

4.4 Groundwater Resources

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This section analyzes the potential for the construction and operation of the Monterey Peninsula Water Supply Project (MPWSP or proposed project), which includes 10 slant wells at CEMEX, to adversely impact local and regional groundwater resources. Specifically, this analysis focuses on how the proposed subsurface slant wells and aquifer storage and recovery (ASR) system improvements would change the groundwater aquifers adjacent to the coast further inland beneath the Salinas Valley, and would change the groundwater levels, flow direction, and water quality within the Seaside Groundwater Basin. The analysis is based on project-specific investigations of the various project components, the review of hydrogeologic models prepared for this and other projects, maps and hydrogeologic and geotechnical reports from the California Department of Water Resources (DWR), United States Geological Survey (USGS), and the California Geological Survey (CGS), and the general plans for Monterey County and the local cities.

The CPUC received several comments on groundwater resources during the April 2015 Draft EIR review period. Some comments focused on significance thresholds and the characterization of baseline conditions. Comments addressed the use of computer modeling and requested an explanation of modeling methodology, specifically addressing the return water component and evaluating a zero return water scenario, while other comments addressed alternate methods of returning water to the basin. Certain commenters requested consideration of more extensive aquifer testing. Where relevant, the comments are addressed in this Impacts section. Note that some groundwater resource issues relative to water supply, return water, and the Monterey County Agency Act are addressed in Section 2.6, Water Rights.

4.4.1 Setting/Affected Environment

This section describes the setting for groundwater resources. The groundwater resources study area encompasses the northern portion of the Salinas Valley Groundwater Basin (SVGB) and the Seaside Groundwater Basin (SGB), specifically, the areas that could be affected by the installation and operation of the source water intake system and the ASR system (see **Figure 4.4-1**).

4.4.1.1 Terminology and Concepts

Groundwater is the water beneath the earth's surface, and hydrogeology is the study of how that water interacts with the underlying geologic units of rock and soil. Most groundwater occurs in sand and gravel units that were deposited by water (referred to as alluvium) and later covered by layers of clay, silt, sand, and gravel. Fluvial deposits refer to clay, silt, sand, and gravel that were laid down by rivers and streams as a result of bank erosion, a process in which the materials are transported and redeposited within the river system in the form of bars, points, and floodplains.

Coarse materials such as sand and gravel hold the most groundwater when saturated and are referred to as aquifers. Layers of finer-grained materials such as clay and silt restrict, but do not prevent, the flow of groundwater and are called aquitards. Aquifers can extend over many square miles and are called basins.

A groundwater basin is an aquifer or a stacked series of aquifers with reasonably well-defined boundaries in a lateral direction and a definable bottom. California's groundwater basins typically include one aquifer or a series of aquifers with intermingled aquitards. In general, groundwater basin boundaries are determined by physical attributes such as the lateral extent of aquifers, obstacles to flow such as bedrock, and groundwater divides. A divide is defined by a line on either side of which groundwater moves in opposite directions. A groundwater divide, similar to a surface water divide, separates distinct groundwater flow regions within an aquifer.

Depending on the type of geologic unit overlying a water-bearing zone, groundwater can be unconfined or confined. The water table in an unconfined aquifer does not have an impermeable aquitard lying over it, and thus pressure is exerted by the overlying water and the atmosphere. Groundwater under these unconfined conditions flows from areas of high groundwater elevation to areas of low groundwater elevation. Under confined conditions, vertical flow from or to the

aquifer is restricted by overlying aquitards. Groundwater under confined conditions flows from areas of high pressure to areas of low pressure and is influenced by the pressure, weight, and confining nature of the overlying sediments; water entering the aquifers from areas of recharge; and water leaving the aquifers through natural discharge or through the pumping of supply wells. When a well penetrating a confined aquifer is pumped, internal aquifer pressure is reduced, which can in turn increase the flow of water towards the well.

4.4.1.2 Local and Regional Hydrogeology

This chapter's description of the groundwater system underlying the project area reflects the scientific community's current understanding of the subsurface geologic units and the depth and extent of the aquifers and aquitards.

Hydrogeology Working Group

This comprehensive description of the groundwater system was developed through the collaborative efforts of recognized experts in Monterey Bay coastal geology and groundwater, as well as stakeholders in the groundwater use and management process who are familiar with this region. This body of expertise is the Hydrogeology Working Group (HWG), with members that represent the Salinas Valley Water Coalition, the Monterey County Farm Bureau, California American Water Company (CalAm); the CPUC/MBNMS CEQA/NEPA team members attend the meetings.¹ To identify the area's hydrology, the HWG relied on previous groundwater studies, published geologic maps, observation of well performance, water quality data, and findings from site-specific subsurface investigations and modeling. The data review and eventual formulation of an evidence- and science-based understanding of the local and regional hydrogeology required several years. So, to enable analysis of the impacts of the proposed project, this EIR/EIS presents the best information available for describing the hydrogeologic setting of the study area.

The following sections describe the groundwater basins, the aquifers and aquitard contained within those basins, and the groundwater system underlying the seawater intake system and the ASR system.

Salinas Valley Groundwater Basin

The Salinas Valley lies within the southern Coast Ranges, between the San Joaquin Valley and the Pacific Ocean, and is drained by the Salinas River. Extending approximately 150 miles from the La Panza Range north-northwest to its mouth at Monterey Bay, the valley is bound on the west by the Santa Lucia Range and Sierra de Salinas, and on the east by the Gabilan and Diablo

¹ The HWG developed a collaborative plan of investigation to assess the hydrogeologic conditions in the project area. The draft work plan provided a phased approach to progressively investigate the hydrogeology and the potential effects of the project on aquifers from the use of subsurface slant wells for obtaining feedwater supply. The final work plan incorporated comments and recommendations by members of the HWG, and covered the investigative steps needed to evaluate the project impacts (Geoscience, 2013c). The final work plan became the hydrogeology investigation roadmap and resulted in the implementation of the fieldwork and modeling efforts described in the approach to analysis, Section 4.4.3.2.

Ranges. The 560 square mile Salinas Valley Groundwater Basin (SVGB)² underlies the Salinas Valley (MCWRA, 2006). The Monterey Bay acts as the northwestern boundary of the SVGB (Brown and Caldwell, 2015). The SVGB contains 10,000 to 15,000-foot deep deposits of marine and terrestrial clay, sand, silt, and gravel as old as 65 million years (DWR, 2004a). The proposed project components associated with groundwater extraction would be located primarily within the 84,400 acre, 132 square mile subarea of the SVGB known as the 180/400 Foot Aquifer Subbasin (DWR, 2004a).³ The 180/400 Foot Aquifer Subbasin boundaries generally coincide with those of the SVGB Pressure Area (or Subbasin) traditionally recognized by the Monterey County Water Resources Agency (MCWRA) and California Department of Water Resources. The hydrologic boundaries of the Pressure Area are the Elkhorn Slough to the north, the East Side Area to the east, the Seaside Basin to the south, and the Pacific Ocean to the west. The precise locations of these boundaries fluctuate depending on seasonal variations, longer-term climate changes and local groundwater pumping. The boundaries and names of the basins have been updated to reflect the currently available information, as shown on **Figure 4.4-1**. This figure illustrates the updated basin boundaries in the western part of the SVGB, which were used in the modeling for the proposed project (HydroFocus, 2016). In this EIR/EIS, the primary area of study within the SVGB is within the Pressure Area.

Pressure Area Aquifers and Aquitards

Water-bearing geologic formations present within the Pressure Area include: Quaternary Alluvium (including the Dune Sands and Terrace Deposits), Aromas Sand, Paso Robles Formation, Purisima Formation, Santa Margarita Sandstone, and Monterey Formation. Not all geologic units are present in all areas. Section 4.2, Geology, Soils and Seismicity, provides a detailed description of these geologic units and **Table 4.4-1**, below, summarizes the characteristics as they relate to groundwater storage.

The Pressure Area is made up of distinct aquifers and aquitards that in some cases extend across several underlying geologic formations and collectively form the groundwater system within the subbasin. **Figure 4.4-2**, a north-to-south graphic representation of the hydrogeologic setting, shows the spatial relationships of the aquifers along the coast from Moss Landing to south of the CEMEX site. As shown, the Pressure Area consists of a series of aquifers at varying depths, which in some locations are separated by laterally extensive aquitards. The Pressure Area includes three prominent water supply aquifers and two, less notable, shallower aquifers. The primary aquifers, named for the average depth at which they occur, are the 180-Foot Aquifer, the 400-Foot Aquifer, and the 900-Foot (Deep) Aquifer, (Kennedy/Jenks, 2004; Geoscience, 2008). The primary aquifers and aquitards in the Pressure Area are discussed in detail below.

² The Salinas Valley Groundwater Basin is also referred to as the Salinas River Groundwater Basin.

³ The 180/400-Foot Aquifer subbasin includes three water bearing units, the 180-Foot, the 400-Foot, and the 900-Foot Aquifers, named for the average depth of each aquifer (USGS, 2011).

**TABLE 4.4-1
SUMMARIZED CHARACTERISTICS OF WATER BEARING GEOLOGIC UNITS**

| Geologic Unit (Listed youngest to oldest) | Geologic and Groundwater Storage Characteristics |
|--|--|
| Quaternary Alluvium | The Younger and Older Dune Sands. Younger, sparsely vegetated, active dunes are present along the coastline. Older dune deposits with more established vegetation are present inland. Shallow groundwater is not expected within the elevated dune deposits, except in localized low-lying areas along the coastline. |
| Terrace Deposits | Former alluvial fan and river floodplain deposits — which may also include marine terrace deposits — that generally consist of sand with some gravels. Terrace deposits at the CEMEX mining facility range from 150 to 163 feet in thickness. |
| Aromas Sand | Both older river deposits and younger windblown deposits of unconsolidated, brown to red sands with interbeds of clay and poorly sorted gravels. |
| Paso Robles Formation | Series of fine-grained, oxidized sand and silt beds that contain gravel beds interbedded with some calcareous beds. The formation is inter-fingered with the lower portion of the Aromas Sand and the upper portion of the Purisima Formation. The Paso Robles Formation is present at depths ranging from less than 100 feet to 600 feet in the northern portion of the project area. |
| Purisima Formation | Layered sand, silt, clay, shale, and some gravel deposited in near-shore and far-shore marine environments. The basal, or lowermost, unit of the Purisima Formation consists of relatively impermeable clay and shale. |
| Santa Margarita Formation | Marine, coarse-grained sandstone that overlies the Monterey Formation. Relatively small pieces of this unit are present beneath the project area in the Seaside vicinity at depths of about 800 feet deep just north of the Ord Terrace Fault and about 500 feet below the ground surface in between the Ord Terrace and Seaside Faults. |
| Monterey Formation | Marine sedimentary unit generally consisting of siliceous and diatomaceous interbedded layers of mudstone, siltstone, sandstone, and claystone. Seams of the expandable clay bentonite are also present. |

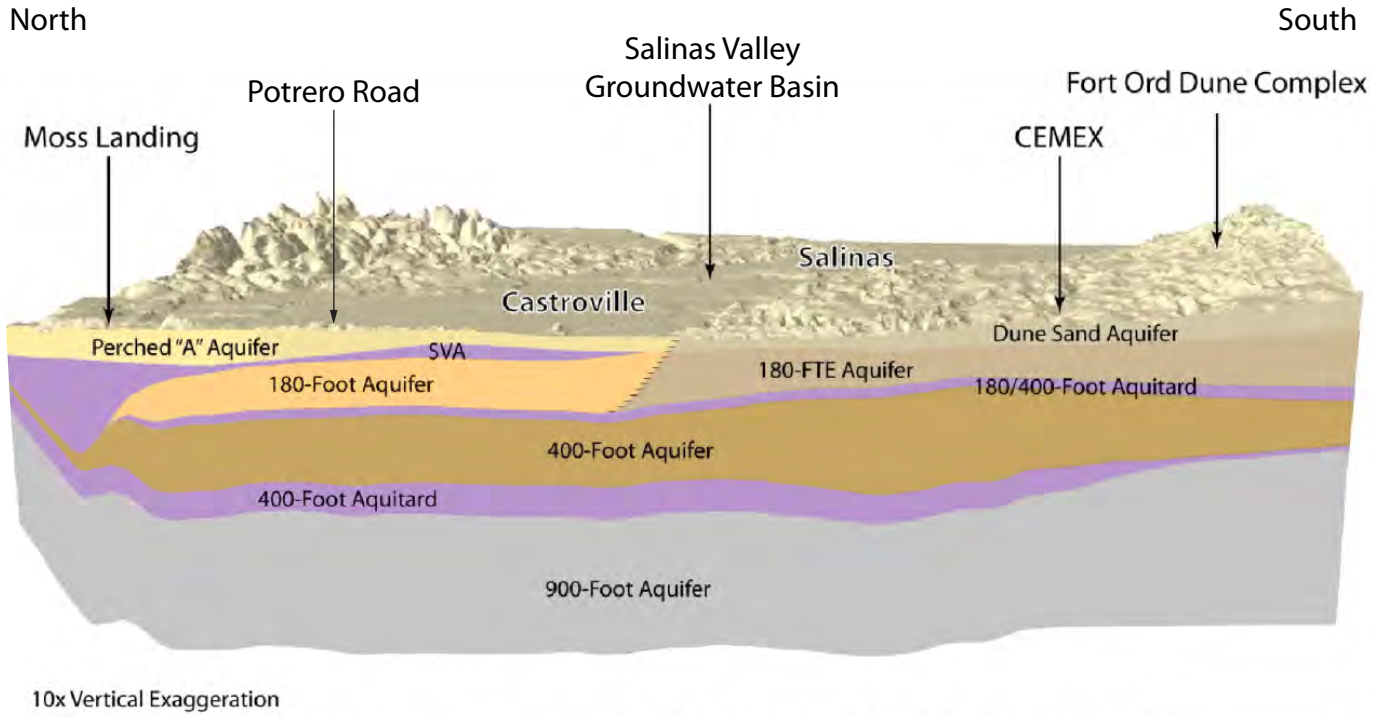
SOURCE: Geoscience, 2016b

Dune Sand Deposits and the Dune Sand Aquifer

Shallow groundwater is present in the Pressure Area and occurs in saturated sand dune deposits above low-permeability clay units such as the Salinas Valley Aquitard where present, or directly above the 180-Foot Aquifer or 180-FTE Aquifer. The shallow groundwater is in the coastal Dune Sand units or in scattered, thin, discontinuous sandy layers both at the coast and inland. Shallow groundwater is not expected to occur within much of the upper, younger Holocene-age⁴ Dune Sand deposits, except in localized low-lying areas along the coastline. There is groundwater within the underlying Pleistocene-age⁵ Older Dune Sand, which extends offshore beneath the ocean and up to 4 miles inland. The Older Dune Sand, referred to as the Dune Sand Aquifer, extends to 85 to 95 feet below the ground surface beneath the CEMEX site and is about 60 feet thick at the locations of the proposed slant wells. The shallow aquifer underlying the Moss Landing Area is referred to as the Perched A Aquifer and differs from the Dune Sand Aquifer in that it is underlain by a defined layer of less permeable, fine-grained sediments known as the Salinas Valley Aquitard. Water quality of the Perched A Aquifer and Dune Sand Aquifer is directly influenced and controlled by seawater. Because of the aquifer's proximity to the ocean,

⁴ Holocene time is from the present to 11,000 years ago.

⁵ Pleistocene time was from 11,000 to 1.6 million years ago.



SOURCE: Adapted from HydroMetric, 2009a

205335.01 Monterey Peninsula Water Supply Project

Figure 4.4-2
Conceptual Model of Coastal Aquifers

most of the water in the Dune Sand Aquifer has been intruded by seawater and is considered saline to brackish (Kennedy/Jenks, 2004).⁶ This influence decreases inland where the infiltration of precipitation and applied agricultural water has more of an influence. **Figure 4.4-3** presents a west to east geologic cross section that illustrates the relationship of the aquifers and geologic units from the CEMEX area to east of Highway 1 and Del Monte Boulevard. The upper portions of the proposed slant wells at the CEMEX site would have well screens installed across them, and would draw water from these deposits.

Salinas Valley Aquitard

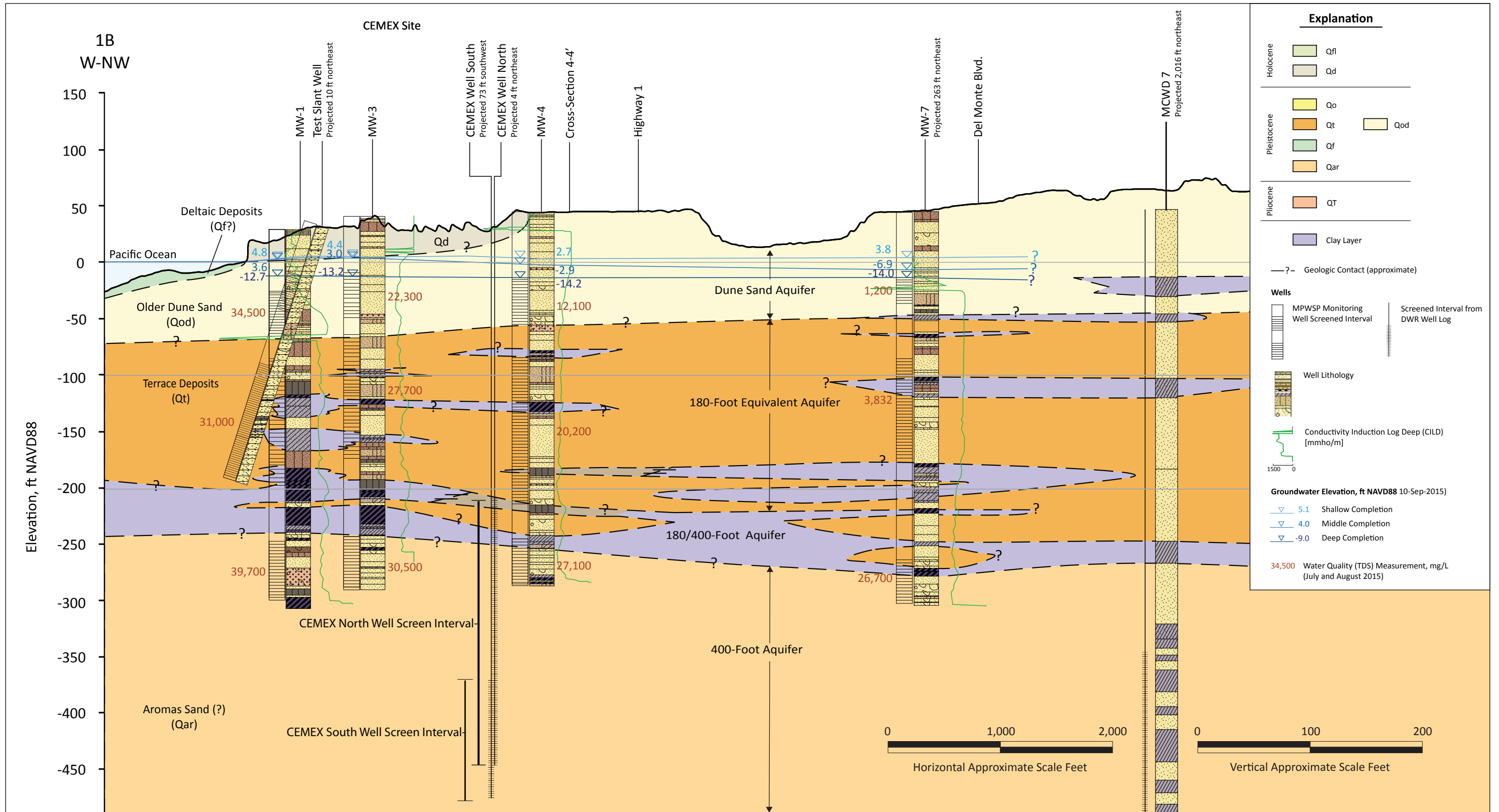
The Salinas Valley Aquitard is a blue or yellow sandy clay formation up to 100 to 150 feet thick that lies mostly north of and generally parallel to the northwest-flowing Salinas River (MCWRA, 2006; Kennedy/Jenks, 2004; Durbin et al., 1978; Geoscience, 2013a). **Figure 4.4-4** shows the extent and thickness of the Salinas Valley Aquitard updated with information provided through the subsurface exploratory program completed at the proposed slant wells site on the CEMEX mining property. The Salinas Valley Aquitard thins and becomes discontinuous away from the centerline of the unit and at the Pacific Ocean, and was not observed in the exploratory borings at the CEMEX site. Consequently, the Dune Sand Aquifer deposits lie directly on top of Terrace Deposits and are thought to be hydraulically connected to the underlying aquifer. The absence or discontinuous nature of the Salinas Valley Aquitard near the proposed slant wells results in unconfined conditions for in the Dune Sand deposits. Elsewhere, the Salinas Valley Aquitard, where present, overlies the 180-Foot Aquifer, creating confined to semi-confined conditions for the underlying aquifers.

180-Foot Aquifer and 180-FTE Aquifer

The location of the 180-Foot Aquifer within the Salinas Valley is variable and extends across more than one stratigraphic or geologic unit. Various interpretations have correlated the aquifer to different combinations of stratigraphic units depending on the investigator, the area under study, and the investigator's interpretation. Consistent with the hydrogeologic understanding developed to support the impact analysis in this EIR/EIS, the 180-Foot Aquifer has been correlated with the lower portions of the Quaternary Alluvium and the upper portions of the Aromas Sand (DWR, 2004a; Geoscience, 2008, 2013a). The lenticular (lens-shaped) sand and gravel bodies that make up the 180-Foot Aquifer indicate that they were originally deposited in a river, where the more laterally extensive units represent river channels that migrated and shifted over time (Kennedy/Jenks, 2004). The 180-Foot Aquifer has been geophysically mapped into the Monterey Bay where the unit is open to the ocean for several miles offshore (Greene, 1970; Eittreim et al., 2000).

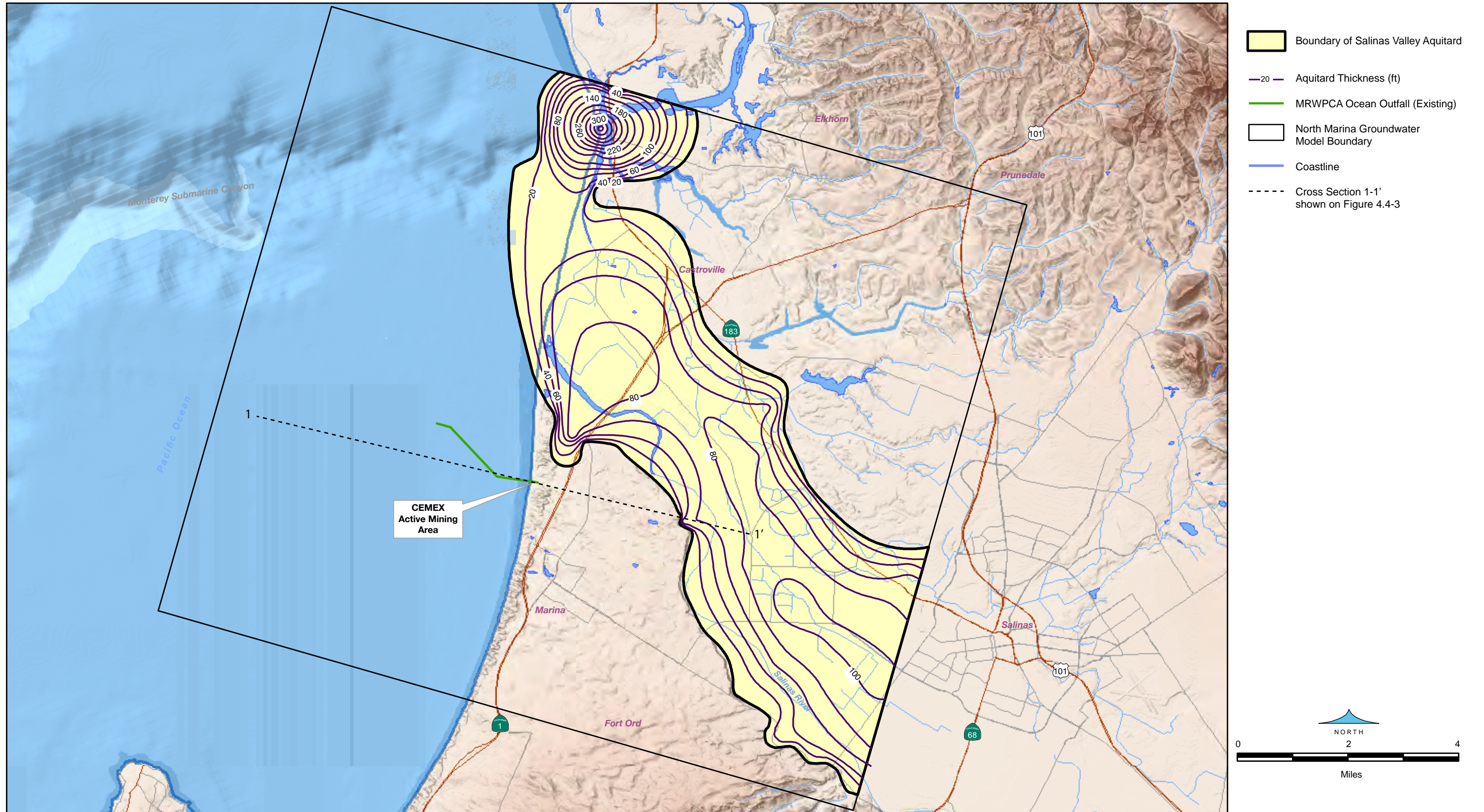
The Dune Sand Aquifer lies directly on top of the Terrace Deposits in the area along the coast with no confining layer to separate them. Based on the investigative work to correlate the hydrogeologic units of the Pressure Area, these Terrace Deposits along the coast appear to be at the same depth, and have similar geologic characteristics, as the inland Quaternary Alluvium of

⁶ Saline water is water that has the approximate salinity of seawater, while brackish water is more saline than fresh water, but not as saline as seawater.



SOURCE: Geoscience, 2016

205335.01 Monterey Peninsula Water Supply Project
Figure 4.4-3
 Project Area Hydrogeologic Cross Section



- Boundary of Salinas Valley Aquitard
- 20 Aquitard Thickness (ft)
- MRWPCA Ocean Outfall (Existing)
- North Marina Groundwater Model Boundary
- Coastline
- Cross Section 1-1' shown on Figure 4.4-3

SOURCE: Geoscience, 2015c

205335.01 Monterey Peninsula Water Supply Project

Figure 4.4-4
Thickness of Salinas Valley Aquitard

the 180-Foot Aquifer in the Salinas Valley (see **Figure 4.4-3**). Even though the Terrace Deposits are older than and lithologically different from the inland deposits of the 180-Foot Aquifer, the units are at the same depth interval, and groundwater likely flows from one unit to the next. **Figure 4.4-2** identifies a “180-FTE Aquifer,” which is shorthand for the 180-Foot Equivalent Aquifer; this chapter refers to it by its shorthand form. This unit is composed of terrace deposits that underwent a different depositional process than the inland 180-Foot Aquifer. However, the unit is at the same depth interval and is considered to be connected and equivalent to the 180-Foot Aquifer. Therefore, considering the level to which these units correlate, and to maintain consistency with the nomenclature used in this region, the aquifer interval is referred to as the 180-FTE Aquifer. At the CEMEX site, the Dune Sand Aquifer and the 180-FTE Aquifer are unconfined, as there are no extensive overlying low-permeability clay units.

The Terrace Deposits of the 180-FTE Aquifer are composed of former alluvial fan and river floodplain deposits, possibly with some marine terrace deposits that contain sand, silt, and gravel now buried under the coastal dunes. There is groundwater within the Terrace Deposits, which extend to 240 to 255 feet below the ground surface beneath the CEMEX site, and are about 135 feet thick at the proposed slant well locations, thinning seaward. Based on the recent groundwater testing data discussed in the Groundwater Quality subsection below, the quality of water in the 180-FTE Aquifer is directly influenced by seawater; this influence extends for miles inland, as discussed below in the Seawater Intrusion section. The lower portion of the proposed slant wells at the CEMEX site would have well screens installed across and would draw water from these deposits.

180/400-Foot Aquitard

As shown on **Figures 4.4-2** and **4.4-3**, the 180- and 400-Foot Aquifers are separated by the 180/400-Foot Aquitard (Kennedy/Jenks, 2004). The unit is mostly 50 to 100 feet thick, is rarely as much as 200 to 250 feet thick, and may be absent in some areas. This aquitard is present beneath the CEMEX site at about 220 feet below the ground surface or about 200 feet below mean sea level, and is 10 to 70 feet thick. The slant wells at the CEMEX site would not penetrate the 180/400-Foot Aquitard.

400-Foot and 900-Foot Aquifers

The underlying 400-Foot Aquifer correlates with the Aromas Sand and the upper Paso Robles Formation (Geoscience, 2008; Yates et al., 2005). At the CEMEX site, the 400-Foot Aquifer is within the Pleistocene Aromas Sand. The unconfined Aromas Sand consists of both older fluvial deposits and younger windblown, or eolian, deposits. The eolian portion of the Aromas Sand crops out just east of the central and southern portion of the project area and extends beneath the project area to offshore on the continental shelf and in the Monterey submarine canyon (CGS, 2002). The unit is up to about 500 feet thick in the northern area and ranges in depth from a few feet near the surface to several hundred feet below the ground surface (HydroMetrics, 2009a). The slant wells at the CEMEX site would not penetrate through the Aromas Sand or deeper geologic units. Based on the recent groundwater testing data, discussed in the Groundwater Quality subsection below, the 400-Foot Aquifer is directly influenced by seawater. This influence extends for miles inland, as discussed below in the Seawater Intrusion subsection.

A blue marine clay separates the 400-Foot Aquifer from the underlying 900-foot (Deep) Aquifer (DWR, 2004a; Geoscience, 2008). The 900-Foot Aquifer correlates with the Paso Robles Formation, the Purisima Formation, and the Santa Margarita Sandstone (Yates et al., 2005). At the CEMEX site, the 900-Foot Aquifer is within the Paso Robles Formation.

East Side Subbasin and Aquifers

The East Side Area is located inland to the east of the Pressure Area and encompasses about 125 square miles along the north side of the Salinas Valley from Gonzales to east of Castroville. The hydrologic boundaries of the East Side Area are generally the Pressure Area to the west, the Gabilan Range along the northeast, and a subarea referred to as the Forebay Subbasin to the south and southeast. With the exception of the relatively impermeable Gabilan Range, the precise locations of the boundaries fluctuate depending on seasonal variations, longer-term climate changes, and local groundwater pumping.

The hydrogeology and groundwater behavior is markedly different in the East Side Area than the Pressure Area due to the different depositional environments and geology (Kennedy/Jenks, 2004). The transition zone between the East Side Area and Pressure Area has been defined based on the transition from predominantly alluvial deposits within the East Side Subbasin to the fluvial deposits that make up the Pressure Area. The clay layers in the Pressure Area pinch out inland into the East Side Area. As noted above, the Salinas Valley Aquitard does not extend much into the East Side Area (Durbin et al., 1978). Water-bearing formations present within the East Side Area include Quaternary Alluvium (both alluvial fan and fluvial deposits), the Aromas Sand, the Paso Robles Formation, and the Purisima Formation (DWR, 2004b).

Seaside Groundwater Basin and Aquifers

The Seaside Groundwater Basin (SGB) encompasses approximately 24 square miles at the southwest corner of the Salinas Valley adjacent to the Pacific Ocean (Yates et al., 2005). The SGB is further subdivided into the Northern and Southern Subbasins by the Laguna Seca Anticline and a segment of the Ord Terrace Fault, which restrict groundwater flow between the subbasins (HydroMetrics 2009a). The two subbasins are further subdivided into coastal and inland subareas with the division boundary just west of General Jim Moore Boulevard.

The SGB consists of three aquifers that correspond with the sedimentary units within the basin: the surficial Aromas Sand (**Table 4.4-1**) (which includes the Dune Sands), a shallow aquifer, and a deep aquifer (HydroMetrics, 2009a). The surficial Aromas Sand Aquifer is unsaturated in many places and, therefore, not directly used to produce potable groundwater as its proximity to the Pacific Ocean makes the water saline to brackish. In 2012, the Sand City desalinization plant produced 208.37 acre-feet (af) of potable water from this saline to brackish unit (CalAm, 2013).

The shallow aquifer is in the unconfined Paso Robles Formation, (**Table 4.4-1**) and generally corresponds with the 400-Foot Aquifer to the north in the SVGB (HydroMetrics, 2009a). The thickness of the unit ranges from about 250 feet just north of the Ord Terrace Fault to over 500 feet in the central and northern portions of the project area. The Aromas Sand, Paso Robles,

and Purisima Formations⁷ are not present in the project area south of the Seaside Fault. The deep aquifer is in the underlying confined Santa Margarita Sandstone (see **Table 4.4-1**) and the Purisima Formation, and generally corresponds with the 900-Foot Aquifer in the SVGB. Groundwater resources in the SGB derive from the Paso Robles Formation and Santa Margarita Sandstone; the Santa Margarita Sandstone transitions with the Purisima Formation in the northern area of the SGB. The proposed ASR injection/extraction wells would be located in the Northern Subbasin, close to the boundary with the SVGB, and would be screened in the Santa Margarita Sandstone. The late Miocene⁸ to Pliocene Santa Margarita Sandstone has surface outcrops east of the project area (CGS, 2002) and is up to 400 feet thick in places (Durbin, 2007). The proposed ASR injection/extraction wells would be drilled to about 1,000 feet below the ground surface and would be screened within the Santa Margarita Sandstone.

The northern hydrologic boundary of the SGB is a flow divide as groundwater to the north of the divide flows to the SVGB and groundwater to the south flows to the SGB (HydroMetrics, 2013). The northern SGB boundary is a dynamic hydrologic divide, the location of which depends on seasonal rainfall patterns, longer-term climate variations, and pumping rates in the SVGB and the SGB. The boundary passes through the former Fort Ord military base south of the city of Marina. The northern boundaries of the shallow and the deep aquifers in the SGB are at different locations, as discussed in the Groundwater Flow subsection below. The approximate flow divide between the SVGB and the SGB is based on groundwater elevation data derived from sampling conducted in the Paso Robles Formation and generally correlates with the 400-Foot Aquifer in the 180/400-Foot Aquifer Subbasin. The flow divide for the Santa Margarita Sandstone is different and appears to be located farther north due to pumping and aquifer characteristics within the Santa Margarita Sandstone and the Deep Aquifer. The basin boundary in the Dune Sands deposits also differs, and is generally not defined because groundwater resources are typically not obtained from the Dune Sands within the Quaternary Alluvium, and because the Dune Sands are in direct hydraulic communication with the ocean and only saturated along the coastal margin (ICF Jones & Stokes, 2008). The other hydrologic boundaries of the SGB are the Sierra de Salinas /Santa Lucia Range to the south and east and the Pacific Ocean to the west.

4.4.1.3 Groundwater Flow and Occurrence

A groundwater basin is much like a surface water reservoir because when water is removed from storage, the water level drops until the supply is replenished. The replenishment of the aquifer, referred to as recharge, occurs when water enters the aquifer either from the surface or from adjacent aquifers. Along the coast, the ocean can also recharge the aquifers and, in some areas, this causes the salty water from the ocean to mix with the fresh groundwater, causing seawater intrusion. This section summarizes groundwater elevations in the SVGB and SGB and describes the effect of development on groundwater flow patterns. The section also discusses how the groundwater inflow and outflow impact the balance – the amount of water entering a groundwater basin versus the amount of water leaving it – in the SVGB and SGB.

⁷ Note that the nomenclature of these individual units has evolved over time as subsequent investigators revised their understanding of the stratigraphy of the region. As reflected in this discussion, some investigators have referred to the Paso Robles and Purisima Formations collectively as “continental deposits.”

⁸ Miocene time was from 5.3 to 24 million years ago.

Groundwater Elevations and Flow Directions

Before extensive pumping began in the Salinas Valley, the regional groundwater flow was predominantly toward the coast from inland areas. Since the 1940s, hydrogeologic studies have shown a regional decline in the groundwater table, which has resulted in a sea-to-land groundwater gradient in some coastal areas. The MCWRA conducts a groundwater monitoring program throughout the Salinas Valley that for the fall 2013 monitoring event included 61 wells in the 180-Foot Aquifer and 103 wells in the 400-Foot Aquifer (Brown and Caldwell, 2015). Water-level data collected from wells in the study area indicate that the direction of groundwater flow is from the ocean to inland, as shown on **Figures 4.4-5** and **4.4-6**.

In the Pressure and East Side Areas, groundwater flows northwest from the upper reaches of the SVGB until it reaches the city of Salinas, at which point groundwater in both the 180-Foot and 400-Foot Aquifers flows towards a groundwater depression north of the city (MCWRA, 2014b). Along the coast, flow in both the 180-Foot and 400-Foot Aquifers is towards the east, or landward, and has resulted in seawater intrusion. At the proposed slant well locations, the Dune Sand and 180-FTE Aquifers along the coast are hydraulically connected to the Pacific Ocean, as verified by the saline chemistry of the groundwater samples collected from borings drilled along the coast. The groundwater flow patterns within the Dune Sand Aquifer are not known but, based on the aquifer depth and geologic structure, it is reasonable to expect that they would be tidally controlled, with little to no net horizontal flow in any particular direction.

There is a groundwater divide along the north side of the SGB separating groundwater flow paths between the SGB and the SVGB in both the shallow and deep aquifers, as illustrated on **Figures 4.4-7** and **4.4-8**. The SGB has been divided into four subareas, with the northern two composing the Northern Subbasin and the southern two composing the Southern Subbasin. The proposed ASR injection/extraction wells would be located near the northern border of the Northern Subbasin. There is a groundwater depression in both the shallow and deep aquifers in the Northern Subbasin, resulting in some landward flow along the coast (HydroMetrics, 2015).

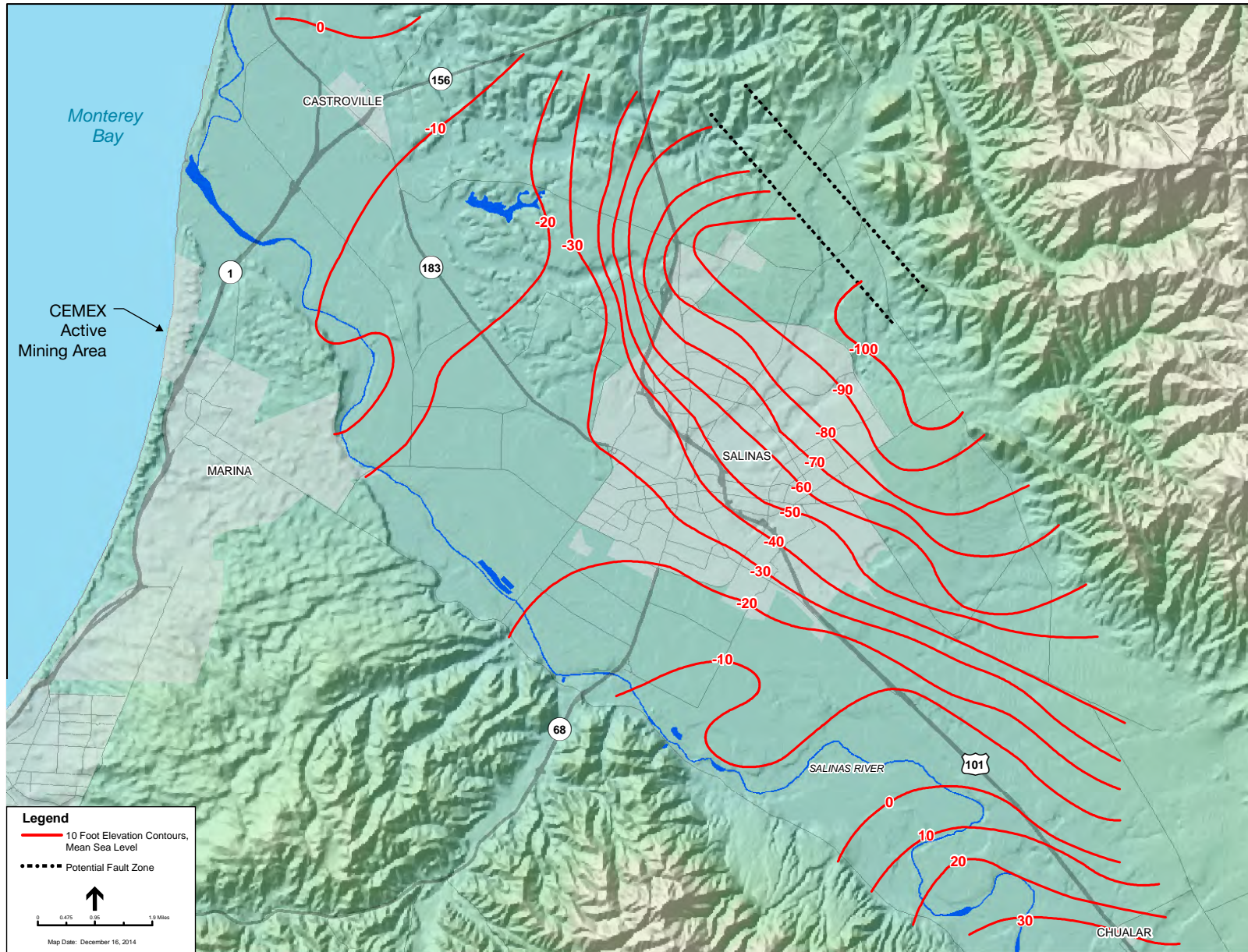
Basin Groundwater Balance

Groundwater balance is a term that describes the amount of water that enters the groundwater system versus the amount of water that leaves. Groundwater enters the system through recharge and can leave the system through groundwater pumping or natural discharge to surface streams. Groundwater recharge occurs from the percolation of rainfall, infiltration from rivers and streams, underflow⁹ originating in upper valley areas, and agricultural irrigation and other return flow,¹⁰ including enhanced groundwater recharge.¹¹ Whether an overlying formation can provide a pathway for recharge depends on numerous factors. For example, recharge from direct

⁹ Underflow refers to groundwater that is flowing through the subsurface aquifers from higher elevation or higher pressure areas to recharge downgradient water bearing sediments.

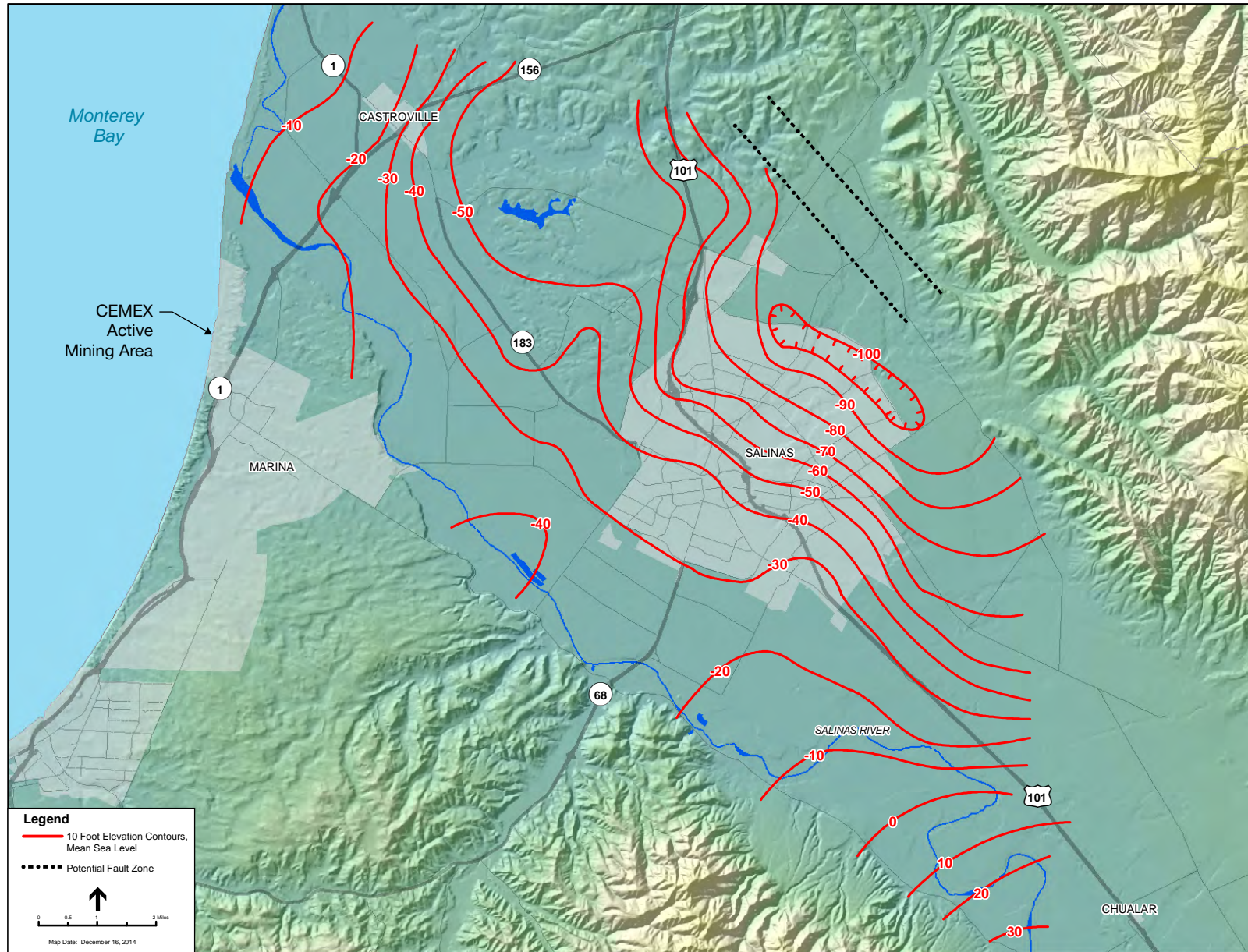
¹⁰ Return flow is irrigation water that is applied to an area and which is not consumed in evaporation or transpiration and returns to a surface stream or aquifer.

¹¹ Enhanced recharge refers to projects intended to accelerate localized recharge such as infiltration basins. The Castroville Seawater Intrusion Project (CSIP) is an example of a recharge project.



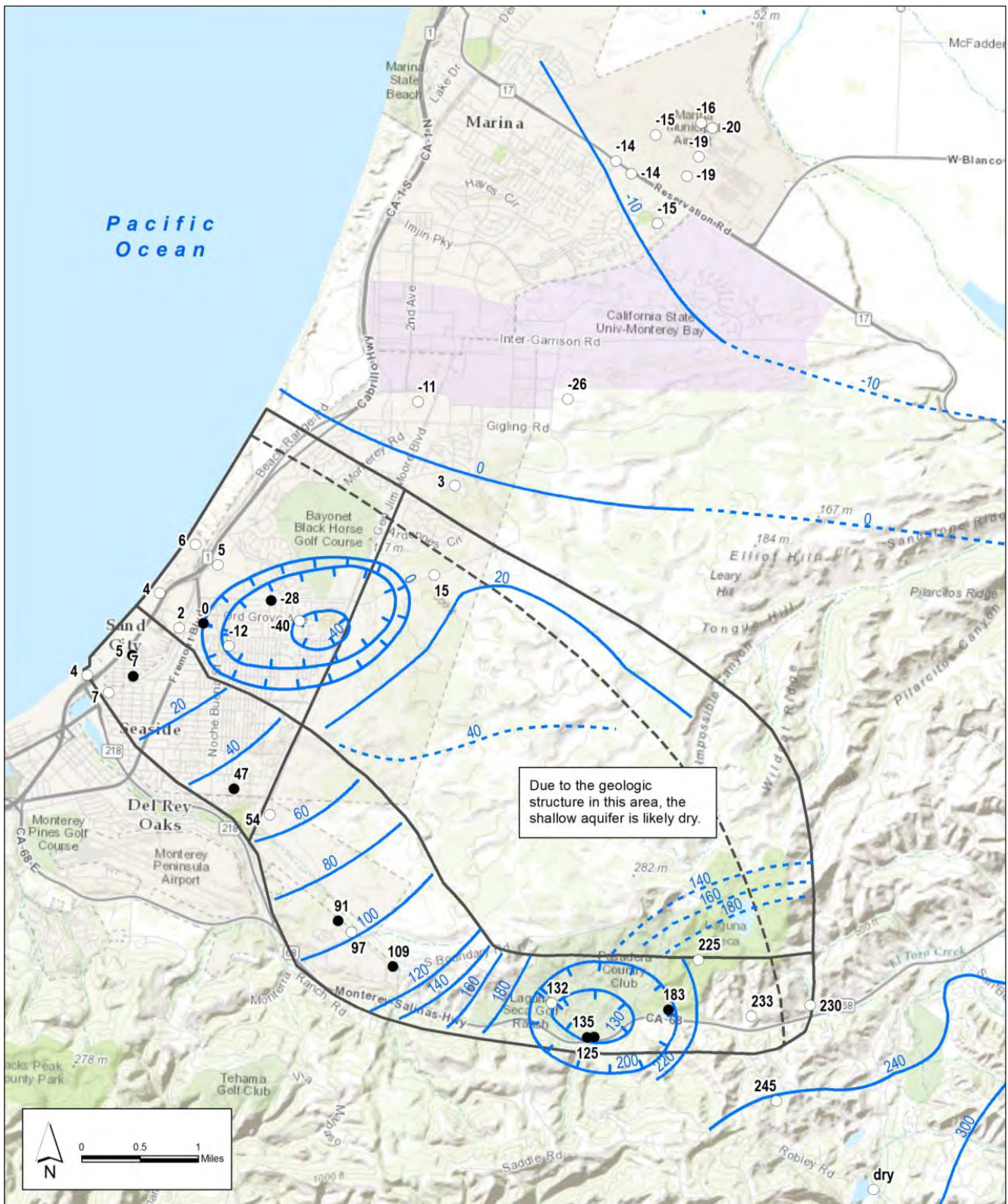
SOURCE: MCRWA, 2014a

205335.01 Monterey Peninsula Water Supply Project
Figure 4.4-5
Salinas Valley Groundwater Basin -
Groundwater Elevations in 180-Foot-Aquifer



SOURCE: MCRWA, 2014a

205335.01 Monterey Peninsula Water Supply Project
Figure 4.4-6
Salinas Valley Groundwater Basin -
Groundwater Elevations in 400-Foot-Aquifer

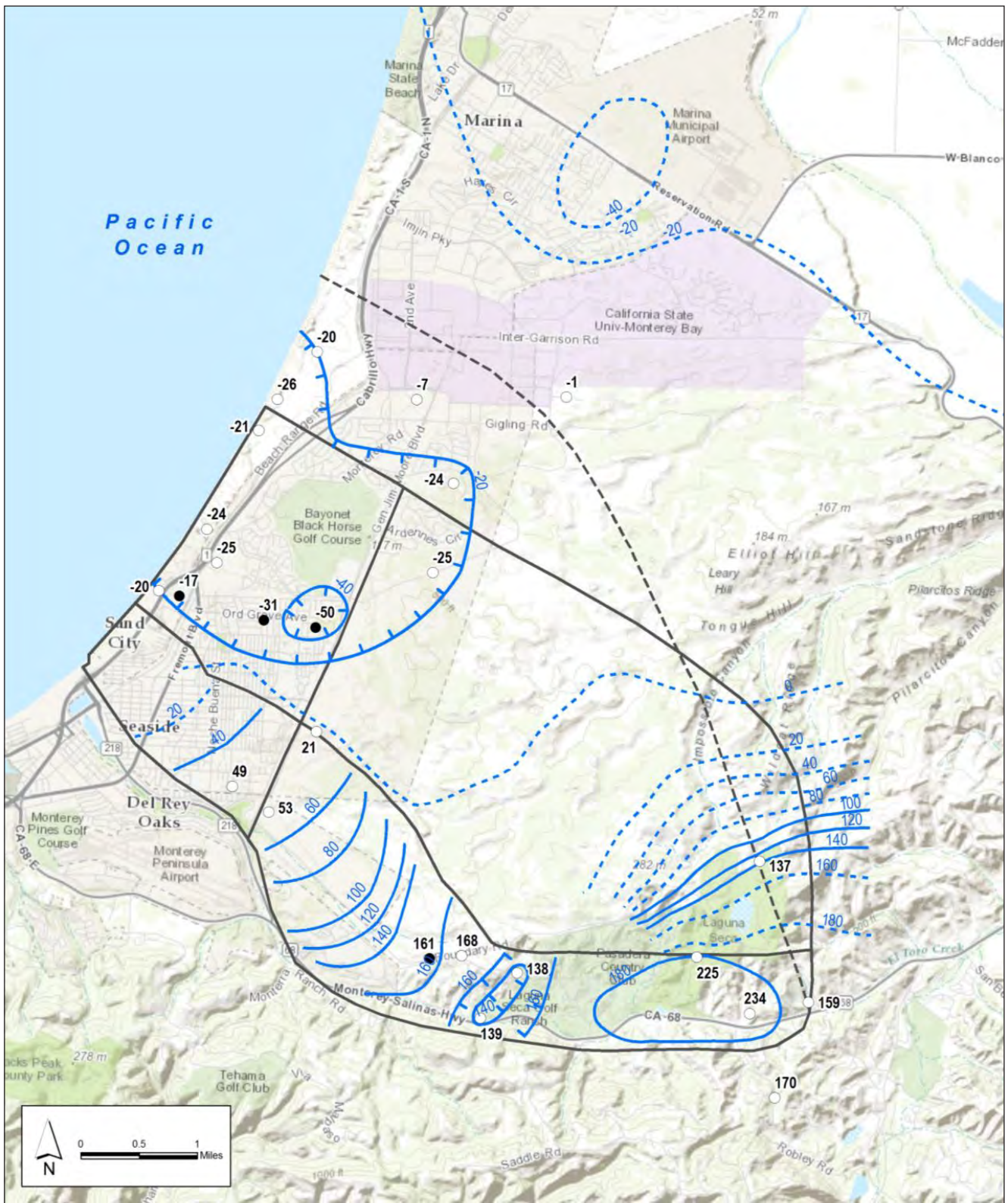


SOURCE: HydroMetrics, 2015

Monterey Peninsula Water Supply Project . 205335.01

Figure 4.4-7

Groundwater Flow – Seaside Basin Shallow Zone, July/August 2015



SOURCE: HydroMetrics, 2015

Monterey Peninsula Water Supply Project . 205335.01

Figure 4.4-8

Groundwater Flow – Seaside Basin Deep Zone, July/August 2015

percolation depends on the absence of near-surface clay layers that can impede the downward flow of water, as is the case in areas where the Salinas Valley Aquitard restricts the downward migration of water (see **Figure 4.4-4**). Similarly, the amount of recharge from underflow depends on the hydrologic interconnections of the water-bearing formations, as well as any groundwater extraction occurring in upgradient areas within the basins. Historically, groundwater withdrawal within both the SVGB and the SGB has outpaced groundwater recharge of fresh water, resulting in overdraft¹² and seawater intrusion conditions (MCWRA, 2014a; Kennedy/Jenks, 2004; HydroMetrics, 2013).

Salinas Valley Groundwater Basin Balance

Inflows and Outflows

A quantitative accounting of the water balance within the SVGB was obtained from the recent study conducted for the MCWRA (Brown and Caldwell, 2015). The study described the current state of the basin as well as the basin's water balance, averaged over the period from 1958 to 1994. The study estimated the overall basin inflow at 504,000 acre-feet per year (afy), of which about 50 percent occurs as stream recharge, 44 percent as deep percolation from agricultural return flows and precipitation, and 6 percent as subsurface inflow from adjacent groundwater basins. Outflow from the basin was estimated at 555,000 afy, of which about 90 percent was identified as groundwater pumping and the remainder as evapotranspiration along riparian corridors.¹³ The MCWRA estimated that in the lower basin portion of the Salinas Valley, recharge occurs by infiltration along the channel of the Salinas River (30 percent) and its tributaries (20 percent), irrigation return water (40 percent), and infiltration and precipitation over the valley floor, subsurface inflow, and seawater intrusion (10 percent) (MCWRA, 2006).

The estimated 555,000 afy of outflow subtracted from the estimated 504,000 afy of inflow results in basin overdraft. This imbalance is documented by seawater intrusion within the basin. Because of the current extent of seawater intrusion within the Pressure Area and the threat of additional seawater intrusion and other water quality deterioration in the SVGB, various programs have been designed to protect and restore the basin.

Groundwater Enhancement Programs in the SVGB

Numerous resource protection programs throughout the SVGB promote groundwater recharge. Specifically, the Salinas Valley Water Project (SVWP) has implemented, or has proposed to implement, various programs to stop seawater intrusion, to provide adequate water supplies to meet the current and future needs of the Salinas Valley, and to improve the hydrologic balance of the SVGB. These programs include modifications to the Nacimiento Spillway, the operation of Nacimiento and San Antonio Reservoirs, which are upstream on the Salinas River, and Salinas River recharge, conveyance, and diversion efforts. The two upstream reservoirs regulate stream flow to maximize recharge to groundwater. Lake San Antonio's capacity is 335,000 af and Lake Nacimiento's capacity is 377,900 af (MCWRA, 2007). Due to the extent of the confining layers

¹² Groundwater overdraft occurs when the groundwater levels are lowered due to excessive pumping at a rate that is greater than natural recharge.

¹³ The MCWRA State of the Basin Study included the SGB within the Pressure Subarea (180-400 Foot Aquifer Subbasin).

that prevent surface infiltration within the subbasin, reservoir operators regulate flows in the Salinas River to maximize groundwater recharge before flows enter the 180/400-Foot Aquifer Subbasin boundary (RMC, 2006). The rate of recharge varies from year to year depending on the seasonal distribution of rainfall and the total annual precipitation. The operation of the reservoirs increases groundwater recharge by about 30,000 afy (RMC, 2003).

As part of the approved SVWP, changes in reservoir operations were implemented as SVWP Phase I and will continue to be made through Phase II of the SVWP to further enhance water conservation. An inflatable rubber dam diversion facility, operating on the Salinas River as part of the SVWP Phase I, captures excess river flows which are used to supplement the agricultural water supply by routing flows of 30 cubic feet per second to the Castroville Seawater Intrusion Project (CSIP). This rerouted water serves as an in-lieu groundwater supply in that it reduces agricultural pumping of groundwater. Phase II of the SVWP plans to increase the diversion at the rubber dam by 30,000 afy and to develop and implement other actions that would route 20,000 afy to the groundwater depression east of the city of Salinas.

The CSIP is a program that has distributed recycled water through the Monterey Regional Water Pollution Control Agency (MRWPCA) service area since 1998 (MCWRA, 2006; MRWPCA, 2013). Tertiary-treated wastewater is obtained from the MRWPCA and delivered to agricultural users within the Pressure and East Side Subbasins of the SVGB, reducing groundwater extraction in those areas. This redistribution of water provides a form of in-lieu groundwater recharge by effectively reducing groundwater extraction in those areas of the basin within the CSIP delivery area. As of 2012, the CSIP was delivering approximately 14,000 afy of recycled water to farm lands in the CSIP delivery area. The CSIP has a goal of increasing this volume to 22,000 afy in Phase II of the Program (MRWPCA, 2012).

Seaside Groundwater Basin Recharge

From 2003 to 2007, SGB recharge including both primary recharge components (percolation from rainfall and infiltration below stream beds) and secondary recharge components (irrigation return flows, leaks from water and sewer pipes, and septic system flows) averaged 3,570 afy (HydroMetrics, 2009a).

In addition to the basin's natural recharge, since 2006, the Monterey Peninsula Water Management District (MPWMD) has run an ASR program that actively enhances groundwater recharge. **Figures 3-2** and **3-9** show the location of the existing and proposed ASR facilities, including the four existing ASR injection/extraction wells. Under the ASR program, Carmel River water is piped to the ASR wells on the former Fort Ord military base, where it is injected into the Santa Margarita Sandstone along the eastern side of the groundwater depression (shown on **Figure 4.48**), and is stored for later extraction and use, as needed. **Table 4.4-2** summarizes the injection volumes.

**TABLE 4.4-2
SUMMARY OF ASR INJECTION VOLUMES (AF)**

| 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|------|------|------|------|------|------|------|------|------|-------|-------|------|------|------|------|
| 2 | 175 | 168 | 160 | 351 | 411 | 12 | 60 | 182 | 1,111 | 1,117 | 131 | 295 | 0 | 215 |

NOTE: All injection volumes in acre-feet

SOURCE: Pueblo Water Resources, 2014, 2016

Groundwater Extraction

Groundwater is an important water supply source for municipal and agricultural use in Monterey County. Groundwater extraction is monitored closely and reported on an annual basis for both groundwater basins addressed in this EIR/EIS. **Table 4.4-3** summarizes groundwater extraction within the northern SVGB and SGB from 2008 to 2014.

**TABLE 4.4-3
GROUNDWATER EXTRACTION SUMMARY FOR THE
SALINAS VALLEY AND SEASIDE GROUNDWATER BASINS (AF)**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---------|---------|---------|---------|---------|----------|----------|
| Salinas Valley Groundwater Basin | | | | | | | |
| 180/400 Foot Aquifer Subbasin | 130,139 | 121,165 | 103,544 | 105,172 | 113,898 | 117,242 | 120,890 |
| Eastside Subarea | 108,696 | 98,988 | 91,300 | 89,052 | 95,543 | 97,622 | 105,644 |
| Seaside Groundwater Basin | | | | | | | |
| Coastal Subareas | 4,242.1 | 3,332.0 | 3,679.9 | 3,298.4 | 2,962.8 | 2,983.52 | 3,120.51 |
| Laguna Seca Subarea | 1,029.9 | 1,060.6 | 867.7 | 853.1 | 870.1 | 912.27 | 919.64 |

NOTES: All values in acre-feet

SOURCES: MCWRA, 2009, 2015; SGB Watermaster, 2008 through 2014.

4.4.1.4 Groundwater Quality

Groundwater quality in the SVGB and SGB is influenced by natural geochemical properties and flow within the different hydrogeologic formations, groundwater pumping and induced seawater intrusion, land use practices, and accidental releases of contaminants into the environment. Additional water quality concerns for the SGB, and particularly the Santa Margarita Sandstone, include the presence of disinfection by-products in the injected water and long-term changes in the geochemistry of the groundwater system. While this section of the EIR/EIS focuses on groundwater basin water quality, Section 4.7, Hazards and Hazardous Materials, provides additional information on areas with contaminated soil and shallow groundwater.

Groundwater Quality at the Proposed Slant Well Locations

CalAm commissioned a subsurface soil and groundwater investigation to further understand the existing subsurface geologic units, aquifers, and water quality of the proposed slant well locations

on the CEMEX site. The investigation included the installation of nested monitoring wells and the test slant well, subsurface lithologic logging, soil and groundwater sample analysis, aquifer testing, and aquifer conditions modeling (Geoscience, 2013c, 2016a, 2016b). **Figure 4.4-9** shows the locations of the nested monitoring wells. The nested wells have screen intervals to discretely sample the Dune Sand Aquifer, 180-FTE Aquifer, and the 400-Foot Aquifer depth intervals. The subsurface investigation provided information and data to better characterize the subsurface stratigraphy, aquifer conditions, how the aquifer responds to pumping, and groundwater chemistry at various depth intervals. Updated information on subsurface materials informed the design of the proposed slant wells, and data on groundwater flow characteristics and water chemistry facilitated further refinement of the groundwater models used to analyze project impacts.

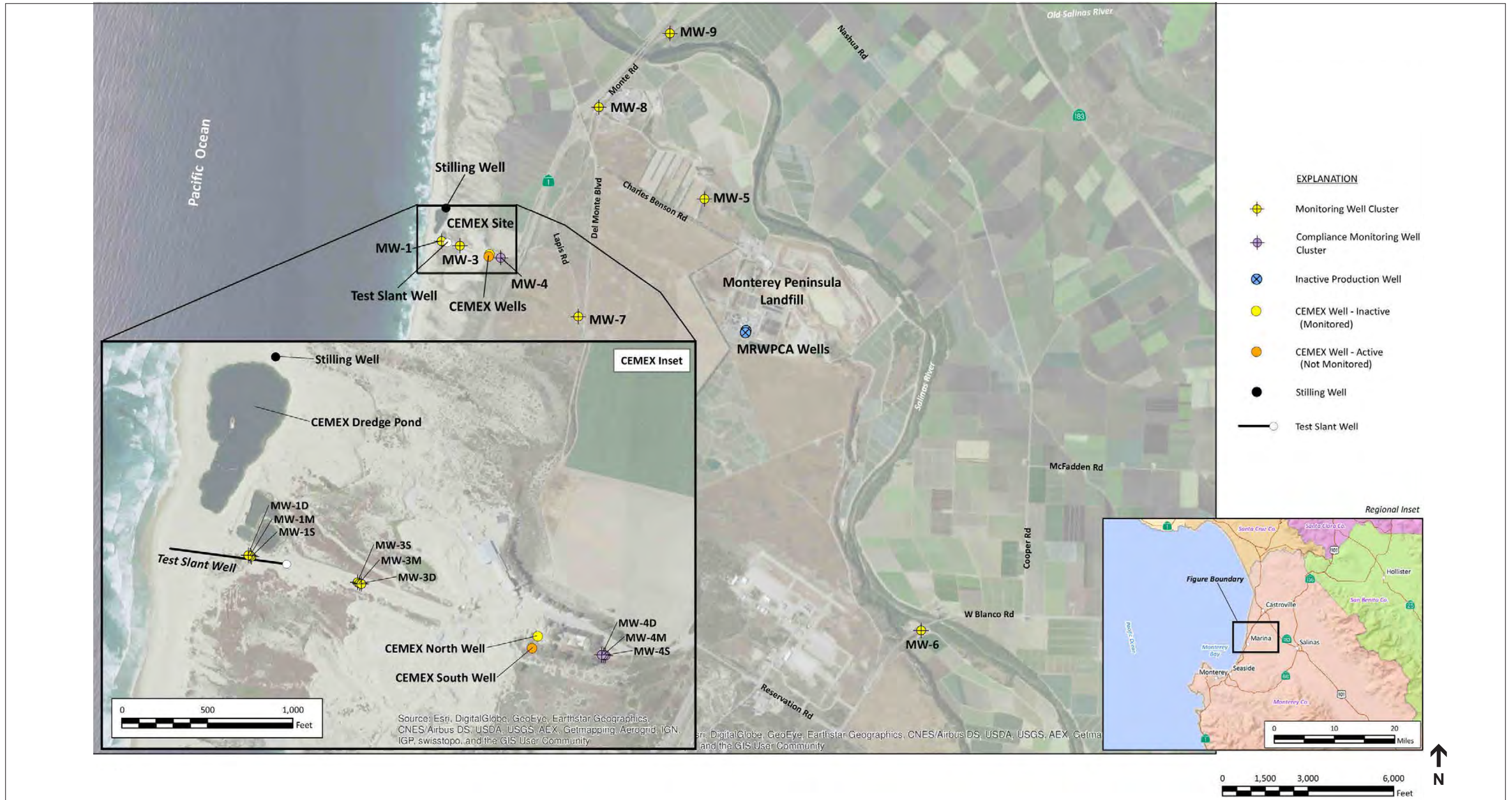
The proposed slant wells would draw water from the Dune Sand Aquifer and the 180-FTE Aquifer from about 30 feet below msl to 200 feet below mean sea level (Geosciences, 2016b). As discussed above in Section 4.2, the Dune Sand Aquifer overlies the 180-FTE Aquifer with no aquitard /between the units. The test slant well is screened across both units and has been sampled on a weekly basis when operational. **Table 4.4-4** summarizes water quality results from the May 19, 2016, sampling event. The table also provides the chemical composition of seawater; as the comparison shows, the water quality from the test slant well closely resembles the average seawater TDS concentration found along the central coast of California.

**TABLE 4.4-4
 GROUNDWATER QUALITY OF TEST SLANT WELL**

| Chemical Parameter | Units | Test Slant Well | Central Coast Seawater Average |
|--|----------|-----------------|--------------------------------|
| Bicarbonate as HCO ₃ ⁻ | mg/L | 139 | 103 |
| Boron | mg/L | 3.54 | 4.35 |
| Bromide | mg/L | 59.4 | 64.5 |
| Calcium | mg/L | 542 | 395 |
| Chloride | mg/L | 16,965 | 18,537 |
| Iron | ug/L | ND | 0.003 |
| Magnesium | mg/L | 1,180 | 1,230 |
| Nitrate as NO ₃ | mg/L | 3 | 0.67 |
| pH (field) | pH units | 7.07 | 7.5-8.5 |
| Potassium | mg/L | 287 | 382 |
| Salinity | psu | 29.4 | 33.69 |
| Sodium | mg/L | 9,357 | 10,329 |
| Sulfate as SO ₄ | mg/L | 2,353 | 2,598 |
| Total Dissolved Solids (Lab) | mg/L | 31,900 | 33,694 |

NOTES:
 mg/l = milligrams per liter; ug/L = micrograms per liter
 psu = practical salinity units; umhos /cm = micromhos per centimeter

SOURCE: Geoscience, 2016a; Hem, 1989



SOURCE: GeoScience, 2016

Monterey Peninsula Water Supply Project . 205335.01
Figure 4.4-9
 Slant Well and Monitoring Well Locations

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Groundwater Quality in the Santa Margarita Sandstone and the Seaside Groundwater Basin

Santa Margarita Sandstone overlies the Monterey Formation, and sections of the unit are present beneath the project area near Seaside at depths of about 800 feet. The proposed project would install two additional ASR wells (ASR-5 and ASR-6 Wells) in the Santa Margarita Sandstone in the northern subarea of the Seaside Basin to increase the injection, storage and extraction capacity.

In 2007, the MPWMD commissioned a study that evaluated the potential geochemical effects of injecting treated drinking water into the Santa Margarita Sandstone (EcoEngineers, 2008). The water quality data for the Santa Margarita Sandstone came from that study. The study estimated the nature and magnitudes of potential dissolution and precipitation reactions, the potential for scaling or biofouling, and the post-injection concentrations of chemicals in the water as compared with drinking water standards. The study used Carmel River water treated to drinking water standards from the CalAm Begonia Iron Removal Plant, and combined the treated water with rock material and native groundwater from the Santa Margarita Sandstone. After an 18-hour exposure period, the water mixture (referred to in the study as leachate) was reanalyzed for water quality constituents and the concentrations were compared with California Primary and Secondary Maximum Contaminant Level (MCL) drinking water standards. **Table 4.4-5** summarizes the water chemistry of the initial treated water and the resulting leachates from two depth intervals. The results indicated that the leachate obtained from mixing treated water with the Santa Margarita Sandstone and its native water did not exceed drinking water standards and did not show significant differences in water quality.

Water Quality and the Existing ASR System

Pueblo Water Resources prepares annual Summary of Operations reports that document the ASR system's well performance and water quality. The ASR system discussions below draw on the water year 2015¹⁴ monitoring activities unless otherwise cited (Pueblo Water Resources, 2016).

Annual injection operations have occurred at the ASR-1 Well since 2002, altering the groundwater quality in the local area from its pre-injection, naturally-occurring conditions. Consequently, making a clear distinction between native and non-native water quality is both complex and somewhat subjective. This change in native water quality, as confirmed by testing, was observed in distant wells such as Well PCA-E, which is located 6,200 feet west of the ASR injection/extraction wells. Well PCA-E is a monitoring well operated by the MPWMD and screened in the Santa Margarita Sandstone. For the 2013 water year, groundwater in Well PCA-E was estimated to contain 22 to 30 percent injected potable water.

¹⁴ A water year is the 12-month period from October 1 of any given year through September 30 of the following year. The water year is designated by the calendar year in which it ends. That is, the water year that starts on October 1, 2016 and ends on September 30, 2017 is the 2017 water year.

**TABLE 4.4-5
WATER CHEMISTRY RESULTS OF MIXING STUDY**

| Chemical Parameter | Treated Carmel River Water | Leachate 540-580 feet | Leachate 730-770 feet | California MCLs |
|------------------------------------|----------------------------|-----------------------|-----------------------|--------------------|
| Alkalinity as CaCO ₃ | 129 | 130 | 128 | NE |
| Aluminum | 0.025 | 0.025 | 0.025 | 1 / 0.2 (Sec) |
| Ammonia Nitrogen | 0.1 | 0.1 | 0.1 | NE |
| Arsenic | ND (0.005) | ND (0.005) | ND (0.005) | 0.010 |
| Antimony | NR | ND (0.0005) | ND (0.0005) | 0.006 |
| Barium | 0.056 | 0.039 | 0.043 | 1 |
| Bromide | 0.11 | 0.11 | 0.11 | NE |
| Beryllium | NR | ND (0.0005) | ND (0.0005) | 0.004 |
| Cadmium | NR | ND (0.00025) | ND (0.00025) | 0.005 |
| Calcium | 36 | 39 | 36 | NE |
| Chloride | 32 | 33 | 33 | 250 (Sec) |
| Dissolved Organic Carbon | 1.4 | 1.6 | 3.4 | NE |
| Chromium | NR | ND (0.0005) | ND (0.0005) | 0.10 |
| Cobalt | NR | ND (0.0005) | ND (0.0005) | NE |
| Dissolved Oxygen | 7.43 | nana | NA | NE |
| Electrical Conductivity | 510 | 484 | 490 | 900 (Sec) |
| Fluoride | 0.30 | 0.25 | 0.27 | 2 |
| Iron | 0.001 | ND (0.02) | ND (0.02) | 0.3 (Sec) |
| Lead | NR | ND (0.0005) | ND (0.0005) | 0.015 ^a |
| Magnesium | 14 | 14 | 13 | NE |
| Manganese | 0.001 | 0.001 | 0.001 | 0.05 (Sec) |
| Mercury | NR | 0.00017 | 0.00044 | 0.002 |
| Molybdenum | NR | 0.0031 | 0.0034 | NE |
| Nickel | NR | 0.0011 | 0.0014 | 0.10 |
| Nitrate/Nitrite as NO ₃ | 0.05 | 0.12 | 0.47 | 10 |
| Oxygen Reduction Potential (ORP) | 749 | 550 | 544 | NE |
| pe (= ORP/59.16) | 12.66 | 9.30 | 9.20 | NE |
| Total Phosphorous | 0.34 | 0.30 | 0.34 | NE |
| Potassium | 2.9 | 2.9 | 3.4 | NE |
| pH | 7.70 | 6.71 | 6.28 | NE |
| Selenium | 0.0017 | 0.0018 | 0.0021 | 0.05 |
| Silicon | 8.41 | 8.88 | 8.41 | NE |
| Silver | NR | ND (0.0005) | ND (0.0005) | 0.10 ^a |
| Sodium | 42 | 40 | 42 | NE |
| Strontium | 0.200 | 0.250 | 0.250 | NE |
| Sulfate as SO ₄ | 84.9 | 85.4 | 79.4 | 250 (Sec) |
| Thallium | NR | ND (0.0005) | ND (0.0005) | 0.002 |
| Uranium | 0.0025 | 0.0025 | 0.0060 | 0.03 |
| Vanadium | NR | 0.00073 | 0.00086 | 0.05 ^a |
| Zinc | 0.210 | 0.034 | 0.84 | 0.5 (Sec) |

NOTES:

MCLs = Primary Maximum Contaminant Levels also referred to as Primary Drinking Water Standards; Sec = Secondary MCLs
 All concentrations in milligrams per liter (mg/L) except conductivity (micromhos per centimeter), ORP (millivolts), and pH (pH units)
 NA = not analyzed ND = not detected above reporting limit NE = not established NR = not reported

^a Lead has a regulatory action level, not an MCL

SOURCE: EcoEngineers, 2008.

The ASR project has historically used the chloride ion to track the general mixing, dilution, and interaction between injected and native groundwater. Chloride is very stable and highly soluble, and is present in both injected and native groundwater. Pueblo Water Resources continually monitors the response of the Santa Margarita Sandstone to the injection and extraction of treated water. The historical chloride concentration of the native groundwater within the Santa Margarita Sandstone has averaged approximately 120 to 130 mg/L in this area of the Seaside Basin. However, injecting treated water into the Santa Margarita Sandstone reduces chloride concentrations in the injection area. Chloride concentrations decreased to as low as 30 mg/l during the March 2015 sampling event, well below the average chloride concentration of 120 mg/L. As a result, repeated ASR injection, storage, and recovery cycles are expected to incrementally produce water that is similar in nature to the injected water, creating a buffer zone of mixed water that gradually increases over time.

Disinfection Byproducts

As part of the current ASR program, Carmel River water is treated by removing iron and manganese, disinfecting the water with sodium hypochlorite, and injecting the potable water into the Santa Margarita Sandstone (Pueblo Water Resources, 2014). The potable water undergoes a chlorination process to disinfect it of possible microbiological contamination prior to injection into the Santa Margarita Sandstone. This chlorination process is known to produce disinfection by-products, including trihalomethanes (THMs)¹⁵ and haloacetic acids (HAAs)¹⁶ that have regulatory limits for drinking water purposes.

While it has been successfully demonstrated at the Seaside Basin ASR site, as well as at other ASR sites in California and elsewhere, that successive injection/storage/recovery cycles can yield fully potable water upon recovery, issues regarding the fate and stability of disinfection by-products in the subsurface can also affect the potability of the recovered water. The monitoring results evaluated by Pueblo Water Resources indicate that the THMs do increase upon initial injection of treated surface water into the Santa Margarita Sandstone, but that concentrations steadily decrease with time. Groundwater monitoring results indicate that, over the course of that time, the pH has remained neutral (between 6 and 8), indicating relatively stable geochemical conditions. The DBP data collected during the 2015 water year indicated that THMs peaked approximately 30 to 90 days after injection and storage, followed by a gradual decline. After approximately 150 to 210 days of storage, THMs had degraded to below the initial injection levels. HAAs degraded to below reporting limits by 90 to 100 days. More importantly, throughout the 2015 water year, THMs were below the MCL of 80 micrograms per liter and HAAs were below the MCL of 60 micrograms per liter.

¹⁵ THMs are a group of four chemicals that are formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. The THMs are chloroform, bromodichloromethane, dibromochloromethane, and bromoform. The USEPA has published the Stage 1 Disinfectants/Disinfection Byproducts Rule to regulate total THMs at a maximum allowable annual average level of 80 parts per billion (USEPA, 2012).

¹⁶ HAAs are a group of chemicals that are formed along with other disinfection by-products when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. The regulated HAAs are monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid. The USEPA has published the Stage 1 Disinfectants/Disinfection Byproducts Rule to regulate HAAs at 60 parts per billion annual average (USEPA, 2012).

During the testing of the ASR project described above, studies found that levels of hydrogen sulfide in the recovered water were much lower than the concentrations in natural groundwater prior to injection, indicating a lasting and significant improvement of water quality during subsurface water storage.¹⁷ This suggests that conditioning the aquifer may be an ancillary benefit of the ASR in the SGB. That is, ASR may reduce hydrogen sulfide in the extracted groundwater, which would then reduce the amount of chemical treatment that needs to be performed at the Seaside Ozone Treatment Plant. According to a report that summarized the pilot study results for the ASR project, the ozone treatment plant may become unnecessary with continued ASR operations over time (Padre Associates, 2004).

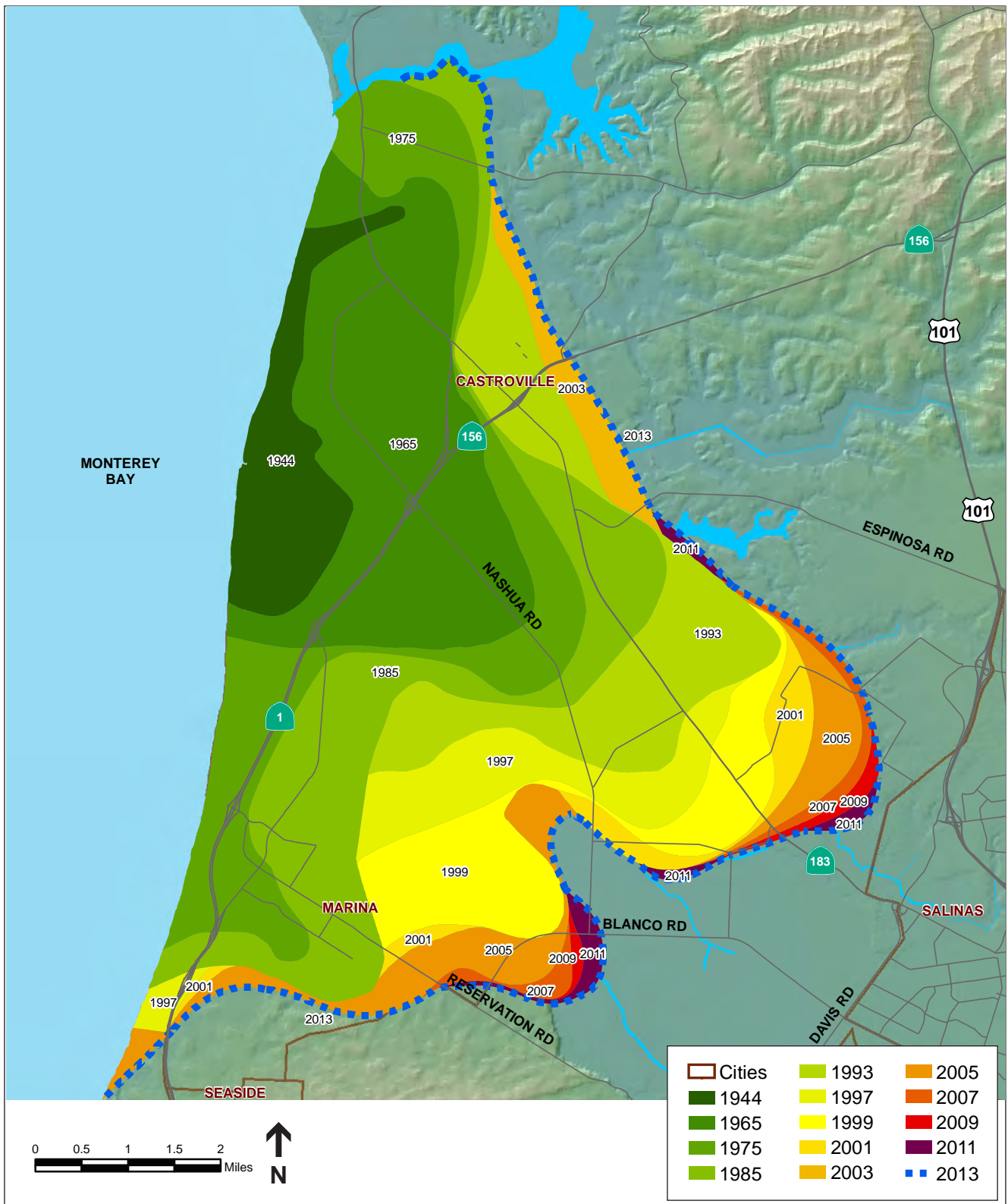
Seawater Intrusion

Figures 4.4-10 and 4.4-11 illustrate the seawater intrusion areas as of 2013 within the 180-Foot and 400-Foot Aquifers, respectively (MCWRA, 2015). Seawater intrusion occurs when ocean water enters fresh groundwater aquifers at the coast and migrates inland. The salty seawater combines with the fresh groundwater to create a mixture referred to as brackish. Brackish groundwater can contain Total Dissolved Solids (TDS) concentrations ranging from that of seawater (about 35,000 mg/L) down to 500 mg/L near the leading edge of the inland seawater intrusion front. Brackish water in the 180-foot aquifer near the proposed project ranges from about 5,000 mg/L to 29,000 mg/L. The California Secondary Drinking Water Standard was amended in 2006 to include a Maximum Recommended Level for TDS in drinking water of 250 mg/L (Cal. Code Regs., tit. 22, § 64449). The MCWRA define the leading edge of inland seawater intrusion as groundwater containing TDS at 500mg/L or more.

The current, standard practice for monitoring the inland advance of seawater intrusion involves TDS analysis of groundwater from a select group of monitoring wells that intersect the seawater-intruded aquifers. The TDS concentration data are used to identify the areas of the aquifer intruded by seawater and to plot the leading edge of the inland seawater intrusion front. The more groundwater wells available in the monitoring program, the better regional seawater intrusion is represented. Regular annual monitoring data can be used to estimate the rate at which seawater is migrating inland. The MCWRA has been conducting seawater intrusion monitoring for many years using several groundwater wells in the western end of the Salinas Valley.

Geophysics are giving researchers the opportunity to study seawater intrusion using high-resolution, regional scale imaging. The technique, sometimes referred to as Electrical Resistivity Tomography (ERT), can be used to differentiate salty water from fresh water hundreds of feet beneath the ground. Electrical resistivity imaging uses a series of sensors placed along a transect line on the ground surface. An electrical current is applied and the sensors measure the electrical resistance the current encounters as it travels at depth between the sensors. Salty water has a lower resistance than freshwater, due to the higher TDS. The high and low resistivity zones in the

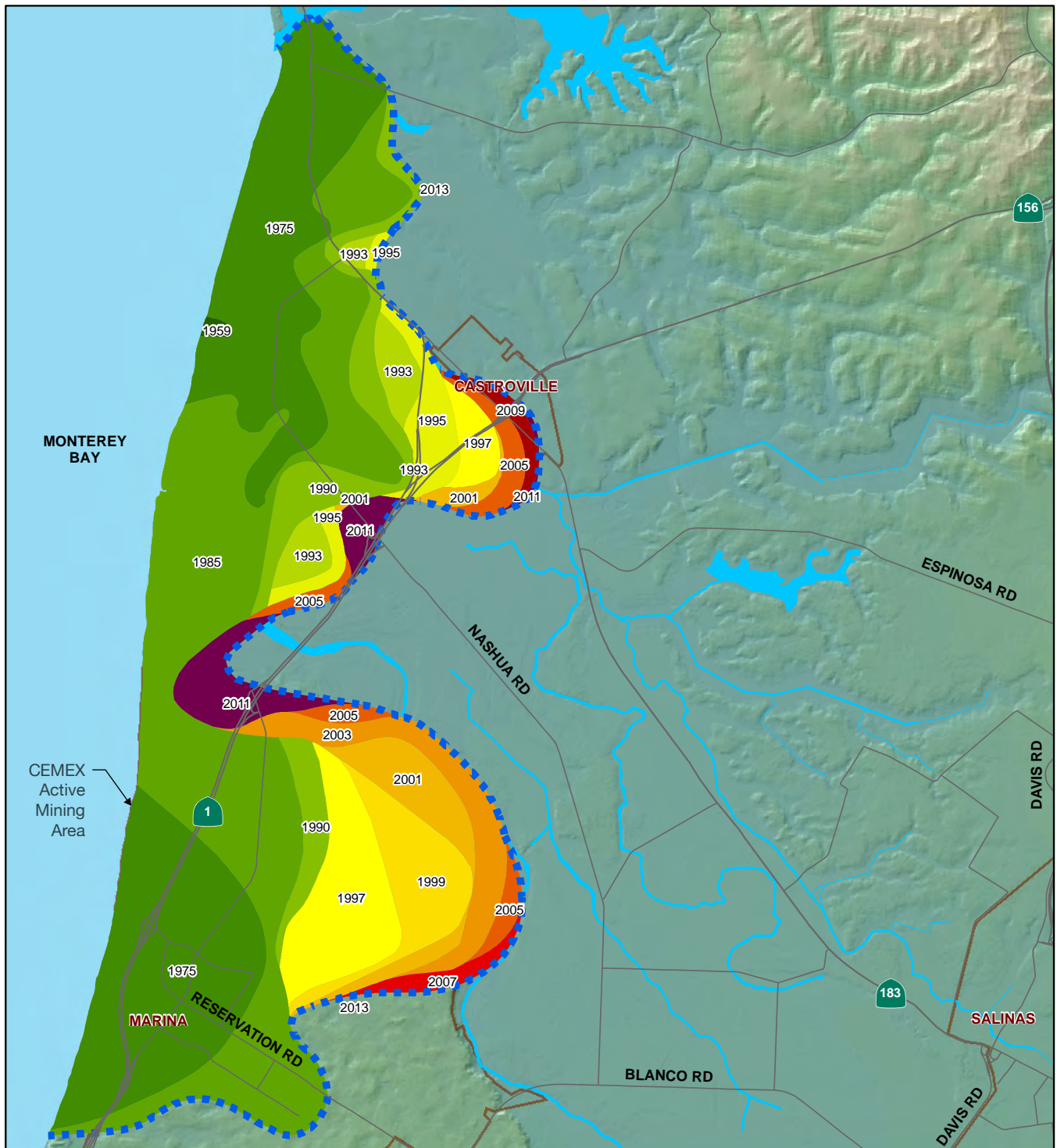
¹⁷ The hydrogen sulfide reduction is likely due to the effects of the injected chlorine residual and dissolved oxygen content. These oxidizers react in the subsurface to stifle anaerobic bioactivity, which normally produces hydrogen sulfide. As the aquifer environment is altered and becomes inhospitable to anaerobes, hydrogen sulfide generation declines. This effect has also been observed in ASR wells in similar coastal aquifers in Santa Barbara, Alameda, and Ventura Counties.



SOURCE: MCWRA, 2015b

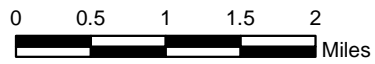
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Figure 4.4-10
 Historic Seawater Intrusion in the
 Salinas Valley Groundwater Basin - 180-Foot Aquifer



- | | |
|----------|--------|
| ■ Cities | ■ 1999 |
| ■ 1959 | ■ 2001 |
| ■ 1975 | ■ 2003 |
| ■ 1985 | ■ 2005 |
| ■ 1990 | ■ 2007 |
| ■ 1993 | ■ 2009 |
| ■ 1995 | ■ 2011 |
| ■ 1997 | ■ 2013 |

* Seawater Intruded Areas By Year



Note: The scale and configuration of all information shown hereon are approximate and are not intended as a guide for survey or design work. Contour lines are drawn from best available data.

Map Date: December 16, 2014

SOURCE: MCWRA, 2014b

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Figure 4.4-11

Historic Seawater Intrusion in the Salinas Valley Groundwater Basin - 400-Foot Aquifer
4.4-30

subsurface are displayed as a series of colors in a cross section that indicate areas of fresh water, brackish water and seawater. Over the past few years, Stanford environmental geophysics researcher Rosemary Knight has conducted a study to determine the viability of using electrical resistivity techniques to study seawater intrusion along the coast of the Monterey Bay. Professor Knight's initial survey was conducted along a 4-mile segment parallel to the beach between the cities of Seaside and Marina. The study found that the electrical resistivity readings positively correlated with measured TDS concentrations to a depth of 500 feet in four area groundwater wells.

Salinas Valley Groundwater Basin

The SVGB is hydrologically connected to Monterey Bay by ocean outcrops of the 180-Foot and 400-Foot Aquifers a few miles offshore (Eittreim, et. al., 2000; Greene, 1970). The ocean outcrops provide a constant source both of pressure and of direct recharge of seawater, and facilitate the recharge of seawater into those aquifers along the coast when groundwater extraction exceeds natural recharge. As a result, a landward groundwater gradient has developed along the coast and induced groundwater recharge from the ocean since the mid-20th century. Seawater intrusion in the SVGB was first documented in 1946 (DWR, 1946). The overdraft condition has degraded groundwater quality along the coast within the SVGB. Before wells extracted water from the Salinas Valley, there was a balance between the seawater in the ocean and the groundwater in the inland aquifers. Surface water within the watershed would infiltrate down into the aquifer, but it would be at a higher elevation than the surface of the ocean. Gravity requires that the difference in elevation forces the freshwater in the inland areas to migrate down and press back against the seawater. With the development of the Salinas Valley, water supply wells were installed and groundwater was extracted from the aquifer. This action reduced the weight of water on the inland side of the seawater/freshwater interface, creating a pressure imbalance, and resulted in the landward migration of the interface to its current location.

The 2013 estimates of seawater intrusion within the 180-Foot and 400-Foot Aquifers indicate that seawater has intruded to a maximum of approximately 8 miles and 3.5 miles inland, respectively, as inferred from chloride concentrations greater than 500 mg/L. The seawater intrusion degraded groundwater supplies, requiring urban and agricultural supply wells within the affected area to be abandoned or destroyed (MCWRA, 2001). Increased degradation of coastal groundwater aquifers led to restrictions on drilling groundwater wells and extracting groundwater from areas affected by seawater intrusion, as discussed in Section 4.4.2, Regulatory Framework. Such restrictions are intended to reduce further inland migration of seawater and reduce the landward advance of the seawater/freshwater interface.

Seaside Groundwater Basin

Groundwater pumping from aquifers in the SGB has exceeded recharge and freshwater inflows that caused pumping depressions near the coast, as shown on the groundwater flow maps for both the shallow aquifer zone (see **Figure 4.4-7**) and the deep aquifer zone (see **Figure 4.4-8**) (HydroMetrics, 2015). In addition, seawater intrusion has occurred just north of the SGB in the adjacent 180/400 Foot Aquifer Subbasin of the SVGB, as discussed above. The boundary

between these two basins is a groundwater divide that migrates in response to variations in natural recharge and pumping on either side of the divide. HydroMetrics noted increased chloride concentrations in two wells along the coast, although the concentrations have not yet exceeded drinking water standards. These conditions all suggest that the SGB could be vulnerable to seawater intrusion.

Regional Sources of Groundwater Contamination

Former industrial, commercial, and military activities in the region have resulted in soil and groundwater contamination from spills, leaking underground tanks, unlined chemical disposal sites, and inadvertent disposal of chemicals. In particular, groundwater in the aquifers located beneath the former Fort Ord military base, within two miles southeast of the proposed slant well locations at the CEMEX sand facility, are contaminated with volatile organic compounds, mostly trichloroethene (TCE) and carbon tetrachloride. Section 4.7, Hazards and Hazardous Materials, discusses these areas of contamination (see **Figures 4.7-1** and **4.7-2** for the locations of known plumes in the region). The closest of these contaminant plumes to the proposed slant wells, known as the OUCTP A-Aquifer Plume and the OUCTP Upper 180-Foot Aquifer Plume, are present in the indicated aquifers of the SVGB in the vicinity of Reservation Road, east of Del Monte Boulevard in Marina. These plumes have undergone considerable investigation, source removal, and remedial action, and the extent of contamination and constituent concentrations have decreased over time.

4.4.2 Regulatory Framework

This section provides an overview of federal, state, and local environmental laws, policies, plans, regulations, and guidelines (referred to generally as “regulatory requirements”) relevant to groundwater resources. A brief summary of each is provided, along with a finding regarding the project’s consistency with those regulatory requirements. The consistency analysis is based on the project as proposed, without mitigation. Where the project, as proposed, would be consistent with the applicable regulatory requirement, no further discussion of project consistency with that regulatory requirement is provided. Where the project, as proposed, would be potentially inconsistent with the applicable regulatory requirement, the reader is referred to the specific impact discussion in Section 4.5.5, Direct and Indirect Effects of the Proposed Project, below, where the potential inconsistency is addressed in more detail. Where applicable, the discussion in Section 4.5.5 identifies feasible mitigation that would resolve or minimize the potential inconsistency.

Many of the regulations described in Section 4.3, Surface Water Hydrology and Water Quality, also apply to groundwater resources, including the Porter-Cologne Water Quality Control Act and the *Water Quality Control Plan for the Central Coastal Basin* (Basin Plan). Additional information on the Basin Plan for the Central Coast Regional Water Quality Control Board (RWQCB), as it applies to groundwater resources, is provided below.

4.4.2.1 Federal

Federal Antidegradation Policy

Section 303 of the Clean Water Act (CWA) (33 U.S.C. § 1313) requires that states adopt water quality standards for waters of the United States within their applicable jurisdiction. Such water quality standards must include, at a minimum, (1) designated uses for all waterbodies within their jurisdiction, (2) water quality criteria necessary to protect the most sensitive of the uses, and (3) antidegradation provisions. Antidegradation policies and implementing procedures must be consistent with the regulations in 40 C.F.R. § 131.12. Antidegradation is an important tool that states use in meeting the CWA requirement that water quality standards protect public health and welfare, enhance water quality, and meet the objective of the Act to “restore and maintain the chemical, physical and biological integrity” of the nation’s waters. The CWA requires that states adopt antidegradation policies and identify implementation methods to provide three levels of water quality protection to maintain and protect (1) existing water uses and the level of water quality, (2) high quality waters, and (3) outstanding national resource waters. The MPWSP would comply with the Federal Antidegradation Policy through the antidegradation policy implemented by California State Water Resources Control Board Resolution 68-18, as described below.

4.4.2.2 State

State Water Resources Control Board (SWRCB) Resolution 68-16 Anti-Degradation Policy

In 1968, the State Water Resources Control Board adopted an anti-degradation policy aimed at maintaining the high quality of waters in California through the issuance of Resolution No. 68-16 (“Statement of Policy with Respect to Maintaining High Quality Waters in California”). The policy prohibits actions that tend to degrade the quality of surface and groundwater. The Regional Water Quality Control Boards oversee this policy (SWRCB, 1968). The anti-degradation policy states that:

- Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies.
- Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters must meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.

SWRCB has interpreted Resolution No. 68-16 to incorporate the federal anti-degradation policy, which applies if a discharge that began after November 28, 1975 would lower existing surface and groundwater quality.

This policy would apply to the treated water to be injected into the proposed ASR injection/extraction wells because this element would be required to comply with the state resolution maintaining the existing water quality. The RWQCB currently regulates the ASR operation under Permit 20808C, which monitors water quality of the ASR injection. Through compliance with Permit 2080C, water quality would be maintained and would, therefore, be consistent with SWRCB State Water Board Resolution 68-16.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Division 7 of the California Water Code) provides the basis for water quality regulation within California and defines water quality objectives as the limits or levels of water constituents established for the reasonable protection of beneficial uses. The SWRCB administers water rights, water pollution control, and water quality functions throughout California, while the Central Coast RWQCB conducts planning, permitting, and enforcement activities. The Porter-Cologne Act requires the RWQCB to establish a regional Basin Plan with water quality objectives, while acknowledging that water quality may be changed to some degree without unreasonably affecting beneficial uses. Beneficial uses, together with the corresponding water quality objectives, are defined as standards, per federal regulations. Therefore, the regional basin plans form the regulatory references for meeting state and federal requirements for water quality control. Changes in water quality are allowed if the change is consistent with the maximum beneficial use of the State waters, it does not unreasonably affect the present or anticipated beneficial uses, and it does not result in water quality less than that prescribed in the water quality control plans. The basin plan regulations also apply to groundwater. The Basin Plan for this location is discussed below in the local regulations subsection.

This Act would apply to the ASR injection/extraction wells because they would have potential to affect water quality and beneficial uses in the Basin through injection of desalinated water. Thus, the proposed project would be required to comply with the Basin Plan water quality objectives established by the Central Coast RWQCB to protect the beneficial uses of the groundwater. This is discussed in the Local Regulations subsection below. Through compliance with the Basin Plan's water quality requirements, the proposed project would be consistent with the Act.

Central Coast Regional Water Quality Control Plan (Basin Plan)

Under the Porter-Cologne Water Quality Control Act, the RWQCB is responsible for authorizing and regulating activities that may discharge wastes to surface water or groundwater resources. The California Water Code (Section 13240) requires the RWQCB to prepare and adopt water quality control plans, or Basin Plans. According to Section 13050 of the California Water Code, Basin Plans designate the waters within a specified area of beneficial uses to be protected, water quality objectives to protect those uses, and a plan to meet the objectives. One significant difference between the State and Federal programs is that California's Basin Plan established standards for groundwater in addition to surface water.

The Basin Plan for the Central Coast, originally adopted in 1971 and last amended in 2011, identifies the beneficial uses of water bodies and provides water quality objectives and standards for waters of the Central Coast of California. The listed beneficial uses for groundwater resources are

- Agricultural water supply (AGR)
- Municipal and domestic water supply (MUN)
- Industrial use (IND)

General objectives are established for taste, odor, and radioactivity; for municipal and domestic supply, additional general objectives are established for bacteria, organic chemicals, and various chemical constituents; and for agricultural supply, general objectives follow the guidelines for water quality from the University of California Agricultural Extension Service. In addition, agriculture supply must be handled such that no controllable water quality factor shall degrade the quality of any groundwater resource or adversely affect long-term soil productivity.

The RWQCB has established water quality objectives for selected groundwater resources; these objectives serve as a basis for evaluating water quality management in the basin. Specific water quality objectives have been defined for the 180-Foot Aquifer and 400-Foot Aquifer for the SVGB, as listed in **Table 4.4-6** below.

**TABLE 4.4-6
 GROUNDWATER QUALITY OBJECTIVES**

| Aquifer | Total Dissolved Solids | Chloride | Sulfate | Boron | Sodium | Nitrate as Nitrogen |
|----------------|-------------------------------|-----------------|----------------|--------------|---------------|----------------------------|
| 180-Foot | 1500 | 250 | 600 | 0.5 | 250 | 1 |
| 400-Foot | 400 | 50 | 100 | 0.2 | 50 | 1 |

NOTES: All concentration are in milligrams per liter (mg/L)
 SOURCE: RWQCB, 2011b.

The Basin Plan would apply to the treated water to be injected into the proposed ASR injection/extraction wells because it could affect the quality and beneficial uses of the Basin’s groundwater. Accordingly, these project elements would be subject to regular water quality monitoring by the RWQCB. This water quality monitoring would ensure that any deviation from the established objectives is identified and corrected pursuant to Basin Plan requirements.

Central Coast Regional Water Quality Control Board – Resolution R3-2008-0010, General Waiver for Specific Types of Discharges

In conjunction with the SWRCB Order No. 2003-0003-DWQ, described above, Resolution No. R3-2008-0010 waives the submittal of Reports of Waste Discharge and the issuance of Waste Discharge Requirements for certain low volume discharges with minimal pollutant concentrations. The order includes well development water, monitoring well purge water, and boring waste discharge. This order would allow the listed wastes to be discharged directly to the land surface as long as the discharge is implemented in a controlled manner that does not cause erosion or other adverse effects. The RWQCB Regional Water Board's Resolution includes the

injection and extraction of treated groundwater, such as with the ASR system, as long as the RWQCB Regional Water Board reviews and approves of the system design and operation. The anticipated volumes and quality of well development water, monitoring well purge water, and soil boring waste discharge generated by the proposed project would comply with the requirements of this resolution, thereby ensuring project consistency.

Division of Water Rights Permit 20808C – Amended Permit for Diversion and Use of Water

In 1995, the State Water Board issued Permit 20808 to the Monterey Peninsula Water Management District (MPWMD) for the proposed Los Padres Reservoir project. The permit was later split and modified several times, and now addresses additional requirements for the diversion of surface and under stream flow from the Carmel River, protection of the Carmel Lagoon and fish habitat, and the injection and storage of Carmel River water in the Seaside Basin using the ASR injection/extraction wells. Permit 20808C set requirements for the ASR system and established a maximum annual Carmel River diversion of 2,900 afy for injection and storage in the Seaside Basin, timing and monitoring requirements for diversion, fish protection measures, and rules for the recovery of the stored water. The current annual volume of stored water that can be recovered is 1,500 afy, plus unrecovered carryover water from previous years, if available. In addition, the volume of recovered water may not exceed 1,500 af for a given year if the volume of water injected that year, plus carryover from previous years, does not equal 1,500 af. In that case, only the volume of water injected that year, plus whatever carryover water is available may be recovered. Implementation of the proposed project would allow CalAm to more effectively utilize its Carmel River water rights by increasing its capacity to inject water for storage when river flows are sufficiently high to allow for diversion. CalAm is presently operating within the terms of the permit and nothing about the proposed project would change its ability to operate consistent with the permit.

State Water Resources Control Board Order No. 2003-0003-DWQ, Statewide General Waste Discharge Requirements for Discharges to Land with a Low Threat to Water Quality

SWRCB Order No. 2003-0003-DWQ established statewide Waste Discharge Requirements regulating certain low-volume discharges that contain minimal pollutant concentrations, thus allowing for their discharge to land without the preparation of a Report of Waste Discharge. The order includes provisions to address well development water, and to monitor well purge water and the discharge of material generated during drilling. This order allows discharge of the listed wastes directly to the land surface as long as the discharge is implemented in a controlled manner that does not cause erosion or other adverse effects. The Central Coast RWQCB General Order WQ-2011-0223, *Waste Discharge Requirements NPDES General Permit for Discharges with Low Threat to Water Quality*, and its Resolution R3-2008-0010, *General Waiver for Specific Types of Discharges*, provide additional details on how this order would apply to the proposed project. The anticipated volumes and quality of well development water, monitoring well purge water, and soil boring waste discharge would be in quantities typical for temporary water well drilling projects in areas with no existing groundwater contamination. Thus, the proposed project's well development discharges would be consistent with the Order.

Sustainable Groundwater Management Act

Adopted in 2014, the Sustainable Groundwater Management Act (SGMA) provides local agencies the capability to customize groundwater sustainability plans to their regional economic and environmental needs. SGMA creates a framework for sustainable, local groundwater management in California. The DWR and the SWRCB are the lead state agencies responsible for developing regulations and reporting requirements necessary to carry out SGMA. DWR sets basin prioritization, basin boundaries, and develops regulations for groundwater sustainability. The SWRCB is responsible for fee schedules, data reporting, probationary designations and interim sustainability plans (DWR, 2016a). The State of California has designated the Salinas Valley as a priority basin and stakeholders have been working since 2015 to form a Groundwater Sustainability Agency for the Salinas Valley. The MPWMD applied to alter the boundaries of the Seaside/Corral de Tierra areas so they are similar to the adjudicated boundaries of the Seaside Basin. While the SGMA does not have a direct impact on the MPWSP, it is included here as it is new legislation affecting both the Salinas Valley Groundwater Basin and the boundaries of the adjudicated Seaside Basin. The proposed project would not adversely affect groundwater management in the Basin, because it would be extracting groundwater that is not presently being used as a potable or an irrigation supply. Rather, when considering seawater intrusion and water surface elevations in the 400-Foot Aquifer, the proposed project may have a positive contribution to the sustainable management of groundwater. Regarding the former, groundwater modeling shows that the proposed project would retard the advance and limit the ultimate inland extent of seawater intrusion. With respect to the latter, by returning in-lieu desalinated water to the CCSD, the proposed project would provide recharge benefits to groundwater levels in the 400-Foot Aquifer. For these reasons, the proposed project would not conflict with the SGMA.

4.4.2.3 Regional and Local

MCWRA Act (1995) (Agency Act)

In accordance with the Agency Act, MCWRA is charged with preventing the waste or diminution of the water supply in its territory by, among other things, controlling groundwater extractions and prohibiting groundwater exportation from the SVGB (MCWRA, 1995). Specifically, section 9(v) of the Agency Act provides that MCWRA has the power:

To prevent the export of groundwater from the SVGB, except that use of water from the basin on any part of Fort Ord shall not be deemed such an export. Nothing in this act shall be deemed to prevent the development and use of the Seaside Groundwater Basin for use on any lands within or without that basin.

If any person or entity attempts to export groundwater from the SVGB, the MCWRA may seek an injunction from the Monterey Superior Court to prohibit such export.

The Agency Act further authorizes the MCWRA to commission groundwater studies to determine whether any portion underlying its territory is threatened with the loss of useable groundwater supply and to adopt an ordinance prohibiting further extraction of groundwater from an area and depth defined by the MCWRA.

As discussed more fully in Section 2.7, Water Rights, given the locations of the slant well screens beyond the jurisdictional boundaries of the County, it is not clear whether the Agency Act applies to the proposed project. However, as further discussed in that section, were the Agency Act to apply, it is preliminarily reasonable to conclude that the proposed project would be consistent. This is because the proposed project would return to the SVGB any incidentally extracted useable groundwater. The water available for export would be new supply, or developed water, not extracted from the SVGB.

MCWRA Ordinance 3709

MCWRA Ordinance 3709 prohibits drilling into and pumping groundwater from the 180-Foot Aquifer within specific onshore areas, designated as Territories A and B (MCWRA, 1993). The proposed seawater intake system would be located at the westernmost edge of Territory B. Although the wells would be drilled within Territory B, the source water for the proposed project would be extracted from beneath the ocean floor, an area not located within the restrictive territories identified by Ordinance 3709. As with the Agency Act, it is not clear that the MCWRA Ordinance 3709 applies to the proposed project. However, for the same reasons presented above, if it were to apply, it is preliminarily reasonable to conclude that the proposed project would be consistent. This issue is discussed further in Section 2.7, Water Rights.

Seaside Groundwater Basin Watermaster (California Superior Court, Monterey California, Case No. M66343)

In 2006, through the adjudication of the Seaside Basin, the Monterey County Superior Court created the Seaside Groundwater Basin Watermaster. The purpose of the Watermaster is to assist the court in administering and enforcing the provisions of the judgment, which pertains to the oversight and management of Seaside Groundwater Basin resources. The Watermaster's objective is to help resolve the problems of lowered groundwater levels and the threat of seawater intrusion, which are the result of over-pumping. A primary objective of the proposed project is to reduce drawdown of Seaside Basin groundwater levels. Thus, through its implementation, the proposed project would be consistent with the adjudication of the Seaside Basin.

4.4.2.4 Consistency with Applicable Regional and Local Land Use Plans and Policies Relevant to Groundwater

Table 4.4-7 describes the regional and local land use plans, policies, and regulations pertaining to groundwater that are relevant to the MPWSP and that were adopted for the purpose of avoiding or mitigating an environmental effect. Section 4.8, Land Use, Land Use Planning, and Recreation, presents a general overview of these policy documents. Also included in **Table 4.4-7** is an analysis of project consistency with such plans, policies, and regulations. The analysis concludes that the proposed project would not conflict with any applicable plan, policy, or regulation, as noted in the table.

**TABLE 4.4-7
APPLICABLE REGIONAL AND LOCAL PLANS AND POLICIES RELEVANT TO GROUNDWATER RESOURCES**

| Project Planning Region | Applicable Plan | Plan Element/ Section | Project Component(s) | Specific Plan, Policy, or Ordinance | Relationship to Avoiding or Mitigating a Significant Environmental Impact | Project Consistency with Plan, Policy, or Ordinance |
|--|------------------------------|-----------------------|--|--|---|--|
| City of Marina (coastal zone & inland areas) | Marina Municipal Code | Water Wells | Subsurface slant wells and monitoring wells for Seawater Intake System | Section 13.12.030 Permit—Required. No person shall construct, repair, reconstruct, abandon, or destroy any well unless a written permit has first been obtained from the County of Monterey. | This policy is intended to protect public health and safety by ensuring wells are properly constructed, maintained, and decommissioned. | <u>Consistent:</u> The applicant proposes and would be required to obtain a Well Construction Permit from the Monterey County Department of Environmental Health prior to commencement of project well construction. |
| County of Monterey (coastal zone & inland areas) | Monterey County Code | Water Wells | Subsurface slant wells and monitoring wells for Seawater Intake System | Section 15.08.030 Permit—Required a. No person shall construct, repair, reconstruct or destroy any well, abandoned well, cathodic protection well, observation well, monitoring well, or test well unless a written permit has first been obtained from the Health Officer of the County or his or her authorized representative as provided in this Chapter. | This policy is intended to protect public health and safety by ensuring wells are properly constructed, maintained, and decommissioned. | <u>Consistent:</u> The applicant proposes and would be required to obtain a Well Construction Permit from the Monterey County Department of Environmental Health prior to commencement of project well construction. |
| County of Monterey (coastal zone & inland areas) | Monterey County Code | Water Wells | Subsurface Slant Wells and monitoring wells for Seawater Intake System | Section 15.08.110 Technical Standards a. Standards. Standards for the construction, repair, reconstruction of or destruction of wells shall be as set forth in Chapter II and Appendices A, B, C D of the Department of Water Resources Bulletin No. 74-81, "Water Well Standards" (December, 1981). | This policy is intended to protect public health and safety by ensuring wells are properly constructed, maintained, and decommissioned. | <u>Consistent:</u> All wells within the State of California are required to be constructed in compliance with DWR Bulletin 74-81. |
| County of Monterey (coastal zone & inland areas) | Monterey County General Plan | Public Services | Source Water Pipeline, MPWSP Desalination Plant, Desalinated Water Pipeline, Brine Discharge Pipeline, Salinas Valley Return Pipeline, Carmel Valley Pump Station, Main System--Hidden Hills and Ryan Ranch--Bishop Interconnection Improvements | Policy PS-2.8: The County shall require that all projects be designed to maintain or increase the site's pre-development absorption of rainfall (minimize runoff), and to recharge groundwater where appropriate. Implementation shall include standards that could regulate impervious surfaces, vary by project type, land use, soils and area characteristics, and provide for water impoundments (retention/detention structures), protecting and planting vegetation, use of permeable paving materials, bioswales, water gardens, and cisterns, and other measures to increase runoff retention, protect water quality, and enhance groundwater recharge. | This policy is intended to minimize the impacts of new impervious surfaces to increase runoff retention, protect water quality, and enhance groundwater recharge. | <u>Consistent:</u> Most of the Seawater Intake System and water conveyance pipelines would be buried below the ground surface, mainly within existing developed or disturbed areas, and would therefore result in no effect on the absorption of rainfall. The MPWSP Desalination Plant and the Carmel Valley Pump Station would be constructed in unpaved areas and all rainwater would be routed to the permeable surrounding sandy soils. |
| County of Monterey (coastal zone & inland areas) | Monterey County General Plan | Public Services | Source Water Pipeline, MPWSP Desalination Plant, Desalinated Water Pipeline, Brine Discharge Pipeline, Salinas Valley Return Pipeline, Carmel Valley Pump Station, Main System--Hidden Hills and Ryan Ranch--Bishop Interconnection Improvements | Policy PS-2.9: The County shall use discretionary permits to manage construction of impervious surfaces in important groundwater recharge areas in order to protect and manage groundwater as a valuable and limited shared resource. Potential recharge area protection measures at sites in important groundwater recharge areas may include, but are not limited to, the following: a. Restrict coverage by impervious materials. b. Limit building or parking footprints. c. Require construction of detention/retention facilities on large-scale development project sites overlying important groundwater recharge areas as identified by Monterey County Water Resources Agency. The County recognizes that detention/retention facilities on small sites may not be practical, or feasible, and may be difficult to maintain and manage. | This policy is intended to preserve impervious surfaces to increase runoff retention, protect water quality, and enhance groundwater recharge. | <u>Consistent:</u> Most of the Seawater Intake System and water conveyance pipelines would be buried below the ground surface, mainly within existing developed or disturbed areas, and would therefore result in no effect on recharge. The MPWSP Desalination Plant and the Carmel Valley Pump Station would be constructed in unpaved areas and all rainwater would be routed to the permeable surrounding sandy soils. |
| County of Monterey (coastal zone & inland areas) | Monterey County General Plan | Safety | Source Water Pipeline, MPWSP Desalination Plant, Desalinated Water Pipeline, Brine Discharge Pipeline, Salinas Valley Return Pipeline, Carmel Valley Pump Station, Main System--Hidden Hills and Ryan Ranch--Bishop Interconnection Improvements | Policy S-3.2: Best Management Practices to protect groundwater and surface water quality shall be incorporated into all development. | This policy is intended to protect surface water and groundwater quality from impacts of development. | <u>Consistent:</u> The proposed project would be subject to the State Construction General Permit, the Monterey County Grading Ordinance, the Monterey County Erosion Control Ordinance, and the RWQCB Resolution R3-2013-0032c, which require the implementation of specific construction-related BMPs to prevent concentrated stormwater run-on/runoff, soil erosion, and release of construction site contaminants. Surface water quality is also discussed in Section 4.3 Surface Water Hydrology and Water Quality. |
| County of Monterey (coastal zone) | North County Land Use Plan | Water Resources | Source Water Pipeline and New Desalinated Water Pipeline, | Policy 2.5.1: The water quality of the North County groundwater aquifers shall be protected, and new development shall be controlled to a level that can be served by identifiable, available, long term-water supplies... | This policy is intended to maintain the quality of groundwater resources and reduce overdraft of basin groundwater supplies. | <u>Consistent:</u> Water conveyance pipelines would be buried below the ground surface, mainly within existing developed or disturbed areas, and would therefore result in no effect on groundwater quality or recharge. |

**TABLE 4.4-7 (Continued)
APPLICABLE REGIONAL AND LOCAL PLANS AND POLICIES RELEVANT TO GROUNDWATER RESOURCES**

| Project Planning Region | Applicable Plan | Plan Element/ Section | Project Component(s) | Specific Plan, Policy, or Ordinance | Relationship to Avoiding or Mitigating a Significant Environmental Impact | Project Consistency with Plan, Policy, or Ordinance |
|--|---------------------|-----------------------|---|--|--|---|
| Fort Ord Reuse Authority (City of Seaside) | Fort Ord Reuse Plan | Conservation | ASR Conveyance Pipeline, ASR Pump-to-Waste Pipeline, ASR Settling Basin, Terminal Reservoir | Hydrology and Water Quality Policy A-1: At the project approval stage, the City shall require new development to demonstrate that all measures will be taken to ensure that runoff is minimized and infiltration maximized in groundwater recharge areas. | This policy is intended to preserve impervious surfaces to increase runoff retention, protect water quality, and enhance groundwater recharge. | <u>Consistent:</u> The above-ground components of the proposed ASR system would be constructed in unpaved areas. All rainwater would be routed to the surrounding unpaved sandy areas and allowed to infiltrate into the subsurface as recharge. The below-ground components would not affect groundwater recharge. |

SOURCES: FORA, 1997; Monterey County, 1982; Monterey County, 2010

4.4.3 Evaluation Criteria

Implementation of the proposed project would have a significant impact related to groundwater resources if it would:

- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted);
- Violate any ground water quality standards or otherwise degrade groundwater quality.

The following descriptions have been developed to elaborate on how these criteria are applied in the impact analyses in Sections 4.4.5.1 and 4.4.5.2, below. Implementation of the proposed project would be considered to have a significant impact associated with groundwater resources if:

- Construction reduced groundwater supplies, or substantially hindered the ability of surface water to recharge the aquifer, resulting in lower groundwater levels.
- Construction discharges to groundwater exceeded water quality standards or otherwise degraded groundwater quality.
- Extraction from the subsurface slant wells substantially depleted groundwater in the SVGB such that there would be a net deficit in aquifer volume.
- Extraction from the subsurface slant wells lowered groundwater levels in the Dune Sand Aquifer or the 180-Foot Equivalent Aquifer so that nearby municipal or private groundwater production wells experienced either a substantial reduction in well yield or physical damage due to exposure of well screens and well pumps.
- Operation of the proposed ASR injection/extraction wells resulted in groundwater mounding, change in groundwater gradients, or lower groundwater levels such that nearby municipal or private groundwater production wells experienced either a substantial reduction in well yield or physical damage due to exposure of well pumps or screens.
- Extraction from the subsurface slant wells interfered substantially with groundwater recharge.
- Extraction from the subsurface slant wells adversely affected groundwater quality by exacerbating seawater intrusion in the SVGB.
- Injection of desalinated water treated to drinking water standards degraded the quality of native groundwater in the SVGB.
- Operation of the proposed ASR injection/extraction wells were to result in discharges to groundwater resources that degrade groundwater quality

4.4.4 Approach to Analysis

Four primary sources of data and information were used to guide the impact analysis presented in this section: 1) information obtained through subsurface investigations commissioned by CalAm; 2) groundwater modeling; 3) the SWRCB Final Review of California American Water Company's Monterey Peninsula Water Supply Project; and 4) CalAm operating rules for injection and extraction of desalinated water by ASR. The following sections describe the details of these four elements of the impact analysis methodology.

4.4.4.1 Subsurface Investigations

Until recently, the general understanding of the subsurface geology near the CEMEX site was limited to information obtained from a few nearby wells, or from detailed investigations at distant locations, such as Marina State Beach or the former Fort Ord. Recognizing the need to obtain additional subsurface information to design the proposed project, CalAm commissioned a subsurface soil and groundwater investigation at the CEMEX site and at an alternate intake location at Potrero Road. These field investigations acquired supplemental information on subsurface geologic units, the hydrogeologic properties of those units, and the current aquifer water quality. This information in turn was used to better understand the hydrogeologic conditions, and to refine input parameters of the groundwater modeling. Additionally, obtaining data on subsurface stratigraphy and groundwater chemistry at various depth intervals helped refine and optimize construction details of the proposed slant wells.

The investigations included drilling exploratory boreholes to identify and correlate the subsurface geologic units, to collect groundwater quality data, and to build clusters of monitoring wells. The details of the subsurface exploration, including boring logs, well construction details, field screening tests results, and laboratory analytical results, are presented in a July 2014 report titled: *Monterey Peninsula Water Supply Project Hydrogeologic Investigation Technical Memorandum TM 1, Summary of Results - Exploratory Boreholes*. The Hydrogeological Working Group peer reviewed TM1 before the final document was released. TM1 is included in **Appendix C3**, and is also discussed in Section 4.2, Geology, Soils, and Seismicity.

Test Slant Well

CalAm installed the test slant well to further evaluate subsurface conditions and to test the response of the Dune Sand Aquifer, the 180-FTE Aquifer, and the 400-Foot Aquifer to pumping. The results have been used to refine the groundwater models and inform the analysis of the proposed project. The first phase of the test slant well investigation began with the construction of a 724-foot long test well drilled at an angle of 19 degrees below horizontal at the CEMEX site. Special Condition 11 of the Coastal Development Permit, "Protection of Nearby Wells," requires the MPWSP HWG to establish baseline water and TDS levels prior to commencing the long term pumping tests (Geoscience 2015b). The long-term pumping test began in mid-April 2015, and results are available at <http://www.watersupplyproject.org/#!test-well/c1f11>.

Monitoring Wells Installation and Testing

To monitor the response of the aquifers to pumping from the test slant well and verify that the aquifers would respond as simulated by the groundwater modeling discussed below, CalAm installed a network of monitoring well clusters at the locations shown on **Figure 4.4-9**, along with a water level data logger in the pond that CEMEX uses to dredge sand (Geoscience, 2016b). The details of the subsurface exploration including boring logs, well construction details, field screening tests results, and laboratory analytical results are presented in a report titled: *Monterey Peninsula Water Supply Project, Hydrogeologic Investigation, Technical Memorandum (TM2) Monitoring Well Completion Report and CEMEX Model Update* (Geosciences, 2016b). The Hydrogeological Working Group peer reviewed TM2 before the final document was released; that document is also discussed in Section 4.2, Geology, Soils, and Seismicity. Four of the monitoring well clusters are located west to east along the CEMEX access road, from near the proposed slant wells to near the CEMEX facility entrance. Monitoring well clusters were also installed at the proposed desalination plant site on Charles Benson Road, at the intersection of Lapis Road and Del Monte Road, and along West Blanco Road about 4 miles southeast of the CEMEX site. The clusters monitor water levels and chemistry in the Dune Sand, 180-FTE, and 400-Foot Aquifers. Groundwater elevation and water quality data developed from monitoring the cluster wells are presented in the impact analysis, below.

4.4.4.2 Groundwater Modeling

Groundwater modeling was a primary analytical tool used to evaluate project impacts on groundwater resources. This section describes the groundwater models and how they were used to simulate the groundwater response to the proposed pumping. The results of the groundwater modeling are presented in *North Marina Groundwater Model Review, Update, and Implementation for Future Slant Well Pumpage Scenarios*, August 12, 2016, prepared by HydroFocus, Inc. (**Appendix E2**).

Groundwater Models

What is a Groundwater Model?

Groundwater models are computer simulations that represent water flow in the environment using mathematical equations. By mathematically representing a simplified version of a hydrogeological system, the effects of reasonable groundwater pumping scenarios can be simulated, evaluated, and compared to determine their effects on an aquifer system. The applicability or usefulness of the model depends on how closely the mathematical equations approximate the physical system being modeled.

Groundwater models consist of individual *cells* in a model *domain*. A domain is the entire area and depth within which the model simulates subsurface conditions. The domain is made of smaller units called cells, which represent a defined three-dimensional area, the size of which is dependent on the coverage area of the model. For example, models that cover an entire groundwater basin of many square miles may have cells that represent one square mile area each,

while models designed to evaluate smaller areas have cells representing only 200 square feet. Each cell contains information about the occurrence and flow of groundwater at that particular location. Using subsurface hydrogeological information from soil borings, well logs, and geologic mapping, each cell is assigned, or populated with, parameters to describe how water moves through that cell. Parameters typically include hydraulic conductivity (the ability of water to flow through a given material), permeability and porosity (the relative amount of open spaces between grains in the geologic material), and the direction of water flow into and out of each of the model cells. Vertical layers are then established based on the subsurface geologic characteristics, such as permeable aquifer zones and less permeable aquitards. After the cells are populated, the model is calibrated with actual groundwater information (depth, hydraulic conductivity, etc.) so that the model can better represent real world conditions.

Once the model has been populated and calibrated, it can be used to predict the effects of hydrological changes, like groundwater extraction, on the behavior of the aquifer or aquifers. The models used for this analysis tested the anticipated response of the aquifer or aquifers to various operating scenarios. The scenarios considered changes in land use conditions, rate and location of project pumping, and implementation of other water supply projects. The results of the scenarios are also compared against baseline, or current, conditions to determine and identify potential effects or impacts.

Limitations of Groundwater Models

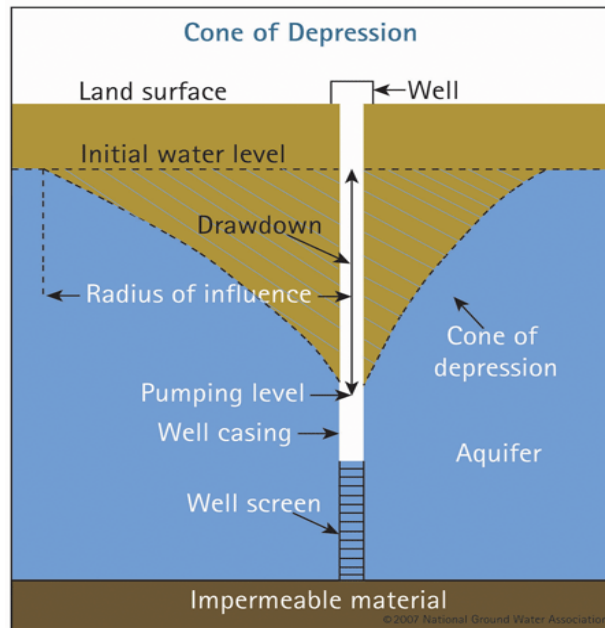
Groundwater models simulate aquifer conditions based on a specific set of data that describes parameters such the subsurface characteristics, groundwater flow, and land use. The more robust the data set, the more capable the model will be to accurately simulate subsurface conditions. Most groundwater models use conservative input parameters so that the output overstates the actual aquifer response. Nevertheless, groundwater models are mathematical-based computer programs that rely on input parameters and, consequently, there is a degree of uncertainty. However, the models used to analyze the proposed project have been used previously and have benefited from input data derived from site-specific subsurface information. Given that, and given the fact that these models were calibrated with known data, the level of degree of uncertainty for this analysis is considered tolerable.

Groundwater Model Terminology

Certain terminology is used in groundwater modeling to describe and illustrate the nature, extent, and movement of groundwater in aquifers, and the response of the aquifers to changes, such as pumping. In addition to calculated values (e.g., changes in the volume of water in storage), the spatial results of the model simulations are commonly expressed as maps that show the simulated response to the pumping of the wells under various scenarios. The maps show the cone of depression, the radius of influence, and particle tracking, terms that are described and illustrated below.

- **Cone of depression** – As water is extracted from a well, it is pulled into the screened section of the slant wells and removed from the subsurface water-bearing unit. Groundwater elevations would decrease around the slant wells in a radial fashion, resulting in a cone of

drawdown centered at the slant wells. This cone would be the steepest and deepest closest to the well screen and rapidly become flatter and shallower away from the slant wells.



SOURCE: http://www.ngwa.org/Fundamentals/use/PublishingImages/cone_of_depression.gif

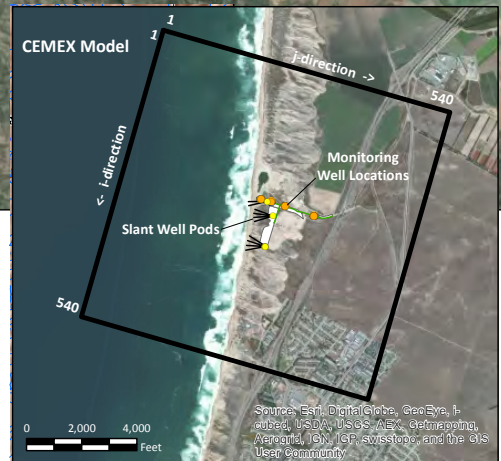
- **Radius of influence** – The radial extent of the area affected by the slant wells—that is, the area within which water levels are anticipated to decrease—is called the radius of influence. The anticipated affected area is depicted using groundwater elevation contour maps. Similar to topographic elevation contours, groundwater contours show the shape and elevations of the groundwater surface. The maximum radius of influence is typically defined as the distance by which the water levels are anticipated to decrease by some amount, such as one foot.
- **Particle tracking** – Using the groundwater elevation maps, the groundwater model can also generate particle tracking maps. Particle tracking maps show the flow path of a particle of water over time. In forward tracking, a particle is placed at a specific cell in the model domain and the model then simulates the path the particle of water will take through other cells as model time moves forward. In reverse tracking, the model simulates the path of where the particle came from, to identify its source.

North Marina Groundwater Model

The NMGWM is a detailed hydrologic computer model covering approximately 149 square miles and includes Elkhorn Slough to Prunedale on the north side, Prunedale to south of Salinas on the east side, south of Salinas to just north of the Fort Ord Dunes State Park on the south side, and extending into Monterey Bay (**Figure 4.4-12**). The NMGWM was originally developed in 2008, integrating information from the regional-scale Salinas Valley Integrated Groundwater and Surface Water Model (SVIGSM) including aquifer parameters, recharge and discharge terms, and boundary conditions in the North Marina area.



----- North Marina Groundwater Model Boundary



SOURCE: Geoscience, 2015c

205335.01 Monterey Peninsula Water Supply Project
Figure 4.4-12
 Groundwater Model Boundaries

The NMGWM is based on model codes of MODFLOW. MODFLOW is a modular finite-difference flow model, which is a computer code that solves the groundwater flow equation. MODFLOW is public domain software that the U.S. Geological Survey developed in the early 1980s. Since MODFLOW's release, the USGS has released numerous updated versions, and MODFLOW is now the de facto standard code for aquifer simulation.

The cell size of the NMGWM is 200 feet by 200 feet oriented along 300 rows and 345 columns, and eight layers of variable thicknesses. Details of the review, update, and refinement of the NMGWM used for this analysis, is presented in **Appendix E2**.

The NMGWM considers the combination of the Dune Sand Aquifer and the 180-FTE as the source aquifers for project source water. Consequently, the modelers added an additional model layer for the Dune Sand Aquifer. The addition of the new model layer was based on the results of the site-specific borings, review and extension of existing geologic cross-sections, creation of revised geologic cross-sections, and evaluation of recent aquifer parameter information for the area. **Table 4.4-8** presents a correlation of geologic units, aquifers, and model layers.

The areal extent and thickness of other model layers were also refined using that same information. The NMGWM model layers and associated parameters such as horizontal and vertical hydraulic conductivity,¹⁸ specific storativity,¹⁹ specific yield,²⁰ and leakage²¹ were refined using the data collected from the site-specific hydrogeologic investigations (Geoscience, 2013c). In addition, the NMGWM model incorporates the anticipated changes in sea level rise due to global climate change (ESA, 2013).

The following terms and concepts associated with the NMGWM are important to understand while reviewing the impact analyses for groundwater resources presented in this section.

Appendix E2 contains some additional details.

Superposition Groundwater Modeling

For this project, the NMGWM is converted to a superposition model and only solves for the groundwater changes due solely to the proposed project. These changes are independent of the effects from the other stresses on the basin such as seasonal climate and agricultural pumping trends, other pumping wells, injection wells, land use, or contributions from rivers. By using superposition, the actual effects of only the proposed project can be isolated from the combined effects of all other basin activity. For example, when the NMGWM reports a 1-foot drawdown in a well, it is understood that the one foot of drawdown would be the effect on the basin of the proposed project only. That well may experience greater drawdown due to other stresses, such as drought or other nearby pumping wells, or may experience increases in water levels due to

¹⁸ Hydraulic conductivity is the rate of water flow through a cross sectional area of an aquifer.

¹⁹ Specific storativity is the amount of water taken out or put back into a unit volume of an aquifer when the water level changes.

²⁰ Specific yield is the amount of water that will drain from an aquifer just due to gravity.

²¹ Leakage is the flow of water from one hydrogeologic unit to another. The leakage may be natural, as through a semi-impervious confining layer, or human-made, as through an uncased well.

**TABLE 4.4-8
CORRELATION OF GEOLOGIC UNITS, AQUIFERS, AND MODEL LAYERS**

| 180/400-Foot Aquifer Subbasin | | | CEMEX Area | | | Models and Corresponding Horizontal Model Layers | |
|---|-----------------------------------|-----------------------------|----------------------------------|-----------------------------------|-----------------------------|--|-------------|
| Surface Geologic Units | Surface Geologic Units Map Symbol | Hydro-stratigraphic Units | Surface Geologic Units | Surface Geologic Units Map Symbol | Hydro-stratigraphic Units | North Marina Groundwater Model (NMGWM) | CEMEX Model |
| Ocean Floor | Qf | Ocean Floor | Ocean Floor | Qf | Ocean Floor | 1 | 1 |
| Alluvium | Qal(a) | Perched "A" Aquifer | Dune Sand | Qd | Dune Sand Aquifer | 2 | 2 |
| | | | Older Dune Sand | Qod | | | 3 |
| | | | | | | | 4 |
| Older Alluvium | Qo | Salinas Valley Aquitard | Older Terrace/ Marine Terrace | Qt (Qmt) | 180-Foot Aquifer Equivalent | 3 | 5 |
| Older Alluvium/ Marine Terrace | Qo/Qmt | 180-Foot Aquifer Equivalent | | | | 4 | 6 |
| Older Alluvium/ Older Alluvial Fan - Antioch | Qo/Qfa | | | | | 7 | |
| Older Alluvial Fan – Placentia | Qfp | 180/400-Foot Aquitard | Aromas Sand | Qar | 180/400-Foot Aquitard | 5 | 9 |
| Aromas Sand (Undifferentiated) | Qae | 400-Foot Aquifer | | | 400-Foot Aquifer | 6 | 10 |
| Aromas Sand – Eolian Facies | Qae | | | | | | |
| Paso Robles Formation | QT | 400-900-Foot Aquitard | Paso Robles Formation | QT | 400-900-Foot Aquitard | 7 | 11 |
| | | 900-Foot Aquifer | | | 900-Foot Aquifer | 8 | 12 |

NOTES:

^a Subsurface Holocene geologic unit not mapped at surface

SOURCE: Geoscience, 2015c.

reduced regional pumping or an extremely wet year. But the proposed project's contribution to that drawdown in the well would remain only 1-foot. Superposition is described in **Appendix E2**, Section 5.2.

Return Water Considerations

The MPWSP proposes to return a certain fraction of water (referred to here as return water) extracted by the slant wells to water users in SVGB as desalinated product water. As a brief review, the Agency Act does not allow groundwater pumped from the SVGB to be exported for any use outside the SVGB (See full discussion in Chapter 2.7, Water Rights). Since the groundwater in this area has been intruded by seawater for decades, the proposed slant wells at CEMEX would extract brackish water, which is a mixture of ocean water and water originating from the inland aquifers of the basin. The freshwater portion of the brackish source water that originated from the inland aquifers would constitute the proposed return water. To achieve consistency with the Agency Act, the MPWSP proposes to return the freshwater component of the brackish water that is extracted through the slant wells. The exact quantity of water to be returned annually would vary and would be determined each year using a mathematical formula. However, for groundwater modeling and impact analysis purposes in this EIR/EIS, it is estimated that somewhere between 0 and 12 percent of the source water withdrawn for the project would comprise water originating from the inland aquifers, and thus would be returned to the basin. The water would be returned to the SVGB through deliveries of up to 800 afy of desalinated product water to the Castroville Community Services District (CCSD). This water would be piped to the CCSD and the CSIP and provided to water customers instead of their pumping an equal amount from the ground. This method of returning water is referred to as in-lieu recharge because the delivered water would reduce the need to pump groundwater in corresponding quantities. The NMGWM accounts for the 0 to 12 percent range by simulating the aquifer response in the various scenarios with a 0, 3, 6, and 12 percent returned product water.

Model Period

The model period for the NMGWM is 63 years. The model scenarios are run over a set time period, beginning with the baseline conditions and extending out to a future point in time, typically set as the life span of a given project. Over this time period, land use, climate conditions, and, if located along the coast, sea level rise would be expected to change. However, as discussed above, superposition modeling does not account for other stresses on the basin except for the effects on groundwater flow from projected sea level rise over the 63 years of modeled operations.

Sea Level Rise

Sea level along the coast of the Monterey Bay is expected to increase over the next six decades, resulting in a landward migration of the coastline and increased inland groundwater gradients at the coast. Sea level rise can influence the amount of ocean water extracted by slant wells and the resulting drawdown. An increase in sea level hastens the inland advance of ocean water above the underlying well screens, and as a result increases the potential for ocean water to flow into the wells. Between 2012 and 2073, sea level is projected to rise by 18.0 inches (ESA, 2013). The effects of sea level rise were integrated into the analysis by modeling the effects of the current sea

level and that expected after 63 years of pumping at the slant wells. The impact analysis refers to current sea level (sea level conditions in 2012, or Model Year 1) and sea level projected for the year 2073, or Model Year 61. Details of the use and application of sea level rise in the NMGWM for is described in **Appendix E2**, sections 4.3 and 5.2.

Model Scenarios

Modeling scenarios were developed to project the drawdown from groundwater pumping at the CEMEX site and the alternative location at Potrero Road, and to assess the uncertainty in drawdown to model assumptions and input. A full list of the modeling runs and assumptions is provided in **Appendix E2**, Table 5.2. The scenarios incorporated the slant well pumping rates, sea level rise, four return water percentages, and aquifer distribution in various configurations.

Calibration

Groundwater models are calibrated by comparing the output, such as simulated groundwater levels, to the groundwater levels measured in monitoring wells within the vicinity. The NMGWM was calibrated with information provided by the localized CEMEX Model, discussed below, and groundwater levels measured in the monitoring wells installed to evaluate slant well pumping. In addition, the NMGWM was calibrated to various monitoring wells in the vicinity, including those installed south of the CEMEX site near Fort Ord. See **Appendix E2** for detailed information on the NMGWM calibration methodology.

Sensitivity Analysis

Sensitivity analyses are performed to determine to what degree certain modeling parameters influence the output results. NMGWM development involved analysis of the sensitivity of model-calculated drawdown to uncertainty in pumping rates, return water volumes, and projected sea level rise. Uncertainty also exists in modeled aquifer parameters and relative contributions of the Dune Sand Aquifer and 180-FT/180-FTE Aquifer to total slant well pumpage. Sensitivity analyses were performed to determine the effects of the aquifer contribution between the Dune Sand Aquifer and the 180-FTE Aquifer and to assess whether varying extraction volumes from each aquifer would alter the modeling results. The NMGWM was run under the 0 percent return water scenario for three Dune Sand/180-FTE Aquifer distributions: 21/79, 44/56, and 66/34 percent. The 44/56 aquifer distribution is most likely and is assumed for the impact analyses below. Additional details on the sensitivity analyses performed for the NMGWM are provided in **Appendix E2**, Section 6.0.

Localized CEMEX Model

The CEMEX model is a MODFLOW-based model that was developed to more accurately model the local effects of slant well pumping. Because the monitoring well cluster locations on the CEMEX site are relatively close to the proposed slant well locations, and because the NMGWM cell size is 200 feet by 200 feet, it was possible that the slant wells and monitoring well clusters might be located in the same model cell. This proximity could reduce the ability of the NMGWM to simulate the changing conditions between the slant and monitoring wells and to estimate the

radius of influence during pumping. To address this, the CEMEX model was developed for the immediate area of the slant wells at the CEMEX site with a cell size of 20 feet by 20 feet (Geoscience, 2014a, 2015c, 2016b). The purpose of the CEMEX model is to better evaluate the localized effects of pumping the slant wells, including the cone of depression and the changes to salinity. Ultimately, the results of this localized model were incorporated into the NMGWM results. **Figure 4.4-12** shows the model boundaries of this CEMEX model.

Seaside Groundwater Basin Modeling

The proposed project includes the injection and storage of treated water in the Santa Margarita Sandstone in the SGB as an addition to the ASR program. Groundwater modeling was previously conducted as part of the development of the ASR program and was presented in the *Final Environmental Impact Report/Environmental Assessment for the Monterey Peninsula Water Management District Phase 1 Aquifer Storage and Recovery Project*, dated August 2006 (MPWMD, 2006). The 2006 ASR modeling results were used to understand the response of the aquifers in the SGB to changes and to inform basin management decisions, such as how to operate the ASR program. The results of the SGB modeling were used to evaluate the impacts of the proposed project on the SGB. The SGB model is described below.

The 2006 ASR modeling effort evaluated changes in groundwater levels and long term changes in groundwater storage in the Santa Margarita Aquifer from operation of the ASR wells. The groundwater model was developed utilizing the WinFlow software program, which simulates two-dimensional steady-state and transient groundwater flow, and used published aquifer parameters for the Santa Margarita aquifer. The model simulated the groundwater level and storage response based on an approximate injection volume of 2,426 af over the course of 183 days and extraction volume of 2,002 af over the course of 153 days, which represented the range of likely “extreme” injection and extraction conditions that could be encountered over the life of the ASR project. The results of the groundwater modeling indicated that long term operation of the ASR program would result in a beneficial impact on SGB storage and groundwater levels at existing water supply wells.

Subsequently, HydroMetrics developed the Seaside Basin Groundwater Model for the Seaside Groundwater Basin Watermaster based on MODFLOW-2005 and SEAWAT 2000 to assist with groundwater management decisions (HydroMetrics, 2009b). The model domain included both the Seaside Basin and the area outside and to the north of the Basin. The model simulates five geologic layers: the Aromas Sand, the upper Paso Robles Aquifer, the middle Paso Robles Aquifer, the lower Paso Robles Aquifer, and the Santa Margarita Sandstone/Purisima Formation. The model simulates groundwater conditions between January 1987 and December 2008. As a part of developing the conceptual model and groundwater simulation, HydroMetrics concluded that the Santa Margarita Sandstone is “highly confined beneath thick clay beds near the ocean, and it does not receive significant deep percolation recharge near the ocean.”

4.4.4.3 SWRCB Final Review of California American Water Company's Monterey Peninsula Water Supply Project

The SWRCB evaluation of the proposed project was considered as guidance for the analysis of groundwater impacts because it elucidates and provides context for the nexus between the thresholds of significance used in this section and recommendations and considerations of the SWRCB relative to water rights. Please refer to Chapter 2, Water Demand, Supplies, and Water Rights, which discusses the legal aspects in further detail.

To provide further clarification, on July 31, 2013, the SWRCB reviewed the proposed project (SWRCB, 2013). The SWRCB described its understanding of the physical setting, the components of the proposed project, and the legal analysis regarding the water to be produced by the slant wells.

The SWRCB reviewed the proposed project and provided specific investigation and modeling requirements to demonstrate that the proposed project “will not harm or cause injury to any other legal user of water” from the SVGB (SWRCB, 2013). The SWRCB identified three possible categories of injury that could occur from the MPWSP. The three foreseeable injuries that overlying users could experience are (1) a reduction in the overall availability of fresh water due to possible incidental extraction by the MPWSP; (2) a reduction in water quality in those wells in a localized area within the capture zone, or area of influence; and, (3) a reduction in groundwater elevations that requires users to expend additional pumping energy to extract water from the Basin.

From its review of the project, SWRCB stated that:

“Key factors will be: (1) how much fresh water Cal-Am extracts as a proportion of the total pumped amount, (to determine the amount of water, that after treatment, would be considered desalinated seawater available for export as developed water); (2) whether pumping affects the water table level in existing users’ wells, (3); whether pumping affects seawater intrusion within the Basin (4) how Cal-Am returns any fresh water it extracts to the Basin to prevent injury to others; and (5) how groundwater rights might be affected in the future if the proportion of fresh and seawater changes in the larger Basin area or the immediate area around Cal-Am’s wells.”

“If overlying groundwater users are protected from injury, appropriation of water consistent with the principles discussed in this report may be possible. To export water outside the Basin, Cal-Am must show 1) the desalinated water it produces is developed water, 2) replacement water methods to return water to the Basin are effective and feasible, and 3) the MPWSP can operate without injury to other users. A physical solution could be employed to assure all groundwater users rights are protected.”

The SWRCB recommended the following actions to support the conclusion of no harm:

“Studies are needed to determine the extent of the Dune Sand Aquifer, the water quality and quantity of the Dune Sand Aquifer, the extent and thickness of the SVA and the extent of the 180-Foot Aquifer.”

“The effects of the MPWSP on the Basin [i.e., the SVGB] need to be evaluated. Specifically, a series of test boring/wells would be needed to assess the hydrogeologic

conditions at the site. Aquifer testing also would be needed to establish accurate baseline conditions and determine the pumping effects on both the Dune Sand Aquifer and the underlying 180-Foot Aquifer. Aquifer tests should mimic proposed pumping rates.”

“Updated groundwater modeling will be needed to evaluate future impacts from the MPWSP. Specifically, modeling scenarios will need to be run to predict changes in groundwater levels, groundwater flow direction, and changes in the extent and boundary of the seawater intrusion front. Additional studies also will be necessary to determine how any extracted fresh water is replaced, whether through re-injection wells, percolation basins, or through existing recharge programs. It may also be necessary to survey the existing groundwater users in the affected area. The studies will form the basis for a plan that avoids injury to other groundwater users and protects beneficial uses in the Basin. To ensure that this modeling provides the best assessment of the potential effects of the MPWSP, it is important that any new information gathered during the initial phases of the groundwater investigation be incorporated into the groundwater modeling studies as well as all available information including current activities that could influence the groundwater quality in the Basin.”

4.4.4.4 Injection and Extraction of Desalinated Water for the ASR Program

The proposed project includes the injection, storage and extraction of treated water from the desalination plant into the Santa Margarita Sandstone in the SGB as an addition to the ASR program. CalAm would manage the injection and extraction of the Carmel River and desalinated water sent to the ASR system to avoid injecting water to, or extracting water from the ASR system, in a manner that might damage the aquifer, or exacerbate overdraft or seawater intrusion (CalAm, 2014). Specifically, the location of the existing groundwater depression in the SGB must be reviewed each year and extraction may only be conducted in wells located east (up gradient) of the center point of the depression and only in a certain preferential order (ASR wells first, then other specific production wells, as needed) to avoid pumping from near the coastline, which could accelerate seawater intrusion. See Section 3.4.2, Description of the Proposed Project provides additional details including the limitations on the rate of injection to prevent over-pressurization and compression of plugging materials in the injection wells.

4.4.5 Direct and Indirect Effects of the Proposed Project

The following impact analyses focus on potential effects on groundwater resources and water quality associated with the proposed project, MPWSP which includes 10 slant wells at CEMEX. The analyses of project impacts considered project plans, current conditions within the project area, applicable regulations and guidelines, and previous environmental assessments. **Table 4.4-9** summarizes the proposed project’s impacts and significance determinations related to groundwater resources.

**TABLE 4.4-9
 SUMMARY OF IMPACTS – GROUNDWATER RESOURCES**

| Impacts | Significance Determinations |
|--|-----------------------------|
| Impact 4.4-1: Deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level during construction. | NI |
| Impact 4.4-2: Violate any groundwater quality standards or otherwise degrade groundwater quality during construction. | LS |
| Impact 4.4-3: Deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level during operations so as to expose well screens and pumps. | LS |
| Impact 4.4-4: Violate any groundwater quality standards or otherwise degrade groundwater quality during operations. | LSM |
| Impact 4.4-C: Cumulative impacts related to Groundwater Resources | LS |

NOTES:
 NI = No Impact
 LS = Less than Significant impact, no mitigation proposed
 LSM = Less than Significant impact with mitigation

4.4.5.1 Construction Impacts and Mitigation Measures

Impact 4.4-1: Deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level during construction. (*No Impact*)

Impact 4.4-1 addresses the effects on groundwater resources that could occur during the construction of the proposed project. In accordance with the significance criteria (Section 4.4.3 above), a significant impact would occur if construction activity reduced groundwater supplies or substantially hindered the ability of surface water to recharge the aquifer, resulting in lower groundwater levels. Under the MPWSP, temporary groundwater use during installation of the slant wells and the ASR injection/extraction wells could deplete groundwater supplies. Impact 4.4-3, below, evaluates the operational impacts related to the decrease in recharge.

Water Supply for Slant Well and ASR Drilling and Construction

The proposed slant wells and ASR injection/extraction wells would be built using a dual-wall, reverse-circulation rotary drill rig.²² Some large-scale drilling projects (comparable to the proposed drilling and well construction) require large volumes of water during well drilling to reduce friction in the drill casing and to help flush rock fragments and pulverized cuttings generated from drilling out the borehole. The volume of water needed for the proposed slant well construction could be

²² Dual-wall, reverse-circulation rotary drilling uses a drilling rig with two rotary drives. One drive rotates the outer drilling casing into the subsurface with a hardened drive or cutting shoe, while the other drive rotates an inner drill pipe and cutting bit. In reverse circulation, air or water is pumped under pressure down between the outer drill casing and inner drill pipe, and air, water, and cuttings are returned to the surface in the inner drill pipe. Upon reaching the desired depth, the inner drill string is removed and the well casing, filter pack, and surface seal is built inside the outer casing, allowing the well to be built while holding the native formation materials back from the borehole. Upon completion, the outer casing is withdrawn, leaving the finished well in place.

between 4 to 5 million gallons, but there might be much less, and perhaps none, depending on how the drilling proceeds (Geoscience, 2014b). The water required for ASR injection/extraction well construction would be less. If the proposed project requires well drilling water, it would be purchased from an outside water purveyor and delivered to the drill site by truck; water would not be extracted from local groundwater sources. No impact on local groundwater supplies would occur because the water needed to build the wells would be provided from an offsite water purveyor and would not be extracted from local groundwater sources.

Water Supply for Pipelines and Other Facility Construction

The proposed project pipelines and MPWSP Desalination Plant, Terminal Reservoir, and Carmel Valley Pump Station would be built using standard construction methods that would require water for dust suppression, concrete washouts, tire washing, and general site maintenance. Water for these operations would be purchased from a local water purveyor and delivered to each construction site by truck. Construction of these facilities would use water in amounts that are typical for this type of project, and groundwater pumping would not be necessary. Therefore, construction of the pipelines and support facilities would not impact groundwater supplies.

Impact Conclusion

There would be no impacts associated with groundwater supplies and recharge during the construction of project facilities.

Mitigation Measures

None proposed.

Impact 4.4-2: Violate groundwater water quality standards or otherwise degrade groundwater quality during construction. (*Less than Significant*)

In accordance with the significance criterion (Section 4.4.3, above), a significant impact would occur if construction discharges to groundwater exceeded water quality standards or otherwise degraded groundwater quality. This analysis evaluates whether construction operations, such as well drilling and the construction of pipelines and other facilities, would result in impacts on groundwater quality. Section 4.3, Surface Water Hydrology and Water Quality, addresses impacts related to surface water quality; Section 4.5, Marine Biological Resources, addresses impacts related to the marine environment.

Water Quality Impacts Associated with Construction of Slant Wells

The nine new slant wells would be built at depths that extend through the Dune Sand Aquifer and the 180-FTE Aquifer, similar to the existing test slant well. The 180-FTE Aquifer is likely hydrologically connected to the inland 180-Foot Aquifer. Inland of the current seawater intrusion front, wells in the 180-Foot Aquifer are used for irrigation and drinking water supplies. The proposed slant wells would be built using a dual-rotary drill rig that uses air, the water already

present in the geologic materials, bentonite mud, and, when necessary, additional potable water to circulate the drill cuttings. If potable water were added, the quality of that water would be better than that of the underlying brackish water and therefore would not degrade groundwater quality. Considering the proposed drilling method, there is a very low potential for groundwater degradation to occur during drilling and, thus, this impact would be less than significant.

Water Quality Impacts Associated with Construction of ASR Injection and Extraction Wells

The ASR injection/extraction wells would be drilled without the use of drilling muds. However, when necessary, and depending on the formation material encountered, commercially available additives might be combined with the drilling water to increase fluid viscosity and stabilize the walls of the boring to prevent reactive shale and clay from swelling and caving into the hole. Other products would be used to enhance the drilling performance and help reduce the buildup of solids, decrease friction, and aid in reducing solids suspension. Drilling mud additives are commonly used by the well drilling industry for the drilling and installation of groundwater wells, and do not contain chemicals that would degrade groundwater quality. Because the additives are combined with the water and are circulated through the borehole annulus during drilling, they react locally within the borehole and do not migrate into the surrounding groundwater formation. The additives are noncorrosive and biodegradable, and do not contain chemicals that would degrade groundwater quality. Therefore, while the use of bentonite muds would be necessary during the drilling of the ASR injection/extraction wells, the potential for degradation to groundwater is low and the impact would be less than significant. Section 4.3, Surface Water Hydrology and Water Quality, addresses the management and disposal of drilling muds and slurries.

All Other Facilities (MPWSP Desalination Plant, Terminal Reservoir, Carmel Valley Pump Station, and All Pipelines)

The proposed pipelines would be built along the TAMC right-of-way, Monterey Peninsula Recreational Trail, and existing road rights-of-way. The Carmel Valley Pump Station would be built on an existing concrete pad. These facilities do not require construction activities within groundwater-bearing zones and thus would have a very low potential to degrade groundwater quality. While pipeline trenches may encounter shallow groundwater, the construction operation of laying a pipeline and backfilling the trench would not release contaminants into the shallow groundwater zone. This impact would be less than significant.

Impact Conclusion

Impacts associated with discharges to groundwater and impacts on groundwater quality during the construction of project facilities would be less than significant.

Mitigation Measures

None proposed.

4.4.5.2 Operations Impacts and Mitigation Measures

Impact 4.4-3: Deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level during operations. (*Less than Significant*)

Impact 4.4-3 evaluates the potential effects of extracting and injecting groundwater as proposed by the MPWSP. This impact analysis addresses the following:

- Changes in available supply in the SVGB from groundwater pumping at CEMEX,
- Effect of groundwater extraction at the CEMEX site on nearby groundwater supply wells,
- Effect of injection and extraction through ASR wells on the SGB, and
- Changes in aquifer recharge in SVGB.

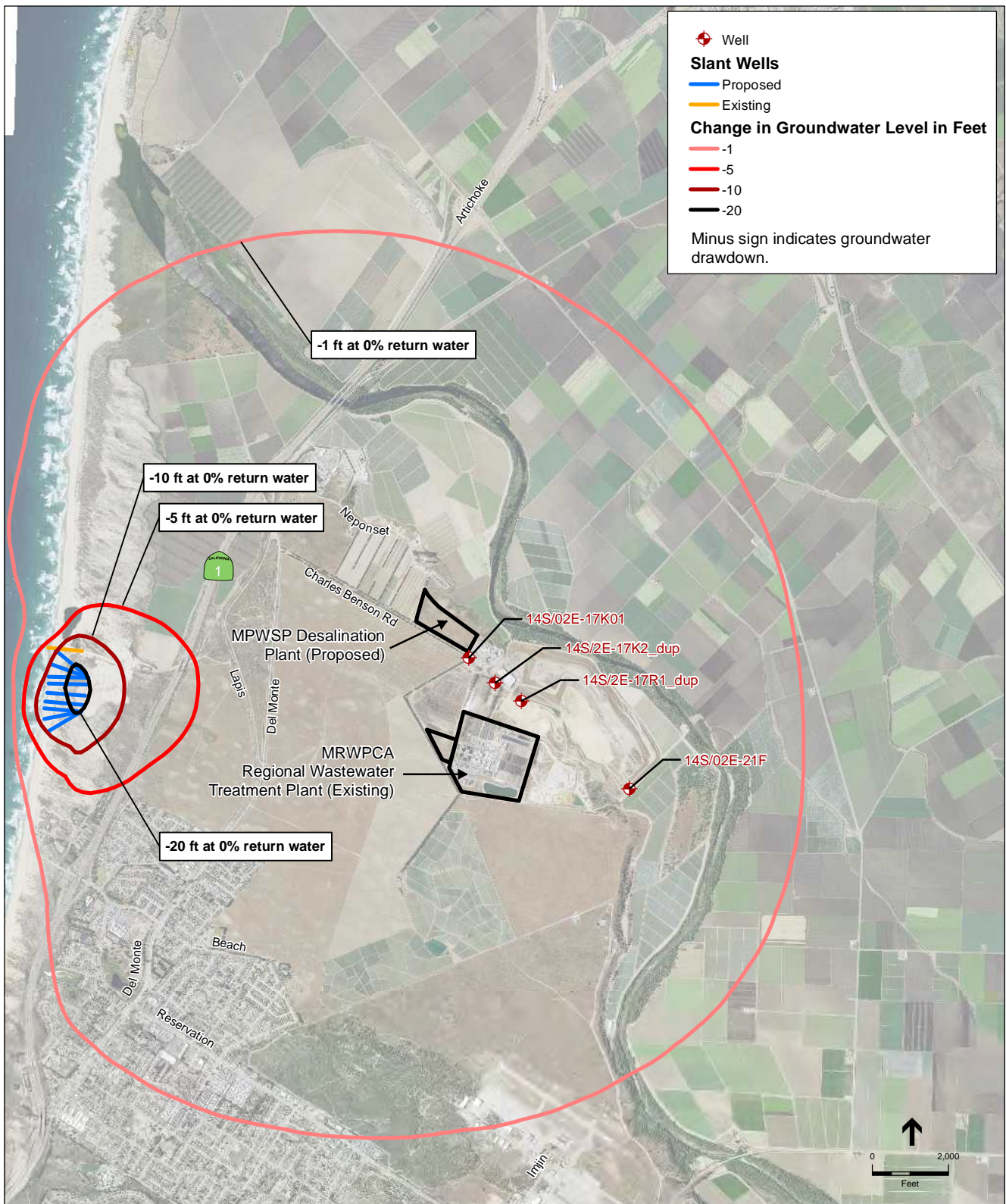
Impact on Groundwater Supply in the SVGB

Please see Section 4.4.4, *Approach to Analysis*, for additional information on modeling, methodology and terms used in this analysis.

This analysis evaluates the extraction and return water components of the proposed project to determine their physical effects on the SVGB basin and determines whether the changes, if any, constitute a significant impact. The significance criterion states that an impact would occur if extraction from the subsurface slant wells substantially depleted groundwater in the SVGB such that there would be a net deficit in aquifer volume. The NMGWM was the primary tool used to evaluate the effects on the basin and its aquifers and is discussed in more detail in Section 4.4.4 Approach to Analysis and in **Appendix E2**.

The first step in this analysis was to determine the pumping scenario that would have the most profound aquifer response surrounding the slant wells at the CEMEX site in order to conservatively judge potential impacts. Extracting groundwater from slant wells at the CEMEX site could cause an aquifer response up to 4 miles inland. **Figure 4.4-13** shows the cone of depression with -1, -5, -10, and -20-foot drawdown contours and the extent of pumping influence in the 180-FTE Aquifer; these drawdowns would stabilize within five years after pumping begins, and would remain stable as long as the MPWSP is pumping. For purposes of this impact analysis, this model scenario assumes that no water would be returned to the SVGB and the sea level would be consistent with current levels. This scenario generates the most pronounced cone of depression with the largest area of influence because groundwater would not be returned to the basin, and because current sea level would not increase groundwater levels and gradients at the coast as it is expected to do in the next 63-years. This scenario is used to represent the maximum area of pumping influence. In other words, **Figure 4.4-13** depicts the improbable worst case aquifer response from the proposed project.

The second step in this analysis was to use the drawdown contour map on **Figure 4.4-13** to determine the area of influence and maximum drawdown caused by the slant well pumping. As shown by modeling result depicted on Figure 4.4-13 the center of the cone of depression and thus, the capture zone for the slant wells show that the majority of the groundwater drawn into the



SOURCE:HydroFocus, 2016

205335.01 Monterey Peninsula Water Supply Project

Figure 4.4-13

Proposed Action: Response of 180-Foot Aquifer after 63 Years
0% Return Water

proposed MPWSP slant wells would originate in the aquifer zones located at and offshore of the coast and would be composed primarily of seawater. This is illustrated by the configuration of the cone of depression shown in **Figure 4.4-13**. The western extent of the cone of depression is just offshore and in close proximity to the slant wells where the drawdown is deepest and contours are steeper, indicating more flow to the slant wells and higher yield near the coast. At the coast, seawater entering the slant wells would have the shortest and least restricted pathway through the overlying sea floor deposits. The drawdown contours extend inland but at considerably shallower gradients, between -1 and -5 feet, indicating that the inland basin is less permeable, and that groundwater must flow through thicker sediments to reach the slant wells. This additional resistance to flow reduces the volume of water available to the slant wells and flattens the gradient. The cone of depression shown on **Figure 4.4-13** illustrates that the majority of the water pumped at the slant wells would originate at the coast and just offshore, where the drawdown is most pronounced while a smaller volume of groundwater would be extracted from the inland portion of the 180-Foot Aquifer.

The third step in this analysis was to assess the quality and current use of the groundwater that would be extracted by the slant wells. The MPWSP slant wells would not extract potable groundwater. The groundwater in the 180-foot Aquifer that is underlying the area influenced by the MPWSP pumping, up to about 4 miles inland, has been intruded with seawater for decades, and far exceeds the State Drinking Water Standard of 500 mg/L of total dissolved solids (TDS).²³ The inland groundwater has been degraded by legacy and ongoing seawater intrusion and is not being produced for beneficial potable uses. **Figure 4.4-10**, above, shows the areas of groundwater in the 180-Foot Aquifer degraded by seawater intrusion over time. The CEMEX site and the area of influence from slant well pumping in the 180-FTE are well within the area degraded by historical sea water intrusion.

Recent testing for TDS in groundwater within the area of influence of the proposed MPWSP slant well pumping verifies the degree of seawater intrusion. Water samples from Monitoring Well MW7M (180-FTE Aquifer) and MW-7D (400-Foot Aquifer), located just over a mile southeast from the proposed slant well location, contained TDS concentrations at 3,832 mg/L and 26,700 mg/L, respectively. Samples from Monitoring Well MW-8M and MW8D, located 1.5 miles to the northeast, had TDS concentrations of 24,000 mg/L and 583 mg/L, respectively. Monitoring Well MW-9S (Dune Sand Aquifer) and MW-9M (180-FTE Aquifer), located 2 miles to the northeast, had TDS concentrations of 3,204 mg/L and 29,000 mg/L, respectively. These data show that groundwater within the inland area of influence of the proposed MWSP slant wells is brackish with elevated TDS attributable to seawater intrusion; the groundwater in the Dune Sand, 180-FTE and 400-foot Aquifer is therefore unsuitable for potable supply.

Current groundwater production in the Dune Sand Aquifer, the 180-FTE Aquifer, and the 400-Foot Aquifer, which are projected to exhibit a response to MPWSP slant well pumping, is limited to minor irrigation and dust control. There are no water supply wells pumping potable water. Most of the wells in this area are no longer active because of seawater intrusion.

²³ TDS is a test for groundwater that can be used to quantify the amount of salts in a sample and is used to test for salinity.

Furthermore, groundwater production is restricted within the seawater intruded coastal areas in the vicinity of the CEMEX site through MCWRA Ordinance 3709, which prohibits drilling wells and pumping groundwater from the 180-FTE Aquifer in order to protect groundwater resources. The slant wells at CEMEX and the area of pumping influence east of CEMEX are within the jurisdictional boundary of Ordinance 3709.

Conclusions of Impact Analysis – Depletion of Groundwater Supply from the SVGB

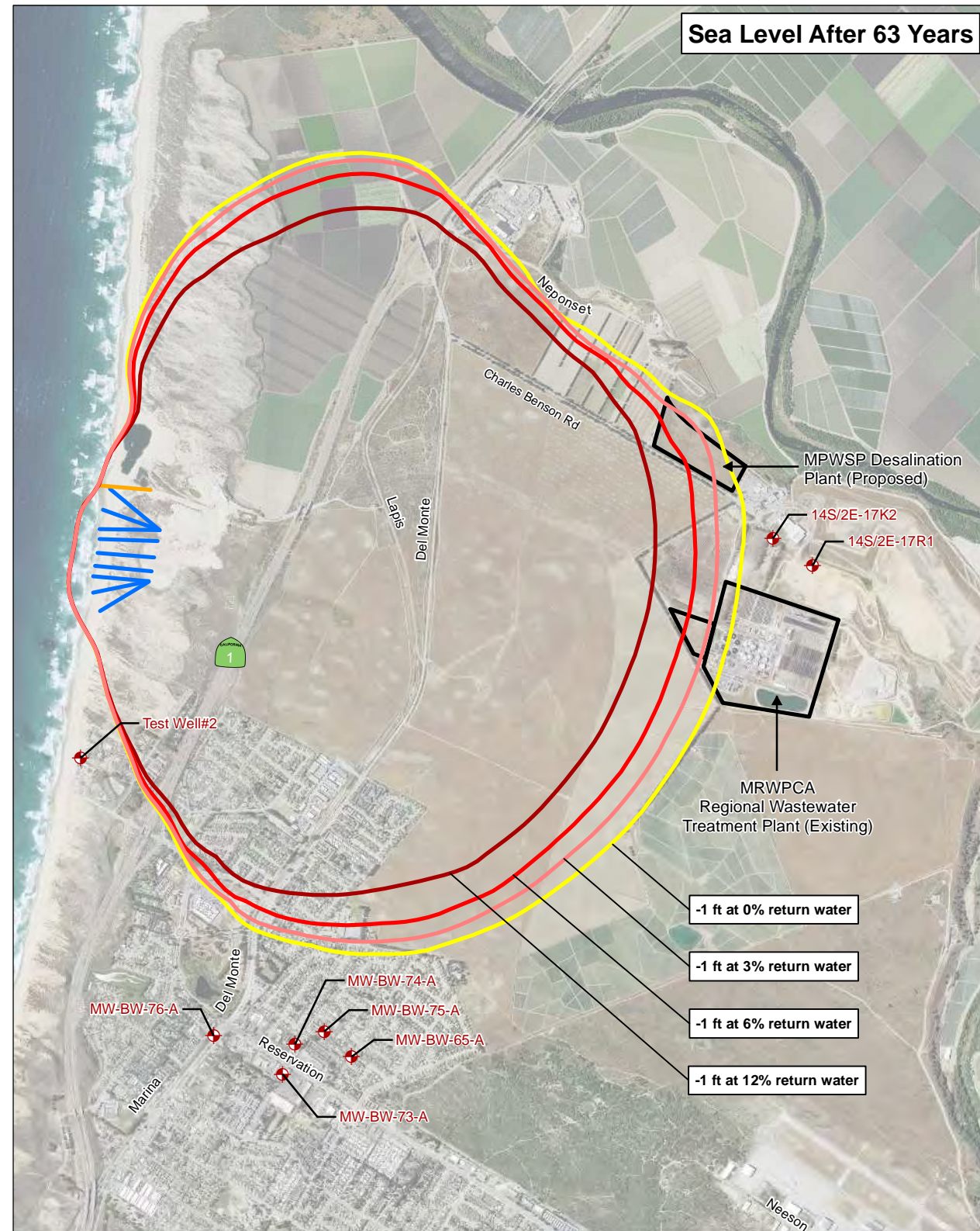
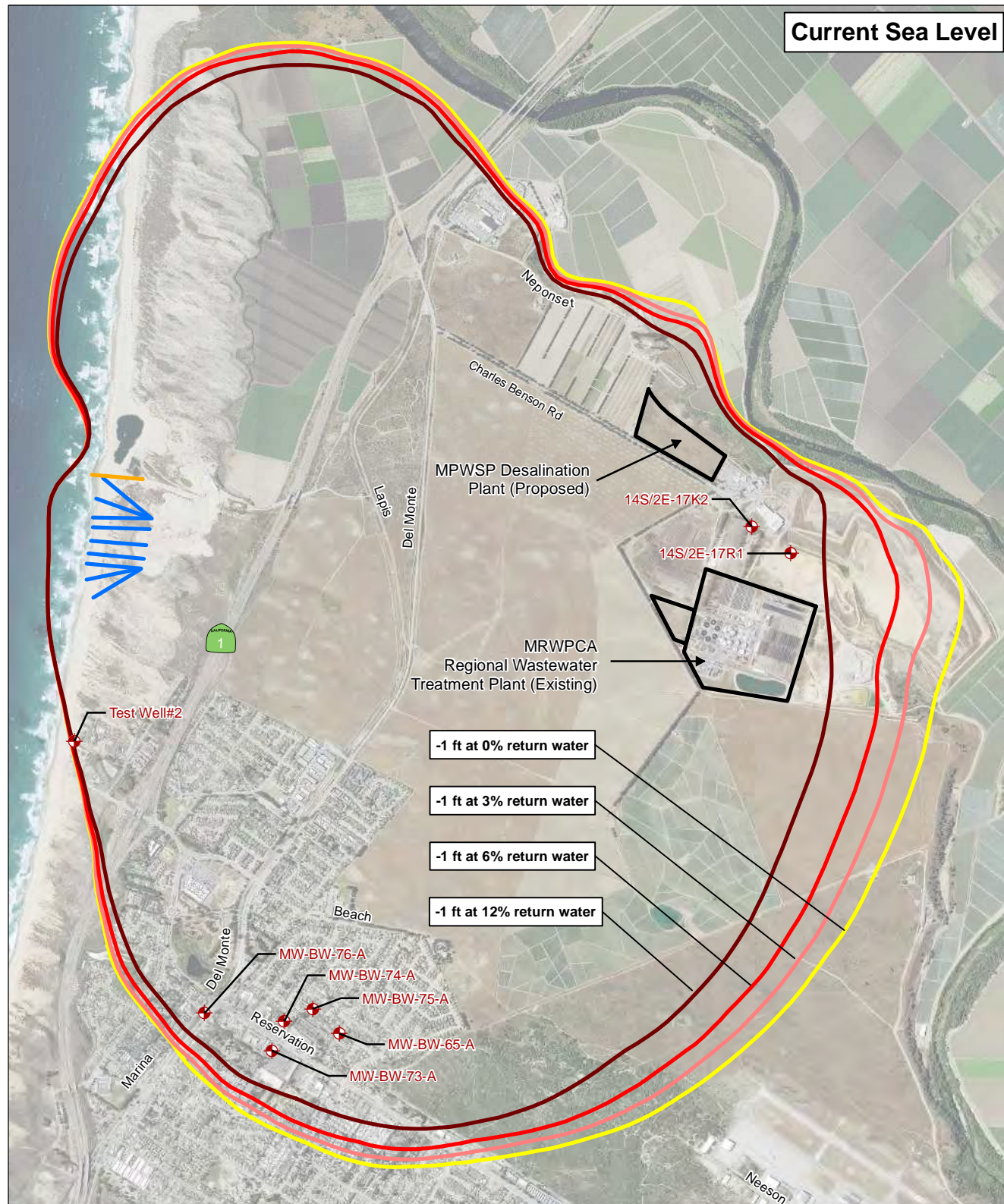
The proposed project would not deplete groundwater supplies; it would extract primarily seawater and a smaller volume of brackish inland groundwater from a localized area with only minor localized groundwater drawdown. The area influenced by the MPWSP groundwater pumping is within a zone that is degraded by seawater intrusion and therefore unusable for potable water supply due to its high salinity. When desalinated water is returned to the basin as part of the MPWSP, groundwater conditions in the 400-Foot Aquifer underlying the CSIP, CCSD, and adjacent areas would improve as water levels increase as a result of in-lieu groundwater recharge. The return water component of the MPWSP would benefit each of the aquifers by either reducing the area of influence or by increasing groundwater levels in other areas. The effects of return water on the basin water levels are discussed below and shown on **Figures 4.4-14 through 4.4-16**. If the proposed project did not return any water, localized depressed groundwater levels would persist in the three affected aquifers throughout the life of the project. However, the area affected by groundwater pumping would remain localized and the proposed project would continue to extract only brackish, degraded groundwater from the coast and, to a lesser extent, the inland portion of the aquifer. Based on the conclusions of this analysis, this impact would be less than significant.

Impact on Nearby Production Wells

An impact would be considered significant if the proposed project lowered groundwater levels in a nearby municipal or private groundwater production well enough to cause a substantial reduction in well yield, or to cause physical damage due to exposure of well screens and well pumps. The nearby production wells that could be affected by MPWSP pumping at the CEMEX site are shown on **Figure 4.4-14** and listed in **Table 4.4-10**.

This impact analysis presents and discusses the NMGWM data that were used to determine the aquifer response to the proposed MPWSP extraction of groundwater at the CEMEX site. These data are used to assess the impacts on the nearby, active groundwater supply wells located within an area extending about 4 miles inland from the CEMEX site.

The aquifer response to the proposed project is shown for the Dune Sand Aquifer, (**Figure 4.4-14**), the 180-FTE Aquifer (**Figure 4.4-15**), and the 400-Foot Aquifer (**Figure 4.4-16**). These figures also show the local nearby water supply wells described in **Table 4.4-10** but locate only those supply wells that are screened in the specified aquifer. For instance, only wells screened in the 180-FTE Aquifer are shown on **Figure 4.4-15**. Each figure also provides a side-by-side comparison of the aquifer response at current sea level in Model Year 1 and the predicted sea level in Model Year 63.



0 2,000
Feet

↑

- ◆ Groundwater Well
- 12% return water as in-lieu groundwater pumping
- 6% return water as in-lieu groundwater pumping
- 3% return water as in-lieu groundwater pumping
- 0% return water

Slant Wells

- Blue Proposed
- Orange Existing

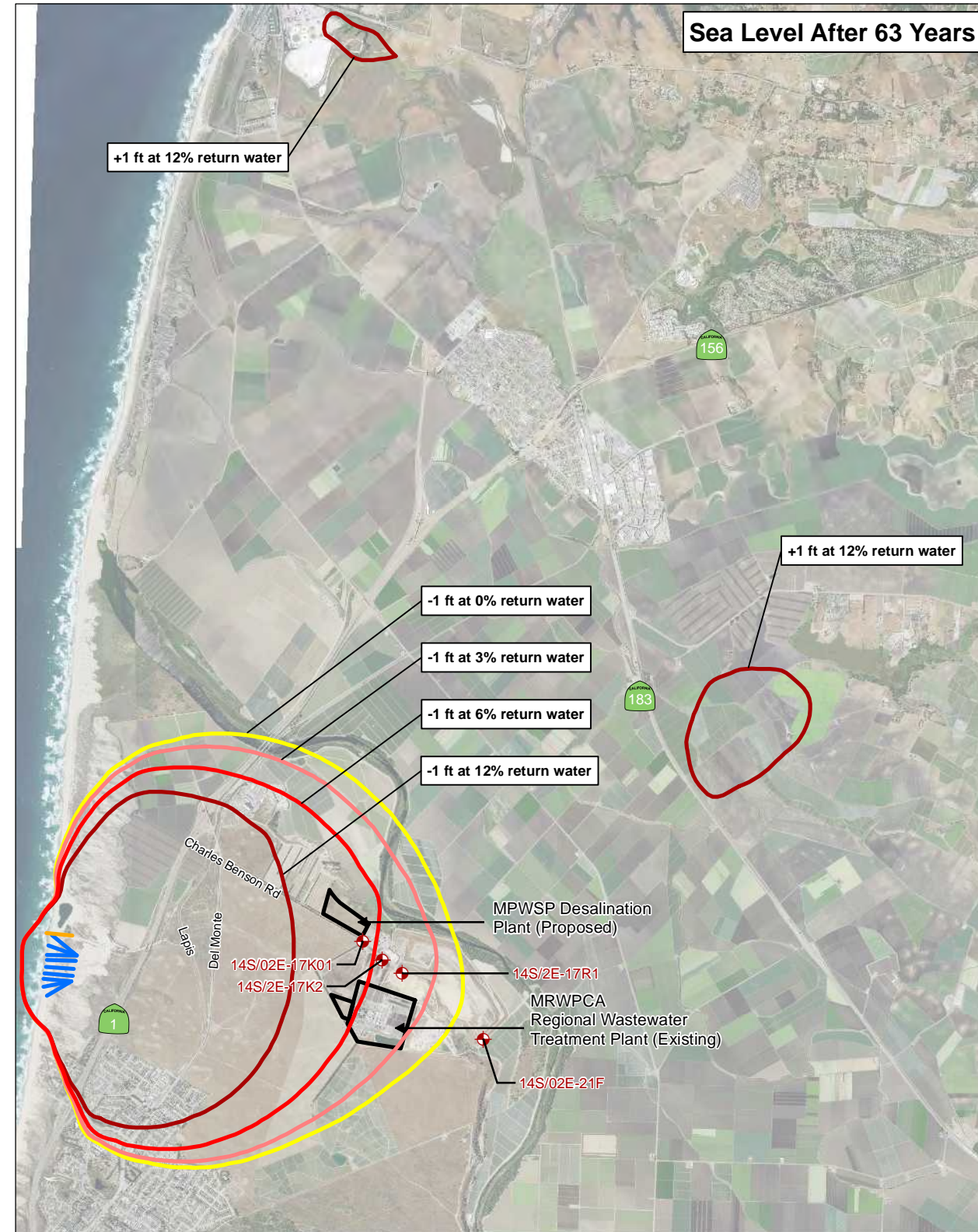
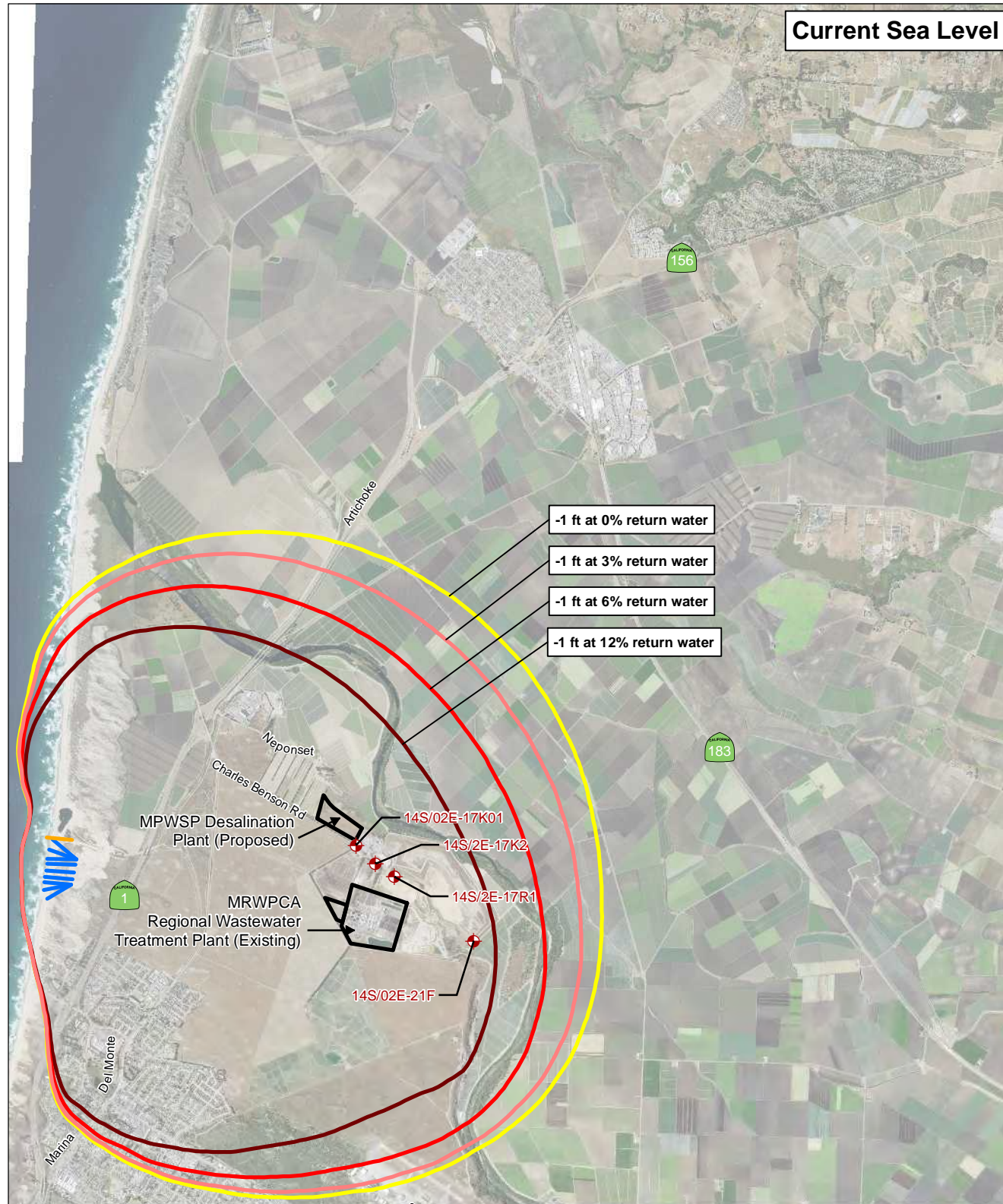
-1 foot response means groundwater levels decline one foot.

SOURCE:HydroFocus, 2016

205335.01 Monterey Peninsula Water Supply Project

Figure 4.4-14

Proposed Action: 1-Foot Response in Dune Sand Aquifer



0 1 Miles

- Groundwater Well
- 12% return water as in-lieu groundwater pumping
- 6% return water as in-lieu groundwater pumping
- 3% return water as in-lieu groundwater pumping
- 0% return water

Slant Wells

- Proposed
- Existing

-1 foot response means groundwater levels decline one foot.

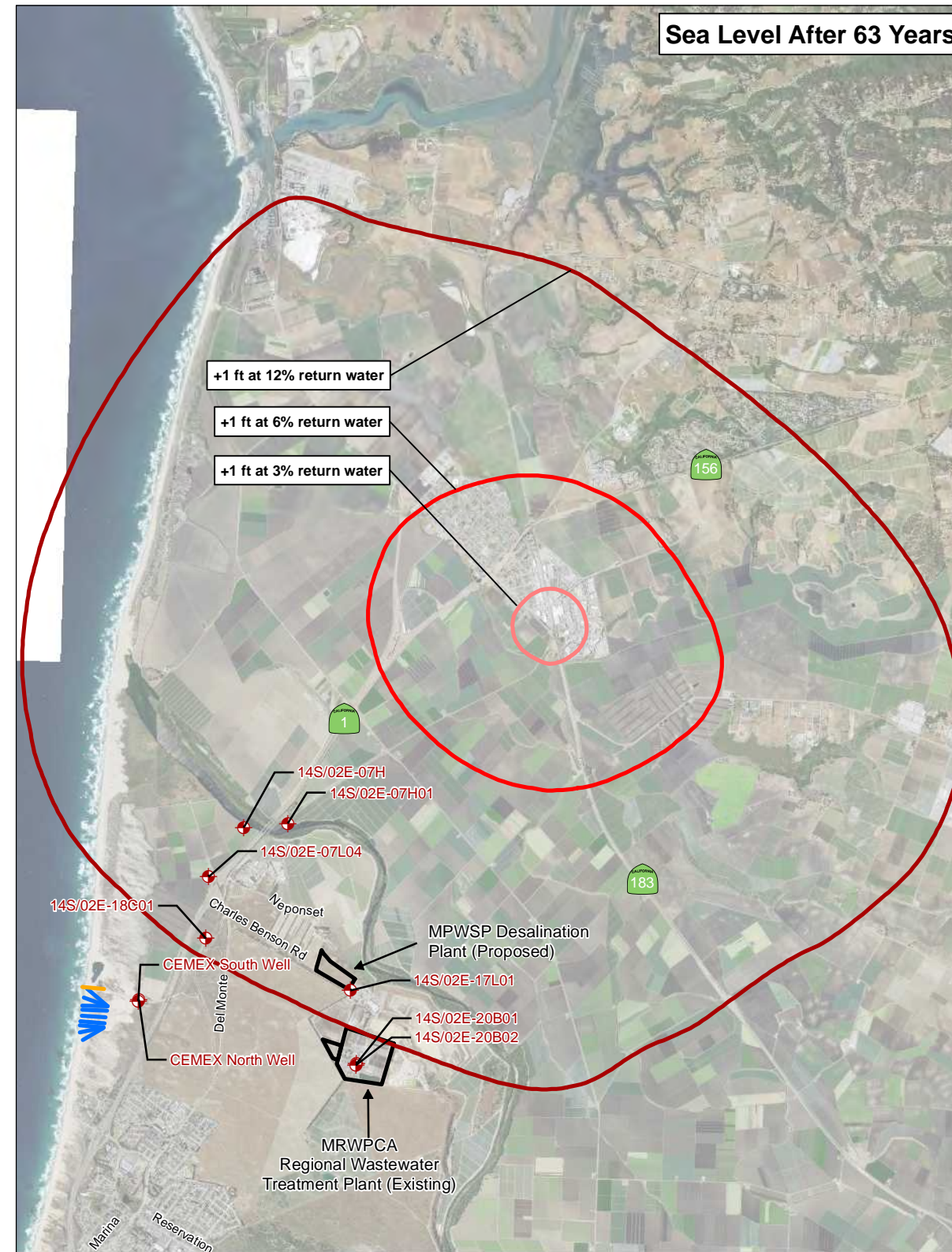
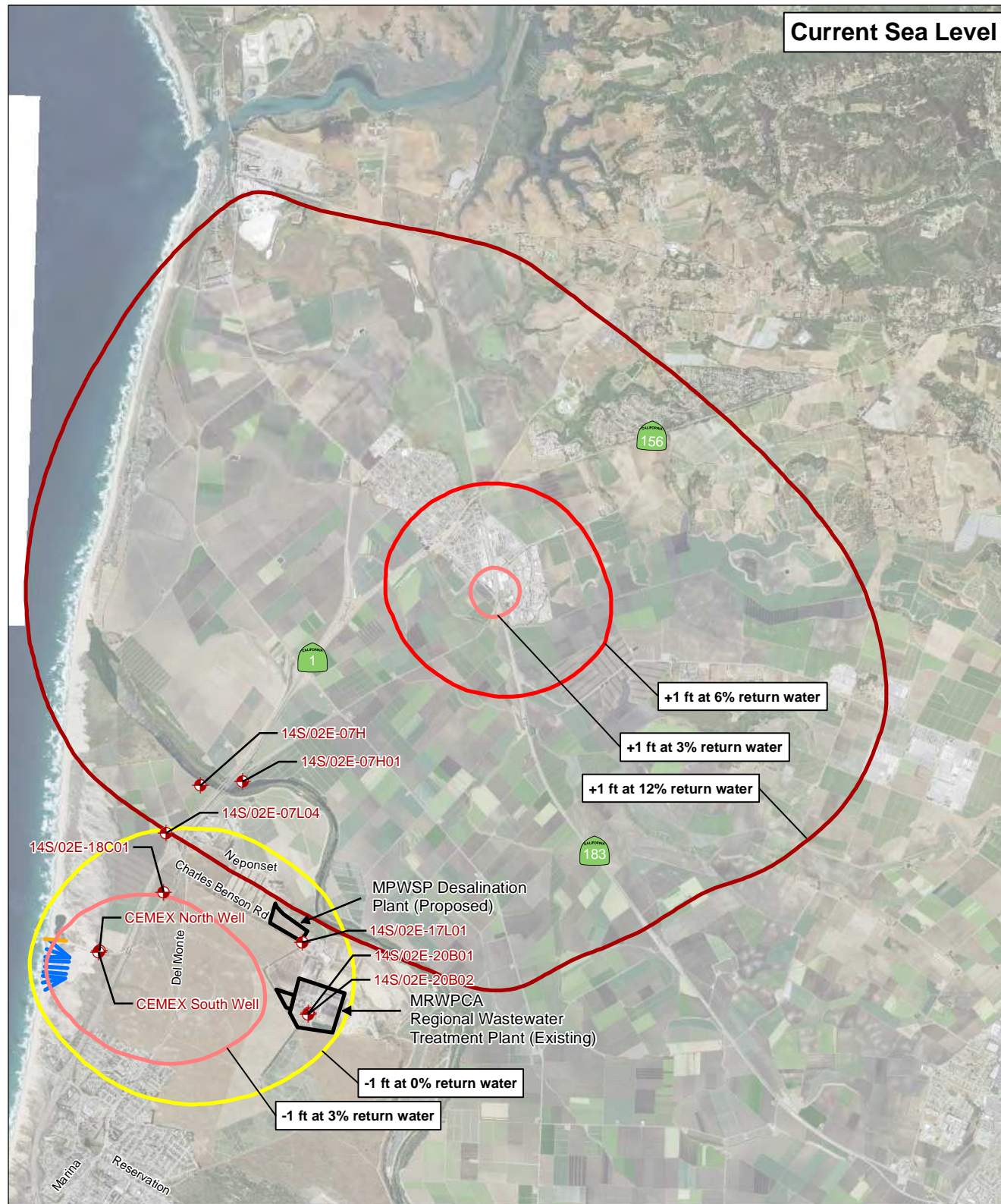
+1 foot response means groundwater levels rise one foot

SOURCE:HydroFocus, 2016

205335.01 Monterey Peninsula Water Supply Project

Figure 4.4-15

Proposed Action: 1-Foot Response in 180-Foot Aquifer



◆ Groundwater Well
 — 12% return water as in-lieu groundwater pumping
 — 6% return water as in-lieu groundwater pumping
 — 3% return water as in-lieu groundwater pumping
 — 0% return water
Slant Wells
 — Proposed
 — Existing

-1 foot response means groundwater levels decline one foot.
 +1 foot response means groundwater levels rise one foot

SOURCE:HydroFocus, 2016

205335.01 Monterey Peninsula Water Supply Project

Figure 4.4-16

Proposed Action: 1-Foot Response in 400-Foot Aquifer

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**TABLE 4.4-10
KNOWN ACTIVE SUPPLY WELLS WITHIN VICINITY
OF THE PROPOSED MPWSP SLANT WELLS**

| Well Owner | Well Number/ID | Aquifer | Use | Status |
|--|--------------------------|-------------|---|--|
| CEMEX | South Well North Well | 400 | South Well is located about 1,600 feet southeast of the insertion point of the proposed slant wells. The well screen is set between 400 and 506 feet and is separated from the intake portion of the slant wells by the 180/400-Foot Aquitard. CEMEX North collapsed and is unusable. | |
| Ag Land Trust | 14S/02E-18C01 | 400 | "Small Well" (14S/2E-18C1) is located between Lapis Road and east of Highway 1 and is used to supply a water truck filling station for dust control. | |
| | 14S/02E-18E01 | 900 | "Big Well" (14S/02E-18E01) is located adjacent to the west side of Highway 1, north of the access road to the CEMEX property. The Big Well has no pump, but is reportedly occasionally hand-bailed for irrigation on local restoration projects. | |
| MRWPCA Regional Wastewater Treatment Plant | 14S/02E-20B01 | 400 | Three wells are located just southeast of the proposed MPWSP Desalination Plant, but only the well screened across the 900-Foot Aquifer is active and is used for domestic purposes (i.e., drinking water, washing, toilets). | |
| | 14S/02E-20B02 | 400 | | |
| | 14S/02E-20B03 | 900 | | |
| Monterey Peninsula Landfill | 14S/02E-17K01 | 180 | Located adjacent to and southeast of the proposed desalination plant site on Charles Benson Road. Four wells are screened across the Dune Sand Aquifer and/or the 180-FTE Aquifer. Three of the water supply wells are used for dust control; the fourth well is inactive. | |
| | 14S/02E-17K02 | DSA and 180 | | |
| | 14S/02E-17R01 | DSA and 180 | | |
| | 14S/02E-21F | 180 | | |
| Bill Baillee/Unknown | 14S/02E-07H | 400 | Two local private wells owned by Bill Baillee (14S/02E-07H and 14S/02E-07H01) and two with unknown owners (14S/02E-17L01 and 14S/02E-07L04). These wells are screened across the 400-Foot Aquifer. | |
| | 14S/02E-07H01 | 400 | | |
| | 14S/02E-17L01 | 400 | | |
| | 14S/02E-07L04 | 400 | | |
| Municipal Wells | | | | Municipal wells are mentioned here, but they are not shown on figures because the City of Marina's Wells 10, 11, and 12 are over 2 miles to the southeast, and are screened in the 900-Foot Aquifer (MCWD, 2005). The Ord Community Wells 29, 30, and 31 are located 5 plus miles to the southeast and are screened in the lower 180-Foot and the 400-Foot Aquifers (MCWD, 2005) |

NOTES:

MRWPCA = Monterey Regional Water Pollution Control Agency
 DSA = Dune Sand Aquifer
 180 = 180-FTE Aquifer or 180-Foot Aquifer
 400 = 400-Foot Aquifer
 900 = 900-Foot Aquifer

SOURCE: Geoscience, 2015c; MRWMD, 2003.

The extent of aquifer response is shown using the -1-foot groundwater contour. This contour was chosen to delimit the minimum regional response of MPWSP pumping. Groundwater levels inside the -1-foot contour would have a groundwater drawdown greater than 1-foot. **Figure 4.4-13** shows where the -1, -5, -10, and -20-foot drawdown contours would be inside the cone of depression formed under the pumping scenario with the greatest magnitude of aquifer response (0 percent return water under current sea level conditions). **Figures 4.4-14** through **4.4-16** show the -1-foot contour under the 0, 3, 6, and 12 percent return water scenarios.

Groundwater modelers used these return water percentages to capture minimum, maximum, and mid-range estimates of return water volumes. The amount of return water, if any, has not yet been established, but is expected to be anywhere between 0 percent and 12 percent. A 0 percent return volume would mean the MPWSP would extract water but not return water to the basin as in-lieu recharge. This would depict the condition that causes the greatest magnitude of aquifer response from MPWSP pumping, also referred to as the “worst case” condition.

Results of Impact Analysis - Proposed Project on Nearby Production Wells

Observations of Pumping Response Applicable to all Aquifers

The maximum pumping response in all three aquifers is depicted by the -1-foot contour at 0 percent return water, under current sea level rise conditions. The -1-foot contours resulting from 3, 6 and 12 percent return water consistently show an aquifer response less than that resulting from the 0 percent return water scenario. The area of pumping influence would be less pronounced under the sea level rise conditions expected after 63 years of operation because higher sea levels exert greater pressures at the coast, making more seawater available to the slant wells. Consequently, groundwater levels may decrease in a well when the MPWSP starts running, but could increase over the 63 years of operation.

Aquifer Response in Dune Sand Aquifer

The Dune Sand Aquifer response from MPWSP pumping, with current sea level conditions and 0 percent return water, would extend a maximum of about 3 miles inland from the CEMEX site (**Figure 4.4-14**). Under sea level conditions after 63 years, the area of influence would be reduced in size by about a mile. Monterey Peninsula Landfill wells 14S/2R-17K2 and 14S/2R-17R1 are screened in the Dune Sand Aquifer.

Aquifer Response in 180-FTE Aquifer

The greatest observed groundwater response to MPWSP pumping would be in the 180-FTE Aquifer under the current sea level conditions (**Figure 4.4-15**). The -1ft contour resulting from the 0 percent return water scenario would extend a maximum distance of about 3.6 miles to the northeast. With sea level rise after 63 years, the aquifer response for all three return water scenarios would be reduced by about a mile. Under the 12 percent return water scenario, two localized areas of groundwater level increase would develop: one would be located 5 miles to the northeast, near Highway 183, and one would develop about 6.5 miles north, near Dolan Road in Moss Landing. Two small circular +1-ft contours indicate an increase in the groundwater level of 1 foot or more.

This increase represents the effects of 12 percent return water, with the corresponding reduced pumping in the 400-Foot Aquifer underlying CSIP and CCSD.²⁴ Monterey Peninsula Landfill wells 14S/2R-17K01, 14S/2R-K02, 14S/2R-17R1, and 14S/2R-21F are screened in the 180-FTE Aquifer.

Aquifer Response in the 400-Foot Aquifer

Under the 0 percent return water scenario and current sea level conditions, the aquifer response would extend inland about 2.5 miles from the CEMEX site (**Figure 4.4-16**). Aquifer response with 3 percent return water and the current sea level would produce two conditions in the 400 Foot Aquifer: an area of pumping response extending inland from CEMEX about 1.8 miles, and an area of localized groundwater level increase near the CCSD. Under a 6 percent return water scenario, and under the current sea level conditions, the only aquifer response would be a groundwater level rise encompassing the CCSD and portions of the CSIP delivery area near Castroville. This change would be a likely result of CCSD reducing groundwater pumping as a result of receiving desalinated return water. With 12 percent return water and at current sea level rise, the groundwater levels in the 400-Foot Aquifer could increase by at least one foot north of the Salinas River, including the CCSD and CSIP areas, and areas east of Highway 183.

The aquifer response with 0 percent return water and sea level conditions after 63 years could result in no aquifer response in the 400-Foot Aquifer. This is because higher sea level would provide more pressure at the coast and available seawater to the slant wells and thus less water would be drawn up from the 400-Foot Aquifer. With 3, 6, and 12 percent return water and sea level rise after 63 years, the aquifer response would be similar to current sea level conditions, resulting in increased water levels extending out from the city of Castroville for about 3 to 4 miles in all directions. The CEMEX South Well, the Ag Land Trust Well (14S/02E-18C01), the MRWPCA Regional Wastewater Treatment Plant wells (14S/02E-20B01, 14S/02E-20B02), and the Bill Baillee/unknown wells (14S/02E-07H01, 14S/02E-07H, 14S/02E-07L01, and 14S/02E-07L04) are screened in the 400-foot Aquifer.

Impact Conclusion – Impact of Proposed Project on Nearby Production Wells

This analysis demonstrated that certain groundwater supply wells located within the slant well area of influence could experience a change in groundwater level between 1 and 5 feet during the life of the project.

The NMGWM considered the effects of the project with and without returning water to the SVGB. The “worst-case” groundwater level declines would occur under the 0 percent return water scenario because, under the 0 percent return water scenario, no water would be returned to the CCSD or CSIP for in-lieu groundwater recharge and pumping in the 400-Foot Aquifer would not be reduced. However, if 3 to 12 percent return water is supplied as in-lieu groundwater recharge, there would be less of a response to MPWSP pumping in the Dune Sand Aquifer, the 180-FTE Aquifer, and the 400-Foot Aquifer. Increased sea level rise over the next 63 years would additionally reduce the area influenced by MPWSP pumping.

²⁴ The two isolated areas of increased groundwater levels in the 180-aquifer (sea level rise conditions after 63 years) are likely due to a pressure response detected by the model that occurs between the two aquifers rather than aquifer leakage or actual groundwater flow between aquifers.

The nearby groundwater production wells affected by the change in groundwater levels are built in the Dune Sand Aquifer, 180-FTE Aquifer, or the 400-Foot Aquifer and thus have casings, pumps, and screens at depths considerably deeper than the depths at which MPWSP pumping could affect the water levels. A water level decline between 1 and 5 feet would not expose screens, cause damage, or reduce yield in the groundwater supply wells influenced by MPWSP pumping. Based on the modeled response of the 24.1-mgd extraction rate at the CEMEX site, the impact on nearby water supply wells would be less than significant.

Applicant Proposed Mitigation Measure

CalAm recognizes the long-term nature of the proposed project and the need to provide continued verification that the project would not contribute to lower groundwater levels in nearby wells within the SVGB. So, as part of the project, CalAm proposes to expand the existing regional groundwater monitoring program to include the area where groundwater elevations are anticipated to decrease by one foot or more in the Dune Sand Aquifer and the 180-FTE Aquifer. This constitutes an Applicant-Proposed mitigation measure that is presented and evaluated at the end of **Impact 4.4-3**.

Impacts of ASR Injection/Extraction Wells

The volume of treated desalinated water routed to the ASR system would depend on precipitation and the water supply demands in any given year, but is expected to be about 2,100 afy. The injection of this additional water into the confined Santa Margarita Sandstone could create short-term groundwater mounding, which can cause localized changes in groundwater levels and flow. A significant impact could occur if operation of the proposed ASR injection/extraction wells resulted in groundwater mounding, change in groundwater gradients, or lower groundwater levels such that nearby municipal or private groundwater production wells were to experience a substantial reduction in well yield or physical damage due to exposure of well pumps or screens. **Figure 4.4-7** shows the groundwater surface and flow patterns in July/August 2015 in the Shallow Zone Aquifer of the SGB, within which the ASR injection/extraction wells would be screened, along with the location of local water supply production wells.

The MPWMD's ASR EIR (2006) analyzed the impacts on groundwater storage and water levels in the SGB. The analysis presented a pilot study and a groundwater model to evaluate the impacts on groundwater storage in the SGB through operation of the ASR program. The analysis determined that up to 2,426 afy could be injected through the implementation of the ASR program, of which up to 2,003 afy would be extracted. The findings of the analysis concluded that injecting excess treated Carmel River water into the ASR injection/extraction wells was beneficial to groundwater storage within the SGB, so long as extraction did not exceed injection on an annual basis.

Since the MPWMD's ASR project was approved with injection beginning in 2001, 2 afy to 1,117 afy of excess Carmel River have been injected into and extracted from storage for a total of about 4,175 af through 2013 (Pueblo Water Resources, 2014). Although the program has not achieved 2,426 afy, the annual volume of water evaluated in the ASR EIR, the groundwater monitoring results indicate that the injection and extraction of water does not adversely affect groundwater storage in the SGB. However, the MPWMD ASR program can only divert winter

flows from the Carmel River that are in excess of in-river needs, and is therefore rainfall dependent. Furthermore, the program does not increase storage in the SGB, since the injected Carmel River water is subsequently pumped back out to reduce CalAm's pumping from the Carmel River and the SGB.

The proposed project would include the installation of two additional ASR injection/extraction wells to increase the reliability of the ASR program to inject and extract Carmel River water, and to allow for the injection and ultimate extraction of treated desalinated water. However, the injection and extraction volumes of water from the desalination plant would be managed such that there would be no net negative change to the storage of groundwater on an annual basis. That is, the volume of water in storage would not be allowed to decrease due to extraction. Water injected in a particular year but not used in that same year could be stored for the next year.

In addition, CalAm must return to the basin 700 afy of water for the next 25 years to mitigate its overdraft of the SGB (Seaside Groundwater Basin Watermaster, 2012b). To accomplish this water exchange, CalAm would extract only 774 afy of its 1,474 afy SGB adjudicated allocation. The payback of 700 afy for 25 years would result in the retention of 17,500 afy in storage, reducing the historical overdraft of the SGB and increasing groundwater levels.

Impact Conclusion – Operation of the ASR Injection/Extraction Wells

Injection and extraction would be managed so that the water provided from the desalination plant would not constitute a net negative change in storage. Because the storage in the aquifer would increase by 700 afy for the first 25 years and then remain constant thereafter, impacts related to mounding, change in groundwater flow directions and excessive extraction would not occur and the impact would be less than significant.

Impacts on Groundwater Recharge

The MPWSP could interfere with groundwater recharge by decreasing groundwater elevations from groundwater pumping, thereby disrupting the existing surface water-groundwater interaction on the Salinas River or creating additional impervious surfaces through the construction of project facilities. Impervious surfaces reduce the volume of rainwater that infiltrates down to the aquifer. A significant impact would occur if the proposed project causes a net deficit in aquifer volume or lowers the local groundwater table level so as to interfere substantially with groundwater recharge. The proposed project's contribution to alteration of the surface water-groundwater interaction and the increase in impervious surfaces is discussed below.

Impacts of the Project on the Surface Water-Groundwater Interaction at the Salinas River

As a river flows over the land surface, it may lose water to the subsurface or gain water by intersecting groundwater from the underlying water table,²⁵ depending on the depth to groundwater relative to the level of the riverbed. This surface water-groundwater interaction

²⁵ The water table is the surface of the shallowest aquifer that is unconfined and open to the overlying atmosphere. In this case, the groundwater surface of the Dune Sand Aquifer or the inland Perched A Aquifer would be the water table.

causes groundwater to discharge to streams in some areas and causes surface water to infiltrate to the subsurface aquifers in others. When a river gains groundwater from the aquifer, that is called a gaining stream; when it loses groundwater to the aquifer, it is called a losing stream. In the case of the MPWSP, the portion of the Salinas River within the area of influence from the slant well pumping is a gaining stream. Consequently, the slant well pumping could draw in groundwater that would otherwise discharge to the river. The proposed project would not directly pull surface water from the Salinas River.

The NMGWM can estimate the loss of groundwater outflow to a surface water feature such as the Salinas River. Based on the modeling, the estimated volume of groundwater removed from the river recharge system would be approximately 400 afy. A similar condition exists for Tembladero Slough, where the volume of groundwater removed by the slant well pumping from that system would be about 65 afy. The volume of water flowing to the ocean through the Salinas River in 2012 was about 250,000 afy, so the reduction of 400 afy is about 0.16 percent of the total flow. From a surface water supply standpoint, this magnitude of groundwater diversion from the Salinas River would be a minor, if not immeasurable, reduction in surface water supply. The same conclusion is applied to the Tembladero Slough, where the removal of 65 afy of groundwater discharge would not constitute a recognizable loss in supply for that system. The reduction of surface water attributable to slant well pumping is not a substantial reduction of water supply and thus this impact would be a less than significant impact.

Impacts of the Project on the Surface Water-Groundwater Interaction at CEMEX

The CEMEX facility has several ponds on its property. The largest pond, located to the north of the slant wells, is the source of the sand mined by CEMEX. The impact analysis of MPWSP pumping effects on recharge considered the largest pond to determine whether the proposed project would have an adverse impact on its recharge or on the current sand mining operations. A significant impact would occur if the proposed pumping at CEMEX reduced recharge to the Dune Sand Aquifer or interfered with or otherwise limited the ability of CEMEX to operate due to intolerable draw down in its main sand mining pond.

Pond Operation

The bottom of the large CEMEX dredge pond is assumed to be at about 10 to 20 feet below the surface water level in the pond (Geoscience, 2015b). The water level in the pond is in hydraulic connection with the ocean, receiving ocean water as seepage through the beach sand and occasional storm surges over the beach and into the pond. Winter storm surges push sand with very little silt or clay particles over the beach and into the largest pond, and the sand settles to the bottom of the pond. CEMEX then dredges the sand from the pond, sorts the sand into different grain sizes depending on the desired end product, and washes the sand to remove residual salts from seawater. The wash water is routed to the smaller ponds located north and east of the location of the proposed slant wells, where the seawater seeps into the sand and migrates back to the ocean. The larger, deeper sand source pond is in an area composed entirely of sand. The water level in the largest pond is controlled by the ocean tides (Geoscience, 2015b). Occasionally, storm surges remove the sand barrier between the larger dredge pond and the ocean and the pond

temporarily becomes a small bay, as occurred in March 2016. The smaller, shallower wash water ponds are fed entirely by the wash water and are not directly connected to either to the ocean or the underlying groundwater; wash water either evaporates or infiltrates into the shallow sand and migrates to the ocean.

A water level transducer was installed in the large dredge pond on the CEMEX property to monitor changes in water elevations. The most recent monitoring report indicates that the pond is tidally influenced (Geoscience, 2015a, b) due to the proximity of the pond to the ocean (within 200 feet). In addition, the pond water level monitoring indicates that the sand mining operations conducted on Monday through Friday also affect pond water levels. Pond water levels fluctuate and decrease during the week as sand and water is pumped out of the pond and then stabilize on Saturday and Sunday when the sand mining operations are closed.

Impact Analysis for CEMEX Dredging Pond Drawdown

This impact analysis is based on the analysis completed for the test slant well, which was completed in September 2014, and is also informed by data that was generated in April 2015 after a five-day constant discharge pump test of the test slant well.

In the September 2014 analysis, the localized CEMEX model was used to determine whether the dredge pond would be influenced by pumping at the proposed test well operating at 2,500 gallons per minute (gpm) (Geoscience, 2014a). The localized CEMEX model simulates the response of the Dune Sand Aquifer in its second, third, and fourth vertical layers. The depth of the large dredge pond falls within the second and part of the third model layer so the response in the dredge pond would be captured as a response in the upper portion of the Dune Sand Aquifer. The CEMEX model simulated the test well pumping for 8 months at 2,500 gpm. The results of the model run showed a drawdown at the dredge pond of about 1 foot. If a drawdown of 1 foot occurred for a pumping rate of 2,500 gpm from one well (the test slant well), there is a possibility that additional drawdown would occur in the pond during operation of the all of the proposed slant wells, which would operate at the combined pumping rate of 24.1 mgd or about 16,736 gpm. However, when compared to the daily tidal fluctuations in the dredge pond water levels of up to eight feet throughout the year, the decline in the water surface of any depth would be masked by the consistent recharge and tidal influence from the ocean.

On March 8, 2015, a water-level transducer was installed in the dredge pond, and it has been collecting data ever since. In April 2015, a five-day constant-discharge pumping test was conducted (Geoscience, 2015b). The transducer showed a series of cyclical fluctuations from March 8 through March 21, followed by relatively flat levels through April 2, followed by similar pattern of cyclical fluctuations at similar elevations through April 11. The cyclical fluctuations are due to a combination of tidal influence and the routine dredging of the pond for sand. The early March fluctuations, which occurred before the pumping test, and the early April fluctuations, which occurred during the pumping test, show a similar pattern at about the same water level, indicating that the water level in the dredge pond was not being influenced by the pumping of the test slant well. This also indicates that as the pond is dredged, the water levels quickly recover, with seawater seeping through the loose sand on the beach.

While pumping at the slant wells could elicit a drawdown response in the large dredge pond over periods of extended pumping, the magnitude of that response would not interfere with recharge to the Dune Sand Aquifer, nor would it inhibit sand mining operations by depleting available water supplies to the pond. This impact is less than significant.

Impacts Related to Impervious Surfaces

Slant Wells

The seawater intake system at the CEMEX site would consist of ten subsurface slant wells and associated pipelines, with aboveground electrical control cabinets at each well head. Each of the five new well head sites would be on a 5,250- to 6,025-square-foot concrete pad within the coastal sand dunes, where the surrounding and underlying soil is loose sand. The pipelines would be completed below ground. Precipitation would continue to infiltrate into the subsurface sands and flow around the well head pads to the water table or migrate to the ocean. This minor amount of added impervious surface would not meaningfully reduce potential recharge area of the shallow aquifer.

ASR Injection/Extraction Wells

Each of the two new ASR injection/extraction wells and pumps, and electrical control system would be housed in a 900-square-foot concrete pump house. The two 900-square-foot pump houses would be surrounded by unpaved soil. Rainwater falling on the pump houses would flow off the structures into the surrounding unpaved areas and would infiltrate down to the water table. Therefore, there would be no reduction to groundwater recharge.

MPWSP Desalination Plant

The MPWSP Desalination Plant would consist of several structures that would result in the creation of about 15 acres of new impervious surfaces that would restrict rainfall from infiltrating into the subsurface. However, rainwater falling on these structures would be routed through conventional drainage structures unpaved onsite area. Rainwater would still be able to infiltrate into the subsurface and recharge the underlying aquifer. Therefore, there would be no reduction to groundwater recharge.

Terminal Reservoir

The Terminal Reservoir would consist of two water storage tanks that would be constructed on a 0.75-acre concrete pad within a fenced 3.5-acre area. The concrete pad would create new impervious surface that would restrict rainfall from infiltrating into the subsurface. Rainwater falling on this structure would be routed to the surrounding area that would remain unpaved. Rainwater would still be able to infiltrate into the subsurface and recharge the underlying aquifer. Therefore, there would be no reduction in groundwater recharge.

Carmel Valley Pump Station

The Carmel Valley Pump Station would be enclosed in a 500-square-foot, single-story building built in an unpaved area. The surrounding area would remain unpaved, providing a route for

rainwater falling on the pump station to infiltrate into the ground and recharge the underlying aquifer. The Carmel Valley Pump Station would not result in a reduction to groundwater recharge.

Pipelines

Construction workers would install 21 total miles of pipelines within or adjacent to existing roads and recreational trails. Most pipeline segments would be installed using conventional open-trench technology. The typical trench width would be 6 feet, and the overall construction corridor for pipeline construction would vary from 50 to 100 feet, depending on the size of the pipe being installed. The trenches would be backfilled and the surfaces restored to their pre-existing conditions. Therefore, there would be no change to the existing amount of impervious surfaces and no change to the existing volume of groundwater recharge.

Impact Conclusion Groundwater Recharge

The MPWSP slant wells would divert and capture some groundwater that would otherwise have flowed to the Salinas River and the Tembladero Slough. The amount of groundwater loss from both of these surface water systems would be minor, if not immeasurable, considering the volume of water that flows through them. The reduction of surface water attributable to slant well pumping is not a substantial loss to groundwater supply, nor does it constitute a substantial interference to surface water recharge and thus this impact would be less than significant. While pumping at the slant wells could cause drawdown in the large dredge pond over periods of extended pumping, the magnitude of that response would not interfere with recharge to the Dune Sand Aquifer, nor would it inhibit sand mining operations by depleting available water supplies to the pond. This impact is less than significant. Facilities proposed for the project would slightly increase the amount of impervious surfaces in the project area, but would not reduce the potential for surface water to recharge the underlying aquifers. Impacts associated with changes to groundwater recharge during the operation of all project facilities would be less than significant.

Impacts on All Other MPWSP Components

None of the other proposed facilities would involve the injection or extraction of groundwater. Therefore, there would be no impact on groundwater supplies from the operation of the monitoring wells, MPWSP Desalination Plant, Terminal Reservoir, pipelines, and pump stations.

Conclusion for Impact 4.4-3

The proposed project would extract mostly seawater and some brackish groundwater from a localized area; no fresh water supplies would be removed from the basin. When water is returned to the basin, groundwater conditions in the 400-Foot Aquifer underlying the CSIP and CCSD and adjacent areas would improve. Water levels in nearby wells may decline in the 180-FTE Aquifer between 1 and 5 feet, but that would not expose screens, cause damage, or reduce yield in the groundwater supply wells. Injection and extraction through the ASR well system would be managed so that the water provided from the desalination plant would not constitute a net change in storage. The reduction of surface water from the Salinas River attributable to slant well pumping would not be a substantial loss to water supply, nor would it constitute a substantial

interference to surface water recharge. Pumping at the slant wells could cause drawdown in the large dredge pond over periods of extended pumping, but the magnitude of that response would not interfere with recharge. The MPWSP may slightly increase the area of impervious surface in the project area, but it would not reduce the potential for surface water to recharge the underlying aquifers. Impacts associated with changes to groundwater recharge during the operation of all project facilities would be less than significant.

Applicant Proposed Measure - Groundwater Monitoring and Avoidance of Well Damage

The project applicant has proposed to expand the existing regional groundwater monitoring program to include the area where groundwater elevations are anticipated to decrease in the Dune Sand Aquifer and the 180-FTE Aquifer. This Applicant Proposed Measure is not required to reduce a potential impact to less than significant.

Applicant Proposed Measure

Applicant Proposed Measure 4.4-3 applies only to the Seawater Intake System.

Applicant Proposed Measure 4.4-3: Groundwater Monitoring and Avoidance of Well Damage.

Prior to the start of MPWSP construction, the project applicant, working with the MCWRA, shall fund and develop a groundwater monitoring and reporting program that expands the current regional groundwater monitoring network to include the area near the proposed slant wells. Once expanded, the program will monitor groundwater levels and water quality within the area where groundwater elevations are anticipated to decrease in the Dune Sand Aquifer and the 180-FTE Aquifer and within at least one mile outside of the predicted radius of influence. The area of groundwater monitoring shall be determined by MCWRA and the MPWSP HWG. The elements of the groundwater monitoring program proposed under this measure are described below.

- Using a current survey of wells within the pumping influence of the slant wells, CalAm will offer to private and public well owners the opportunity to participate in a voluntary groundwater monitoring program to conduct groundwater elevation and quality monitoring. The voluntary groundwater monitoring program shall include retaining an independent hydrogeologist to evaluate the conditions and characteristics (e.g., well depth, well screen interval, pump depth and condition, and flow rate) of participating wells prior to the start of slant well pumping. Water elevation and quality monitoring shall begin following initial groundwater well assessment.
- Based on a review of the well network of voluntary well owners, CalAm will identify areas lacking adequate groundwater data and if deemed necessary, install new monitoring wells. These new wells would be in the 180-Foot Aquifer.
- Seven clusters of monitoring wells were recently completed on and near the CEMEX property. These well clusters monitor various depths within the Dune Sand Aquifer, the 180-Foot Aquifer, and the 400-Foot Aquifer and shall be included in the monitoring network.
- Using the groundwater data developed through the voluntary well monitoring program and data gathered at the new monitoring wells, CalAm will evaluate

whether project pumping is causing a measurable and consistent drawdown of local groundwater levels in nearby wells that is distinguishable from seasonal groundwater level fluctuations. In the event that a consistent and measurable drawdown is identified, CalAm will determine if the observed degree of drawdown would damage or otherwise adversely affect active water supply wells. Adverse effects from lowered groundwater levels in existing active groundwater supply wells can include cavitation²⁶ due to exposure of the well screen, water elevation declines that draw water below pump intakes, reduced well yields and pumping rates, and changes in groundwater quality indicating that project pumping is drawing lower quality water toward the well. Adverse effects would only occur in active wells; inactive wells would not be considered for mitigation.

- If it is determined that a nearby active groundwater well has been damaged or otherwise negatively affected by the project pumping of the slant wells, the project applicant shall coordinate with the well owner to arrange for an interim water supply and begin developing a mutually agreed upon course of action to repair or deepen the existing well, restore groundwater yield by improving well efficiency, provide long term replacement of water supply, or construct a new well.

Applicant Proposed Measure 4.4-3 would monitor changes in the groundwater surface elevations caused by the proposed pumping at the slant wells through a voluntary program and use of new groundwater monitoring wells. If it is determined that the project is causing groundwater levels to damage local active wells, this measure would ensure that active wells are repaired or replaced. Implementation of **Applicant Proposed Mitigation Measure 4.4-3** is not necessary to address any significant project effect.

Impact 4.4-4: Violate any groundwater quality standards or otherwise degrade groundwater quality during operations. (*Less than Significant with Mitigation*)

Impact 4.4-4 addresses the impacts on groundwater quality during the operation of the proposed project. Water quality considerations associated with the project operations include the exacerbation of seawater intrusion and the potential for the proposed project to cause new contamination, or to extend the limits of existing groundwater contamination through pumping at the seawater intake system, ASR injection/extraction wells, and other project facilities. The slant wells would extract water from the Dune Sand Aquifer and the 180-FTE Aquifer of the SVGB, while the ASR wells would periodically inject water into and extract groundwater from the Santa Margarita Sandstone in the SGB.

Operation of Subsurface Slant Wells

Impact on Groundwater Quality Within Slant Well Pumping Area of Influence

This impact analysis considers the effect of continuous pumping at the CEMEX site on local groundwater quality in the Dune Sand and 180-FTE Aquifer. As discussed in Impact 4.4-3, and

²⁶ Cavitation is caused by introducing air into well water by exposing the well screen or pump. The air can cause a drop in liquid pressure moving through the pump impeller's opening, causing bubbles to form and collapse. The hydraulic impacts caused by the collapsing bubbles can be strong enough to damage the pump.

shown in **Figures 4.4-10** and **4.4-11**, the water quality in the Dune Sand and 180-FTE Aquifers is degraded from seawater intrusion and has been for decades. The MPWSP slant wells would pump that water for the desalination plant source water. **Figure 4.4-13** shows the extent of the cone of depression formed in the 180-FTE Aquifer during slant well pumping at the CEMEX site and the resultant groundwater drawdown projected under the conservative pumping scenario where sea level is at current levels and no water is return to the basin as part of the MPWSP.

The timeframe over which the cone of depression would develop to its full extent is also an important consideration in this analysis. According to the NMGWM, the time required for the cone of depression in the 180-FTE Aquifer to reach its maximum extent, as shown in **Figure 4.4-13**, is between 1 and 5 years after groundwater project start-up. After 5 years, the cone of depression would equilibrate and remain somewhat stable throughout the projected 63 years of operation. Based on this timeframe, localized changes in water quality could be realized within the first 5 years of project operation and could stabilize at that level. The NMGWM also projects that the timeframe for groundwater recovery after the MPWSP is offline would be in the range of 1 to 5 years.

From the time the slant wells begin pumping, and throughout the life of the project, local groundwater quality around the slant wells and within the cone of depression could change from the brackish quality it is now to higher salinity groundwater. The degradation in water quality (measured as an increase in TDS) would occur because the slant wells would draw in the brackish water that is currently in the aquifer formation and seawater would flow in to replace it. This effect would be most detectable near the coast at the CEMEX site and less pronounced inland because seawater would enter the slant wells more readily closer to the Monterey Bay compared to farther east where a smaller fraction of brackish groundwater would be drawn from the inland portion of the aquifers.

This impact analysis considers whether this projected degradation in localized water quality would constitute a significant impact. A significant impact would occur if the proposed project violated water quality standards or degraded a groundwater source such that it would interrupt or eliminate the available potable groundwater for other users in the basin. Groundwater in the Dune Sand and the 180-FTE Aquifers within the area projected to be affected by slant well pumping is not used for potable supply or irrigation. As stated in Impact 4.4-3, the use of the current groundwater production in this area is limited to minor irrigation and dust control. There are no water supply wells pumping potable water, and most of the wells in this area are no longer active because of seawater intrusion. Furthermore, groundwater production is restricted in the vicinity of the CEMEX site through MCWRA Ordinance 3709, which prohibits drilling wells and pumping groundwater from the 180-FTE Aquifer in order to protect groundwater resources.

Based on current groundwater quality and the minimal groundwater use within the area affected by slant well pumping, the localized change in groundwater quality that could occur as a result of slant well pumping is not expected to violate water quality standards or interrupt or eliminate the potable or irrigation groundwater supply available to other basin users. Therefore, this impact is considered less than significant.

Impact on Seawater Intrusion

As shown on **Figures 4.4-10** and **4.4-11**, the current location of the seawater/freshwater interface is about 8 miles inland in the 180-Foot Aquifer and 3.5 miles inland in the 400-Foot Aquifer. Once operational, the proposed slant wells would extract 24.1 mgd from the subsurface. A significant impact would occur if the proposed project caused the seawater/freshwater interface to migrate further inland, thereby exacerbating the seawater intrusion condition in the SVGB.

The effects on seawater intrusion were evaluated using the NMGWM with particle tracking (described in the Approach to Analysis section, above). **Figure 4.4-17** shows the coastal seawater intrusion in the SVGB using the seawater/freshwater interface location estimated by the MCWRA and shown in **Figures 4.4-10** and **4.4-11**. Before running the model to simulate the 63 years of operation, individual water “particles” were placed along the leading edge of the mapped seawater intrusion front. Without the project, these particles are expected to continue to migrate inland with the movement of the seawater/freshwater interface. The NMGWM is a superposition model, meaning that modeled project effects are isolated from all other stresses in the basin, such as the effects from other groundwater pumpers, inland pressure gradients, injection systems, and recharge. In superposition, the NMGWM output is therefore the change attributable solely to the slant well pumping. **Figure 4.4-17** depicts the resulting particle-tracking outputs, showing that a number of particles radiate away from the seawater/freshwater front back towards the coast. In **Figure 4.4-17**, some particle locations change substantially, whereas others do not. As to those that do change, the change in particle location shows where the seawater front would be after 63 years of MPWSP pumping *if that was the only factor affecting groundwater movement in the basin* (no recharge, no groundwater pumping, no pressure gradients, etc.). Therefore, **Figure 4.4-17** illustrates the MPWSP's contribution to redirecting or reversing the inland advance of seawater intrusion. Because there are many stresses in the basin, the MPWSP project would not necessarily draw the leading edge of the seawater intrusion line back towards the coast to the extent shown by the particle-tracking output, but it does indicate that the MPWSP provides a benefit for the basin. Based on the particle-tracking results, the MPWSP would not exacerbate seawater intrusion, and groundwater extraction from the coast, as part of project operations, would be expected to retard future inland migration of the seawater/freshwater interface. The proposed project would facilitate the reduction of seawater intrusion in the long term, and the impacts of the proposed project are considered less than significant.

Impacts Associated with Existing Groundwater Remediation Systems

Past industrial, commercial, or military sites have residual soil and groundwater contamination caused by past spills, leaking underground tanks, unlined chemical disposal sites or inadvertent land disposal of chemicals in the SVGB and the SGB, as discussed in detail in Section 4.7, Hazards and Hazardous Materials. When contaminated groundwater is found at these sites, a common remedy is to pump the contaminated water out, treat it, and either dispose of it or use it for non-potable supply; this process is referred to as “pump and treat.” Pumping contaminated water out of the ground requires extraction wells that, similar to the slant wells proposed by the proposed project, can create a cone of depression and an accompanying area of influence. When the area of influence of a pump and treat site intersects that of another water extraction system,

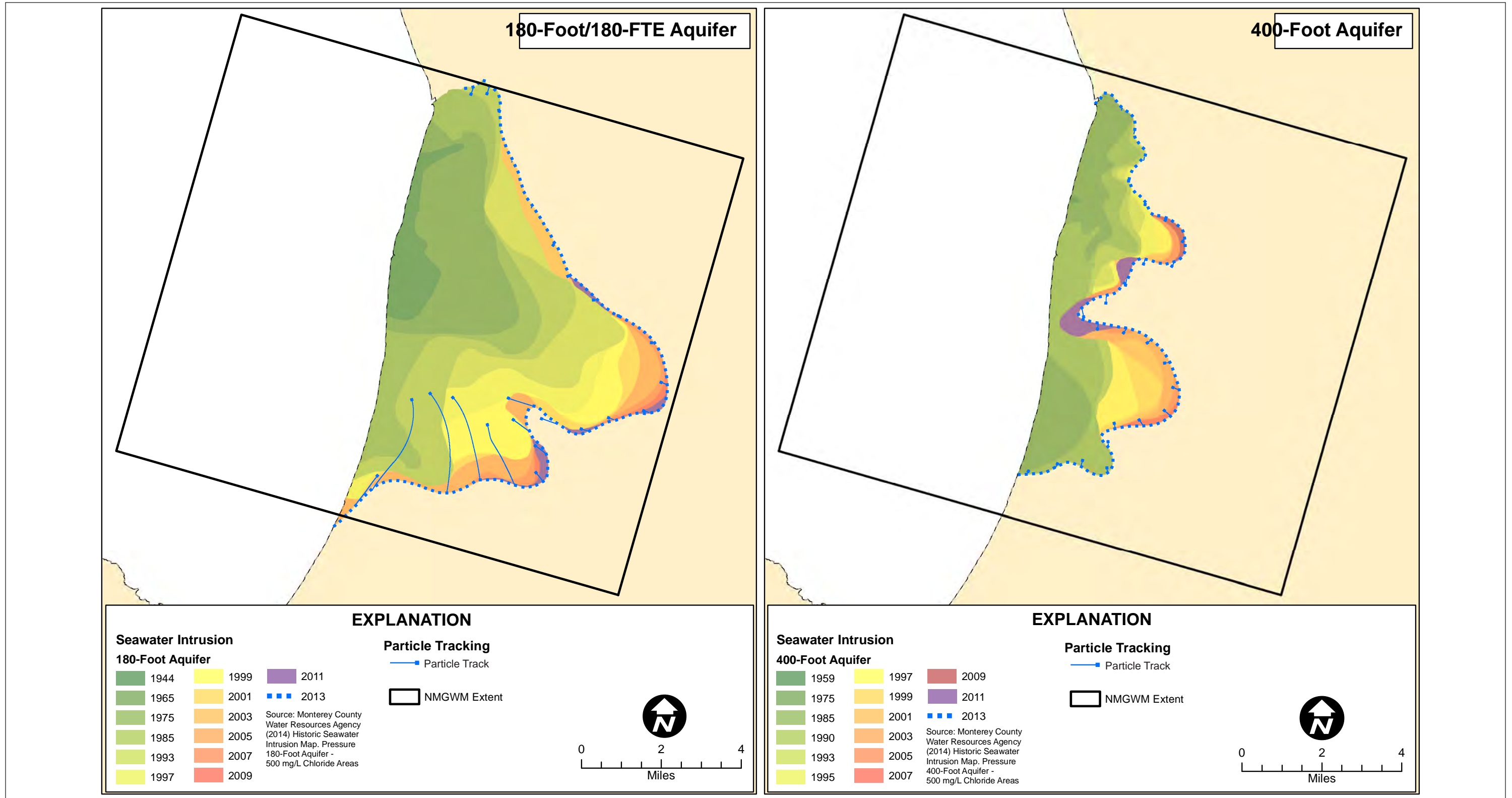
the cones of depression interfere with each other and can cause the groundwater contamination to spread into previously uncontaminated or previously remediated areas.

The proposed slant wells would produce a radius of influence in the Dune Sand Aquifer and the 180-FTE Aquifer, as shown on **Figures 4.4-14** and **4.4-15** and as discussed in Impact 4.4-3. Within the CEMEX area, the NMGWM projects that groundwater elevations could decrease and that decrease could incrementally affect groundwater flow directions. If there are nearby inland sites that are remediating contaminated groundwater in the same aquifers and that are located within the radius of influence of the slant wells, then the pumping of the slant wells could potentially interfere with those remediation activities, pulling contaminated groundwater into currently uncontaminated areas and degrading the existing water quality. This would violate the state policy of maintaining the existing water quality. A significant impact would occur if the proposed project created a condition that would violate water quality standards or otherwise degrade water quality.

The U.S. Army has been conducting investigation and cleanup activities at the former Fort Ord military reservation since 1986 (Fort Ord Base Realignment and Closure Office, U.S. Army, 2012). The ongoing remediation will continue until contaminant levels in the groundwater are reduced to clean-up levels or below, and are protective of human health. The northwestern border of the former Fort Ord is located within 2 miles southeast of the seawater intake system.

As discussed in the Setting for Section 4.7, Hazards and Hazardous Materials, the former Fort Ord military base has several plumes of contaminated groundwater located southeast of the seawater intake system, as shown on **Figure 4.7-1**. Source removal and ongoing groundwater remediation efforts have effectively reduced the contaminant concentrations and extents in these plumes. Three of the plumes closest to the slant wells are located within the area in which the NMGWM estimates groundwater levels would decrease by one to two feet in the Dune Sand Aquifer and the 180-Foot Aquifer. The A-Aquifer is a shallow inland aquifer above the 180-Foot Aquifer and is not known to be hydraulically connected to the Dune Sand Aquifer at the proposed slant well locations. **Figure 4.7-1** shows the location and current configuration of the contaminant plumes and **Figure 4.4-15** shows the -1-foot drawdown contour of what is considered the “worst case” aquifer response from the proposed project (180-FTE Aquifer, no return water, with 2012 sea level conditions). Comparison of **Figures 4.7-1** and **4.4-15** shows that the -1-foot contour is approaching the contaminant plumes. If the drawdown caused by the slant well pumping were to intersect and alter the local flow gradient near the plumes, the slight change could influence the plumes to migrate further northwest into currently uncontaminated areas and to degrade water quality. The possible overlap of the slant well radius of influence with each of these plumes is discussed below.

OUCTP A-Aquifer Plume. The OUCTP A-Aquifer Plume, located about 2 miles southeast of the slant wells, is contaminated by carbon tetrachloride. This plume was previously under remediation by pump-and-treat technology (Ahtna, 2016). The A-Aquifer plume is currently being treated using enhanced in situ bioremediation, followed by monitored natural attenuation. This method involves enhancing naturally occurring microbes to break down the contaminants



SOURCE: HydroFocus, 2016

Monterey Peninsula Water Supply Project . 205335.01

Figure 4.4-17
Proposed Action Impact on Location of Freshwater/Seawater Interface

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into non-toxic compounds, and does not require the extraction of groundwater. As a consequence, there are no longer any operational extraction wells producing cones of depression within the area of the OUCTP A-Aquifer Plume. If the radius of influence of the proposed slant wells does reach the western portion of the OUCTP A-Aquifer Plume, then the decrease in groundwater elevations could alter the existing groundwater flow direction. This change in flow direction could pull the OUCTP Plume further northwest, spreading the contamination to areas that are not now contaminated above action levels. As previously discussed, this location is about 2 miles from the slant wells. At this distance, the NMGWM simulations decrease in accuracy and the anticipated 1 to 2-foot groundwater elevation decrease within the radius of influence is less certain to extend this far. Nonetheless, the simulation indicates that the decrease in groundwater elevations is possible and could result in a significant impact. This impact would be reduced to less than significant with the implementation of **Mitigation Measure 4.4-4 (Groundwater Monitoring and Avoidance of Impacts on Groundwater Remediation Plumes)**, which would require CalAm to monitor groundwater flow directions at the nearby known contaminated groundwater plumes and to work with the responsible parties if the proposed project would adversely impact those ongoing remediation efforts.

OUCTP Upper 180-Foot-Aquifer Plume. The OUCTP Upper 180-Foot Aquifer Plume, located a little over 3 miles southeast of the slant wells, is using pump-and-treat technology for groundwater remediation (Ahtna, 2016). At its largest, the treatment system had seven extraction wells operating throughout the extent of the plume, including at the westernmost edge of the plume. As cleanup of the plume has proceeded, the extent of the plume has become smaller as concentrations in the groundwater have decreased. Currently, only one extraction well is in operation in the central area of the plume. The operation of the extraction well also serves to contain the plume and prevent its migration further west because groundwater flows toward the extraction well and cannot escape further west. As measured during the December 2014 monitoring event, the cone of depression around the extraction well was about 22 feet below the surrounding groundwater levels. With a cone of depression of 10 or more feet, the 1- to 2-foot decrease in groundwater levels caused by the proposed slant wells would be unable to overcome the cone of depression at the extraction wells. Therefore, with the ongoing extraction system, the impact of the slant wells would be less than significant and no mitigation is proposed.

Impacts Associated with ASR Injection/Extraction Wells

Interference with Existing Groundwater Remediation Systems. The injection of desalinated product water into the proposed ASR-5 and ASR-6 Wells would increase groundwater elevations and the volume of water in underground storage. This increase in groundwater elevations would alter groundwater flow patterns in the vicinity of the proposed ASR-5 and ASR-6 Wells. If there are nearby sites that are remediating contaminated groundwater in the Santa Margarita Sandstone aquifer and are located within the area where groundwater elevations are expected to rise, then the increase of groundwater elevations could interfere with those remediation activities, pushing contaminated groundwater into currently uncontaminated areas and degrading the existing water quality.

As previously discussed, the addition of the ASR injection/extraction wells would increase the capacity to inject and store water in the Santa Margarita Sandstone in the SGB. The SGB is separated by a groundwater divide from the SVGB to the north, where the former Fort Ord sites discussed above are located. As previously discussed, water would be injected and extracted from the desalination plant into the SGB such that there would be no net negative change in storage on an annual basis.

The target aquifer for injection and storage is in the Santa Margarita Sandstone, at a depth of about 1,000 feet below the ground surface. Currently, a groundwater depression caused by historical overdraft is located to the south of the ASR system, with its center close to General Jim Moore Boulevard, as shown on **Figures 4.4-7** and **4.4-8**. The presence of this groundwater depression would cause the additional water injected and stored in the Santa Margarita Sandstone to flow toward that depression to the south. Consequently, only remediation sites with groundwater contamination in the Santa Margarita Sandstone at about 1,000 feet below the ground surface and located within the area between the ASR injection/extraction wells and the center of the groundwater depression could be affected. As shown on **Figure 4.7-2**, the nearest contaminated sites are located along Del Monte Boulevard, near the coast and west of the groundwater depression; however, the contamination is in the surficial Aromas Sand Aquifer. There are no known contaminated sites undergoing groundwater remediation in the area between the ASR injection/extraction wells and the edge of the groundwater depression. Therefore, the potential for the ASR injection/extraction wells operation to interfere with groundwater remediation activities at nearby contaminated sites would be low and thus, this impact is less than significant.

Addition of Treated Water to the Santa Margarita Aquifer. The ASR component for the proposed project would continue to utilize and augment the existing ASR system. The expansion includes the construction of two additional ASR injection/extraction wells along General Jim Moore Boulevard (see **Figure 3-9a**) that would increase the reliability of storing Carmel River water in the SGB, and would facilitate the injection, storage, and extraction of desalinated water. The seawater pumped from the slant wells would be treated to potable drinking water standards at the proposed desalination plant and pumped through the water supply distribution system to the SGB, where the water would be injected into the ASR injection/extraction wells for later recovery during dry periods (see **Figure 3-2**). As discussed in the Setting, the primary water quality concern associated with ASR projects using potable water is that DBPs, including THMs and HAAs, are formed during the disinfection process. Additionally, the injection of oxygenated water could potentially alter the geochemistry of the groundwater and increase the concentration of minerals in groundwater.

The existing ASR system treats surface water from the Carmel River to drinking water standards and then injects that treated water into storage in the Santa Margarita Sandstone for later extraction and use. As discussed in the Setting, the MPWMD conducted investigations to evaluate the effects of injecting water treated to drinking water standards into the Santa Margarita Sandstone. Their investigations, as well as ongoing monitoring, concluded that the DBPs do increase upon initial injection of treated surface water into the Santa Margarita Sandstone, but

concentrations steadily decreased with time and the existing conditions are restored over the course of six to eight months (Pueblo Water Resources, 2014). Groundwater monitoring results indicate that over the course of that time, the pH remains neutral (between 6 and 8), indicating relatively stable geochemical conditions.

The RWQCB currently regulates the ASR project under Permit 20808C. The MPWMD continues to conduct groundwater studies and monitoring to document the changes to the groundwater system due to ASR, and to ensure that the ASR project does not degrade groundwater quality within the SGB. The RWQCB will continue to require a monitoring and response program for continued operation of the project and to protect groundwater quality in the Santa Margarita Sandstone. Expansion of the ASR project would require the approval from the RWQCB for implementation, which would require a similar level of water quality testing and monitoring to ensure that the injected water would not degrade the receiving groundwater in the SGB.

In accordance with the evaluation criteria, this impact would be significant if adding treated desalinated water into the current ASR system degraded the existing groundwater quality. **Table 4.4-11** compares the water chemistry of the treated Carmel River water to the water chemistry of desalinated water currently produced by the Sand City desalination plant. The Sand City desalination plant uses the same technology that would be used by the proposed desalination plant, so the resulting water chemistry would be similar. As shown in **Table 4.4-11**, the water chemistry of the treated Carmel River water is similar to the Sand City desalination plant product water. Therefore, it would be reasonable to expect that the Santa Margarita Sandstone would have the same reaction to the injection of the treated desalination plant water as to the treated Carmel River water. This is a less than significant impact.

Maintenance of the ASR Wells. ASR injection/extraction wells sites are susceptible to well plugging because all water sources have at least some level of suspended solids, which can include particulates, bionutrients, or oxidants (Pueblo Water Resources, 2014). During injection, a trace amount of suspended solids is collected in the gravel pack of the well, in the aquifer material surrounding the gravel pack of the well, and in the silt trap of the well pipe.²⁷ Over time, the accumulated silt will clog the pore spaces of the well gravel pack and native aquifer materials, restricting the flow of aquifer water into the well and reducing well efficiencies. As a part of the routine operation of the ASR injection/extraction wells, each well must be periodically cleaned to maintain well efficiency. The cleaning process involves backflushing the wells and pumping out the turbid water. The inappropriate discharge of this turbid, sediment-laden, backflush water could adversely affect groundwater resources.

²⁷ The silt trap of the well is a blank (no well screen openings) section of well pipe below the well screen that provides a place for sediment to accumulate without clogging the well screen.

**TABLE 4.4-11
 WATER CHEMISTRY OF TREATED CARMEL RIVER WATER AND SAND CITY DESALINATED WATER**

| Chemical Parameter | Treated Carmel River Water | Treated Sand City Desalinated Water |
|------------------------------------|----------------------------|-------------------------------------|
| Alkalinity as CaCO ₃ | 129 | 55 - 125 |
| Aluminum | 0.025 | nd (0.010) |
| Ammonia Nitrogen | 0.1 | na |
| Arsenic | nd (0.005) | nd (0.001) |
| Antimony | na | nd (0.0004) |
| Barium | 0.056 | 0.014 |
| Boron | na | 0.5 – 0.877 |
| Bromide | 0.11 | na |
| Beryllium | na | nd (0.0003) |
| Cadmium | na | nd (0.001) |
| Calcium | 36 | 18 – 45 |
| Chloride | 32 | 72 |
| Dissolved Organic Carbon | 1.4 | na |
| Chromium | na | nd (0.007) |
| Cobalt | na | na |
| Dissolved Oxygen | 7.43 | 9.77 |
| Electrical Conductivity | 510 | 315 – 690 |
| Fluoride | 0.30 | 0.10 |
| Iron | 0.001 | nd (0.06) |
| Lead | na | nd (0.001) |
| Magnesium | 14 | nd (1) – 8 |
| Manganese | 0.001 | nd (0.010) |
| Mercury | na | nd (0.0002) |
| Molybdenum | na | 0.003 |
| Nickel | na | 0.001 |
| Nitrate/Nitrite as NO ₃ | 0.05 | na |
| Oxygen Reduction Potential (ORP) | 749 | 128.8 |
| Ortho-Phosphate | na | nd (0.77) |
| Total Phosphorous | 0.34 | na |
| Potassium | 2.9 | nd (5) |
| pH | 7.70 | 7.51 |
| Selenium | 0.0017 | nd (0.002) |
| Silicon | 8.41 | nd (10) – 12 |
| Silver | na | nd (0.010) |
| Sodium | 42 | 51.9 |
| Strontium | 0.200 | 0.131 |
| Sulfate as SO ₄ | 84.9 | 19.2 |
| Thallium | na | nd (0.0003) |
| Uranium | 0.0025 | na |
| Vanadium | na | nd (0.050) |
| Zinc | 0.210 | nd (0.050) |

NOTES: All concentrations in milligrams per liter (mg/L) except conductivity (micromhos per centimeter), ORP (millivolts), and pH (pH units)

na = not analyzed

nd = not detected above reporting limit in parentheses

SOURCE: EcoEngineers, 2008; Sand City Desalination Plant, 2011, 2014.

The well maintenance activities of the existing ASR injection/extraction wells have indicated that a weekly frequency of backflushing keeps the aquifer pore spaces clear of sediment and maintains well efficiencies (Pueblo Water Resources, 2014). The backflushing process consists of the following steps:

- Removing the well pump assembly
- Mechanically brushing the wells screens to dislodge sediment
- Bailing out the sediment-laden water
- Airlifting and swabbing the well pipe
- Chemically treating the well screen with glycolic acid and hydrochloric acid to remove and inhibit scale growth in the well screens
- Airlifting and swabbing the well pipe
- Chlorinating the well overnight, followed by airlifting to remove the chlorine solution the next day

Reports indicate that the initial discharge of backwash is a deep orange-brown turbid water, becoming cloudy after about 5 minutes, and clear within about 15 to 20 minutes for each screen interval being cleaned (Pueblo Water Resources, 2014). The effectiveness of the backflushing is checked by 10-minute specific capacity tests to verify the return of the well efficiency.

The discharge water would be pumped through subsurface piping and conveyed through the proposed ASR Pump-to-Waste Pipeline to the existing settling basin for the Phase I facilities at the intersection of General Jim Moore Boulevard and Coe Avenue, and infiltrated into the ground (**Figure 3-9a**). The settling basin is unlined to allow the discharge water to infiltrate into the subsurface soils, eventually migrating down back into the aquifer and leaving the sediment in the basin. The sediment that would accumulate in the basin would be periodically removed and disposed of at an appropriate disposal site. The depth to groundwater beneath the settling basin is about 350 or more feet below the ground surface (Pueblo Water Resources, 2013). It is reasonable to expect that a 350-foot deep water column of sediments would be adequate to successfully remove the sediment and polish the water before the water infiltrates into the aquifer.

As a part of the project design, the periodic backflushing of ASR-5 and ASR-6 Wells would use the same process used for the existing ASR injection/extraction wells. Pipelines would be built to connect wells ASR-5 and ASR-6 into the existing pipeline system that includes the pipeline that discharges to the existing settling basin. Routing the discharge water to the existing settling basin and infiltrating it through soil would remove the sediments. Considering this process would be conducted when needed, water quality impacts associated with discharge water would be less than significant impact.

MPWSP Desalination Plant and All Pipelines and Conveyance Facilities

No other project facilities would inject or extract water. Therefore, these project facilities would cause no impact related to groundwater quality or interference with existing groundwater remediation activities.

Impact Conclusion

Slant well pumping at the Cemex site could intersect the OUCTP A-Aquifer plume and degrade groundwater in areas not affected by the current contaminant plume. This is considered a significant impact that could be reduced to less than significant by **Mitigation Measure 4.4-4**. The OUCTP Upper 180-Foot Aquifer Plume would not be impacted by the MPWSP pumping because the magnitude of drawdown (about 1-2 feet) would be masked by the cone of depression currently created by the pump and treat remediation system. The proposed project would result in a less than significant impact related to interference with existing groundwater remediation activities, with the possible exception of two of the OUCTP plumes at the former Fort Ord. The impact would be reduced to less than significant with the implementation of **Mitigation Measure 4.4-4**, described below.

All Other Project Components

The operation of the MPWSP Desalination Plant, monitoring wells, Terminal Reservoir, pipelines, and pump stations would not involve the use of or discharges to groundwater. Therefore, there would be no impact relative to groundwater quality.

Impact Conclusion for Groundwater Quality

For the slant wells, the seawater/freshwater interface would migrate back toward the ocean, which would be a less-than-significant impact. For the slant wells, the potential impact of interference with existing remediation systems would be reduced to less than significant with the implementation of Mitigation Measure 4.4-4. For the ASR injection/extraction wells, the net addition of injection water is considered a less than significant impact. For the ASR injection/extraction wells, the potential impact of interference with existing remediation systems would be less than significant. The operation of all other project facilities would have no impact on groundwater quality.

Therefore, for the proposed project as a whole, the potential operations impacts would be less than significant with mitigation, relative to groundwater quality.

Mitigation Measure

Mitigation Measure 4.4-4 applies only to the Seawater Intake System.

Mitigation Measure 4.4-4: (Groundwater Monitoring and Avoidance of Impacts on Groundwater Remediation Plumes).

Prior to the start of MPWSP construction, the project applicant shall incorporate the future quarterly groundwater elevation monitoring results for the two OUCTP plumes into the well monitoring program described above in **Applicant Proposed Measure 4.4-3** until the

two OUCTP plumes have been appropriately remediated and the RWQCB no longer requires remediation activities. Groundwater elevation data shall be obtained from the periodic monitoring reports developed by the U.S. Army and its contractors. The elements of the additions to the groundwater monitoring program proposed under this mitigation measure are described below.

- Using the most recent monitoring reports available through the U.S. Army and its contractors, the groundwater elevations in the A-Aquifer and the Upper 180-Foot Aquifer for wells at and downgradient of the westernmost edge of the two OUCTP plumes shall be incorporated into the well monitoring program described above for **Applicant Proposed Mitigation Measure 4.4-3**.
- The groundwater elevation results shall be evaluated by Cal Am and its consultants on a quarterly basis to assess whether the cone of depression from the proposed seawater intake system is approaching or has reached the edge of the two OUCTP plumes. If the analysis concludes that the slant well pumping could intersect or could influence the flow direction of two OUCTP plumes, then the project applicant shall reimburse the U.S. Army for the necessary additional costs to address changes in the plume flow direction, arrest migration of the plumes, and/or to remediate areas of new contamination created by slant well pumping. CalAm shall consider using existing groundwater remediation and monitoring wells that remain on the site to expand the existing treatment systems.
- When the ongoing remediation of the two OUCTP plumes has been completed and the RWQCB authorizes closure of the two OUCTP plumes remediation activities, this mitigation measure shall no longer apply.

Mitigation Measure 4.4-4 would monitor changes in the groundwater surface elevation caused by MPWSP pumping near the two OUCTP Plumes. If it is determined that MPWSP pumping could interfere with the Fort Ord plumes, this mitigation measure requires CalAm to take actions so the plumes do not expand and contaminate other areas, such as reimbursing the US Army for work necessary to change the plume flow direction, arrest migration of the plumes, and/or to remediate areas of new contamination created by slant well pumping. This mitigation would reduce the impacts to less than significant.

4.4.6 Cumulative Effects of the Proposed Project

The cumulative scenario and cumulative impacts methodology are described in Section 4.1.7. Table 4.1-2 lists potential cumulative projects.

Impact 4.4-C: Cumulative impacts related to Groundwater Resources. (*Less than Significant*)

The geographic scope of the cumulative analysis for groundwater resources includes portions of the SVGB and the SGB. Within the SVGB, it is the western half of the Pressure Area extending from the coast of the Monterey Bay to about Davis Road in Salinas and from Moss Landing south

to the jurisdictional boundary of the Pressure Area and the SGB (**Figure 4.4-1**). The geographic scope within the SGB includes the entire basin as it is shown in **Figure 4.4-1**.

The geographic scope also includes a vertical element, which includes the underground aquifers in the SVGB and the SGB. In the SVGB, the aquifers of concern are the Dune Sand Aquifer, 180-FTE Aquifer, 180-Foot Aquifer (inland and east of CEMEX), and 400-foot Aquifer. In the SGB, the aquifer of concern is the surficial shallow aquifer, which is in the unconfined Paso Robles Formation and the underlying confined Santa Margarita Sandstone.

Cumulative groundwater impacts would be significant if they would substantially deplete or interfere with groundwater supplies, violate water quality standards, or degrade water quality. This analysis evaluates cumulative impacts within the basins associated with the aquifer response to groundwater extraction and injection. The significance thresholds are based on the physical effects from changes to the volume and quality of the groundwater. The surface infrastructure associated with the slant wells and the ASR wells, such as pipelines and pump stations, would not impact groundwater resources and is therefore not discussed further in this section.

Baseline conditions evaluated in the project-specific analysis in Section 4.4.5 reflect the contributions of past actions, including existing, operational projects that withdraw or return groundwater, on groundwater resources within the geographic scope. Therefore, the timeframe considered for the cumulative analysis is the life of the project plus two years to allow for aquifer recovery. Substantial quantities of groundwater would not be used or affected during the project construction phase; therefore, construction-phase effects are not addressed since the project's contribution to any cumulative effects would not be cumulatively considerable in nature or extent (*less than significant*).

The current and reasonably foreseeable future projects listed in **Table 4.1-2** that are within the geographic scope and have the potential to combine with the groundwater-related impacts of the proposed project are the Salinas Valley Water Project Phase II (No. 1), the Interlake Tunnel (No. 24), and the Regional Urban Water Augmentation Project (RUWAP) Desalination Element (No. 31). These projects are located within the SVGB. There are no known present or reasonably foreseeable future cumulative projects in the Santa Margarita Sandstone of the SGB.

The potential cumulative operations-phase groundwater resources impacts are discussed below.

Salinas Valley Water Project Phase II (No. 1)

The Salinas Valley Water Project Phase II would deliver additional surface water to the Pressure Area and East Side Area to offset pumping and help retard seawater intrusion. This would occur in the 180-Foot Aquifer and the 400-Foot Aquifer. Phase II would have a beneficial effect on the Pressure Area of the SVGB as it would curtail groundwater extraction and reduce stress on the groundwater aquifers. The MPWSP would draw seawater and brackish inland water from the western edge of the Pressure Area, which, over time, is expected to facilitate the retreat of the seawater intrusion front. If the MPWSP ultimately returns a portion of the desalinated product

water to the basin as in-lieu groundwater recharge, then it would benefit the 400-foot aquifer by reducing groundwater pumping in the area underlying the CSIP and CCSD.

The MPWSP would capture about 400 afy of shallow groundwater that would otherwise discharge to the Salinas River and the Monterey Bay. The MPWSP's 400 afy contribution would only amount to about 0.3 percent of the 135,000 afy diversion of groundwater that would otherwise enter the Salinas River proposed under Phase II, and would not result in a significant reduction in surface supply. Notwithstanding minor, potential cumulative reductions in Salinas River flows, Phase II and the MPWSP would have a cumulative beneficial effect on groundwater resources in the Pressure Area of the SVGB. Overall, Phase II and the MPWSP would have a cumulative beneficial effect on the SVGB.

Interlake Tunnel (No. 24)

The Interlake Tunnel Project would produce additional surface water storage and supply for downstream groundwater recharge and reduction of saltwater intrusion in the SVGB. The MPWSP would, over the course of the project, contribute to retarding the advancement of sea water intrusion through groundwater pumping in the already intruded western portion of the Pressure Area. The MPWSP would also enhance groundwater supplies in the 400-foot aquifer if the proposed project ultimately returns water to the basin. Overall, once implemented, both projects would eventually contribute to a cumulative beneficial impact for groundwater supply and quality.

RUWAP Desalination Element (No. 31)

As explained in Table 4.1-2, it is not reasonably foreseeable that MCWD would implement its prior plan to build a 2,700 afy desalination plant at its Armstrong Ranch property. However, the planning effort involving MCWD, Fort Ord Reuse Authority (FORA), and MRWPCA will explore the most cost effective and technically efficient mix of potential water sources, one being desalination. The feasibility study could conclude that a smaller desalination plant, such as a plant producing 1,000 afy, could be a viable option to provide the 973 afy shortfall to support the FORA Base Realignment Plan (BRP). This cumulative impact discussion, therefore, assumes that desalination would be chosen as a preferred water supply option and a 1,000 afy plant would be proposed at the MCWD Armstrong Ranch property, with intake wells located along the coast south of the CEMEX site near Reservation Road.

The cones of depression created by MPWSP pumping in the Dune Sands Aquifer and 180-FTE Aquifer are depicted in **Figures 4.4-14** and **4.4-15**, respectively. As shown, the cones of depression, delimited by the -1-foot drawdown contour, would extend south up to 2 miles to include the MCWD Reservation Road property under all sea level and return water scenarios. The MPWSP would pump about ten times the amount of groundwater per day than a smaller (1,000 afy) MCWD plant and, thus, the area of influence from the MPWSP pumping would cover a larger area than the MCWD project. If the proposed MCWD project were also pumping near the coast, its cone of depression, expected to be smaller and more confined, would likely intersect or be encompassed by the cone of depression created by MPWSP pumping. When cones of

depression from two or more pumping wells overlap, it causes what is referred to as well interference. Interference between pumping wells can create a combined drawdown effect where groundwater levels are lower than would be expected from the individual pumping wells. Typically, the combined drawdown of two or more wells is equal to the sum of the drawdowns caused by each well individually. Well interference between the slant wells at MPWSP and MCWD would cause a significant cumulative impact if groundwater levels were lowered in a nearby municipal or private groundwater production well such that the well would be damaged, yield would be substantially reduced, the well owner would be required to deepen or abandon the well, or if it would otherwise deplete groundwater in the SVGB, making it unavailable to other users.

If groundwater pumping for the MPWSP and the MCWD desalination plants were to happen simultaneously, it is reasonable to predict that the cones of depression from the two systems would be close enough to cause some degree of well interference and increased drawdown near the coast, between the CEMEX site and the MCWD property at Reservation Road. There are no operating groundwater production wells in this area. As discussed in **Impact 4.3-3**, current groundwater production in the MPWSP source aquifers is limited to minor irrigation and dust control. There are no groundwater water supply wells pumping potable water in this area, and most wells in this area are no longer active because of seawater intrusion.

With the operation of both the MPWSP and a desalination project at MCWD, the decline in groundwater levels due to well interference would not adversely affect operating groundwater production wells. The cumulative effect of the two projects would also not deplete the basin groundwater supply because the groundwater in this area is degraded by seawater intrusion and is unusable for potable water supply or irrigation use due to its high salinity. Additionally, with the MCWD desalination plant and the MPWSP operating simultaneously, there could be a combined beneficial effect because with the two projects, the zone of capture for inland flowing seawater would expand to the south to extract more intruding seawater and aid in retarding the inland advance of the existing seawater intrusion front. The RUWAP desalination element and the MPWSP, if they were to be operated concurrently, would not result in a significant cumulative impact and could contribute to a beneficial effect to reduce of seawater intrusion.

Because the MPWSP combined with the possible RUWAP desalination element would not result in a significant adverse cumulative impact and may have beneficial consequences, and the Salinas Valley Water Project Phase II and the Interlake Tunnel would have beneficial effects, the cumulative effect of these four possible projects on groundwater resources would be less than significant. Therefore, the proposed project would not have a cumulatively considerable contribution to a significant cumulative impact during operations (*less than significant*).

References – Groundwater Resources

- Ahtna, 2016, *Final Operable Unit Carbon Tetrachloride Plume Fourth Quarter 2014 through Third Quarter 2015 Groundwater Monitoring Report, Former Fort Ord, California*, March 2016.
- Brown and Caldwell, 2015. *State of the Salinas River Groundwater Basin*, January 16, 2015.
- California American Water Company (CalAm), 2013. *Table of Sand City Desalination Production Totals*. July 3, 2013.
- California American Water Company (CalAm), 2014. *Operations Rules for the Injection and Extraction of Desalinated Water into ASR Well System*. May 2, 2014.
- California Geological Survey (CGS), 2002. *Geologic Map of the Monterey 30'x60' Quadrangle and Adjacent Areas, California, California: A Digital Database*, compiled by CGS, David L., H. Gary Greene, George J. Saucedo, and Cynthia L. Pridmore, Regional Geologic Map No. 1.
- California Public Utilities Commission (CPUC), 2009. *California American Water Company, Coastal Water Project, Final Environmental Impact Report*. Prepared for California Public Utilities Commission, October 30, 2009. Available for public review at the California Public Utilities Commission.
- California Public Utilities Commission (CPUC), 2010. *Decision Approving Regional Project, Adopting Settlement Agreement and Issuing Certificate of Public Convenience and Necessity for California-American Water Facilities*. Date of Issuance 12/3/2010.
- Center for Groundwater Evaluation and Management, (CGEM) (No Date) *Sentinel Geophysics: Imaging Saltwater Intrusion, Monterey to Santa Cruz, CA*. Rosemary Knight (Stanford), Adam Pidlisecky (University of Calgary), Tara Moran (Stanford). Stanford University, Stanford, CA
- Department of Water Resources (DWR; previously known as the state Department of Public Works, Division of Water Resources), 1946. *Salinas Basin Investigation Summary Report, Bulletin 52-B*.
- Department of Water Resources (DWR), 2004a. *California's Groundwater, Bulletin 118, Central Coast Hydrologic Region, Salinas Valley Groundwater Basin, 180/400 Foot Aquifer Subbasin*. February 27, 2004.
- Department of Water Resources (DWR), 2004b. *California's Groundwater, Bulletin 118, Central Coast Hydrologic Region, Salinas Valley Groundwater Basin, Eastside Aquifer Subbasin*. February 27, 2004.
- Department of Water Resources (DWR), 2016a. *Sustainable Groundwater Management*. Website Accessed July 2016. <http://www.water.ca.gov/groundwater/sgm/>
- Department of Water Resources (DWR), 2016b. *California State Groundwater Elevation Monitoring Program (CASGEM) Groundwater Basin Prioritization. Final Results*, June 2014.

- Durbin, Timothy J., Glenn W. Kapple, and John R. Freckleton, 1978. *Two-Dimensional and Three-Dimensional Digital Flow Models of the Salinas Valley Ground-Water Basin, California*, United States Geological Survey Water-Resources Investigations 78-113.
- Durbin, Timothy J., Inc., 2007. *Groundwater Flow and Transport Model Seaside Groundwater Basin Monterey County, California*. October 26, 2007.
- EcoEngineers Pty Ltd, 2008. *Assessment of Geochemical Effects Monterey Peninsula Water Management District, Phase IAquifer Storage and Recovery Project WY2008*. August 2008.
- Eittreim, Stephen L., Roberto J. Anima, Andrew J. Stevenson, and Florence L. Wong, 2000. *Seafloor Rocks and Sediments of the Continental Shelf from Monterey Bay to Point Sur, California*, USGS Miscellaneous Field Studies Map MF-2345.
- Environmental Science Associates (ESA), 2013. *Technical Memorandum, Monterey Peninsula Water Supply Project: Coastal Water Elevations and Sea Level Rise Scenarios*. April 2, 2013.
- Fort Ord Reuse Authority (FORA), 1997. *Fort Ord Reuse Plan*. Adopted June 13, 1997.
- Fort Ord Base Realignment and Closure Office, U.S. Army. 2012. *Final 3rd Five-Year Review Report for Fort Ord Superfund Site, Monterey County, California*. September 2012.
- Geoscience Support Services, Inc. (Geoscience), 2008. *North Marina Groundwater Model, Evaluation of Potential Projects*. July 25, 2008.
- Geoscience Support Services, Inc. (Geoscience), 2012. *Aquifer Pumping Test Analysis and Evaluation of Specific Capacity and Well Efficiency Relationships SL-1 Test Slant Well Well, Doheny Beach, Dana Point, California*, dated September 7, 2012.
- Geoscience Support Services, Inc. (Geoscience), 2013a. *Review and Comments to the December 2, 2012, Technical Memorandum, Prepared by Mr. Timothy Durbin “California-American Water Company – Comments on proposal to pump groundwater from the Salinas Valley groundwater basin”*. February 6, 2013.
- Geoscience Support Services, Inc. (Geoscience), 2013b. *Updated Basin Boundaries and Salinas Valley Aquitard Map*, provided as Figure 4.4-1 in this EIR. April 2013.
- Geoscience Support Services, Inc. (Geoscience), 2013c. *Monterey Peninsula Water Supply Project, Hydrogeologic Investigation Work Plan*. August 2, 2013.
- Geoscience Support Services, Inc. (Geoscience), 2014a. *Draft Monterey Peninsula Water Supply Project, Results of Test Slant Well Modeling at Proposed CEMEX Site*, June 27, 2014.
- Geoscience Support Services, Inc. (Geoscience), 2014b. *Personal communication, Geosciences to ESA*, October 3, 2014.
- Geoscience Support Services, Inc. (Geoscience), 2015a. *Monterey Peninsula Water Supply Project Groundwater Monitoring Report No. 2, 13-Mar-15 - 20-Mar-15*. March 23, 2015.

- Geoscience Support Services, Inc. (Geoscience), 2015b. *Draft Technical Memorandum, Baseline Water and Total Dissolved Solids Levels, Monterey Peninsula Water Supply Project Area*. April 15, 2015.
- Geoscience Support Services, Inc. (Geoscience), 2015c. *Draft Monterey Peninsula Water Supply Project Groundwater Modeling and Analysis*, April 17, 2015.
- Geoscience Support Services, Inc. (Geoscience), 2016a. *Monterey Peninsula Water Supply Project, Test Slant Well Long Term Pumping Monthly Monitoring Report No. 7, 1-May-16 - 31-May-16*, June 15, 2016.
- Geoscience Support Services, Inc. (Geoscience), 2016b. *Monterey Peninsula Water Supply Project, Hydrogeologic Investigation, Technical Memorandum (TM2) Monitoring Well Completion Report and CEMEX Model Update*, July 15, 2016.
- Greene, H. Gary, 1970. Marine Geologic Map of Southern Monterey Bay. U.S. Geological Survey Open File Map, Plate 1, 1970.
- Hem, John, 1989. *Study and Interpretation of the Chemical Characteristics of Natural Water*, U.S. Geological Survey, Water Supply Paper 2254. Available online at: <http://pubs.usgs.gov/wsp/wsp2254/html/pdf.html>.
- HydroFocus, 2016, *North Marina Groundwater Model Review, Revision, and Implementation for Slant Well Pumping Scenarios*, November 23.
- HydroGeoLogic, 2015. *Final 2014 Annual And Third Quarter Groundwater Monitoring Report, Operable Unit 1, Fritzsche Army Airfield Fire Drill Area, Former Fort Ord, California*, February 2015.
- HydroMetrics LLC. (HydroMetrics), 2009a. *Basin Management Action Plan, Seaside Groundwater Basin, Monterey County, California*, February 2009.
- HydroMetrics LLC. (HydroMetrics), 2009b. *Seaside Groundwater Basin Modeling and Protective Groundwater Elevations*, prepared for the Seaside Groundwater Basin Watermaster, November 2009.
- HydroMetrics LLC., (HydroMetrics), 2013. *Water Year 2013, Seawater Intrusion Analysis Report, Seaside Basin, Monterey County, California*, December 5, 2013.
- HydroMetrics, LLC., (HydroMetrics), 2015. *Water Year 2105, Seawater Intrusion Analysis Report, Seaside Basin, Monterey County, California*, December 2015.
- ICF Jones & Stokes and Camp, Dresser & McKee, Inc. (ICF Jones & Stokes), 2008. *Monterey Peninsula Water Management District, 95-10 Project Constraints Analysis*, Prepared for the Monterey Peninsula Water Management District. August 2008.
- Kennedy/Jenks Consultants, 2004. Final Report, Hydrostratigraphic Analysis of the Northern Salinas Valley, prepared for Monterey County Water Resources Agency. May 14, 2014.
- Marina Coast Water District (MCWD), 2005. Marina Coast Water District Urban Water Management Plan. December 2005.

Monterey County, 1982. *North County – Local Coastal Land Use Plan*, certified 1982, updated March 9, 1995.

Monterey County, 2010. *2010 Monterey County General Plan*. Adopted October 26, 2010.

Monterey County Water Resource Agency (MCWRA) 1993. *Ordinance 3709 - An Ordinance of the Monterey County Water Resources Agency Prohibiting Groundwater Extractions and the Drilling of New Groundwater Extraction Facilities in Certain Portions of the Pressure 180-Foot Aquifer After January 1, 1995*.

Monterey County Water Resources Agency (MCWRA), 1995. *Monterey County Water Resources Agency Act*, Adopted April 11, 1995.

Monterey County Water Resources Agency (MCWRA), 2001. *Draft Environmental Impact Report/ Environmental Impact Statement for the Salinas Valley Water Project*, 2001.

Monterey County Water Resources Agency (MCWRA), 2006. *Monterey County Groundwater Management Plan*, May 2006.

Monterey County Water Resources Agency (MCWRA), 2007. *MCWRA Reservoirs: What Was, What Is, and What Will Be, Nacitone Public Meeting, Heritage Ranch Senior Center*, September 19, 2007.

Monterey County Water Resources Agency (MCWRA), 2009. *2008 Groundwater Summary Report*, October 2009.

Monterey County Water Resources Agency (MCWRA), 2014a. *Salinas Valley Basin, August 2013, Lines of Equal Ground Water Elevation in the Pressure 180-Foot and East Side Shallow Aquifers; and Pressure 400-Foot and East Side Deep Aquifers*. December 16, 2014.

Monterey County Water Resources Agency (MCWRA), 2014b. *Historic Seawater Intrusion Map, Pressure 180-Foot Aquifer – 500 mg/L Chloride Areas and Pressure 400-Foot Aquifer*. December 16, 2014.

Monterey County Water Resources Agency (MCWRA), 2015. *2014 Groundwater Extraction Summary Report*. October 2015.

Monterey Peninsula Water Management District (MPWMD), 2006. *Final Environmental Impact Report/Environmental Assessment for the Monterey Peninsula Water Management District Phase I Aquifer Storage and Recovery Project*, State Clearinghouse #2004121065. August 2006.

Monterey Regional Water Management Department (MRWMD), 2003. *Groundwater Well Data in Vicinity of MRWMD Site*. September 2003.

Monterey Regional Water Pollution Control Agency (MRWPCA), 2012. *Monterey Peninsula Groundwater Replenishment Project*, presentation at the Granite Rock Expo 2012. February 24, 2012.

- Monterey Regional Water Pollution Control Agency (MRWPCA), 2013. *Turning Wastewater into Safe Water, Recycled Water*. Available online at: http://www.mrwpc.org/about_facilities_water_recycling.php. Accessed July 2, 2014.
- Padre Associates, Inc., 2004. *Summary of Operations, Water Year 2003 Injection Testing, Santa Margarita Test Injection Well*, prepared for Monterey Peninsula Water Management District, March 2004.
- Pueblo Water Resources, 2013. *Summary of Operations, Monterey Peninsula ASR Project, Water Year 2012*, prepared for Monterey Peninsula Water Management District. September 2013.
- Pueblo Water Resources, 2014. *Summary of Operations, Monterey Peninsula ASR Project, Water Year 2013*, prepared for Monterey Peninsula Water Management District. June 2014.
- Pueblo Water Resources, 2016. *Draft Summary of Operations, Monterey Peninsula ASR Project, Water Year 2015, Prepared for Monterey Peninsula Water Management District*, June
- RMC, 2003. *Salinas Valley Water Project, Engineers Report*, prepared for Monterey County Water Resources Agency. January 2003.
- RMC, 2006. *Salinas Valley Integrated Regional Water Management, Functionally Equivalent Plan, Summary Document UPDATE*, prepared for Monterey County Water Resources Agency. May 2006.
- Regional Water Quality Control Board, Central Coast (RWQCB), 2011a. *Waste Discharge Requirements Order No. R3-2011-0223, NPDES Permit No. CAG993001, General Permit for Discharges with Low Threat to Water Quality*, 2011.
- Regional Water Quality Control Board, Central Coast (RWQCB), 2011b. *Water Quality Control Plan for the Central Coast Basin*. June 2011.
- Sand City Desalination Plant, 2011. *2011 Finished Water Chemistry Results*.
- Sand City Desalination Plant, 2014. *Brine Discharge Field Measurements*. January 22, 2014.
- Seaside Groundwater Basin (SGB) Watermaster, 2008. *Seaside Groundwater Basin Watermaster, Reported Quarterly and Annual Water Production (in Acre Feet) from the Seaside Groundwater Basin for all Producers Included in the Seaside Basin Adjudication – Water Year 2008*.
- Seaside Groundwater Basin (SGB) Watermaster, 2009. *2009 Water Year, Seaside Groundwater Basin Watermaster, Reported Quarterly and Annual Water Production (in Acre Feet) from the Seaside Groundwater Basin for all Producers Included in the Seaside Basin Adjudication, 2009*.
- Seaside Groundwater Basin (SGB) Watermaster, 2010. *2010 Water Year, Seaside Groundwater Basin Watermaster, Reported Quarterly and Annual Water Production (in Acre Feet) from the Seaside Groundwater Basin for all Producers Included in the Seaside Basin Adjudication, 2010*.

- Seaside Groundwater Basin (SGB) Watermaster, 2011. *2011 Water Year, Seaside Groundwater Basin Watermaster, Reported Quarterly and Annual Water Production (in Acre Feet) from the Seaside Groundwater Basin for all Producers Included in the Seaside Basin Adjudication, 2011.*
- Seaside Groundwater Basin (SGB) Watermaster, 2012a. *Seaside Groundwater Basin Watermaster, Reported Quarterly and Annual Water Production (in Acre Feet) from the Seaside Groundwater Basin for all Producers Included in the Seaside Basin Adjudication – Water Year 2012.* November 29, 2012.
- Seaside Groundwater Basin Watermaster, 2012b. *Meeting Minutes from November 29, 2012 Board Meeting.* November 29, 2012.
- Seaside Groundwater Basin (SGB) Watermaster, 2013. *Seaside Groundwater Basin Watermaster, Reported Quarterly and Annual Water Production (in Acre Feet) from the Seaside Groundwater Basin for all Producers Included in the Seaside Basin Adjudication – Water Year 2013.*
- Seaside Groundwater Basin (SGB) Watermaster, 2014. *Seaside Groundwater Basin Watermaster, Reported Quarterly and Annual Water Production (in Acre Feet) from the Seaside Groundwater Basin for all Producers Included in the Seaside Basin Adjudication – Water Year 2014*
- Stanford Connects, 2016. *Seeing into the Earth: Imaging our Groundwater Aquifers.* <http://stanfordconnects.stanford.edu/watch/seeing-earth-imaging-our-groundwater-aquifers/>. Accessed November 2016.
- State Water Resources Control Board (SWRCB), 1968. Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California.* October 28, 1968.
- State Water Resources Control Board (SWRCB), 2013. *Final Review of California American Water Company's Monterey Peninsula Water Supply Project.* July 31, 2013.
- State Water Resources Control Board (SWRCB), 2015. *Final Review of California American Water Company's Monterey Peninsula Water Supply Project.* July 31, 2013.
- Svindland, Rich, 2015. *Memo from Rich Svindland, CalAm to Eric Zigas, ESA re: Clarification to Applicant Proposed Mitigation Measure.* April 2015.
- United State Environmental Protection Agency (USEPA), 2012. *Disinfection Byproducts: A Reference Resource.* April 12, 2012.
- United States Geological Survey (USGS), 2011. *Status and Understanding of Groundwater Quality in the Monterey Bay and Salinas Valley Groundwater Basins, 2005: California GAMA Priority Basin Project, Scientific Investigations Report 2011-5058,* 2011
- Yates, E.B., M.B. Feeney, and L.I. Rosenberg, 2005. *Seaside Groundwater Basin: Update On Water Resources Conditions,* prepared for Monterey Peninsula Water Management District, 2005.