlchange_180FT-180FTE_Run5nminus1n_6panel_4-15.mxd

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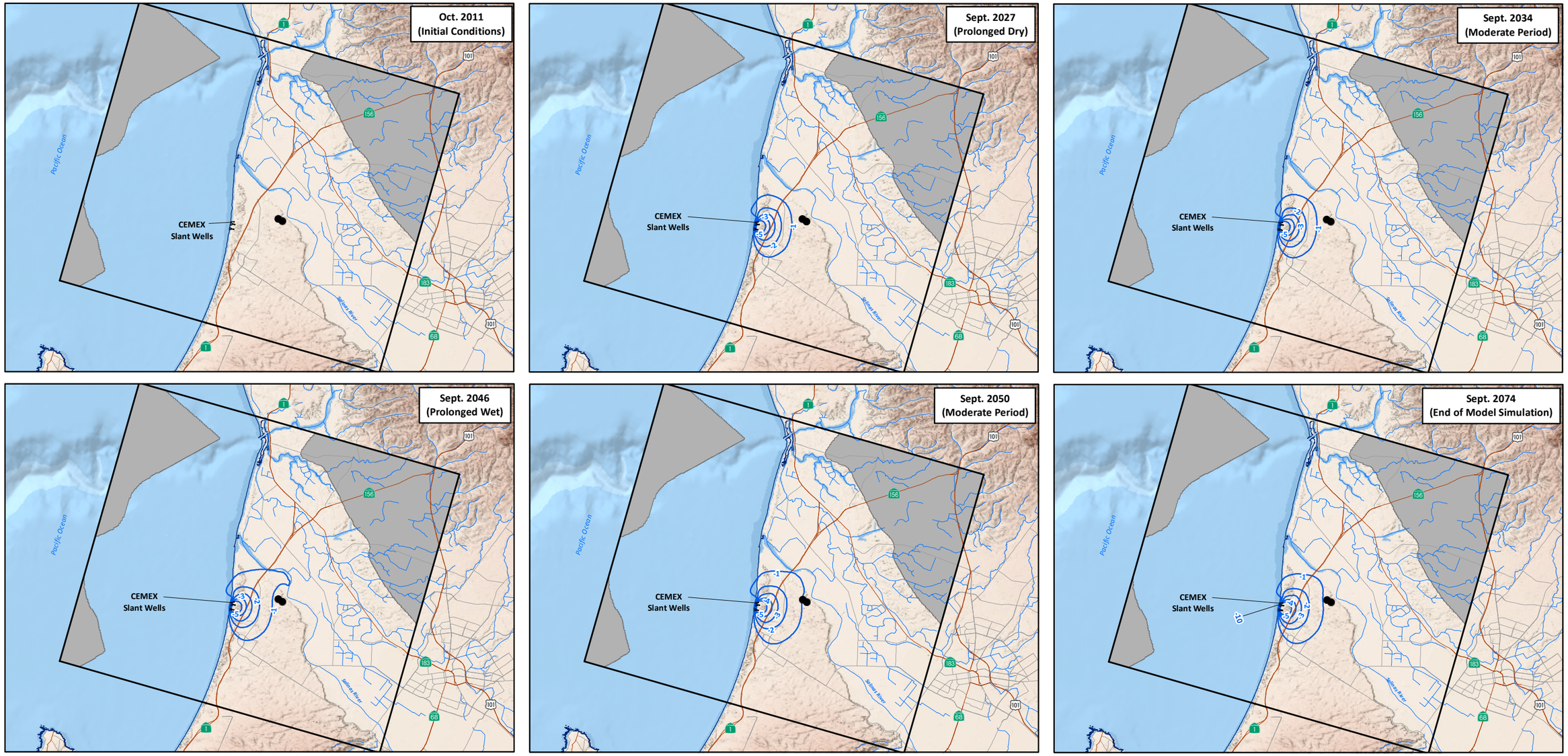

EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide
(DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Injection Well at Charles Benson Site for Returning Basin Water

CEMEX Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 48 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 5ncb - Variant 2012 Land Use with Returning Basin Water
at Charles Benson Rd. Site
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 5ncb (RUN 5ncb MINUS RUN 1n)

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Figure 107

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_107_wlchange_dunesand_Run5ncbminus1n_6panel_4-15.mxd

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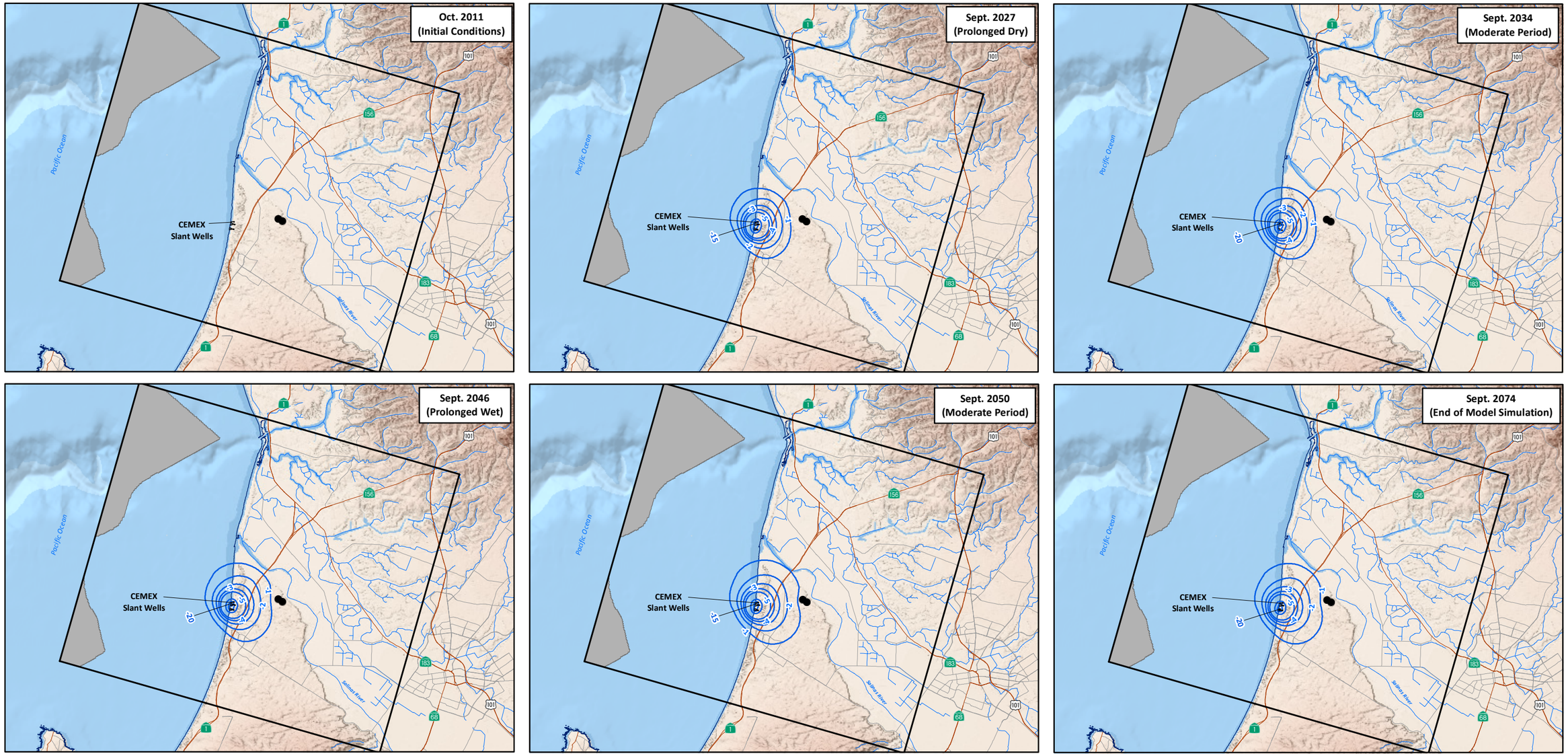
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Injection Well at Charles Benson Site for Returning Basin Water

Note: 180-FTE = 180-Foot Equivalent Aquifer

CEMEX Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 48 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 5ncb - Variant 2012 Land Use with Returning Basin Water
at Charles Benson Rd. Site
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 5ncb (RUN 5ncb MINUS RUN 1n)

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Figure 108

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/11_Fig_110_wlchange_180FT-180FTE_Run5ncbminus1n_6panel_1-15.mxd

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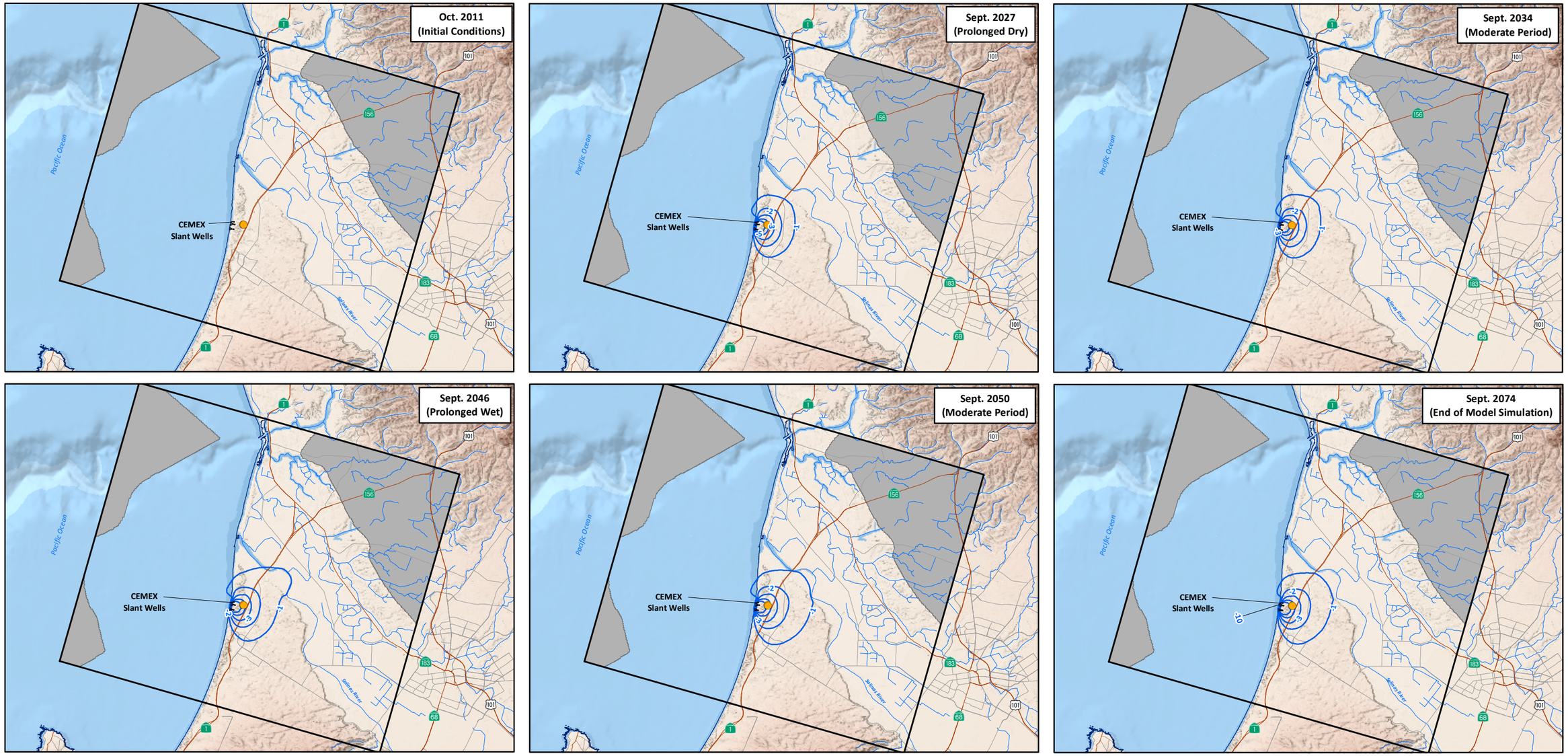
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Injection Well at CEMEX Site for Returning Basin Water

CEMEX Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 48 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 5nc - Variant 2012 Land Use with Returning Basin Water
at CEMEX Site
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 5nc (RUN 5nc MINUS RUN 1n)

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Figure 109

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_109_wlchange_dunesand_Run5ncminus1n_6panel_4-15.mxd

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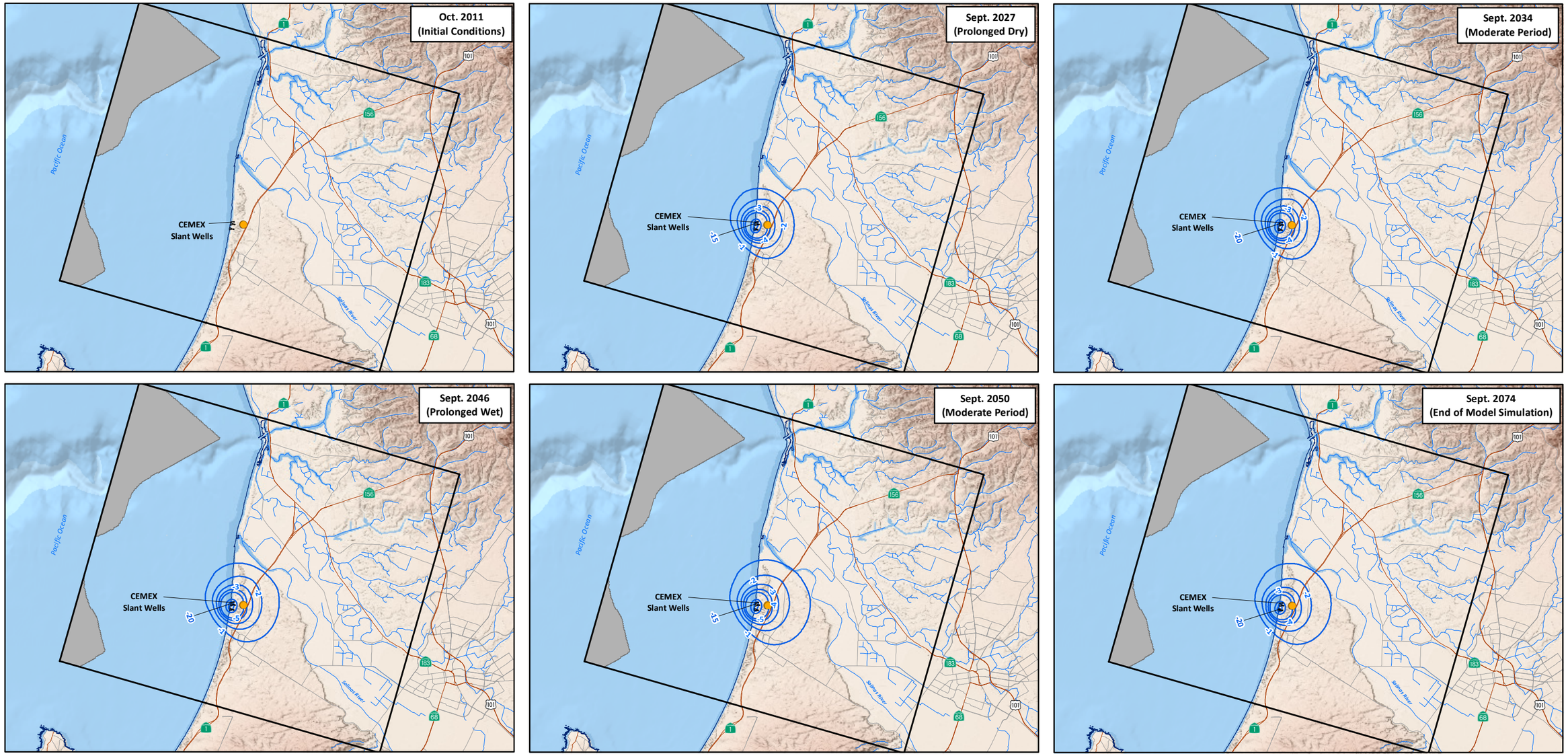

EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Injection Well at CEMEX Site for Returning Basin Water

Note: 180-FTE = 180-Foot Equivalent Aquifer

CEMEX Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 48 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 5nc - Variant 2012 Land Use with Returning Basin Water
at CEMEX Site
(Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 5nc (RUN 5nc MINUS RUN 1n)

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Figure 110

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_110_wlchange_180FT-180FTE_Run5ncminus1n_6panel_4-15.mxd

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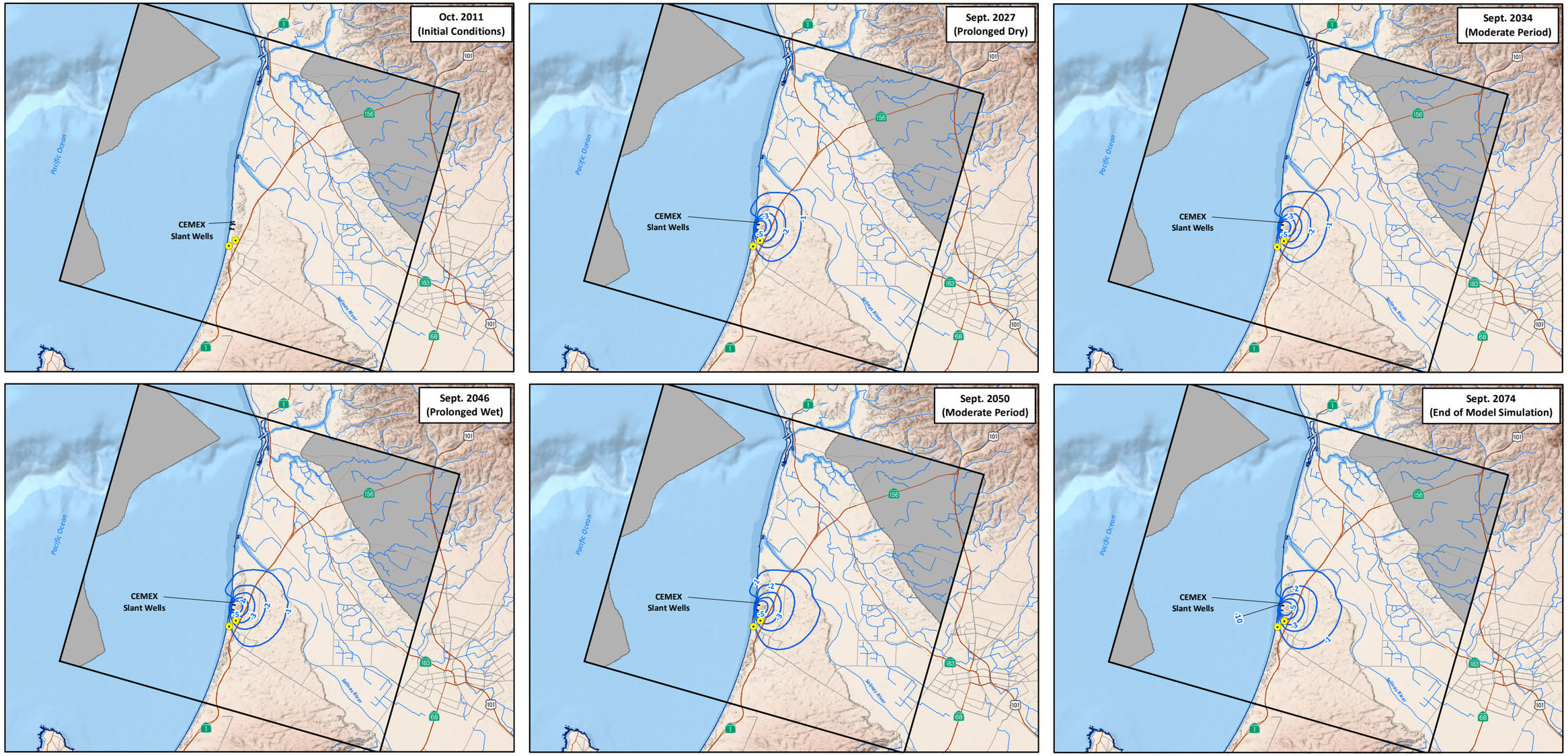
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)

Run 2f - Cumulative with MCWD (No Project) 2060 Land Use

Run 5f - Variant 2060 Land Use with MCWD (Dune Sand & 180-FTE)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 5f (RUN 5f MINUS RUN 2f)

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Figure 111

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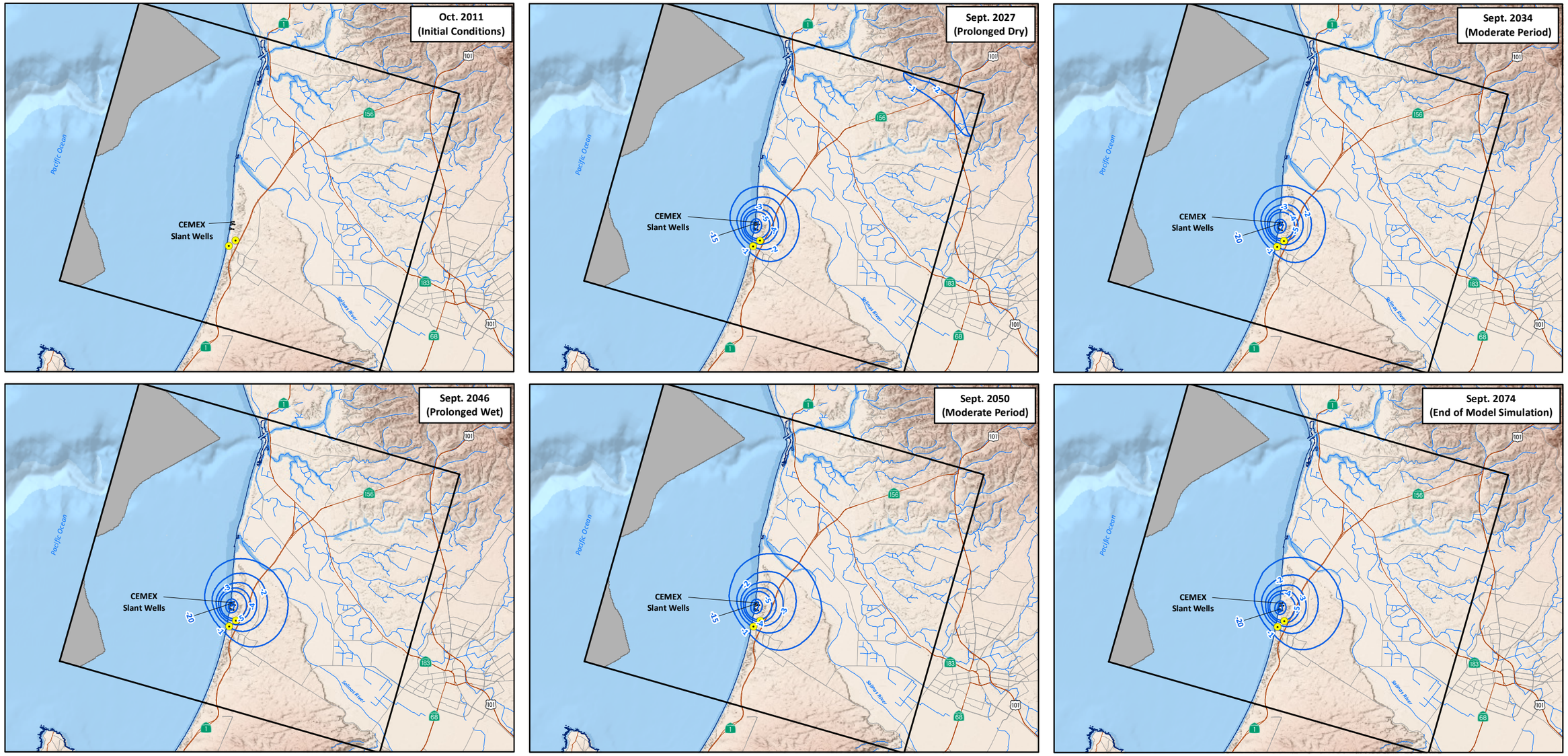
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2 4 8 Miles

CEMEX Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 48 for Detailed Slant Well Layout)

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 5f - Variant 2060 Land Use with MCWD
(Dune Sand & 180-FTE)

CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 5f (RUN 5f MINUS RUN 2f)

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Figure 112

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_112_wlchange_180FT-180FTE_Run5fminus2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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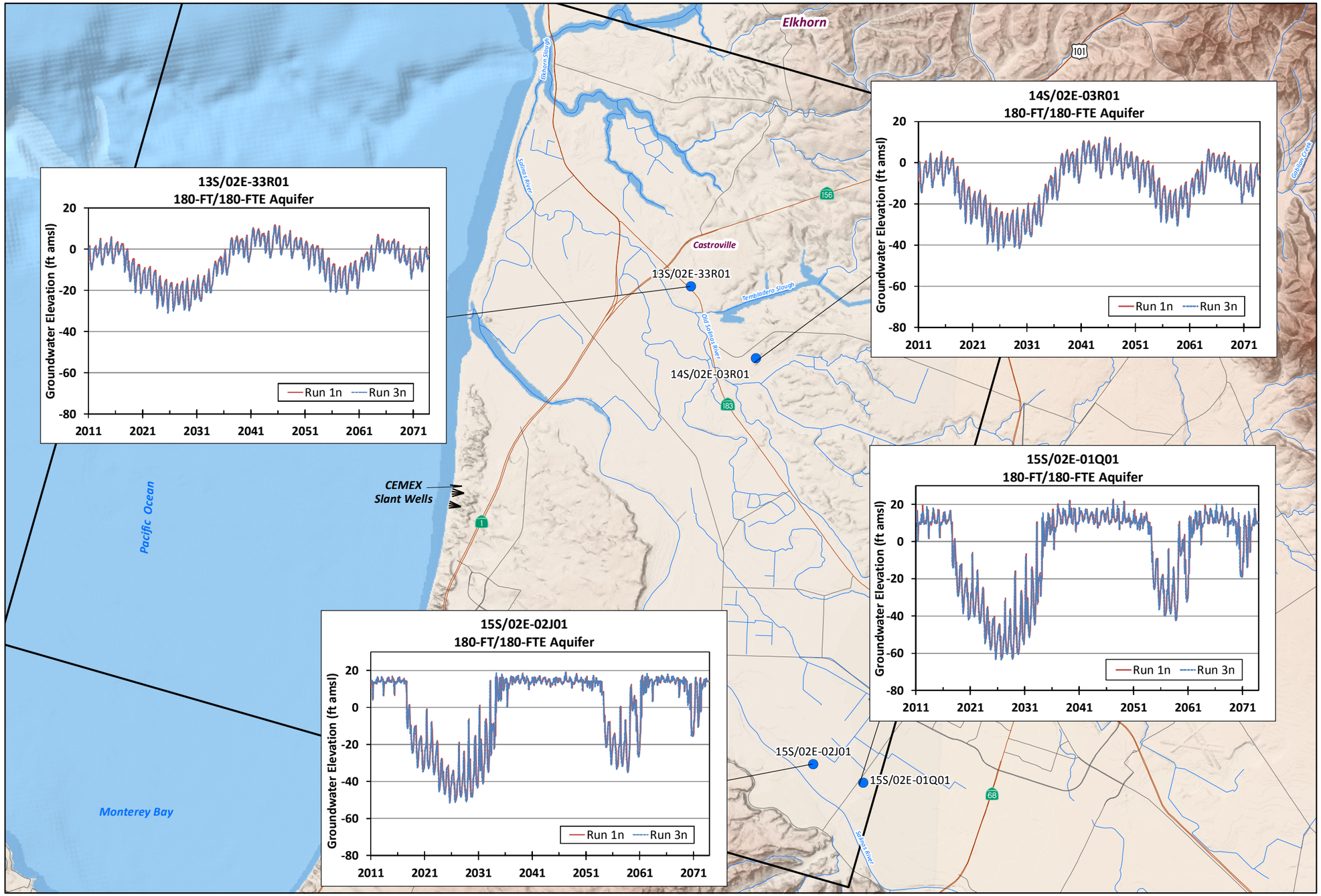
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 3n VERSUS RUN 1n (180-FT/180-FTE AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 3n - Project 2012 Land Use (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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NORTH

0 1 2 4 Miles

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Figure 113

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_113_hydrographs_Run3n_vs_Run1n_180FT-180FTE_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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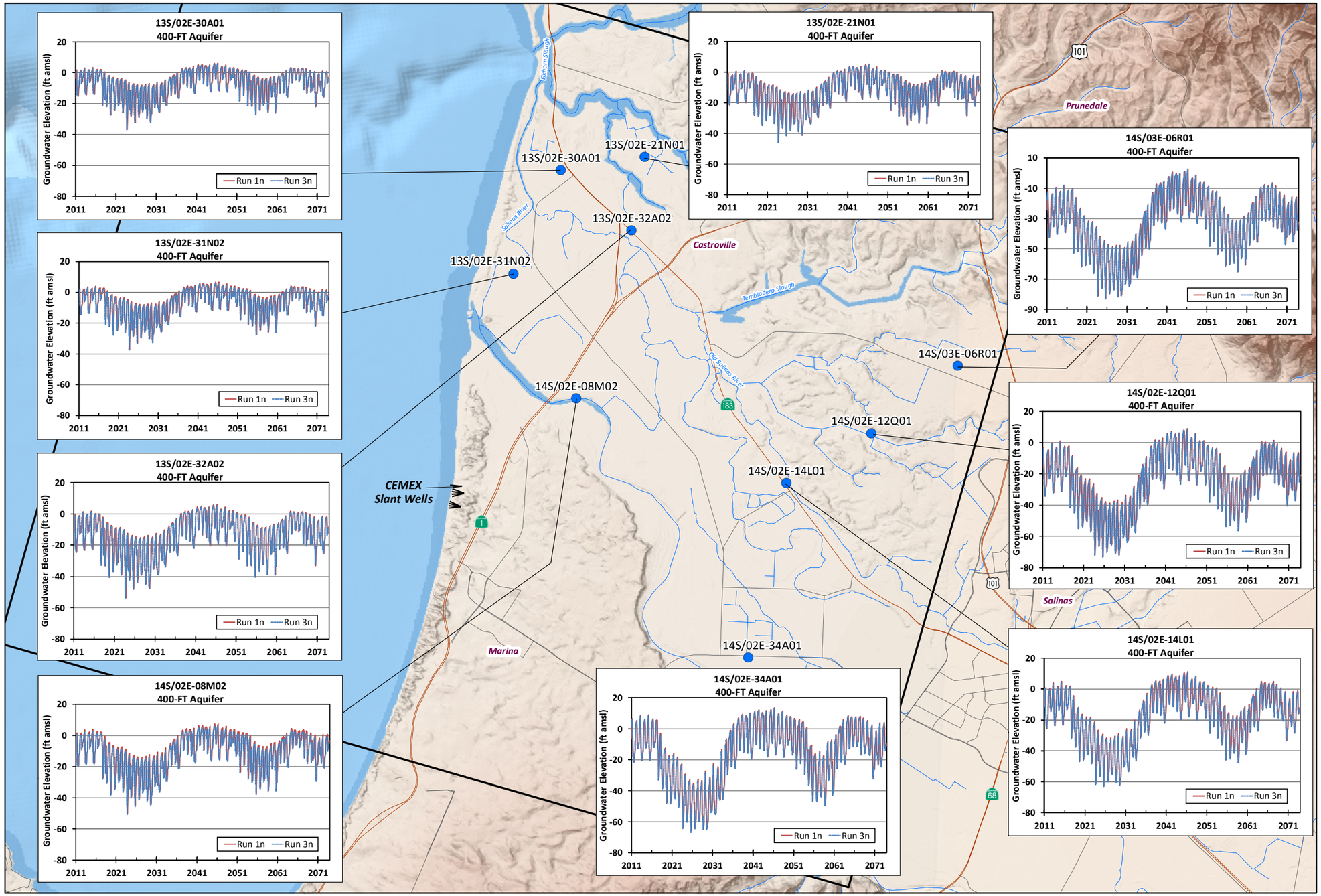
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 3n VERSUS RUN 1n (400-FT AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 3n - Project 2012 Land Use (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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NORTH

0 1 2 4 Miles

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Figure 114

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_114_hydrographs_Run3n_vs_Run1n_400FT_4-15.mxd

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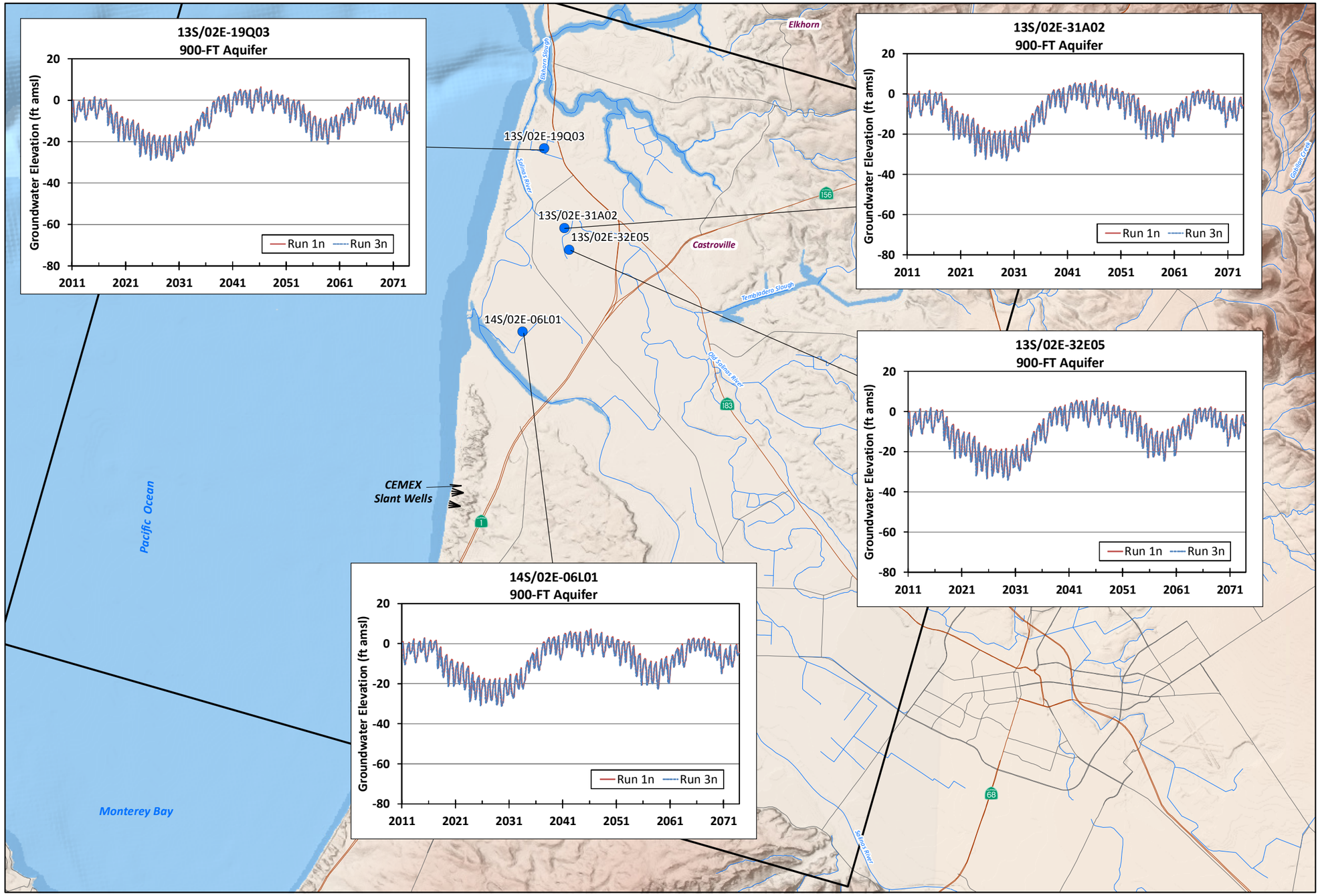
HYDROGRAPHS FOR SELECTED WELLS RUN 3n VERSUS RUN 1n (900-FT AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 3n - Project 2012 Land Use (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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Figure 115

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_115_hydrographs_Run3n_vs_Run1n_900FT_4-15.mxd

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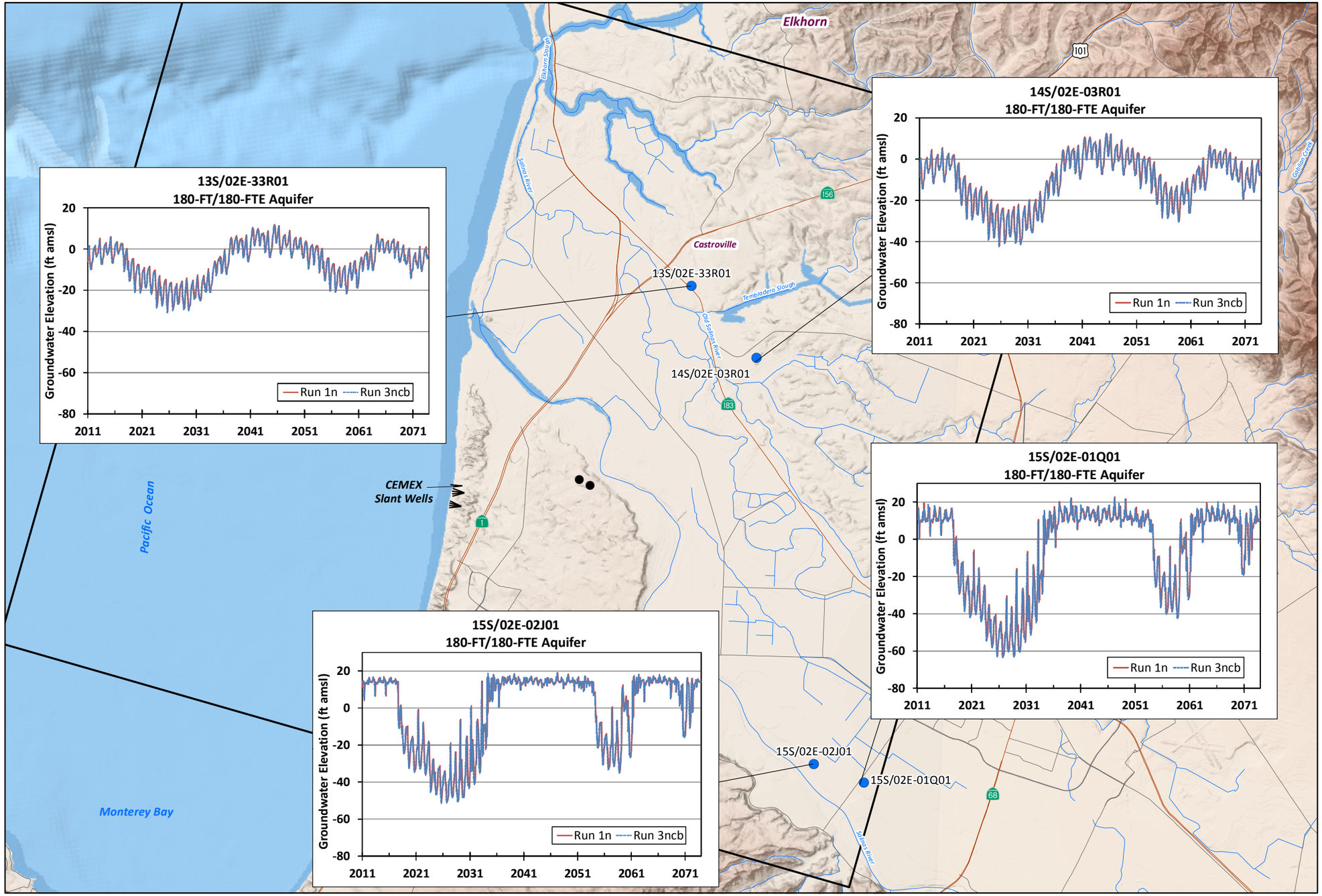
HYDROGRAPHS FOR SELECTED WELLS RUN 3ncb VERSUS RUN 1n (180-FT/180-FTE AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)
- Injection Well at Charles Benson Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 3ncb - Project 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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Figure 116

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_116_hydrographs_Run3ncb_vs_Run1n_180FT-180FTE_4-15.mxd

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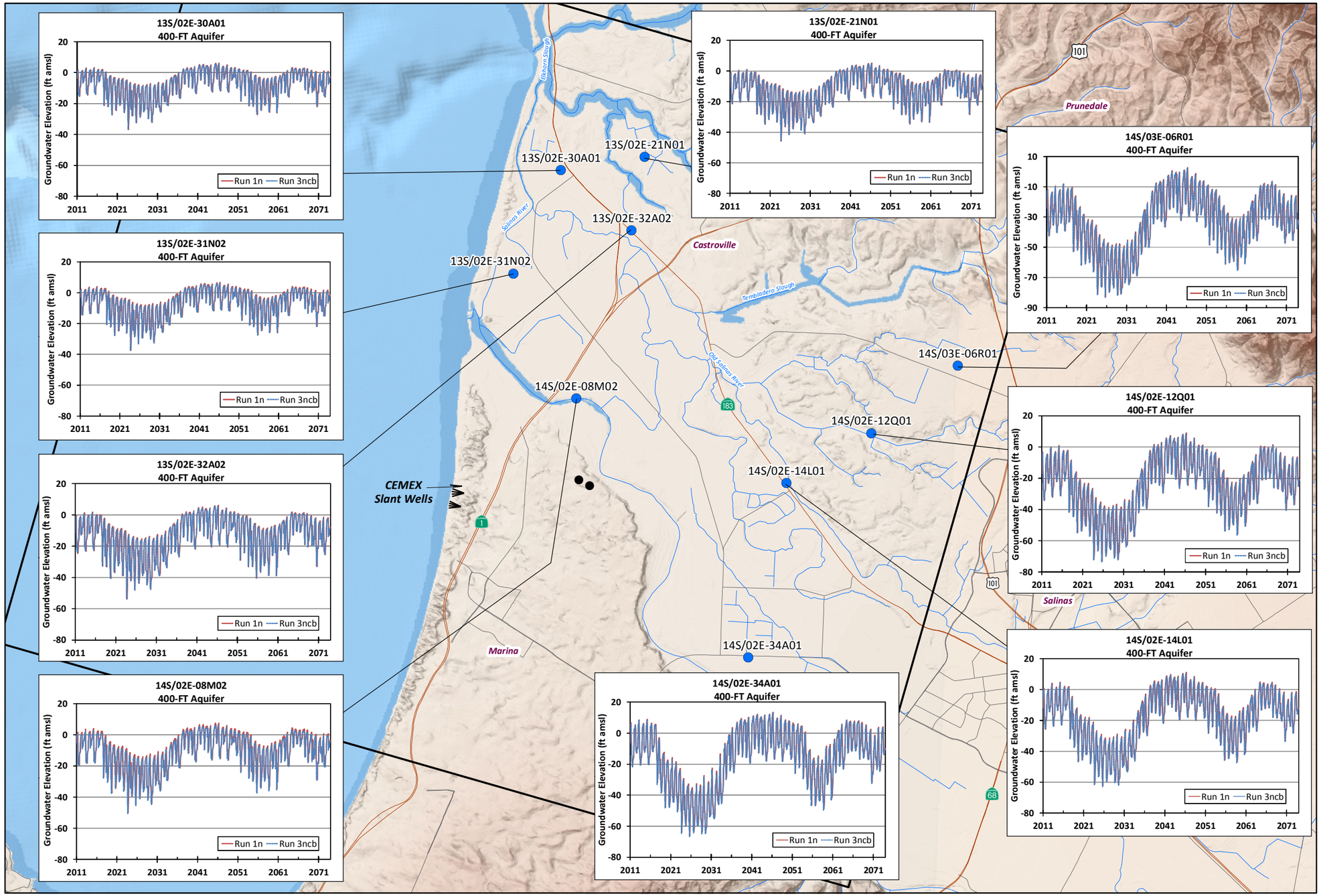
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 3ncb VERSUS RUN 1n (400-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)
- Injection Well at Charles Benson Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 3ncb - Project 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)

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Figure 117

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_117_hydrographs_Run3ncb_vs_Run1n_400FT_4-15.mxd

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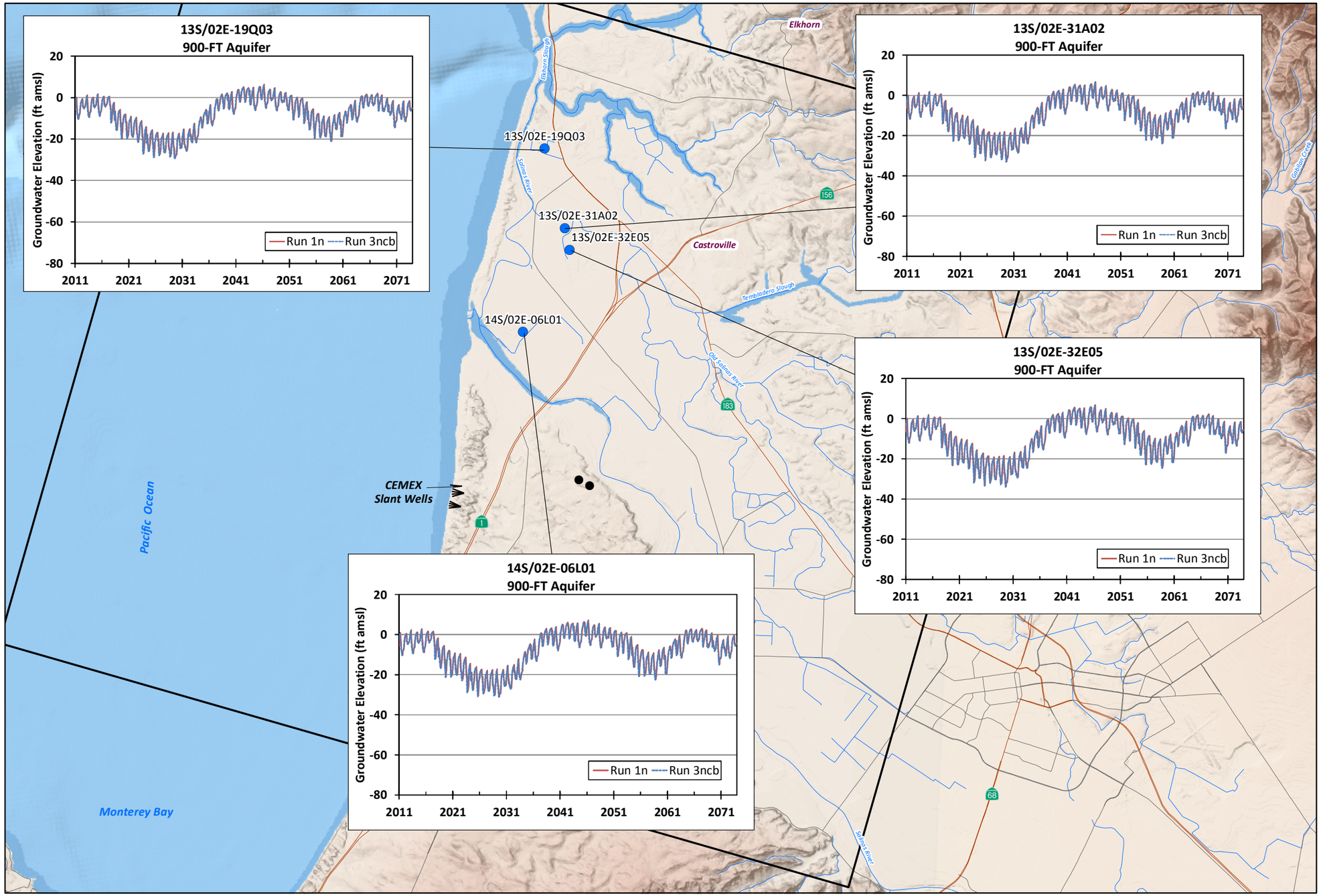
HYDROGRAPHS FOR SELECTED WELLS RUN 3ncb VERSUS RUN 1n (900-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)
- Injection Well at Charles Benson Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 3ncb - Project 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)

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Figure 118

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_118_hydrographs_Run3ncb_vs_Run1n_900FT_4-15.mxd

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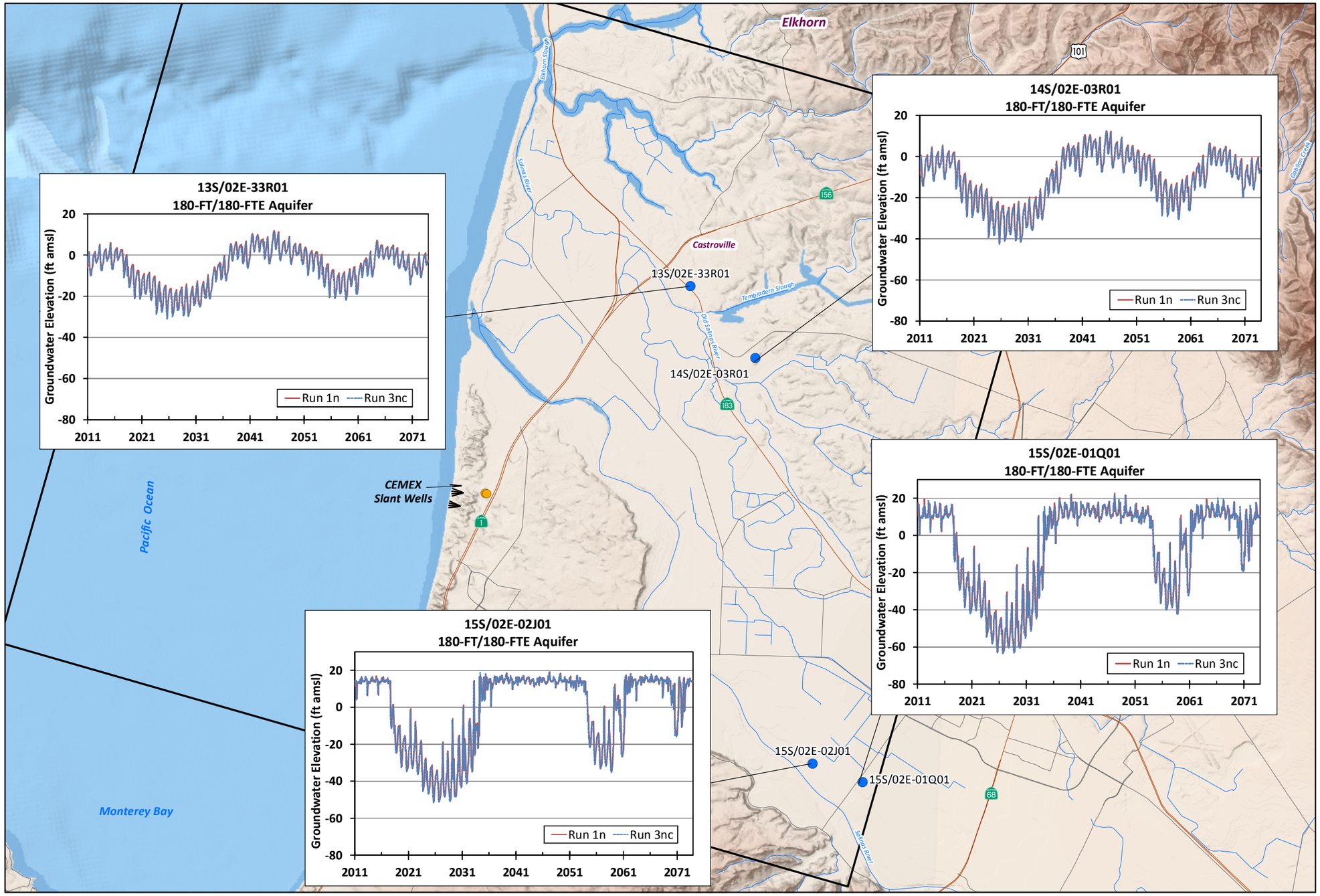
HYDROGRAPHS FOR SELECTED WELLS RUN 3nc VERSUS RUN 1n (180-FT/180-FTE AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)
- Injection Well at CEMEX Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 3nc - Project 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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Figure 119

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_119_hydrographs_Run3nc_vs_Run1n_180FT-180FTE_4-15.mxd

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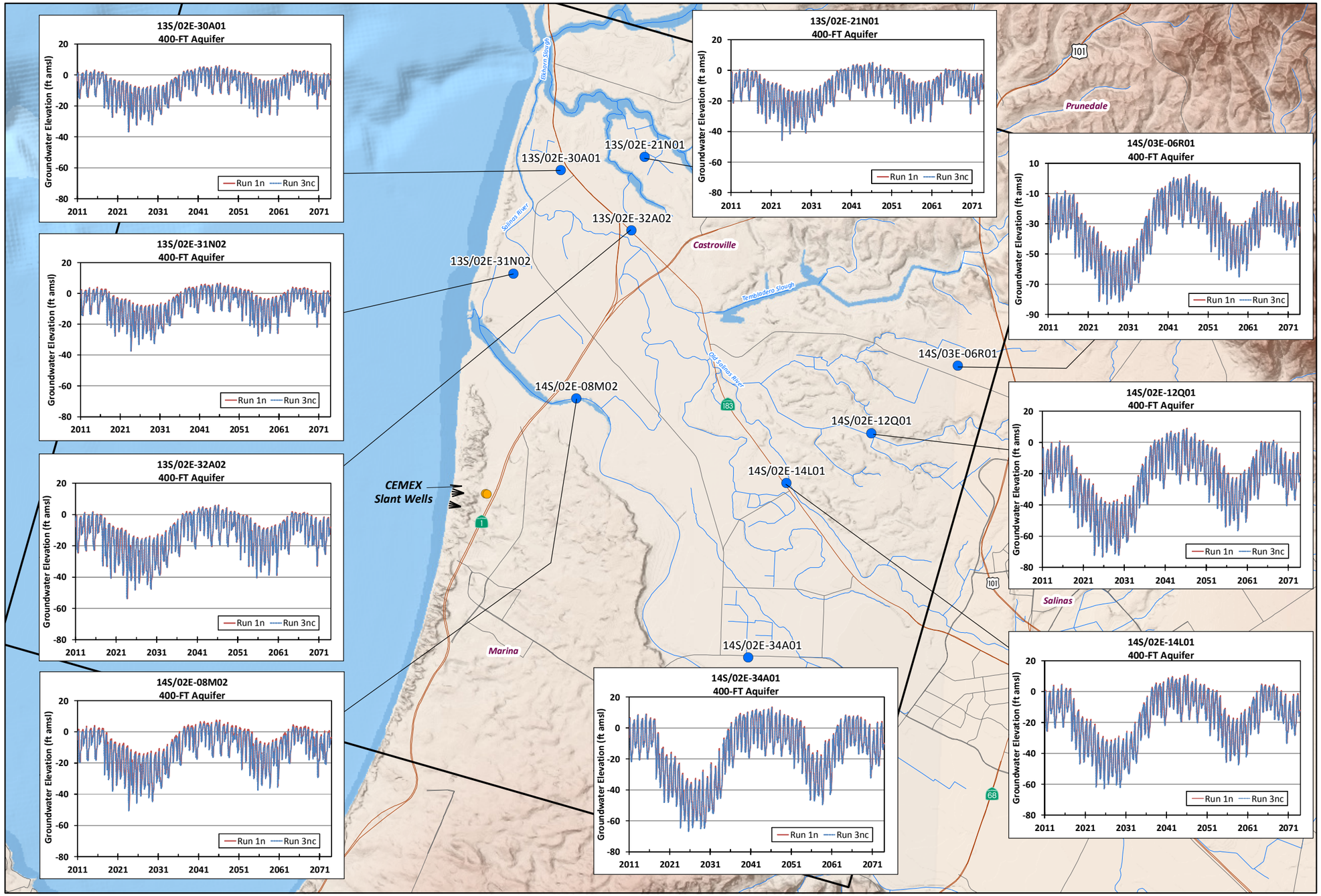
HYDROGRAPHS FOR SELECTED WELLS RUN 3nc VERSUS RUN 1n (400-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)
- Injection Well at CEMEX Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 3nc - Project 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)

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Figure 120

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_120_hydrographs_Run3nc_vs_Run1n_400FT_4-15.mxd

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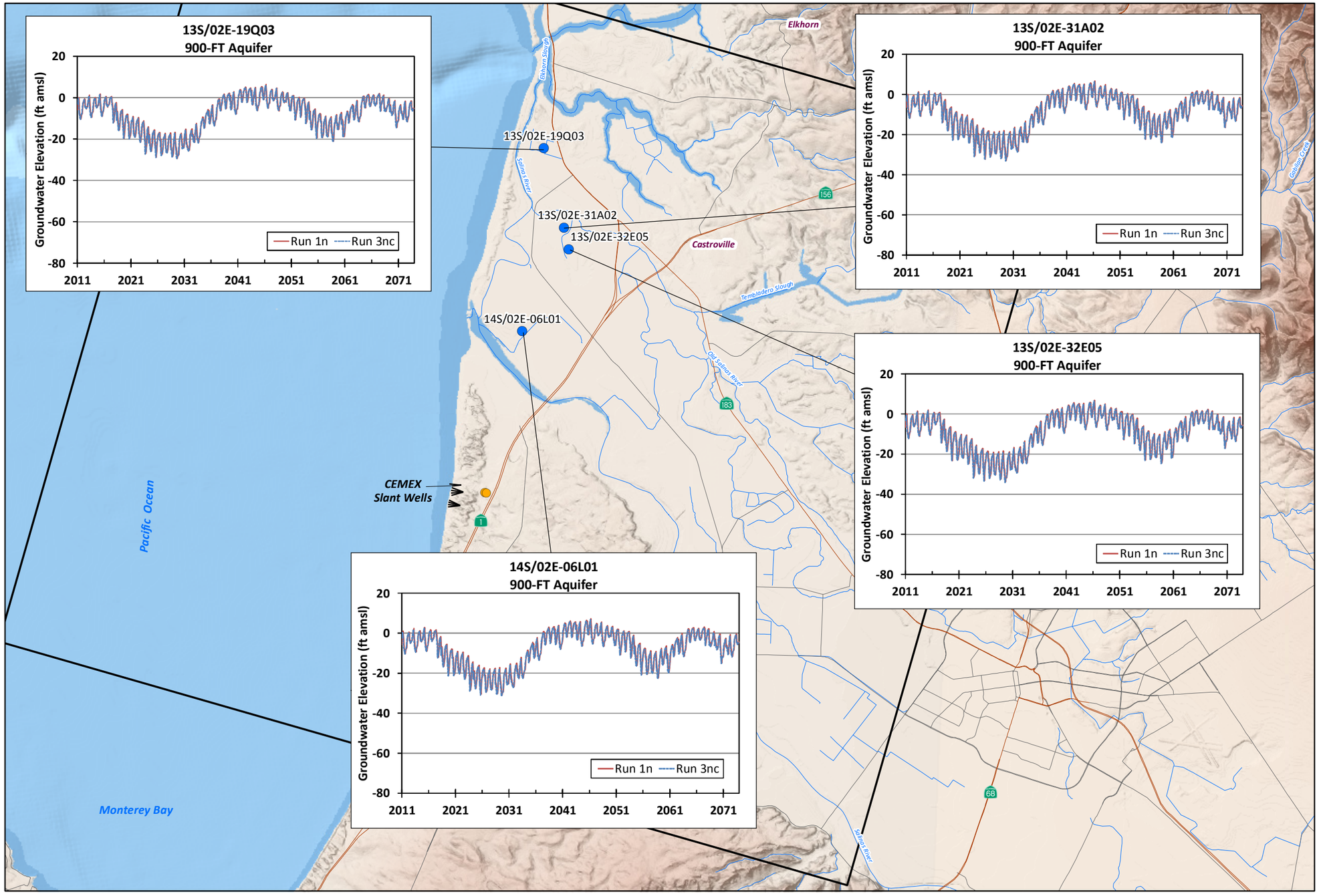
HYDROGRAPHS FOR SELECTED WELLS RUN 3nc VERSUS RUN 1n (900-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)
- Injection Well at CEMEX Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 3nc - Project 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)

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Figure 121

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_121_hydrographs_Run3nc_vs_Run1n_900FT_4-15.mxd

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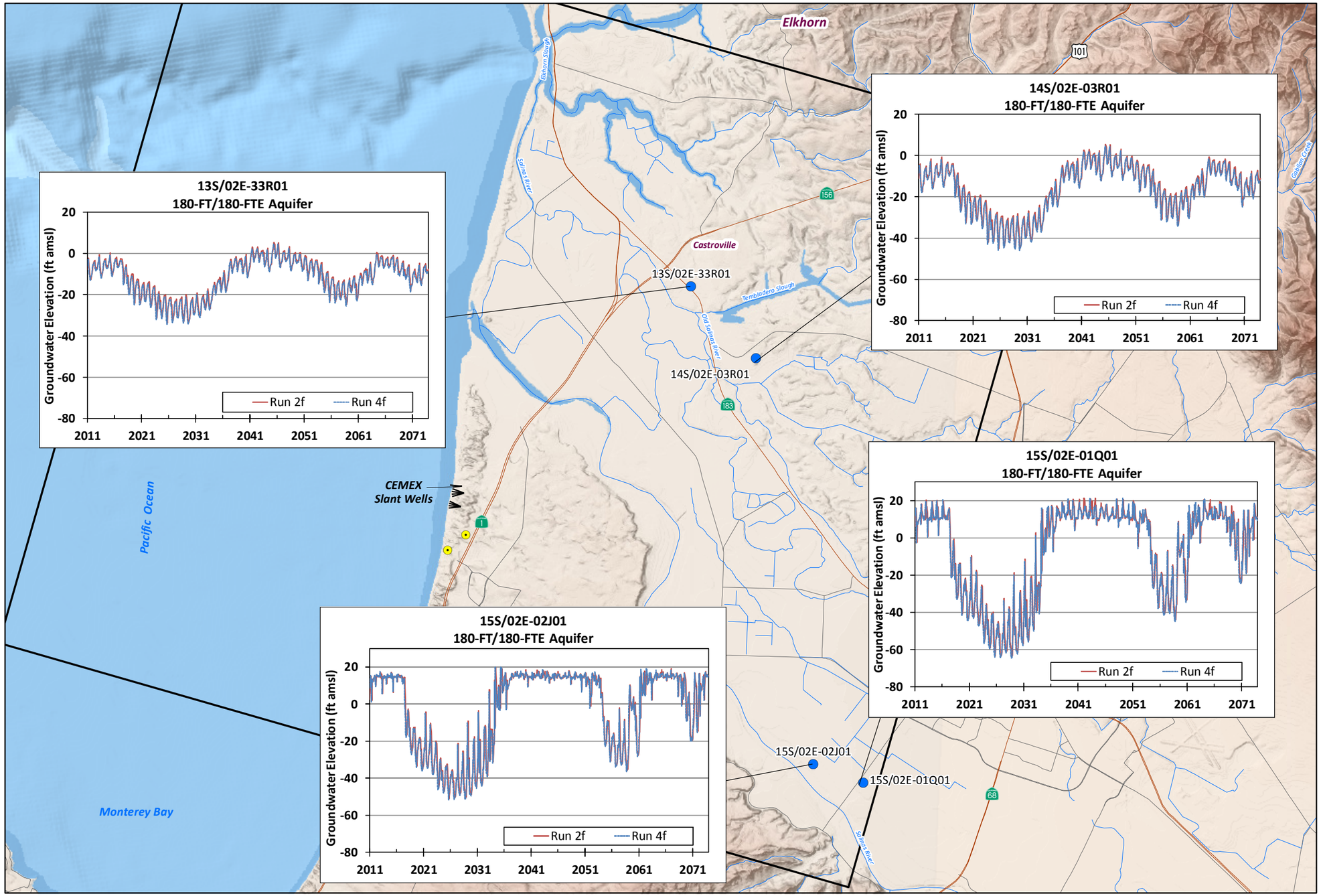
HYDROGRAPHS FOR SELECTED WELLS RUN 4f VERSUS RUN 2f (180-FT/180-FTE AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative with MCWD (No Project) 2060 Land Use

Run 4f - Project 2060 Land Use with MCWD (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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Figure 122

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_122_hydrographs_Run4f_vs_Run2f_180FT-180FTE_4-15.mxd

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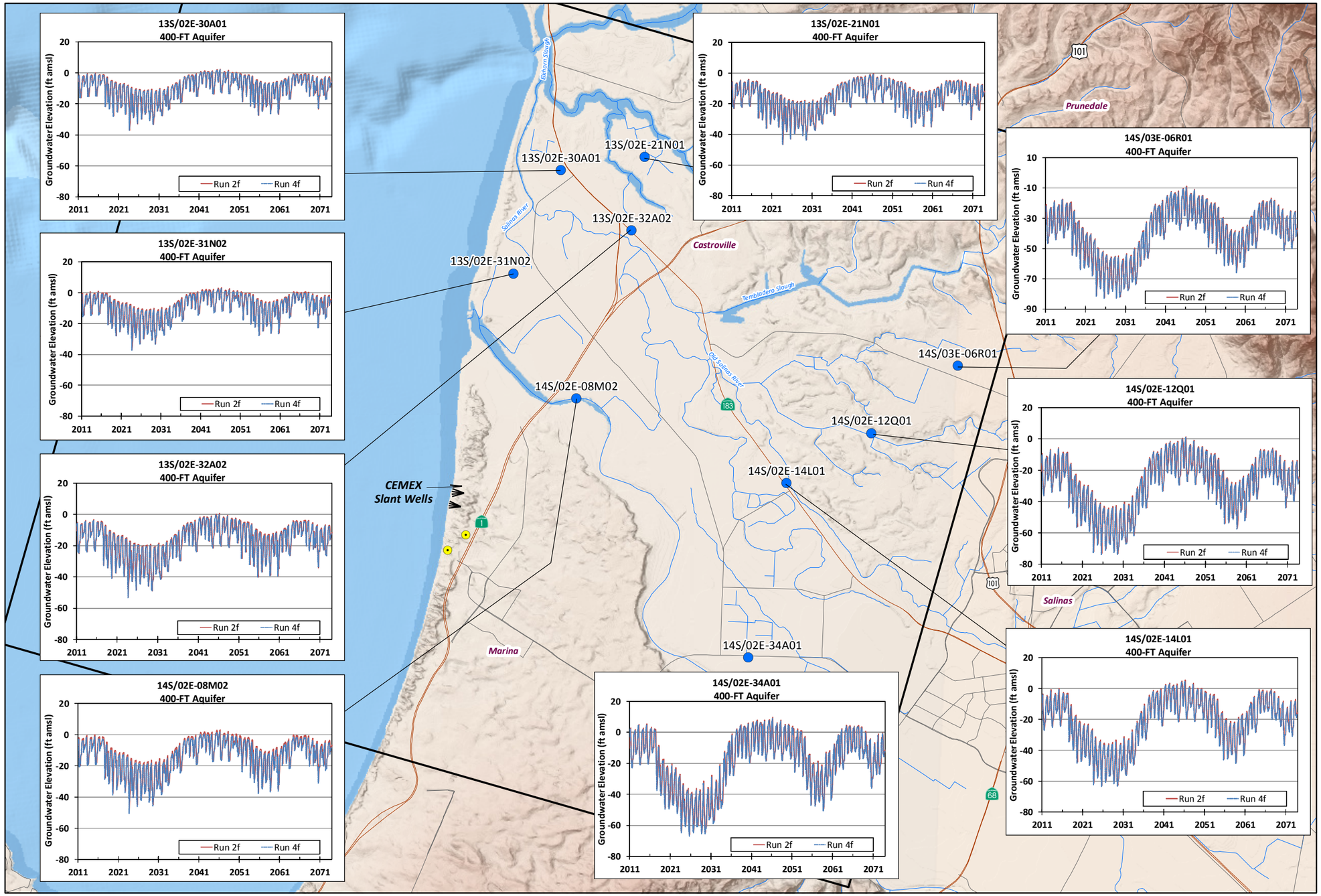
HYDROGRAPHS FOR SELECTED WELLS RUN 4f VERSUS RUN 2f (400-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative with MCWD (No Project) 2060 Land Use

Run 4f - Project 2060 Land Use with MCWD (Dune Sand & 180-FTE)

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Figure 123

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_123_hydrographs_Run4f_vs_Run2f_400FT_4-15.mxd

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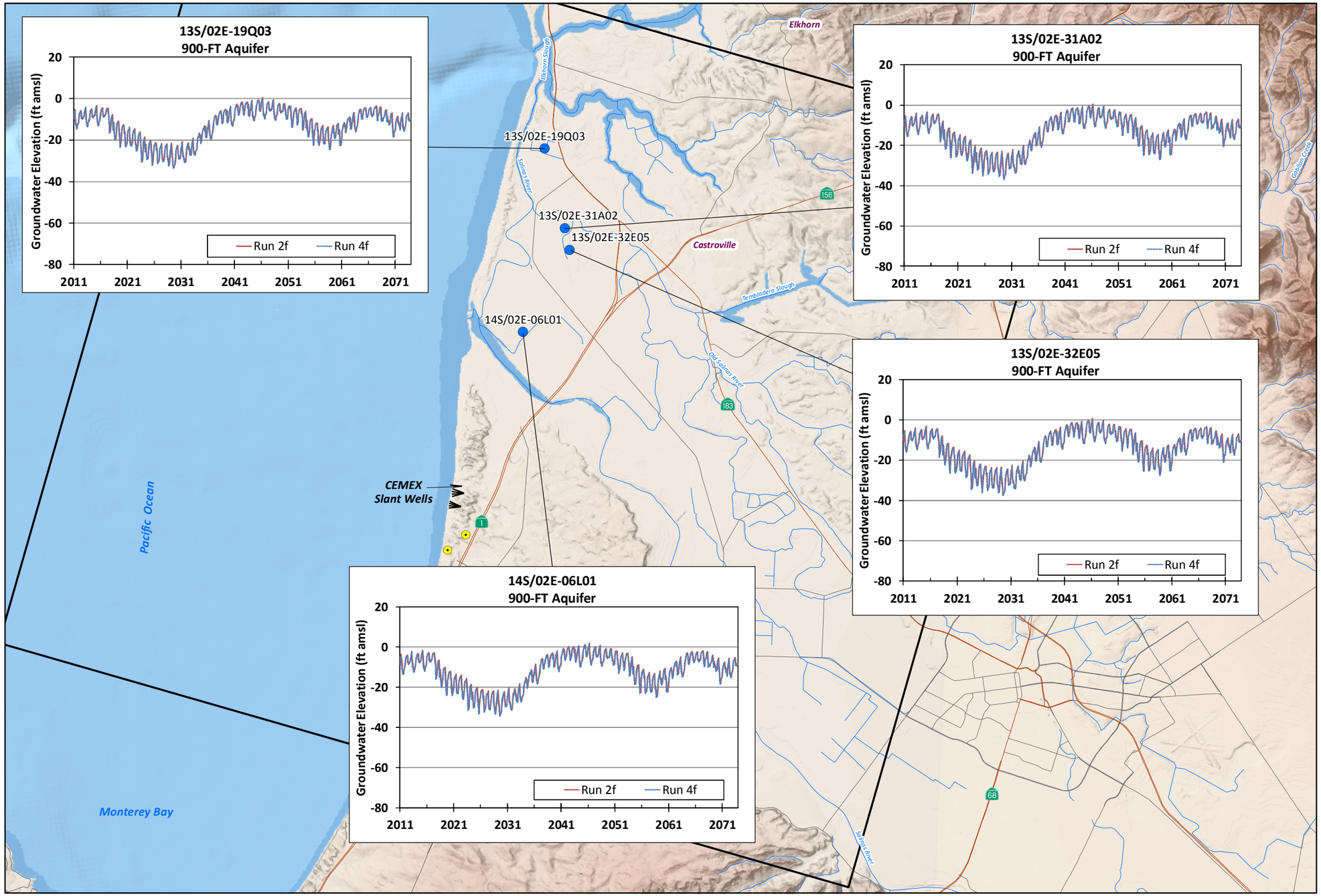
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 4f VERSUS RUN 2f (900-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 47 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative with MCWD (No Project) 2060 Land Use

Run 4f - Project 2060 Land Use with MCWD (Dune Sand & 180-FTE)

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Figure 124

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_124_hydrographs_Run4f_vs_Run2f_900FT_4-15.mxd

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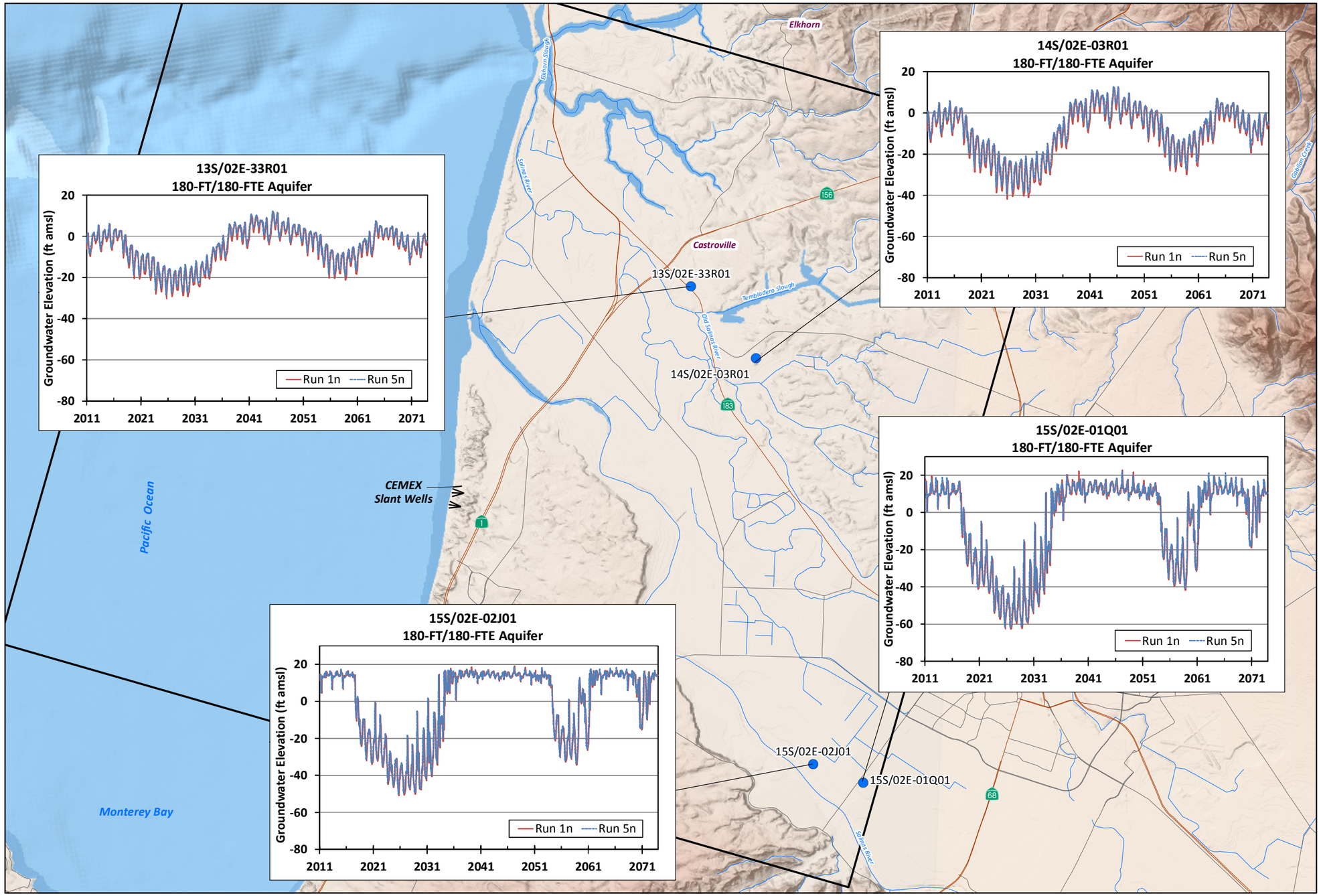
HYDROGRAPHS FOR SELECTED WELLS RUN 5n VERSUS RUN 1n (180-FT/180-FTE AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 5n - Variant 2012 Land Use (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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Figure 125

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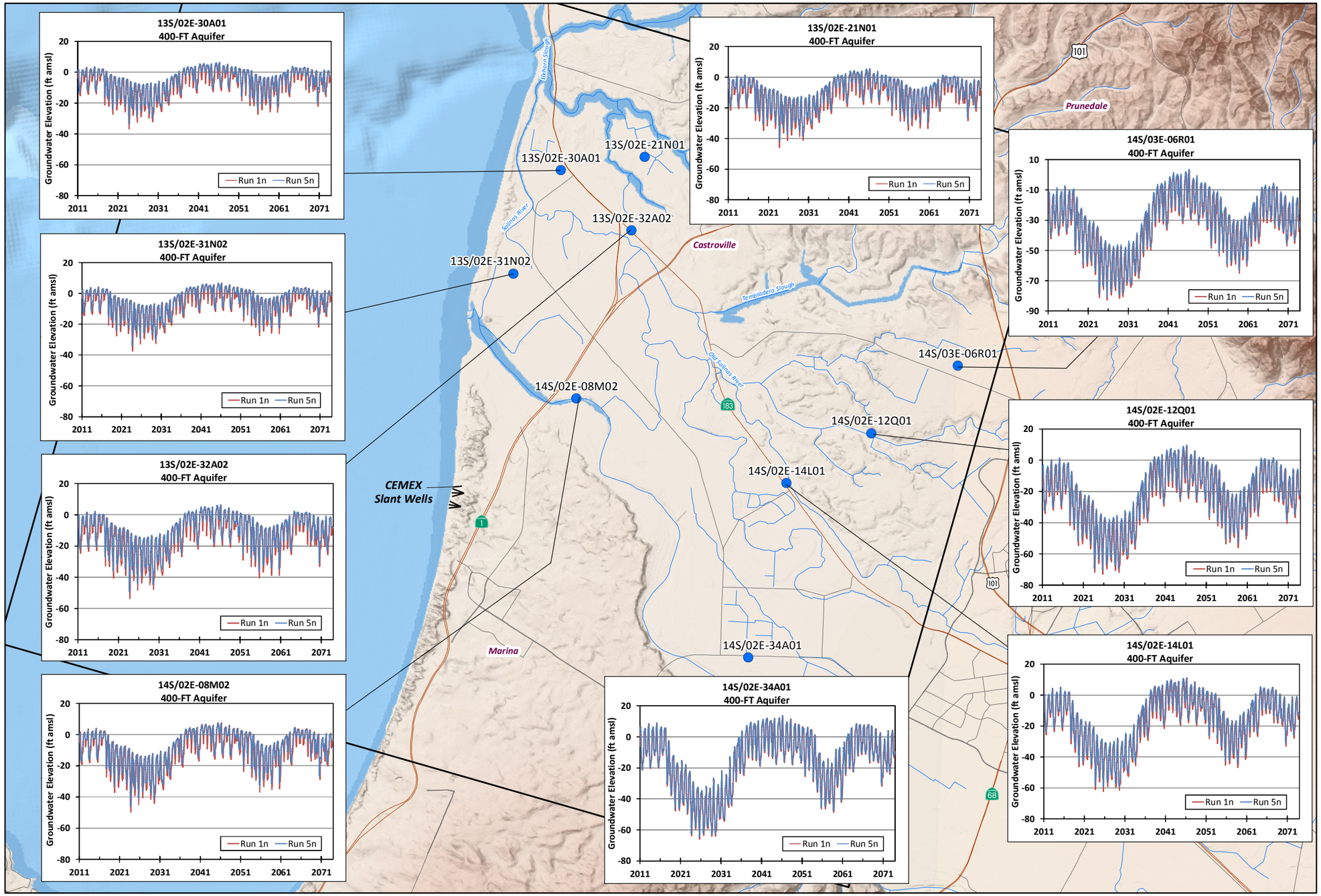
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 5n VERSUS RUN 1n (400-FT AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 5n - Variant 2012 Land Use (Dune Sand & 180-FTE)

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Figure 126

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_126_hydrographs_Run5n_vs_Run1n_400FT_4-15.mxd

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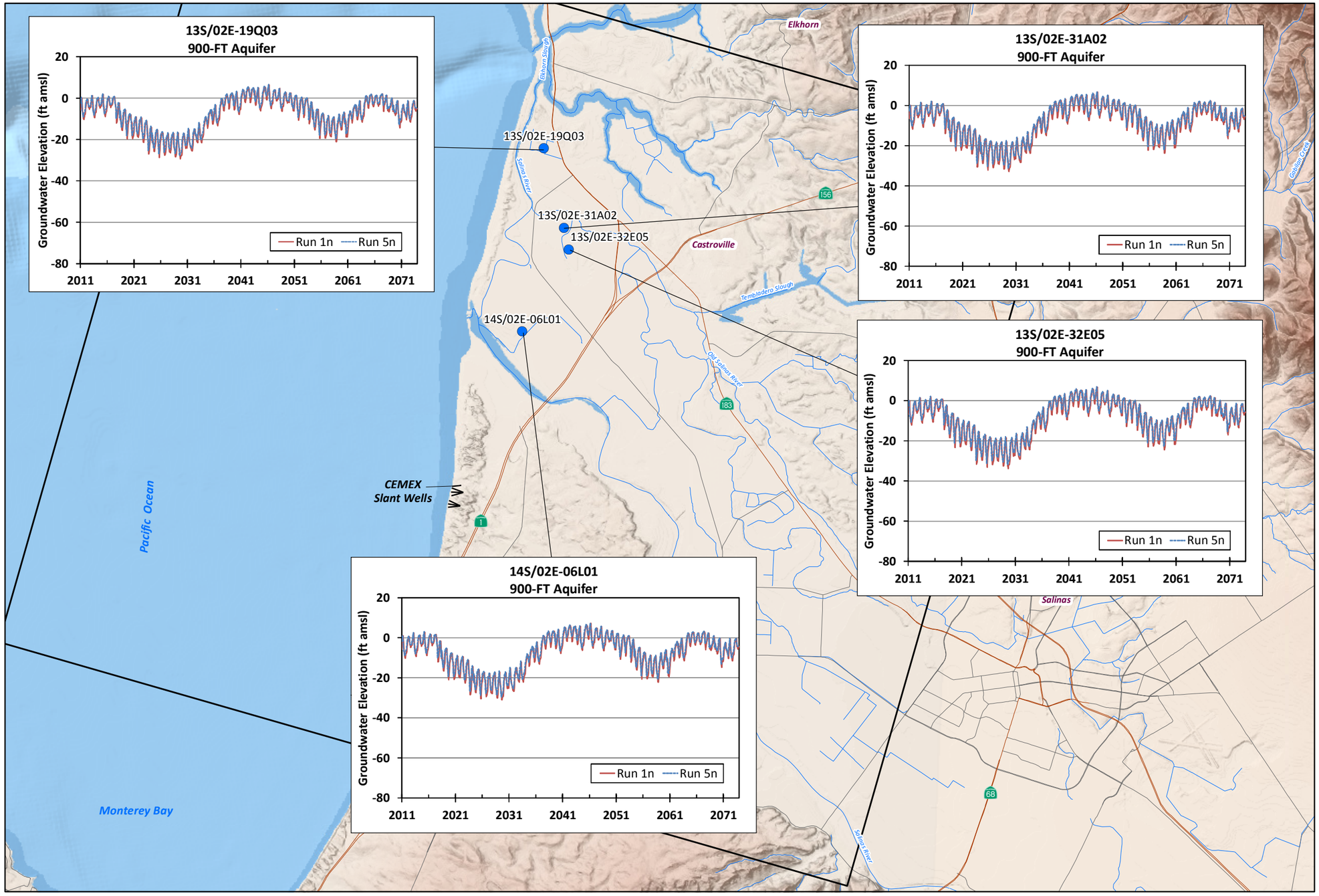
HYDROGRAPHS FOR SELECTED WELLS RUN 5n VERSUS RUN 1n (900-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 5n - Variant 2012 Land Use (Dune Sand & 180-FTE)

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Figure 127

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_127_hydrographs_Run5n_vs_Run1n_900FT_4-15.mxd

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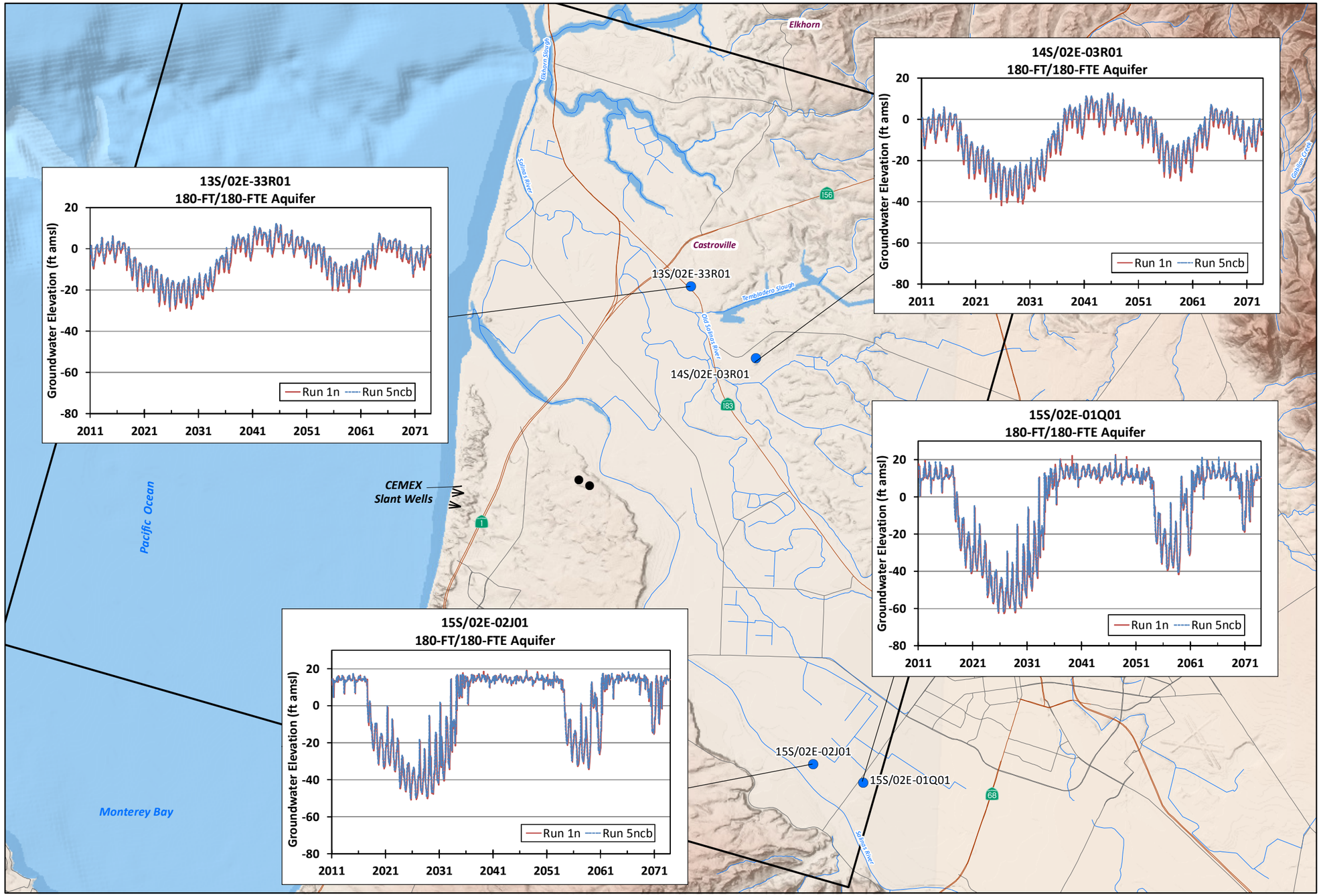
HYDROGRAPHS FOR SELECTED WELLS RUN 5ncb VERSUS RUN 1n (180-FT/180-FTE AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)
- Injection Well at Charles Benson Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 5ncb - Variant 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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Figure 128

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_128_hydrographs_Run5ncb_vs_Run1n_180FT-180FTE_4-15.mxd

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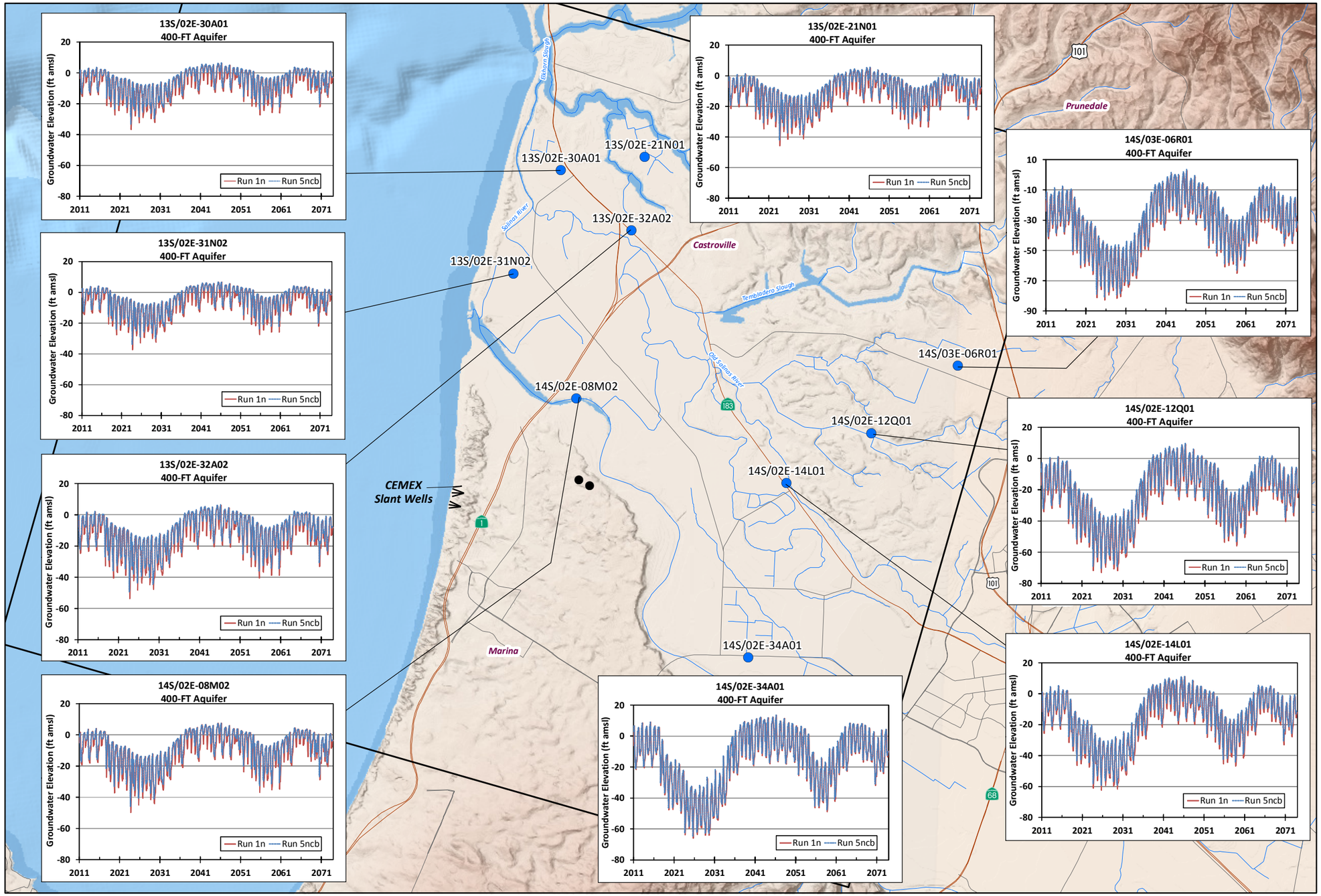
HYDROGRAPHS FOR SELECTED WELLS RUN 5ncb VERSUS RUN 1n (400-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)
- Injection Well at Charles Benson Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 5ncb - Variant 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)

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Figure 129

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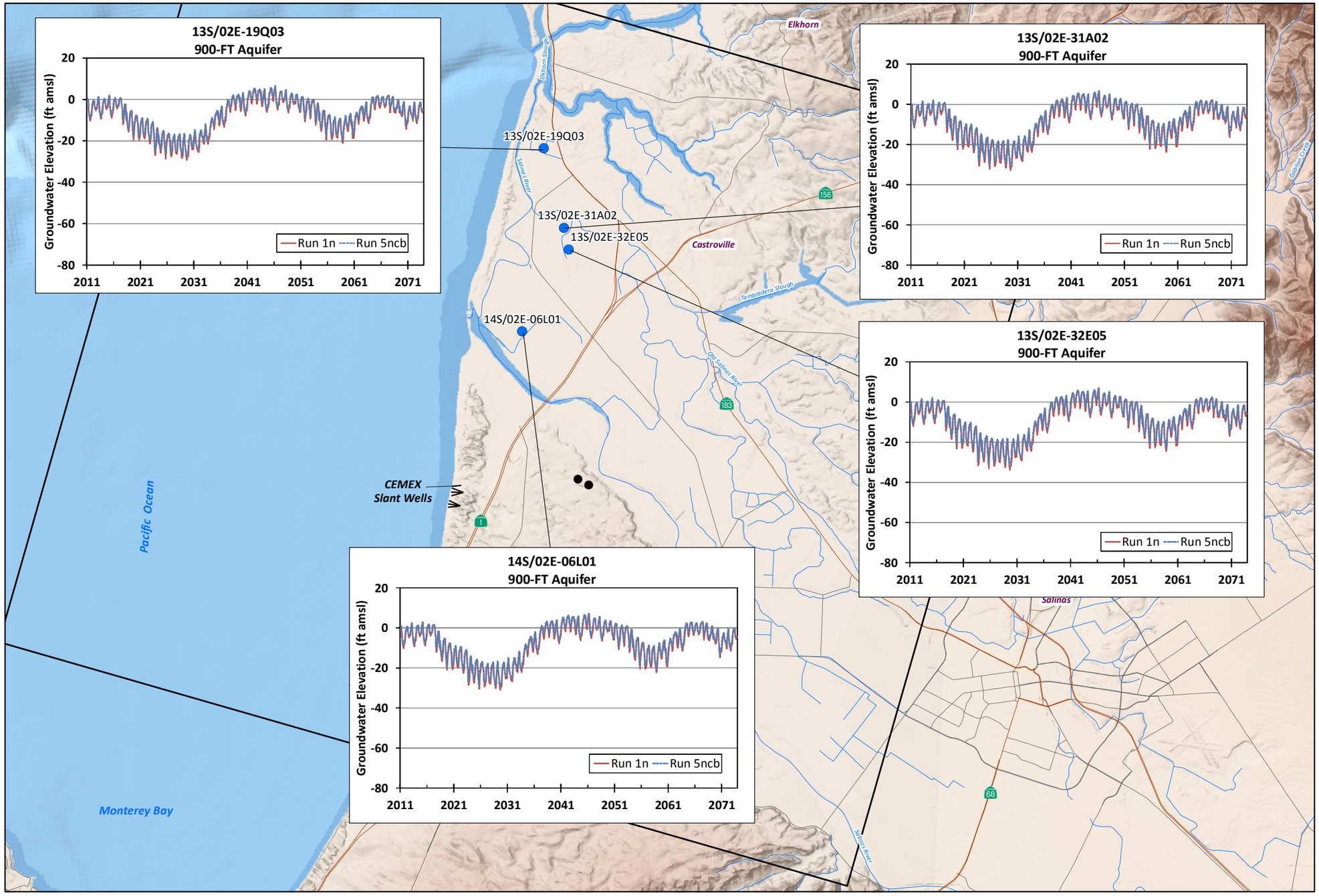
HYDROGRAPHS FOR SELECTED WELLS RUN 5ncb VERSUS RUN 1n (900-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)
- Injection Well at Charles Benson Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 5ncb - Variant 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)

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Figure 130

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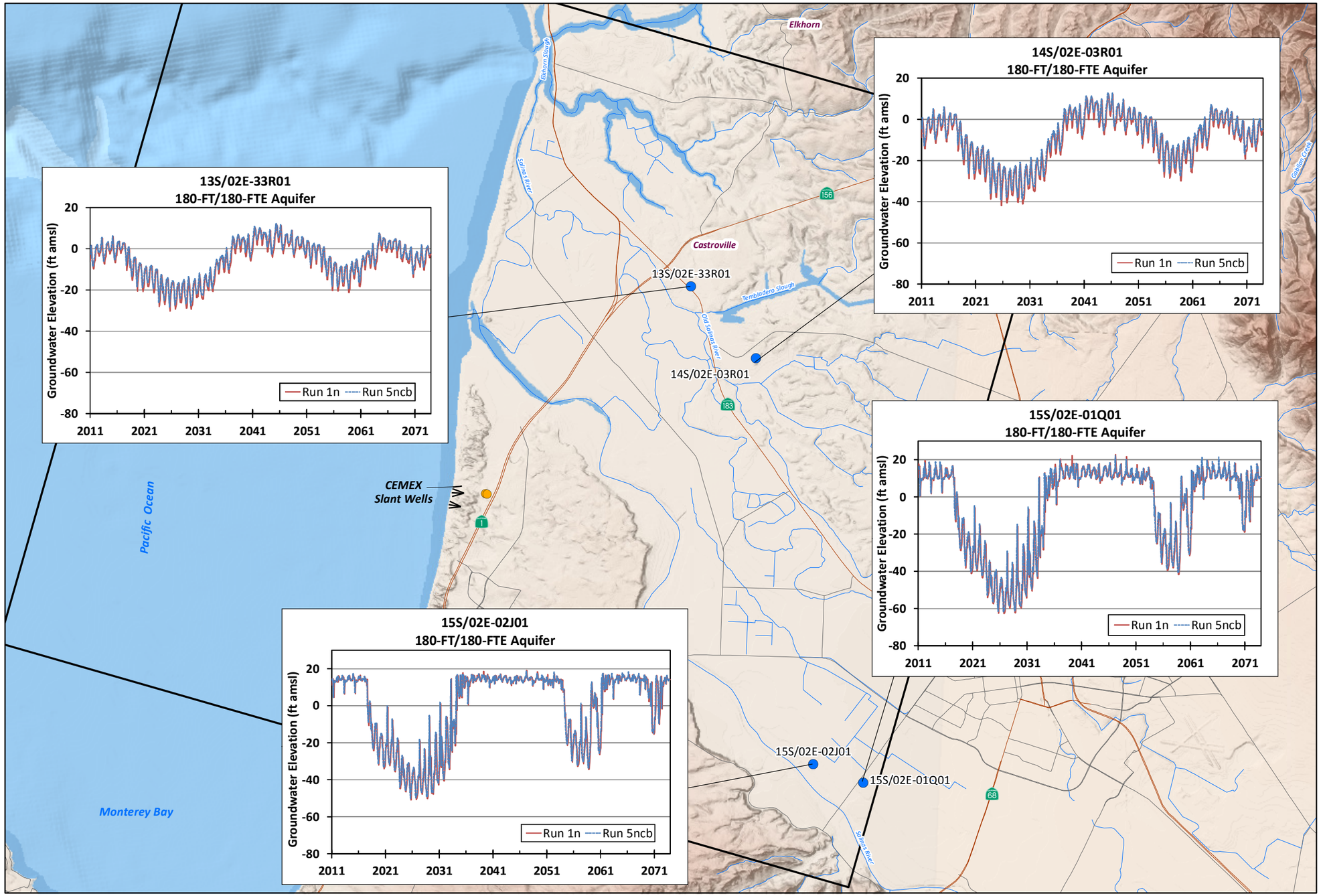
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 5nc VERSUS RUN 1n (180-FT/180-FTE AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)
- Injection Well at CEMEX Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 5nc - Variant 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

17-Apr-15

Prepared by: DB. Map Projection: State Plane 1983, Zone IV.

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NORTH

0 1 2 4 Miles

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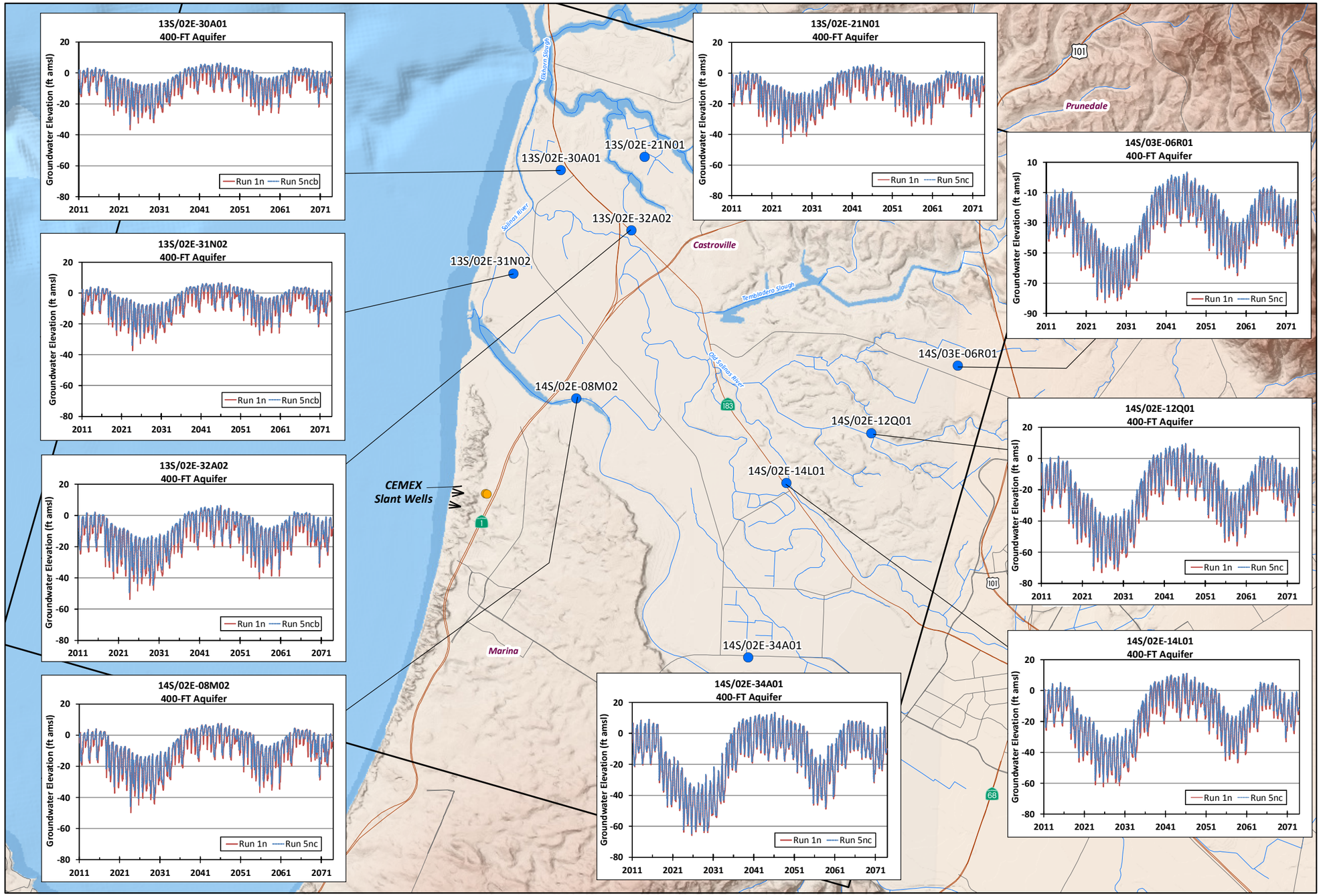
Figure 131

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_131_hydrographs_Run5nc_vs_Run1n_180FT-180FTE_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 5nc VERSUS RUN 1n (400-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)
- Injection Well at CEMEX Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 5nc - Variant 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)

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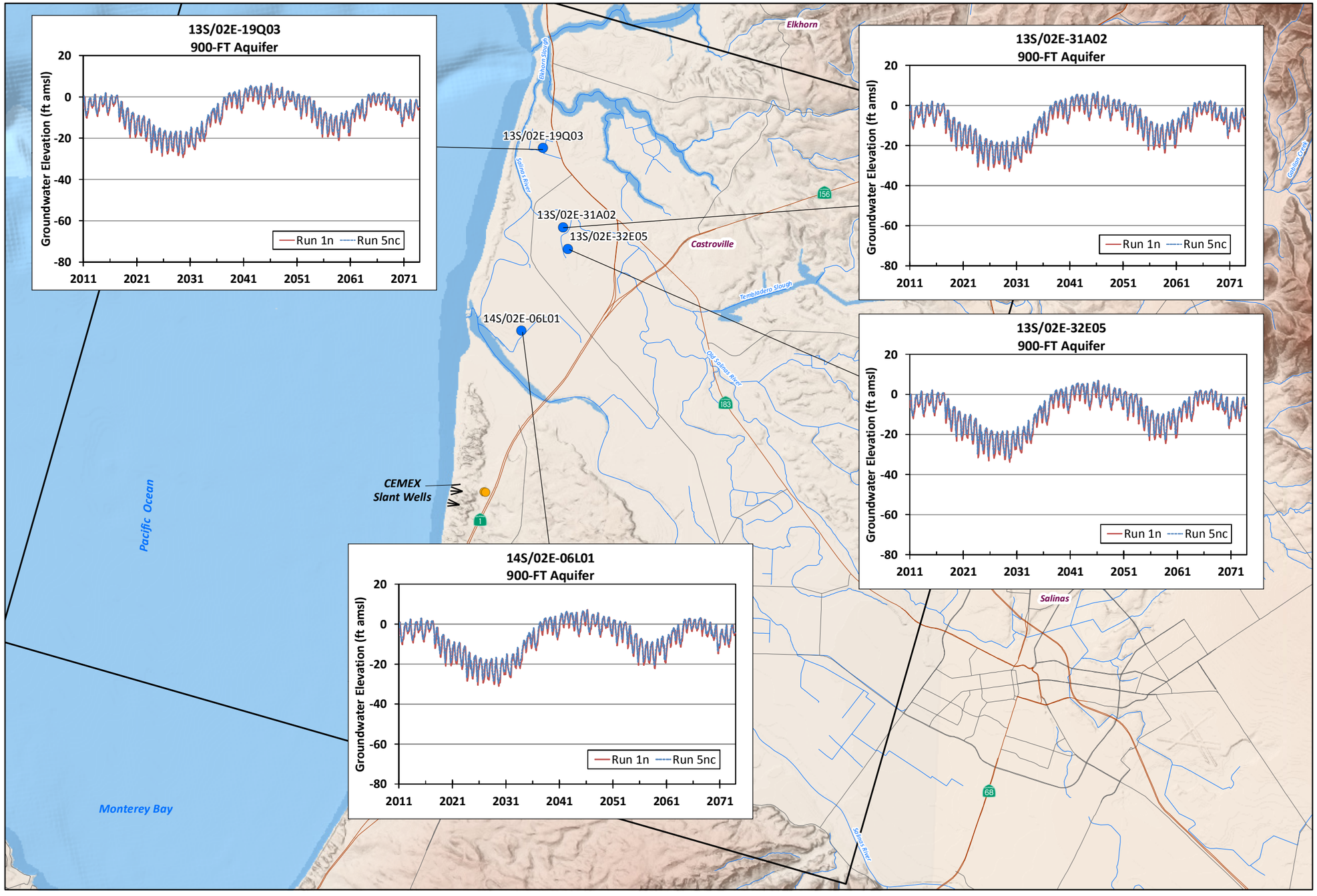
Figure 132

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_132_hydrographs_Run5nc_vs_Run1n_400FT_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 5nc VERSUS RUN 1n (900-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)
- Injection Well at CEMEX Site for Returning Basin Water

Run 1n - Baseline (No Project) 2012 Land Use

Run 5nc - Variant 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)

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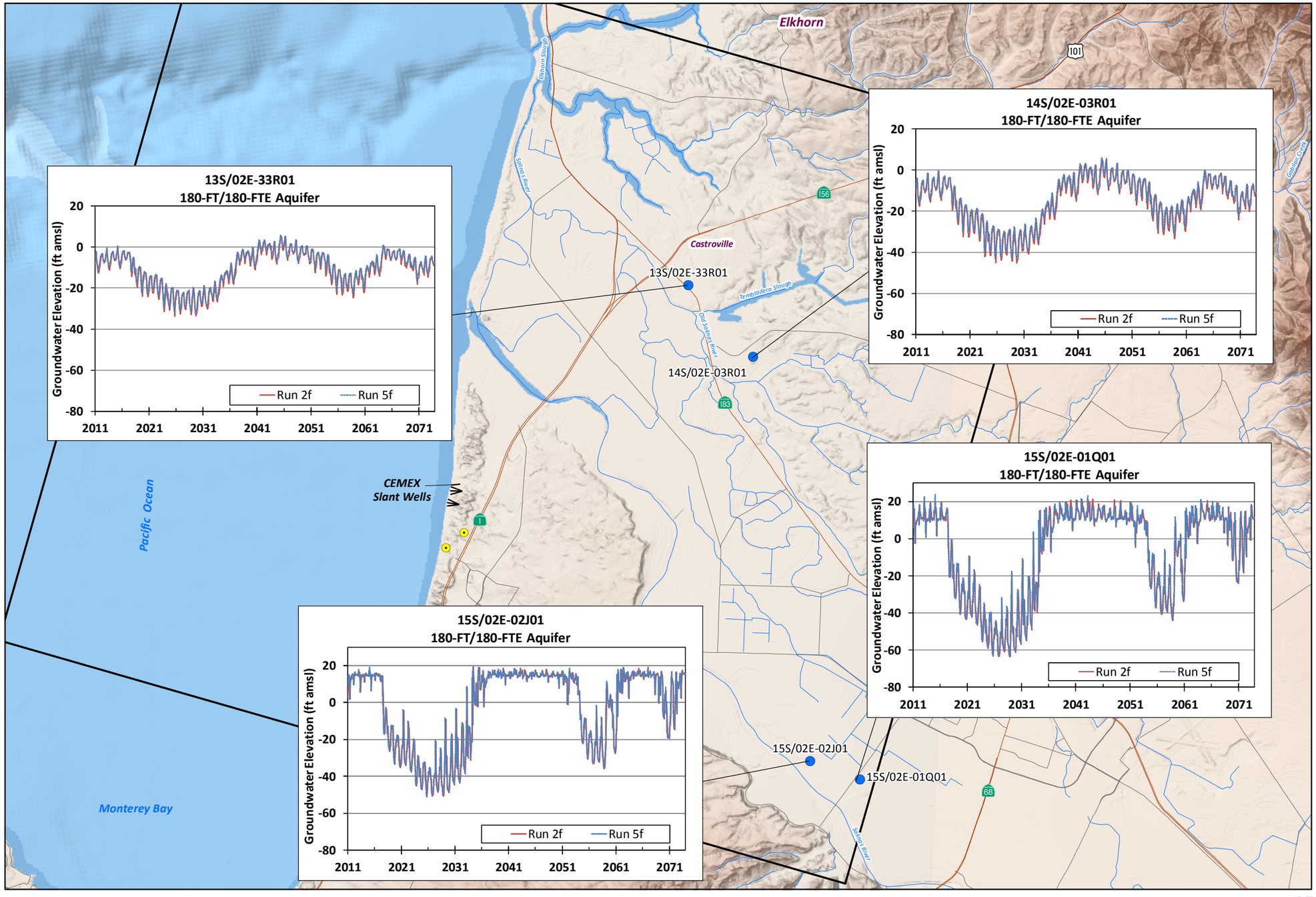
Figure 133

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_133_hydrographs_Run5nc_vs_Run1n_900FT_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 5f VERSUS RUN 2f (180-FT/180-FTE AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative with MCWD (No Project) 2060 Land Use

Run 5f - Variant 2060 Land Use with MCWD (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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Figure 134

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_134_hydrographs_Run5f_vs_Run2f_180FT-180FTE_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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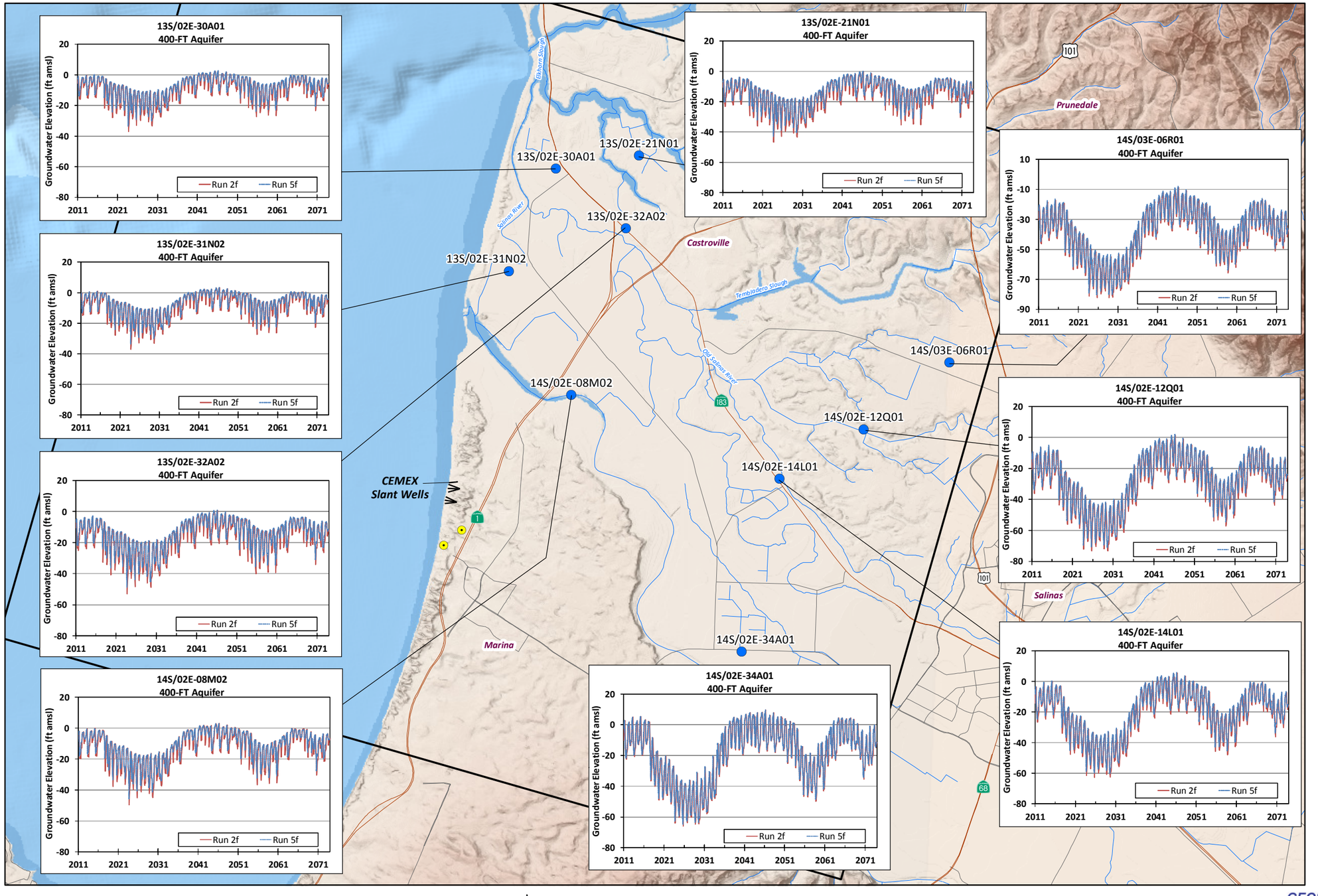
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 5f VERSUS RUN 2f (400-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative with MCWD (No Project) 2060 Land Use

Run 5f - Variant 2060 Land Use with MCWD (Dune Sand & 180-FTE)

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Figure 135

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_135_hydrographs_Run5f_vs_Run2f_400FT_4-15.mxd

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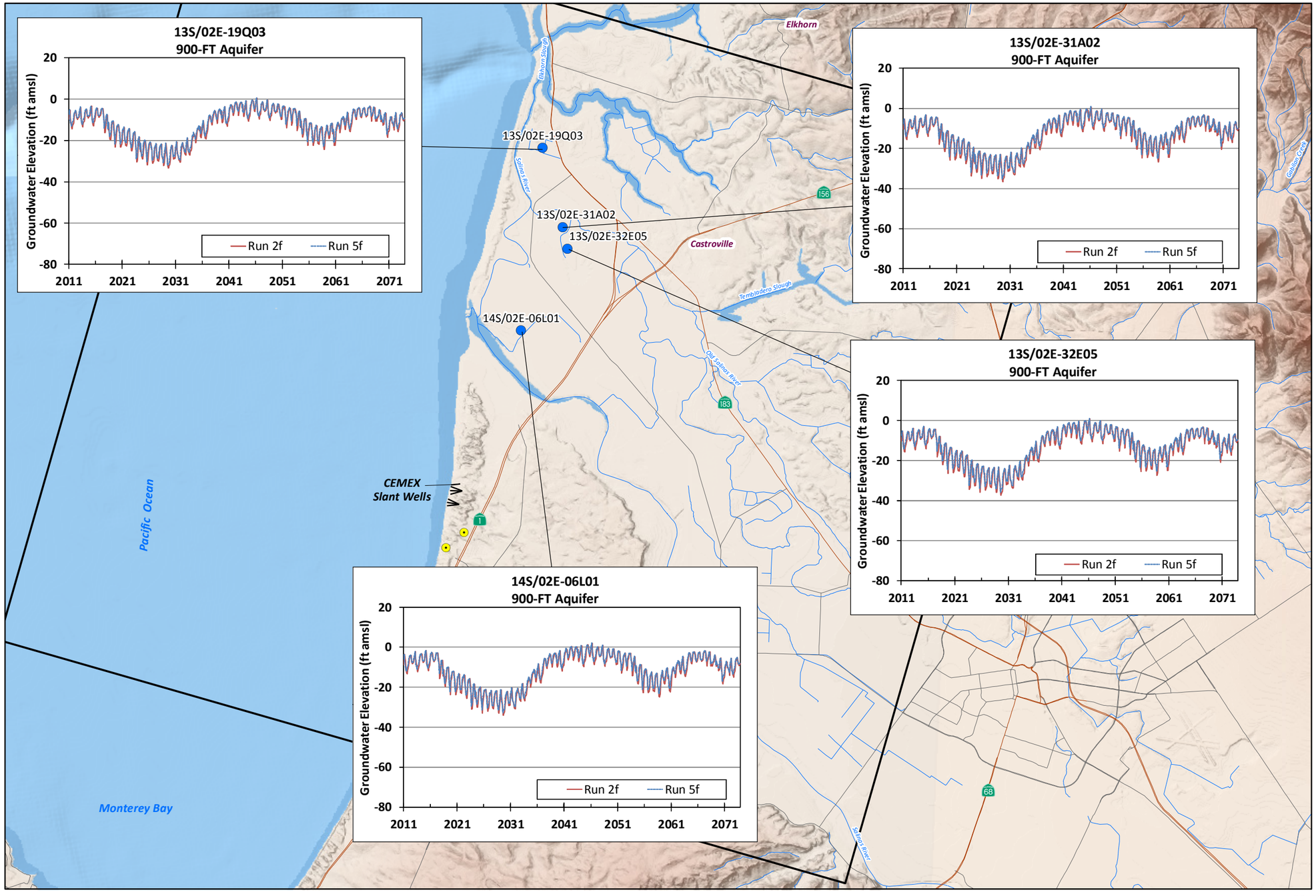
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 5f VERSUS RUN 2f (900-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- CEMEX Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 48 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative with MCWD (No Project) 2060 Land Use

Run 5f - Variant 2060 Land Use with MCWD (Dune Sand & 180-FTE)

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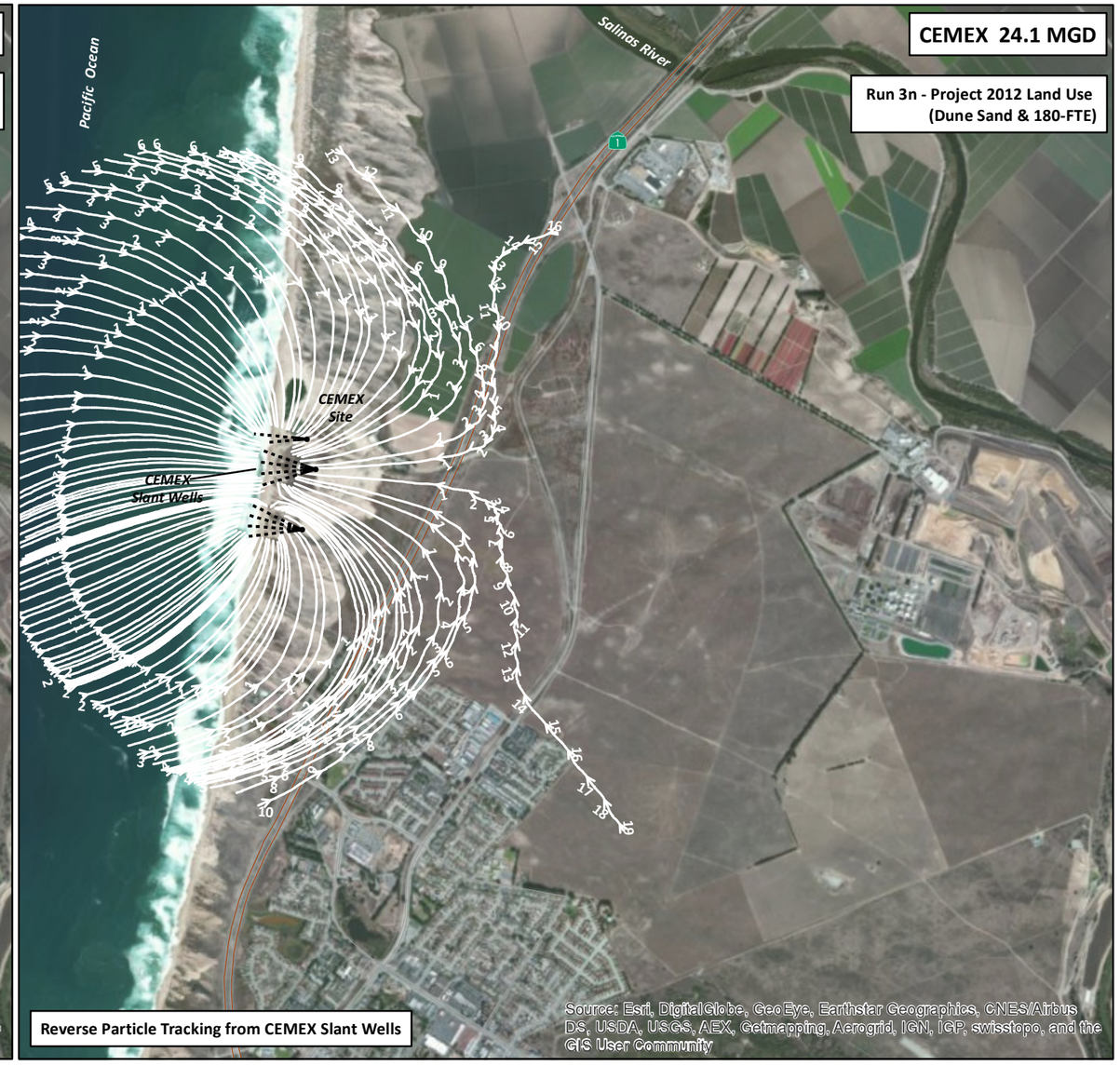
Figure 136

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_136_hydrographs_Run5f_vs_Run2f_900FT_4-15.mxd



EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,500 5,000 Feet

Run 1n - Baseline (No Project)
2012 Land Use

Run 3n - Project 2012 Land Use
(Dune Sand & 180-FTE)

PARTICLE TRACKING NEAR CEMEX SITE
NO PROJECT (RUN 1n) AND
CEMEX 24.1 MGD (RUN 3n)
180-FT/180-FTE AQUIFER

17-Apr-15

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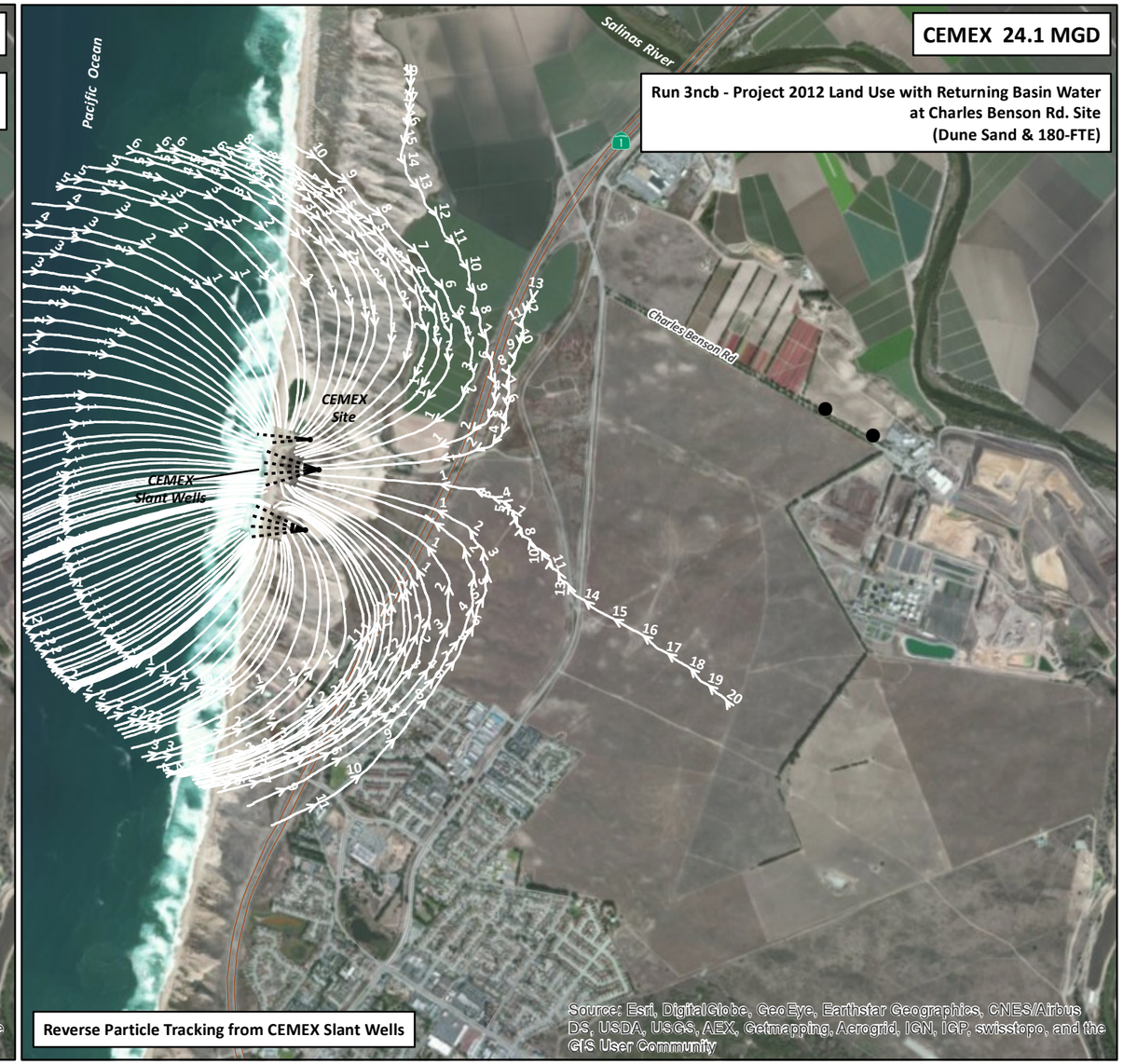
Figure 137

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_137_Run1nRun3n_parttrack_CEMEX_180FTE_2panel_4-15.mxd



EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Injection Well at Charles Benson Site for Returning Basin Water

Note: 180-FTE = 180-Foot Equivalent Aquifer

Run 1n - Baseline (No Project)
2012 Land Use

Run 3ncb - Project 2012 Land Use with Returning Basin Water
at Charles Benson Rd. Site
(Dune Sand & 180-FTE)

NORTH

0 2,500 5,000 Feet

PARTICLE TRACKING NEAR CEMEX SITE NO PROJECT (RUN 1n) AND CEMEX 24.1 MGD (RUN 3ncb) 180-FT/180-FTE AQUIFER

17-Apr-15

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Figure 138

EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Injection Well at CEMEX Site for Returning Basin Water

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,500 5,000 Feet

Run 1n - Baseline (No Project)
2012 Land Use

Run 3nc - Project 2012 Land Use with Returning Basin Water
at CEMEX Site
(Dune Sand & 180-FTE)

PARTICLE TRACKING NEAR CEMEX SITE NO PROJECT (RUN 1n) AND CEMEX 24.1 MGD (RUN 3nc) 180-FT/180-FTE AQUIFER

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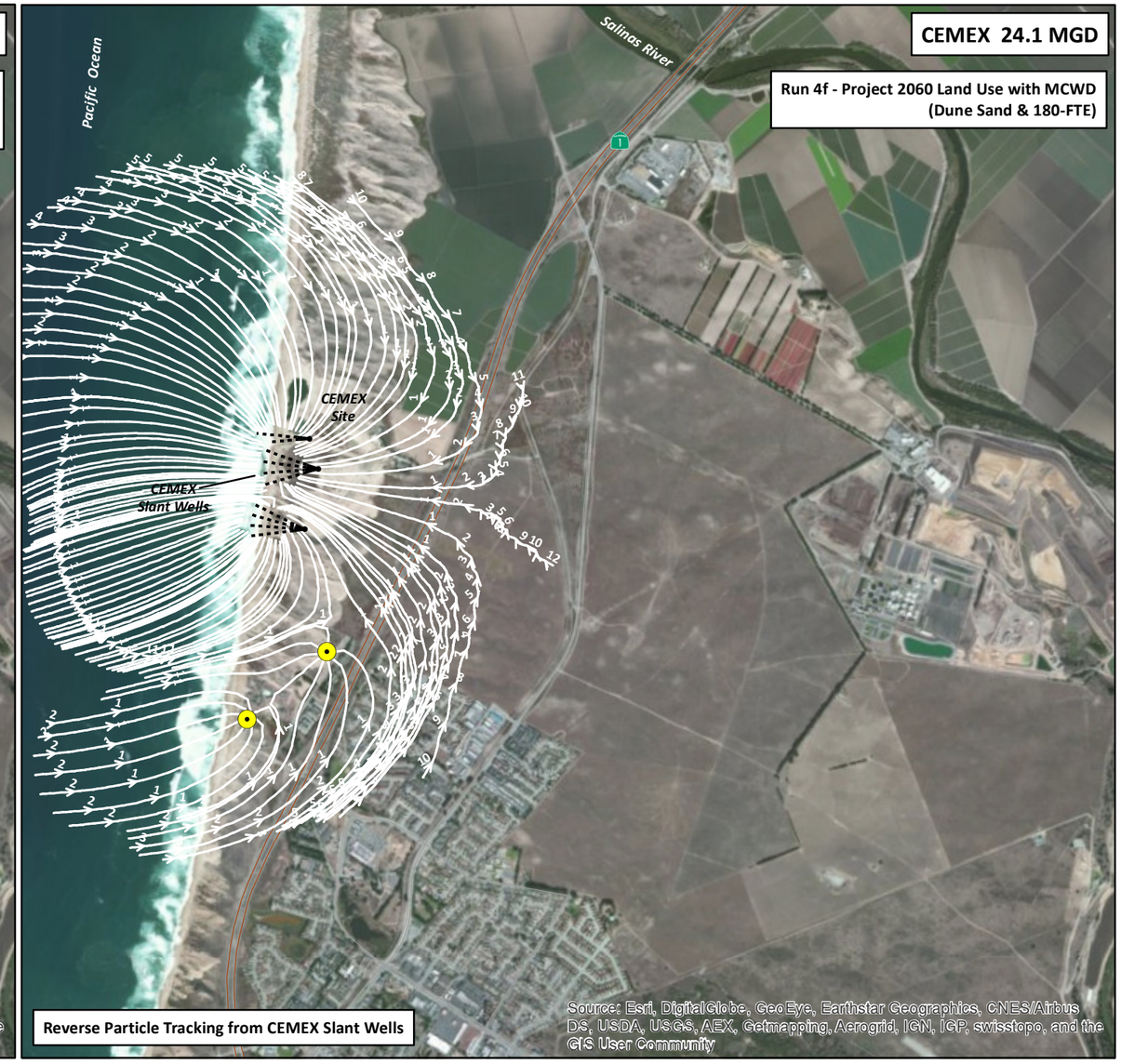
Figure 139

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_139_Run1nRun3nc_parttrack_CEMEX_180FTE_2panel_4-15.mxd



EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

Proposed Marina Coast Water District Desalination Well

Slant Wellhead
Blank Casing
Well Screen

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Note: 180-FTE = 180-Foot Equivalent Aquifer

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 4f - Project 2060 Land Use with MCWD
(Dune Sand & 180-FTE)

NORTH

0 2,500 5,000 Feet

17-Apr-15

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PARTICLE TRACKING NEAR CEMEX SITE
NO PROJECT (RUN 2f) AND
CEMEX 24.1 MGD (RUN 4f)
180-FT/180-FTE AQUIFER

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Figure 140

EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

CEMEX Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 48 for Detailed Slant Well Layout)

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,500 5,000 Feet

Run 1n - Baseline (No Project)
2012 Land Use

Run 5n - Variant 2012 Land Use
(Dune Sand & 180-FTE)

PARTICLE TRACKING NEAR CEMEX SITE
NO PROJECT (RUN 1n) AND
CEMEX 15.5 MGD (RUN 5n)
180-FT/180-FTE AQUIFER

17-Apr-15

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Figure 141

EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

CEMEX Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 48 for Detailed Slant Well Layout)

Injection Well at Charles Benson Site for Returning Basin Water

Note: 180-FTE = 180-Foot Equivalent Aquifer

Run 1n - Baseline (No Project)
2012 Land Use

Run 5ncb - Variant 2012 Land Use with Returning Basin Water
at Charles Benson Rd. Site
(Dune Sand & 180-FTE)

NORTH

0 2,500 5,000 Feet

17-Apr-15

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PARTICLE TRACKING NEAR CEMEX SITE
NO PROJECT (RUN 1n) AND
CEMEX 15.5 MGD (RUN 5ncb)
180-FT/180-FTE AQUIFER

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Figure 142

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_142_Run1nRun5ncb_parttrack_CEMEX_180FTE_2panel_4-15.mxd

EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

CEMEX Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 48 for Detailed Slant Well Layout)

Injection Well at CEMEX Site for Returning Basin Water

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,500 5,000 Feet

Run 1n - Baseline (No Project)
2012 Land Use

Run 5nc - Variant 2012 Land Use with Returning Basin Water
at CEMEX Site
(Dune Sand & 180-FTE)

PARTICLE TRACKING NEAR CEMEX SITE NO PROJECT (RUN 1n) AND CEMEX 15.5 MGD (RUN 5nc) 180-FT/180-FTE AQUIFER

17-Apr-15

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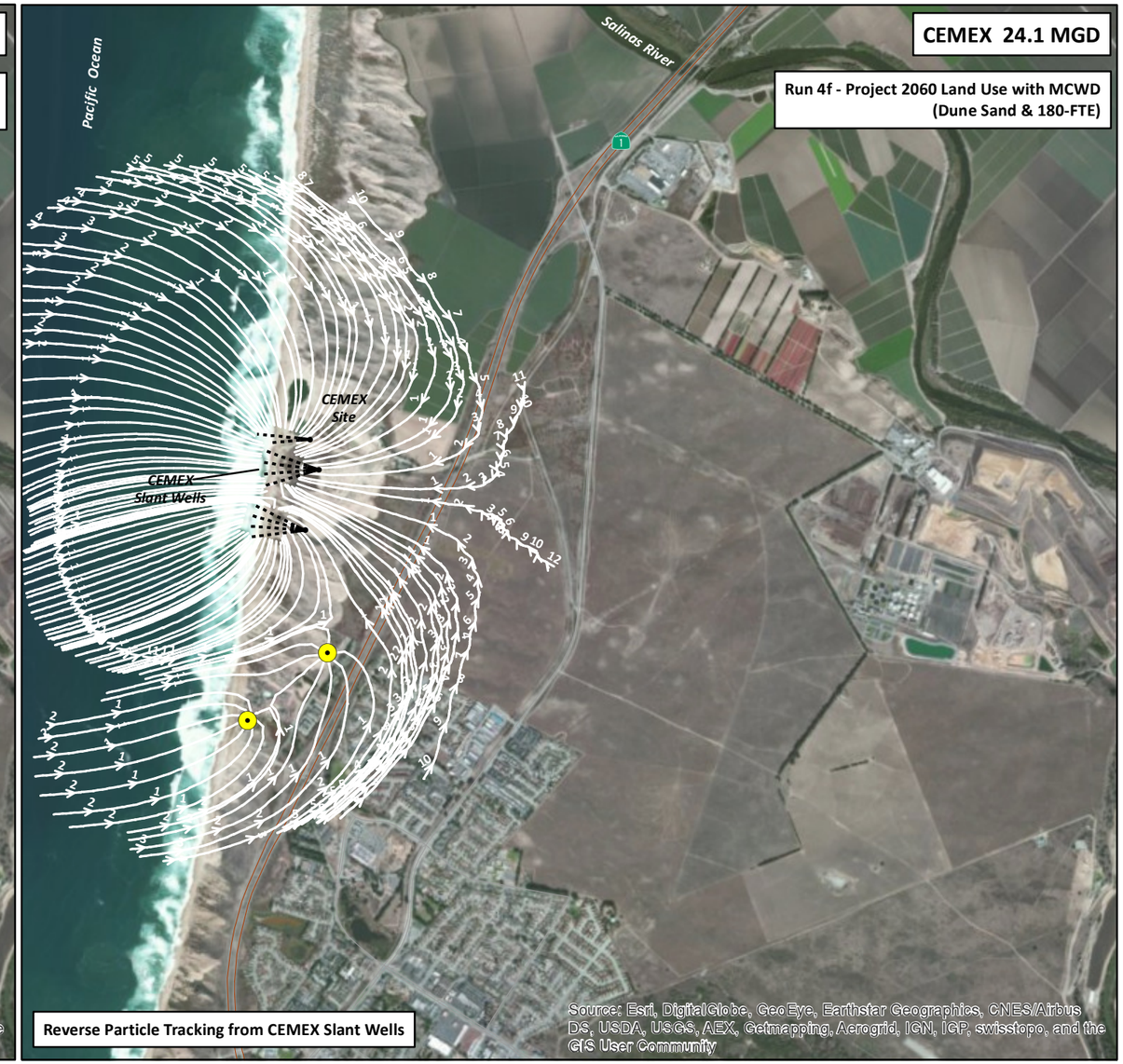
Figure 143

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_143_Run1nRun5nc_parttrack_CEMEX_180FTE_2panel_4-15.mxd



EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

Proposed Marina Coast Water District Desalination Well

Slant Wellhead
Blank Casing
Well Screen

CEMEX Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 47 for Detailed Slant Well Layout)

Note: 180-FTE = 180-Foot Equivalent Aquifer

Run 1n - Baseline (No Project)
2012 Land Use

Run 4f - Project 2060 Land Use with MCWD
(Dune Sand & 180-FTE)

NORTH

0 2,500 5,000 Feet

6-Mar-15

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PARTICLE TRACKING NEAR CEMEX SITE NO PROJECT (RUN 1n) AND CEMEX 24.1 MGD (RUN 4f) 180-FT/180-FTE AQUIFER

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Figure 144

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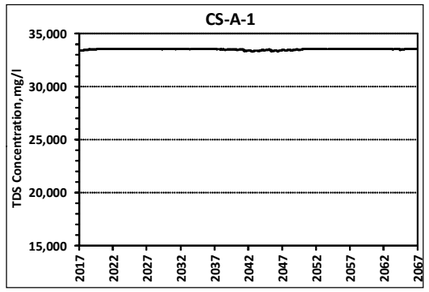
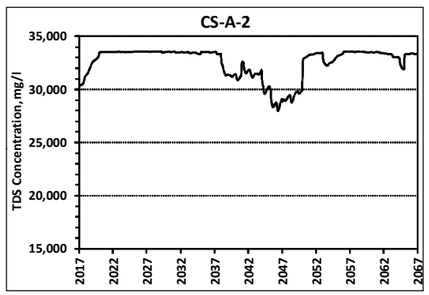
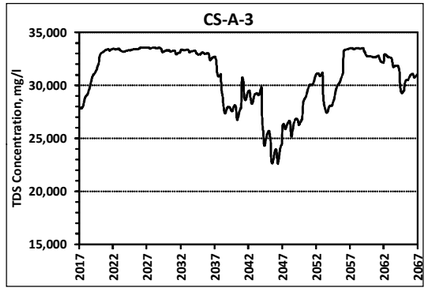
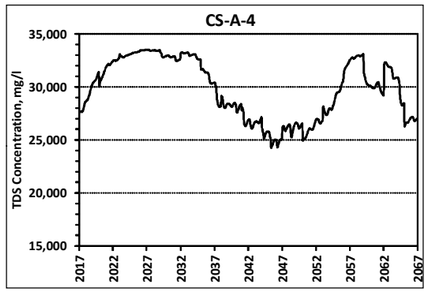
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

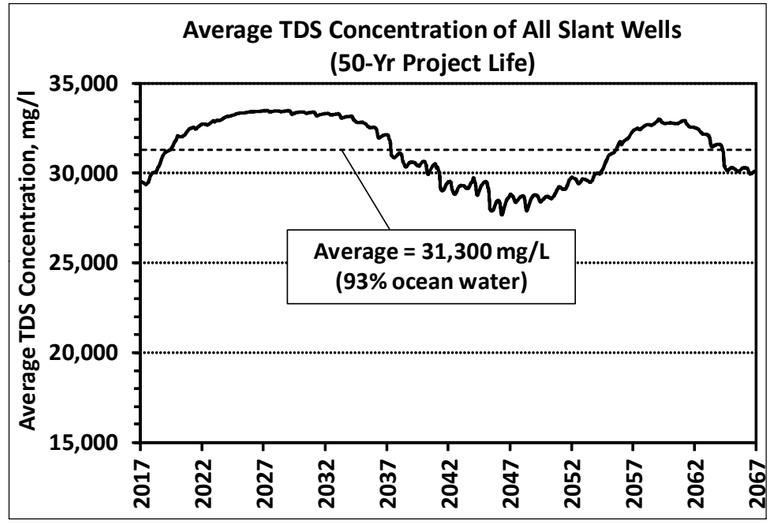
PREDICTED PERCENT OF OCEAN WATER IN CEMEX SITE PROJECT SLANT WELLS - RUN 3n

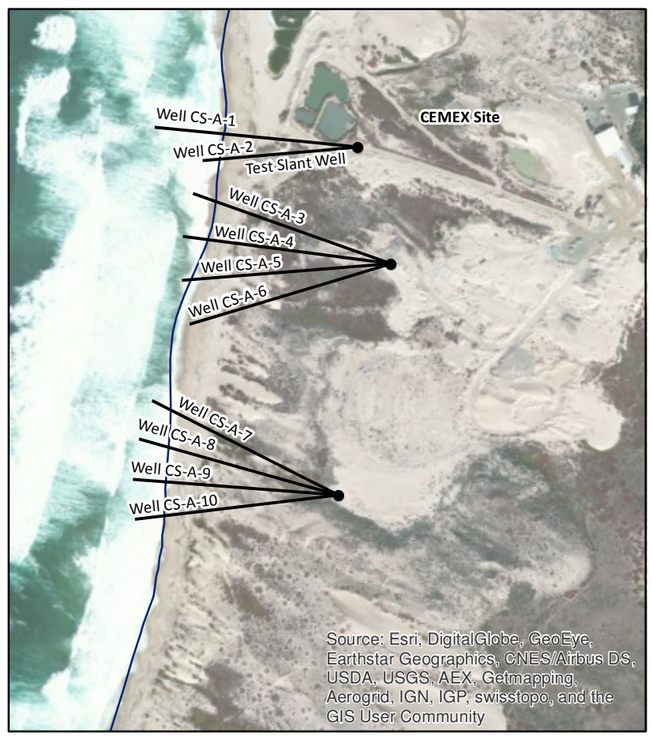


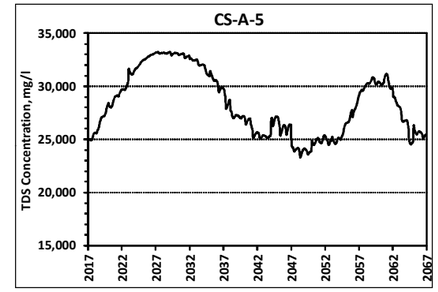


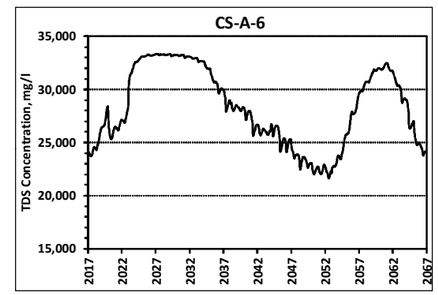


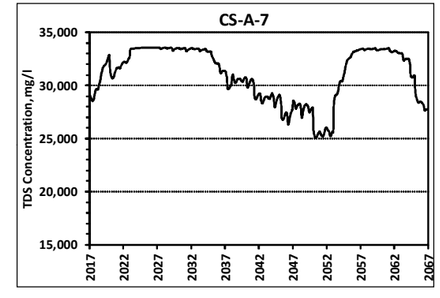


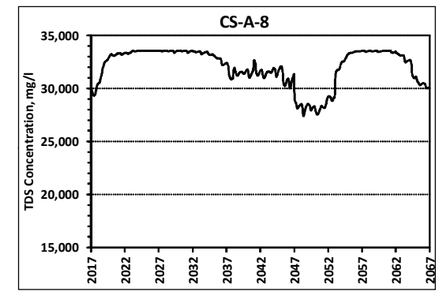


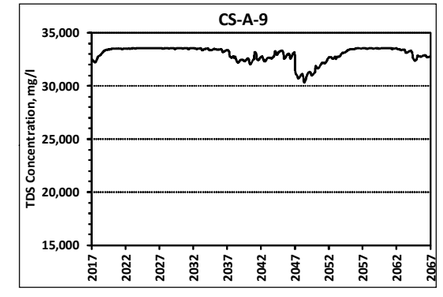


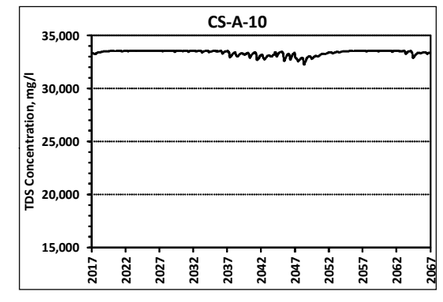












EXPLANATION

Run 3n - Project 2012 Land Use
(Dune Sand & 180-FTE)

Note: 180-FTE = 180-Foot Equivalent Aquifer

17-Apr-15

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NORTH

0 500 1,000 2,000 Feet

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Figure 145

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_145_Percent_OceanWater_CEMEX_Run3n_4-15.mxd

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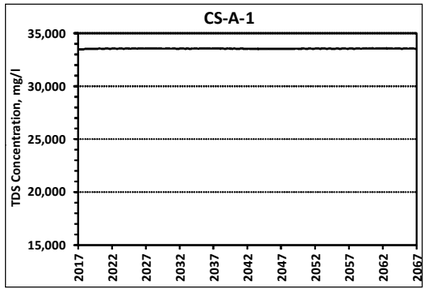
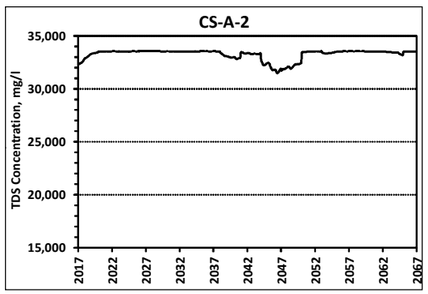
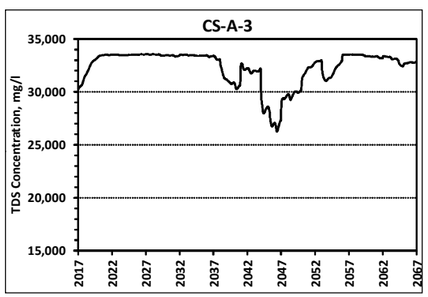
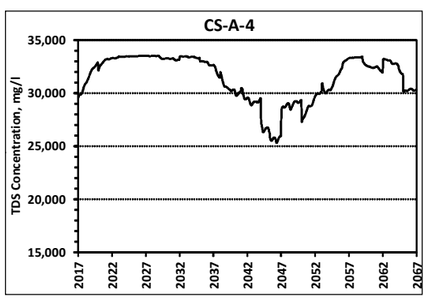
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

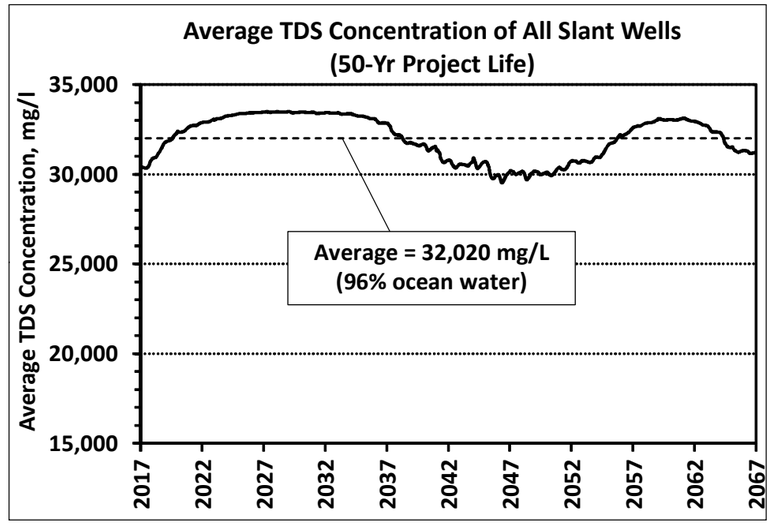
PREDICTED PERCENT OF OCEAN WATER IN CEMEX SITE PROJECT SLANT WELLS - RUN 4f

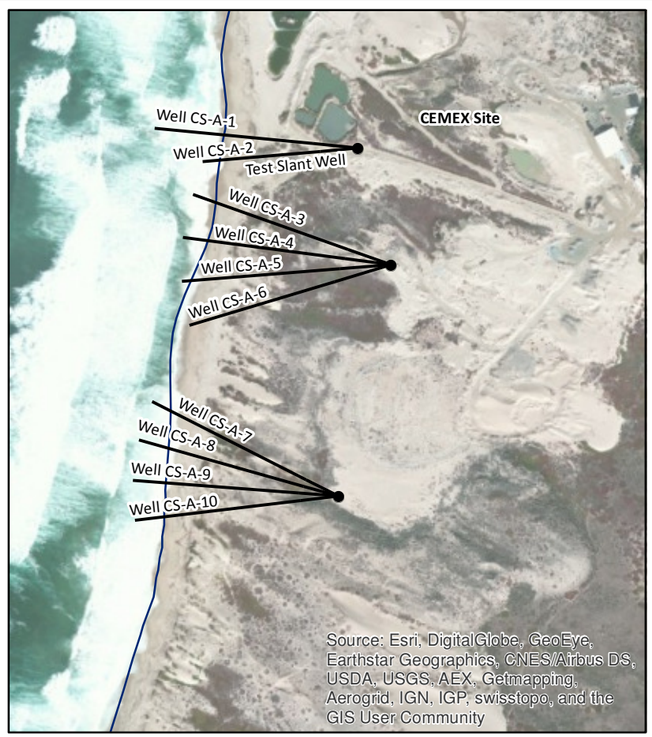


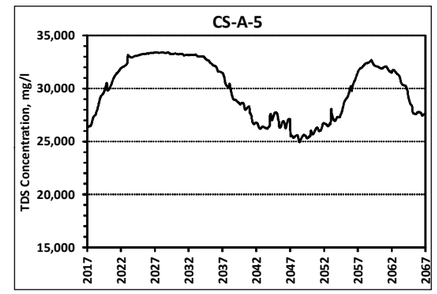


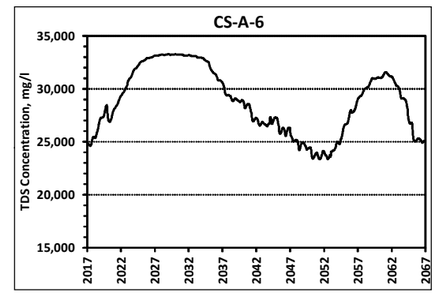


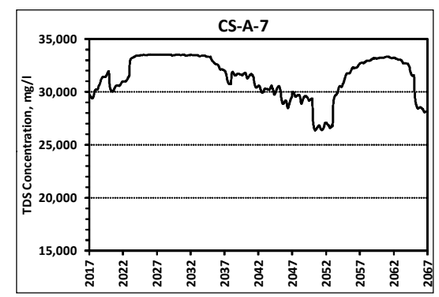


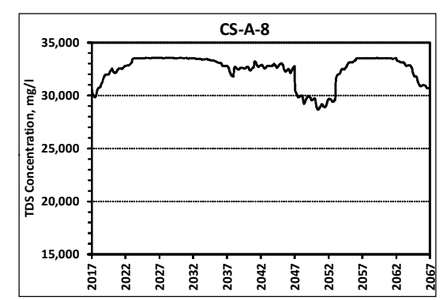


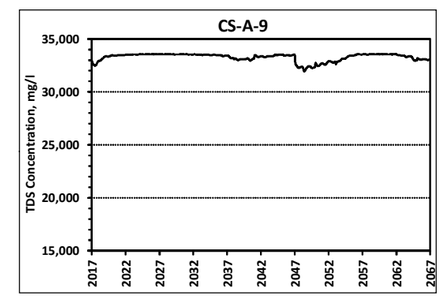


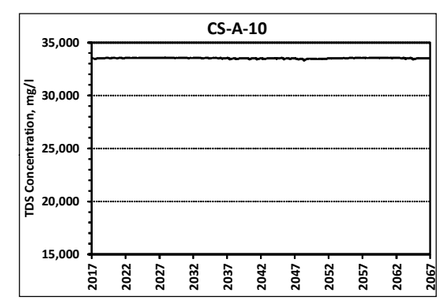












EXPLANATION

Run 4f - Project 2060 Land Use with MCWD
(Dune Sand & 180-FTE)

Note: 180-FTE = 180-Foot Equivalent Aquifer

17-Apr-15

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NORTH

0 500 1,000 2,000 Feet

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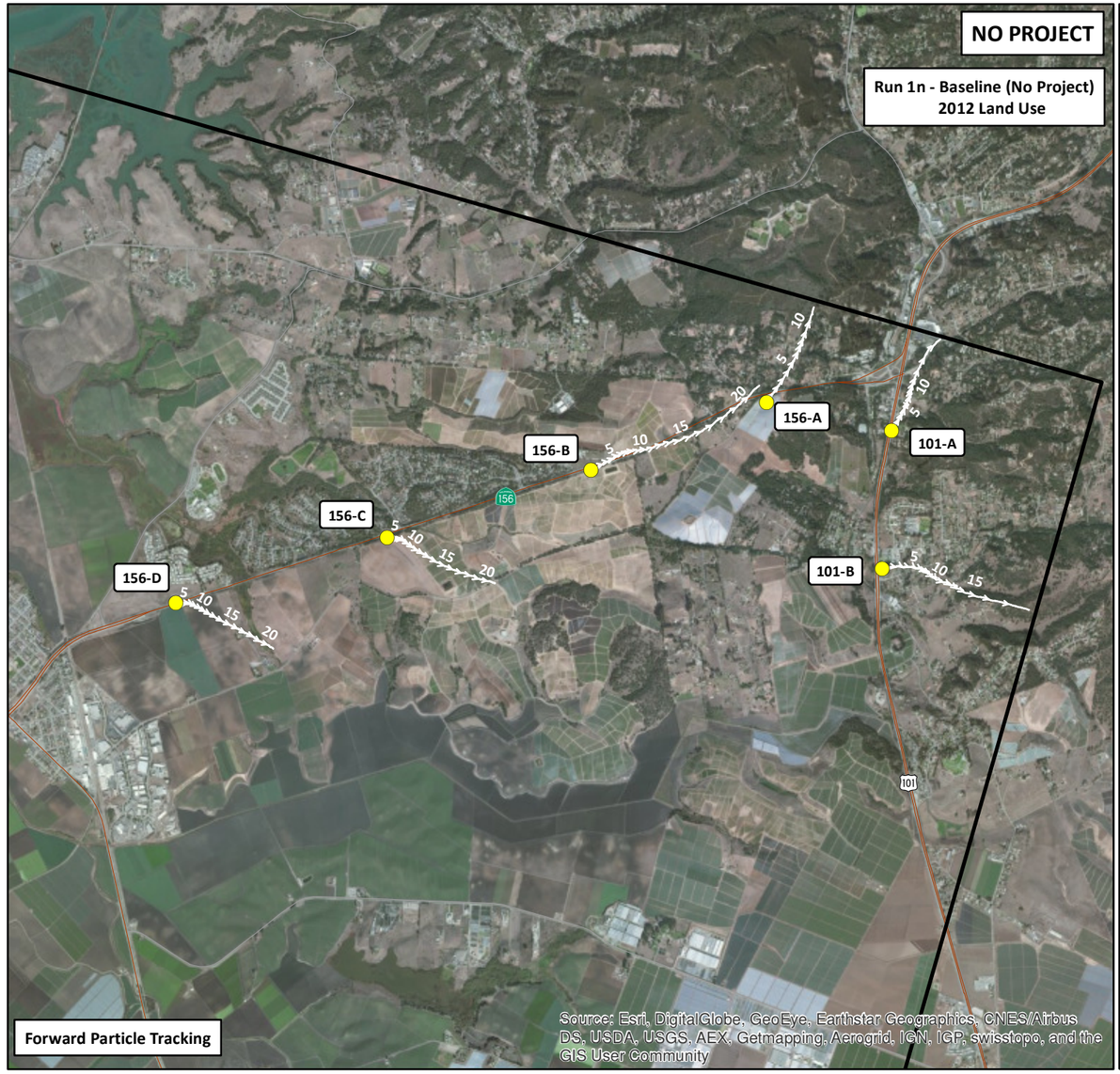
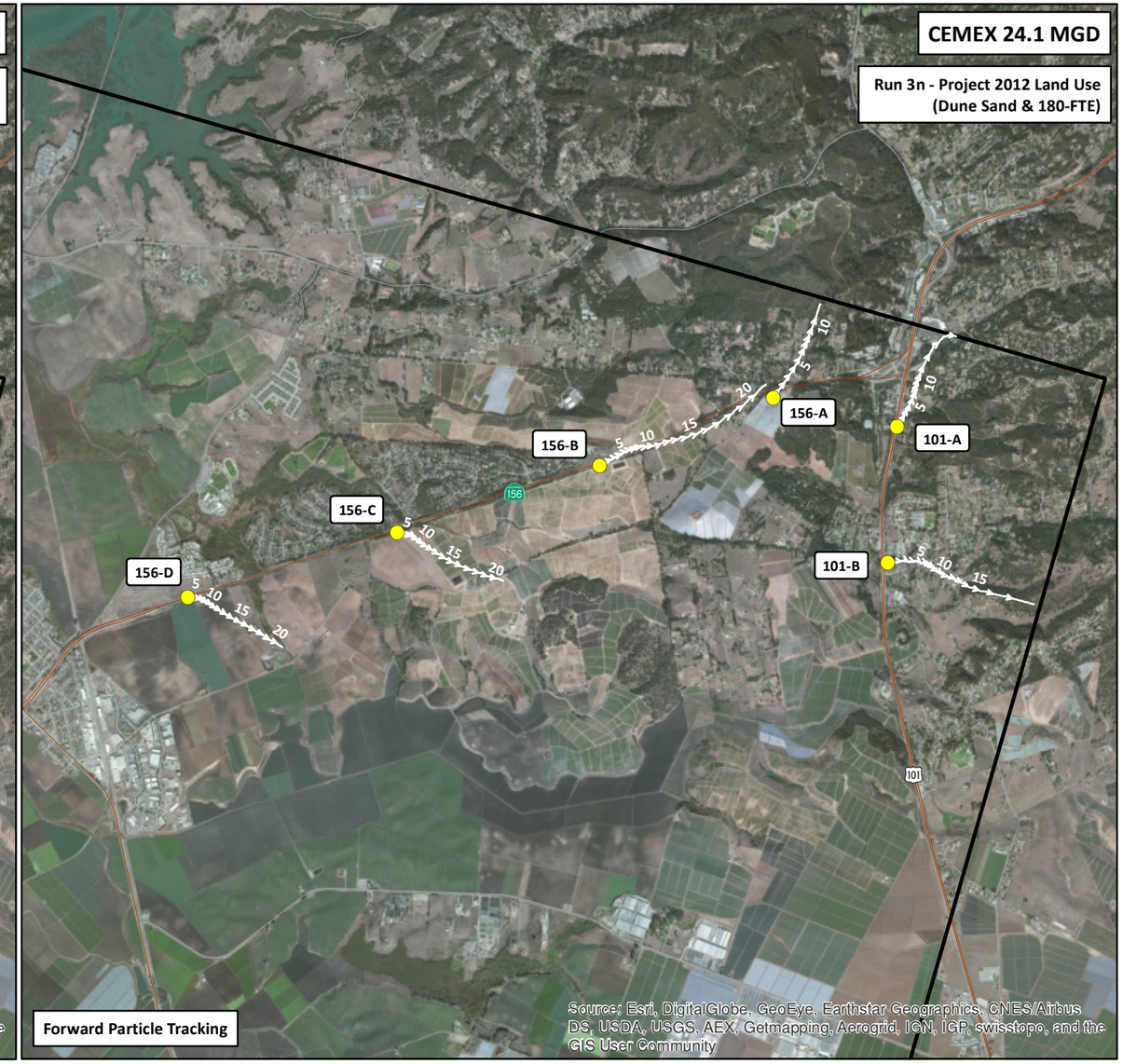
Figure 146

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_146_Percent_OceanWater_CEMEX_Run4f_4-15.mxd





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

Run 1n - Baseline (No Project) 2012 Land Use

Run 3n - Project 2012 Land Use (Dune Sand & 180-FTE)

NORTH

0 2,000 4,000 8,000 Feet

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PARTICLE TRACKING NEAR PRUNEDALE
NO PROJECT (RUN 1n) AND
CEMEX 24.1 MGD (RUN 3n)
180-FT/180-FTE AQUIFER

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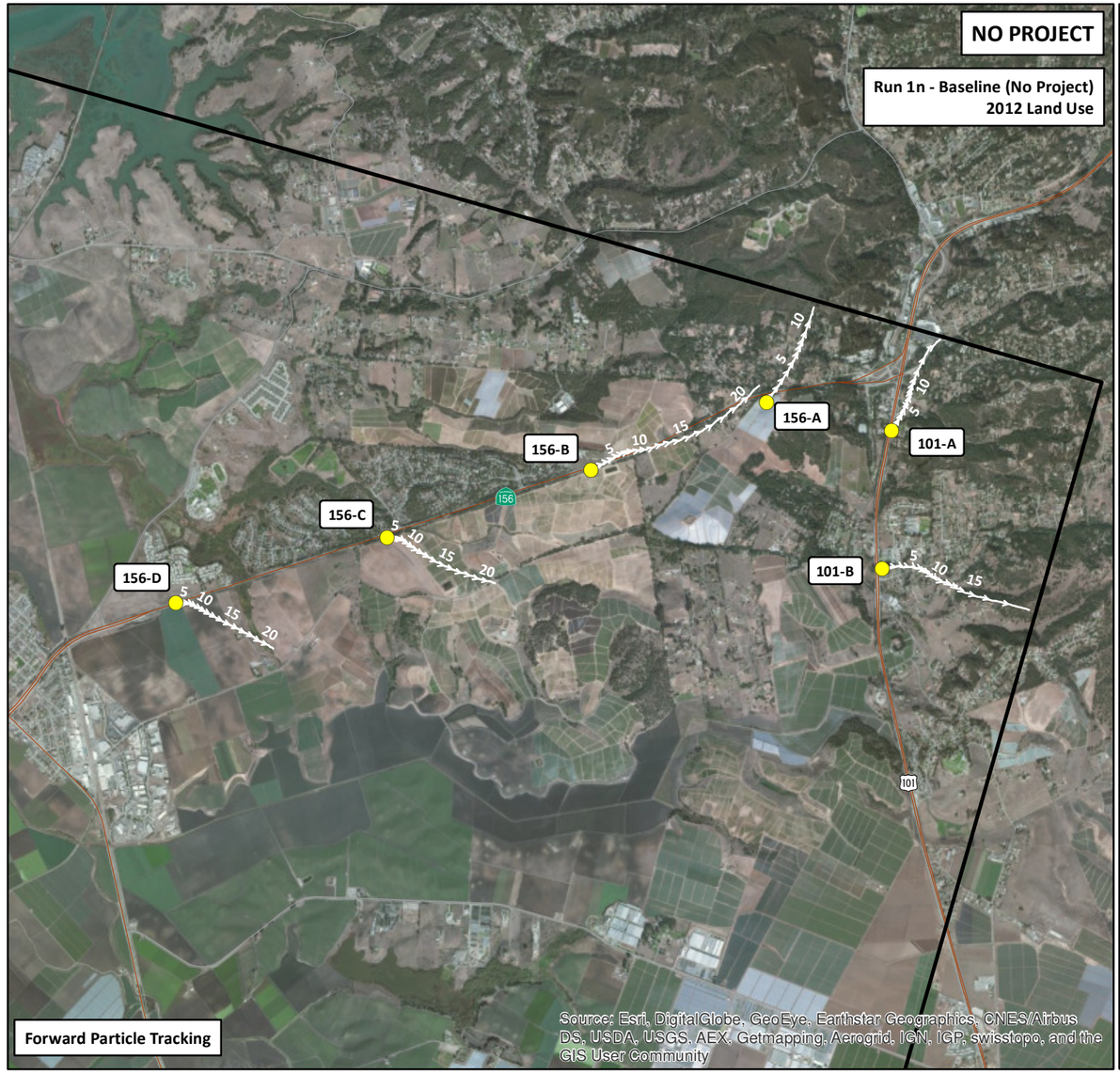
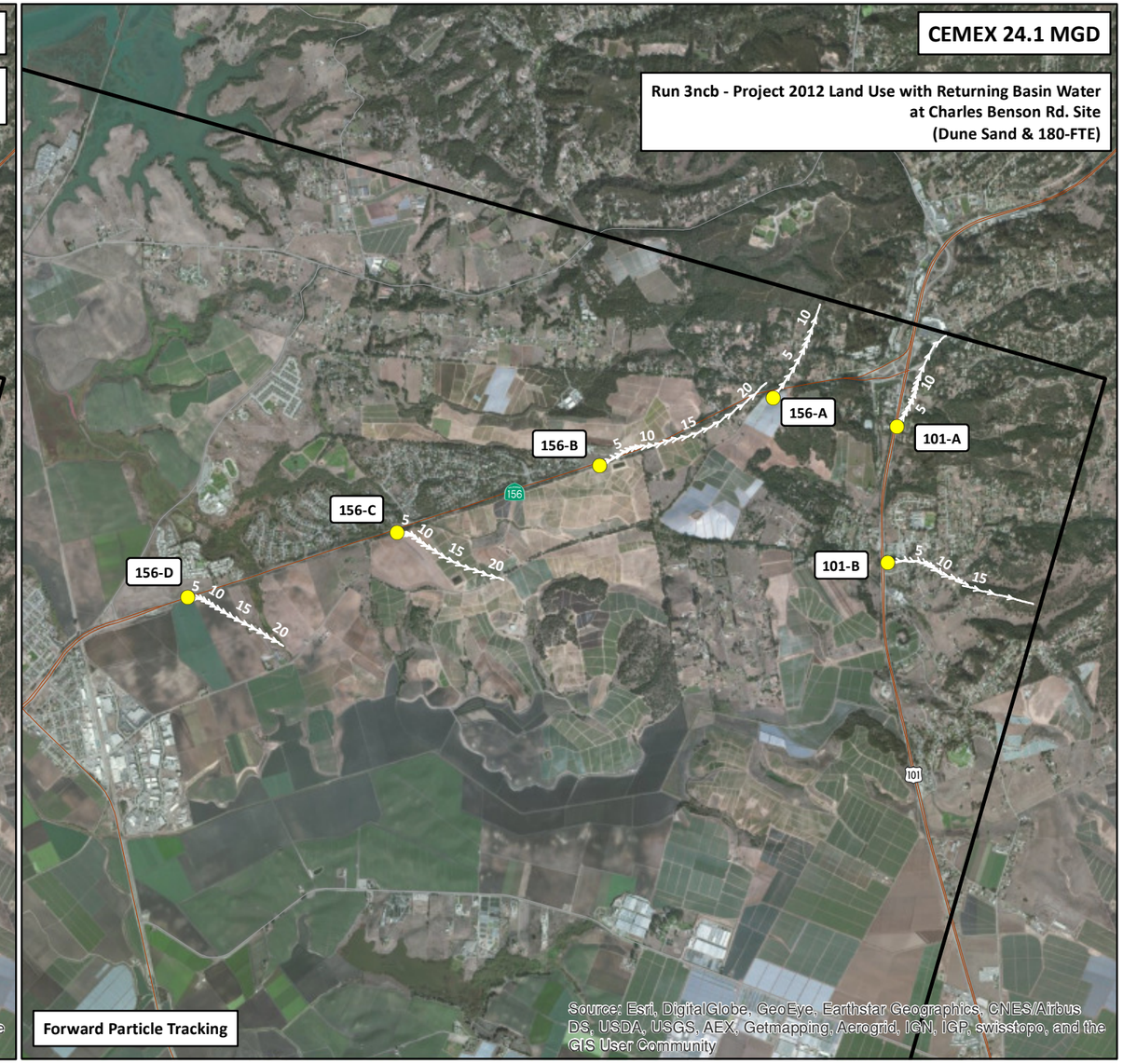
Figure 147





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

Run 1n - Baseline (No Project)
2012 Land Use

Run 3ncb - Project 2012 Land Use with Returning Basin Water
at Charles Benson Rd. Site
(Dune Sand & 180-FTE)

NORTH

0 2,000 4,000 8,000 Feet

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PARTICLE TRACKING NEAR PRUNEDALE
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CEMEX 24.1 MGD (RUN 3ncb)
180-FT/180-FTE AQUIFER

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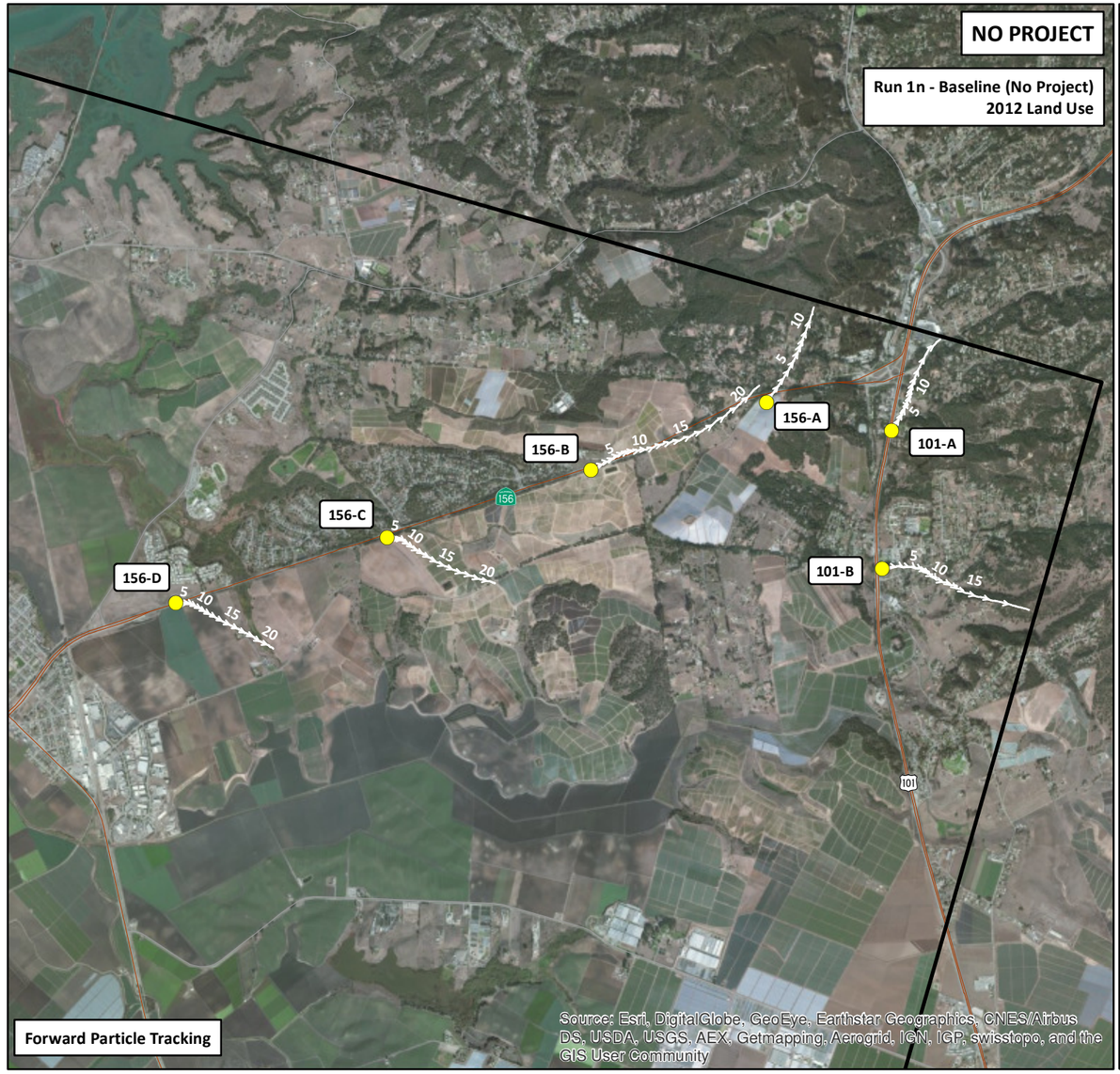
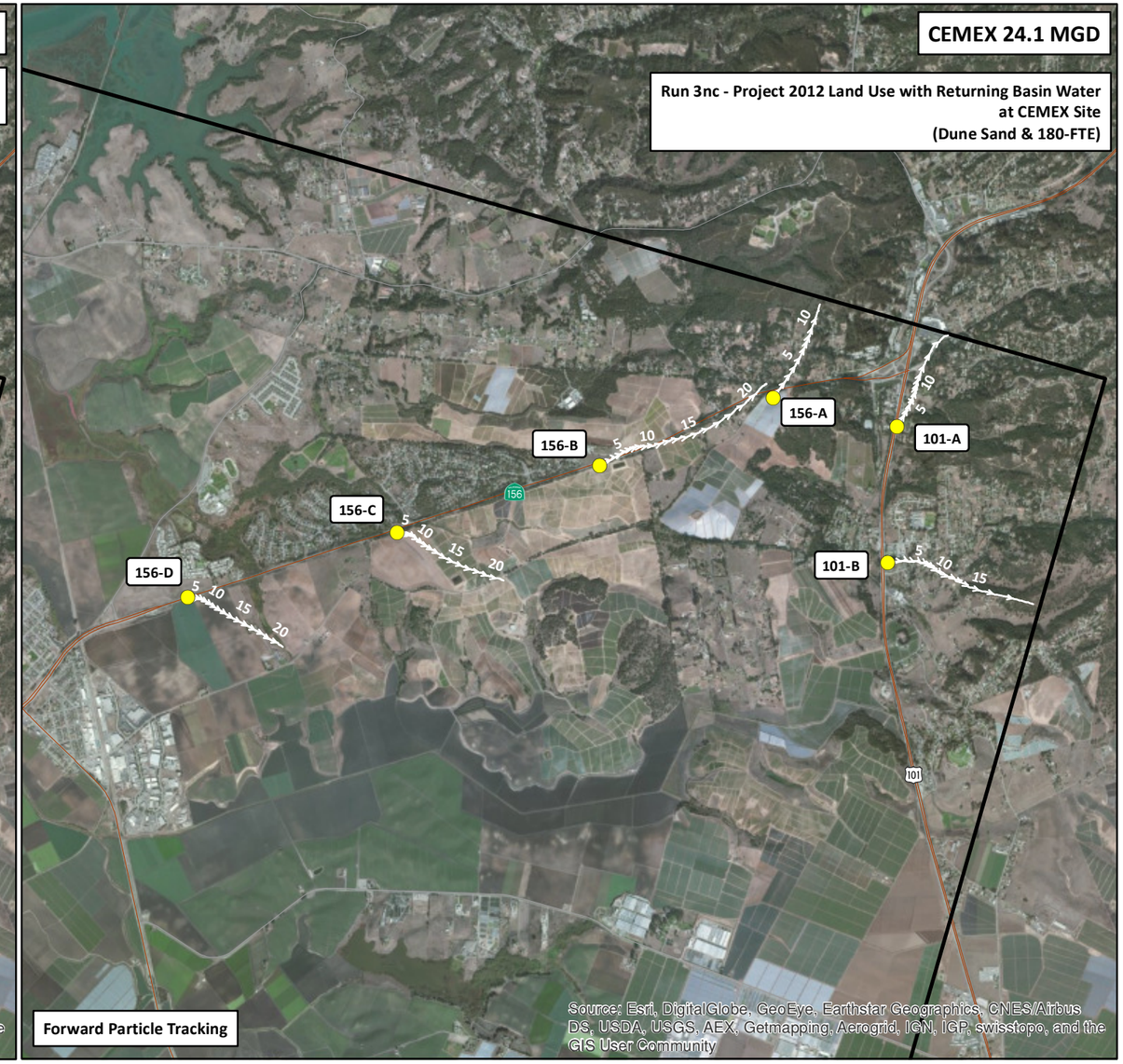
Figure 148





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

Run 1n - Baseline (No Project)
2012 Land Use

Run 3nc - Project 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)

NORTH

0 2,000 4,000 8,000 Feet

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PARTICLE TRACKING NEAR PRUNEDALE
NO PROJECT (RUN 1n) AND
CEMEX 24.1 MGD (RUN 3nc)
180-FT/180-FTE AQUIFER

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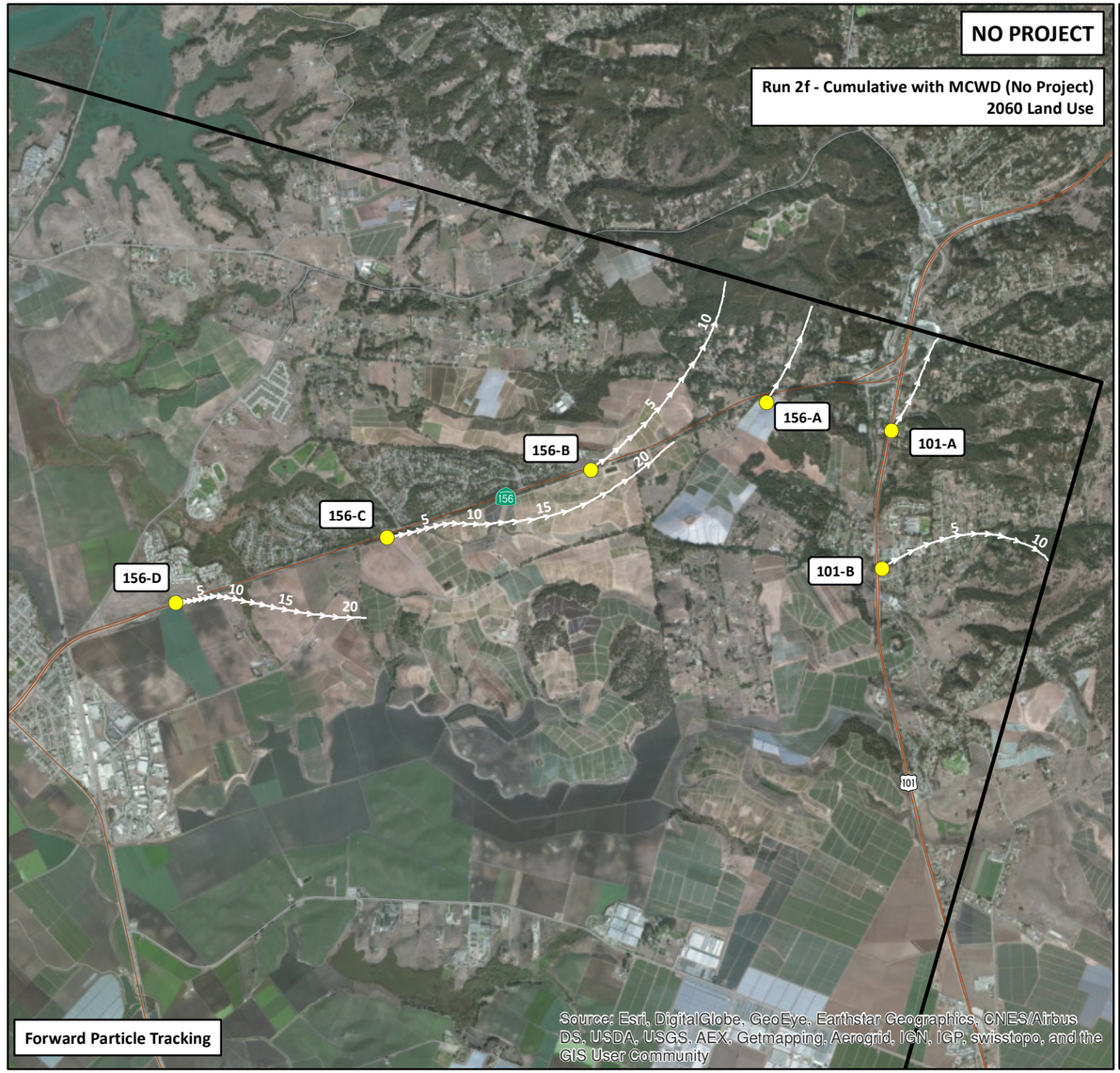
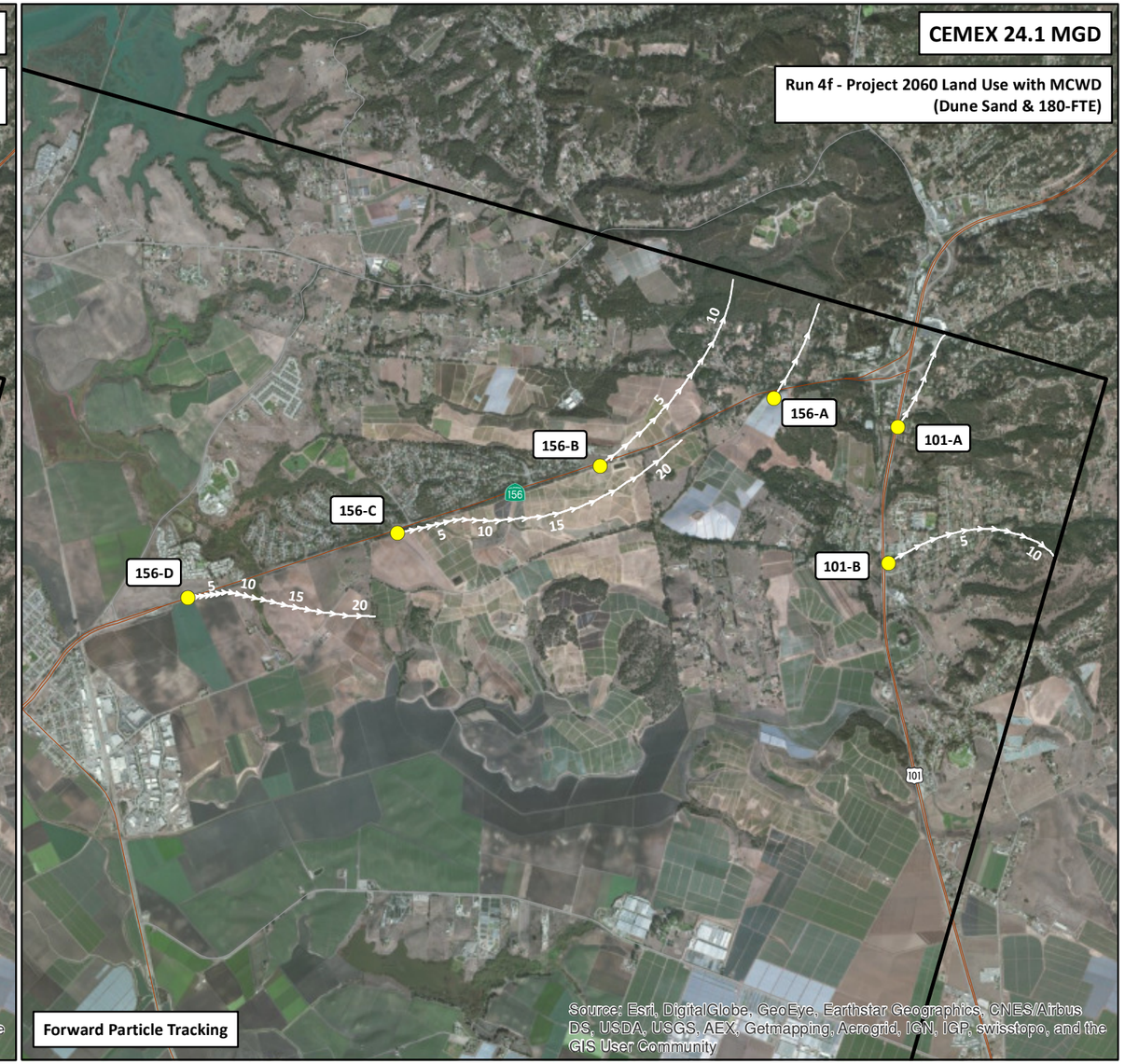
Figure 149





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,000 4,000 8,000 Feet

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 4f - Project 2060 Land Use with MCWD
(Dune Sand & 180-FTE)

PARTICLE TRACKING NEAR PRUNEDALE
NO PROJECT (RUN 2f) AND
CEMEX 24.1 MGD (RUN 4f)
180-FT/180-FTE AQUIFER

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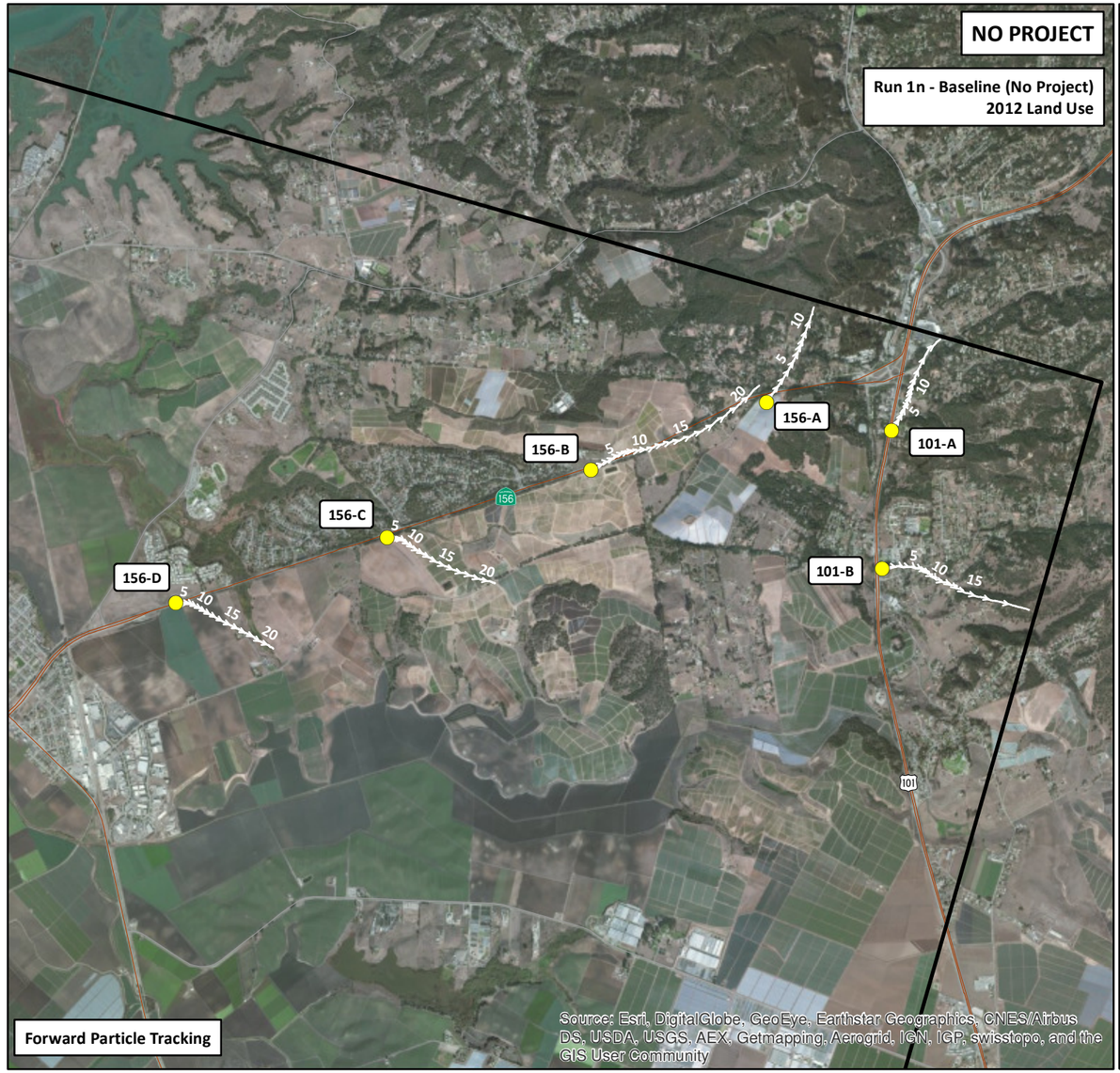
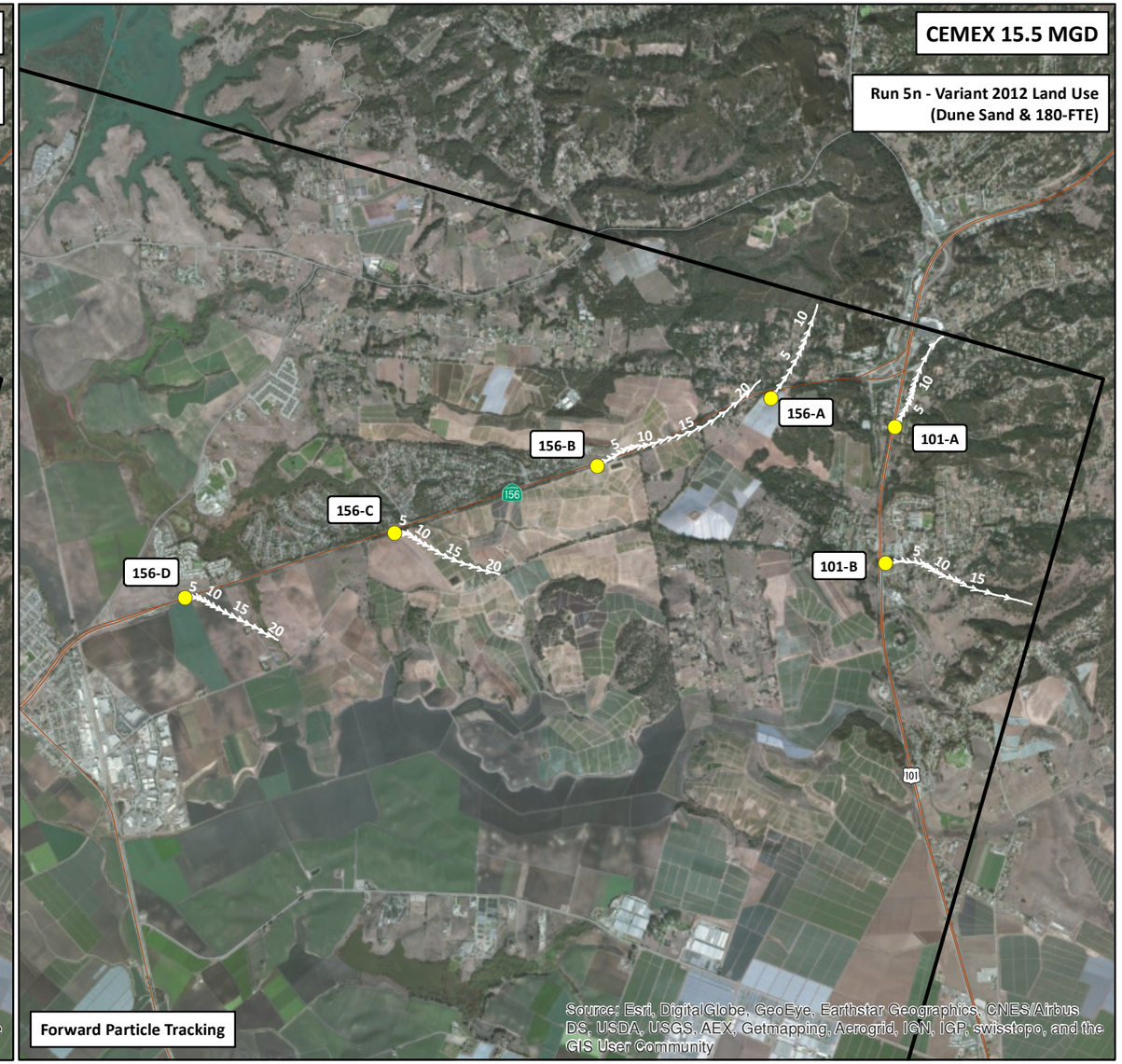
Figure 150





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,000 4,000 8,000 Feet

Run 1n - Baseline (No Project)
2012 Land Use

Run 5n - Variant 2012 Land Use
(Dune Sand & 180-FTE)

PARTICLE TRACKING NEAR PRUNEDALE
NO PROJECT (RUN 1n) AND
CEMEX 15.5 MGD (RUN 5n)
180-FT/180-FTE AQUIFER

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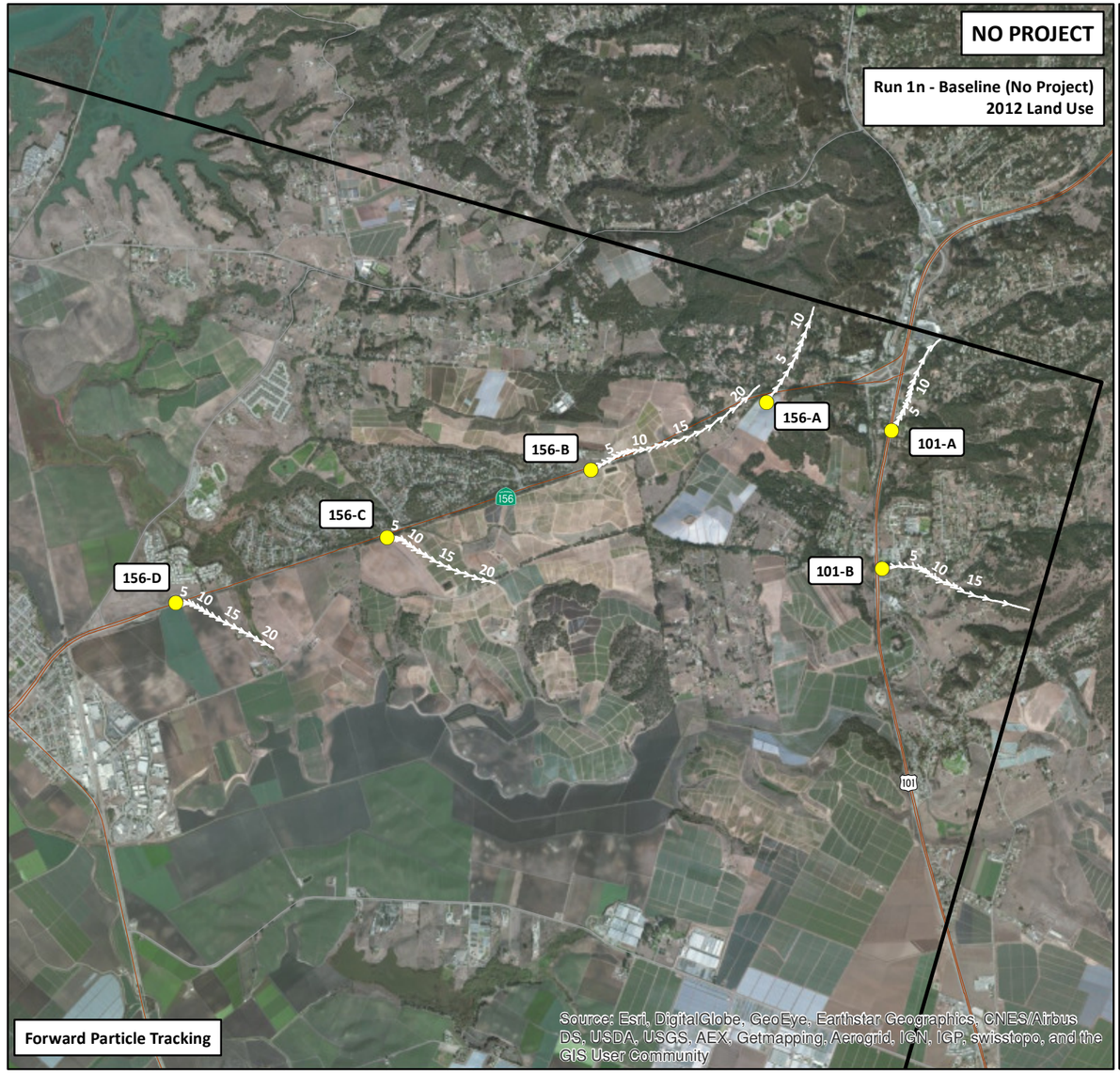
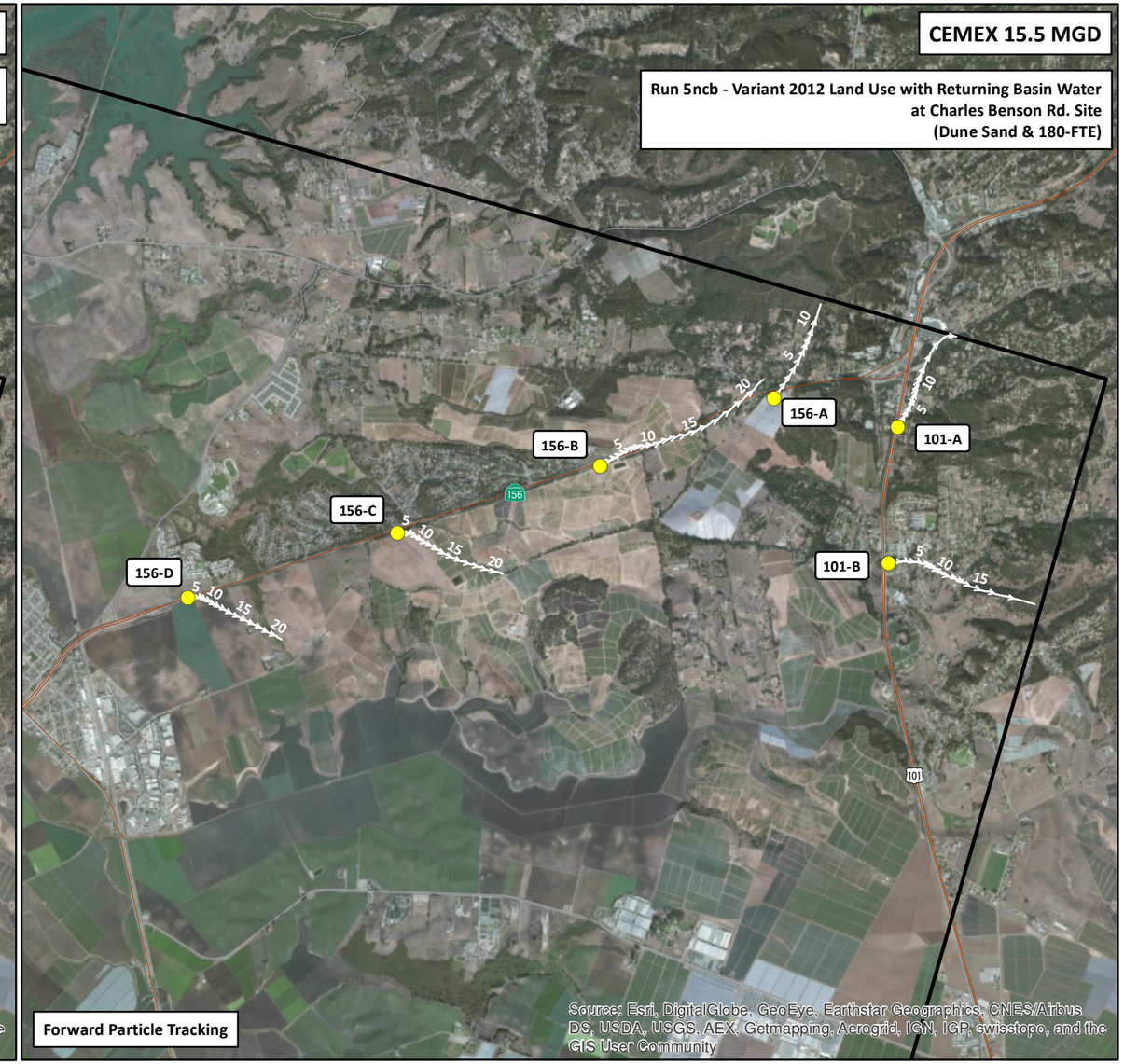
Figure 151

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_151_parttrk_180FT-180FTE_Run1nRun5n_Prunedale_2panel_4-15.mxd





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

Run 1n - Baseline (No Project)
2012 Land Use

Run 5ncb - Variant 2012 Land Use with Returning Basin Water
at Charles Benson Rd. Site
(Dune Sand & 180-FTE)

NORTH

0 2,000 4,000 8,000 Feet

PARTICLE TRACKING NEAR PRUNEDALE
NO PROJECT (RUN 1n) AND
CEMEX 15.5 MGD (RUN 5ncb)
180-FT/180-FTE AQUIFER

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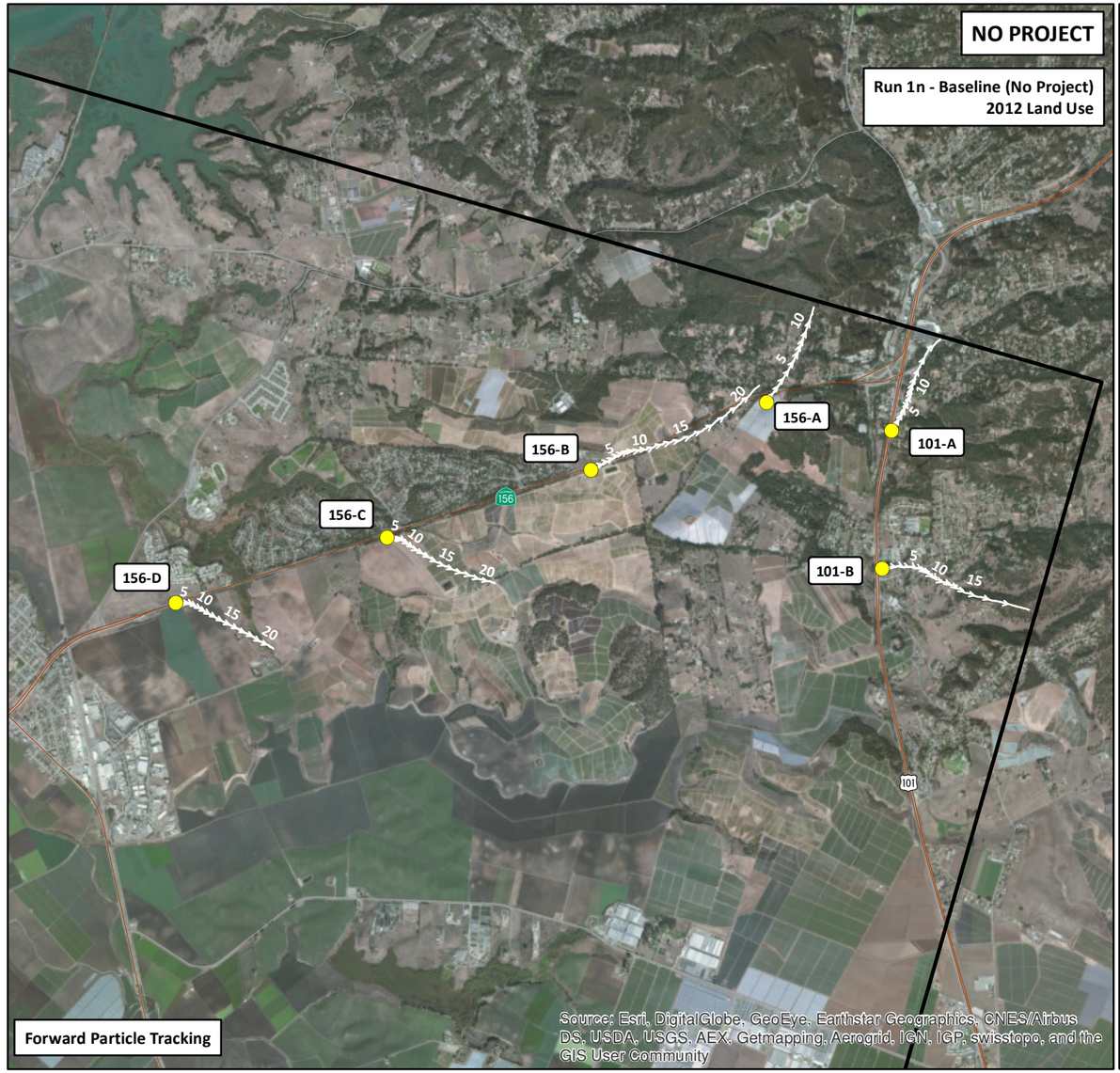
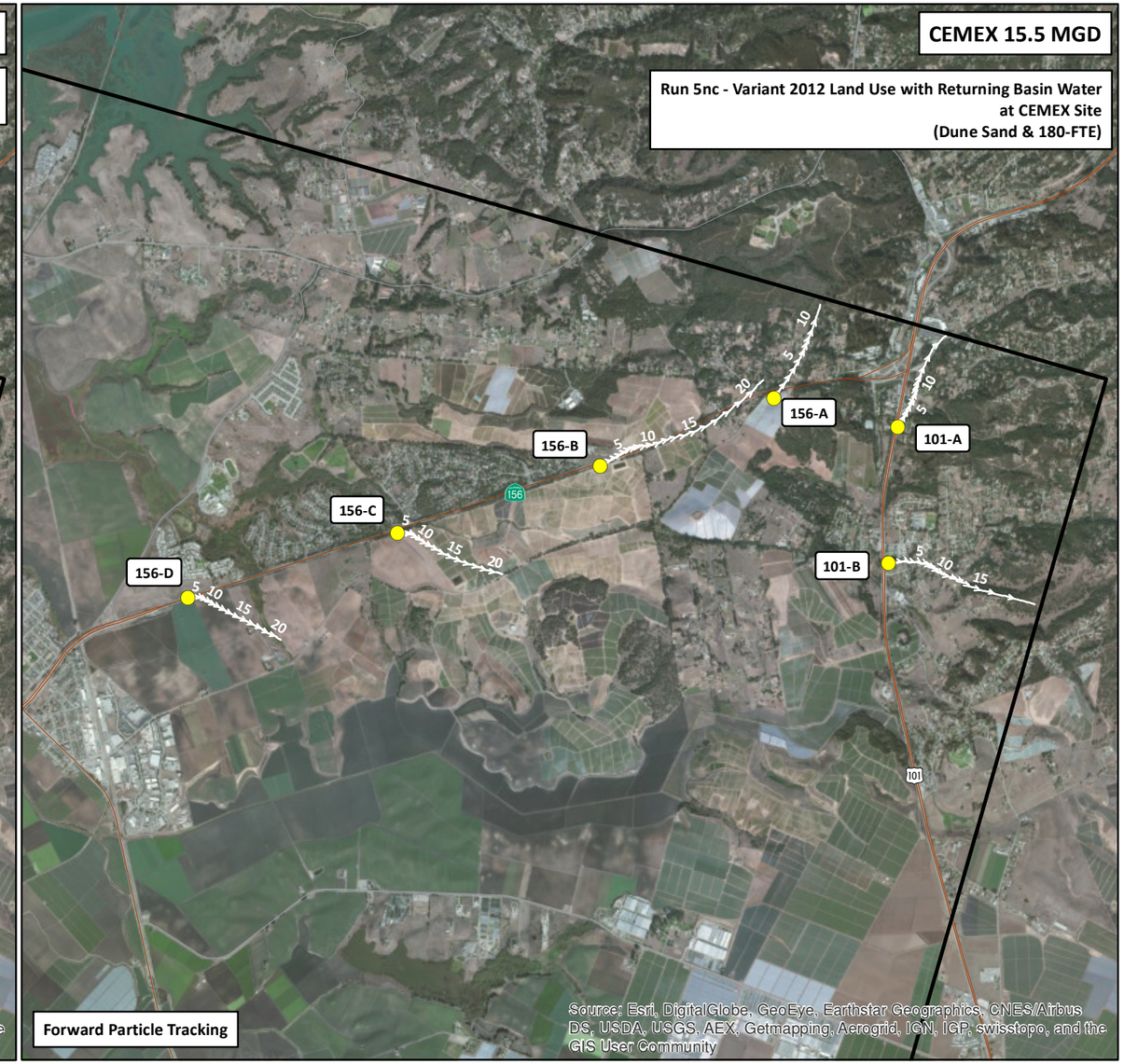
Figure 152

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_152_parttrk_180FT-180FTE_Run1nRun5ncb_Prunedale_2panel_4-15.mxd





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

Run 1n - Baseline (No Project)
2012 Land Use

Run 5nc - Variant 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)

NORTH

0 2,000 4,000 8,000 Feet

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PARTICLE TRACKING NEAR PRUNEDALE
NO PROJECT (RUN 1n) AND
CEMEX 15.5 MGD (RUN 5nc)
180-FT/180-FTE AQUIFER

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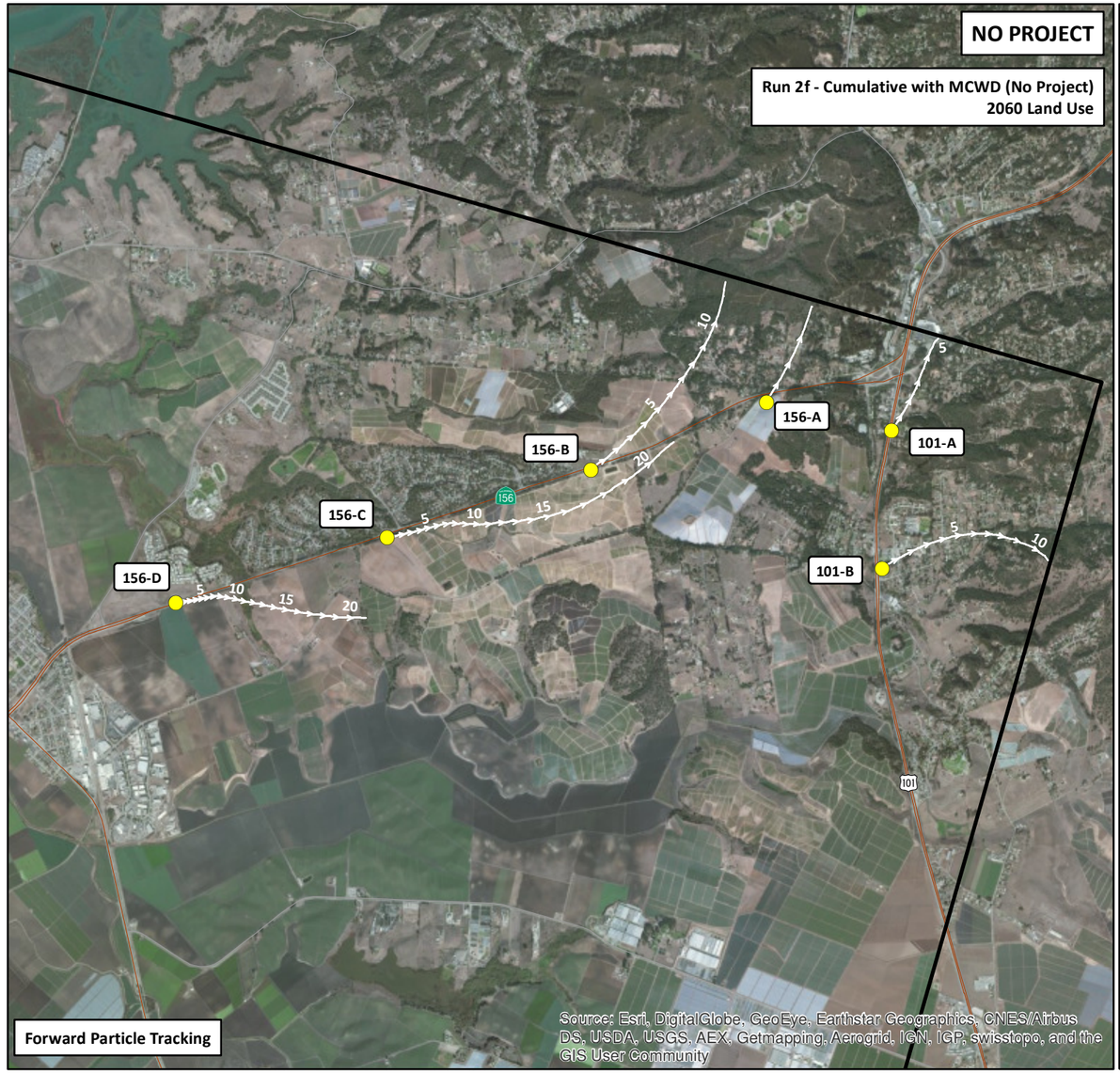
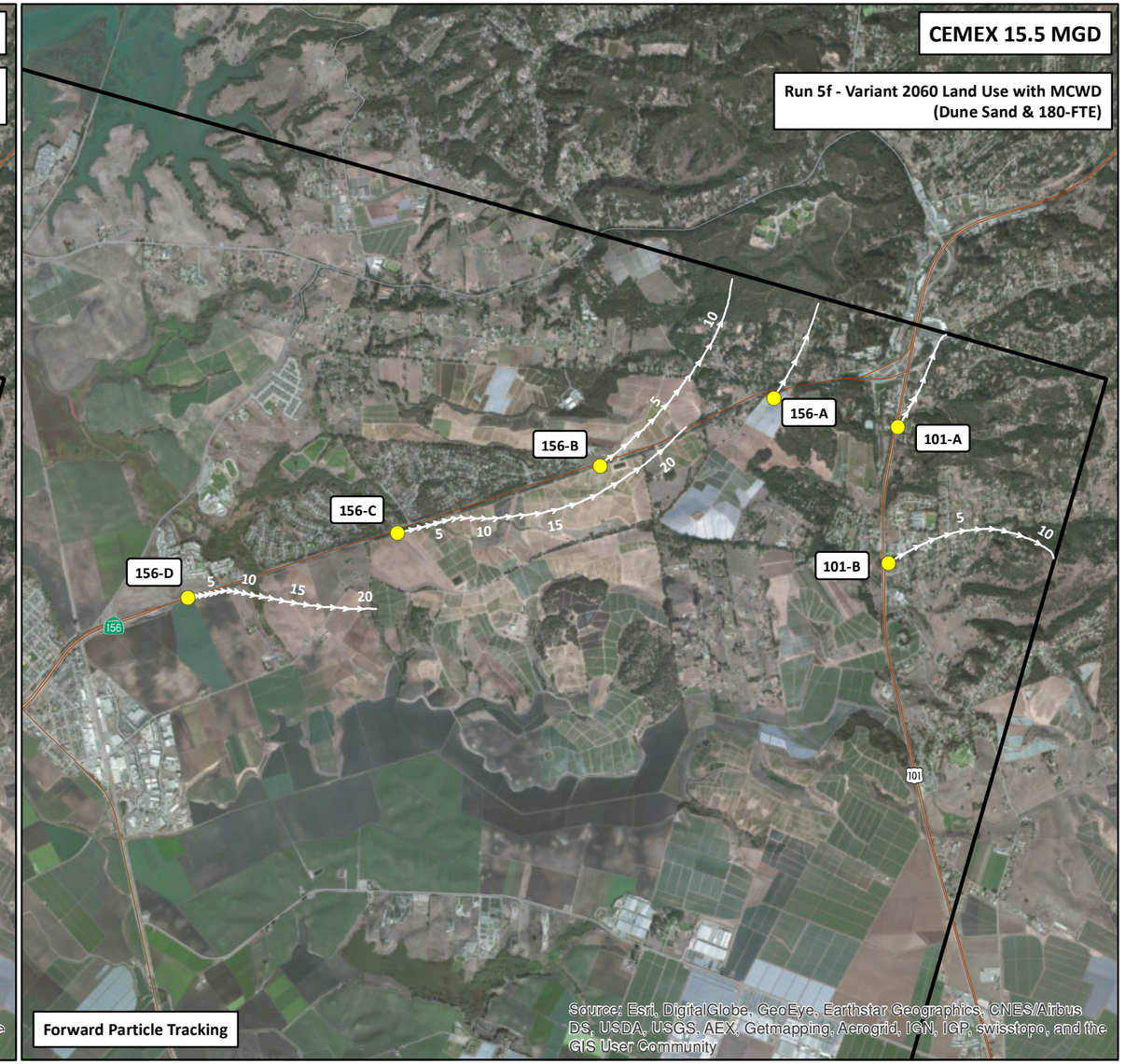
Figure 153

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_153_parttrk_180FT-180FTE_Run1nRun5nc_Prunedale_2panel_4-15.mxd





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,000 4,000 8,000 Feet

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 5f - Variant 2060 Land Use with MCWD (Dune Sand & 180-FTE)

PARTICLE TRACKING NEAR PRUNEDALE
NO PROJECT (RUN 2f) AND
CEMEX 15.5 MGD (RUN 5f)
180-FT/180-FTE AQUIFER

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Figure 154

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_154_parttrk_180FT-180FTE_Run2fRun5f_Prunedale_2panel_4-15.mxd

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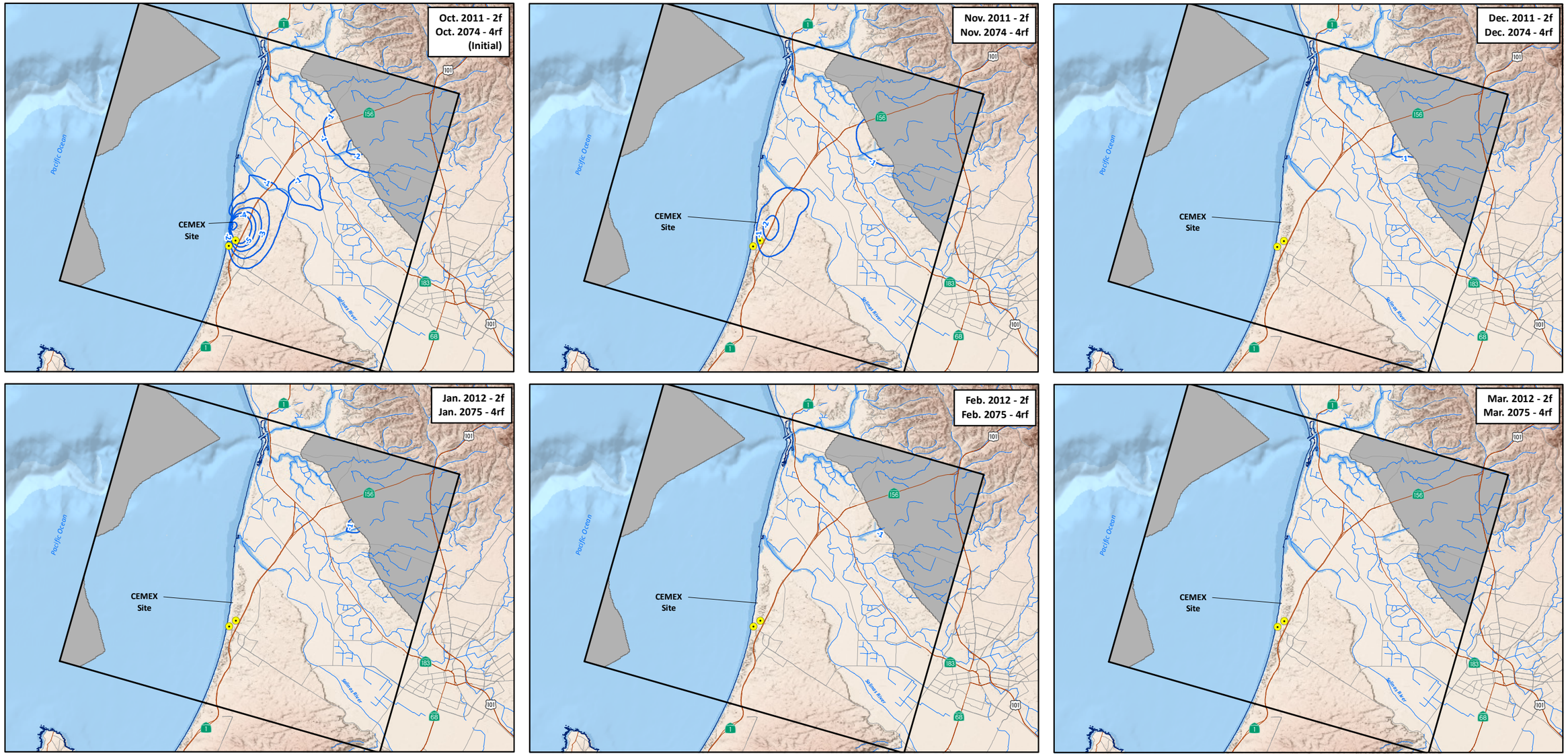
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

NORTH

0 2 4 8 Miles

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 4rf - Post-CEMEX with MCWD
2060 Land Use (Dune Sand & 180-FTE)

CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 4rf (RUN 4rf MINUS RUN 2f)

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Figure 155

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_155_wlchange_dunesand_Run4rfminus2f_6panel_4-15.mxd

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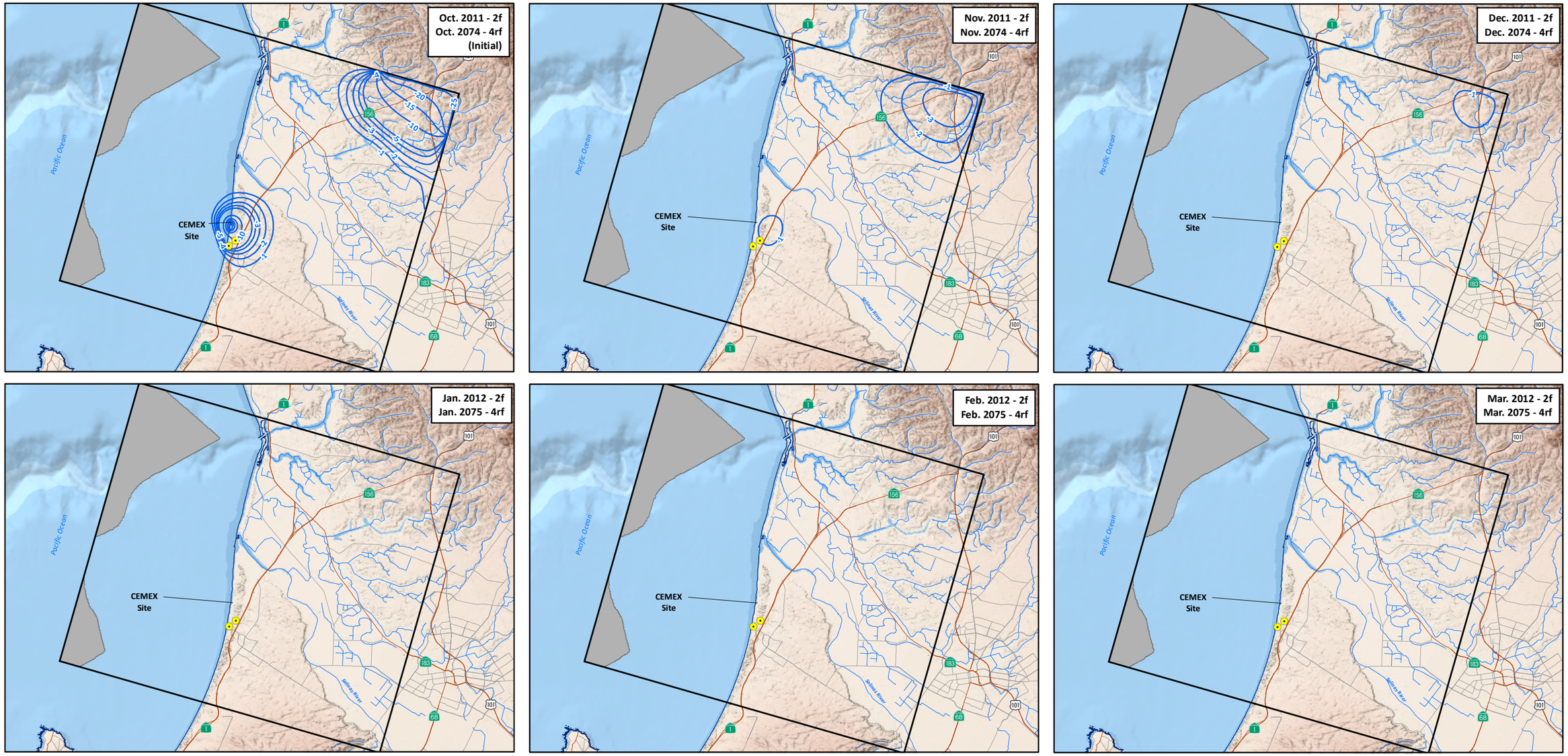
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2 4 8 Miles

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 4rf - Post-CEMEX with MCWD
2060 Land Use (Dune Sand & 180-FTE)

CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 4rf (RUN 4rf MINUS RUN 2f)

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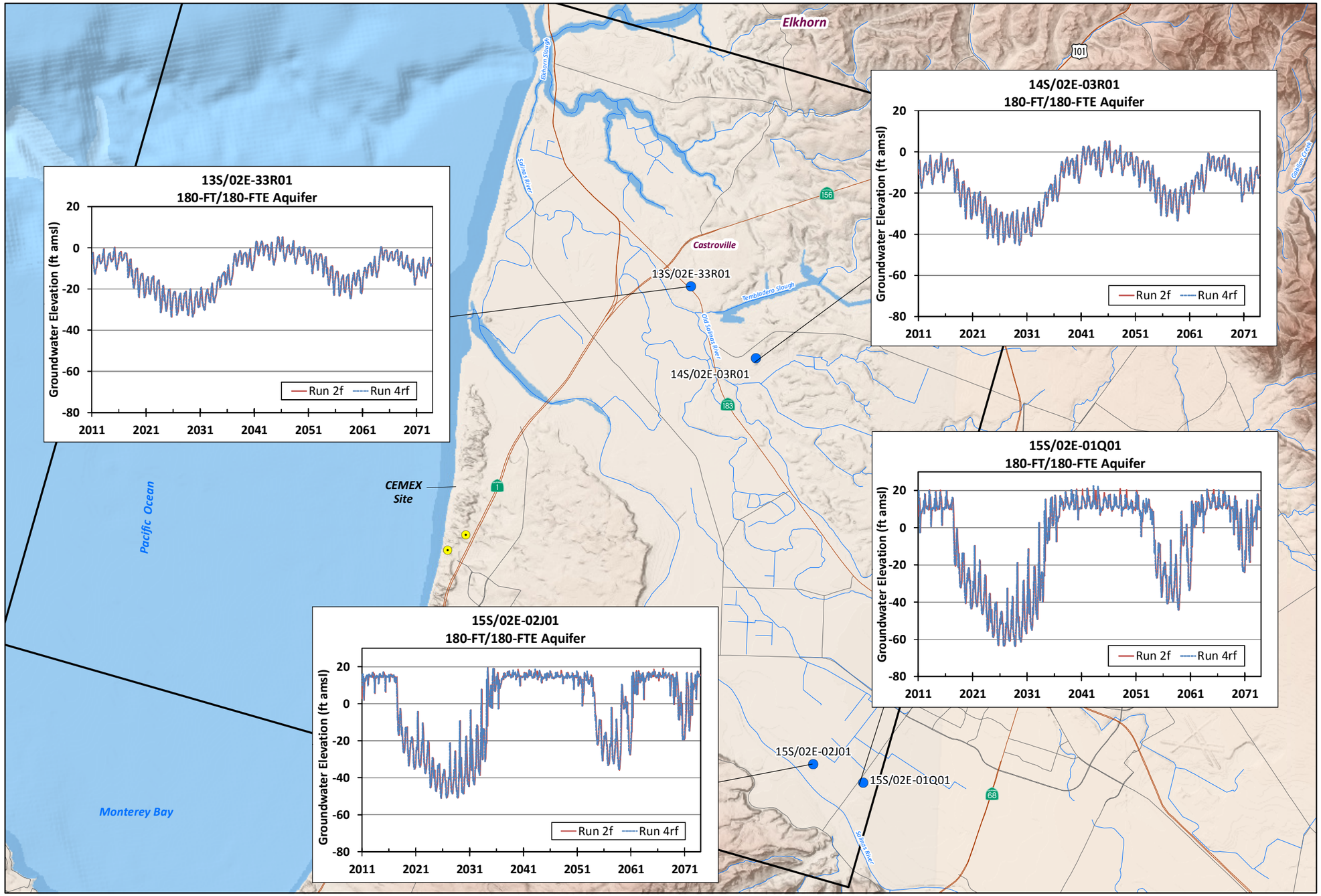
Figure 156

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_156_wlchange_180FT-180FTE_Run4rfminus2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 4rf VERSUS RUN 2f (180-FT/180-FTE AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative with MCWD (No Project) 2060 Land Use

Run 4rf - Post-CEMEX with MCWD 2060 Land Use (Dune Sand & 180-FTE)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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NORTH

0 1 2 4 Miles

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Figure 157

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_157_hydrographs_Run4rf_vs_Run2f_180FT-180FTE_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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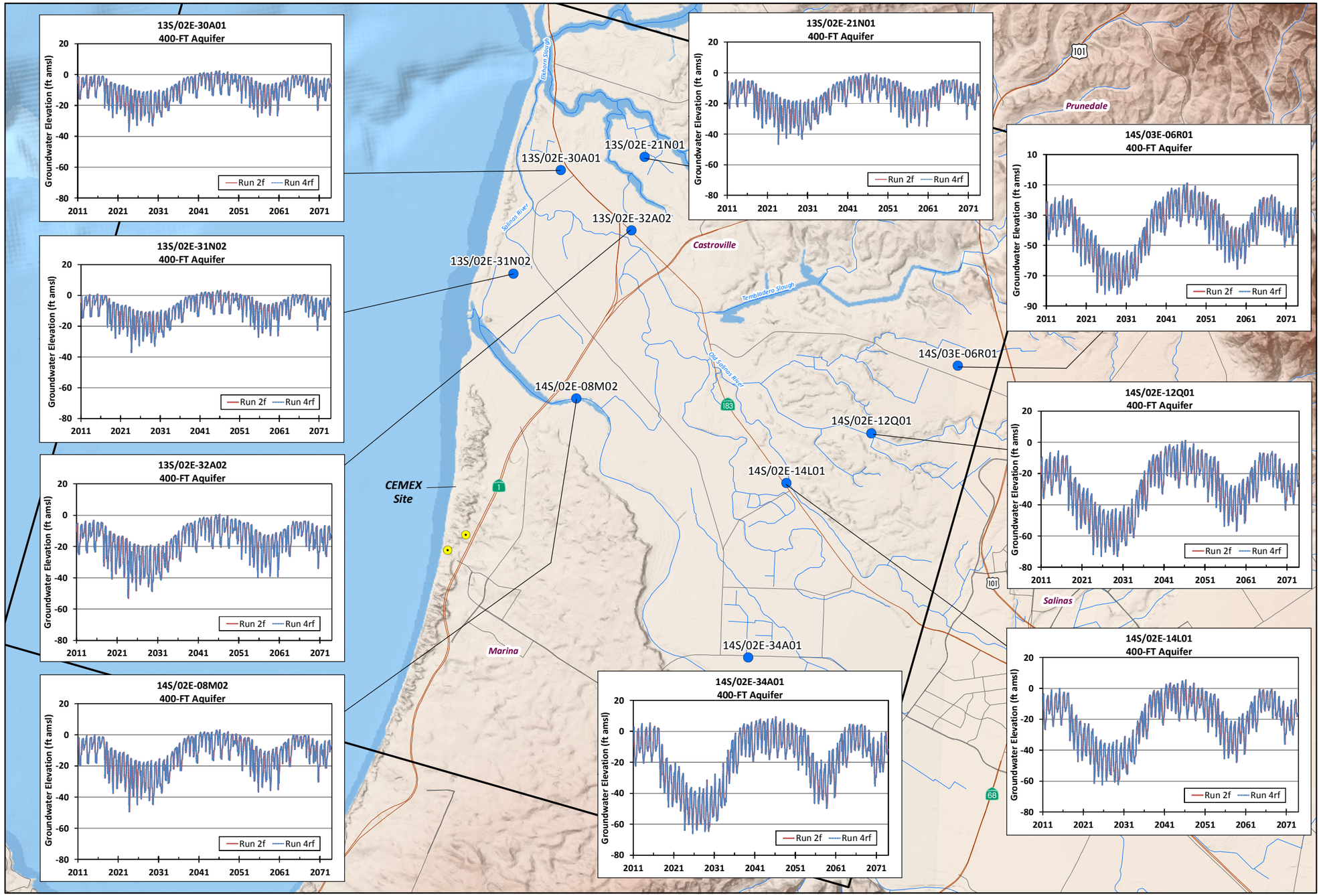
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 4f VERSUS RUN 2f (400-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative with MCWD (No Project) 2060 Land Use

Run 4rf - Post-CEMEX with MCWD 2060 Land Use (Dune Sand & 180-FTE)

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NORTH

0 1 2 4 Miles

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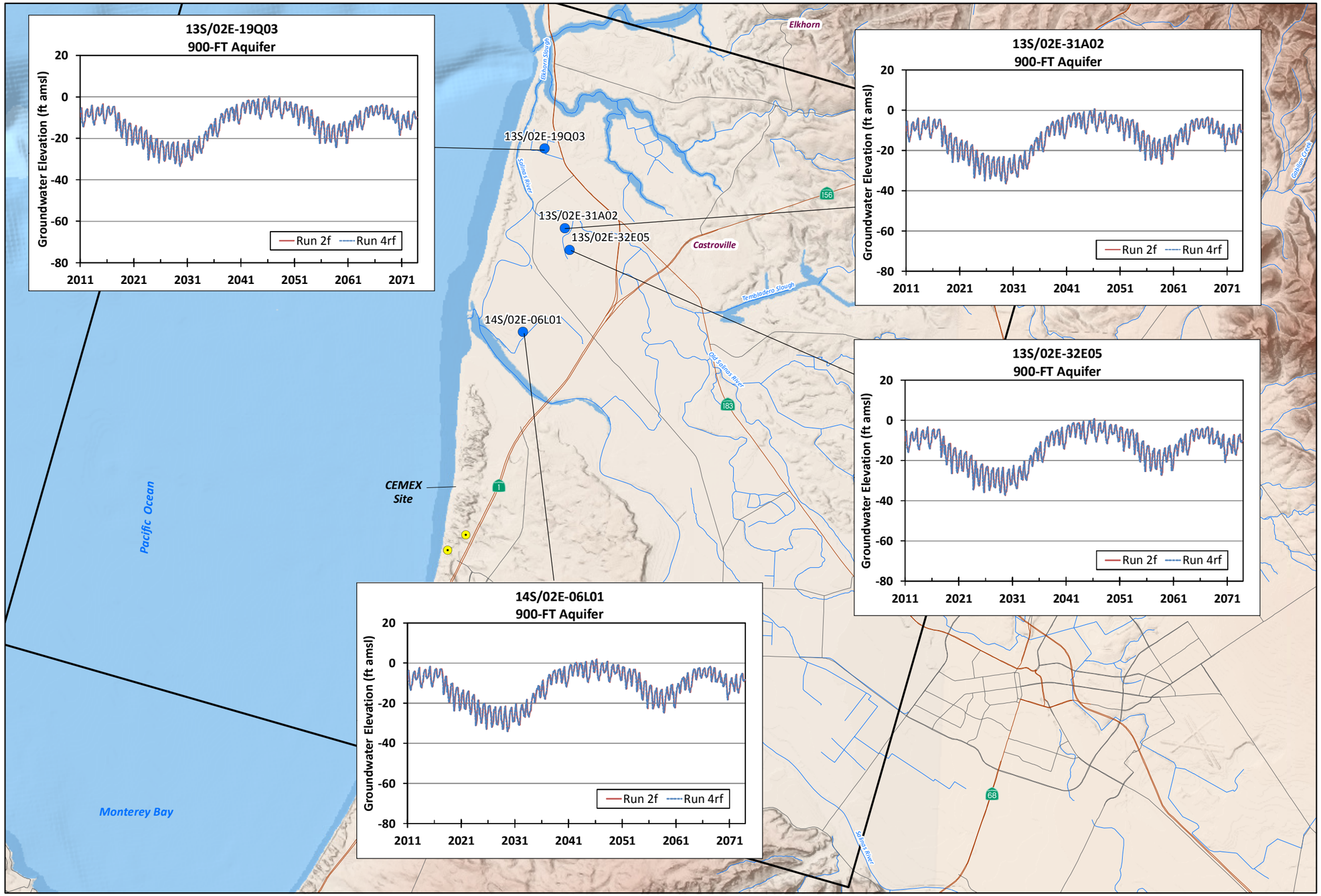
Figure 158

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_158_hydrographs_Run4rf_vs_Run2f_400FT_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 4rf VERSUS RUN 2f (900-FT AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative with MCWD (No Project) 2060 Land Use

Run 4rf - Post-CEMEX with MCWD 2060 Land Use (Dune Sand & 180-FTE)

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NORTH

0 1 2 4 Miles

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Figure 159

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_159_hydrographs_Run4rf_vs_Run2f_900FT_4-15.mxd

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MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

ACTIVE WELLS NEAR THE POTRERO ROAD SLANT WELL SITE

EXPLANATION

Active Well
(Screen Unknown)

Potrero Road Slant Wells
Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 49 for Detailed
Slant Well Layout)

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NORTH

0 1,250 2,500 5,000 Feet

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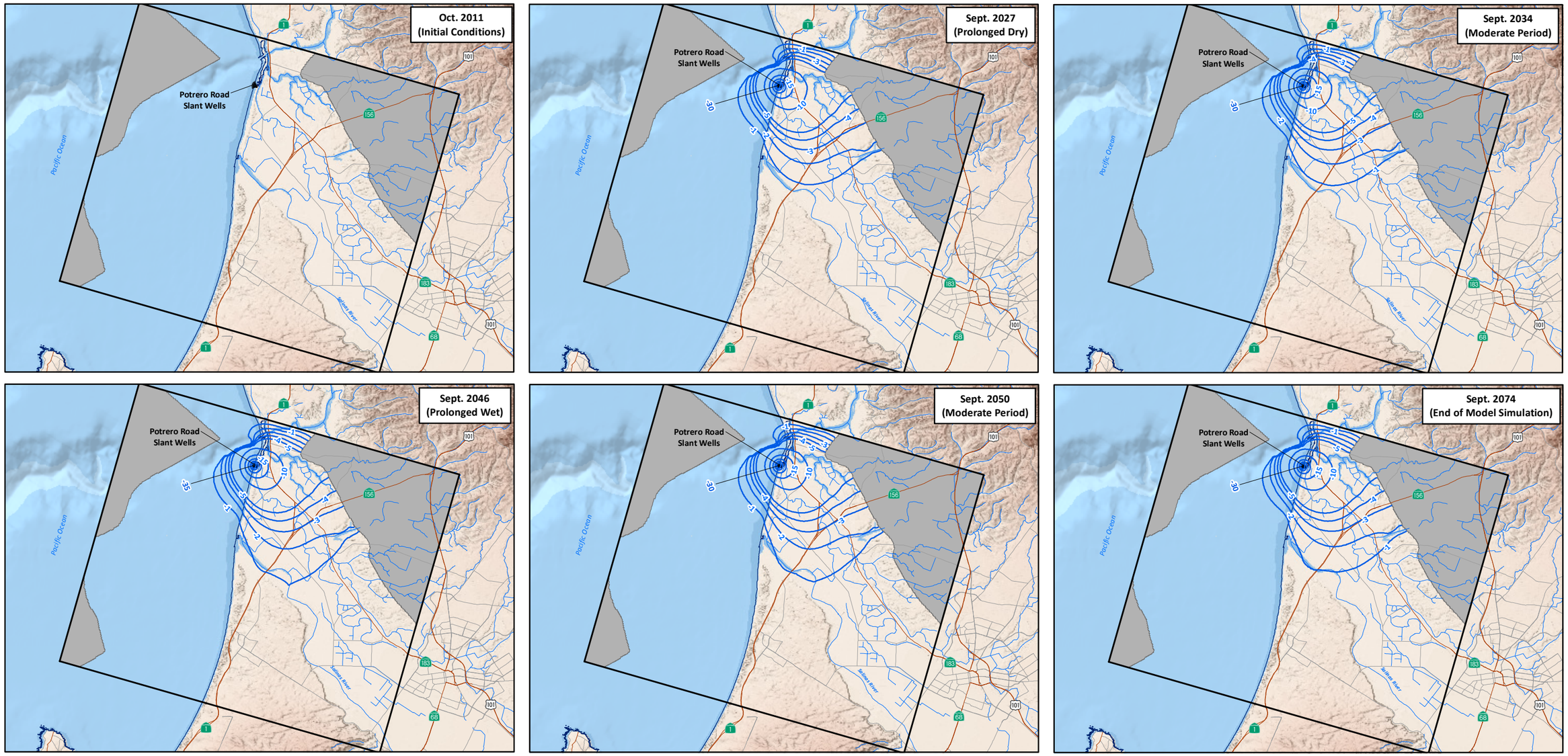
Figure 160

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_160_well_loc_Potrero_area_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Potrero Road Slant Wells - Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 49 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 6sn - Project 2012 Land Use (Dune Sand)

NORTH

0 2 4 8 Miles

17-Apr-15

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 6sn (RUN 6sn MINUS RUN 1n)

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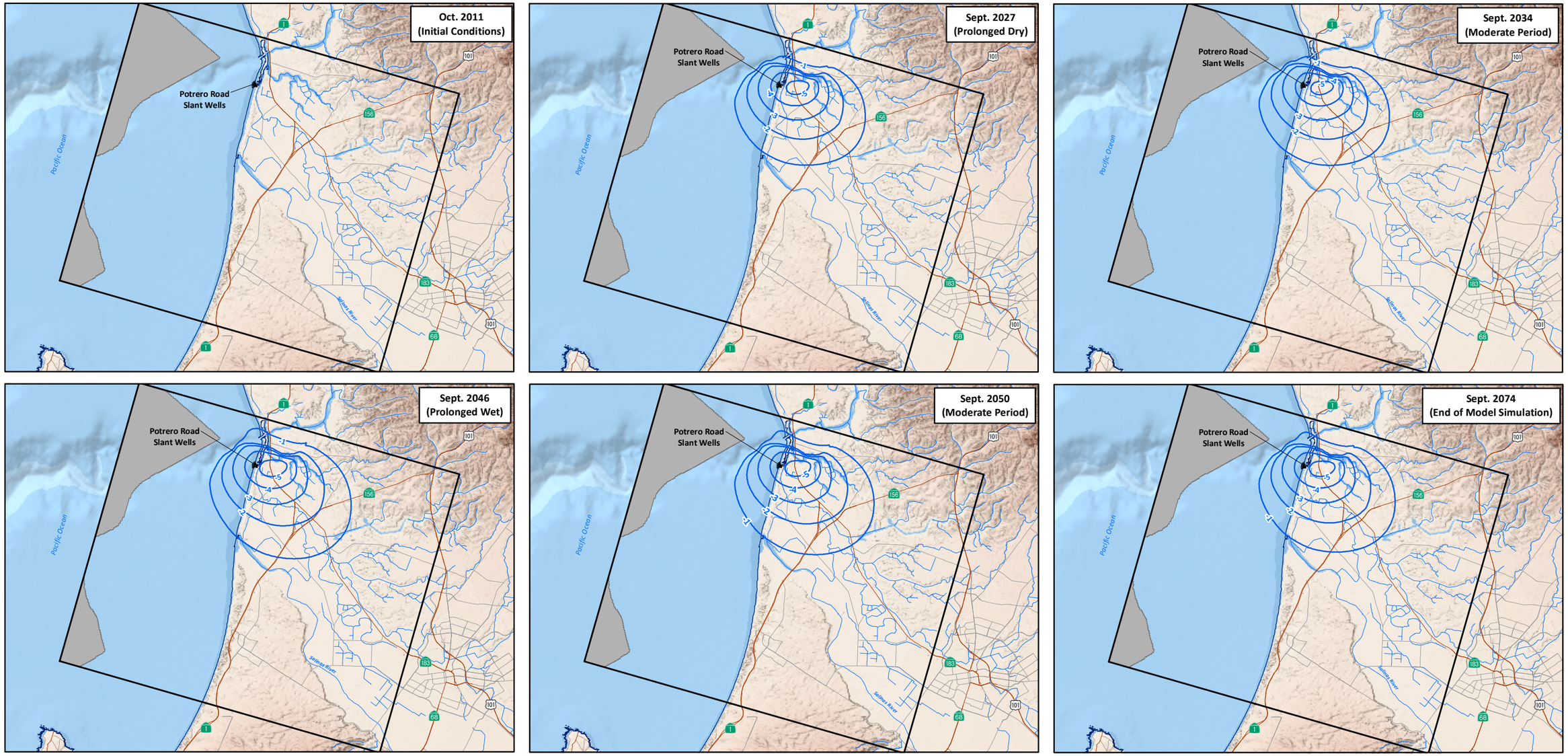
Figure 161

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_161_wlchange_dunesand_Run6snminus1n_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Note: 180-FTE = 180-Foot Equivalent Aquifer

Potrero Road Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 49 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 6sn - Project 2012 Land Use
(Dune Sand)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 6sn (RUN 6sn MINUS RUN 1n)

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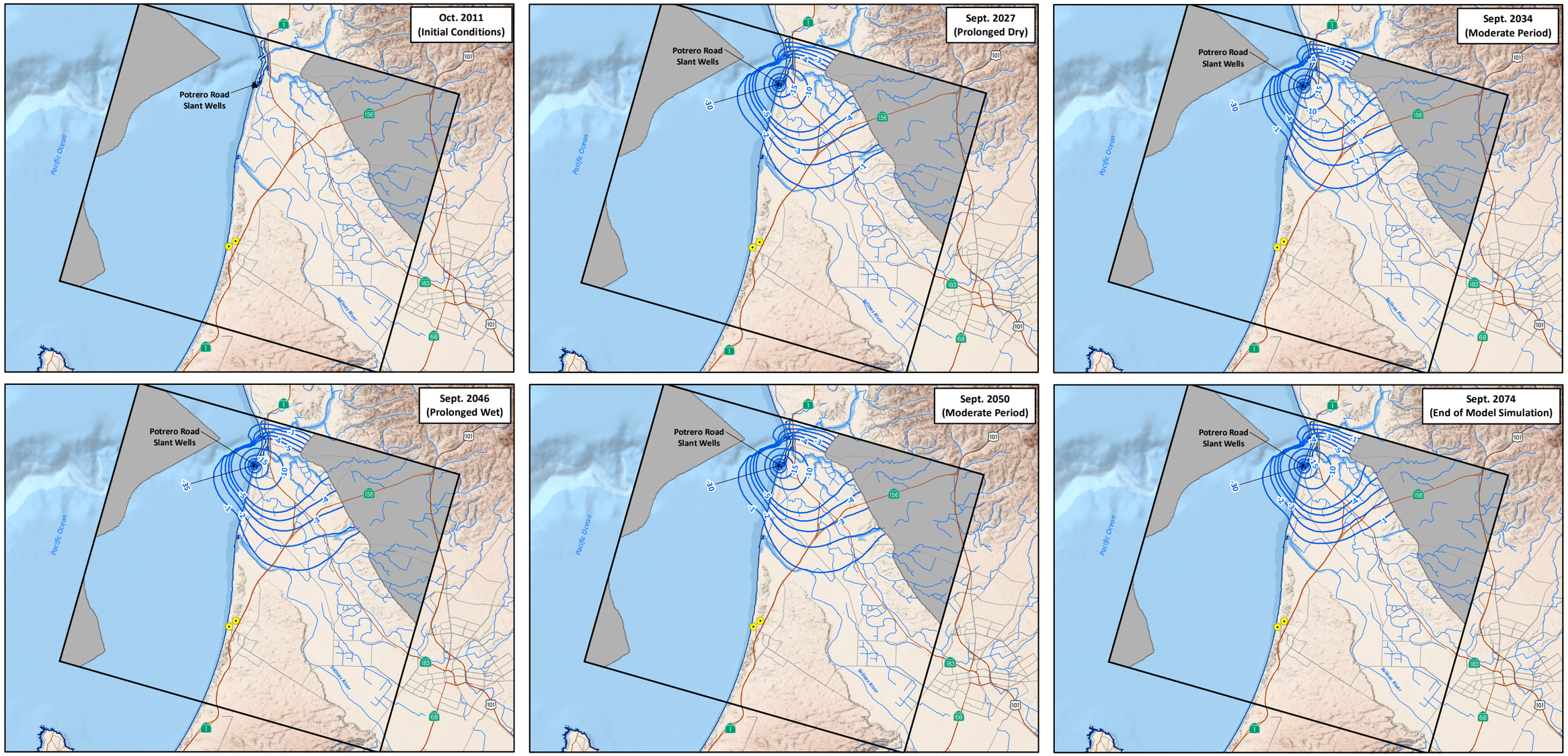
Figure 162

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_162_wlchange_180FT-180FTE_Run6snminus1n_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

Potrero Road Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 49 for Detailed Slant Well Layout)

Run 2f - Cumulative Baseline (No Project)
2060 Land Use with MCWD

Run 7sf - Project 2060 Land Use with MCWD
(Dune Sand)

NORTH

0 2 4 8 Miles

17-Apr-15

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 7sf (RUN 7sf MINUS RUN 2f)

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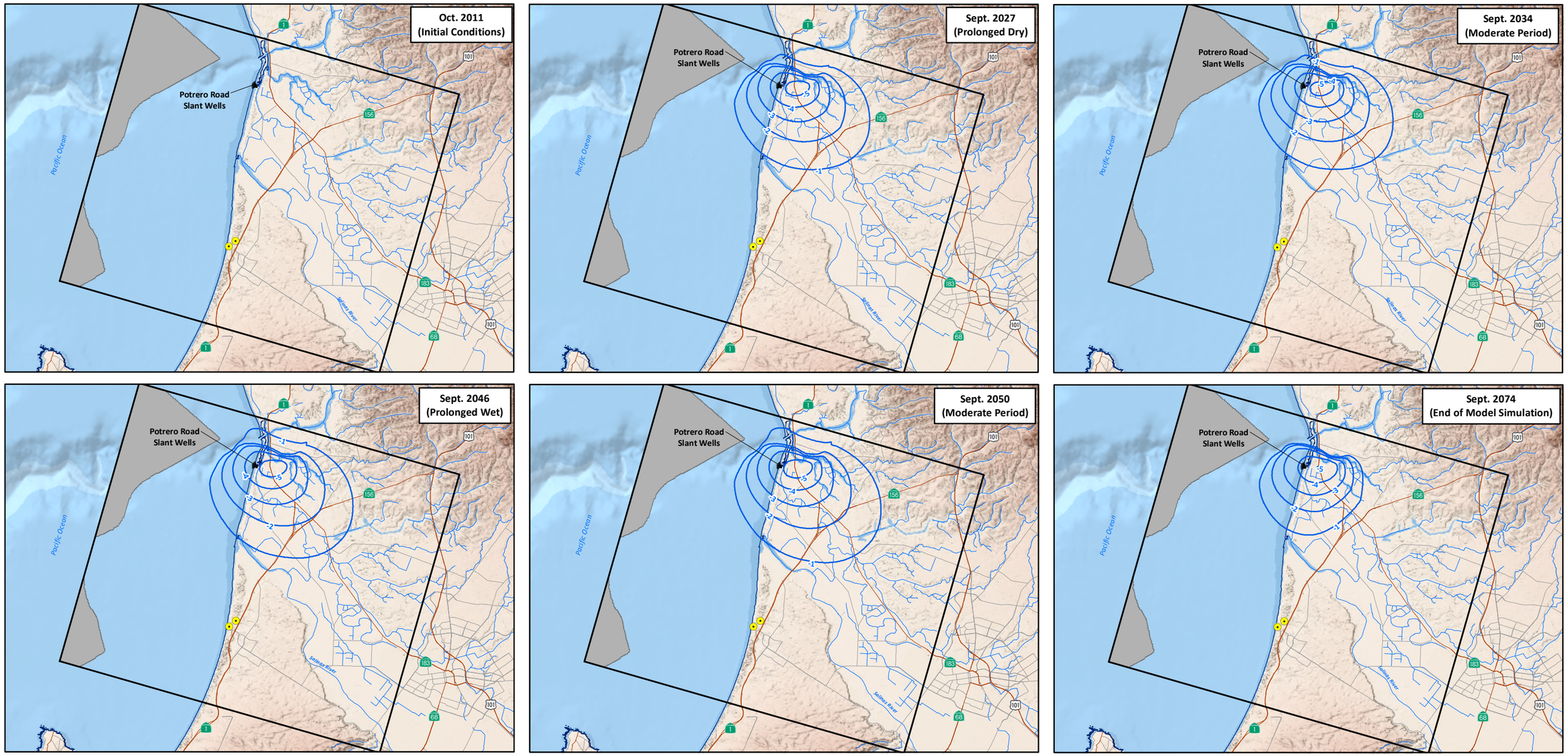
Figure 163

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_163_wlchange_dunesand_Run7sfminus2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2 4 8 Miles

Potrero Road Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 49 for Detailed Slant Well Layout)

Run 2f - Cumulative Baseline (No Project)
2060 Land Use with MCWD

Run 7sf - Project 2060 Land Use with MCWD
(Dune Sand)

CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 7sf (RUN 7sf MINUS RUN 2f)

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Figure 164

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_164_wlchange_180FT-180FTE_Run7sfminus2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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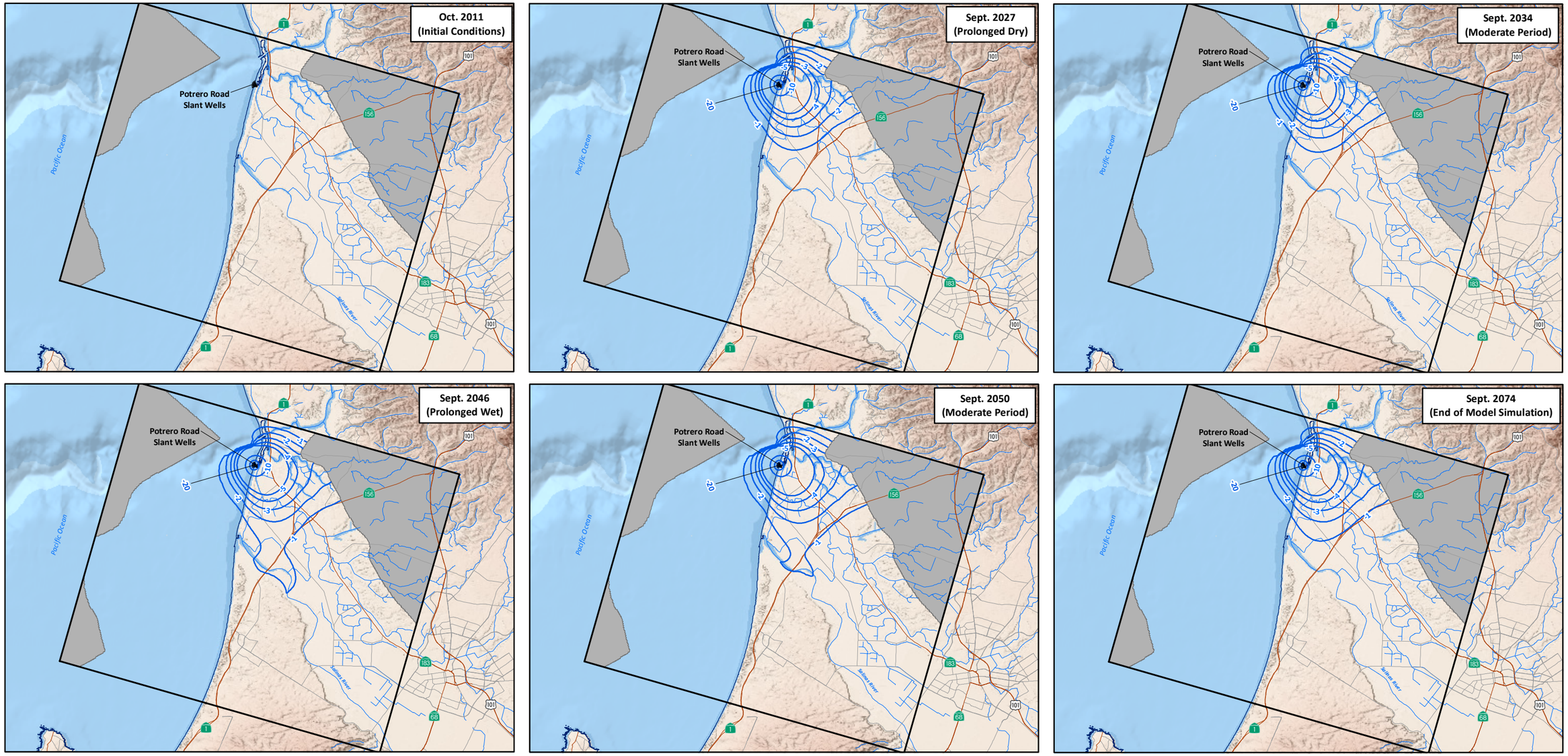
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide
(DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Potrero Road Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 50 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 8sn - Variant 2012 Land Use
(Dune Sand)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 8sn (RUN 8sn MINUS RUN 1n)

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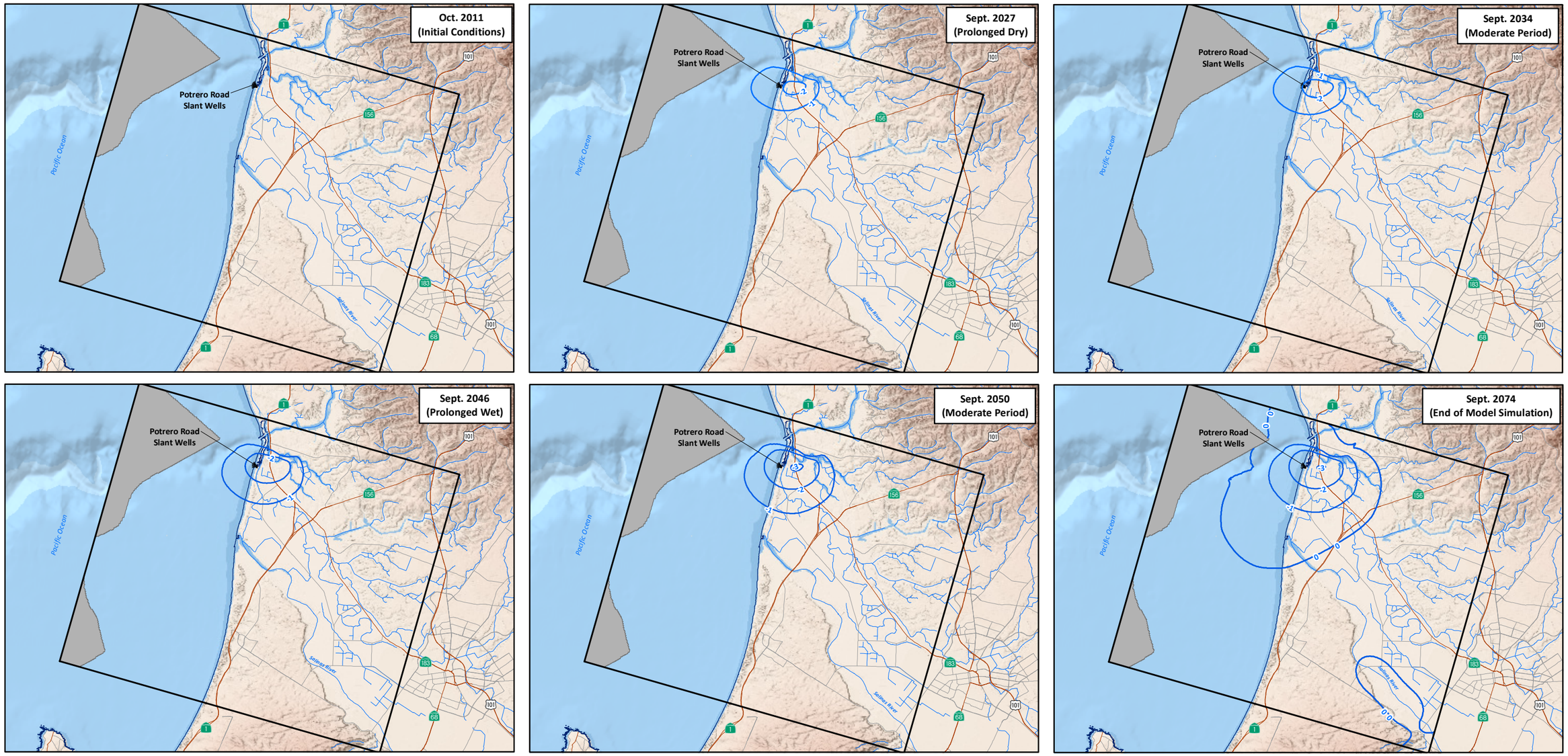
Figure 165

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_165_wlchange_dunesand_Run8snminus1n_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Note: 180-FTE = 180-Foot Equivalent Aquifer

Potrero Road Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 50 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 8sn - Variant 2012 Land Use
(Dune Sand)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 8sn (RUN 8sn MINUS RUN 1n)

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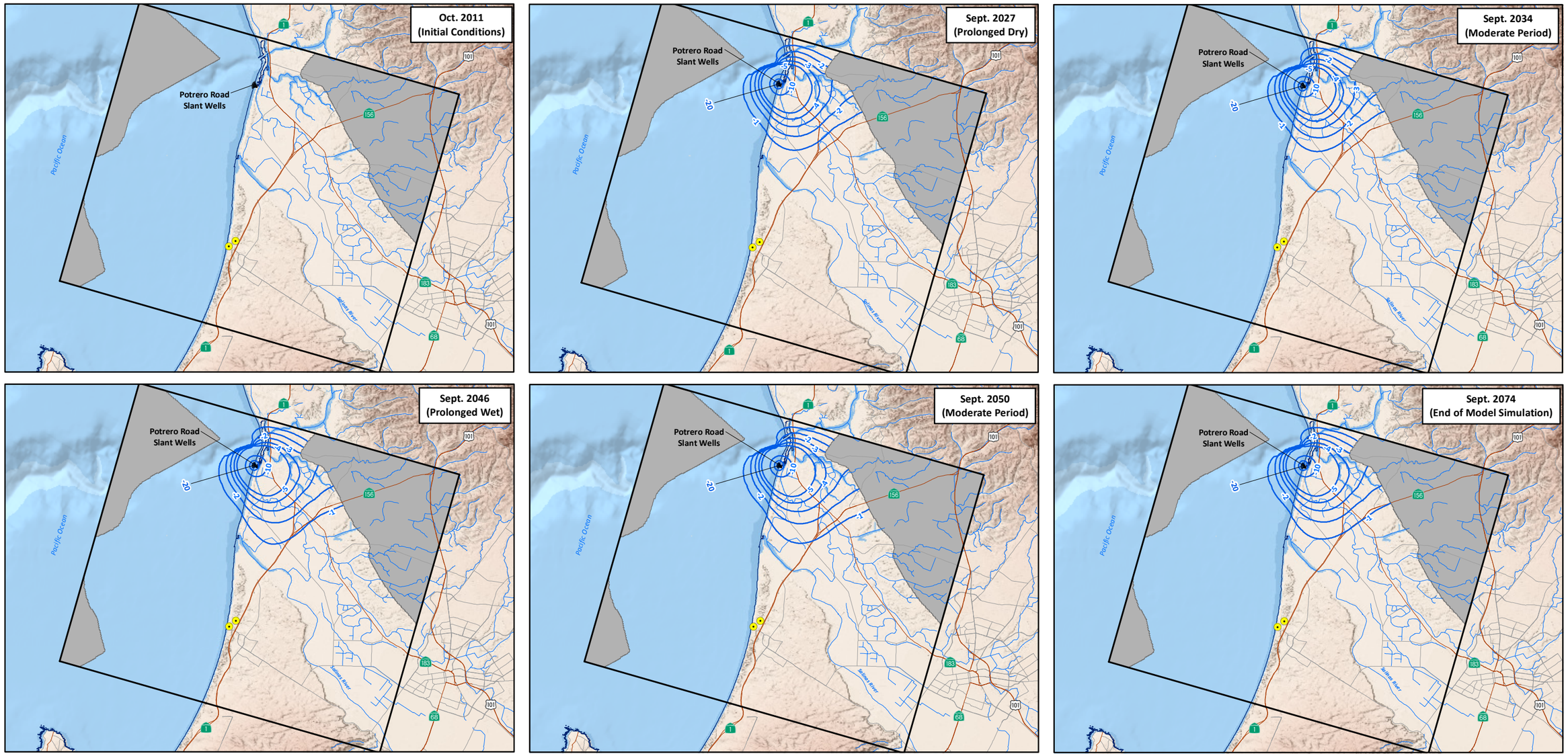
Figure 166

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_166_wlchange_180FT-180FTE_Run8snminus1n_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

Potrero Road Slant Wells - Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 50 for Detailed Slant Well Layout)

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 8sf - Variant 2060 Land Use with MCWD (Dune Sand)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 8sf (RUN 8sf MINUS RUN 2f)

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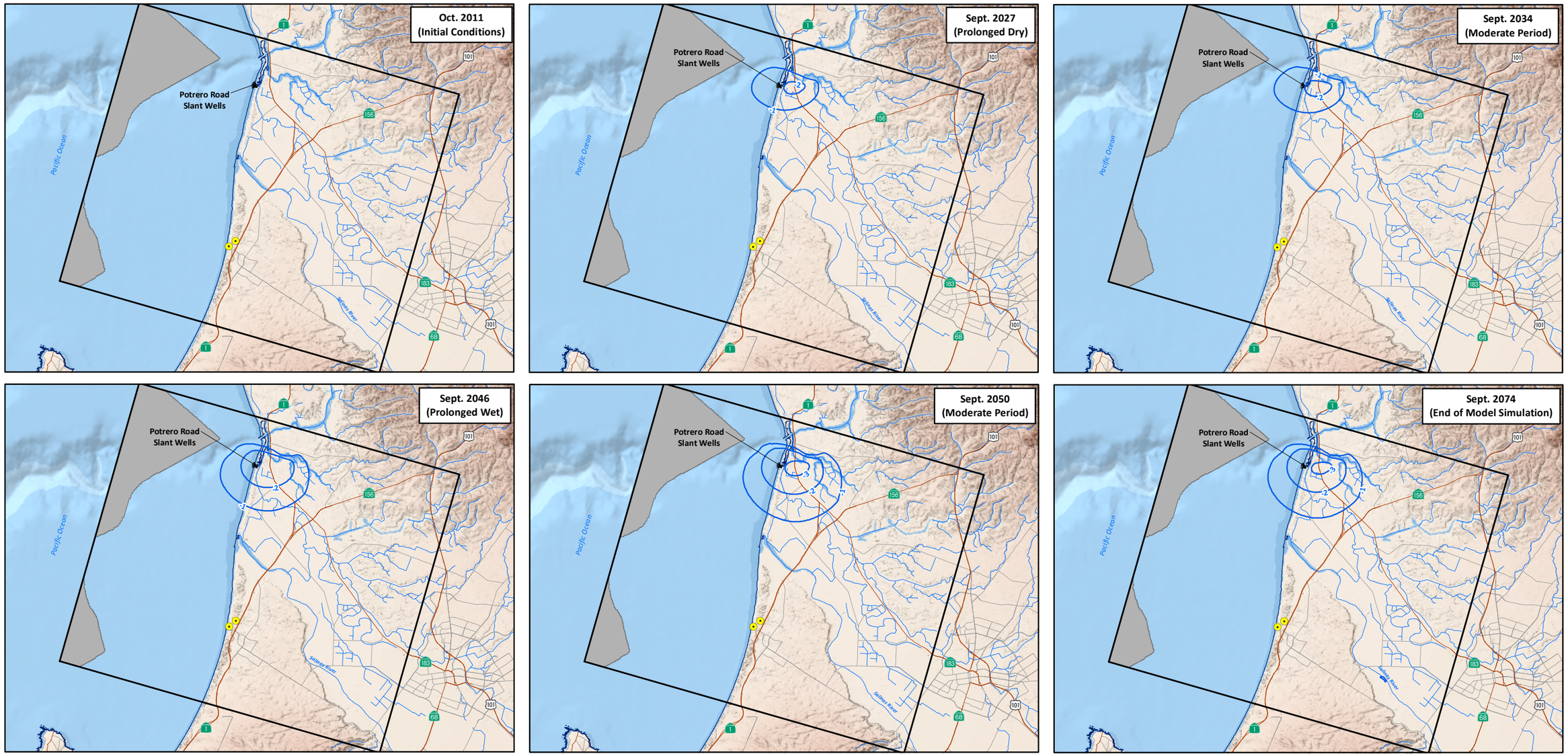
Figure 167

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_167_wlchange_dunesand_Run8sfminus2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

Potrero Road Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 50 for Detailed Slant Well Layout)

Run 2f - Cumulative Baseline (No Project)
2060 Land Use with MCWD

Run 8sf - Variant 2060 Land Use with MCWD
(Dune Sand)

NORTH

0 2 4 8 Miles

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CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 8sf (RUN 8sf MINUS RUN 2f)

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Figure 168

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_168_wlchange_180FT-180FTE_Run8sfminus2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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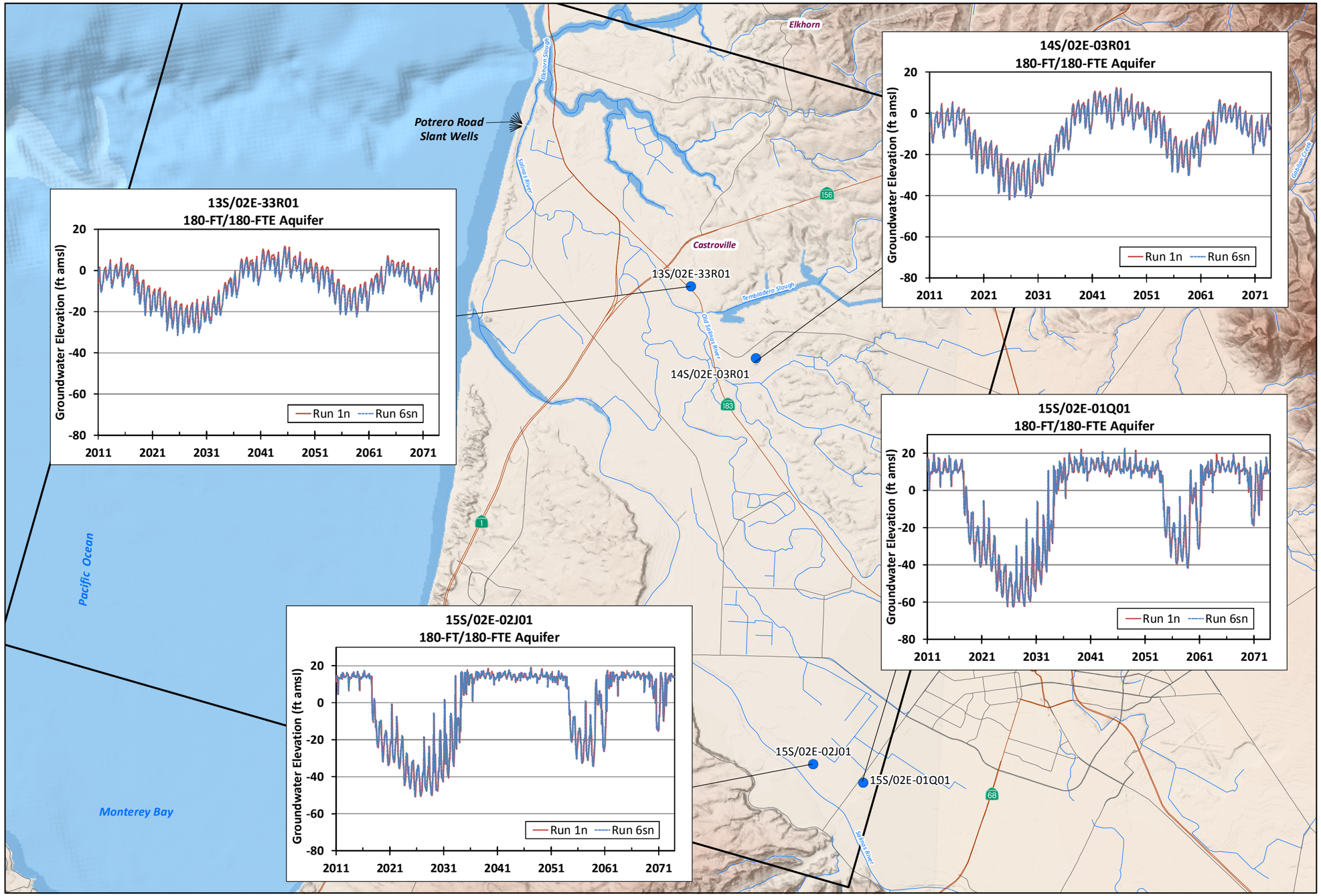
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 6sn VERSUS RUN 1n (180-FT/180-FTE AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

Potrero Road Slant Wells Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 49 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 6sn - Project 2012 Land Use (Dune Sand)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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NORTH

0 1 2 4 Miles

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Figure 169

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_169_hydrographs_Run6sn_vs_Run1n_180FT-180FTE_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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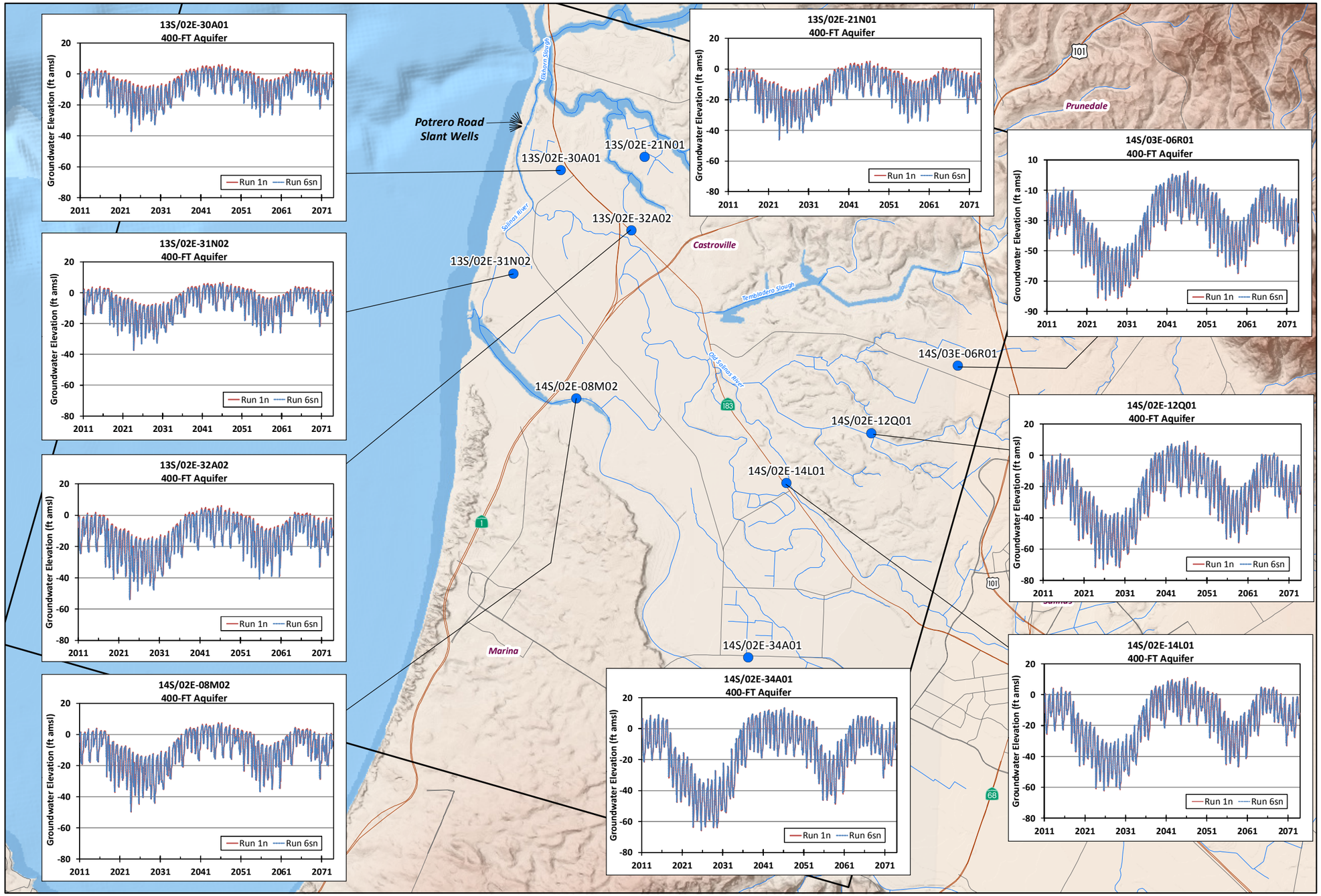
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 6sn VERSUS RUN 1n (400-FT AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

Potrero Road Slant Wells Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 49 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 6sn - Project 2012 Land Use (Dune Sand)

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NORTH

0 1 2 4 Miles

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Figure 170

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CALIFORNIA AMERICAN WATER AND
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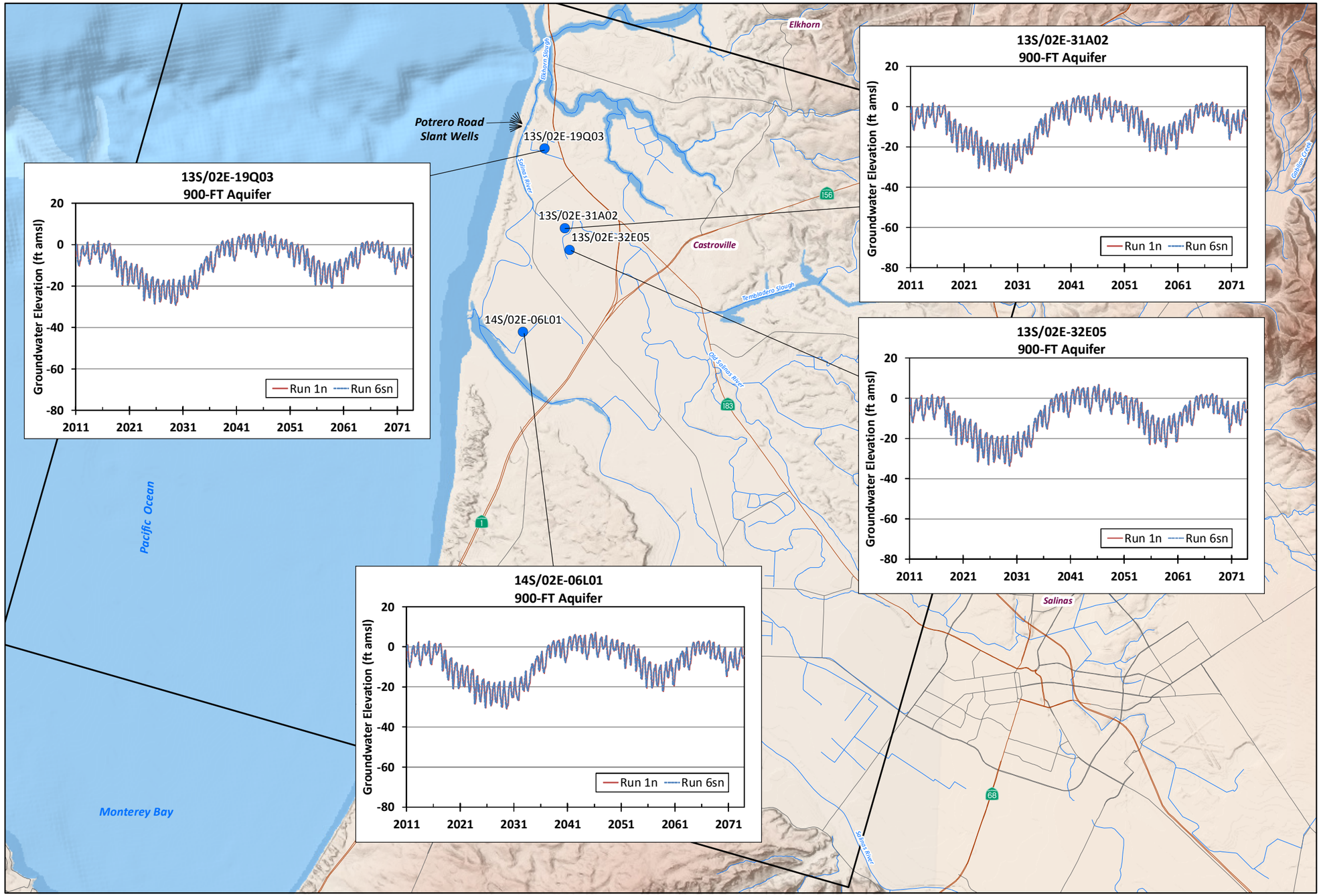
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 6sn VERSUS RUN 1n (900-FT AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

Potrero Road Slant Wells Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 49 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 6sn - Project 2012 Land Use (Dune Sand)

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NORTH

0 1 2 4 Miles

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Figure 171

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_171_hydrographs_Run6sn_vs_Run1n_900FT_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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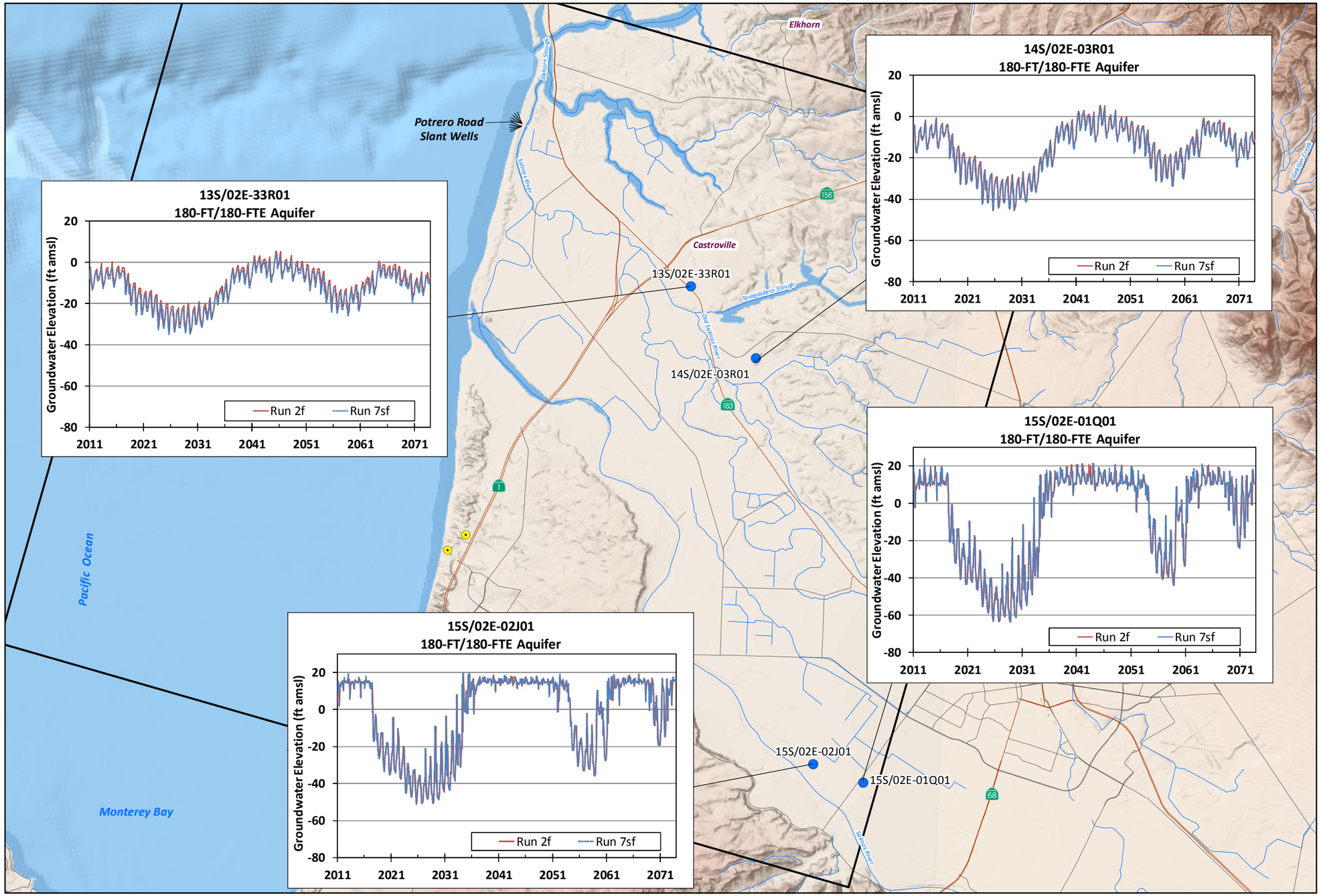
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 7sf VERSUS RUN 2f (180-FT/180-FTE AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- Potrero Road Slant Wells Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 49 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 7sf - Project 2060 Land Use with MCWD (Dune Sand)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

17-Apr-15

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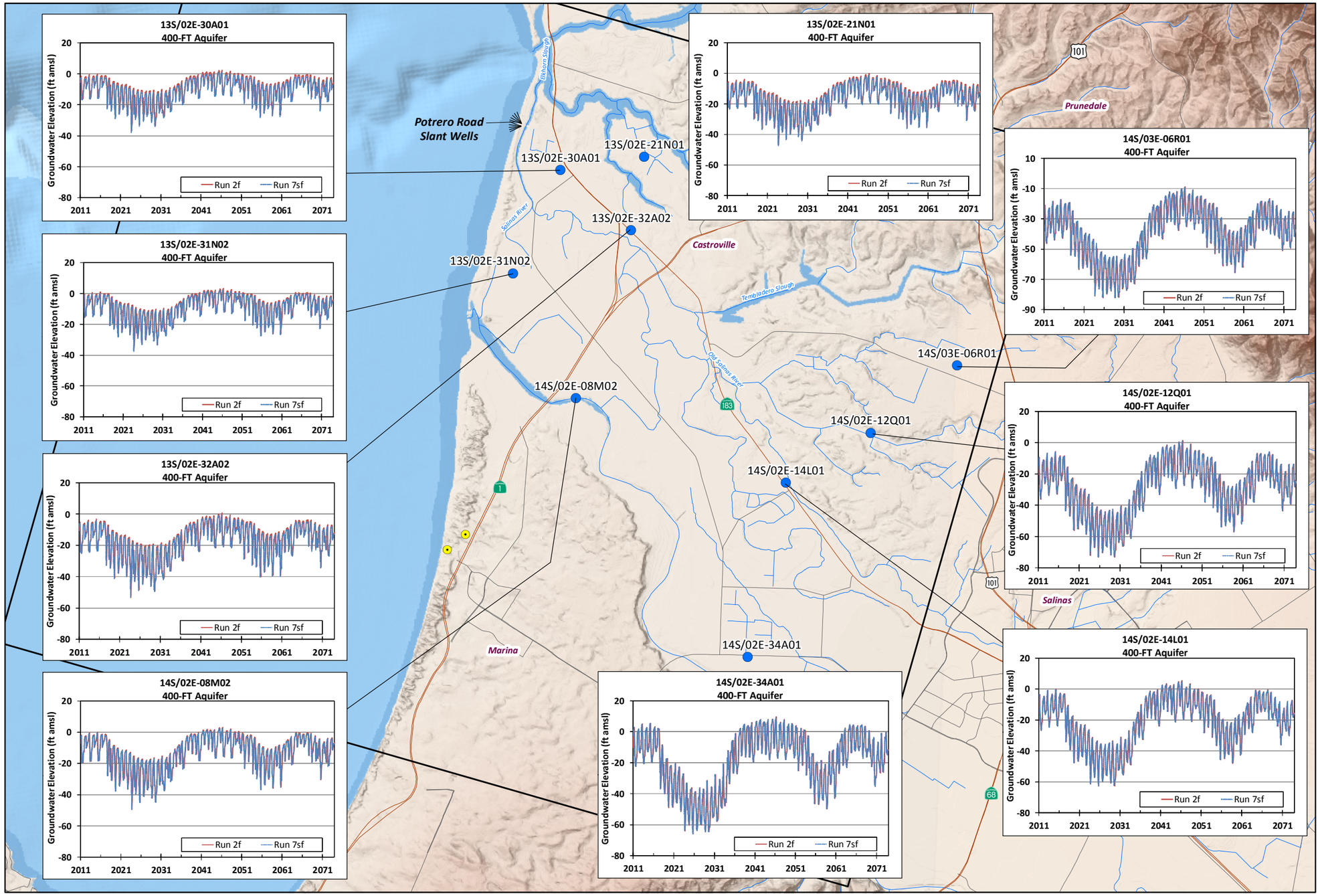
Figure 172

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_172_hydrographs_Run7sf_vs_Run1n_2n_180FT-180FTE_4-15.mxd

CALIFORNIA AMERICAN WATER AND
ENVIRONMENTAL SCIENCE ASSOCIATES

MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 7sf VERSUS RUN 2f (400-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- Potrero Road Slant Wells Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 49 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 7sf - Project 2060 Land Use with MCWD (Dune Sand)

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Figure 173

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_173_hydrographs_Run7sf_vs_Run1n_2n_400FT_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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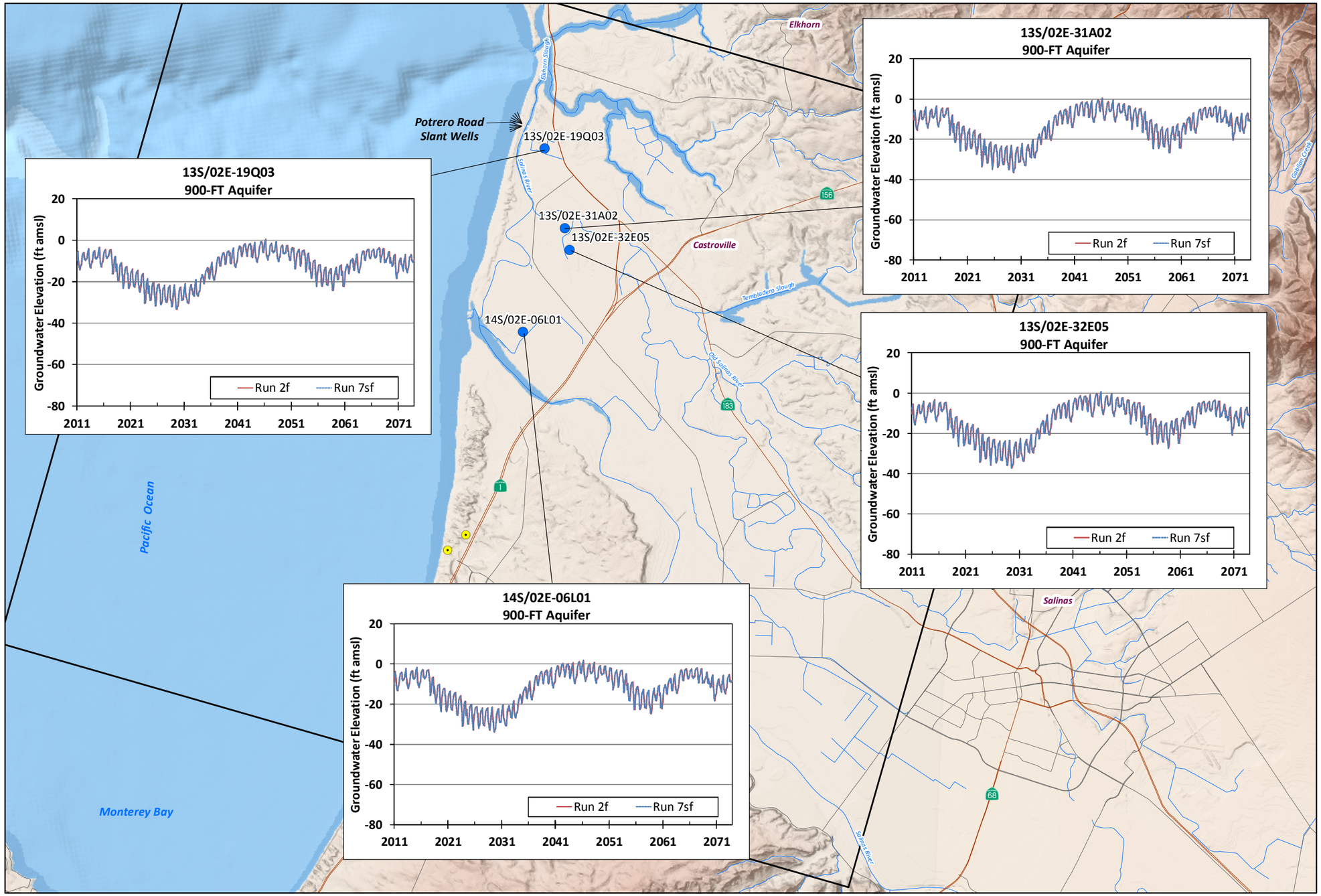
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 7sf VERSUS RUN 2f (900-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- Potrero Road Slant Wells Configuration A (Feedwater Supply of 24.1 MGD) (See Figure 49 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 7sf - Project 2060 Land Use with MCWD (Dune Sand)

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Figure 174

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_174_hydrographs_Run7sf_vs_Run1n_2n_900FT_4-15.mxd

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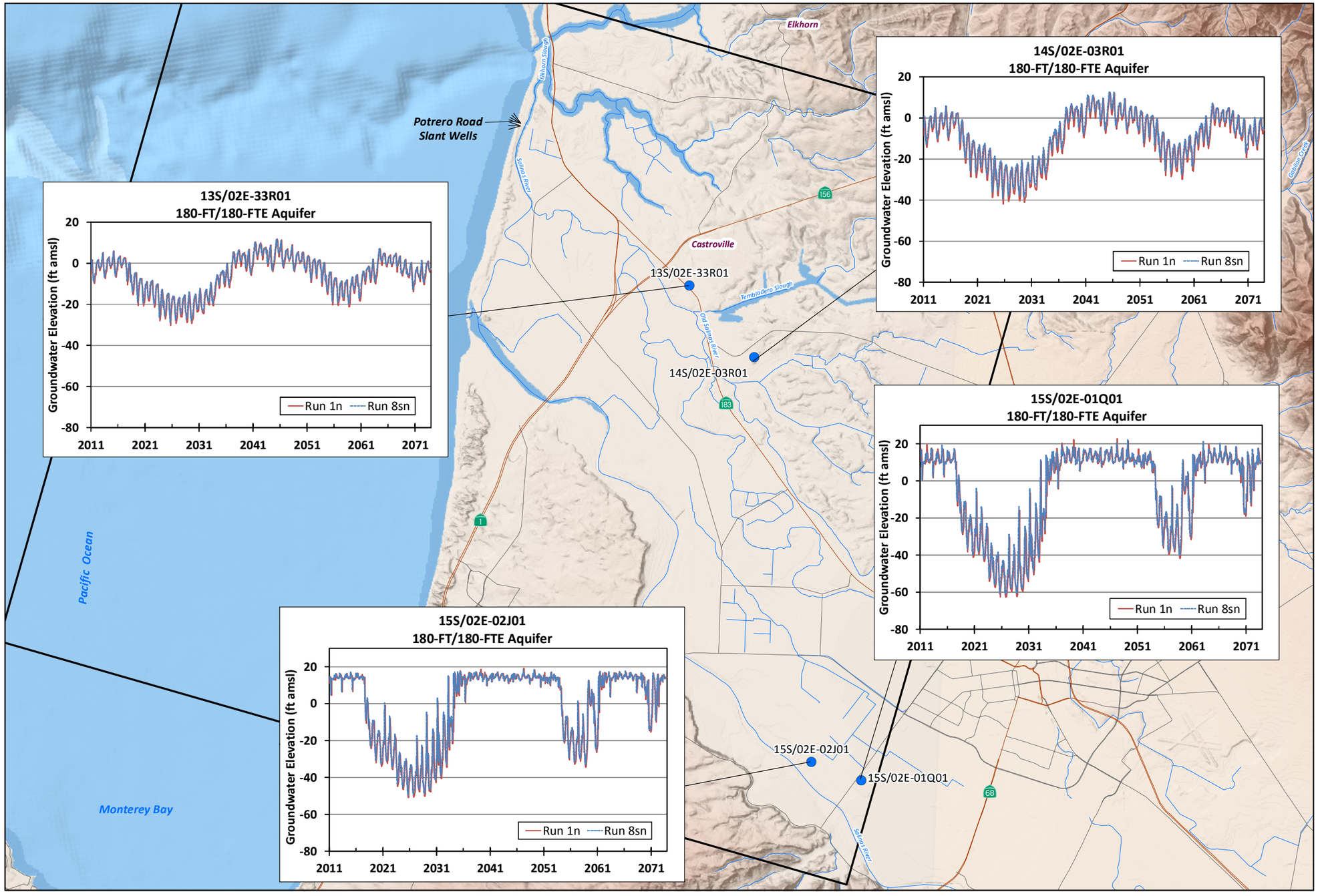
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 8sn VERSUS RUN 1n (180-FT/180-FTE AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

Potrero Road Slant Wells Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 50 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 8sn - Variant 2012 Land Use (Dune Sand)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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Figure 175

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_175_hydrographs_Run8sn_vs_Run1n_180FT-180FTE_4-15.mxd

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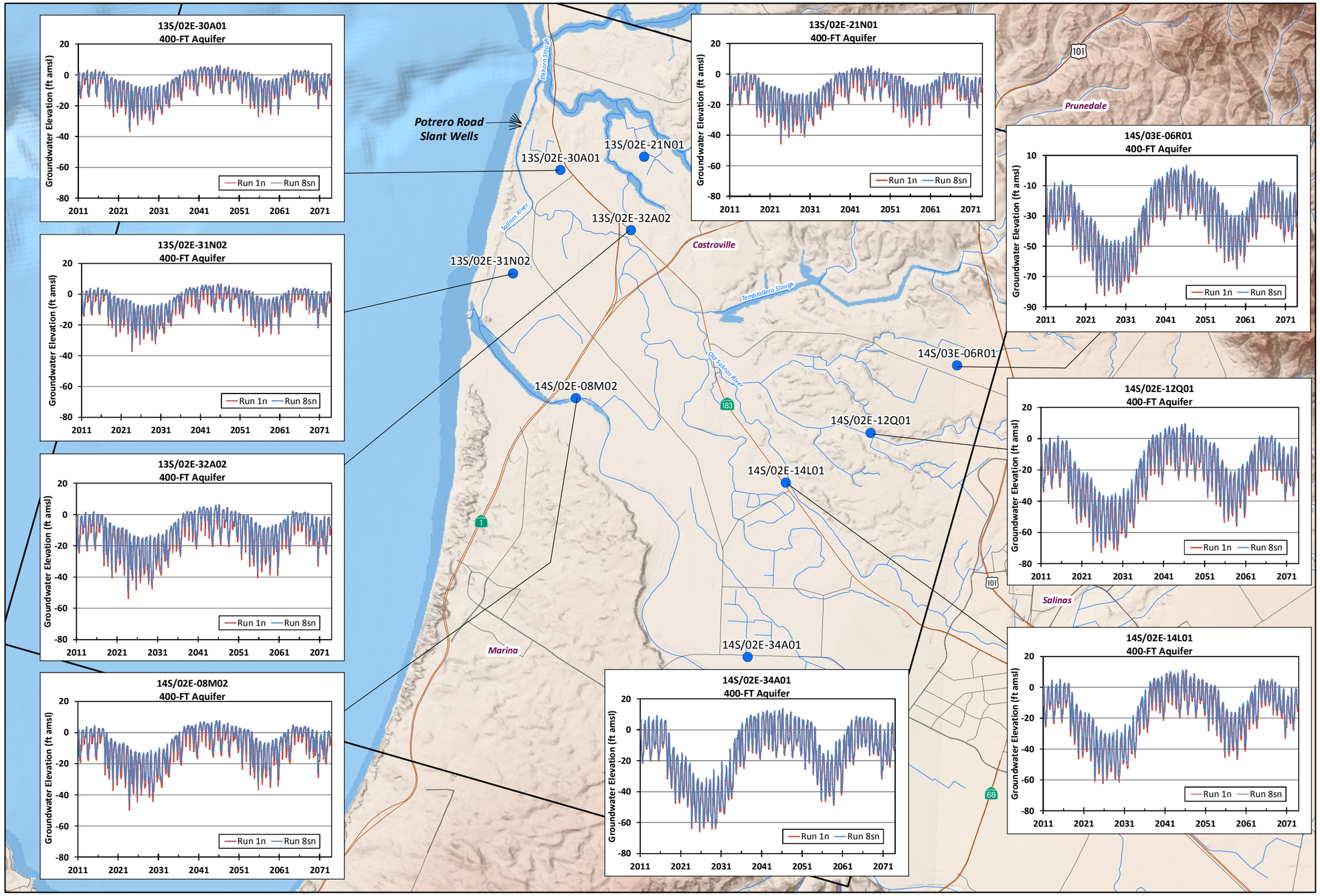
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 8sn VERSUS RUN 1n (400-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- Potrero Road Slant Wells Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 50 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 8sn - Variant 2012 Land Use (Dune Sand)

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Figure 176

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_176_hydrographs_Run8sn_vs_Run1n_400FT_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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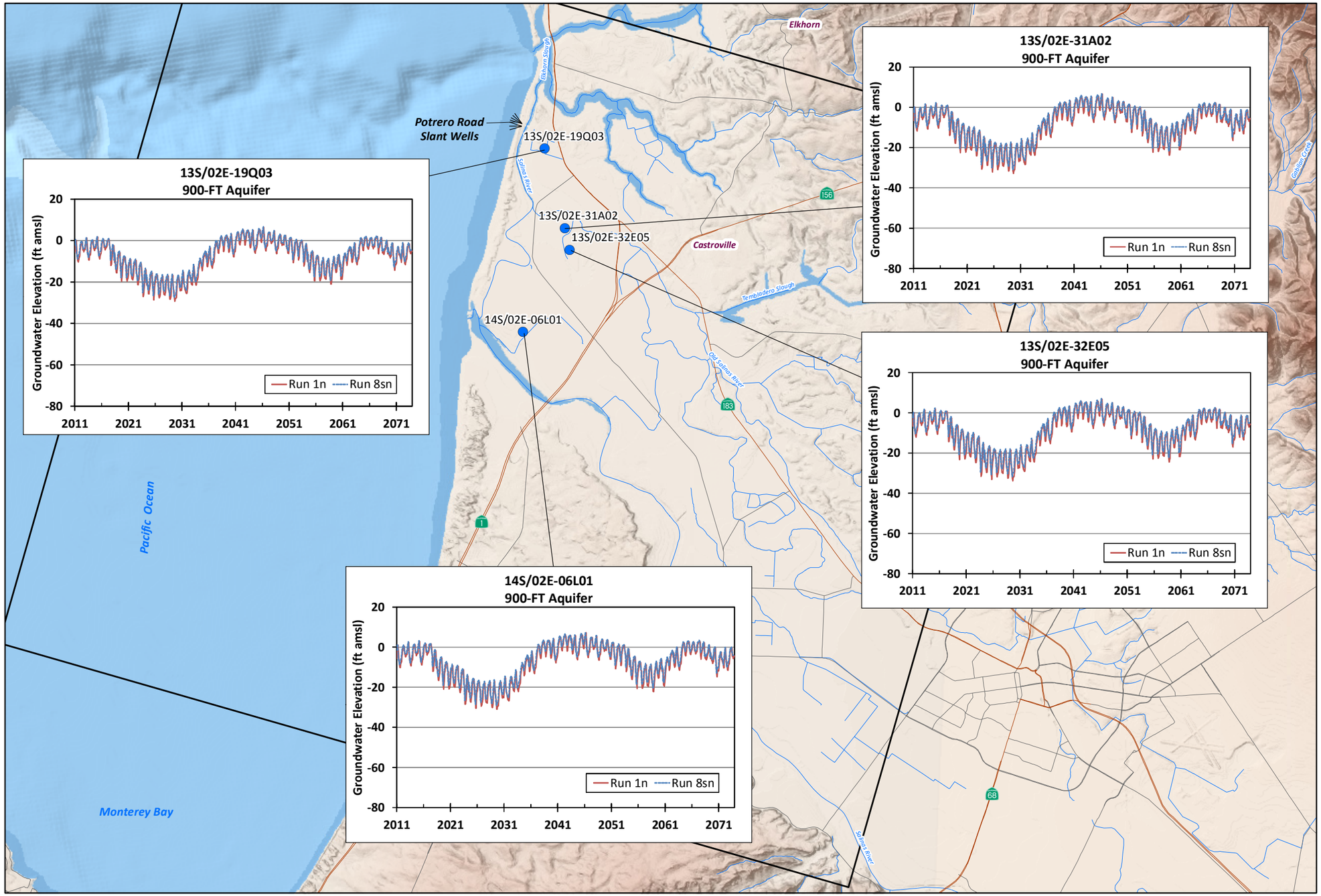
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 8sn VERSUS RUN 1n (900-FT AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

Potrero Road Slant Wells Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 50 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project) 2012 Land Use

Run 8sn - Variant 2012 Land Use (Dune Sand)

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Figure 177

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_177_hydrographs_Run8sn_vs_Run1n_900FT_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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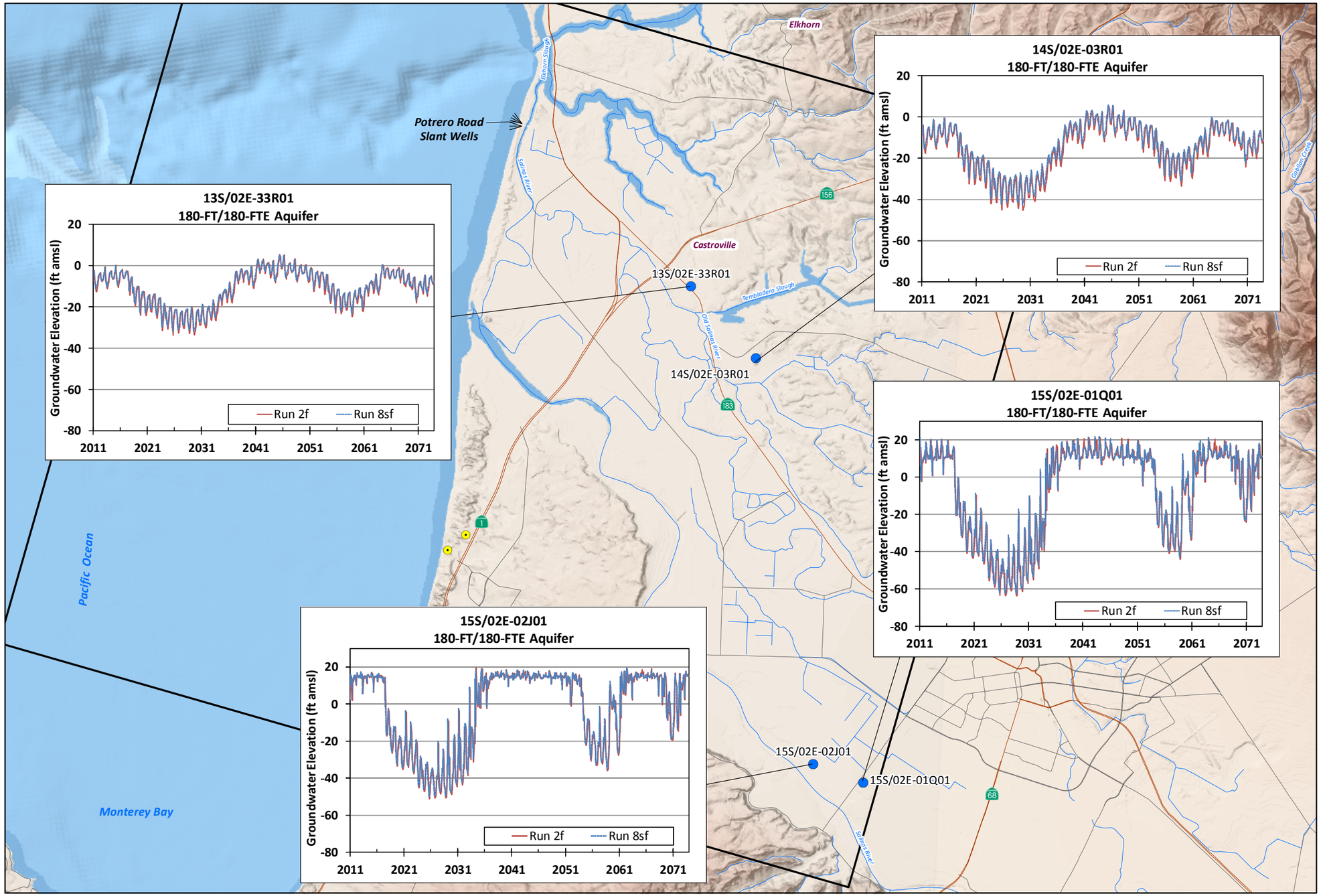
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 8sf VERSUS RUN 2f (180-FT/180-FTE AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- Potrero Road Slant Wells Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 50 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 8sf - Variant 2060 Land Use with MCWD (Dune Sand)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

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Figure 178

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_178_hydrographs_Run8sf_vs_Run2f_180FT-180FTE_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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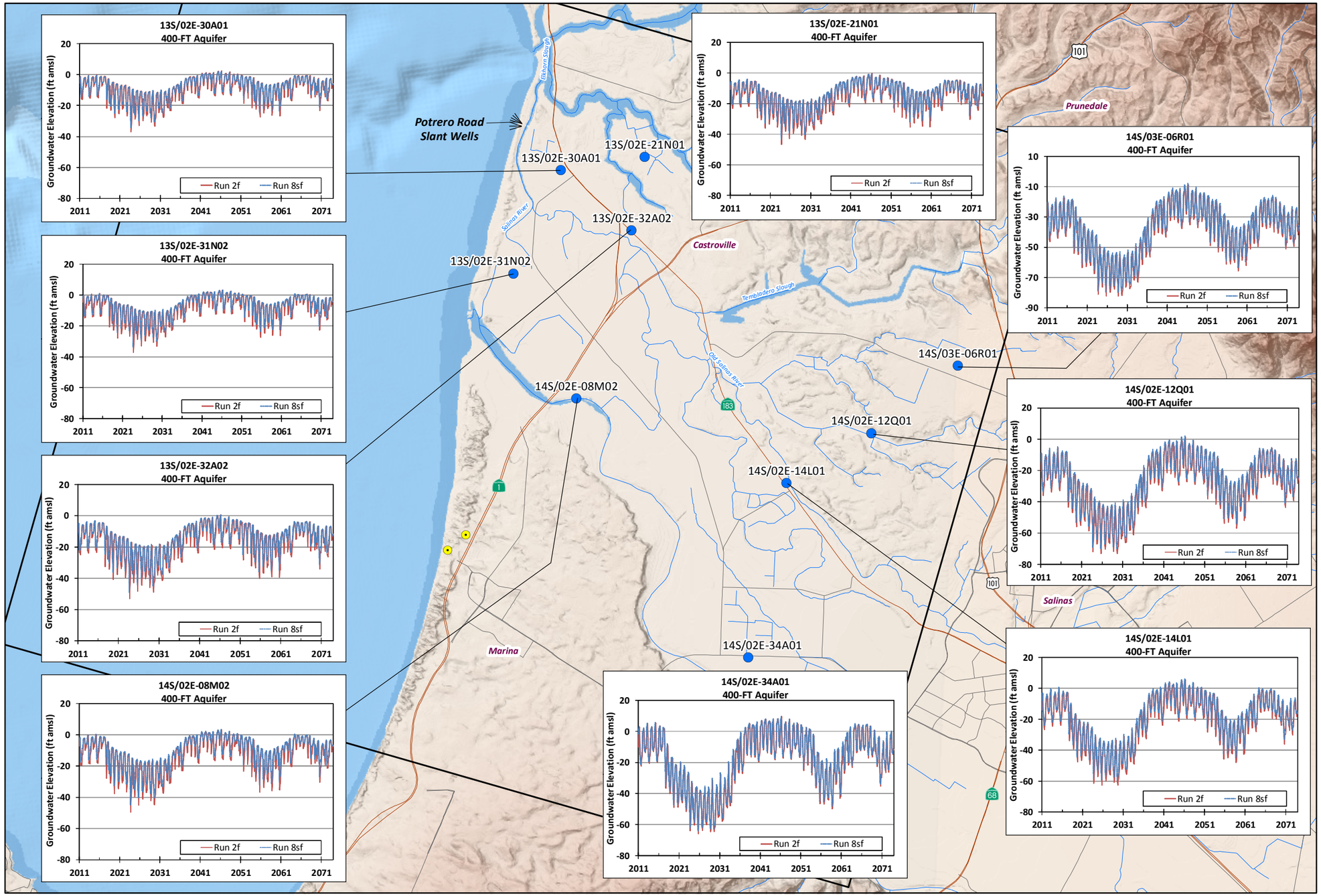
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 8sf VERSUS RUN 2f (400-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- Potrero Road Slant Wells Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 50 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 8sf - Variant 2060 Land Use with MCWD (Dune Sand)

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Figure 179

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_179_hydrographs_Run8sf_vs_Run2f_400FT_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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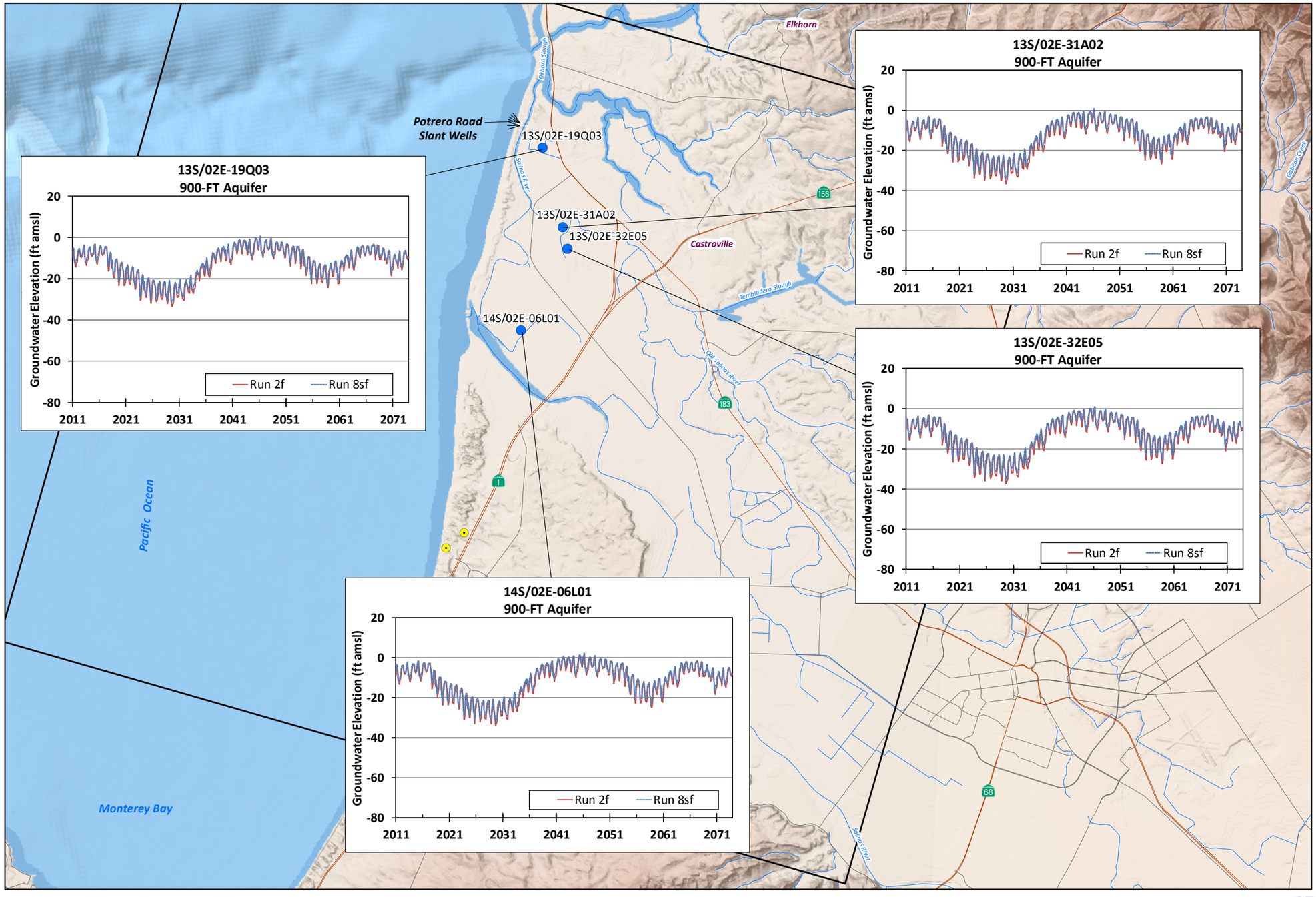
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 8sf VERSUS RUN 2f (900-FT AQUIFER)



EXPLANATION

- Well with Hydrograph
- North Marina Groundwater Model Boundary
- Potrero Road Slant Wells Configuration B (Feedwater Supply of 15.5 MGD) (See Figure 50 for Detailed Slant Well Layout)
- Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 8sf - Variant 2060 Land Use with MCWD (Dune Sand)

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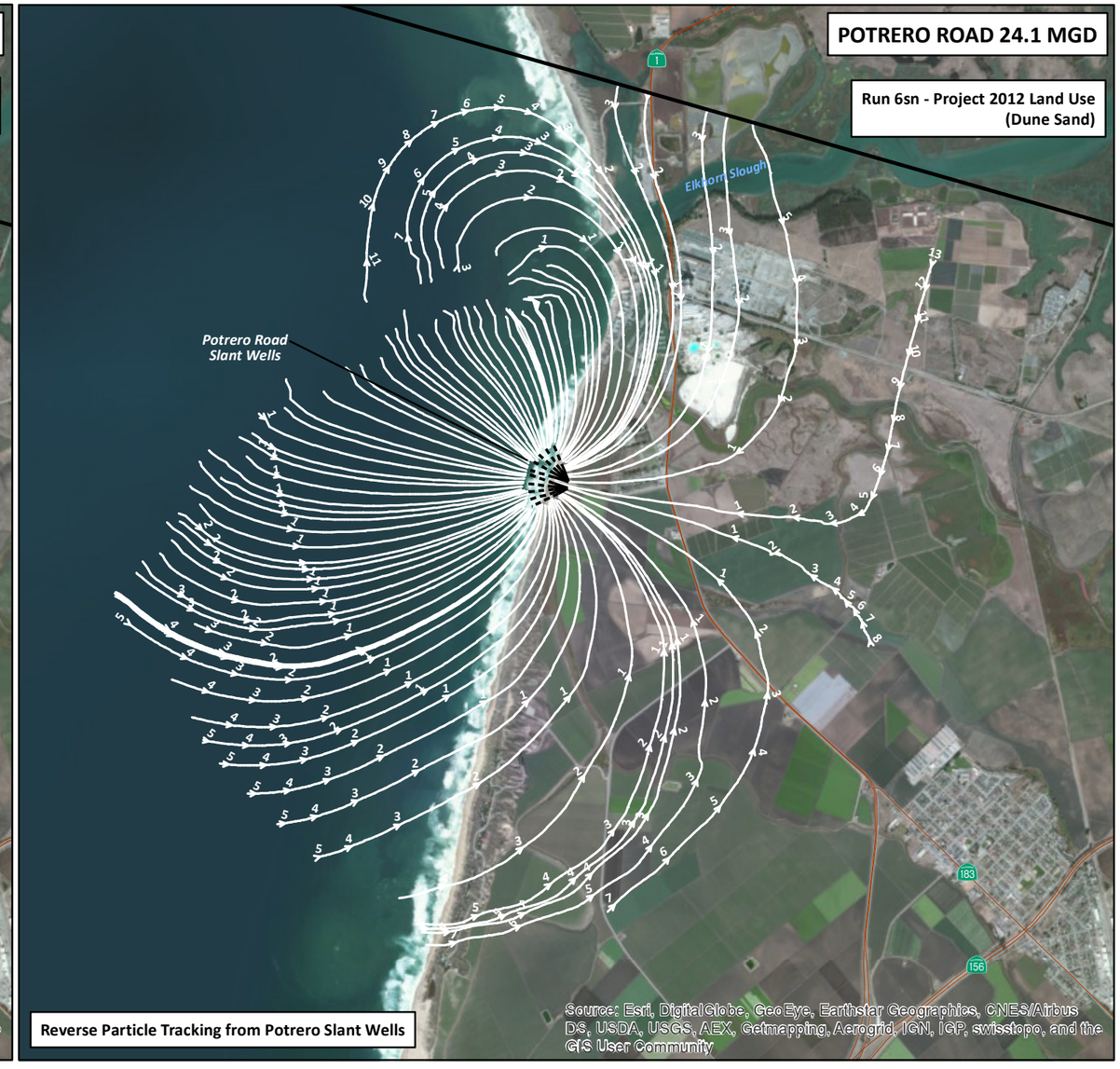
Figure 180

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_180_hydrographs_Run8sf_vs_Run2f_900FT_4-15.mxd



EXPLANATION

white line	Particle Travel Path
white arrow	Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

Potrero Road Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 49 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 6sn - Project 2012 Land Use
(Dune Sand)

NORTH

0 3,500 7,000 Feet

17-Apr-15

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PARTICLE TRACKING NEAR POTRERO ROAD NO PROJECT (RUN 1n) AND POTRERO ROAD 24.1 MGD (RUN 6sn) DUNE SAND AQUIFER

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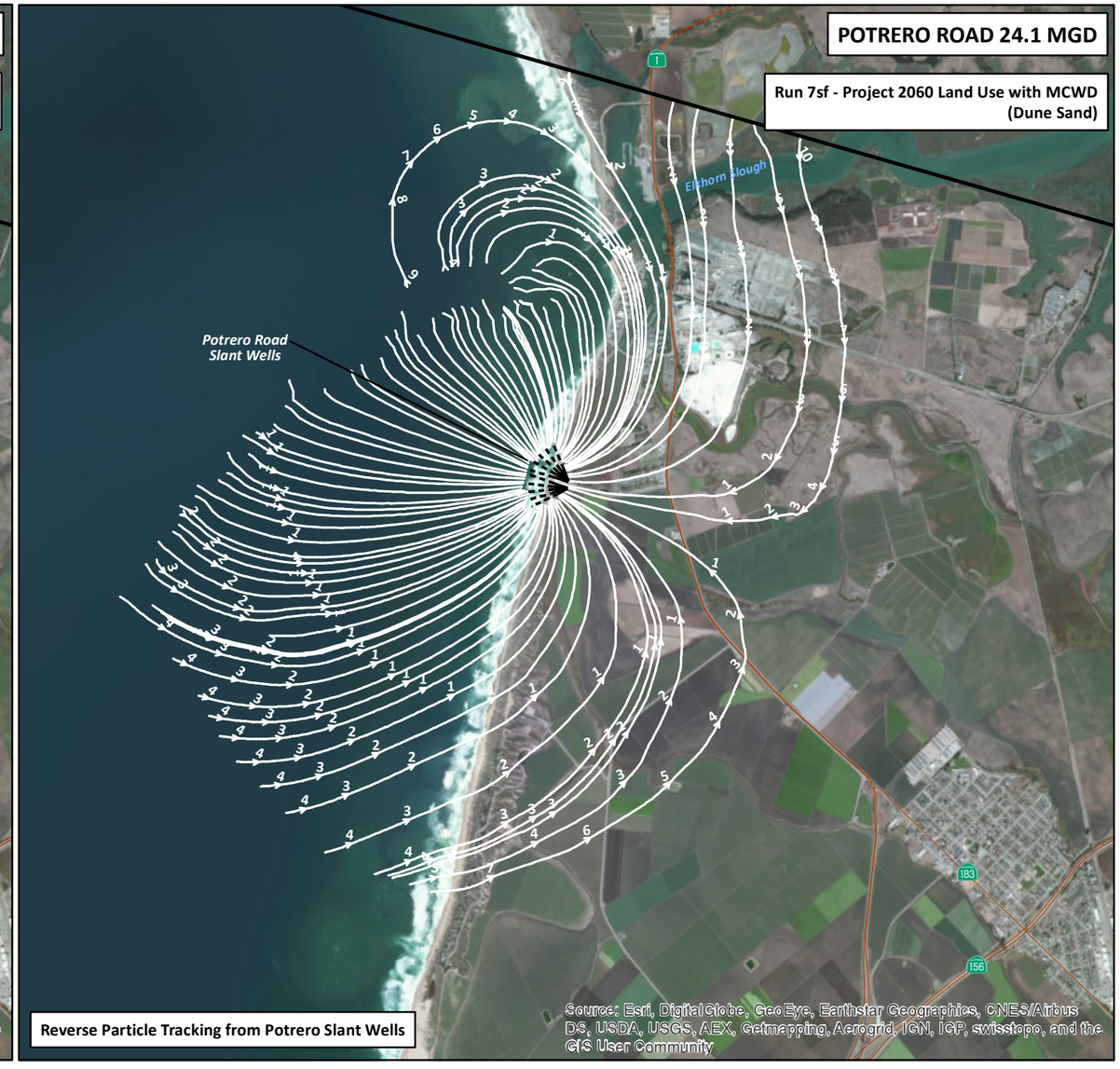
Figure 181

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_181_parttrk_dunesand_Run1nRun6sn_Potrero_2panel_4-15.mxd



EXPLANATION

white line	Particle Travel Path
white arrow	Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

Potrero Road Slant Wells - Configuration A
(Feedwater Supply of 24.1 MGD)
(See Figure 49 for Detailed Slant Well Layout)

Run 2f - Cumulative Baseline (No Project)
2060 Land Use with MCWD

Run 7sf - Project 2060 Land Use with MCWD
(Dune Sand)

NORTH

0 3,500 7,000 Feet

PARTICLE TRACKING NEAR POTRERO ROAD NO PROJECT (RUN 2f) AND POTRERO ROAD 24.1 MGD (RUN 7sf) DUNE SAND AQUIFER

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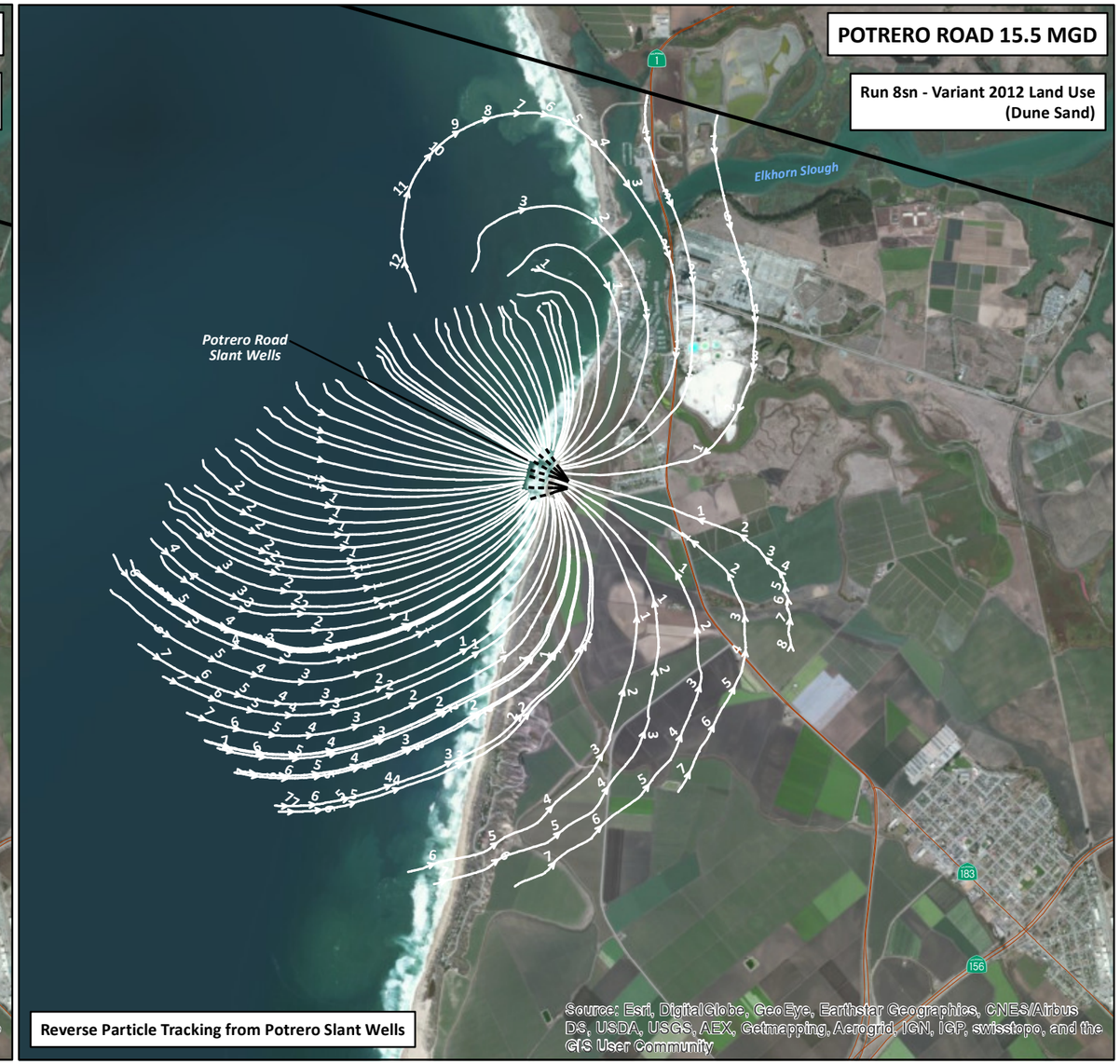
Figure 182

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_182_parttrk_dunesand_Run2fRun7sf_Potrero_2panel_4-15.mxd



EXPLANATION

white line	Particle Travel Path
white arrow	Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

Potrero Road Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 50 for Detailed Slant Well Layout)

Run 1n - Baseline (No Project)
2012 Land Use

Run 8sn - Variant 2012 Land Use
(Dune Sand)

NORTH

0 3,500 7,000 Feet

PARTICLE TRACKING NEAR POTRERO ROAD NO PROJECT (RUN 1n) AND POTRERO ROAD 15.5 MGD (RUN 8sn) DUNE SAND AQUIFER

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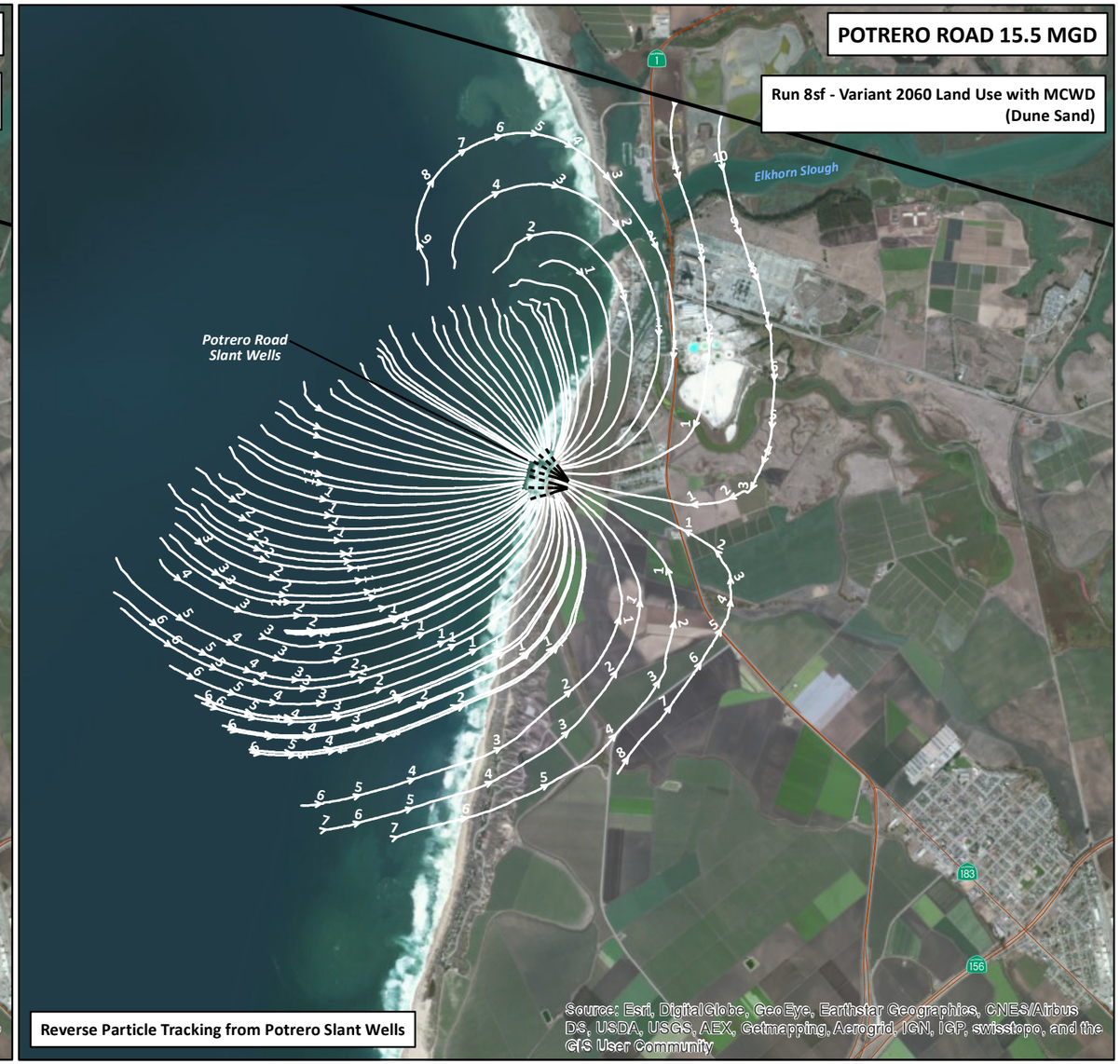
Figure 183

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_183_parttrk_dunesand_Run1nRun8sn_Potrero_2panel_4-15.mxd



EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

Potrero Road Slant Wells - Configuration B
(Feedwater Supply of 15.5 MGD)
(See Figure 50 for Detailed Slant Well Layout)

PARTICLE TRACKING NEAR POTRERO ROAD NO PROJECT (RUN 2f) AND POTRERO ROAD 15.5 MGD (RUN 8sf) DUNE SAND AQUIFER

17-Apr-15

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NORTH

0 3,500 7,000 Feet

Run 2f - Cumulative Baseline (No Project)
2060 Land Use with MCWD

Run 8sf - Variant 2060 Land Use with MCWD
(Dune Sand)

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Figure 184

CALIFORNIA AMERICAN WATER AND
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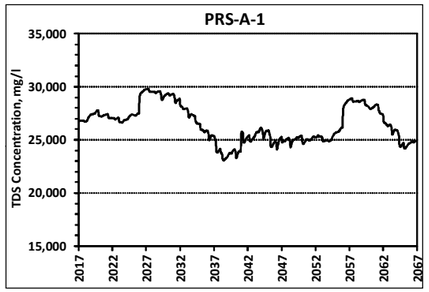
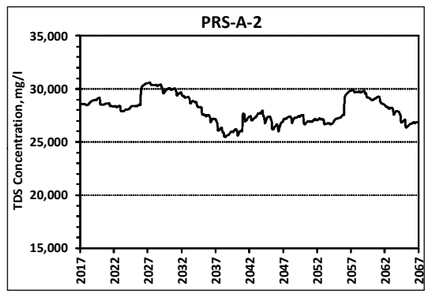
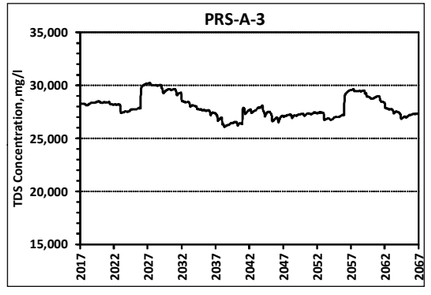
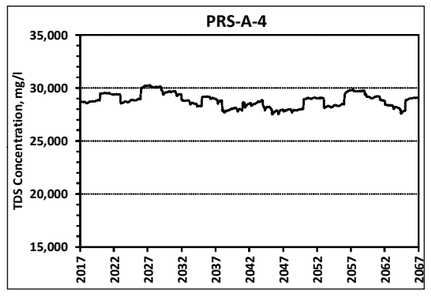
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

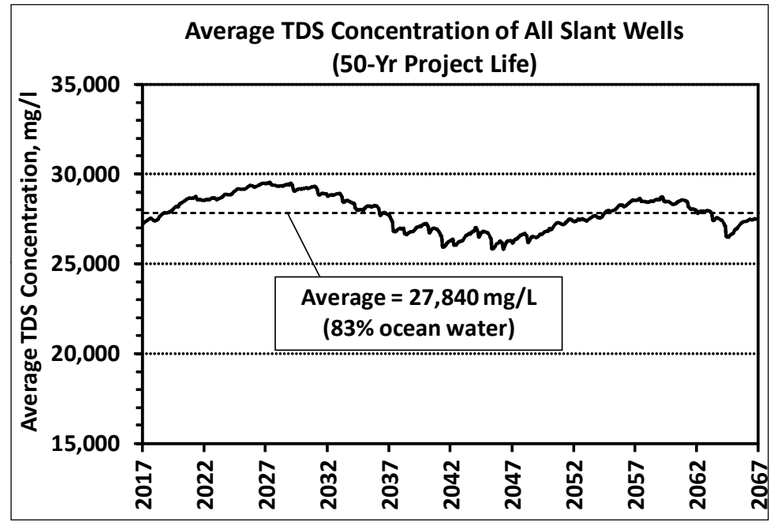
PREDICTED PERCENT OF OCEAN WATER IN POTRERO ROAD SITE PROJECT SLANT WELLS - RUN 6sn

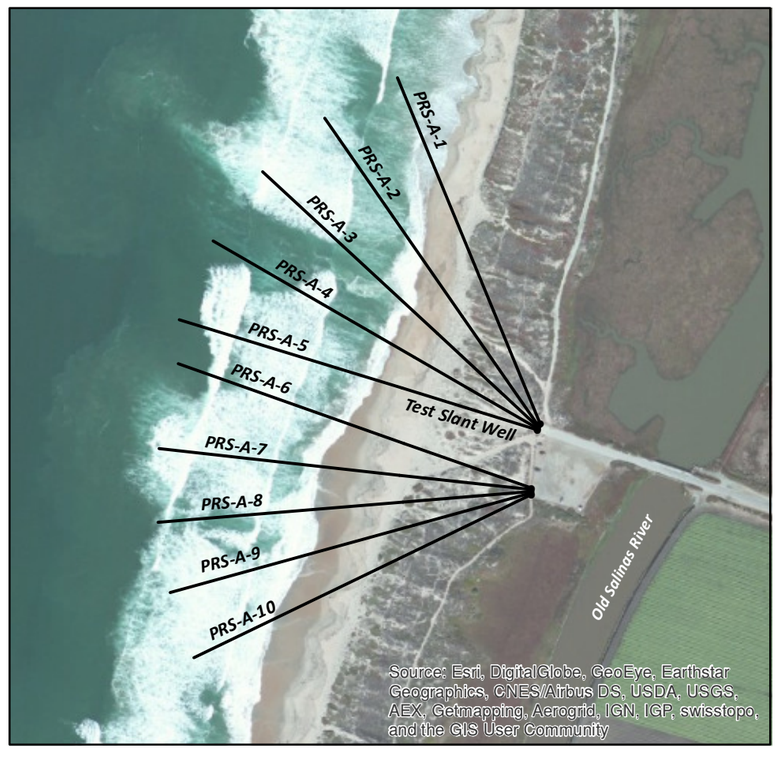


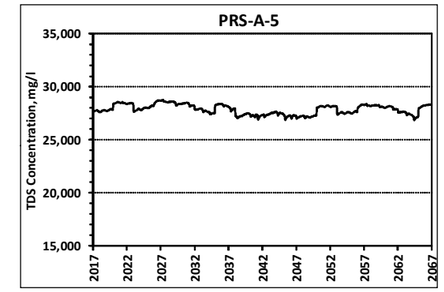


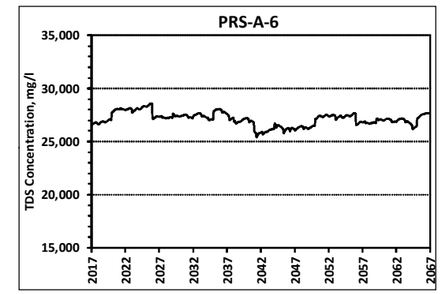


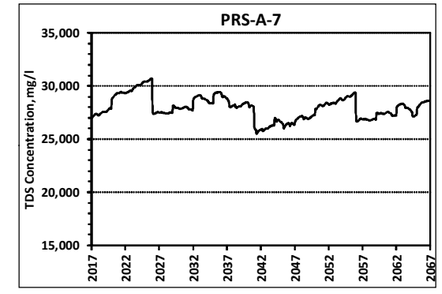


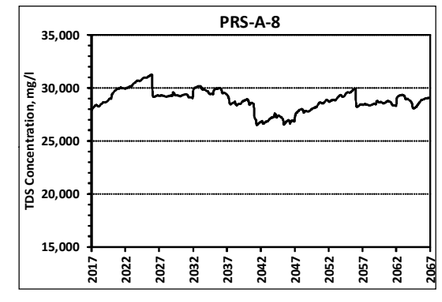


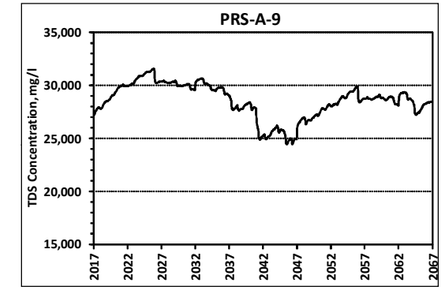


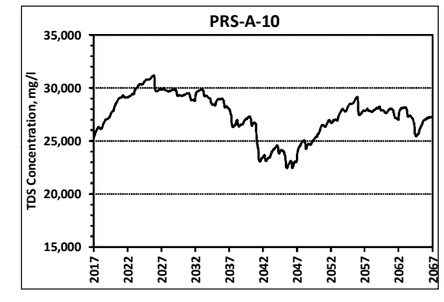












EXPLANATION

Run 6sn - Project 2012 Land Use
(Dune Sand)

17-Apr-15

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NORTH

0 100 200 300 400 800
Feet

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Figure 185

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_185_Percent_OceanWater_Potrero_Run6sn_4-15.mxd

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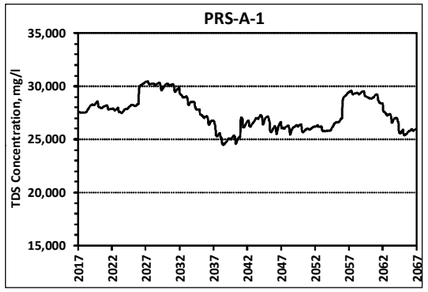
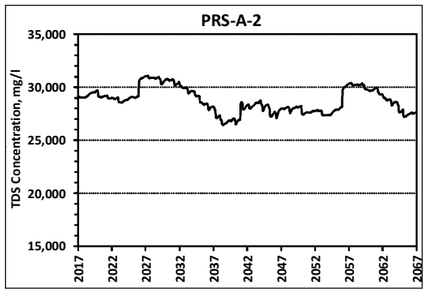
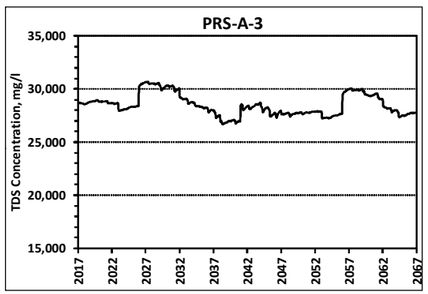
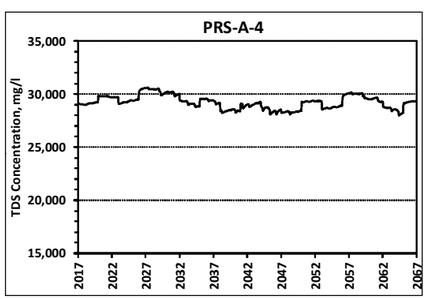
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

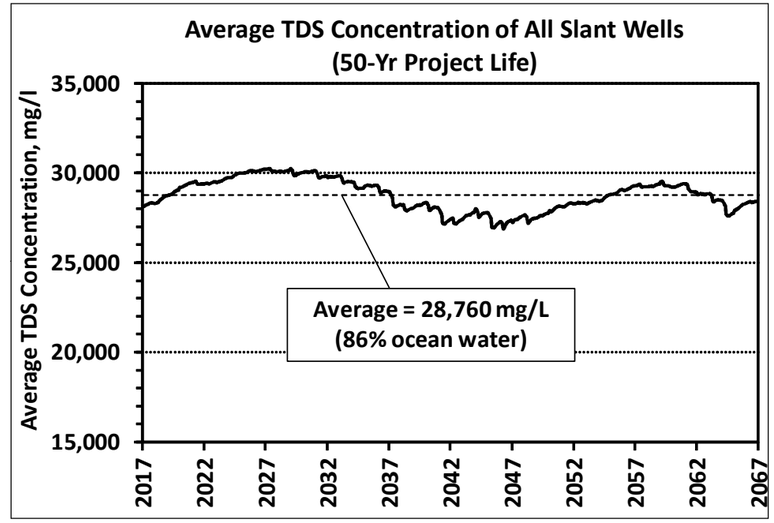
PREDICTED PERCENT OF OCEAN WATER IN POTRERO ROAD SITE PROJECT SLANT WELLS - RUN 7sf

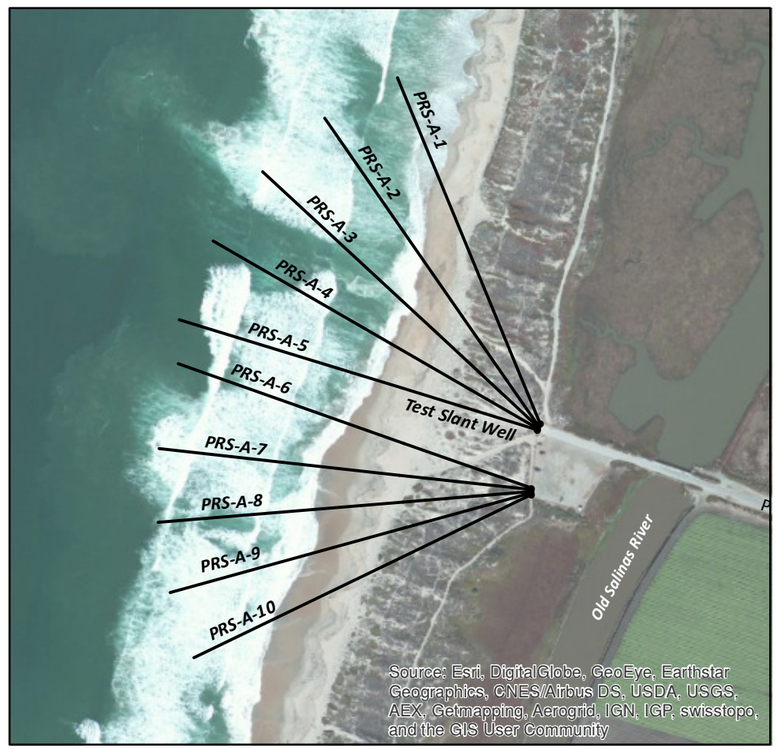


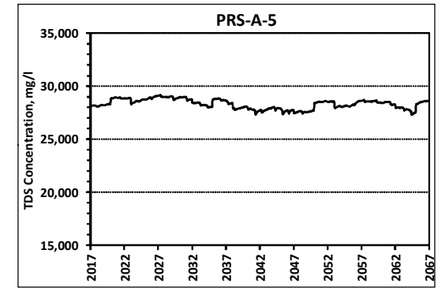


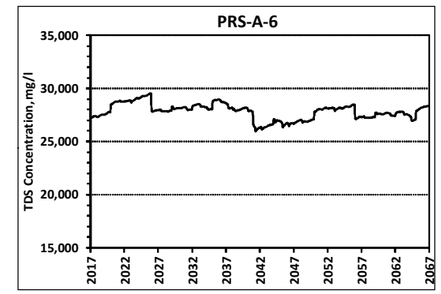


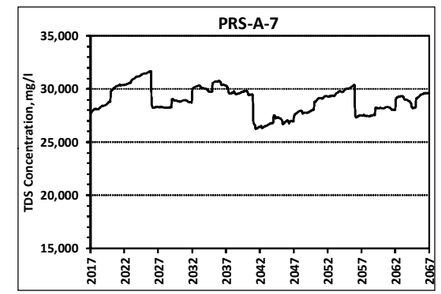


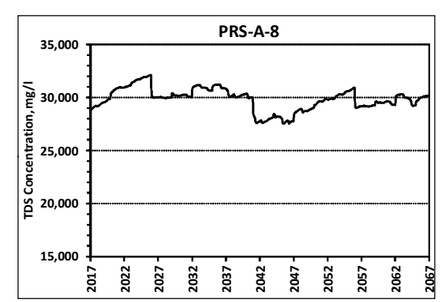


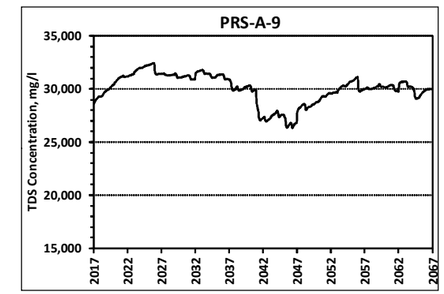


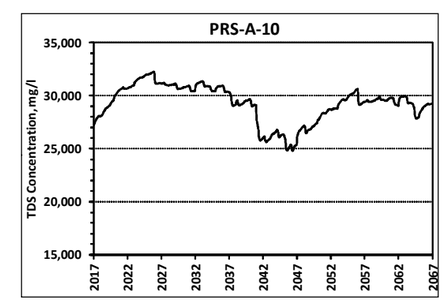












EXPLANATION

Run 7sf - Project 2060 Land Use with MCWD
(Dune Sand)

17-Apr-15

Prepared by: DB. Map Projection: State Plane 1983, Zone IV.

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NORTH

0 100 200 300 400 800
Feet

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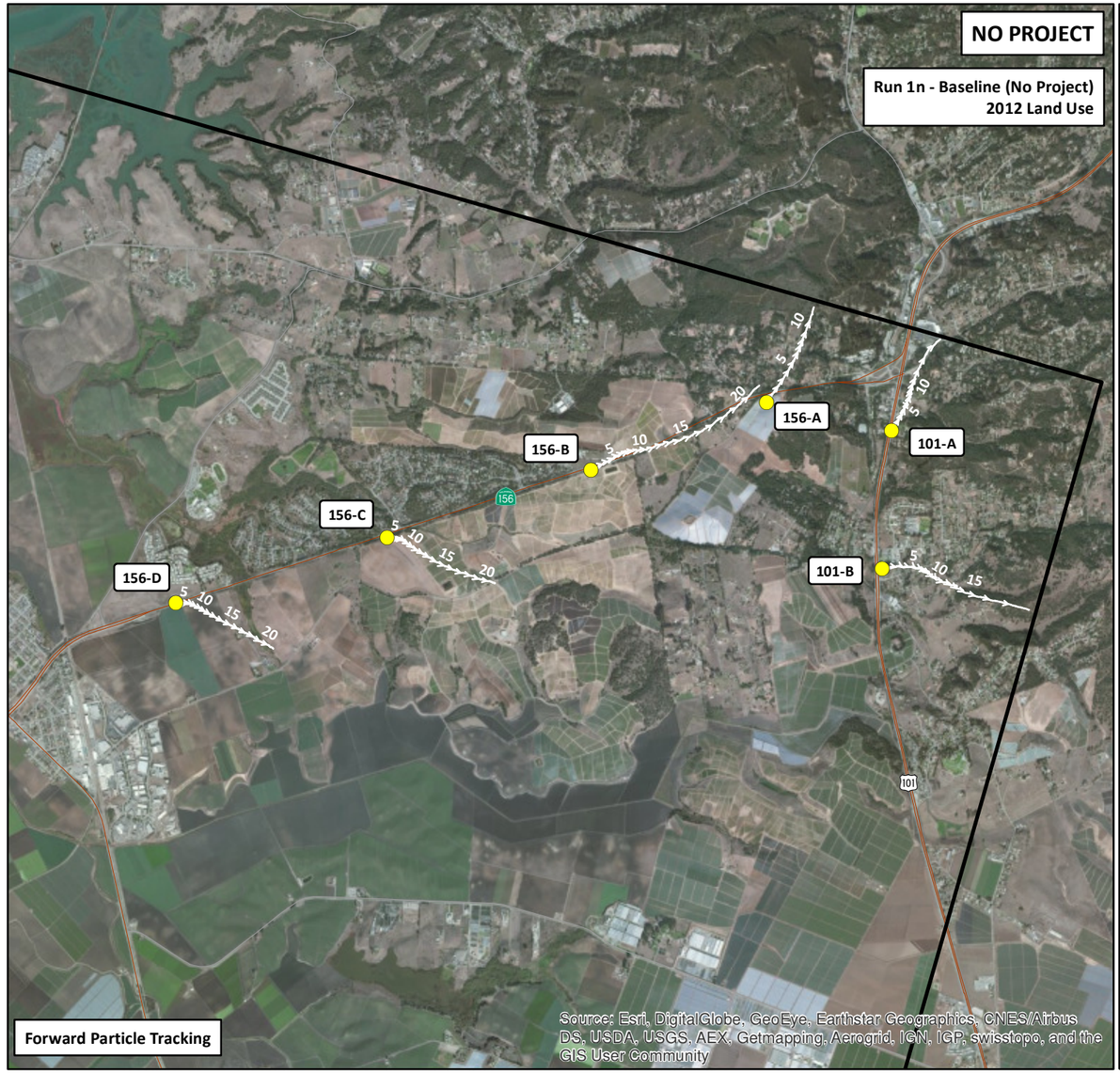
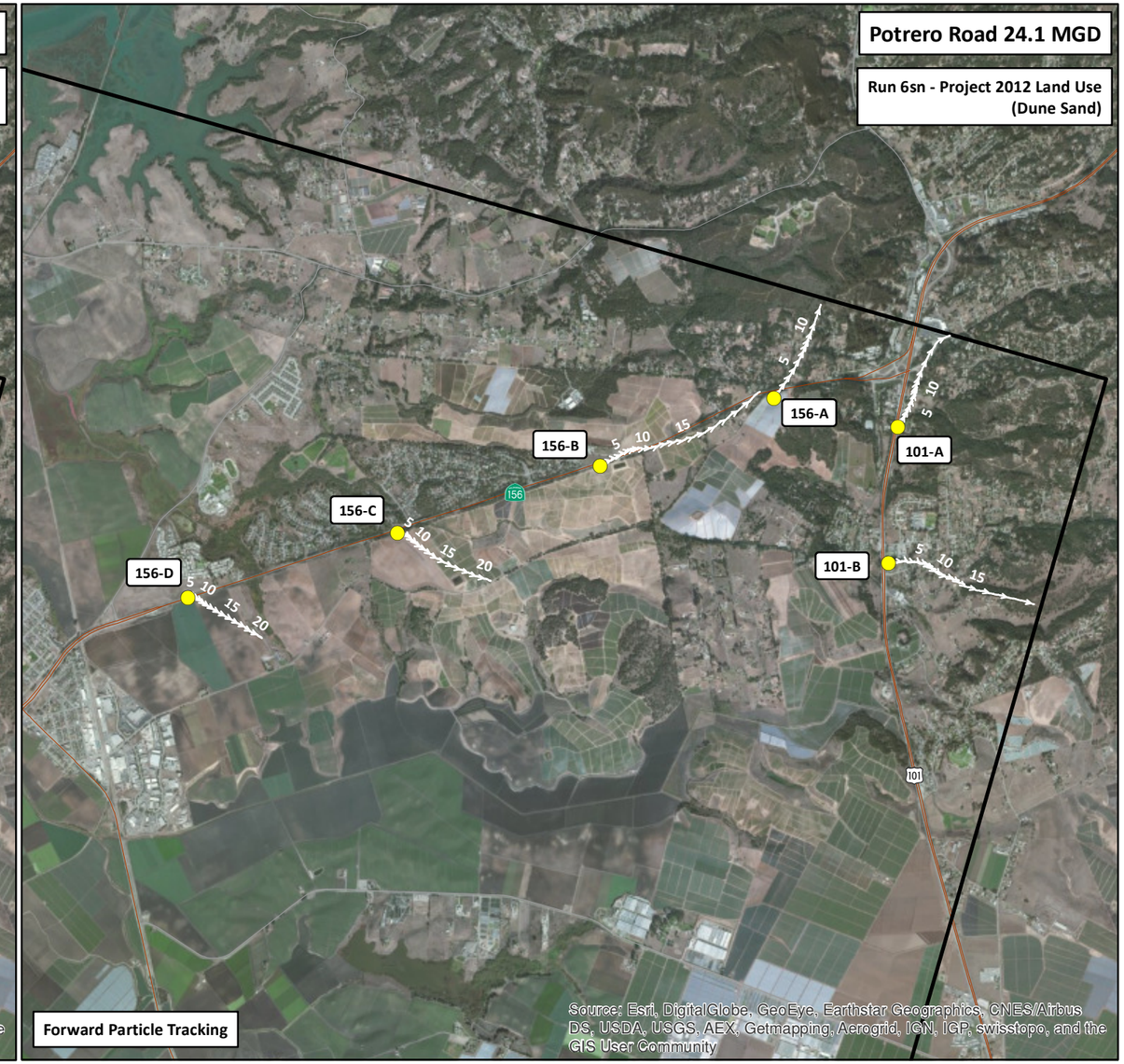
Figure 186

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_186_Percent_OceanWater_Potrero_Run7sf_4-15.mxd





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,000 4,000 8,000 Feet

Run 1n - Baseline (No Project)
2012 Land Use

Run 6sn - Project 2012 Land Use
(Dune Sand)

PARTICLE TRACKING NEAR PRUNEDALE
NO PROJECT (RUN 1n) AND
POTRERO ROAD 24.1 MGD (RUN 6sn)
180-FT/180-FTE AQUIFER

17-Apr-15

Prepared by: DB. Map Projection: State Plane 1983, Zone IV.

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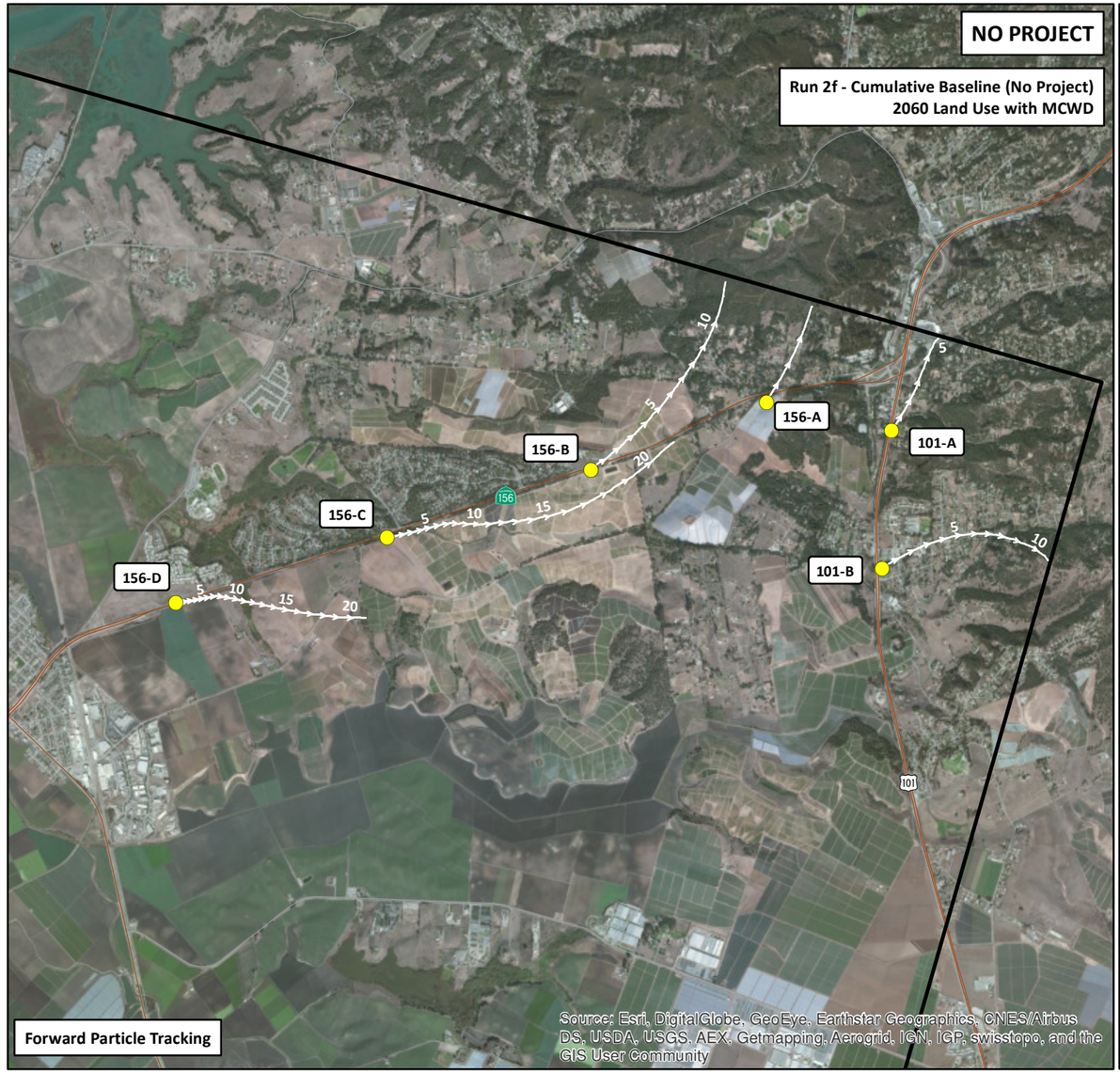
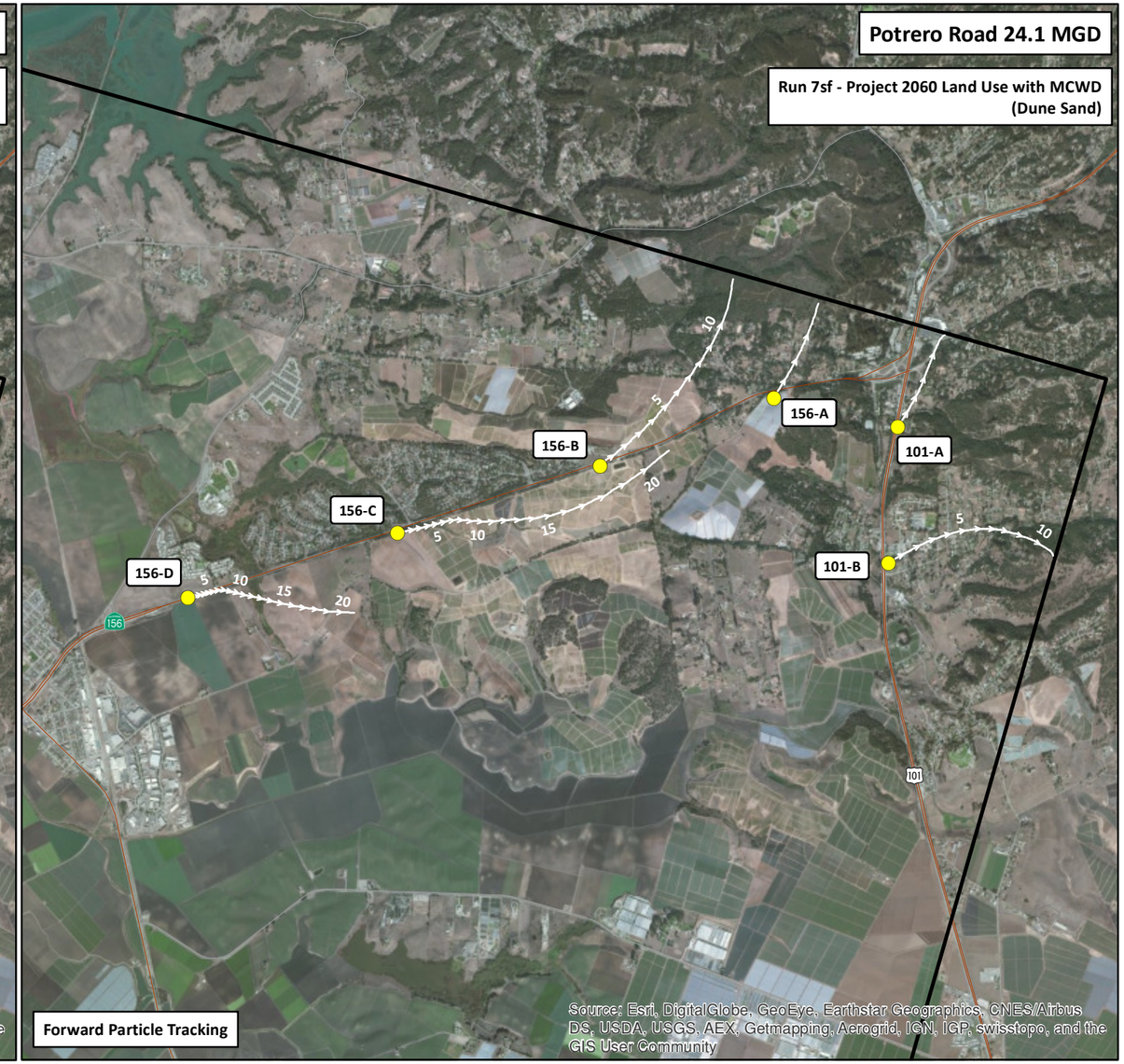
Figure 187

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_187_parttrk_180FT-180FTE_Run1nRun6sn_Prunedale_2panel_4-15.mxd





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,000 4,000 8,000 Feet

Run 2f - Cumulative Baseline (No Project)
2060 Land Use with MCWD

Run 7sf - Project 2060 Land Use with MCWD
(Dune Sand)

PARTICLE TRACKING NEAR PRUNEDALE
NO PROJECT (RUN 2f) AND
POTRERO ROAD 24.1 MGD (RUN 7sf)
180-FT/180-FTE AQUIFER

17-Apr-15

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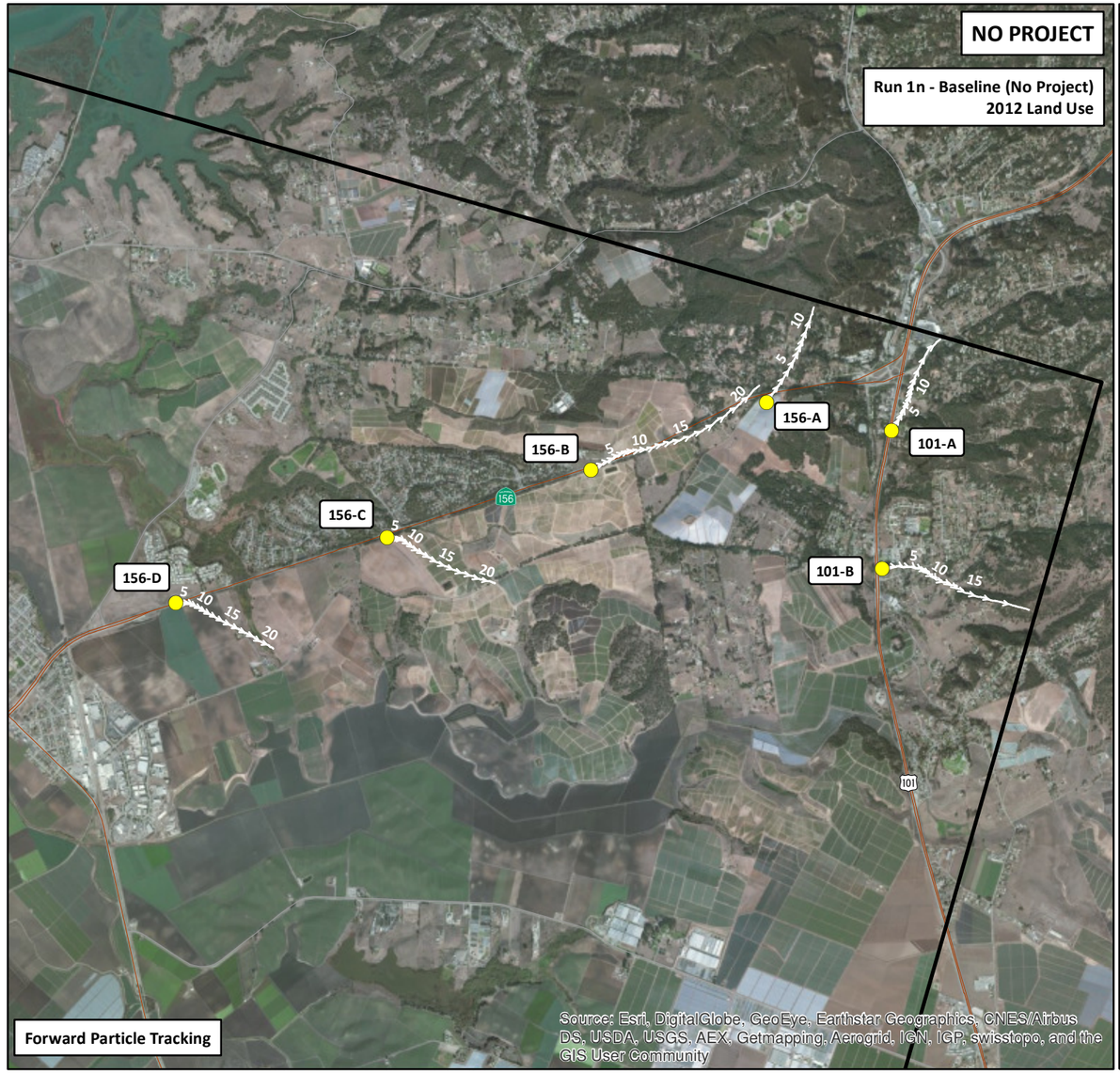
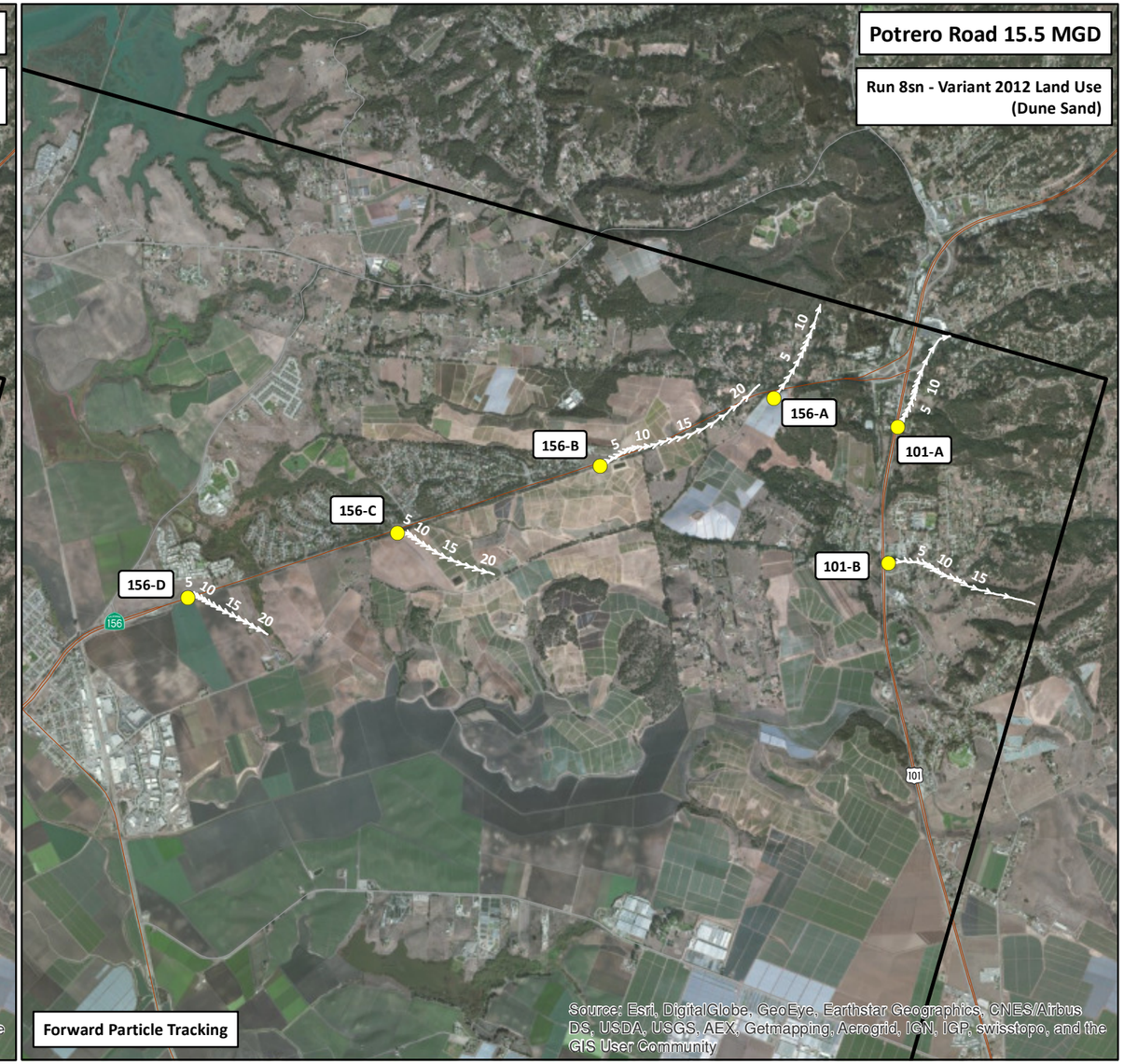
Figure 188

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_188_parttrk_180FT-180FTE_Run2fRun7sf_Prunedale_2panel_4-15.mxd





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,000 4,000 8,000 Feet

Run 1n - Baseline (No Project)
2012 Land Use

Run 8sn - Variant 2012 Land Use
(Dune Sand)

PARTICLE TRACKING NEAR PRUNEDALE
NO PROJECT (RUN 1n) AND
POTRERO ROAD 15.5 MGD (RUN 8sn)
180-FT/180-FTE AQUIFER

17-Apr-15

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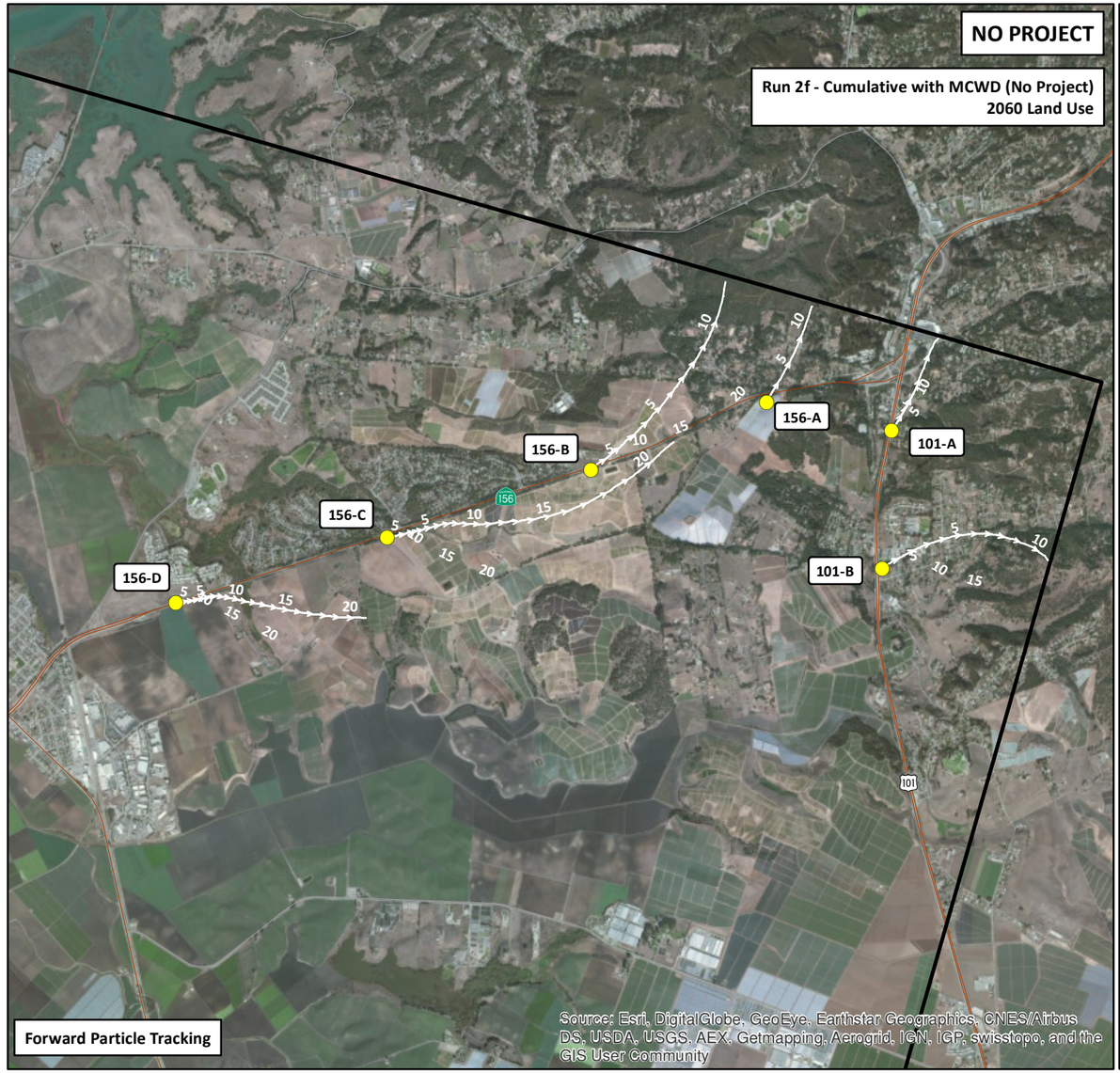
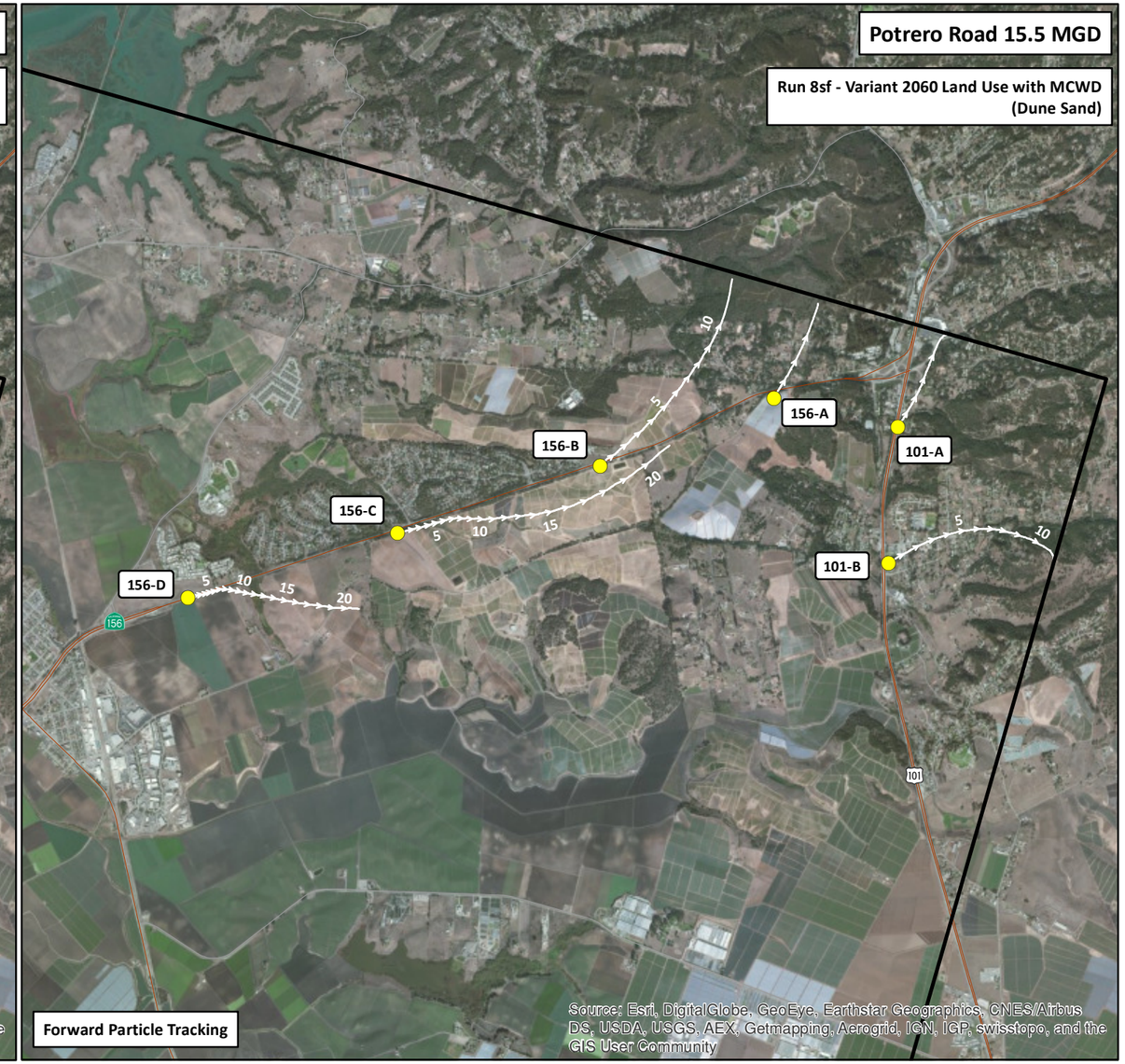
Figure 189

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_189_parttrk_180FT-180FTE_Run1nRun8sn_Prunedale_2panel_4-15.mxd





EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,000 4,000 8,000 Feet

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 8sf - Variant 2060 Land Use with MCWD (Dune Sand)

PARTICLE TRACKING NEAR PRUNEDALE NO PROJECT (RUN 2f) AND POTRERO ROAD 15.5 MGD (RUN 8sf) 180-FT/180-FTE AQUIFER

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Figure 190

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_190_parttrk_180FT-180FTE_Run2fRun8sf_Prunedale_2panel_4-15.mxd

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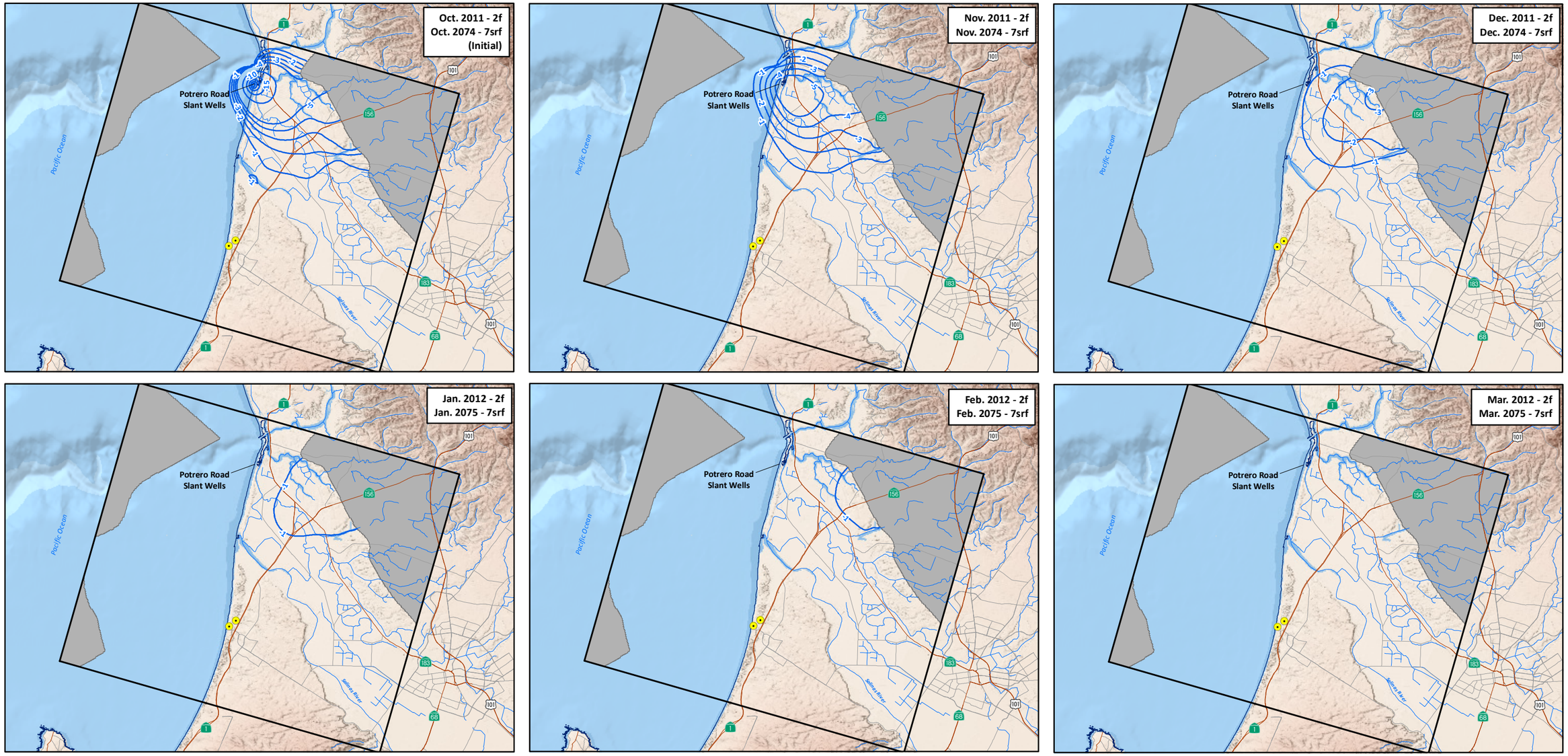
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

NORTH

0 2 4 8 Miles

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 7srf - Post-Potrero with MCWD
2060 Land Use (Dune Sand)

CHANGES IN GROUNDWATER ELEVATIONS FOR DUNE SAND AQUIFER IN SELECTED YEARS FOR RUN 7srf (RUN 7srf MINUS RUN 2f)

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Figure 191

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_191_wlchange_dunesand_Run7srfminus2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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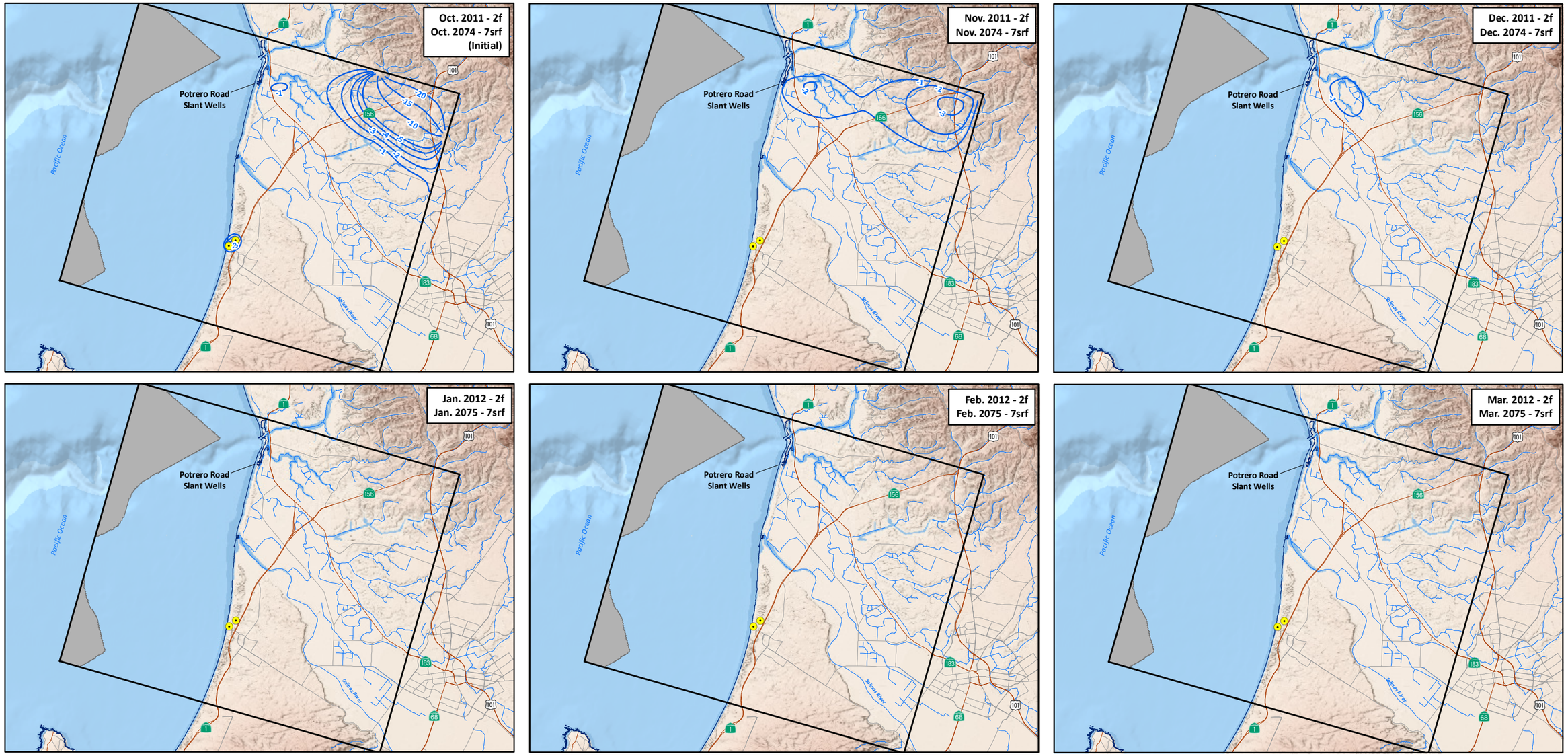
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS



EXPLANATION

North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide (DOC, NOAA et al., 2011)

-5 Change in Groundwater Elevation (ft)

Proposed Marina Coast Water District Desalination Well

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2 4 8 Miles

Run 2f - Cumulative with MCWD (No Project)
2060 Land Use

Run 7srf - Post-Potrero with MCWD
2060 Land Use (Dune Sand)

CHANGES IN GROUNDWATER ELEVATIONS FOR 180-FT/180-FTE AQUIFER IN SELECTED YEARS FOR RUN 7srf (RUN 7srf MINUS RUN 2f)

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Figure 192

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_192_wlchange_180FT-180FTE_Run7srfminus2f_6panel_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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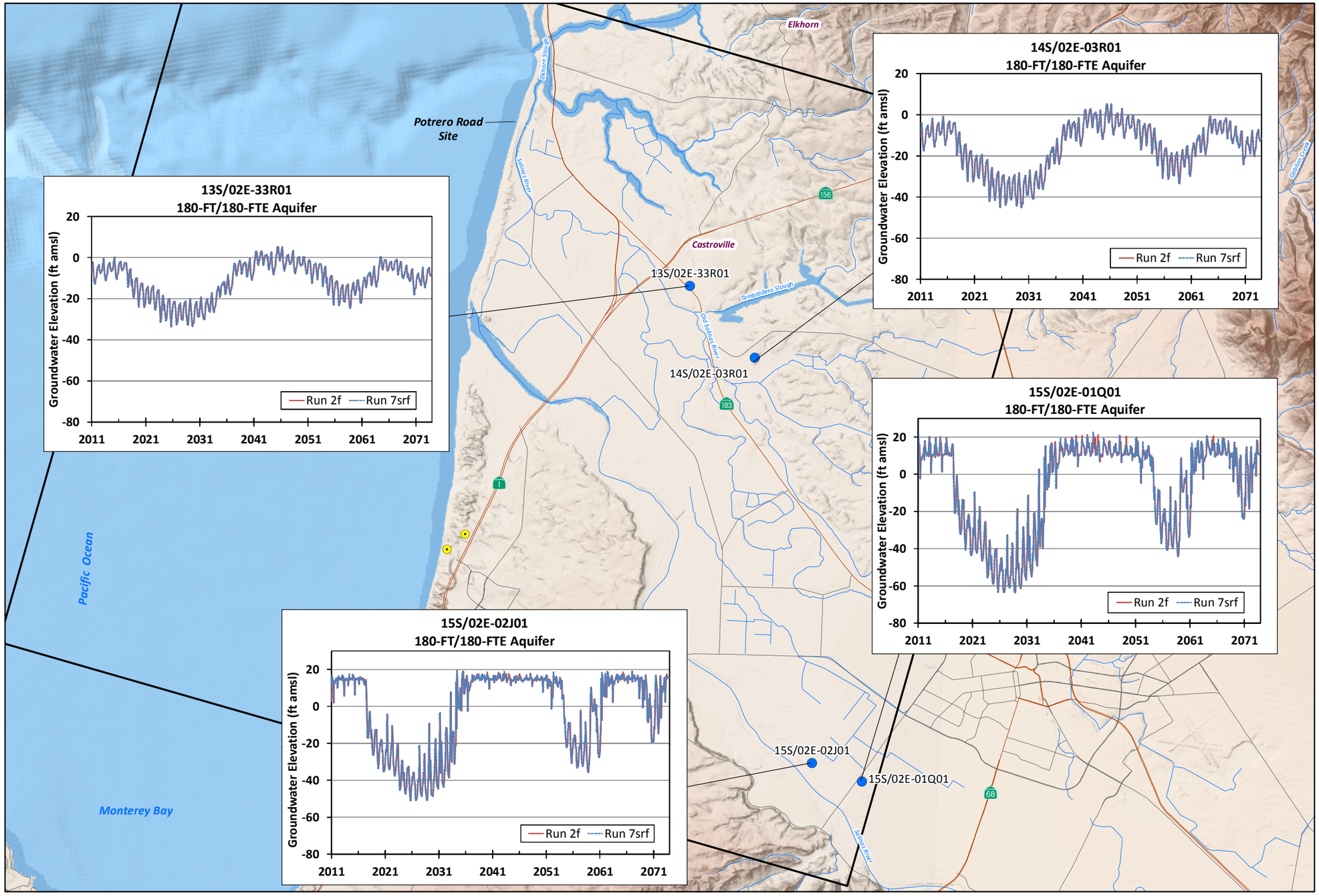
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 7srf VERSUS RUN 2f (180-FT/180-FTE AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 7srf - Project 2060 Land Use with MCWD (Dune Sand)

NOTE: 180-FTE = 180-Foot Equivalent Aquifer

17-Apr-15

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NORTH

0 1 2 4 Miles

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Figure 193

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_193_hydrographs_Run7srf_vs_Run2f_180FT-180FTE_4-15.mxd

CALIFORNIA AMERICAN WATER AND
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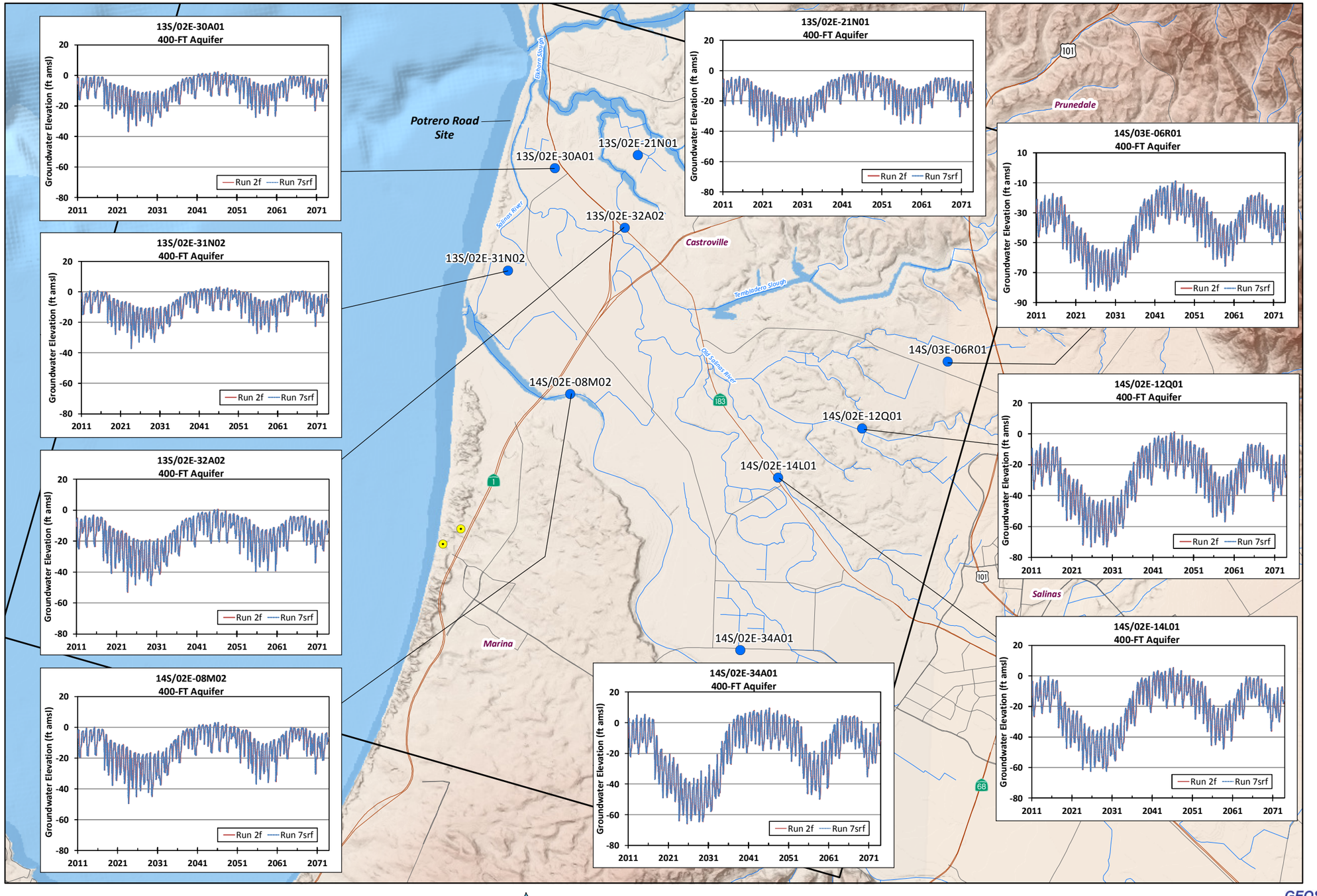
MONTEREY PENINSULA WATER SUPPLY PROJECT
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 7srf VERSUS RUN 2f (400-FT AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 7srf - Project 2060 Land Use with MCWD (Dune Sand)

17-Apr-15

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NORTH

0 1 2 4 Miles

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Figure 194

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/11_Fig_207_hydrographs_Run7srf_vs_Run2f_400FT_3-15.mxd

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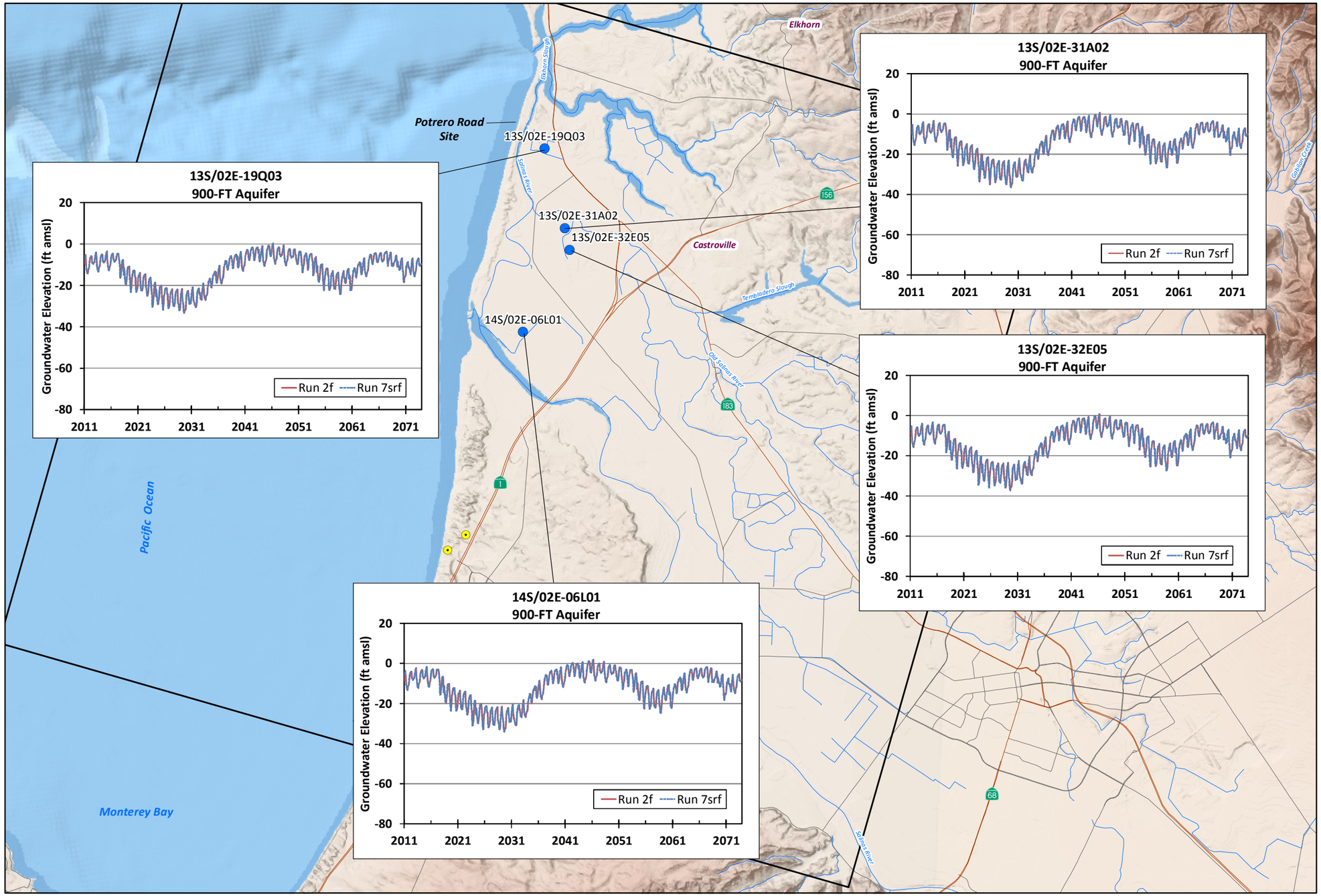
GROUNDWATER MODELING AND ANALYSIS

HYDROGRAPHS FOR SELECTED WELLS RUN 7srf VERSUS RUN 2f (900-FT AQUIFER)



EXPLANATION

Well with Hydrograph

North Marina Groundwater Model Boundary

Proposed Marina Coast Water District Desalination Well

Run 2f - Cumulative Baseline (No Project) 2060 Land Use with MCWD

Run 7srf - Project 2060 Land Use with MCWD (Dune Sand)

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Figure 195

GIS_proj/mcwsp_cal_am/esa_TM_proj_modeling_9-14/14_Fig_195_hydrographs_Run7srf_vs_Run2f_900FT_4-15.mxd

TABLES

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Table 1
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MPWSP Matrix of Modeling Runs and Assumptions

Project Site	Model Run		Model Time	Land Use	MPWSP			SVWP	MCWD	Ground Water Replenishment (GWR) Project with Additional CSIP Water Delivery
					CEMEX Site	Potrero Rd. Site	Returning Basin Water	Phase II Equivalent	1.5 MGD Desal (Product Water)	
					From Dune Sand & 180-FTE Aquifer	From Dune Sand Aquifer				
					MGD					
No Project	1n	Baseline (No Project)	2012-2074	2012						
	2f	Cumulative with MCWD (No Project)	2012-2074	2060					Yes	
	2af	Cumulative with SVWP II and MCWD (No Project)	2012-2074	2060				Yes	Yes	
CEMEX	3n	Project 2012 Land Use (Dune Sand & 180-FTE)	2012-2074	2012	24.1/9.5*		CSIP			
	3ncb	Project 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)	2012-2074	2012	24.1/9.5*		Injection of 1,080 AFY at Charles Benson Rd. Site			
	3nc	Project 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)	2012-2074	2012	24.1/9.5*		Injection of 1,080 AFY at CEMEX Site			
	4f	Project 2060 Land Use with MCWD (Dune Sand & 180-FTE)	2012-2074	2060	24.1/9.5*		CSIP		Yes	
	4rf	Post-CEMEX with MCWD (Dune Sand & 180-FTE)	2075-2137	2060	0/0				Yes	
	5n	Variant 2012 Land Use (Dune Sand & 180-FTE)	2012-2074	2012	15.5/6.1*		CSIP			Yes
	5ncb	Variant 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)	2012-2074	2012	15.5/6.1*		Injection of 700 AFY at Charles Benson Rd. Site			Yes
	5nc	Variant 2012 Land Use with Returning Basin Water at CEMEX Site(Dune Sand & 180-FTE)	2012-2074	2012	15.5/6.1*		Injection of 700 AFY at CEMEX Site			Yes
	5f	Variant 2060 Land Use with MCWD (Dune Sand & 180-FTE)	2012-2074	2060	15.5/6.1*		CSIP		Yes	Yes
Potrero Road	6sn	Project 2012 Land Use (Dune Sand)	2012-2074	2012		24.1/9.5*				
	7sf	Project 2060 Land Use with MCWD (Dune Sand)	2012-2074	2060		24.1/9.5*			Yes	
	7srf	Post-Potrero with MCWD (Dune Sand)	2075-2137	2060		0/0			Yes	
	8sn	Variant 2012 Land Use (Dune Sand)	2012-2074	2012		15.5/6.1*				Yes
	8sf	Variant 2060 Land Use with MCWD (Dune Sand)	2012-2074	2060		15.5/6.1*			Yes	Yes

Notes:

Hydrology period spans 63 years and is synthesized using hydrologic data from the period from 1949-2011
All model runs account for sea level rise
* These values represent the amount of feedwater supply and product water (i.e., feedwater supply/product water)
"a" denotes SVWP Phase I and SVWP Phase II
"c" denotes returning basin water at the CEMEX Site
"cb" denotes returning basin water at the Charles Benson Rd. Site
"f" denotes using 2060 land use for cumulative analysis
"n" denotes no MCWD Desalination Project
"r" denotes Post-Project rebound model run; the initial heads used for the Post-Project runs will be the ending heads as of 2074
"s" denotes shallow alluvium or Dune Sand Aquifer
"180-FTE" denotes terrace deposits at the CEMEX Site that are hydrostratigraphically equivalent to the 180-FT Aquifer

Table 2
DRAFT

Annual Groundwater Budget for North Marina Groundwater Model Run 1n - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	20,008	72,285	0	36,349	128,642	80,622	0	0	2,201	15,946	98,769	29,873
1950	2013	677	53,052	0	21,642	75,370	49,447	0	0	2,190	19,287	70,925	4,445
1951	2014	9,629	71,132	0	22,874	103,634	80,621	0	0	2,392	20,694	103,707	-73
1952	2015	1,152	51,920	0	21,024	74,096	49,414	0	0	2,246	20,675	72,335	1,761
1953	2016	10,790	70,477	0	22,498	103,765	80,620	0	0	2,517	21,452	104,589	-824
1954	2017	2,157	51,557	0	20,762	74,476	49,472	0	0	2,277	21,217	72,966	1,510
1955	2018	8,152	40,065	0	22,753	70,969	66,024	0	0	2,222	18,475	86,721	-15,751
1956	2019	13,495	27,298	0	30,240	71,033	78,303	0	0	1,646	11,818	91,766	-20,733
1957	2020	8,277	26,363	0	34,919	69,558	65,875	0	0	1,454	8,675	76,005	-6,446
1958	2021	4,339	22,867	0	37,521	64,727	64,462	0	0	1,376	7,427	73,265	-8,538
1959	2022	-1,505	39,144	0	39,573	77,212	66,110	0	0	1,330	6,729	74,169	3,043
1960	2023	-2,994	35,641	0	39,912	72,559	68,744	0	0	1,314	6,776	76,835	-4,276
1961	2024	2,958	30,564	0	44,728	78,250	80,329	0	0	1,270	5,592	87,191	-8,941
1962	2025	888	28,662	0	50,257	79,807	80,159	0	0	1,222	4,280	85,660	-5,853
1963	2026	-8,391	27,060	0	51,704	70,373	65,875	0	0	1,215	4,085	71,175	-803
1964	2027	-11,573	23,250	0	52,646	64,323	64,470	0	0	1,216	3,953	69,639	-5,316
1965	2028	-16,104	38,734	0	53,620	76,250	66,384	0	0	1,208	3,785	71,378	4,872
1966	2029	-16,107	34,739	0	53,084	71,716	69,839	0	0	1,205	3,948	74,991	-3,275
1967	2030	-13,926	61,560	0	52,746	100,380	92,353	0	0	1,192	4,222	97,768	2,613
1968	2031	-24,394	45,883	0	49,523	71,013	61,200	0	0	1,189	4,427	66,816	4,197
1969	2032	-16,662	67,461	0	47,115	97,914	87,808	0	0	1,209	5,246	94,263	3,651
1970	2033	-24,826	51,375	0	43,619	70,167	57,972	0	0	1,205	5,666	64,843	5,324
1971	2034	-18,157	78,881	0	40,211	100,935	81,020	0	0	1,272	7,097	89,389	11,546
1972	2035	-29,056	78,717	0	31,143	80,803	48,186	0	0	1,519	11,424	61,128	19,675
1973	2036	-15,128	57,017	0	26,400	68,290	47,376	0	0	1,721	13,815	62,913	5,377
1974	2037	-554	77,486	0	26,139	103,071	80,649	0	0	1,802	15,984	98,435	4,636
1975	2038	-9,994	75,862	0	20,753	86,620	43,404	0	0	3,080	24,533	71,017	15,603
1976	2039	-457	59,177	0	19,325	78,045	46,861	0	0	2,687	26,041	75,589	2,456
1977	2040	5,027	43,105	0	19,837	67,968	47,367	0	0	2,390	23,301	73,058	-5,090
1978	2041	14,631	69,029	0	21,810	105,470	80,619	0	0	2,747	22,810	106,176	-705
1979	2042	2,322	69,325	0	18,199	89,846	43,299	0	0	5,455	30,055	78,808	11,038
1980	2043	8,671	54,688	0	17,638	80,997	46,792	0	0	4,198	29,914	80,904	93

Table 2
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Annual Groundwater Budget for North Marina Groundwater Model Run 1n - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	11,837	39,178	0	18,546	69,562	47,367	0	0	2,711	26,052	76,130	-6,569
1982	2045	19,739	66,641	0	20,761	107,141	80,620	0	0	3,427	24,825	108,871	-1,730
1983	2046	6,388	67,725	0	17,522	91,636	43,302	0	0	6,558	31,673	81,532	10,104
1984	2047	20,901	65,877	0	19,666	106,445	80,684	0	0	4,396	27,943	113,022	-6,577
1985	2048	10,940	46,619	0	18,753	76,312	49,402	0	0	2,608	25,677	77,686	-1,374
1986	2049	18,324	67,080	0	20,772	106,176	80,620	0	0	3,329	25,010	108,959	-2,784
1987	2050	8,193	48,691	0	19,451	76,335	49,439	0	0	2,479	24,034	75,952	383
1988	2051	12,656	48,976	0	21,052	82,684	65,814	0	0	2,332	21,210	89,357	-6,673
1989	2052	11,777	51,243	0	22,802	85,822	68,766	0	0	2,367	18,566	89,699	-3,877
1990	2053	5,156	52,757	0	22,646	80,559	56,113	0	0	2,021	18,188	76,323	4,236
1991	2054	7,446	47,966	0	23,209	78,621	66,025	0	0	2,138	17,393	85,557	-6,936
1992	2055	11,292	28,365	0	29,253	68,910	79,345	0	0	1,674	12,426	93,445	-24,536
1993	2056	8,373	26,265	0	34,218	68,856	65,875	0	0	1,479	8,971	76,326	-7,470
1994	2057	4,824	22,824	0	36,983	64,631	64,462	0	0	1,392	7,620	73,474	-8,843
1995	2058	-875	39,150	0	39,101	77,376	66,223	0	0	1,345	6,883	74,452	2,924
1996	2059	-2,085	35,695	0	39,536	73,146	69,254	0	0	1,322	6,904	77,480	-4,334
1997	2060	-16,432	71,345	0	34,818	89,731	58,976	0	0	1,410	8,694	69,081	20,650
1998	2061	-2,282	35,160	0	34,370	67,248	69,193	0	0	1,466	9,050	79,709	-12,461
1999	2062	-15,684	74,240	0	29,694	88,250	48,459	0	0	1,670	12,047	62,176	26,074
2000	2063	-7,410	53,160	0	24,475	70,225	47,368	0	0	1,903	15,468	64,739	5,486
2001	2064	4,185	74,823	0	24,751	103,759	80,688	0	0	1,967	17,554	100,210	3,549
2002	2065	-6,414	73,232	0	19,951	86,769	43,316	0	0	3,756	25,913	72,984	13,785
2003	2066	2,750	43,154	0	19,801	65,704	45,060	0	0	2,483	22,641	70,183	-4,479
2004	2067	4,489	47,765	0	20,272	72,526	49,451	0	0	2,410	21,549	73,411	-885
2005	2068	4,204	46,667	0	19,989	70,861	44,805	0	0	2,488	22,411	69,704	1,156
2006	2069	10,402	44,679	0	22,558	77,638	64,936	0	0	2,166	18,032	85,135	-7,496
2007	2070	7,610	46,594	0	23,576	77,781	64,579	0	0	2,023	16,453	83,055	-5,274
2008	2071	10,055	37,268	0	27,889	75,211	77,506	0	0	1,732	13,227	92,465	-17,253
2009	2072	-450	49,854	0	27,098	76,502	56,149	0	0	1,763	12,916	70,827	5,675
2010	2073	8,579	75,350	0	26,057	109,987	81,091	0	0	1,863	15,605	98,559	11,428
2011	2074	-2,018	55,211	0	22,390	75,583	49,413	0	0	2,092	18,136	69,641	5,943

Table 2
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Annual Groundwater Budget for North Marina Groundwater Model Run 1n - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		949	51,078	0	29,723	81,750	63,587	0	0	2,142	15,594	81,323	427

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 3
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Annual Groundwater Budget for North Marina Groundwater Model Run 2f - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	6,492	64,835	0	42,327	113,654	75,984	4,263	0	1,792	10,456	92,496	21,158
1950	2013	-6,340	50,139	0	27,732	71,531	49,093	4,263	0	1,900	12,470	67,726	3,804
1951	2014	1,892	65,199	0	28,366	95,457	75,983	4,263	0	1,874	13,301	95,421	36
1952	2015	-5,065	48,652	0	26,695	70,282	49,091	4,263	0	1,957	13,346	68,657	1,625
1953	2016	3,312	64,352	0	27,727	95,390	75,982	4,263	0	1,914	13,856	96,016	-626
1954	2017	-3,834	48,358	0	26,185	70,708	49,161	4,263	0	1,986	13,768	69,178	1,530
1955	2018	1,766	29,999	0	29,125	60,890	63,011	4,263	0	1,926	11,863	81,064	-20,174
1956	2019	9,339	22,420	0	39,215	70,974	75,238	4,263	0	1,459	7,254	88,214	-17,240
1957	2020	3,473	21,826	0	44,482	69,782	64,186	4,263	0	1,340	5,608	75,397	-5,615
1958	2021	-852	19,353	0	47,246	65,747	62,866	4,263	0	1,295	4,980	73,404	-7,657
1959	2022	-5,780	32,572	0	49,767	76,559	64,274	4,263	0	1,253	4,477	74,267	2,291
1960	2023	-7,594	29,420	0	50,299	72,126	66,604	4,263	0	1,251	4,474	76,593	-4,467
1961	2024	-2,587	24,579	0	55,502	77,493	76,967	4,263	0	1,224	3,788	86,241	-8,748
1962	2025	-4,194	23,464	0	60,858	80,127	76,732	4,263	0	1,213	3,085	85,293	-5,165
1963	2026	-12,537	22,398	0	62,132	71,993	64,186	4,263	0	1,211	3,006	72,666	-673
1964	2027	-16,026	19,680	0	62,827	66,481	62,874	4,263	0	1,211	2,954	71,302	-4,821
1965	2028	-19,640	32,098	0	64,158	76,617	64,549	4,263	0	1,205	2,795	72,812	3,805
1966	2029	-20,172	29,010	0	63,852	72,690	67,698	4,263	0	1,201	2,859	76,021	-3,331
1967	2030	-18,260	51,826	0	64,008	97,574	87,568	4,263	0	1,183	2,874	95,888	1,685
1968	2031	-27,445	37,797	0	61,395	71,747	59,810	4,263	0	1,188	3,023	68,284	3,463
1969	2032	-21,001	55,319	0	59,320	93,639	83,025	4,263	0	1,190	3,298	91,777	1,862
1970	2033	-28,701	42,364	0	56,501	70,164	56,604	4,263	0	1,185	3,519	65,572	4,592
1971	2034	-23,999	64,693	0	53,118	93,812	76,238	4,263	0	1,199	4,022	85,723	8,089
1972	2035	-37,016	71,754	0	43,531	78,269	48,253	4,263	0	1,303	5,915	59,734	18,535
1973	2036	-26,011	55,575	0	37,535	67,099	47,334	4,263	0	1,454	7,336	60,387	6,712
1974	2037	-10,310	70,651	0	35,546	95,888	76,011	4,263	0	1,525	8,758	90,557	5,331
1975	2038	-18,132	71,549	0	27,852	81,269	43,866	4,263	0	1,820	14,155	64,104	17,165
1976	2039	-10,490	57,336	0	25,330	72,176	47,171	4,263	0	1,968	15,766	69,169	3,007
1977	2040	-6,039	43,996	0	25,717	63,674	47,326	4,263	0	1,981	14,311	67,881	-4,207
1978	2041	4,052	64,420	0	27,454	95,926	75,981	4,263	0	1,850	14,096	96,190	-264
1979	2042	-6,108	63,732	0	23,050	80,674	43,763	4,263	0	2,786	19,259	70,071	10,603
1980	2043	-906	52,321	0	22,332	73,747	47,102	4,263	0	2,319	19,630	73,315	431

Table 3
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Annual Groundwater Budget for North Marina Groundwater Model Run 2f - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	1,890	40,285	0	23,268	65,444	47,326	4,263	0	2,177	17,229	70,995	-5,552
1982	2045	10,014	61,538	0	25,532	97,083	75,982	4,263	0	2,043	16,310	98,598	-1,515
1983	2046	-1,150	61,605	0	21,796	82,251	43,764	4,263	0	3,245	21,263	72,535	9,716
1984	2047	11,297	59,929	0	24,112	95,338	76,047	4,263	0	2,421	18,860	101,591	-6,253
1985	2048	3,253	45,113	0	23,392	71,758	49,091	4,263	0	2,180	17,101	72,636	-878
1986	2049	10,264	61,288	0	25,276	96,829	75,982	4,263	0	2,202	16,759	99,206	-2,377
1987	2050	1,731	46,168	0	24,106	72,005	49,092	4,263	0	2,121	15,962	71,438	567
1988	2051	5,356	46,228	0	25,740	77,324	62,484	4,263	0	2,069	14,327	83,143	-5,819
1989	2052	5,383	46,527	0	27,917	79,827	65,408	4,263	0	2,055	12,550	84,276	-4,449
1990	2053	152	47,717	0	28,540	76,409	54,610	4,263	0	1,790	11,844	72,506	3,902
1991	2054	1,953	43,286	0	28,980	74,219	63,012	4,263	0	1,913	11,601	80,790	-6,571
1992	2055	7,005	22,818	0	36,382	66,205	75,918	4,263	0	1,540	8,294	90,015	-23,810
1993	2056	4,686	21,690	0	42,473	68,849	64,186	4,263	0	1,379	6,109	75,937	-7,088
1994	2057	548	19,285	0	45,618	65,451	62,866	4,263	0	1,321	5,319	73,769	-8,318
1995	2058	-4,279	32,588	0	48,337	76,646	64,386	4,263	0	1,271	4,730	74,650	1,996
1996	2059	-6,031	29,569	0	49,083	72,620	67,114	4,263	0	1,266	4,688	77,331	-4,711
1997	2060	-20,787	64,091	0	44,262	87,566	56,921	4,263	0	1,302	5,631	68,117	19,448
1998	2061	-6,933	30,228	0	43,563	66,859	66,908	4,263	0	1,354	5,918	78,443	-11,585
1999	2062	-21,526	67,172	0	38,613	84,258	48,525	4,263	0	1,480	7,443	61,711	22,547
2000	2063	-14,194	51,327	0	32,416	69,549	47,327	4,263	0	1,658	9,582	62,830	6,719
2001	2064	-3,157	68,104	0	31,595	96,542	76,051	4,263	0	1,697	10,934	92,944	3,598
2002	2065	-12,403	67,499	0	25,414	80,510	43,780	4,263	0	2,341	16,434	66,818	13,692
2003	2066	-5,643	42,991	0	25,215	62,563	45,287	4,263	0	2,126	14,734	66,410	-3,847
2004	2067	-3,065	45,738	0	25,802	68,475	49,093	4,263	0	2,053	13,921	69,330	-855
2005	2068	-2,975	45,224	0	25,275	67,524	45,455	4,263	0	2,105	14,538	66,361	1,162
2006	2069	2,383	41,597	0	28,522	72,502	62,484	4,263	0	1,885	11,720	80,351	-7,850
2007	2070	464	36,958	0	30,601	68,023	62,189	4,263	0	1,751	10,359	78,562	-10,539
2008	2071	6,717	30,142	0	36,958	73,817	74,191	4,263	0	1,512	7,920	87,885	-14,068
2009	2072	-6,738	43,840	0	36,143	73,245	54,781	4,263	0	1,534	7,843	68,421	4,824
2010	2073	528	67,517	0	34,385	102,430	76,308	4,263	0	1,599	9,166	91,336	11,094
2011	2074	-7,727	52,852	0	29,689	74,813	49,093	4,263	0	1,798	11,057	66,212	8,602

Table 3
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Annual Groundwater Budget for North Marina Groundwater Model Run 2f - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		-5,583	45,914	0	37,463	77,795	61,590	4,263	0	1,704	10,007	77,565	231

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 4
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Annual Groundwater Budget for North Marina Groundwater Model Run 2af - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	-4,301	51,260	0	35,719	82,678	21,797	4,263	0	3,052	14,932	44,044	38,634
1950	2013	-6,348	30,304	0	22,131	46,087	26,190	4,263	0	2,781	17,860	51,094	-5,007
1951	2014	-7,043	47,740	0	20,997	61,694	18,467	4,263	0	3,943	20,179	46,852	14,843
1952	2015	-4,795	28,557	0	20,442	44,205	25,987	4,263	0	3,328	20,371	53,950	-9,745
1953	2016	-5,376	45,498	0	19,941	60,062	15,370	4,263	0	5,032	21,874	46,539	13,523
1954	2017	-3,269	27,301	0	19,504	43,536	22,614	4,263	0	4,142	21,879	52,898	-9,362
1955	2018	9,350	22,437	0	25,112	56,899	61,590	4,263	0	2,550	15,695	84,098	-27,199
1956	2019	13,902	22,169	0	35,428	71,499	75,083	4,263	0	1,640	8,992	89,978	-18,480
1957	2020	6,837	21,614	0	40,830	69,282	63,551	4,263	0	1,432	6,729	75,974	-6,693
1958	2021	1,897	19,179	0	44,136	65,213	62,585	4,263	0	1,350	5,755	73,954	-8,741
1959	2022	-6,396	31,906	0	45,954	71,464	57,510	4,263	0	1,324	5,293	68,390	3,074
1960	2023	-5,318	28,247	0	47,109	70,038	65,176	4,263	0	1,294	5,140	75,874	-5,836
1961	2024	-757	24,334	0	52,980	76,557	76,315	4,263	0	1,246	4,173	85,998	-9,441
1962	2025	-2,668	23,358	0	58,794	79,484	76,419	4,263	0	1,214	3,312	85,208	-5,724
1963	2026	-11,515	22,281	0	60,401	71,166	63,613	4,263	0	1,211	3,189	72,277	-1,110
1964	2027	-15,133	19,602	0	61,436	65,904	62,593	4,263	0	1,212	3,097	71,165	-5,261
1965	2028	-21,795	31,641	0	61,621	71,466	57,778	4,263	0	1,216	3,046	66,303	5,163
1966	2029	-19,594	28,517	0	61,744	70,667	66,270	4,263	0	1,202	3,064	74,799	-4,132
1967	2030	-22,330	51,289	0	59,742	88,701	75,984	4,263	0	1,193	3,324	84,765	3,936
1968	2031	-28,049	36,165	0	58,054	66,170	54,672	4,263	0	1,197	3,398	63,530	2,640
1969	2032	-27,702	52,412	0	53,818	78,528	64,475	4,263	0	1,224	4,030	73,992	4,536
1970	2033	-30,274	38,401	0	52,101	60,228	47,314	4,263	0	1,218	4,155	56,950	3,278
1971	2034	-33,758	56,924	0	45,863	69,029	47,122	4,263	0	1,339	5,453	58,177	10,851
1972	2035	-47,483	69,805	0	36,565	58,887	10,806	4,263	0	1,642	8,599	25,310	33,577
1973	2036	-25,328	37,050	0	28,560	40,282	29,150	4,263	0	1,986	12,115	47,515	-7,233
1974	2037	-22,347	56,329	0	26,815	60,797	22,445	4,263	0	2,368	14,035	43,112	17,686
1975	2038	-18,133	53,330	0	21,362	56,559	9,649	4,263	0	3,957	21,247	39,116	17,443
1976	2039	-10,840	39,479	0	18,557	47,196	5,729	4,263	0	7,585	24,732	42,309	4,888
1977	2040	-3,952	25,059	0	18,349	39,457	6,104	4,263	0	6,975	23,785	41,127	-1,670
1978	2041	-995	42,827	0	17,985	59,817	12,849	4,263	0	11,516	25,655	54,283	5,534
1979	2042	-757	49,391	0	16,060	64,694	4,845	4,263	0	19,090	31,185	59,383	5,310
1980	2043	5,030	38,760	0	15,731	59,521	5,729	4,263	0	18,486	31,102	59,580	-59

Table 4
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Annual Groundwater Budget for North Marina Groundwater Model Run 2af - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	8,373	24,554	0	16,275	49,201	6,104	4,263	0	14,664	28,300	53,331	-4,129
1982	2045	8,155	42,543	0	16,468	67,166	12,849	4,263	0	17,367	29,002	63,481	3,685
1983	2046	5,993	49,117	0	15,098	70,208	4,845	4,263	0	23,373	33,755	66,236	3,972
1984	2047	9,956	43,228	0	15,627	68,811	12,849	4,263	0	20,720	31,776	69,608	-797
1985	2048	8,683	26,261	0	15,909	50,853	5,139	4,263	0	16,396	29,382	55,181	-4,328
1986	2049	9,203	42,395	0	16,166	67,764	12,849	4,263	0	18,315	29,789	65,216	2,549
1987	2050	7,121	26,152	0	16,210	49,483	5,139	4,263	0	14,966	28,423	52,791	-3,307
1988	2051	15,771	28,435	0	18,484	62,690	42,023	4,263	0	8,511	24,424	79,222	-16,532
1989	2052	15,934	26,315	0	23,421	65,670	62,510	4,263	0	2,867	17,636	87,277	-21,606
1990	2053	-1,256	36,816	0	23,032	58,592	11,245	4,263	0	2,849	16,760	35,117	23,475
1991	2054	8,269	22,696	0	23,179	54,144	53,375	4,263	0	2,803	17,352	77,792	-23,648
1992	2055	15,126	21,965	0	33,572	70,663	75,605	4,263	0	1,722	9,850	91,440	-20,777
1993	2056	8,452	21,522	0	39,207	69,181	63,551	4,263	0	1,480	7,236	76,531	-7,349
1994	2057	3,408	19,134	0	42,702	65,244	62,585	4,263	0	1,378	6,121	74,348	-9,104
1995	2058	-5,028	32,092	0	44,516	71,580	57,304	4,263	0	1,356	5,620	68,543	3,037
1996	2059	-3,731	28,305	0	45,963	70,537	65,686	4,263	0	1,310	5,394	76,653	-6,115
1997	2060	-36,863	63,200	0	36,892	63,229	9,965	4,263	0	1,641	8,136	24,005	39,224
1998	2061	-7,335	22,805	0	36,124	51,595	62,290	4,263	0	1,716	8,852	77,121	-25,526
1999	2062	-27,196	60,068	0	31,364	64,236	11,078	4,263	0	1,937	11,108	28,386	35,850
2000	2063	-14,216	32,167	0	24,410	42,361	27,591	4,263	0	2,336	15,481	49,672	-7,310
2001	2064	-12,022	51,638	0	23,333	62,949	21,797	4,263	0	2,936	17,335	46,331	16,618
2002	2065	-11,031	51,302	0	19,279	59,549	9,611	4,263	0	7,810	24,401	46,085	13,465
2003	2066	-4,795	23,790	0	18,314	37,309	4,954	4,263	0	6,781	23,567	39,565	-2,256
2004	2067	-277	25,998	0	18,173	43,894	8,984	4,263	0	7,501	23,638	44,387	-493
2005	2068	5,973	27,865	0	18,998	52,837	30,044	4,263	0	5,577	22,765	62,650	-9,813
2006	2069	12,672	20,502	0	25,605	58,779	62,484	4,263	0	2,281	14,738	83,766	-24,987
2007	2070	7,250	27,524	0	29,364	64,137	54,122	4,263	0	1,963	11,414	71,762	-7,625
2008	2071	9,197	27,441	0	35,413	72,051	67,413	4,263	0	1,657	8,748	82,081	-10,030
2009	2072	-9,614	37,997	0	33,348	61,731	39,947	4,263	0	1,702	9,239	55,152	6,579
2010	2073	-14,826	56,239	0	27,272	68,685	26,623	4,263	0	2,319	13,469	46,674	22,010
2011	2074	-11,286	34,497	0	24,593	47,803	27,034	4,263	0	2,406	15,403	49,106	-1,302

Table 4
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Annual Groundwater Budget for North Marina Groundwater Model Run 2af - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		-5,542	35,361	0	31,939	61,757	37,038	4,263	0	5,073	15,024	61,398	360

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 5
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Annual Groundwater Budget for North Marina Groundwater Model Run 3n - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	19,454	73,431	0	55,816	148,700	79,871	0	26,981	1,930	12,403	121,185	27,516
1950	2013	1,377	53,934	0	41,151	96,463	48,920	0	26,981	2,047	14,517	92,465	3,998
1951	2014	10,448	71,854	0	41,960	124,262	79,870	0	26,981	2,144	15,505	124,500	-238
1952	2015	2,003	53,229	0	40,146	95,379	48,889	0	26,981	2,092	15,476	93,438	1,941
1953	2016	11,512	71,446	0	41,367	124,325	79,869	0	26,981	2,259	16,114	125,223	-898
1954	2017	3,032	52,658	0	39,774	95,464	48,945	0	26,981	2,115	15,905	93,947	1,517
1955	2018	9,106	40,369	0	42,669	92,144	65,265	0	26,981	2,072	14,040	108,358	-16,215
1956	2019	14,994	27,296	0	52,466	94,757	77,546	0	26,981	1,569	9,396	115,492	-20,736
1957	2020	9,701	26,369	0	57,986	94,055	65,000	0	26,981	1,408	7,143	100,532	-6,477
1958	2021	5,691	22,862	0	60,949	89,501	63,588	0	26,981	1,342	6,142	98,053	-8,552
1959	2022	-194	39,161	0	63,166	102,133	65,234	0	26,981	1,291	5,567	99,073	3,060
1960	2023	-1,684	35,655	0	63,442	97,413	67,873	0	26,981	1,284	5,583	101,720	-4,308
1961	2024	4,245	30,567	0	68,494	103,307	79,455	0	26,981	1,247	4,660	112,342	-9,036
1962	2025	2,189	28,682	0	74,376	105,247	79,285	0	26,981	1,217	3,647	111,129	-5,882
1963	2026	-7,082	27,072	0	75,888	95,879	65,000	0	26,981	1,215	3,509	96,704	-826
1964	2027	-10,296	23,251	0	76,912	89,867	63,596	0	26,981	1,216	3,406	95,198	-5,331
1965	2028	-14,853	38,713	0	77,915	101,775	65,509	0	26,981	1,207	3,253	96,949	4,826
1966	2029	-14,844	34,751	0	77,335	97,242	68,968	0	26,981	1,203	3,371	100,522	-3,280
1967	2030	-12,649	61,519	0	76,855	125,725	91,480	0	26,981	1,185	3,515	123,161	2,564
1968	2031	-23,161	45,929	0	73,663	96,432	60,326	0	26,981	1,187	3,733	92,227	4,204
1969	2032	-15,461	67,521	0	70,988	123,047	86,934	0	26,981	1,195	4,261	119,371	3,677
1970	2033	-23,594	51,327	0	67,462	95,195	57,107	0	26,981	1,194	4,641	89,923	5,271
1971	2034	-17,043	78,912	0	63,645	125,514	80,145	0	26,981	1,240	5,625	113,992	11,523
1972	2035	-28,650	79,184	0	53,293	103,828	47,667	0	26,981	1,427	8,571	84,646	19,182
1973	2036	-14,363	57,831	0	47,999	91,466	46,979	0	26,981	1,600	10,286	85,846	5,619
1974	2037	253	78,347	0	46,740	125,340	79,898	0	26,981	1,667	11,788	120,334	5,006
1975	2038	-9,251	77,136	0	38,744	106,629	42,881	0	26,981	2,602	17,922	90,385	16,244
1976	2039	300	60,491	0	36,861	97,651	46,461	0	26,981	2,383	19,301	95,126	2,525
1977	2040	5,868	44,460	0	38,203	88,532	46,970	0	26,981	2,188	17,447	93,585	-5,054
1978	2041	15,260	70,005	0	40,412	125,676	79,868	0	26,981	2,442	17,221	126,511	-835
1979	2042	3,234	70,204	0	34,900	108,338	42,778	0	26,981	4,642	22,566	96,967	11,371
1980	2043	9,568	55,648	0	34,445	99,662	46,391	0	26,981	3,430	22,638	99,440	222

Table 5
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Annual Groundwater Budget for North Marina Groundwater Model Run 3n - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	12,716	40,448	0	36,377	89,541	46,970	0	26,981	2,403	19,834	96,188	-6,647
1982	2045	20,319	67,650	0	38,955	126,925	79,869	0	26,981	2,944	18,992	128,785	-1,860
1983	2046	7,248	68,567	0	33,872	109,686	42,781	0	26,981	5,590	23,978	99,329	10,357
1984	2047	21,704	66,634	0	37,160	125,498	79,932	0	26,981	3,803	21,467	132,183	-6,685
1985	2048	11,822	47,659	0	36,803	96,283	48,875	0	26,981	2,371	19,596	97,823	-1,540
1986	2049	19,078	68,224	0	38,952	126,254	79,869	0	26,981	2,892	19,139	128,880	-2,627
1987	2050	9,136	49,581	0	37,890	96,607	48,913	0	26,981	2,272	18,271	96,437	170
1988	2051	13,431	50,042	0	40,289	103,762	64,939	0	26,981	2,182	16,316	110,417	-6,655
1989	2052	12,565	51,690	0	42,920	107,175	68,015	0	26,981	2,094	14,330	111,419	-4,244
1990	2053	6,022	53,628	0	42,720	102,369	55,368	0	26,981	1,910	13,851	98,109	4,260
1991	2054	8,474	48,393	0	43,450	100,317	65,267	0	26,981	2,007	13,199	107,453	-7,137
1992	2055	12,731	28,272	0	51,162	92,164	78,471	0	26,981	1,597	9,772	116,821	-24,657
1993	2056	9,884	26,264	0	57,134	93,282	65,000	0	26,981	1,428	7,346	100,754	-7,472
1994	2057	6,220	22,816	0	60,288	89,324	63,588	0	26,981	1,357	6,288	98,213	-8,889
1995	2058	472	39,167	0	62,598	102,237	65,348	0	26,981	1,305	5,687	99,321	2,916
1996	2059	-718	35,652	0	63,008	97,942	68,383	0	26,981	1,292	5,672	102,328	-4,385
1997	2060	-15,393	71,673	0	57,718	113,998	58,103	0	26,981	1,357	6,942	93,382	20,616
1998	2061	-941	34,962	0	57,315	91,336	68,317	0	26,981	1,406	7,221	103,925	-12,588
1999	2062	-15,073	74,645	0	51,646	111,218	47,940	0	26,981	1,567	9,117	85,604	25,614
2000	2063	-6,484	54,154	0	45,381	93,050	46,971	0	26,981	1,757	11,452	87,161	5,889
2001	2064	5,039	75,868	0	44,704	125,612	79,939	0	26,981	1,804	12,919	121,643	3,969
2002	2065	-5,561	74,285	0	37,430	106,154	42,795	0	26,981	3,186	19,004	91,966	14,188
2003	2066	3,531	44,437	0	38,378	86,346	44,557	0	26,981	2,277	16,943	90,758	-4,412
2004	2067	5,300	48,734	0	39,147	93,182	48,925	0	26,981	2,209	16,092	94,207	-1,025
2005	2068	4,898	47,975	0	38,597	91,470	44,431	0	26,981	2,264	16,686	90,361	1,108
2006	2069	11,263	45,243	0	42,653	99,159	64,414	0	26,981	2,012	13,727	107,134	-7,974
2007	2070	8,628	47,383	0	44,136	100,147	63,823	0	26,981	1,898	12,537	105,238	-5,091
2008	2071	11,230	37,278	0	49,533	98,041	76,631	0	26,981	1,643	10,287	115,542	-17,501
2009	2072	420	49,969	0	48,917	99,307	55,283	0	26,981	1,659	10,054	93,977	5,330
2010	2073	9,435	76,014	0	46,893	132,342	80,215	0	26,981	1,731	11,772	120,700	11,642
2011	2074	-1,006	56,229	0	42,385	97,609	48,877	0	26,981	1,956	13,522	91,336	6,273

Table 5
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Annual Groundwater Budget for North Marina Groundwater Model Run 3n - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		1,928	51,640	0	50,547	104,116	62,879	0	26,981	1,959	11,923	103,742	374

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 6
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Annual Groundwater Budget for North Marina Groundwater Model Run 3ncb - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	19,169	73,431	1,080	55,507	149,186	79,871	0	26,981	1,930	12,488	121,269	27,917
1950	2013	923	53,934	1,080	40,754	96,692	48,920	0	26,981	2,047	14,664	92,612	4,080
1951	2014	9,958	71,854	1,080	41,562	124,453	79,870	0	26,981	2,144	15,675	124,669	-216
1952	2015	1,501	53,229	1,080	39,744	95,555	48,889	0	26,981	2,092	15,649	93,611	1,944
1953	2016	11,007	71,446	1,080	40,969	124,502	79,869	0	26,981	2,259	16,294	125,402	-900
1954	2017	2,528	52,658	1,080	39,374	95,640	48,945	0	26,981	2,115	16,083	94,124	1,516
1955	2018	8,604	40,369	1,080	42,242	92,294	65,265	0	26,981	2,072	14,190	108,508	-16,214
1956	2019	14,491	27,296	1,080	51,993	94,860	77,546	0	26,981	1,569	9,500	115,596	-20,736
1957	2020	9,198	26,369	1,080	57,494	94,141	65,000	0	26,981	1,408	7,229	100,617	-6,477
1958	2021	5,188	22,862	1,080	60,445	89,574	63,588	0	26,981	1,342	6,215	98,126	-8,552
1959	2022	-697	39,161	1,080	62,658	102,202	65,234	0	26,981	1,291	5,637	99,143	3,060
1960	2023	-2,188	35,655	1,080	62,935	97,482	67,873	0	26,981	1,284	5,653	101,791	-4,308
1961	2024	3,742	30,567	1,080	67,973	103,362	79,455	0	26,981	1,247	4,715	112,398	-9,035
1962	2025	1,685	28,682	1,080	73,838	105,285	79,285	0	26,981	1,217	3,686	111,168	-5,883
1963	2026	-7,583	27,072	1,080	75,347	95,917	65,000	0	26,981	1,215	3,545	96,740	-823
1964	2027	-10,799	23,251	1,080	76,369	89,902	63,596	0	26,981	1,216	3,440	95,233	-5,331
1965	2028	-15,356	38,713	1,080	77,371	101,809	65,509	0	26,981	1,207	3,287	96,983	4,826
1966	2029	-15,349	34,751	1,080	76,794	97,276	68,968	0	26,981	1,203	3,406	100,557	-3,282
1967	2030	-13,150	61,519	1,080	76,319	125,768	91,480	0	26,981	1,185	3,556	123,202	2,566
1968	2031	-23,669	45,929	1,080	73,128	96,468	60,326	0	26,981	1,187	3,774	92,268	4,200
1969	2032	-15,962	67,521	1,080	70,465	123,104	86,934	0	26,981	1,195	4,315	119,425	3,679
1970	2033	-24,097	51,327	1,080	66,944	95,253	57,107	0	26,981	1,194	4,700	89,982	5,271
1971	2034	-17,546	78,912	1,080	63,141	125,587	80,145	0	26,981	1,240	5,698	114,065	11,523
1972	2035	-29,154	79,184	1,080	52,825	103,936	47,667	0	26,981	1,427	8,679	84,754	19,181
1973	2036	-14,866	57,831	1,080	47,542	91,587	46,979	0	26,981	1,600	10,407	85,967	5,620
1974	2037	-250	78,347	1,080	46,303	125,480	79,898	0	26,981	1,667	11,928	120,474	5,006
1975	2038	-9,754	77,136	1,080	38,374	106,835	42,881	0	26,981	2,602	18,128	90,591	16,244
1976	2039	-199	60,491	1,080	36,498	97,869	46,461	0	26,981	2,383	19,515	95,339	2,530
1977	2040	5,361	44,460	1,080	37,816	88,717	46,970	0	26,981	2,188	17,637	93,775	-5,058
1978	2041	14,757	70,005	1,080	40,021	125,863	79,868	0	26,981	2,442	17,407	126,697	-835
1979	2042	2,731	70,204	1,080	34,555	108,570	42,778	0	26,981	4,642	22,798	97,199	11,371
1980	2043	9,062	55,648	1,080	34,099	99,889	46,391	0	26,981	3,430	22,870	99,671	218

Table 6
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Annual Groundwater Budget for North Marina Groundwater Model Run 3ncb - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	12,213	40,448	1,080	36,006	89,746	46,970	0	26,981	2,403	20,040	96,394	-6,647
1982	2045	19,815	67,650	1,080	38,576	127,121	79,869	0	26,981	2,944	19,190	128,983	-1,862
1983	2046	6,746	68,567	1,080	33,533	109,926	42,781	0	26,981	5,590	24,216	99,567	10,359
1984	2047	21,202	66,634	1,080	36,798	125,714	79,932	0	26,981	3,803	21,683	132,399	-6,685
1985	2048	11,317	47,659	1,080	36,429	96,484	48,875	0	26,981	2,371	19,798	98,025	-1,541
1986	2049	18,575	68,224	1,080	38,574	126,453	79,869	0	26,981	2,892	19,338	129,079	-2,626
1987	2050	8,633	49,581	1,080	37,506	96,800	48,913	0	26,981	2,272	18,464	96,630	170
1988	2051	12,928	50,042	1,080	39,883	103,933	64,939	0	26,981	2,182	16,487	110,588	-6,655
1989	2052	12,063	51,690	1,080	42,491	107,325	68,015	0	26,981	2,094	14,478	111,568	-4,243
1990	2053	5,519	53,628	1,080	42,293	102,520	55,368	0	26,981	1,910	14,001	98,260	4,260
1991	2054	7,971	48,393	1,080	43,015	100,458	65,267	0	26,981	2,007	13,340	107,594	-7,136
1992	2055	12,228	28,272	1,080	50,693	92,272	78,471	0	26,981	1,597	9,880	116,929	-24,657
1993	2056	9,380	26,264	1,080	56,645	93,370	65,000	0	26,981	1,428	7,434	100,842	-7,472
1994	2057	5,717	22,816	1,080	59,787	89,401	63,588	0	26,981	1,357	6,364	98,289	-8,888
1995	2058	-31	39,167	1,080	62,092	102,308	65,348	0	26,981	1,305	5,758	99,392	2,916
1996	2059	-1,221	35,652	1,080	62,503	98,014	68,383	0	26,981	1,292	5,744	102,399	-4,385
1997	2060	-15,896	71,673	1,080	57,230	114,088	58,103	0	26,981	1,357	7,032	93,472	20,615
1998	2061	-1,444	34,962	1,080	56,829	91,426	68,317	0	26,981	1,406	7,311	104,015	-12,588
1999	2062	-15,577	74,645	1,080	51,179	111,328	47,940	0	26,981	1,567	9,227	85,714	25,613
2000	2063	-6,987	54,154	1,080	44,935	93,181	46,971	0	26,981	1,757	11,583	87,292	5,889
2001	2064	4,537	75,868	1,080	44,279	125,764	79,939	0	26,981	1,804	13,071	121,794	3,969
2002	2065	-6,064	74,285	1,080	37,065	106,366	42,795	0	26,981	3,186	19,217	92,178	14,188
2003	2066	3,028	44,437	1,080	37,991	86,536	44,557	0	26,981	2,277	17,133	90,947	-4,411
2004	2067	4,797	48,734	1,080	38,750	93,362	48,925	0	26,981	2,209	16,272	94,387	-1,025
2005	2068	4,395	47,975	1,080	38,206	91,655	44,431	0	26,981	2,264	16,871	90,547	1,109
2006	2069	10,761	45,243	1,080	42,224	99,308	64,414	0	26,981	2,012	13,874	107,281	-7,974
2007	2070	8,124	47,383	1,080	43,695	100,282	63,823	0	26,981	1,898	12,673	105,374	-5,092
2008	2071	10,726	37,278	1,080	49,070	98,154	76,631	0	26,981	1,643	10,401	115,656	-17,502
2009	2072	-83	49,969	1,080	48,456	99,422	55,283	0	26,981	1,659	10,170	94,092	5,330
2010	2073	8,933	76,014	1,080	46,450	132,476	80,215	0	26,981	1,731	11,906	120,833	11,643
2011	2074	-1,508	56,229	1,080	41,961	97,762	48,877	0	26,981	1,956	13,675	91,489	6,273

Table 6
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Annual Groundwater Budget for North Marina Groundwater Model Run 3ncb - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		1,430	51,640	1,080	50,104	104,254	62,879	0	26,981	1,959	12,054	103,873	382

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 7
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Annual Groundwater Budget for North Marina Groundwater Model Run 3nc - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	19,313	73,431	1,080	55,183	149,007	79,871	0	26,981	1,930	12,489	121,270	27,737
1950	2013	1,156	53,934	1,080	40,458	96,628	48,920	0	26,981	2,047	14,645	92,592	4,035
1951	2014	10,210	71,854	1,080	41,274	124,418	79,870	0	26,981	2,144	15,651	124,646	-228
1952	2015	1,756	53,229	1,080	39,457	95,522	48,889	0	26,981	2,092	15,623	93,585	1,937
1953	2016	11,266	71,446	1,080	40,684	124,476	79,869	0	26,981	2,259	16,269	125,377	-901
1954	2017	2,787	52,658	1,080	39,088	95,613	48,945	0	26,981	2,115	16,056	94,097	1,516
1955	2018	8,863	40,369	1,080	41,955	92,267	65,265	0	26,981	2,072	14,163	108,481	-16,214
1956	2019	14,750	27,296	1,080	51,708	94,834	77,546	0	26,981	1,569	9,475	115,570	-20,736
1957	2020	9,458	26,369	1,080	57,211	94,117	65,000	0	26,981	1,408	7,206	100,594	-6,477
1958	2021	5,447	22,862	1,080	60,165	89,554	63,588	0	26,981	1,342	6,195	98,105	-8,552
1959	2022	-438	39,161	1,080	62,379	102,182	65,234	0	26,981	1,291	5,617	99,122	3,060
1960	2023	-1,928	35,655	1,080	62,656	97,462	67,873	0	26,981	1,284	5,633	101,770	-4,308
1961	2024	4,002	30,567	1,080	67,697	103,347	79,455	0	26,981	1,247	4,700	112,382	-9,035
1962	2025	1,946	28,682	1,080	73,567	105,276	79,285	0	26,981	1,217	3,675	111,157	-5,881
1963	2026	-7,326	27,072	1,080	75,078	95,904	65,000	0	26,981	1,215	3,535	96,730	-826
1964	2027	-10,539	23,251	1,080	76,100	89,892	63,596	0	26,981	1,216	3,430	95,223	-5,331
1965	2028	-15,096	38,713	1,080	77,103	101,800	65,509	0	26,981	1,207	3,277	96,973	4,826
1966	2029	-15,092	34,751	1,080	76,525	97,264	68,968	0	26,981	1,203	3,396	100,548	-3,284
1967	2030	-12,893	61,519	1,080	76,048	125,754	91,480	0	26,981	1,185	3,545	123,190	2,564
1968	2031	-23,407	45,929	1,080	72,857	96,459	60,326	0	26,981	1,187	3,763	92,257	4,202
1969	2032	-15,705	67,521	1,080	70,190	123,086	86,934	0	26,981	1,195	4,300	119,409	3,677
1970	2033	-23,838	51,327	1,080	66,667	95,236	57,107	0	26,981	1,194	4,682	89,965	5,271
1971	2034	-17,287	78,912	1,080	62,861	125,567	80,145	0	26,981	1,240	5,678	114,044	11,522
1972	2035	-28,894	79,184	1,080	52,539	103,909	47,667	0	26,981	1,427	8,653	84,728	19,182
1973	2036	-14,607	57,831	1,080	47,255	91,559	46,979	0	26,981	1,600	10,379	85,939	5,619
1974	2037	9	78,347	1,080	46,017	125,453	79,898	0	26,981	1,667	11,902	120,447	5,006
1975	2038	-9,494	77,136	1,080	38,093	106,815	42,881	0	26,981	2,602	18,107	90,570	16,245
1976	2039	57	60,491	1,080	36,215	97,843	46,461	0	26,981	2,383	19,492	95,317	2,525
1977	2040	5,622	44,460	1,080	37,531	88,694	46,970	0	26,981	2,188	17,611	93,749	-5,055
1978	2041	15,016	70,005	1,080	39,736	125,837	79,868	0	26,981	2,442	17,382	126,672	-835
1979	2042	2,990	70,204	1,080	34,278	108,552	42,778	0	26,981	4,642	22,781	97,181	11,370
1980	2043	9,322	55,648	1,080	33,820	99,870	46,391	0	26,981	3,430	22,850	99,651	219

Table 7
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Annual Groundwater Budget for North Marina Groundwater Model Run 3nc - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	12,472	40,448	1,080	35,721	89,721	46,970	0	26,981	2,403	20,015	96,368	-6,647
1982	2045	20,074	67,650	1,080	38,292	127,097	79,869	0	26,981	2,944	19,165	128,958	-1,862
1983	2046	7,006	68,567	1,080	33,256	109,909	42,781	0	26,981	5,590	24,199	99,550	10,359
1984	2047	21,461	66,634	1,080	36,517	125,691	79,932	0	26,981	3,803	21,661	132,376	-6,685
1985	2048	11,578	47,659	1,080	36,143	96,460	48,875	0	26,981	2,371	19,772	97,999	-1,540
1986	2049	18,834	68,224	1,080	38,289	126,427	79,869	0	26,981	2,892	19,313	129,054	-2,627
1987	2050	8,892	49,581	1,080	37,219	96,773	48,913	0	26,981	2,272	18,437	96,603	169
1988	2051	13,187	50,042	1,080	39,595	103,905	64,939	0	26,981	2,182	16,458	110,559	-6,655
1989	2052	12,323	51,690	1,080	42,203	107,296	68,015	0	26,981	2,094	14,449	111,539	-4,242
1990	2053	5,778	53,628	1,080	42,005	102,491	55,368	0	26,981	1,910	13,972	98,230	4,260
1991	2054	8,230	48,393	1,080	42,728	100,431	65,267	0	26,981	2,007	13,313	107,567	-7,136
1992	2055	12,487	28,272	1,080	50,408	92,247	78,471	0	26,981	1,597	9,855	116,904	-24,657
1993	2056	9,640	26,264	1,080	56,363	93,347	65,000	0	26,981	1,428	7,411	100,819	-7,472
1994	2057	5,977	22,816	1,080	59,507	89,380	63,588	0	26,981	1,357	6,343	98,268	-8,889
1995	2058	228	39,167	1,080	61,812	102,287	65,348	0	26,981	1,305	5,738	99,371	2,916
1996	2059	-961	35,652	1,080	62,223	97,994	68,383	0	26,981	1,292	5,723	102,379	-4,385
1997	2060	-15,636	71,673	1,080	56,947	114,064	58,103	0	26,981	1,357	7,008	93,448	20,615
1998	2061	-1,185	34,962	1,080	56,546	91,404	68,317	0	26,981	1,406	7,288	103,992	-12,588
1999	2062	-15,317	74,645	1,080	50,893	111,301	47,940	0	26,981	1,567	9,200	85,688	25,614
2000	2063	-6,728	54,154	1,080	44,648	93,154	46,971	0	26,981	1,757	11,556	87,265	5,889
2001	2064	4,796	75,868	1,080	43,994	125,738	79,939	0	26,981	1,804	13,045	121,768	3,970
2002	2065	-5,805	74,285	1,080	36,785	106,345	42,795	0	26,981	3,186	19,196	92,158	14,188
2003	2066	3,287	44,437	1,080	37,704	86,509	44,557	0	26,981	2,277	17,105	90,920	-4,411
2004	2067	5,056	48,734	1,080	38,463	93,334	48,925	0	26,981	2,209	16,244	94,359	-1,025
2005	2068	4,654	47,975	1,080	37,919	91,628	44,431	0	26,981	2,264	16,844	90,520	1,108
2006	2069	11,020	45,243	1,080	41,937	99,280	64,414	0	26,981	2,012	13,847	107,254	-7,974
2007	2070	8,383	47,383	1,080	43,408	100,254	63,823	0	26,981	1,898	12,645	105,346	-5,093
2008	2071	10,986	37,278	1,080	48,784	98,128	76,631	0	26,981	1,643	10,375	115,630	-17,502
2009	2072	177	49,969	1,080	48,169	99,395	55,283	0	26,981	1,659	10,143	94,065	5,330
2010	2073	9,194	76,014	1,080	46,164	132,452	80,215	0	26,981	1,731	11,879	120,807	11,645
2011	2074	-1,251	56,229	1,080	41,674	97,732	48,877	0	26,981	1,956	13,647	91,461	6,271

Table 7
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Annual Groundwater Budget for North Marina Groundwater Model Run 3nc - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		1,687	51,640	1,080	49,821	104,228	62,879	0	26,981	1,959	12,032	103,850	378

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 8
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Annual Groundwater Budget for North Marina Groundwater Model Run 4f - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	5,648	65,566	0	63,868	135,082	75,233	4,263	26,981	1,662	8,761	116,900	18,182
1950	2013	-5,530	51,117	0	50,057	95,643	48,941	4,263	26,981	1,767	10,161	92,113	3,530
1951	2014	2,669	66,123	0	50,226	119,018	75,232	4,263	26,981	1,729	10,679	118,884	135
1952	2015	-4,084	49,581	0	48,712	94,209	48,941	4,263	26,981	1,825	10,764	92,774	1,435
1953	2016	4,118	65,494	0	49,392	119,004	75,231	4,263	26,981	1,763	11,100	119,338	-334
1954	2017	-2,866	49,225	0	48,079	94,439	49,011	4,263	26,981	1,854	11,088	93,196	1,242
1955	2018	2,999	30,052	0	51,661	84,713	62,258	4,263	26,981	1,807	9,746	105,055	-20,342
1956	2019	10,861	22,424	0	62,910	96,196	74,487	4,263	26,981	1,399	6,243	113,373	-17,178
1957	2020	4,846	21,829	0	68,478	95,153	63,331	4,263	26,981	1,308	4,903	100,786	-5,632
1958	2021	450	19,354	0	71,431	91,235	61,993	4,263	26,981	1,267	4,386	98,890	-7,655
1959	2022	-4,486	32,509	0	74,070	102,093	63,401	4,263	26,981	1,231	3,962	99,838	2,256
1960	2023	-6,386	29,457	0	74,589	97,661	65,730	4,263	26,981	1,228	3,948	102,150	-4,489
1961	2024	-1,283	24,587	0	79,808	103,112	76,091	4,263	26,981	1,215	3,365	111,915	-8,803
1962	2025	-2,934	23,478	0	85,337	105,881	75,858	4,263	26,981	1,213	2,757	111,071	-5,190
1963	2026	-11,267	22,408	0	86,621	97,762	63,331	4,263	26,981	1,211	2,694	98,479	-717
1964	2027	-14,764	19,679	0	87,397	92,313	62,001	4,263	26,981	1,211	2,646	97,102	-4,790
1965	2028	-18,411	32,083	0	88,737	102,408	63,675	4,263	26,981	1,205	2,502	98,626	3,783
1966	2029	-18,958	29,025	0	88,403	98,469	66,824	4,263	26,981	1,201	2,556	101,825	-3,356
1967	2030	-17,027	51,808	0	88,540	123,321	86,695	4,263	26,981	1,177	2,545	121,660	1,661
1968	2031	-26,244	37,787	0	85,939	97,481	58,934	4,263	26,981	1,188	2,697	94,062	3,420
1969	2032	-19,848	55,335	0	83,840	119,327	82,149	4,263	26,981	1,184	2,907	117,483	1,843
1970	2033	-27,456	42,395	0	81,091	96,030	55,955	4,263	26,981	1,185	3,113	91,497	4,533
1971	2034	-22,908	64,731	0	77,577	119,400	75,364	4,263	26,981	1,184	3,513	111,305	8,095
1972	2035	-36,002	72,003	0	67,673	103,674	47,735	4,263	26,981	1,261	5,020	85,261	18,414
1973	2036	-25,577	56,228	0	61,498	92,149	46,940	4,263	26,981	1,384	6,134	85,703	6,446
1974	2037	-9,712	71,341	0	59,003	120,633	75,260	4,263	26,981	1,437	7,153	115,094	5,539
1975	2038	-17,337	73,021	0	49,511	105,195	43,352	4,263	26,981	1,666	11,012	87,275	17,921
1976	2039	-9,808	58,913	0	46,274	95,379	46,778	4,263	26,981	1,830	12,307	92,159	3,220
1977	2040	-5,301	45,186	0	47,240	87,125	46,931	4,263	26,981	1,848	11,390	91,413	-4,288
1978	2041	4,657	65,587	0	49,028	119,272	75,230	4,263	26,981	1,707	11,281	119,462	-190
1979	2042	-5,326	65,134	0	43,205	103,013	43,249	4,263	26,981	2,504	15,073	92,069	10,944
1980	2043	-283	53,626	0	42,410	95,753	46,708	4,263	26,981	2,010	15,439	95,401	352

Table 8
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Annual Groundwater Budget for North Marina Groundwater Model Run 4f - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	2,688	41,494	0	44,067	88,249	46,931	4,263	26,981	2,024	13,717	93,916	-5,667
1982	2045	10,886	62,534	0	46,572	119,991	75,231	4,263	26,981	1,903	13,106	121,484	-1,493
1983	2046	-337	62,772	0	41,503	103,938	43,250	4,263	26,981	2,873	16,745	94,112	9,826
1984	2047	11,981	61,085	0	44,475	117,541	75,295	4,263	26,981	2,180	15,114	123,833	-6,293
1985	2048	4,192	46,198	0	44,440	94,830	48,941	4,263	26,981	2,038	13,736	95,958	-1,128
1986	2049	10,925	62,452	0	46,259	119,636	75,231	4,263	26,981	1,949	13,485	121,909	-2,273
1987	2050	2,713	47,157	0	45,445	95,315	48,941	4,263	26,981	1,986	12,848	95,018	297
1988	2051	6,286	46,914	0	47,563	100,762	61,610	4,263	26,981	1,939	11,667	106,459	-5,697
1989	2052	6,065	46,724	0	50,329	103,118	64,658	4,263	26,981	1,898	10,384	108,184	-5,066
1990	2053	1,364	48,321	0	51,188	100,872	53,864	4,263	26,981	1,681	9,812	96,601	4,271
1991	2054	2,803	43,623	0	51,581	98,007	62,259	4,263	26,981	1,785	9,597	104,885	-6,878
1992	2055	8,548	22,837	0	59,806	91,191	75,044	4,263	26,981	1,470	7,060	114,818	-23,628
1993	2056	6,127	21,690	0	66,300	94,117	63,331	4,263	26,981	1,344	5,328	101,247	-7,130
1994	2057	1,905	19,281	0	69,673	90,859	61,993	4,263	26,981	1,293	4,674	99,204	-8,345
1995	2058	-2,951	32,565	0	72,525	102,139	63,513	4,263	26,981	1,245	4,178	100,179	1,960
1996	2059	-4,712	29,551	0	73,282	98,121	66,240	4,263	26,981	1,240	4,127	102,851	-4,730
1997	2060	-19,584	64,320	0	68,281	113,017	56,258	4,263	26,981	1,264	4,886	93,652	19,365
1998	2061	-5,513	30,176	0	67,576	92,239	66,142	4,263	26,981	1,318	5,095	103,799	-11,560
1999	2062	-20,618	67,561	0	62,284	109,227	48,007	4,263	26,981	1,399	6,288	86,938	22,289
2000	2063	-13,360	52,132	0	55,684	94,456	46,932	4,263	26,981	1,548	7,895	87,619	6,837
2001	2064	-2,325	68,831	0	54,200	120,706	75,300	4,263	26,981	1,585	8,838	116,967	3,739
2002	2065	-11,598	68,961	0	46,264	103,627	43,266	4,263	26,981	2,078	12,741	89,329	14,298
2003	2066	-4,963	44,261	0	46,703	86,001	44,792	4,263	26,981	1,994	11,750	89,779	-3,779
2004	2067	-2,250	46,802	0	47,670	92,222	48,941	4,263	26,981	1,917	11,181	93,282	-1,060
2005	2068	-2,142	46,283	0	46,914	91,055	45,086	4,263	26,981	1,961	11,593	89,883	1,172
2006	2069	3,214	41,906	0	51,066	96,186	62,107	4,263	26,981	1,765	9,658	104,774	-8,588
2007	2070	1,579	37,313	0	53,693	92,585	61,433	4,263	26,981	1,638	8,615	102,929	-10,344
2008	2071	8,267	30,293	0	60,472	99,032	73,316	4,263	26,981	1,446	6,748	112,753	-13,722
2009	2072	-5,372	43,896	0	59,747	98,271	54,134	4,263	26,981	1,464	6,718	93,560	4,711
2010	2073	1,148	67,827	0	57,637	126,611	75,434	4,263	26,981	1,510	7,661	115,848	10,763
2011	2074	-6,862	53,700	0	52,670	99,508	48,943	4,263	26,981	1,667	9,070	90,924	8,584

Table 8
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Annual Groundwater Budget for North Marina Groundwater Model Run 4f - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		-4,594	46,453	0	60,293	102,152	60,941	4,263	26,981	1,604	8,193	101,982	170

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 9
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Annual Groundwater Budget for North Marina Groundwater Model Run 4rf - 2075 to 2137

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2075	-145	65,336	0	30,921	96,112	75,984	4,263	0	1,763	11,336	93,346	2,766
1950	2076	-6,734	50,277	0	27,818	71,360	49,093	4,263	0	1,891	12,413	67,661	3,700
1951	2077	1,631	65,286	0	28,439	95,356	75,983	4,263	0	1,866	13,242	95,354	2
1952	2078	-5,129	48,742	0	26,736	70,350	49,091	4,263	0	1,954	13,311	68,619	1,730
1953	2079	3,177	64,410	0	27,765	95,352	75,982	4,263	0	1,912	13,822	95,979	-627
1954	2080	-3,836	48,260	0	26,208	70,632	49,161	4,263	0	1,984	13,748	69,156	1,476
1955	2081	1,727	30,171	0	29,143	61,042	63,011	4,263	0	1,925	11,842	81,042	-20,000
1956	2082	9,331	22,414	0	39,204	70,949	75,238	4,263	0	1,459	7,257	88,217	-17,268
1957	2083	3,470	21,825	0	44,475	69,770	64,186	4,263	0	1,340	5,609	75,399	-5,628
1958	2084	-858	19,353	0	47,243	65,738	62,866	4,263	0	1,295	4,980	73,405	-7,666
1959	2085	-5,755	32,522	0	49,772	76,540	64,274	4,263	0	1,253	4,477	74,266	2,273
1960	2086	-7,629	29,433	0	50,304	72,109	66,604	4,263	0	1,251	4,473	76,591	-4,483
1961	2087	-2,578	24,579	0	55,503	77,504	76,967	4,263	0	1,224	3,788	86,241	-8,737
1962	2088	-4,208	23,463	0	60,868	80,123	76,732	4,263	0	1,213	3,084	85,292	-5,169
1963	2089	-12,546	22,398	0	62,140	71,992	64,186	4,263	0	1,211	3,006	72,665	-673
1964	2090	-16,026	19,680	0	62,833	66,487	62,874	4,263	0	1,211	2,953	71,301	-4,815
1965	2091	-19,644	32,097	0	64,163	76,616	64,549	4,263	0	1,205	2,795	72,812	3,804
1966	2092	-20,172	29,010	0	63,858	72,696	67,698	4,263	0	1,201	2,858	76,021	-3,325
1967	2093	-18,271	51,823	0	64,014	97,565	87,568	4,263	0	1,183	2,874	95,888	1,677
1968	2094	-27,456	37,795	0	61,404	71,743	59,810	4,263	0	1,188	3,022	68,283	3,460
1969	2095	-21,003	55,304	0	59,331	93,632	83,025	4,263	0	1,190	3,297	91,776	1,856
1970	2096	-28,714	42,367	0	56,513	70,166	56,604	4,263	0	1,185	3,518	65,570	4,596
1971	2097	-23,986	64,659	0	53,130	93,804	76,238	4,263	0	1,199	4,021	85,721	8,083
1972	2098	-37,056	71,766	0	43,548	78,258	48,253	4,263	0	1,302	5,910	59,729	18,530
1973	2099	-26,004	55,567	0	37,548	67,110	47,334	4,263	0	1,453	7,331	60,382	6,728
1974	2100	-10,316	70,574	0	35,568	95,826	76,011	4,263	0	1,525	8,749	90,547	5,279
1975	2101	-18,065	71,477	0	27,873	81,285	43,866	4,263	0	1,819	14,136	64,083	17,201
1976	2102	-10,534	57,305	0	25,338	72,109	47,171	4,263	0	1,966	15,759	69,159	2,950
1977	2103	-5,929	43,997	0	25,718	63,785	47,326	4,263	0	1,981	14,312	67,882	-4,098
1978	2104	3,974	64,454	0	27,467	95,895	75,981	4,263	0	1,846	14,088	96,178	-284
1979	2105	-6,110	63,688	0	23,061	80,639	43,763	4,263	0	2,799	19,246	70,071	10,568
1980	2106	-967	52,418	0	22,336	73,787	47,102	4,263	0	2,341	19,627	73,333	454

Table 9
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Annual Groundwater Budget for North Marina Groundwater Model Run 4rf - 2075 to 2137

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2107	1,858	40,398	0	23,265	65,521	47,326	4,263	0	2,181	17,237	71,007	-5,486
1982	2108	10,142	61,519	0	25,525	97,186	75,982	4,263	0	2,139	16,322	98,706	-1,519
1983	2109	-1,226	61,493	0	21,813	82,080	43,764	4,263	0	3,253	21,235	72,516	9,564
1984	2110	11,214	59,980	0	24,115	95,310	76,047	4,263	0	2,425	18,855	101,590	-6,280
1985	2111	3,274	45,173	0	23,394	71,840	49,091	4,263	0	2,181	17,100	72,635	-795
1986	2112	10,271	61,326	0	25,292	96,889	75,982	4,263	0	2,216	16,737	99,198	-2,310
1987	2113	1,655	46,117	0	24,111	71,884	49,092	4,263	0	2,117	15,958	71,431	453
1988	2114	5,478	46,108	0	25,758	77,344	62,484	4,263	0	2,068	14,313	83,129	-5,785
1989	2115	5,218	46,485	0	27,924	79,627	65,408	4,263	0	2,020	12,544	84,235	-4,608
1990	2116	331	47,640	0	28,578	76,548	54,610	4,263	0	1,788	11,818	72,479	4,069
1991	2117	2,036	43,060	0	29,019	74,116	63,012	4,263	0	1,910	11,574	80,760	-6,644
1992	2118	7,068	22,734	0	36,413	66,215	75,918	4,263	0	1,539	8,280	90,001	-23,786
1993	2119	4,685	21,691	0	42,488	68,864	64,186	4,263	0	1,378	6,105	75,932	-7,068
1994	2120	541	19,286	0	45,631	65,457	62,866	4,263	0	1,321	5,316	73,766	-8,309
1995	2121	-4,289	32,588	0	48,343	76,643	64,386	4,263	0	1,271	4,729	74,648	1,995
1996	2122	-6,026	29,586	0	49,082	72,642	67,114	4,263	0	1,265	4,687	77,330	-4,688
1997	2123	-20,751	64,087	0	44,249	87,585	56,921	4,263	0	1,302	5,634	68,120	19,465
1998	2124	-6,902	30,295	0	43,524	66,917	66,908	4,263	0	1,354	5,927	78,453	-11,536
1999	2125	-21,448	67,121	0	38,583	84,255	48,525	4,263	0	1,481	7,453	61,722	22,533
2000	2126	-14,126	51,131	0	32,418	69,423	47,327	4,263	0	1,659	9,579	62,828	6,595
2001	2127	-3,069	68,118	0	31,598	96,647	76,051	4,263	0	1,696	10,928	92,939	3,708
2002	2128	-12,536	67,504	0	25,415	80,383	43,780	4,263	0	2,294	16,430	66,768	13,615
2003	2129	-5,615	43,136	0	25,197	62,718	45,287	4,263	0	2,127	14,758	66,436	-3,717
2004	2130	-3,129	45,807	0	25,776	68,454	49,093	4,263	0	2,054	13,945	69,355	-901
2005	2131	-2,867	45,145	0	25,269	67,547	45,455	4,263	0	2,105	14,544	66,368	1,179
2006	2132	2,530	41,520	0	28,536	72,586	62,484	4,263	0	1,885	11,711	80,343	-7,757
2007	2133	365	37,100	0	30,584	68,049	62,189	4,263	0	1,751	10,367	78,570	-10,522
2008	2134	6,687	30,147	0	36,923	73,757	74,191	4,263	0	1,512	7,933	87,900	-14,143
2009	2135	-6,706	43,841	0	36,121	73,256	54,781	4,263	0	1,535	7,850	68,430	4,826
2010	2136	592	67,466	0	34,359	102,417	76,308	4,263	0	1,600	9,178	91,350	11,067
2011	2137	-7,842	52,806	0	29,679	74,642	49,093	4,263	0	1,798	11,064	66,218	8,424

Table 9
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Annual Groundwater Budget for North Marina Groundwater Model Run 4rf - 2075 to 2137

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		-5,698	45,918	0	37,289	77,510	61,590	4,263	0	1,704	10,016	77,574	-64

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 10
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Annual Groundwater Budget for North Marina Groundwater Model Run 5n - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	20,538	71,806	0	47,101	139,445	75,964	0	17,353	2,276	13,632	109,225	30,220
1950	2013	1,008	52,407	0	32,170	85,585	45,795	0	17,353	2,259	16,201	81,608	3,977
1951	2014	9,821	70,614	0	33,001	113,436	75,963	0	17,353	2,448	17,261	113,025	411
1952	2015	1,404	51,395	0	31,283	84,083	45,795	0	17,353	2,308	17,315	82,771	1,311
1953	2016	10,749	70,109	0	32,512	113,370	75,962	0	17,353	2,584	17,917	113,815	-445
1954	2017	2,367	51,013	0	30,944	84,323	45,795	0	17,353	2,338	17,766	83,251	1,072
1955	2018	7,771	40,736	0	33,300	81,808	60,130	0	17,353	2,308	15,725	95,516	-13,708
1956	2019	12,723	27,221	0	41,964	81,908	73,394	0	17,353	1,720	10,858	103,325	-21,417
1957	2020	7,723	26,337	0	47,309	81,369	60,865	0	17,353	1,515	8,272	88,005	-6,636
1958	2021	3,996	22,884	0	50,078	76,959	59,451	0	17,353	1,429	7,145	85,378	-8,419
1959	2022	-1,894	39,176	0	52,164	89,445	61,099	0	17,353	1,389	6,529	86,370	3,075
1960	2023	-3,308	35,656	0	52,426	84,774	63,737	0	17,353	1,363	6,536	88,989	-4,215
1961	2024	2,637	30,571	0	57,301	90,509	75,319	0	17,353	1,292	5,443	99,407	-8,898
1962	2025	534	28,624	0	62,892	92,051	75,149	0	17,353	1,228	4,250	97,980	-5,930
1963	2026	-8,752	27,032	0	64,355	82,635	60,865	0	17,353	1,219	4,055	83,492	-857
1964	2027	-11,825	23,250	0	65,334	76,758	59,459	0	17,353	1,218	3,917	81,947	-5,189
1965	2028	-16,423	38,767	0	66,257	88,601	61,374	0	17,353	1,213	3,773	83,712	4,889
1966	2029	-16,407	34,733	0	65,695	84,021	64,832	0	17,353	1,208	3,904	87,297	-3,276
1967	2030	-14,162	61,521	0	65,384	112,743	87,591	0	17,353	1,199	4,118	110,260	2,483
1968	2031	-24,541	45,843	0	62,281	83,583	56,438	0	17,353	1,192	4,356	79,338	4,245
1969	2032	-16,823	67,451	0	59,661	110,290	83,044	0	17,353	1,218	5,054	106,668	3,622
1970	2033	-24,960	51,357	0	56,221	82,617	53,210	0	17,353	1,238	5,512	77,312	5,305
1971	2034	-18,199	78,889	0	52,494	113,184	76,257	0	17,353	1,322	6,666	101,599	11,585
1972	2035	-28,537	78,311	0	42,632	92,406	43,657	0	17,353	1,602	10,116	72,728	19,678
1973	2036	-14,794	56,632	0	37,548	79,385	42,818	0	17,353	1,814	12,040	74,025	5,360
1974	2037	-336	77,082	0	36,801	113,547	75,992	0	17,353	1,888	13,664	108,897	4,649
1975	2038	-9,822	74,882	0	29,682	94,741	38,796	0	17,353	3,254	20,363	79,766	14,975
1976	2039	-292	58,617	0	28,270	86,595	42,303	0	17,353	2,705	21,641	84,002	2,593
1977	2040	5,026	42,389	0	29,413	76,828	42,810	0	17,353	2,453	19,551	82,167	-5,338
1978	2041	14,663	68,428	0	31,584	114,676	75,961	0	17,353	2,852	19,257	115,423	-748
1979	2042	2,413	68,793	0	26,498	97,704	38,796	0	17,353	5,661	24,975	86,784	10,920
1980	2043	8,719	54,176	0	26,124	89,019	42,236	0	17,353	4,371	24,894	88,853	165

Table 10
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Annual Groundwater Budget for North Marina Groundwater Model Run 5n - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	11,932	38,656	0	27,788	78,376	42,810	0	17,353	2,828	21,878	84,870	-6,494
1982	2045	19,734	66,269	0	30,272	116,275	75,962	0	17,353	3,539	20,979	117,833	-1,558
1983	2046	6,366	67,143	0	25,652	99,161	38,796	0	17,353	6,773	26,378	89,299	9,862
1984	2047	20,973	65,375	0	28,689	115,037	76,027	0	17,353	4,485	23,552	121,417	-6,380
1985	2048	11,073	45,963	0	28,320	85,356	45,795	0	17,353	2,606	21,549	87,303	-1,947
1986	2049	18,350	66,692	0	30,363	115,404	75,962	0	17,353	3,367	21,010	117,691	-2,287
1987	2050	8,355	47,945	0	29,306	85,607	45,795	0	17,353	2,498	20,148	85,793	-187
1988	2051	12,665	48,524	0	31,481	92,670	61,050	0	17,353	2,398	17,992	98,792	-6,121
1989	2052	11,600	50,803	0	33,669	96,072	64,107	0	17,353	2,317	15,964	99,741	-3,669
1990	2053	4,996	52,484	0	33,340	90,820	51,452	0	17,353	2,115	15,640	86,560	4,260
1991	2054	7,069	47,670	0	33,836	88,576	60,131	0	17,353	2,240	14,939	94,662	-6,086
1992	2055	10,574	28,436	0	40,817	79,827	74,336	0	17,353	1,751	11,251	104,691	-24,864
1993	2056	7,770	26,247	0	46,593	80,610	60,865	0	17,353	1,539	8,453	88,211	-7,601
1994	2057	4,434	22,847	0	49,557	76,838	59,451	0	17,353	1,447	7,280	85,531	-8,693
1995	2058	-1,299	39,200	0	51,703	89,605	61,213	0	17,353	1,404	6,643	86,613	2,992
1996	2059	-2,420	35,658	0	52,062	85,299	64,247	0	17,353	1,374	6,624	89,598	-4,298
1997	2060	-16,623	71,268	0	47,092	101,737	54,211	0	17,353	1,491	8,124	81,179	20,558
1998	2061	-2,429	35,019	0	46,663	79,254	64,431	0	17,353	1,528	8,401	91,712	-12,458
1999	2062	-15,410	73,932	0	41,248	99,770	43,930	0	17,353	1,761	10,642	73,686	26,084
2000	2063	-7,212	52,525	0	35,381	80,694	42,811	0	17,353	1,997	13,261	75,421	5,273
2001	2064	4,121	74,289	0	35,203	113,613	76,031	0	17,353	2,043	14,827	110,253	3,360
2002	2065	-6,251	72,433	0	28,737	94,920	38,796	0	17,353	3,870	21,378	81,397	13,522
2003	2066	3,067	42,774	0	29,731	75,571	41,877	0	17,353	2,507	18,779	80,515	-4,944
2004	2067	4,724	47,163	0	30,422	82,309	45,795	0	17,353	2,433	17,858	83,439	-1,130
2005	2068	4,154	46,344	0	29,757	80,255	40,455	0	17,353	2,526	18,574	78,907	1,347
2006	2069	10,507	43,986	0	33,413	87,906	60,465	0	17,353	2,231	15,359	95,408	-7,501
2007	2070	7,735	46,460	0	34,722	88,917	59,916	0	17,353	2,095	14,095	93,459	-4,542
2008	2071	9,701	37,298	0	39,485	86,484	72,740	0	17,353	1,809	11,713	103,614	-17,129
2009	2072	-519	49,645	0	38,894	88,020	51,387	0	17,353	1,853	11,499	82,092	5,928
2010	2073	8,535	74,868	0	37,063	120,466	76,328	0	17,353	1,952	13,533	109,166	11,300
2011	2074	-1,814	54,522	0	33,132	85,841	45,795	0	17,353	2,163	15,358	80,669	5,172

Table 10
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Annual Groundwater Budget for North Marina Groundwater Model Run 5n - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		881	50,780	0	40,715	92,376	58,950	0	17,353	2,207	13,435	91,944	432

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 11
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Annual Groundwater Budget for North Marina Groundwater Model Run 5ncb - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	20,354	71,806	700	46,914	139,774	75,964	0	17,353	2,276	13,701	109,294	30,480
1950	2013	711	52,407	700	31,940	85,758	45,795	0	17,353	2,259	16,325	81,732	4,026
1951	2014	9,504	70,614	700	32,772	113,589	75,963	0	17,353	2,448	17,400	113,164	426
1952	2015	1,081	51,395	700	31,053	84,229	45,795	0	17,353	2,308	17,457	82,914	1,315
1953	2016	10,429	70,109	700	32,284	113,522	75,962	0	17,353	2,584	18,061	113,959	-437
1954	2017	2,042	51,013	700	30,715	84,469	45,795	0	17,353	2,338	17,911	83,397	1,073
1955	2018	7,448	40,736	700	33,052	81,937	60,130	0	17,353	2,308	15,851	95,642	-13,704
1956	2019	12,397	27,221	700	41,675	81,993	73,394	0	17,353	1,720	10,943	103,410	-21,417
1957	2020	7,397	26,337	700	47,001	81,436	60,865	0	17,353	1,515	8,338	88,071	-6,636
1958	2021	3,670	22,884	700	49,764	77,018	59,451	0	17,353	1,429	7,204	85,437	-8,419
1959	2022	-2,220	39,176	700	51,846	89,501	61,099	0	17,353	1,389	6,585	86,426	3,075
1960	2023	-3,634	35,656	700	52,108	84,830	63,737	0	17,353	1,363	6,593	89,046	-4,216
1961	2024	2,311	30,571	700	56,974	90,556	75,319	0	17,353	1,292	5,490	99,454	-8,898
1962	2025	210	28,624	700	62,551	92,085	75,149	0	17,353	1,228	4,283	98,013	-5,928
1963	2026	-9,078	27,032	700	64,011	82,665	60,865	0	17,353	1,219	4,085	83,522	-858
1964	2027	-12,153	23,250	700	64,988	76,784	59,459	0	17,353	1,218	3,945	81,975	-5,191
1965	2028	-16,749	38,767	700	65,911	88,629	61,374	0	17,353	1,213	3,801	83,740	4,889
1966	2029	-16,733	34,733	700	65,350	84,050	64,832	0	17,353	1,208	3,933	87,326	-3,276
1967	2030	-14,488	61,521	700	65,045	112,779	87,591	0	17,353	1,199	4,153	110,296	2,483
1968	2031	-24,865	45,843	700	61,944	83,622	56,438	0	17,353	1,192	4,392	79,374	4,248
1969	2032	-17,151	67,451	700	59,332	110,333	83,044	0	17,353	1,218	5,099	106,713	3,620
1970	2033	-25,287	51,357	700	55,897	82,666	53,210	0	17,353	1,238	5,562	77,362	5,304
1971	2034	-18,525	78,889	700	52,180	113,244	76,257	0	17,353	1,322	6,726	101,659	11,585
1972	2035	-28,862	78,311	700	42,353	92,501	43,657	0	17,353	1,602	10,210	72,822	19,679
1973	2036	-15,118	56,632	700	37,276	79,490	42,818	0	17,353	1,814	12,142	74,127	5,363
1974	2037	-661	77,082	700	36,546	113,667	75,992	0	17,353	1,888	13,783	109,016	4,651
1975	2038	-10,148	74,882	700	29,470	94,904	38,796	0	17,353	3,254	20,526	79,928	14,976
1976	2039	-616	58,617	700	28,066	86,767	42,303	0	17,353	2,705	21,811	84,172	2,596
1977	2040	4,703	42,389	700	29,197	76,989	42,810	0	17,353	2,453	19,708	82,324	-5,335
1978	2041	14,337	68,428	700	31,362	114,827	75,961	0	17,353	2,852	19,409	115,575	-748
1979	2042	2,087	68,793	700	26,304	97,885	38,796	0	17,353	5,661	25,155	86,964	10,921
1980	2043	8,393	54,176	700	25,928	89,198	42,236	0	17,353	4,371	25,072	89,032	166

Table 11
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Annual Groundwater Budget for North Marina Groundwater Model Run 5ncb - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	11,607	38,656	700	27,576	78,539	42,810	0	17,353	2,828	22,041	85,032	-6,493
1982	2045	19,408	66,269	700	30,054	116,431	75,962	0	17,353	3,539	21,135	117,989	-1,558
1983	2046	6,041	67,143	700	25,463	99,347	38,796	0	17,353	6,773	26,563	89,484	9,862
1984	2047	20,648	65,375	700	28,483	115,205	76,027	0	17,353	4,485	23,719	121,583	-6,378
1985	2048	10,742	45,963	700	28,105	85,510	45,795	0	17,353	2,606	21,709	87,463	-1,953
1986	2049	18,023	66,692	700	30,144	115,559	75,962	0	17,353	3,367	21,165	117,847	-2,287
1987	2050	8,028	47,945	700	29,086	85,760	45,795	0	17,353	2,498	20,302	85,947	-188
1988	2051	12,340	48,524	700	31,250	92,813	61,050	0	17,353	2,398	18,134	98,934	-6,121
1989	2052	11,275	50,803	700	33,420	96,198	64,107	0	17,353	2,317	16,090	99,867	-3,669
1990	2053	4,671	52,484	700	33,097	90,952	51,452	0	17,353	2,115	15,771	86,691	4,261
1991	2054	6,743	47,670	700	33,582	88,696	60,131	0	17,353	2,240	15,059	94,782	-6,086
1992	2055	10,248	28,436	700	40,532	79,916	74,336	0	17,353	1,751	11,340	104,780	-24,864
1993	2056	7,444	26,247	700	46,286	80,678	60,865	0	17,353	1,539	8,521	88,278	-7,601
1994	2057	4,107	22,847	700	49,243	76,898	59,451	0	17,353	1,447	7,340	85,591	-8,693
1995	2058	-1,625	39,200	700	51,386	89,662	61,213	0	17,353	1,404	6,700	86,670	2,992
1996	2059	-2,746	35,658	700	51,745	85,357	64,247	0	17,353	1,374	6,682	89,655	-4,298
1997	2060	-16,949	71,268	700	46,788	101,806	54,211	0	17,353	1,491	8,194	81,248	20,558
1998	2061	-2,755	35,019	700	46,359	79,324	64,431	0	17,353	1,528	8,471	91,782	-12,459
1999	2062	-15,736	73,932	700	40,970	99,866	43,930	0	17,353	1,761	10,738	73,781	26,085
2000	2063	-7,538	52,525	700	35,120	80,807	42,811	0	17,353	1,997	13,374	75,534	5,273
2001	2064	3,795	74,289	700	34,958	113,742	76,031	0	17,353	2,043	14,955	110,382	3,360
2002	2065	-6,577	72,433	700	28,531	95,088	38,796	0	17,353	3,870	21,546	81,565	13,522
2003	2066	2,741	42,774	700	29,508	75,722	41,877	0	17,353	2,507	18,930	80,666	-4,944
2004	2067	4,396	47,163	700	30,194	82,453	45,795	0	17,353	2,433	18,004	83,585	-1,132
2005	2068	3,829	46,344	700	29,533	80,406	40,455	0	17,353	2,526	18,725	79,058	1,348
2006	2069	10,182	43,986	700	33,160	88,028	60,465	0	17,353	2,231	15,480	95,528	-7,500
2007	2070	7,409	46,460	700	34,460	89,029	59,916	0	17,353	2,095	14,208	93,571	-4,542
2008	2071	9,376	37,298	700	39,203	86,577	72,740	0	17,353	1,809	11,805	103,706	-17,129
2009	2072	-844	49,645	700	38,613	88,114	51,387	0	17,353	1,853	11,592	82,185	5,928
2010	2073	8,207	74,868	700	36,805	120,579	76,328	0	17,353	1,952	13,649	109,281	11,298
2011	2074	-2,140	54,522	700	32,892	85,975	45,795	0	17,353	2,163	15,492	80,803	5,172

Table 11
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Annual Groundwater Budget for North Marina Groundwater Model Run 5ncb - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		558	50,780	700	40,450	92,488	58,950	0	17,353	2,207	13,541	92,050	438

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 12
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Annual Groundwater Budget for North Marina Groundwater Model Run 5nc - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	20,447	71,806	700	46,712	139,665	75,964	0	17,353	2,276	13,709	109,302	30,363
1950	2013	863	52,407	700	31,756	85,726	45,795	0	17,353	2,259	16,320	81,727	3,999
1951	2014	9,668	70,614	700	32,593	113,575	75,963	0	17,353	2,448	17,392	113,156	418
1952	2015	1,244	51,395	700	30,875	84,214	45,795	0	17,353	2,308	17,448	82,904	1,310
1953	2016	10,593	70,109	700	32,107	113,509	75,962	0	17,353	2,584	18,053	113,951	-443
1954	2017	2,210	51,013	700	30,537	84,460	45,795	0	17,353	2,338	17,902	83,387	1,073
1955	2018	7,615	40,736	700	32,872	81,923	60,130	0	17,353	2,308	15,839	95,630	-13,707
1956	2019	12,565	27,221	700	41,492	81,978	73,394	0	17,353	1,720	10,928	103,395	-21,417
1957	2020	7,565	26,337	700	46,817	81,420	60,865	0	17,353	1,515	8,322	88,056	-6,636
1958	2021	3,838	22,884	700	49,581	77,004	59,451	0	17,353	1,429	7,190	85,423	-8,419
1959	2022	-2,052	39,176	700	51,663	89,487	61,099	0	17,353	1,389	6,571	86,412	3,075
1960	2023	-3,466	35,656	700	51,927	84,816	63,737	0	17,353	1,363	6,579	89,032	-4,216
1961	2024	2,480	30,571	700	56,794	90,544	75,319	0	17,353	1,292	5,478	99,442	-8,897
1962	2025	376	28,624	700	62,374	92,074	75,149	0	17,353	1,228	4,274	98,004	-5,930
1963	2026	-8,908	27,032	700	63,835	82,658	60,865	0	17,353	1,219	4,077	83,514	-856
1964	2027	-11,983	23,250	700	64,812	76,778	59,459	0	17,353	1,218	3,937	81,967	-5,189
1965	2028	-16,584	38,767	700	65,735	88,619	61,374	0	17,353	1,213	3,793	83,733	4,886
1966	2029	-16,563	34,733	700	65,174	84,044	64,832	0	17,353	1,208	3,926	87,318	-3,274
1967	2030	-14,318	61,521	700	64,868	112,771	87,591	0	17,353	1,199	4,144	110,286	2,485
1968	2031	-24,697	45,843	700	61,765	83,611	56,438	0	17,353	1,192	4,382	79,364	4,247
1969	2032	-16,983	67,451	700	59,152	110,320	83,044	0	17,353	1,218	5,087	106,701	3,619
1970	2033	-25,118	51,357	700	55,716	82,654	53,210	0	17,353	1,238	5,549	77,349	5,305
1971	2034	-18,357	78,889	700	51,999	113,230	76,257	0	17,353	1,322	6,713	101,645	11,585
1972	2035	-28,694	78,311	700	42,171	92,487	43,657	0	17,353	1,602	10,196	72,808	19,678
1973	2036	-14,950	56,632	700	37,095	79,477	42,818	0	17,353	1,814	12,130	74,114	5,363
1974	2037	-494	77,082	700	36,367	113,654	75,992	0	17,353	1,888	13,772	109,005	4,649
1975	2038	-9,980	74,882	700	29,300	94,902	38,796	0	17,353	3,254	20,523	79,926	14,976
1976	2039	-446	58,617	700	27,896	86,767	42,303	0	17,353	2,705	21,809	84,170	2,598
1977	2040	4,876	42,389	700	29,022	76,988	42,810	0	17,353	2,453	19,700	82,316	-5,329
1978	2041	14,505	68,428	700	31,186	114,820	75,961	0	17,353	2,852	19,402	115,568	-748
1979	2042	2,254	68,793	700	26,139	97,886	38,796	0	17,353	5,661	25,157	86,967	10,919
1980	2043	8,562	54,176	700	25,759	89,197	42,236	0	17,353	4,371	25,072	89,031	166

Table 12
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Annual Groundwater Budget for North Marina Groundwater Model Run 5nc - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	11,780	38,656	700	27,402	78,538	42,810	0	17,353	2,828	22,034	85,025	-6,487
1982	2045	19,576	66,269	700	29,880	116,425	75,962	0	17,353	3,539	21,129	117,983	-1,558
1983	2046	6,209	67,143	700	25,299	99,351	38,796	0	17,353	6,773	26,568	89,489	9,862
1984	2047	20,818	65,375	700	28,312	115,205	76,027	0	17,353	4,485	23,715	121,580	-6,375
1985	2048	10,913	45,963	700	27,930	85,507	45,795	0	17,353	2,606	21,702	87,456	-1,949
1986	2049	18,193	66,692	700	29,970	115,554	75,962	0	17,353	3,367	21,158	117,840	-2,286
1987	2050	8,195	47,945	700	28,910	85,750	45,795	0	17,353	2,498	20,294	85,939	-190
1988	2051	12,507	48,524	700	31,071	92,802	61,050	0	17,353	2,398	18,124	98,924	-6,122
1989	2052	11,444	50,803	700	33,240	96,187	64,107	0	17,353	2,317	16,078	99,855	-3,668
1990	2053	4,835	52,484	700	32,916	90,935	51,452	0	17,353	2,115	15,758	86,679	4,256
1991	2054	6,911	47,670	700	33,402	88,684	60,131	0	17,353	2,240	15,046	94,770	-6,086
1992	2055	10,416	28,436	700	40,350	79,902	74,336	0	17,353	1,751	11,326	104,766	-24,864
1993	2056	7,612	26,247	700	46,103	80,662	60,865	0	17,353	1,539	8,505	88,263	-7,601
1994	2057	4,276	22,847	700	49,061	76,884	59,451	0	17,353	1,447	7,326	85,577	-8,693
1995	2058	-1,457	39,200	700	51,204	89,648	61,213	0	17,353	1,404	6,686	86,656	2,992
1996	2059	-2,578	35,658	700	51,563	85,343	64,247	0	17,353	1,374	6,668	89,641	-4,298
1997	2060	-16,781	71,268	700	46,604	101,790	54,211	0	17,353	1,491	8,178	81,232	20,558
1998	2061	-2,587	35,019	700	46,175	79,308	64,431	0	17,353	1,528	8,456	91,767	-12,459
1999	2062	-15,567	73,932	700	40,788	99,853	43,930	0	17,353	1,761	10,724	73,767	26,085
2000	2063	-7,370	52,525	700	34,939	80,794	42,811	0	17,353	1,997	13,362	75,522	5,272
2001	2064	3,961	74,289	700	34,779	113,730	76,031	0	17,353	2,043	14,945	110,372	3,358
2002	2065	-6,408	72,433	700	28,363	95,088	38,796	0	17,353	3,870	21,546	81,564	13,524
2003	2066	2,906	42,774	700	29,331	75,710	41,877	0	17,353	2,507	18,922	80,658	-4,947
2004	2067	4,567	47,163	700	30,017	82,447	45,795	0	17,353	2,433	17,995	83,576	-1,129
2005	2068	3,997	46,344	700	29,357	80,397	40,455	0	17,353	2,526	18,716	79,050	1,347
2006	2069	10,349	43,986	700	32,980	88,014	60,465	0	17,353	2,231	15,467	95,516	-7,502
2007	2070	7,576	46,460	700	34,279	89,015	59,916	0	17,353	2,095	14,195	93,558	-4,543
2008	2071	9,544	37,298	700	39,021	86,563	72,740	0	17,353	1,809	11,791	103,692	-17,128
2009	2072	-676	49,645	700	38,430	88,099	51,387	0	17,353	1,853	11,577	82,170	5,929
2010	2073	8,375	74,868	700	36,624	120,566	76,328	0	17,353	1,952	13,636	109,269	11,297
2011	2074	-1,970	54,522	700	32,713	85,965	45,795	0	17,353	2,163	15,480	80,791	5,174

Table 12
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Annual Groundwater Budget for North Marina Groundwater Model Run 5nc - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		724	50,780	700	40,271	92,476	58,950	0	17,353	2,207	13,531	92,041	435

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 13
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Annual Groundwater Budget for North Marina Groundwater Model Run 5f - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	6,086	64,982	0	54,596	125,664	70,981	4,263	17,353	1,827	9,605	104,029	21,636
1950	2013	-6,356	49,932	0	40,620	84,196	46,749	4,263	17,353	1,909	11,201	81,474	2,722
1951	2014	1,370	65,122	0	40,640	107,132	70,980	4,263	17,353	1,890	11,819	106,305	827
1952	2015	-5,048	48,641	0	39,407	83,000	46,749	4,263	17,353	1,960	11,854	82,178	821
1953	2016	2,653	64,475	0	39,872	107,000	70,979	4,263	17,353	1,927	12,286	106,807	192
1954	2017	-3,949	48,179	0	38,800	83,030	46,749	4,263	17,353	1,988	12,201	82,554	477
1955	2018	849	30,084	0	41,798	72,730	56,774	4,263	17,353	1,968	10,831	91,189	-18,458
1956	2019	8,268	22,374	0	52,250	82,893	69,988	4,263	17,353	1,502	7,172	100,278	-17,386
1957	2020	2,382	21,810	0	57,552	81,744	58,831	4,263	17,353	1,372	5,632	87,450	-5,707
1958	2021	-1,755	19,359	0	60,376	77,981	57,493	4,263	17,353	1,316	5,001	85,425	-7,445
1959	2022	-6,750	32,576	0	62,840	88,665	58,898	4,263	17,353	1,278	4,539	86,331	2,335
1960	2023	-8,522	29,448	0	63,333	84,259	61,231	4,263	17,353	1,265	4,514	88,627	-4,368
1961	2024	-3,450	24,596	0	68,433	89,579	71,589	4,263	17,353	1,232	3,821	98,257	-8,678
1962	2025	-5,225	23,453	0	73,801	92,030	71,356	4,263	17,353	1,213	3,129	97,314	-5,285
1963	2026	-13,588	22,394	0	75,089	83,895	58,831	4,263	17,353	1,211	3,048	84,706	-811
1964	2027	-16,947	19,694	0	75,923	78,670	57,501	4,263	17,353	1,211	2,983	83,311	-4,641
1965	2028	-20,732	32,139	0	77,205	88,611	59,173	4,263	17,353	1,208	2,829	84,825	3,786
1966	2029	-21,180	29,005	0	76,925	84,750	62,325	4,263	17,353	1,201	2,878	88,020	-3,271
1967	2030	-19,210	51,763	0	77,115	109,668	82,444	4,263	17,353	1,185	2,888	108,133	1,536
1968	2031	-28,352	37,655	0	74,644	83,948	54,677	4,263	17,353	1,188	3,042	80,522	3,425
1969	2032	-21,949	55,371	0	72,473	105,895	77,898	4,263	17,353	1,192	3,305	104,011	1,884
1970	2033	-29,449	42,404	0	69,706	82,661	51,703	4,263	17,353	1,188	3,533	78,040	4,620
1971	2034	-24,855	64,811	0	66,156	106,112	71,113	4,263	17,353	1,216	4,046	97,991	8,120
1972	2035	-37,537	71,630	0	56,668	90,761	43,808	4,263	17,353	1,342	5,856	72,621	18,140
1973	2036	-26,316	55,342	0	50,730	79,756	42,724	4,263	17,353	1,495	7,092	72,927	6,829
1974	2037	-10,888	70,650	0	48,311	108,074	71,008	4,263	17,353	1,568	8,268	102,460	5,613
1975	2038	-18,254	71,206	0	39,834	92,787	40,666	4,263	17,353	1,832	12,391	76,506	16,281
1976	2039	-10,631	57,557	0	37,180	84,105	43,808	4,263	17,353	1,960	13,644	81,028	3,078
1977	2040	-6,300	43,939	0	37,693	75,332	42,719	4,263	17,353	2,022	12,722	79,078	-3,746
1978	2041	3,306	64,113	0	39,414	106,834	70,978	4,263	17,353	1,889	12,649	107,133	-299
1979	2042	-6,220	63,612	0	34,281	91,672	40,666	4,263	17,353	2,781	16,573	81,636	10,036
1980	2043	-1,082	52,317	0	33,603	84,838	43,807	4,263	17,353	2,191	16,840	84,454	384

Table 13
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Annual Groundwater Budget for North Marina Groundwater Model Run 5f - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	1,329	40,339	0	34,817	76,485	42,719	4,263	17,353	2,192	15,094	81,621	-5,136
1982	2045	9,412	61,442	0	37,157	108,011	70,979	4,263	17,353	2,192	14,514	109,301	-1,291
1983	2046	-1,387	61,434	0	32,768	92,815	40,666	4,263	17,353	3,184	18,299	83,765	9,050
1984	2047	10,558	60,054	0	35,352	105,964	71,043	4,263	17,353	2,442	16,568	111,669	-5,704
1985	2048	3,258	44,978	0	35,445	83,681	46,749	4,263	17,353	2,169	14,990	85,524	-1,843
1986	2049	9,594	61,431	0	37,038	108,063	70,979	4,263	17,353	2,214	14,756	109,565	-1,502
1987	2050	1,584	46,183	0	36,381	84,148	46,749	4,263	17,353	2,118	14,036	84,519	-371
1988	2051	4,885	45,990	0	38,174	89,048	57,360	4,263	17,353	2,098	12,841	93,914	-4,866
1989	2052	4,511	46,762	0	40,472	91,745	60,405	4,263	17,353	2,070	11,597	95,687	-3,942
1990	2053	-810	47,438	0	41,165	87,793	49,613	4,263	17,353	1,865	11,099	84,193	3,600
1991	2054	753	43,277	0	41,429	85,459	56,775	4,263	17,353	1,990	10,826	91,207	-5,748
1992	2055	5,898	22,706	0	49,089	77,693	70,544	4,263	17,353	1,598	8,132	101,889	-24,196
1993	2056	3,640	21,673	0	55,422	80,735	58,831	4,263	17,353	1,416	6,119	87,982	-7,247
1994	2057	-306	19,291	0	58,693	77,678	57,493	4,263	17,353	1,348	5,339	85,796	-8,118
1995	2058	-5,203	32,638	0	61,353	88,788	59,010	4,263	17,353	1,308	4,799	86,733	2,055
1996	2059	-6,841	29,575	0	62,057	84,791	61,741	4,263	17,353	1,284	4,732	89,373	-4,582
1997	2060	-21,446	64,065	0	57,283	99,903	52,005	4,263	17,353	1,355	5,718	80,693	19,210
1998	2061	-7,564	30,251	0	56,650	79,337	61,888	4,263	17,353	1,390	5,869	90,763	-11,426
1999	2062	-21,916	66,910	0	51,558	96,553	43,971	4,263	17,353	1,532	7,312	74,430	22,122
2000	2063	-14,488	51,160	0	45,325	81,997	42,720	4,263	17,353	1,706	9,080	75,122	6,875
2001	2064	-3,830	68,104	0	43,997	108,272	71,048	4,263	17,353	1,754	10,089	104,507	3,765
2002	2065	-12,633	67,357	0	36,995	91,719	40,666	4,263	17,353	2,341	14,218	78,842	12,877
2003	2066	-5,475	43,264	0	37,639	75,428	43,242	4,263	17,353	2,107	12,789	79,754	-4,326
2004	2067	-2,918	45,769	0	38,556	81,408	46,749	4,263	17,353	2,032	12,153	82,549	-1,142
2005	2068	-3,290	45,215	0	37,526	79,451	41,409	4,263	17,353	2,107	12,731	77,863	1,587
2006	2069	2,121	41,768	0	41,260	85,150	57,859	4,263	17,353	1,922	10,797	92,194	-7,045
2007	2070	-551	37,183	0	43,557	80,189	57,181	4,263	17,353	1,798	9,762	90,357	-10,168
2008	2071	5,801	30,152	0	49,898	85,851	69,064	4,263	17,353	1,556	7,736	99,972	-14,121
2009	2072	-7,413	43,792	0	49,383	85,762	49,885	4,263	17,353	1,585	7,720	80,806	4,957
2010	2073	-112	67,514	0	47,154	114,555	71,183	4,263	17,353	1,661	8,843	103,303	11,252
2011	2074	-7,734	52,431	0	42,864	87,561	46,749	4,263	17,353	1,816	10,224	80,406	7,155

Table 13
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Annual Groundwater Budget for North Marina Groundwater Model Run 5f - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		-6,194	45,885	0	50,059	89,751	57,023	4,263	17,353	1,725	9,158	89,523	228

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 14
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Summary of Average Annual Groundwater Budgets for North Marina Groundwater Model CEMEX Area Predictive Runs

Project Site	Model Run	Description	Model Time	Land Use	[1] INFLOW: Northern, Eastern and Southern Model Boundary (Underflow)	[2] INFLOW: Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	[3] INFLOW: MPWSP with Injection Returning Basin Water	[4] INFLOW: Ocean Inflow	[5] INFLOW: Total Inflow	[6] OUTFLOW: Non-Project Groundwater Pumping	[7] OUTFLOW: Marina Coast Water District Desalination Pumping	[8] OUTFLOW: MPWSP Project Slant Well Pumping	[9] OUTFLOW: Aquifer Loss to Streams	[10] OUTFLOW: Ocean Outflow	[11] OUTFLOW: Total Outflow	[12] Change in Groundwater Storage
					[acre-ft/yr]											
No Project	1n	Baseline (No Project)	2012-2074	2012	949	51,078	0	29,723	81,750	63,587	0	0	2,142	15,594	81,323	427
	2f	Cumulative with MCWD (No Project)	2012-2074	2060	-5,583	45,914	0	37,463	77,795	61,590	4,263	0	1,704	10,007	77,565	231
	2af	Cumulative with SVWP II and MCWD (No Project)	2012-2074	2060	-5,542	35,361	0	31,939	61,757	37,038	4,263	0	5,073	15,024	61,398	360
CEMEX	3n	Project 2012 Land Use (Dune Sand & 180-FTE)	2012-2074	2012	1,928	51,640	0	50,547	104,116	62,879	0	26,981	1,959	11,923	103,742	374
	3ncb	Project 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)	2012-2074	2012	1,430	51,640	1,080	50,104	104,254	62,879	0	26,981	1,959	12,054	103,873	382
	3nc	Project 2012 Land Use with Returning Basin Water at CEMEX Site (Dune Sand & 180-FTE)	2012-2074	2012	1,687	51,640	1,080	49,821	104,228	62,879	0	26,981	1,959	12,032	103,850	378
	4f	Project 2060 Land Use with MCWD (Dune Sand & 180-FTE)	2012-2074	2060	-4,594	46,453	0	60,293	102,152	60,941	4,263	26,981	1,604	8,193	101,982	170
	4rf	Post-CEMEX with MCWD (Dune Sand & 180-FTE)	2075-2137	2060	-5,698	45,918	0	37,289	77,510	61,590	4,263	0	1,704	10,016	77,574	-64
	5n	Variant 2012 Land Use (Dune Sand & 180-FTE)	2012-2074	2012	881	50,780	0	40,715	92,376	58,950	0	17,353	2,207	13,435	91,944	432
	5ncb	Variant 2012 Land Use with Returning Basin Water at Charles Benson Rd. Site (Dune Sand & 180-FTE)	2012-2074	2012	558	50,780	700	40,450	92,488	58,950	0	17,353	2,207	13,541	92,050	438
	5nc	Variant 2012 Land Use with Returning Basin Water at CEMEX Site(Dune Sand & 180-FTE)	2012-2074	2012	724	50,780	700	40,271	92,476	58,950	0	17,353	2,207	13,531	92,041	435
	5f	Variant 2060 Land Use with MCWD (Dune Sand & 180-FTE)	2012-2074	2060	-6,194	45,885	0	50,059	89,751	57,023	4,263	17,353	1,725	9,158	89,523	228

Table 14
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Summary of Average Annual Groundwater Budgets for North Marina Groundwater Model CEMEX Area Predictive Runs

					[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
					INFLOW					OUTFLOW						
Project Site	Model Run	Description	Model Time	Land Use	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
					[acre-ft/yr]											

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 15
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Annual Groundwater Budget for North Marina Groundwater Model Run 6sn - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	24,239	71,843	0	52,243	148,325	79,880	0	26,981	2,273	13,013	122,146	26,179
1950	2013	5,740	52,483	0	38,507	96,730	48,927	0	26,981	2,233	14,834	92,974	3,756
1951	2014	14,830	70,600	0	39,680	125,111	79,879	0	26,981	2,474	15,937	125,270	-159
1952	2015	6,417	51,549	0	37,771	95,737	48,896	0	26,981	2,294	15,828	93,999	1,738
1953	2016	15,947	69,957	0	39,220	125,124	79,878	0	26,981	2,600	16,541	125,999	-875
1954	2017	7,445	51,032	0	37,453	95,930	48,952	0	26,981	2,324	16,257	94,513	1,417
1955	2018	13,396	40,425	0	39,890	93,710	65,274	0	26,981	2,266	14,184	108,705	-14,995
1956	2019	18,279	27,272	0	48,495	94,045	77,555	0	26,981	1,663	8,867	115,066	-21,021
1957	2020	13,139	26,362	0	53,952	93,452	65,010	0	26,981	1,468	6,467	99,925	-6,473
1958	2021	9,260	22,870	0	56,961	89,091	63,598	0	26,981	1,383	5,642	97,604	-8,513
1959	2022	3,422	39,157	0	59,133	101,711	65,245	0	26,981	1,342	5,090	98,657	3,054
1960	2023	1,982	35,628	0	59,428	97,038	67,883	0	26,981	1,320	5,113	101,297	-4,260
1961	2024	7,902	30,562	0	64,683	103,147	79,465	0	26,981	1,272	4,349	112,068	-8,921
1962	2025	5,855	28,650	0	70,645	105,150	79,295	0	26,981	1,222	3,485	110,983	-5,833
1963	2026	-3,435	27,051	0	72,103	95,719	65,010	0	26,981	1,216	3,312	96,518	-799
1964	2027	-6,683	23,250	0	73,110	89,677	63,606	0	26,981	1,216	3,226	95,029	-5,352
1965	2028	-11,189	38,752	0	74,131	101,694	65,519	0	26,981	1,208	3,097	96,805	4,889
1966	2029	-11,155	34,736	0	73,525	97,106	68,978	0	26,981	1,205	3,207	100,371	-3,265
1967	2030	-8,985	61,534	0	73,089	125,637	91,490	0	26,981	1,195	3,349	123,015	2,622
1968	2031	-19,456	45,868	0	69,851	96,263	60,337	0	26,981	1,189	3,541	92,047	4,216
1969	2032	-11,687	67,404	0	67,141	122,858	86,944	0	26,981	1,212	4,077	119,214	3,644
1970	2033	-19,856	51,333	0	63,499	94,977	57,118	0	26,981	1,207	4,383	89,689	5,288
1971	2034	-13,141	78,870	0	59,600	125,329	80,156	0	26,981	1,284	5,326	113,746	11,583
1972	2035	-23,461	78,380	0	49,128	104,047	47,674	0	26,981	1,542	8,177	84,374	19,673
1973	2036	-9,622	56,834	0	44,331	91,543	46,984	0	26,981	1,748	10,447	86,159	5,384
1974	2037	4,790	77,029	0	43,746	125,565	79,907	0	26,981	1,839	12,248	120,974	4,591
1975	2038	-4,581	75,202	0	36,869	107,490	42,887	0	26,981	3,259	19,188	92,315	15,175
1976	2039	4,985	58,741	0	35,352	99,077	46,466	0	26,981	2,856	20,402	96,704	2,374
1977	2040	10,317	42,595	0	36,424	89,336	46,975	0	26,981	2,432	18,170	94,558	-5,222
1978	2041	19,861	68,616	0	38,417	126,893	79,877	0	26,981	2,855	17,797	127,510	-616
1979	2042	7,693	68,856	0	33,672	110,222	42,784	0	26,981	5,795	23,862	99,421	10,800
1980	2043	14,078	54,310	0	33,178	101,566	46,396	0	26,981	4,503	23,628	101,507	59

Table 15
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Annual Groundwater Budget for North Marina Groundwater Model Run 6sn - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	17,169	38,844	0	34,764	90,777	46,975	0	26,981	2,909	20,433	97,298	-6,521
1982	2045	24,952	66,418	0	37,128	128,498	79,878	0	26,981	3,580	19,468	129,907	-1,409
1983	2046	11,612	67,411	0	32,834	111,857	42,787	0	26,981	6,904	25,266	101,938	9,919
1984	2047	26,067	65,462	0	35,548	127,077	79,941	0	26,981	4,523	22,087	133,532	-6,455
1985	2048	16,176	46,098	0	34,875	97,149	48,882	0	26,981	2,740	20,093	98,696	-1,547
1986	2049	23,388	66,754	0	37,025	127,166	79,878	0	26,981	3,399	19,600	129,858	-2,692
1987	2050	13,642	48,038	0	35,794	97,474	48,920	0	26,981	2,538	18,691	97,129	345
1988	2051	17,817	48,383	0	37,777	103,977	64,949	0	26,981	2,380	16,305	110,615	-6,638
1989	2052	16,876	50,996	0	39,880	107,753	68,024	0	26,981	2,283	14,166	111,454	-3,701
1990	2053	10,334	52,355	0	39,644	102,333	55,377	0	26,981	2,054	13,760	98,172	4,161
1991	2054	12,687	47,748	0	40,599	101,034	65,276	0	26,981	2,176	13,307	107,739	-6,705
1992	2055	16,190	28,355	0	47,607	92,153	78,482	0	26,981	1,692	9,472	116,626	-24,473
1993	2056	13,197	26,268	0	53,256	92,721	65,010	0	26,981	1,492	6,694	100,177	-7,456
1994	2057	9,650	22,829	0	56,444	88,923	63,598	0	26,981	1,399	5,771	97,749	-8,826
1995	2058	3,959	39,174	0	58,704	101,837	65,358	0	26,981	1,356	5,187	98,882	2,955
1996	2059	2,821	35,642	0	59,112	97,575	68,393	0	26,981	1,329	5,200	101,902	-4,327
1997	2060	-11,438	71,210	0	53,737	113,510	58,113	0	26,981	1,429	6,291	92,814	20,696
1998	2061	2,639	35,199	0	53,316	91,155	68,327	0	26,981	1,485	6,770	103,563	-12,409
1999	2062	-10,209	73,920	0	47,658	111,369	47,946	0	26,981	1,694	8,673	85,294	26,075
2000	2063	-1,963	52,715	0	42,139	92,891	46,976	0	26,981	1,925	11,705	87,587	5,304
2001	2064	9,485	74,220	0	42,081	125,786	79,948	0	26,981	2,007	13,429	122,364	3,423
2002	2065	-996	72,810	0	35,886	107,700	42,801	0	26,981	3,992	20,278	94,051	13,649
2003	2066	8,013	42,535	0	36,324	86,873	44,563	0	26,981	2,517	17,467	91,528	-4,655
2004	2067	9,820	47,093	0	36,998	93,910	48,932	0	26,981	2,458	16,542	94,913	-1,003
2005	2068	9,562	46,347	0	36,658	92,567	44,435	0	26,981	2,548	17,365	91,329	1,238
2006	2069	15,745	44,181	0	40,036	99,962	64,420	0	26,981	2,192	13,775	107,367	-7,405
2007	2070	12,979	46,253	0	41,109	100,340	63,832	0	26,981	2,048	12,441	105,302	-4,962
2008	2071	15,088	37,285	0	45,991	98,364	76,642	0	26,981	1,758	10,032	115,413	-17,049
2009	2072	4,731	49,733	0	44,958	99,422	55,293	0	26,981	1,793	9,495	93,561	5,860
2010	2073	13,760	74,993	0	43,489	132,242	80,226	0	26,981	1,906	11,745	120,857	11,385
2011	2074	3,251	54,515	0	39,431	97,196	48,884	0	26,981	2,129	13,717	91,710	5,486

Table 15
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Annual Groundwater Budget for North Marina Groundwater Model Run 6sn - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		6,085	50,818	0	47,556	104,459	62,887	0	26,981	2,199	12,036	104,103	356

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 16
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Annual Groundwater Budget for North Marina Groundwater Model Run 7sf - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	9,760	64,783	0	58,937	133,480	75,243	4,263	26,981	1,781	8,027	116,295	17,185
1950	2013	-1,815	50,023	0	45,885	94,093	48,942	4,263	26,981	1,879	8,983	91,047	3,046
1951	2014	6,452	65,179	0	46,460	118,090	75,242	4,263	26,981	1,864	9,647	117,996	94
1952	2015	-262	48,734	0	44,807	93,280	48,942	4,263	26,981	1,935	9,573	91,694	1,586
1953	2016	7,899	64,216	0	45,726	117,842	75,241	4,263	26,981	1,904	10,042	118,431	-589
1954	2017	1,027	48,098	0	44,230	93,355	49,012	4,263	26,981	1,960	9,854	92,070	1,285
1955	2018	6,468	29,813	0	47,711	83,992	62,267	4,263	26,981	1,911	8,646	104,068	-20,075
1956	2019	13,878	22,429	0	59,058	95,365	74,496	4,263	26,981	1,448	5,316	112,505	-17,140
1957	2020	7,967	21,830	0	64,850	94,647	63,341	4,263	26,981	1,333	4,288	100,205	-5,558
1958	2021	3,669	19,357	0	67,806	90,831	62,003	4,263	26,981	1,290	3,894	98,431	-7,599
1959	2022	-1,248	32,562	0	70,443	101,757	63,412	4,263	26,981	1,246	3,538	99,439	2,318
1960	2023	-3,113	29,481	0	70,941	97,309	65,741	4,263	26,981	1,245	3,520	101,750	-4,441
1961	2024	1,951	24,581	0	76,387	102,919	76,102	4,263	26,981	1,219	3,077	111,642	-8,723
1962	2025	354	23,463	0	81,965	105,782	75,868	4,263	26,981	1,213	2,594	110,918	-5,137
1963	2026	-7,991	22,395	0	83,229	97,633	63,341	4,263	26,981	1,211	2,513	98,309	-676
1964	2027	-11,547	19,680	0	83,961	92,093	62,012	4,263	26,981	1,211	2,470	96,937	-4,844
1965	2028	-15,142	32,107	0	85,337	102,302	63,686	4,263	26,981	1,205	2,349	98,484	3,818
1966	2029	-15,682	29,017	0	85,000	98,335	66,835	4,263	26,981	1,201	2,392	101,671	-3,336
1967	2030	-13,756	51,823	0	85,147	123,214	86,705	4,263	26,981	1,182	2,384	121,515	1,699
1968	2031	-22,918	37,742	0	82,535	97,359	58,944	4,263	26,981	1,188	2,528	93,904	3,455
1969	2032	-16,501	55,366	0	80,355	119,220	82,160	4,263	26,981	1,189	2,718	117,310	1,909
1970	2033	-24,072	42,359	0	77,525	95,812	55,963	4,263	26,981	1,185	2,906	91,298	4,514
1971	2034	-19,429	64,678	0	73,930	119,179	75,375	4,263	26,981	1,197	3,254	111,070	8,109
1972	2035	-32,318	71,732	0	63,680	103,094	47,741	4,263	26,981	1,295	4,397	84,678	18,416
1973	2036	-21,166	55,486	0	57,583	91,903	46,945	4,263	26,981	1,442	5,616	85,246	6,657
1974	2037	-5,669	70,639	0	55,160	120,130	75,269	4,263	26,981	1,518	6,664	114,696	5,435
1975	2038	-13,337	71,275	0	45,634	103,572	43,358	4,263	26,981	1,809	10,214	86,625	16,946
1976	2039	-5,727	57,250	0	42,871	94,394	46,783	4,263	26,981	1,952	11,482	91,461	2,933
1977	2040	-1,197	44,116	0	43,781	86,701	46,936	4,263	26,981	1,965	10,580	90,725	-4,024
1978	2041	8,728	64,338	0	45,520	118,586	75,239	4,263	26,981	1,838	10,400	118,721	-135
1979	2042	-1,485	63,638	0	39,788	101,941	43,256	4,263	26,981	2,798	14,239	91,537	10,404
1980	2043	3,742	52,354	0	39,127	95,223	46,713	4,263	26,981	2,318	14,542	94,817	406

Table 16
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Annual Groundwater Budget for North Marina Groundwater Model Run 7sf - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	6,564	40,276	0	40,710	87,550	46,936	4,263	26,981	2,160	12,785	93,125	-5,575
1982	2045	14,734	61,476	0	43,105	119,315	75,241	4,263	26,981	2,131	12,059	120,674	-1,359
1983	2046	3,471	61,430	0	38,239	103,140	43,257	4,263	26,981	3,263	15,846	93,609	9,531
1984	2047	15,771	60,014	0	41,117	116,902	75,304	4,263	26,981	2,423	14,037	123,008	-6,106
1985	2048	8,104	44,899	0	40,743	93,745	48,942	4,263	26,981	2,160	12,527	94,873	-1,128
1986	2049	14,881	61,249	0	42,679	118,809	75,241	4,263	26,981	2,196	12,326	121,007	-2,198
1987	2050	6,538	46,076	0	41,665	94,279	48,942	4,263	26,981	2,101	11,602	93,889	390
1988	2051	10,048	45,990	0	43,661	99,699	61,621	4,263	26,981	2,055	10,444	105,364	-5,664
1989	2052	9,972	46,728	0	46,251	102,951	64,667	4,263	26,981	2,049	9,158	107,118	-4,167
1990	2053	4,667	47,493	0	46,842	99,002	53,873	4,263	26,981	1,782	8,478	95,377	3,625
1991	2054	6,607	43,269	0	47,633	97,509	62,268	4,263	26,981	1,898	8,509	103,919	-6,410
1992	2055	11,554	22,813	0	55,941	90,309	75,055	4,263	26,981	1,535	6,246	114,080	-23,771
1993	2056	9,225	21,688	0	62,604	93,518	63,341	4,263	26,981	1,372	4,654	100,611	-7,093
1994	2057	5,043	19,286	0	66,039	90,368	62,003	4,263	26,981	1,316	4,126	98,689	-8,321
1995	2058	207	32,621	0	68,931	101,759	63,523	4,263	26,981	1,266	3,711	99,744	2,015
1996	2059	-1,507	29,570	0	69,670	97,733	66,251	4,263	26,981	1,261	3,668	102,423	-4,690
1997	2060	-16,201	64,032	0	64,532	112,363	56,266	4,263	26,981	1,297	4,214	93,021	19,342
1998	2061	-2,354	30,144	0	63,909	91,699	66,151	4,263	26,981	1,347	4,526	103,269	-11,570
1999	2062	-16,903	67,150	0	58,220	108,467	48,014	4,263	26,981	1,473	5,283	86,013	22,453
2000	2063	-9,413	51,255	0	51,675	93,518	46,937	4,263	26,981	1,645	7,033	86,859	6,659
2001	2064	1,462	68,129	0	50,465	120,056	75,309	4,263	26,981	1,690	8,052	116,296	3,760
2002	2065	-7,779	67,292	0	42,618	102,131	43,273	4,263	26,981	2,299	11,875	88,690	13,441
2003	2066	-976	43,208	0	42,996	85,229	44,798	4,263	26,981	2,112	10,751	88,905	-3,676
2004	2067	1,660	45,736	0	43,884	91,280	48,942	4,263	26,981	2,030	10,108	92,324	-1,044
2005	2068	1,745	45,155	0	43,245	90,144	45,090	4,263	26,981	2,087	10,654	89,075	1,069
2006	2069	7,195	41,581	0	47,345	96,120	62,112	4,263	26,981	1,868	8,700	103,923	-7,803
2007	2070	5,094	37,110	0	49,626	91,830	61,442	4,263	26,981	1,739	7,600	102,025	-10,195
2008	2071	11,233	30,183	0	56,550	97,966	73,326	4,263	26,981	1,506	5,907	111,983	-14,017
2009	2072	-2,165	43,812	0	55,666	97,313	54,142	4,263	26,981	1,527	5,667	92,579	4,734
2010	2073	5,149	67,427	0	53,430	126,006	75,445	4,263	26,981	1,598	6,551	114,838	11,169
2011	2074	-2,925	52,637	0	48,381	98,093	48,944	4,263	26,981	1,781	7,871	89,840	8,253

Table 16
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Annual Groundwater Budget for North Marina Groundwater Model Run 7sf - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		-981	45,877	0	56,567	101,464	60,949	4,263	26,981	1,697	7,422	101,312	152

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 17
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Annual Groundwater Budget for North Marina Groundwater Model Run 7srf - 2075 to 2137

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2075	794	64,745	0	31,218	96,757	75,984	4,263	0	1,795	10,689	92,731	4,025
1950	2076	-6,462	50,116	0	27,732	71,385	49,093	4,263	0	1,901	12,411	67,668	3,717
1951	2077	1,926	65,078	0	28,390	95,395	75,983	4,263	0	1,872	13,267	95,385	9
1952	2078	-5,048	48,896	0	26,665	70,513	49,091	4,263	0	1,958	13,367	68,679	1,834
1953	2079	3,287	64,317	0	27,716	95,320	75,982	4,263	0	1,915	13,867	96,027	-708
1954	2080	-3,846	48,233	0	26,179	70,566	49,161	4,263	0	1,987	13,774	69,185	1,381
1955	2081	1,862	29,830	0	29,142	60,835	63,011	4,263	0	1,927	11,850	81,051	-20,217
1956	2082	9,344	22,428	0	39,262	71,034	75,238	4,263	0	1,457	7,238	88,196	-17,162
1957	2083	3,472	21,829	0	44,508	69,810	64,186	4,263	0	1,340	5,602	75,390	-5,581
1958	2084	-855	19,355	0	47,260	65,760	62,866	4,263	0	1,295	4,977	73,401	-7,641
1959	2085	-5,773	32,559	0	49,776	76,561	64,274	4,263	0	1,253	4,476	74,266	2,296
1960	2086	-7,638	29,461	0	50,301	72,124	66,604	4,263	0	1,251	4,474	76,592	-4,468
1961	2087	-2,576	24,579	0	55,497	77,500	76,967	4,263	0	1,224	3,789	86,242	-8,742
1962	2088	-4,197	23,464	0	60,864	80,131	76,732	4,263	0	1,213	3,085	85,292	-5,161
1963	2089	-12,532	22,398	0	62,127	71,993	64,186	4,263	0	1,211	3,007	72,667	-674
1964	2090	-16,019	19,680	0	62,823	66,484	62,874	4,263	0	1,211	2,954	71,302	-4,818
1965	2091	-19,633	32,100	0	64,151	76,619	64,549	4,263	0	1,205	2,796	72,813	3,806
1966	2092	-20,168	29,010	0	63,845	72,688	67,698	4,263	0	1,201	2,860	76,022	-3,334
1967	2093	-18,248	51,816	0	64,004	97,572	87,568	4,263	0	1,183	2,875	95,889	1,683
1968	2094	-27,447	37,808	0	61,393	71,754	59,810	4,263	0	1,188	3,023	68,284	3,470
1969	2095	-21,010	55,366	0	59,311	93,667	83,025	4,263	0	1,190	3,299	91,778	1,889
1970	2096	-28,717	42,369	0	56,492	70,145	56,604	4,263	0	1,185	3,520	65,572	4,573
1971	2097	-23,973	64,634	0	53,111	93,771	76,238	4,263	0	1,199	4,023	85,724	8,048
1972	2098	-37,018	71,702	0	43,534	78,217	48,253	4,263	0	1,302	5,914	59,733	18,485
1973	2099	-26,021	55,598	0	37,553	67,130	47,334	4,263	0	1,454	7,330	60,381	6,749
1974	2100	-10,390	70,733	0	35,547	95,890	76,011	4,263	0	1,524	8,758	90,556	5,334
1975	2101	-18,106	71,482	0	27,853	81,229	43,866	4,263	0	1,820	14,156	64,105	17,124
1976	2102	-10,492	57,267	0	25,334	72,109	47,171	4,263	0	1,966	15,765	69,166	2,943
1977	2103	-5,893	44,023	0	25,714	63,844	47,326	4,263	0	1,979	14,314	67,882	-4,039
1978	2104	4,031	64,351	0	27,466	95,848	75,981	4,263	0	1,846	14,087	96,177	-329
1979	2105	-6,106	63,744	0	23,050	80,689	43,763	4,263	0	2,791	19,258	70,076	10,613
1980	2106	-934	52,469	0	22,325	73,860	47,102	4,263	0	2,345	19,649	73,360	500

Table 17
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Annual Groundwater Budget for North Marina Groundwater Model Run 7srf - 2075 to 2137

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2107	1,858	40,360	0	23,257	65,475	47,326	4,263	0	2,182	17,247	71,018	-5,542
1982	2108	10,067	61,460	0	25,543	97,069	75,982	4,263	0	2,143	16,302	98,690	-1,621
1983	2109	-1,205	61,630	0	21,806	82,231	43,764	4,263	0	3,264	21,243	72,535	9,695
1984	2110	11,320	59,898	0	24,123	95,341	76,047	4,263	0	2,442	18,843	101,595	-6,254
1985	2111	3,320	45,105	0	23,402	71,826	49,091	4,263	0	2,179	17,090	72,623	-797
1986	2112	10,232	61,364	0	25,279	96,876	75,982	4,263	0	2,187	16,751	99,184	-2,308
1987	2113	1,552	46,202	0	24,108	71,861	49,092	4,263	0	2,121	15,964	71,440	421
1988	2114	5,471	46,147	0	25,749	77,367	62,484	4,263	0	2,068	14,319	83,134	-5,768
1989	2115	5,292	46,520	0	27,928	79,739	65,408	4,263	0	1,986	12,542	84,200	-4,461
1990	2116	149	47,675	0	28,562	76,386	54,610	4,263	0	1,789	11,828	72,490	3,897
1991	2117	1,957	43,243	0	28,996	74,196	63,012	4,263	0	1,912	11,591	80,779	-6,582
1992	2118	7,086	22,742	0	36,405	66,233	75,918	4,263	0	1,539	8,284	90,005	-23,772
1993	2119	4,691	21,691	0	42,482	68,864	64,186	4,263	0	1,379	6,106	75,934	-7,069
1994	2120	545	19,286	0	45,624	65,454	62,866	4,263	0	1,321	5,317	73,768	-8,314
1995	2121	-4,299	32,615	0	48,336	76,651	64,386	4,263	0	1,271	4,730	74,650	2,002
1996	2122	-6,037	29,568	0	49,081	72,613	67,114	4,263	0	1,266	4,688	77,331	-4,718
1997	2123	-20,770	64,060	0	44,265	87,555	56,921	4,263	0	1,302	5,630	68,116	19,439
1998	2124	-6,919	30,217	0	43,568	66,866	66,908	4,263	0	1,353	5,917	78,442	-11,576
1999	2125	-21,513	67,172	0	38,611	84,270	48,525	4,263	0	1,480	7,443	61,712	22,558
2000	2126	-14,139	51,311	0	32,409	69,581	47,327	4,263	0	1,659	9,584	62,834	6,748
2001	2127	-3,218	68,119	0	31,604	96,505	76,051	4,263	0	1,696	10,925	92,935	3,570
2002	2128	-12,508	67,547	0	25,404	80,443	43,780	4,263	0	2,290	16,444	66,777	13,666
2003	2129	-5,716	43,158	0	25,201	62,643	45,287	4,263	0	2,126	14,760	66,437	-3,794
2004	2130	-3,129	45,909	0	25,773	68,553	49,093	4,263	0	2,052	13,950	69,358	-805
2005	2131	-3,044	45,255	0	25,252	67,462	45,455	4,263	0	2,106	14,573	66,397	1,066
2006	2132	2,303	41,373	0	28,529	72,205	62,484	4,263	0	1,885	11,719	80,351	-8,146
2007	2133	512	37,106	0	30,652	68,270	62,189	4,263	0	1,749	10,331	78,532	-10,262
2008	2134	6,719	30,206	0	36,961	73,886	74,191	4,263	0	1,511	7,917	87,883	-13,997
2009	2135	-6,756	43,835	0	36,145	73,224	54,781	4,263	0	1,535	7,841	68,420	4,804
2010	2136	539	67,471	0	34,399	102,409	76,308	4,263	0	1,599	9,159	91,330	11,079
2011	2137	-7,803	52,807	0	29,708	74,711	49,093	4,263	0	1,798	11,045	66,199	8,512

Table 17
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Annual Groundwater Budget for North Marina Groundwater Model Run 7srf - 2075 to 2137

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		-5,680	45,913	0	37,291	77,523	61,590	4,263	0	1,704	10,009	77,567	-43

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 18
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Annual Groundwater Budget for North Marina Groundwater Model Run 8sn - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	22,919	71,272	0	44,893	139,085	76,025	0	17,353	2,482	13,877	109,736	29,348
1950	2013	3,424	51,526	0	30,591	85,541	45,836	0	17,353	2,399	16,278	81,865	3,676
1951	2014	12,286	70,082	0	31,591	113,958	76,024	0	17,353	2,670	17,370	113,416	542
1952	2015	3,770	50,654	0	29,829	84,253	45,836	0	17,353	2,454	17,410	83,053	1,200
1953	2016	13,274	69,469	0	31,124	113,867	76,023	0	17,353	2,806	18,042	114,224	-357
1954	2017	4,844	50,128	0	29,533	84,505	45,836	0	17,353	2,487	17,868	83,544	961
1955	2018	10,301	40,602	0	31,476	82,379	60,200	0	17,353	2,447	15,585	95,585	-13,206
1956	2019	14,715	27,234	0	39,146	81,094	73,454	0	17,353	1,778	9,947	102,531	-21,436
1957	2020	9,729	26,335	0	44,315	80,378	60,928	0	17,353	1,563	7,170	87,014	-6,635
1958	2021	5,997	22,885	0	47,310	76,192	59,514	0	17,353	1,462	6,253	84,582	-8,390
1959	2022	124	39,199	0	49,337	88,660	61,163	0	17,353	1,422	5,624	85,562	3,098
1960	2023	-1,222	35,565	0	49,640	83,984	63,800	0	17,353	1,394	5,663	88,209	-4,226
1961	2024	4,705	30,591	0	54,701	89,998	75,382	0	17,353	1,310	4,799	98,843	-8,845
1962	2025	2,606	28,610	0	60,501	91,717	75,209	0	17,353	1,236	3,831	97,629	-5,913
1963	2026	-6,651	27,023	0	61,961	82,333	60,928	0	17,353	1,225	3,648	83,153	-820
1964	2027	-9,750	23,241	0	62,948	76,439	59,523	0	17,353	1,219	3,554	81,648	-5,209
1965	2028	-14,314	38,784	0	63,863	88,333	61,437	0	17,353	1,215	3,414	83,419	4,914
1966	2029	-14,256	34,724	0	63,263	83,731	64,895	0	17,353	1,211	3,533	86,991	-3,260
1967	2030	-11,970	61,481	0	62,828	112,339	87,646	0	17,353	1,208	3,683	109,889	2,450
1968	2031	-22,328	45,796	0	59,725	83,193	56,497	0	17,353	1,194	3,899	78,942	4,251
1969	2032	-14,626	67,553	0	56,970	109,897	83,099	0	17,353	1,232	4,499	106,183	3,714
1970	2033	-22,789	51,314	0	53,518	82,042	53,267	0	17,353	1,259	4,857	76,735	5,308
1971	2034	-16,047	78,847	0	49,669	112,469	76,312	0	17,353	1,358	5,908	100,930	11,539
1972	2035	-25,658	77,919	0	39,832	92,093	43,712	0	17,353	1,676	9,383	72,123	19,970
1973	2036	-12,188	55,947	0	35,327	79,086	42,874	0	17,353	1,911	11,855	73,993	5,092
1974	2037	2,272	76,277	0	34,991	113,540	76,053	0	17,353	2,004	13,674	109,084	4,457
1975	2038	-7,244	73,954	0	28,833	95,544	38,850	0	17,353	3,652	21,206	81,061	14,483
1976	2039	2,346	57,714	0	27,473	87,533	42,358	0	17,353	3,156	22,369	85,236	2,297
1977	2040	7,734	41,452	0	28,376	77,562	42,866	0	17,353	2,643	19,937	82,799	-5,237
1978	2041	17,326	67,648	0	30,319	115,293	76,022	0	17,353	3,188	19,425	115,987	-694
1979	2042	5,022	68,192	0	26,013	99,228	38,849	0	17,353	6,351	25,890	88,443	10,785
1980	2043	11,211	53,715	0	25,537	90,463	42,290	0	17,353	5,159	25,611	90,412	51

Table 18
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Annual Groundwater Budget for North Marina Groundwater Model Run 8sn - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	14,431	37,887	0	26,890	79,208	42,866	0	17,353	3,190	22,226	85,635	-6,427
1982	2045	22,318	65,622	0	29,095	117,036	76,023	0	17,353	3,935	21,161	118,471	-1,436
1983	2046	8,836	66,794	0	25,225	100,855	38,850	0	17,353	7,609	27,337	91,148	9,707
1984	2047	23,432	64,615	0	27,718	115,764	76,088	0	17,353	5,008	23,842	122,290	-6,526
1985	2048	13,694	45,287	0	27,207	86,188	45,835	0	17,353	2,894	21,786	87,868	-1,680
1986	2049	20,786	66,157	0	29,136	116,078	76,023	0	17,353	3,767	21,191	118,333	-2,254
1987	2050	10,929	47,117	0	28,047	86,093	45,836	0	17,353	2,705	20,359	86,252	-159
1988	2051	15,008	47,843	0	29,804	92,655	61,110	0	17,353	2,559	17,794	98,815	-6,160
1989	2052	14,185	50,277	0	31,617	96,079	64,167	0	17,353	2,447	15,572	99,538	-3,459
1990	2053	7,457	51,757	0	31,359	90,573	51,512	0	17,353	2,223	15,341	86,429	4,143
1991	2054	9,460	47,209	0	32,054	88,722	60,203	0	17,353	2,364	14,720	94,639	-5,917
1992	2055	12,610	28,391	0	38,403	79,403	74,395	0	17,353	1,811	10,535	104,094	-24,691
1993	2056	9,672	26,249	0	43,782	79,702	60,928	0	17,353	1,588	7,390	87,258	-7,557
1994	2057	6,404	22,849	0	46,850	76,103	59,514	0	17,353	1,481	6,381	84,729	-8,626
1995	2058	716	39,192	0	48,909	88,817	61,276	0	17,353	1,435	5,724	85,788	3,029
1996	2059	-374	35,619	0	49,305	84,550	64,310	0	17,353	1,405	5,752	88,819	-4,269
1997	2060	-14,278	70,930	0	44,121	100,774	54,268	0	17,353	1,546	7,077	80,244	20,530
1998	2061	-276	35,134	0	43,780	78,638	64,490	0	17,353	1,583	7,547	90,973	-12,335
1999	2062	-12,639	73,405	0	38,490	99,256	43,984	0	17,353	1,838	9,890	73,065	26,191
2000	2063	-4,779	51,827	0	33,436	80,485	42,867	0	17,353	2,096	13,176	75,492	4,993
2001	2064	6,746	73,487	0	33,584	113,816	76,092	0	17,353	2,179	14,895	110,518	3,299
2002	2065	-3,798	71,805	0	28,004	96,011	38,849	0	17,353	4,424	22,237	82,863	13,147
2003	2066	5,593	41,589	0	28,579	75,761	41,912	0	17,353	2,695	18,993	80,953	-5,192
2004	2067	7,357	46,502	0	29,189	83,049	45,836	0	17,353	2,607	18,034	83,830	-781
2005	2068	6,793	45,395	0	28,702	80,890	40,508	0	17,353	2,753	18,975	79,589	1,301
2006	2069	12,962	43,460	0	31,681	88,103	60,517	0	17,353	2,359	15,153	95,381	-7,278
2007	2070	10,230	45,799	0	32,734	88,762	59,972	0	17,353	2,199	13,737	93,260	-4,498
2008	2071	12,015	37,247	0	37,023	86,286	72,802	0	17,353	1,891	11,079	103,124	-16,839
2009	2072	2,021	49,414	0	36,098	87,534	51,446	0	17,353	1,935	10,685	81,419	6,115
2010	2073	10,889	74,248	0	34,763	119,900	76,383	0	17,353	2,069	13,162	108,967	10,933
2011	2074	712	53,434	0	31,302	85,447	45,835	0	17,353	2,284	15,253	80,726	4,721

Table 18
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Annual Groundwater Budget for North Marina Groundwater Model Run 8sn - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		3,249	50,353	0	38,767	92,369	59,006	0	17,353	2,375	13,223	91,958	412

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 19
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Annual Groundwater Budget for North Marina Groundwater Model Run 8sf - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1949	2012	8,488	64,636	0	51,091	124,215	71,045	4,263	17,353	1,916	8,694	103,270	20,944
1950	2013	-3,919	49,207	0	37,531	82,819	46,775	4,263	17,353	1,983	9,946	80,320	2,499
1951	2014	3,739	64,464	0	37,783	105,987	71,044	4,263	17,353	1,995	10,632	105,287	700
1952	2015	-2,590	48,038	0	36,443	81,891	46,775	4,263	17,353	2,036	10,606	81,033	858
1953	2016	5,198	63,580	0	37,069	105,847	71,043	4,263	17,353	2,032	11,077	105,767	80
1954	2017	-1,528	47,632	0	35,879	81,983	46,776	4,263	17,353	2,064	10,943	81,399	584
1955	2018	3,067	29,843	0	38,684	71,594	56,851	4,263	17,353	2,045	9,499	90,010	-18,416
1956	2019	10,172	22,374	0	49,199	81,746	70,055	4,263	17,353	1,540	5,890	99,100	-17,354
1957	2020	4,369	21,809	0	54,811	80,988	58,898	4,263	17,353	1,390	4,724	86,628	-5,640
1958	2021	200	19,361	0	57,828	77,389	57,560	4,263	17,353	1,331	4,283	84,790	-7,400
1959	2022	-4,772	32,584	0	60,323	88,135	58,966	4,263	17,353	1,299	3,888	85,768	2,367
1960	2023	-6,525	29,453	0	60,805	83,733	61,299	4,263	17,353	1,281	3,870	88,066	-4,333
1961	2024	-1,457	24,596	0	66,077	89,216	71,657	4,263	17,353	1,242	3,375	97,890	-8,674
1962	2025	-3,097	23,420	0	71,603	91,927	71,424	4,263	17,353	1,214	2,849	97,102	-5,176
1963	2026	-11,430	22,363	0	72,811	83,744	58,898	4,263	17,353	1,211	2,770	84,494	-751
1964	2027	-14,759	19,684	0	73,593	78,518	57,568	4,263	17,353	1,211	2,722	83,118	-4,600
1965	2028	-18,404	32,135	0	74,823	88,554	59,241	4,263	17,353	1,207	2,595	84,659	3,895
1966	2029	-18,907	29,012	0	74,484	84,589	62,393	4,263	17,353	1,201	2,637	87,846	-3,257
1967	2030	-16,843	51,837	0	74,533	109,527	82,509	4,263	17,353	1,188	2,620	107,933	1,595
1968	2031	-25,863	37,650	0	72,036	83,822	54,742	4,263	17,353	1,188	2,791	80,336	3,486
1969	2032	-19,474	55,433	0	69,762	105,721	77,963	4,263	17,353	1,197	2,987	103,764	1,958
1970	2033	-27,016	42,339	0	67,089	82,412	51,764	4,263	17,353	1,192	3,213	77,786	4,626
1971	2034	-22,384	64,709	0	63,396	105,721	71,178	4,263	17,353	1,234	3,592	97,620	8,101
1972	2035	-34,945	71,339	0	53,466	89,859	43,861	4,263	17,353	1,379	4,899	71,756	18,104
1973	2036	-23,364	55,012	0	47,643	79,292	42,780	4,263	17,353	1,554	6,274	72,224	7,068
1974	2037	-8,210	70,136	0	45,247	107,174	71,072	4,263	17,353	1,645	7,432	101,764	5,409
1975	2038	-15,518	70,144	0	36,931	91,557	40,704	4,263	17,353	1,945	11,509	75,774	15,783
1976	2039	-7,910	56,386	0	34,540	83,016	43,848	4,263	17,353	2,063	12,772	80,299	2,716
1977	2040	-3,469	43,038	0	35,061	74,630	42,775	4,263	17,353	2,107	11,813	78,311	-3,681
1978	2041	6,150	63,140	0	36,685	105,975	71,042	4,263	17,353	1,996	11,562	106,216	-241
1979	2042	-3,622	62,664	0	31,818	90,860	40,703	4,263	17,353	3,045	15,675	81,039	9,822
1980	2043	1,477	51,495	0	31,230	84,202	43,846	4,263	17,353	2,503	15,950	83,914	288

Table 19
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Annual Groundwater Budget for North Marina Groundwater Model Run 8sf - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
1981	2044	3,898	39,481	0	32,415	75,794	42,775	4,263	17,353	2,324	14,116	80,831	-5,037
1982	2045	11,921	60,577	0	34,546	107,045	71,043	4,263	17,353	2,337	13,356	108,351	-1,306
1983	2046	1,047	60,704	0	30,383	92,134	40,703	4,263	17,353	3,529	17,367	83,215	8,919
1984	2047	13,028	59,398	0	32,838	105,263	71,106	4,263	17,353	2,680	15,441	110,844	-5,580
1985	2048	5,650	44,162	0	32,750	82,562	46,775	4,263	17,353	2,280	13,799	84,470	-1,908
1986	2049	12,117	60,780	0	34,340	107,237	71,043	4,263	17,353	2,349	13,538	108,545	-1,308
1987	2050	4,086	45,335	0	33,591	83,012	46,775	4,263	17,353	2,210	12,800	83,401	-388
1988	2051	7,202	45,390	0	35,209	87,801	57,422	4,263	17,353	2,184	11,530	92,753	-4,952
1989	2052	7,089	46,548	0	37,324	90,961	60,468	4,263	17,353	2,183	10,166	94,433	-3,471
1990	2053	1,616	46,750	0	37,829	86,196	49,674	4,263	17,353	1,930	9,578	82,798	3,398
1991	2054	3,185	42,927	0	38,404	84,517	56,851	4,263	17,353	2,067	9,476	90,011	-5,494
1992	2055	7,703	22,709	0	46,135	76,548	70,611	4,263	17,353	1,642	6,953	100,823	-24,275
1993	2056	5,540	21,670	0	52,654	79,863	58,898	4,263	17,353	1,441	5,129	87,084	-7,221
1994	2057	1,682	19,297	0	56,061	77,040	57,560	4,263	17,353	1,367	4,546	85,089	-8,049
1995	2058	-3,210	32,642	0	58,758	88,190	59,078	4,263	17,353	1,332	4,085	86,111	2,079
1996	2059	-4,825	29,542	0	59,470	84,187	61,809	4,263	17,353	1,300	4,040	88,765	-4,578
1997	2060	-19,240	63,927	0	54,311	98,997	52,066	4,263	17,353	1,385	4,688	79,755	19,242
1998	2061	-5,500	30,249	0	53,831	78,581	61,951	4,263	17,353	1,417	5,001	89,985	-11,405
1999	2062	-19,412	66,800	0	48,230	95,618	44,027	4,263	17,353	1,591	5,971	73,205	22,414
2000	2063	-11,922	50,728	0	42,179	80,985	42,776	4,263	17,353	1,782	7,946	74,120	6,865
2001	2064	-1,390	67,446	0	41,062	107,118	71,112	4,263	17,353	1,838	9,011	103,577	3,541
2002	2065	-10,232	66,208	0	34,345	90,322	40,703	4,263	17,353	2,489	13,253	78,060	12,261
2003	2066	-3,051	42,469	0	35,007	74,425	43,264	4,263	17,353	2,191	11,738	78,809	-4,384
2004	2067	-443	45,134	0	35,807	80,497	46,775	4,263	17,353	2,112	11,007	81,509	-1,012
2005	2068	-877	44,541	0	34,896	78,560	41,456	4,263	17,353	2,204	11,713	76,989	1,571
2006	2069	4,780	41,236	0	38,402	84,418	57,915	4,263	17,353	1,992	9,586	91,109	-6,692
2007	2070	1,717	36,951	0	40,431	79,099	57,242	4,263	17,353	1,868	8,469	89,195	-10,096
2008	2071	7,663	30,157	0	46,828	84,648	69,129	4,263	17,353	1,603	6,530	98,877	-14,230
2009	2072	-5,250	43,729	0	46,070	84,548	49,944	4,263	17,353	1,639	6,328	79,527	5,021
2010	2073	2,415	67,287	0	43,708	113,411	71,248	4,263	17,353	1,737	7,368	101,969	11,442
2011	2074	-5,354	51,707	0	39,520	85,873	46,775	4,263	17,353	1,899	8,835	79,125	6,749

Table 19
DRAFT

Annual Groundwater Budget for North Marina Groundwater Model Run 8sf - 2012 to 2074

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
		INFLOW					OUTFLOW						
Hydrology Year	Model Year	Northern, Eastern and Southern Model Boundary (Underflow)	Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	MPWSP with Injection Returning Basin Water	Ocean Inflow	Total Inflow	Non-Project Groundwater Pumping	Marina Coast Water District Desalination Pumping	MPWSP Project Slant Well Pumping	Aquifer Loss to Streams	Ocean Outflow	Total Outflow	Change in Groundwater Storage
		[acre-ft/yr]											
Average		-3,834	45,492	0	47,264	88,922	57,080	4,263	17,353	1,799	8,214	88,708	214

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
[4] Based on the results from the groundwater predictive model run.
[5] = [1] + [2] + [3] + [4]
[6] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

Table 20
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Summary of Average Annual Groundwater Budgets for North Marina Groundwater Model Potrero Road Area Predictive Runs

Project Site	Model Run	Description	Model Time	Land Use	[1] INFLOW: Northern, Eastern and Southern Model Boundary (Underflow)	[2] INFLOW: Stream Recharge and Deep Percolation from Precipitation and Applied Water (Irrigation)	[3] INFLOW: MPWSP with Injection Returning Basin Water	[4] INFLOW: Ocean Inflow	[5] INFLOW: Total Inflow	[6] OUTFLOW: Non-Project Groundwater Pumping	[7] OUTFLOW: Marina Coast Water District Desalination Pumping	[8] OUTFLOW: MPWSP Project Slant Well Pumping	[9] OUTFLOW: Aquifer Loss to Streams	[10] OUTFLOW: Ocean Outflow	[11] OUTFLOW: Total Outflow	[12] Change in Groundwater Storage
					[acre-ft/yr]											
No Project	1n	Baseline (No Project)	2012-2074	2012	949	51,078	0	29,723	81,750	63,587	0	0	2,142	15,594	81,323	427
	2f	Cumulative with MCWD (No Project)	2012-2074	2060	-5,583	45,914	0	37,463	77,795	61,590	4,263	0	1,704	10,007	77,565	231
	2af	Cumulative with SVWP II and MCWD (No Project)	2012-2074	2060	-5,542	35,361	0	31,939	61,757	37,038	4,263	0	5,073	15,024	61,398	360
Potrero	6sn	Project 2012 Land Use (Dune Sand)	2012-2074	2012	6,085	50,818	0	47,556	104,459	62,887	0	26,981	2,199	12,036	104,103	356
	7sf	Project 2060 Land Use with MCWD (Dune Sand)	2012-2074	2060	-981	45,877	0	56,567	101,464	60,949	4,263	26,981	1,697	7,422	101,312	152
	7srf	Post-Potrero with MCWD (Dune Sand)	2012-2074	2060	-5,680	45,913	0	37,291	77,523	61,590	4,263	0	1,704	10,009	77,567	-43
	8sn	Variant 2012 Land Use (Dune Sand)	2075-2137	2012	3,249	50,353	0	38,767	92,369	59,006	0	17,353	2,375	13,223	91,958	412
	8sf	Variant 2060 Land Use with MCWD (Dune Sand)	2012-2074	2060	-3,834	45,492	0	47,264	88,922	57,080	4,263	17,353	1,799	8,214	88,708	214

[1] Based on the results from the groundwater predictive model run.
[2] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[3] Monterey Peninsular Water Supply Project water reurning to the basin with injection.
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[7] Groundwater predictive model input: Projected pumping from MCWD desal wells.
[8] Groundwater predictive model input: Projected pumping from MPWSP slant wells.
[9] Groundwater predictive model input: Based on the results from SVIGSM predictive model run.
[10] Based on the results from the groundwater predictive model run.
[11] = [6] + [7] + [8] + [9] + [10]
[12] = [5] - [11]

APPENDIX A

Hydrologic Modeling of the Monterey Peninsula Water Supply Project Using the Salinas Valley Integrated Ground and Surface Water Model

Prepared by Ludorff and Scalmanini, Consulting Engineers

GEOSCIENCE

UPDATED DRAFT
Version 2

Hydrologic Modeling of the Monterey Peninsula Water Supply Project Using the Salinas Valley Integrated Ground and Surface Water Model

Prepared for
Geoscience

Prepared by
Luhdorff and Scalmanini, Consulting Engineers, Woodland, CA

March 2015

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APPENDIX

Appendix A SVIGSM Calibration Well Locations in the Pressure and East Side Subareas

SVIGSM Calibration Groundwater Levels

Model Calibration Residuals: Pressure Subarea Groundwater Level Residual Frequency Distributions

Model Calibration Residuals: East Side Subarea Groundwater Level Residual Frequency Distributions

Model Calibration Residuals: Pressure Subarea, Layer 1 Simulated Minus Observed Groundwater Levels

LIST OF ACRONYMS

af	acre feet
afy	acre feet per year
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CSIP	Castroville Seawater Intrusion Project
DWR	California Department Water Resources
ET	evapotranspiration
FMMP	Farmland Mapping and Monitoring Program
GEMS	Groundwater Summary Report
GIS	Geographic Information Systems
HWG	Hydrogeologic Working Group
LSCE	Luhdorff and Scalmanini, Consulting Engineers, Inc.
MPWSP	Monterey Peninsula Water Supply Project
MCWRA	Monterey County Water Resources Agency
MGD	million gallons per day
NMFS	National Marine Fisheries Service
NMGWM	North Marina Groundwater Model
NOAA	National Oceanic and Atmospheric Administration
NOP	Notice of Preparation
SRDF	Salinas River Diversion Facility
SVIGSM	Salinas Valley Integrated Ground and Surface Water Model
SVWP	Salinas Valley Water Project
USGS	US Geological Survey
WRCC	Western Regional Climate Center

1 INTRODUCTION

This report summarizes work conducted by Luhdorff and Scalmanini, Consulting Engineers (LSCE) to assist in evaluating impacts from the Monterey Peninsula Water Supply Project (MPWSP or Project) on the Salinas Valley groundwater basin (Basin) (Figure 1). The work completed by LSCE included the following:

- extending the historical simulation period of the Monterey County Water Resources Agency (MCWRA) Salinas Valley Integrated Ground and Surface Water Model (SVIGSM)(Montgomery Watson, 1997),
- recalibrating the SVIGSM with a focus on the extended simulation period through the adjustment of recharge and discharge input parameters,
- developing and running baseline and Project predictive simulations using the SVIGSM,
- evaluating model output results, and
- submitting SVIGSM model output to Geoscience to be used as boundary condition input into Geoscience's numerical model of the coastal area of the Pressure and East Side subareas of the Salinas Valley (Figure 2).

This report focuses on documenting the extension and recalibration of the SVIGSM along with the predictive scenario results of the MPWSP generated by the SVIGSM with a focus on the influence the MPWSP has on Salinas River streamflow and interaction with underlying groundwater aquifers in the Pressure and East Side subareas of the Salinas Valley.

2 BACKGROUND

The SVIGSM has been used historically by the MCWRA to simulate, on a regional basis, hydrogeologic conditions in the Basin. The SVIGSM was used in the analysis of impacts from the Salinas Valley Water Project (SVWP) and in the development of the biological assessment for the SVWP in the 1990s to 2000s. Most recently, the SVIGSM was used in 2008 to assist in the evaluation of a similar water supply project with a different well design and configuration (2008 Project). Analyses for the 2008 Project used the SVIGSM to simulate future land use conditions (2030 land use) along with a SVWP Phase 2 project described in the SVWP EIR/EIS as a baseline condition. Subsequent to work associated with analyzing the 2008 Project, which included responding to public comment, the project was redesigned as the MPWSP that included a revision of the framework of the analysis of environmental impacts.

The revised analysis of the MPWSP included an extension of the time period from a period representing water year 1949 (October 1948-September 1949) through 1994 to a 63-year calibration simulation period from 1949 through 2011. The extension of the historical simulation period was conducted to ensure that the SVIGSM was able to simulate current regional hydrologic conditions that included the reoperation of Nacimiento and San Antonio reservoirs and also Phase 1 of the SVWP. In addition, the SVIGSM was recalibrated to historical groundwater conditions that existed over the extended (1949-2011) calibration period, with a focus on the period from 1995 through 2011. The intent of the recalibration effort was to retain the existing model framework and aquifer properties as originally conceptualized by Water Resource and Information Management Engineering, Inc. (WRIME) and MCWRA due to the inability to obtain the SVIGSM source modeling code. This model extension effort was conducted to ensure that the SVIGSM could adequately simulate, on a regional basis, more current land and water use conditions compared to the previous version of the model. Following the extension of the SVIGSM, the model was used to simulate the influence of the MPWSP on the regional groundwater and surface water system.

This report describes the work conducted to extend the calibration period of the SVIGSM and update the model calibration. The SVIGSM was primarily used to provide output data on streamflow, recharge, and other boundary condition data for input into the larger scale and higher resolution North Marina Groundwater Model (North Marina Model or NMGWM) developed by Geoscience. The objective of using the SVIGSM was to simulate environmental impacts from the MPWSP on a regional scale and provide output to Geoscience for incorporation into the North Marina Model.

3 DESCRIPTION OF THE SVIGSM

The SVIGSM was originally developed for the purposes of providing an analytical tool to be used by Monterey County during the Salinas River Basin Management Plan process (Montgomery Watson, 1997). Conceptually, the SVIGSM consists of three (3) model layers (an aquitard and an aquifer for each layer) corresponding to different hydrostratigraphic units as indicated in **Table 1**. Historical SVIGSM files relating to the model development and calibration were available through LSCE's previous involvement in the SVWP development process. Updated SVIGSM model runs previously used in support of development of the biological assessment for the Salinas Valley Water Project in 2005 and model files used during the feasibility and environmental analyses of the 2008 Project, both conducted by WRIME, were in possession of and were provided by RMC Water and Environment (RMC) for use in evaluations of the MPWSP. The updated SVIGSM files that were provided by RMC included updated versions of executable files that were changed since the initial SVWP analyses conducted in the 1990s. No source code information for these updated executable model files was provided and no formal documentation of differences and changes in model code over time is available. The most recent model files used in the analysis for the Project included a SVIGSM executable file from March 2008 (IGSM_F2C_V6.40_2008-03-25.exe) and accompanying structural model files (e.g., element and node configuration, model subareas and subgroups) from environmental analyses conducted by WRIME for the 2008 Project (WRIME, 2008). These files were used as the basis for developing and conducting all SVIGSM runs for the MPWSP evaluation. One of the more notable changes to the SVIGSM since the original calibration conducted as part of the SVWP EIR/EIS was the incorporation of more spatially discrete data inputs for groundwater pumping. In the original SVIGSM calibration runs, groundwater pumping was only specified for each of the six (6) model subarea whereas the revised SVIGSM model code and data files include a total of 32 pumping subgroups.

4 UPDATING AND APPLICATION OF THE SVIGSM

The previous calibration of the SVIGSM was conducted using the water years 1949 through 1994. As part of the application of the SVIGSM for use in modeling impacts of the MPWSP, the calibration period was extended through the 2011 water year. Necessary model inputs for the extended calibration period were assembled from numerous data sources, consistent with the data sources utilized for the original model calibration. The model inputs and data sources for the calibration update are summarized in **Table 2**. In some cases, complete time-series data, as originally used in the SVIGSM calibration and with which to extend the calibration time period, were unavailable for an input location or data type. In such instances, replacement data sources were used, if available, and appropriate relationships between available datasets were used to infer between gaps in available input data. The focus of the application of the SVIGSM, including the updated calibration, was on the Pressure and East Side model subareas.

4.1 Modifications to SVIGSM Layer Configuration

As part of the process of evaluating impacts from the MPWSP, additional work was performed by Geoscience, in coordination with a Hydrogeologic Working Group (HWG) consisting of representatives from Salinas Valley stakeholders, to characterize the hydrogeologic conditions in the vicinity of the proposed Project areas. This effort included additional subsurface investigations through test hole borings and water level and quality sampling. This work resulted in revisions to model layer configurations within the North Marina Model developed by Geosciences. The revised layer configurations in the North Marina Model were provided by Geoscience for incorporation into the SVIGSM. With these data, the configuration of model layering within the SVIGSM was subsequently modified within the vicinity of the North Marina Model in order to maintain consistency in layer elevations and thicknesses between the SVIGSM and the North Marina Model. Within the domain of the North Marina Model, layer elevations and thicknesses in the SVIGSM were changed to be consistent with revised values in the North Marina Model. Additionally, layer elevations and thickness in the SVIGSM in the areas adjacent to the perimeter of the North Marina Model were also adjusted to incorporate the refined hydrogeologic conceptualization within the North Marina Model area and provide a reasonable transition across the boundaries of the North Marina Model. The magnitude of the adjustment to layer elevations in the SVIGSM in the area corresponding to the North Marina Model domain boundary varied with elevation declines averaging two to 30 feet and elevation increases averaging 10 to 37 feet. These average declines and increases in layer elevations are relatively small when compared to average layer thicknesses that range from 162 to 613 feet.

4.2 Land Use Data Development

For the purposes of updating the SVIGSM model calibration period, and also for use in developing predictive modeling scenarios for evaluating impacts from the MPWSP, it was important to have updated data for land use conditions. The previous SVIGSM calibration runs

contained land use data through September 1994, differentiated into ten (10) land use categories: urban, native vegetation, riparian vegetation, truck crop, field crop, vineyard, irrigated pasture, orchard, grain, and sugar beets as summarized in **Table 3**. Land use categories follow the definitions outlined in the California Department Water Resources (DWR) Standard Land Use Legend (DWR, 2009). Representations of current land use conditions and future land use conditions were developed for the purposes of extending the SVIGSM calibration period through 2011 and also for use in predictive hydrologic modeling relating to the MPWSP.

4.2.1 Current (2012) Land Use Conditions

Data representing updated ("current") land use conditions to be used in the modeling were initially developed by ESA, in consultation with LSCE, using Geographic Information Systems (GIS) and were based on analysis of aerial photography from 2012 (NAIP, 2012) together with land use data in GIS form for 1997 provided by MCWRA. Land use information was not available for 2011, therefore, 2012 land use information was considered to be representative of 2011. Using the 1997 MCWRA land use data as a starting point, aerial photography from 2012 were reviewed in the Pressure and East Side model subareas, and all land uses and field boundaries were adjusted from those designated for 1997 in accordance with interpretations of land use from the 2012 aerial photography. For the purpose of gathering feedback, the procedure of developing spatial data representing current land use conditions, as previously described, and preliminary results from this effort, were presented and discussed with the MCWRA, although no formal review of the data was conducted by MCWRA. Because the focus of the hydrologic modeling was on the Pressure and East Side subareas in the vicinity of the MPWSP, thorough updating of current land use conditions emphasized these two subareas with less emphasis placed on other subareas in the groundwater basin. Land use updates were defined in terms of the ten (10) land use categories used in the SVIGSM. Through this process, a GIS dataset was developed that was used to represent the current land use condition in hydrologic modeling conducted with the SVIGSM.

Table 3 summarizes the total acres of each land use category in the current land use condition and changes in areas between 1994 (from the original SVIGSM calibration) and 2012. The most notable changes in land uses between 1994 and 2012 include increased areas of urban and truck crop by about 7,000 acres each and an overall decrease in native vegetation of about 16,000 acres. **Figure 3a** illustrates the spatial distribution of current land uses in the model area as used to develop input for the SVIGSM. The current land use data was used to extend the model calibration period through September 2011 (end of water year 2011), using linear interpolation for the period 1995 through 2011 (using 2012 land use data). The 2012 land use data were also used as the current land use condition in some predictive scenarios designed to evaluate impacts from the MPWSP.

4.2.2 Future (2060) Land Use Conditions

As part of the evaluation of potential impacts from the MPWSP under future land use conditions, predictive hydrologic modeling scenarios were also conducted using estimated land use conditions for 2060. The spatial representation of future land use conditions was initially developed by ESA, in consultation with LSCE, from a combination of current land use conditions (developed as described above) and future build-out land use conditions (or zoning) as defined in General Plans available for the model area. Using the data representing current land use conditions as a basis, the current land use data were modified in accordance with future land uses or zoning depicted in General Plans. All areas designated as future urban areas in a General Plan were modified to be urban under the future land use condition; additionally, all areas mapped as urban in the current land use data (based on areas already developed as urban) retained the urban designation for the future land use condition, even if the area was not assigned an urban land use in the General Plan. The retention of existing urban land uses under the future land use configuration, even if some of those areas were not identified as urban under the General Plans, were made under the assumption that once land was developed as urban, there is little likelihood that there would be a future conversion to native vegetation or agriculture. As a result of a lack of specificity in the General Plans regarding future cropping patterns or crop types, areas of current agricultural land uses that were also designated future agriculture in a General Plan, retained all the specifics relating to the type of agricultural land use from the current land use condition. Farmland areas (prime farmland, farmland of statewide importance, and unique farmland) as mapped in 2010 by the California Department of Conservation, Farmland Mapping and Monitoring Program (FMMP)(FMMP, 2010) were used to define the extent of future agriculture development throughout the Salinas Valley. Using the FMMP data, areas designated as future agricultural land in a General Plan were constrained to the extent of the FMMP farmland areas. In other words, it was assumed that future agricultural development would be limited to within the FMMP farmland areas. Areas already developed for agriculture in 2012 were maintained as agriculture in the future land use even if they were located outside of the FMMP farmland area.

Table 3 summarizes the total acres by land use category and by SVIGSM subarea in the future land use condition, including changes between the current (2012) and future (2060) land use. Comparing future and current land use conditions, future conditions consist of over 48,000 acres of additional urban area with decreased areas of truck crop (-13,180 acres). The combined increases in urban area and native vegetation converted to agriculture (crop type unknown) between current and future, result in an overall decrease in native vegetation by over 43,000 acres. **Figure 3b** illustrates the spatial distribution of future land uses in the model area.

Together **Table 3 and Figure 3c** illustrate trends in land use conditions across the 1994, current, and future time frames. Logical progressions in major land uses are evident across these three

time periods with increasing urban areas and decreases primarily in native vegetation over time, most notably in the Pressure, East Side, and Fort Ord/Toro model subareas.

4.3 Hydrologic Model Inputs

Numerous hydrologic inputs are required for the SVIGSM and were assembled from different sources as outlined in **Table 2**. Hydrologic input data from the original calibration data sources, as described in the report by Montgomery Watson on the SVIGSM update and calibration (Montgomery Watson, 1997), were sought out and acquired for the updated calibration time period between October 1994 and September 2011. Hydrologic data for many inputs were available for the period of water years 1995-2004 from recent SVIGSM modeling efforts conducted by WRIME (WRIME, 2008). These model inputs were required at various time steps and spatial locations as indicated in **Table 2** and are briefly discussed below.

4.3.1 Precipitation

Daily precipitation data from eight (8) meteorological stations (Salinas FAA, Soledad, King City, Priest Valley, Pinnacles National Park, Arroyo Seco, Nacimiento Reservoir, San Antonio Reservoir), distributed throughout the Salinas Valley and surrounding area, are incorporated into the SVIGSM. These locations include mainly stations monitored by National Oceanic and Atmospheric Administration (NOAA), with data obtained from the Western Regional Climate Center (WRCC), and additional measurements made by MCWRA at Nacimiento and San Antonio Reservoirs. Available data for the updated calibration period were acquired and any data gaps were filled using correlations between precipitation stations with available data.

4.3.2 Evapotranspiration

Monthly evapotranspiration (ET) data is input into the SVIGSM and provided for each land use category in the model, specific to each model subarea. The original calibration data used average monthly values of ET for the region reported by DWR, without any annual variation, throughout the entirety of the 1949 -1994 calibration time period (Montgomery Watson, 1997). Subsequent to the original model calibration period, more extensive measured ET data became available through the California Irrigation Management Information System (CIMIS), mostly since the early 1990s. As part of the calibration update, available reference ET data from CIMIS were acquired and incorporated into the SVIGSM calibration period. Because the original ET data in the SVIGSM calibration were based on a limited dataset, the ET data model inputs were recreated for the entire updated calibration period (1995-2011) using measured monthly ET, as available, with average monthly ET values used for the time period predating measured ET, generally prior to 1984. As was done with precipitation data, when possible, correlations among ET stations were used to fill gaps in available ET data. From the monthly reference ET data and using crop ET coefficients previously used in the SVIGSM, monthly ET data were calculated for

each land use type within each model subarea for the duration of the updated calibration period 1949-2011. Additionally, reservoir ET data were acquired from MCWRA.

4.3.3 Surface Water

For the updated calibration, daily streamflow data from files created by WRIME as part of previous modeling efforts conducted in 2008, were used to extend the SVIGSM calibration through 2004. Additional daily streamflow data and reservoir releases were acquired from available data sources, including US Geological Survey (USGS) streamflow gaging stations and MCWRA reservoir release records, in order to extend the model calibration beyond 2004 to 2011.

Data relating to monthly surface water diversions and surface water deliveries, including upper Basin diversions referred to in the SVIGSM as the Clark Colony diversions within the Forebay subarea, were updated in the model calibration using data from previous SVIGSM files created by WRIME (WRIME, 2008) for the hydrologic period 1995-2004. Average monthly values for the available period were used to extend the Clark Colony diversion dataset through 2011 for the updated calibration. Additionally, past and future upper Basin diversions by San Luis Obispo County are not delivered within the SVIGSM area and the monthly diversion amounts by San Luis Obispo County are derived from previous SVIGSM files provided by RMC that were developed to model future predictive scenarios and indicate a constant diversion of 1,450 acre feet (AF) per month, in accordance with their water right of 17,500 acre-feet per year (afy) (San Luis Obispo County, 2013). Monthly diversions of 1,450 AF by San Luis Obispo County beginning in January 2011 were included in the updated calibration.

Data for the monthly volume of recycled water delivered by the Salinas Valley Reclamation Project for agricultural use in the Castroville Seawater Intrusion Project (CSIP) area were obtained from MCWRA (MCWRA, 2013) for the calibration period. Recycled water deliveries initially began in July 1998. Additionally, surface water diversions occurring at the Salinas River Diversion Facility (SRDF), constructed as part of Phase I of the SVWP, also are being delivered to the CSIP area, and data for these diversions were acquired from MCWRA and included in the SVIGSM calibration update. The construction of the SRDF was completed and surface water diversions at this location began in May 2010.

4.3.4 Groundwater Pumping

Groundwater pumping is an important input component in the SVIGSM calibration. In the original SVIGSM calibration, groundwater pumping was specified only by subarea; in subsequent revisions to the SVIGSM, additional capability to specify pumping by subgroups within each subarea was included, providing increased ability to specify pumping in a spatially discrete manner. Accordingly, in model revisions, groundwater pumping, particularly in the Pressure and East Side subareas, was spatially distributed into numerous pumping subgroups.

Records of groundwater pumping in the Basin are collected and maintained by MCWRA and these data are reported annually in the MCWRA Groundwater Summary (GEMS) Reports (MCWRA, 2014a). Additionally, monthly groundwater pumping data were provided to LSCE by MCWRA for both urban and agricultural purposes within the Basin. These data, however, were summarized by subarea. MCWRA's monthly data was used in conjunction with information contained in GEMS reports to estimate groundwater pumping over the updated calibration period. The SVIGSM requires groundwater pumping by subgroup, therefore, it was necessary to spatially distribute the groundwater pumping data provided by MCWRA into the many pumping subgroups within each model subarea.

Using the monthly pumping totals from MCWRA for each subarea, a routine was followed through which pumping was distributed to each model element based on water demand for the period 1995-2011. This routine consisted of the following steps:

1. All reported agricultural pumping data provided by MCWRA were adjusted according to the percent of wells for which data was not available for a given reporting period, as indicated on GEMS reports. These adjustments to pumping ranged from increases between 2 and 18 percent over reported pumping. Reported urban pumping was assumed to be reasonably complete and was therefore not adjusted in this manner.

2. Agricultural water demand was estimated on a monthly time step for each model element as the difference between precipitation and ET in accordance with land use designations within the element.

3. Agricultural groundwater pumping was estimated on a monthly time step as agricultural water demand minus surface water deliveries. Pumping was then adjusted to account for inefficiencies in crop irrigation practices.

4. Estimated agricultural groundwater pumping on a monthly basis was totaled for each pumping subgroup and calculated as a percent of total agricultural pumping for the subarea.

5. Reported monthly agricultural groundwater pumping data from MCWRA were distributed to each pumping subgroup according to percent calculated in step 4 for each month.

6. Reported urban groundwater pumping was similarly distributed spatially based on percent of urban area within each element and then totaled for each pumping subgroup; however, some adjustments to the distribution of urban pumping were made to account for differential demand between urban areas, specifically in the vicinity of the City of Salinas where data indicated demand was greater on a per acre basis than in other areas

designated urban. Urban water demand for the City of Salinas was based on reported amounts from MCWRA annual GEMS reports for the period 1995-2011.

Groundwater pumping data from the original calibration dataset for 1949-1994, which were only available as total pumping by subarea, were also spatially distributed into pumping subgroups following the method described above.

Additional groundwater pumping data for the Fort Ord/Toro model subarea were assembled from annual water production reports of the Seaside Groundwater Basin Watermaster and from data tables provided in a model report for the Seaside Basin by Durbin (2007).

5 SVIGSM MODEL CALIBRATION

5.1 Calibration Methodology

Using the assembled and extended model inputs for the updated calibration period, the SVIGSM was recalibrated with a focus on the Pressure and East Side subareas and during the model extension timeframe. The model calibration focused primarily on adjusting recharge and discharge input values with a comparison of simulated groundwater levels versus observed groundwater levels in wells previously used as calibration wells in the original model calibration. The intent of the model extension and recalibration effort was to retain the existing modeling framework and aquifer properties and any adjustments that were necessary to recalibrate the model focused on recharge and discharge input values. Groundwater elevation measurements, collected at approximately monthly intervals in the calibration wells, were provided by MCWRA for the entire calibration period since 1949, as available. The period of record of available groundwater level data for each calibration well is variable and monitoring of some of the original calibration wells has been discontinued. Hydrographs of simulated versus observed groundwater elevations in calibration wells were compared for the updated calibration period through 2011. Based on preliminary calibration runs and comparison of simulated versus observed groundwater levels in calibration wells, the spatial distribution of urban groundwater pumping, particularly for the City of Salinas was adjusted, and the vertical distribution of pumping (percent being pumped from each of the three model layers) was refined.

During the model calibration, the vertical distribution of groundwater pumping was adjusted to more closely simulate the observed conditions within all three (3) model layers based on water levels at calibration wells. Groundwater levels in each calibration well individually reflect conditions in distinct depth intervals corresponding with different model layers. Accordingly, the hydrographs of simulated and observed water levels for calibration wells were used as guidance in making adjustments to the vertical distribution of pumping for different time periods during the updated model calibration period.

In addition to comparison of location-specific water levels at calibration wells, simulated groundwater levels were compared with groundwater level contours interpreted by MCWRA for Fall 2011 (MCWRA, 2014b), to evaluate the spatial patterns in simulated versus observed groundwater levels. Lastly, as part of the calibration, SVIGSM output from calibration runs were provided to Geosciences for groundwater flow and transport simulations using the North Marina Model. Simulated levels and chloride concentrations in groundwater from the North Marina Model were further compared with available observed data provided by MCWRA to inform additional adjustments to the SVIGSM pumping distribution.

5.2 Boundary Conditions and Aquifer Properties

All boundary conditions (except for groundwater pumping distribution) and aquifer properties from the original model calibration were retained for the calibration update. However, as indicated above, the SVIGSM layer configurations (elevations and thicknesses) were modified in the area of the North Marina Model to be consistent with revisions to the interpreted hydrostratigraphy and model layering in the North Marina Model.

5.3 Calibration Results

The spatial distribution of the calibration wells with select hydrographs showing the simulated versus observed groundwater levels in the final calibrated model are displayed in **Figure 5**. The calibration well hydrographs suggest that the SVIGSM is reasonably well calibrated within the Pressure subarea and in parts of the East Side subareas. Overall, the extended calibration period (1995-2011) exhibits the best agreement between simulated and observed water levels as compared to the 1949 through 1994 time period, although agreement between simulated and observed water levels showed improvement from the original model calibration (Montgomery Watson, 1997) throughout the entire calibration period. This is likely in part because of better documentation and availability of model input data, including groundwater pumping data, for more recent years and also because of improvements in the hydrogeologic conceptualization within the NMGWM area. Simulated and observed water levels throughout the Pressure subarea exhibit good agreement, especially for calibration wells in the 180-Foot Aquifer, although these wells are limited in number. In the East Side subarea, simulated groundwater levels tend to be higher than observed in many areas, mainly towards the hills and along the margins of the valley in the northern and eastern parts of the subarea. This tendency was also exhibited in the original model calibration (Montgomery Watson, 1997). Although simulated groundwater levels tend to be higher than observed in these areas, the influences of climatic conditions on long and short-term water level fluctuations are still captured in the East Side subarea. As a model intended for more regional analyses, this likely indicates that the SVIGSM does not fully capture the hydrogeologic complexities present within the East Side subarea, particularly along the margins of the subarea. Nevertheless, the extended model calibration indicates that the SVIGSM is reasonably well calibrated throughout most of the NMGWM domain, particularly in the Pressure subarea. Additional results of calibration water levels are included in **Appendix A** as hydrographs and plots of residuals (simulated minus observed data).

Contours of the simulated groundwater elevations in SVIGSM layers 1 and 2 at the end of September 2011 from the calibrated model are shown in **Figures 6a and 6b**. Both of these figures illustrate the general gradient for groundwater flow simulated by the SVIGSM in layers 1 and 2. Most notable from these contours are the areas of low groundwater elevations in the northern parts of the Pressure and East Side subareas as simulated for September 2011 in the final calibrated model. Contours of groundwater elevation, interpreted by MCWRA for August

2011, are displayed separately for the 180-foot/East Side shallow aquifer zone as **Figure 7a** and 400-Foot/East Side deep aquifer zone as **Figure 7b**. The general spatial patterns and groundwater flow directions evident in simulated groundwater elevations at the end of September 2011 (**Figures 6a and 6b**) are similar and consistent with those interpreted by MCWRA for August 2011 (**Figures 7a and 7b**), although the interpreted contours from August 2011 data are generally lower than those simulated for September 2011 in the final calibrated model.

5.4 SVIGSM Model Calibration Outputs

SVIGSM calibration outputs were provided to Geosciences for incorporation into the NMGWM. These outputs included monthly output of groundwater levels at SVIGSM nodes located along the edge of the NMGWM domain, groundwater pumping by element, deep percolation by element, and streambed infiltration by stream node. These data were incorporated into the NMGWM for use in model calibration.

6 DESCRIPTION AND DEVELOPMENT OF SVIGSM SCENARIOS

In order to evaluate potential future impacts from the MPWSP, multiple predictive model scenarios were developed and simulated using the SVIGSM. Model runs included baseline scenarios without the MPWSP and also scenarios with different configurations for MPWSP well locations and pumping rates. The details of SVIGSM runs conducted for this evaluation are summarized in **Table 4**.

6.1 Simulated Hydrology for Model Scenarios

Previous modeling efforts using SVIGSM have relied on historic hydrology data derived from the dataset of hydrologic inputs for the original SVIGSM calibration period between 1949 and 1994 (Montgomery Watson, 1997) or an extended hydrologic dataset for 1949 through 2004 (WRIME, 2008) for use as the simulated hydrology for predictive modeling. A different approach to developing the simulated hydrology was used for the predictive modeling conducted for this evaluation. Demand for water to meet agricultural needs represents the largest fraction of water demand in the Salinas Valley. Agricultural water demand (i.e. ET) is a function of crop type, meteorological conditions, and irrigation practices; some of this water demand is met by precipitation and the remainder is assumed to be met through applied irrigation water. To accurately estimate the groundwater pumping over the predictive simulation period, it is important to have adequate hydrologic data for the simulation period, including measured ET and precipitation. Although previous predictive modeling used the hydrologic dataset from the calibration period, measured ET data were only available since water year 1984 and so monthly ET data prior to 1984 in the updated model calibration represent average monthly values from available ET data for the period after 1984. Therefore, estimation of monthly water demand using the hydrologic dataset for the updated calibration in years prior to 1984 would not accurately capture climatic influences on water demand. Because estimating water demand, and thereby groundwater pumping, are integral to modeling with the SVIGSM, years with hydrologic data suitable for use in the simulated future hydrologic period were reduced by this limitation in the calibration dataset.

Additionally, an essential component of predictive modeling using the SVIGSM is the incorporation of minimum streamflow triggers consistent with the SVWP streamflow prescriptions included in the biological opinion issued by the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) (NMFS, 2007). WRIME (2008) had previously incorporated these minimum streamflow requirements as input to the SVIGSM for the historic period 1949-2004 and these model files had also been provided by RMC for use in this evaluation.

Consequently, recognizing temporal limitations present in each of these two datasets, a synthesized hydrologic period of 63 years representing 2012 through 2074 was constructed for

the predictive simulations using hydrologic data for individual water years 1984 through 2004. **Figures 8a and 8b** show historical annual precipitation data for the calibration period as measured at three (3) locations in the Salinas Valley with the time periods for which average and variable ET data were used in the calibration. **Figure 8a** presents annual precipitation totals whereas **Figure 8b** presents the cumulative departure from the mean precipitation over the calibration time period. Together these figures show the following general historical annual precipitation trends:

- 1949-1959 normal to slightly dry conditions (average to slightly below average precipitation)
- 1960-1972 dry conditions (below average precipitation)
- 1973-1983 wet conditions (above average precipitation)
- 1984-1987 normal conditions (average precipitation)
- 1988-1992 dry conditions (below average precipitation)
- 1993-1998 wet conditions (above average precipitation)
- 1999-2011 normal conditions (average precipitation).

Figure 8c is a plot of the cumulative departure from the mean annual precipitation using the dataset for the simulated future hydrologic period. As illustrated in **Figure 8c**, the simulated future hydrologic period represents a hydrologic period consisting of long and short periods of dry and wet conditions as well as periods of average precipitation representing a range of potential future hydrologic conditions for the evaluation of impacts from the MPWSP. The overall average precipitation simulated in the synthesized hydrologic period is slightly wetter on average than historical averages at the three stations, however, the beginning and ending of the simulated hydrology are at the same cumulative departure level. All predictive modeling scenarios (baseline, Project, and post-Project runs) were conducted using the assembled 63-year simulated future hydrologic period.

6.2 Baseline Scenarios

Three baseline modeling scenarios were developed for the SVIGSM, representing conditions without the MPWSP, provide the foundation with which to evaluate potential impacts from the Project. These baseline scenario runs were developed as outlined in **Table 4** and represent a range of potential background land use and groundwater development conditions that may occur. The baseline runs include model runs 1, 2f, and 2af as summarized in **Table 4**. A fourth baseline scenario, run 1n, was developed for the NMGWM using output from the SVIGSM baseline run 1.

6.2.1 Land Use Conditions

As discussed earlier, representations of current (2012) and future (2060) land use conditions were developed for the SVIGSM area. These data are summarized in **Table 3** and displayed in

Figures 3a, 3b, and 4 and were used as the basis for estimating foundational groundwater demands for the predictive simulation period under a range of potential future land use conditions throughout the Salinas Valley as represented in the baseline scenarios.

6.2.2 Basin Groundwater Pumping Estimates

Agricultural Groundwater Pumping

Demand for water to meet agricultural needs represents the largest fraction of water demand in the Salinas Valley. Agricultural water demand is a function of the distribution of crop types and meteorological conditions; some of this water demand is met by precipitation and the remainder is assumed to be met through applied irrigation water. For all of the predictive scenarios, agricultural demand was estimated on a monthly time step for each element as the difference between precipitation and ET in accordance with land use designations within the element and accounting for crop (irrigation) efficiencies. This approach is generally consistent with methods of estimating agricultural demand and groundwater pumping previously used in SVIGSM (Montgomery Watson, 1997), although month to month residual soil moisture is assumed to be constant. Monthly crop ET was estimated based on reference ET data and crop coefficients, based on relationships and crop coefficients derived from previous SVIGSM data files. Total agricultural water demand was then estimated using crop ET and crop irrigation efficiency.

To estimate groundwater pumping, it was first assumed that all agricultural water demand was met through a combination of precipitation and/or irrigation within a given month and that agricultural pumping is equal to the total agricultural water demand minus precipitation minus any surface water deliveries. Groundwater pumping in the model is specified for each of the 32 subgroups. Accordingly, agricultural groundwater pumping was estimated monthly for each subgroup as the sum of agricultural water demand for all elements in the subgroup minus precipitation and surface water deliveries. This routine was performed for each of the three (3) baseline scenarios, which included two different land use conditions (current and future) and different surface water diversion scenarios (SVWP Phase I and Phase II). An increase of 5 percent in crop irrigation efficiency was assumed to occur between current (2012) and future (2060) land use conditions.

Results derived through this approach to estimating future groundwater pumping were compared with groundwater pumping derived from reported data by MCWRA during the updated calibration period from 1995-2011. Over this period, the estimated pumping derived from water demand calculations was similar to those values based on reported pumping from MCWRA, although generally slightly greater, as indicated on **Figure 9.** It is important to note that it is believed that the groundwater pumping totals reported by MCWRA are below actual pumping amounts. This is because MCWRA does not obtain annual groundwater pumping records for wells with discharges less than 3 inches in diameter. This is in addition to a percentage of larger

wells for which MCWRA may not receive annual groundwater pumping reports as indicated in GEMS reports (MCWRA, 2014a). Additional calibration runs were conducted using the estimated groundwater pumping for 1995-2011 and these indicated an overall improvement in the model calibration.

Urban Groundwater Pumping

Urban groundwater pumping for the predictive scenarios was derived for each model subgroup based on estimates of urban demand per urban acre and the number of urban acres present within the subgroup. Monthly urban groundwater pumping data provided by MCWRA was used in combination with information from the MCWRA annual GEMS reports (MCWRA, 2014a) to estimate monthly urban groundwater pumping. Because monthly urban pumping data were only provided by MCWRA at a subarea spatial scale, GEMS reports were used to identify localized areas of urban pumping within the Salinas Valley, including the City of Salinas. Initially, monthly urban pumping data from MCWRA was distributed to model subgroups assuming equal pumping per urban acre within each subarea and in accordance with the number of urban acres within each subgroup. The resulting distributed pumping amounts for the subgroups encompassing the City of Salinas were found to be lower than values reported in the MCWRA GEMS reports. It is believed that the difference in pumping values for these subgroups was a result of greater population density (and therefore greater water usage on a per acre basis) within the City of Salinas in comparison with other areas designated urban in the Salinas Valley. In order to account for the relatively higher urban water use (per acre) in the City of Salinas area, pumping was calculated separately for subgroups encompassing the City.

Annual pumping data for the City of Salinas were assigned to months of the year based on the temporal (monthly) distribution of urban pumping for the entirety of the Pressure and East Side subareas. The estimated monthly pumping for the City of Salinas was then distributed evenly to the subgroups encompassing the City. Monthly pumping amounts for the City of Salinas area were then subtracted from the monthly subarea pumping totals provided by MCWRA and the remaining urban pumping within each subarea were ultimately evenly distributed, on a per acre basis, to subgroups based on the number of urban acres.

To estimate urban demand and groundwater pumping under each of the land use conditions (current and future) being simulated in predictive modeling scenarios, the average monthly urban pumping values per urban acre determined for water years 2009-2011 were used to derive total monthly urban pumping for each subgroup. Monthly urban pumping was not varied year to year according to changes in climatic or hydrologic conditions.

6.2.3 Sea Level Rise

Potential rise in future sea level was incorporated into all predictive model runs using a constant sea level based on the mean predicted sea level for the period 2012 and 2074 (occurring in 2047)

(ESA PWA, 2013). A constant sea level value was used in the SVIGSM because the model incorporates constant head nodes within the Monterey Bay to simulate sea level and the existing SVIGSM was therefore not configured to model changing sea level over time. Additionally, in order to evaluate the impact of the MPWSP during a hypothetical "post-Project" period, it was important to retain a consistent sea level condition throughout the duration of all of the predictive model simulations in order to isolate the influence of the Project on surface and groundwater features. An analysis of the sensitivity of the SVIGSM to different potential sea levels was conducted through comparison of separate model runs with predicted 2012 and 2074 sea level conditions and is discussed in **Section 7.4**.

6.2.4 Salinas Valley Water Project

Two different phases of development of the SVWP were also incorporated into the baseline model runs. SVWP Phase I includes average annual surface water diversions of around 9,700 afy at the SRDF and are representative of the average diversions originally designed for the SVWP (**Figure 10**). These diversion amounts are structured according to the 36 cubic feet per second (cfs) maximum diversion capacity of the current SRDF occurring during the months of April through October as outlined in **Table 5**. Additionally, an average of 12,500 afy of recycled water are assumed to be delivered as part of the SVWP Phase I. The monthly and annual recycled water deliveries modeled for predictive scenarios are representative of recent recycled water deliveries as reported by MCWRA (MCWRA, 2013) and are indicated in **Table 5**. All of the SVWP Phase I surface and recycled water are delivered to the current CSIP area, which is shown as the SVWP Phase I delivery area on **Figure 10**. These deliveries are used to meet water demand and offset groundwater pumping in the SVWP Phase I area.

An additional baseline scenario incorporating a SVWP Phase II configuration was also developed based on very general information contained in the Notice of Preparation (NOP) of an Environmental Impact Report for a SVWP Phase II issued by MCWRA on June 25, 2014 (MCWRA, 2014c). Description of the SVWP Phase II provided in the NOP suggests that Phase II would divert up to 135,000 afy of water from the Salinas River for delivery to offset groundwater pumping in areas within the Salinas Valley, primarily in the Pressure and East Side subareas (the 135,000 afy includes the SVWP Phase I diversion). The NOP indicates that two (2) additional water diversion facilities would be constructed in the Forebay and Pressure subareas as part of this project. **Figure 10** shows the locations of the SVWP Phase II diversions (Castroville Canal Intake and East Side Canal Intake) indicated in the NOP and the primary water delivery locations modeled in the SVWP Phase II scenarios. In the Phase II scenarios, a maximum of about 121,500 afy of surface water was allowed to be diverted from the Salinas River (in addition to the SVWP Phase I amount), split evenly between the two diversion points identified in the NOP. Maximum annual surface water diversion of about 135,000 AF was used for predictive modeling of Phase II because it was assumed that the total surface water diversions

for Phase II indicated in the NOP also include surface water being diverted at the SRDF as part of Phase I. Diversions at the SRDF have priority over upstream diversions occurring at the Phase II Castroville Canal Intake and East Side Canal Intake. All Phase II surface water was delivered to offset groundwater pumping in SVIGSM pumping subgroups in accordance with guidance provided by Geoscience and a delivery priority scheme focused on offsetting pumping in areas of low groundwater levels (**Figure 10)**. The low numbers assigned to the SVIGSM subgroups shown on **Figure 10** received a higher priority to receive surface water deliveries.

6.2.5 Marina Coast Water District Desalination Project

A desalination project by the Marina Coast Water District (MCWD) was included in all three of the SVIGSM baseline model scenarios. This project was modeled as two wells located in the vicinity of the current MCWD headquarters (**Figure 11**) pumping a combined total of 3.8 million gallons per day (MGD) of feedwater to supply a desalination plant. These two wells are assumed to be vertical wells at the locations on **Figure 11** pumping equal volumes of water entirely from the 180-Foot Aquifer (SVIGSM Layer 1).

6.2.6 Groundwater Replenishment Project

The Monterey Peninsula Groundwater Replenishment Project (GWR) is being developed to collect and treat sources of wastewater and stormwater runoff for groundwater recharge. A portion of the treated water from the GWR is planned on being delivered to the CSIP area in some of the project scenarios which involve a reduction in the amount of Project pumping. The amount of GWR water averages around 4,200 acre feet per year over the 63 year simulation period and is used to offset groundwater pumping for irrigation purposes.

6.2.7 Minimum Streamflow Requirements and Reservoir Operation

Minimum streamflow requirements prescribed in the SVWP biological opinion were included in all predictive simulations as streamflow triggers developed by WRIME during previous SVIGSM modeling efforts (WRIME, 2008). Additionally, reservoir operations were incorporated in the predictive scenarios utilizing appropriate reservoir rule curves for San Antonio and Nacimiento Reservoirs in accordance with communication with MCWRA. The rule curve for Nacimiento Reservoir was updated to reflect reservoir operations based on spillway modifications completed as part of SVWP Phase I.

6.2.8 Assumptions and Limitations

One of the fundamental assumptions used to estimate groundwater pumping in the predictive modeling scenarios is that all of the estimated groundwater demand at a selected location is met by groundwater pumping occurring directly beneath the location. In reality wells are not evenly spaced throughout the landscape and water pumped from a well may be conveyed great distances to meet water demand. Nevertheless, given the regional nature of the SVIGSM and scale of the

model elements, it is believed that this assumption is valid for this modeling effort. Additionally, it is assumed that on a monthly time step, all estimated water demand is satisfied through a combination of precipitation and irrigation. A major limitations in estimating groundwater pumping for predictive scenarios and also for the updated calibration period concerns unreported pumping, in particular groundwater pumping that is not reported from wells with discharge piping less than three inches in diameter. It is not known how much unreported pumping has historically occurred within the Salinas Valley. However, the approach to estimating groundwater pumping from land use and climatic conditions, as employed for this modeling, generally estimated slightly more groundwater pumping than was determined for 1995-2011 based on reported values from MCWRA. This suggests that the estimated groundwater pumping values are likely very reasonable.

6.3 MPWSP Scenarios

Using the baseline SVIGSM scenarios described above as a foundation, model scenarios for the SVIGSM were developed to simulate several potential configurations of the MPWSP as outlined in **Table 4**. The modeled Project scenarios included two potential Project locations, at either the CEMEX site or the Potrero Road Site (**Figure 11**), superimposed on various background (baseline) conditions of land use and SVWP development as described for the baseline scenarios. Additional Project runs composed of a reduction in Project pumping (Variant) were also modeled with background conditions consisting of baseline run 1 and 2f along with GWR deliveries (**Table 4**). All scenarios utilizing the SVIGSM simulating MPWSP operations incorporated a very small amount of desalinated water (approximately 800 to 900 afy) returned to the Basin and delivered within the CSIP/SVWP Phase I area (**Figure 10**), in accordance with the monthly values shown in **Table 5.**

6.3.1 CEMEX Site

The CEMEX Project site is located north of the City of Marina as shown in **Figure 11** and the main Project configuration evaluated at this location consists of 10 slant wells pumping a total of 24.1 MGD of feedwater to produce approximately 9.5 MGD of desalinated product water. Specific details of the Project are provided in reports by Geoscience (2014) and ESA (2014). The well locations modeled in the SVIGSM are displayed in **Figure 11** and represent the midpoint of the screened interval within each of the slant wells. It is important to note that misalignments between the boundary delineating the Monterey Bay and Pressure subareas exist in the SVIGSM when compared with the actual coastline. This misalignment could have been fixed with a revision to the source code which was not available. This misalignment of the coastline results in the Project wells being located at a distance at the CEMEX site from the Monterey Bay which is greater than the actual planned distance.

The proposed slant wells at the CEMEX site would be completed within both the 180-Foot equivalent aquifer and the overlying Dune Sand Aquifer. The SVIGSM is only a three-layer model and the Dune Sand Aquifer corresponds with an aquitard feature in the SVIGSM (**Table 1**). Consequently, only the portion of pumping assigned to the 180-Foot Equivalent Aquifer, as indicated by Geoscience, was simulated in the SVIGSM. This equates to approximately 17.4 MGD of the total Project pumping of 24.1 MGD as shown on **Table 4**. The 24.1 MGD Project at CEMEX was modeled with each of the three baseline runs as background conditions. These scenarios are model runs 3, 4, and 4a as listed in **Table 4**. Three variant Project scenarios were also modeled at the CEMEX site. These variant Project runs consist of seven (7) wells pumping a total of 15.5 MGD of feedwater to produce 6.1 MGD of product water. As with the 24.1 MGD Project, only the portion of pumping assigned to the 180-Foot equivalent aquifer, approximately 11.1 MGD, was simulated in the SVIGSM. The variant Project was modeled using baseline runs 1 and 2f as the background condition and designated as model runs 5, 5n, and 5f (**Table 4)**.

Model runs 5n, 5, and 5f included water delivered to the CSIP area (the SVWP Phase I delivery area) from the GWR. As mentioned above, the average annual amount of water supplied by the GWR was approximately 4,200 afy during the simulation period with deliveries occurring every month. This water is planned to augment existing CSIP and SVWP Phase I deliveries for irrigation in lieu of groundwater pumping.

6.3.2 Potrero Road Site

The Potrero Road Project site is located near Moss Landing as shown on **Figure 11**. The main Project configuration evaluated for the Potrero Road site consists of 10 slant wells pumping a total of 24.1 MGD of feedwater to supply 9.5 MGD of product water. Specific details of the Project are provided in reports by Geoscience (2014) and ESA (2014). As mentioned earlier for the CEMEX site, misalignment between the coastline in the SVIGSM and the actual coastline also exist in the Potrero Road area. In contrast to the CEMEX site, at the Potrero Road site the coastline in the SVIGSM is further inland than in reality. Because of this it was necessary to move the Project wells approximately 1,100 feet inland from their actual locations in order to avoid placing the wells in Monterey Bay in these scenarios.

The proposed slant wells at the Potrero Road site would be completed only within the Dune Sand Aquifer, which is not represented as a discrete aquifer layer in the SVIGSM. The SVIGSM is only a three-layer model and the Dune Sand Aquifer corresponds with an aquitard feature in the SVIGSM (**Table 1**). Recognizing this limitation in the SVIGSM, all of the Project pumping was modeled as occurring within Layer 1 of the SVIGSM under guidance by Geoscience in order to provide the most appropriate SVIGSM output data for use in the North Marina Model. As a result, 24.1 MGD of total Project pumping were modeled in Layer 1 of the SVIGSM with two of the three (3) baseline runs as background conditions (runs 1 and 2f) (**Table 4**). These scenarios are model runs 6sn and 7sf as summarized in **Table 4**. A variant Project configuration consisting

of seven (7) wells pumping a total of 15.5 MGD of feedwater to produce 6.1 MGD of product water was also modeled at the Potrero Road site. The variant Project was only modeled using baseline runs 1 and 2f as background conditions and this scenario is represented in model runs 8sn and 8sf in **Table 4**.

6.3.3 Post-Project Runs

At the request of the HWG, two post-Project scenarios were modeled to evaluate the Basin response after a hypothetical end of the Project. Post-Project runs were completed for each of the CEMEX and Potrero Road sites but only for the 24.1 MGD Project scenarios. In the post-Project scenarios, the groundwater conditions at the end of the simulated 63-year period of Project operation were used as initial conditions for a 63-year post-Project simulation period after cessation of Project pumping. The post-Project runs were completed with baseline run 2f background conditions and are represented as model runs 4rf and 7srf for the CEMEX and Potrero Road sites, respectively, as detailed in **Table 4**.

6.3.4 Sea Level Rise Sensitivity Analysis

In order to evaluate the sensitivity of the model to different sea level rise conditions, two (2) additional model runs were conducted utilizing model run 3 with different sea level conditions representative of 2012 and 2074. These sea level rise sensitivity analysis runs are summarized in **Table 4** and results from these simulations were compared with those from run 3 (2047 sea level conditions) to evaluate the sensitivity of the SVIGSM and the response of the Project to changes in sea level conditions.

6.4 SVIGSM Model Scenario Outputs

SVIGSM model scenario outputs were provided to Geosciences for incorporation into the NMGWM. These outputs included monthly output of groundwater levels at SVIGSM nodes located along the edge of the NMGWM domain, groundwater pumping by element, deep percolation by element, and streambed infiltration by stream node. These data were incorporated into the NMGWM for more detailed analysis of Project impacts.

7 SVIGSM SCENARIO RESULTS

The description of the Project scenario results from the SVIGSM focus on changes in water budget components in the Pressure and East Side subareas. Focused discussion of results that are within the boundary of the NMGWM are not described in this report, rather the Geoscience report (Geoscience, 2015) includes details on Project-related influences on a local scale. Specifically, changes to seawater intrusion as a result of the Project and variations in groundwater levels are addressed in the Geoscience report.

The results of SVIGSM predictive scenarios described below are organized into baseline no Project results, CEMEX Project location results and Potrero Road Project location results followed by the results of the sea level rise sensitivity analysis.

7.1 Baseline Conditions

The three baseline scenarios, Runs 1, 2f, and 2af, were reviewed to assess the influence the two primary variables, land use and SVWP, have on surface water and groundwater conditions. The influence that changes between current (2012) and future (2060) land use conditions and between the SVWP Phase I project and the SVWP Phase II project have on water budget components are illustrated in **Figures 12a through 12l**.

7.1.1 Groundwater Budget Results

The influence the three baseline runs have on groundwater budgets in the Pressure and East Side subareas are presented in **Figures 12a, 12b, and 12c**. One of the three graphs showing temporal variations of groundwater budget components **(Figure 12b)** shows very little variation among the three baseline runs. This figure shows end-of-year groundwater storage, which varies between nine (9) and ten (10) million afy. The other two figures show temporal variations in groundwater pumping and deep percolation (recharge). Pumping responds to the difference in water demands between the current and future land use conditions as shown in **Figure 12a** where groundwater pumping is generally less in the Pressure and East Side subareas under the future land use (Run 2f) as compared to current land use condition (Run 1). A pronounced decline in annual groundwater pumping occurs with the implementation of the SVWP Phase II project which is expected due to the dramatic decrease in pumping as a result of increased surface water supplies offsetting groundwater pumping during the irrigation season. Accompanying decreases in deep percolation (recharge to groundwater) as presented in **Figure 12c** are expected when comparing Run 1 to Runs 2f and 2af due to the decrease in groundwater pumping. The spatial distributions of deep percolation during dry and wet periods are illustrated in **Figures 12h through 12l**. These six figures show the spatial variation in recharge across the Pressure and East Side subareas during wet and dry periods for each of the three baseline runs.

7.1.2 Surface Water Budget Results

The influence the three baseline runs have on surface water budgets in the Pressure and East Side subareas are presented in **Figures 12d, 12e, and 12f**. One of the three graphs showing temporal variations of surface water budget components **(Figure 12f)** shows very little variation among the three baseline runs. This figure shows annual streamflow (primarily from the Salinas River) to Monterey Bay. The lack of variation even between runs 1, 2f, and 2af where the SVWP Phase I and II are simulated indicates that the streamflow to the Bay is governed largely by the minimum flow criteria for the SVWP. General variation in streamflow is likely heavily influenced by reservoir operating criteria governing releases and spills of stored water into the Salinas River. Infiltration of streamflow to groundwater is presented in **Figure 12d** and surface water diversions are shown in **Figure 12e**. Streamflow infiltration is generally less in run 2af as compared to runs 1 and 2f, likely due to combined influences from reductions in groundwater pumping and the greater amount of diversions that occur upstream of the Pressure and Eastside subareas in run 2af's SVWP Phase II operations. The reduction in groundwater pumping decreases, on a long term basis, the hydraulic gradient between groundwater and surface water and associated decrease in recharge from the Salinas River.

7.2 CEMEX Location Results

Seven predictive scenarios (Runs 3, 4, 4a, 4ar, 5n, 5 and 5f) were developed to simulate the influence of the operation of the MPWSP at the CEMEX location on groundwater and surface water features, both during operations of the Project and during a post-Project period should the MPWSP permanently cease operations. Five additional predictive scenarios (runs 3n, 3ncb, 3nc, 5ncb, and 5nc) were developed but were only simulated by Geoscience using the NMGWM with minor modifications of input boundary conditions from the SVIGSM run 3 to offset the influence of the MCWD desalination project or to simulate different locations for the injection of basin return water from the Project.

Modeling scenario results for groundwater pumping, storage, and deep percolation (recharge) along with recharge from streamflow, surface water diversions, and streamflow were reviewed to assess the influence of the MPWSP and the difference between Project operations and baseline conditions.

7.2.1 Groundwater Budget Results

The influence the MPWSP has on groundwater budgets in the Pressure and East Side subareas for runs 3, 4, 4a, 4ar, 5n, 5, and 5f are presented in **Figures 13a-c, 14a-c, 15a-c, 16a-c, 17a-c, 18a-c, and 19a-c**. SVIGSM results for groundwater pumping in **Figures 13a, 14a, 15a, 16a, 17a, 18a, and 19a** shows the magnitude of MPWSP pumping located in the Pressure subarea as compared to baseline results. The Project pumping is approximately 18,000 afy in runs 3, 4, and 4a and about 12,000 afy for runs 5n, 5, and 5f when the MPWSP is operated at a reduced

capacity. The bottom portion of the figure shows the relative difference in groundwater pumping between Project and baseline runs. The slight increase in pumping in run 4a compared to runs 3 and 4 is associated with an increase in non-Project pumping that occurs as a result of the indirect influence Project pumping has on SVWP Phase II diversions from the Salinas River. The magnitude of the differences in pumping in runs 5n, 5, and 5f to the baseline run 1 is the combined influence of the Marina Coast Water District desalination project pumping and reduction in pumping associated with GWR water deliveries which influences the differences in groundwater pumping in figures 17a, 18a, and 19a.

End-of-year cumulative groundwater storage in the Pressure and East Side subareas along with the relative difference in cumulative storage between Project runs and associated baseline runs are illustrated in **Figures 13b, 14b, 15b, 16b, 17b, 18b, and 19b**. There are very small declines in cumulative storage ranging from about 3,000 to 5,000 afy in the Pressure and East Side subareas in those runs with Project pumping. This is compared to total storage of about 10,000,000 acre feet that exists in both subareas. These differences are extremely small and amount to about 0.1 percent of total aquifer storage in these two subareas. Runs 5n, 5, and 5f result in slight increases in cumulative storage compared to baseline results. The slight increases in cumulative storage are about 0.1 percent of total cumulative aquifer storage in the two subareas. (**Figures 17b, 18b, and 19b**).

Figure 16b shows the change in aquifer storage during the post-Project period. A decline in storage is present in the first one to four years following the cessation of Project pumping. This indicates that the SVIGSM simulates an influence on aquifer storage from Project pumping for a period of one year in the Pressure subarea and up to four years in the East Side subarea, respectively, followed by little change in aquifer storage for the remainder of the simulation period.

Runs 3, 4, 4a, 4ar, 5n, 5, and 5f do not result in any change in deep percolation in the Pressure and East Side subareas as illustrated in **Figures 13c, 14c, 15c, 16c, 17c, 18c, and 19c**.

7.2.2 Surface Water Budget Results

The influence the MPWSP may have on surface water budgets in the Pressure and East Side subareas are presented in **Figures 13d-f, 14d-f, 15d-f, 16d-f, 17d-f, 18d-f, and 19d-f**. Infiltration of streamflow to groundwater is presented in **Figures 13d, 14d, 15d, 16d, 17d, 18d, and 19d** along with the difference between Project runs and associated baseline runs. Infiltration is dependent on available streamflow (shown in **Figures 13f, 14f, 15f, 16f, 17f, 18f, and 19f**) and the MPWSP results in an increase in infiltration between 1,000 to 3,000 afy when the Project is operating at full capacity (runs 3, 4, and 4a). However, for the reduced capacity (runs 5n, 5, and 5f) simulations where GWR water is delivered to the CSIP area and groundwater pumping is reduced, there is a slight decrease in infiltration primarily during dry periods of 1,000 to 2,000

afy. During normal and wet years infiltration is unchanged or there is some slight increase (**Figures 17d, 18d, and 19d**). Infiltration, when it does occur, is about 10 percent of MPWSP pumping and about one or two percent of the total amount of infiltration that occurs under baseline conditions. The increase in infiltration is due to a modeling artifact in SVIGSM. This artifact involves the SVIGSM inaccurately representing the coastline location. In the CEMEX area, the model boundary with Monterey Bay is located offshore and therefore, the Project wells are effectively pumping further landward from the actual coastline boundary. This results in a higher amount of groundwater storage depletion than what would occur of the model boundary and coastline matched and Project wells could be placed at that boundary instead of further inland and also an increases amount of infiltration from the Salinas River. A sensitivity analysis was conducted by moving the Project wells in the SVIGSM in run 3 toward the coastline a similar distance to what is planned. The sensitivity analysis resulted in a reduction in the depletion in groundwater storage in the Pressure subarea by about 1000 afy and reduced infiltration from the Salinas River approximately 1,000 afy as compared to run 3 results.

The residual effect on stream infiltration following the cessation of Project operations is noticed in the first year of post-Project operations. The cessatation of Project operations results in an increase of about 1,000 acre feet of additional infiltration within the domain of the NMGWM as illustrated in **Figure 16d.** The MPWSP does not influence the amount of diversions off the Salinas River under SVWP Phase I operations as shown in **Figures 13e, 14e, 17e, 18e, and 19e**. There is a very small decline in diversions of the SVWP Phase II (about two percent) in some years from the Forebay and Pressure subareas in run 4a **(Figure 15e)** more so than in run 4 (**Figure 14e**). This is potentially the result of the minor influence the MPWSP has on Salinas River streamflow which in turn influences diversions in some years Streamflow infiltration decreases during those periods when streamflow diversions are high. This is likely due to a reduction in streamflow during periods of high diversions which leaves less streamflow in the Pressure and East Side subareas available for recharge. Under post-Project conditions (**Figure 16e**) in run 4rf, diversions are relatively unchanged.

The MPWSP operations result in a very slight reduction (less than one percent) in streamflow in the Salinas River entering Monterey Bay in runs 3, 4, 4a, 5n and 5 (**Figures 13f, 14f, 15f, 17f, 18f, and 19f**).

7.3 Potrero Road Project Results

Five predictive scenarios (Runs 6s, 7s, 7as, 7sr, and 8s) were developed to simulate the influence the operation of the MPWSP at the Potrero Road location has on groundwater and surface water features both during operations of the Project and during a post-Project period should the MPWSP permanently cease operations (**Figures 19a-f, 20a-f, 21a-f, 22a-f, and 23a-f**). The influence the scenarios have on groundwater pumping, storage, and deep percolation (recharge) along with recharge from streamflow, surface water diversions, and streamflow were reviewed to

assess the influence of the MPWSP and the difference between Project operations and associated baseline conditions.

7.3.1 Groundwater Budget Results

The influence the MPWSP has on groundwater budgets in the Pressure and East Side subareas for runs 6sn, 7sf, 7srf, 8sn, and 8sf are presented in **Figures 20a-c, 21a-c, 22a-c, 23a-c, and 24a-c**. SVIGSM results for groundwater pumping in **Figures 20a, 21a, 22a, 23a, and 24a** shows the magnitude of scenario pumping located in the Pressure subarea as compared to baseline results. The Project pumping is approximately 27,000 afy in runs 6sn and 7sf, however, the difference in pumping illustrated in Figures 20a and 21a is influenced by the absence or presence of pumping for the Marina Coast Water District project in run 6sn (absence) and run 7sf. Project pumping is about 17,000 afy for runs 8sn and 8sf when the MPWSP is operated at a reduced capacity. Similar in nature to runs 6sn and 7sf, the difference in pumping between runs 8sn and 8sf and baseline conditions in Figures 23a and 24a are influenced by the simulation of Marina Coast Water District project pumping.

End-of-year groundwater storage in the Pressure and East Side subareas along with the relative difference between Project runs and corresponding baseline runs are presented in **Figures 20b, 21b, 22b, 23b, and 24b**. There are very small variations in storage ranging from no change to about 10,000 afy The changes in storage are less than 1 percent of the total storage in either the Pressure and East Side subareas.

Runs 6sn, 7sf, 7srf, 8sn, and 8srf do not result in any change in deep percolation in the Pressure and East Side subareas as illustrated in **Figures 20c, 21c, 22c, 23c, and 24c**.

7.3.2 Surface Water Budget Results

The influence the MPWSP may have on surface water budgets in the Pressure and East Side subareas are presented in **Figures 20d-f, 21d-f, 22d-f, 23d-f, and 24d-f**. Infiltration of streamflow to groundwater is presented in **Figures 20d, 21d, 22d, 23d, and 24d** along with the difference between Project runs and associated baseline runs. Infiltration is dependent on available streamflow (shown in **Figures 20f, 21f, 22f, 23f, and 24f**) and the MPWSP results in very little changes in infiltration compared to each run's respective baseline condition. This is likely due to the location of the Potrero Road site being further away from the Salinas River compared to the CEMEX location. Very little change in infiltration from streamflow occurs under post-Project conditions as illustrated in **Figure 22d.** The most variation between Project and baseline runs occurs in the Project variant runs, 8sn and 8srf, which include the delivery of GWR water to the CSIP area with corresponding decreases in groundwater pumping. The resultant decrease in groundwater pumping results in slightly less infiltration from the Salinas River.

The MPWSP located at Potrero Road does not influence the amount of diversions off the Salinas River under SVWP Phase I operations as shown in **Figures 20e, 21e, 23e, and 24e**. Under post-Project conditions (**Figure 22e**) in run 7sr, diversions are also unchanged.

The MPWSP operations result in very slight variations (less than one percent) in streamflow in the Salinas River entering Monterey Bay (**Figures 20f, 21f, 22f, 23f, and 24f**). These variations result in very small increases and decreases in Salinas River streamflow of less than one percent of the streamflow. The model runs with the most effect on Salinas River streamflow involve the Project variant runs, 8sn and 9srf, which include the delivery of GWR water to the CSIP area and with corresponding decreases in groundwater pumping. The resultant decrease in groundwater pumping results in slightly less infiltration from the Salinas River.

7.4 Sea Level Rise Sensitivity Analysis

A sensitivity analysis was conducted to assess the influence the magnitude of sea level rise would have on effects from Project operations at the CEMEX location. The sensitivity analysis, as described previously, compares existing sea levels to increases in sea level expected in 2047 and 2074 (the end of the simulation of Project impacts). These changes were input into the MPWSP run 3 and the results are illustrated in **Figures 25a through 25f**.

Sea level rise has the most influence on groundwater storage conditions, as represented by **Figure 25b,** in which increases in sea level as reflected by 2074 levels result in an increase in aquifer storage as compared to the 2047 sea levels used in all the MPWSP scenario runs. In contrast, existing sea levels, as represented by 2012 levels, result in a decline (negative values of aquifer storage when reviewing the difference hydrograph) in aquifer storage as compared to 2047 sea levels. The influence on aquifer storage that both 2012 and 2074 sea levels have as compared to 2047 sea levels is expected as increases in sea levels would likely result in seawater intrusion if groundwater conditions along the coastal areas of the Basin do not change. Changes in sea level rise do not effect Project ground water pumping or deep percolation as shown in **Figures 25a and 25c**.

The largest influence sea level has on surface water is on the infiltration of streamflow to groundwater as shown in **Figure 25d**. Higher groundwater levels resulting from higher sea levels (2074) result in slightly reduced streamflow infiltration, likely due to a decrease in the hydraulic gradient between surface water and groundwater. In contrast, the lower sea level as depicted by the 2012 levels result in a small increase in infiltration of about two percent relative to 2047 sea levels. There are very small changes to diversions or to streamflow, as shown in **Figures 25e and 25f**, resulting from variations in sea level.

Overall, there was little influence on groundwater and surface water conditions as a result of potential changes in sea level conditions.

8 CONCLUSIONS

Overall, the extended model calibration period provides a reasonable calibration of water levels in both the Pressure and East Side subareas, which is improved from the original model calibration done in 1997, with the most notable improvement occurring during the extended model calibration period between 1995 and 2011 and in the Pressure subarea. This is likely because of better documentation and availability of model input data, including groundwater pumping data, for more recent years and also because of improvements in the hydrogeologic conceptualization within the NMGWM area. Simulated and observed water levels throughout the Pressure subarea exhibit generally good agreement, especially for calibration wells in the 180-Foot Aquifer, although these wells are limited in number. Simulated water levels in the East Side subarea tend to be higher than observed levels during the calibration period, although the influences of climatic conditions on long and short-term water level fluctuations are captured in the East Side subarea. This likely indicates that the SVIGSM, as a regional model, does not capture all of the hydrogeologic complexities present within the East Side subarea. Nevertheless, the generally good calibration of the model in the Pressure subarea suggests that the output from the model are reasonable for the intended use through incorporation into the NMGWM.

Generally, the MPWSP was simulated by the SVIGSM to have very little influence on groundwater and surface water conditions when evaluating the influence the Project has in the Pressure and East Side subareas. The influence the Project has on groundwater storage and infiltration from the Salinas River at the CEMEX location is overestimated based on the SVIGSM model grid not corresponding to the Monterey Bay, thereby resulting in the MPWSP wells having a greater influence on groundwater storage and infiltration from the Salinas River than if the Project wells were able to be located more accurately at the coastline.

The CEMEX location appears to have a greater influence on Basin ground water and surface water conditions in the vicinity of the Salinas River as compared to the Potrero Road location. This is the result of the Potrero Road location being located further away from the Salinas River and the Project wells being located in the model in a more accurate location as compared to the CEMEX location.

Changes in sea levels from current (2012) to 2047 to 2074 did not have much influence on MPWSP effects on groundwater and surface water conditions. The changes of higher sea levels results in changes to aquifer storage and infiltration from the Salinas River of less than one percent which is well within modeling uncertainty.

9 REFERENCES

California Department of Water Resources, 2009, Standard Land Use Legend, February 2009, http://www.water.ca.gov/landwateruse/lusrvymain.cfm.

Timothy Durbin, Inc., 2007, Groundwater Flow and Transport Model, Seaside Groundwater Basin, Monterey, California, prepared for RBF Consulting, October 26, 2007.

ESA PWA, 2013, Monterey Peninsula Water Supply Project: Coastal Water Elevations and Sea Level Rise Scenarios, Memorandum, April 2, 2013.

Farmland Mapping and Monitoring Program, 2010, Monterey County 2010 Farmland Mapping and Monitoring Program GIS Data, http://www.conservation.ca.gov/dlrp/fmmp/Pages/Monterey.aspx.

Geoscience, 2015, Draft Modeling Report in preparation.

Monterey County Water Resources Agency, 2013, Monterey County Water Recycling Projects – Operations Update, Memorandum to Board of Directors, February 20, 2013.

Monterey County Water Resources Agency, 2014a, Annual Groundwater Summary Reports, http://www.mcwra.co.monterey.ca.us/.

Monterey County Water Resources Agency, 2014b, Fall 2011 Groundwater Elevation Contours, http://www.mcwra.co.monterey.ca.us/.

Monterey County Water Resources Agency, 2014c, Notice of Preparation of an Environmental Impact Report and Notice of Public Scoping Meeting, Salinas Valley Water Project, Phase II, June 25, 2014.

Montgomery Watson, 1997, Salinas Valley Integrated Ground Water and Surface Water Model Update, Final Report, May 1997.

National Marine Fisheries Service, 2007, Biological Opinion, Monterey County Water Resources Agency, Salinas Valley Water Project in Monterey County, California, June 21, 2007.

San Luis Obispo County, 2014, Nacimiento Water Project, General Project Background, http://www.slocounty.ca.gov/PW/NacWP/General_Project_Information.htm.

Seaside Groundwater Basin Watermaster, 2013, Annual Water Production Reports 2006-2012, http://www.seasidebasinwatermaster.org/Data.html.

WRIME, 2008, Groundwater Modeling Simulation of Impacts for Monterey Regional Water Supply Project, 20,000 AFY Desalination Pumping Scenario (Scenario 4d), Technical Memorandum, October 29, 2008.

TABLES

Table 1

SVIGSM Model Layering

Name of Hydrostratigraphic Unit	SVIGSM Layer*
Aquitard Layer	1a
180-Foot Aquifer	1
180/400 Aquitard	2a
400-Foot Aquifer	2
400/900 Aquitard	3a
900-Foot (Deep) Aquifer	3

* a = aquitard (vertical hydraulic conductivity and thickness are input)

Table 2

Summary of Data Sources for SVIGSM Model Calibration Update and Predictive Simulations

Data Type Description	Data Source(s)	Updated and/or Available Time Period (by water year)	Time Interval	Modeling Use (Calibration/ Predictive)	Notes
Land Use Conditions	MCWRA, ESA	1995-2011; 1997, 2012, 2060	Snapshots in time; annual data interpolated from snapshots	Calibration and Predictive	2011/2012 land use data generated using aerial photograph interpretation (NAIP, 2012) from 1997 land use data provided by MCWRA with a focus on the Pressure and East Side model subareas; additional revisions to urban outlines were performed throughout the model area; annual land use conditions for 1995-2011 linearly interpolated between 1994 (from original SVIGSM calibration) and 2011; 2060 land use data developed based on analysis of county and city General Plans indicating future land use and zoning
Precipitation	DWR, NOAA, WRCC	1995-2011	Daily	Calibration and Predictive	Available data obtained for stations in the SVIGSM; data gaps filled based on relationships with other stations
Evapotranspiration (ET)	CIMIS, MCWRA	1984-2011	Monthly	Calibration and Predictive	Available data obtained for stations in the SVIGSM; data gaps filled based on relationships with other stations; data for calibration years predating any available data filled using averages
Streamflow, Reservoir Releases	USGS, MCWRA	1995-2011	Daily	Calibration and Predictive	Available data obtained for stations in the SVIGSM; data gaps filled based on relationships with other stations
Groundwater Pumping	MCWRA	1995-2011	Monthly/Annually	Calibration	Monthly total metered groundwater pumping data provided by MCWRA for each SVIGSM subarea; additional data used from MCWRA annual Ground Water Summary Reports (GEMS reports)
Surface Water Diversions and CSIP Recycled Water Deliveries	MCWRA, RMC	1995-2011	Monthly	Calibration and Predictive	Available data from MCWRA for Salinas River Diversion Facility surface water diversions and CSIP recycled water deliveries used for calibration and as basis for estimating future diversions and deliveries; other SVIGSM surface water diversions based on data previously used in the model
Salinas Valley Water Project Streamflow Prescriptions	RMC	1949-2004	Daily	Predictive	Minimum flow triggers based on data from previous SVIGSM scenarios provided by RMC
Reservoir Operating Rule Curve and Elevation-Capacity Curve	MCWRA	1995-2011	Not Applicable	Predictive	Input data developed based on data and operational practices provided and indicated by MCWRA
Groundwater Levels	MCWRA	1995-2011	Variable	Calibration	Available groundwater level data for wells used in previous SVIGSM calibration used for calibration update

Acronyms: DWR = California Department of Water Resources, NOAA = National Oceanic and Atmospheric Administration, WRCC = Western Regional Climate Center, CIMIS = DWR California Irrigation Management System, MCWRA = Monterey County Water Resources Agency, RMC = RMC Water and Environment, ESA = Environmental Science Associates

Table 3
Comparison of Data for Land Use Conditions Used in SVIGSM

Land Use Condition	SVIGSM Subarea	Land Use Type										
		Urban*	Native Vegetation	Riparian Vegetation	Truck Crop	Field Crop	Vineyard	Irrigated Pasture	Orchard	Grain	Sugar Beets	Agriculture, Unknown (Mod Ag Demand)**
1994 Land Use (original SVIGSM calibration data)	Ft Ord/Toro	6,390	28,800	0	10	0	0	10	0	0	0	
	Pressure	13,350	20,520	3,940	50,980	880	740	360	30	0	0	
	East Side	11,720	26,010	0	30,420	2,740	3,120	470	30	0	0	
	Forebay	3,870	20,960	5,270	36,450	3,110	14,800	1,650	610	0	0	
	Upper Valley	3,880	36,200	7,250	26,010	530	16,060	2,010	410	0	0	
	TOTAL	**39,200**	**132,470**	**16,450**	**143,850**	**7,250**	**34,710**	**4,480**	**1,070**	**0**	**0**	
2012 Land Use	Ft Ord/Toro	6,780	28,410	0	10	0	0	0	0	0	0	
	Pressure	16,020	16,030	3,770	54,420	100	150	250	20	60	0	
	East Side	13,990	20,740	20	35,490	490	2,750	600	160	290	0	
	Forebay	5,100	18,580	5,270	35,730	1,680	16,280	1,090	490	950	1,600	
	Upper Valley	4,220	32,560	7,240	25,300	320	17,270	2,100	460	2,730	150	
	TOTAL	**46,090**	**116,310**	**16,270**	**150,920**	**2,570**	**36,440**	**4,020**	**1,110**	**4,010**	**1,740**	
2060 Land Use	Ft Ord/Toro	17,940	17,260	0	10	0	0	0	0	0	0	0
	Pressure	26,770	7,790	3,660	51,800	100	220	40	20	60	0	360
	East Side	34,140	9,610	20	27,390	450	2,140	320	150	40	0	270
	Forebay	7,720	14,080	4,960	34,390	1,620	16,260	930	480	870	1,460	3,960
	Upper Valley	7,700	24,470	6,670	24,250	320	17,100	2,080	460	2,710	150	6,460
	TOTAL	**94,250**	**73,230**	**15,290**	**137,740**	**2,480**	**35,740**	**3,350**	**1,090**	**3,660**	**1,610**	**11,040**
Change 1994 to 2012	Ft Ord/Toro	400	-390	0	10	0	0	0	0	0	0	
	Pressure	2,670	-4,480	-170	3,440	-780	-590	-110	-10	60	0	
	East Side	2,270	-5,260	20	5,070	-2,240	-360	140	130	290	0	
	Forebay	1,230	-2,370	0	-720	-1,430	1,480	-560	-120	950	1,600	
	Upper Valley	340	-3,630	-10	-700	-210	1,220	90	50	2,730	150	
	TOTAL	**6,900**	**-16,160**	**-170**	**7,070**	**-4,670**	**1,740**	**-460**	**40**	**4,010**	**1,740**	
Change 2012 to 2060	Ft Ord/Toro	11,160	-11,150	0	10	0	0	0	0	0	0	0
	Pressure	10,760	-8,240	-100	-2,610	0	70	-200	10	0	0	360
	East Side	20,160	-11,120	0	-8,090	-30	-610	-280	-10	-250	0	270
	Forebay	2,630	-4,500	-300	-1,330	-50	-10	-160	0	-70	-130	3,960
	Upper Valley	3,480	-8,090	-560	-1,050	0	-170	-20	0	-20	0	6,460
	TOTAL	**48,160**	**-43,070**	**-980**	**-13,180**	**-80**	**-700**	**-670**	**-10**	**-340**	**-120**	**11,040**

*For urban water demand calculations, a variable per acre water demand was used based on location and urban classification; different water demands were used for urban and suburban areas.

**For agricultural water demand, a moderate water demand crop was used to calculate water demand for areas of future unknown agricultural land use designation.

Note: All acreage numbers are rounded for presentation purposes.

Table 4
Description of SVIGSM Runs

Project Site	SVIGSM Run		Simulated Hydrology Period[1]	Land Use Condition	Sea Level Rise Condition	Monterey Peninsula Water Supply Project Scenario Descriptions: CEMEX Site: Total from Dune Sand & 180-Foot Equivalent Aquifer	Monterey Peninsula Water Supply Project Scenario Descriptions: Potrero Road Site: Total from Dune Sand Aquifer	Monterey Peninsula Water Supply Project Scenario Descriptions: Modeled Project Pumping in SVIGSM Layer 1 (180-Ft Aquifer)[4]	Salinas Valley Water Project	Ground Water Replenishment (GWR) Project (CSIP Delivery)	MCWD[3] Desalination Project (pumping assumed from 180-Ft Aquifer)
				Year	Year	MGD[3]		MGD[3]			MGD[3]
No Project	1	Baseline (No Project)	63 year future	2012	2047				Phase I		3.8/1.5*
	2f	Cumulative Baseline (No Project)	63 year future	2060	2047				Phase I		3.8/1.5*
	2af	Cum BL w/SVWP II (No Project)	63 year future		2047				Phase I & II		3.8/1.5*
CEMEX Site	3	Project 2012 (Dune Sand & 180 equiv[2])	63 year future	2012	2047	24.1/9.5*		17.4	Phase I		3.8/1.5*
	4	Project 2060 (Dune Sand & 180 equiv[2])	63 year future	2060	2047	24.1/9.5*		17.4	Phase I		3.8/1.5*
	4a	Project 2060 (Dune Sand & 180 equiv[2] w/SVWP II)	63 year future		2047	24.1/9.5*		17.4	Phase I & II		3.8/1.5*
	4rf	Post-Project (Dune Sand & 180 equiv[2])	63 year future		2047	0/0		0	Phase I		3.8/1.5*
	5n	Variant 2012 Land Use (Dune Sand & 180-FTE)	63 year future	2012	2047	15.5/6.1*		11.1	Phase I	Yes	0/0
	5	Variant Project 2012 (Dune Sand & 180 equiv[2])	63 year future	2012	2047	15.5/6.1*		11.1	Phase I	Yes	3.8/1.5*
	5f	Variant Project 2060 (Dune Sand & 180 equiv[2])	63 year future	2060	2047	15.5/6.1*		11.1	Phase I	Yes	3.8/1.5*
Potrero Road Site	6sn	Project 2012 (Dune Sand)	63 year future	2012	2047		24.1/9.5*	24.1	Phase I		0/0
	7sf	Project 2060 (Dune Sand)	63 year future	2060	2047		24.1/9.5*	24.1	Phase I		3.8/1.5*
	7srf	Post-Project (Dune Sand w/SVWP II)	63 year future		2047		0/0	0	Phase I		3.8/1.5*
	8sn	Variant Project 2012 (Dune Sand)	63 year future	2012	2047		15.5/6.1*	15.5	Phase I	Yes	0/0
	8sf	Variant Project 2012 (Dune Sand)	63 year future	2060	2047		15.5/6.1*	15.5	Phase I	Yes	3.8/1.5*
Sea Level Rise Sensitivity Analysis	3-2012 SLR	Run 3 with 2012 Sea Level Rise Condition	63 year future	2012	2012	24.1/9.5*		17.4	Phase I		3.8/1.5*
	3-2074 SLR	Run 3 with 2074 Seal Level Rise Condition	63 year future	2012	2074	24.1/9.5*		17.4	Phase I		3.8/1.5*

1. All simulations use a 63-year period of synthesized hydrology assembled from measured data during the historic period 1984-2004.
2. "180 equiv" denotes terrace deposits at CEMEX that are hydrostratigraphically equivalant to the 180-Foot Aquifer.
3. Abbreviations: MGD = million gallons per day; MCWD = Marina Coast Water District
4. Values represent estimated portion of pumping assigned to SVIGSM Layer 1 as indicated by Geoscience.
* Values represent the amount of feedwater supply and product water (feedwater supply/product water).

Table 5

Summary of Modeled Monthly Water Deliveries

Diversion/Delivery Description	Diversion Point Location	Delivery Location	Annual Volume (AF)	
			Average	Maximum
Clark Colony	Forebay	Forebay	6,000	7,500
Recycled Water	NA	Pressure and East Side SVWP[1] Phase I area	12,600	12,600
Salinas Valley Water Project Phase I Maximum Diversion[2] (Salinas River Diversion Facility)	Pressure	Pressure and East Side SVWP[1] Phase I area	9,400	14,400
Salinas Valley Water Project Phase II Maximum Diversion[2] (Castroville Canal Intake and East Side Canal Intake)	Forebay and Pressure	Throughout SVWP[1] Phase II delivery area	72,000	135,000
Groundwater Replenishment Project	NA	Pressure and Eastside SVWP Phase 1 and CSIP Area	4,300	4,300
Desalinated Project Water Returned to Basin				
Project 24.1 MGD (CEMEX and Potrero Road Sites)	NA	Pressure and East Side SVWP[1] Phase I area	880	880
Variant Project 15.5 MGD (CEMEX and Potrero Road Sites)	NA	Pressure and East Side SVWP[1] Phase I area	550	550

FIGURES

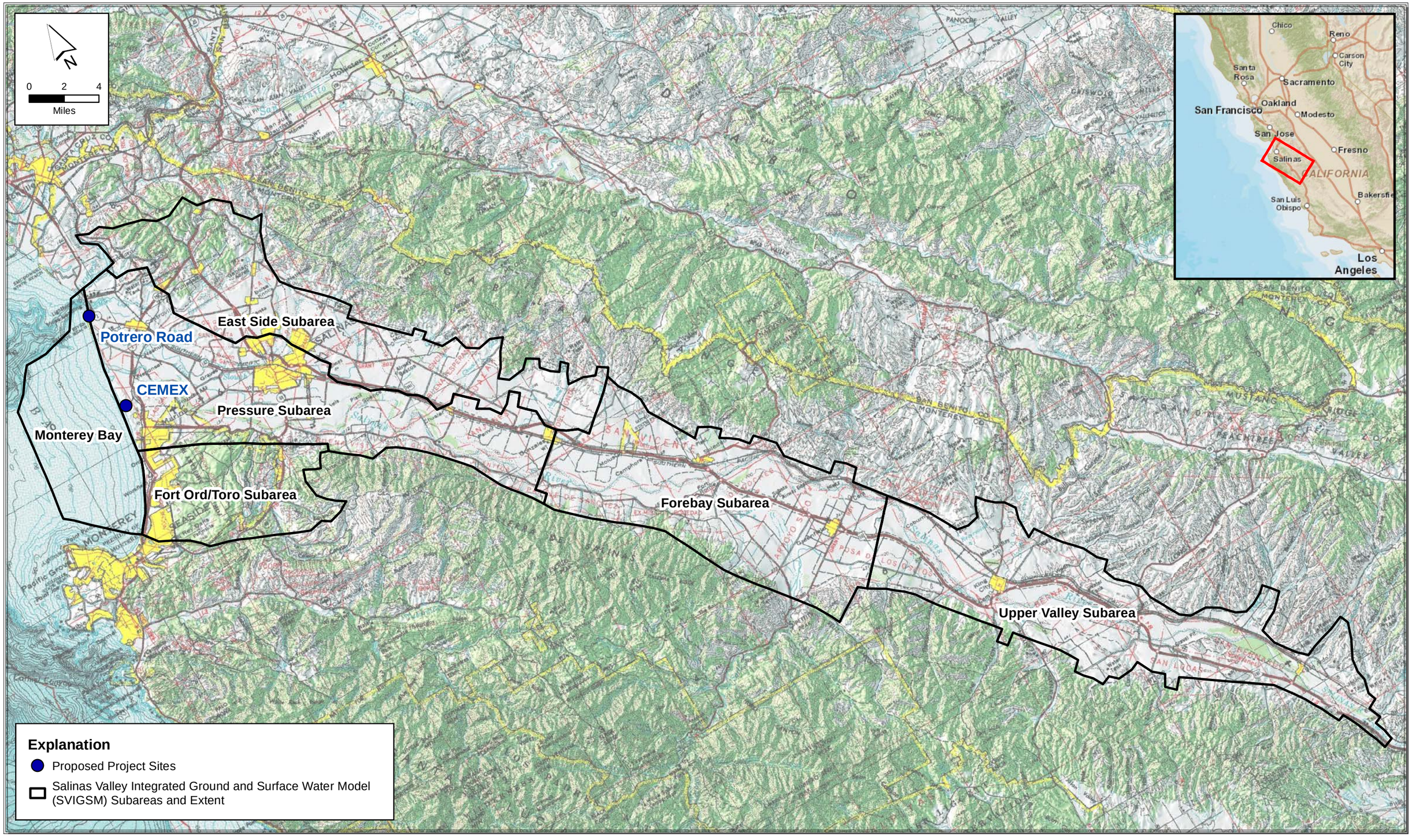

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Figure 1
SVIGSM and Project Sites Location Map
Monterey Peninsula Water Supply Project

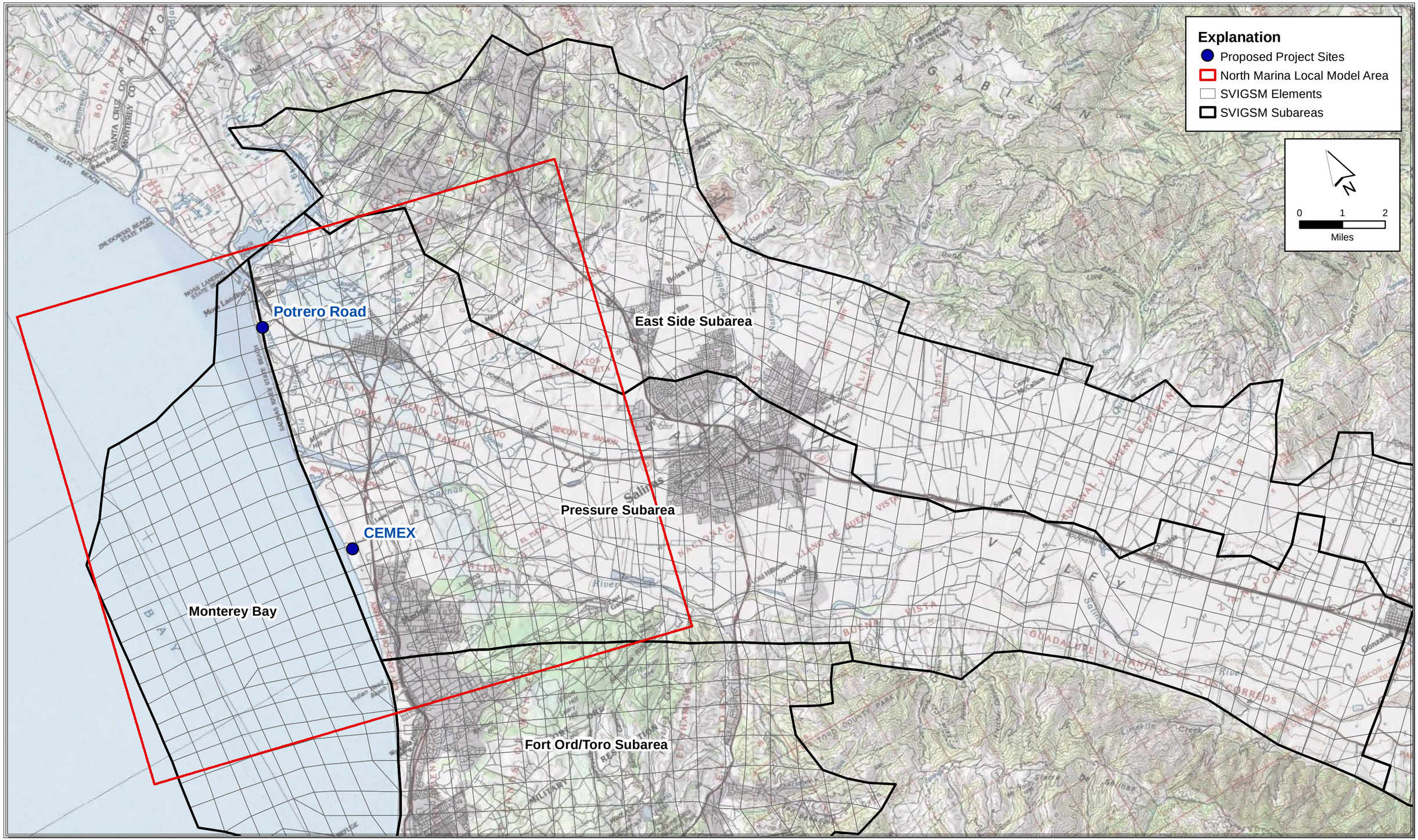

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Figure 2
Proposed Project Locations Relative to the SVIGSM and the North Marina Local Model
Monterey Peninsula Water Supply Project

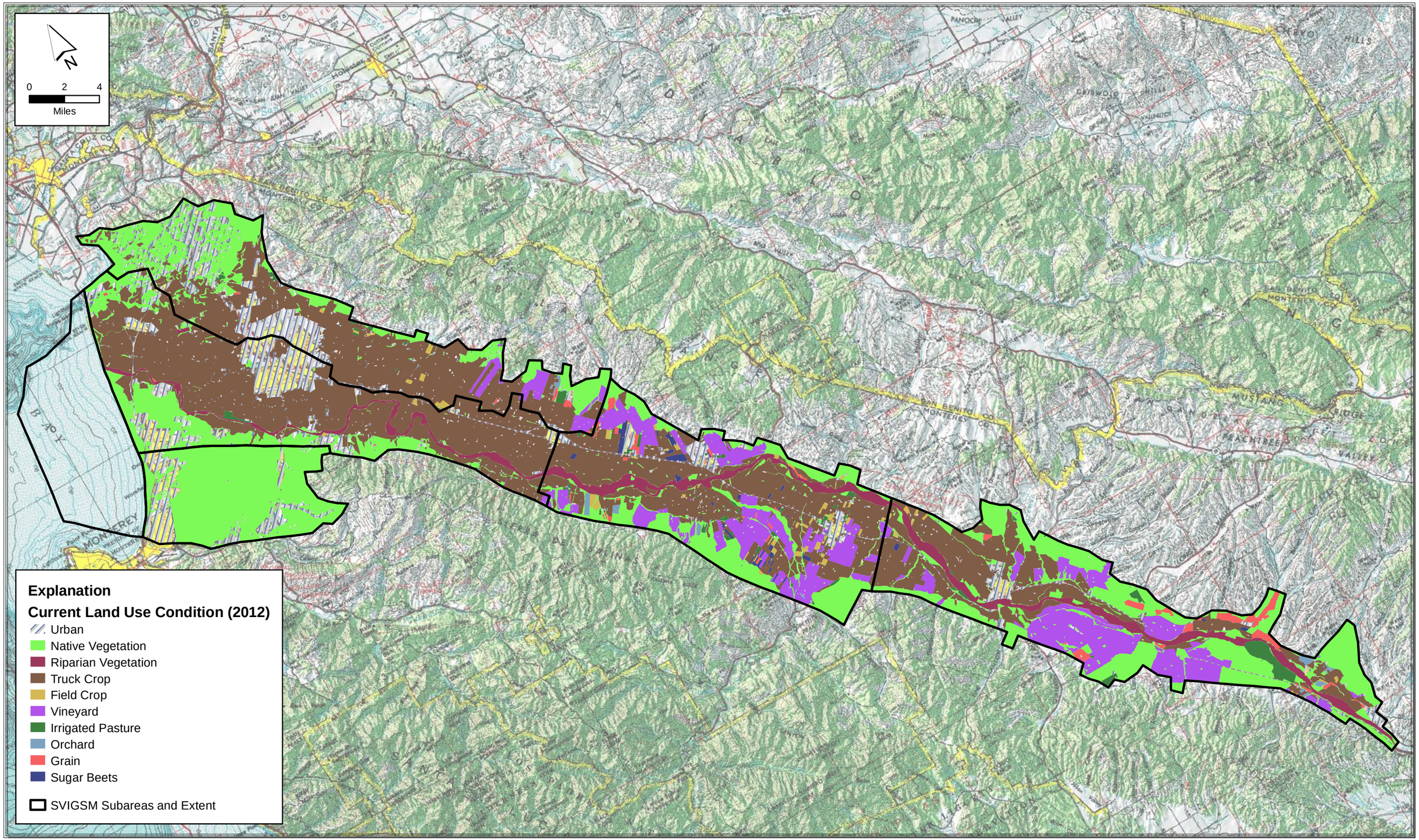

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Figure 3a
Modeled Current Land Use Condition (2012)
Monterey Peninsula Water Supply Project

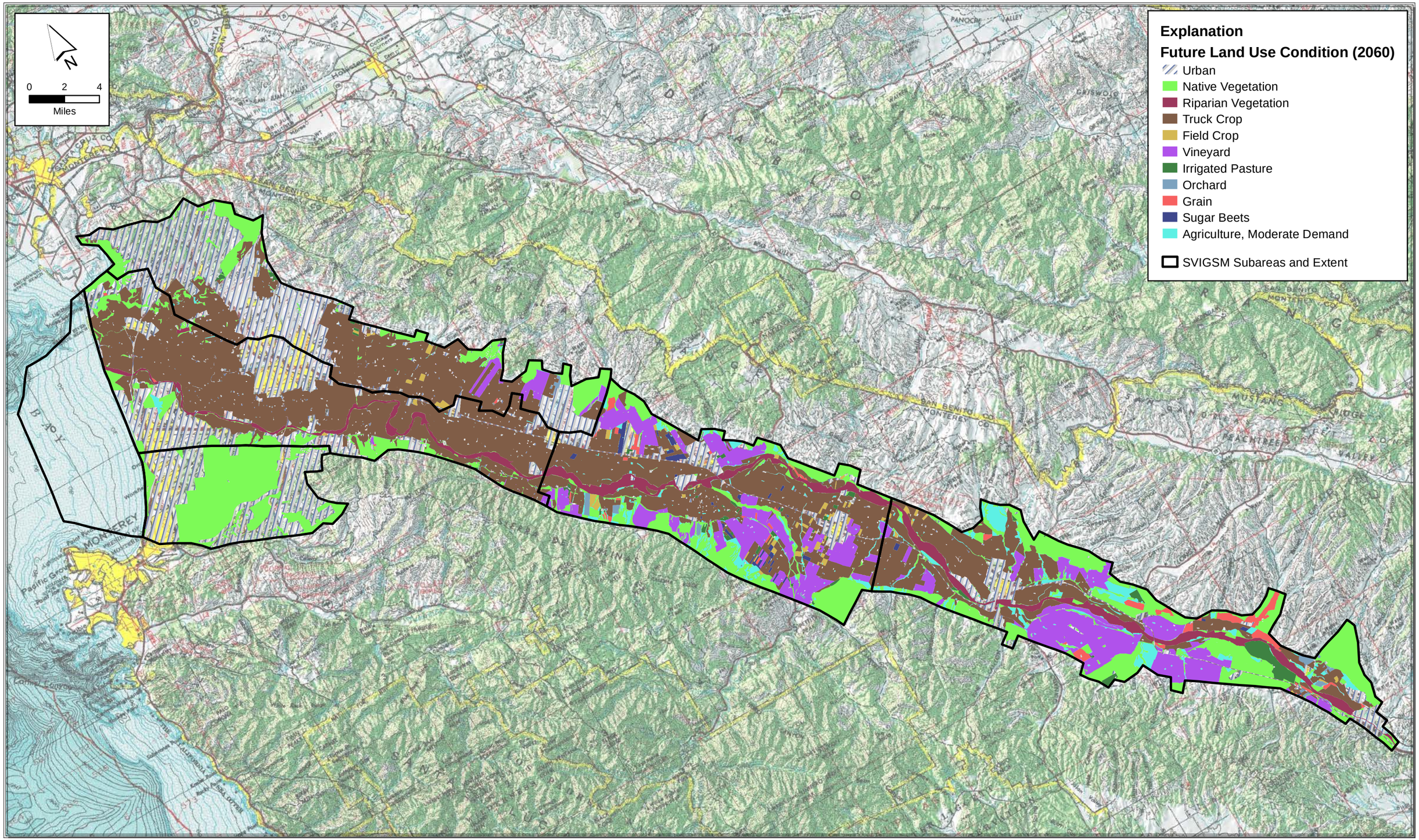

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Figure 3b
Modeled Future Land Use Condition (2060)
Monterey Peninsula Water Supply Project

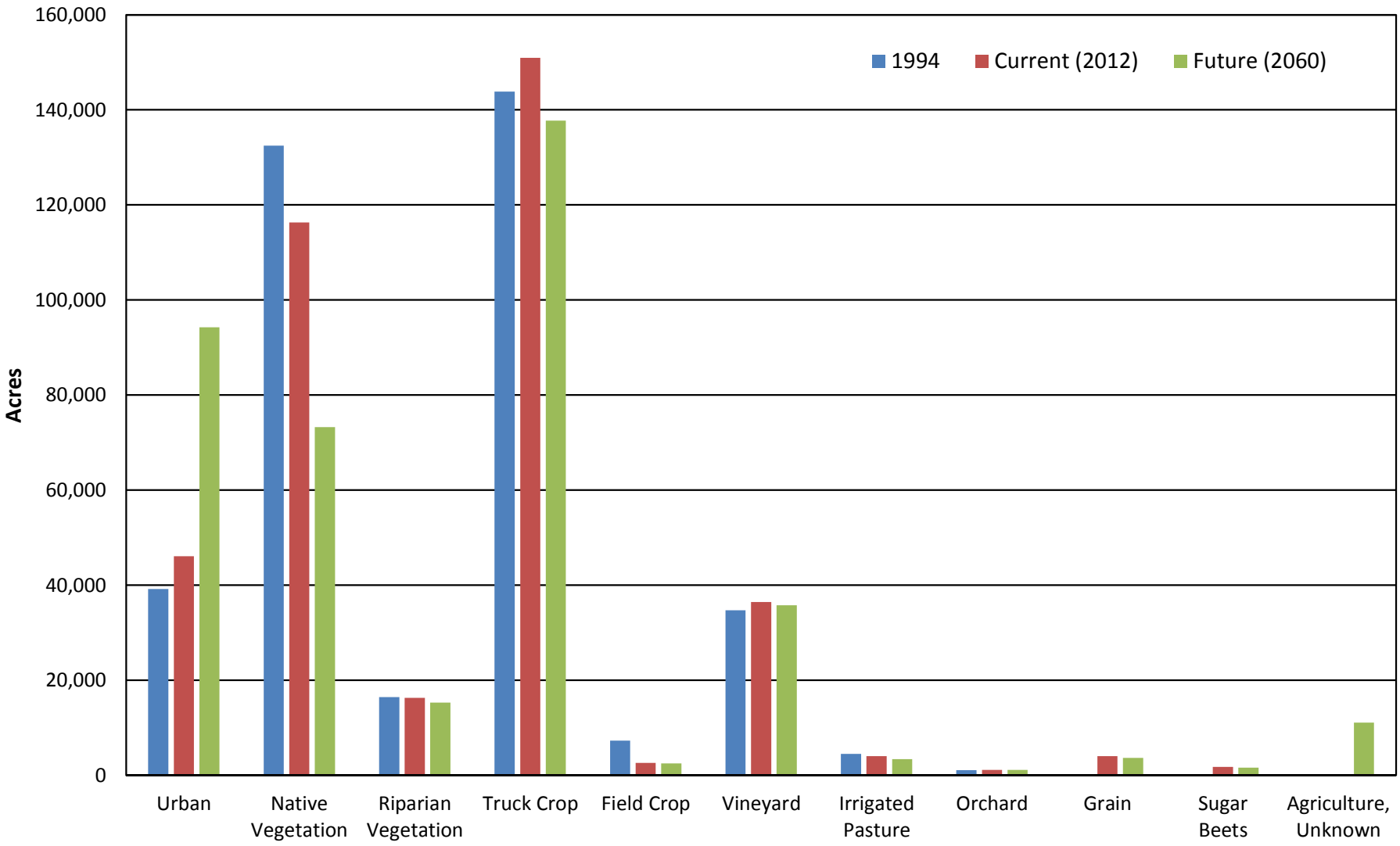

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Figure 4

Comparison of Modeled Land Use Conditions By Year

Monterey Peninsula Water Supply Project

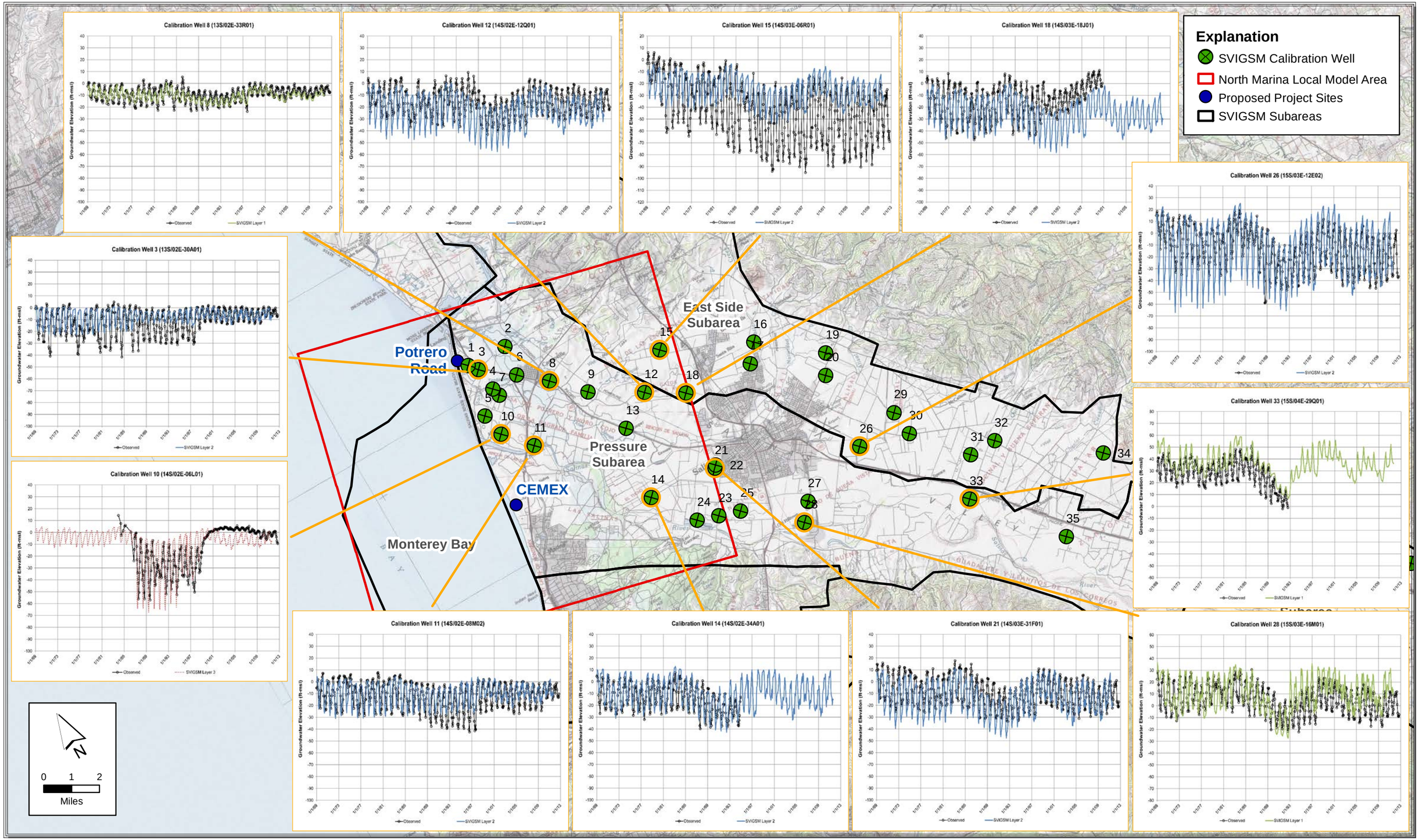

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Figure 5
SVIGSM Updated Calibration Hydrographs
Monterey Peninsula Water Supply Project

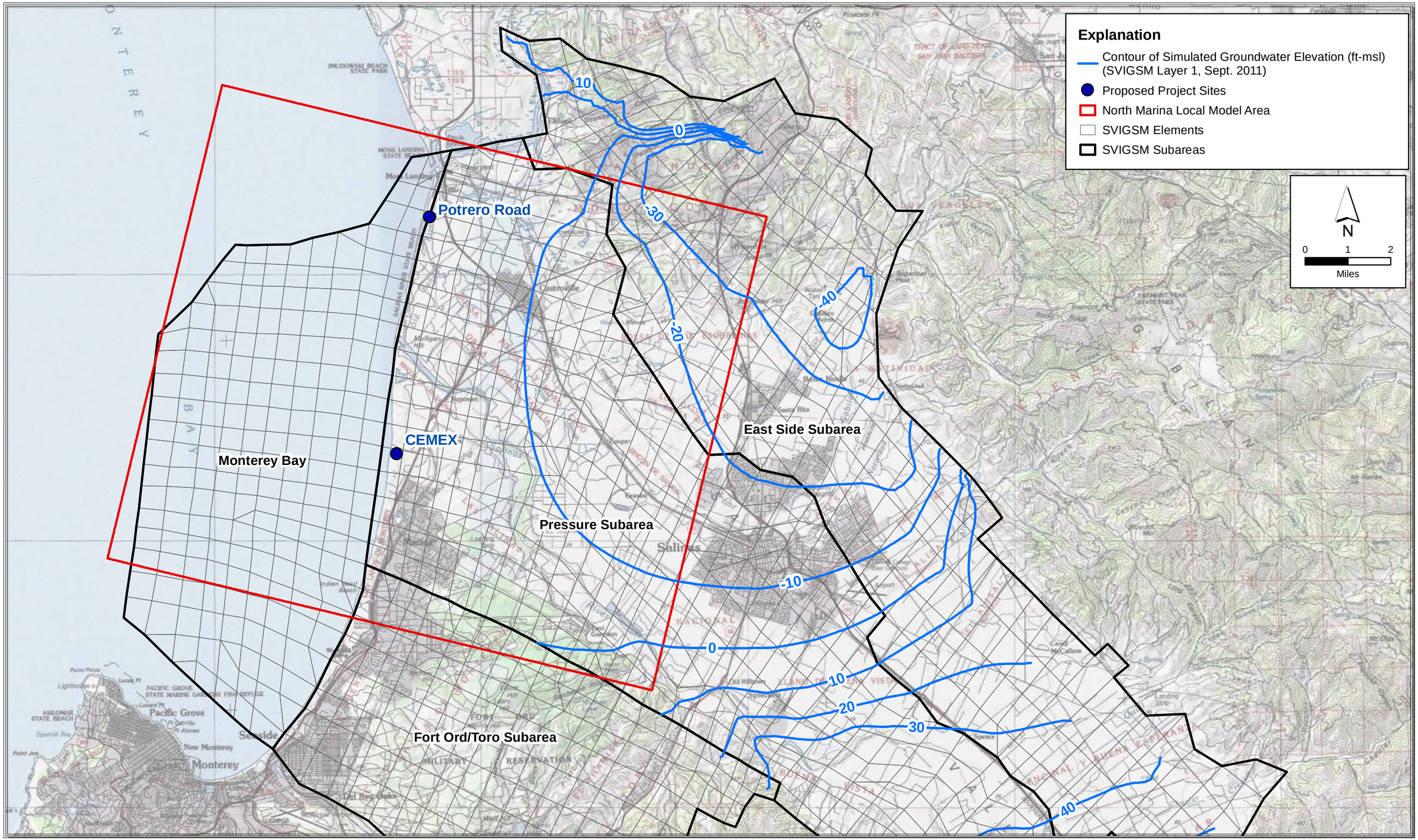

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Figure 6a
Contours of SVIGSM Layer 1 Simulated Groundwater Elevations from Updated Calibration: September 2011
Monterey Peninsula Water Supply Project

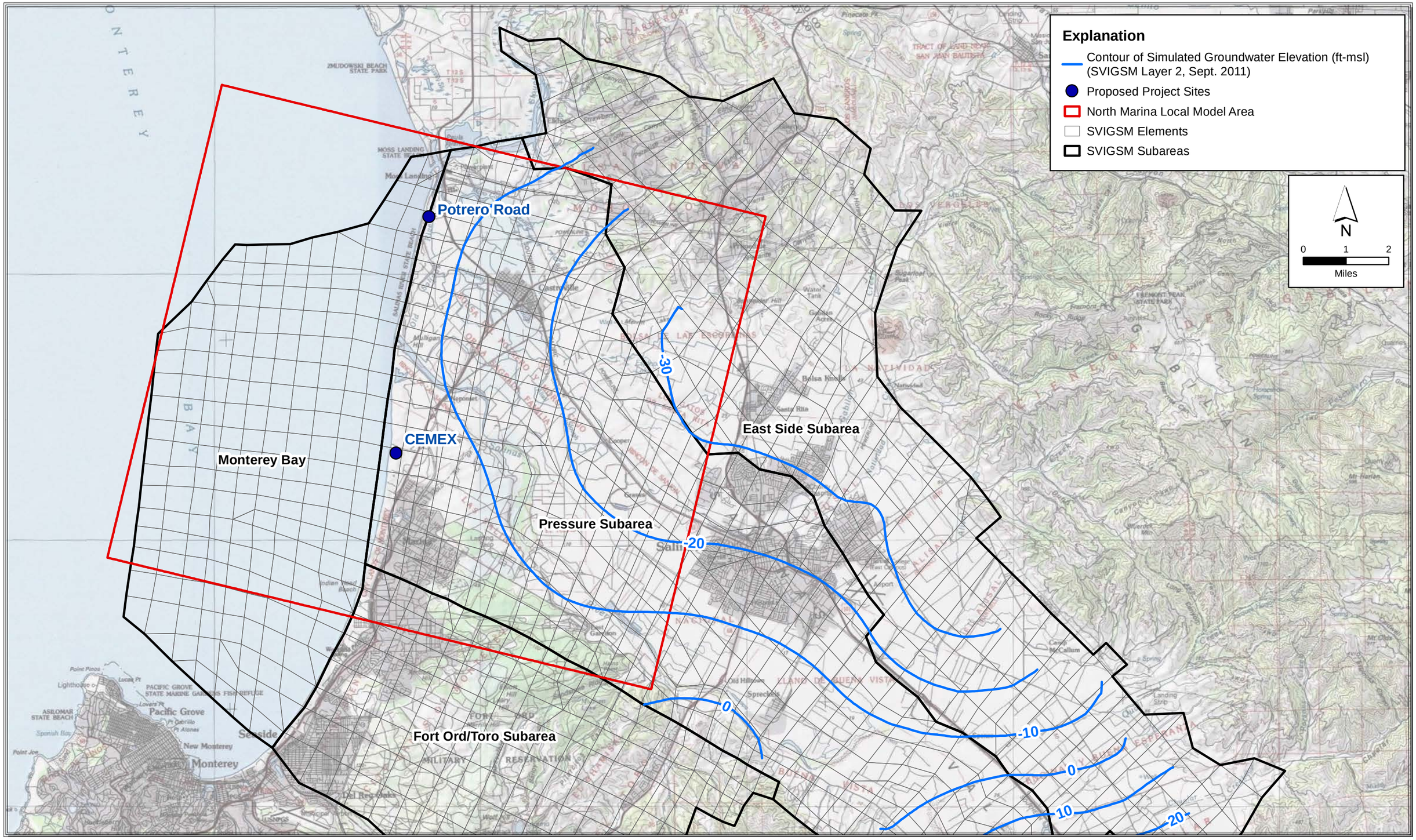

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Figure 6b
Contours of SVIGSM Layer 2 Simulated Groundwater Elevation from Updated Calibration: September 2011
Monterey Peninsula Water Supply Project

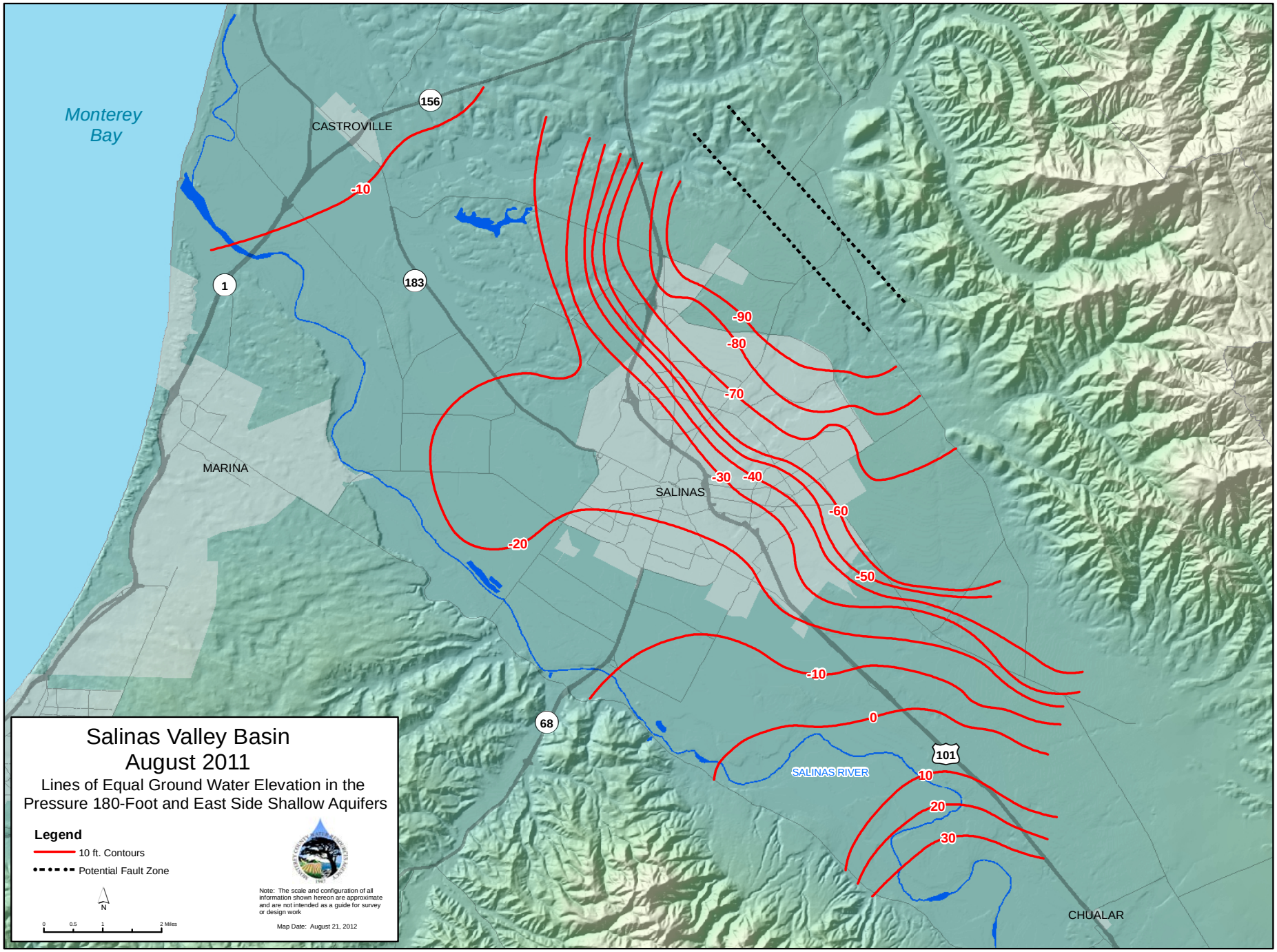

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Figure 7a

Shallow Zone Groundwater Elevation Contours Interpreted by MCWRA: August 2011

Monterey Peninsula Water Supply Project

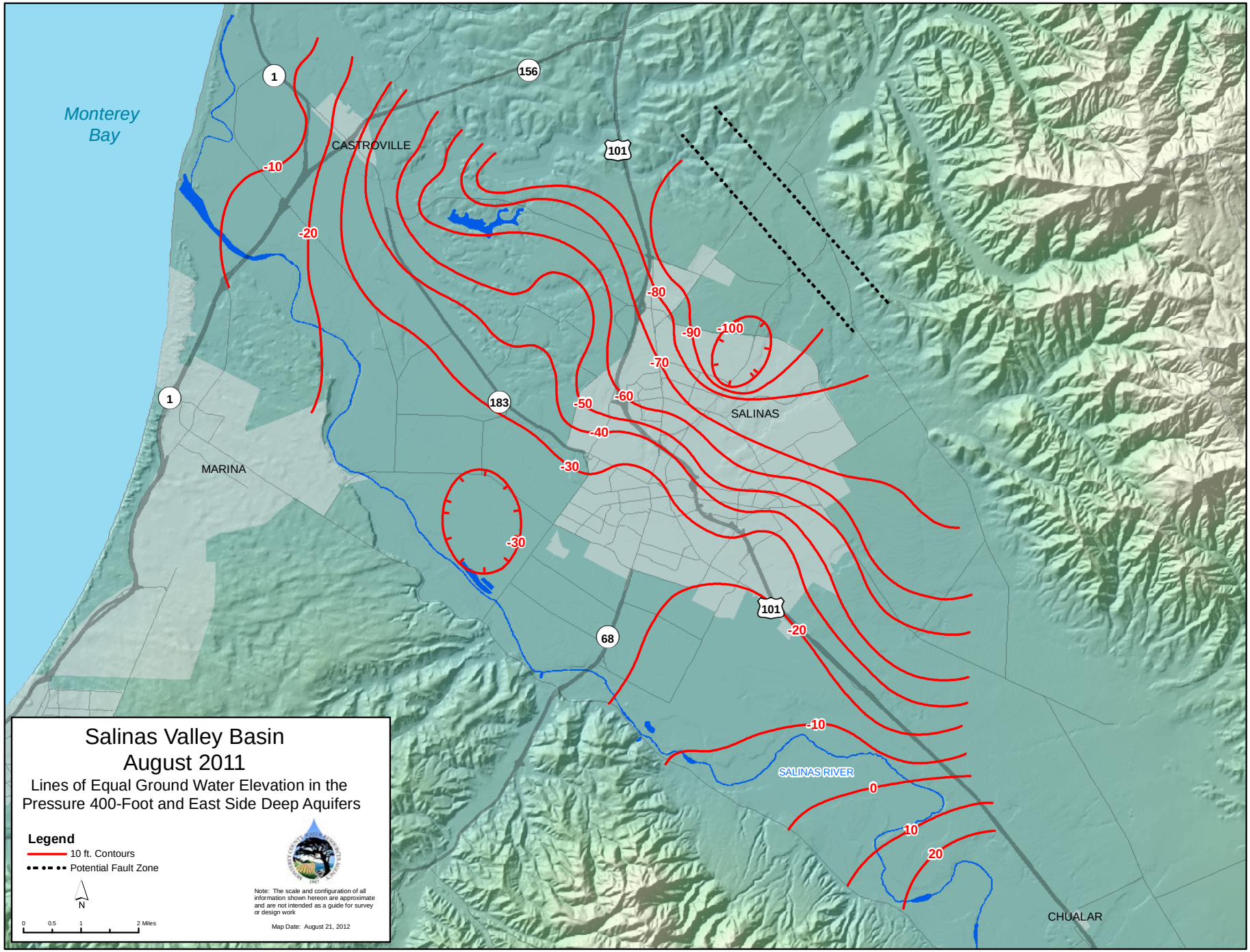

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Figure 7b

Deeper Zone Groundwater Elevation Contours Interpreted by MCWRA: August 2011

Monterey Peninsula Water Supply Project

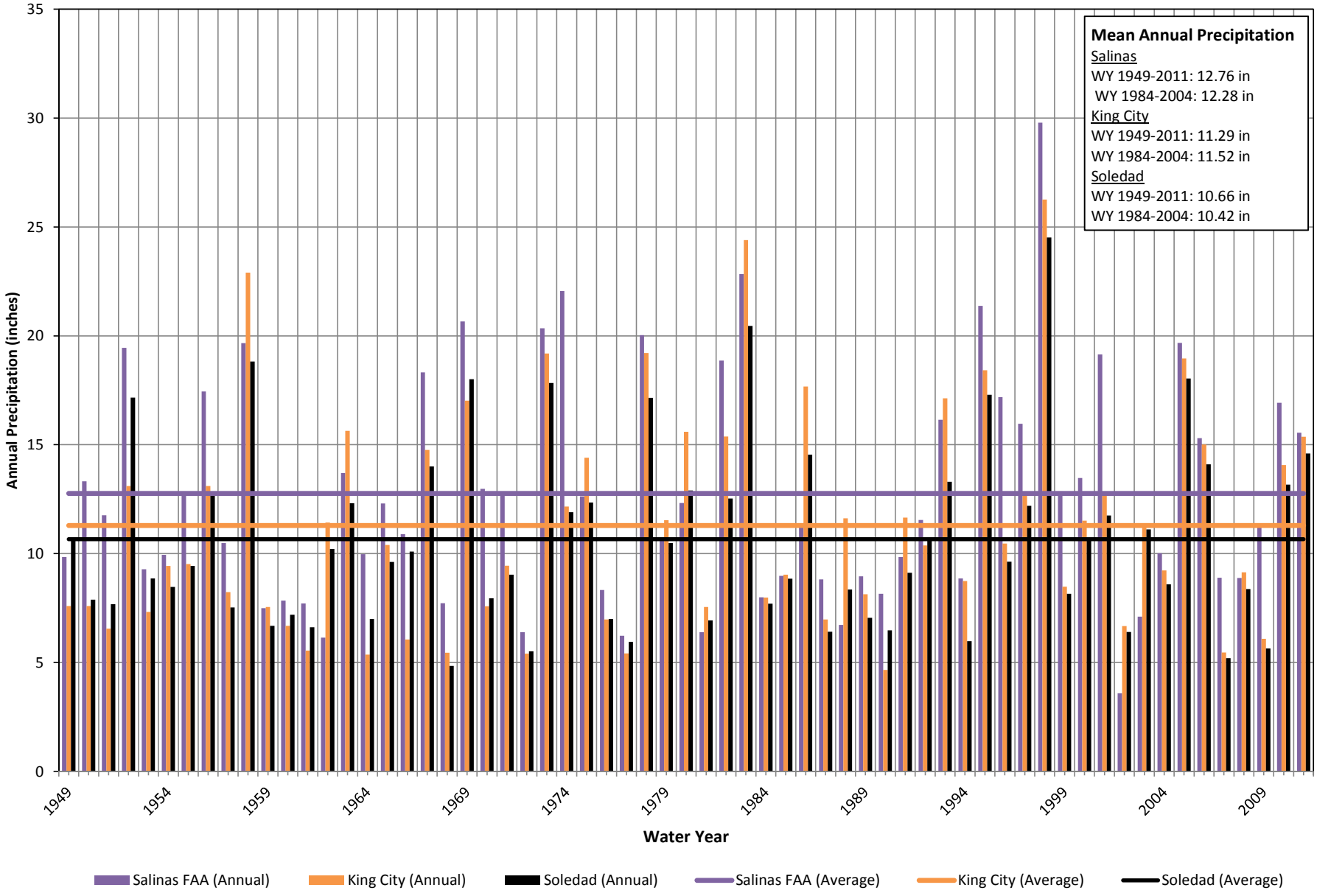

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Figure 8a
Historical Salinas Valley Precipitation
Annual Total: Water Years 1949-2011
Monterey Peninsula Water Supply Project

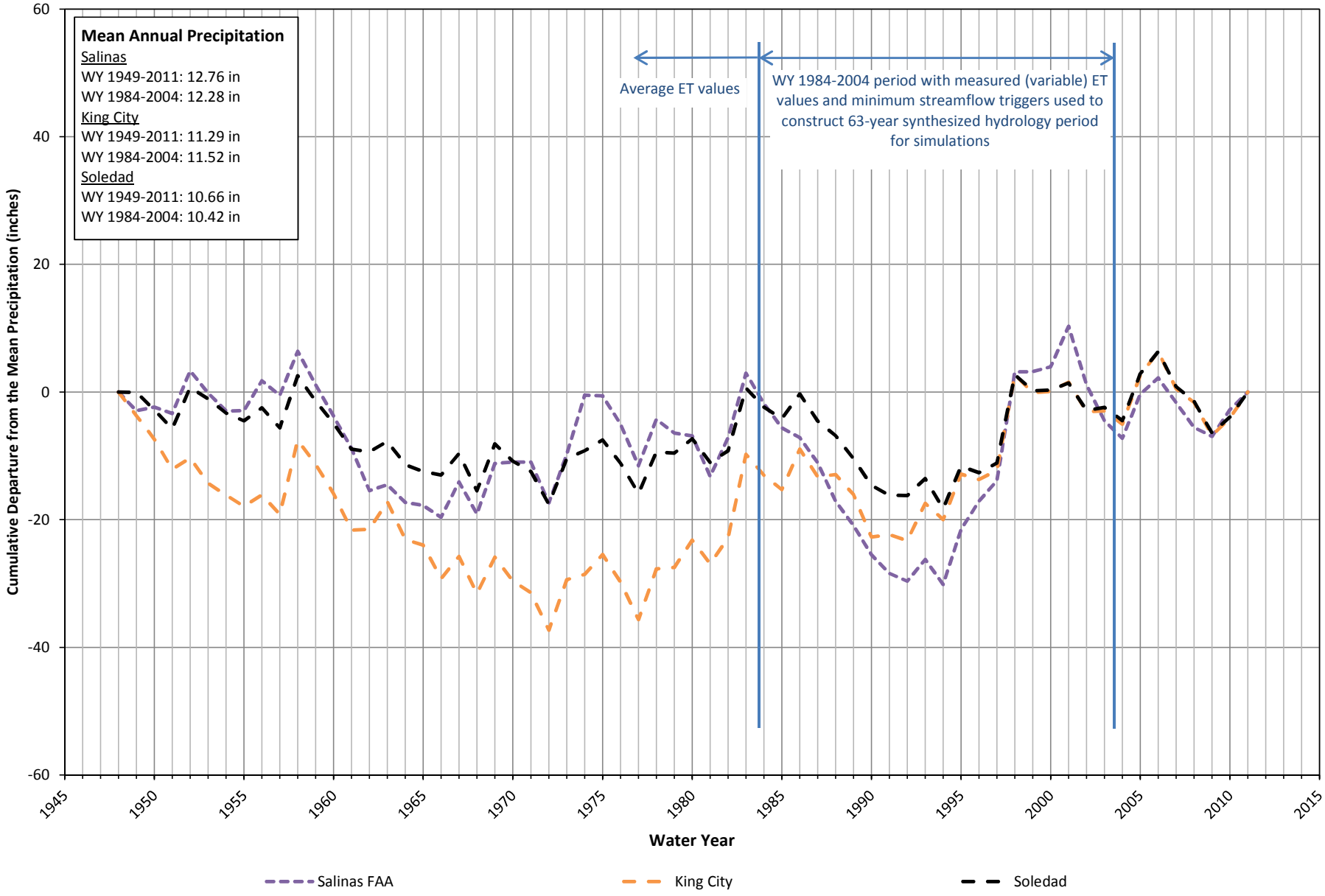

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Figure 8b
Historical Salinas Valley Precipitation
Cumulative Departure From the Mean
Monterey Peninsula Water Supply Project

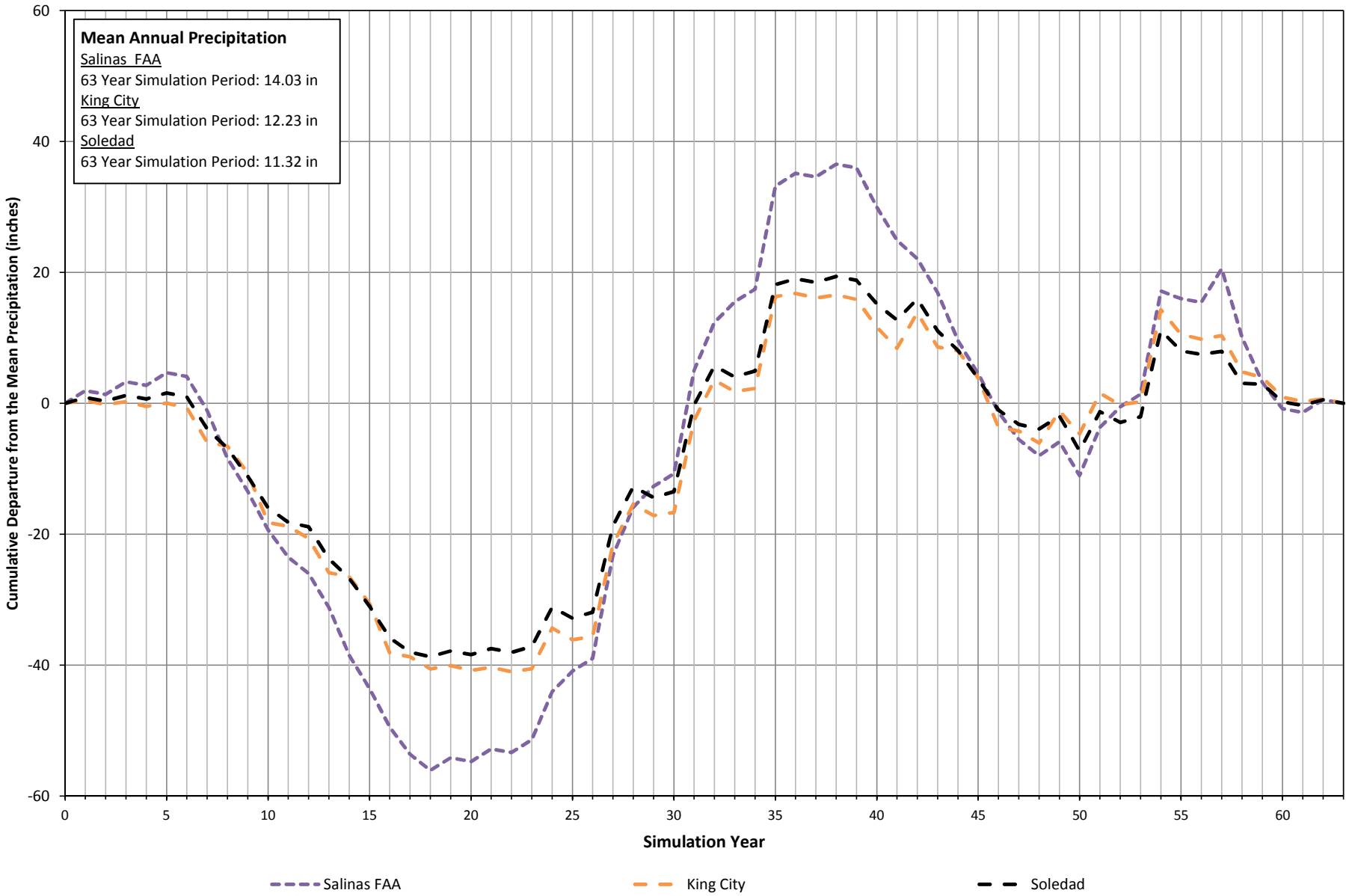

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Figure 8c
63 Year Synthesized Future Hydrology Period
Precipitation Cumulative Departure From the Mean
Monterey Peninsula Water Supply Project

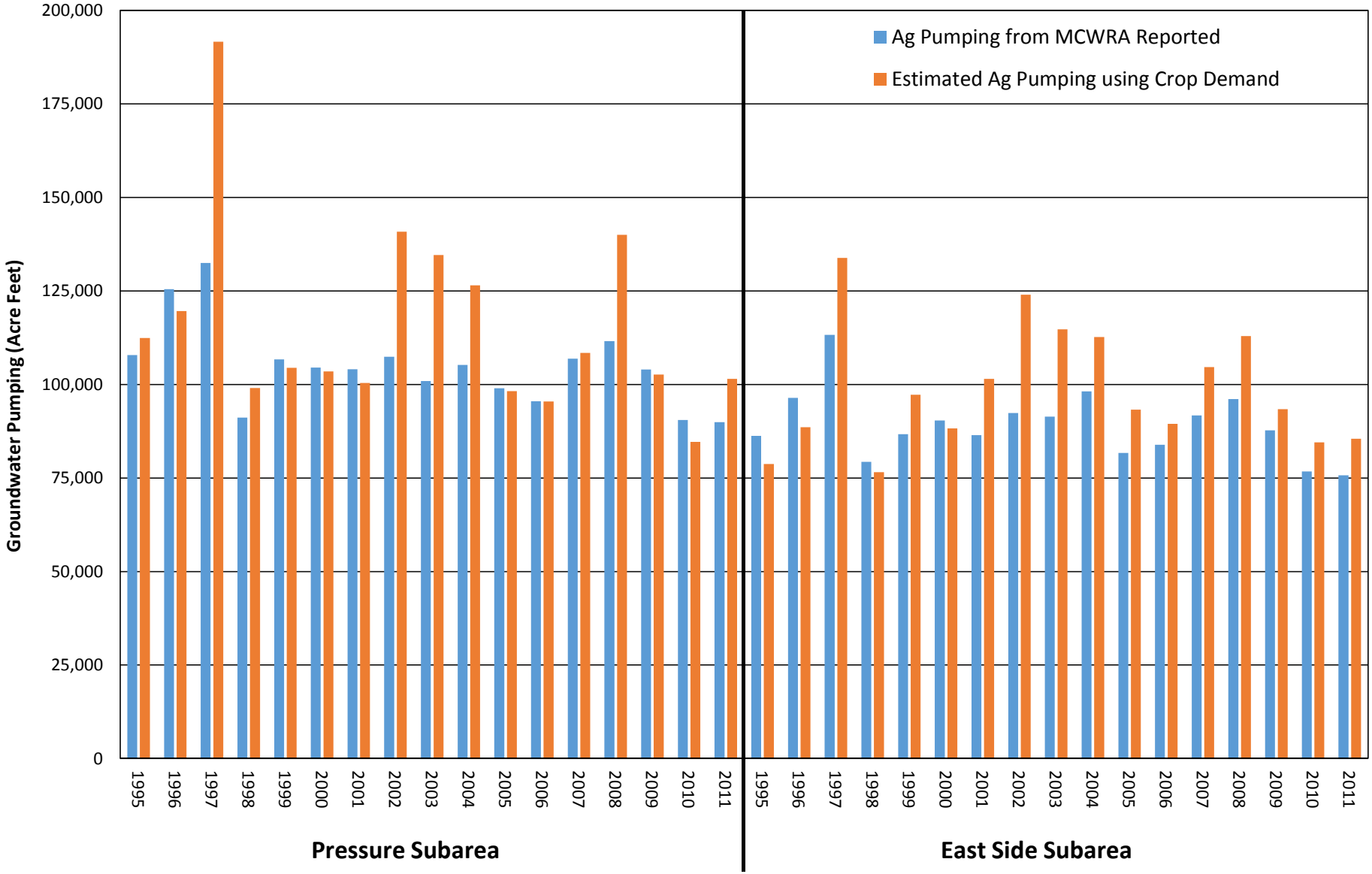

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Figure 9
Comparison of Agricultural Pumping Estimates for Calibration
MCWRA Reported vs. Estimated From Demand Calculations
Monterey Peninsula Water Supply Project

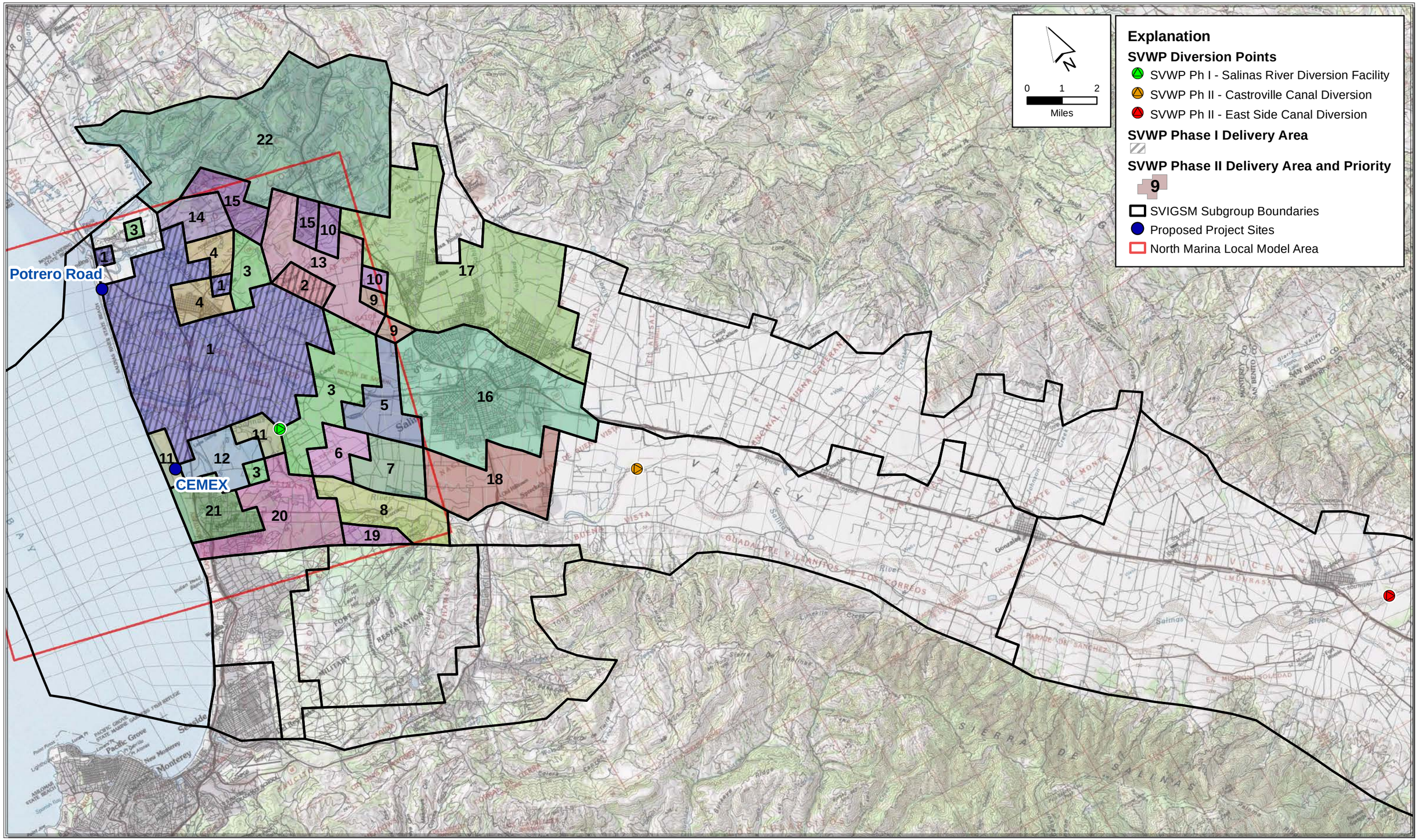

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Figure 10
Primary Salinas Valley Water Project Diversion and Delivery Locations
Monterey Peninsula Water Supply Project

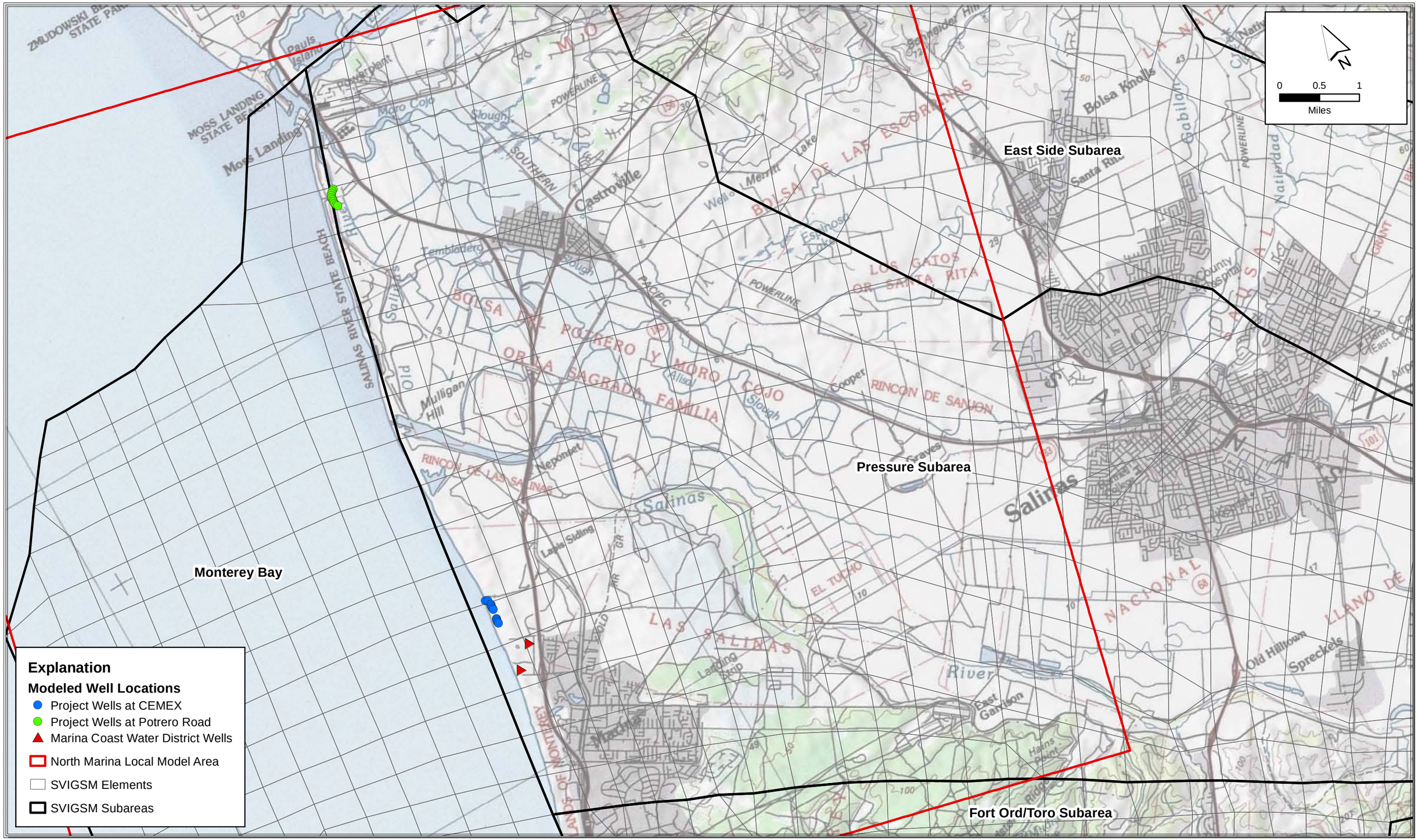

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Figure 11
Modeled Locations for Proposed Project Wells and Marina Coast Water District Wells
Monterey Peninsula Water Supply Project

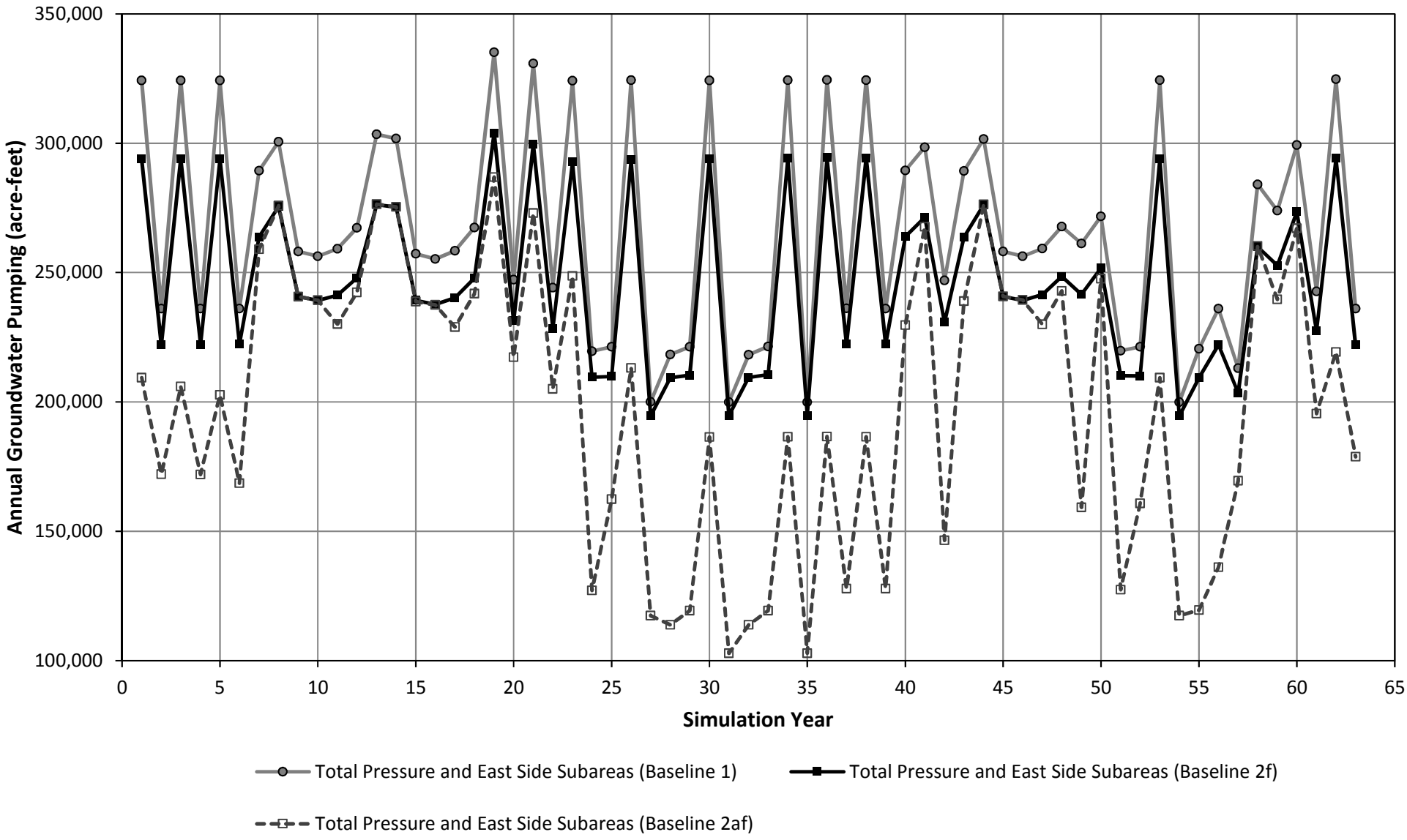

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Figure 12a
Simulated Annual Groundwater Pumping
Baseline Comparison
Monterey Peninsula Water Supply Project

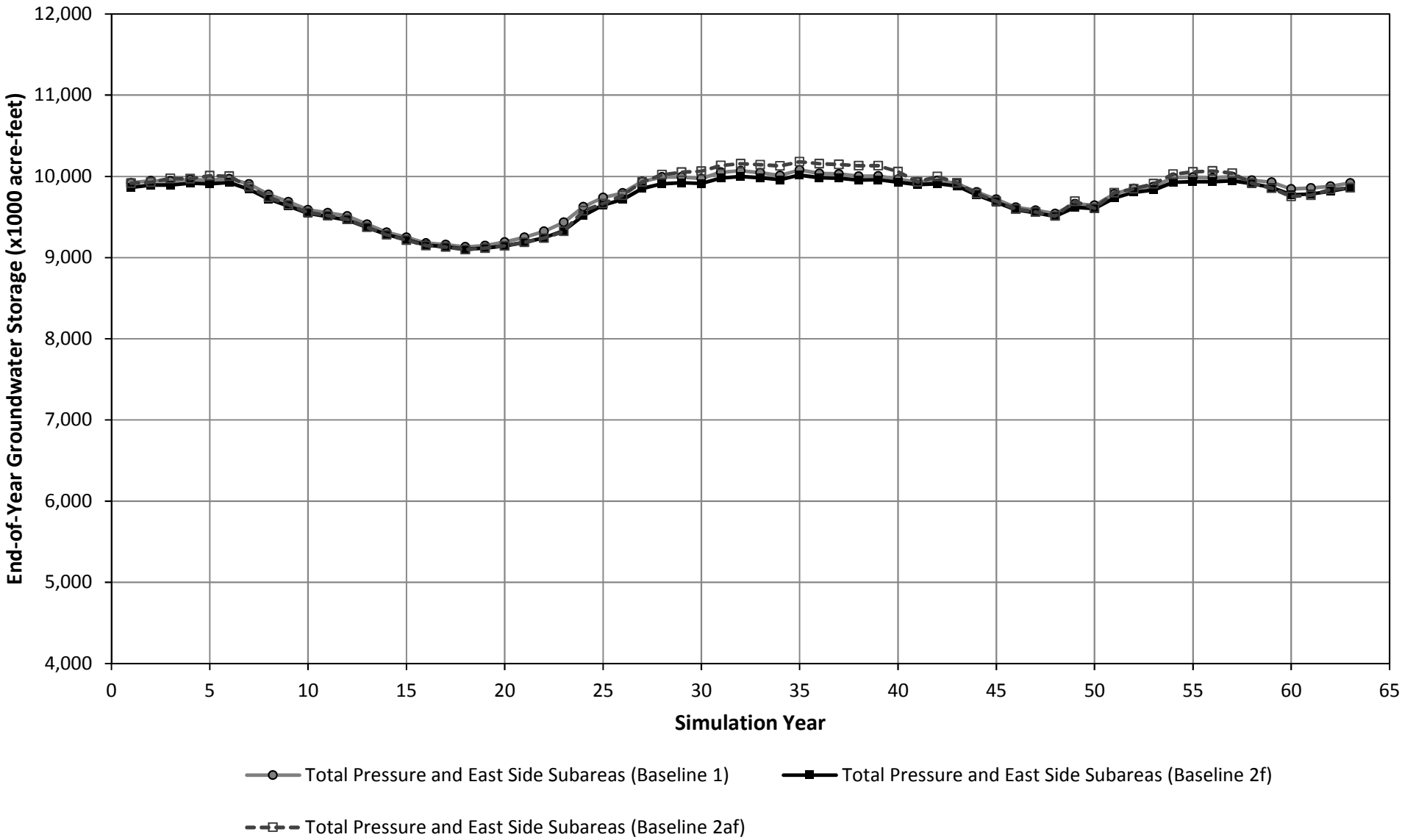

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Figure 12b
Simulated End-of-Year Groundwater Storage
Baseline Comparison
Monterey Peninsula Water Supply Project

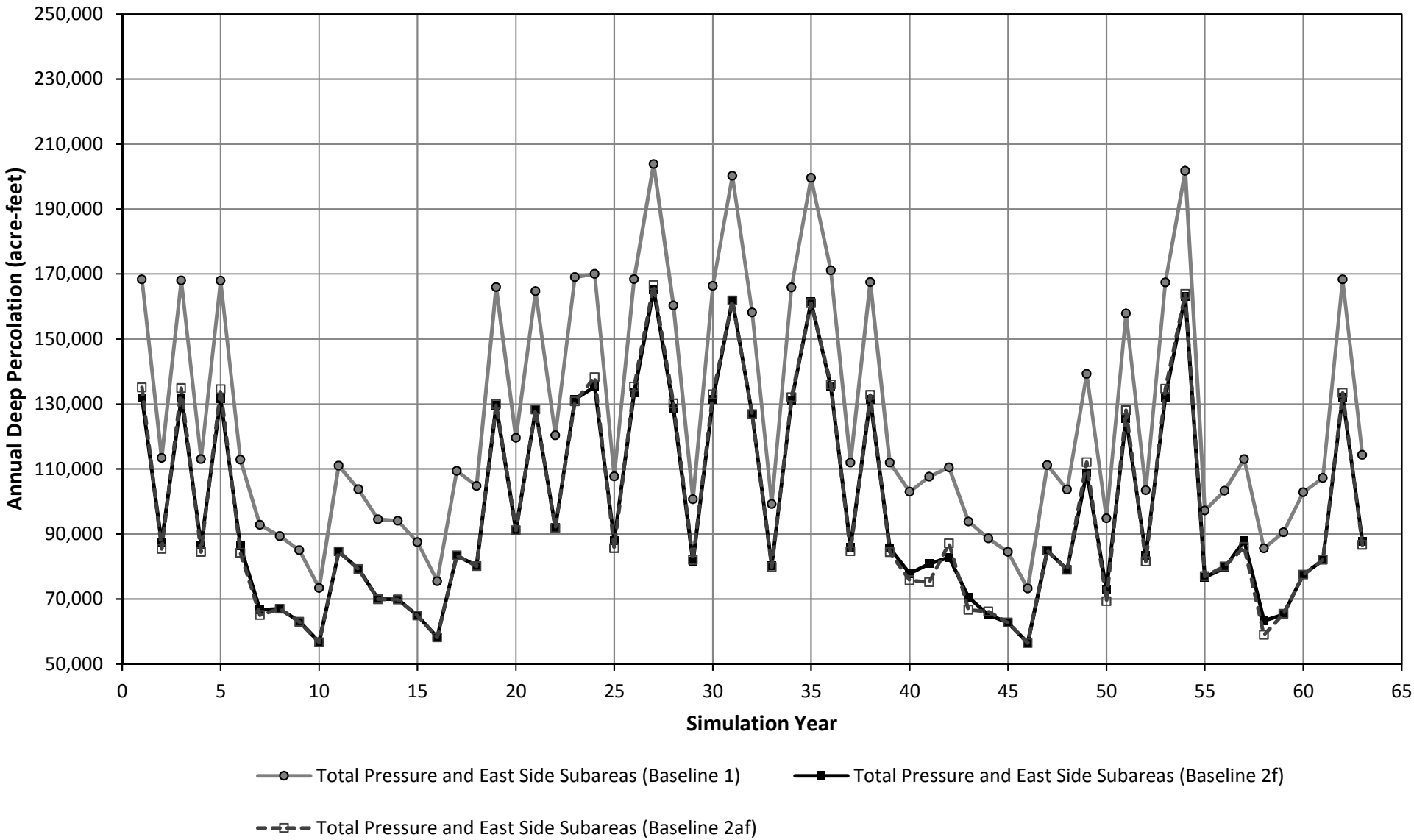

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Figure 12c
Simulated Annual Deep Percolation
Baseline Comparison
Monterey Peninsula Water Supply Project

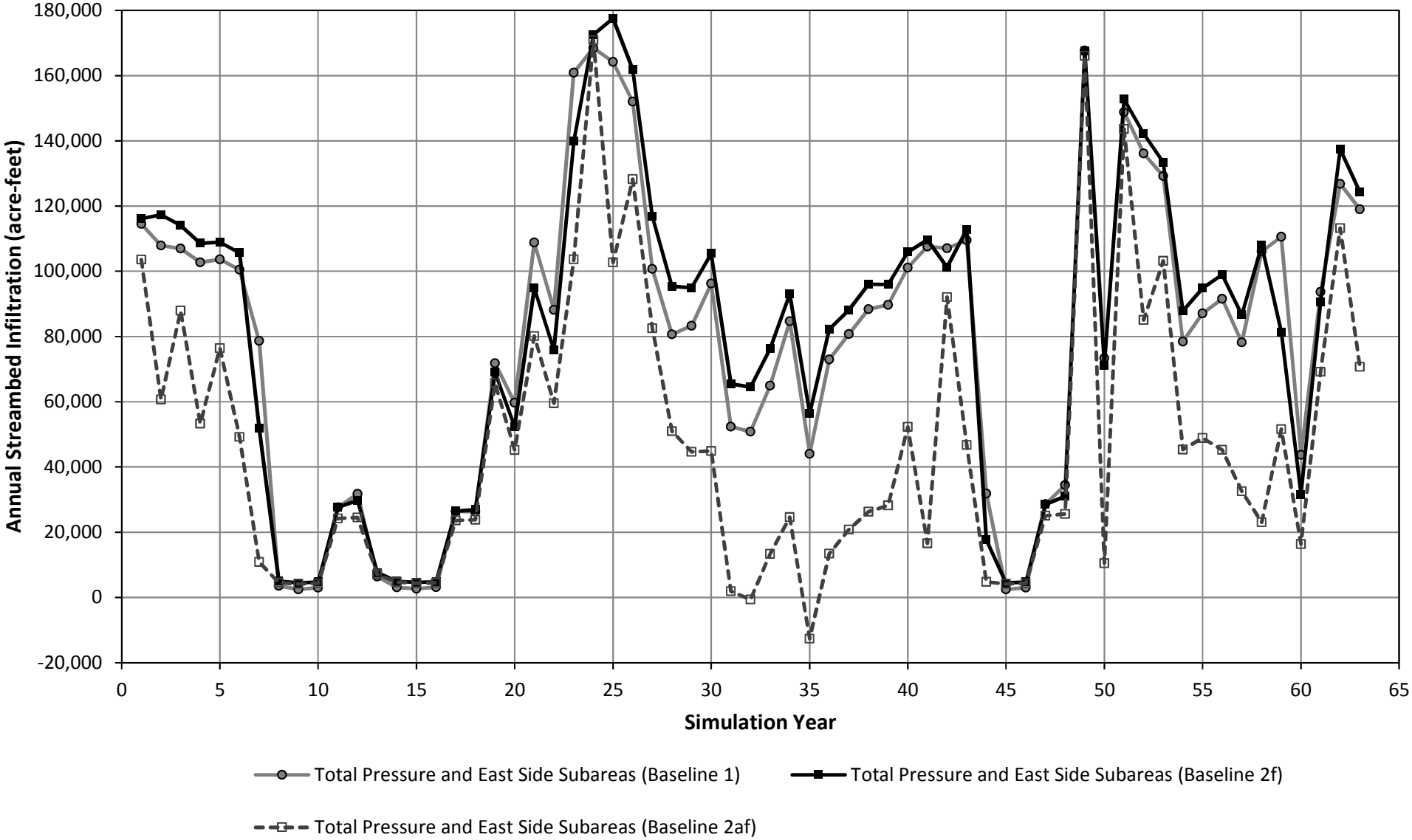

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Figure 12d
Simulated Annual Streambed Infiltration
Baseline Comparison
Monterey Peninsula Water Supply Project

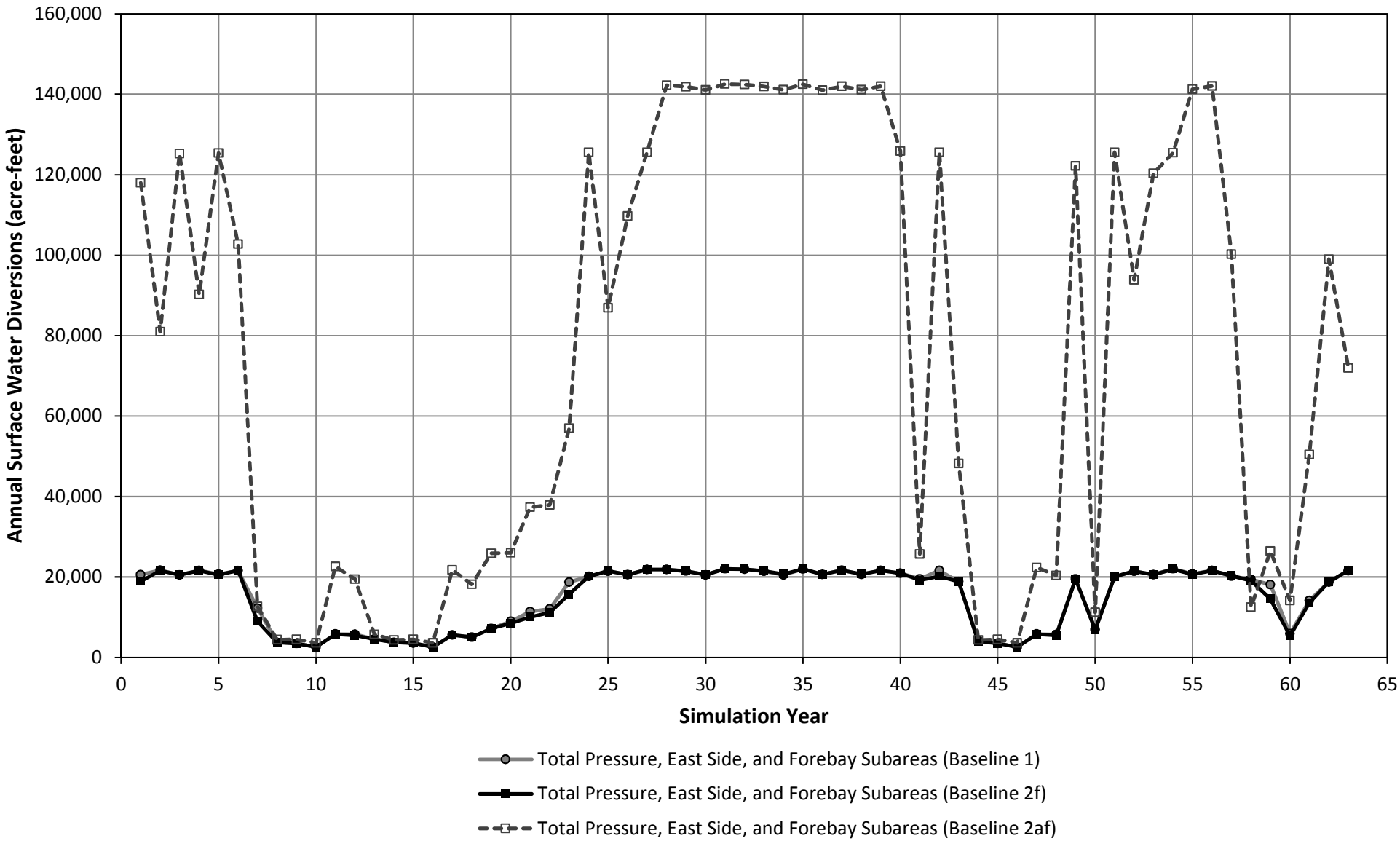

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Figure 12e
Simulated Annual Surface Water Diversions
Baseline Comparison
Monterey Peninsula Water Supply Project

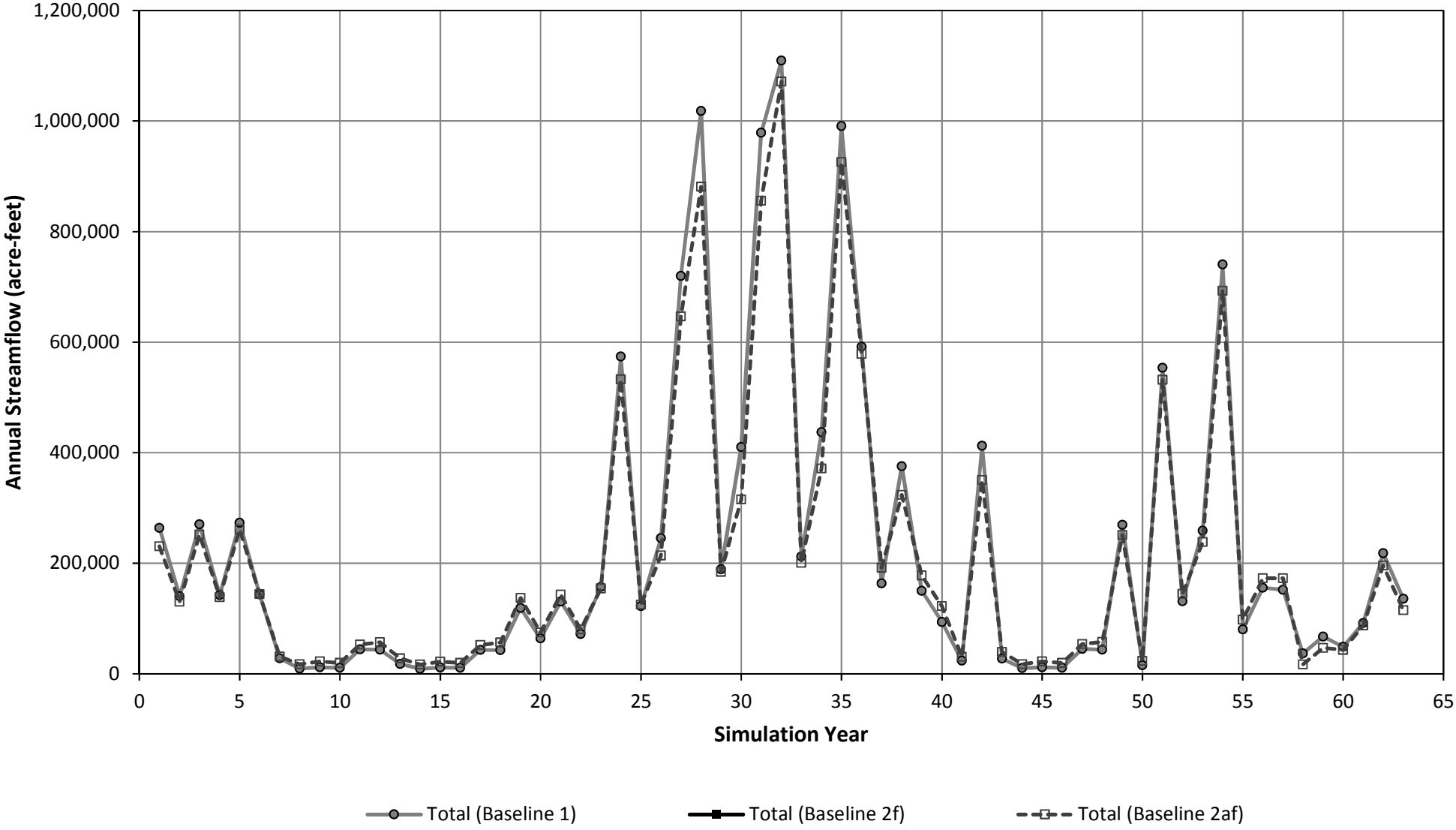

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Figure 12f
Simulated Annual Streamflow to the Bay
Baseline Comparison
Monterey Peninsula Water Supply Project

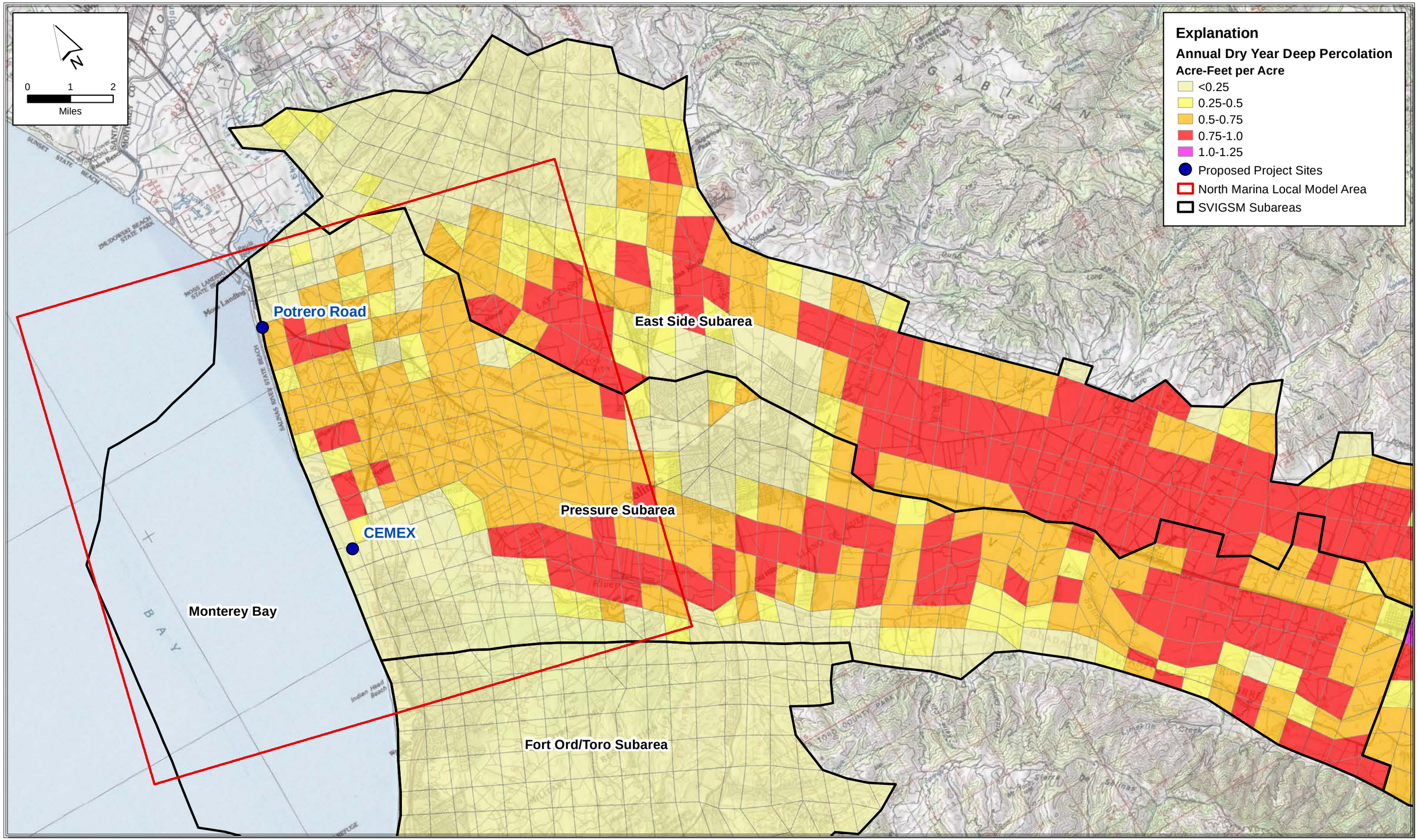

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Figure 12g
Deep Percolation in Typical Dry Year: Baseline Run 1
Monterey Peninsula Water Supply Project

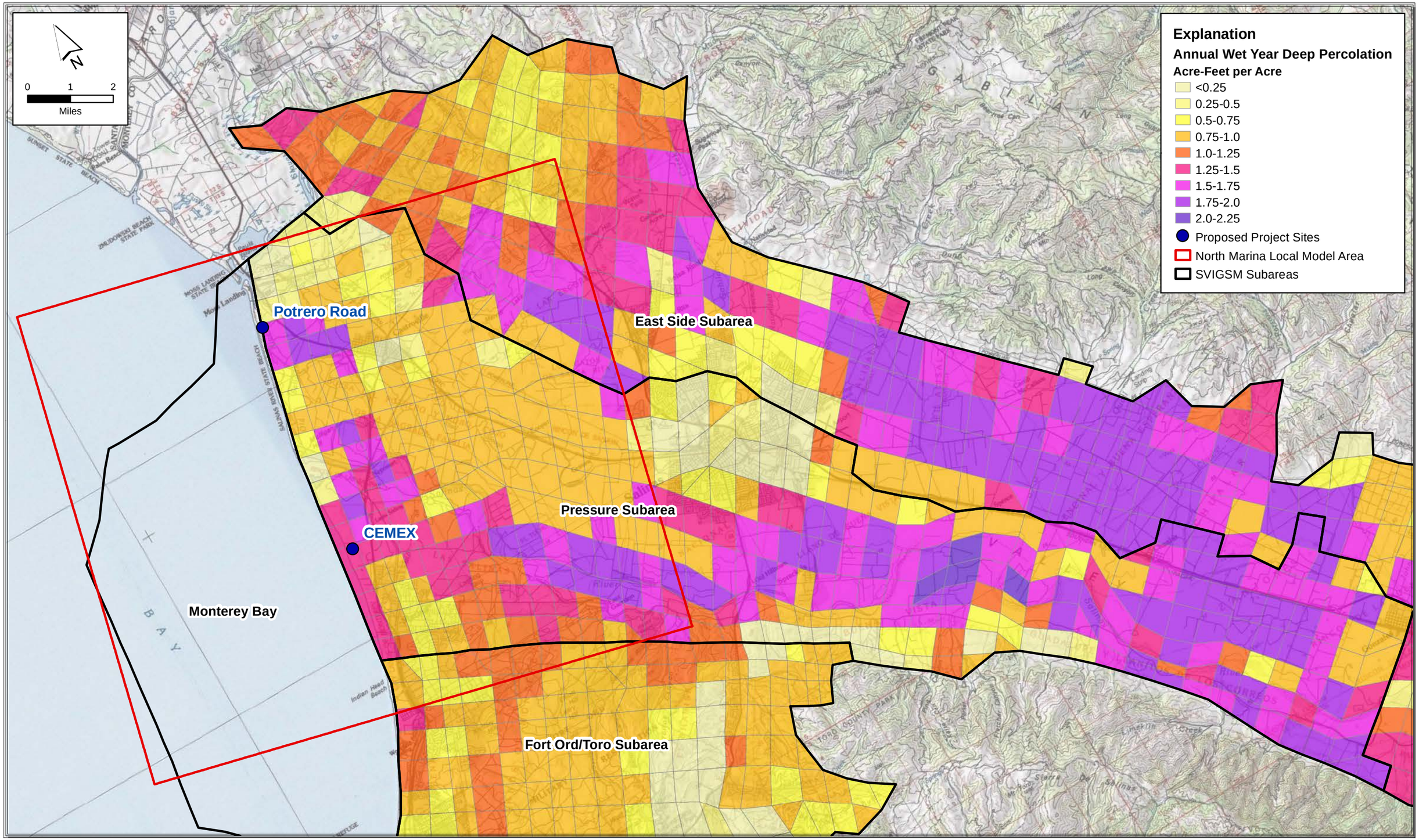

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Figure 12h
Deep Percolation in Typical Wet Year: Baseline Run 1
Monterey Peninsula Water Supply Project

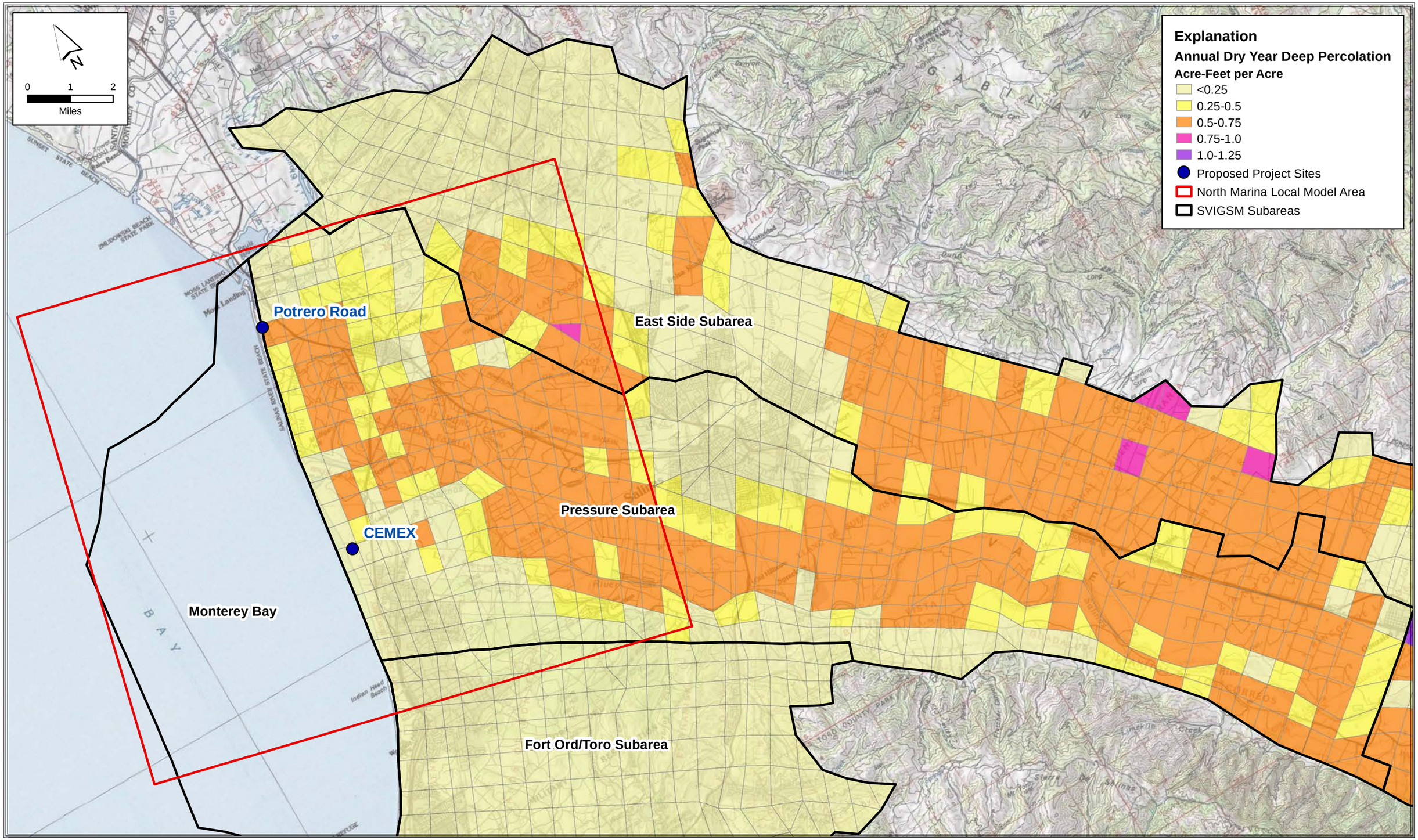

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Figure 12i
Deep Percolation in Typical Dry Year: Baseline Run 2f
Monterey Peninsula Water Supply Project

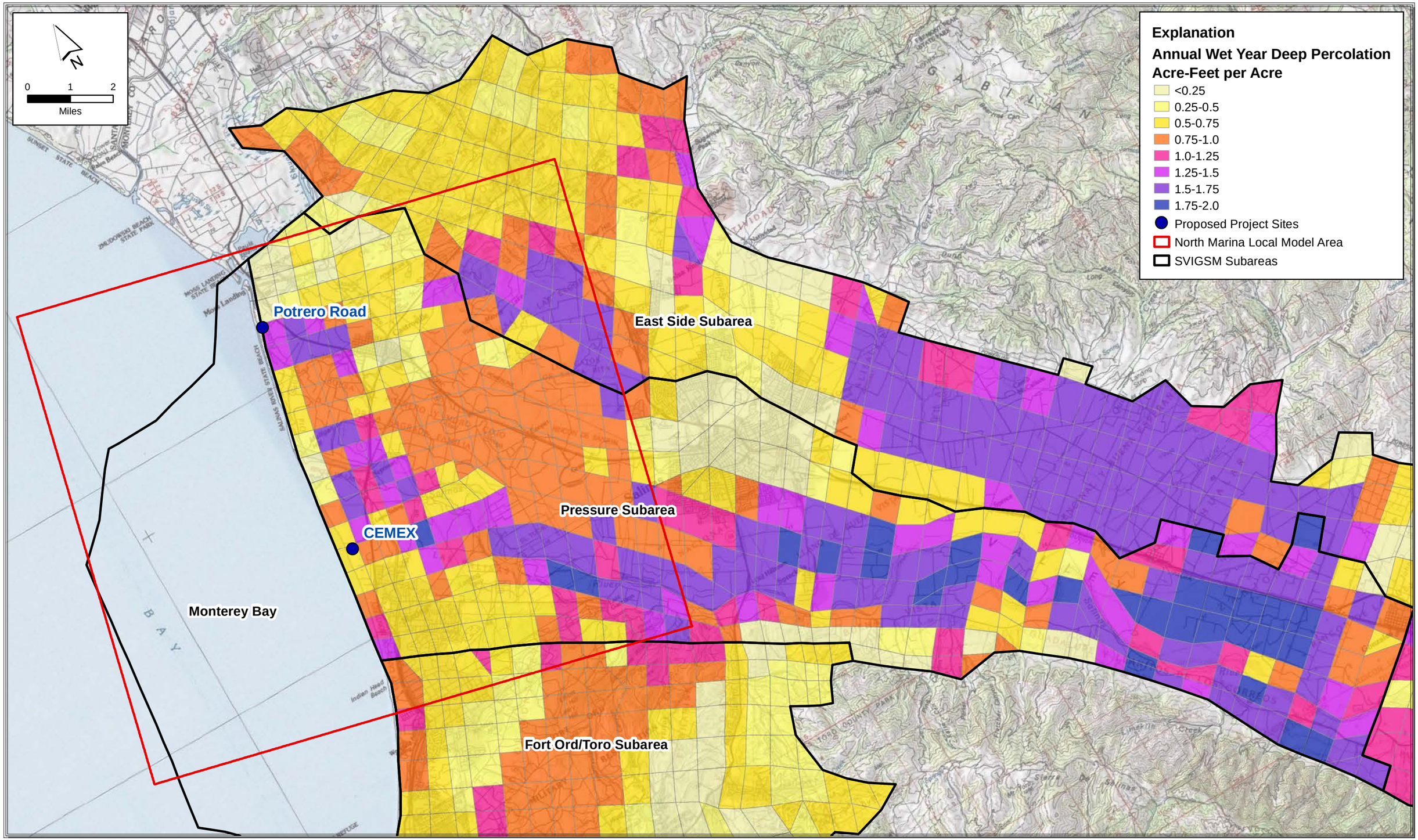

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Figure 12j
Deep Percolation in Typical Wet Year: Baseline Run 2f
Monterey Peninsula Water Supply Project

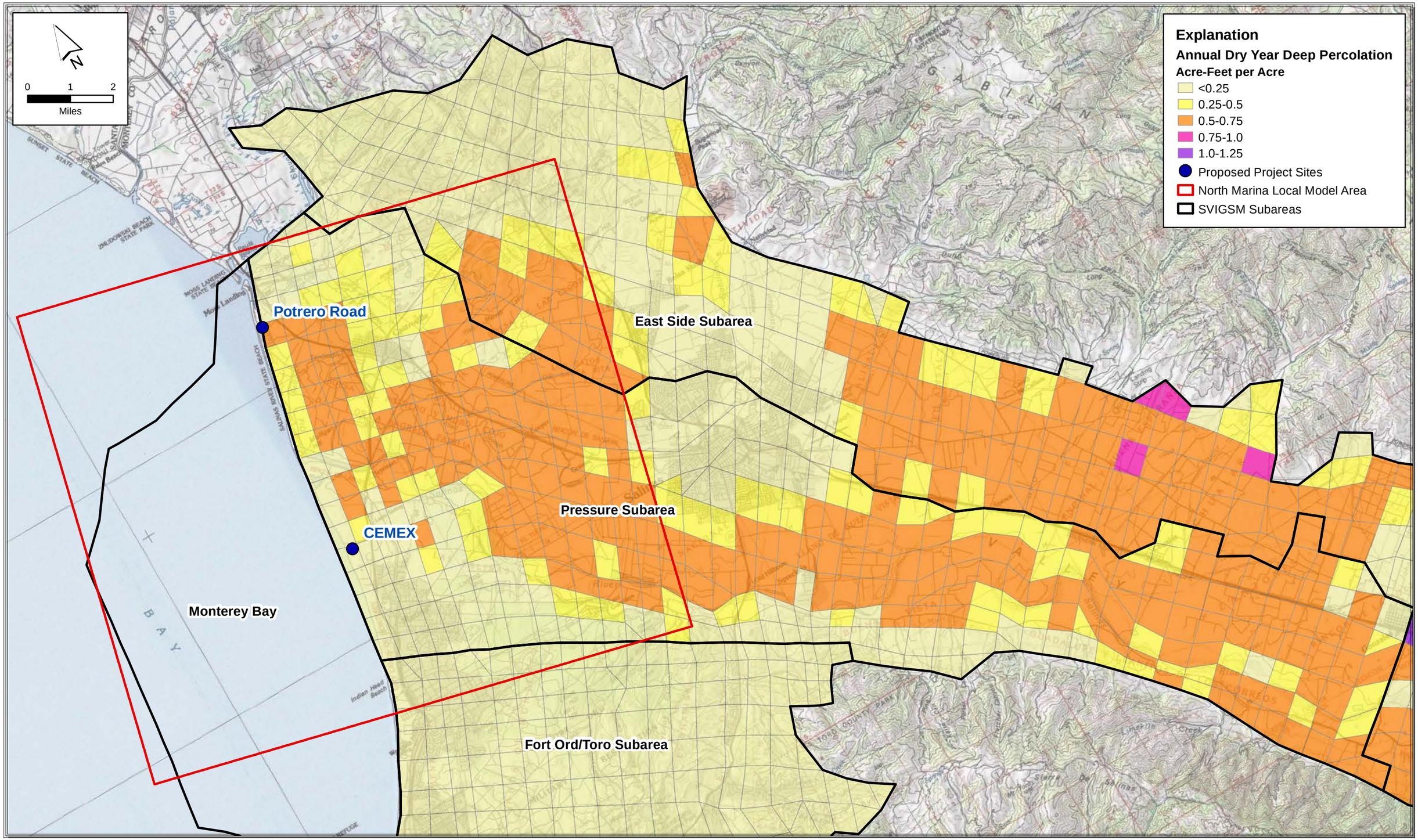

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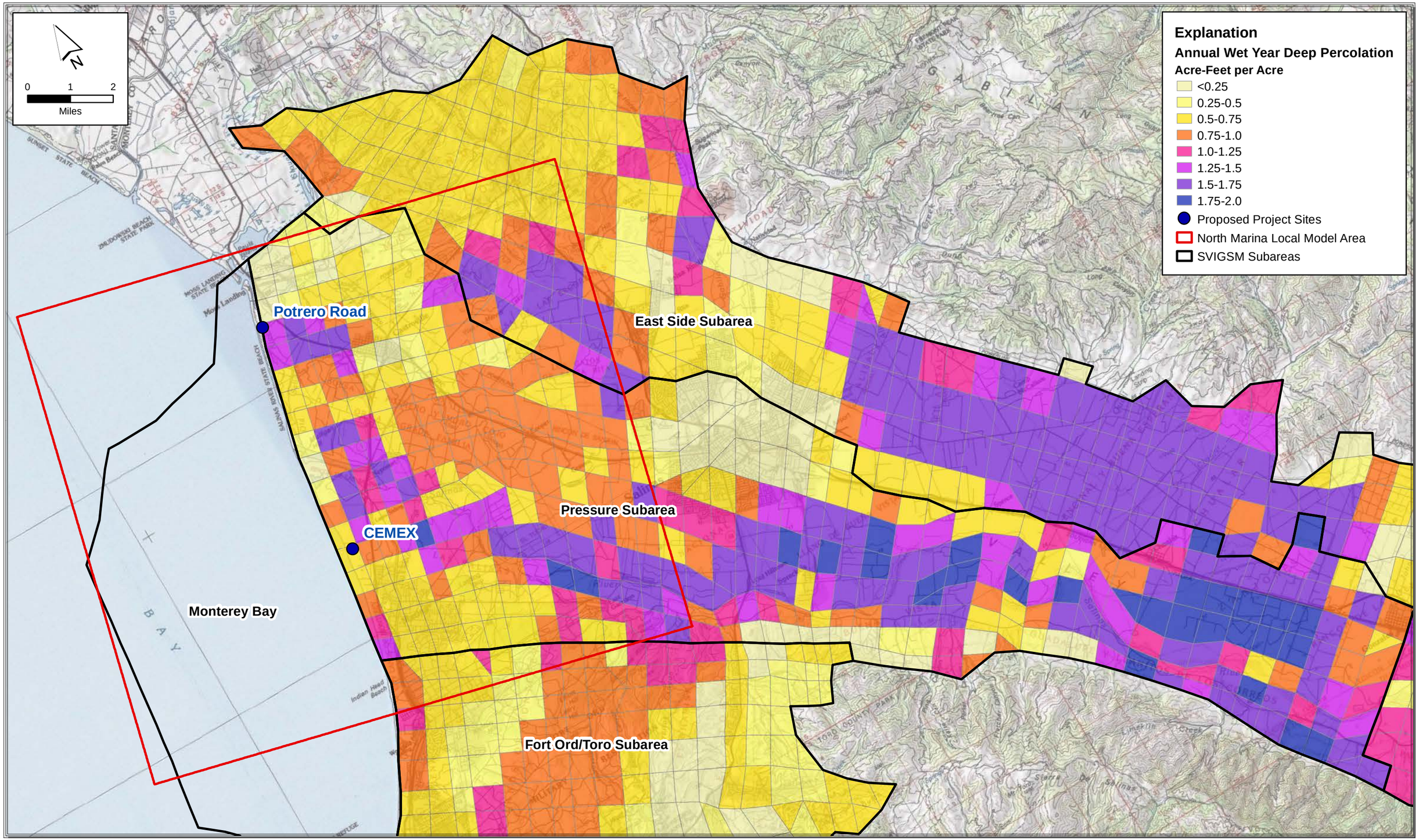
Figure 12k
Deep Percolation in Typical Dry Year: Baseline Run 2af
Monterey Peninsula Water Supply Project



Path: X:\2012 Job Files\12-047\Letters, reports\Report\Map Figures\Figure 12l Baseline Run 2a Deep Percolation Typical Wet Year.mxd

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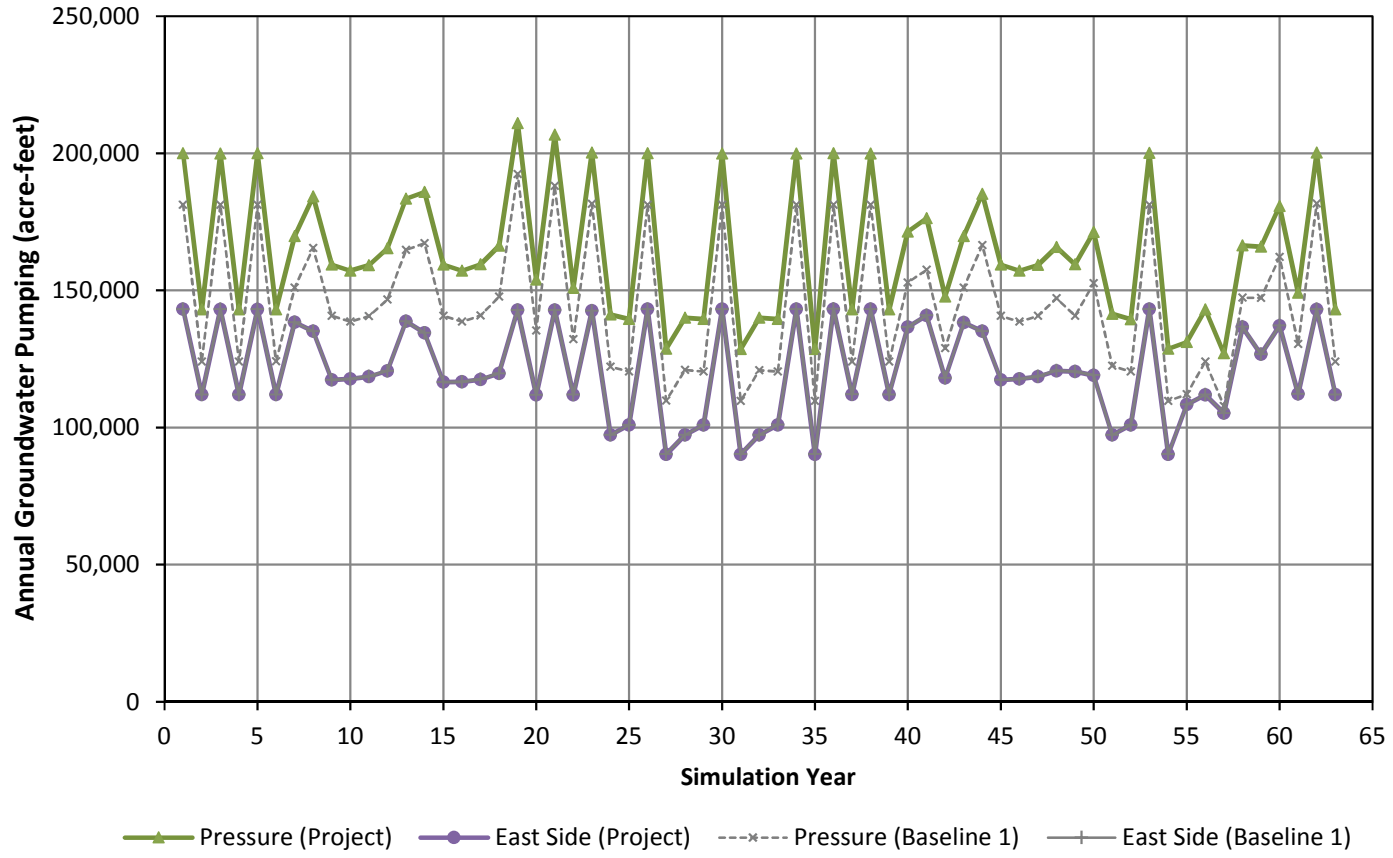
Figure 12l
Deep Percolation in Typical Wet Year: Baseline Run 2af
Monterey Peninsula Water Supply Project



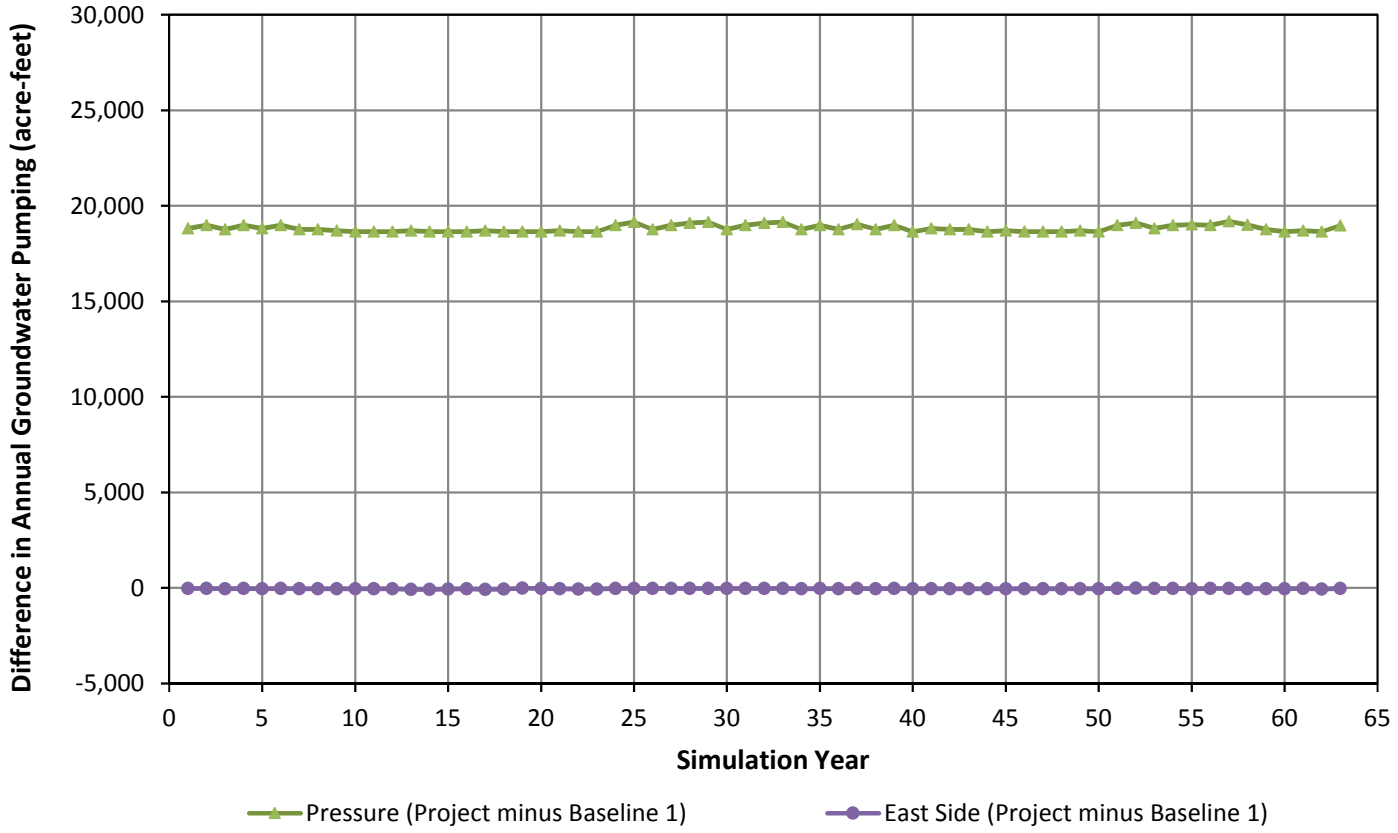


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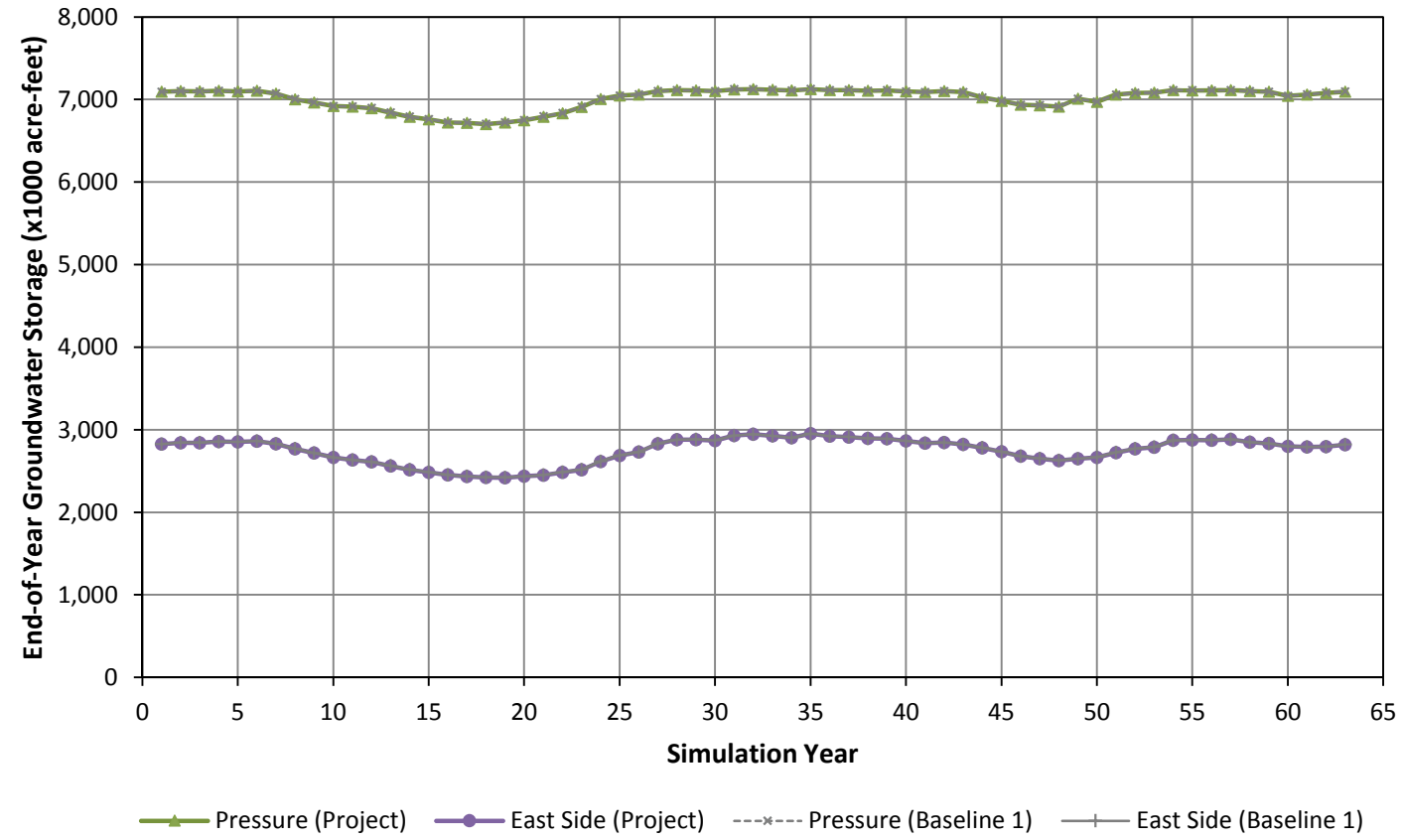
Figure 13a
Simulated Annual Groundwater Pumping
Project Run 3: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



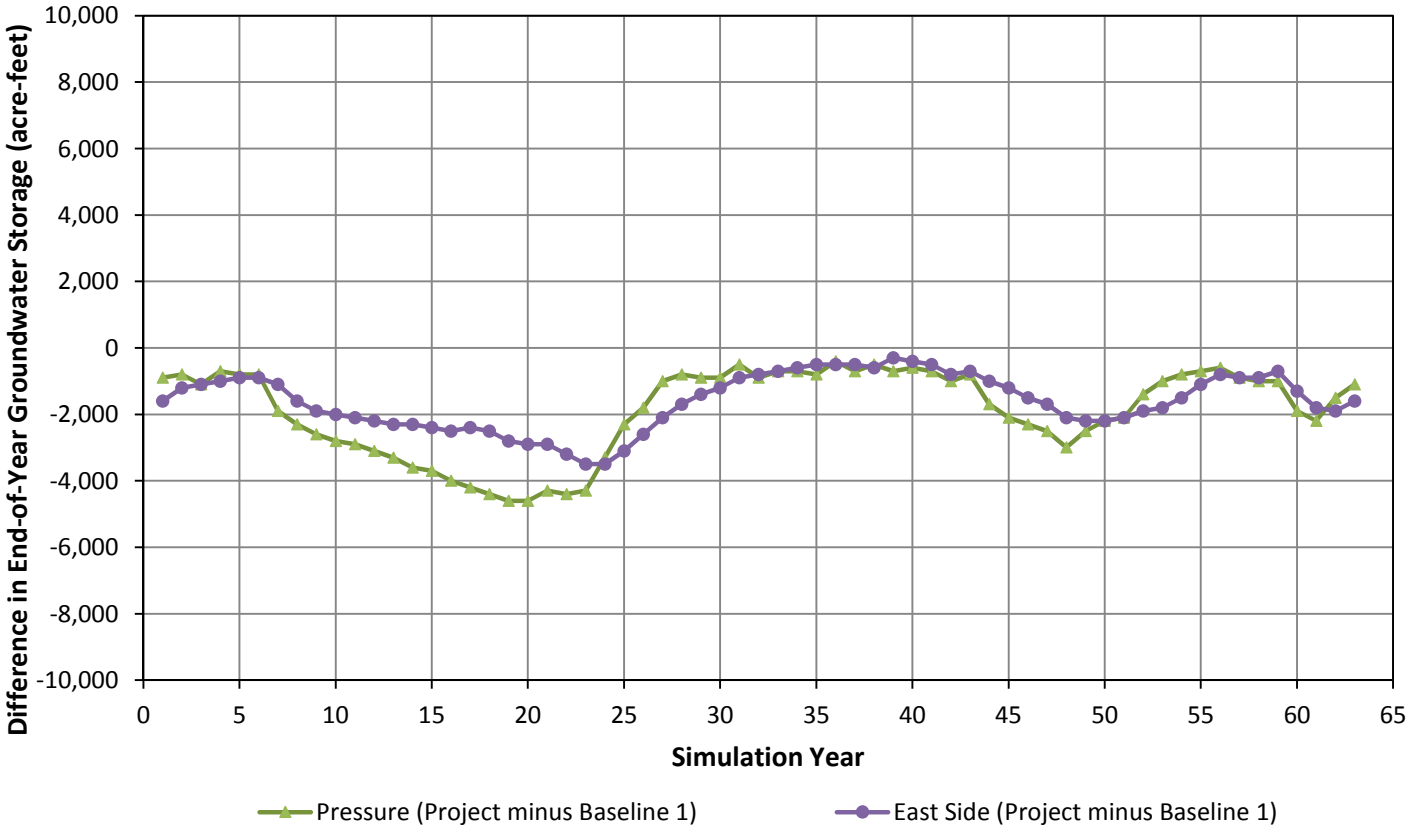


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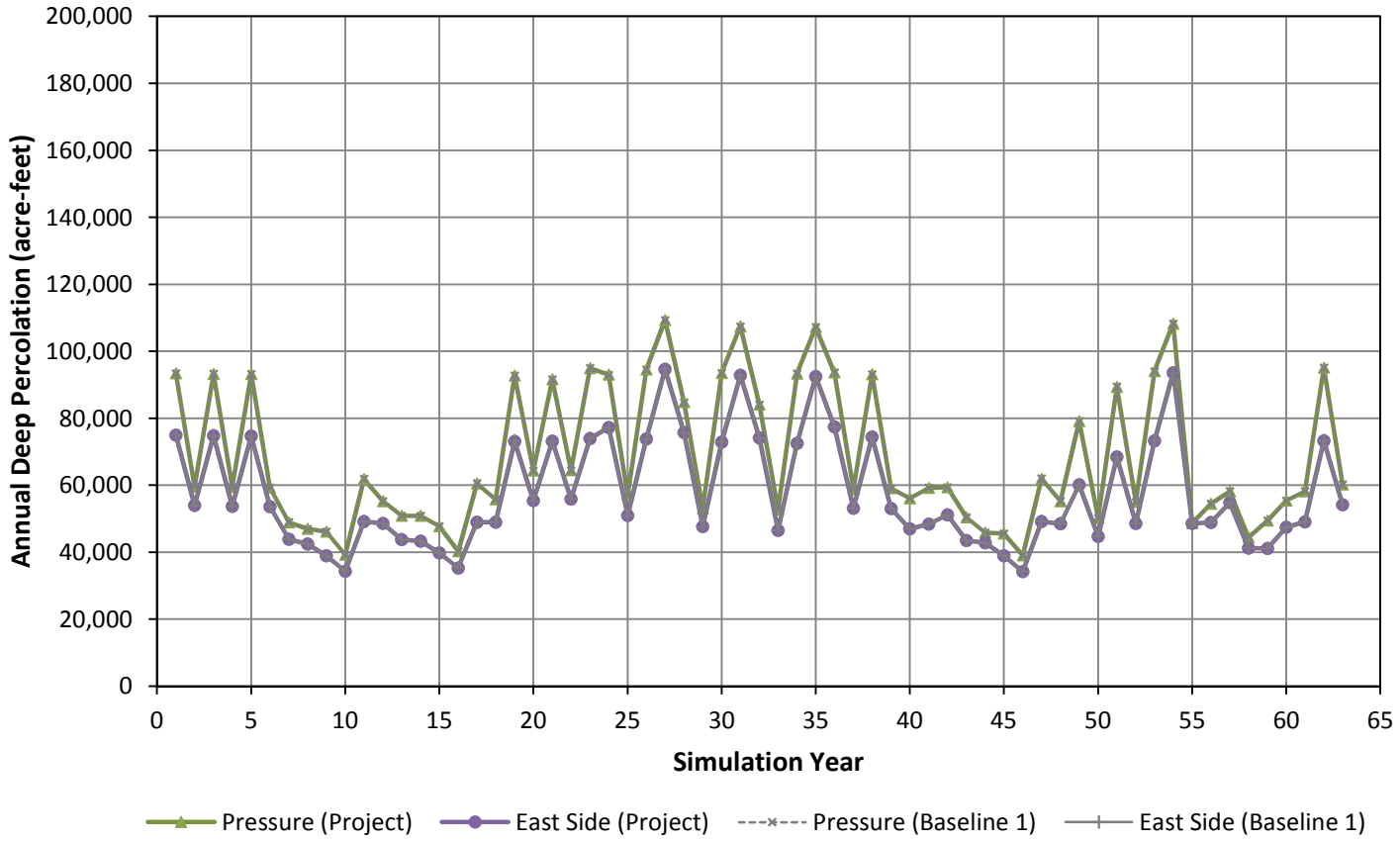
Figure 13b
Simulated End-of-Year Groundwater Storage
Project Run 3: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



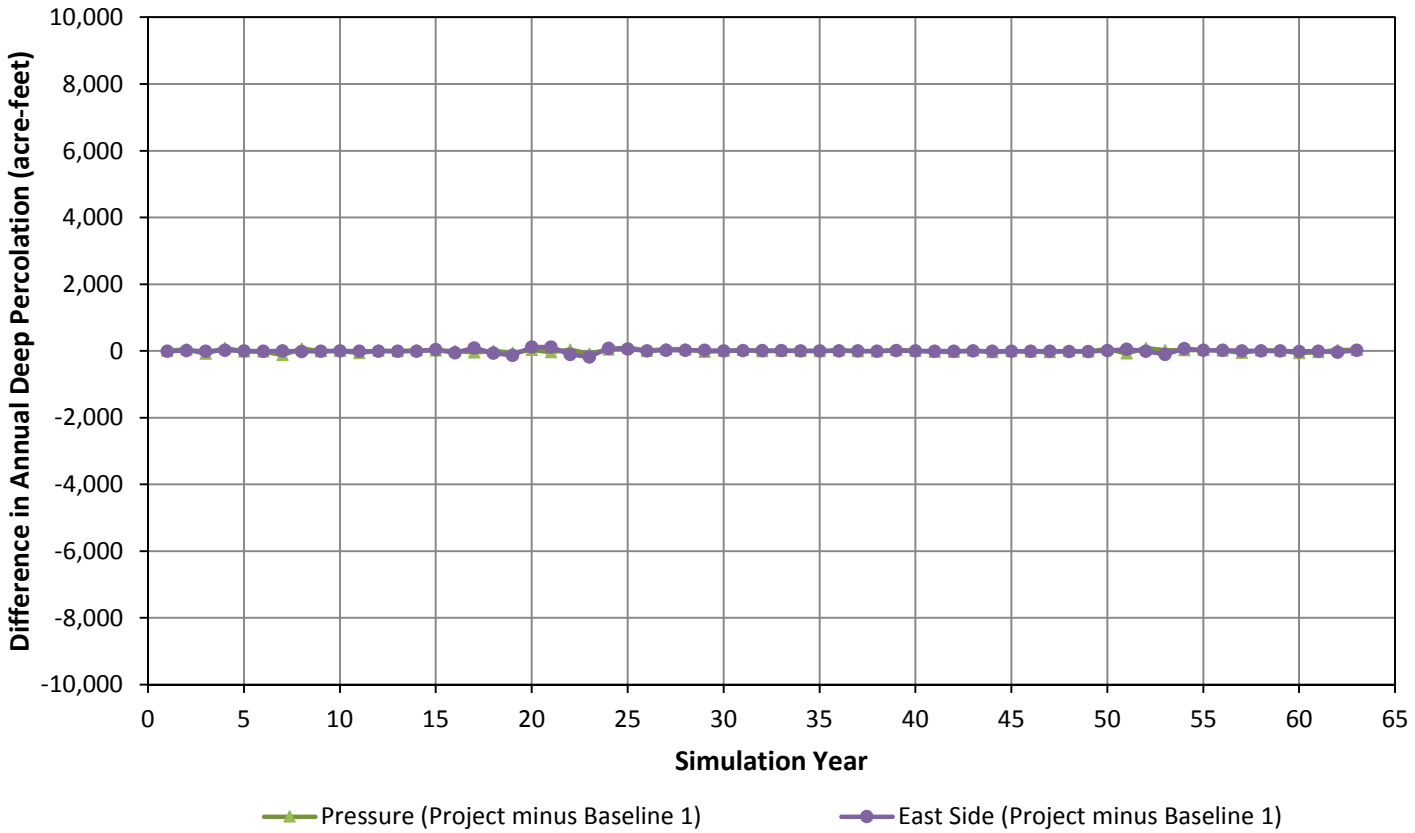


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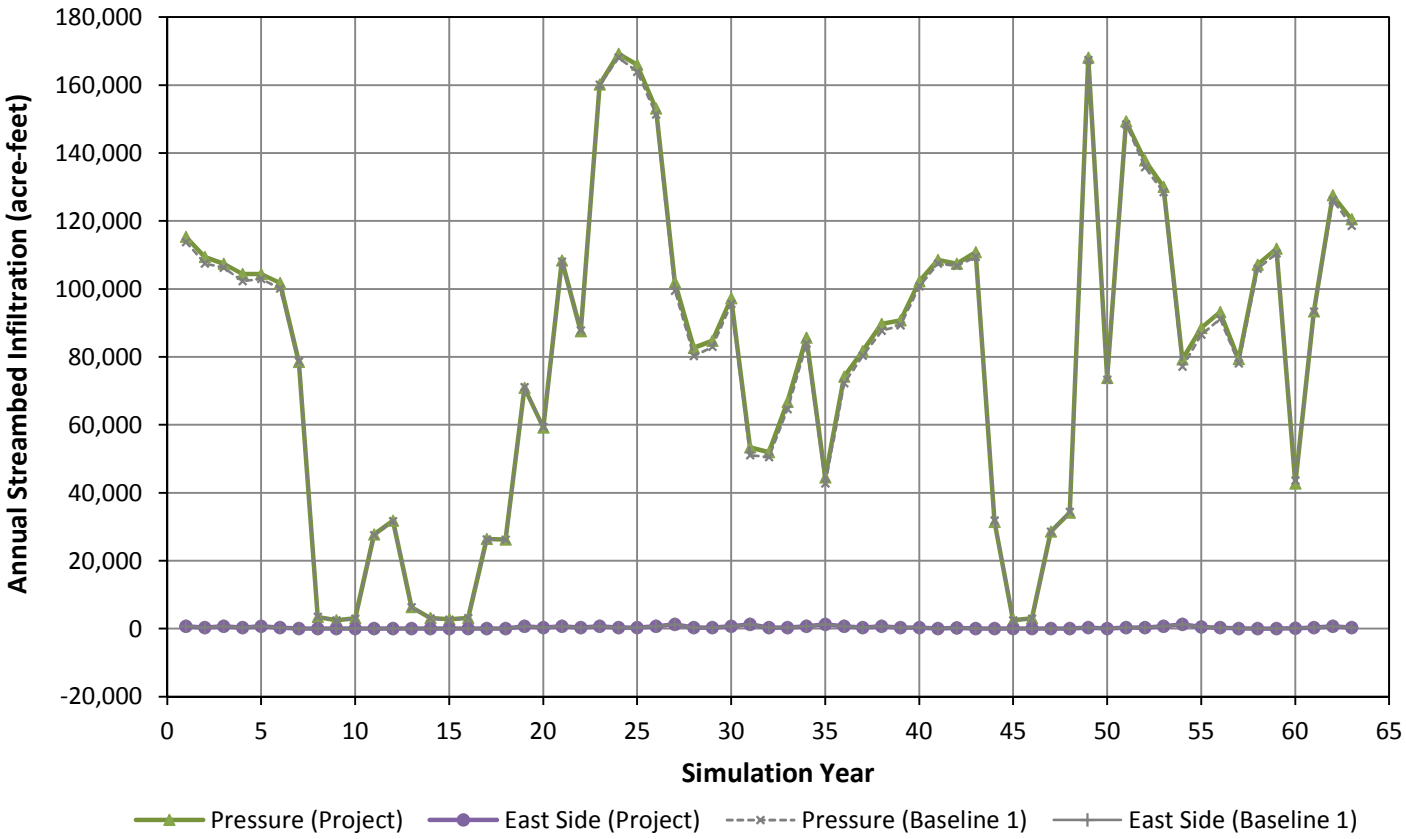
Figure 13c
Simulated Annual Deep Percolation
Project Run 3: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



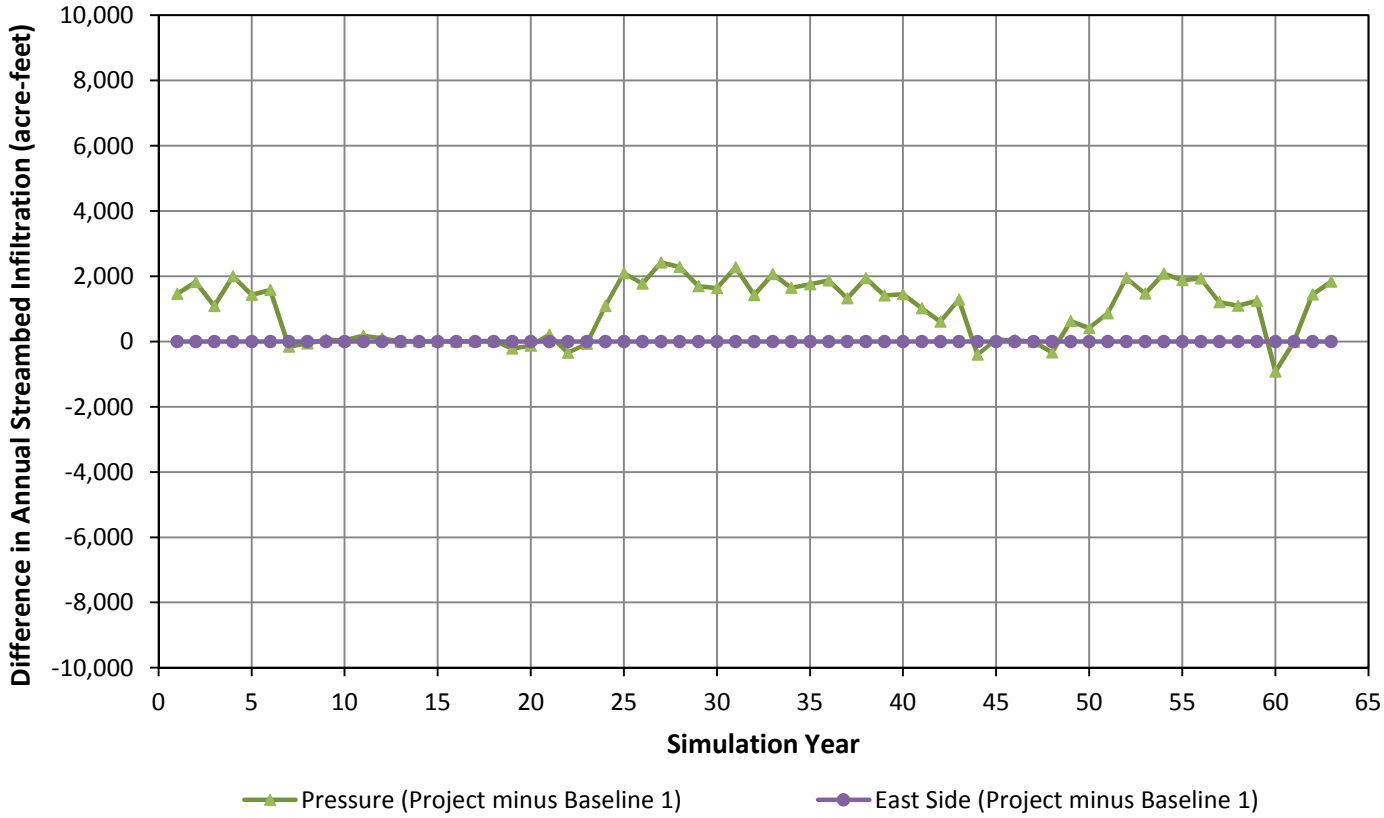


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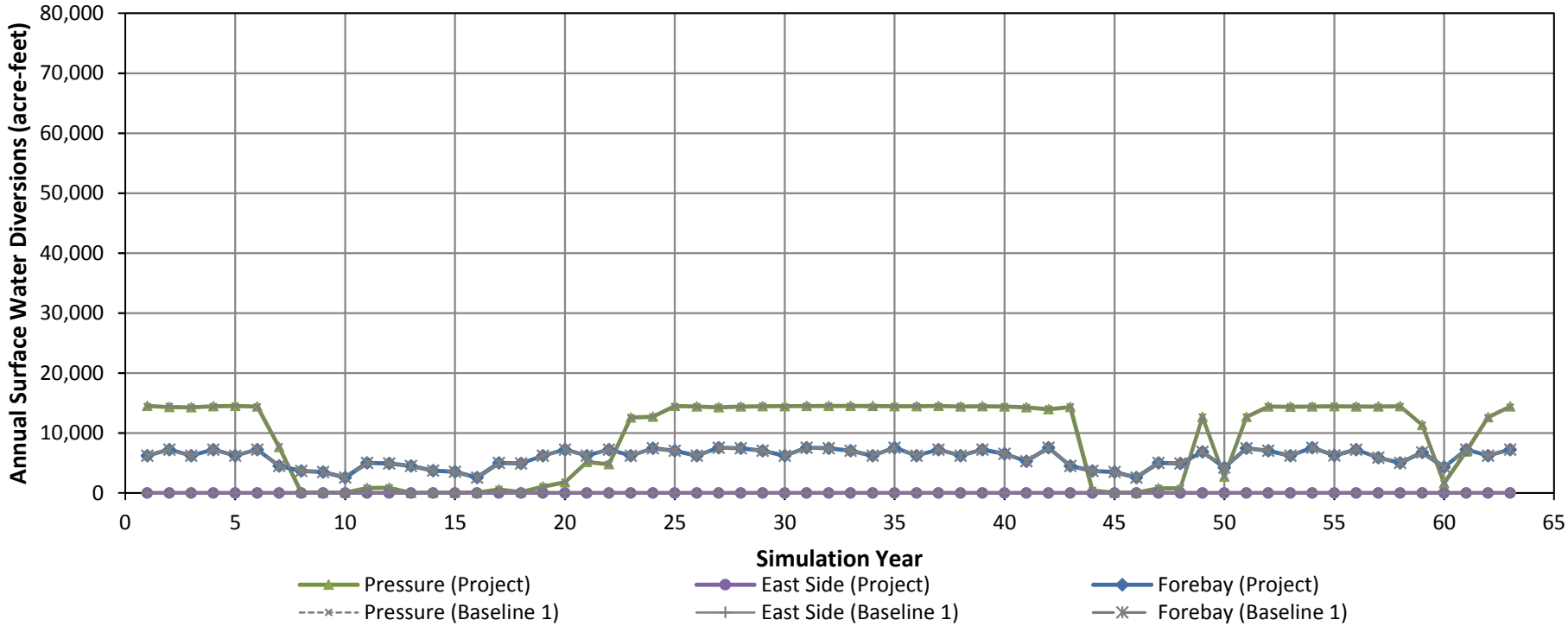
Figure 13d
Simulated Annual Streambed Infiltration
Project Run 3: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



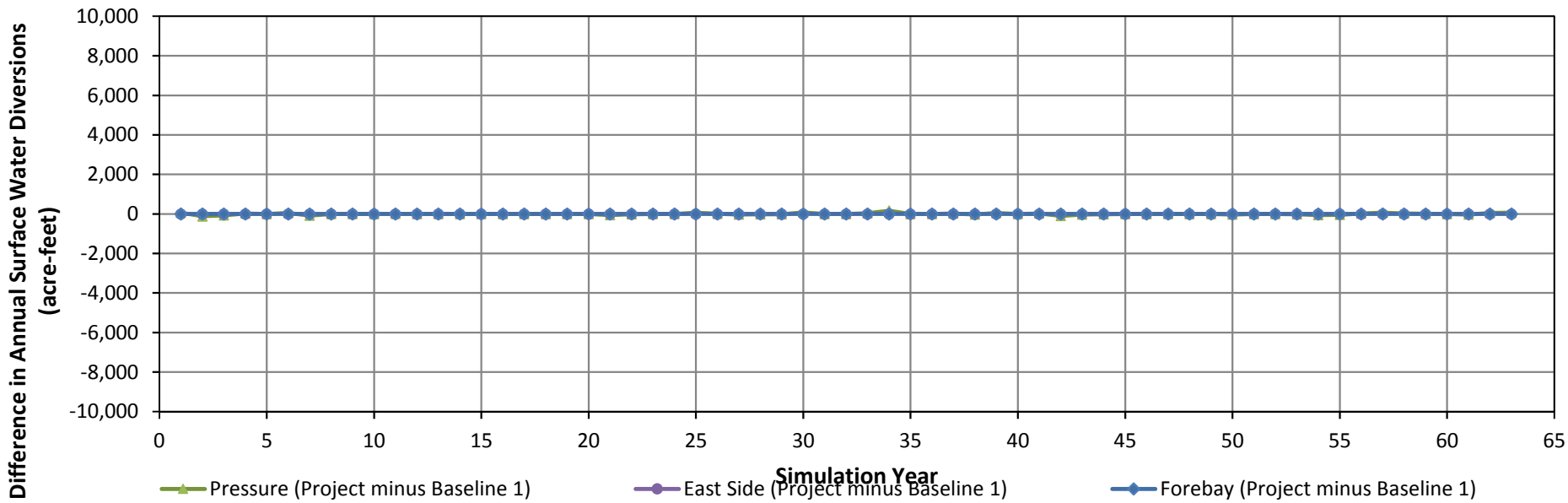


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Figure 13e
Simulated Annual Surface Water Diversions
Project Run 3: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project

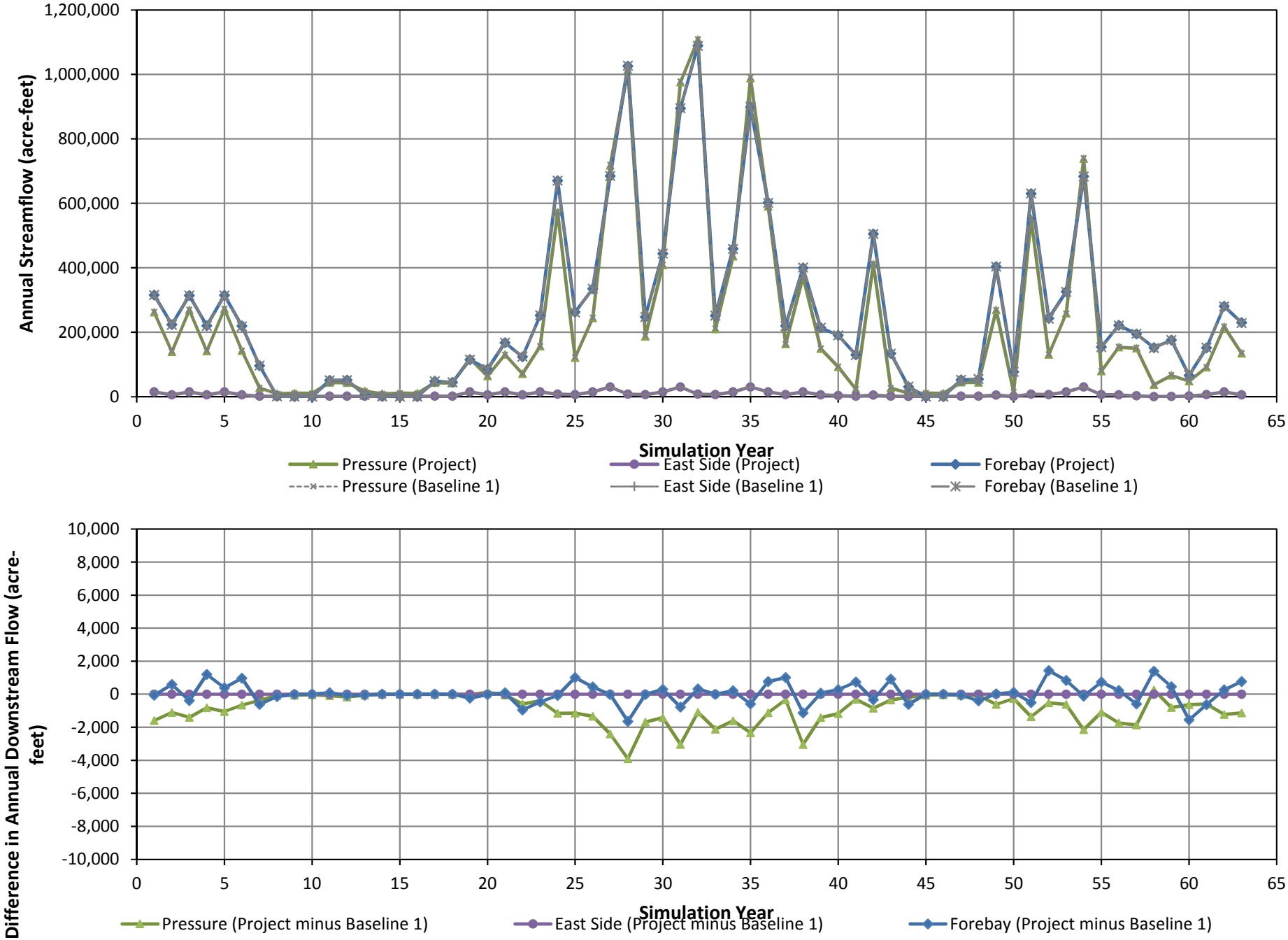

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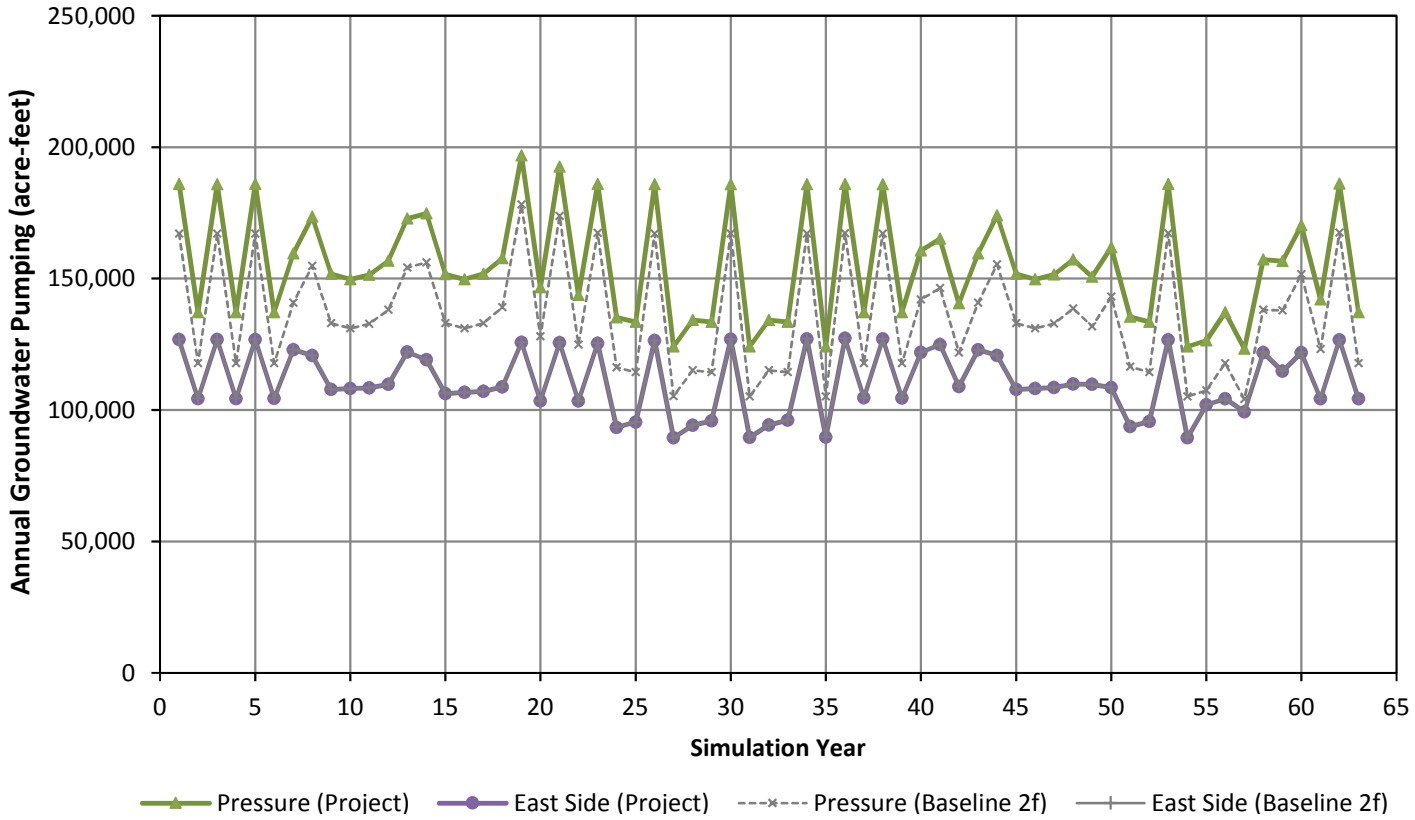
Figure 13f
Simulated Annual Downstream Flow
Project Run 3: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



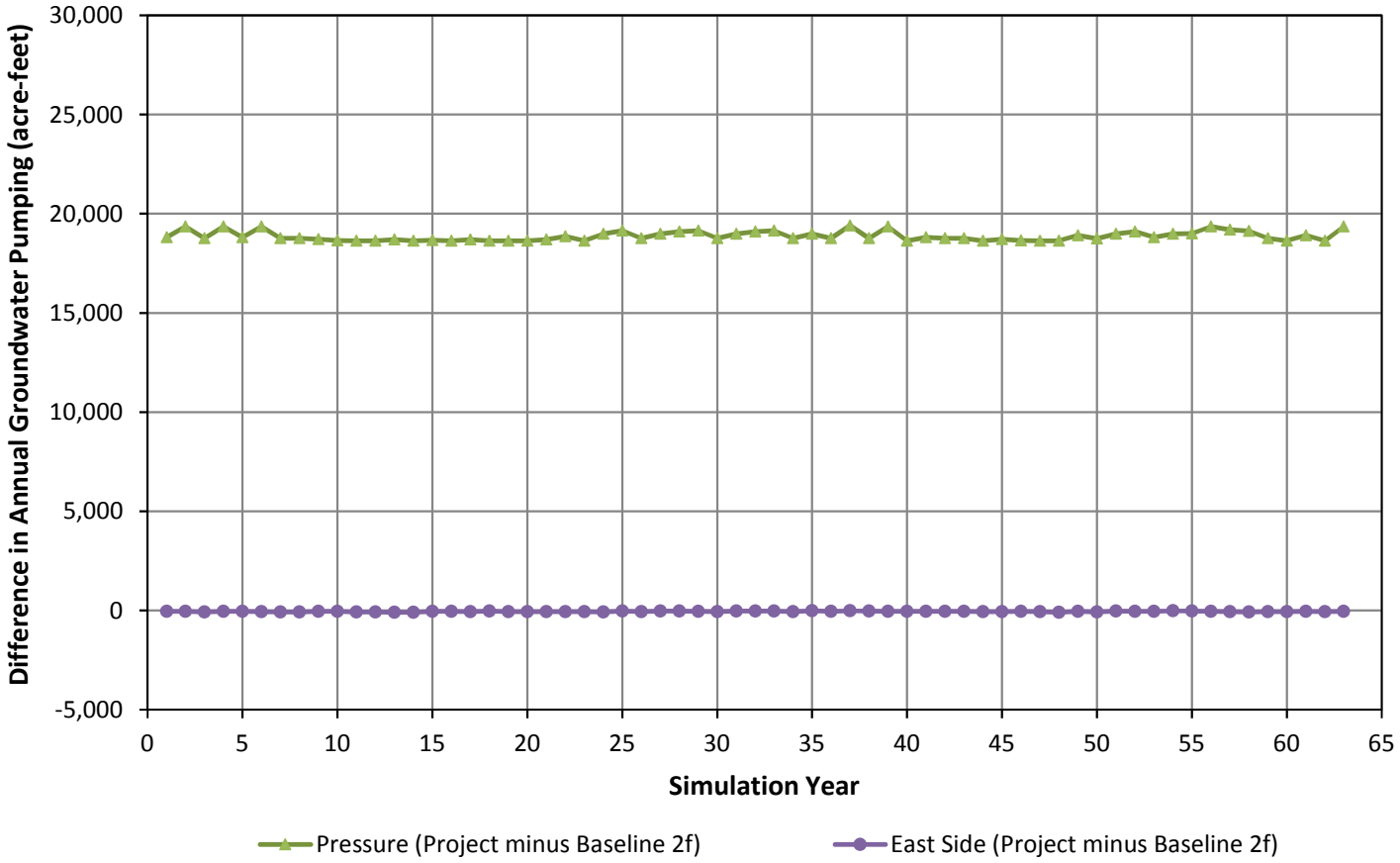


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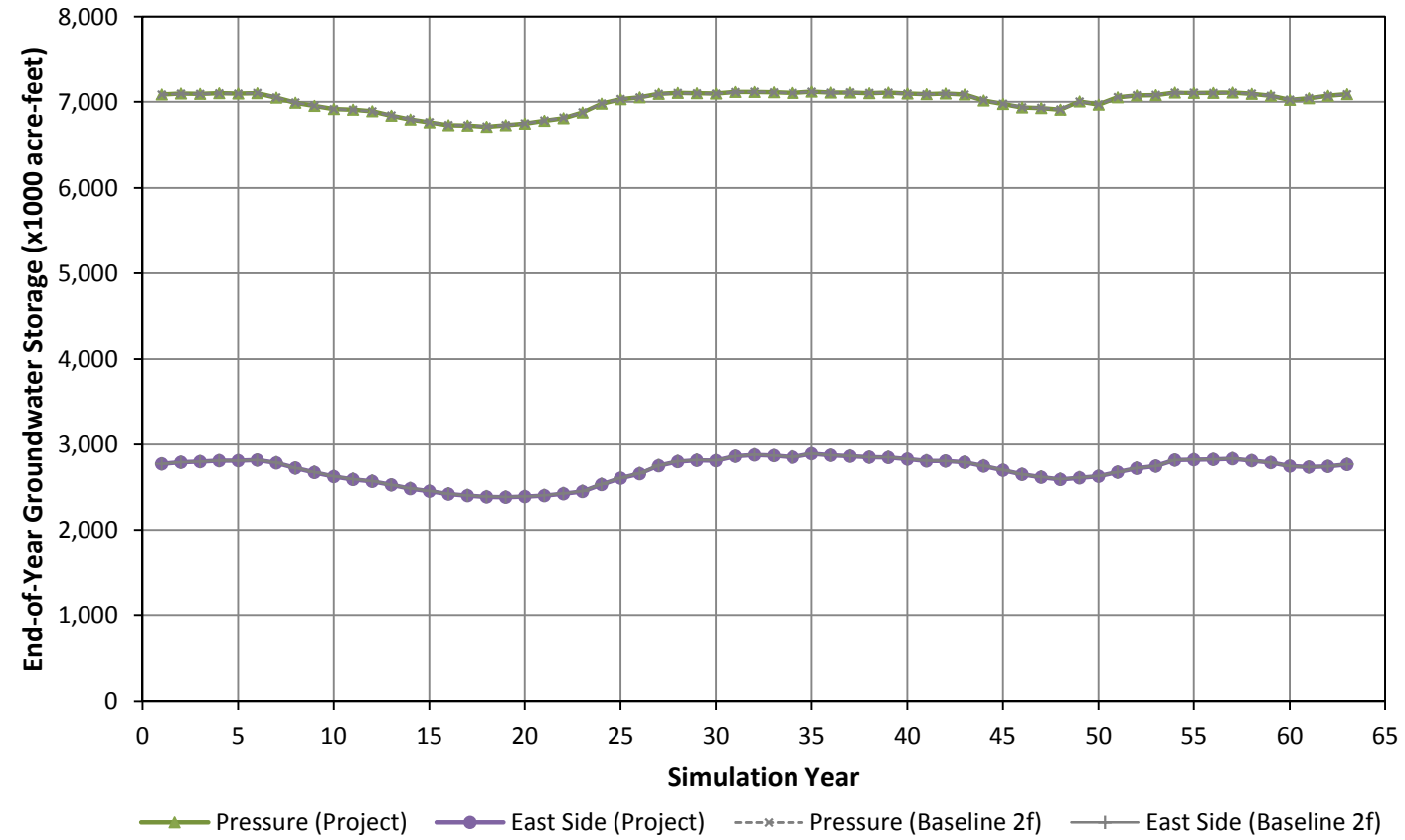
Figure 14a
Simulated Annual Groundwater Pumping
Project Run 4: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



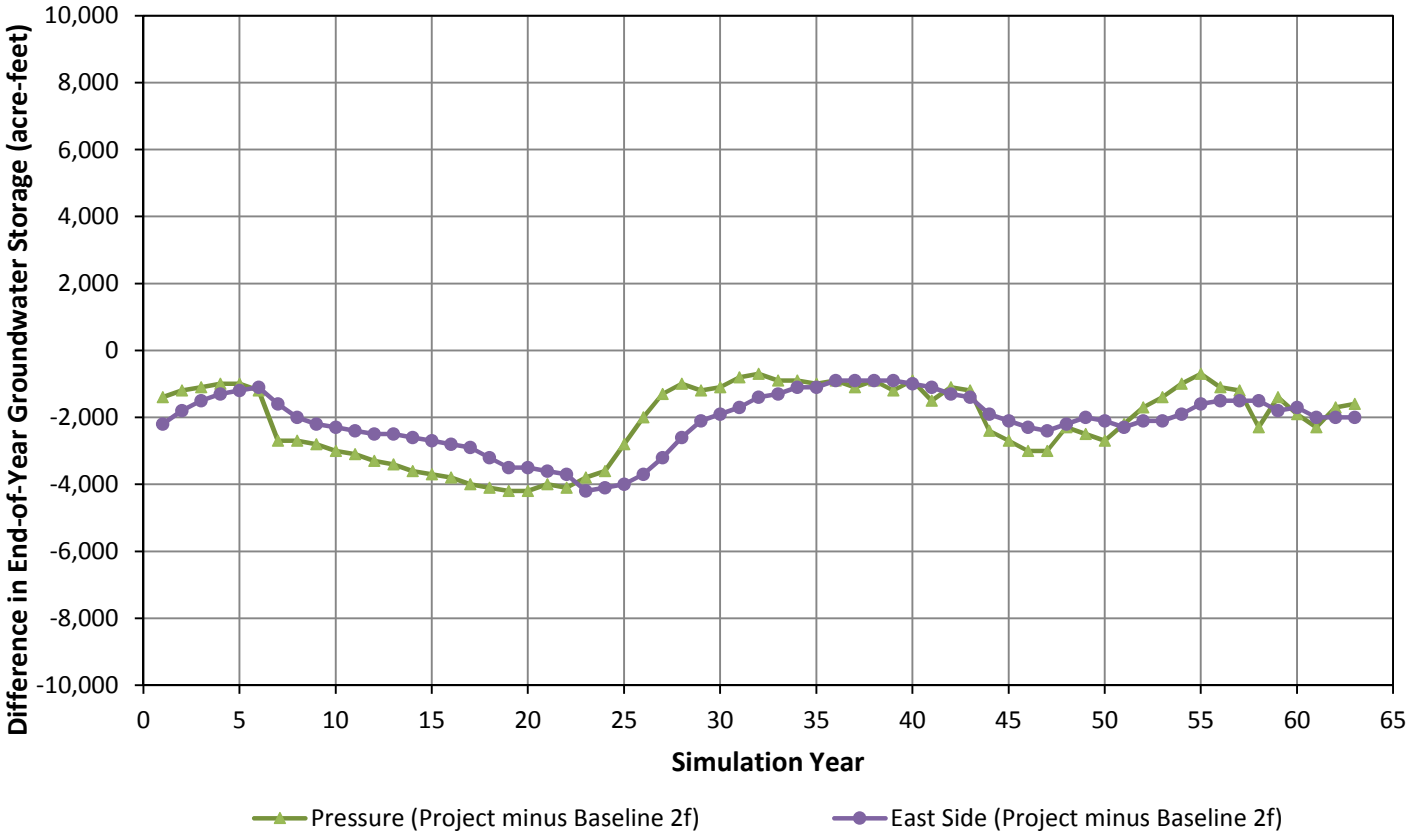


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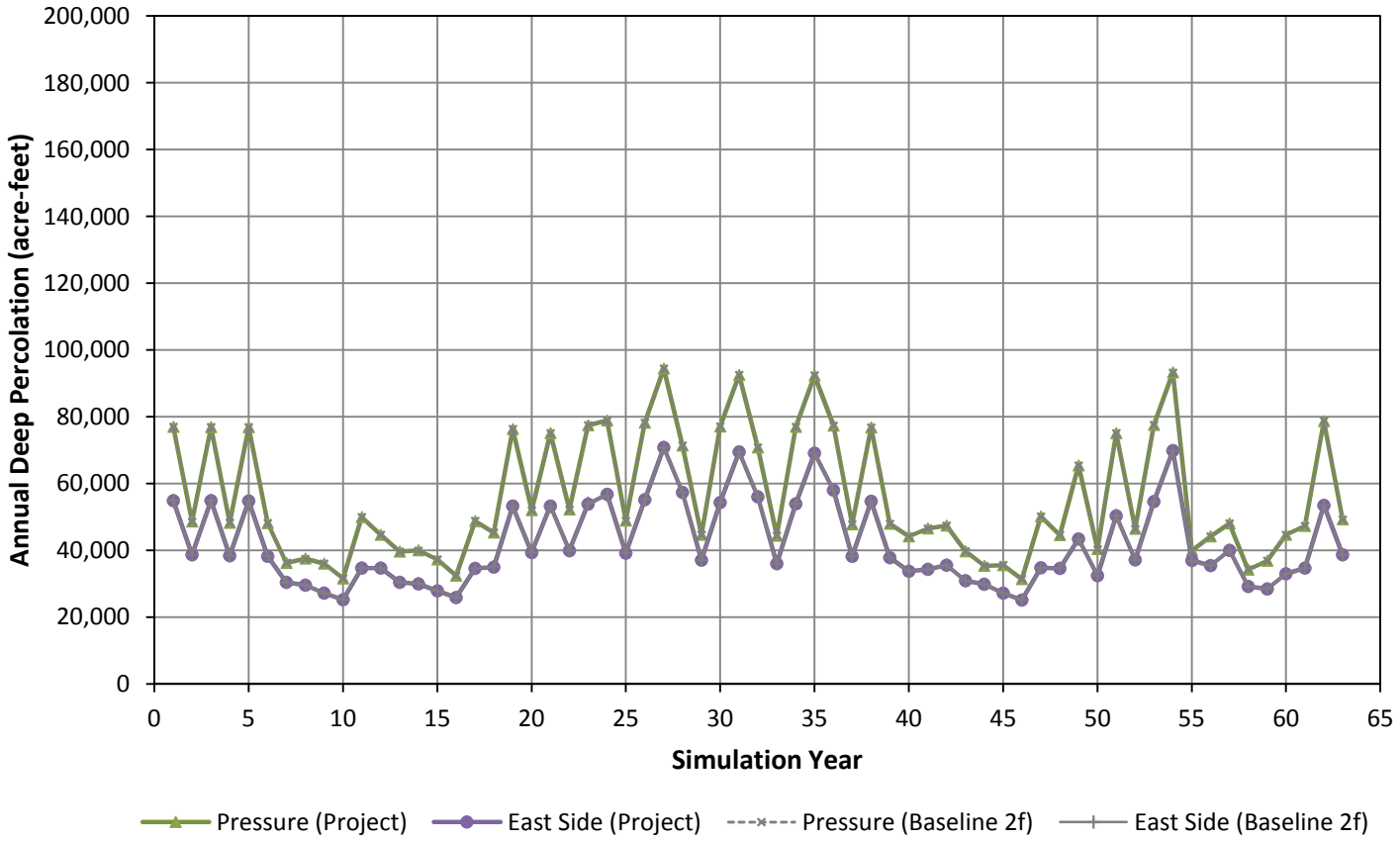
Figure 14b
Simulated End-of-Year Groundwater Storage
Project Run 4: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



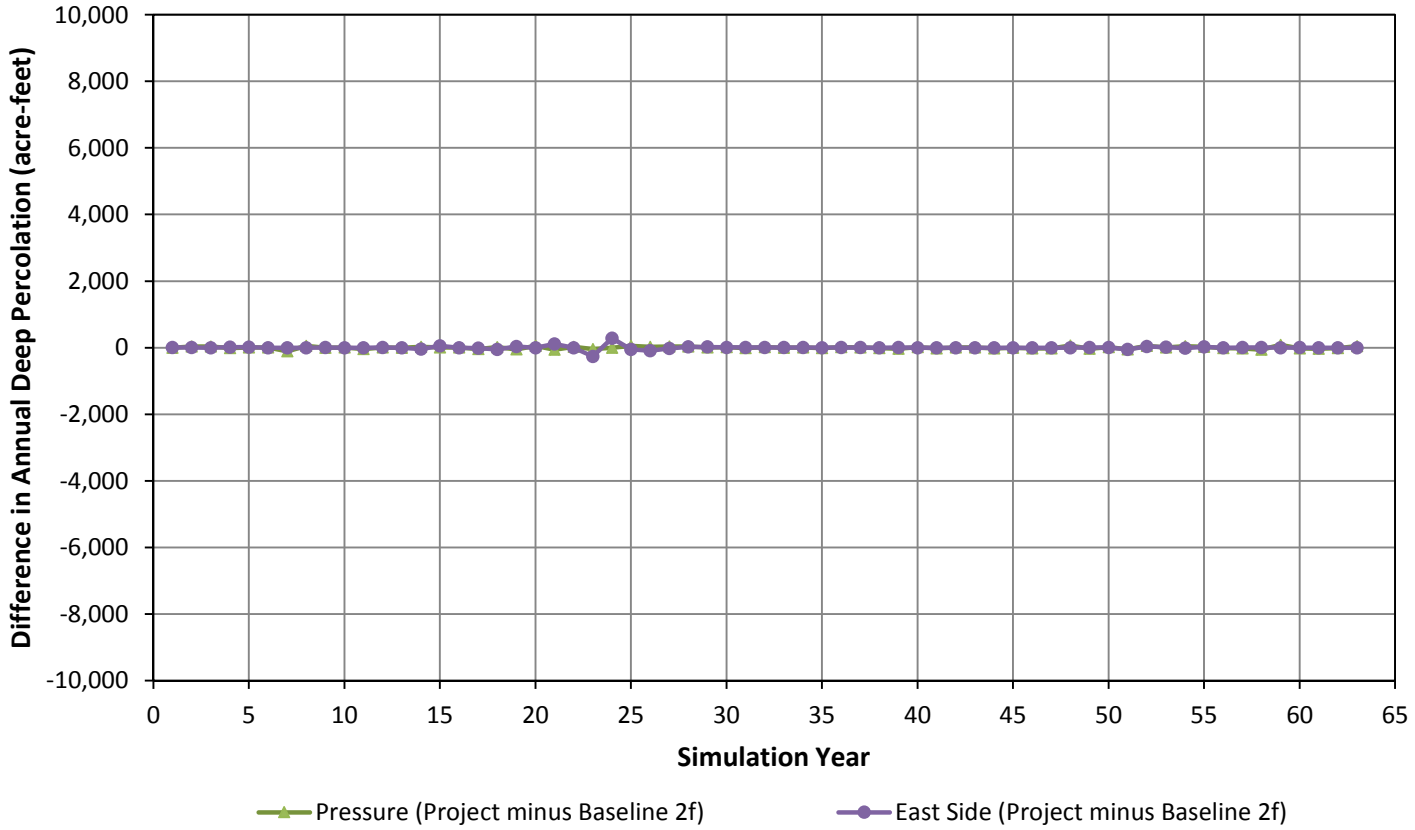


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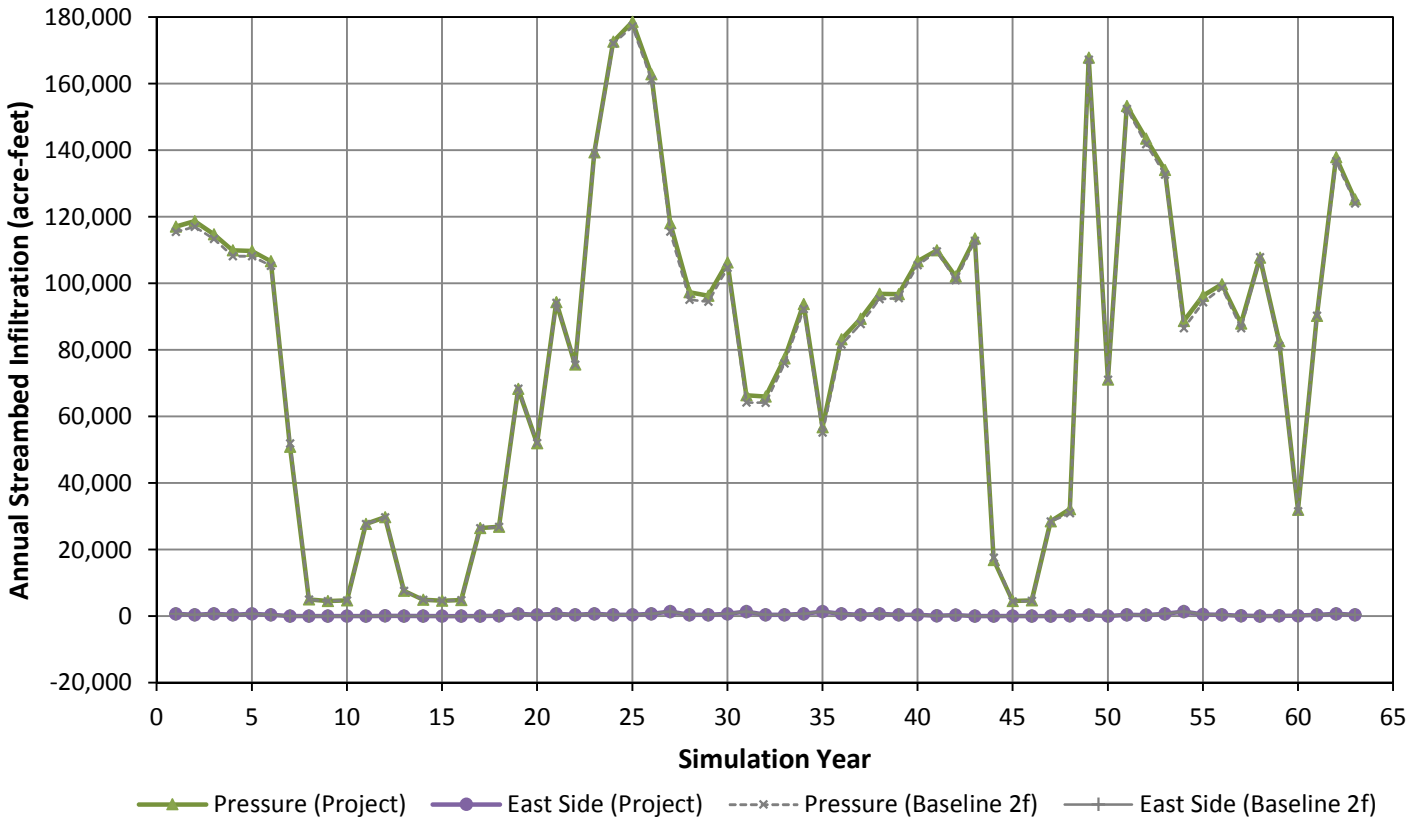
Figure 14c
Simulated Annual Deep Percolation
Project Run 4: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



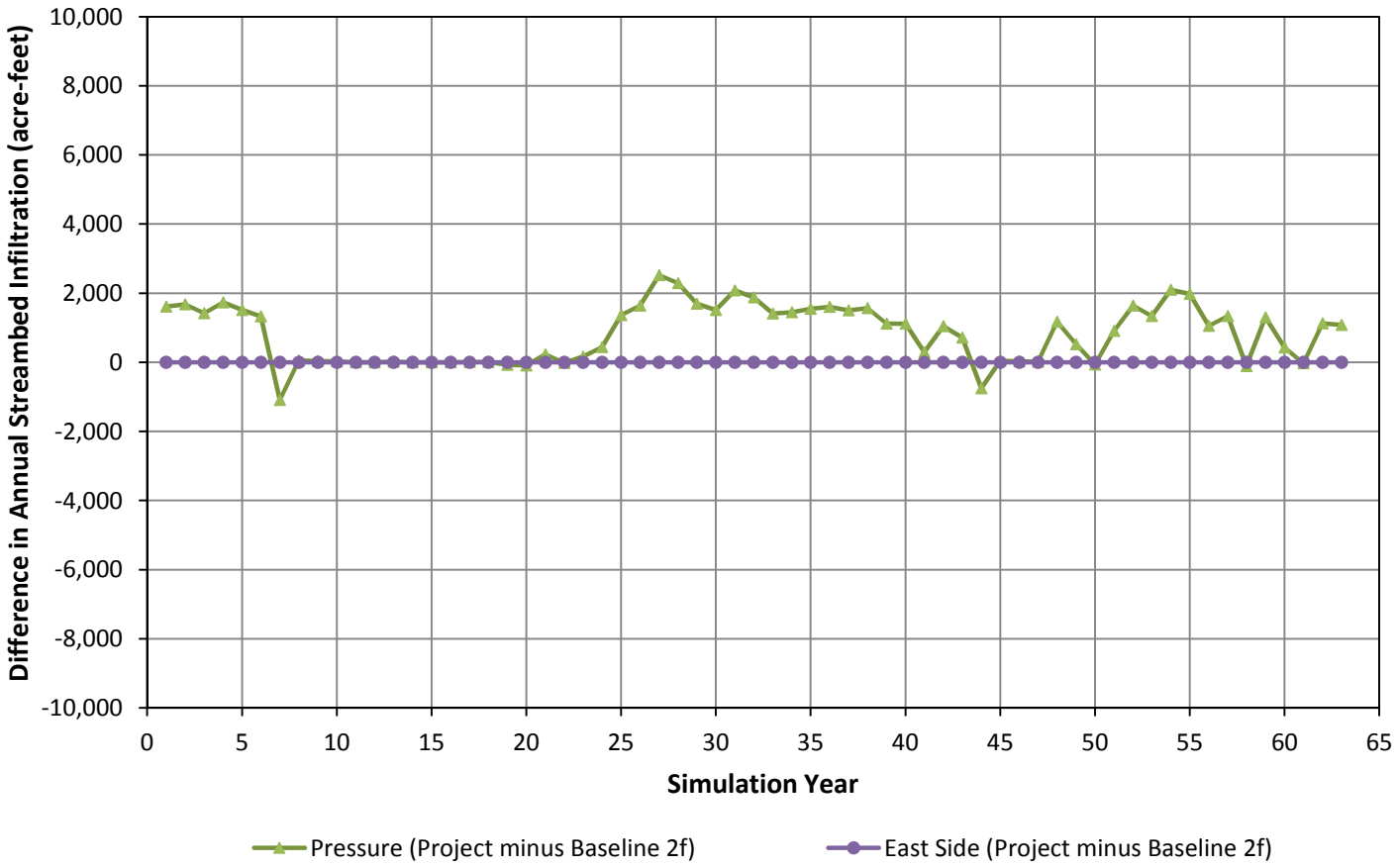


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Figure 14d
Simulated Annual Streambed Infiltration
Project Run 4: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project

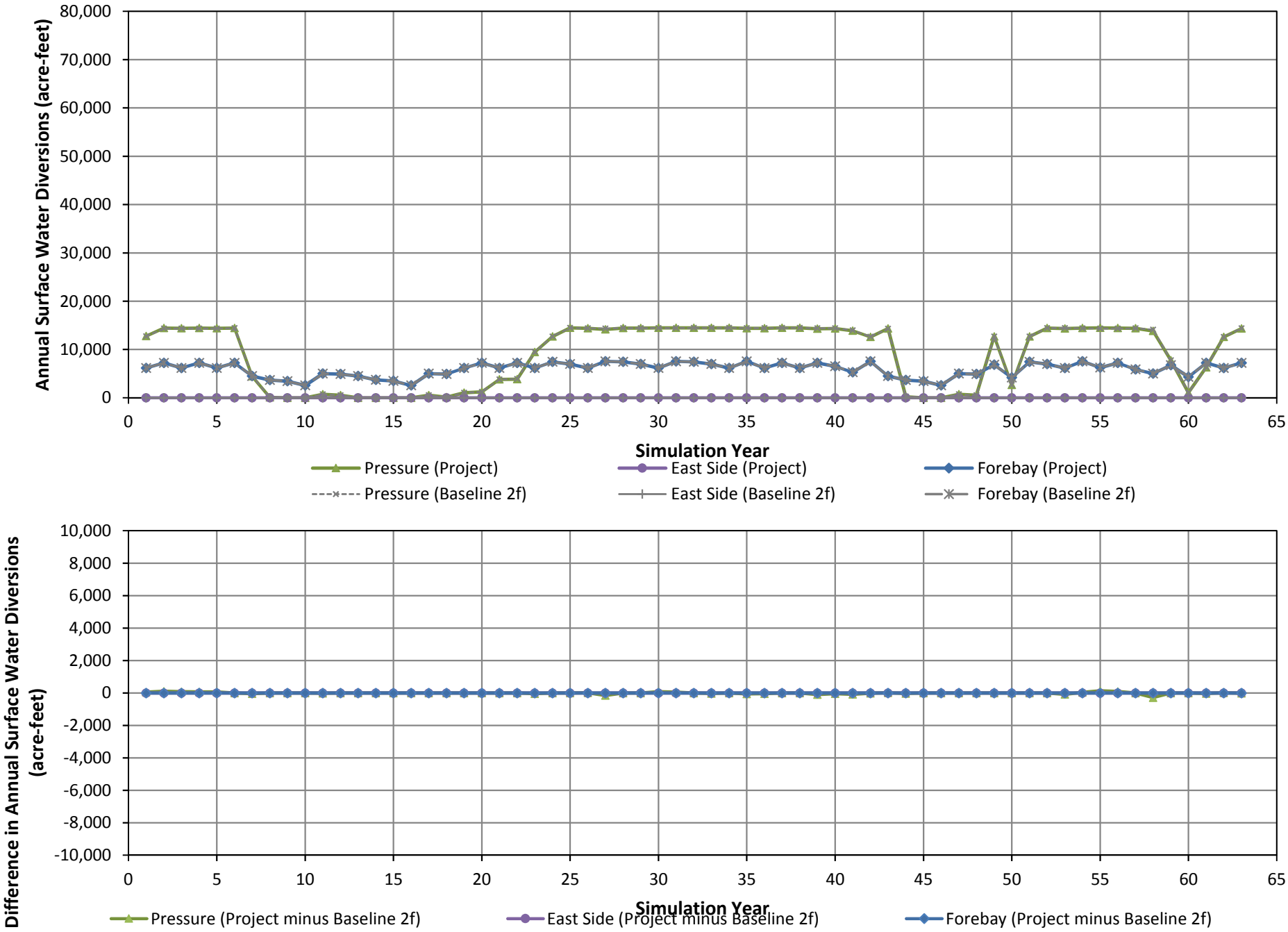

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Figure 14e
Simulated Annual Surface Water Diversions
Project Run 4: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project

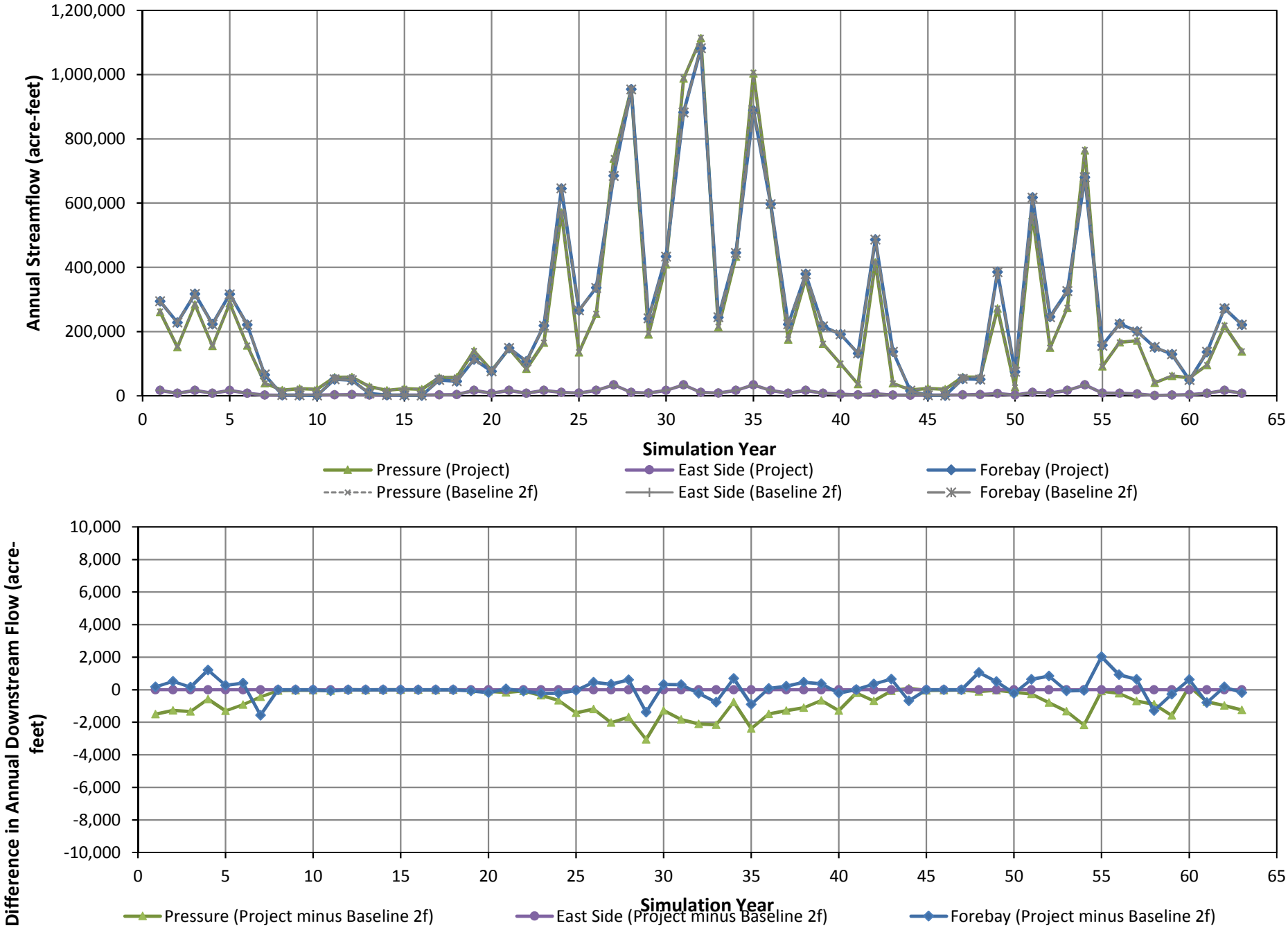

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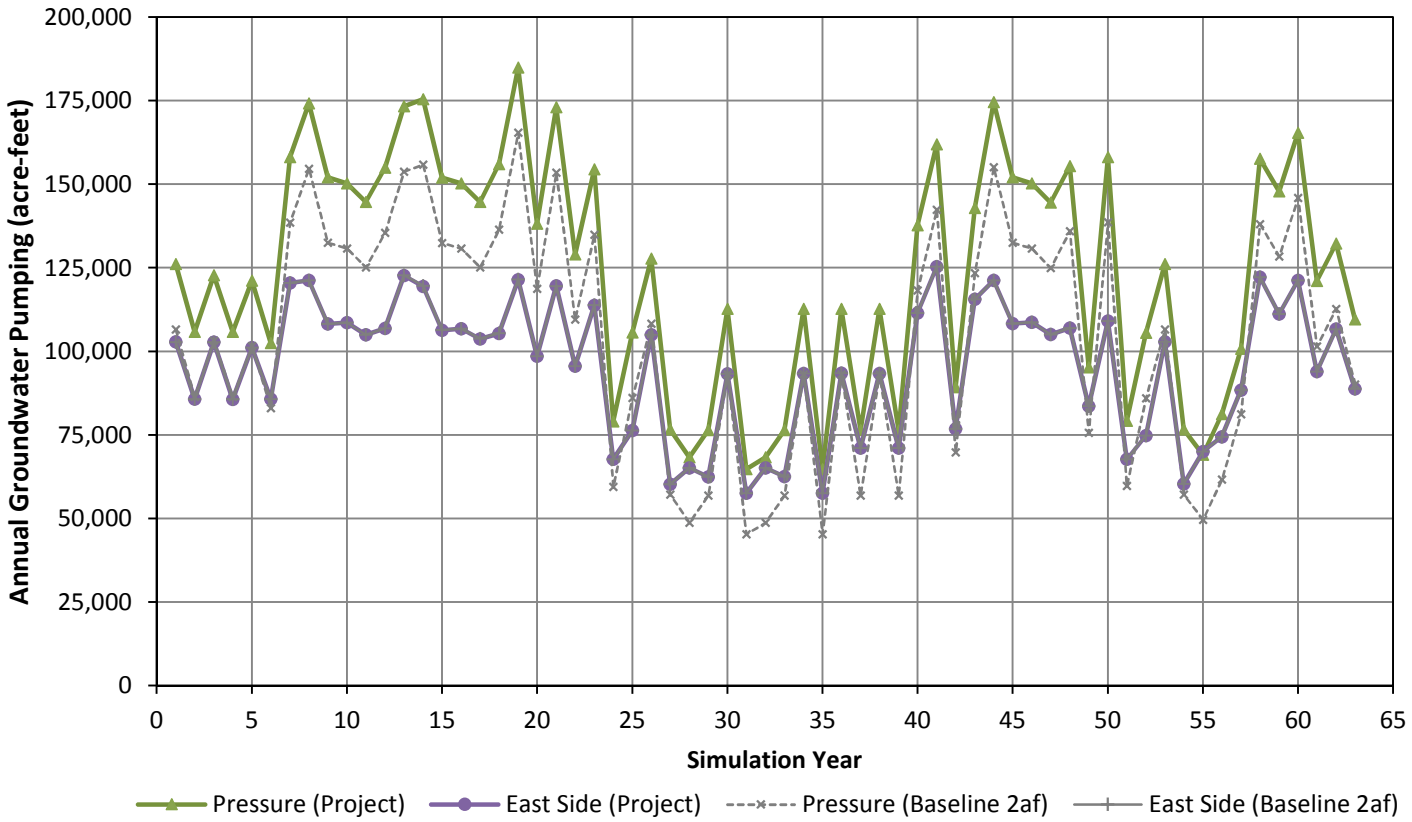
Figure 14f
Simulated Annual Downstream Flow
Project Run 4: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



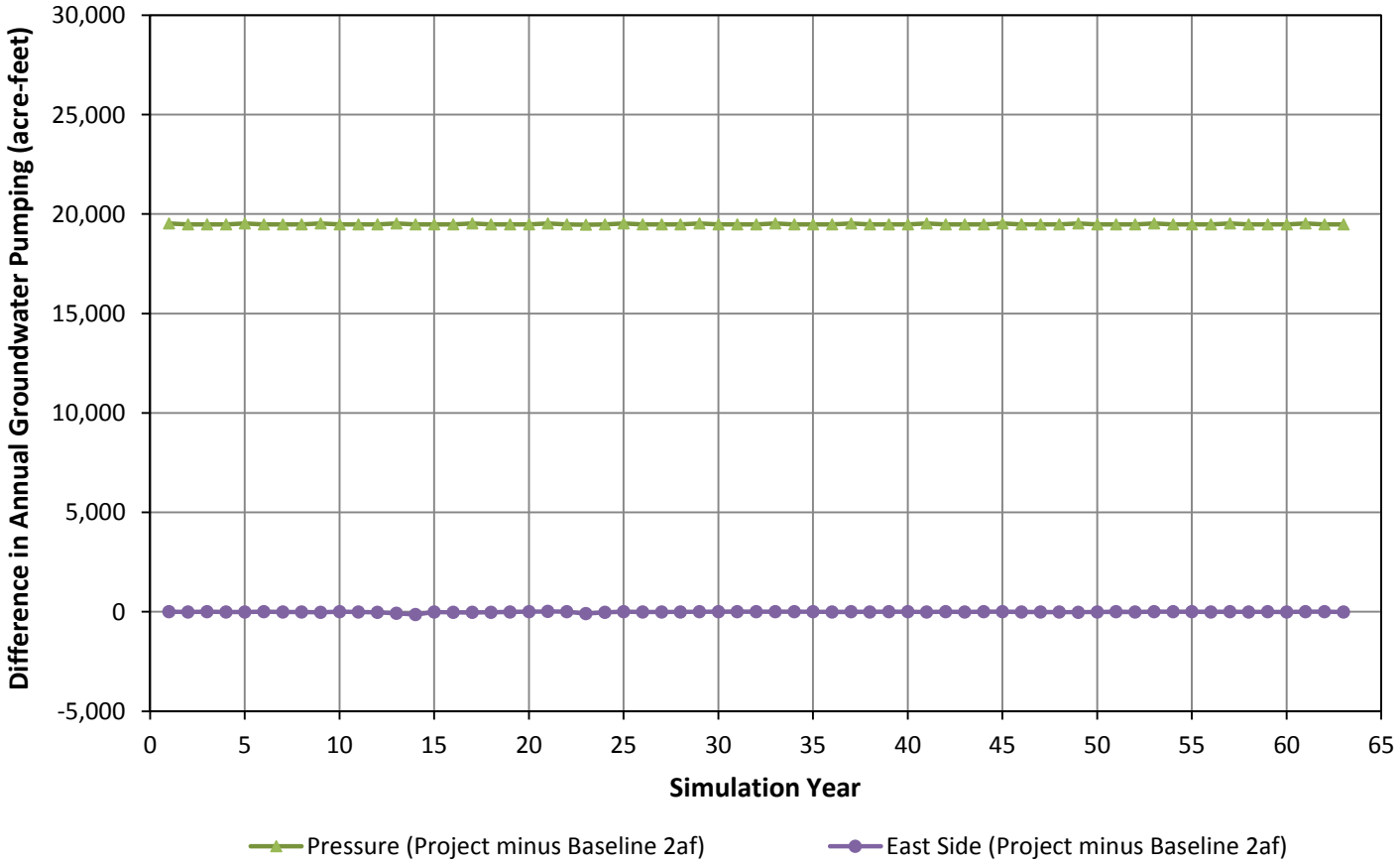


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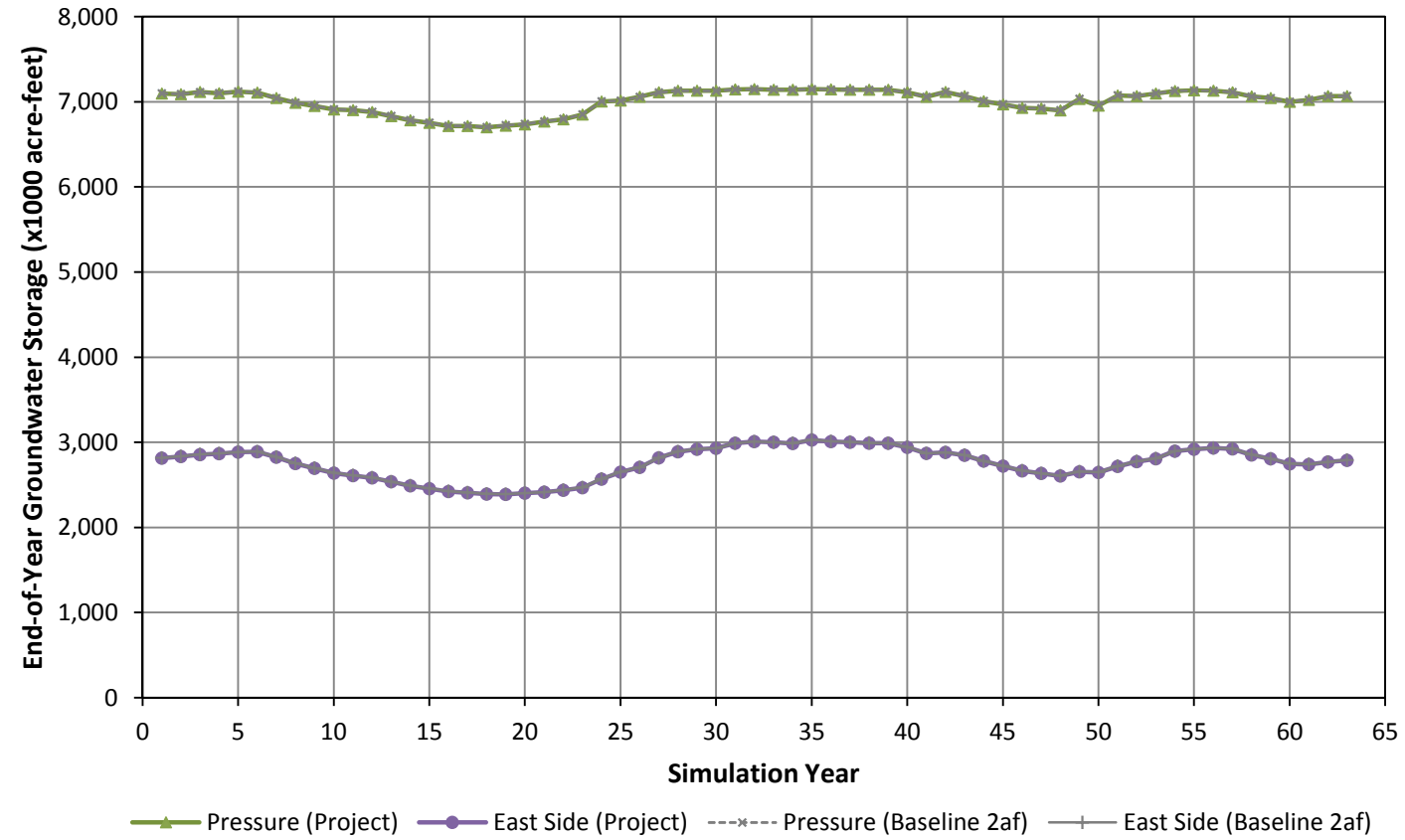
Figure 15a
Simulated Annual Groundwater Pumping
Project Run 4a: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



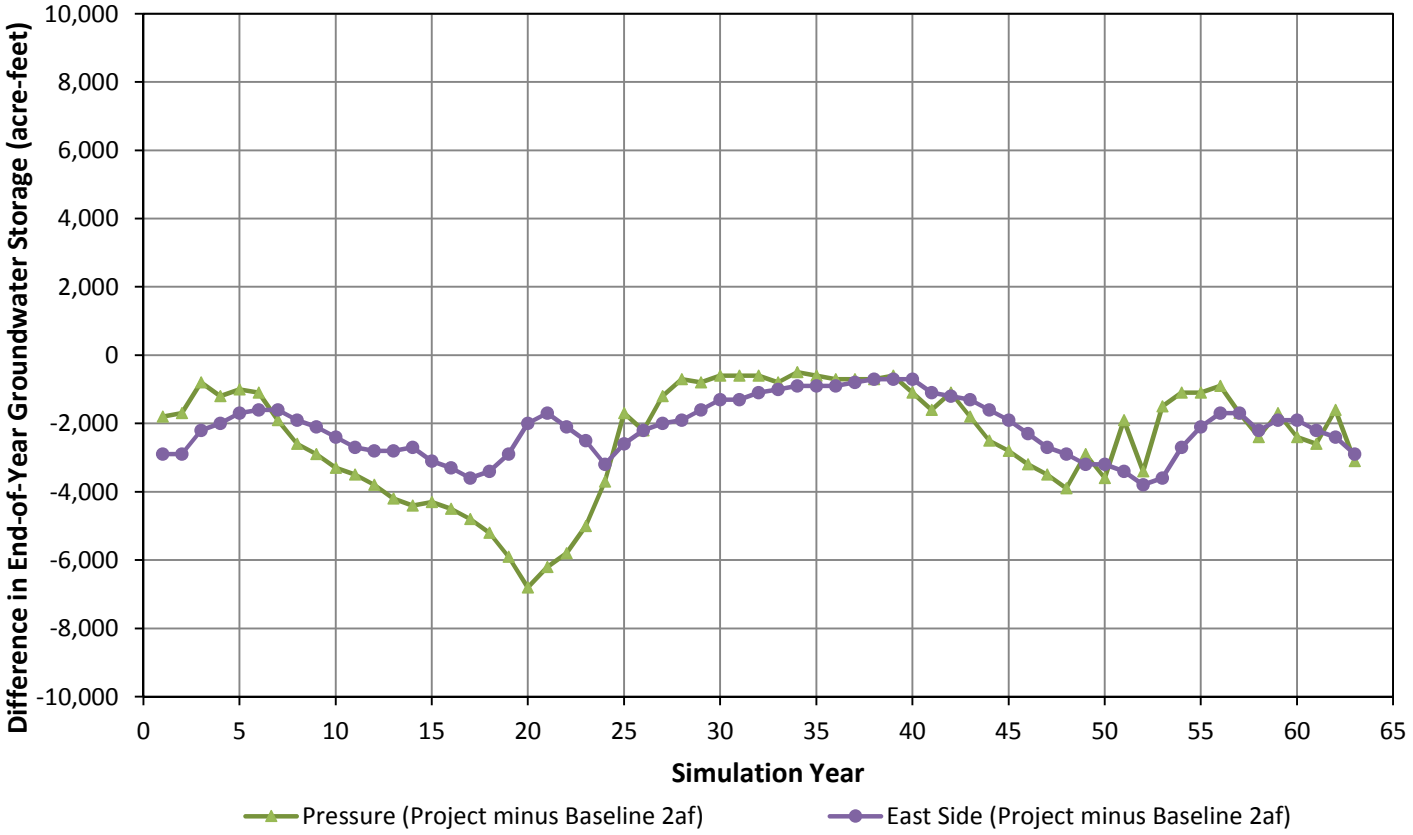


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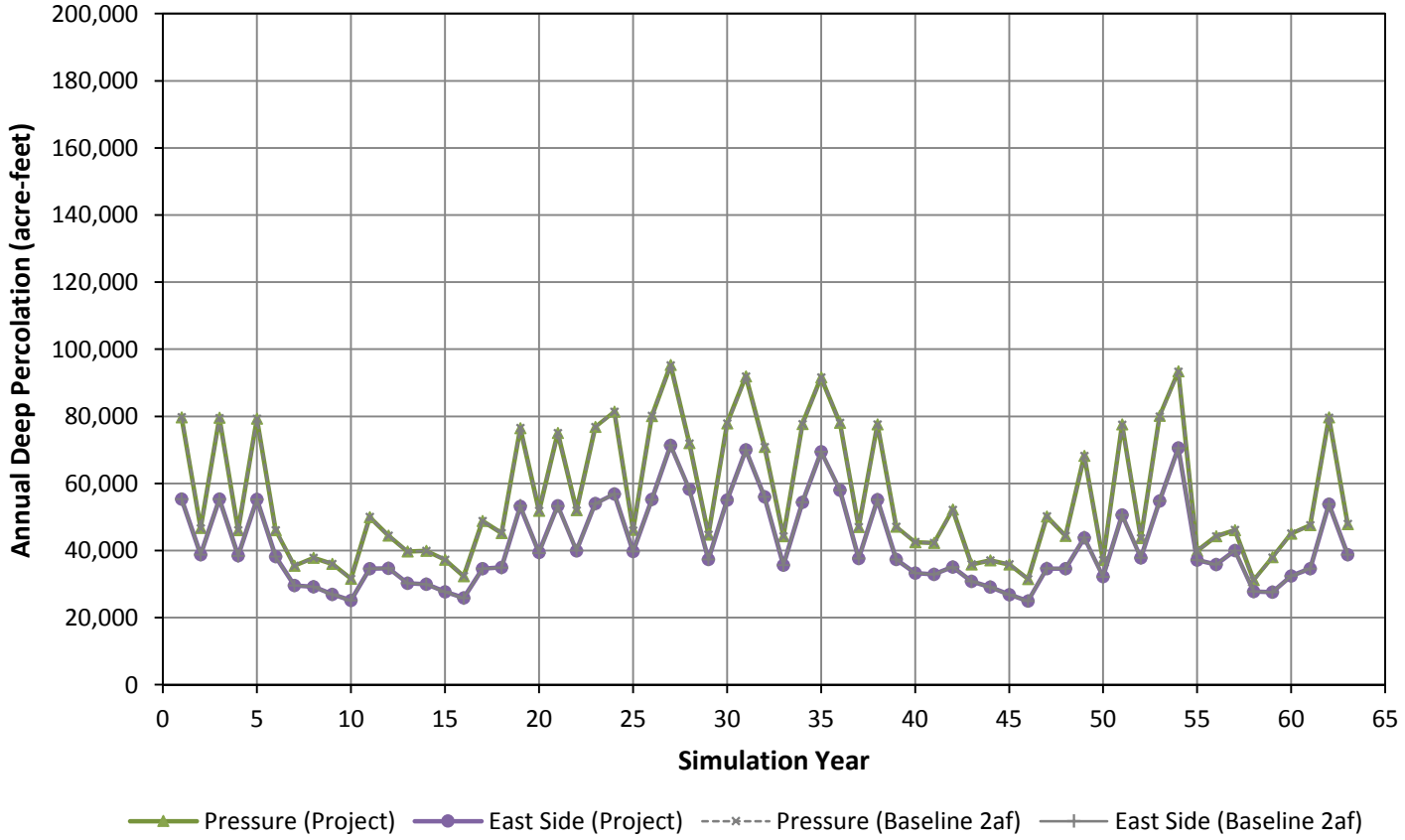
Figure 15b
Simulated End-of-Year Groundwater Storage
Project Run 4a: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



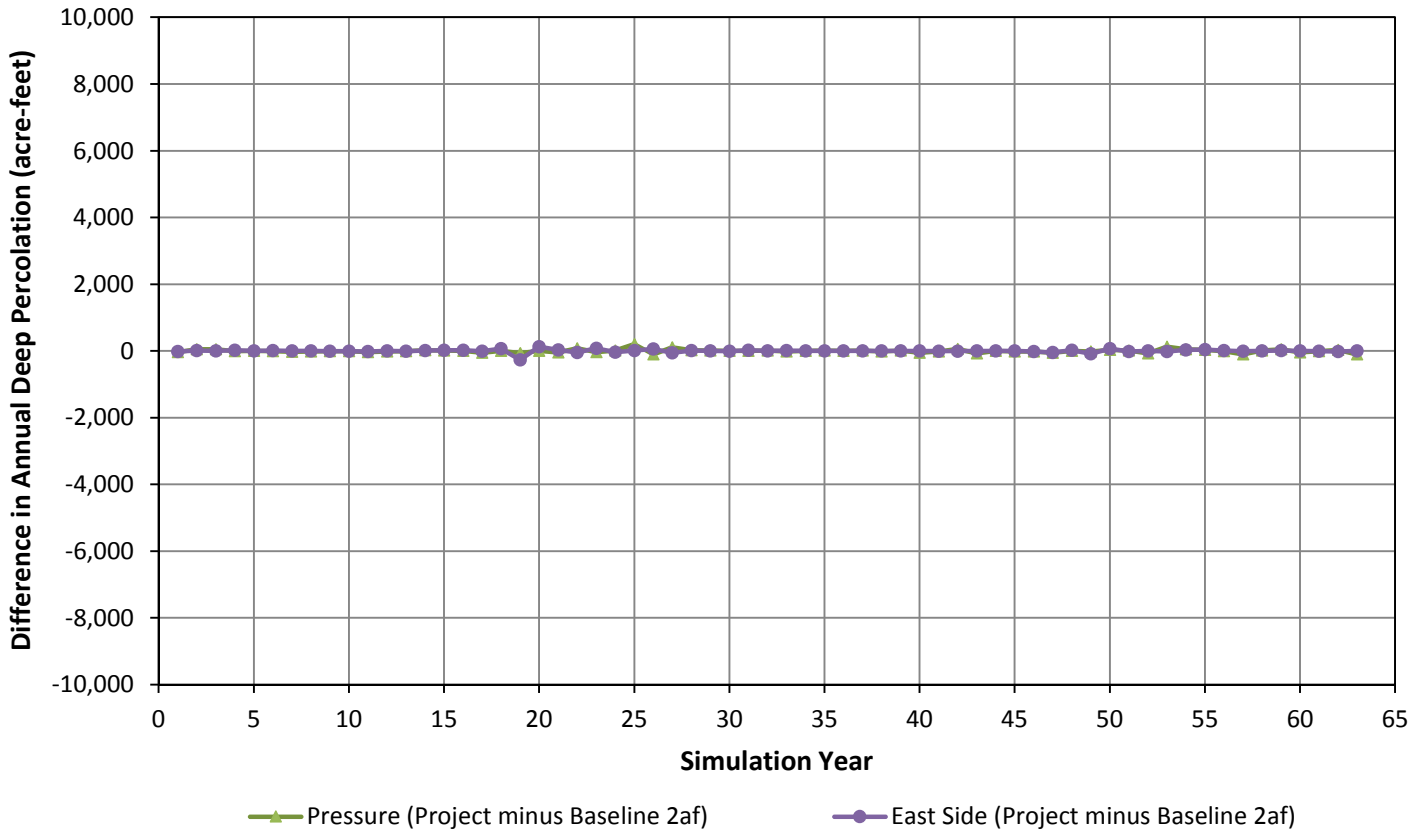


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Figure 15c
Simulated Annual Deep Percolation
Project Run 4a: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project

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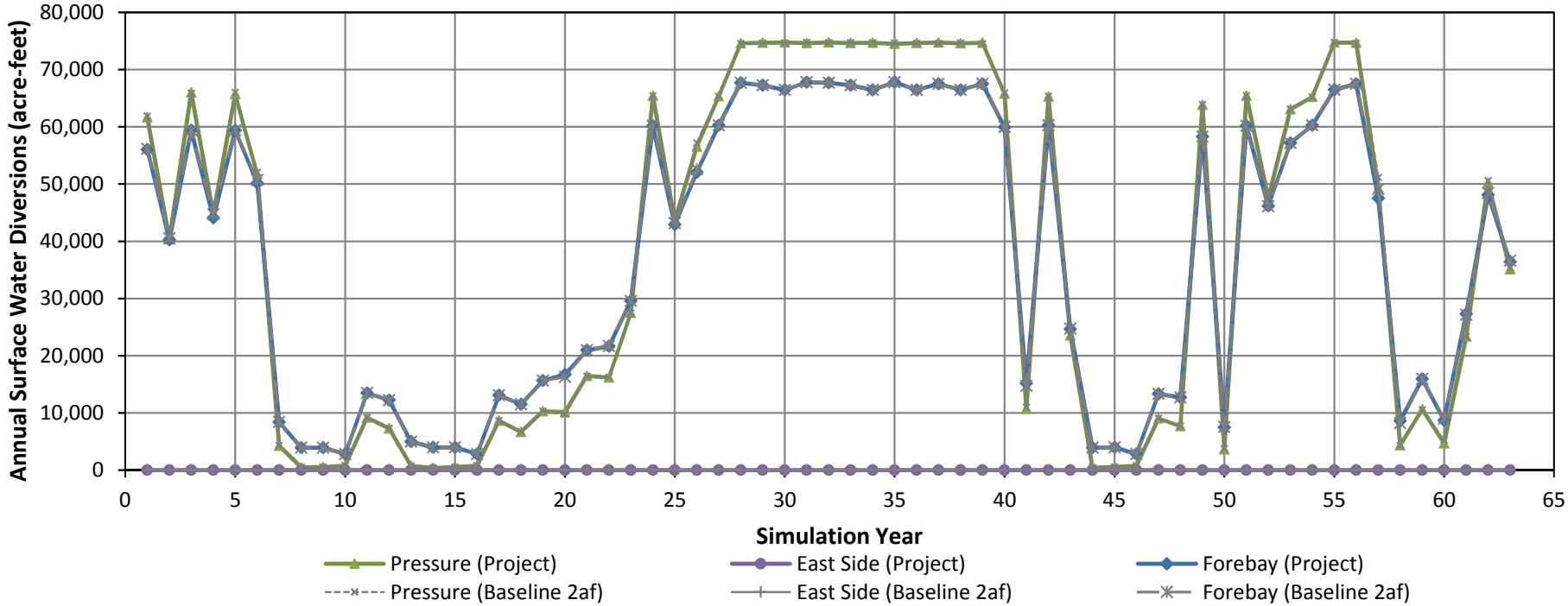
Figure 15d
Simulated Annual Streambed Infiltration
Project Run 4a: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



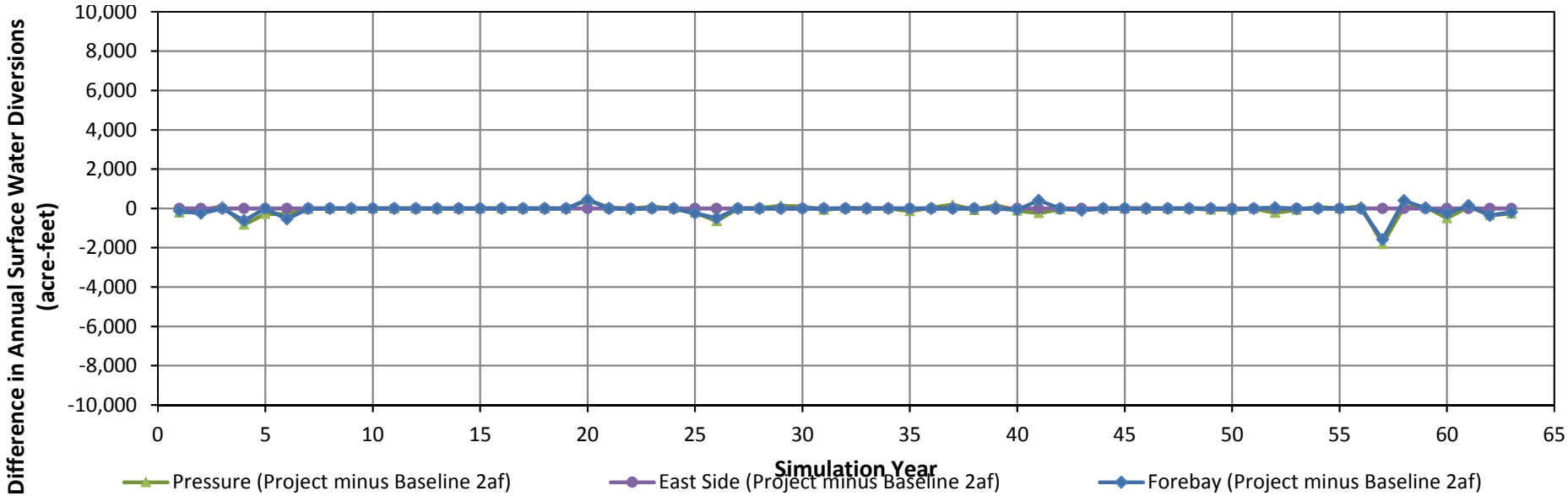


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Figure 15e
Simulated Annual Surface Water Diversions
Project Run 4a: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project

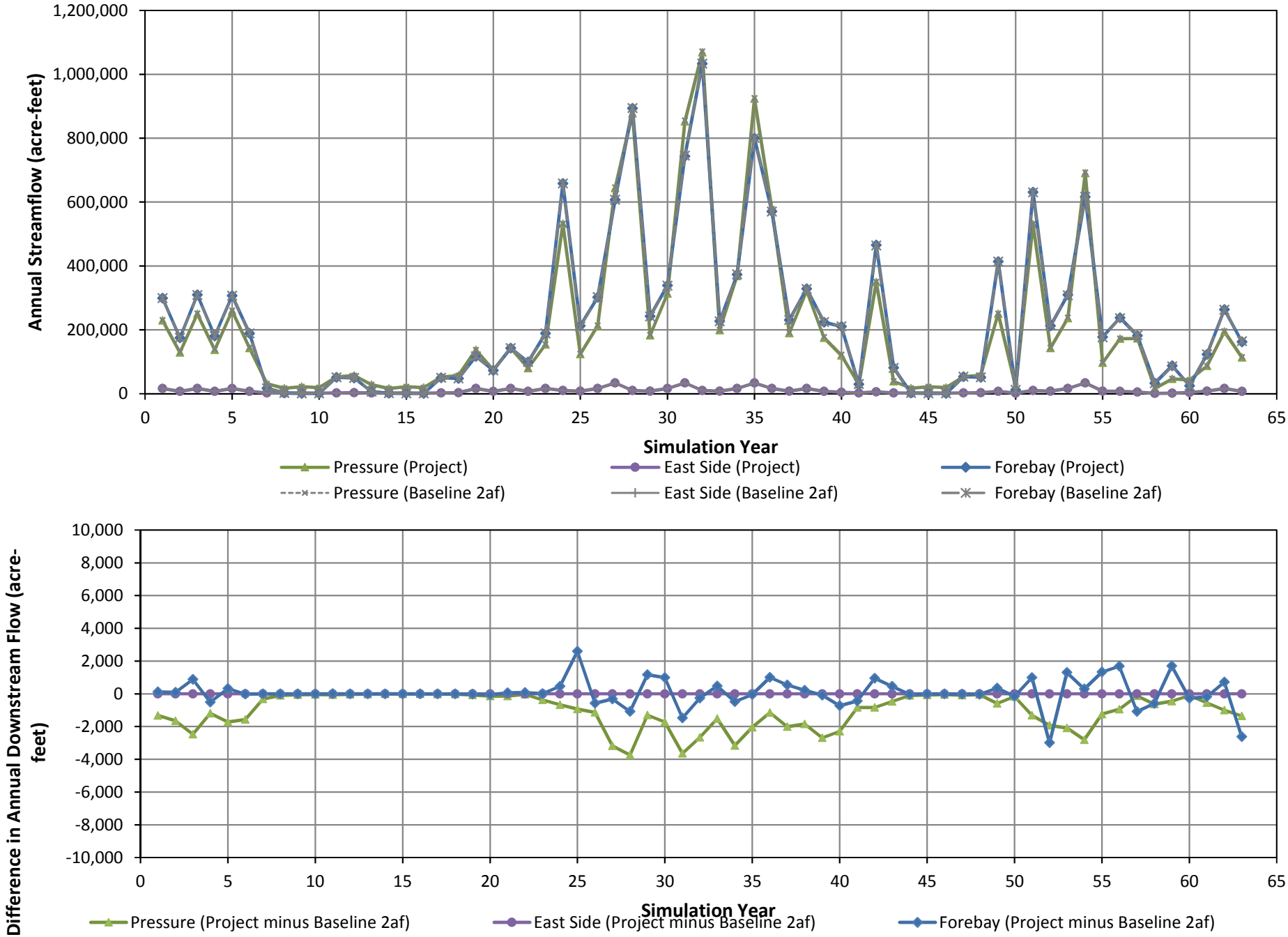

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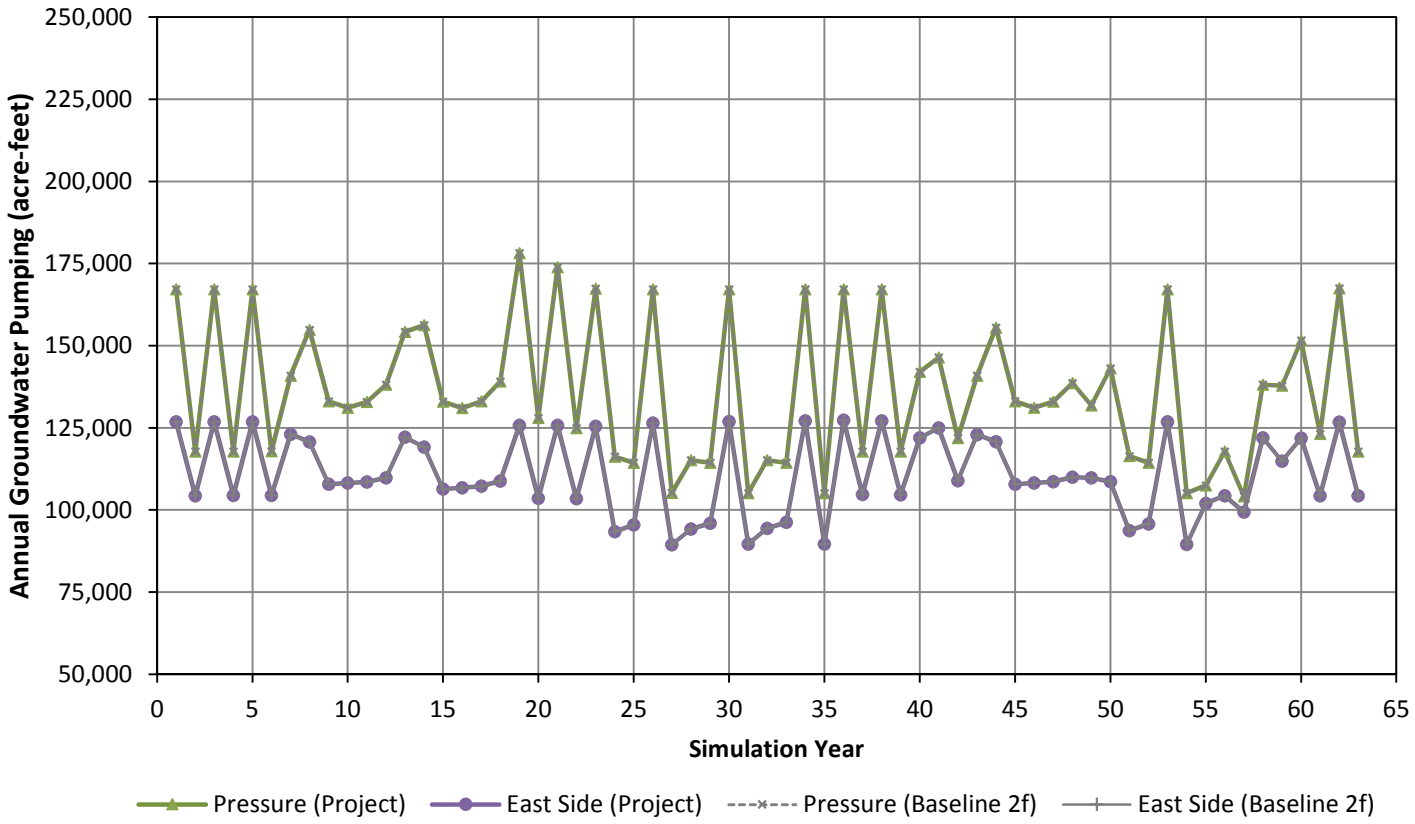
Figure 15f
Simulated Annual Downstream Flow
Project Run 4a: CEMEX 24.1 MGD
Monterey Peninsula Water Supply Project



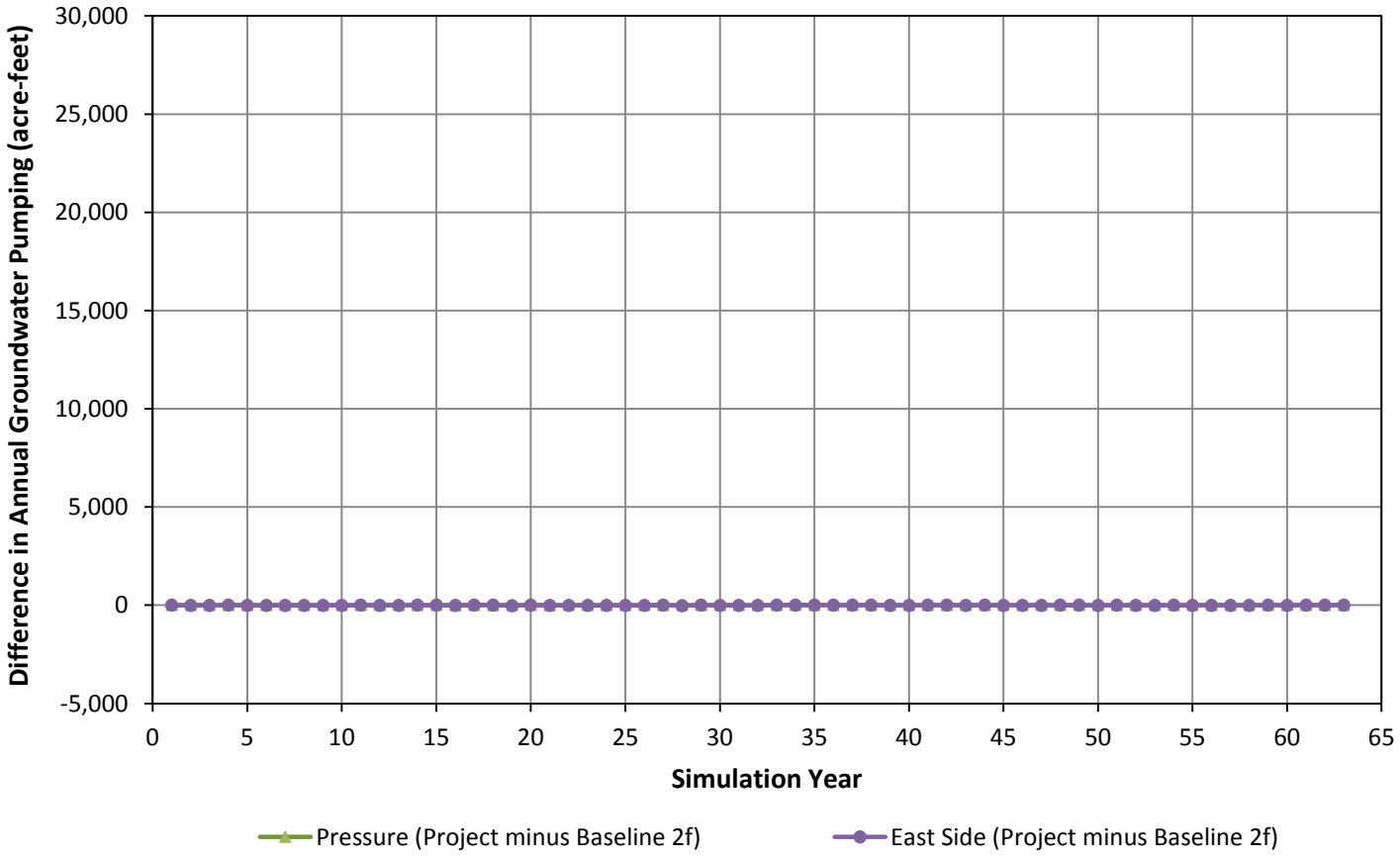


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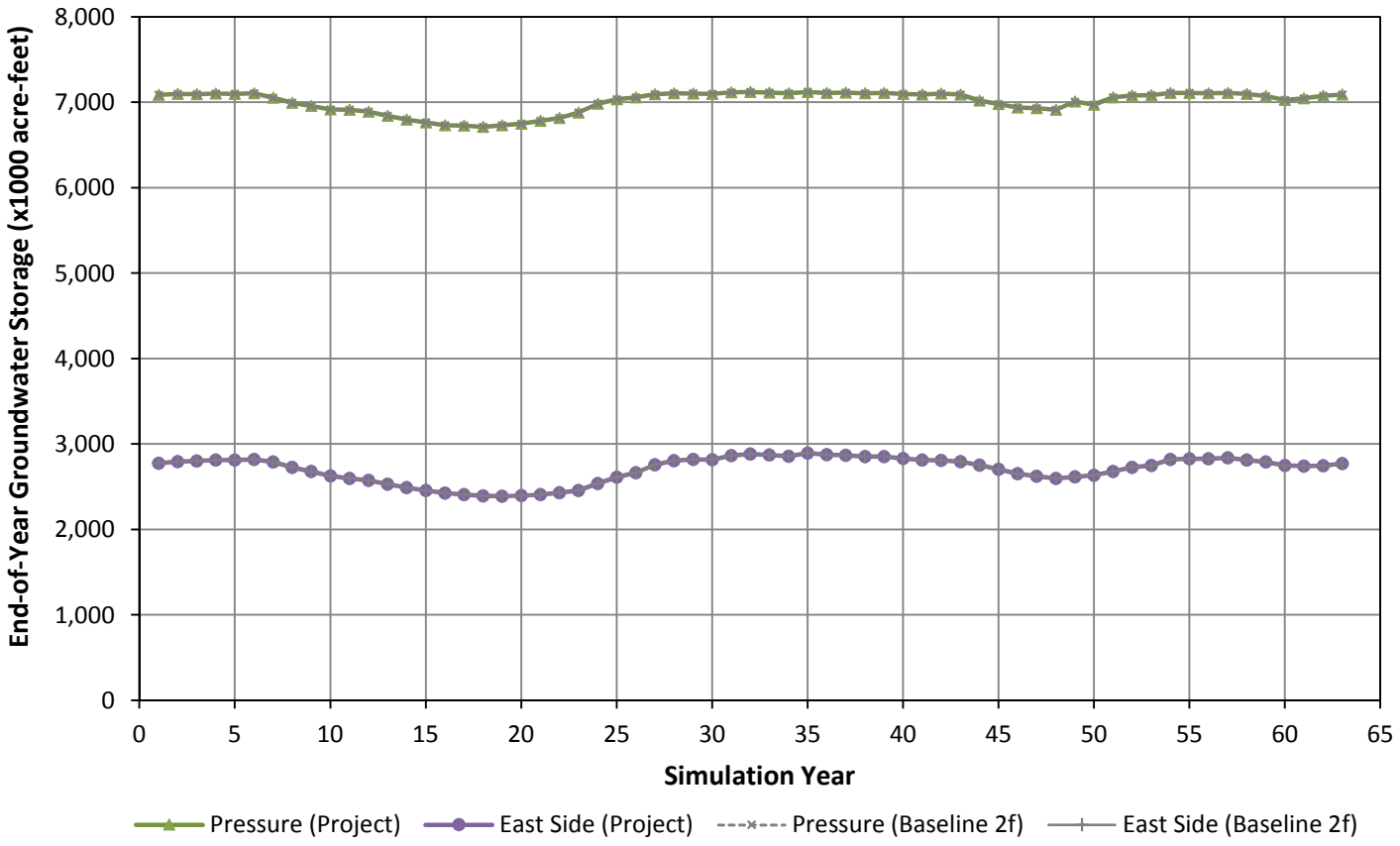
Figure 16a
Simulated Annual Groundwater Pumping
Project Run 4rf: Post project
Monterey Peninsula Water Supply Project



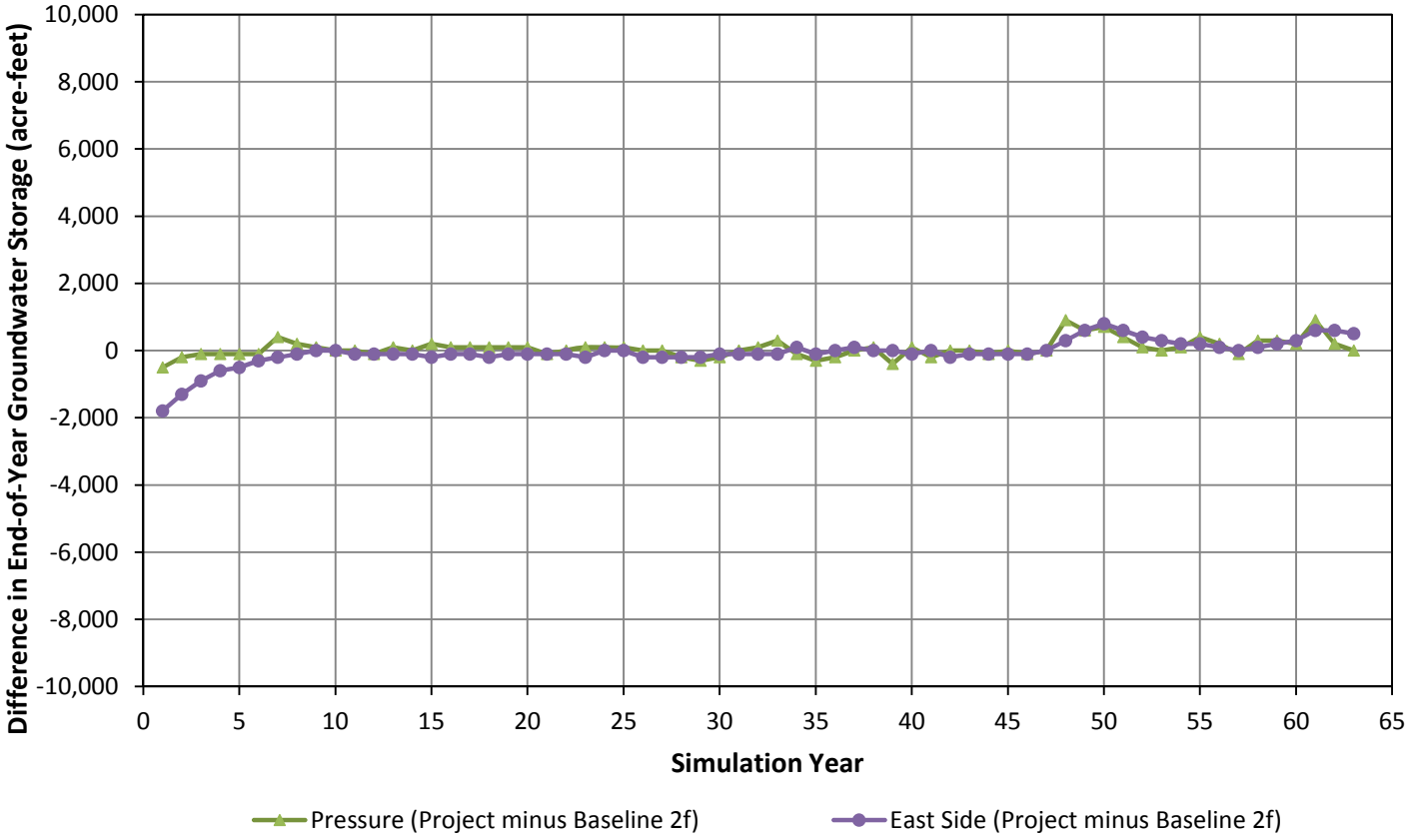


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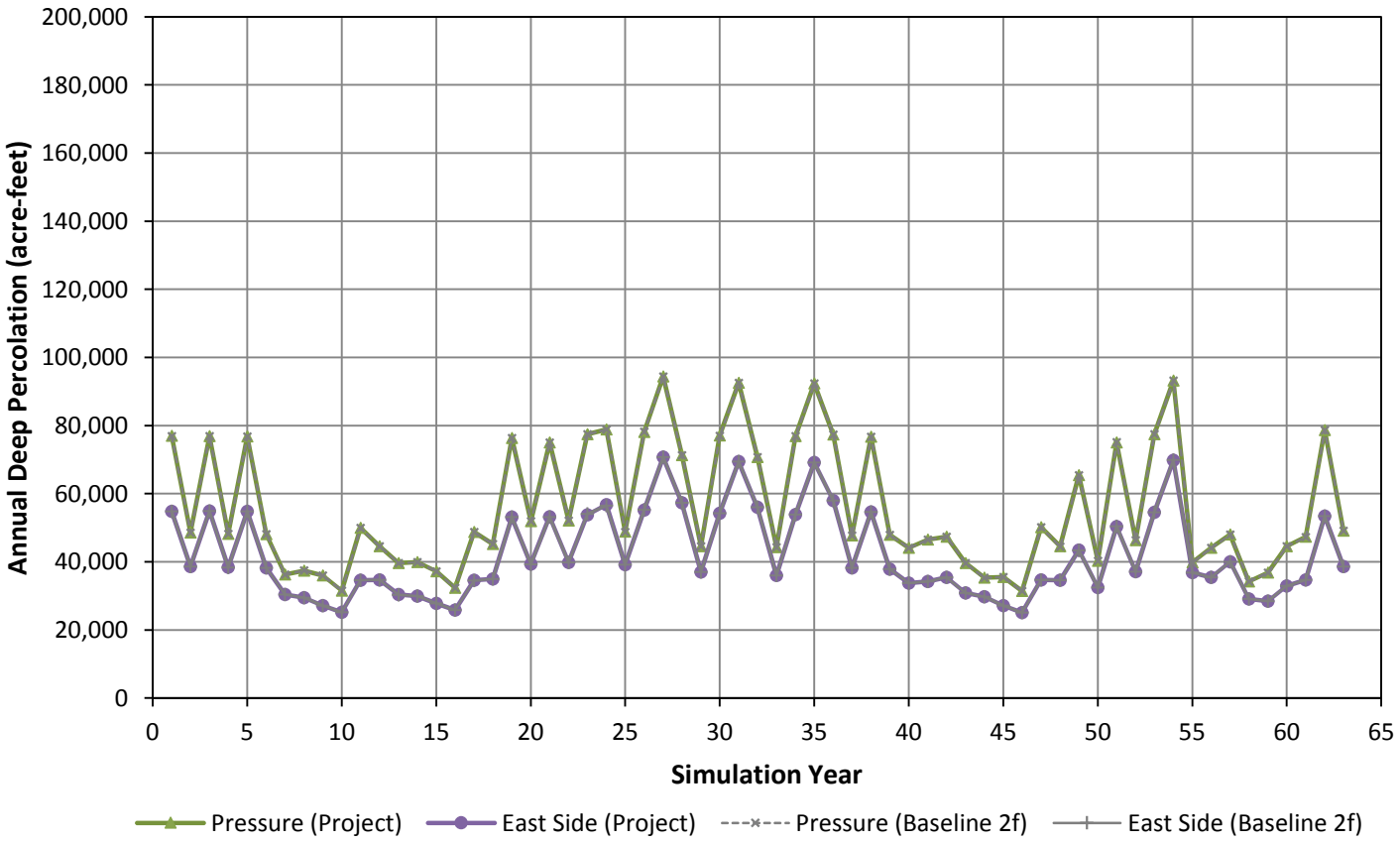
Figure 16b
Simulated End-of-Year Groundwater Storage
Project Run 4rf: Post project
Monterey Peninsula Water Supply Project



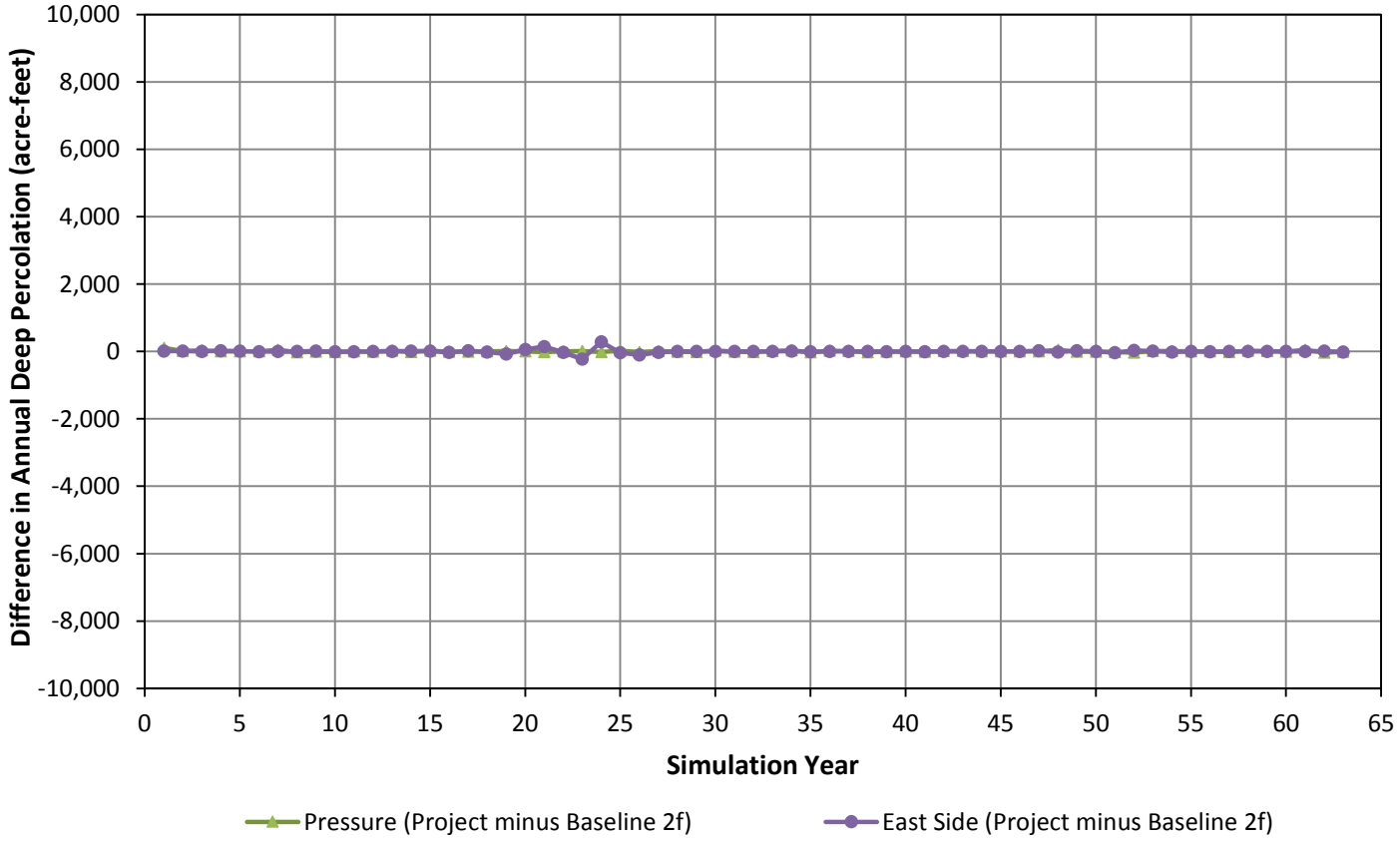


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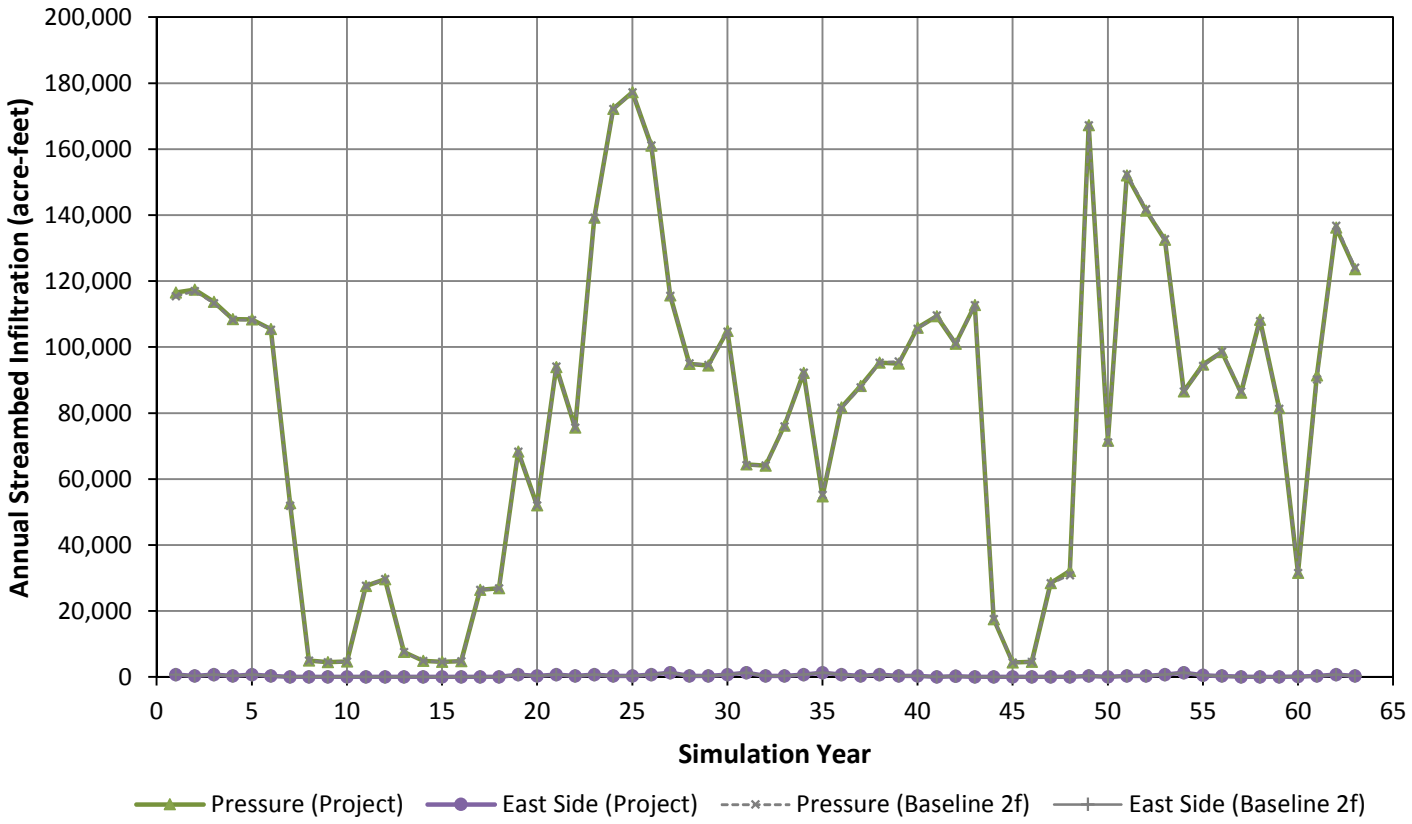
Figure 16c
Simulated Annual Deep Percolation
Project Run 4rf: Post project
Monterey Peninsula Water Supply Project



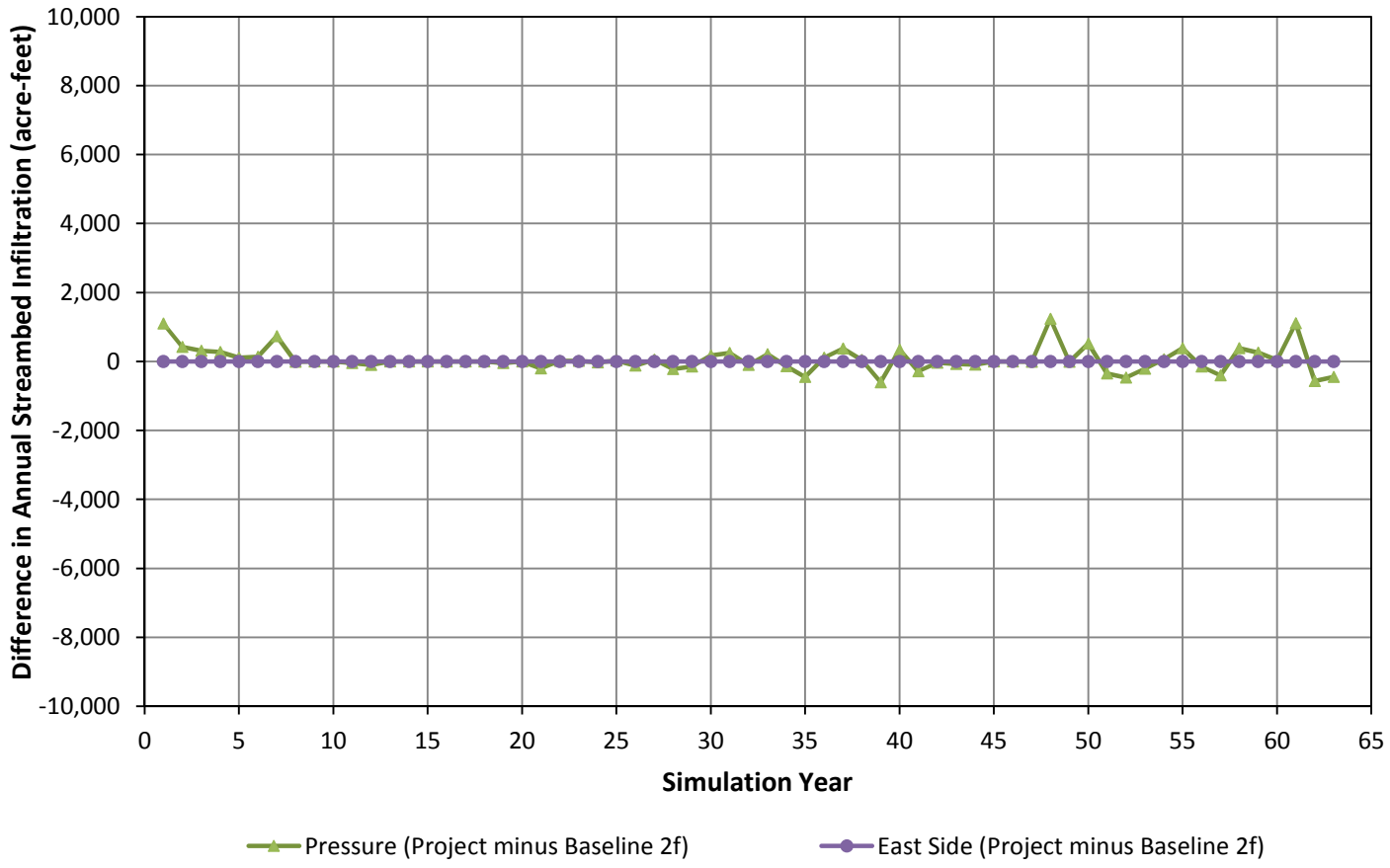


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Figure 16d
Simulated Annual Streambed Infiltration
Project Run 4rf: Post project
Monterey Peninsula Water Supply Project

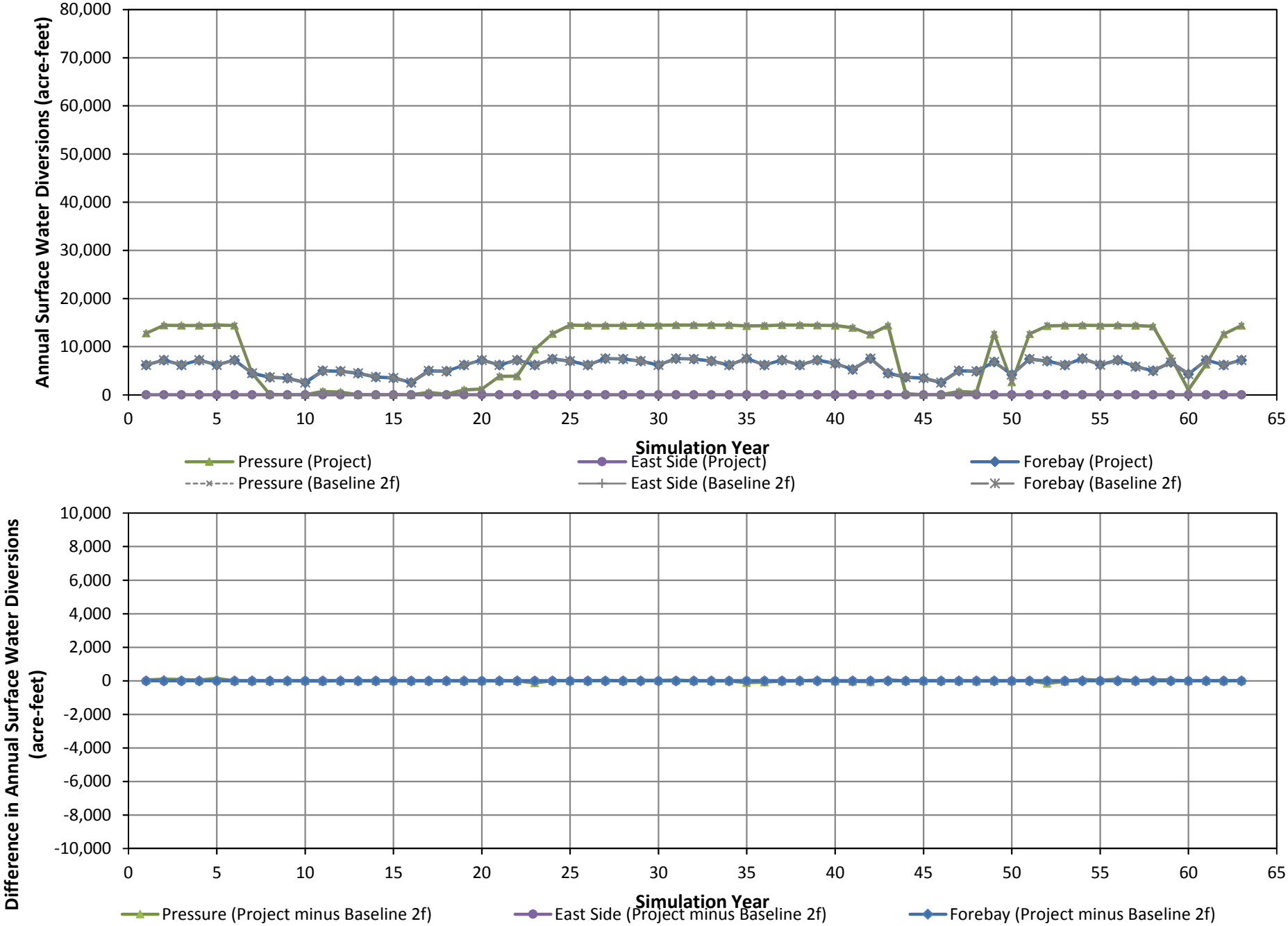

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Figure 16e
Simulated Annual Surface Water Diversions
Project Run 4rf: Post project
Monterey Peninsula Water Supply Project

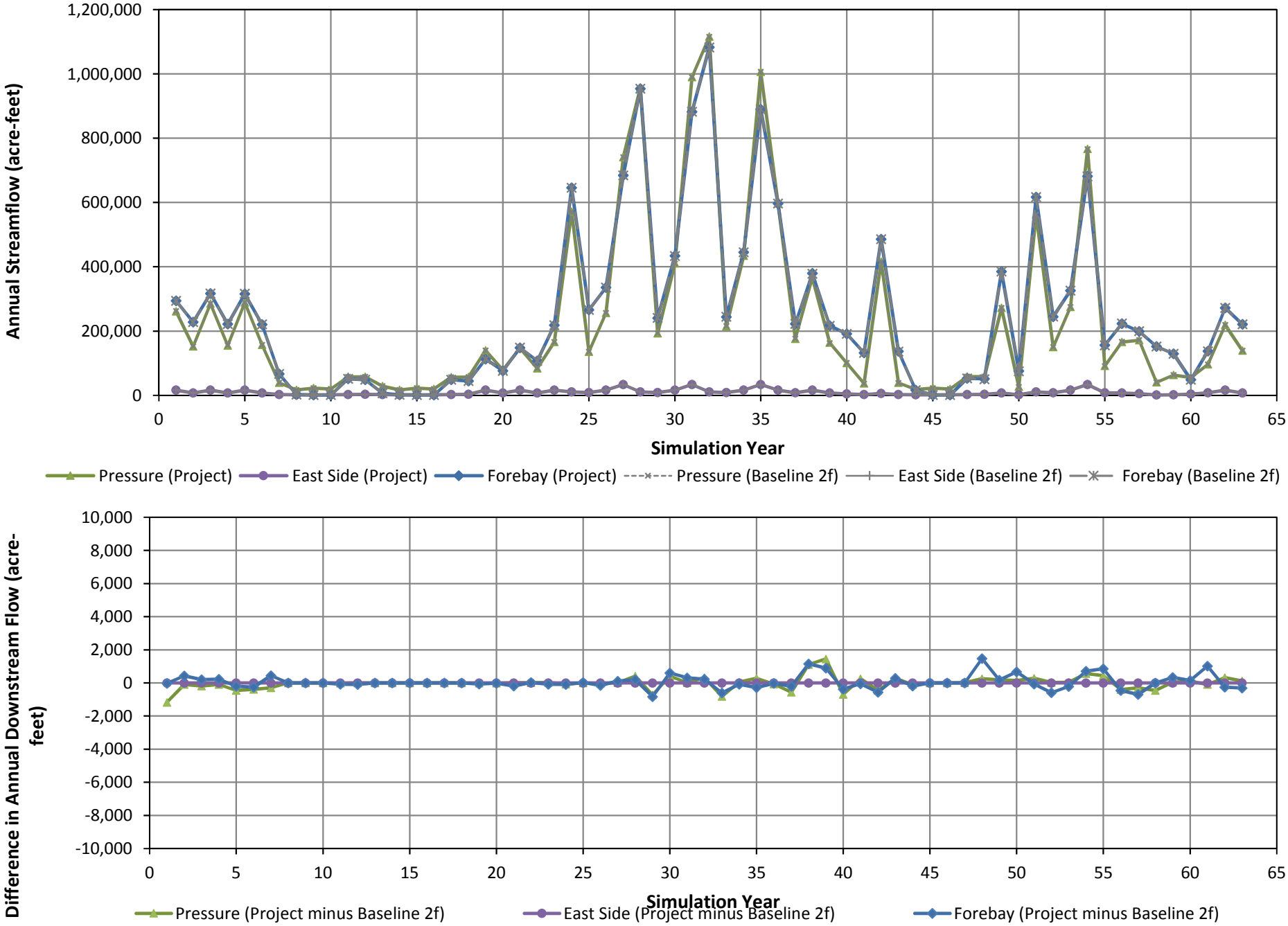

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Figure 16f
Simulated Annual Downstream Flow
Project Run 4rf: Post project
Monterey Peninsula Water Supply Project

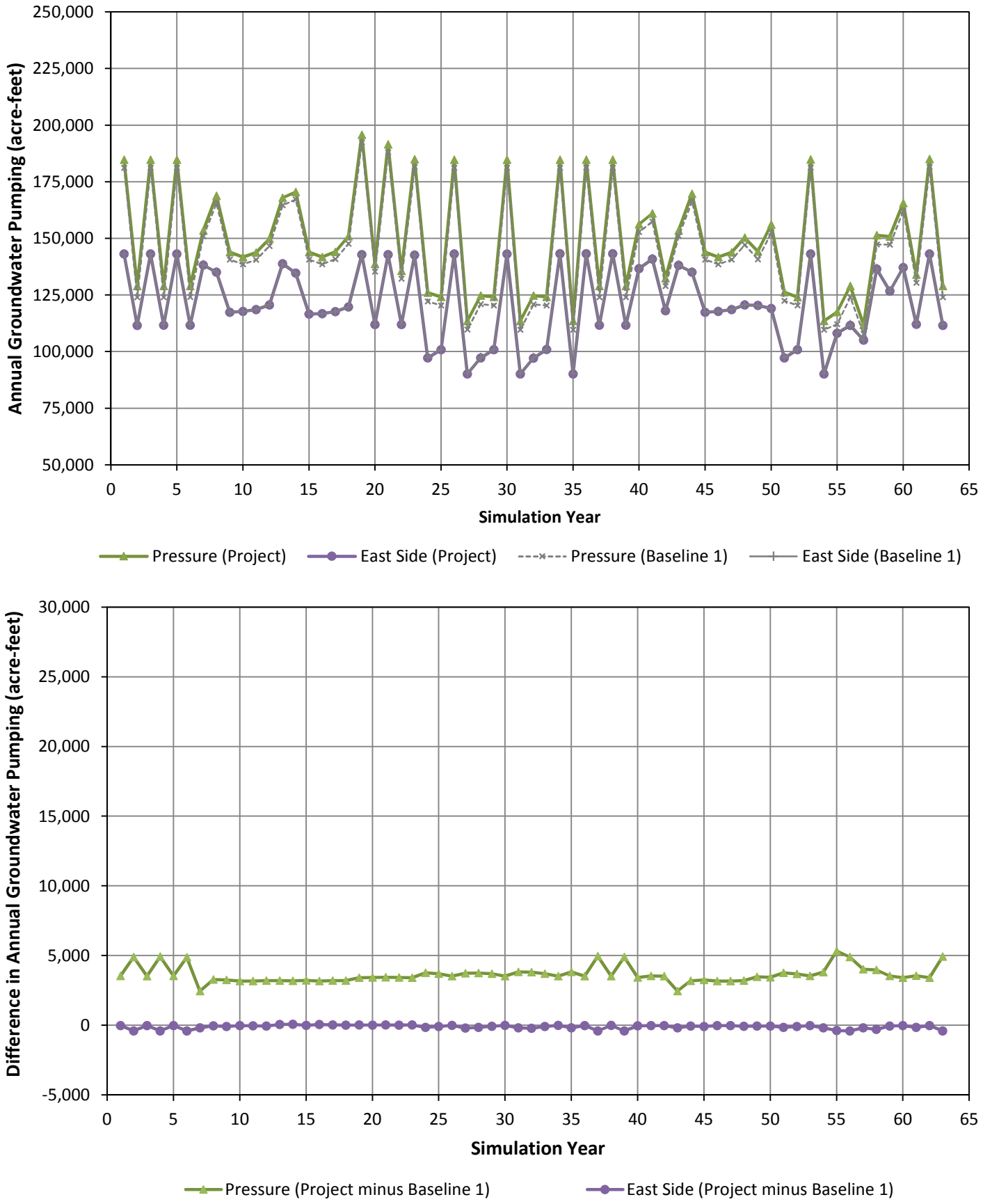

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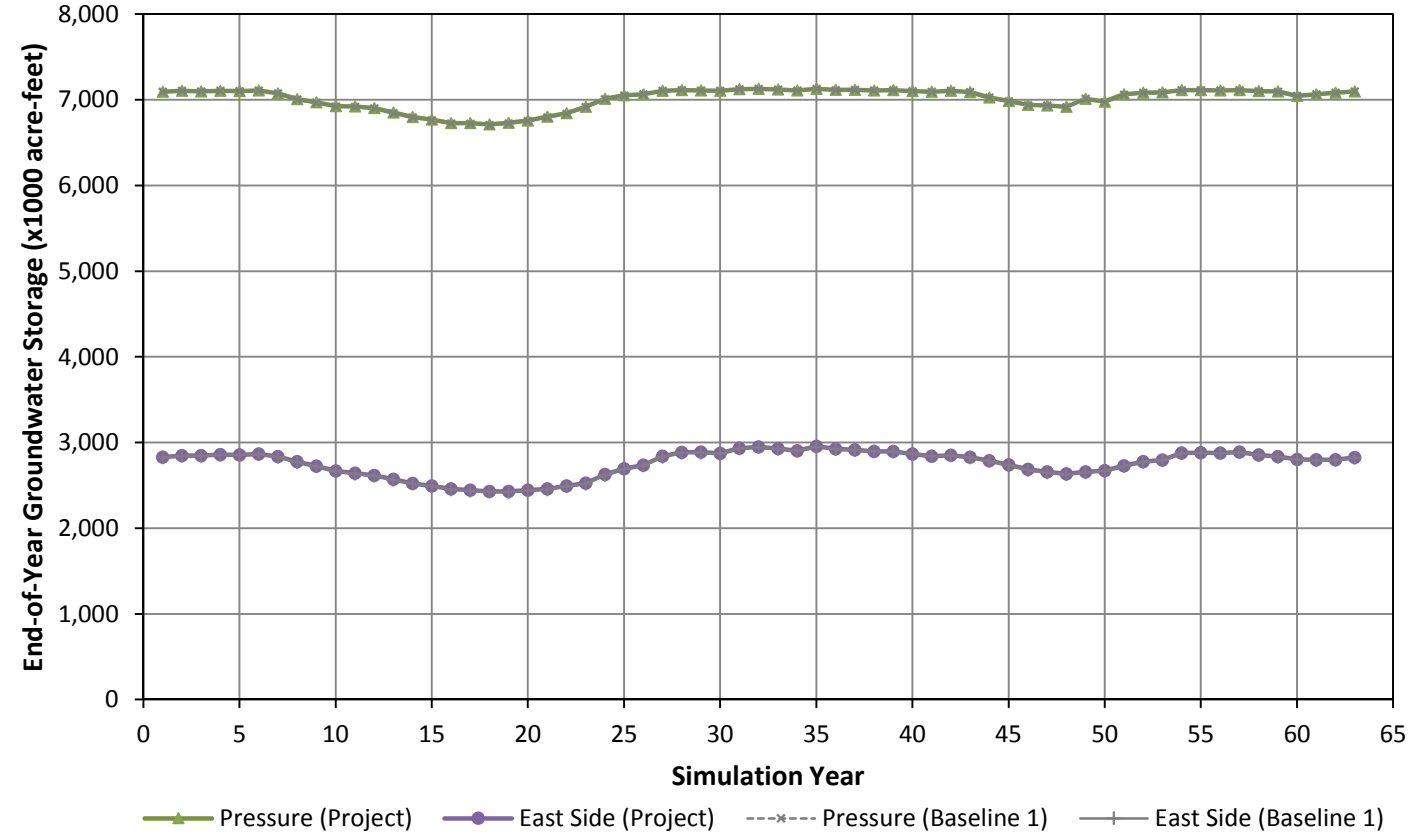
Figure 17a
Simulated Annual Groundwater Pumping
Project Run 5n: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



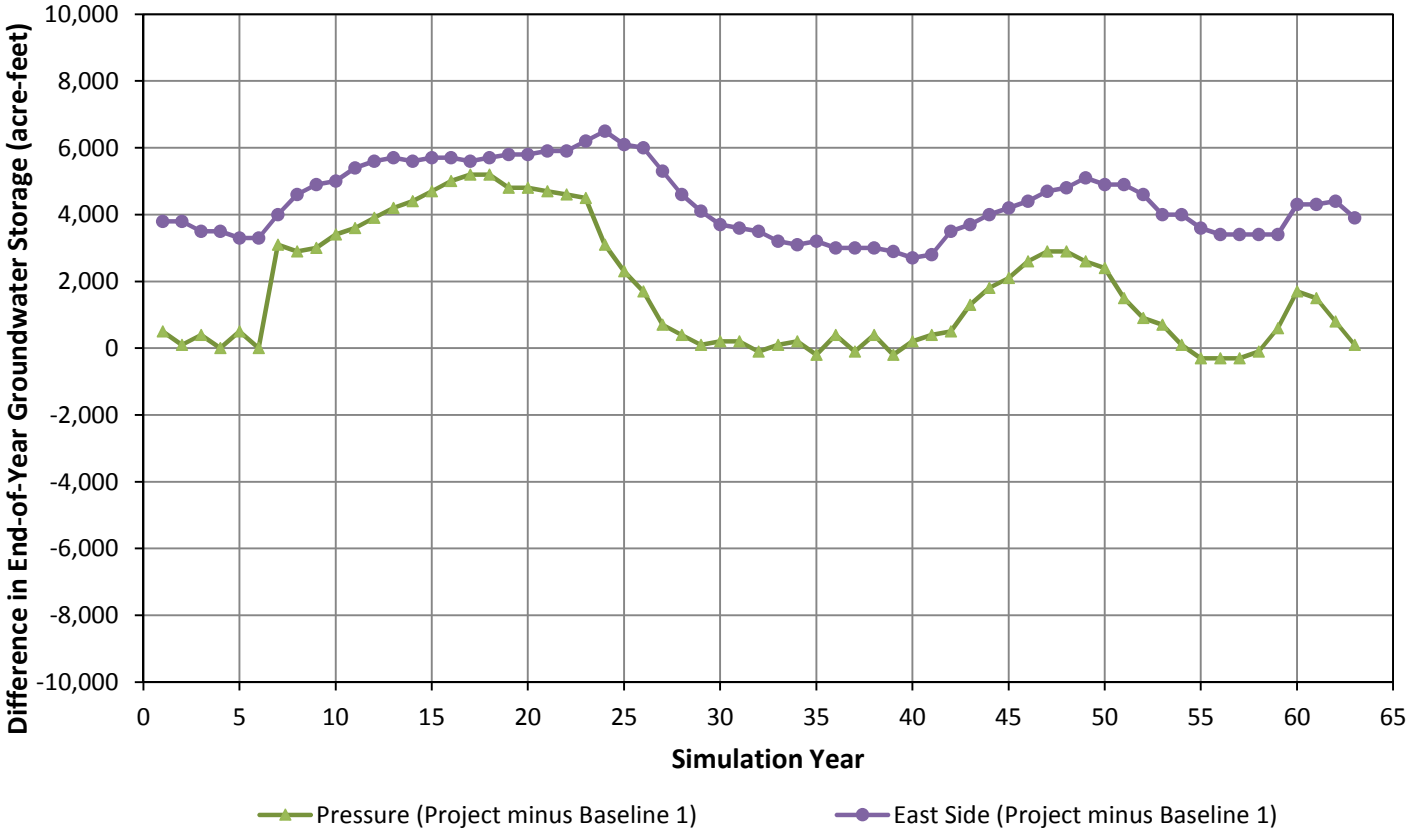


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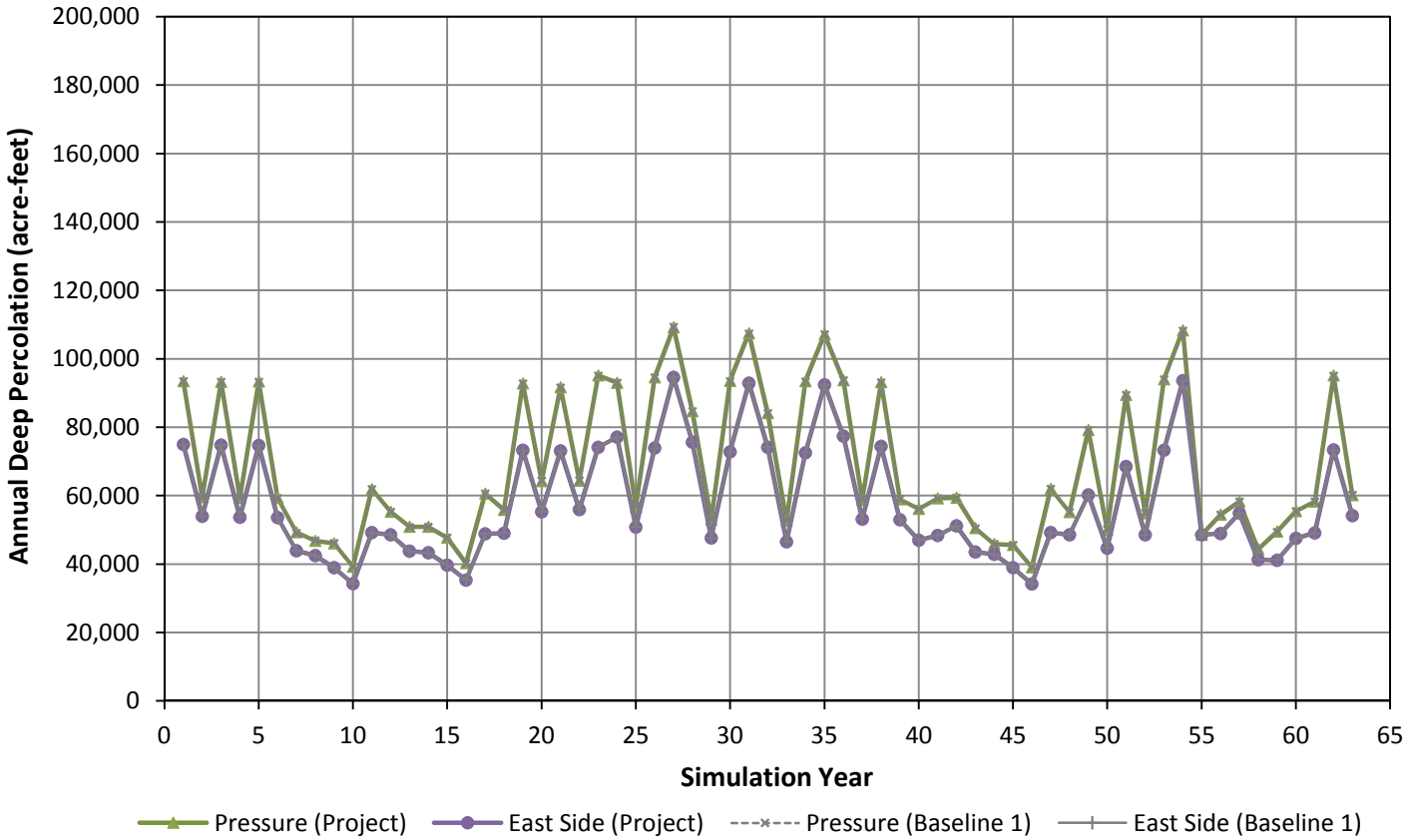
Figure 17b
Simulated End-of-Year Groundwater Storage
Project Run 5n: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



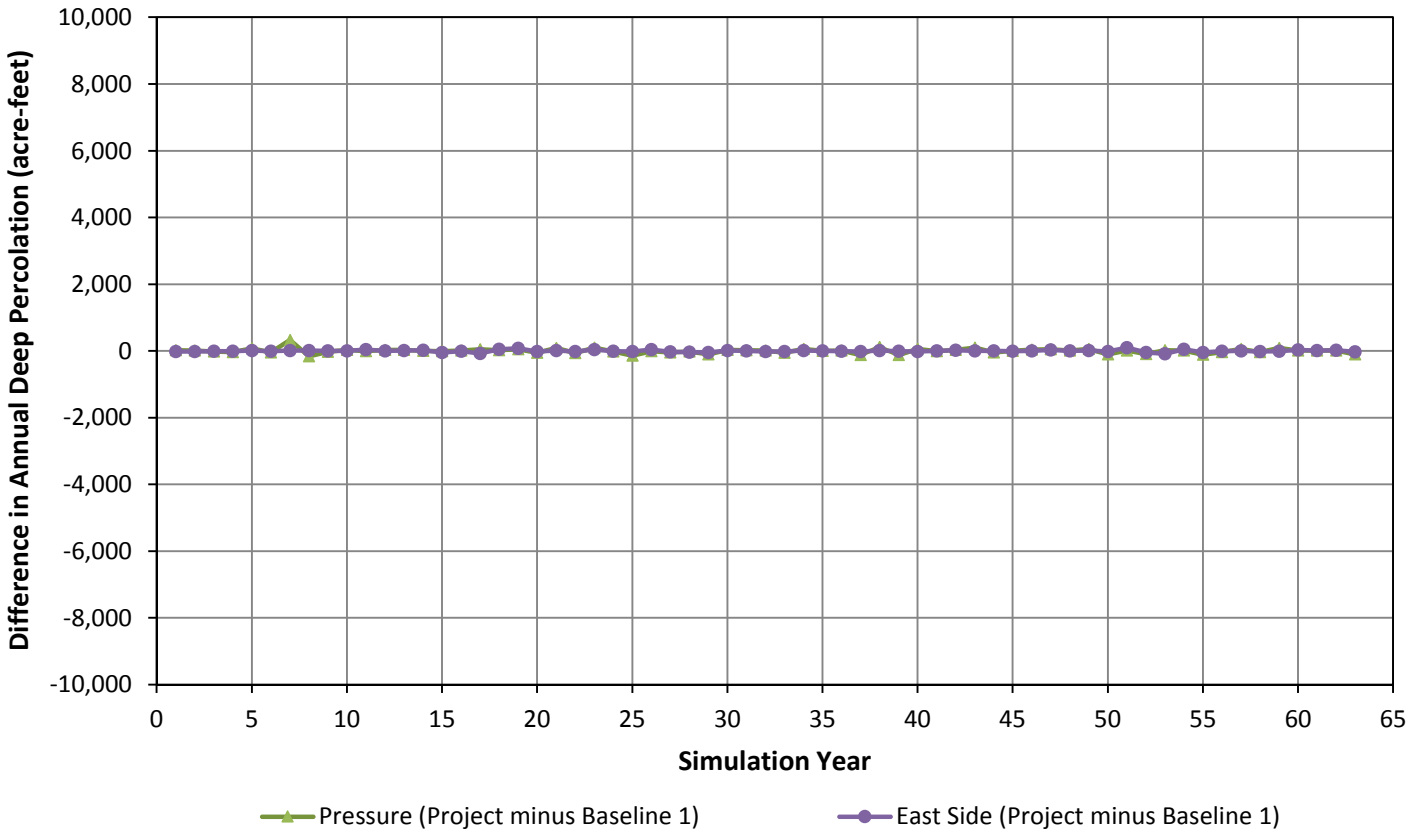


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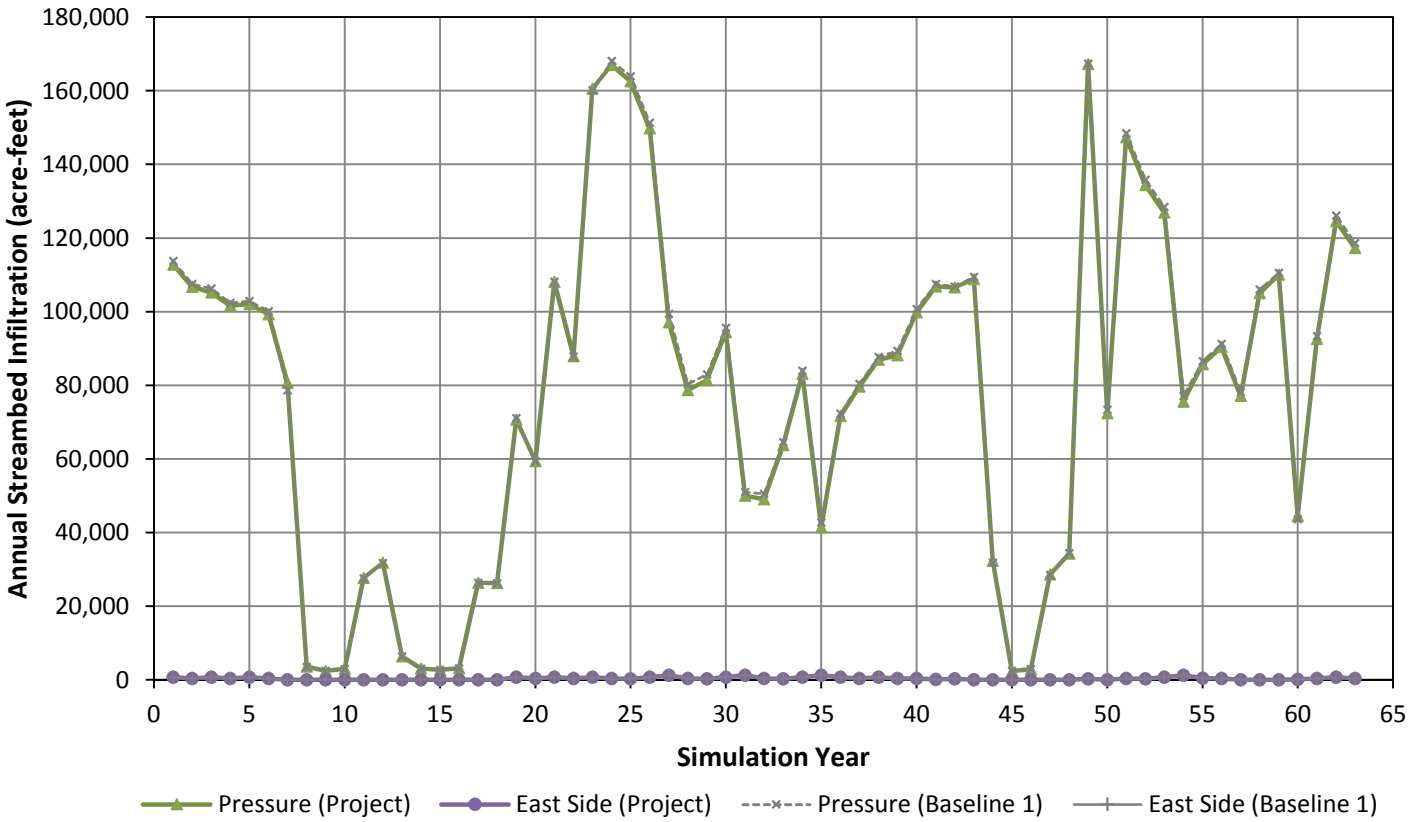
Figure 17c
Simulated Annual Deep Percolation
Project Run 5n: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



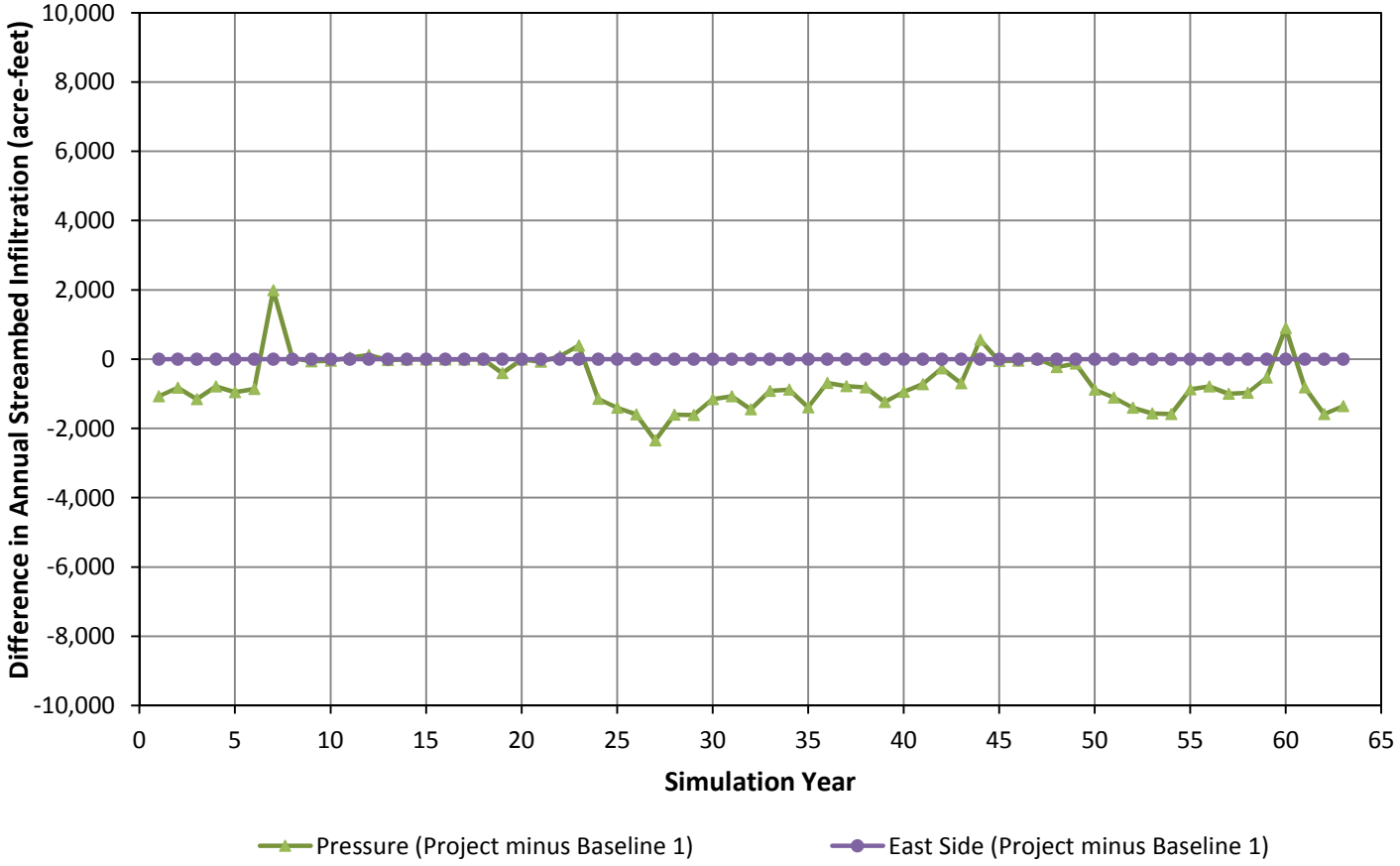


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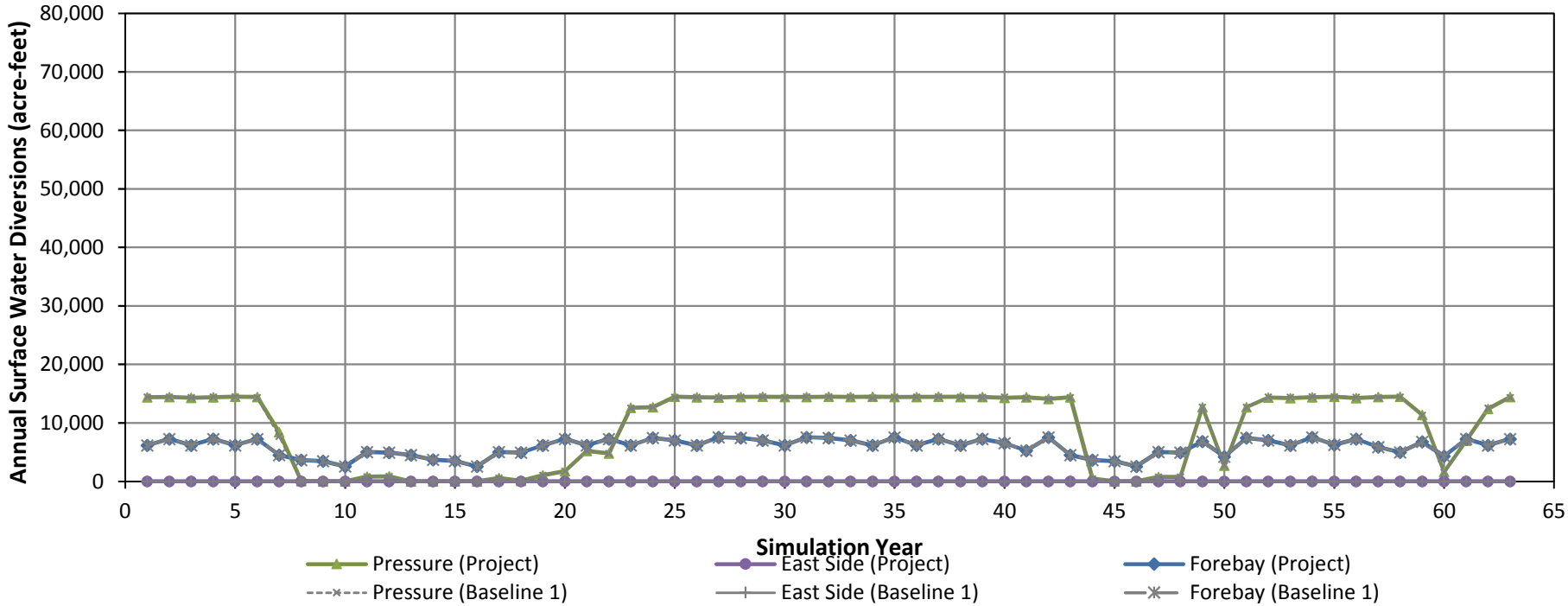
Figure 17d
Simulated Annual Streambed Infiltration
Project Run 5n: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



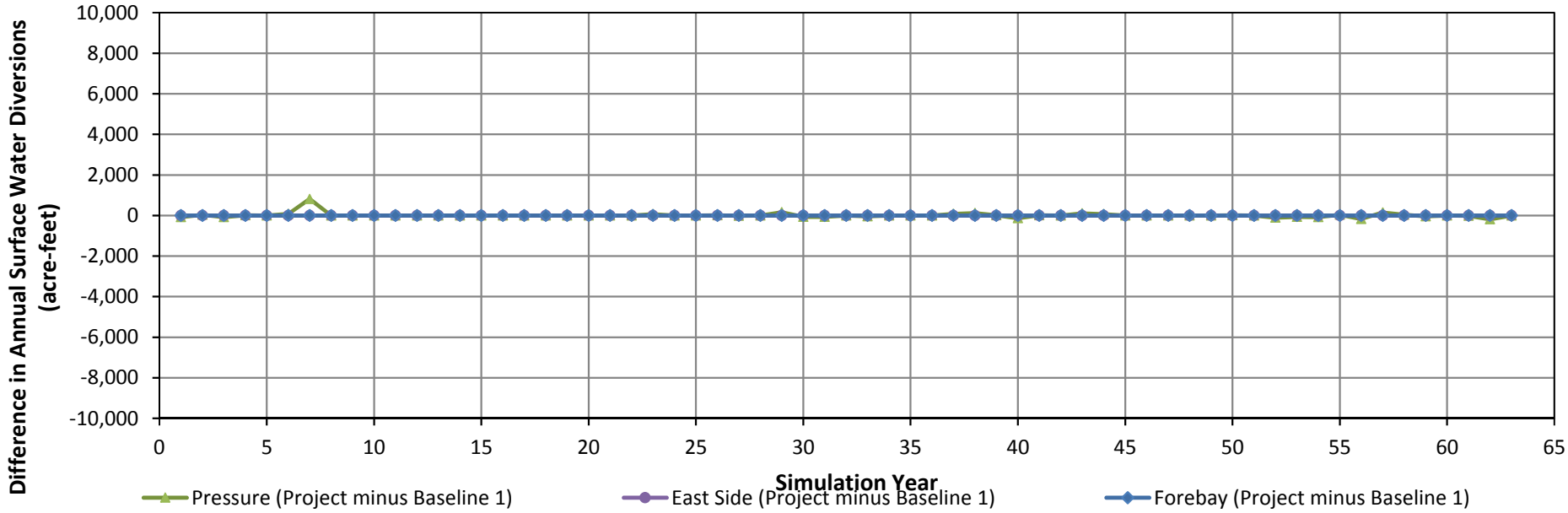


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Figure 17e
Simulated Annual Surface Water Diversions
Project Run 5n: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project

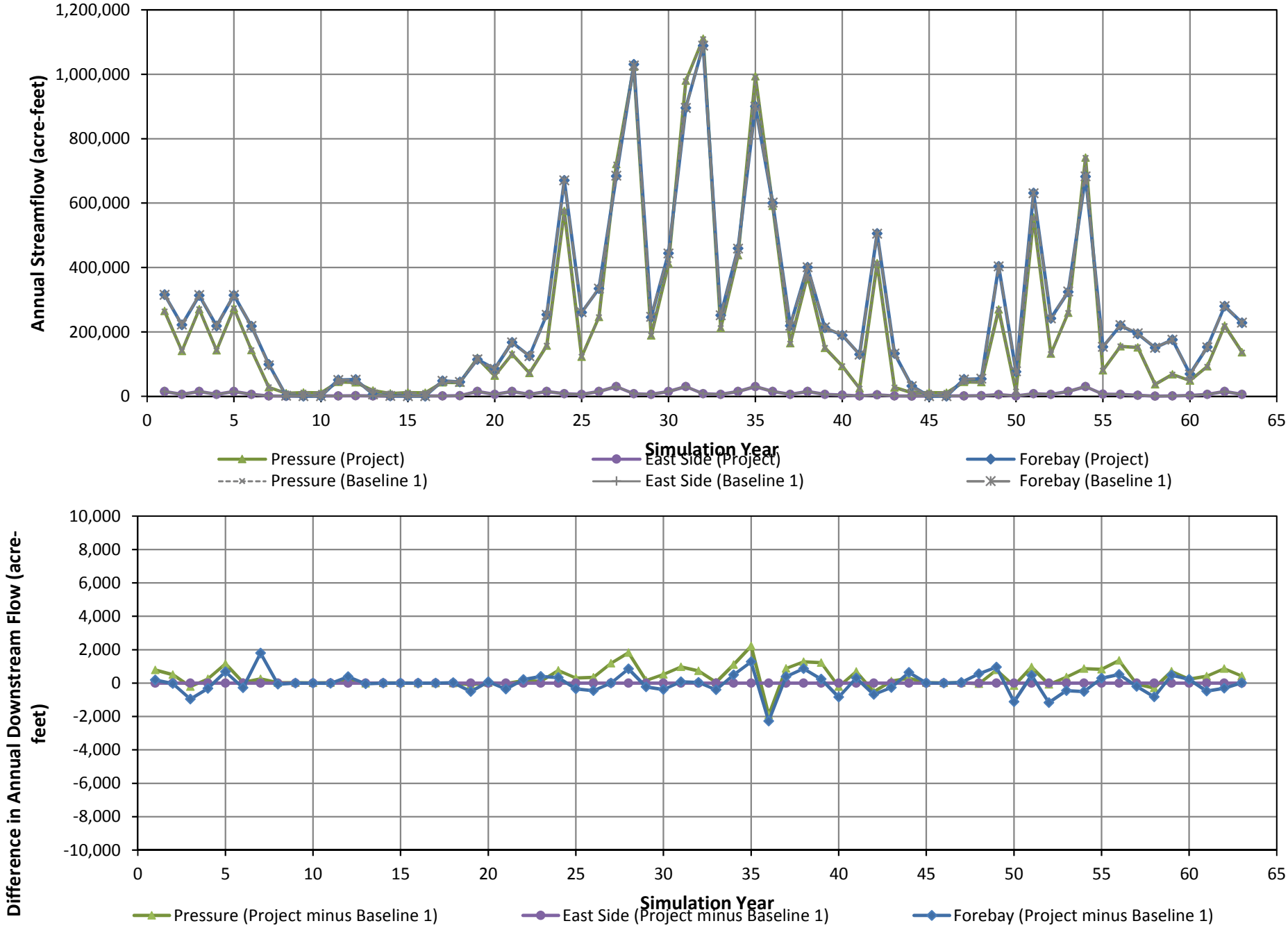

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Figure 17f
Simulated Annual Downstream Flow
Project Run 5n: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project

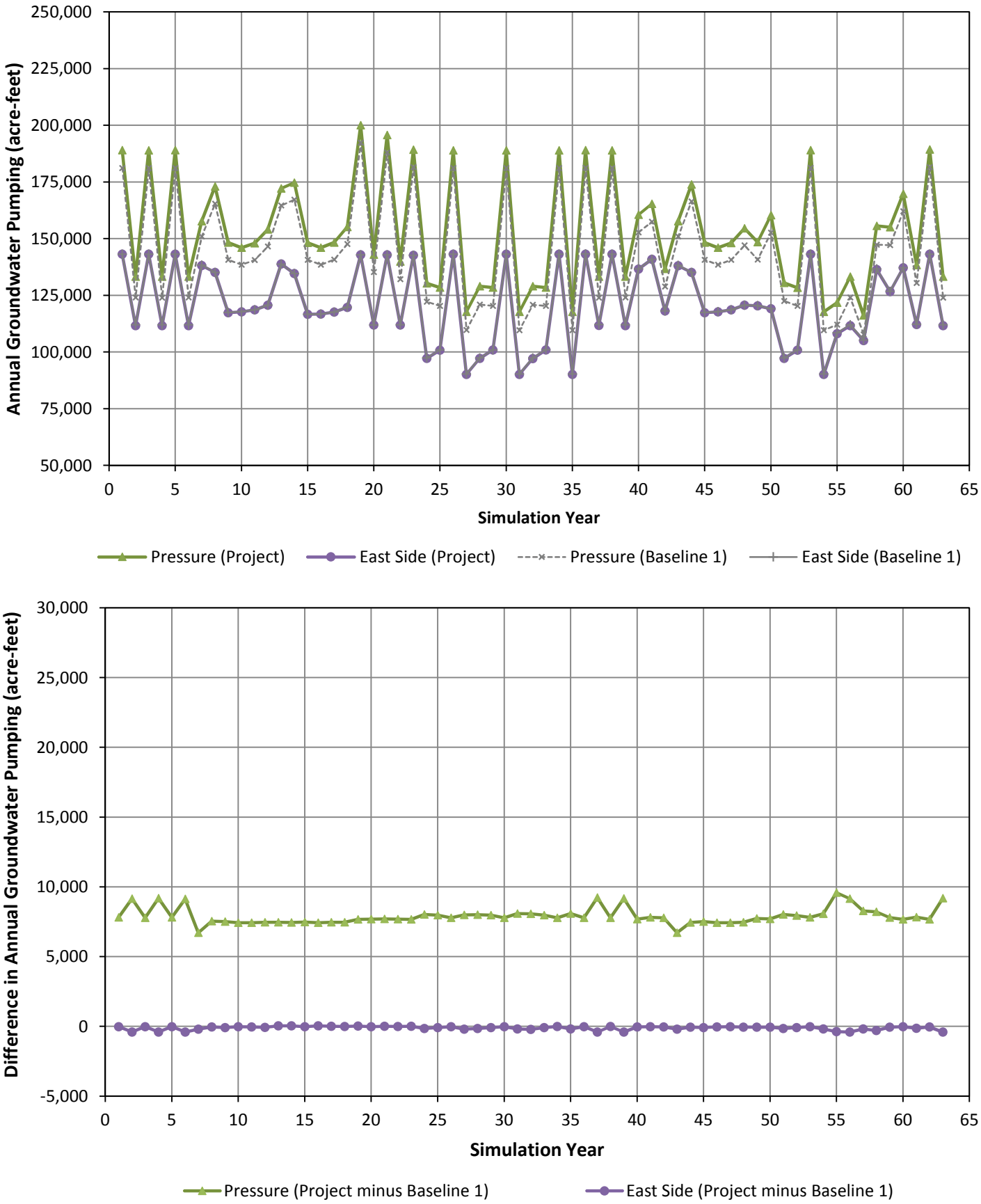

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Figure 18a
Simulated Annual Groundwater Pumping
Project Run 5: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project

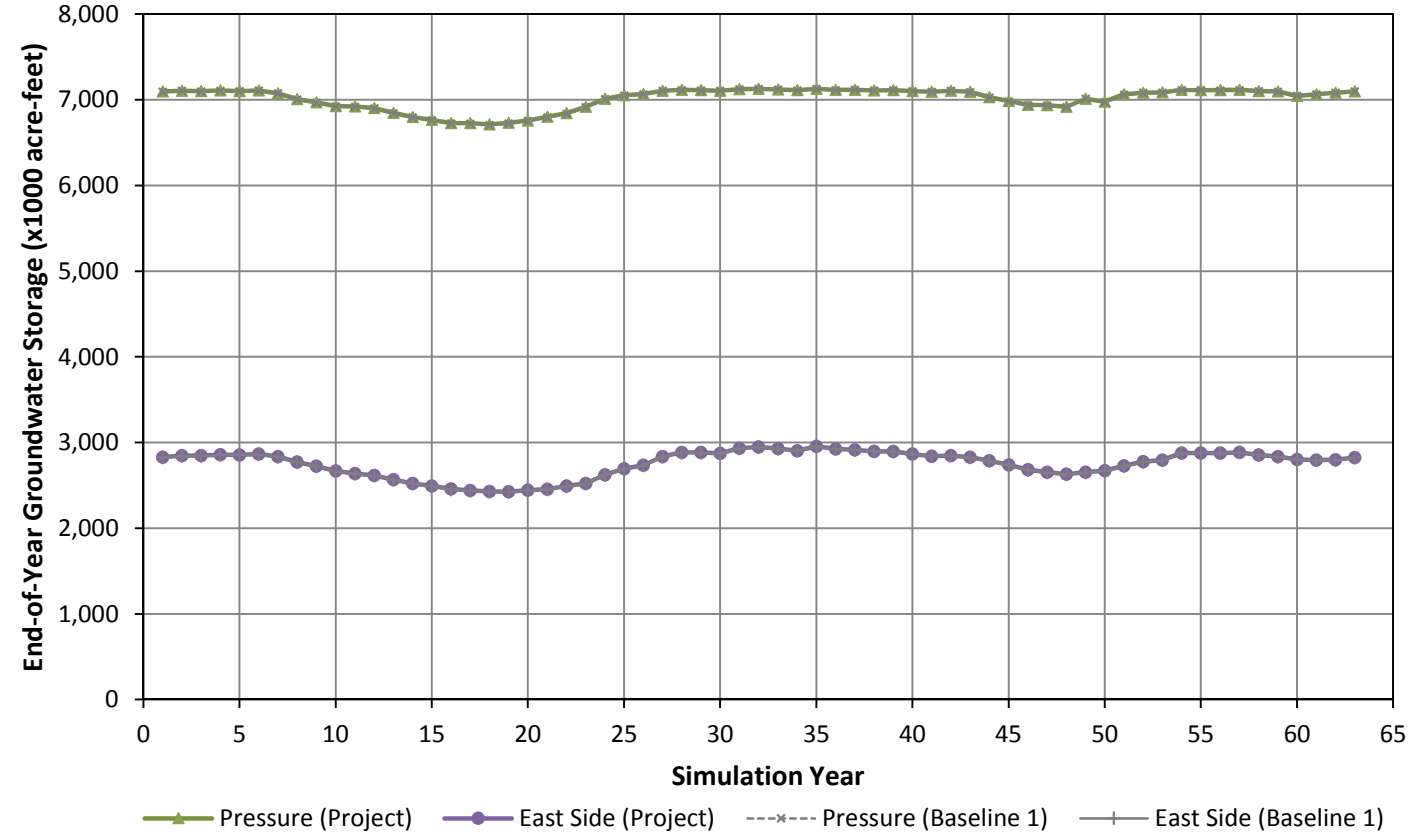

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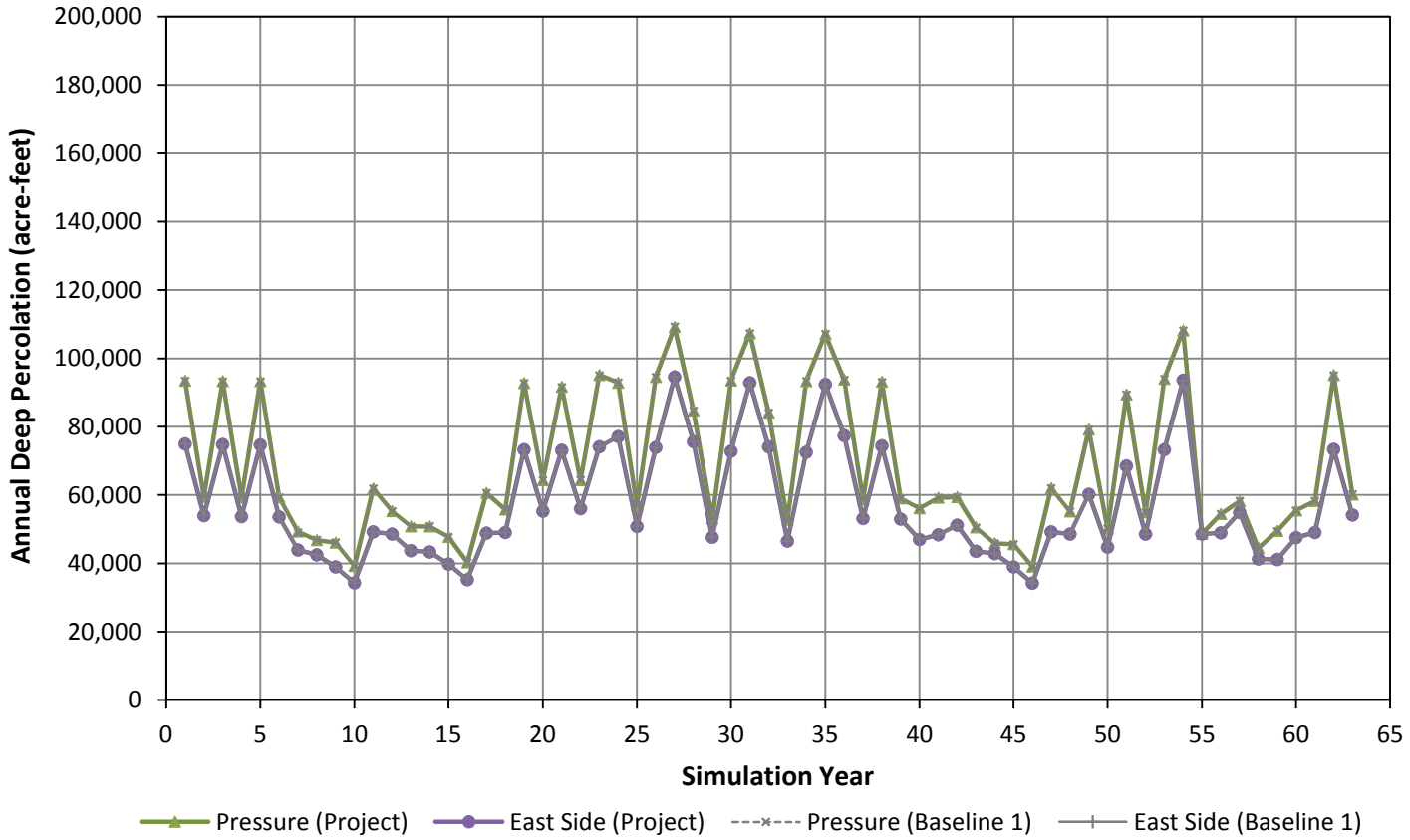
Figure 18b
Simulated End-of-Year Groundwater Storage
Project Run 5: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



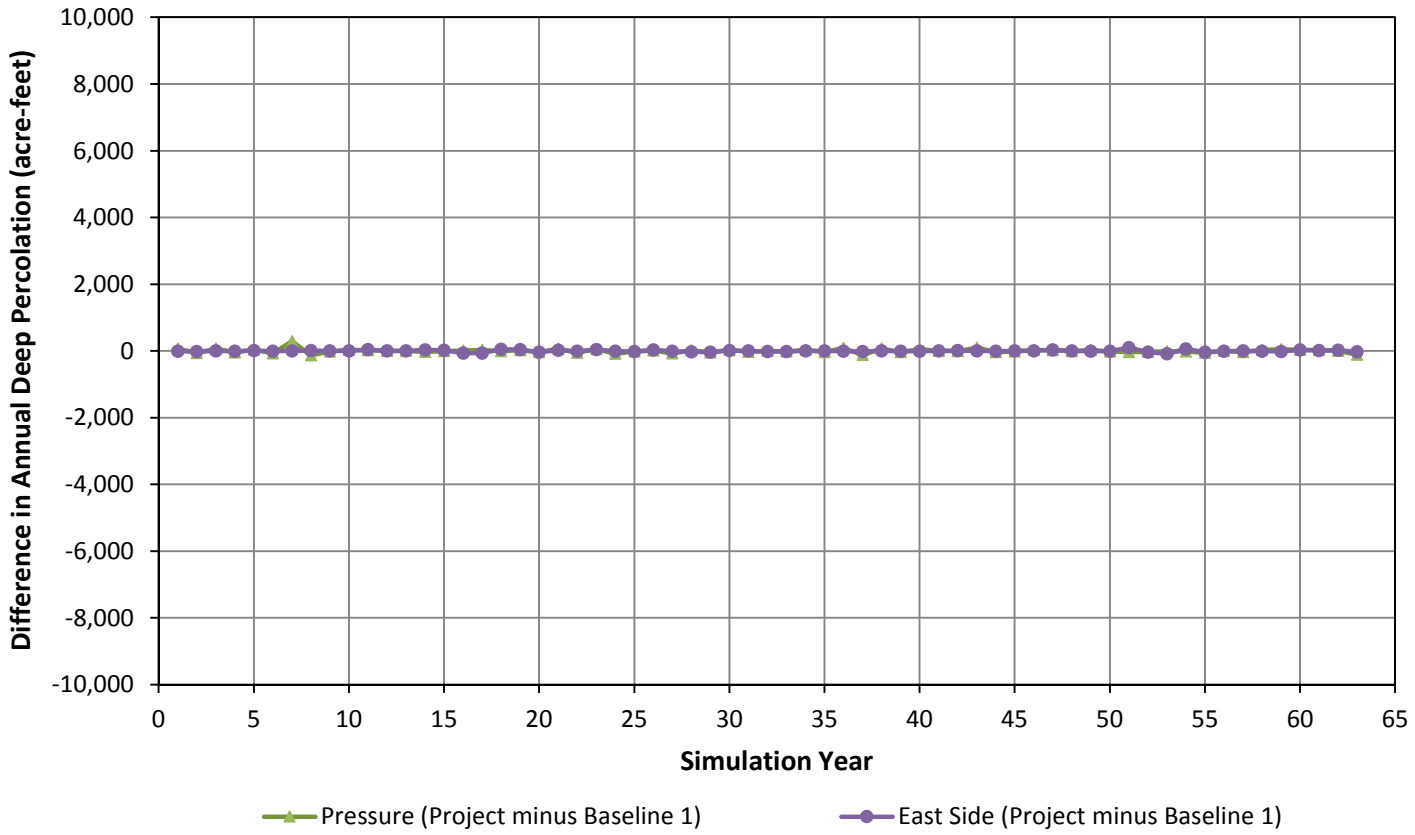


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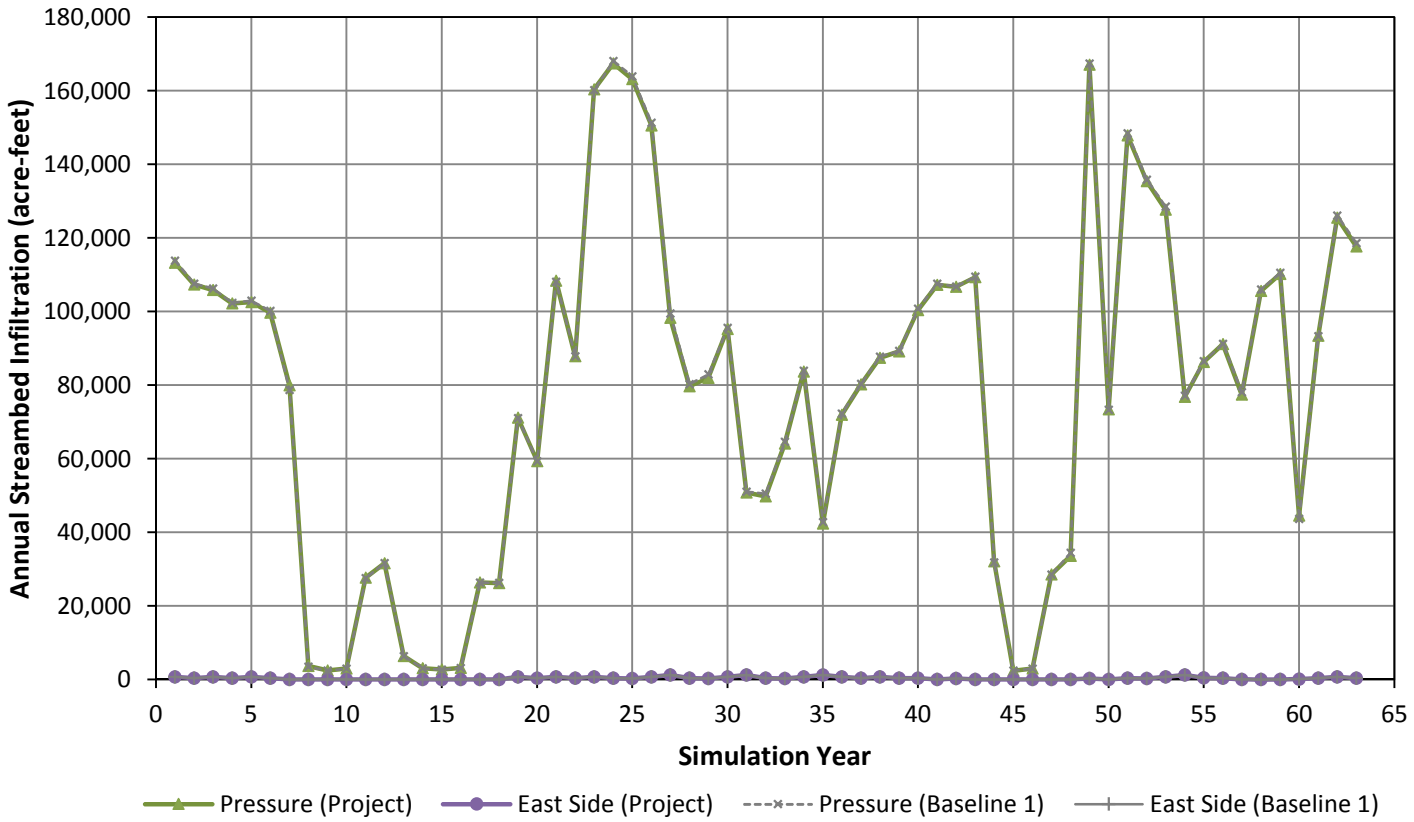
Figure 18c
Simulated Annual Deep Percolation
Project Run 5: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



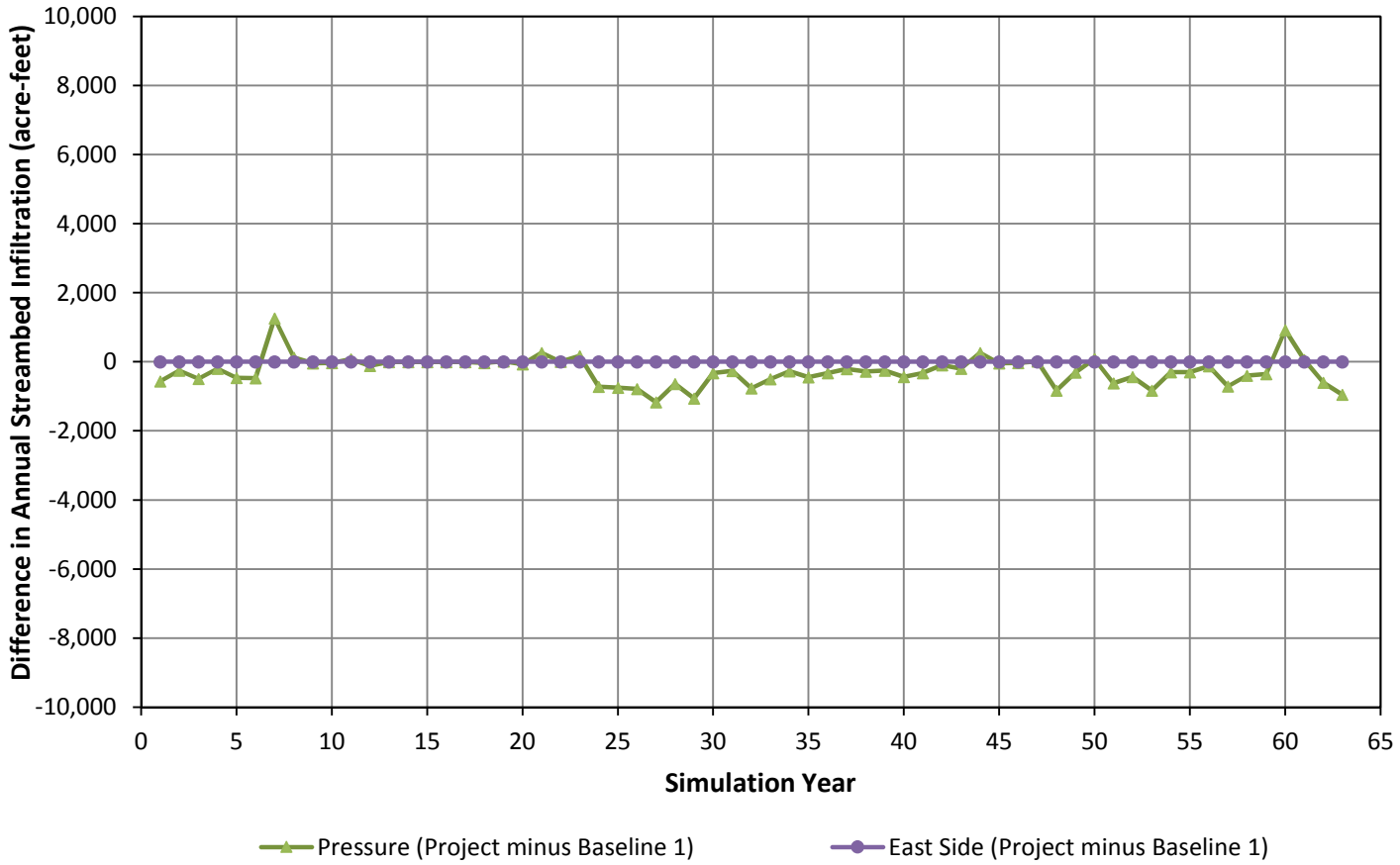


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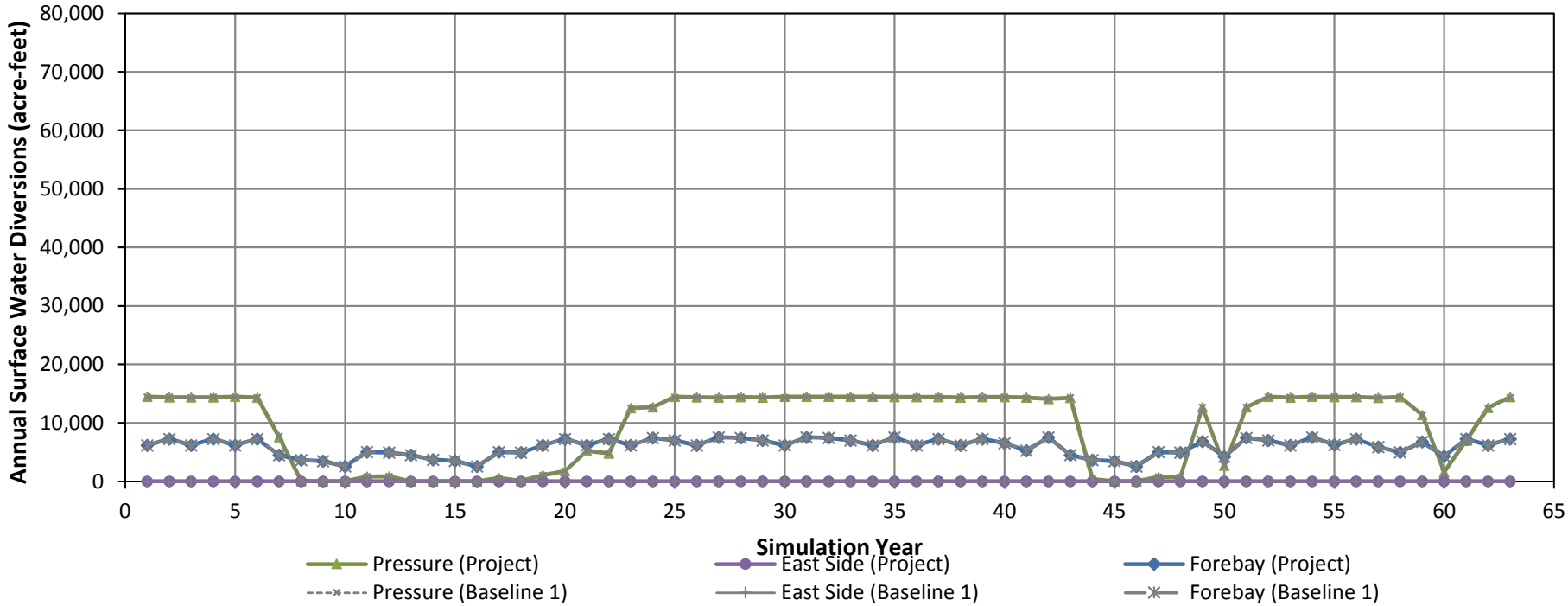
Figure 18d
Simulated Annual Streambed Infiltration
Project Run 5: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



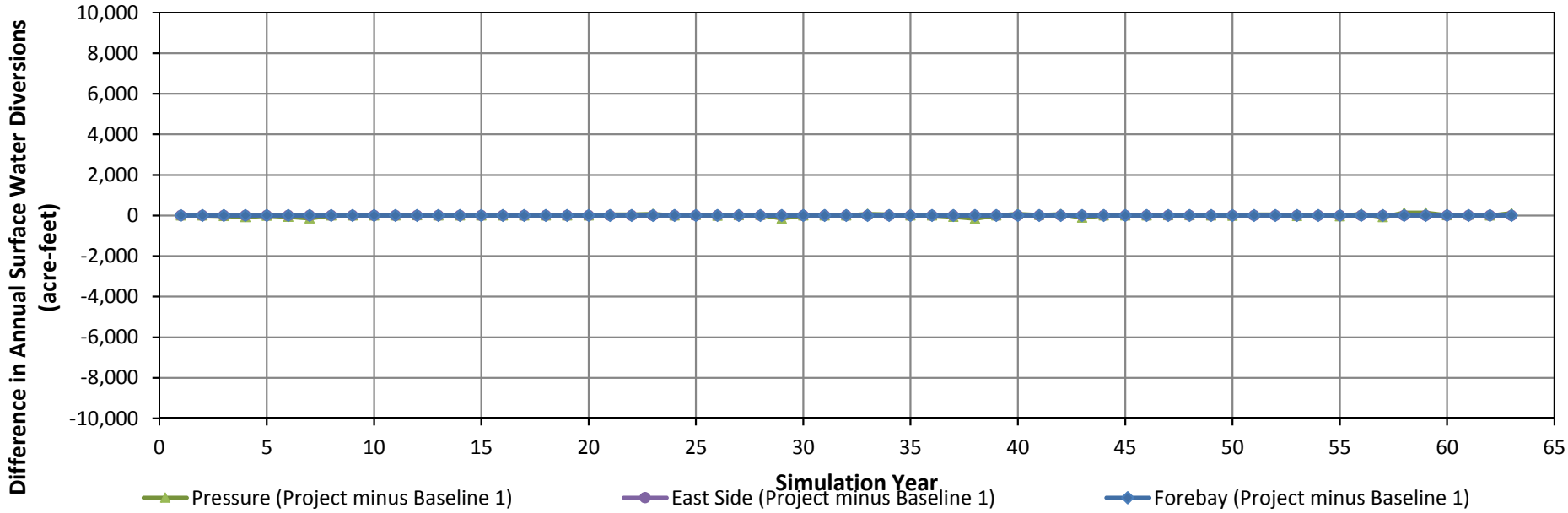


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Figure 18e
Simulated Annual Surface Water Diversions
Project Run 5: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project

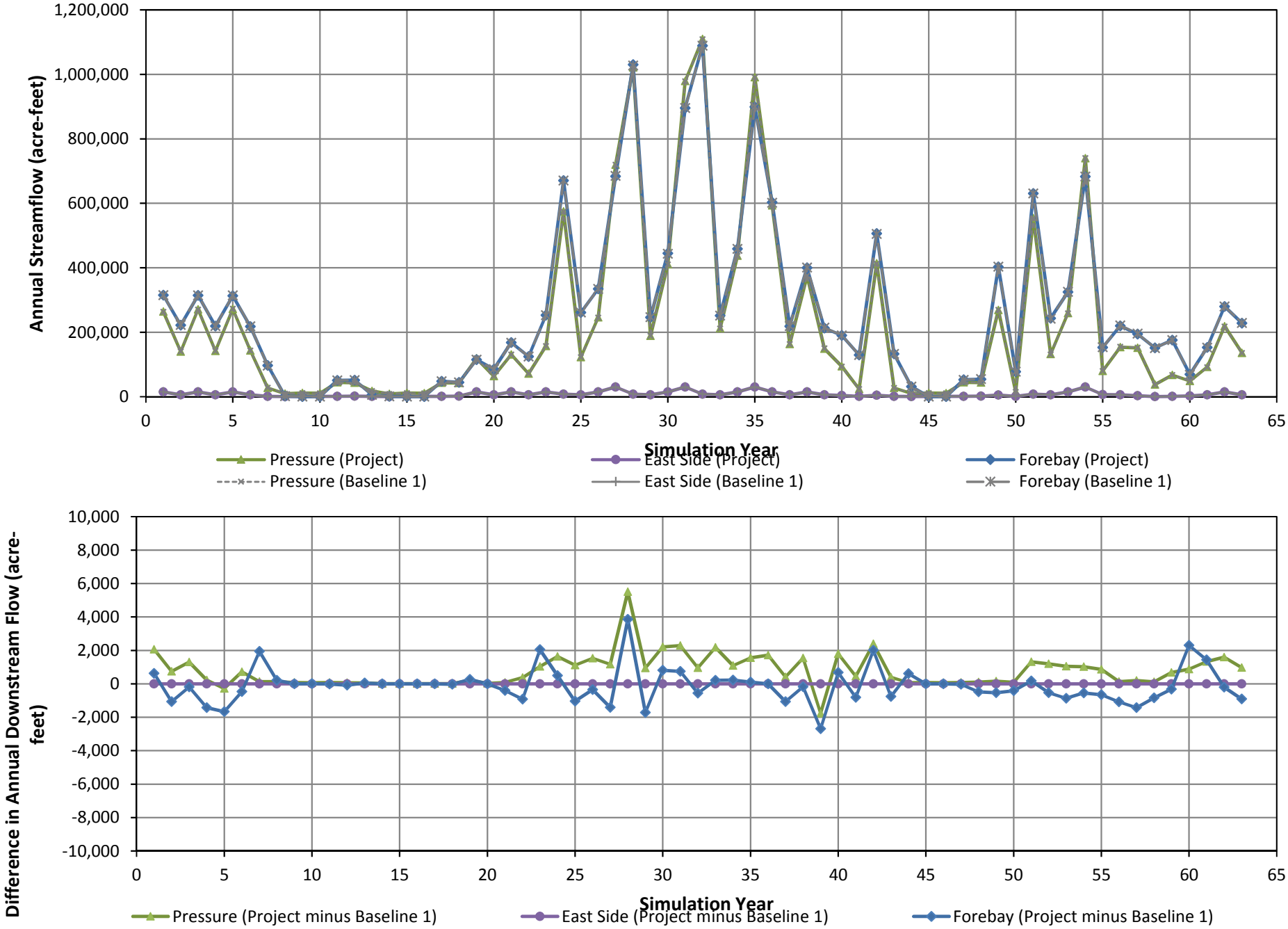

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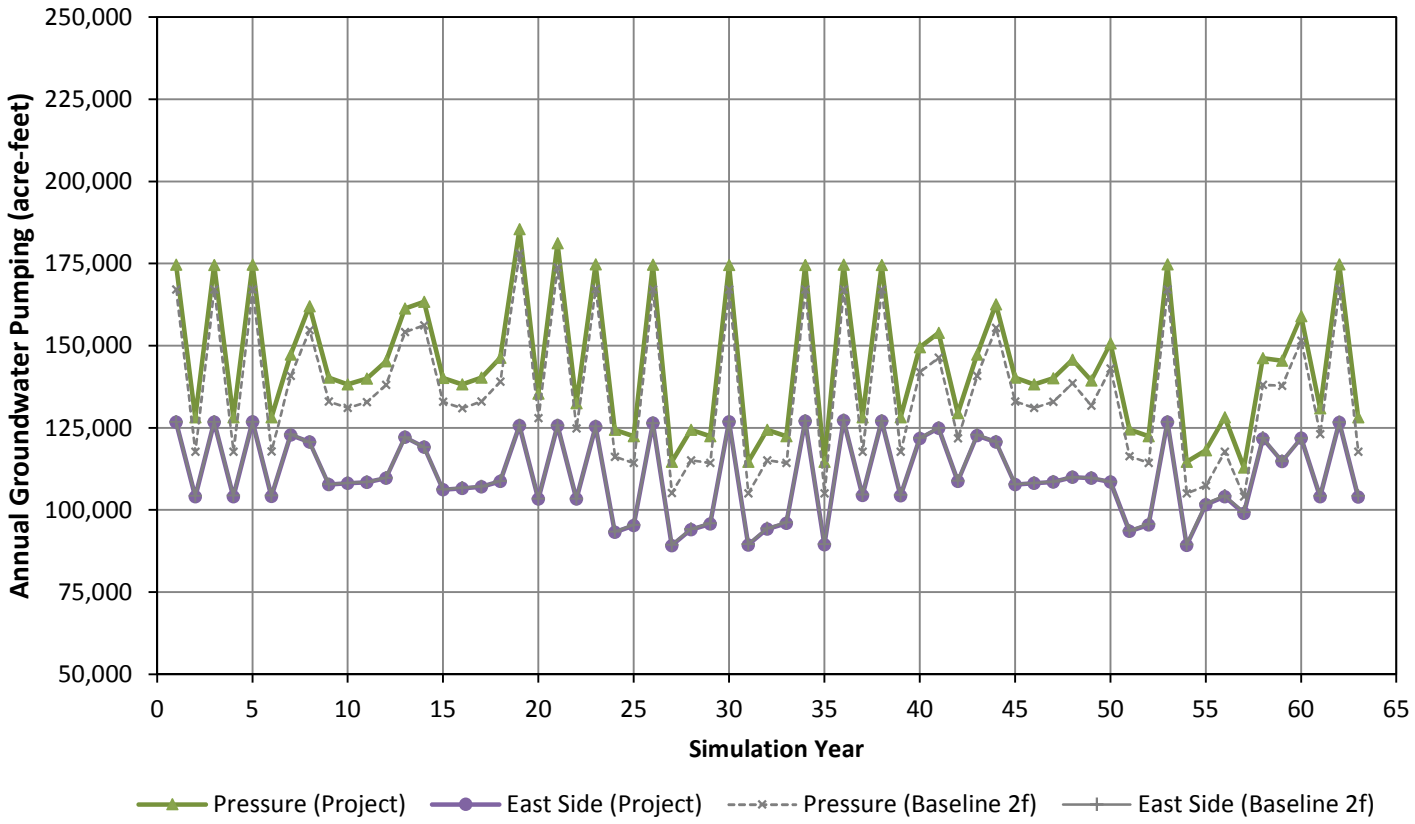
Figure 18f
Simulated Annual Downstream Flow
Project Run 5: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



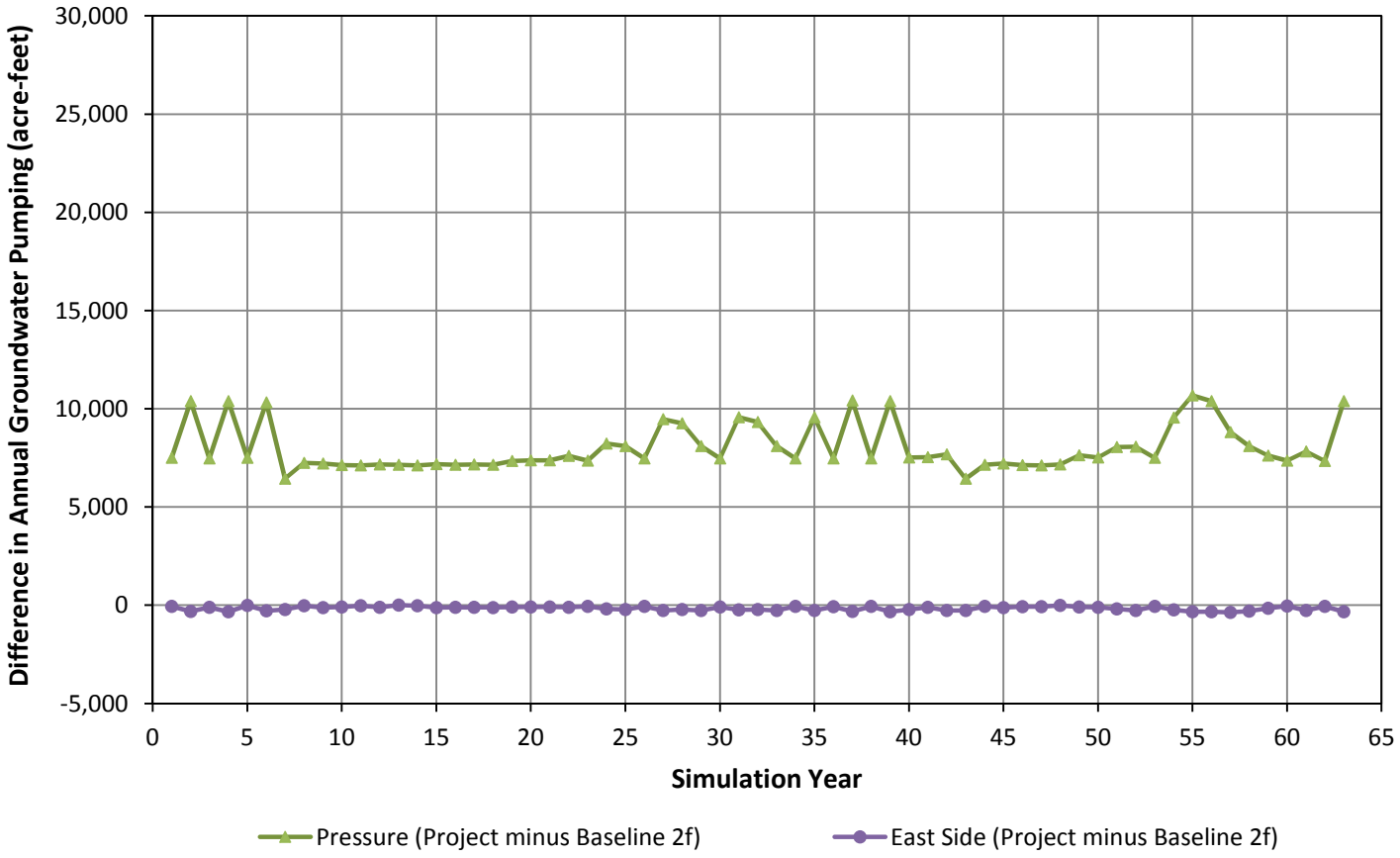


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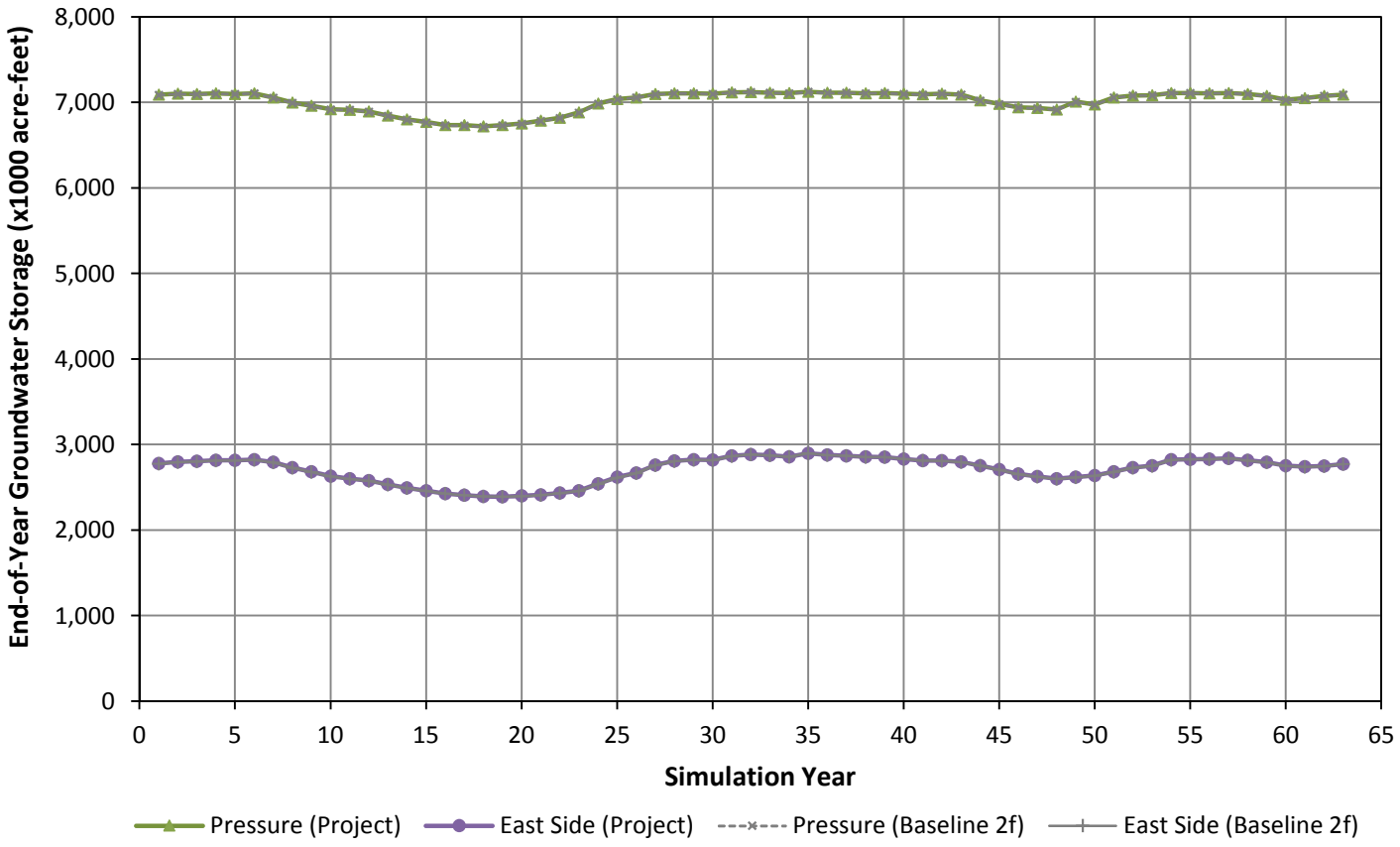
Figure 19a
Simulated Annual Groundwater Pumping
Project Run 5f: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



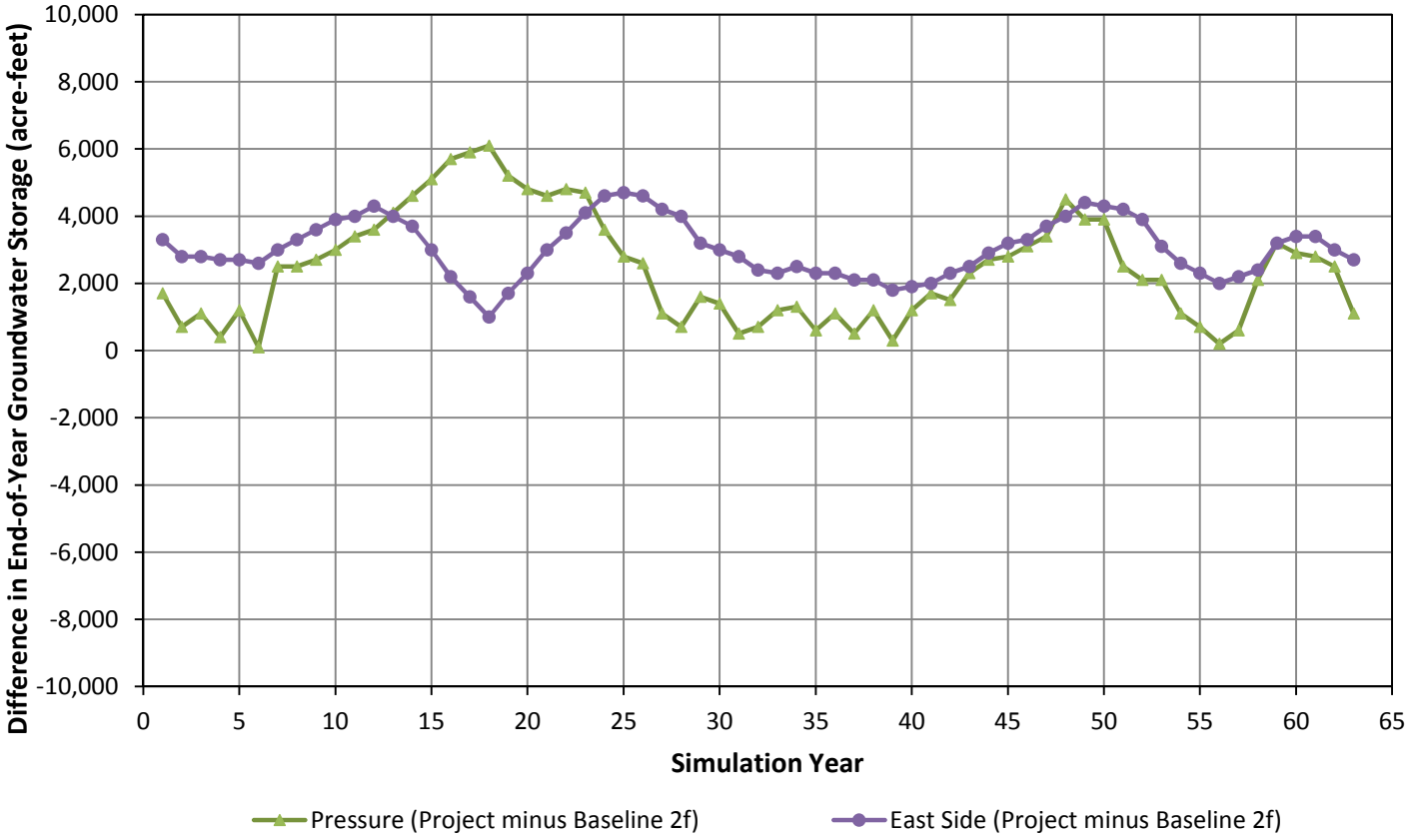


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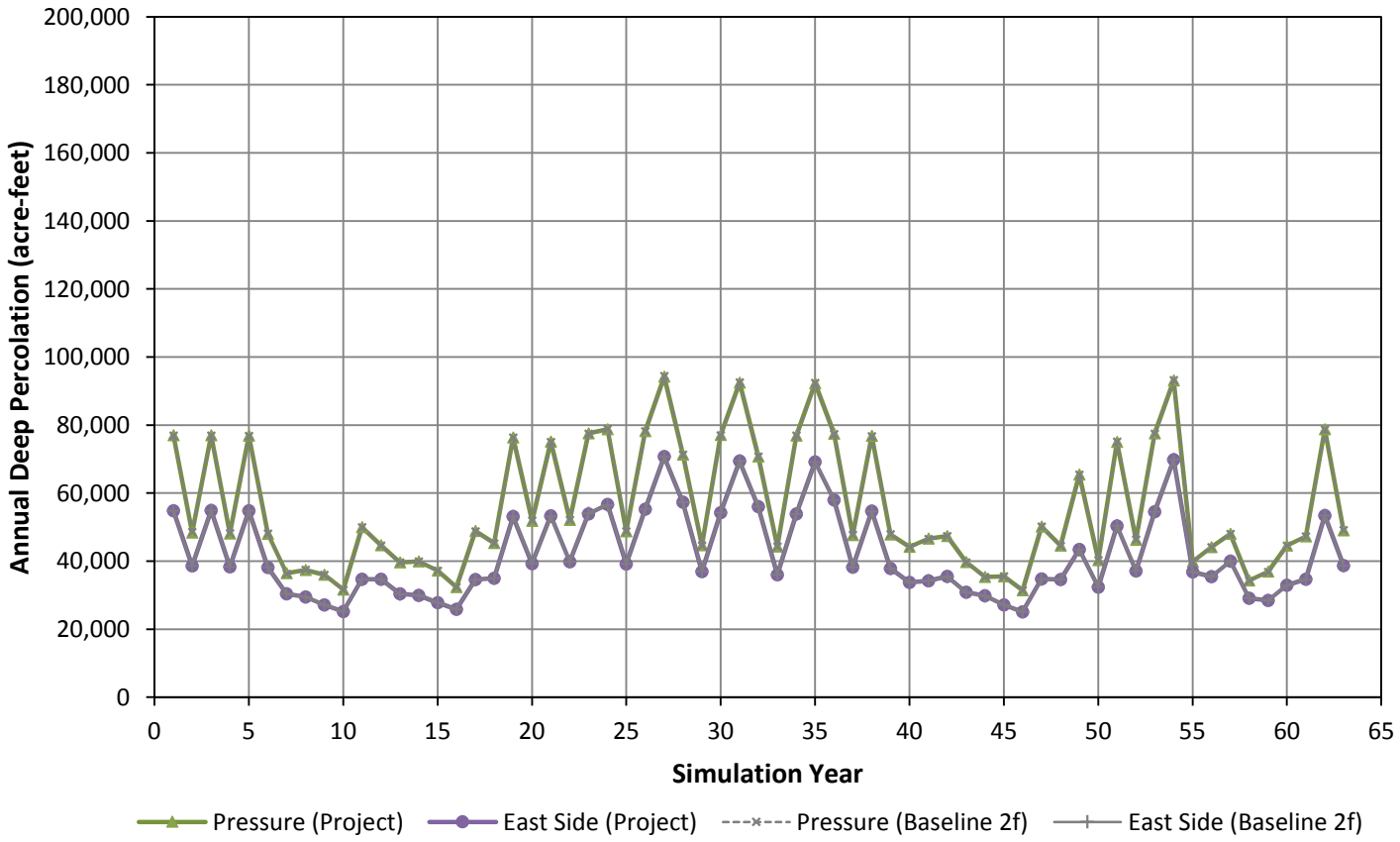
Figure 19b
Simulated End-of-Year Groundwater Storage
Project Run 5f: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



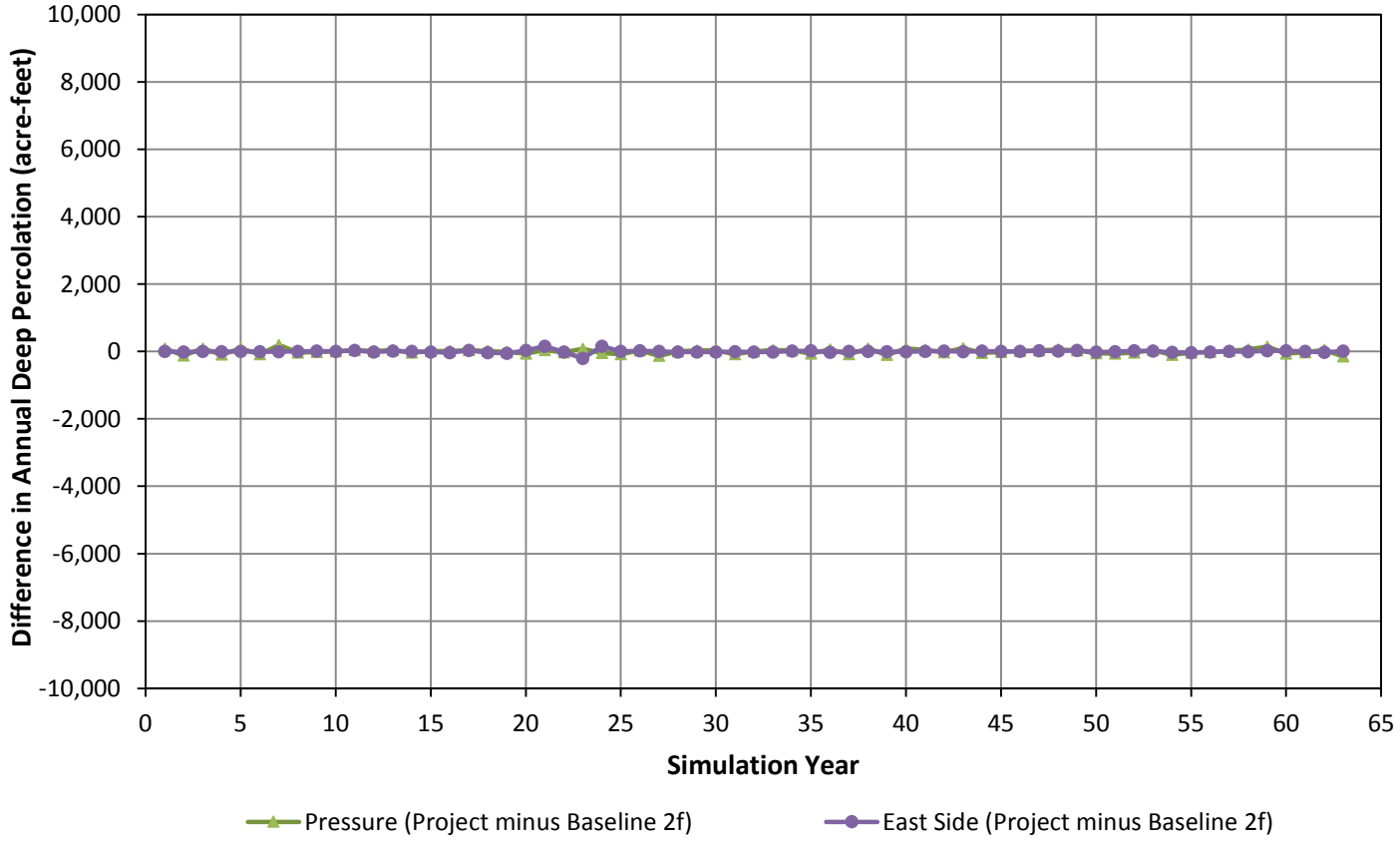


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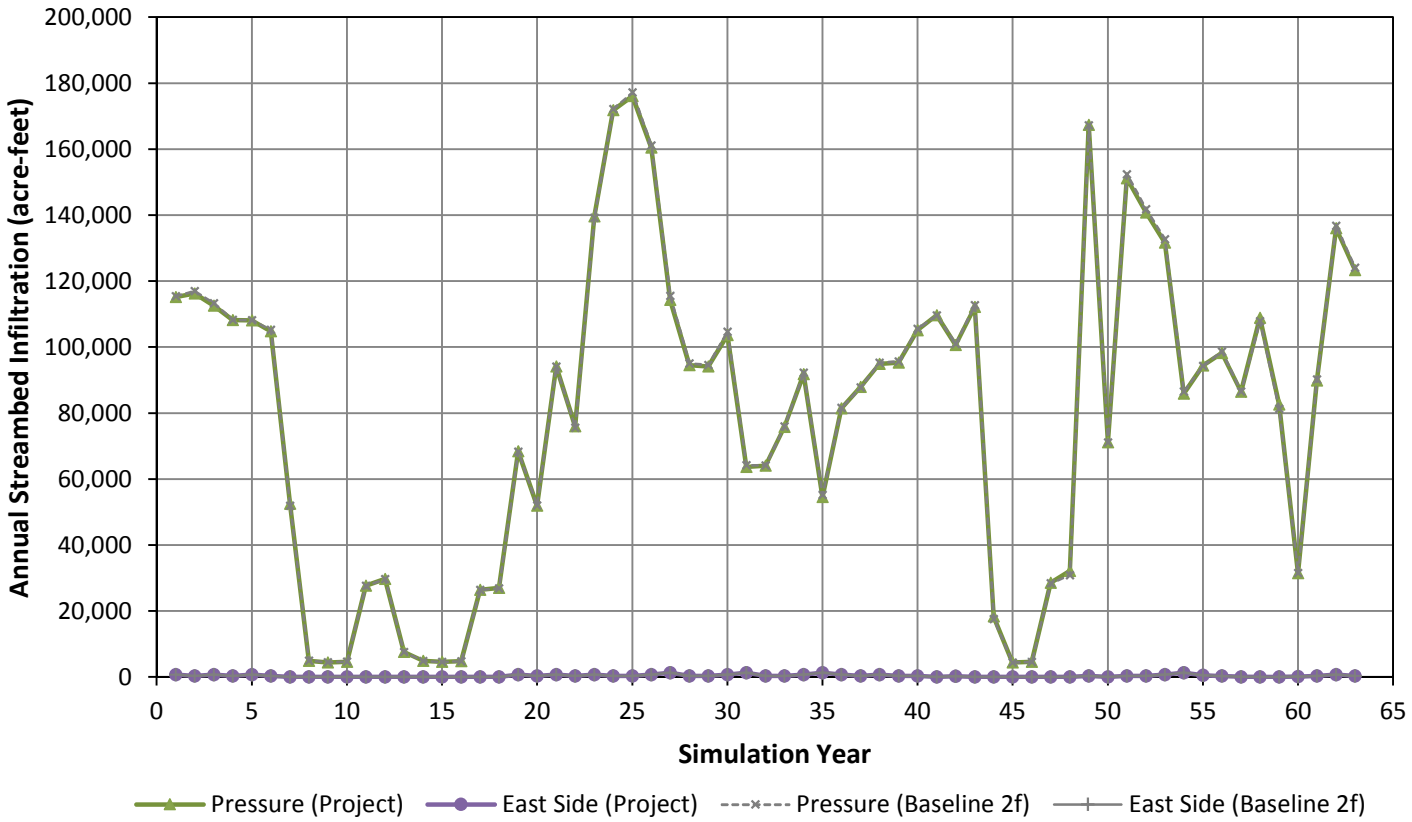
Figure 19c
Simulated Annual Deep Percolation
Project Run 5f: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



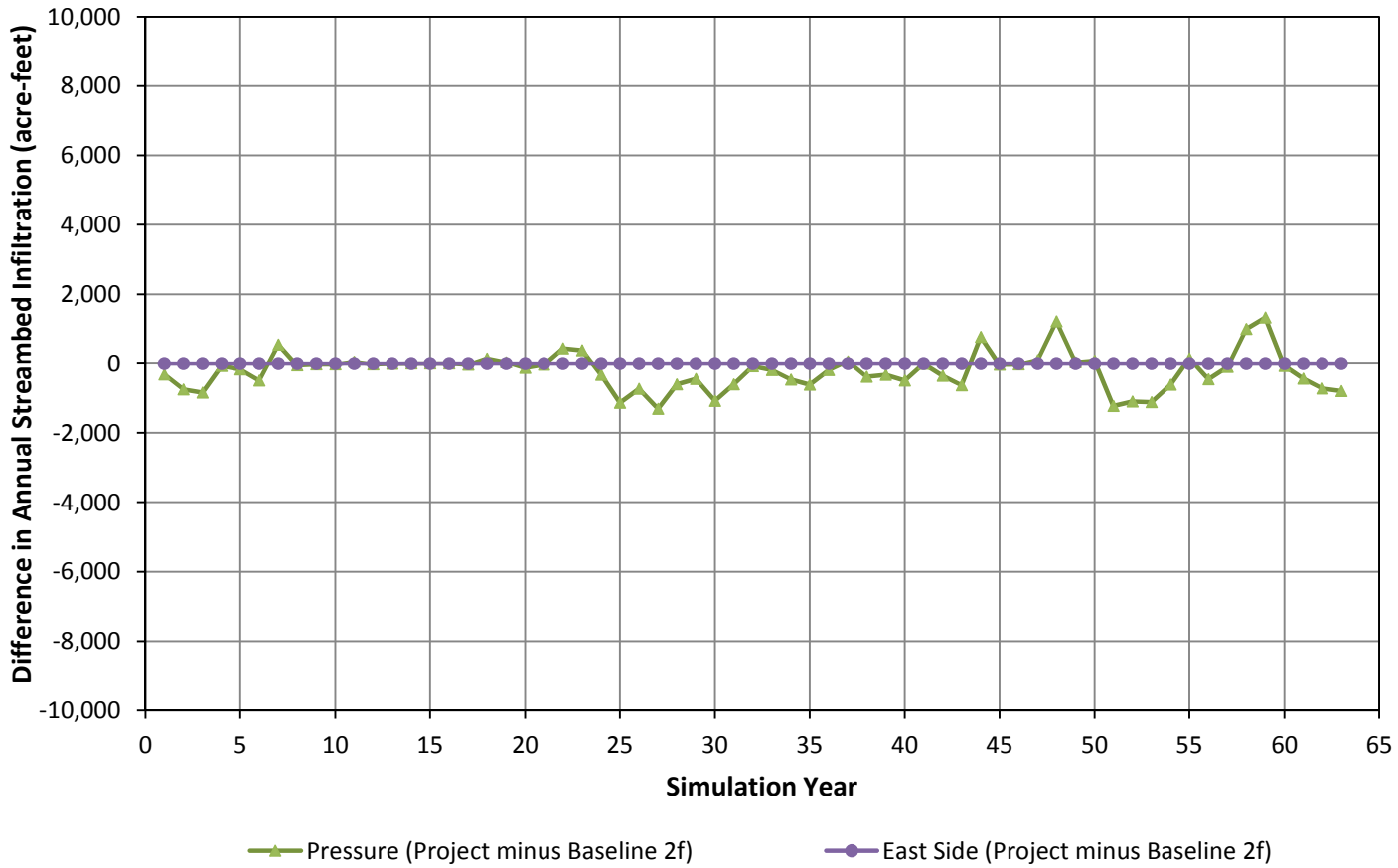


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Figure 19d
Simulated Annual Streambed Infiltration
Project Run 5f: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project

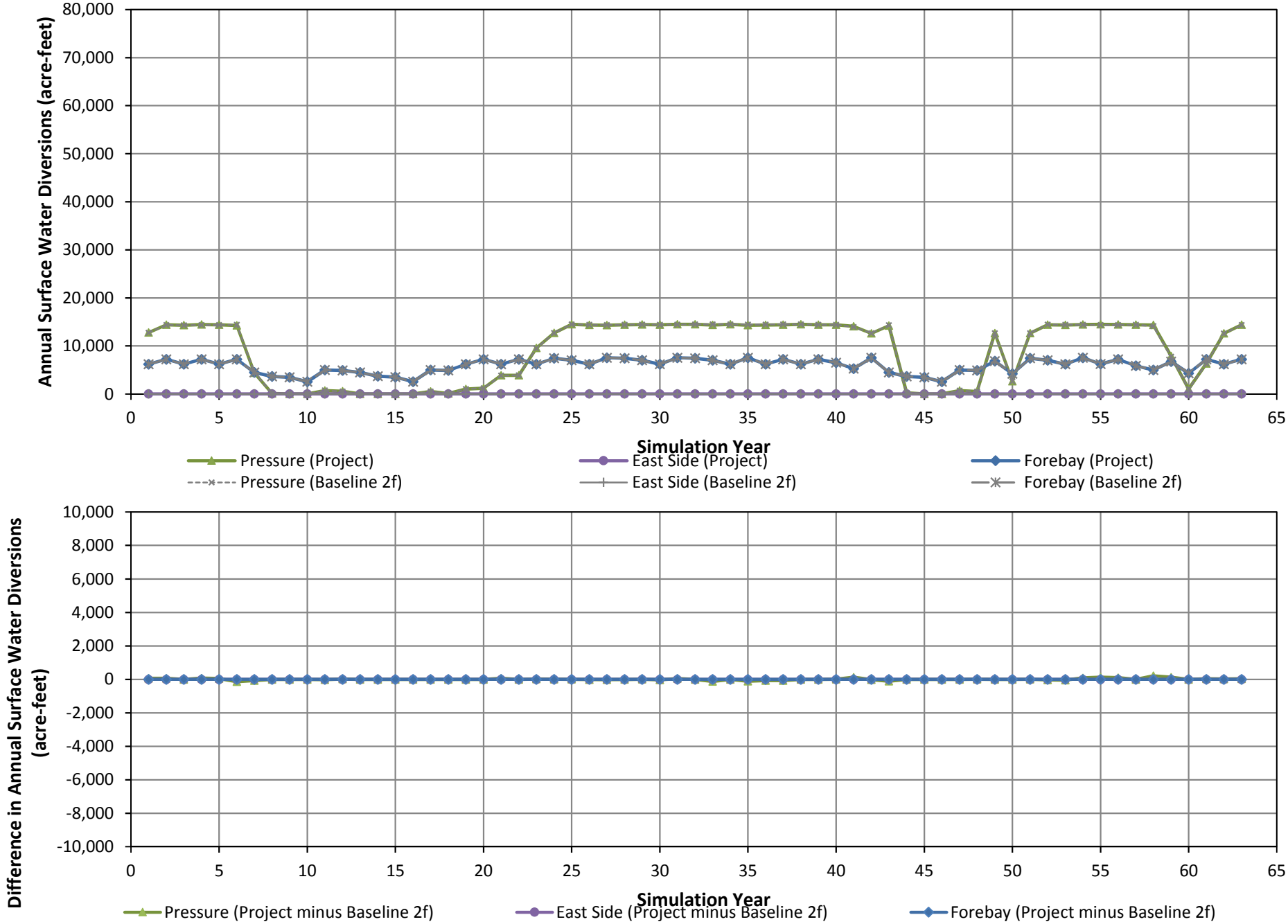

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Figure 19e
Simulated Annual Surface Water Diversions
Project Run 5f: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project

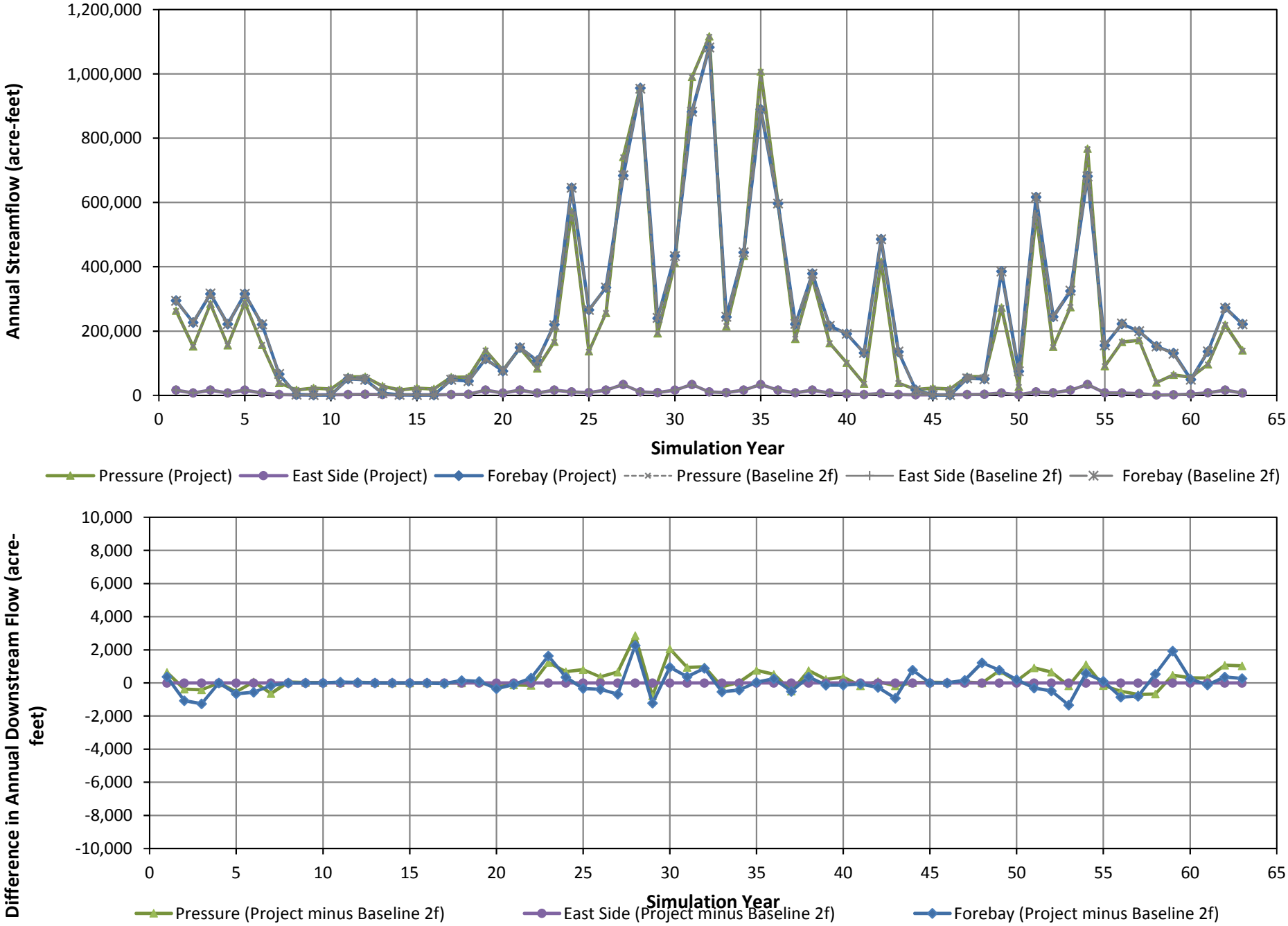

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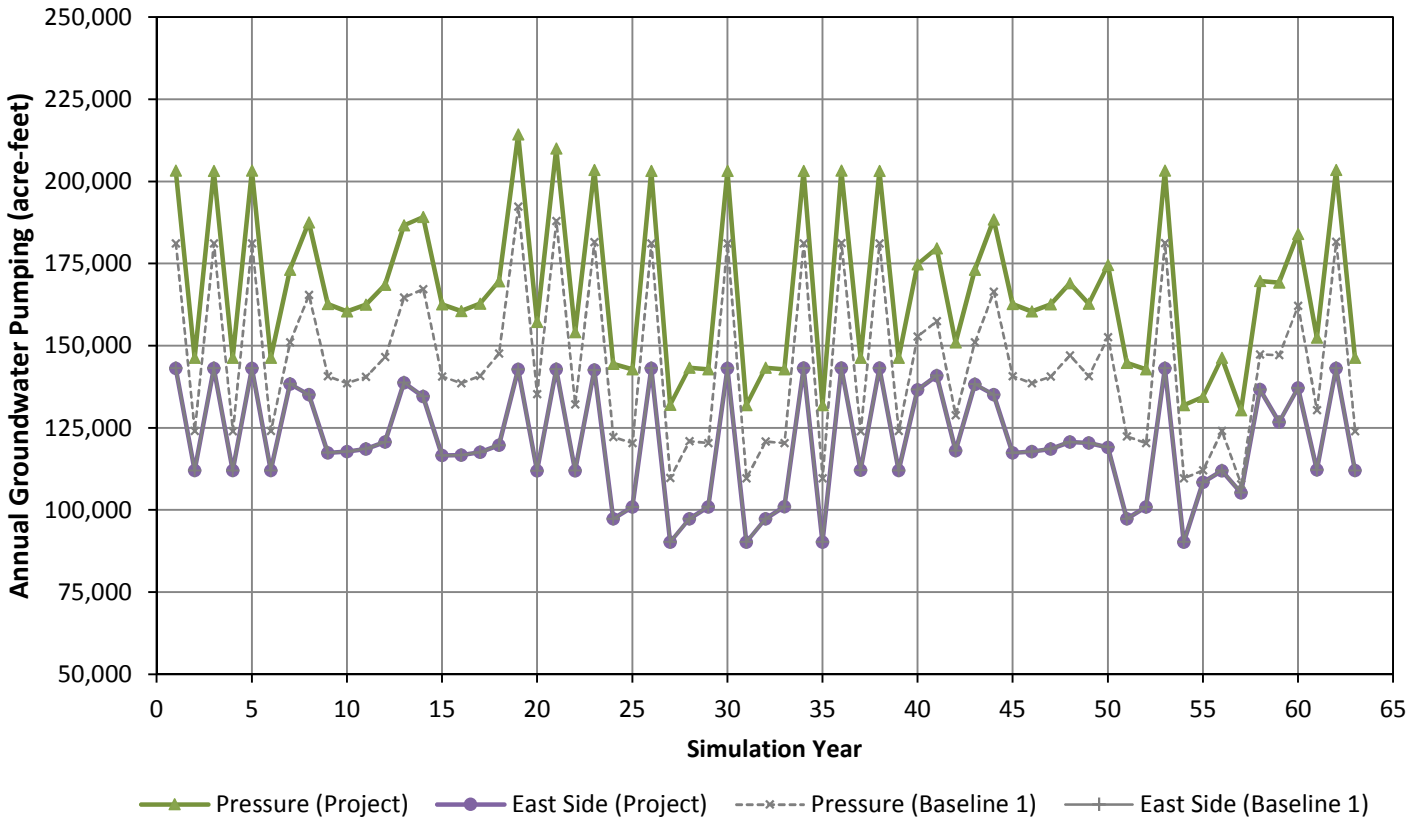
Figure 19f
Simulated Annual Downstream Flow
Project Run 5f: CEMEX 15.5 MGD
Monterey Peninsula Water Supply Project



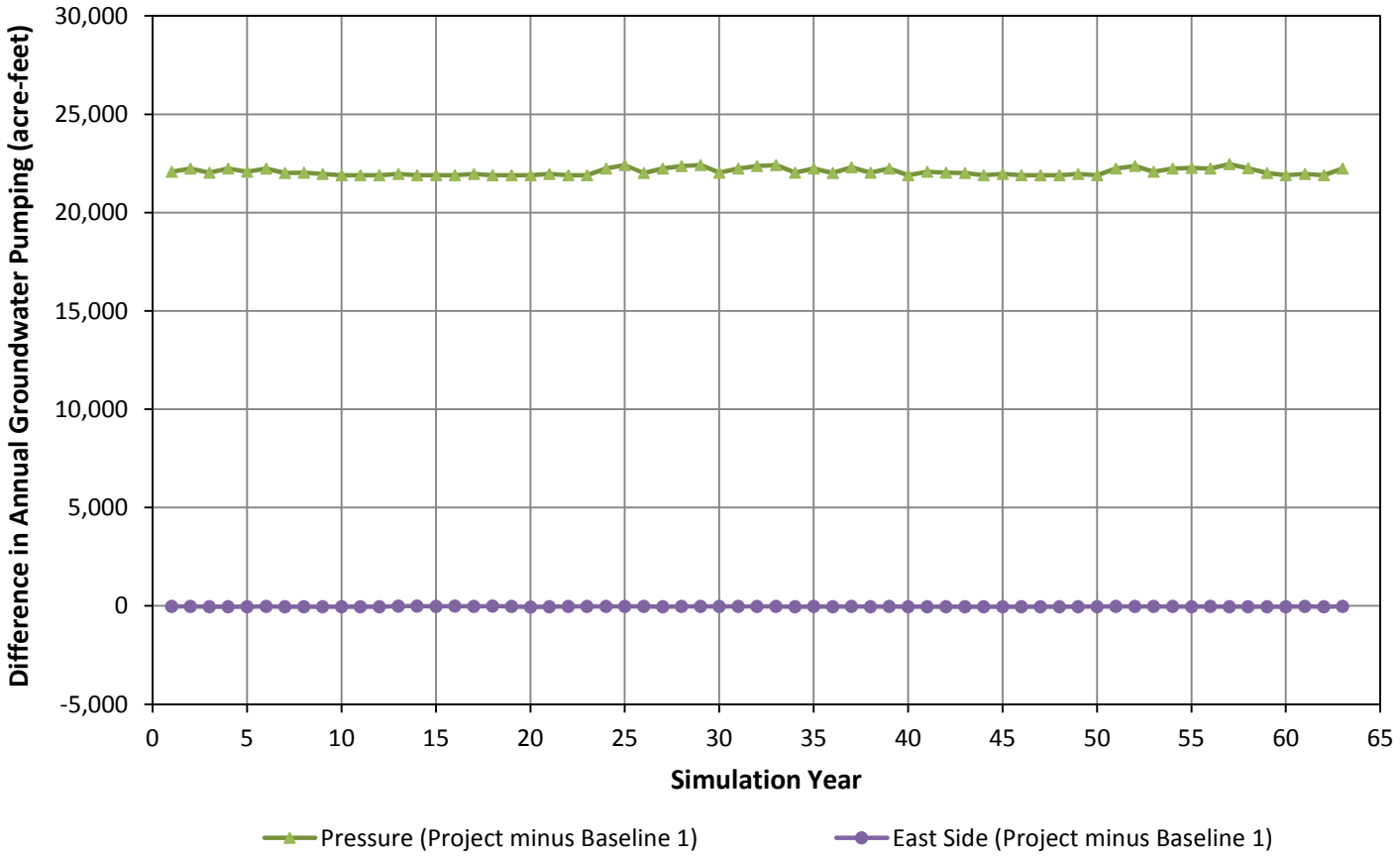


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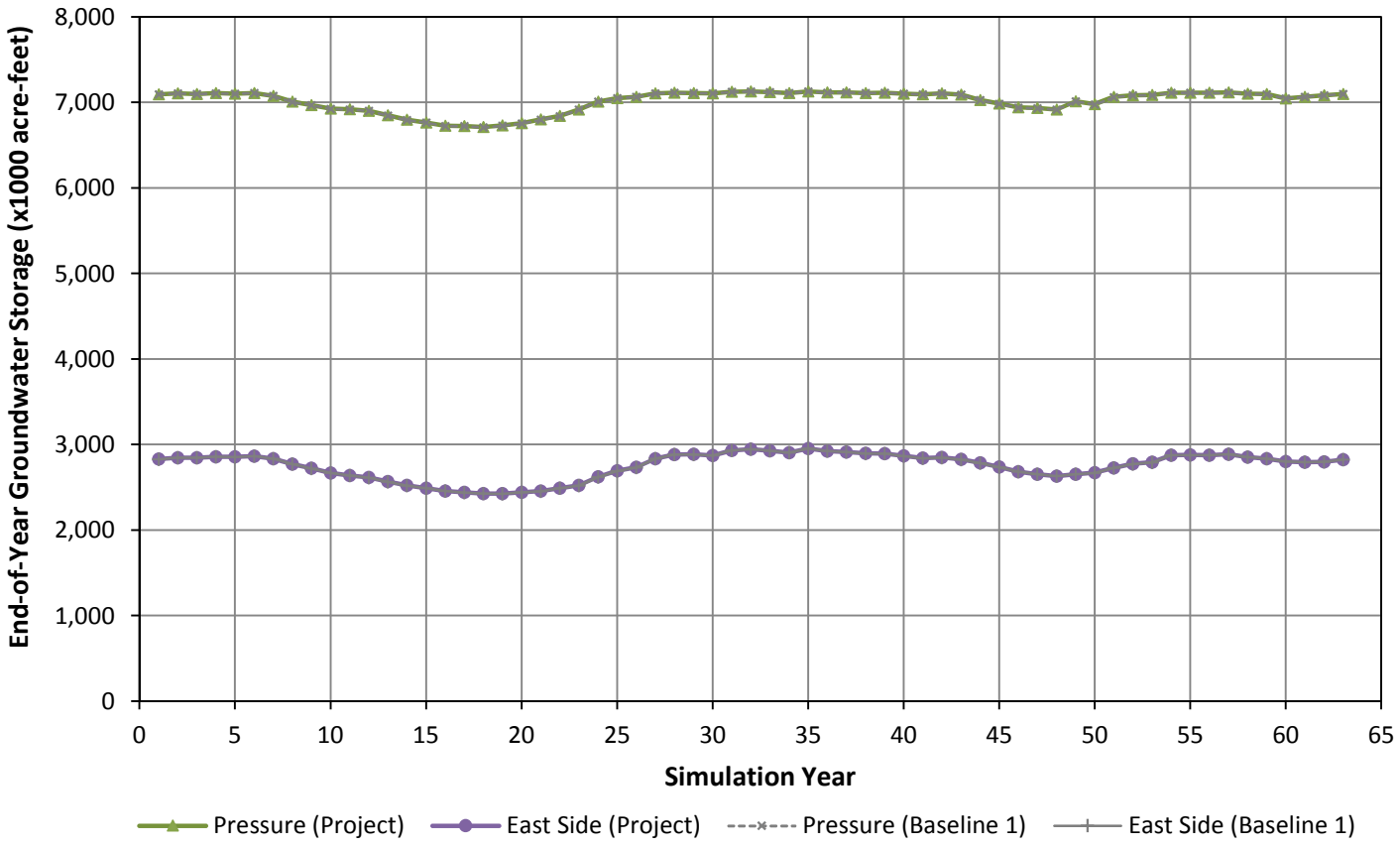
Figure 20a
Simulated Annual Groundwater Pumping
Project Run 6sn: Potrero rd 24.1 MGD
Monterey Peninsula Water Supply Project



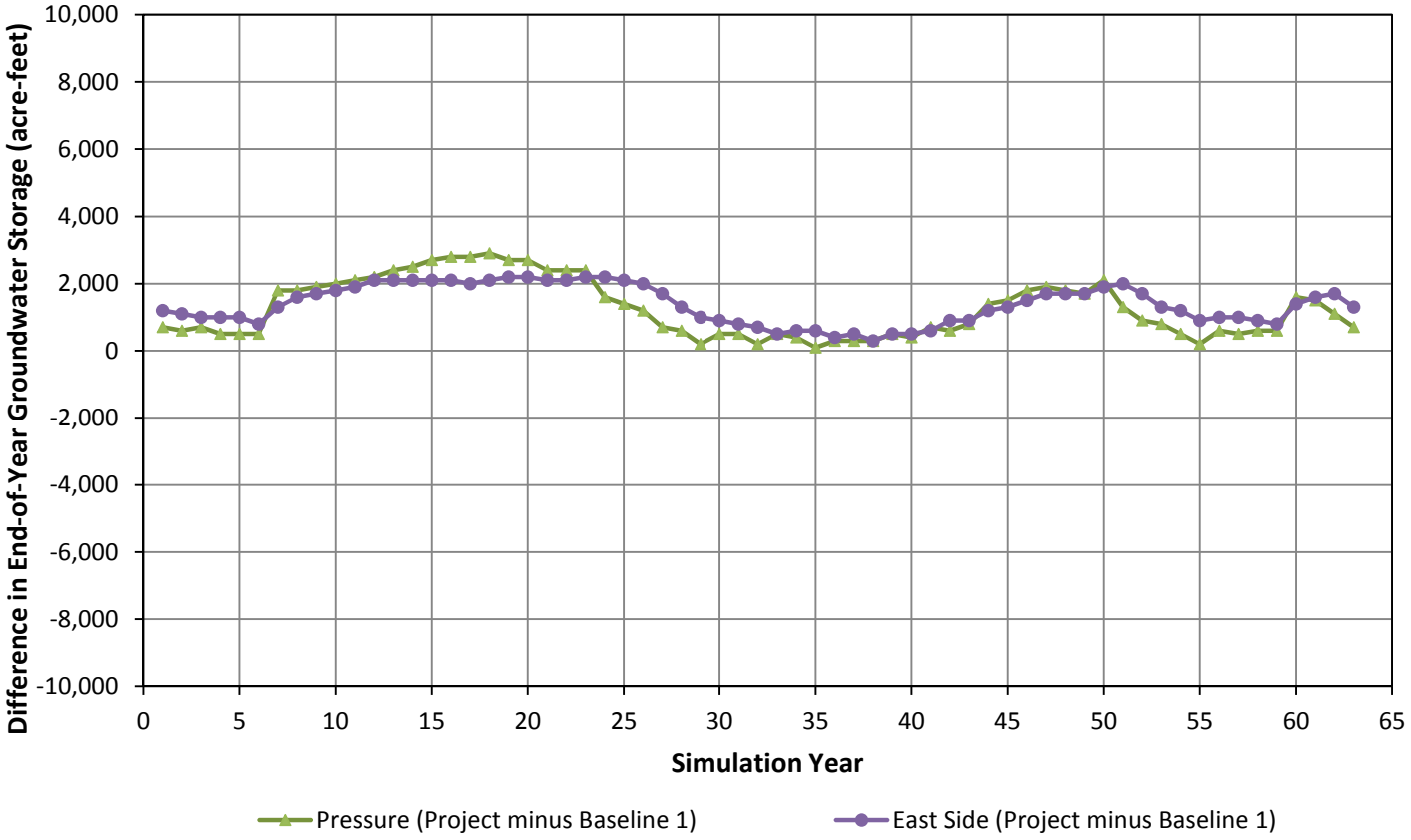


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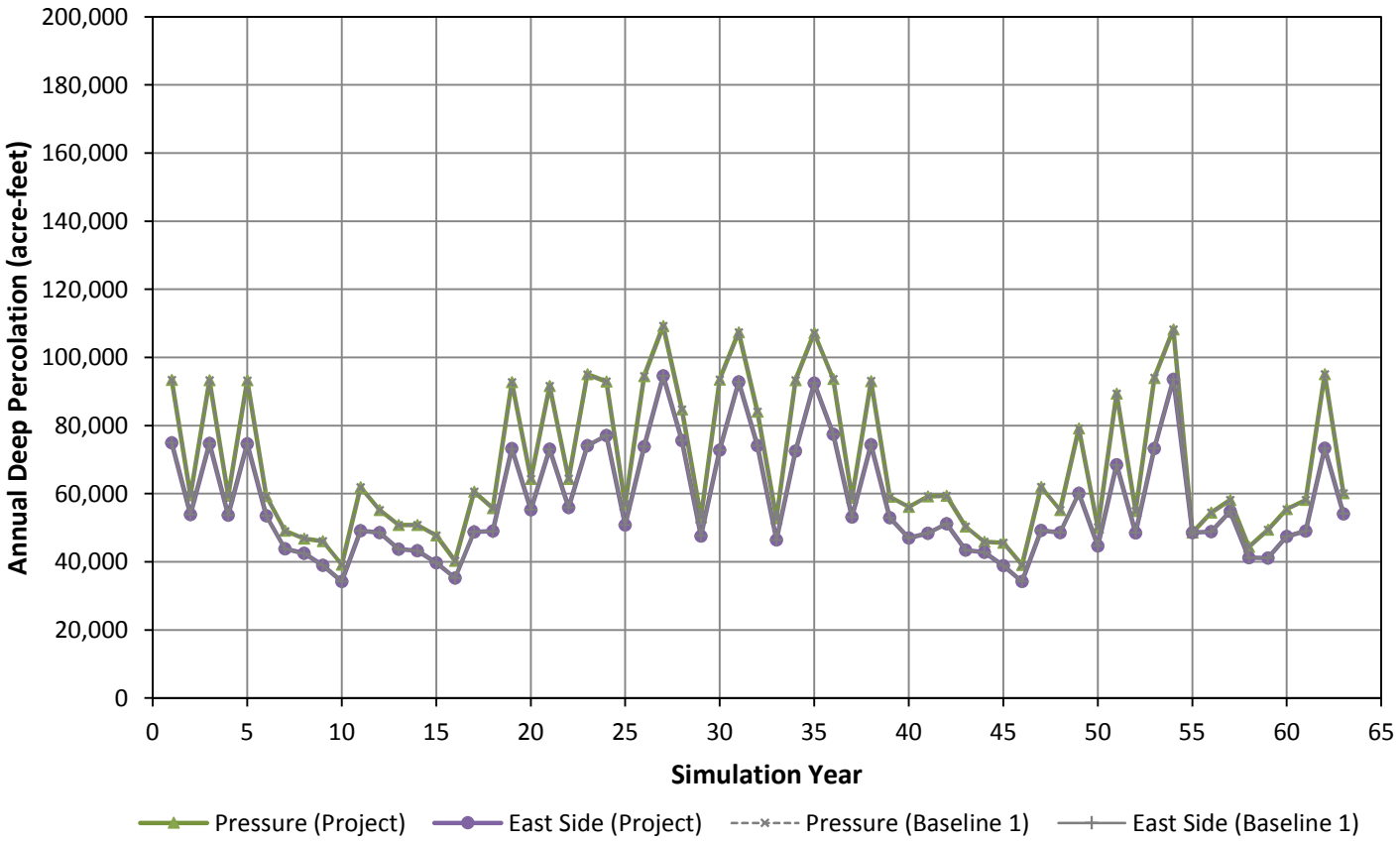
Figure 20b
Simulated End-of-Year Groundwater Storage
Project Run 6sn: Potrero rd 24.1 MGD
Monterey Peninsula Water Supply Project



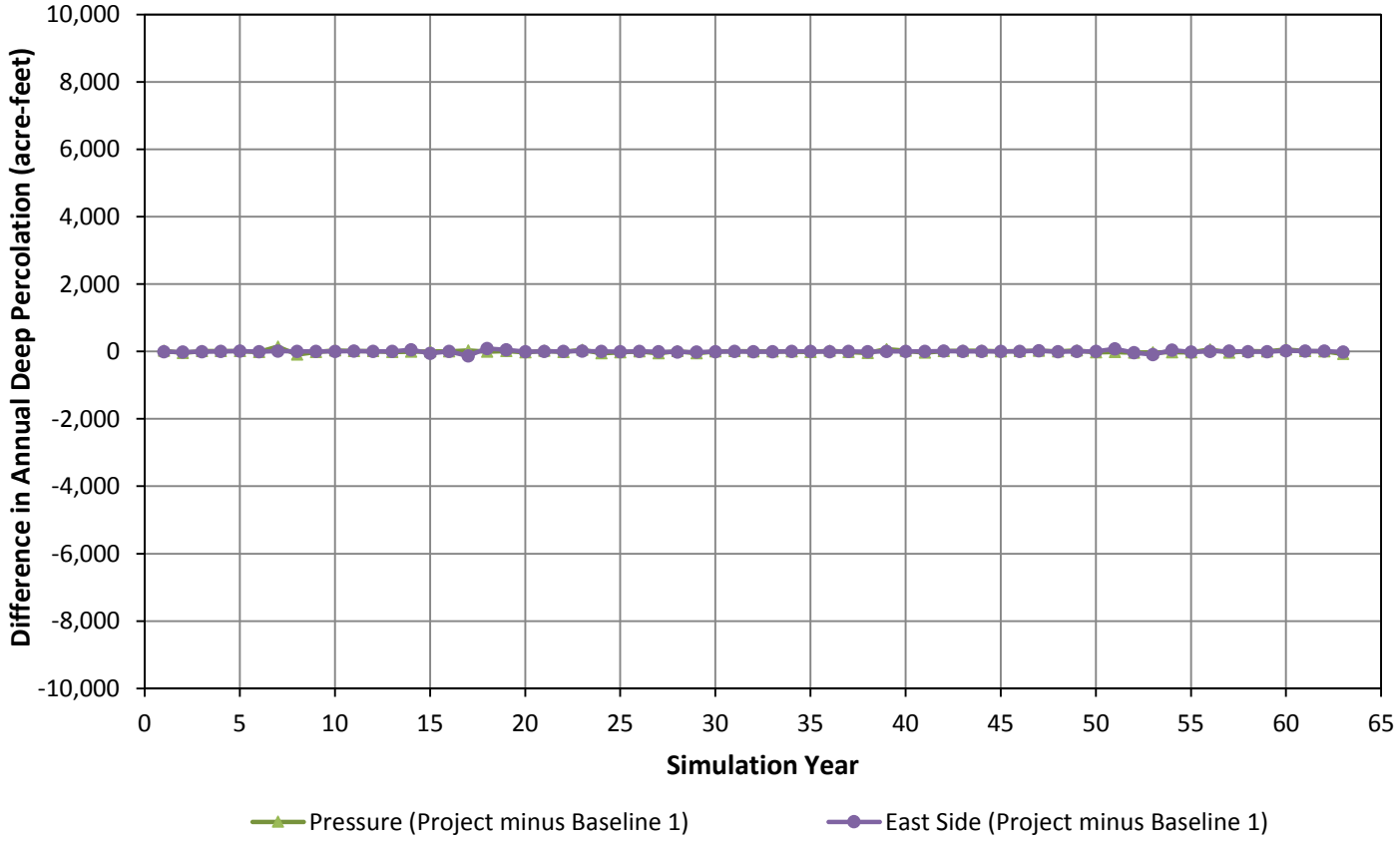


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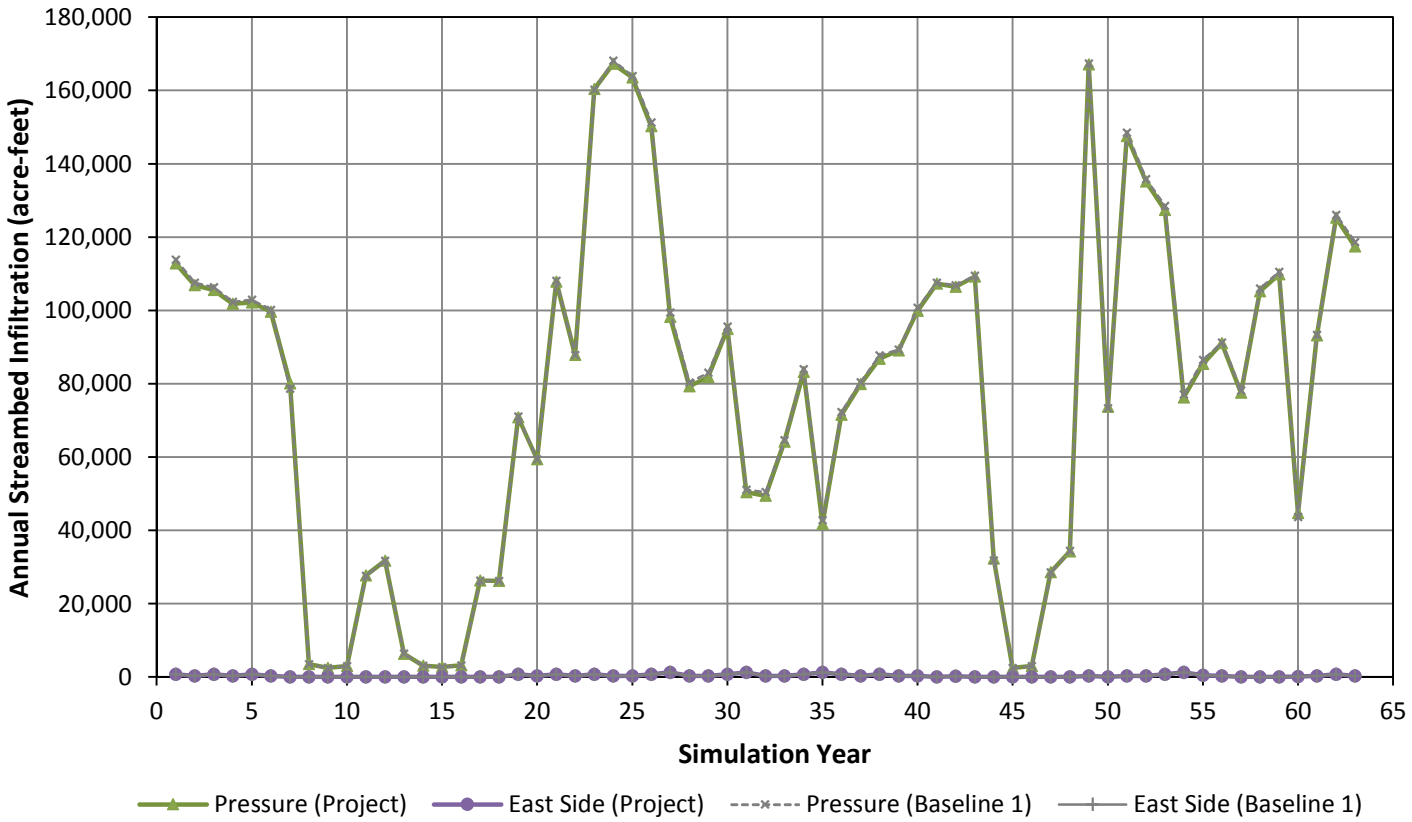
Figure 20c
Simulated Annual Deep Percolation
Project Run 6sn: Potrero rd 24.1 MGD
Monterey Peninsula Water Supply Project



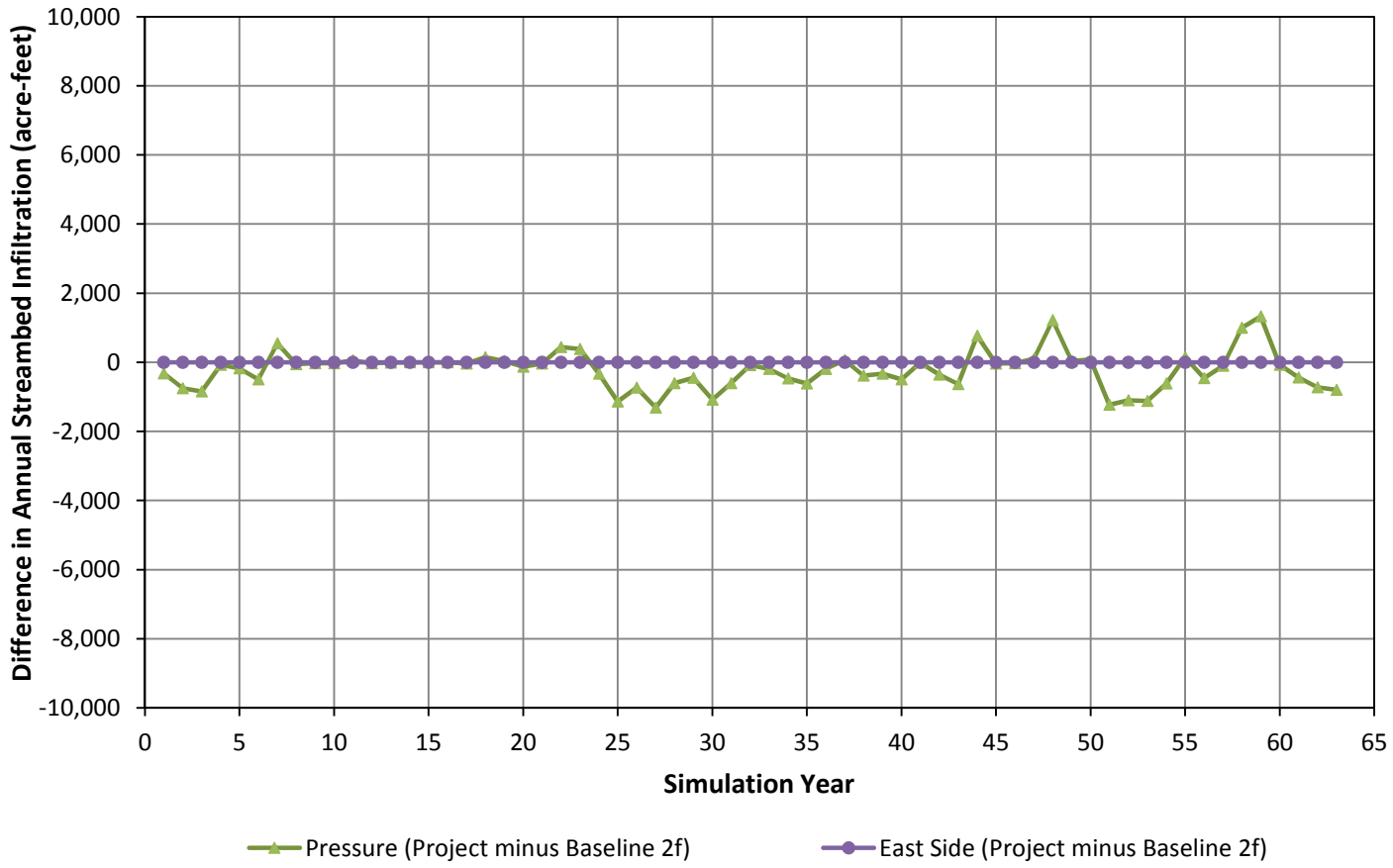


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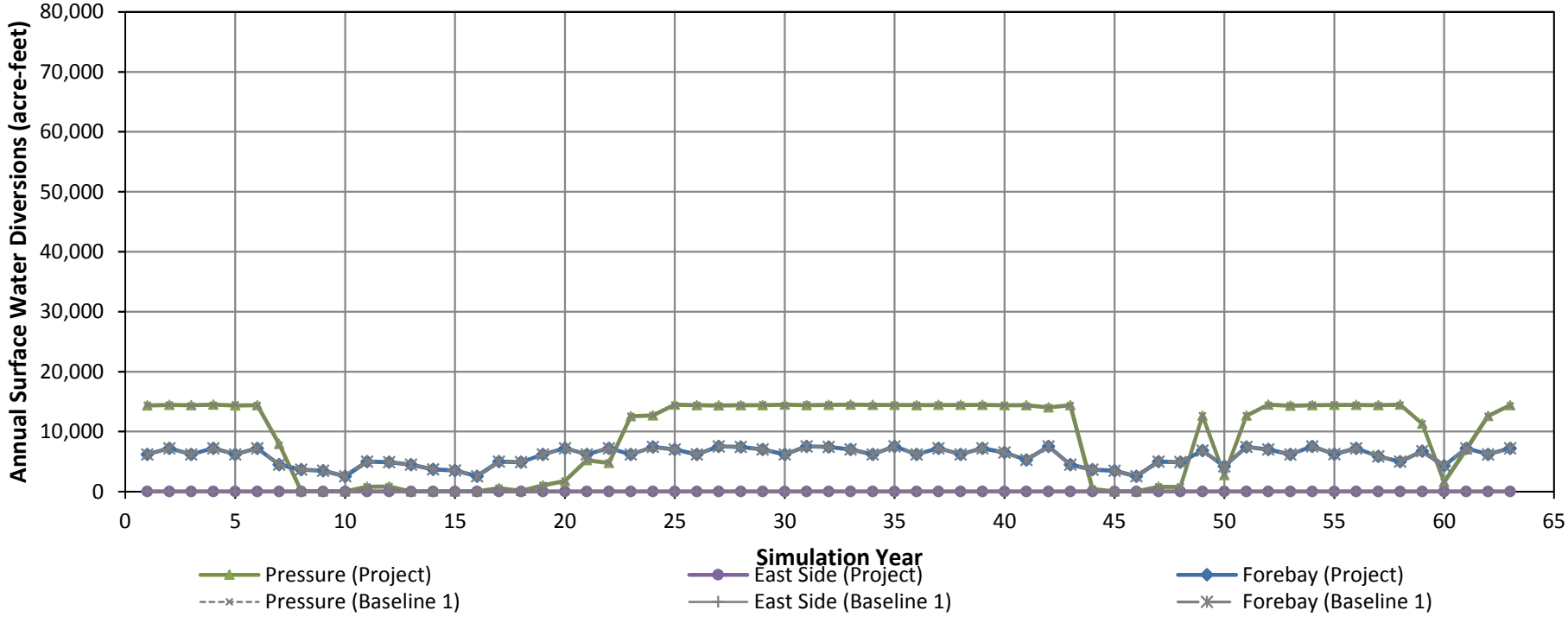
Figure 20d
Simulated Annual Streambed Infiltration
Project Run 6sn: Potrero rd 24.1 MGD
Monterey Peninsula Water Supply Project



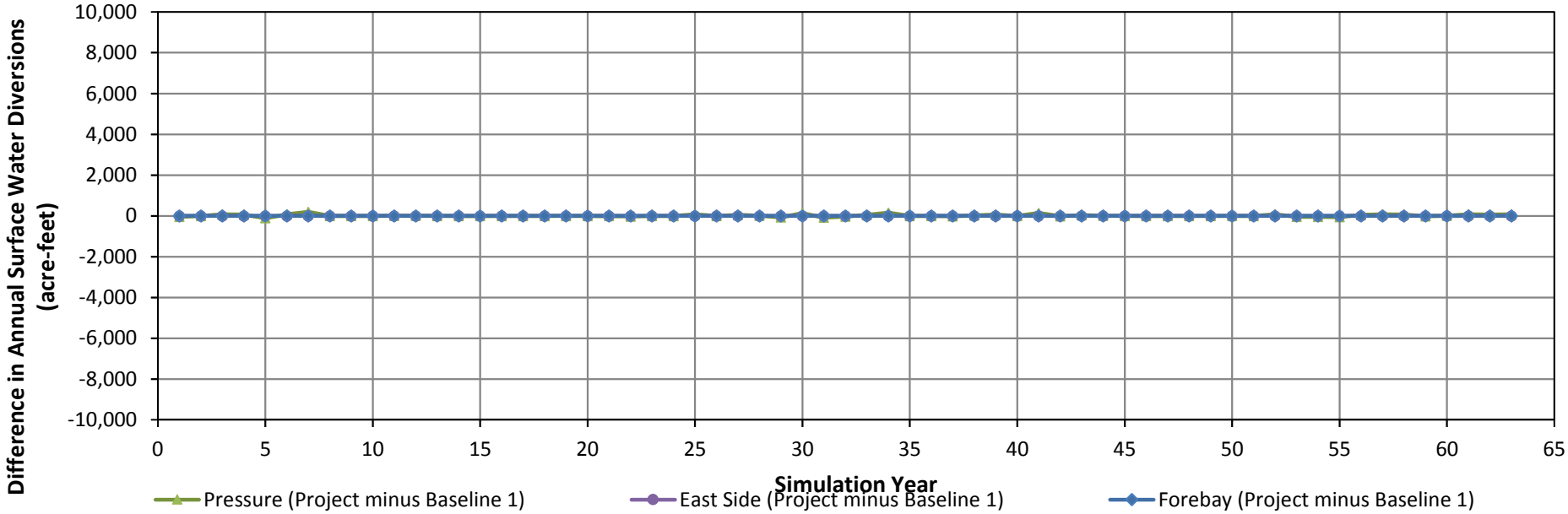


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Figure 20e
Simulated Annual Surface Water Diversions
Project Run 6sn: Potrero rd 24.1 MGD
Monterey Peninsula Water Supply Project

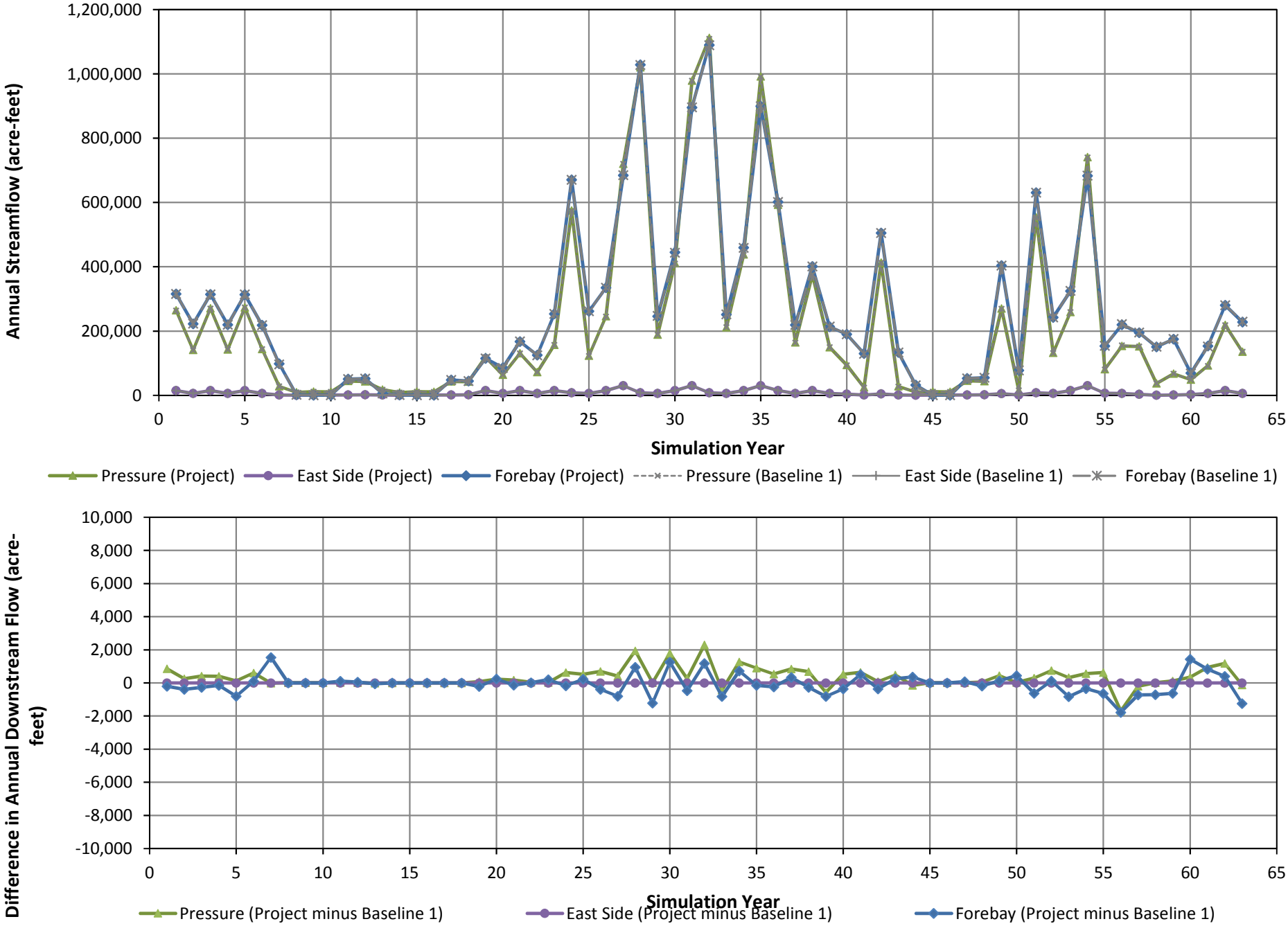

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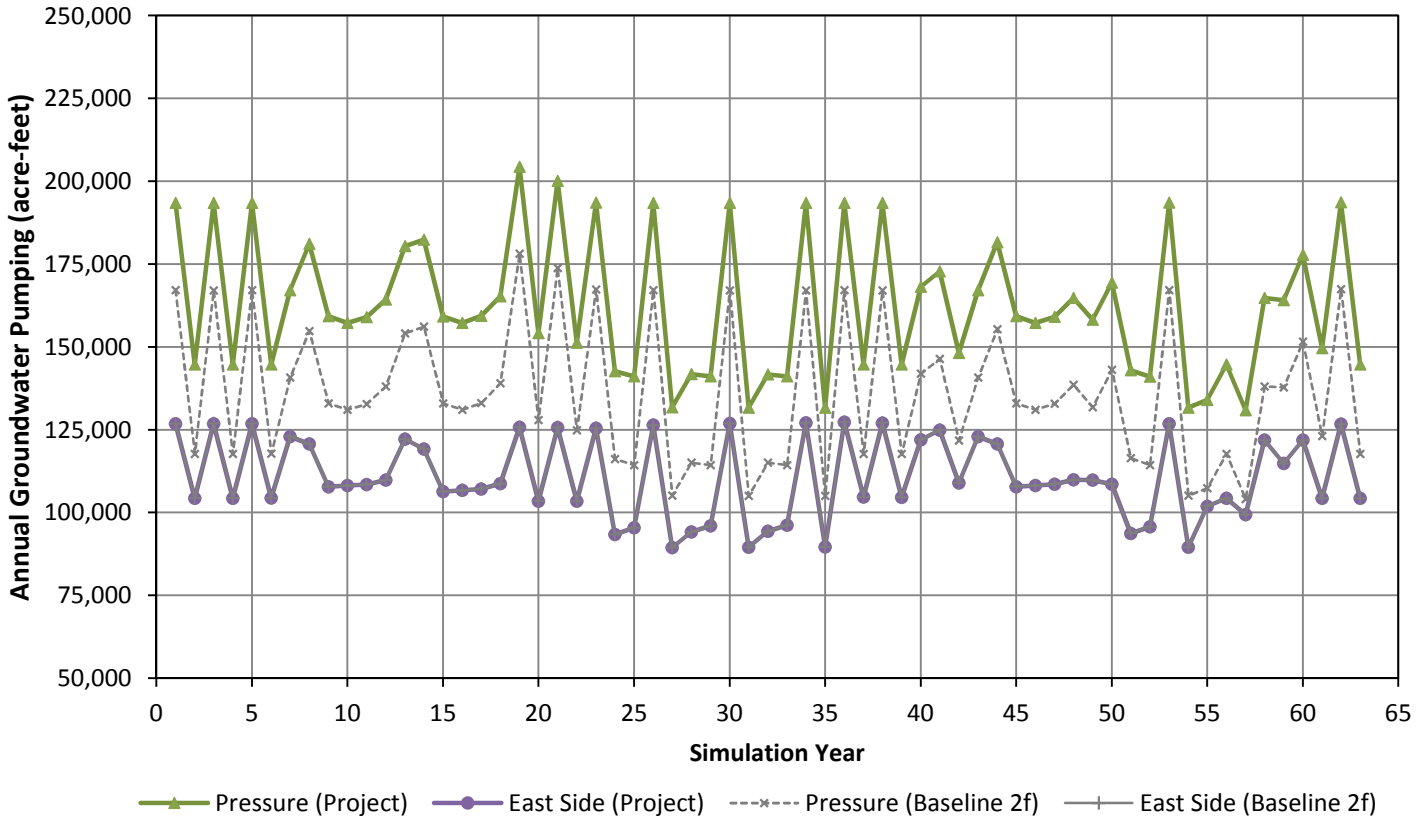
Figure 20f
Simulated Annual Downstream Flow
Project Run 6sn: Potrero rd 24.1 MGD
Monterey Peninsula Water Supply Project



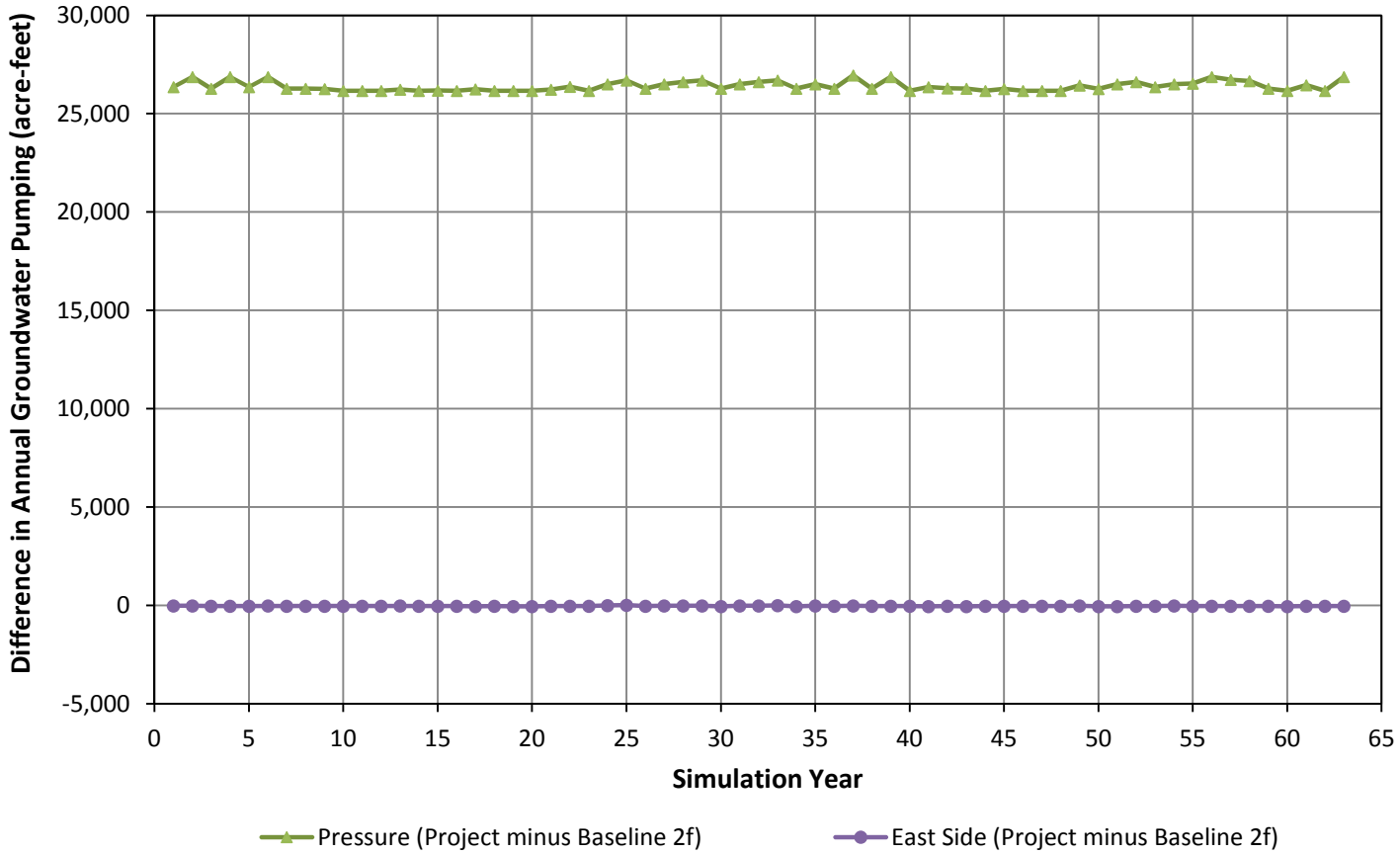


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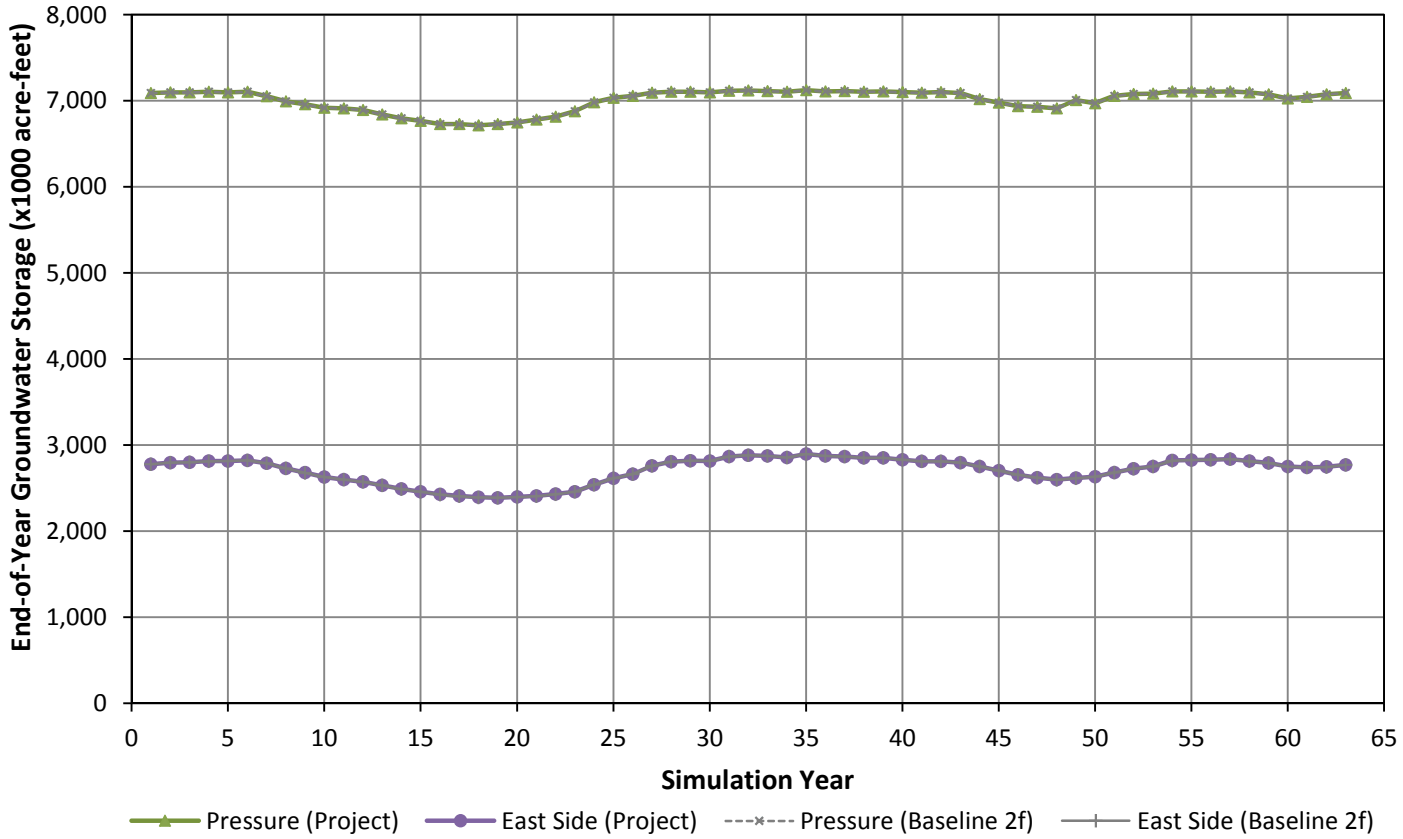
Figure 21a
Simulated Annual Groundwater Pumping
Project Run 7sf: Potrero Rd 24.1 MGD
Monterey Peninsula Water Supply Project



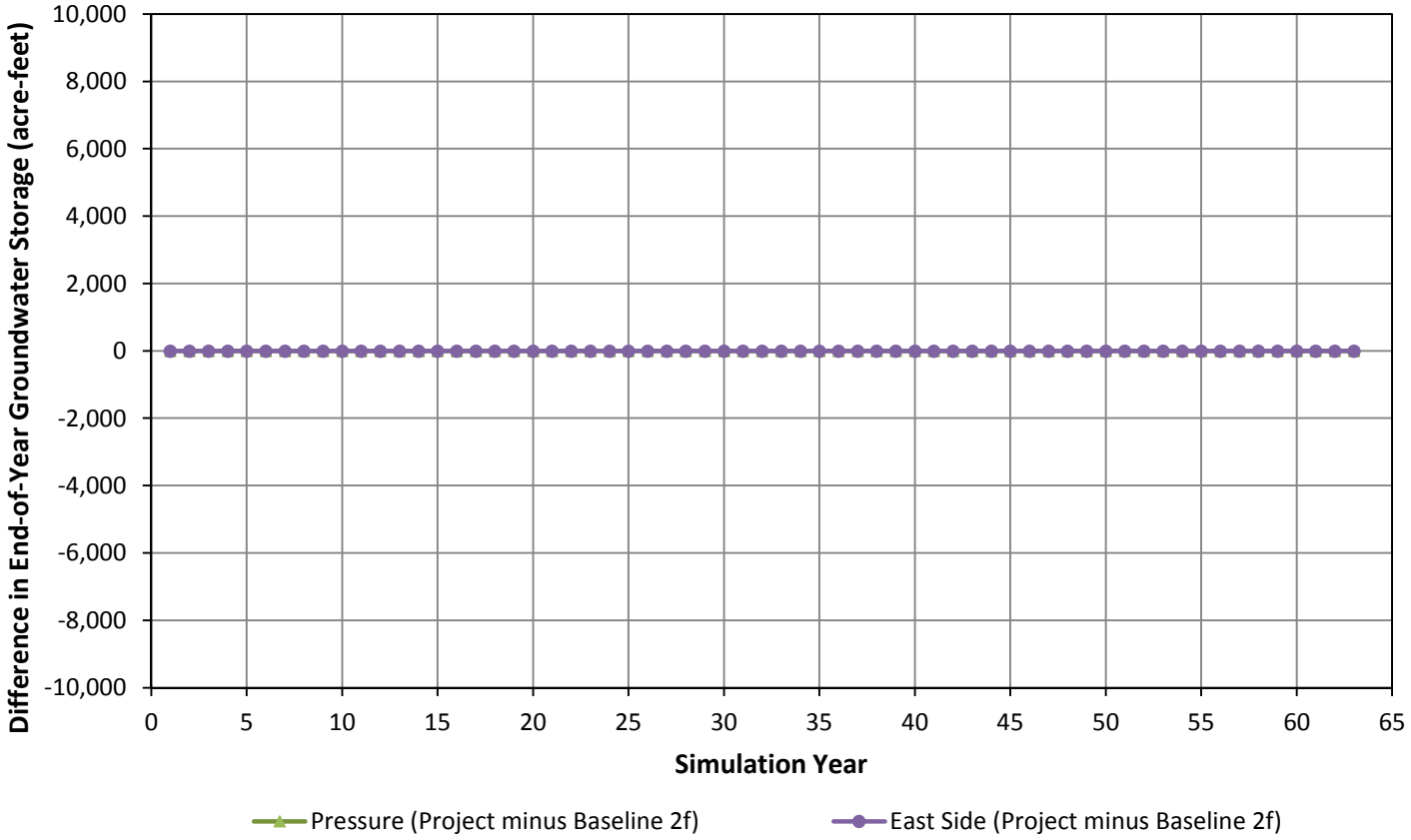


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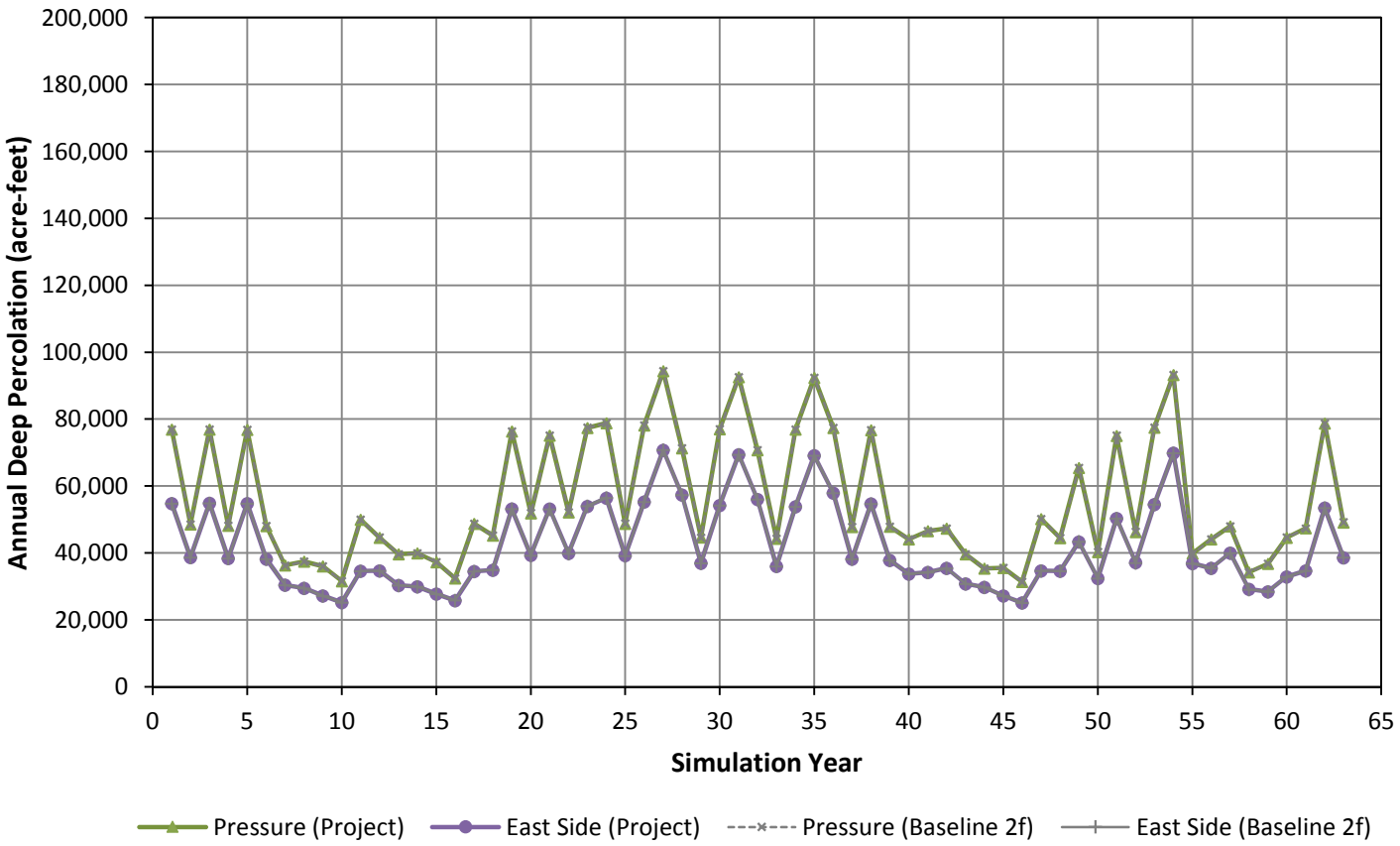
Figure 21b
Simulated End-of-Year Groundwater Storage
Project Run 7sf: Potrero Rd 24.1 MGD
Monterey Peninsula Water Supply Project



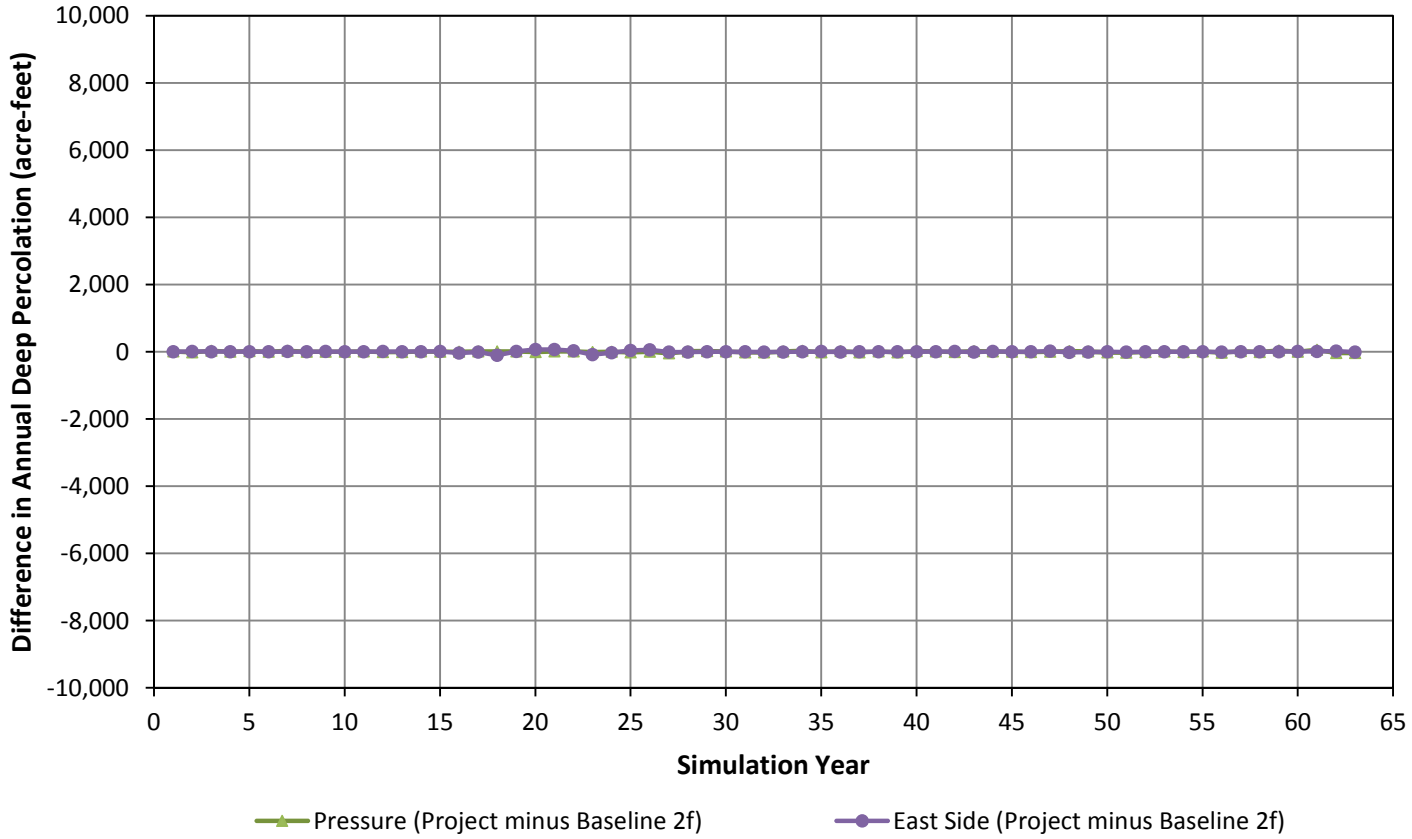


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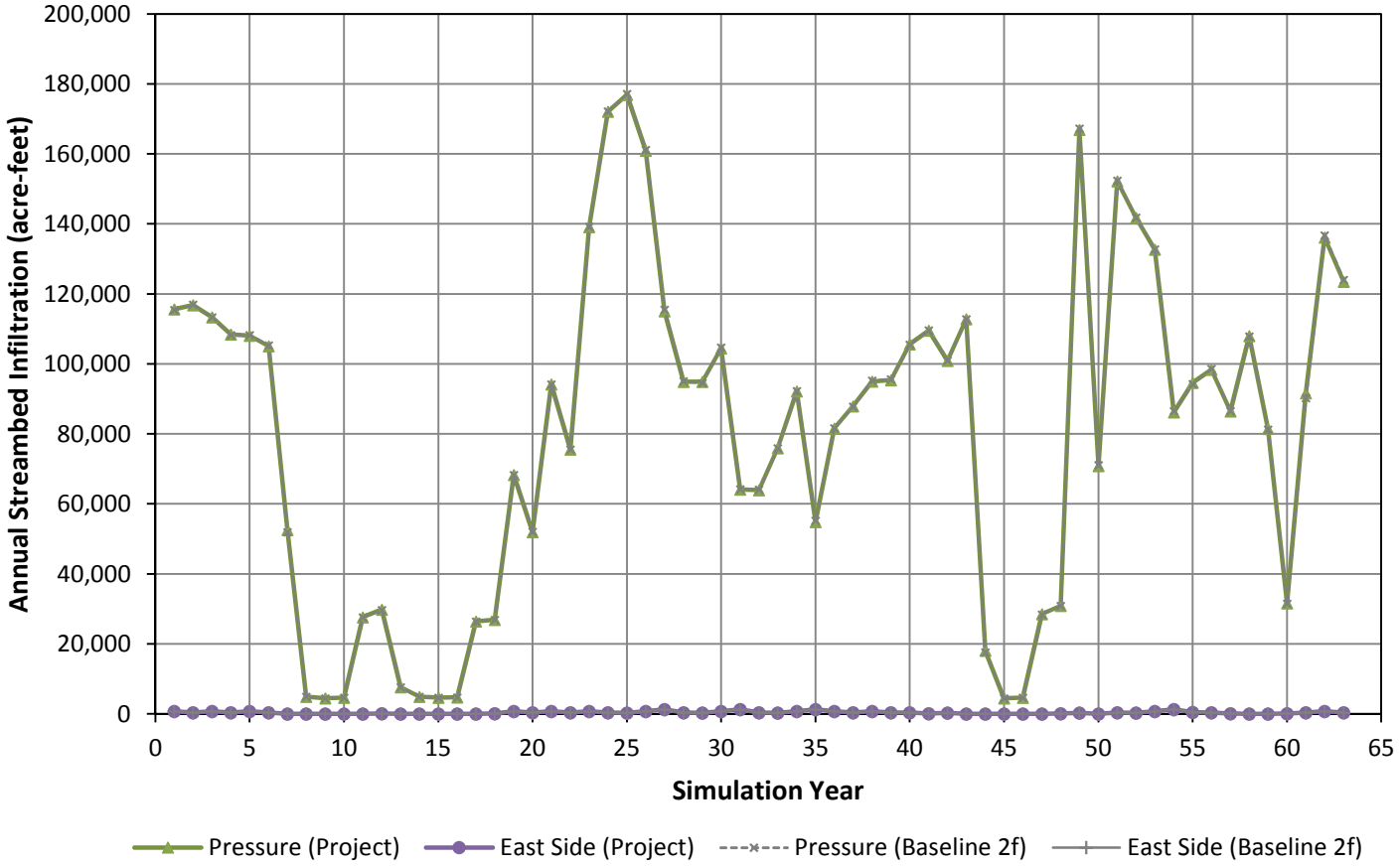
Figure 21c
Simulated Annual Deep Percolation
Project Run 7sf: Potrero Rd 24.1 MGD
Monterey Peninsula Water Supply Project



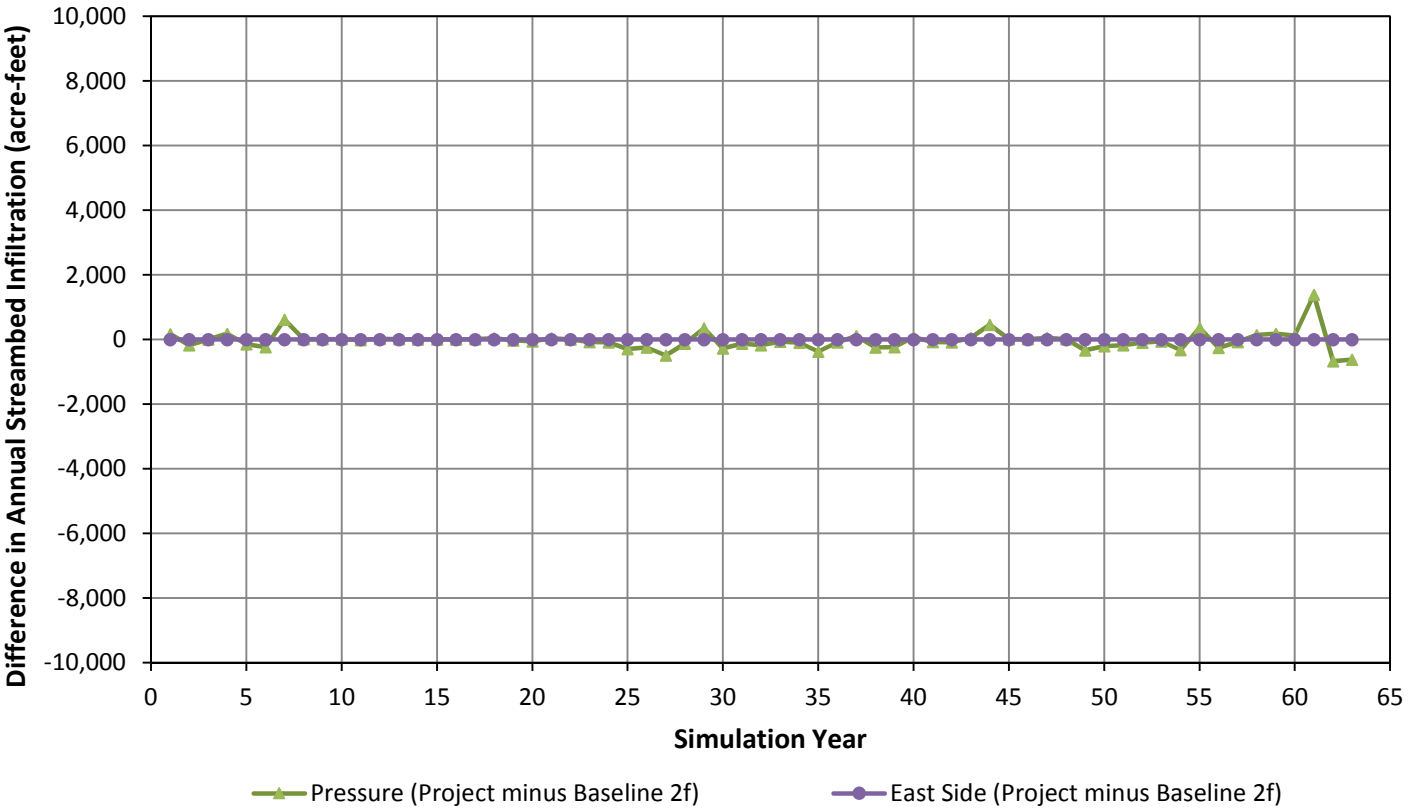


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Figure 21d
Simulated Annual Streambed Infiltration
Project Run 7sf: Potrero Rd 24.1 MGD
Monterey Peninsula Water Supply Project

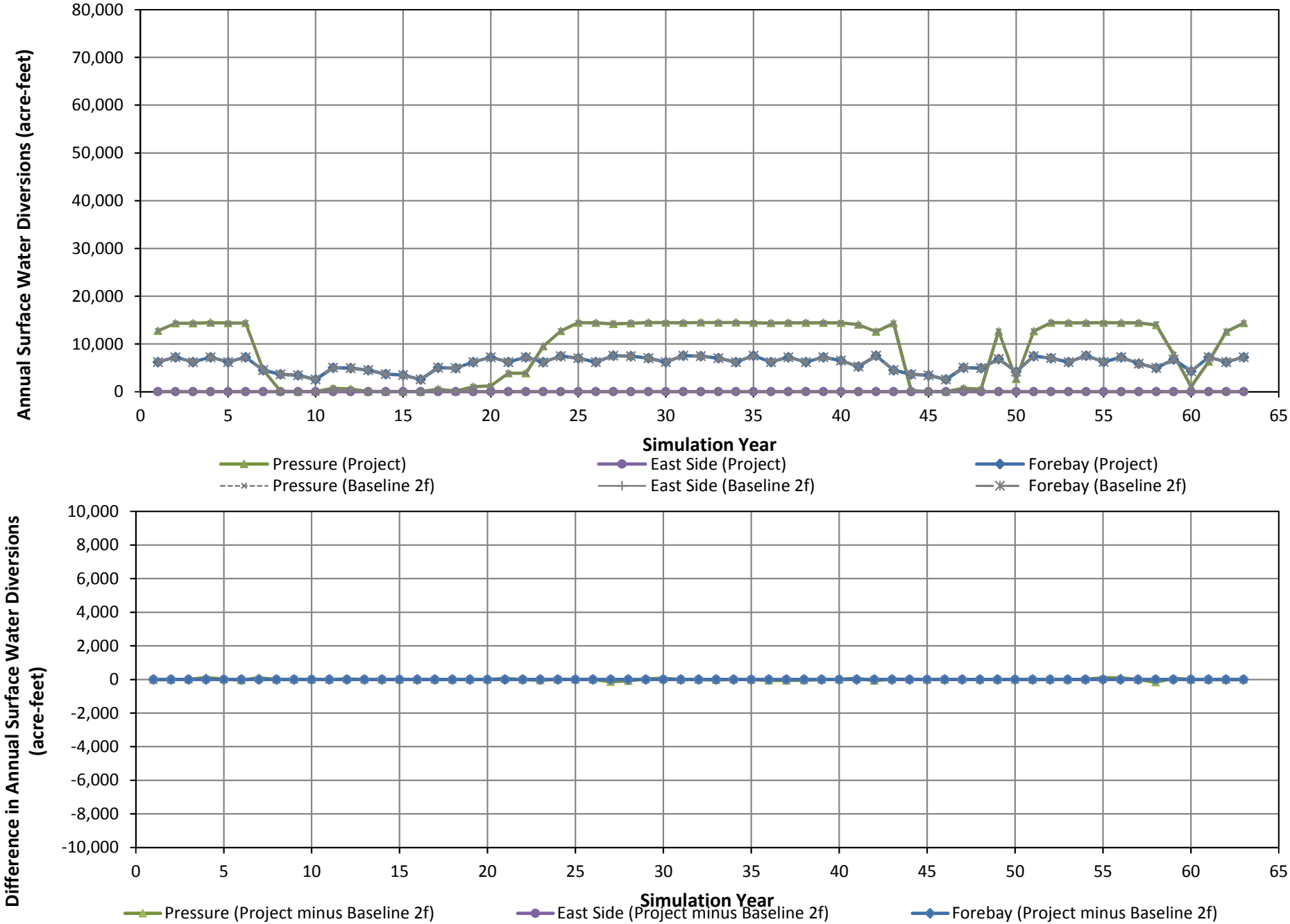

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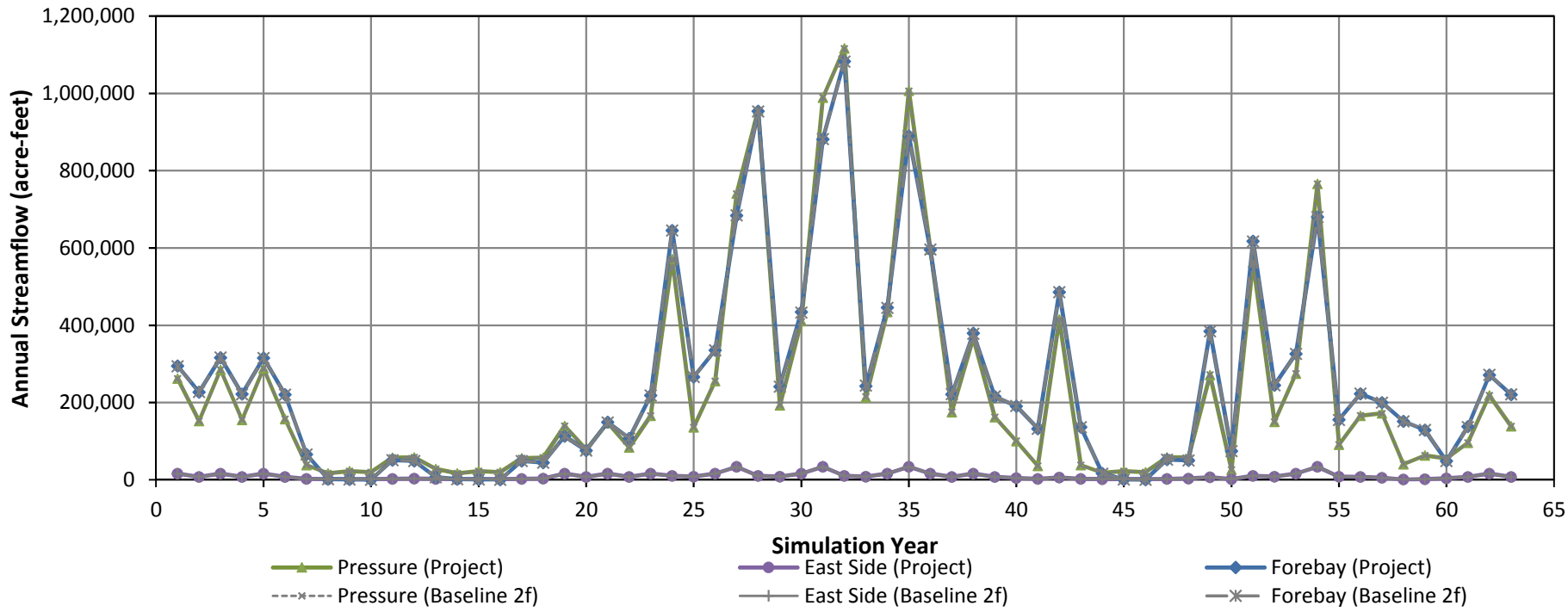
Figure 21e
Simulated Annual Surface Water Diversions
Project Run 7sf: Potrero Rd 24.1 MGD
Monterey Peninsula Water Supply Project



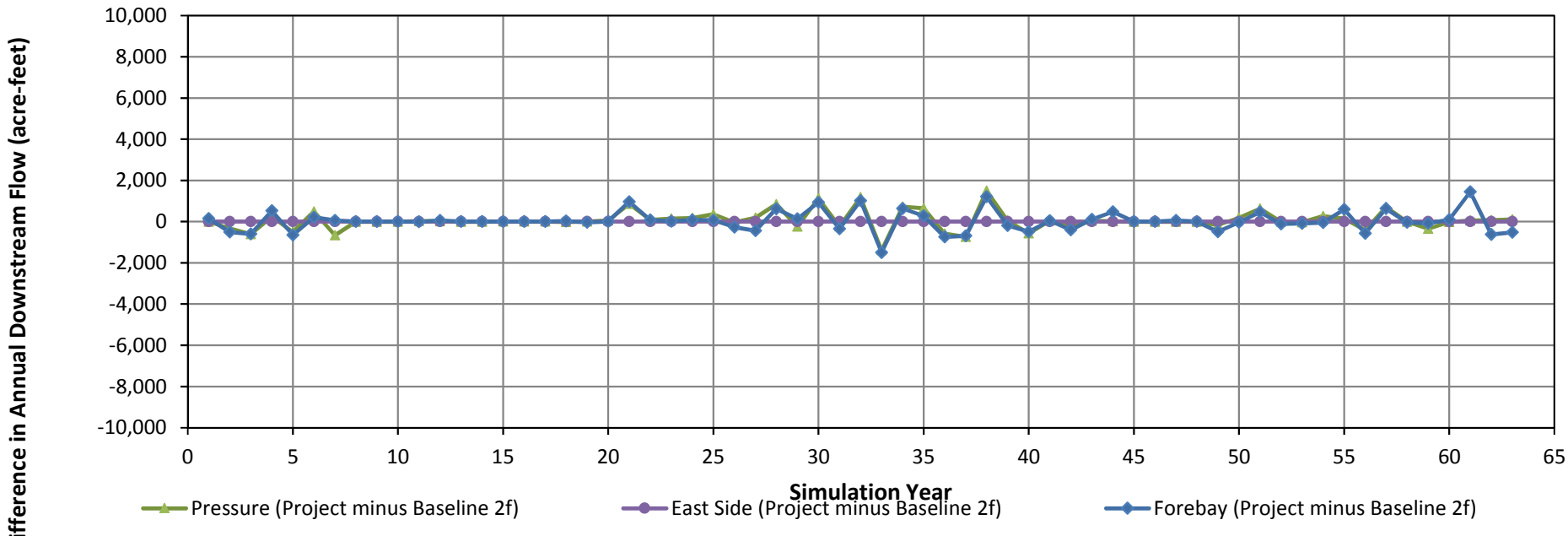


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Figure 21f
Simulated Annual Downstream Flow
Project Run 7sf: Potrero Rd 24.1 MGD
Monterey Peninsula Water Supply Project

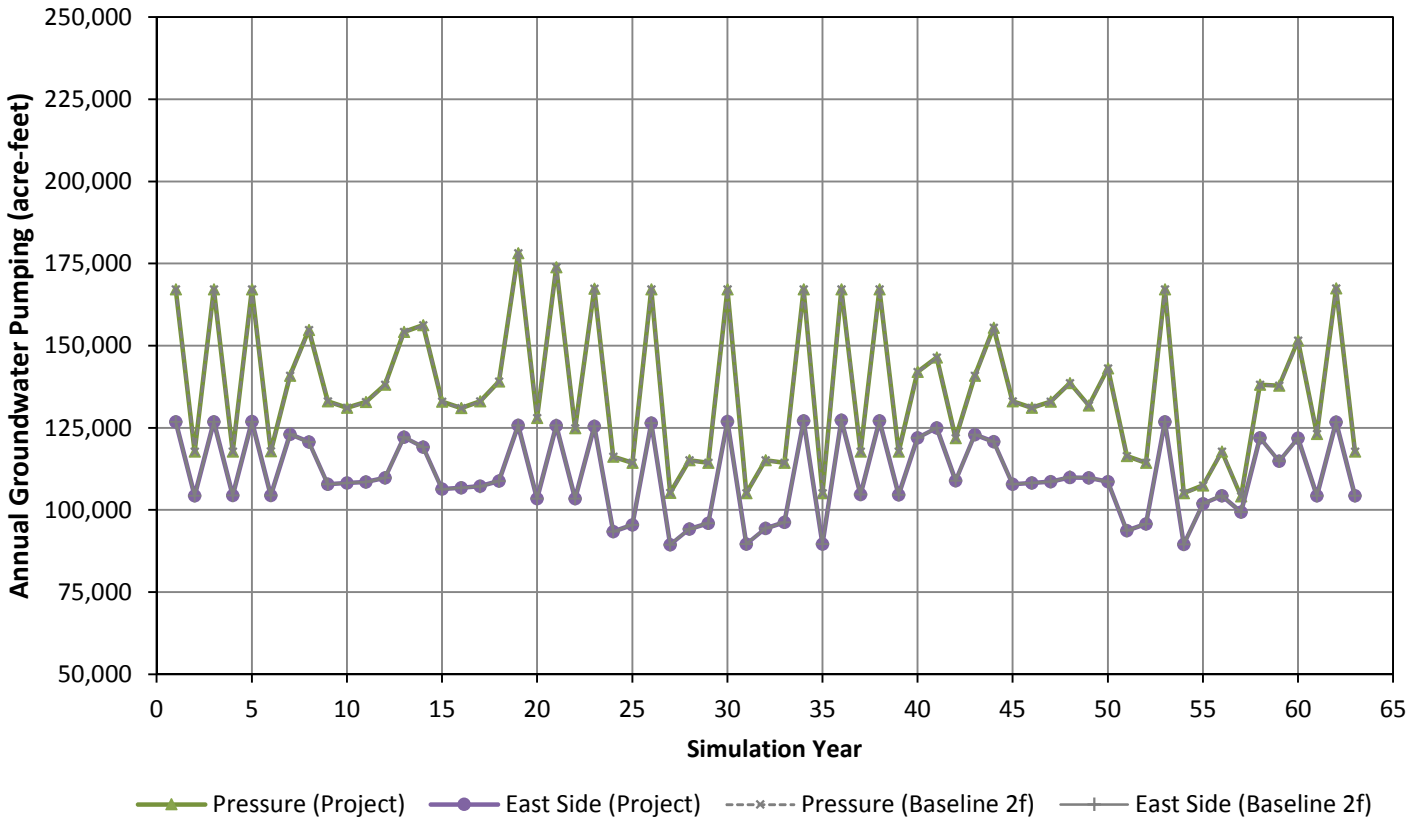

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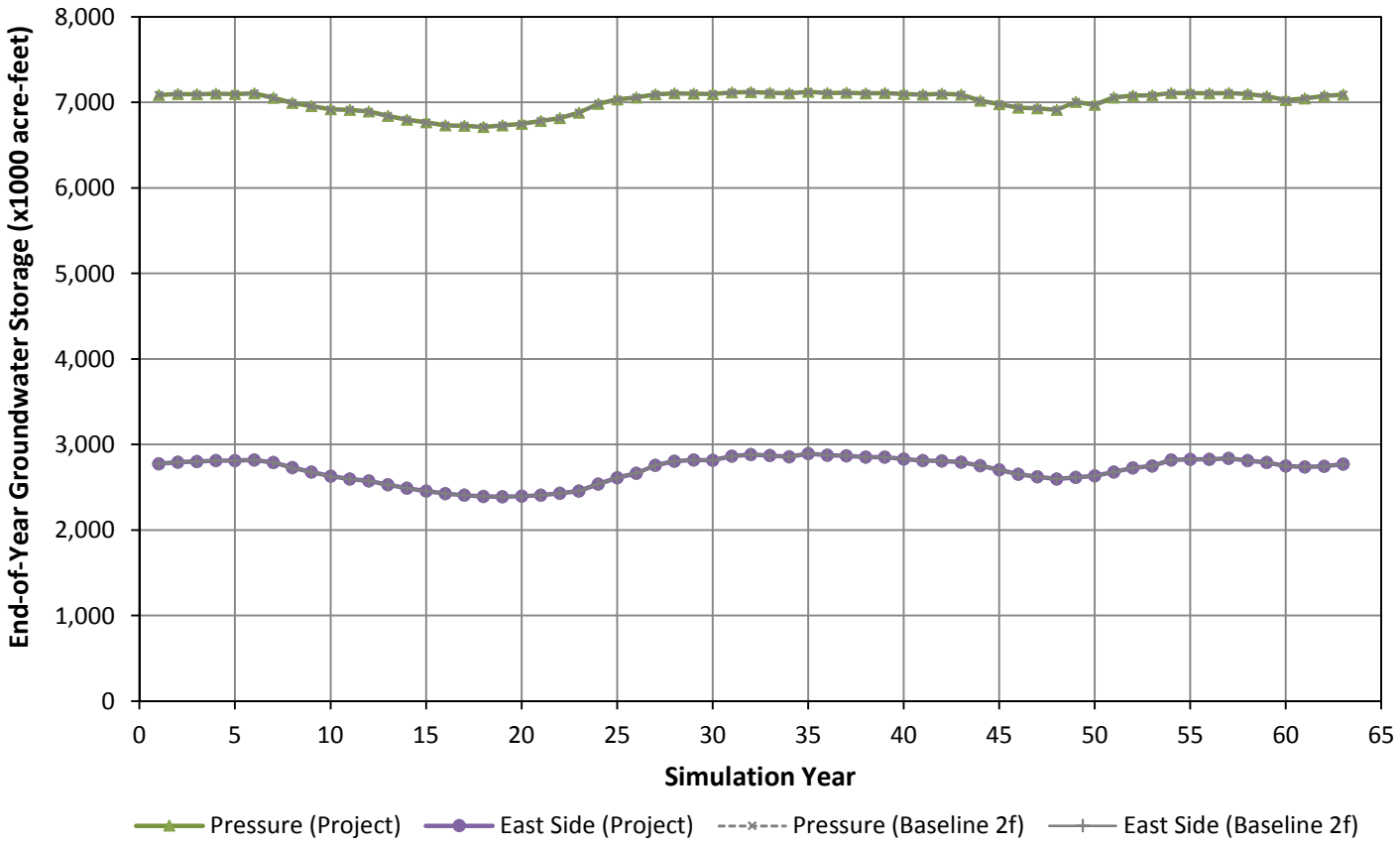
Figure 22a
Simulated Annual Groundwater Pumping
Project Run 7srf: Post project
Monterey Peninsula Water Supply Project



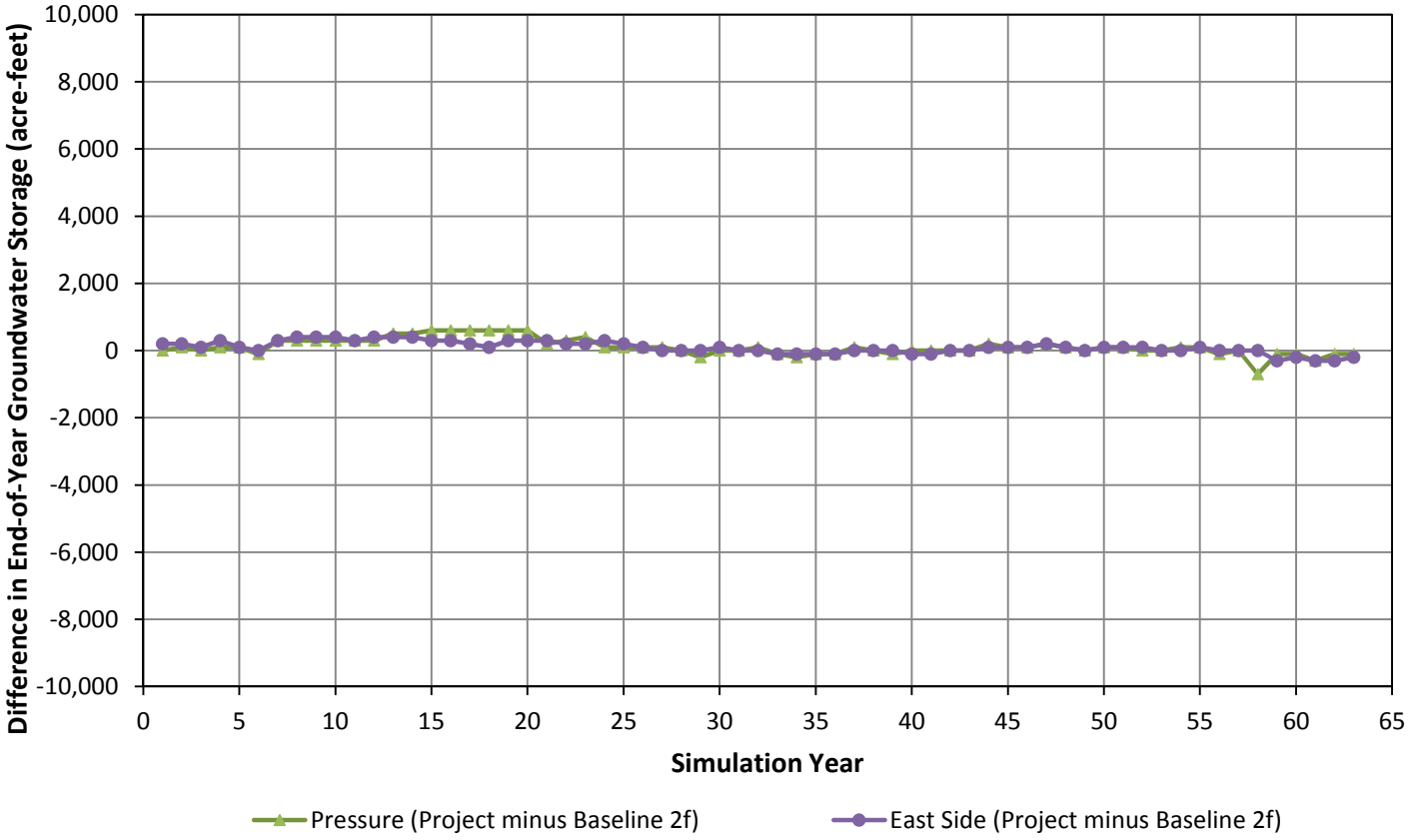


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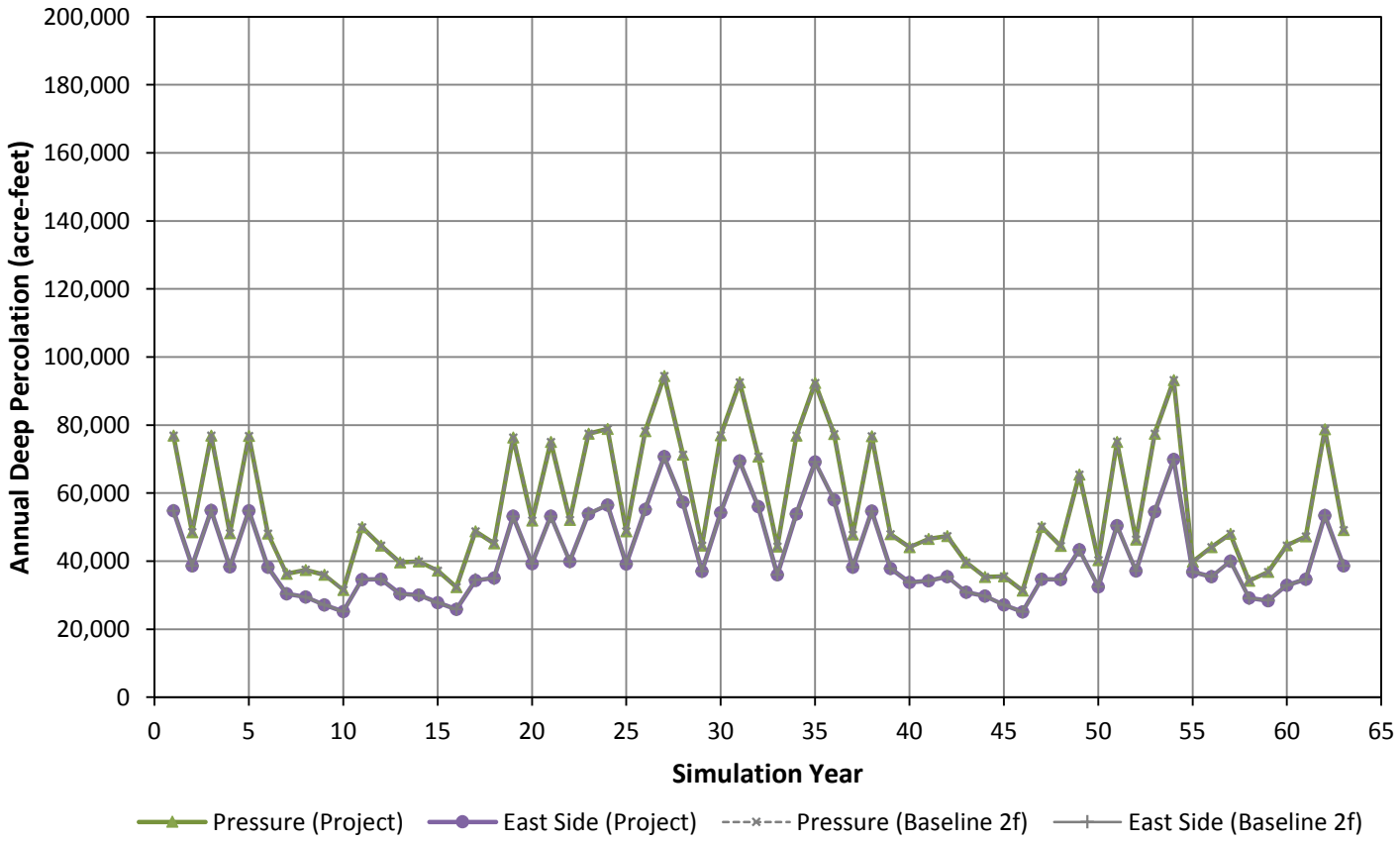
Figure 22b
Simulated End-of-Year Groundwater Storage
Project Run 7srf: Post project
Monterey Peninsula Water Supply Project



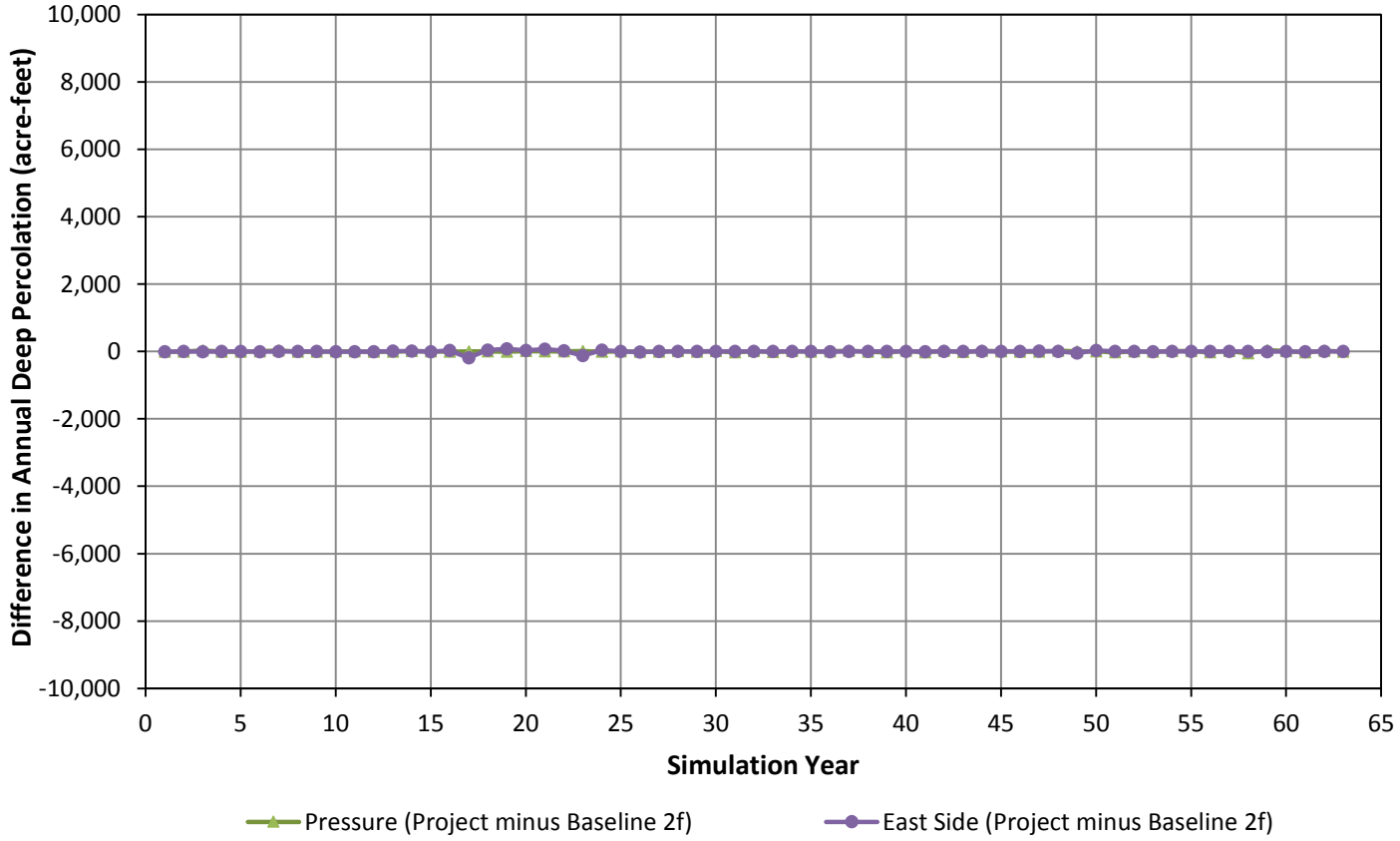


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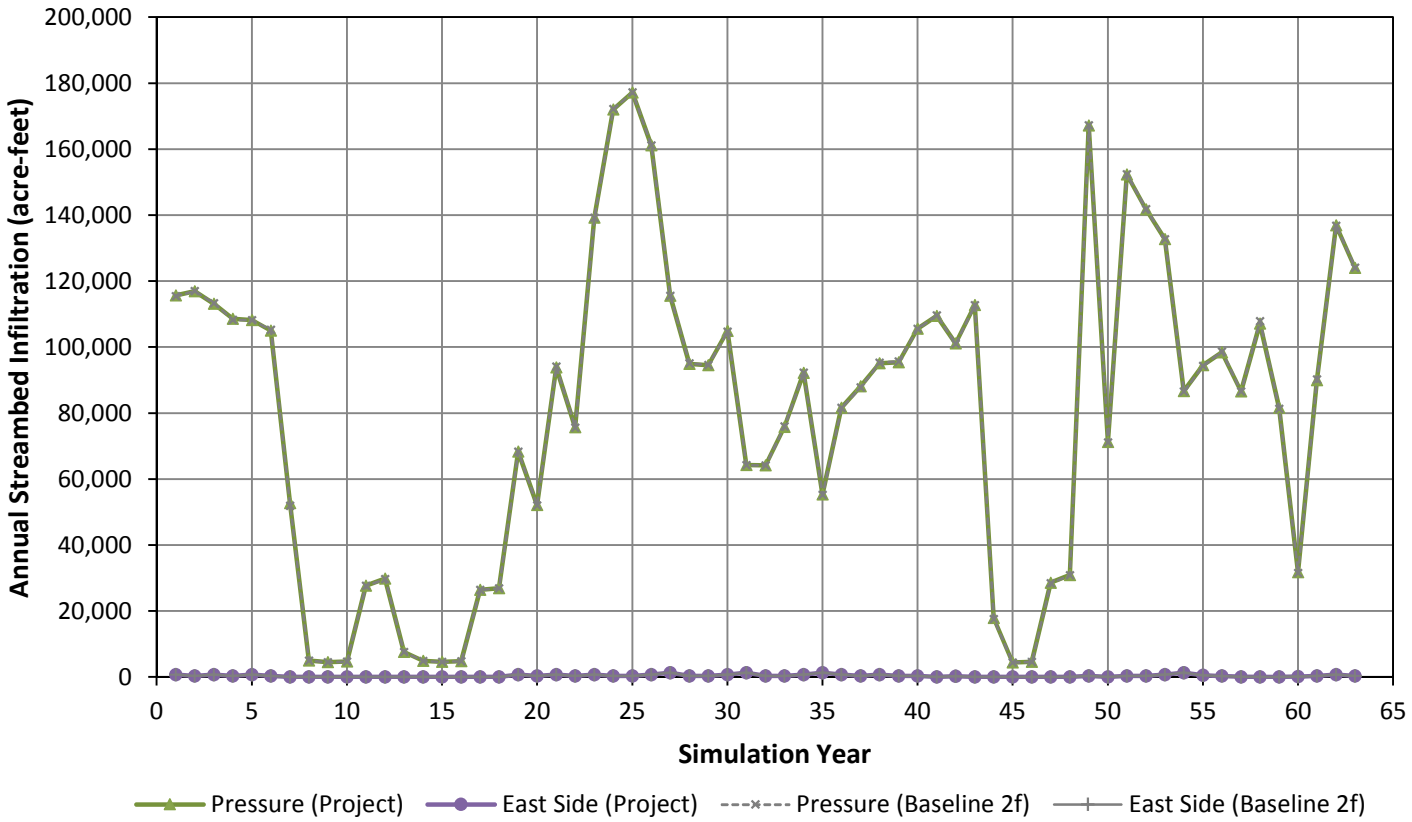
Figure 22c
Simulated Annual Deep Percolation
Project Run 7srf: Post project
Monterey Peninsula Water Supply Project



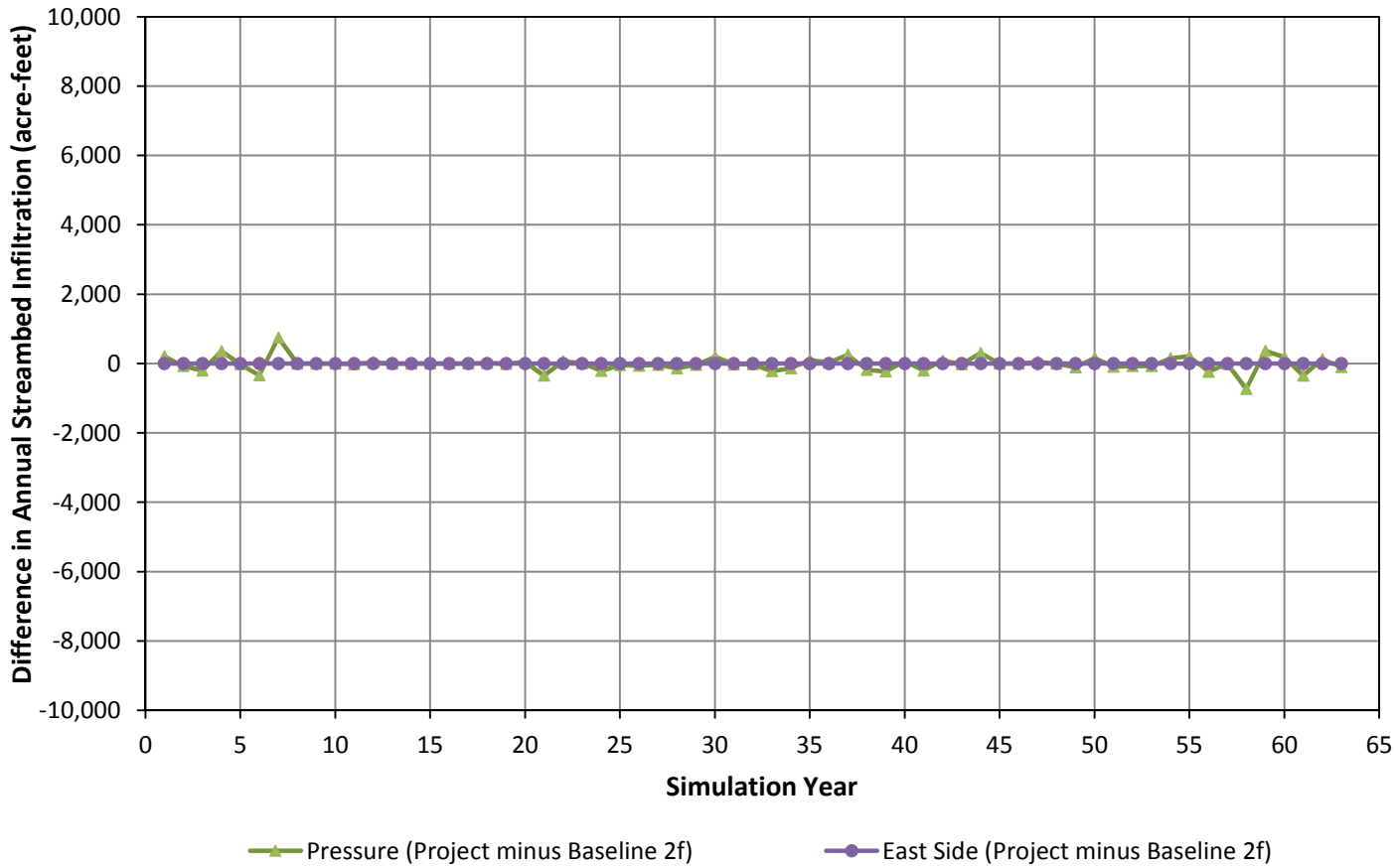


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Figure 22d
Simulated Annual Streambed Infiltration
Project Run 7srf: Post project
Monterey Peninsula Water Supply Project

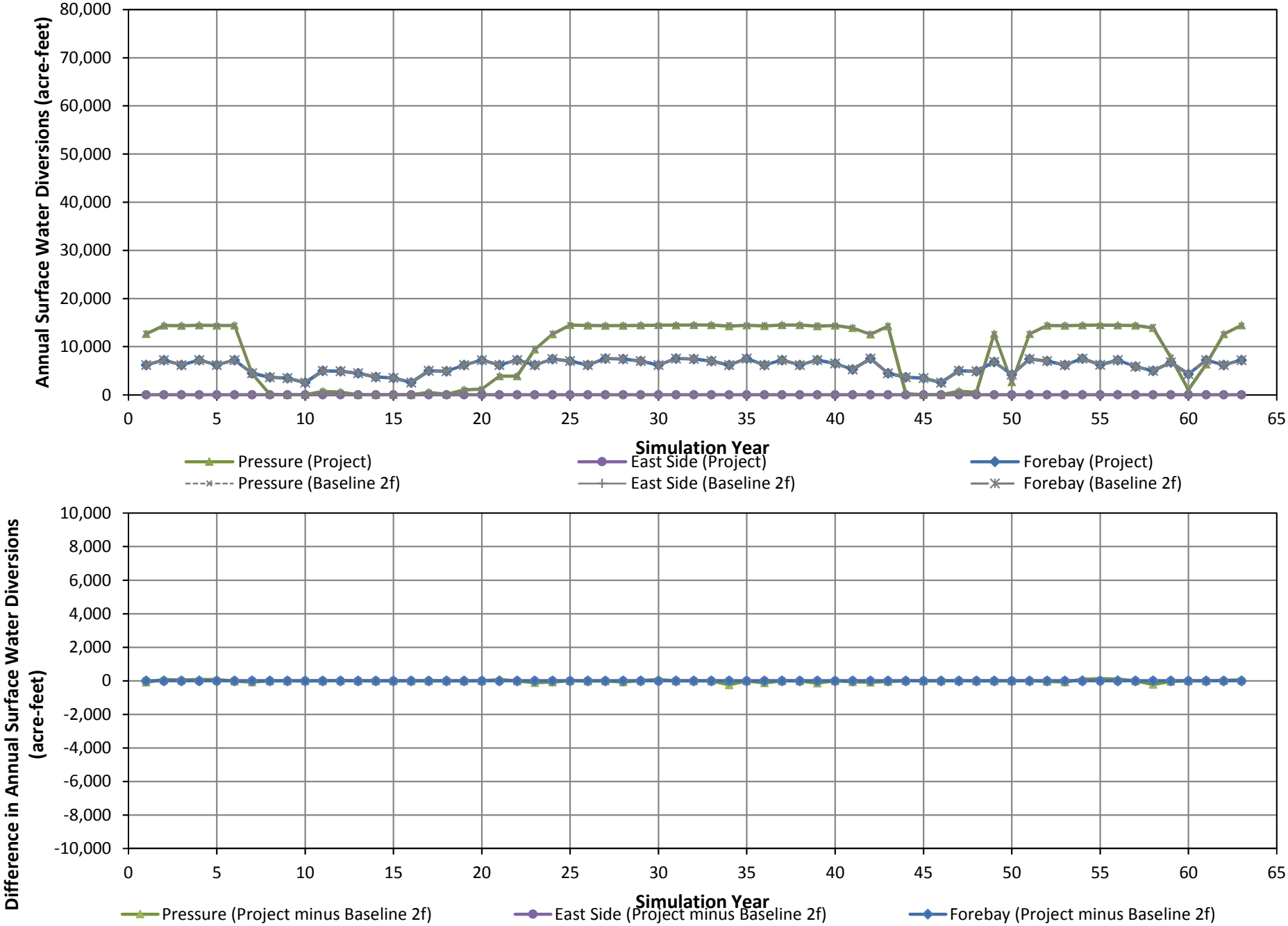

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Figure 22e
Simulated Annual Surface Water Diversions
Project Run 7srf: Post project
Monterey Peninsula Water Supply Project

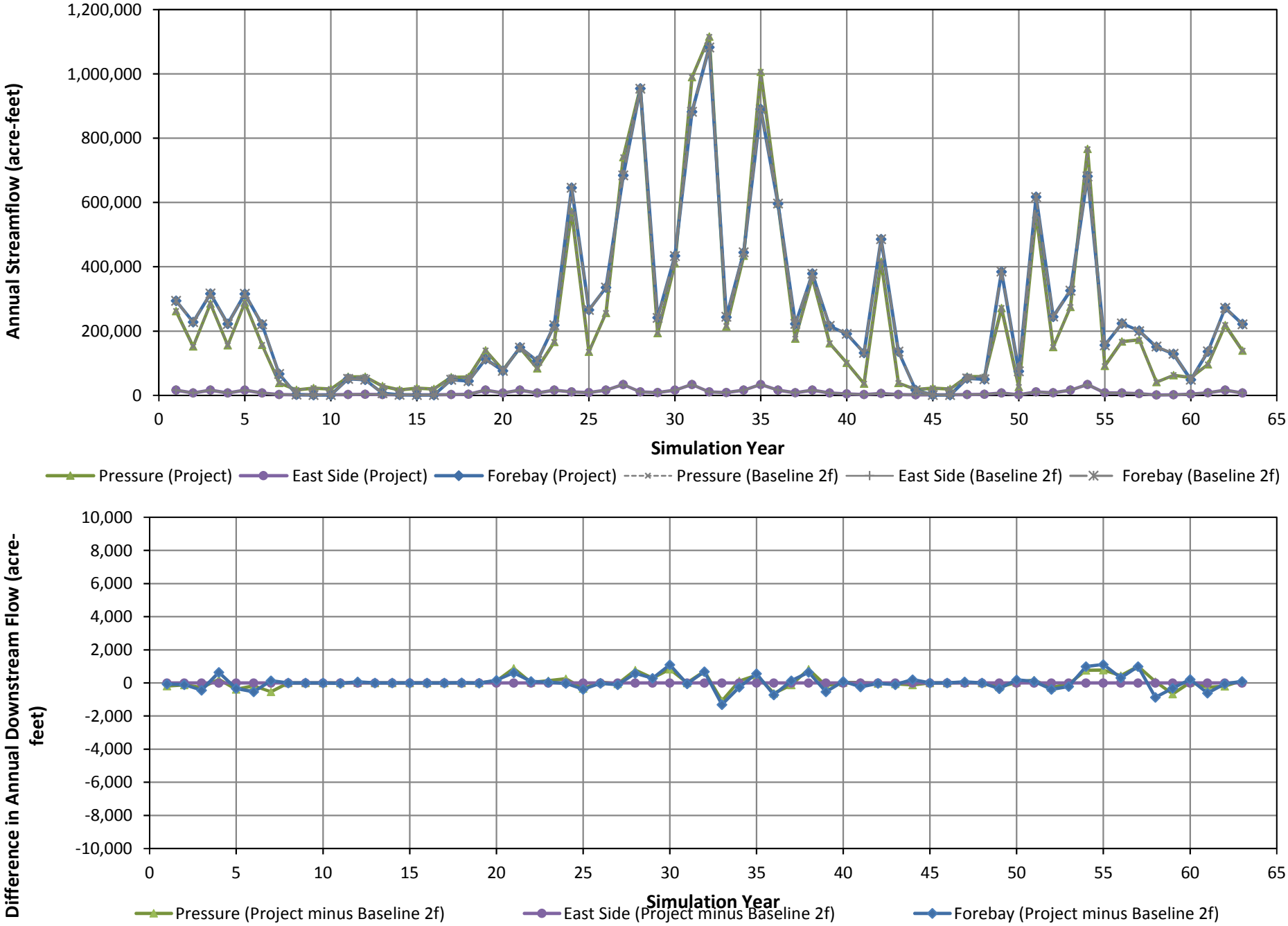

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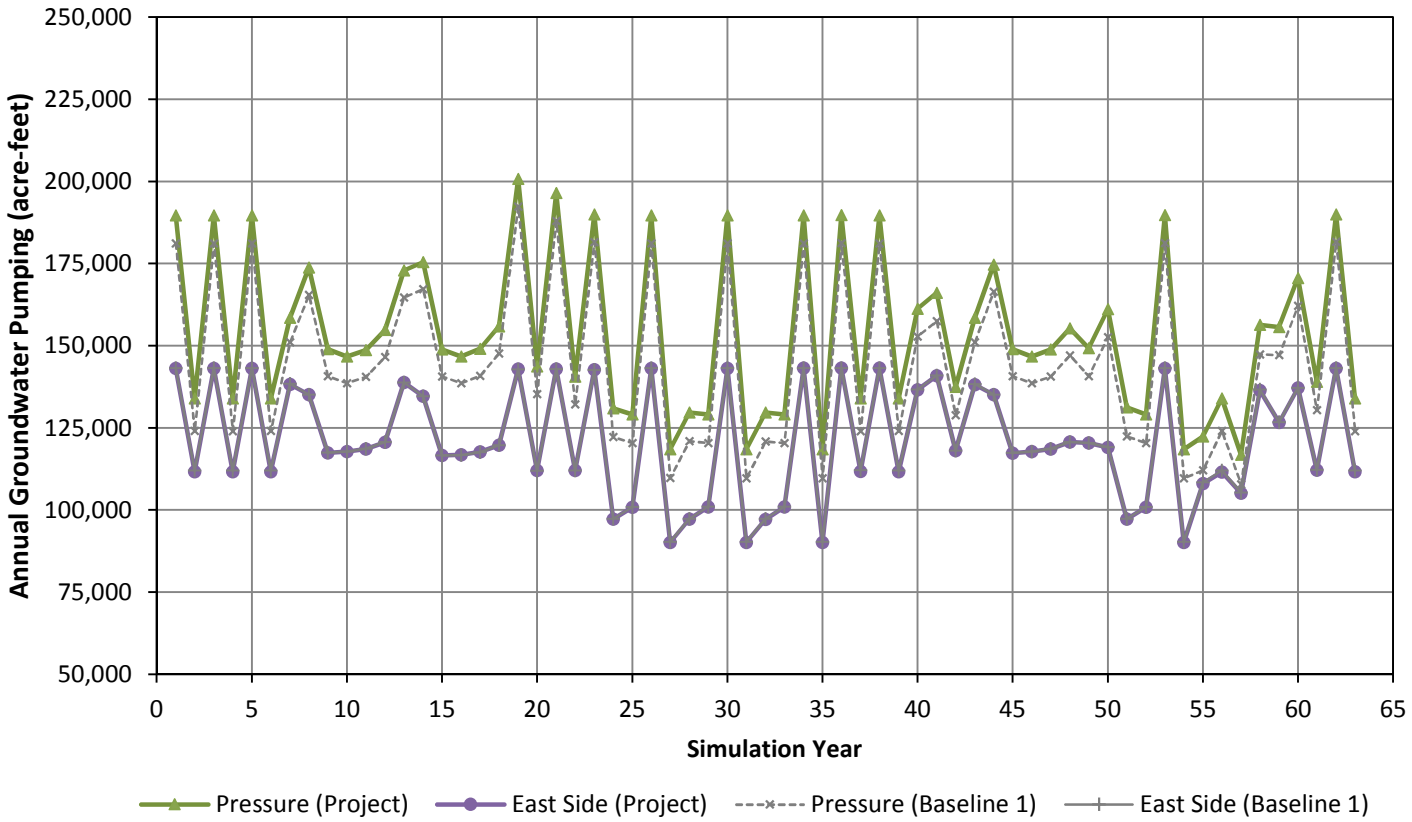
Figure 22f
Simulated Annual Downstream Flow
Project Run 7srf: Post project
Monterey Peninsula Water Supply Project



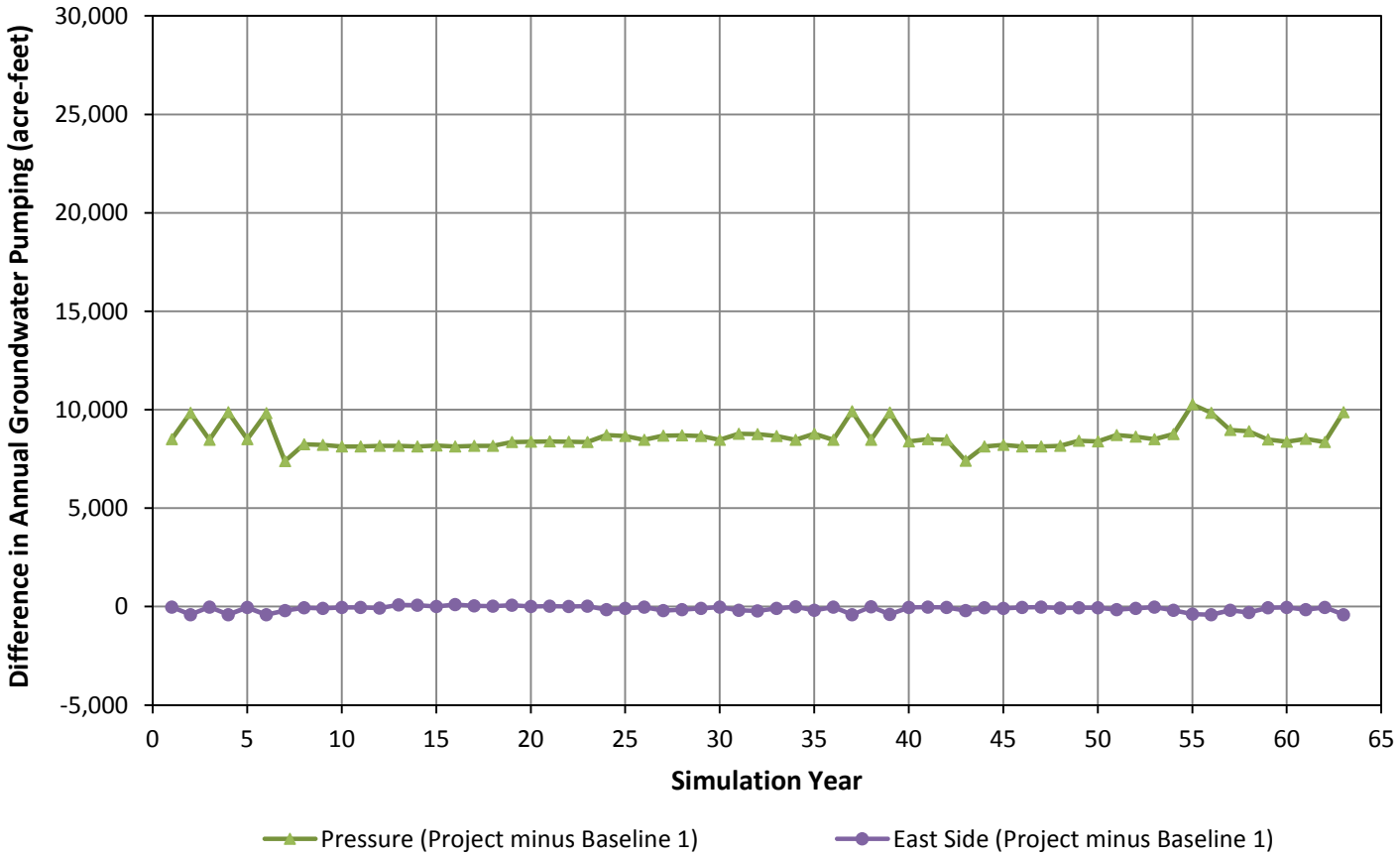


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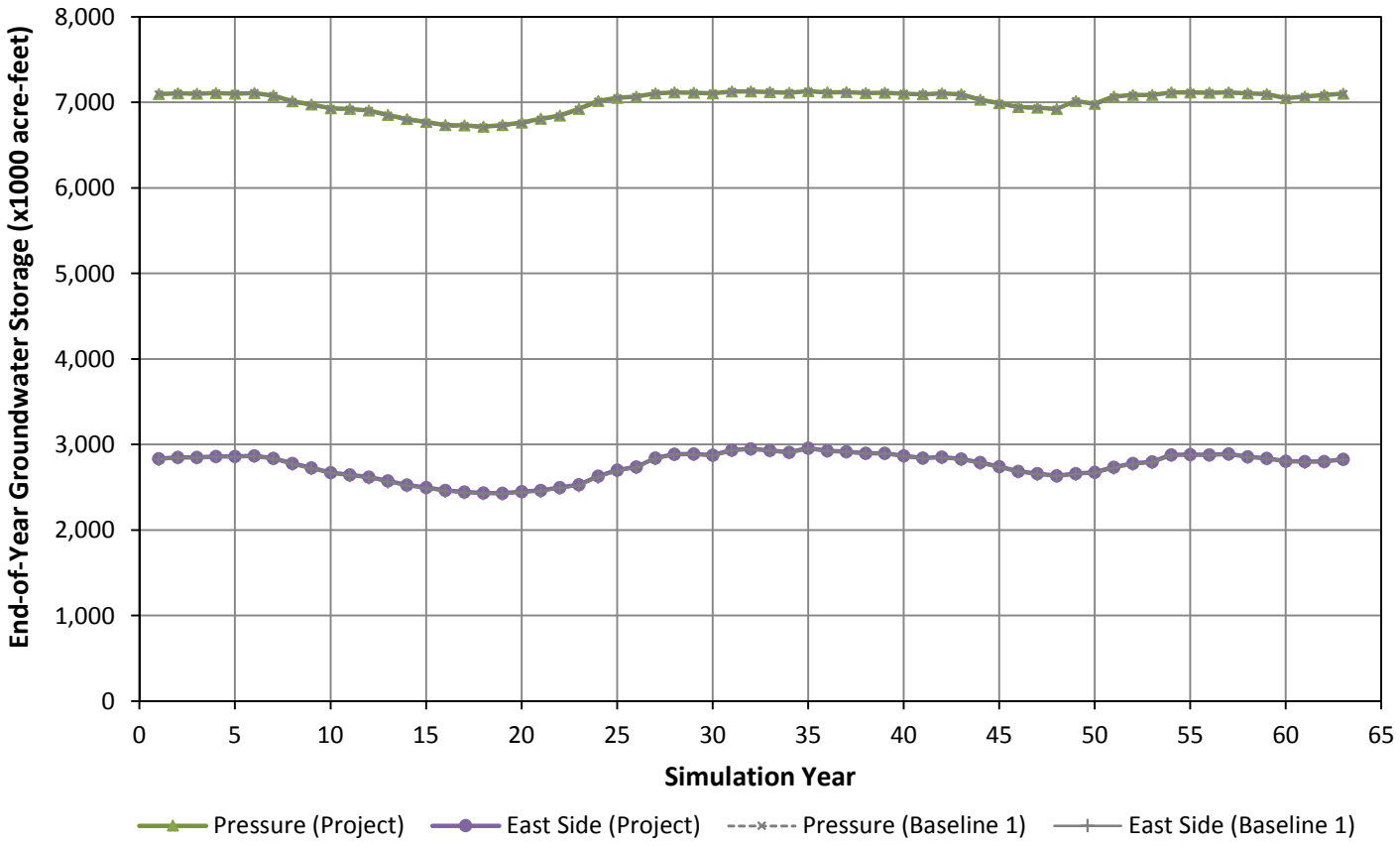
Figure 23a
Simulated Annual Groundwater Pumping
Project Run 8sn: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project



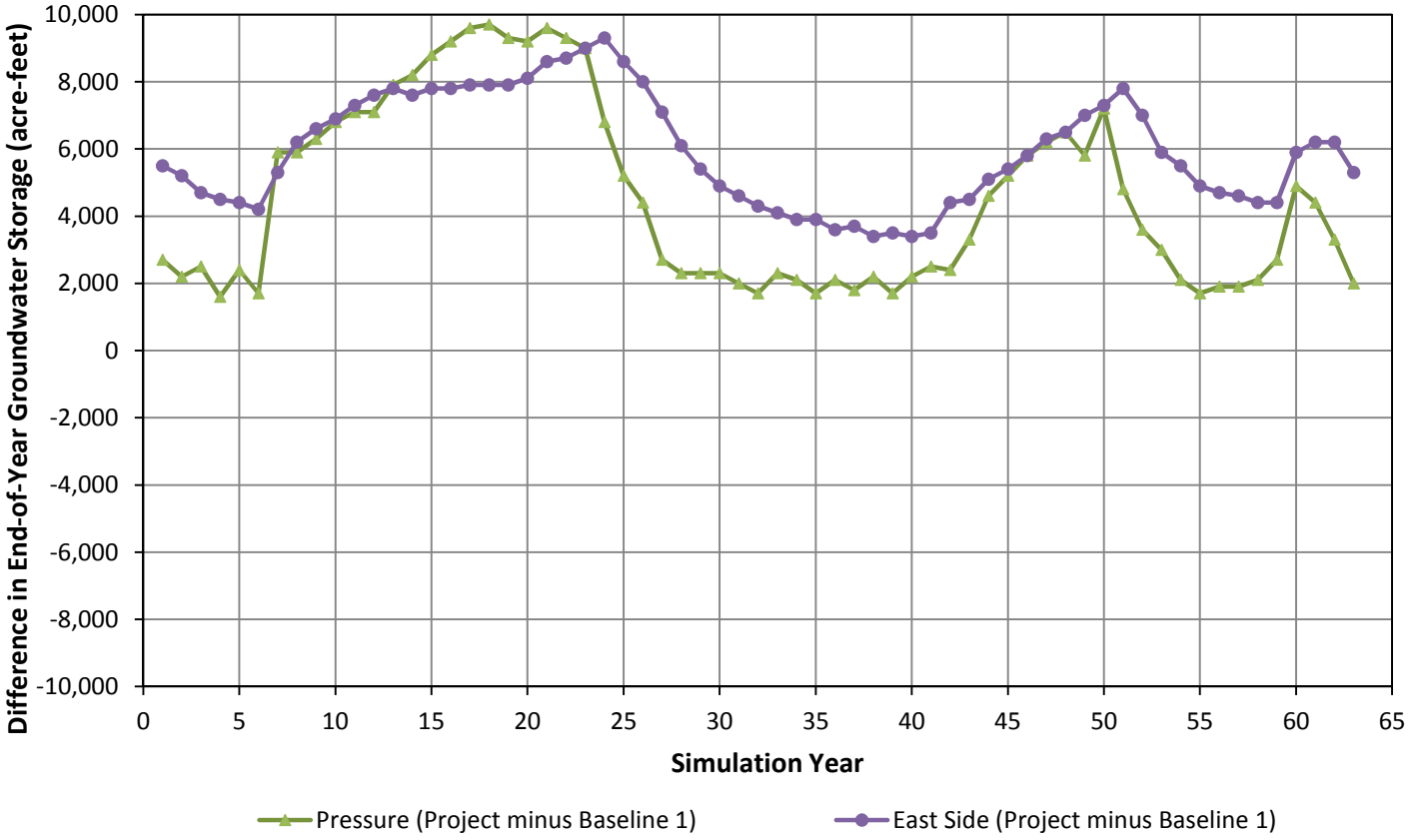


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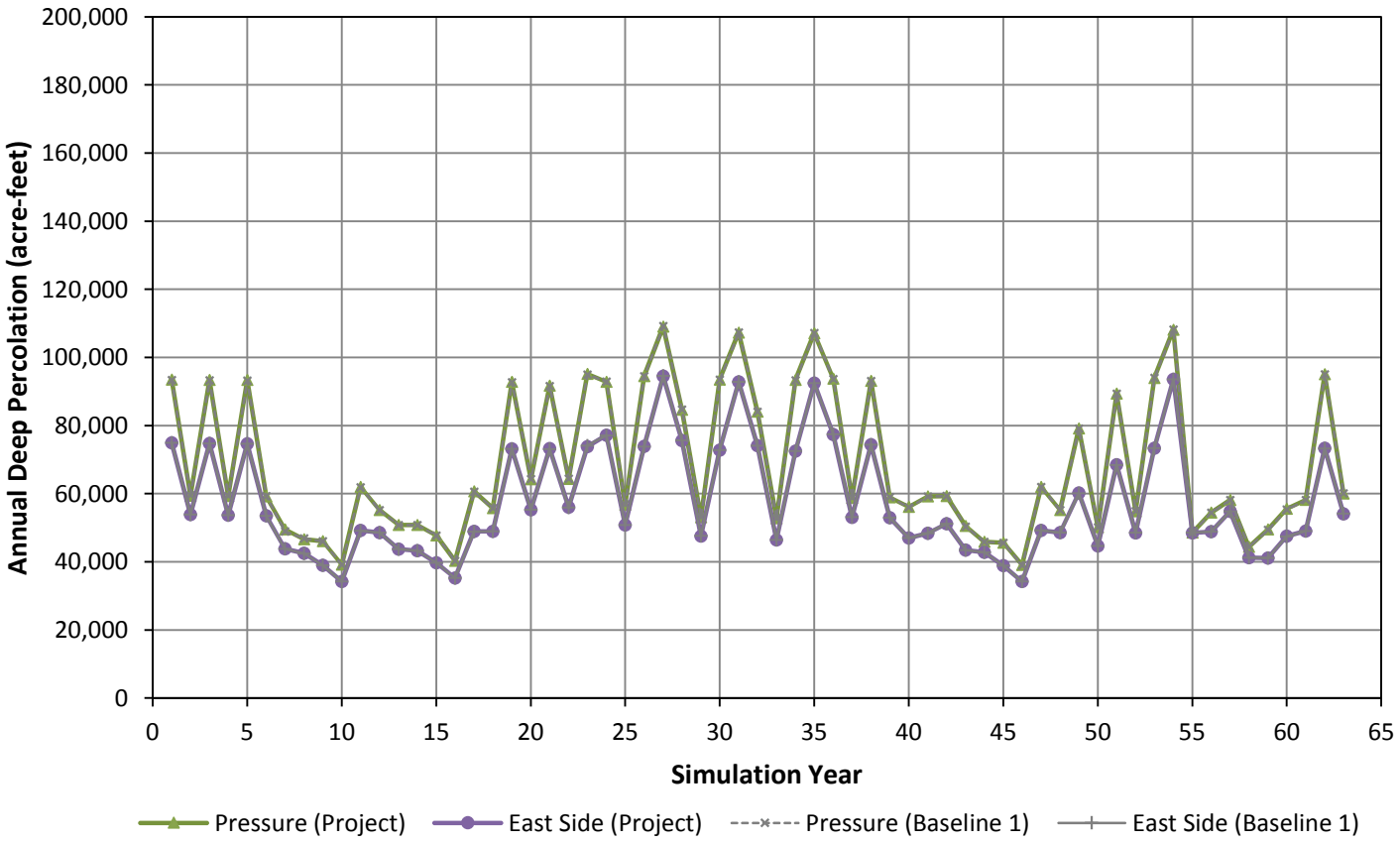
Figure 23b
Simulated End-of-Year Groundwater Storage
Project Run 8sn: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project



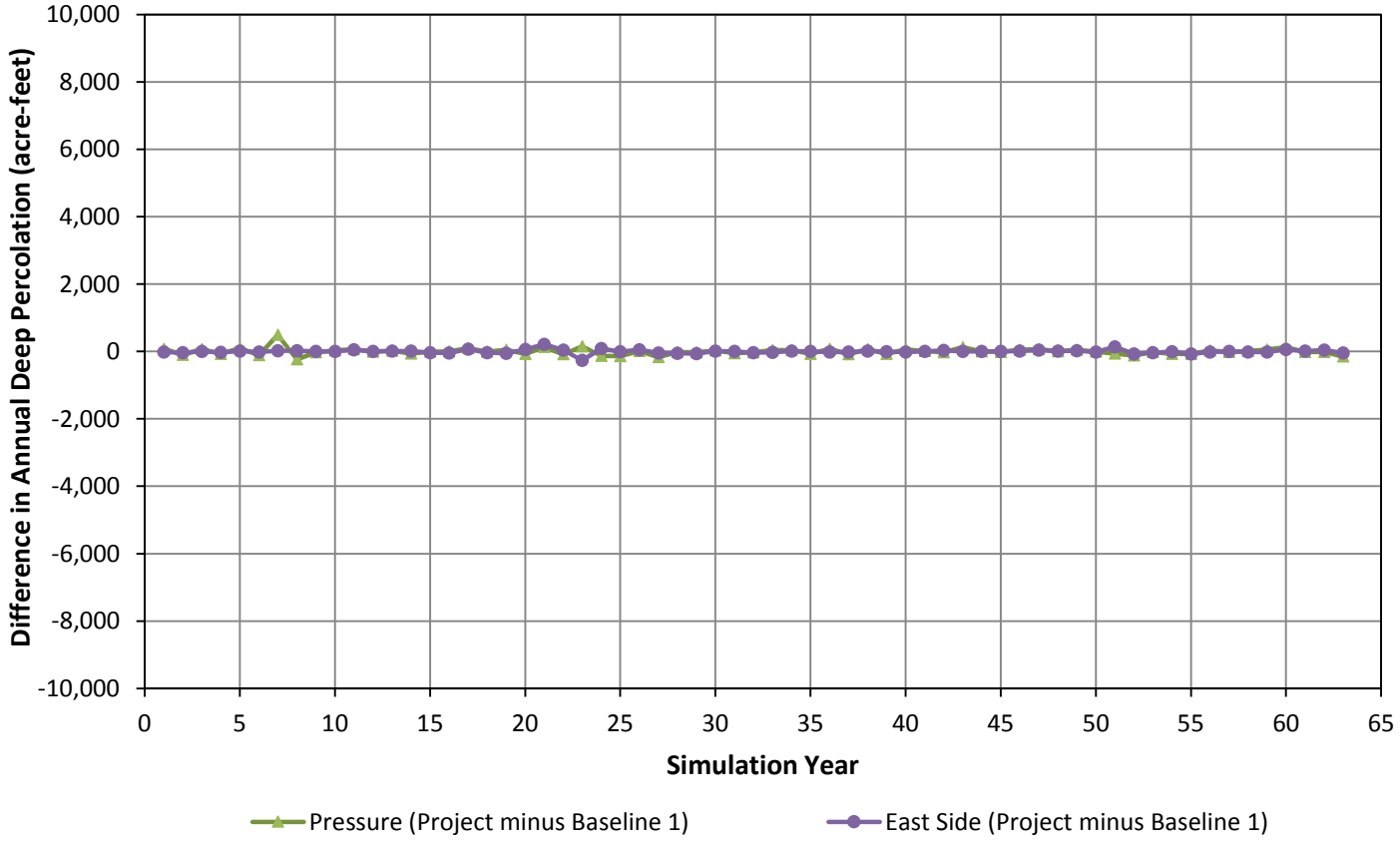


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Figure 23c
Simulated Annual Deep Percolation
Project Run 8sn: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project

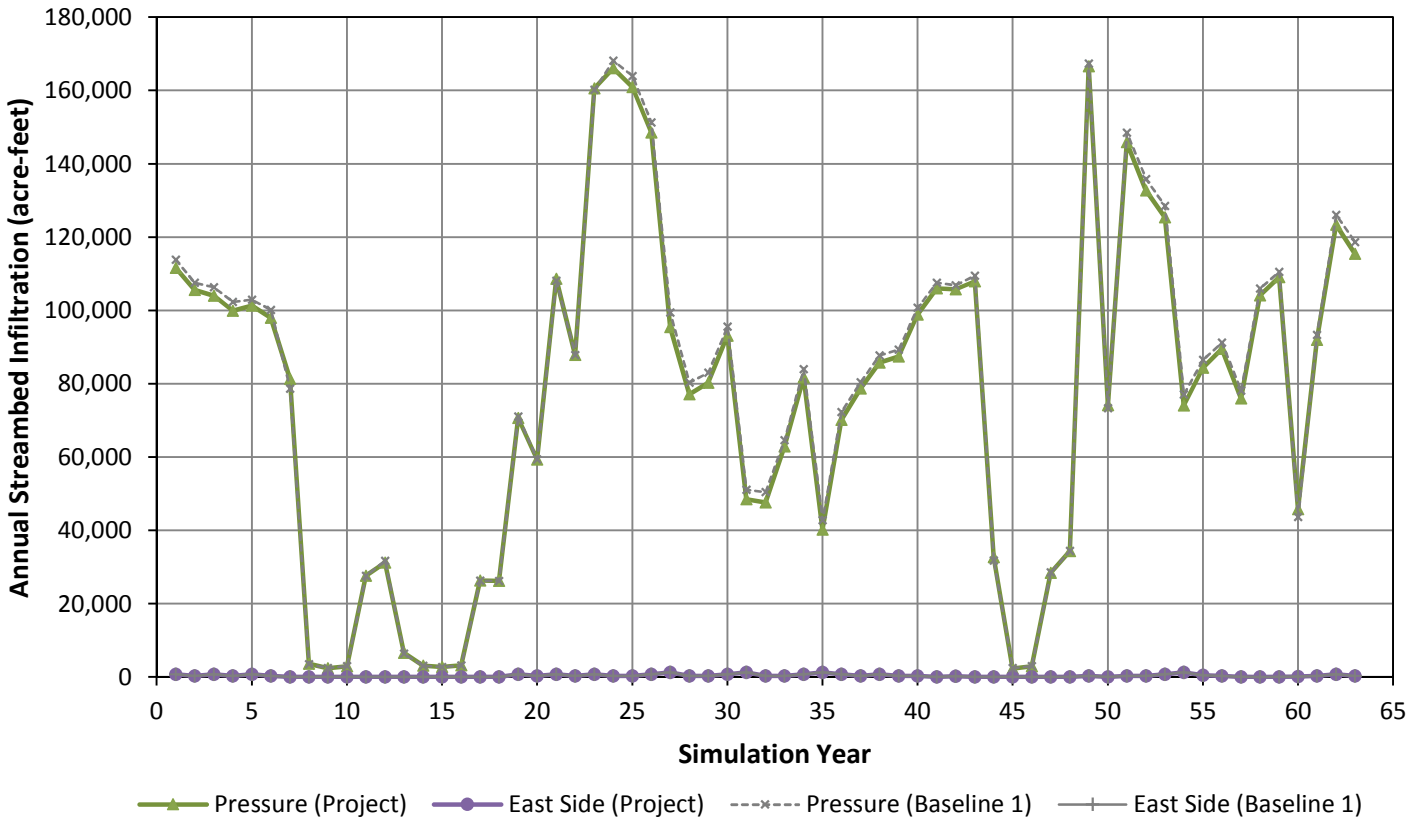

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Figure 23d
Simulated Annual Streambed Infiltration
Project Run 8sn: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project

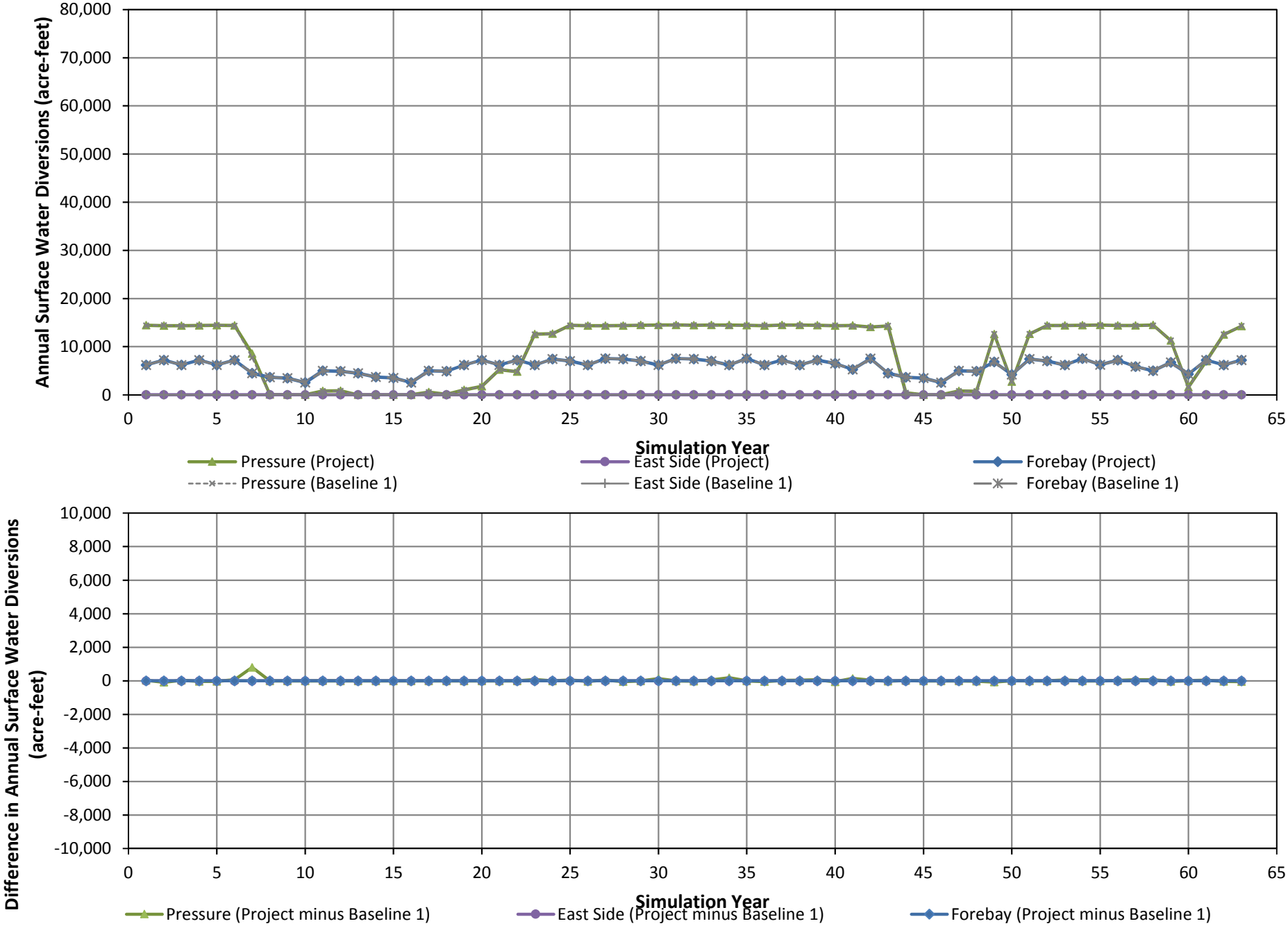

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Figure 23e
Simulated Annual Surface Water Diversions
Project Run 8sn: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project

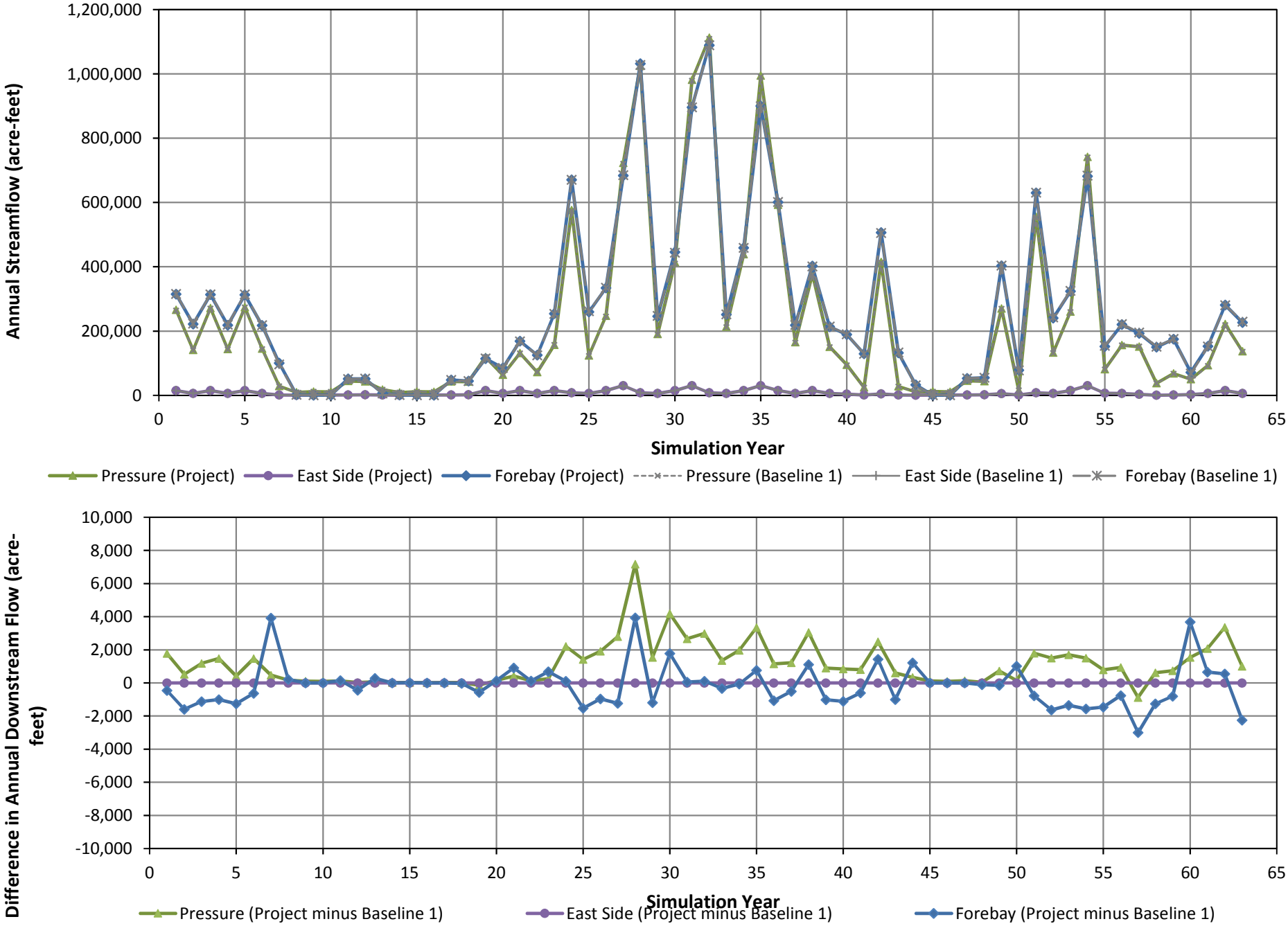

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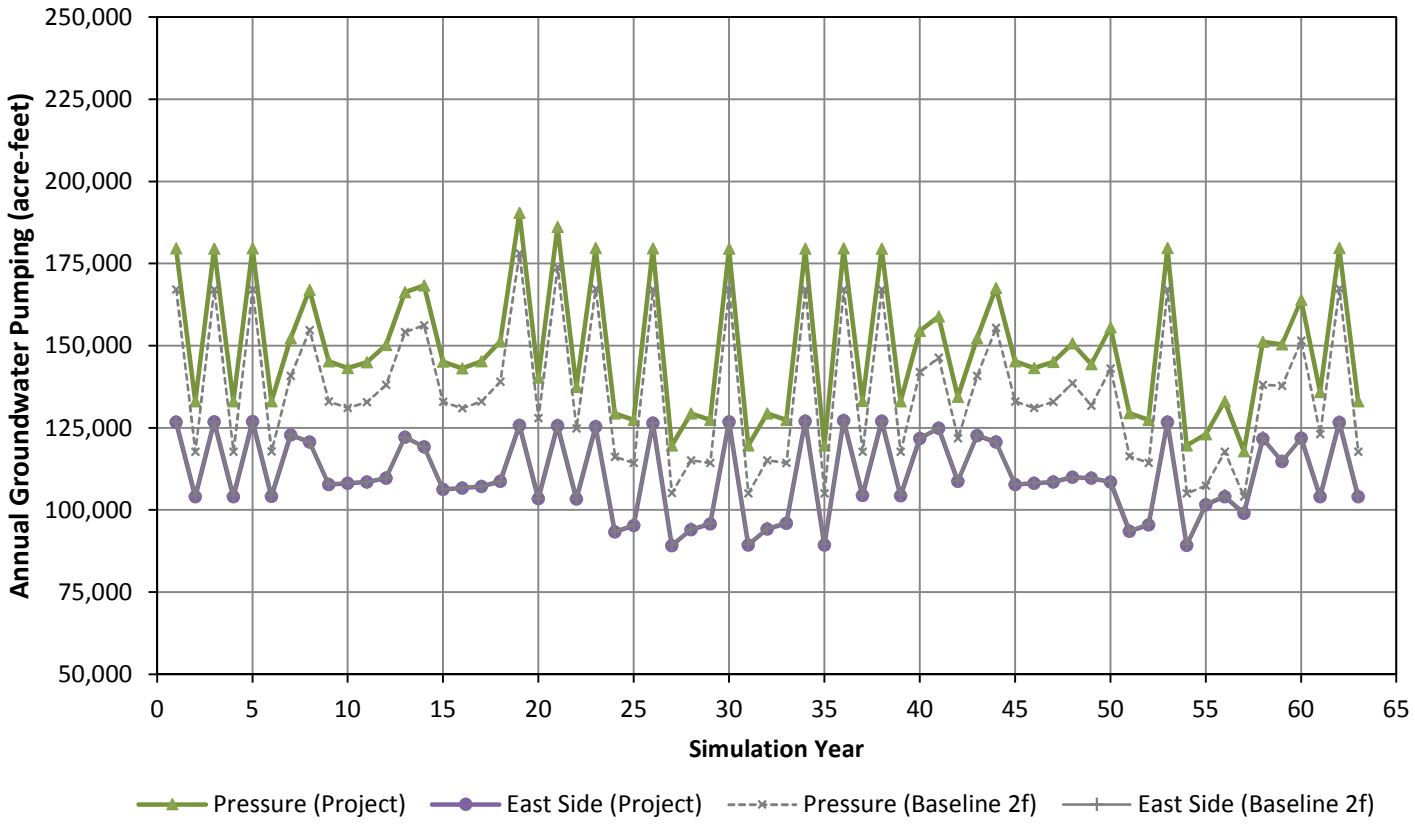
Figure 23f
Simulated Annual Downstream Flow
Project Run 8sn: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project



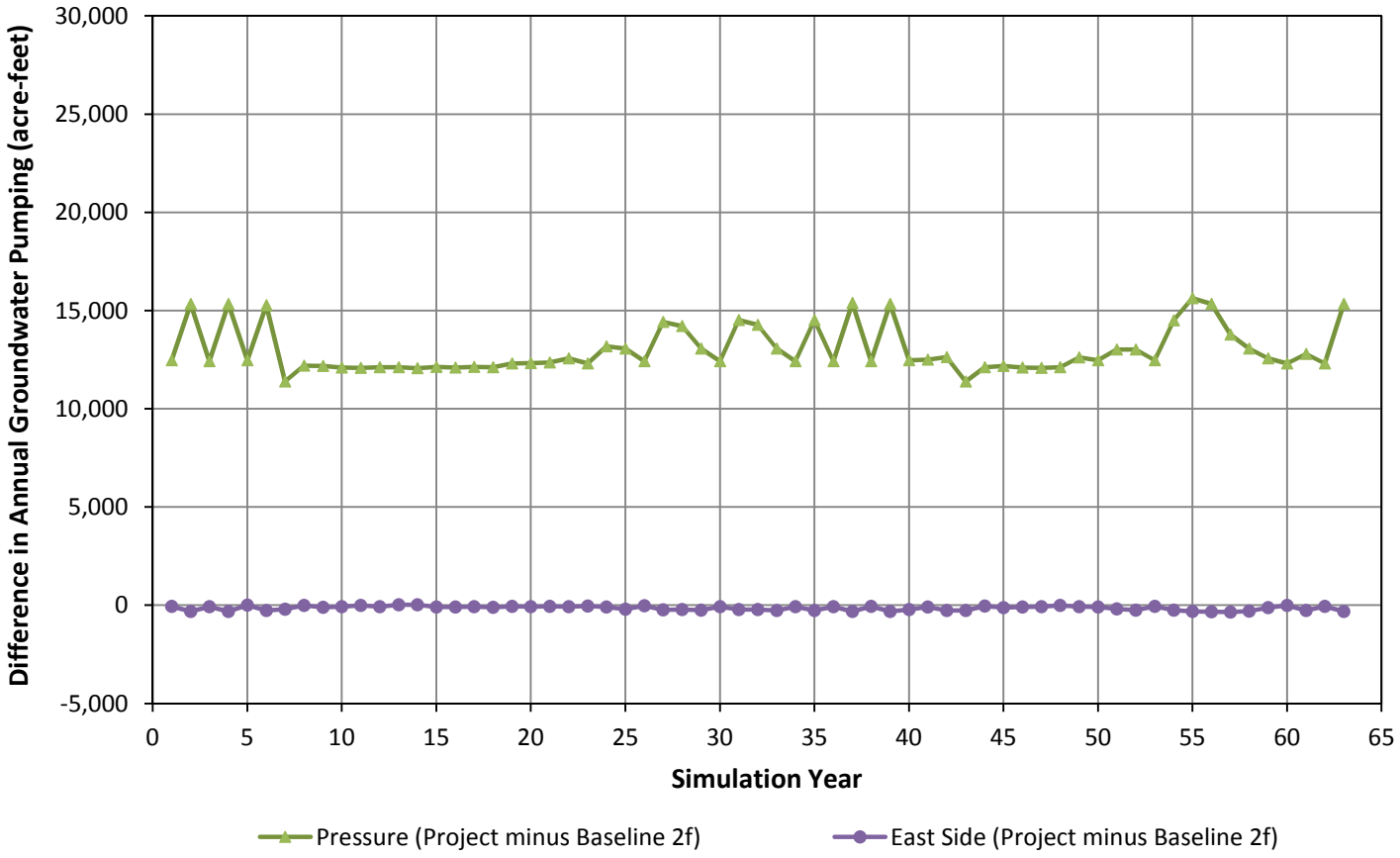


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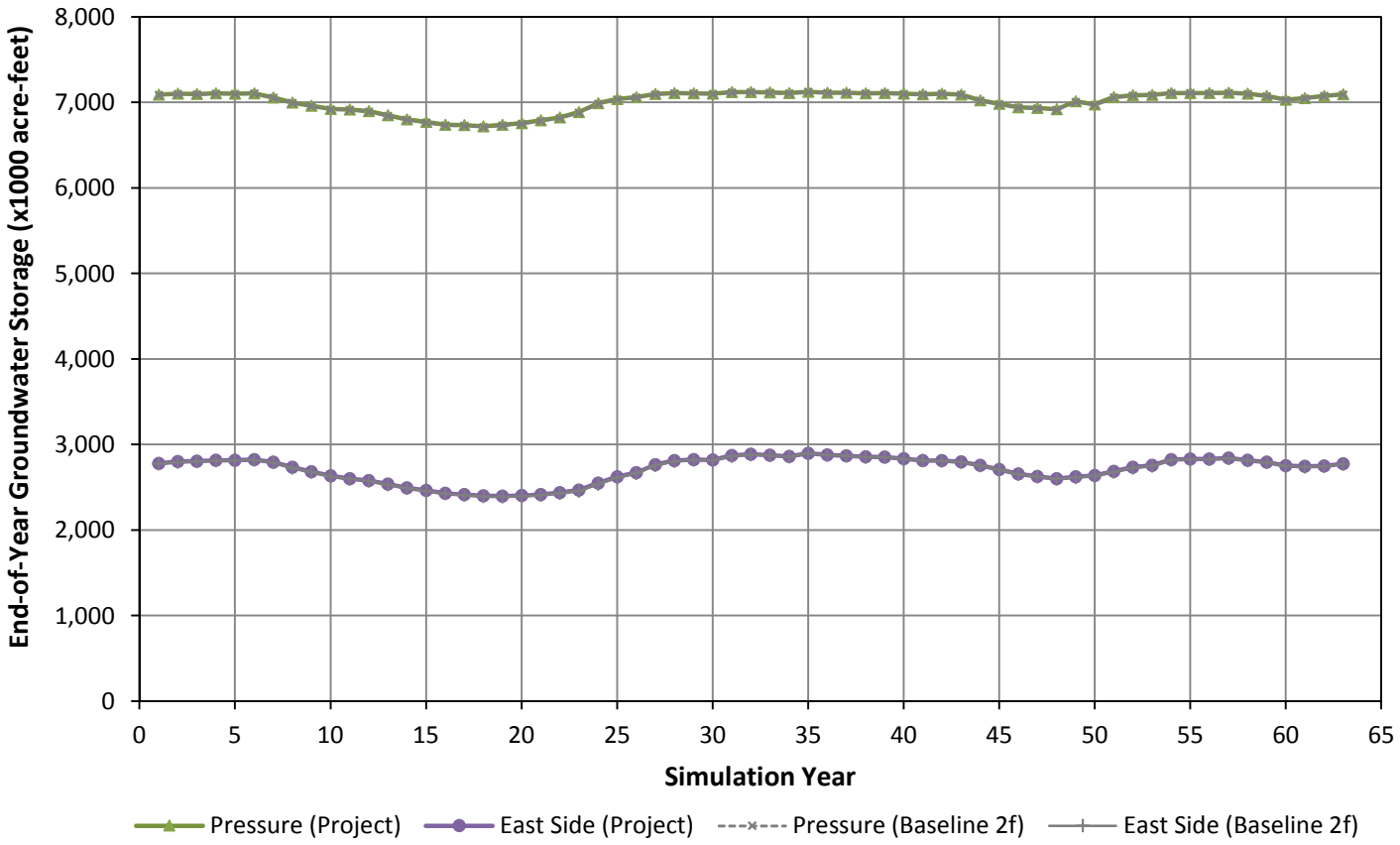
Figure 24a
Simulated Annual Groundwater Pumping
Project Run 8sf: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project



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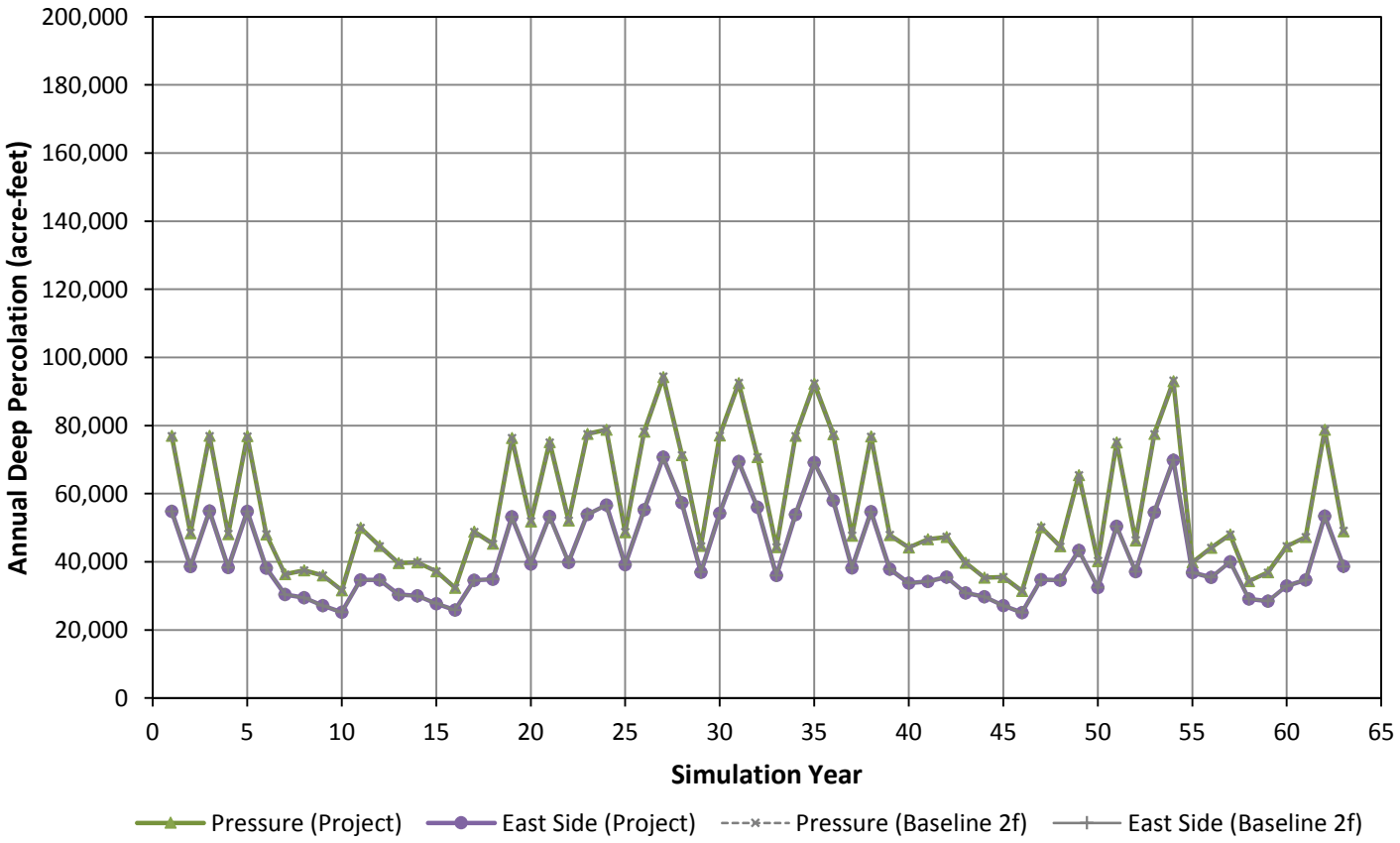
CONSULTING ENGINEERS

Figure 24b
Simulated End-of-Year Groundwater Storage
Project Run 8sf: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project



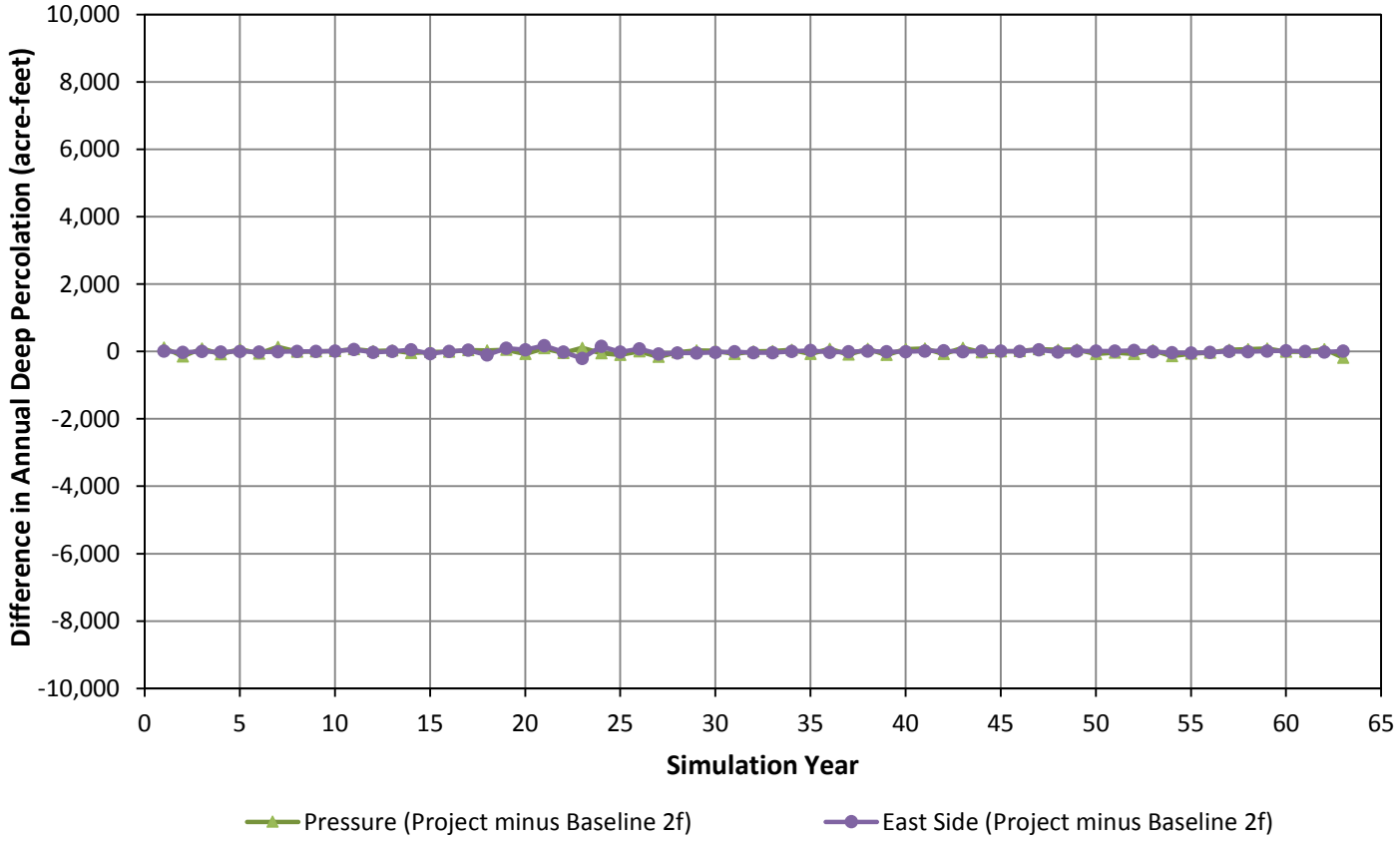


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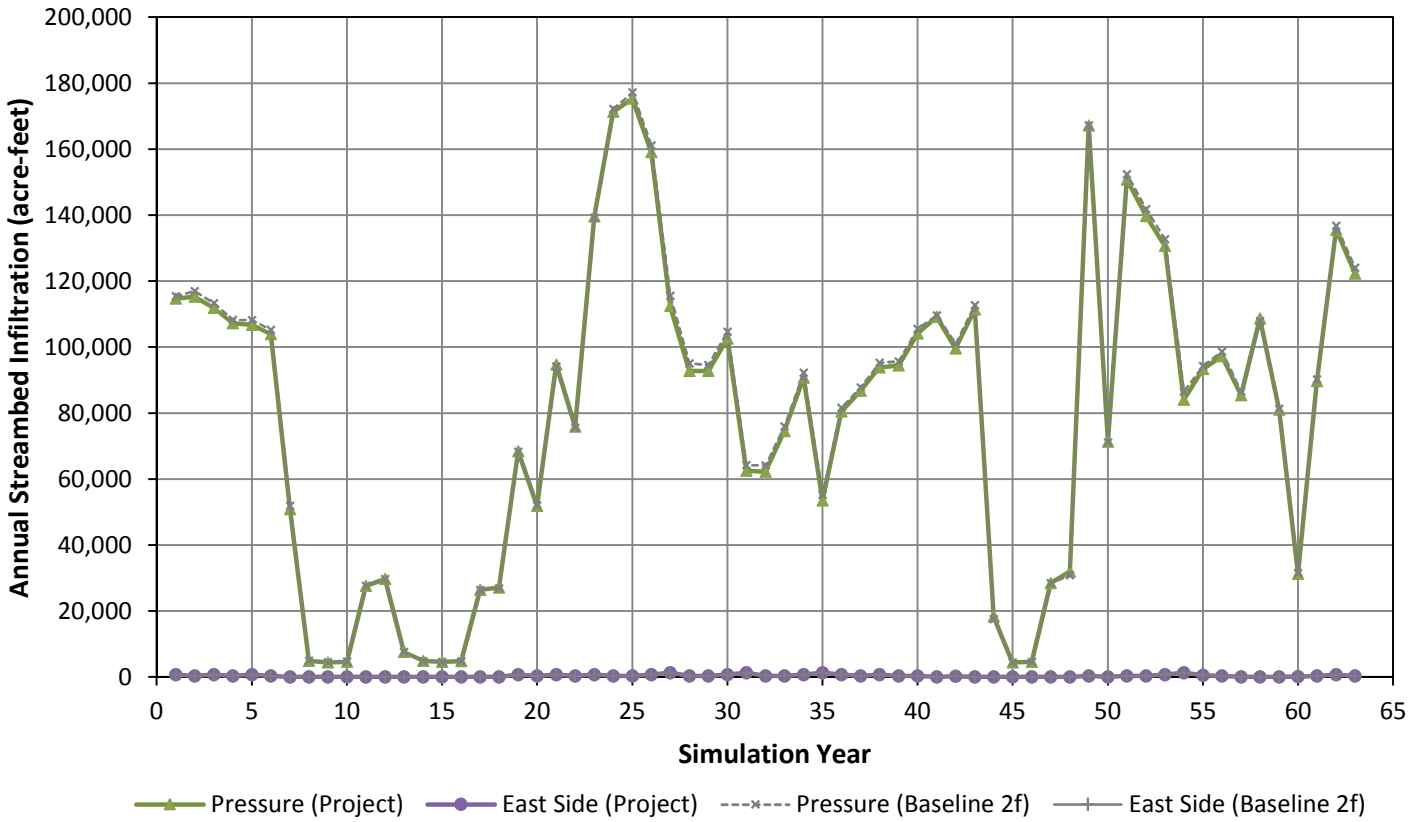
Figure 24c
Simulated Annual Deep Percolation
Project Run 8sf: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project



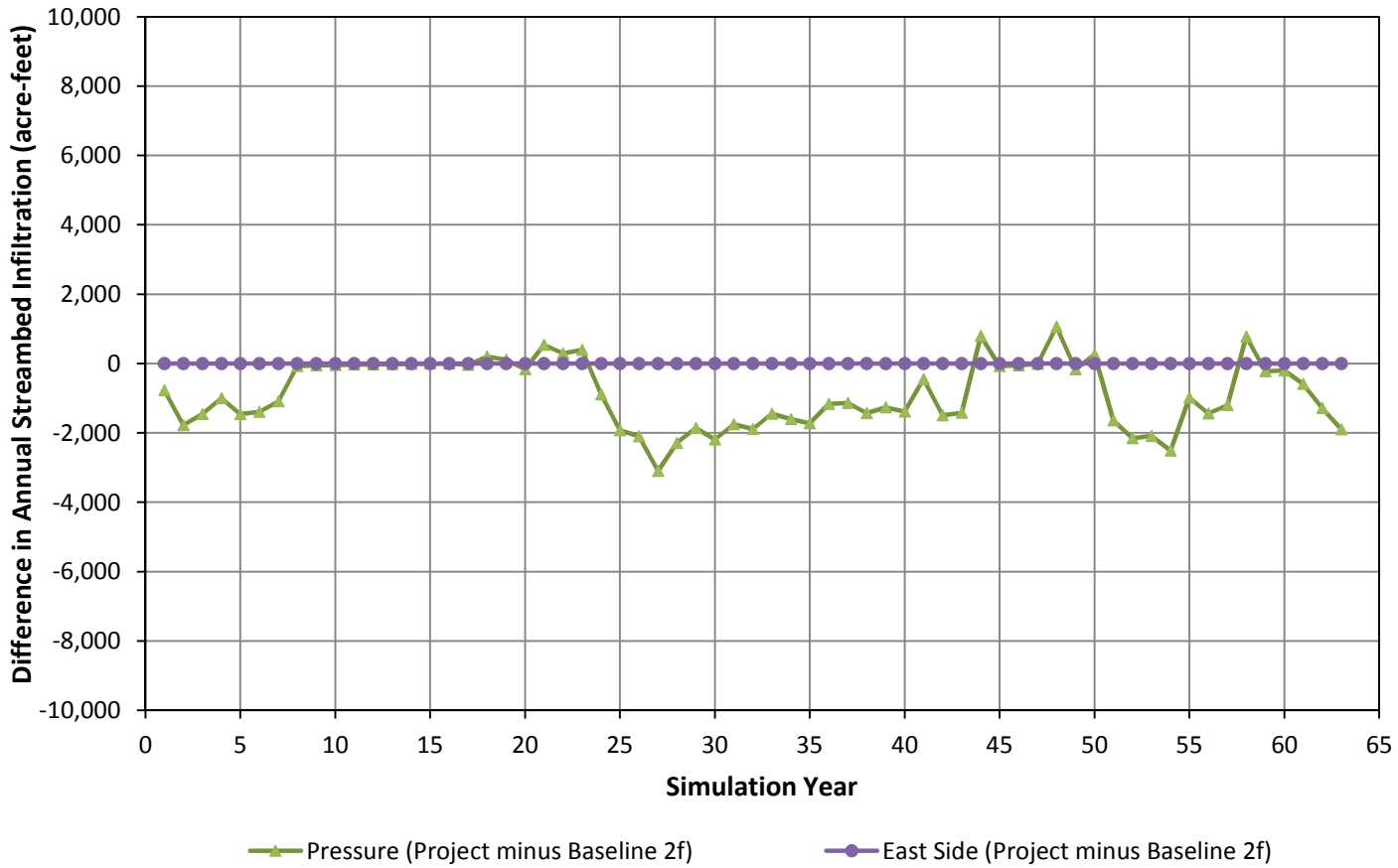


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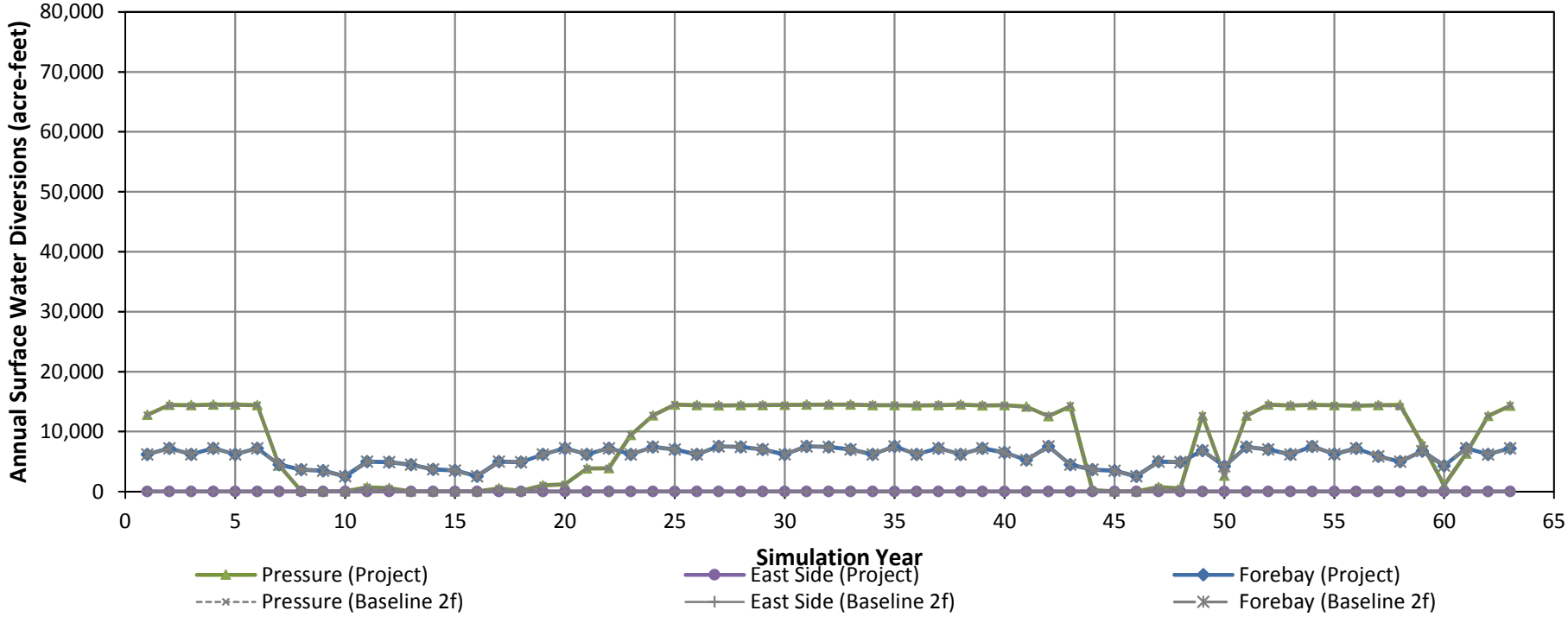
Figure 24d
Simulated Annual Streambed Infiltration
Project Run 8sf: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project



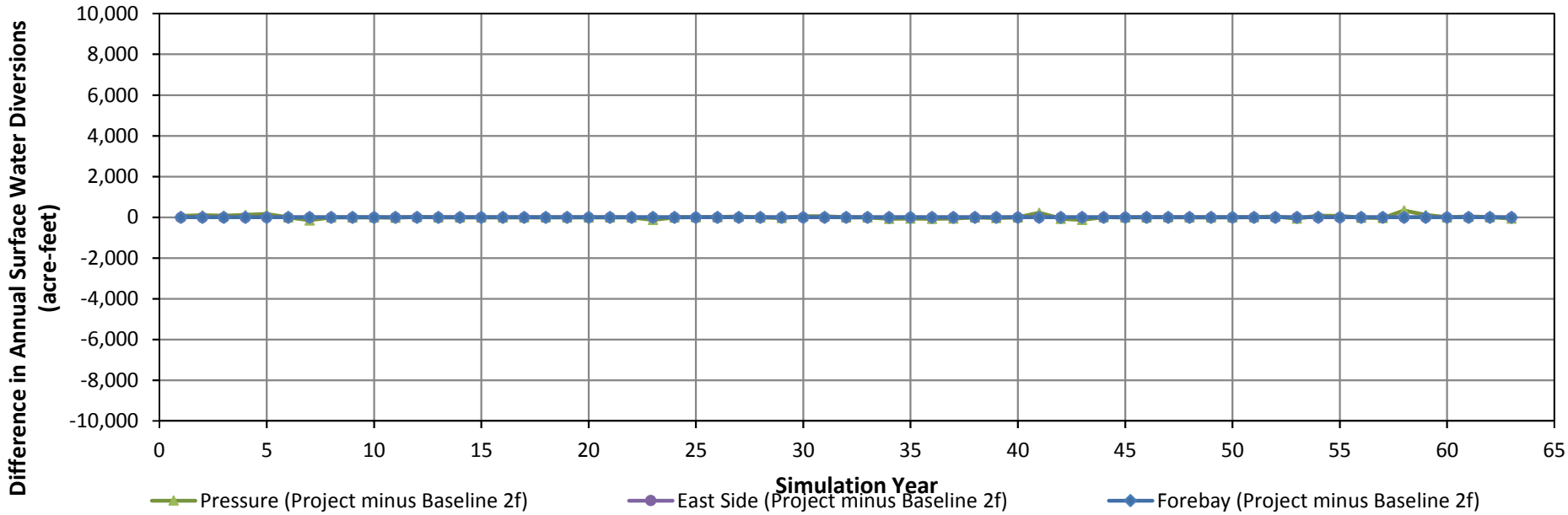


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Figure 24e
Simulated Annual Surface Water Diversions
Project Run 8sf: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project

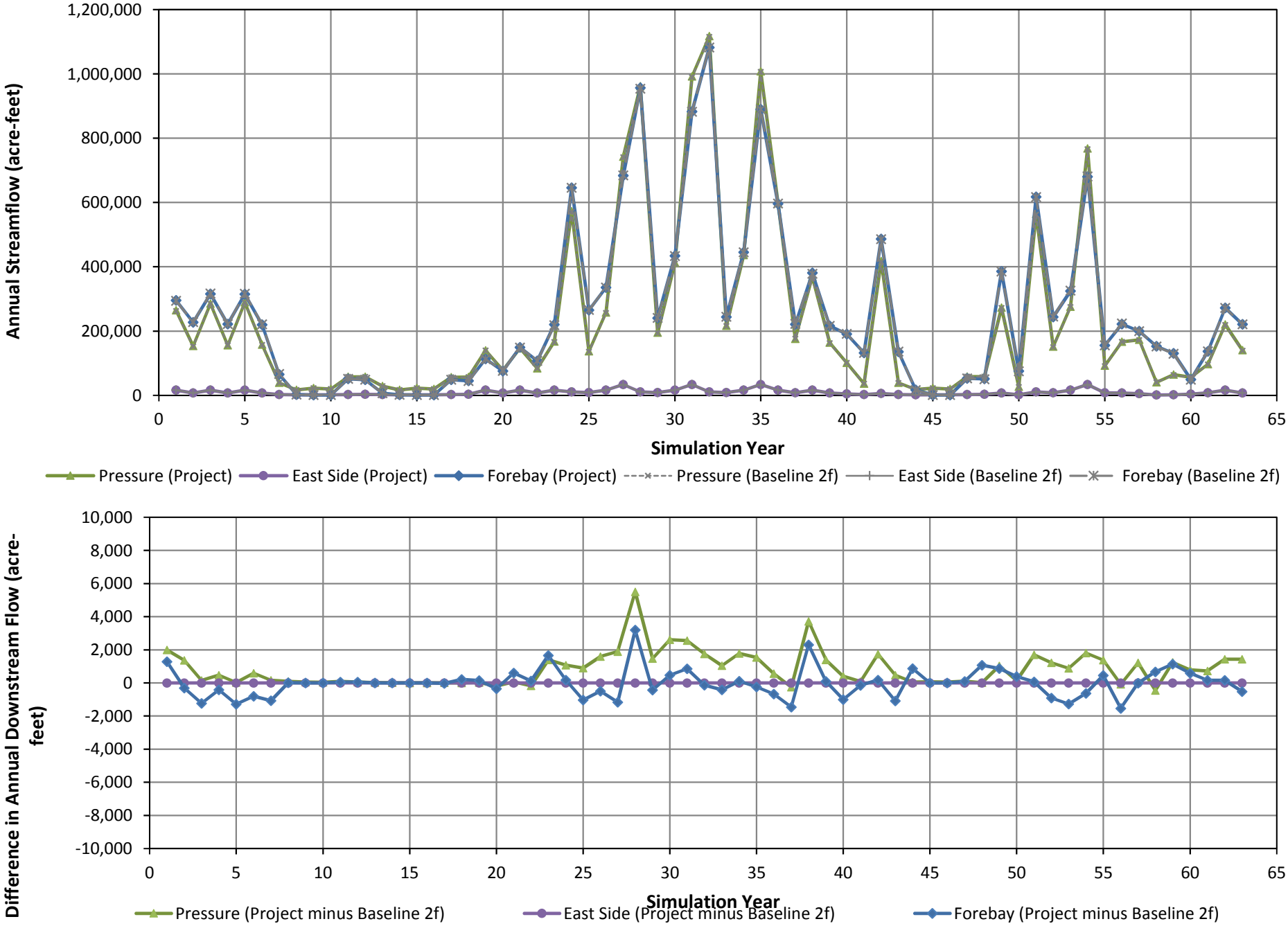

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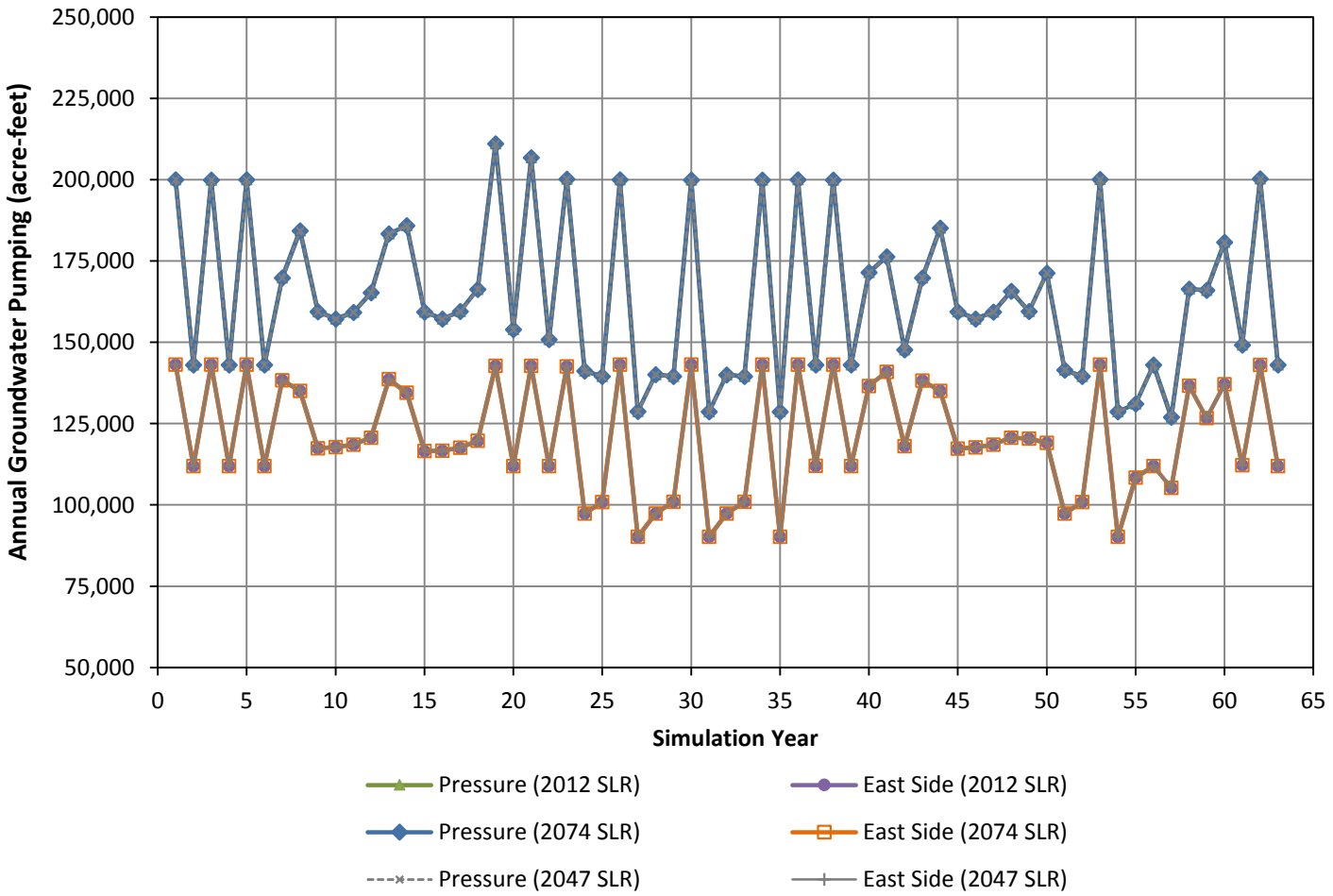
Figure 24f
Simulated Annual Downstream Flow
Project Run 8sf: Potrero rd 15.1 MGD
Monterey Peninsula Water Supply Project



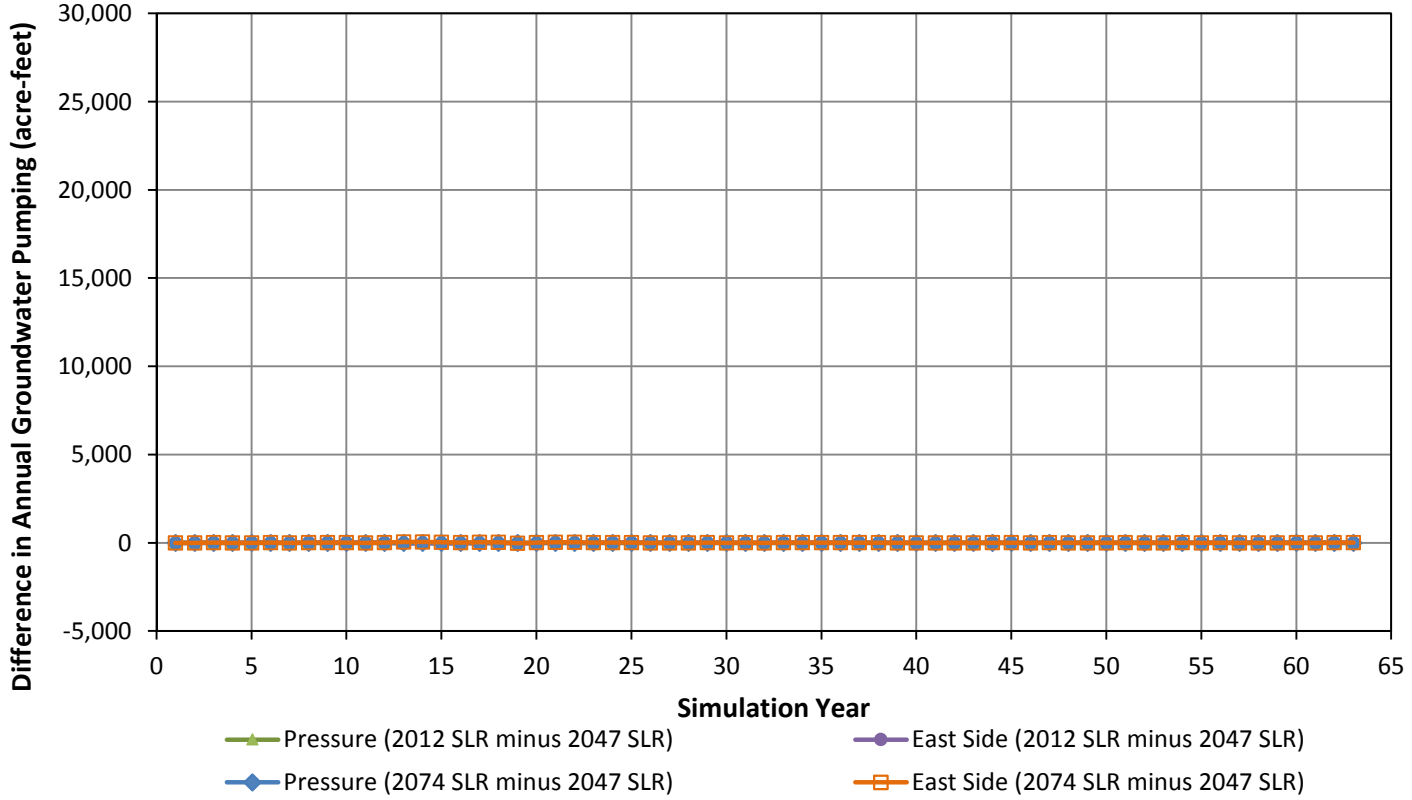


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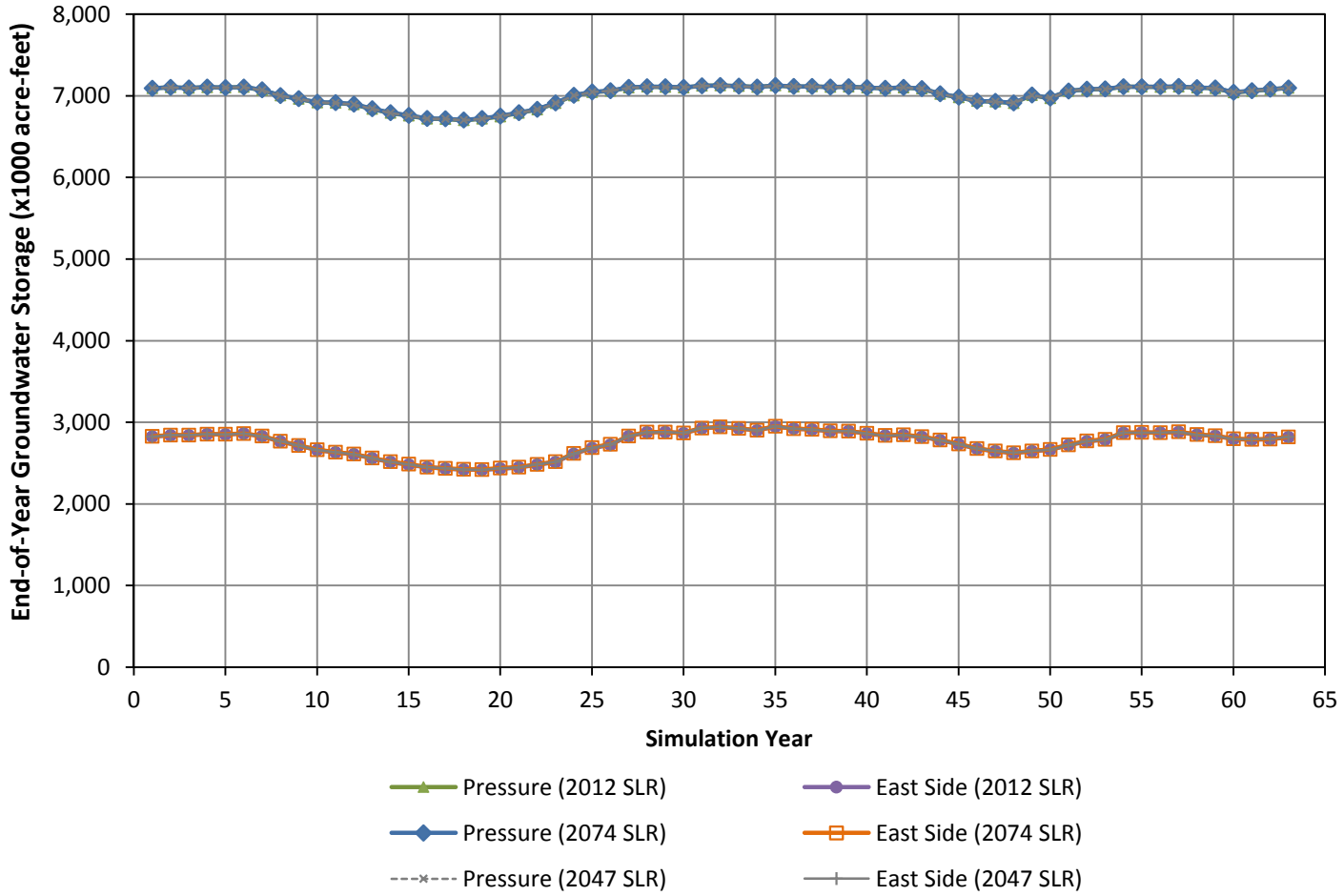
Figure 25a
Simulated Annual Groundwater Pumping
Sea Level Rise Sensitivity Analysis: Run 3
Monterey Peninsula Water Supply Project



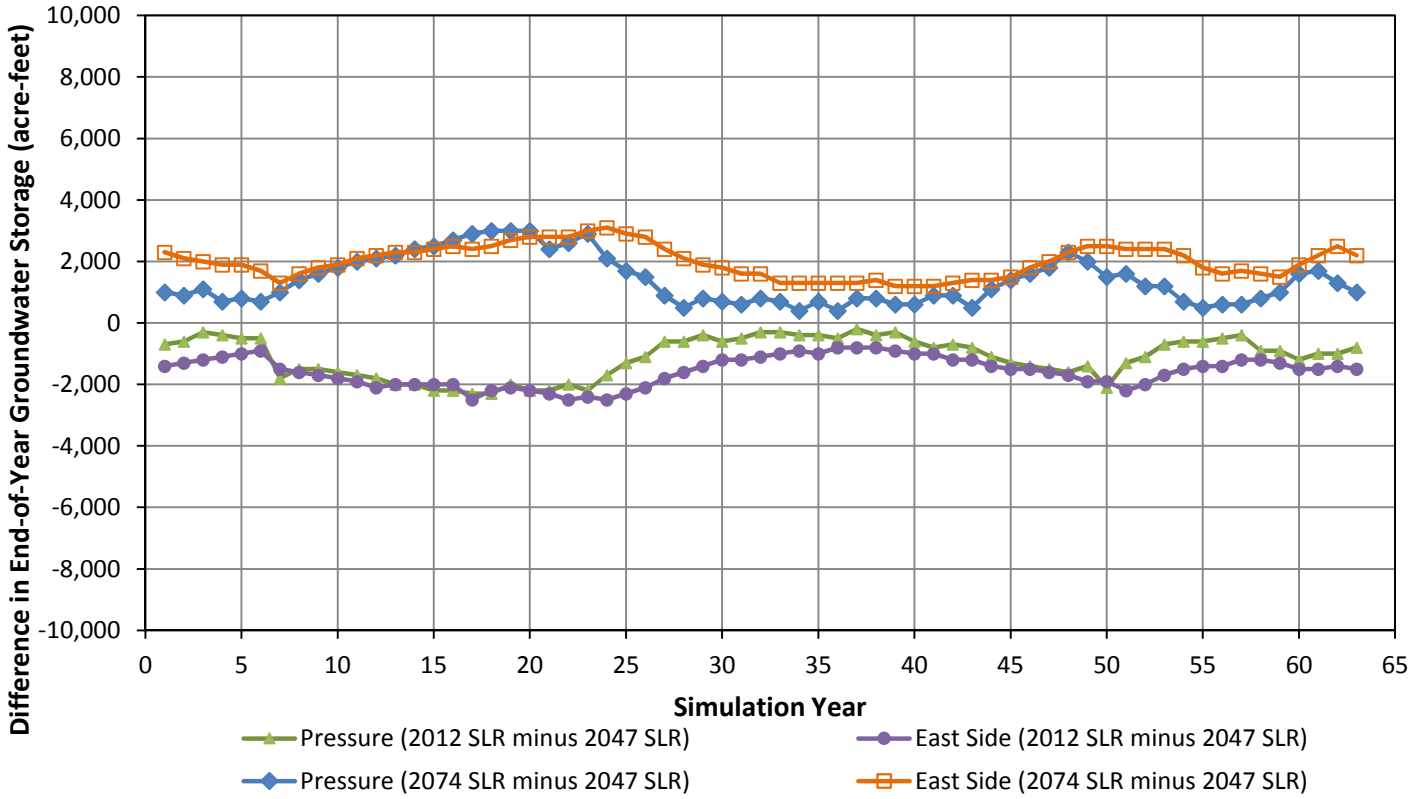


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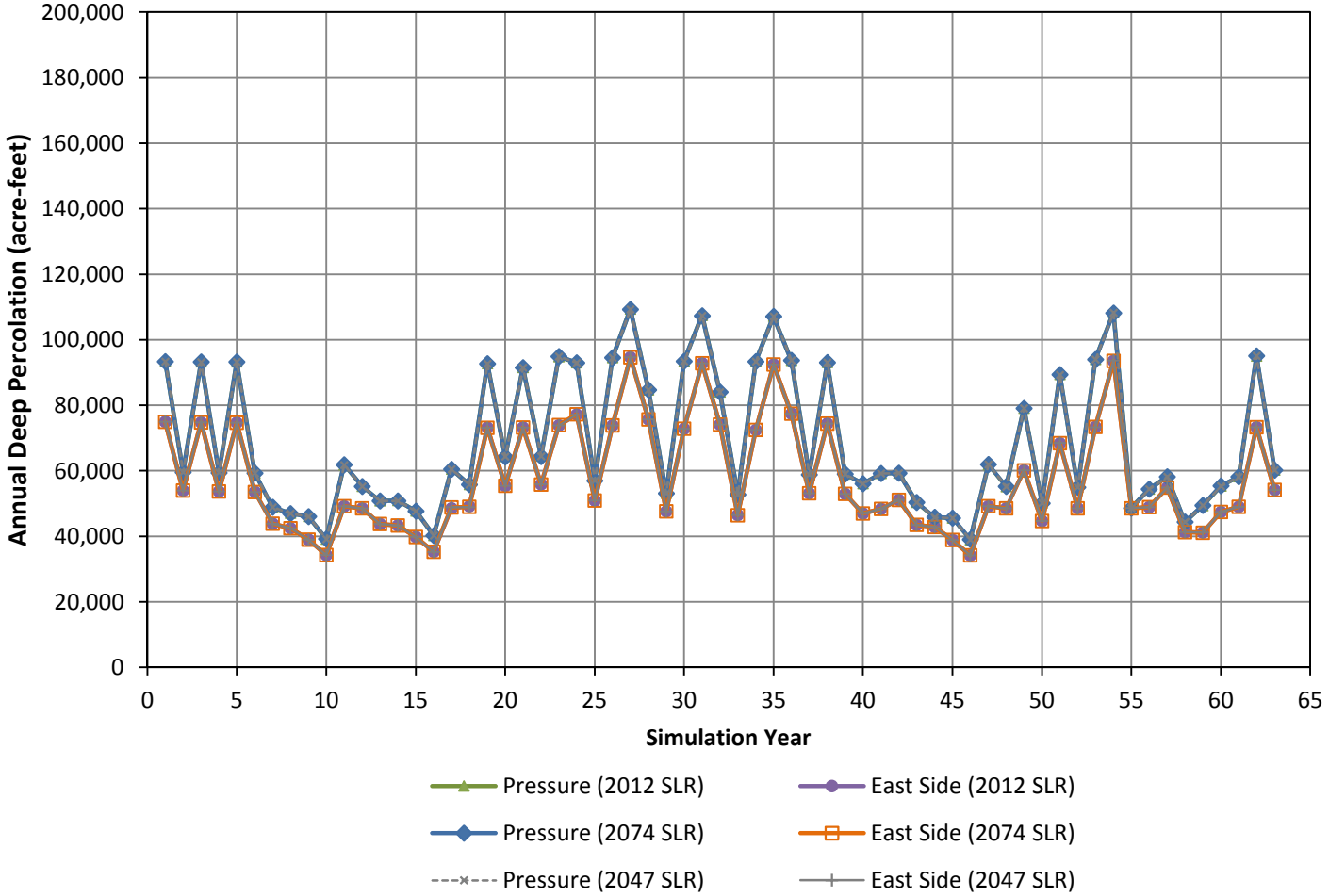
Figure 25b
Simulated End-of-Year Groundwater Storage
Sea Level Rise Sensitivity Analysis: Run 3
Monterey Peninsula Water Supply Project



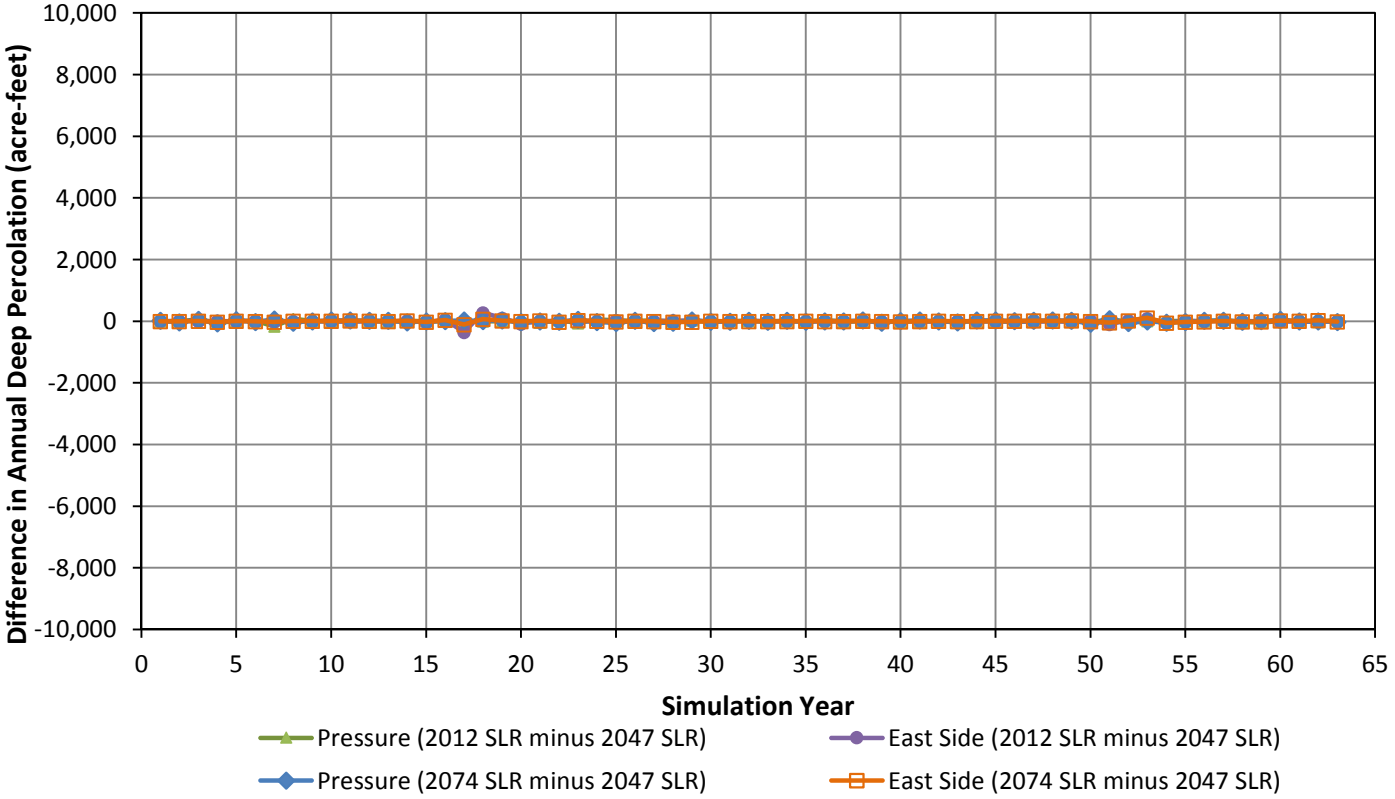


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Figure 25c
Simulated Annual Deep Percolation
Sea Level Rise Sensitivity Analysis: Run 3
Monterey Peninsula Water Supply Project

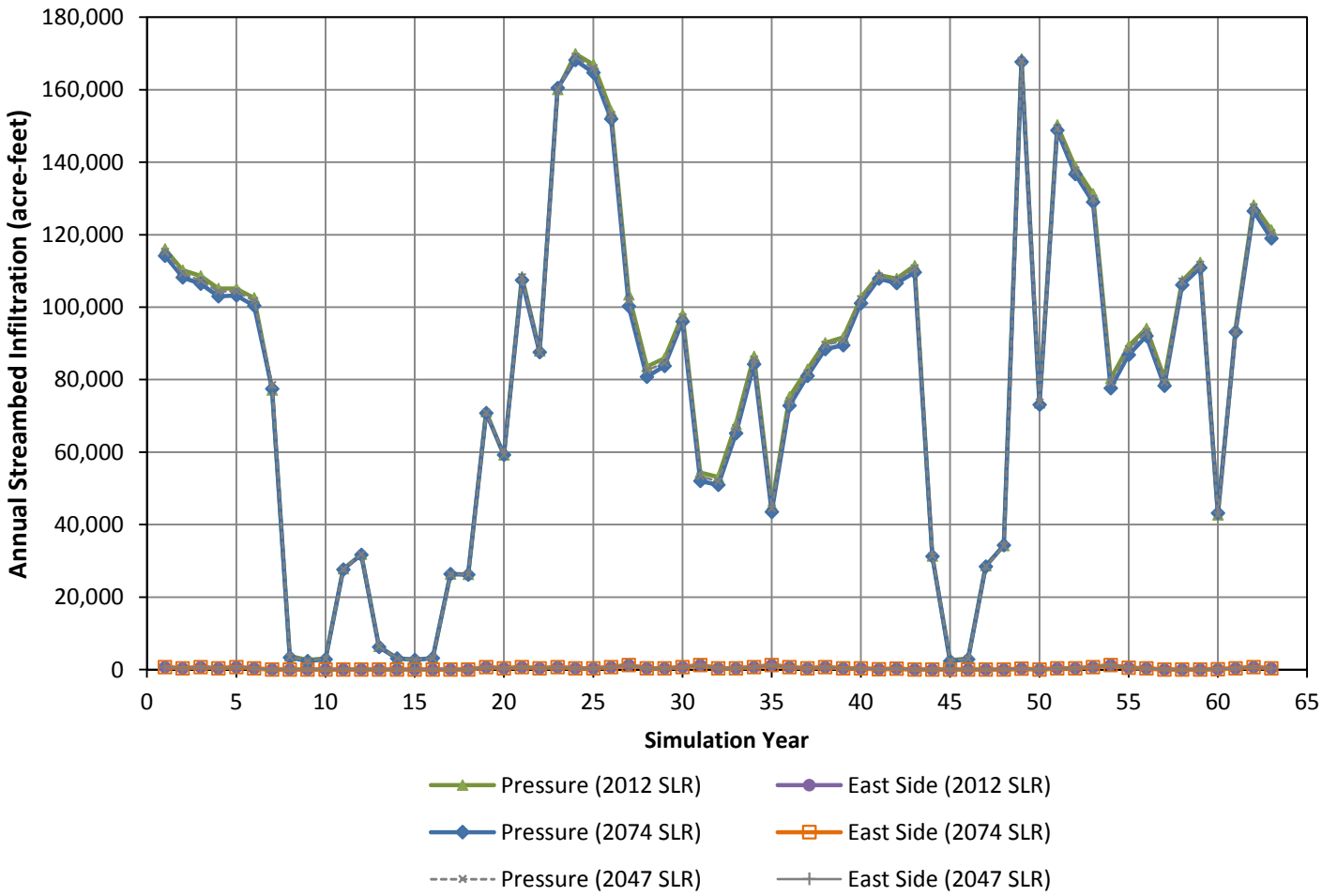

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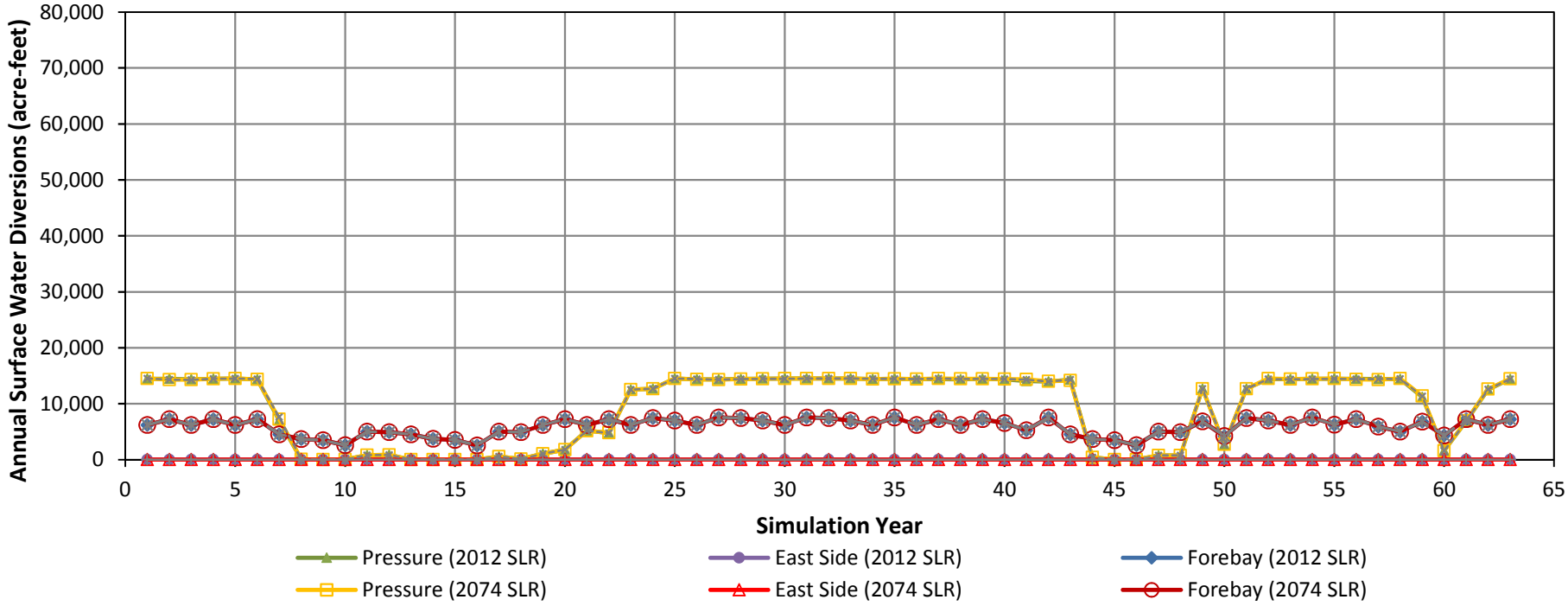
Figure 25d
Simulated Annual Streambed Infiltration
Sea Level Rise Sensitivity Analysis: Run 3
Monterey Peninsula Water Supply Project



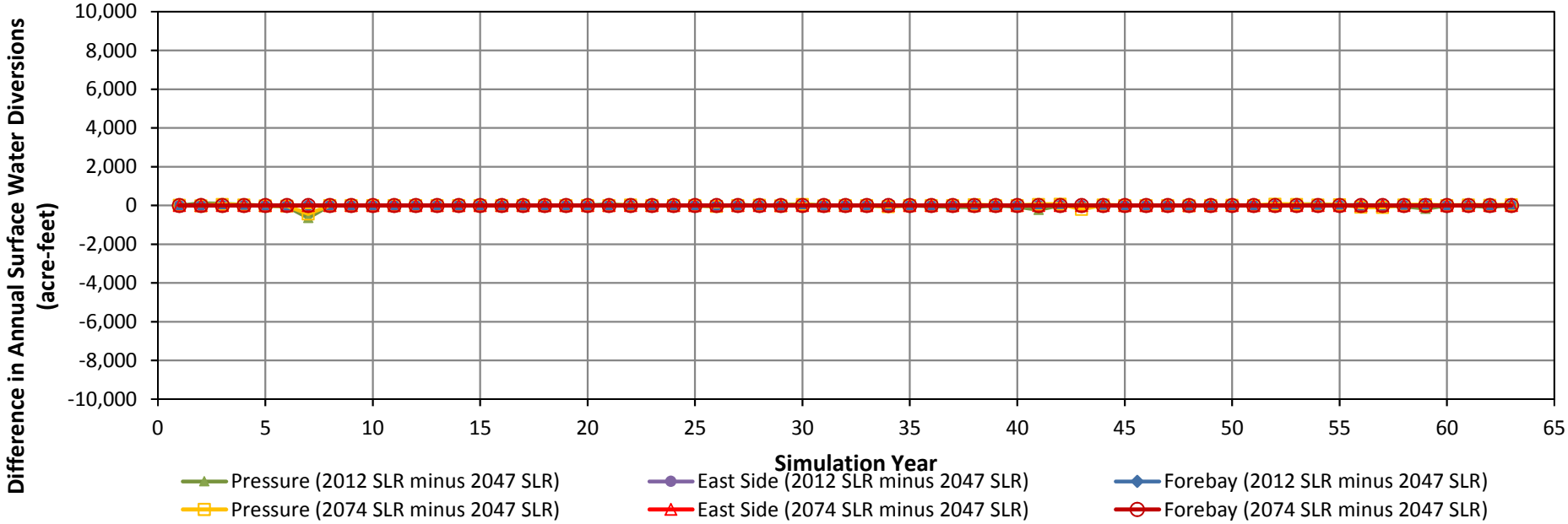


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Figure 25e
Simulated Annual Surface Water Diversions
Sea Level Rise Sensitivity Analysis: Run 3
Monterey Peninsula Water Supply Project

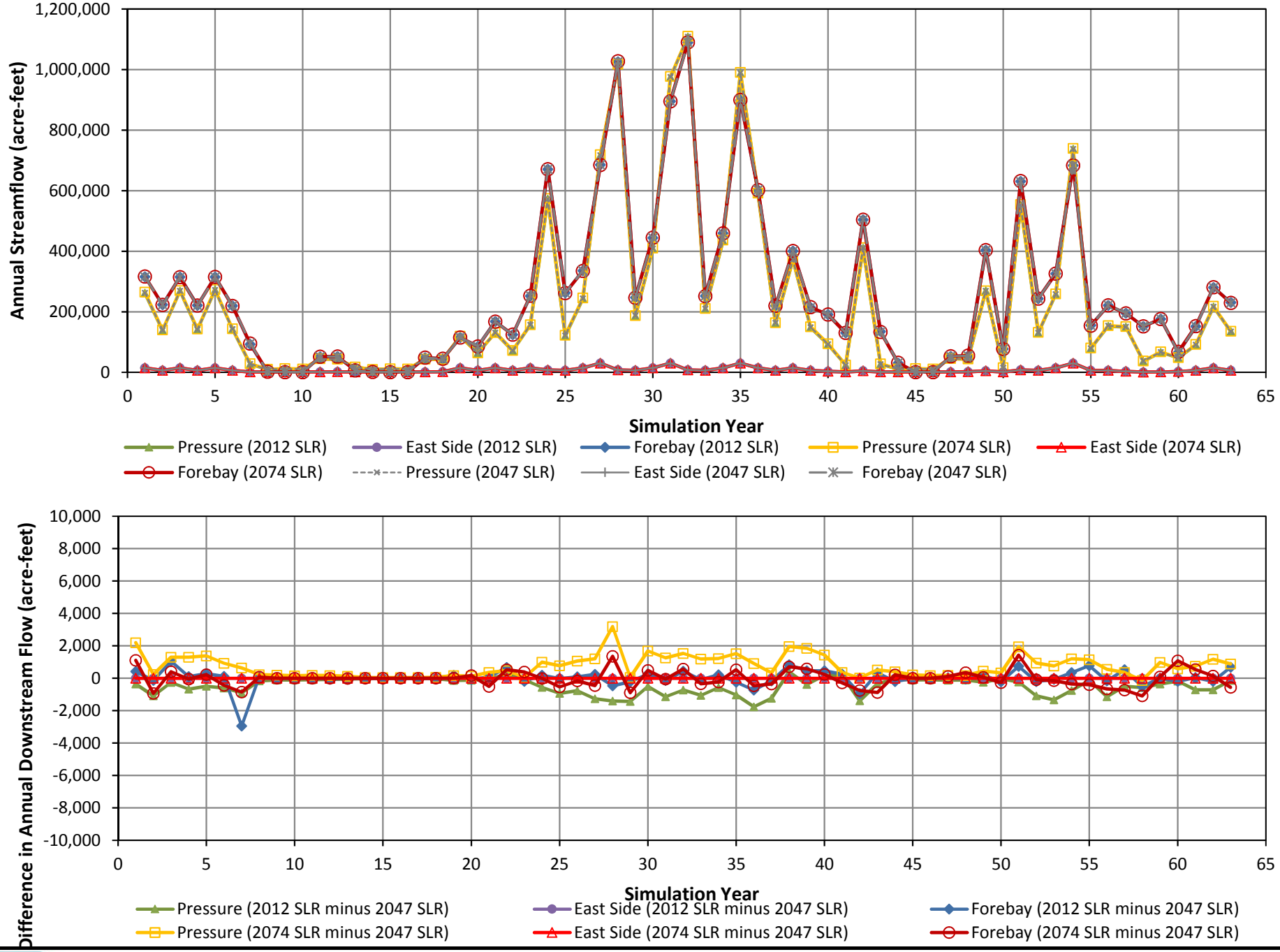

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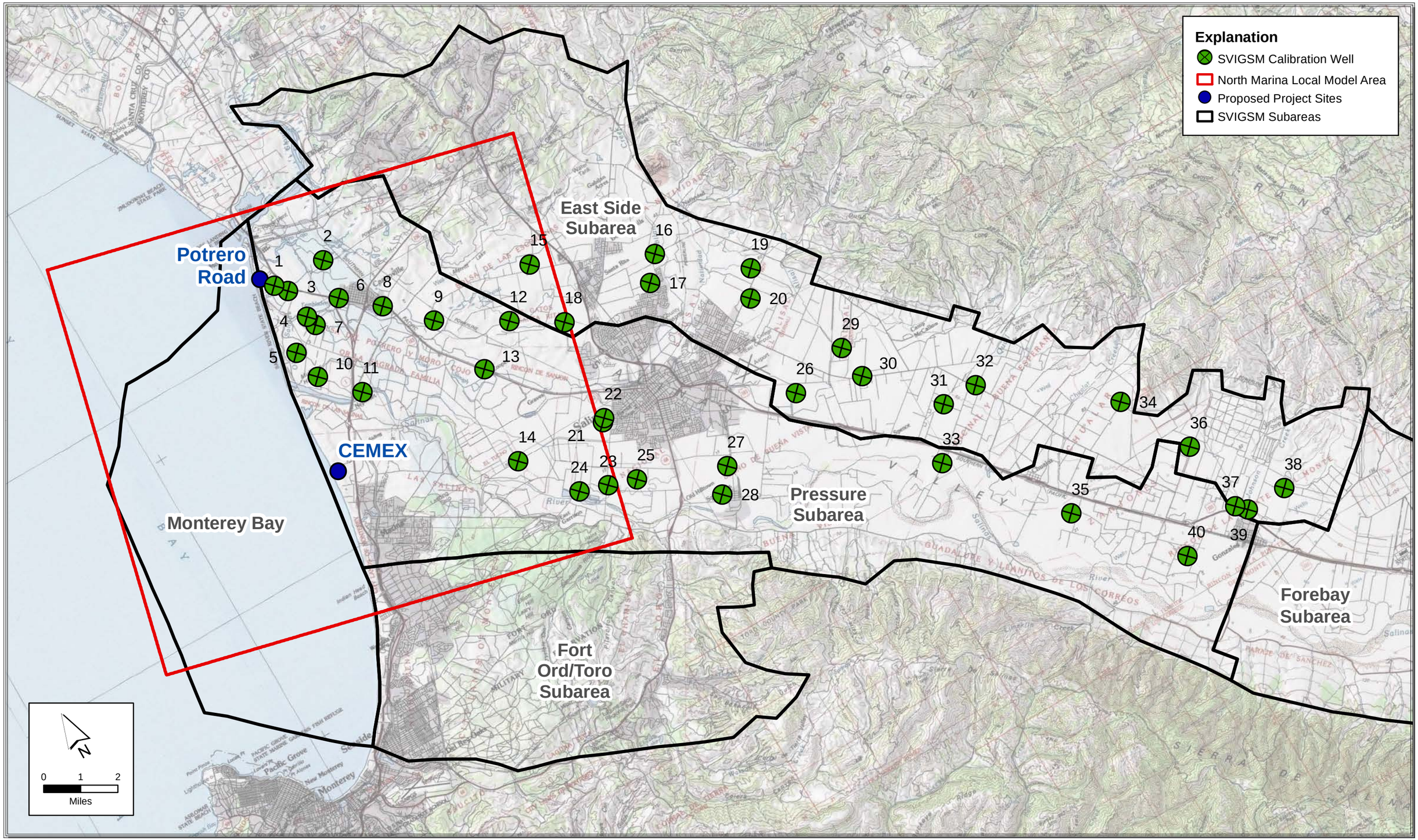
Figure 25f
Simulated Annual Downstream Flow
Sea Level Rise Sensitivity Analysis: Run 3
Monterey Peninsula Water Supply Project

APPENDIX A

SVIGSM Calibration Well Locations in the Pressure and East Side Subareas



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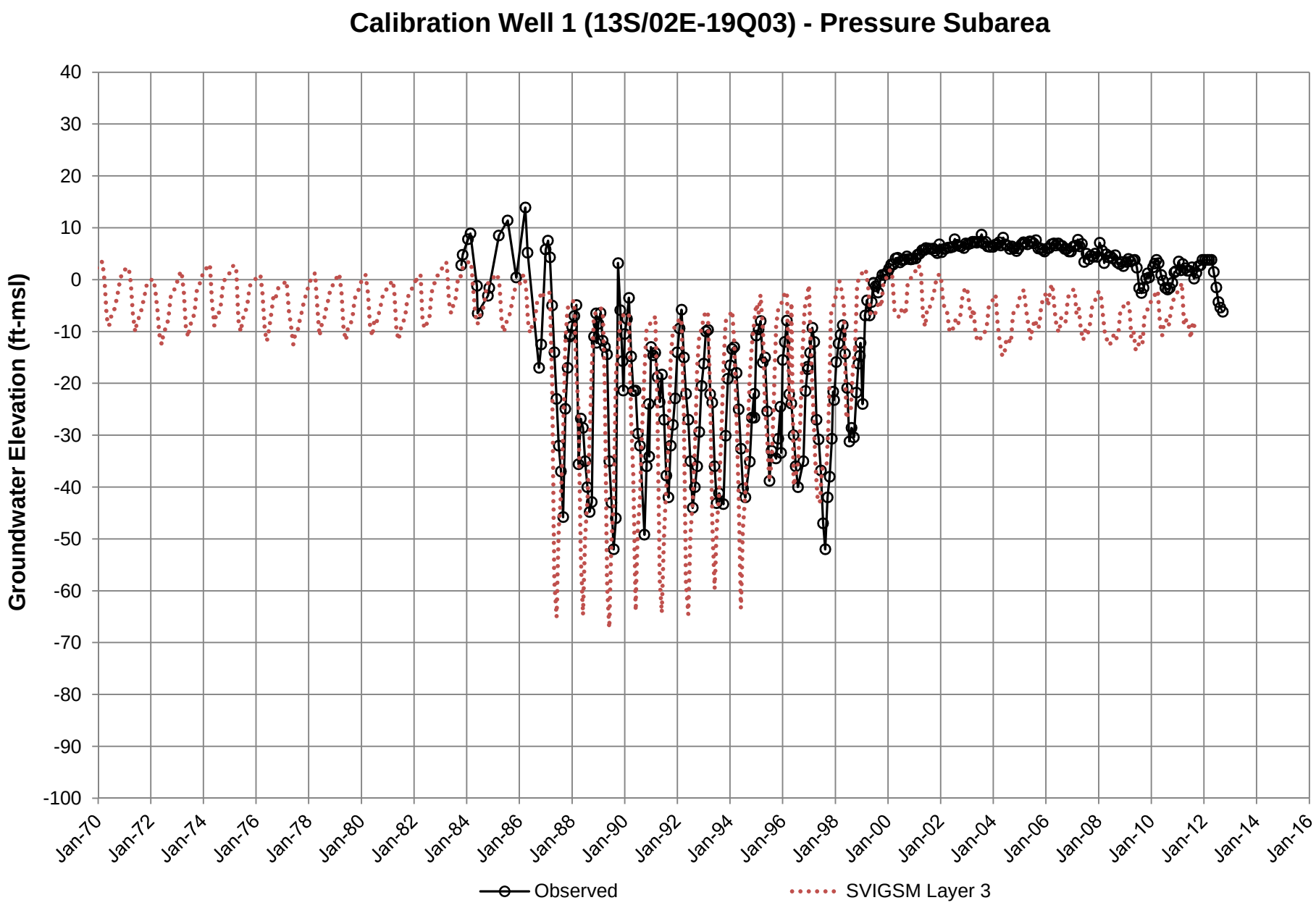
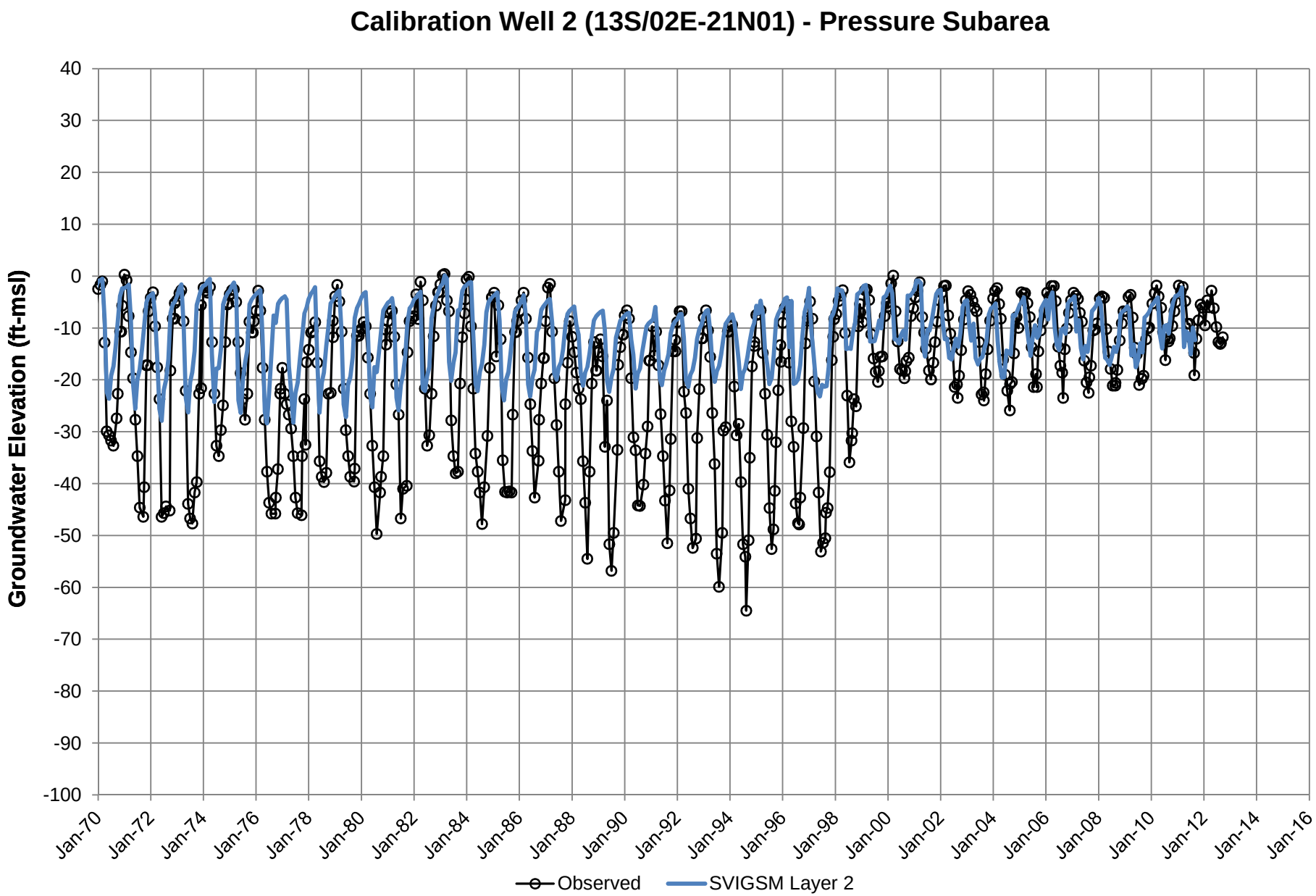
Appendix A
SVIGSM Calibration Well Locations in the Pressure and East Side Subareas
Monterey Peninsula Water Supply Project

SVIGSM Calibration Groundwater Levels


Calibration Well 1 (13S/02E-19Q03) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Jan-14
Jan-16
Observed
SVIGSM Layer 3



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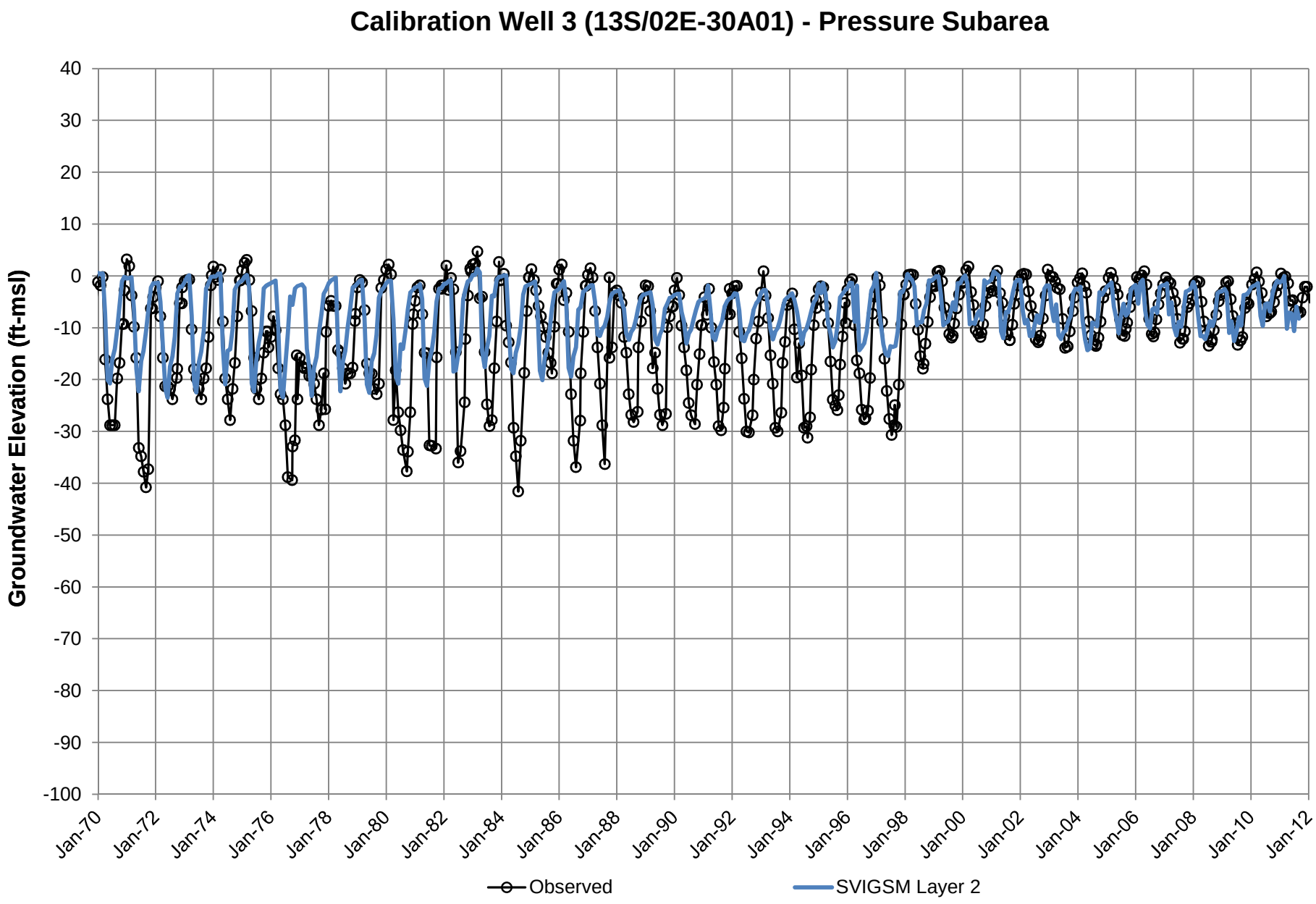
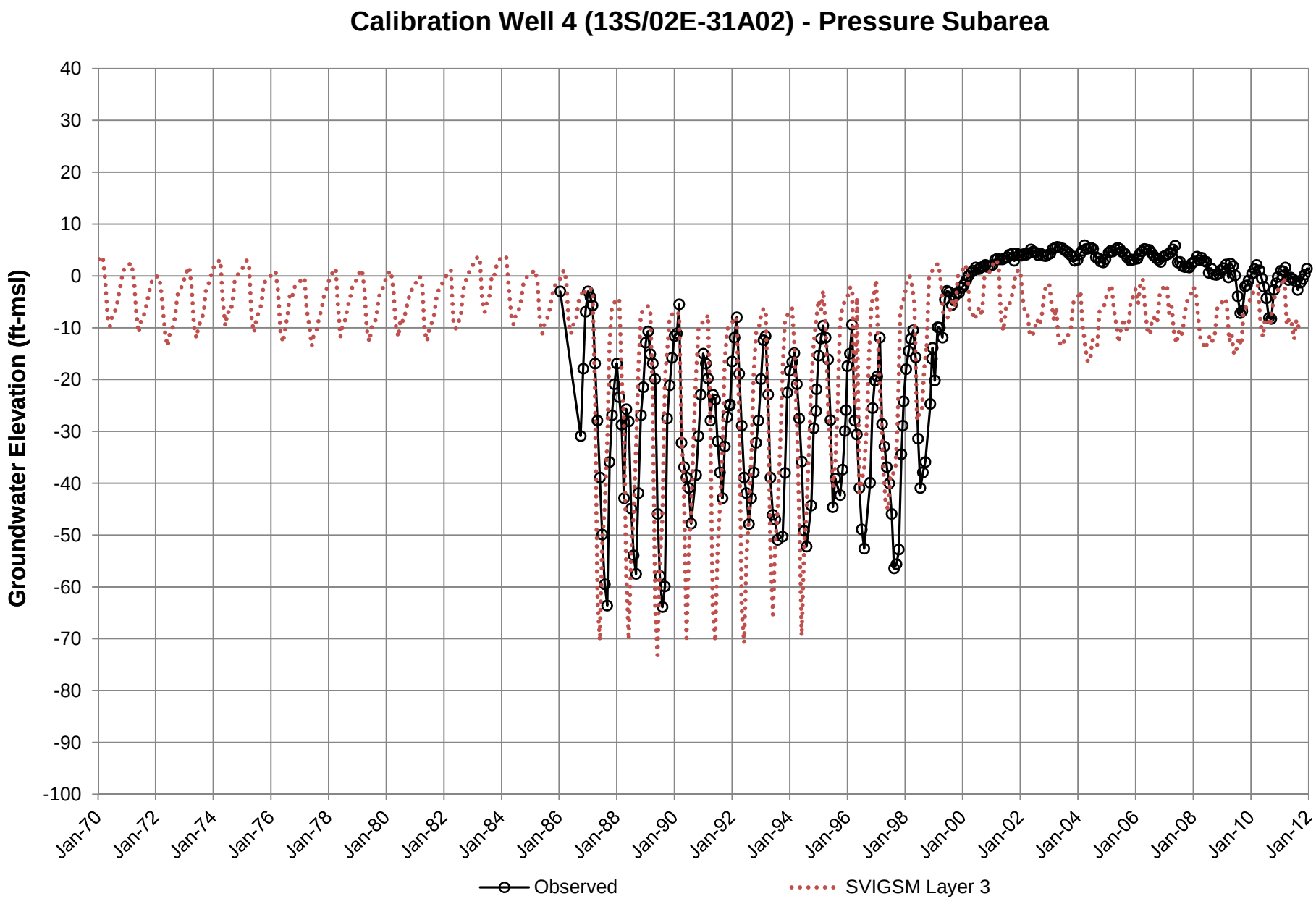
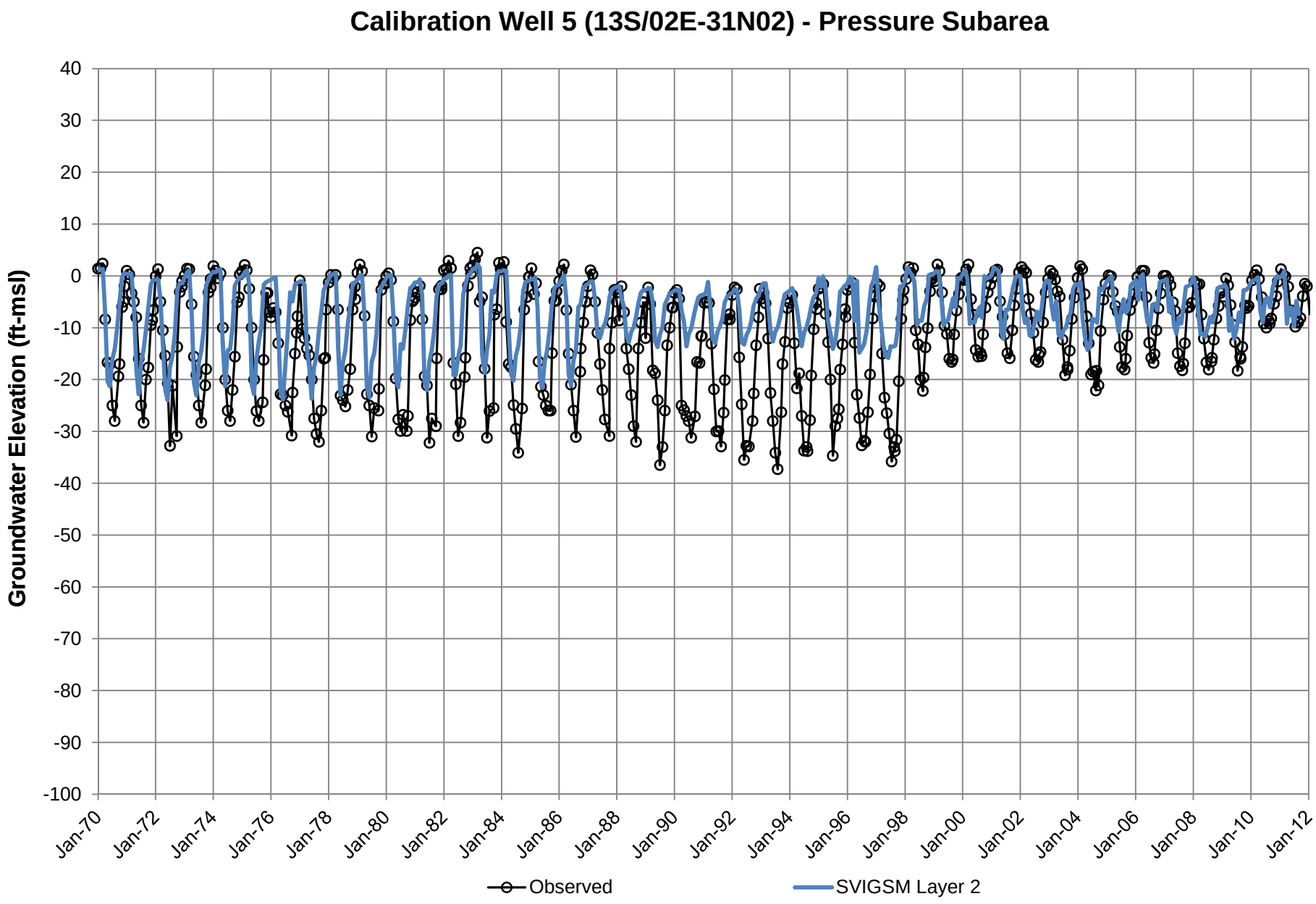
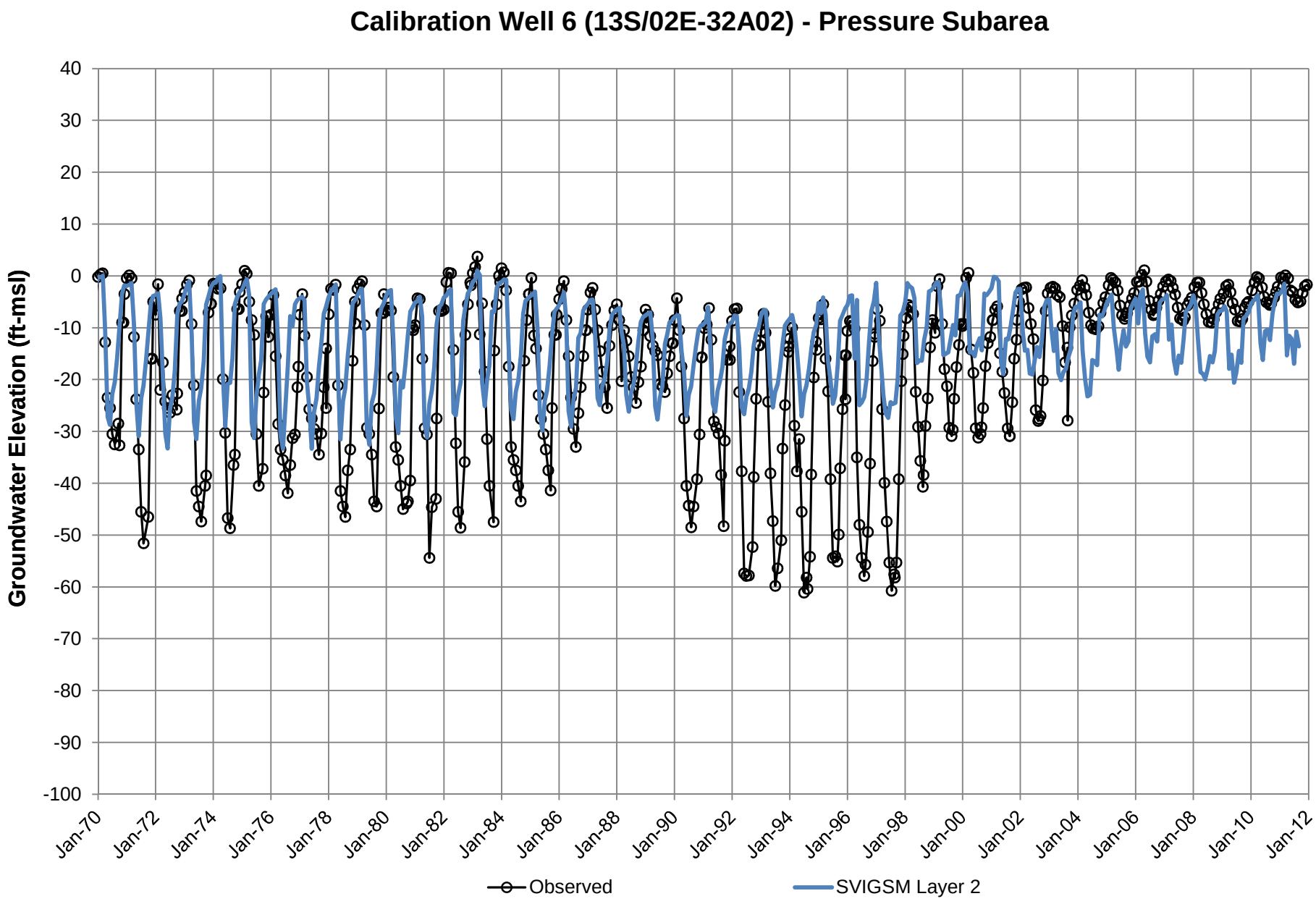
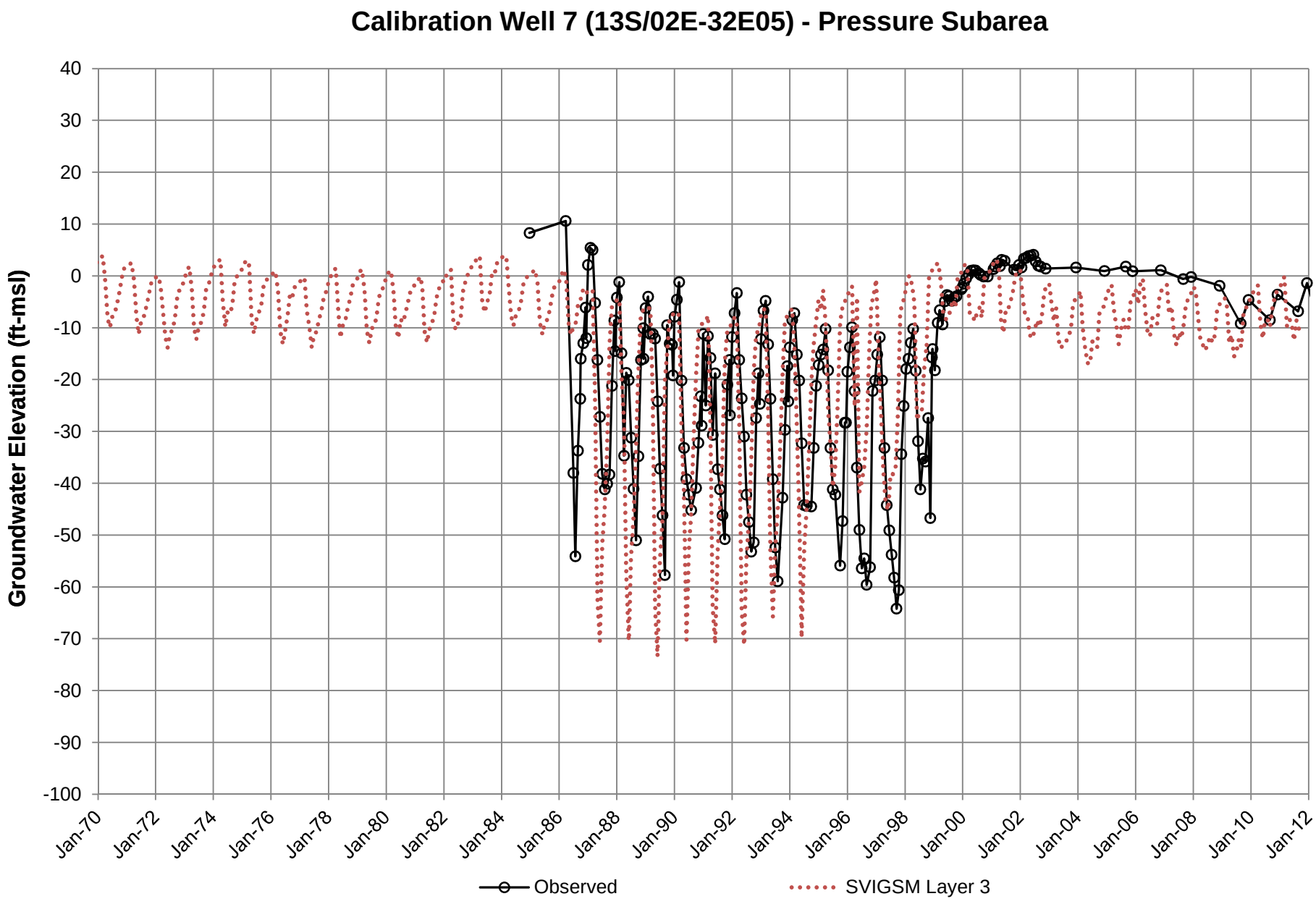
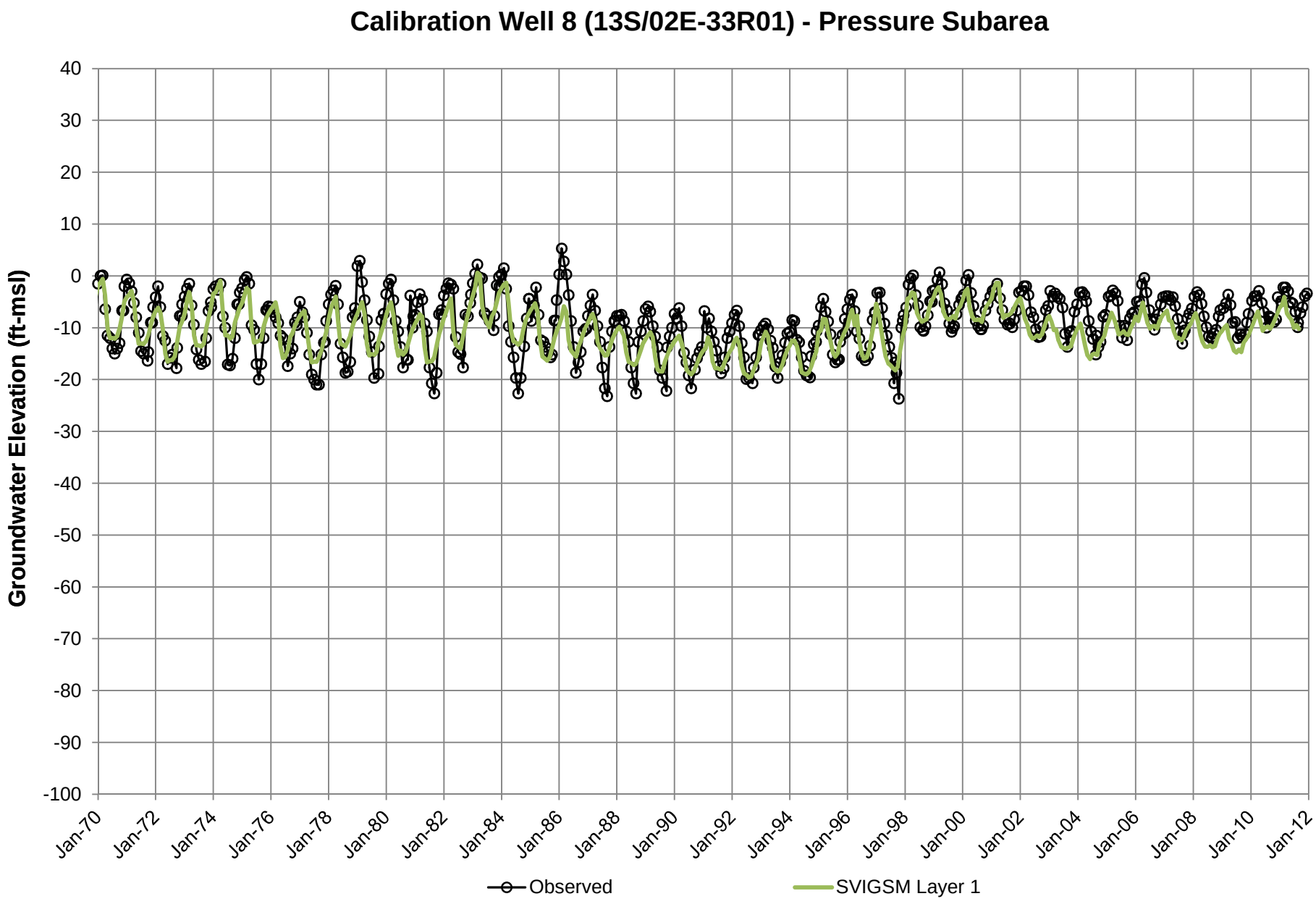

Calibration Well 3 (13S/02E-30A01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

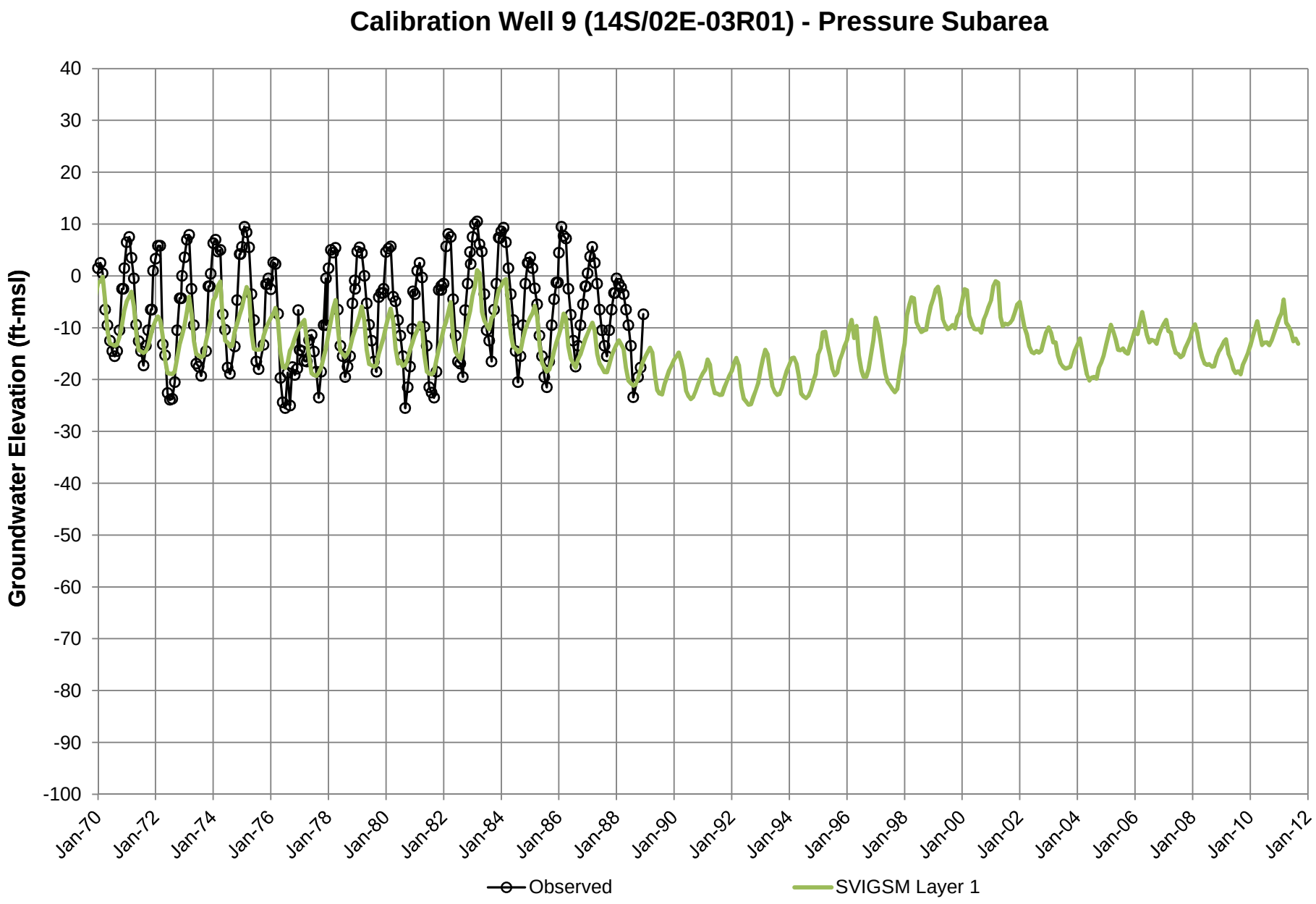

Calibration Well 4 (13S/02E-31A02) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 3

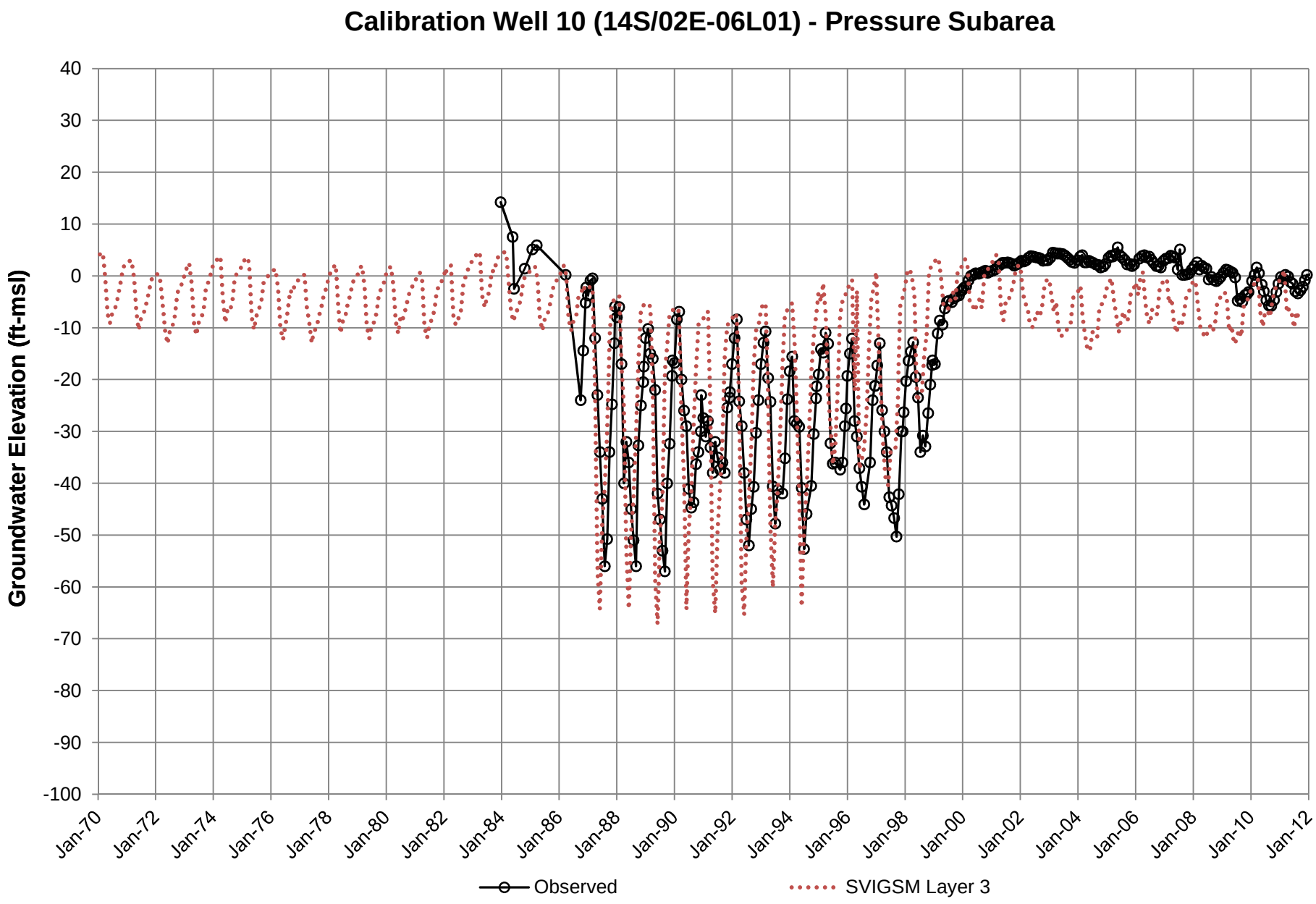

Calibration Well 5 (13S/02E-31N02) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

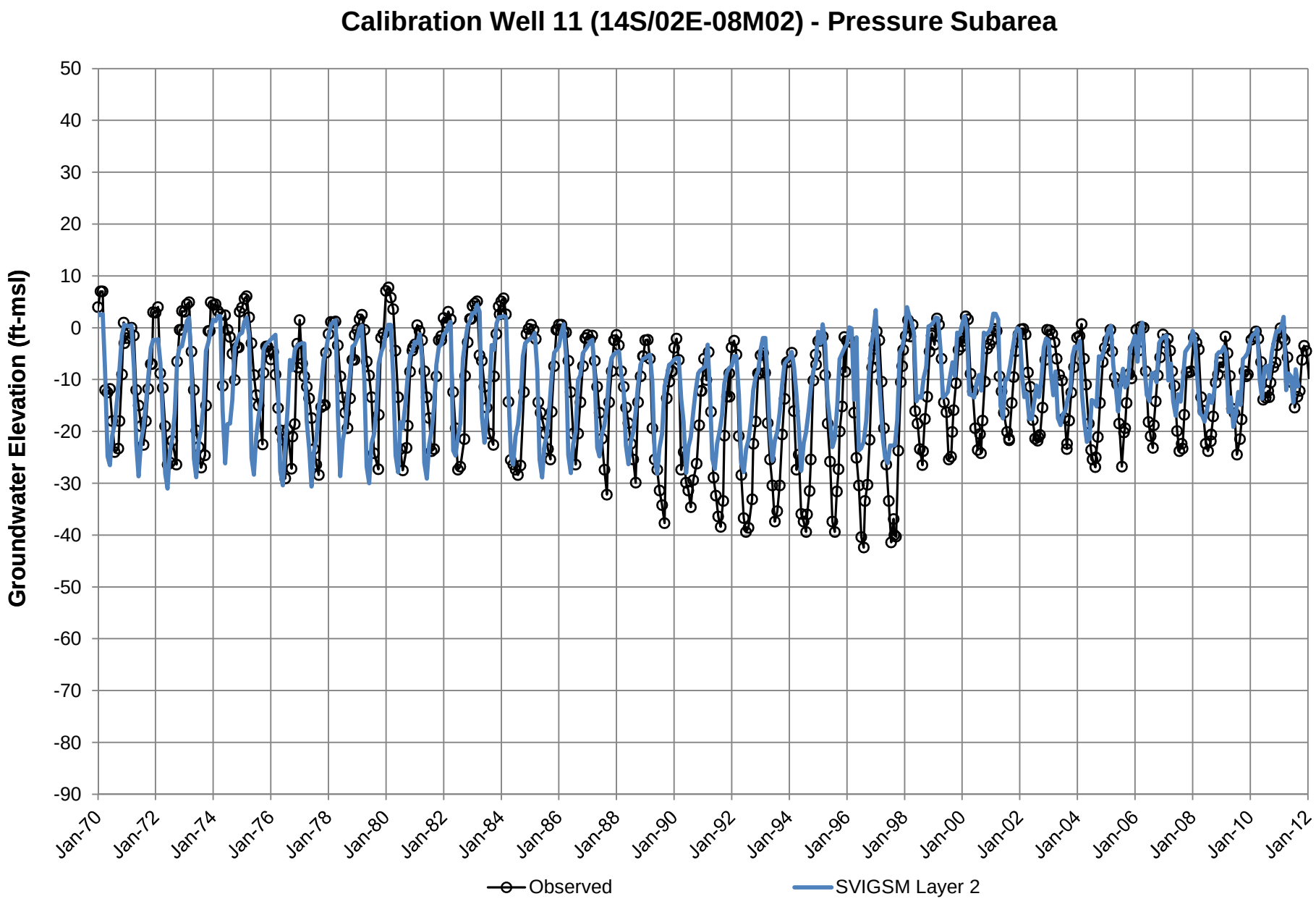

Calibration Well 6 (13S/02E-32A02) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

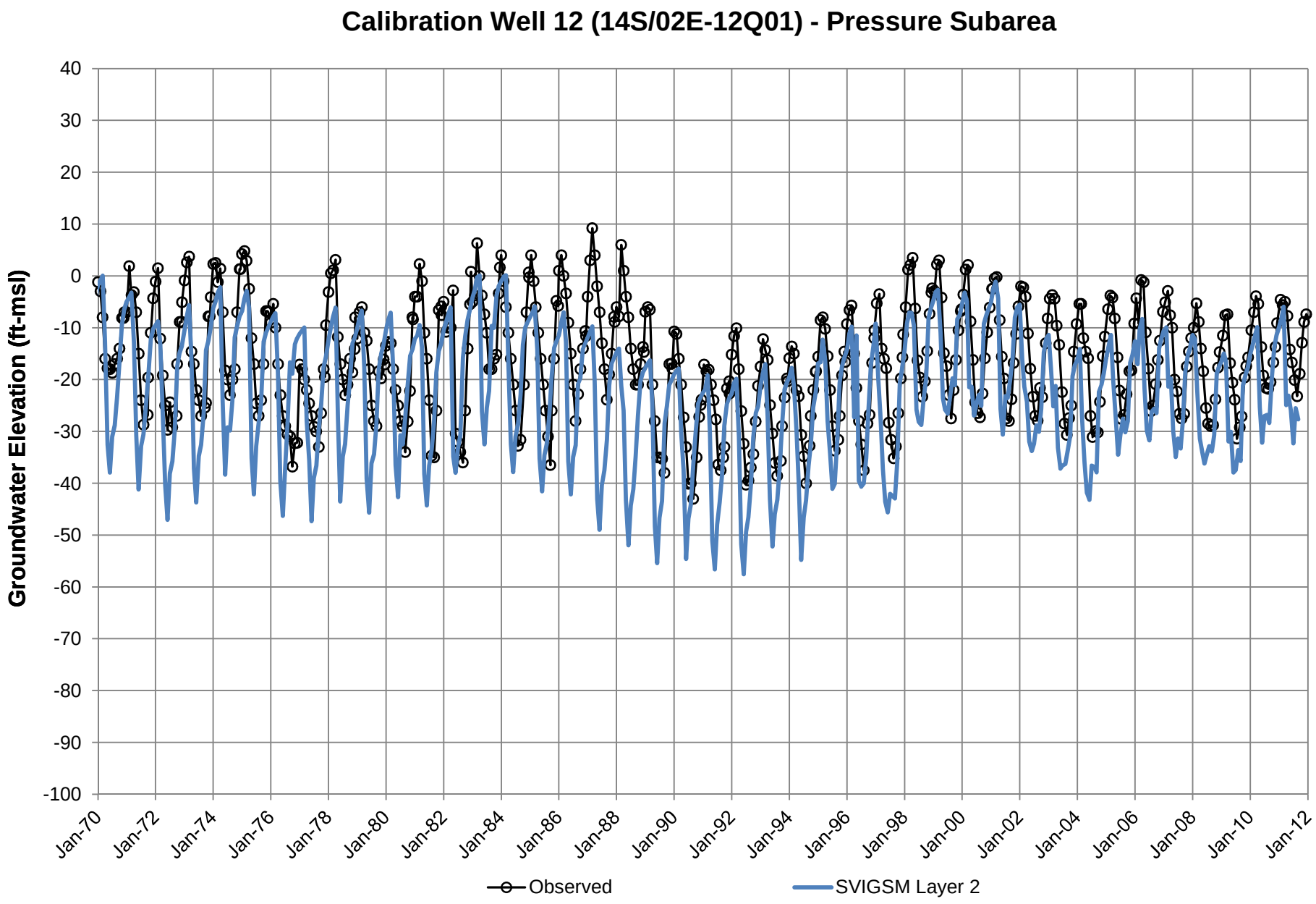

Calibration Well 7 (13S/02E-32E05) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 3

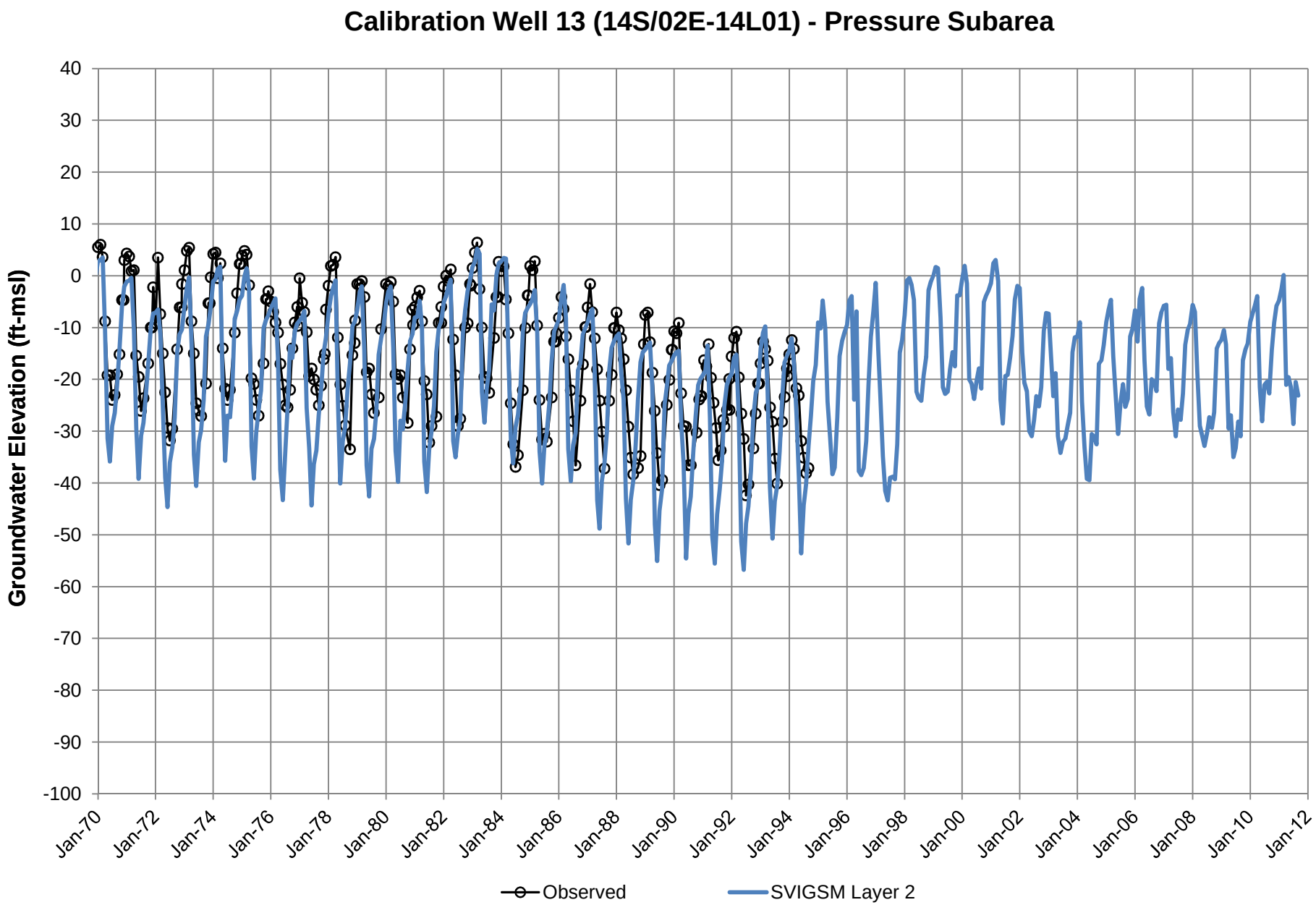

Calibration Well 8 (13S/02E-33R01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 1

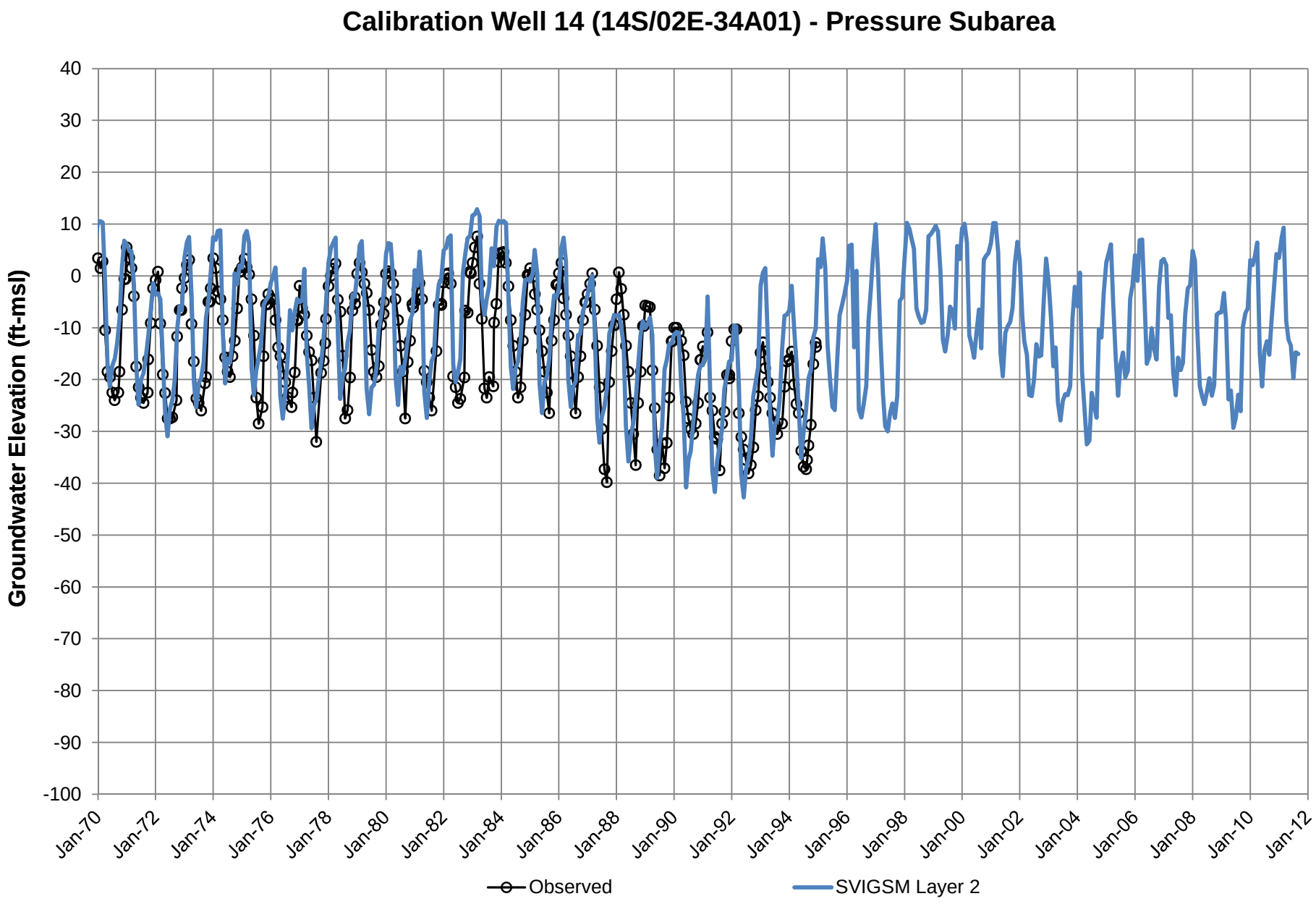

Calibration Well 9 (14S/02E-03R01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 1

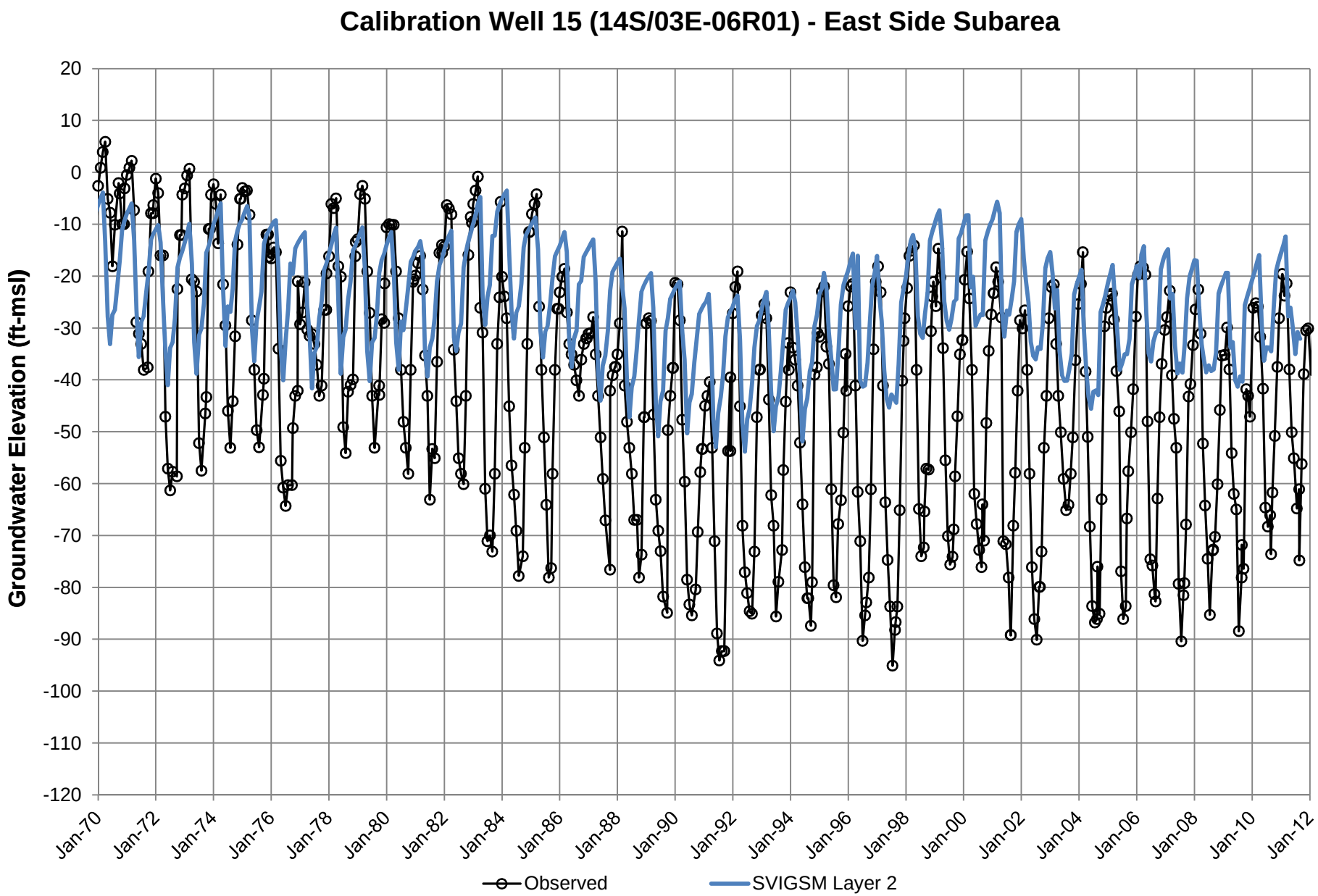

Calibration Well 10 (14S/02E-06L01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 3

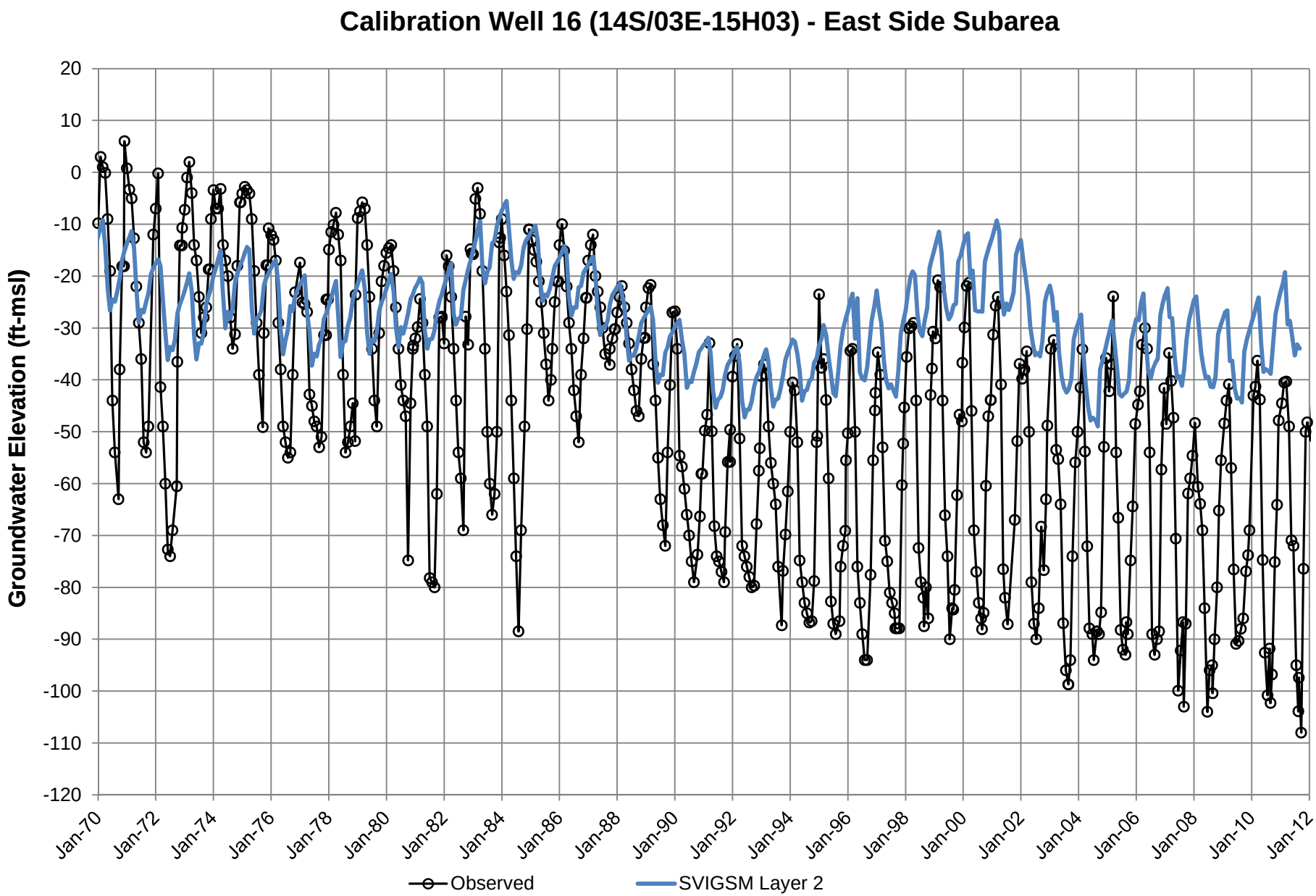

Calibration Well 11 (14S/02E-08M02) - Pressure Subarea
Groundwater Elevation (ft-msl)
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

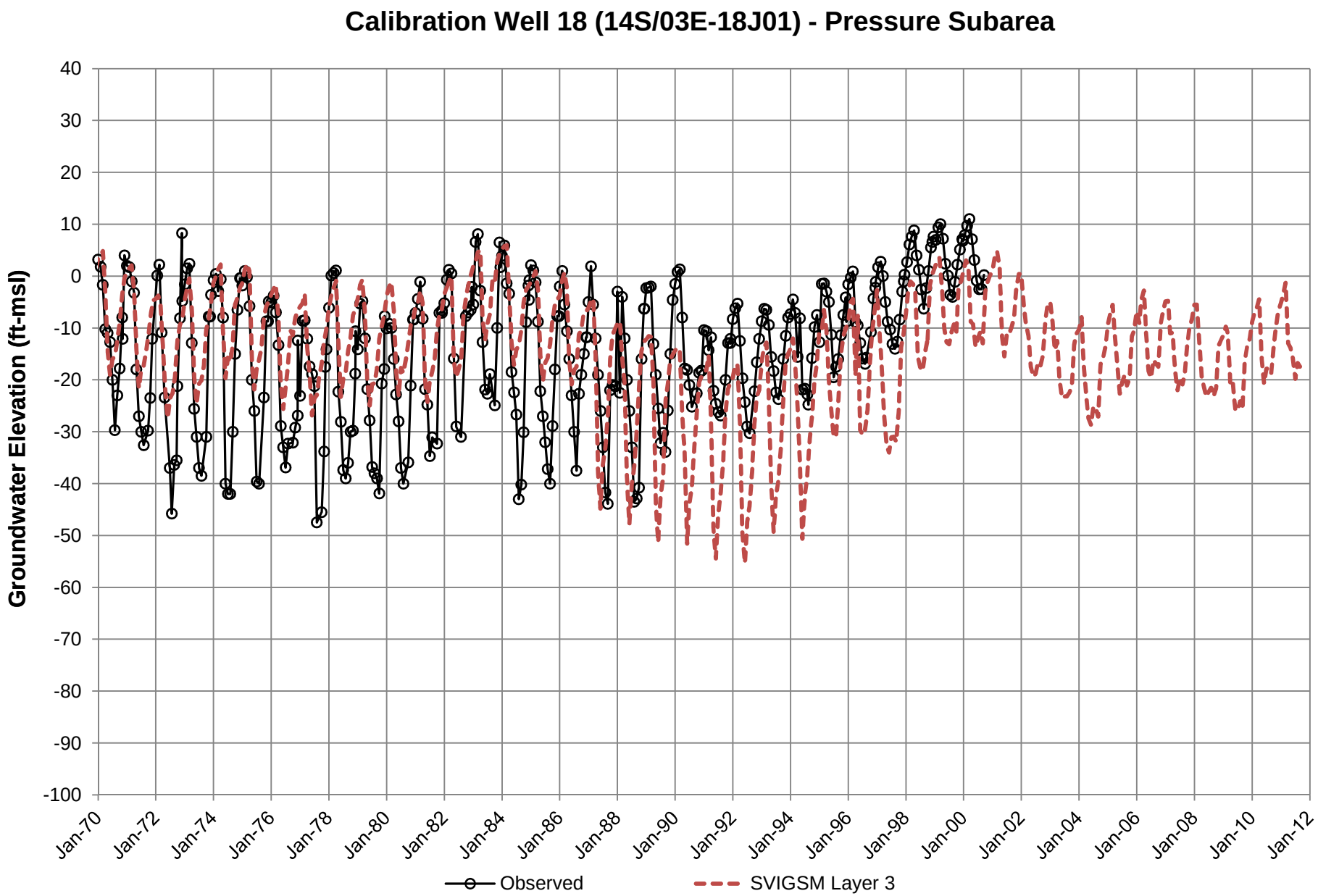

Calibration Well 12 (14S/02E-12Q01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

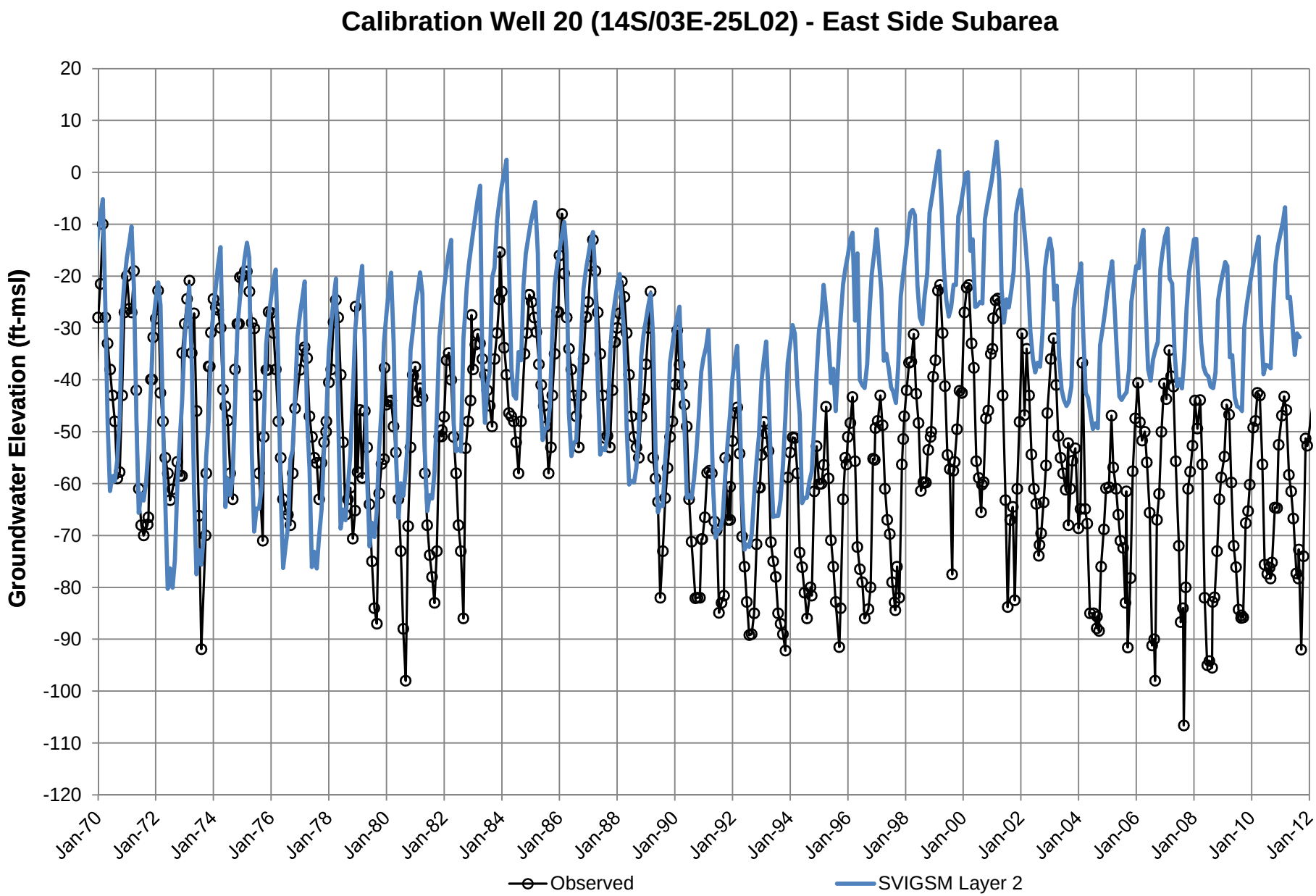

Calibration Well 13 (14S/02E-14L01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

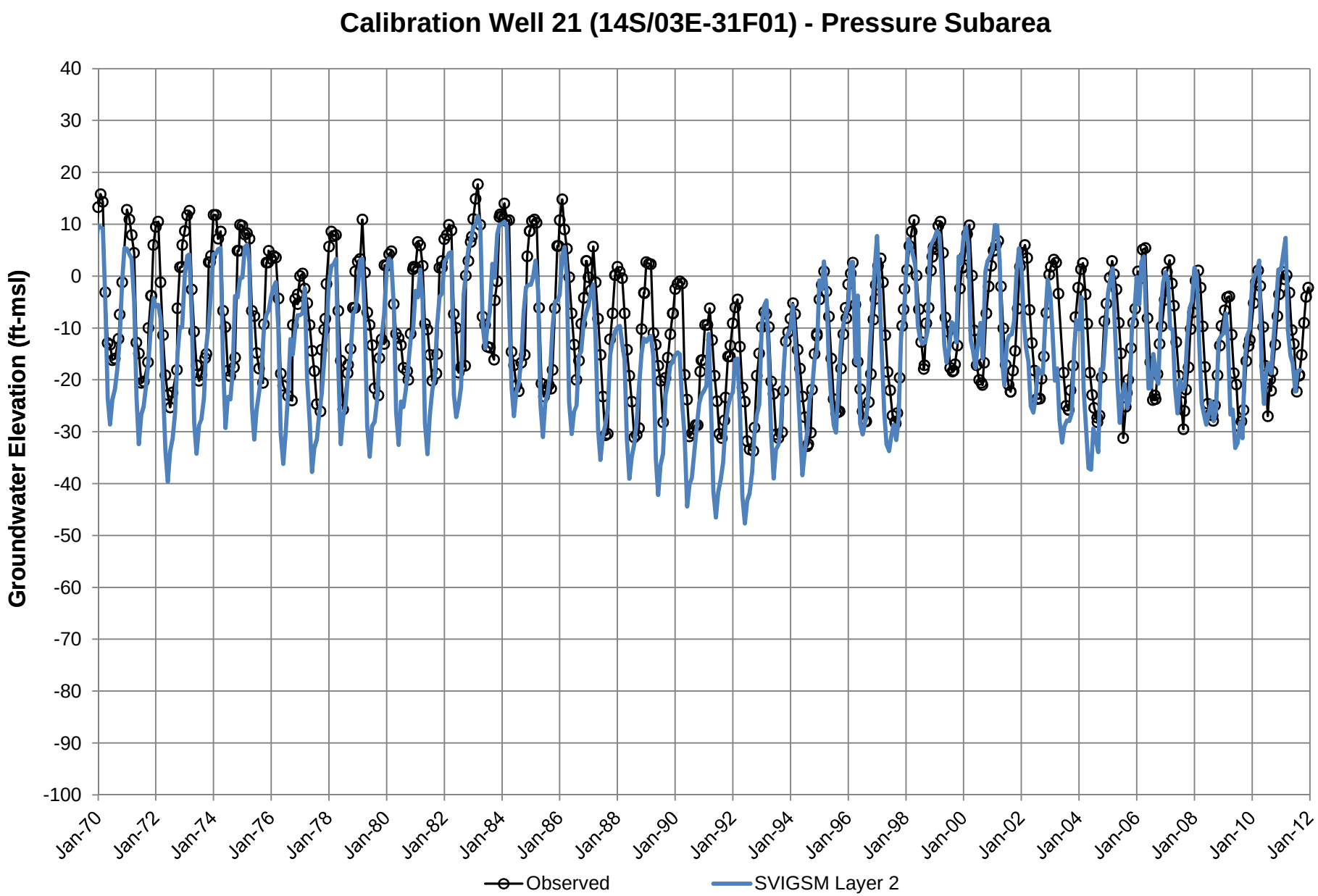

Calibration Well 14 (14S/02E-34A01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

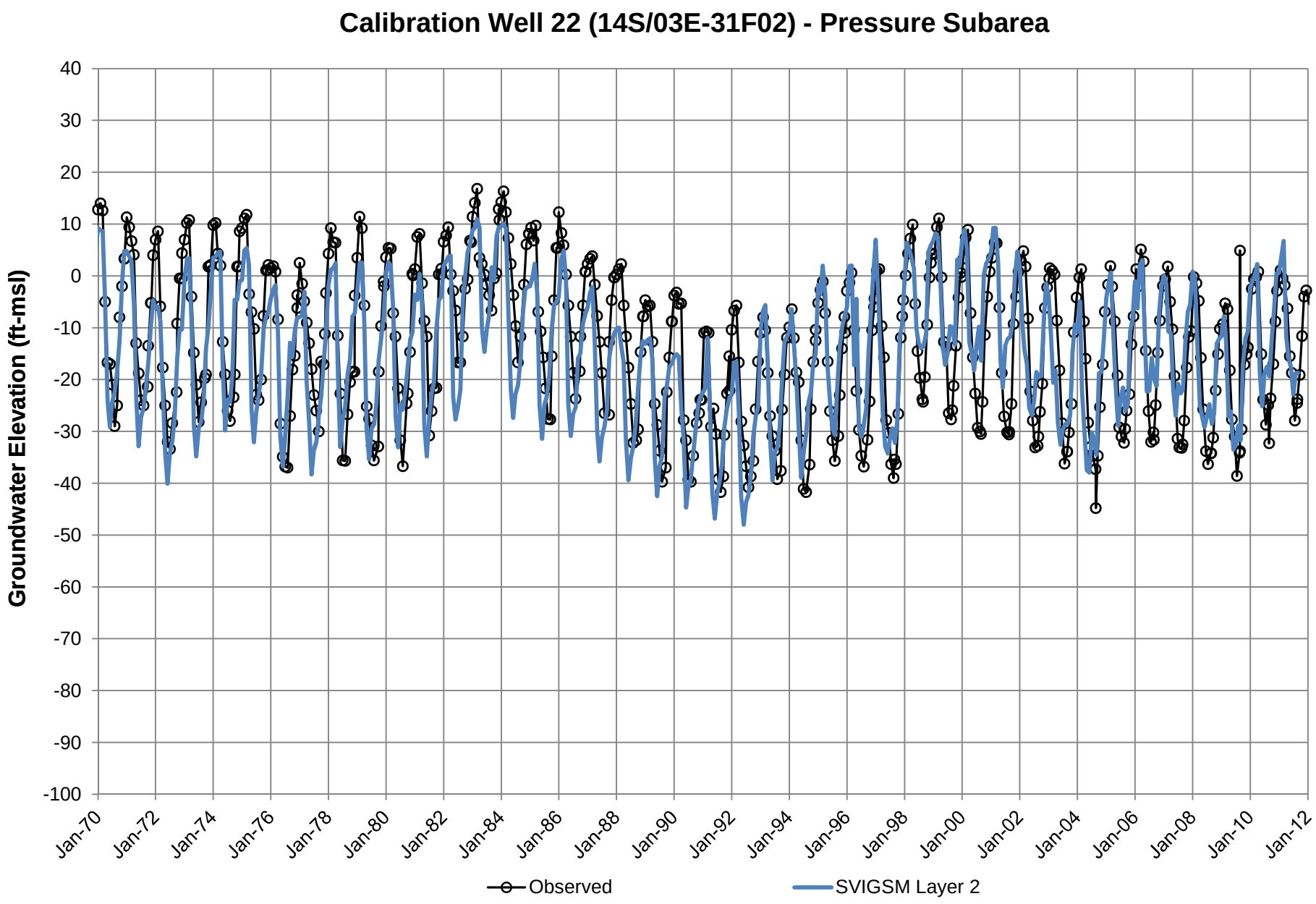

Calibration Well 15 (14S/03E-06R01) - East Side Subarea
Groundwater Elevation (ft-msl)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

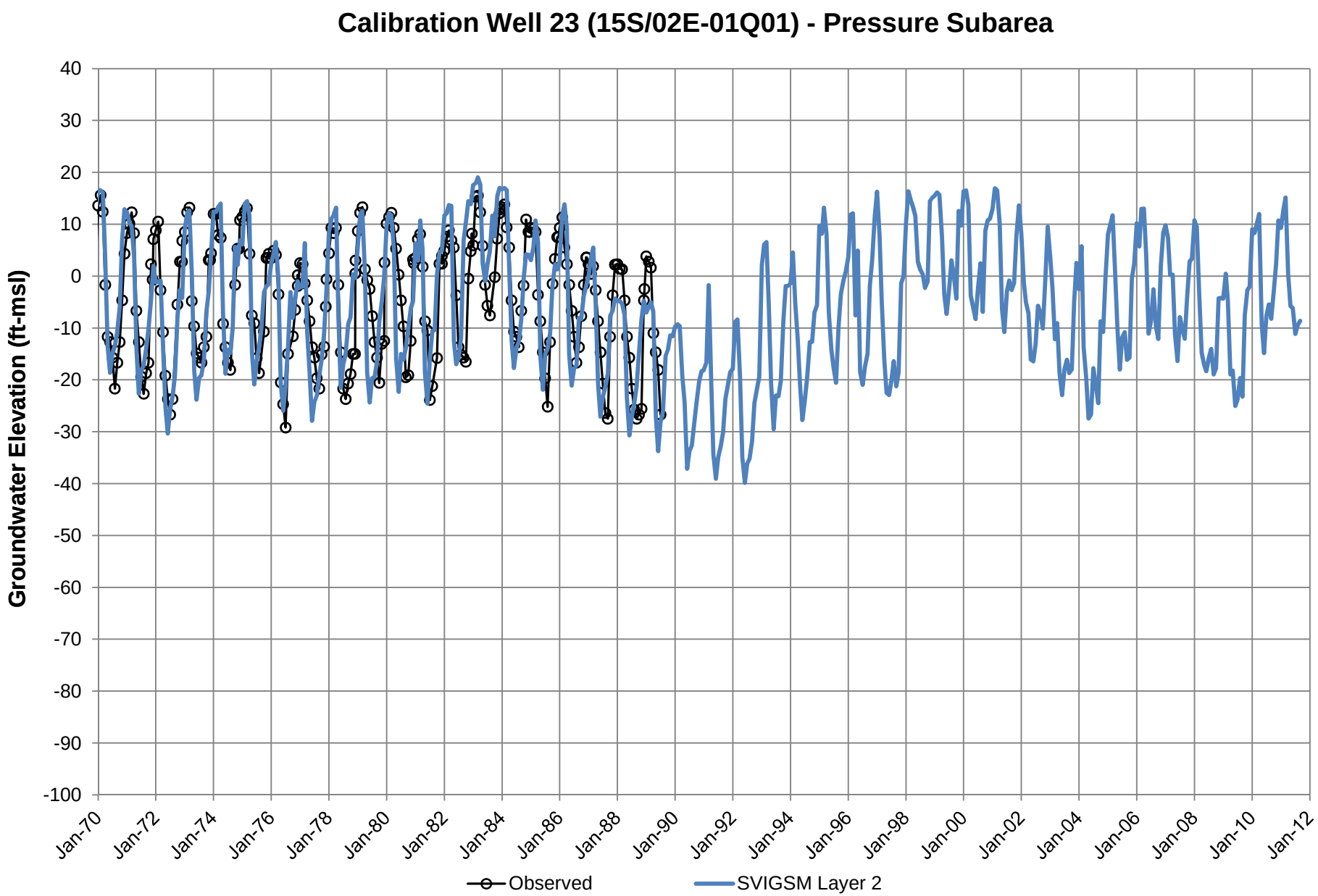

Calibration Well 16 (14S/03E-15H03) - East Side Subarea
Groundwater Elevation (ft-msl)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

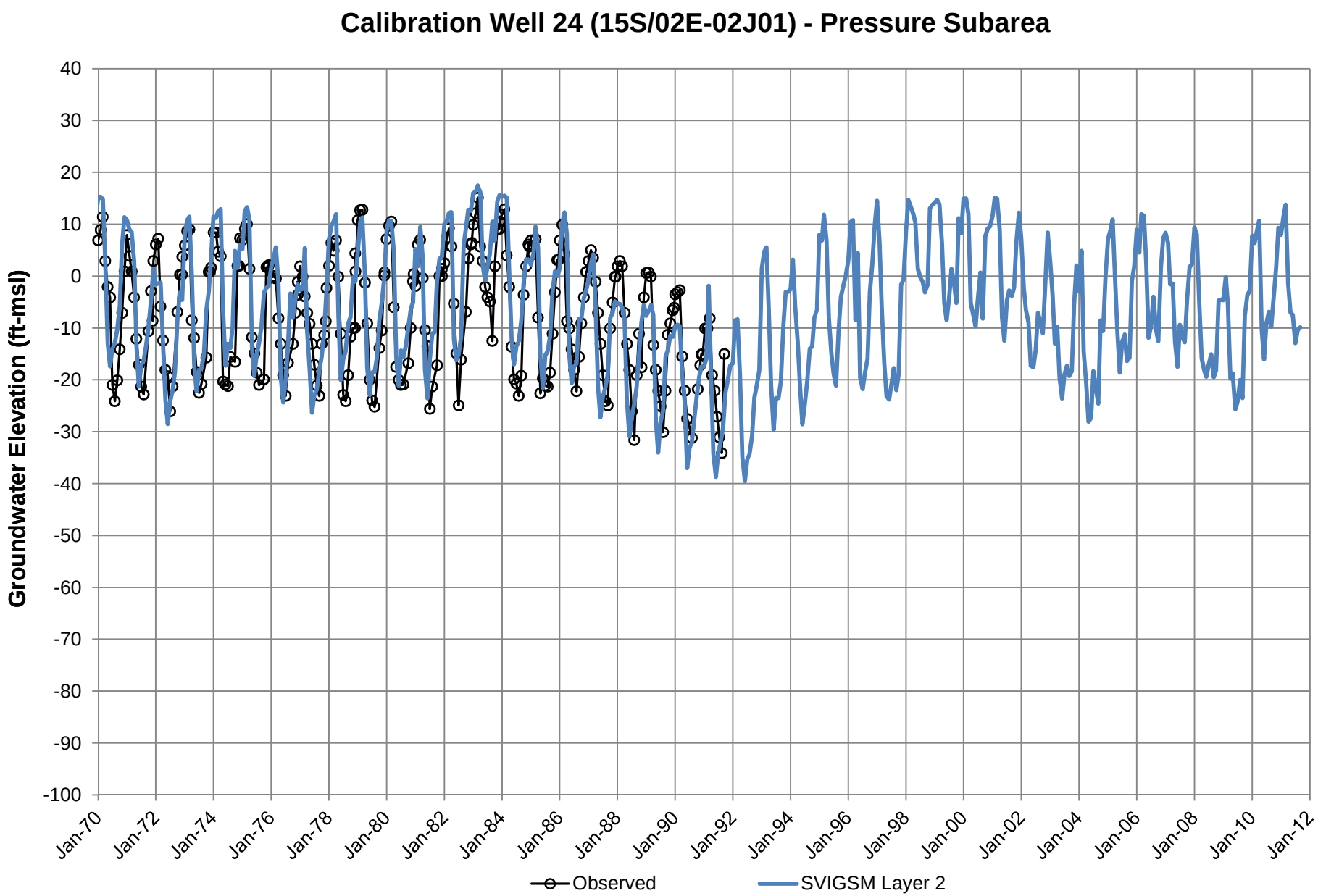

Calibration Well 18 (14S/03E-18J01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 3

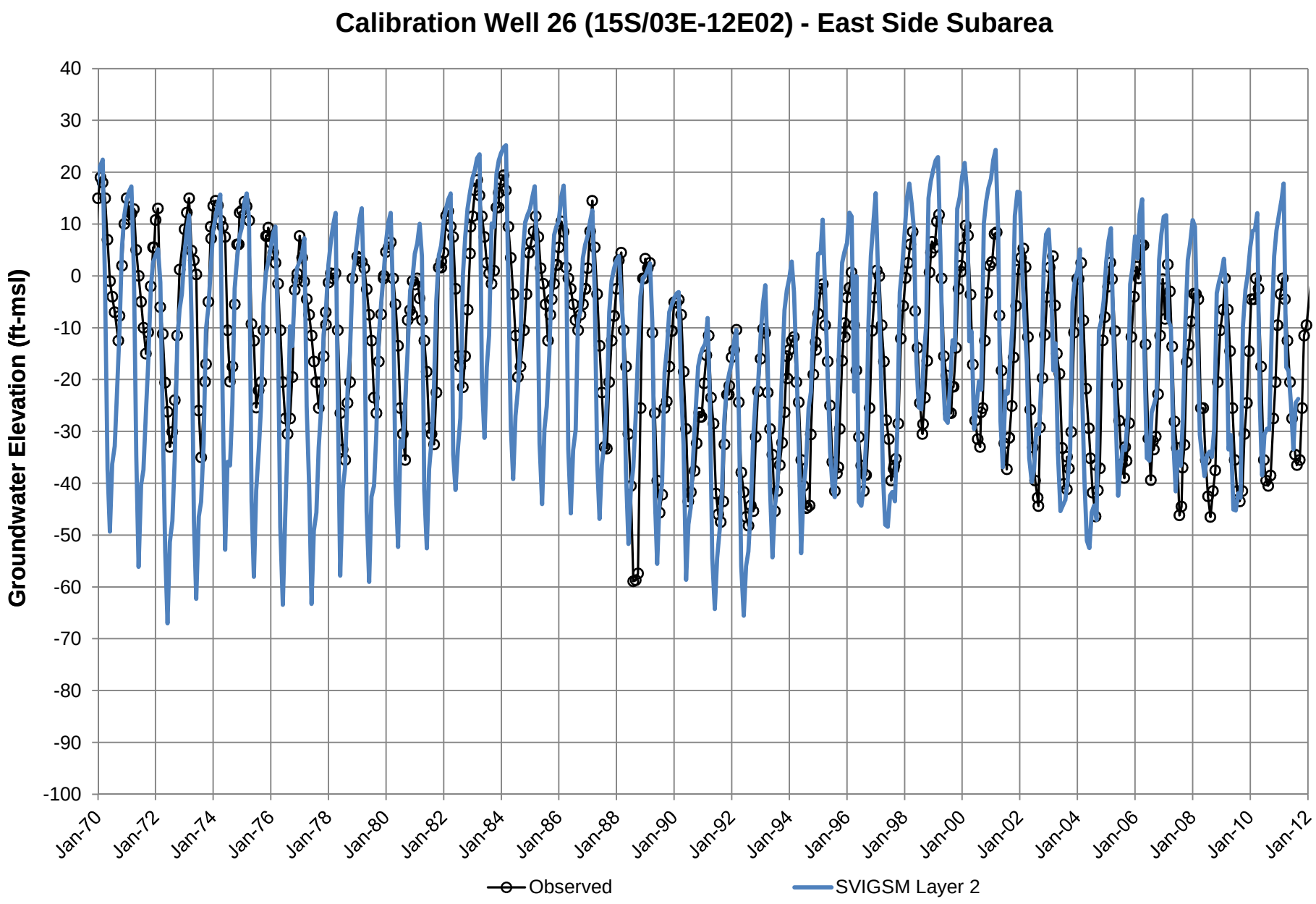

Calibration Well 20 (14S/03E-25L02) - East Side Subarea
Groundwater Elevation (ft-msl)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

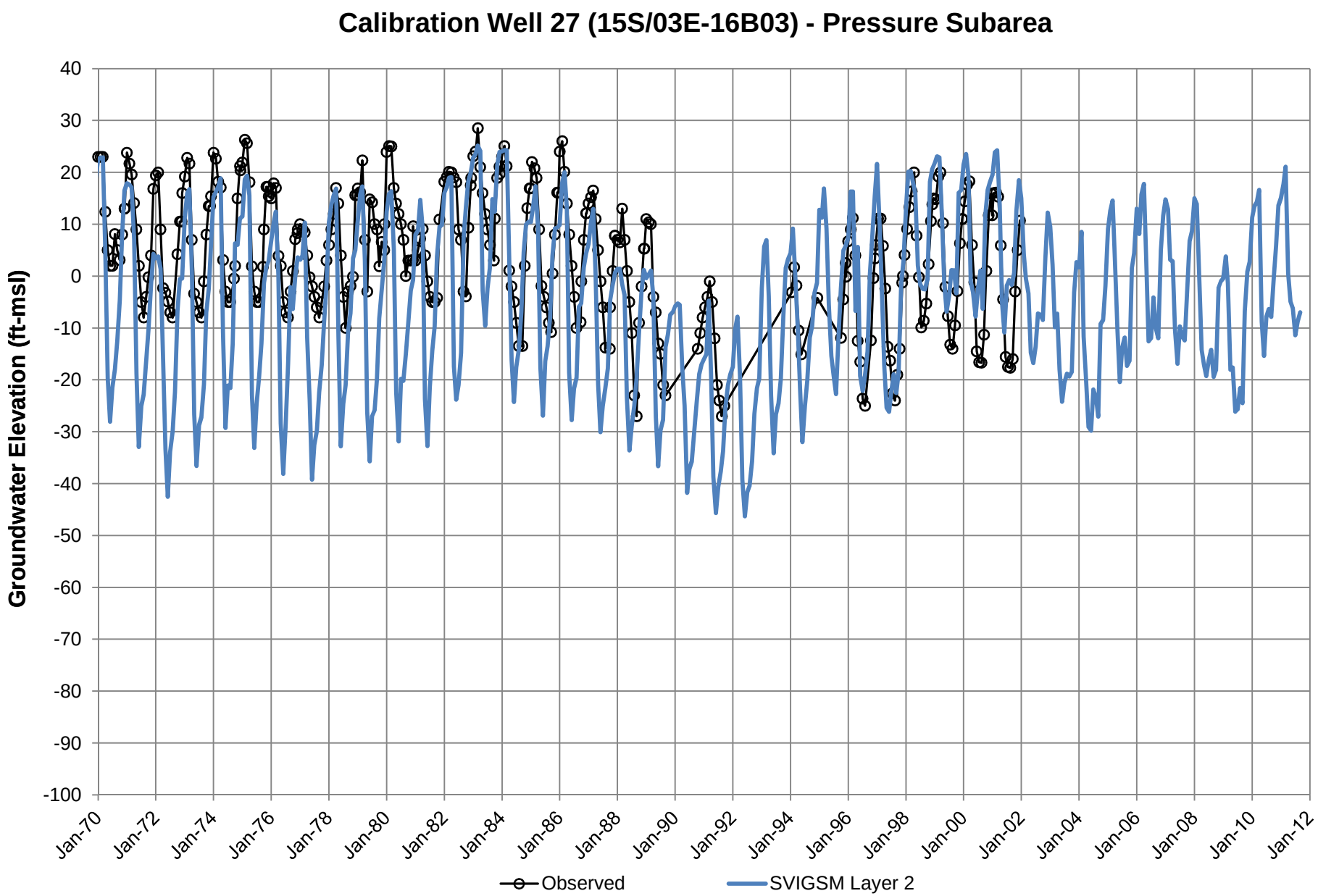

Calibration Well 21 (14S/03E-31F01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

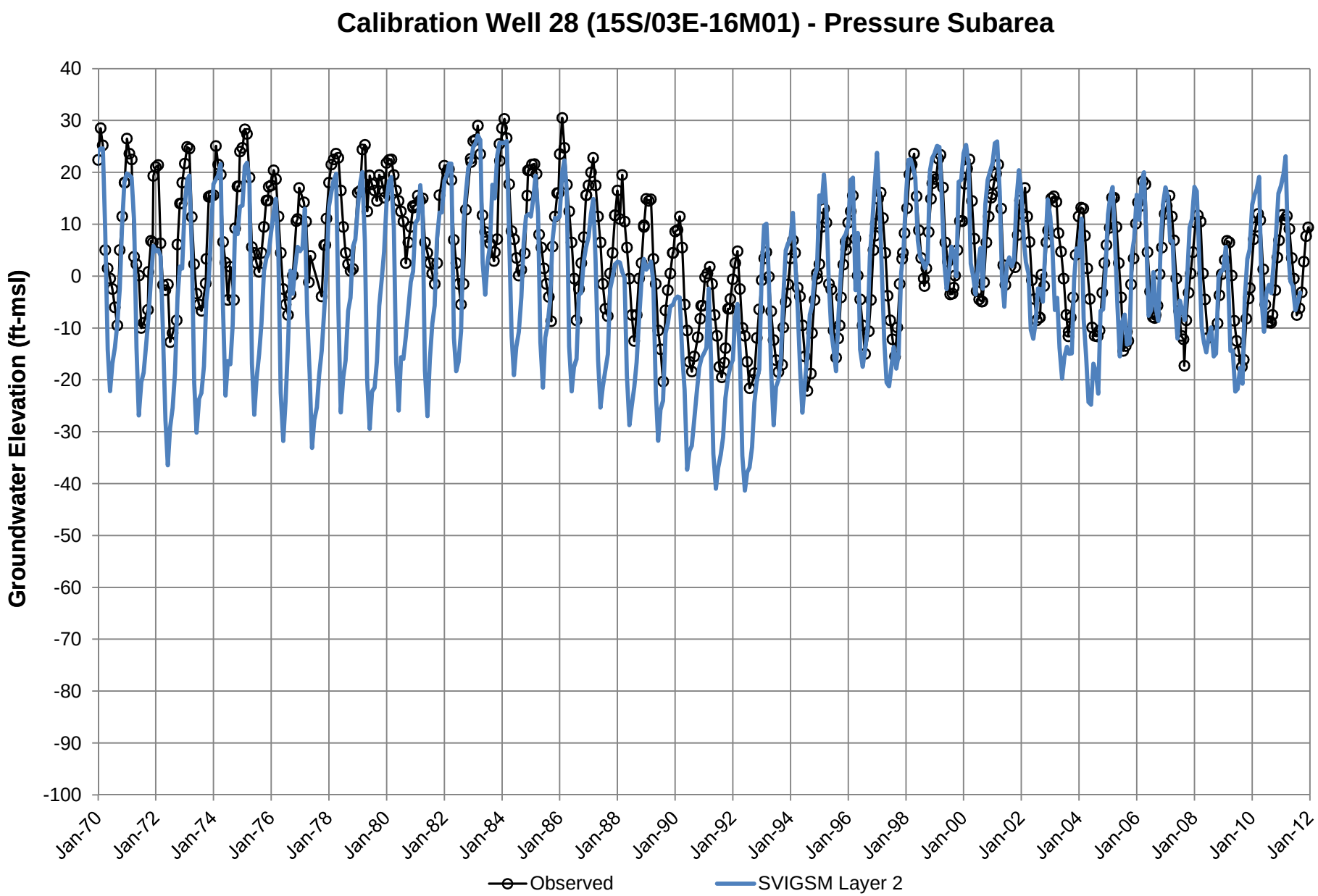

Calibration Well 22 (14S/03E-31F02) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

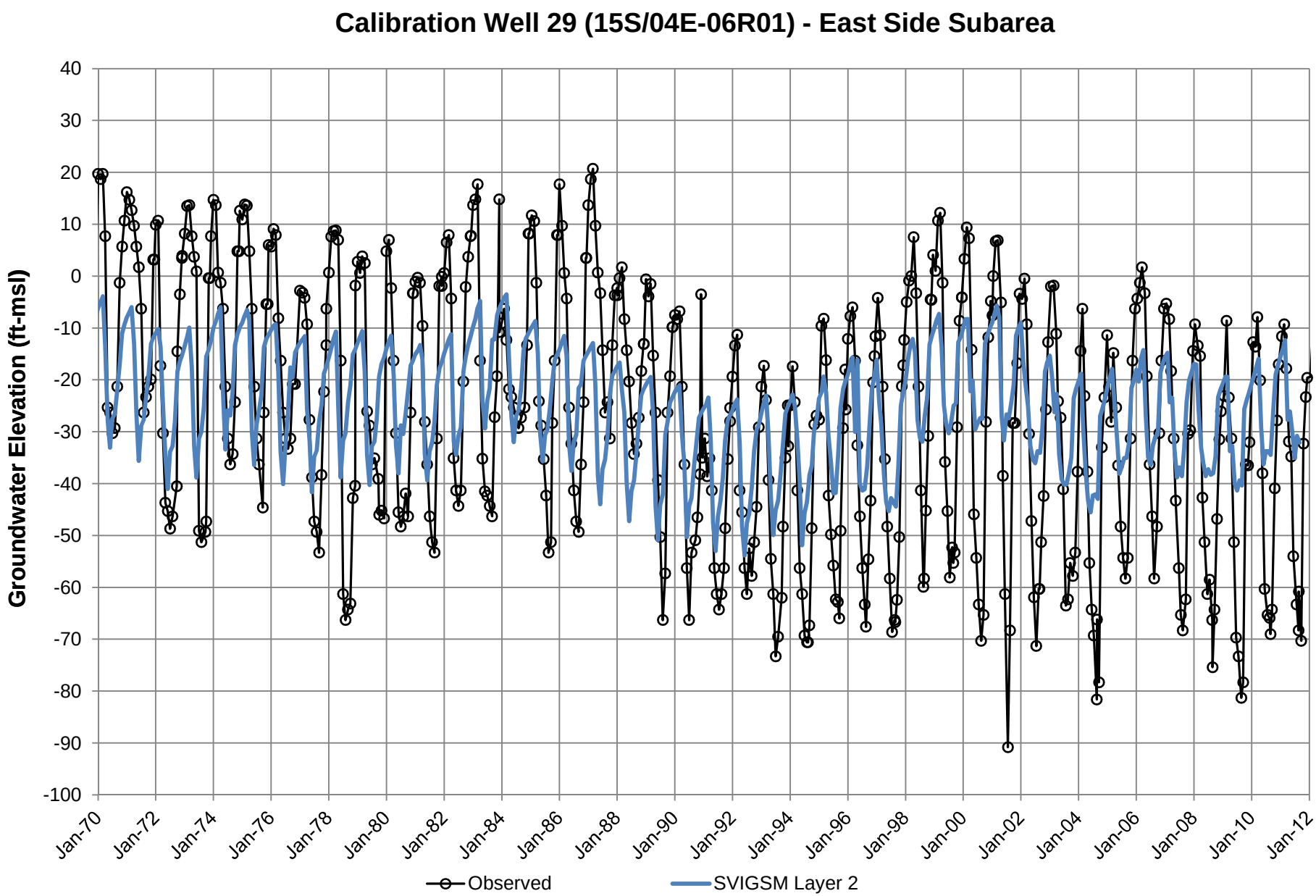

Calibration Well 23 (15S/02E-01Q01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

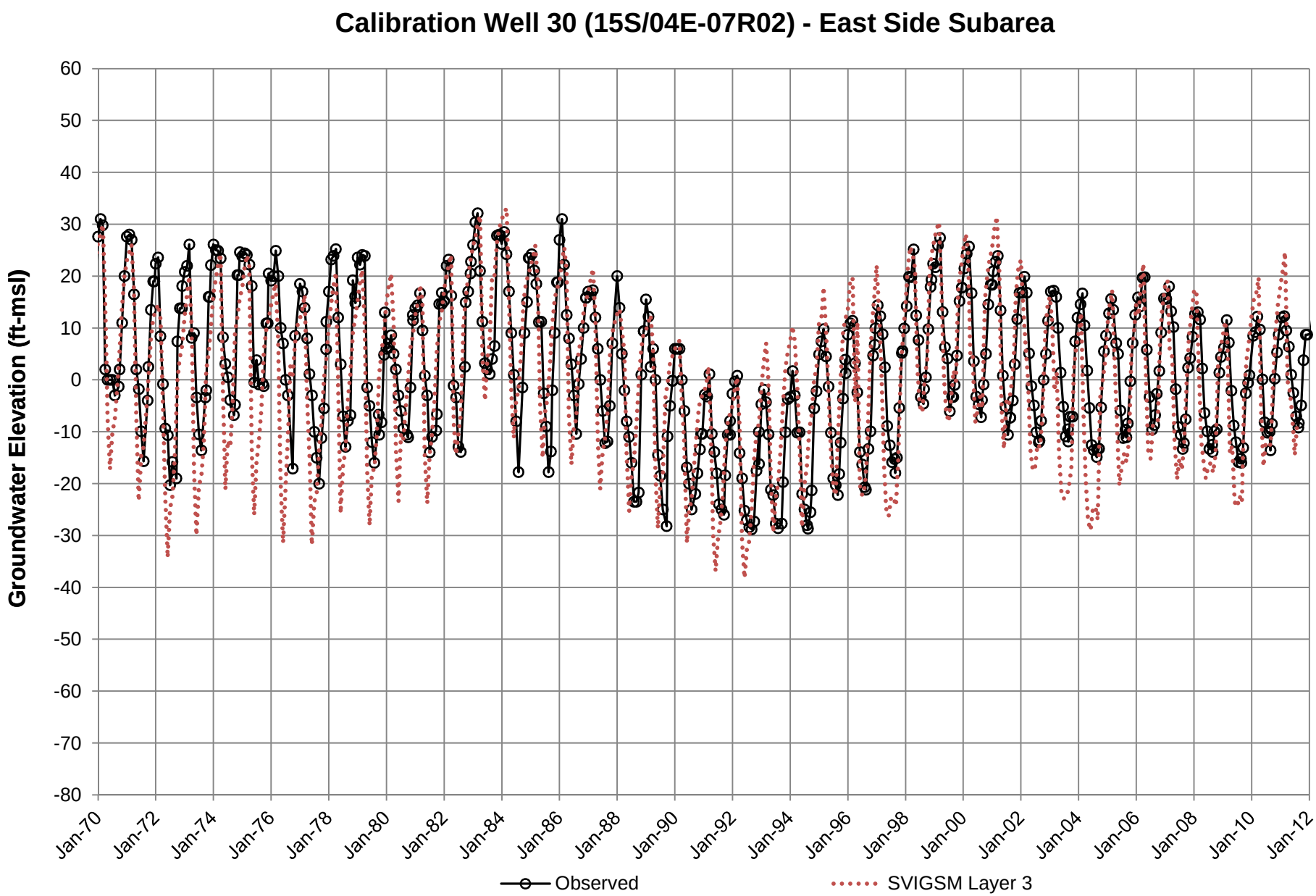

Calibration Well 24 (15S/02E-02J01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

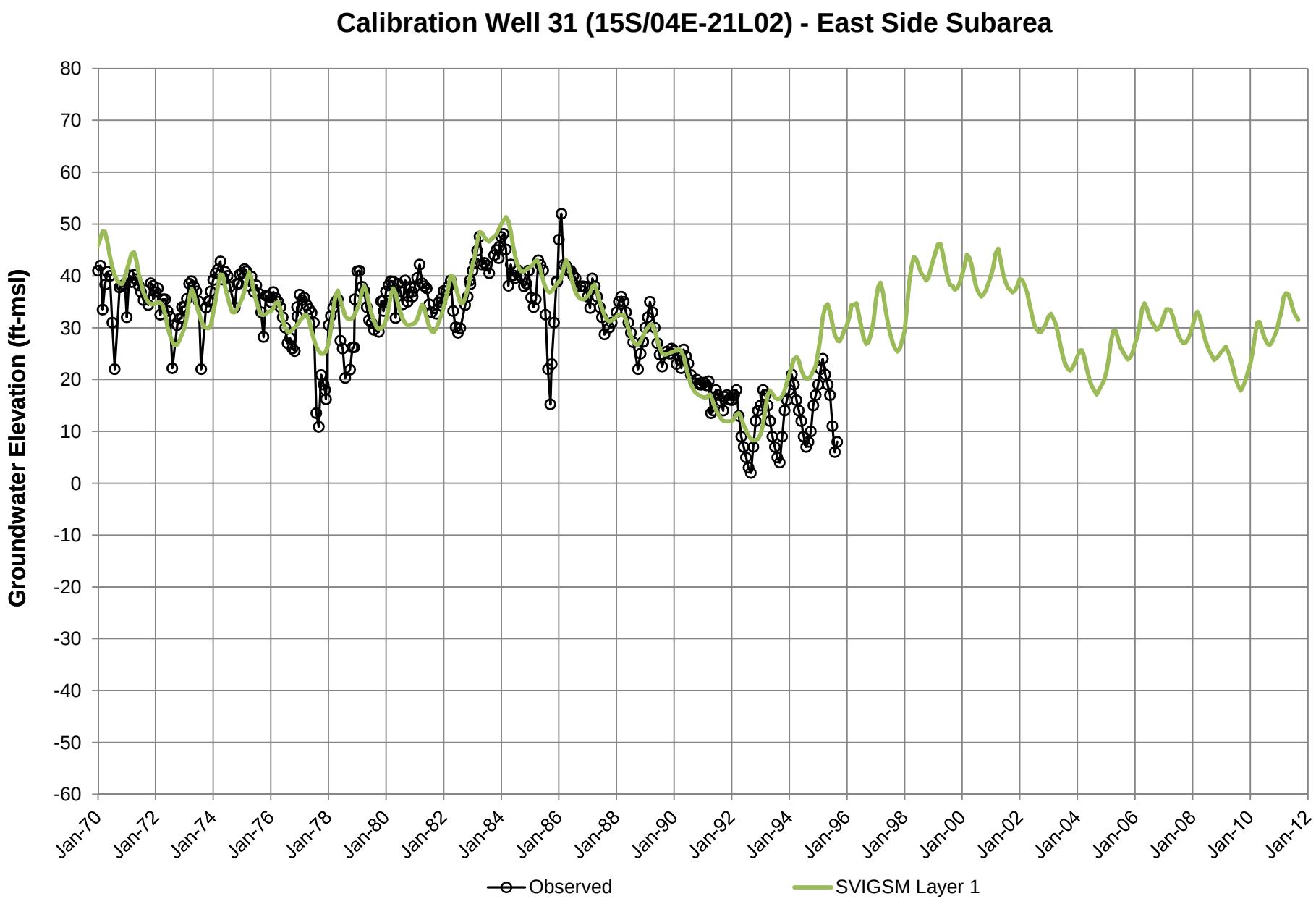

Calibration Well 26 (15S/03E-12E02) - East Side Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

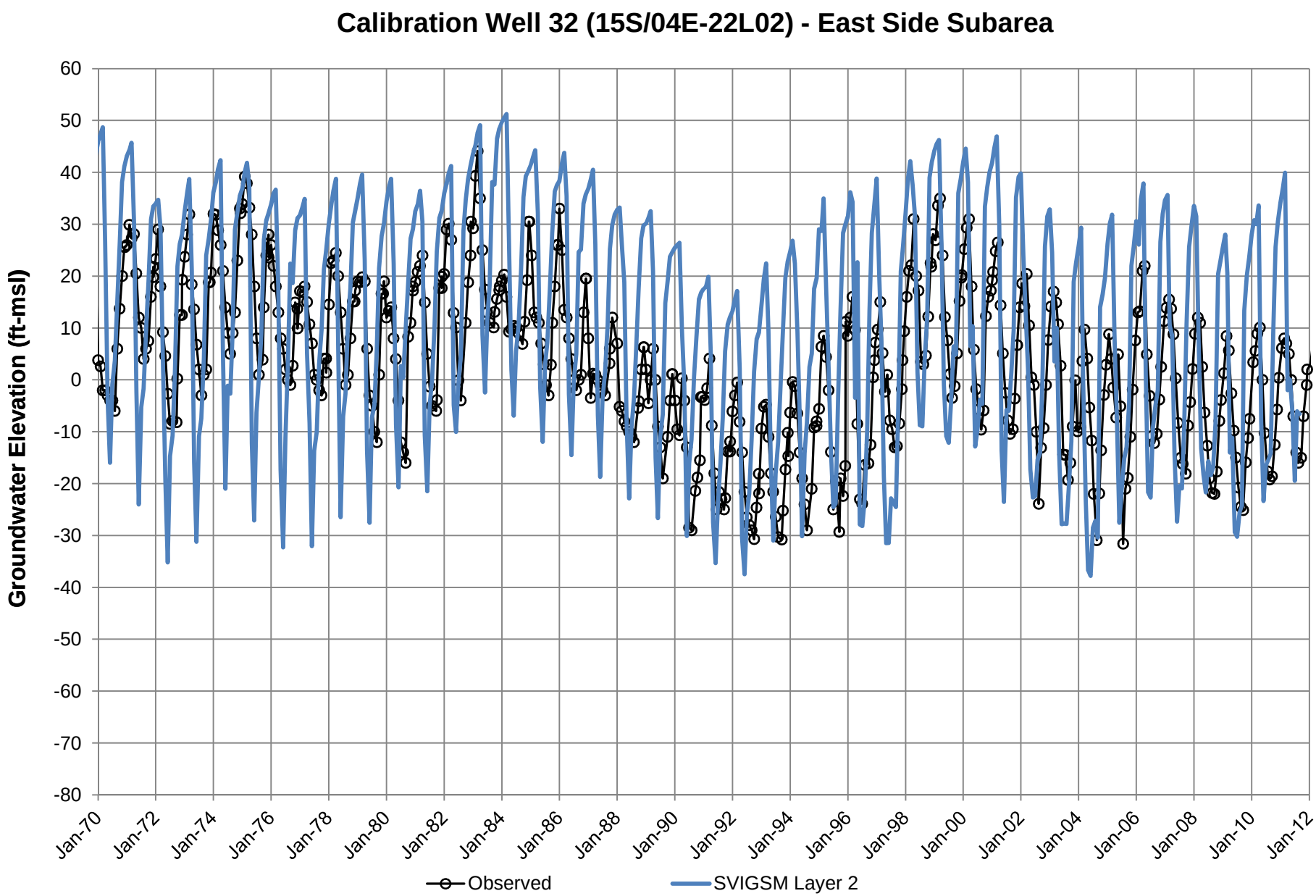

Calibration Well 27 (15S/03E-16B03) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

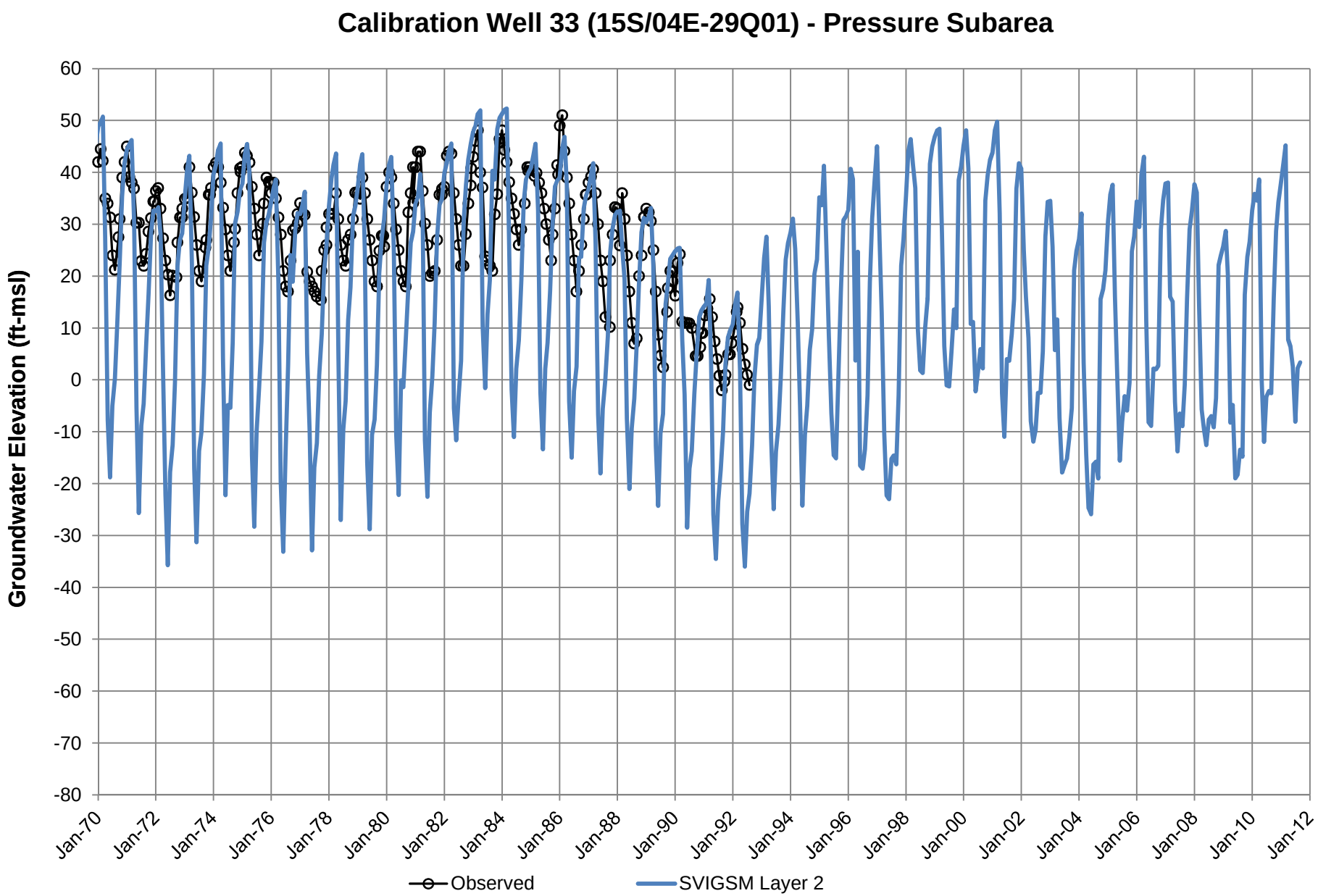

Calibration Well 28 (15S/03E-16M01) - Pressure Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

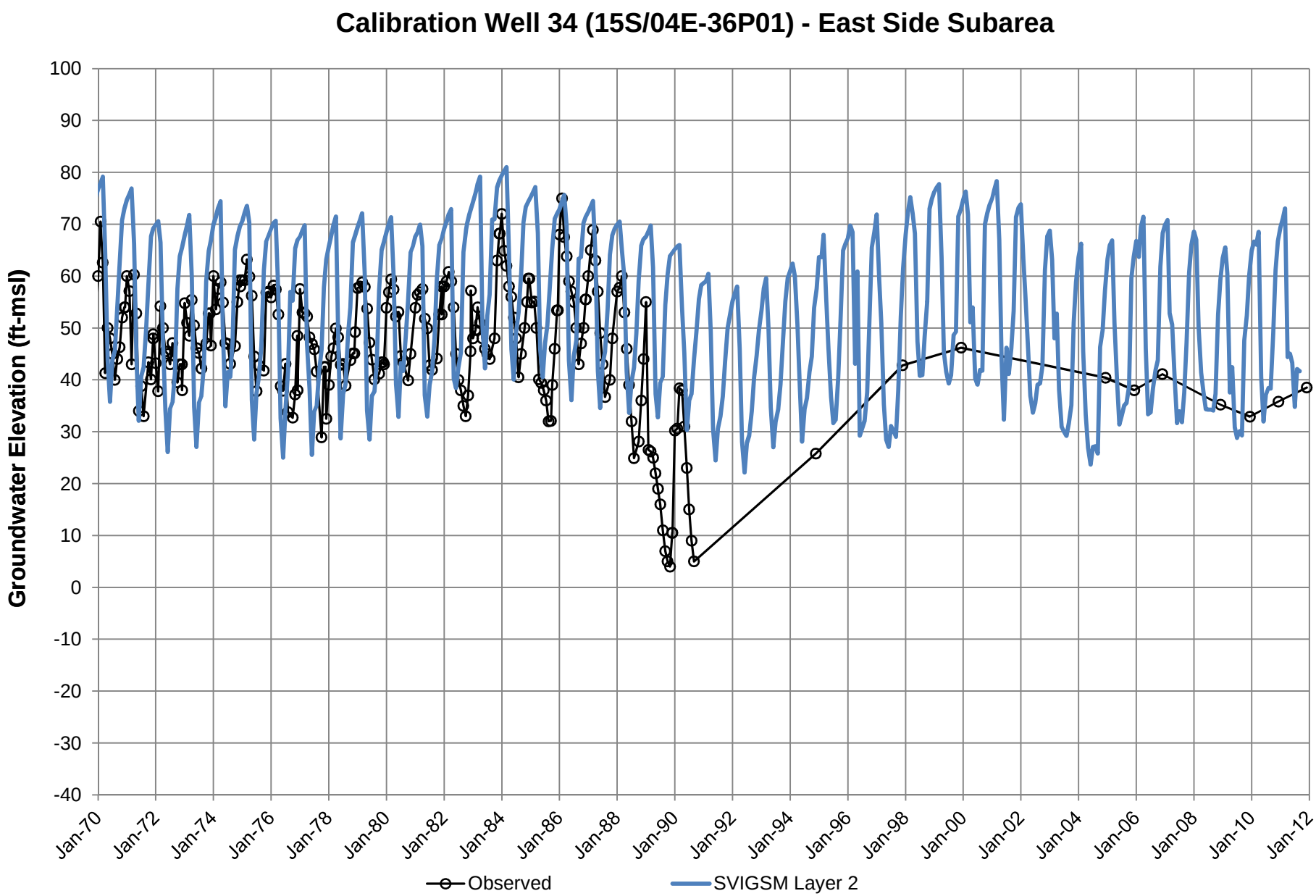

Calibration Well 29 (15S/04E-06R01) - East Side Subarea
Groundwater Elevation (ft-msl)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

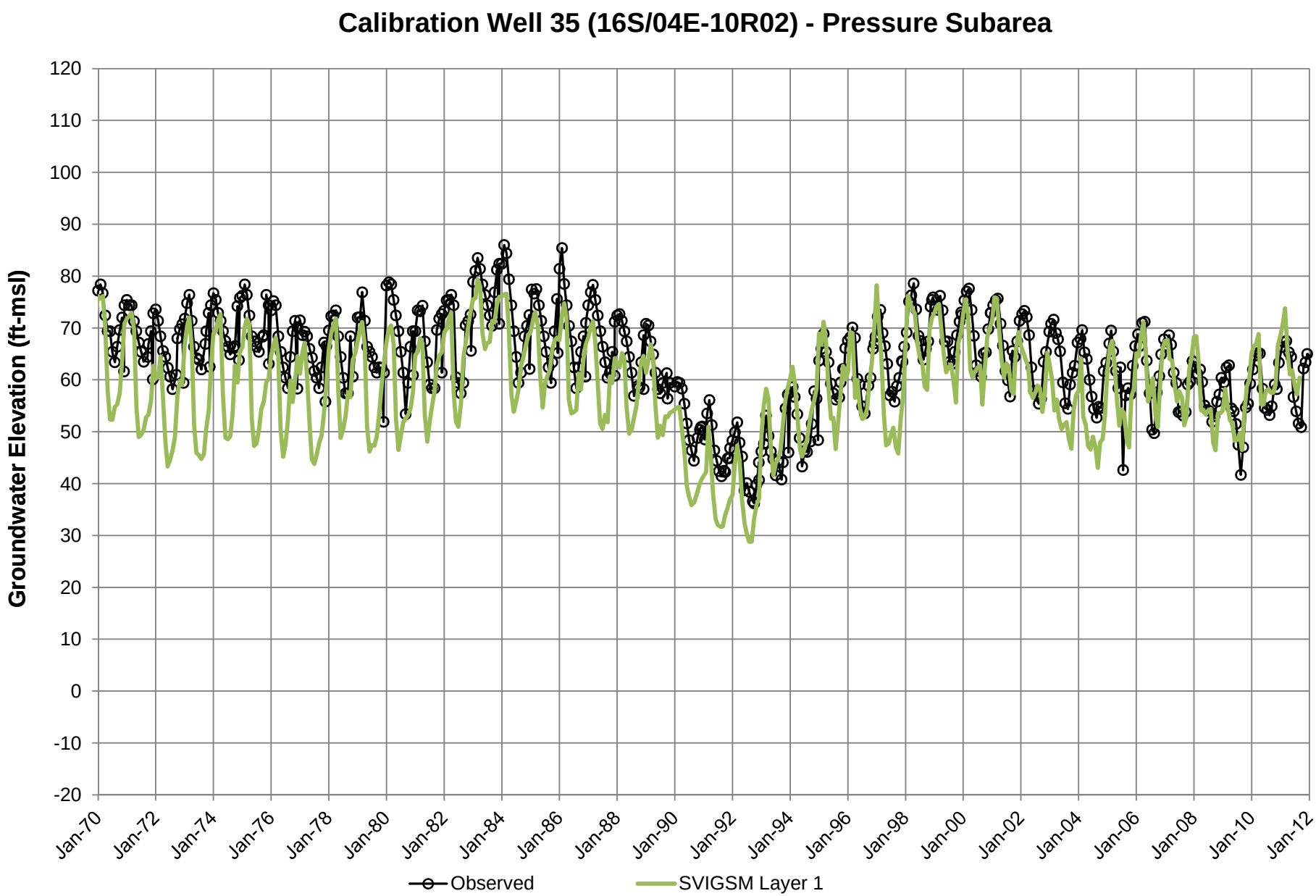

Calibration Well 30 (15S/04E-07R02) - East Side Subarea
Groundwater Elevation (ft-msl)
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 3

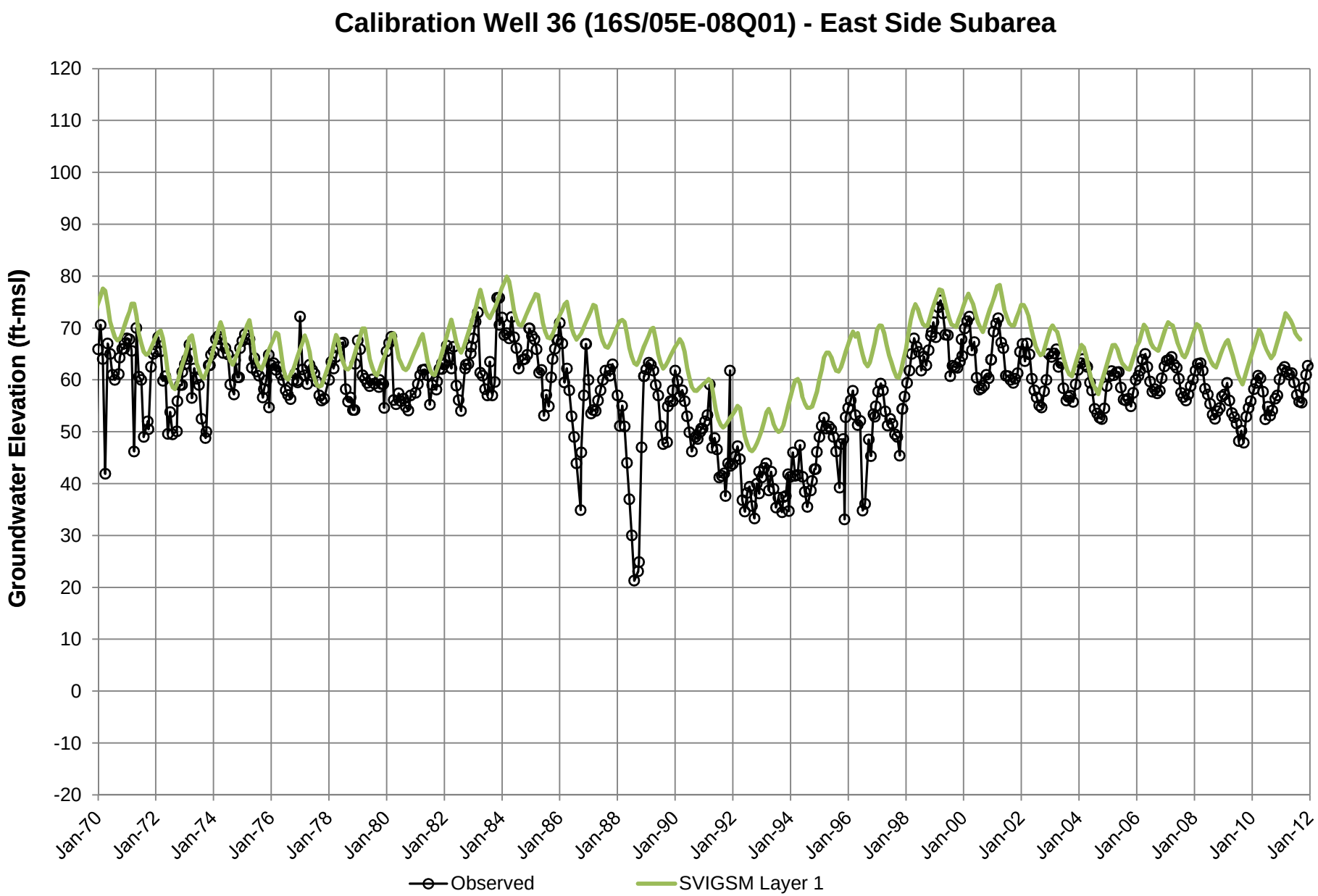

Calibration Well 31 (15S/04E-21L02) - East Side Subarea
Groundwater Elevation (ft-msl)
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 1

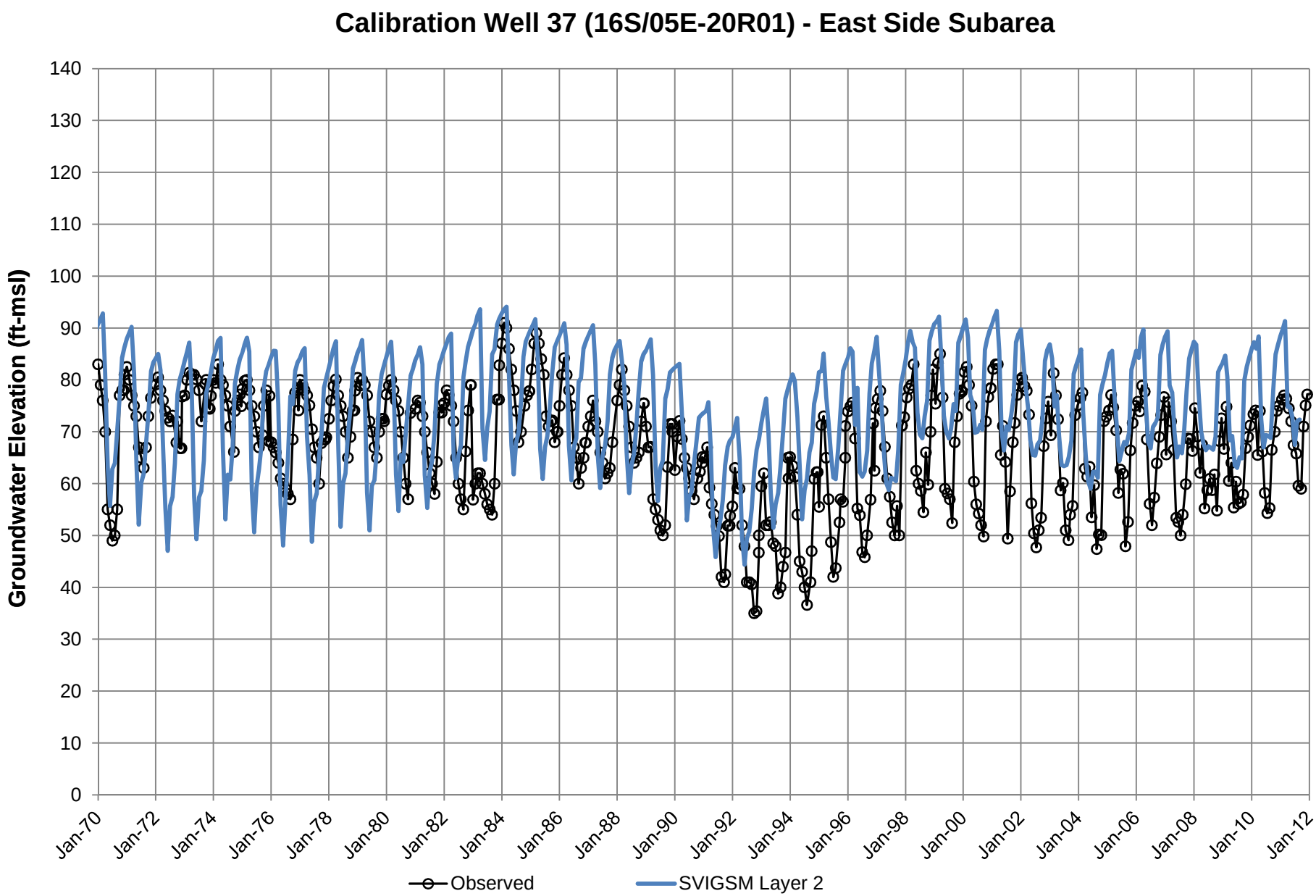

Calibration Well 32 (15S/04E-22L02) - East Side Subarea
Groundwater Elevation (ft-msl)
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

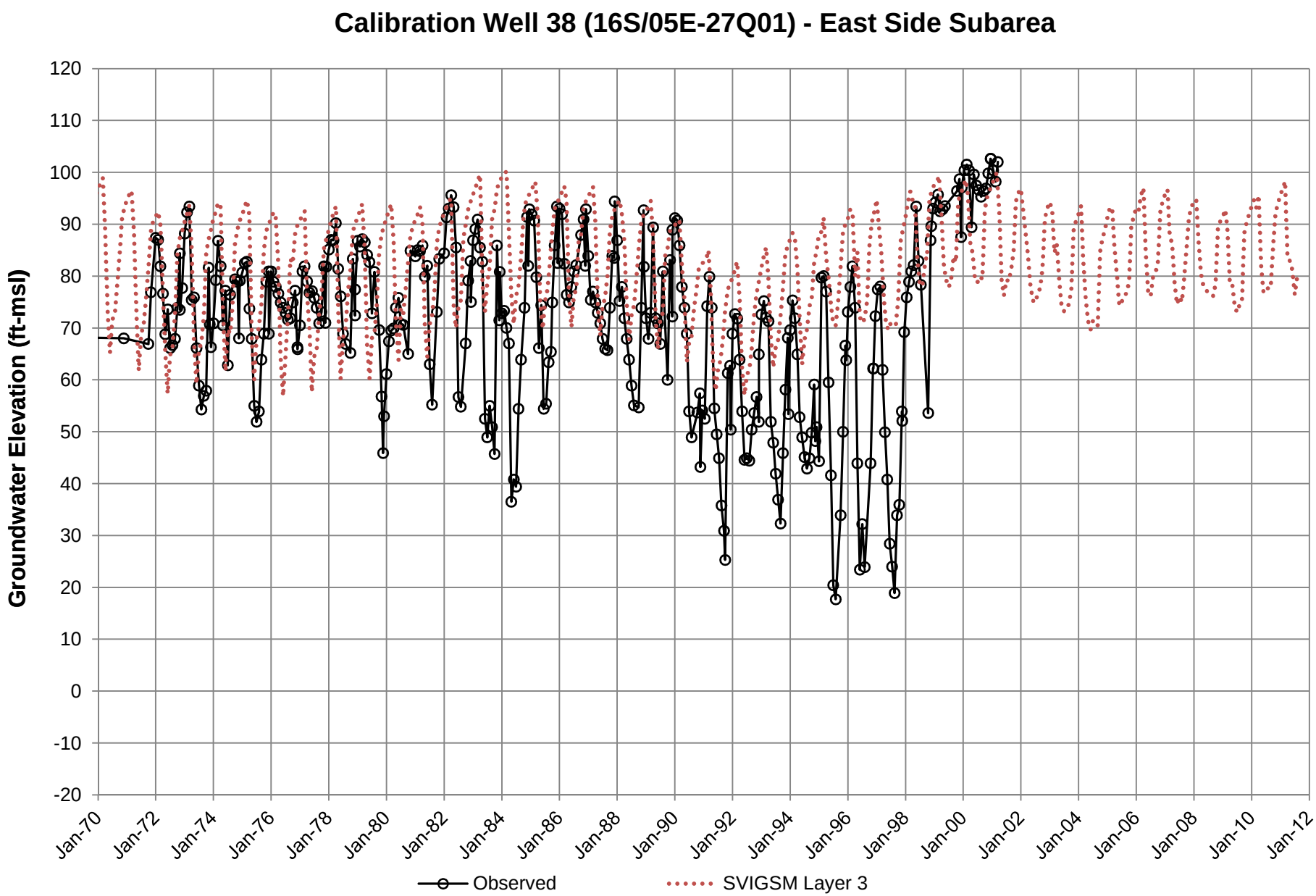

Calibration Well 33 (15S/04E-29Q01) - Pressure Subarea
Groundwater Elevation (ft-msl)
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

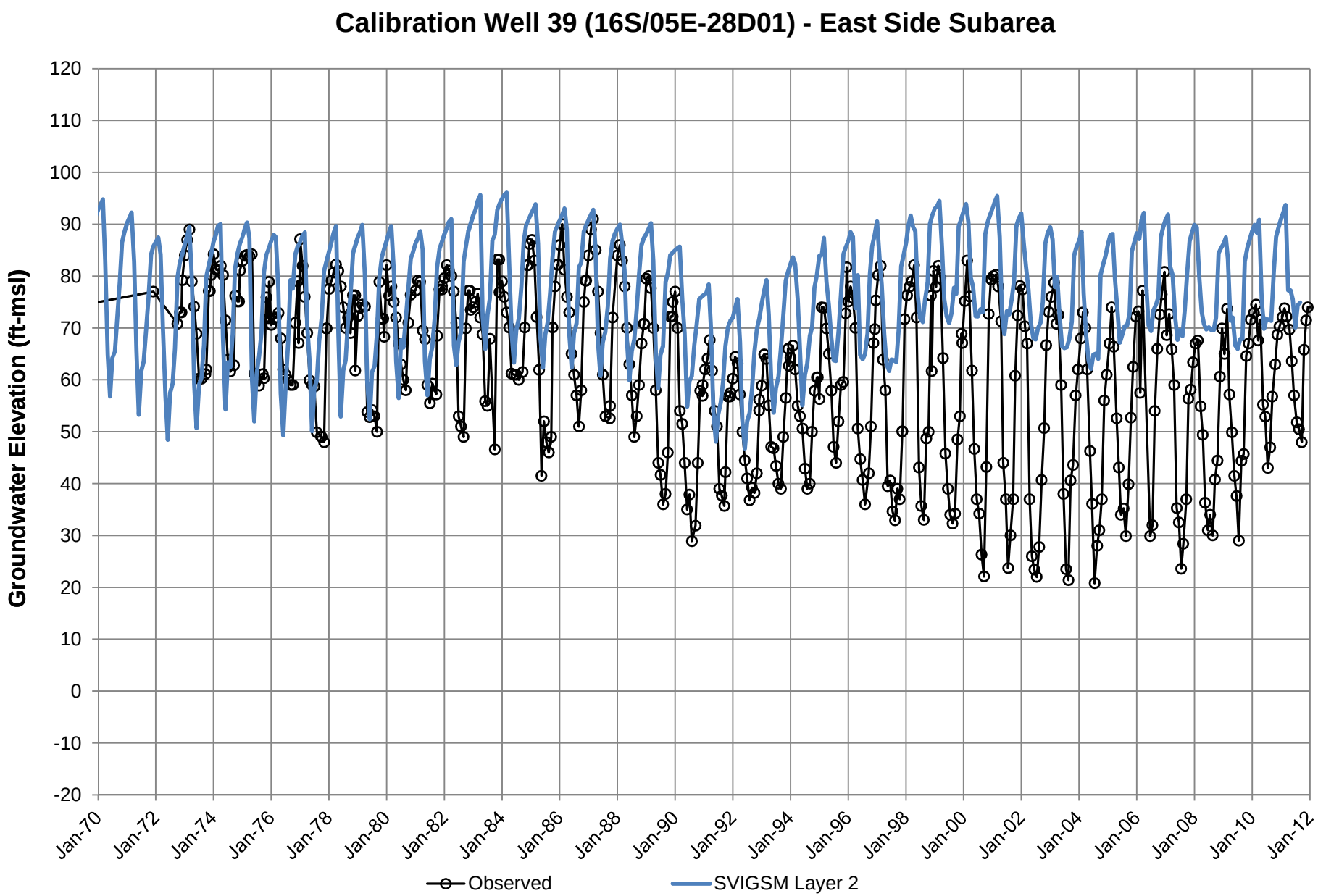

Calibration Well 34 (15S/04E-36P01) - East Side Subarea
Groundwater Elevation (ft-msl)
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

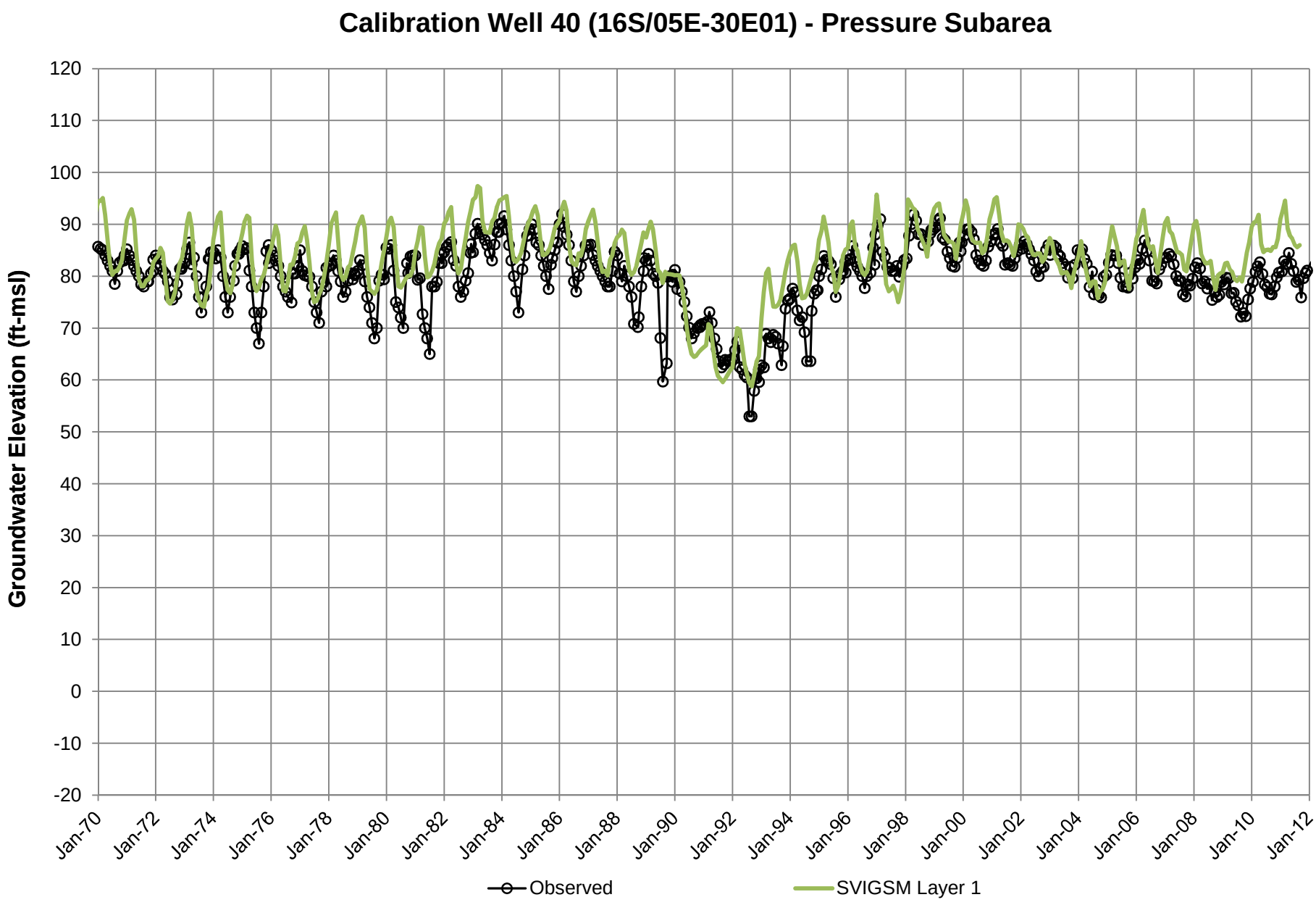

Calibration Well 35 (16S/04E-10R02) - Pressure Subarea
Groundwater Elevation (ft-msl)
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 1


Calibration Well 36 (16S/05E-08Q01) - East Side Subarea
Groundwater Elevation (ft-msl)
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 1


Calibration Well 37 (16S/05E-20R01) - East Side Subarea
Groundwater Elevation (ft-msl)
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

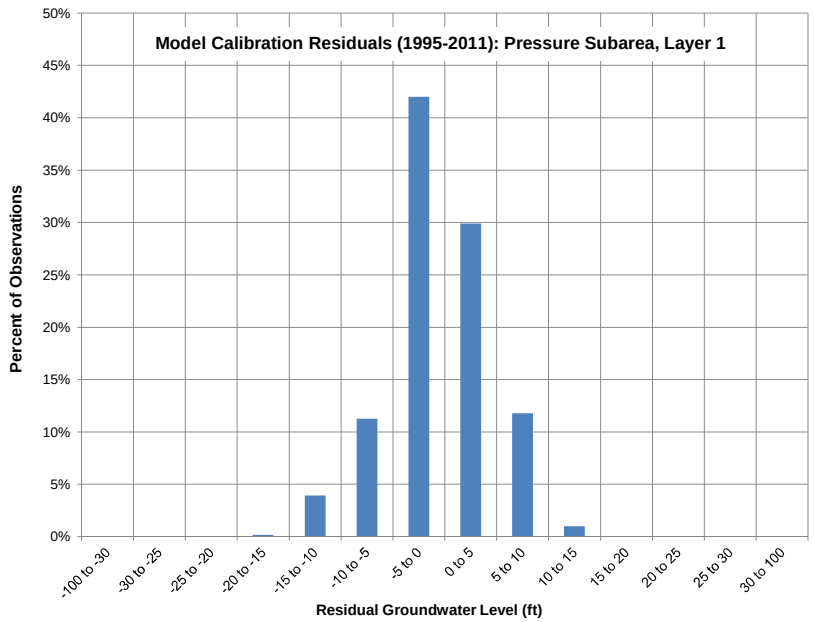

Calibration Well 38 (16S/05E-27Q01) - East Side Subarea
Groundwater Elevation (ft-msl)
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 3

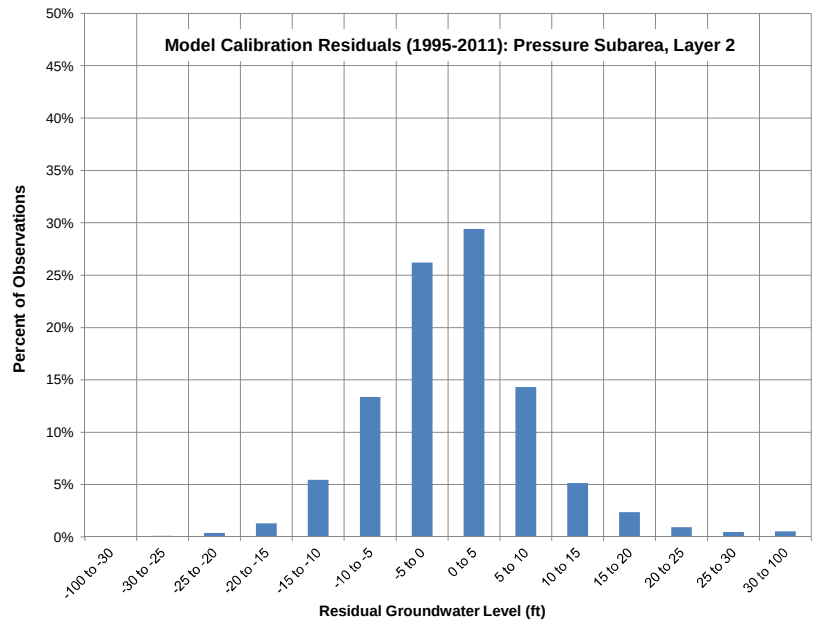

Calibration Well 39 (16S/05E-28D01) - East Side Subarea
Groundwater Elevation (ft-msl)
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 2

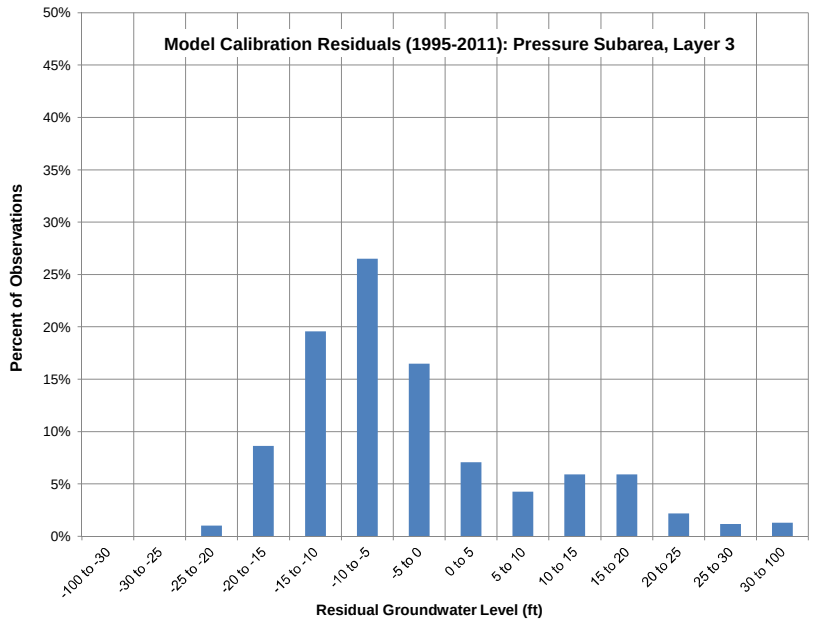

Calibration Well 40 (16S/05E-30E01) - Pressure Subarea
Groundwater Elevation (ft-msl)
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
Jan-70
Jan-72
Jan-74
Jan-76
Jan-78
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04
Jan-06
Jan-08
Jan-10
Jan-12
Observed
SVIGSM Layer 1

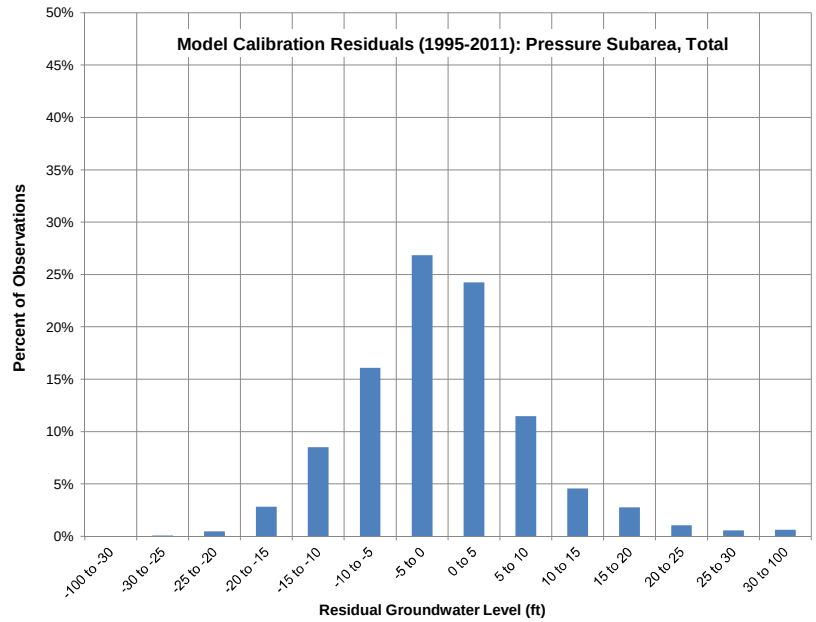
Model Calibration Residuals:

Pressure Subarea Groundwater Level Residual Frequency Distributions


Model Calibration Residuals (1995-2011): Pressure Subarea, Layer 1
Percent of Observations
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
-100 to -30
-30 to -25
-25 to -20
-20 to -15
-15 to -10
-10 to -5
-5 to 0
0 to 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 100
Residual Groundwater Level (ft)

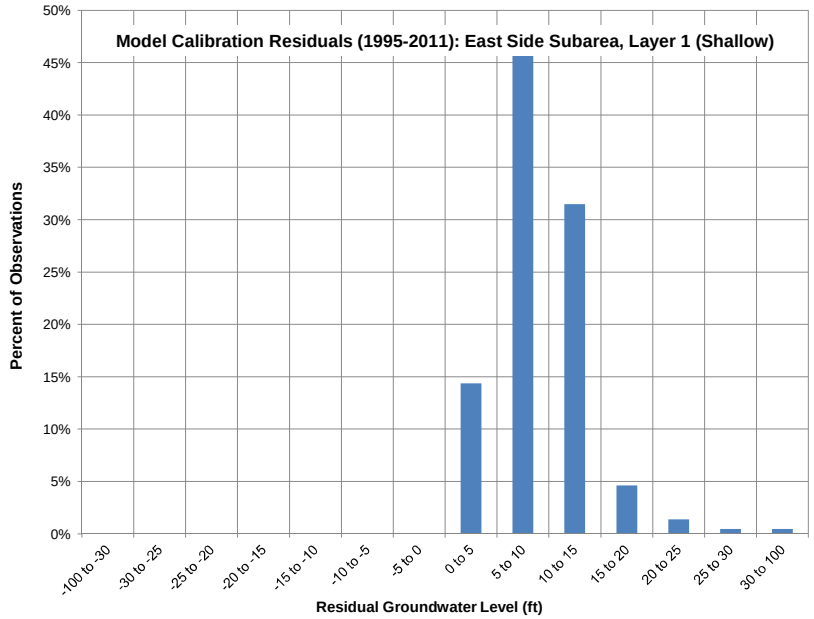

Model Calibration Residuals (1995-2011): Pressure Subarea, Layer 2
Percent of Observations
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
-100 to -30
-30 to -25
-25 to -20
-20 to -15
-15 to -10
-10 to -5
-5 to 0
0 to 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 100
Residual Groundwater Level (ft)

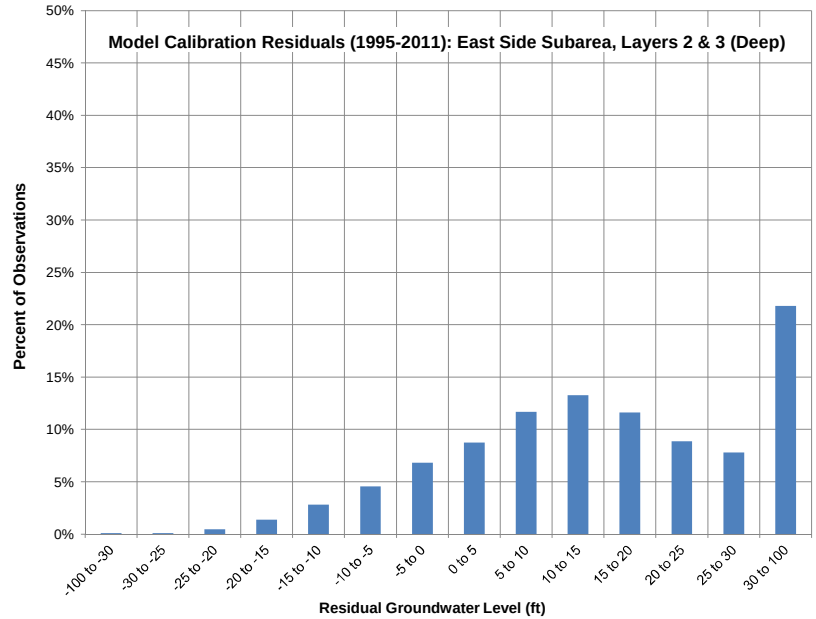

Model Calibration Residuals (1995-2011): Pressure Subarea, Layer 3
Percent of Observations
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
-100 to -30
-30 to -25
-25 to -20
-20 to -15
-15 to -10
-10 to -5
-5 to 0
0 to 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 100
Residual Groundwater Level (ft)

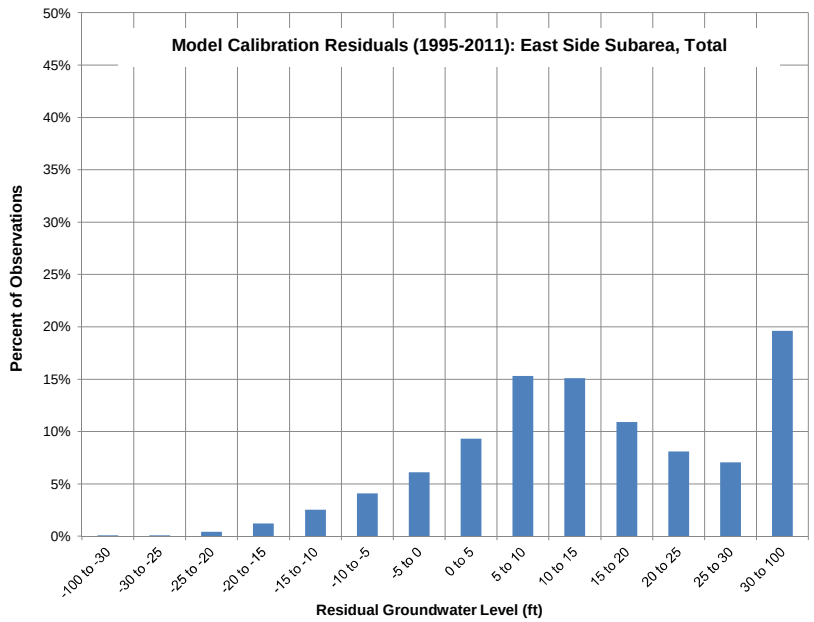

Model Calibration Residuals (1995-2011): Pressure Subarea, Total
Percent of Observations
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
-100 to -30
-30 to -25
-25 to -20
-20 to -15
-15 to -10
-10 to -5
-5 to 0
0 to 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 100
Residual Groundwater Level (ft)

Model Calibration Residuals:

East Side Subarea Groundwater Level Residual Frequency Distributions

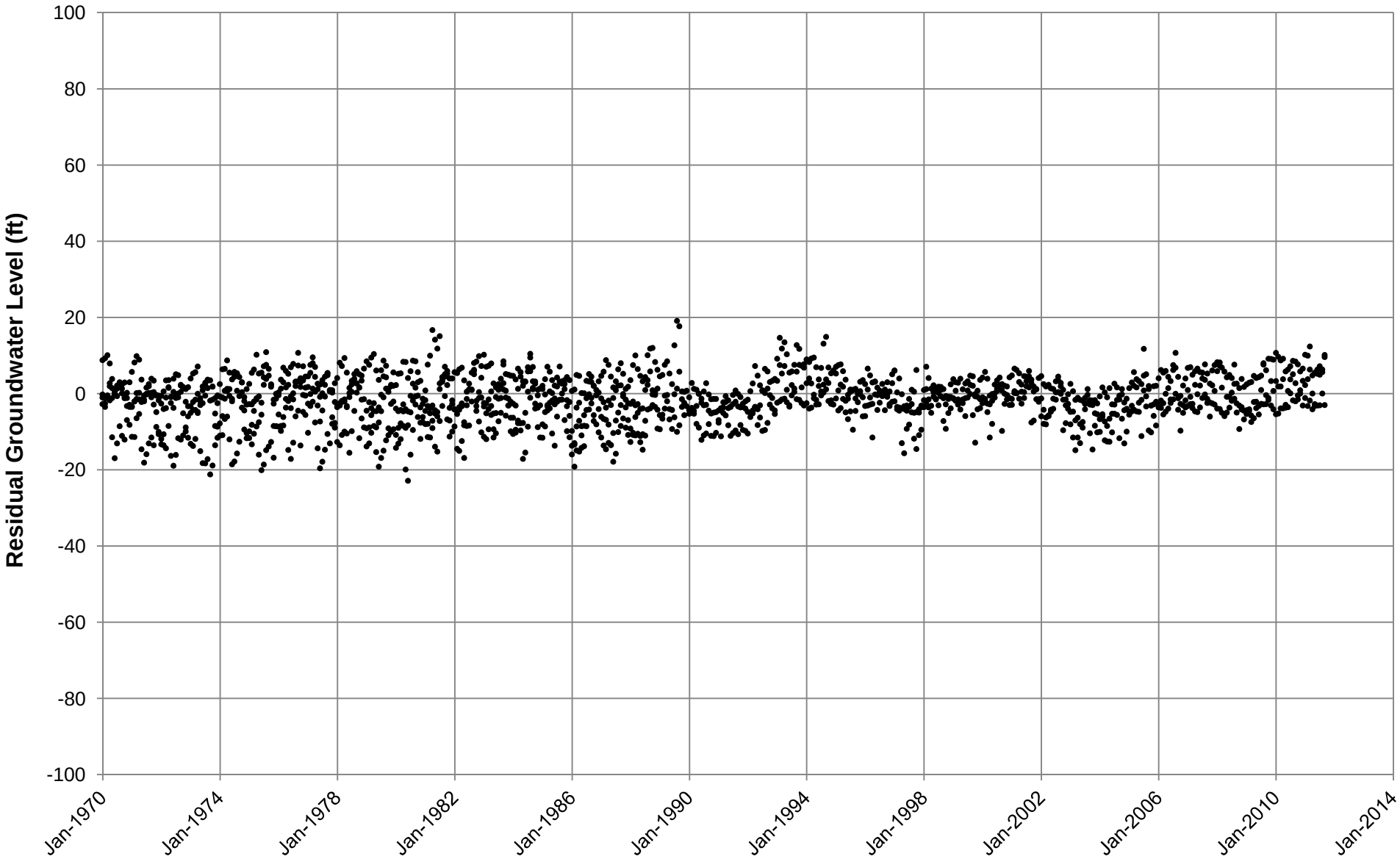

Model Calibration Residuals (1995-2011): East Side Subarea, Layer 1 (Shallow)
Percent of Observations
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
-100 to -30
-30 to -25
-25 to -20
-20 to -15
-15 to -10
-10 to -5
-5 to 0
0 to 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 100
Residual Groundwater Level (ft)


Model Calibration Residuals (1995-2011): East Side Subarea, Layers 2 & 3 (Deep)
Percent of Observations
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
-100 to -30
-30 to -25
-25 to -20
-20 to -15
-15 to -10
-10 to -5
-5 to 0
0 to 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 100
Residual Groundwater Level (ft)


Model Calibration Residuals (1995-2011): East Side Subarea, Total
Percent of Observations
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
-100 to -30
-30 to -25
-25 to -20
-20 to -15
-15 to -10
-10 to -5
-5 to 0
0 to 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 100
Residual Groundwater Level (ft)

Model Calibration Residuals:

Pressure Subarea, Layer 1 Simulated Minus Observed Groundwater Levels



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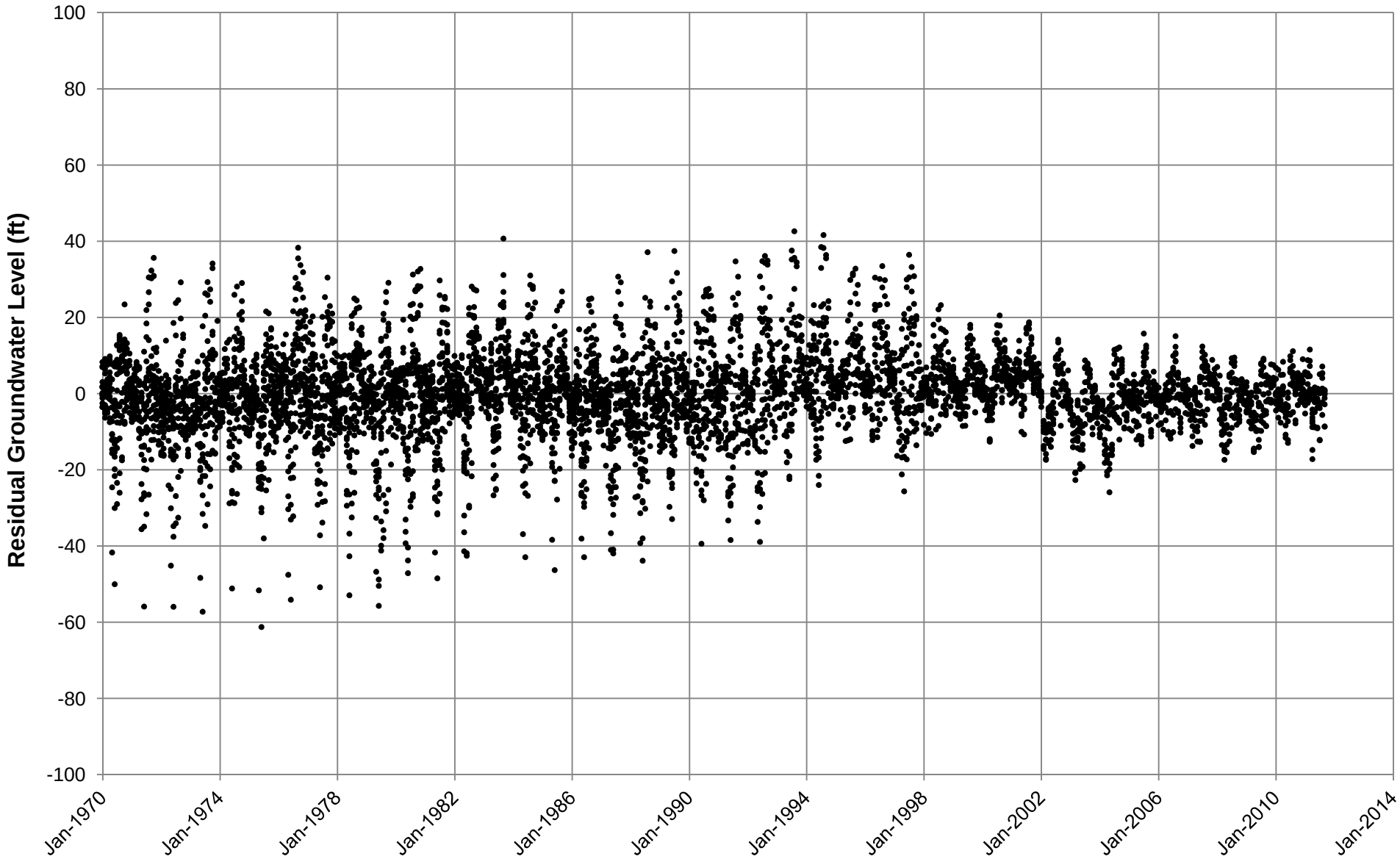
Appendix A

Model Calibration Residuals: Pressure Subarea, Layer 1

Simulated minus Observed Groundwater Levels

Monterey Peninsula Water Supply Project



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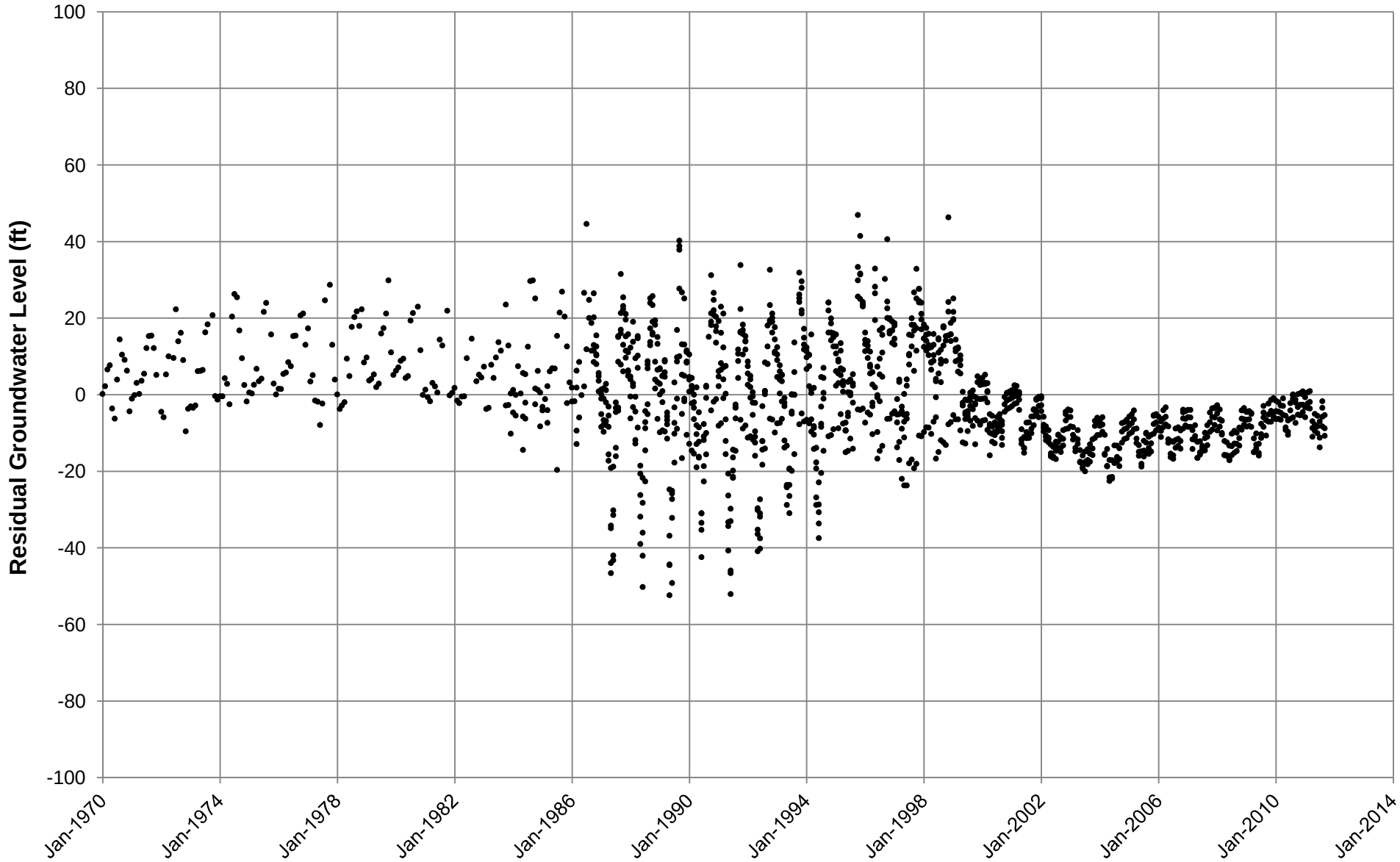
Appendix A

Model Calibration Residuals: Pressure Subarea, Layer 2

Simulated minus Observed Groundwater Levels

Monterey Peninsula Water Supply Project



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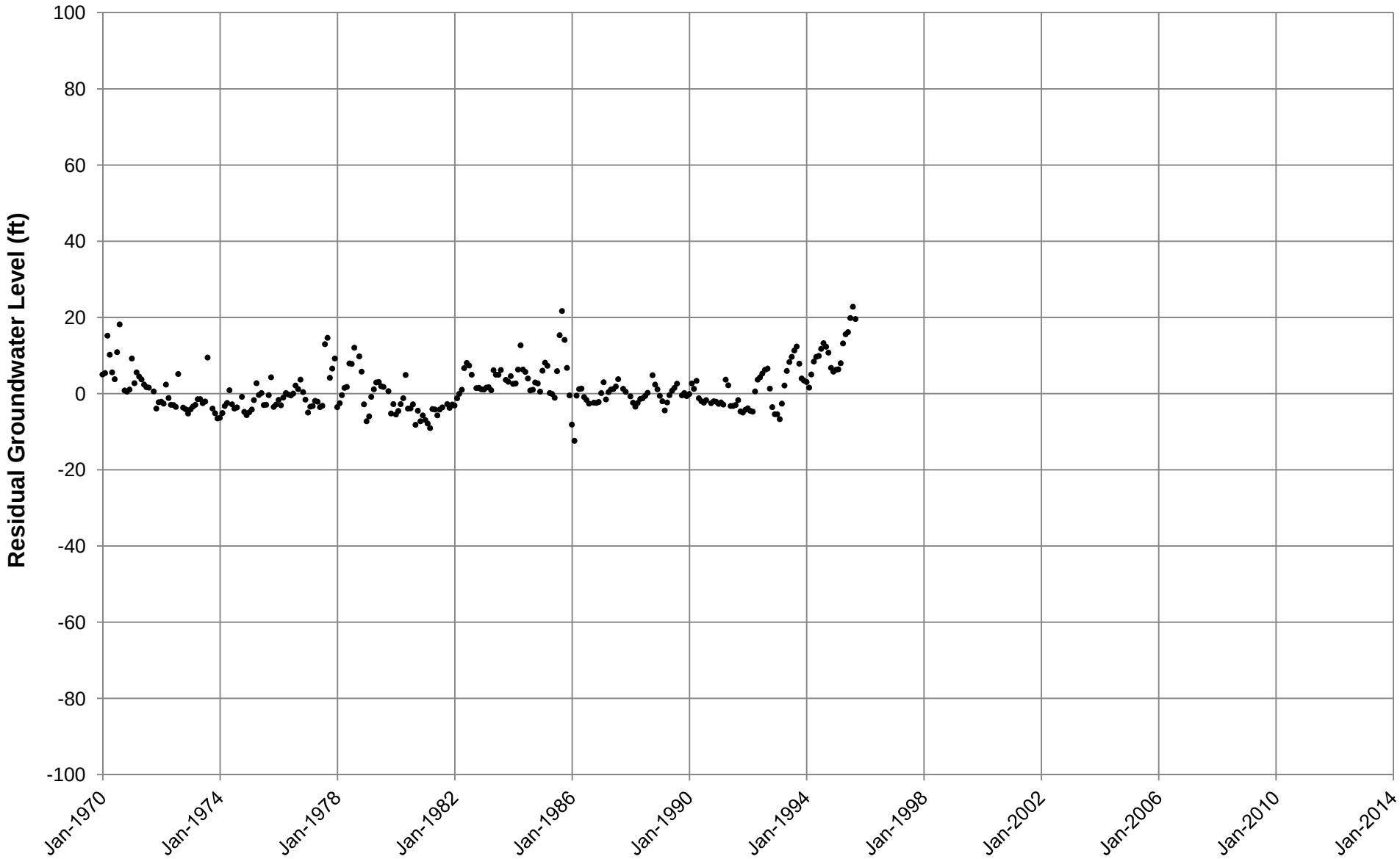
Appendix A

Model Calibration Residuals: Pressure Subarea, Layer 3

Simulated minus Observed Groundwater Levels

Monterey Peninsula Water Supply Project



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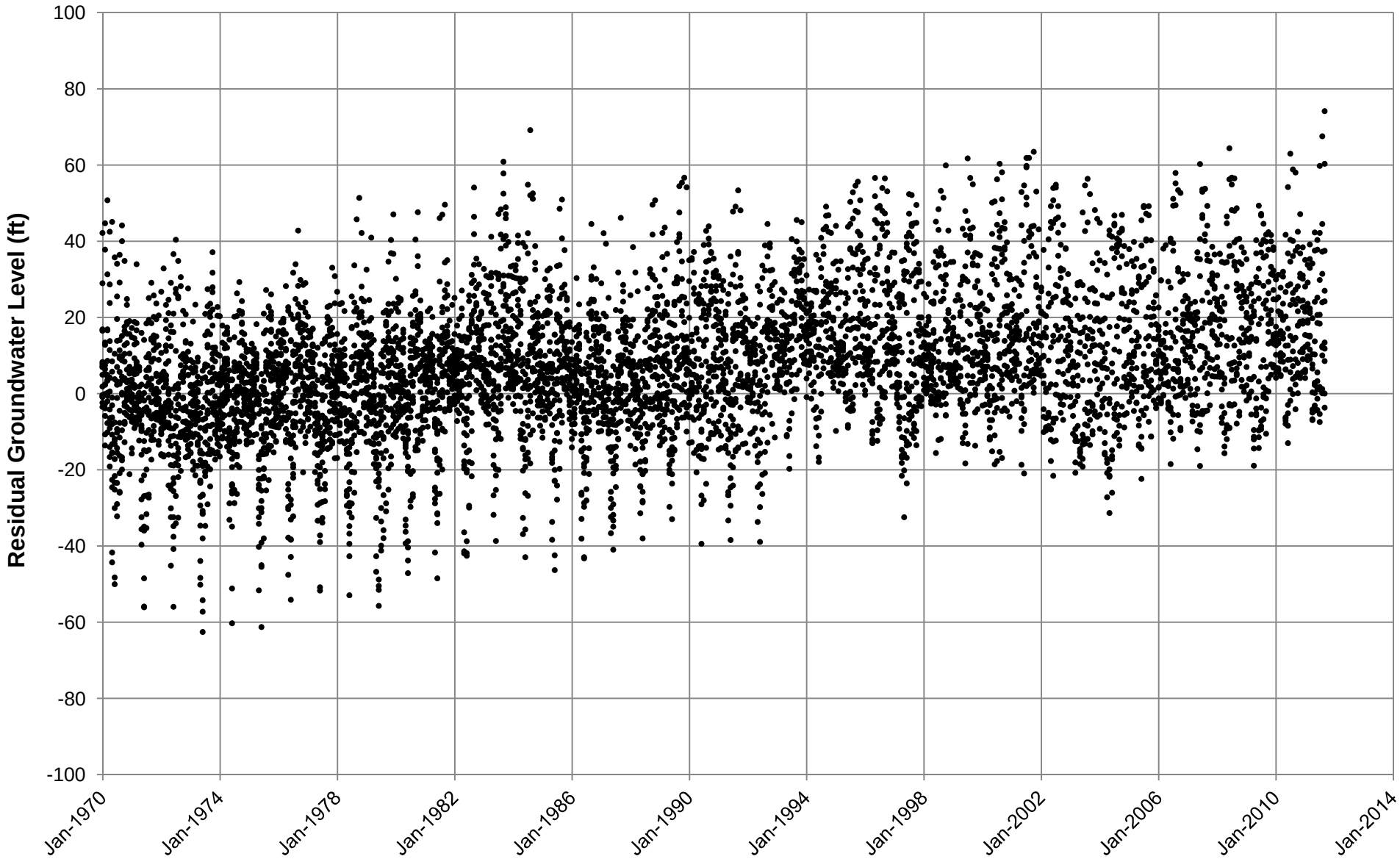
Appendix A

Model Calibration Residuals: East Side Subarea, Layer 1 (Shallow)

Simulated minus Observed Groundwater Levels

Monterey Peninsula Water Supply Project



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Appendix A

Model Calibration Residuals: East Side Subarea, Layers 2 & 3 (Deep)

Simulated minus Observed Groundwater Levels

Monterey Peninsula Water Supply Project

GEOSCIENCE

GEOSCIENCE Support Services, Inc. | P (909) 451-6650 | F (909) 451-6638

620 W. Arrow Highway, Suite 2000, La Verne, CA 91750 | Mailing: P.O. Box 220, Claremont, CA 91711