WY 2021 Annual Report

Monterey Subbasin

Marina Coast Water District Groundwater Sustainability Agency
Salinas Valley Basin Groundwater Sustainability Agency

August 2024

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List of Abbreviations

AEM	airborne electromagnetic
AF	acre-foot
AFY	acre-feet per year
CBI	Consensus Building Institute
CCR	California Code of Regulations
CCRWQCB	Central Coast Regional Water Quality Control Board
CCWG	Central Coast Wetlands Group
COCs	constituents of concern
COVID-19	coronavirus disease of 2019
DACs	disadvantaged communities
DDW	Division of Drinking Water
DWR	California Department of Water Resources
FO	Fort Ord
ft	foot
GDE	Groundwater dependent ecosystem
GEMS	Groundwater Extraction Management System
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCB	Hexachlorobenzene
ILRP	Irrigated Lands Regulatory Program
IM5	first interim milestone
InSAR	Interferometric Synthetic Aperture Radar
IPR	indirect potable reuse
IRWM	Integrated Regional Water Management
IRWMP	Integrated Regional Water Management Plan
ISW	interconnected surface water
JPA	Joint Powers Authority
MBGWFM	Monterey Subbasin Groundwater Flow Model
MCL	Maximum Contaminant Level
MCWD	Marina Coast Water District
MCWRA	Monterey County Water Resources Agency
mg/L	milligram per liter
MO	measurable objective
MODFLOW	U.S. Geological Survey modular finite-difference flow model
MOU	Memorandum of Understanding
MPWMD	Monterey Peninsula Water Management District
MT	minimum threshold
NAVD 88	North American Vertical Datum of 1988
NMFS	National Marine Fisheries Service

P&MAs	Projects and Management Actions
RMS	Representative Monitoring Site
SGMA	Sustainable Groundwater Management Act
SMC	Sustainable Management Criteria
SMCL	Secondary Maximum Contaminant Level
SRDF	Salinas River Diversion Facility
SVA	Salinas Valley Aquitard
SVBGSA	Salinas Valley Basin Groundwater Sustainability Agency
SVGB	Salinas Valley Groundwater Basin
SVIHM	Salinas Valley Integrated Hydrologic Model
SVOM	Salinas Valley Operational Model
SWIG	Seawater Intrusion Working Group
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TCE	trichloroethene
1,2,3 TCP	Trichloropropane
TDS	total dissolved solids
UG/L	microgram per liter
UMHOS/CM	micromhos per centimeter
USGS	United States Geological Survey
WBZ	Water Budget Zone
WY	water year

1 EXECUTIVE SUMMARY

The Monterey Subbasin (referred to herein as "the Subbasin"), California Department of Water Resources (DWR) Basin No. 3-004.10, is classified as a "medium priority" basin. To address the long-term reliability of groundwater within the Subbasin, the Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA) and the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) co-developed a Groundwater Sustainability Plan (GSP), which was adopted by both GSAs and submitted to DWR on January 31, 2022. The GSP establishes two Management Areas within the Subbasin. These Management Areas include the Marina-Ord Management Area (Marina-Ord Area) and the Corral de Tierra Management Area (Corral de Tierra Area). The Marina-Ord Area consists of the lands within the City of Marina, the City of Seaside, and the former Fort Ord. The Corral de Tierra Area consists of the remainder of the Subbasin, which includes lands generally located south of State Route 68 and a few parcels along the northern subbasin boundary with the 180/400-Foot Aquifer Subbasin.

MCWD GSA has developed information for the Marina-Ord Area, and the SVBGSA has developed information for the Corral de Tierra Area.

This Water Year (WY) 2021 Annual Report for the Subbasin has been prepared in compliance with the California Code of Regulations (CCR) 23 §356.2. WY 2021 includes the period from October 1, 2020, through September 30, 2021.

In WY 2021, groundwater conditions remained similar to conditions in recent years, with slight changes related to specific sustainability indicators. WY 2021 is classified as a dry year.

The groundwater data for the Marina Ord Area and the Corral De Tierra Area in WY 2021 are summarized below:

Marina-Ord Area

- Groundwater elevations in representative monitoring site (RMS) wells screened in the Dune Sand, Upper 180-Foot, Lower 180-Foot, and 400-Foot Aquifers in the northern Marina-Ord Area were stable and within their natural range of fluctuations. Groundwater elevations in two RMS wells screened in the 400-Foot Aquifer located in the southwestern portion of the Marina-Ord Area and all RMS wells screened in the Deep Aquifers continued to decline and are below their minimum thresholds (MT).
- Groundwater extractions for WY 2021 in the Marina-Ord Area were approximately 2,757 acre-feet (AF). MCWD was the only agency that pumped groundwater water in the Marina-Ord Area. The groundwater production, measured by direct metering, was for urban water use only.
- The seawater intrusion extent was not updated in WY 2021 since not all seawater intrusion RMS wells were sampled after data collection for the Monterey Subbasin GSP.

- There were no exceedances of groundwater quality regulatory standards or minimum thresholds for the constituents of concern (COCs) in water quality RMS wells in the Marina-Ord Area.
- Subsidence, measured using Interferometric Synthetic-Aperture Radar (InSAR) data and provided by DWR, shows no subsidence in the Monterey Subbasin.
- Groundwater elevations measured at the interconnected surface water (ISW) RMS well were higher than its MT and measurable objective (MO).

Corral de Tierra Area

- Groundwater elevations decreased in most wells in the El Toro Primary Aquifer System during this dry water year, with most RMS wells showing elevations below their MT.
- Groundwater extractions for reporting year 2021 (November 1, 2020, through October 31, 2021) were approximately 1,135 AF in the Corral de Tierra Area.
- There is no seawater intrusion in the Corral de Tierra Area.
- The groundwater quality MT for arsenic and iron in Divisions of Drinking Water wells was exceeded in WY 2021; however, this was not due to GSA management action. The Irrigated Lands Regulatory Program (ILRP) on-farm domestic wells were not sampled in WY 2021.
- As mentioned above, no subsidence was detected in the Monterey Subbasin.
- There are no existing shallow monitoring wells in the Corral de Tierra Area that can be used to measure ISW. SVBGSA will install one new shallow monitoring well along El Toro Creek during GSP implementation.

Since the GSP submittal in January 2021, the MCWD GSAs and SVBGSA have taken actions to implement the GSP. These include:

- Continuing intra-basin coordination through staff and consultant meetings;
- Continuing stakeholder engagement through committee meetings and one-on-one communications;
- Initiating efforts to expand the seawater intrusion monitoring network and the Groundwater Extraction Management System (GEMS) program;
- Beginning to provide recycled water to MCWD customers and continuing the Recycled Water Feasibility Study to assess the possibility of implementing an indirect potable reuse (IPR) project in the Marina-Ord Area;
- Supporting the 2022 Yearly Update of the 180/400-Foot Aquifer Subbasin GSP;
- Continuing to convene and participate in the Seawater Intrusion Working Group (SWIG);

- Creating the Deep Aquifer Study Cooperative Funding Partnership and releasing the Request for Qualifications for the Study; and
- Funding expansion of the Seawater Intrusion Model to cover all potential seawater intruded areas of the Salinas Valley.

The GSP outlined 26 Projects and Management Actions (P&MAs) for the Subbasin. Implementation has not yet begun for most of the P&MAs except for the ones that were currently ongoing. A brief description of each P&MA is listed in Section 5.3.

2 INTRODUCTION

2.1 Purpose

The 2014 California Sustainable Groundwater Management Act (SGMA) requires that, following adoption of a GSP, GSAs annually report on the condition of the Subbasin and show that the GSP is being implemented in a manner that will likely achieve the sustainability goal for the Subbasin. This report fulfills that requirement for the Salinas Valley – Monterey Subbasin (Subbasin; Department of Water Resources [DWR] Basin 3-004.10).

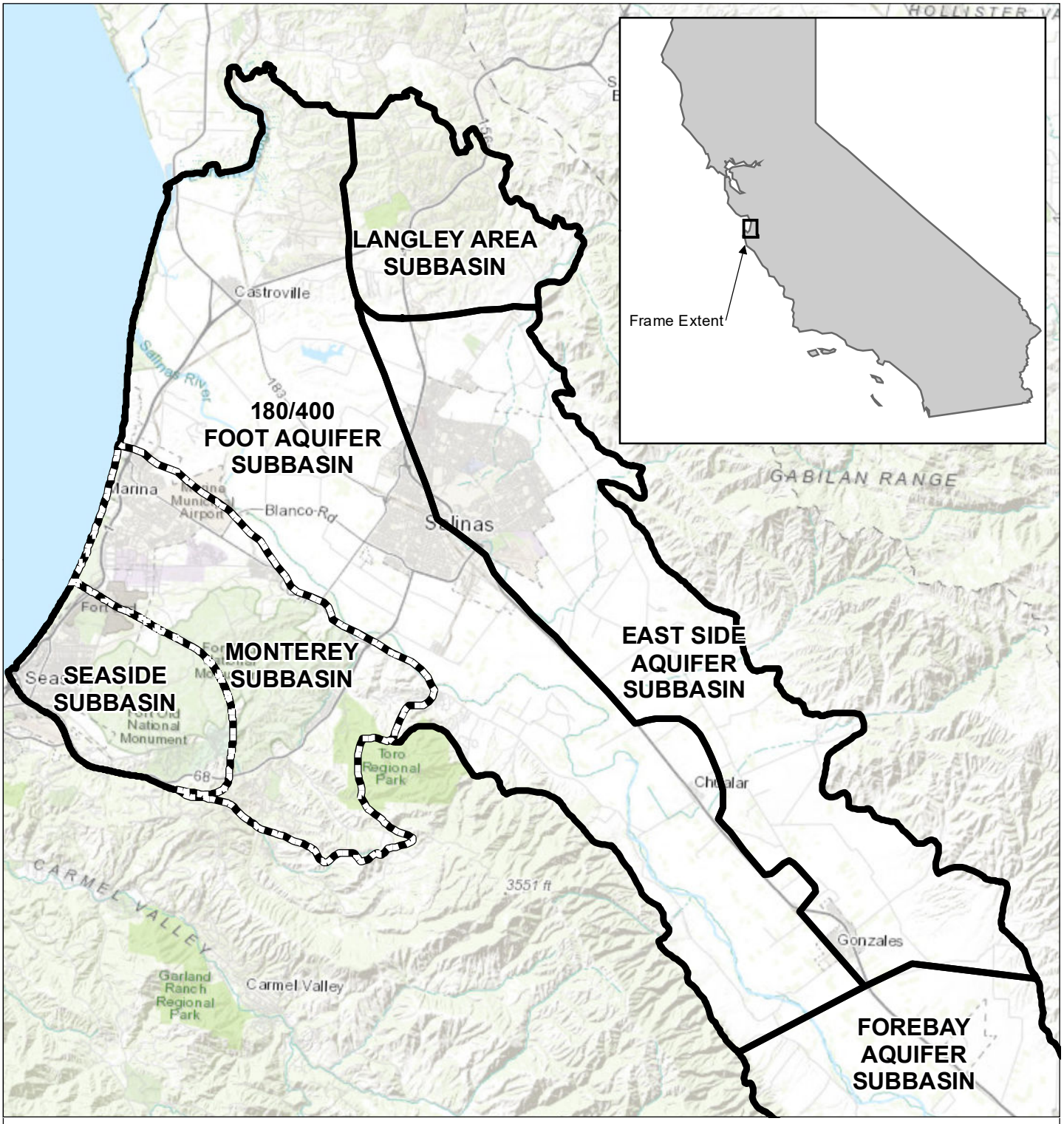
This WY 2021 Annual Report for the Subbasin has been prepared in compliance with CCR 23 §356.2. WY 2021 includes the period from October 1, 2020, through September 30, 2021. This Annual Report also contains available and appropriate historical information back to calendar year 2015, the effective date of SGMA as required by CCR 23 §356.2 (b). These data provide an understanding of Subbasin conditions through the current reporting year. This Annual Report describes Subbasin conditions and includes hydrographs, groundwater elevation contour maps, estimates of changes in groundwater storage, and maps depicting the distribution of groundwater extraction across the Subbasin. It compares WY 2021 data to Sustainable Management Criteria (SMCs) as a measure of where the Subbasin is with respect to the sustainability goal that must be reached by the end of 2042.

2.2 Monterey Subbasin Groundwater Sustainability Plan

The GSP has been co-developed by MCWD GSA and SVBGSA. The MCWD GSA is a single-agency GSA formed by the MCWD. The SVBGSA is a Joint Powers Authority (JPA) with membership comprising the County of Monterey, Monterey County Water Resources Agency (MCWRA), City of Salinas, City of Soledad, City of Gonzales, City of King, Castroville Community Services District, and Monterey One Water.

The GSAs developed the GSP for the Monterey Subbasin in concert with the five other Salinas Valley Subbasin GSPs: the Eastside Aquifer Subbasin (DWR subbasin 3-004.02), the Forebay Aquifer Subbasin (DWR subbasin 3-004.04), the Upper Valley Aquifer Subbasin (DWR subbasin 3-004.05), the Langley Area Subbasin (DWR subbasin 3-004.09) and the 180/400-Foot Aquifer Subbasin (DWR subbasin 3-004.01).

The GSP covers the entire Monterey Subbasin, which encompasses 30,850 acres (or 48.2 square miles) in the northwestern Salinas Valley Groundwater Basin (SVGB) in the Central Coast region of California (Figure 2-1). The Monterey Subbasin has been designated as medium priority by DWR. The GSP established two management areas within the Subbasin (Figure 2-2): the Marina-Ord Area and the Corral de Tierra Area.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

N

0 4 8

(Scale in Miles)

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 April 2022.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Monterey Subbasin

Monterey Subbasin
WY 2021 Annual Report
March 2022
Figure 2-1

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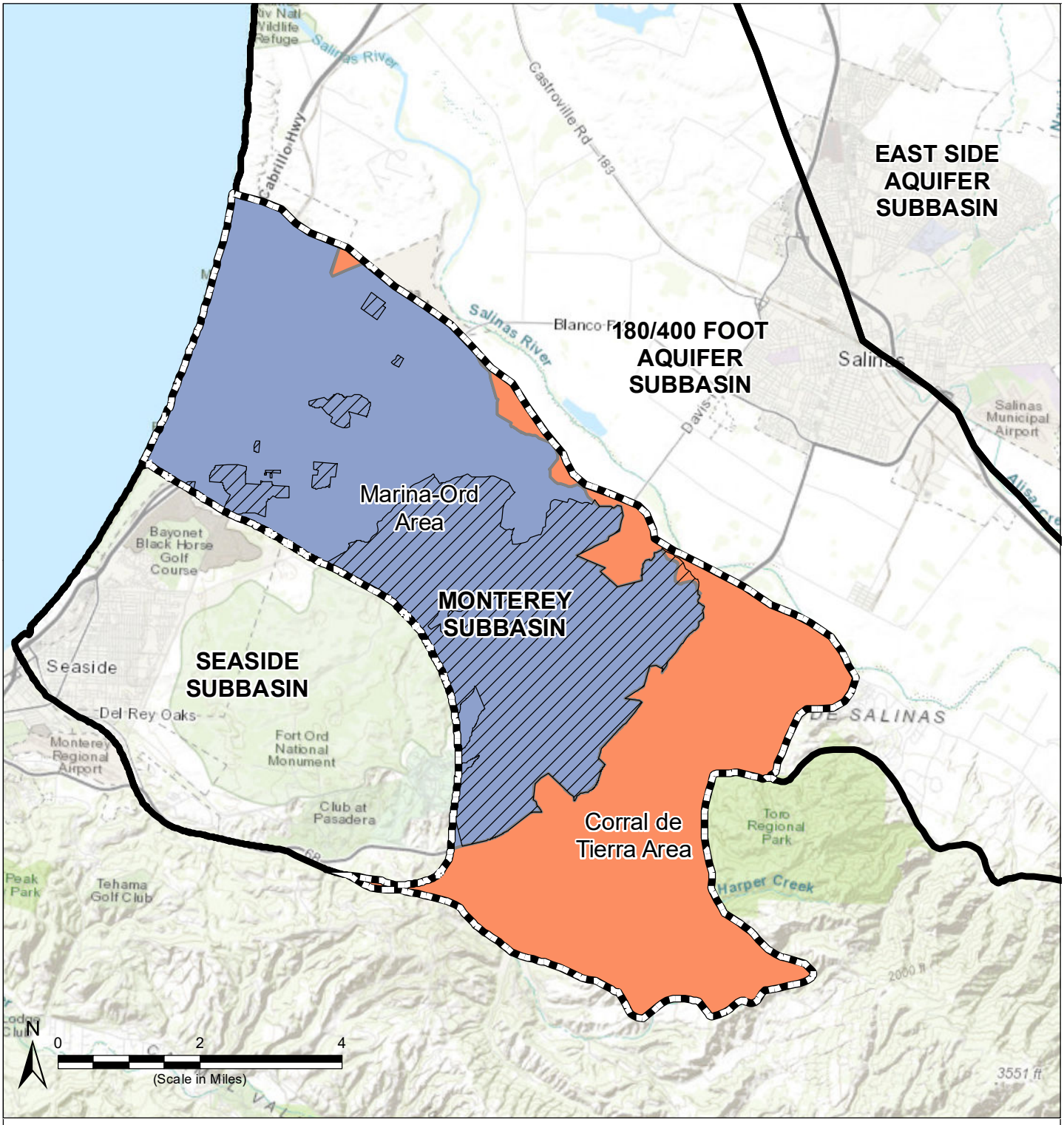

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Federal Lands

Management

- Marina-Ord
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 April 2022.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Management Areas

Monterey Subbasin
WY 2021 Annual Report
March 2022
Figure 2-2

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2.3 Organization of This Report

This Annual Report has been developed pursuant to GSP Emergency Regulations §356.2. The Report outlines subbasin conditions, including groundwater elevations, groundwater extractions, surface water use, total water use, and changes in groundwater storage. The Report also reports on actions taken to implement the GSP and identifies any progress in reaching interim milestones.

3 SUBBASIN SETTING

The Monterey Subbasin is located at the northwestern end of the Salinas Valley Groundwater Basin, an approximately 90-mile-long alluvial basin underlying the elongated, intermountain valley of the Salinas River. The Subbasin includes the portions of the Monterey Bay coastal plain, south of the approximate location of the Reliz Fault, as well as upland areas to the southeast of the coastal plain. The Monterey Subbasin is hydrostratigraphically complex and represents a transition zone between the more defined, laterally continuous aquifer system along the central axis of the Salinas Valley and the less continuous aquifer systems towards the Sierra de Salinas.

3.1 Principal Aquifers and Aquitards

The Monterey Subbasin GSP defined a series of principal aquifers and aquitards respectively for the Marina-Ord Area and the Corral de Tierra Area

Hydrostratigraphy in the Marina-Ord Area consists of a series of laterally continuous aquifers consistent with the aquifers that form the distinguishing features of the northern Salinas Valley. The principal aquifers within the Marina-Ord Area include the unconfined Dune Sand Aquifer and the confined aquifers known as the 180-Foot Aquifer, the 400-Foot Aquifer, and the Deep Aquifers. Hydraulic conductivity of the aquifers underlying the Marina-Ord Area varies by aquifer and location. Groundwater production generally occurs from the 180-Foot, 400-Foot, and Deep Aquifers.

The aquifers have historically been described within the Corral de Tierra Area by their geologic names, such as the Aromas Sand, Paso Robles Formation, and Santa Margarita Sandstone (Geosyntec, 2007; Yates 2005). Based on the best available information and many wells that span multiple formations, these geologic formations are grouped to form the El Toro Primary Aquifer System.

3.2 Natural Groundwater Recharge and Discharge

Natural groundwater recharge occurs through the infiltration of surface water, deep percolation of excess applied irrigation water, and deep percolation of infiltrating precipitation. Most of the Marina-Ord Area has good recharge potential due to the high permeability of the Dune Sand Aquifer, which subsequently recharges the underlying 180-Foot and 400-Foot Aquifers. Most of the Corral de Tierra Area also has good recharge potential due to high permeability soils that recharge the underlying sandy, gravelly layers of the Aromas Sand and Paso Robles Formation.

The primary surface water bodies in the Subbasin are the Salinas River and Toro Creek. The Salinas River crosses into the Subbasin in two locations in the Corral de Tierra Area and may provide some recharge in areas that are not underlain by the Salinas Valley Aquitard (SVA) that generally exists in the 180/400-Foot Aquifer Subbasin. Toro Creek is generally perennial below

the confluence with Watson Creek (Feikert, 2001). Recorded streamflows at United States Geological Survey (USGS) gage 11152540 from 1961 to 2001 indicate a mean annual streamflow of 1,590 acre-feet per year (AFY) for Toro Creek, however, not all years registered flow (GeoSyntec, 2007). Additionally, most flow occurs in the winter and spring months (GeoSyntec, 2007).

3.3 Precipitation and Water Year Type

Precipitation that falls within the Subbasin contributes to runoff and percolation components of the water budget. The precipitation within the Subbasin was estimated per a 4-kilometer gridded dataset from the Regressions on Independent Slopes Model (PRISM)[1], which estimates the daily precipitation rates and represents the spatial distribution of precipitation over the entire extent of the Subbasin. The total precipitation in WY 2021 was estimated to be approximately 11.07 inches (in).

DWR's methodology was used to assign a water year type of critical, dry, below normal, above normal, or wet based on precipitation that occurred in the Subbasin during the current year and prior years (DWR, 2021b). Using DWR's methodology, WY 2021 was a dry year.

Table 3-1 identifies the assigned water year type for each water year since 2015.

Table 3-1. Water Year Type

WY	Precipitation (in)	Water Year Index	Water Year Type
2015	12.9	11.1	Dry
2016	19.4	16.8	Above Normal
2017	23.7	22.0	Wet
2018	11.6	16.5	Above Normal
2019	20.5	17.0	Above Normal
2020	14.6	17.0	Above Normal
2021	11.1	12.5	Dry

[1] https://prism.oregonstate.edu/recent/

4 2021 DATA AND SUBBASIN CONDITIONS

This section details the Subbasin conditions and WY 2021 data. Where WY 2021 data are not available, it includes the most recent data available. Monitoring data are included in this Annual Report and submitted electronically on forms provided by DWR.

4.1 Groundwater Elevations

The current groundwater elevation monitoring network in the Monterey Subbasin contains 48 wells, 35 of which are RMS wells in the Marina-Ord Area and 13 of which are RMS wells in the Corral de Tierra Area. Figure 7-1 to Figure 7-6 in the Subbasin GSP[2] show the locations of the groundwater elevation monitoring network and RMS wells within the Marina-Ord Area and the Corral de Tiera Area.

The groundwater elevation monitoring network and RMS network for each management area are broken out by principal aquifer. However, as discussed in GSP, the 180-Foot Aquifer is separated into an "upper" and a "lower" portion by a clay layer in the coastal areas of the Marina-Ord Area. In these areas, groundwater elevation and seawater intrusion conditions in the upper 180-Foot Aquifer are distinct from those in the lower 180-Foot Aquifer, while conditions in the lower 180-Foot Aquifer are consistent with those observed in the 400-Foot Aquifer. Therefore, the monitoring network and RMS network are selected to additionally distinguish the upper 180-Foot Aquifer and the lower 180-Foot Aquifer.

This section presents groundwater elevation contours from WY 2021 and long-term hydrographs for selected wells in the Subbasin's monitoring network.

4.1.1 Groundwater Elevation Contours

Groundwater elevation contours maps for the Marina-Ord Area during August 2020, Fall 2020, and Spring 2021 are represented on Figure 4-1, Figure 4-2, and Figure 4-3, respectively.

Groundwater elevation contour maps for the Marina-Ord Area were prepared for Fall 2020 and Spring 2021[3]. These maps identify seasonal groundwater elevations in each principal aquifer within the Marina-Ord Area for WY 2021. The data presented on the Fall 2020 groundwater contour map corresponds to the November and December time frame upon which MTs and MOs for the Subbasin and neighboring subbasins within the greater Salinas Valley Basin have been established. In addition, groundwater elevation maps for each principal aquifer in the Marina-Ord Area were prepared for August 2020 to compare with Fall groundwater elevation

[2] The Subbasin GSP could be downloaded via the SGMA Portal: https://sgma.water.ca.gov/portal/gsp/preview/128

[3] Data between August 15, 2020 and December 15, 2020, are used to develop groundwater contours for the Fall 2020 season. For wells that have multiple measurements during this period, priority was given to measurements taken closer to December 1st, 2020. Data between January 15, 2021 and April 15, 2021, are used to develop groundwater contours for the Spring 2021 season, with priority given to measurements taken closer to March 5, 2021.

contours presented in the GSP, which were based upon August 2017 data. These data are generally representative of some of the lowest seasonal groundwater levels observed in the Subbasin during a given water year.

Groundwater elevation maps for Fall 2020 and August 2021 for the El Toro Primary Aquifer in the Corral De Tierra Area are presented on Figure 4-4 and Figure 4-5, respectively.

Groundwater flow directions and groundwater levels observed during these periods in the Marina-Ord Area and Corral de Tierra Area are summarized below.

4.1.1.1 Marina-Ord Area

The Principal Aquifers in the Marina Ord Area include the Dune Sand Aquifer, 180-Foot Aquifer, 400-Foot Aquifer, and Deep Aquifers.

Dune Sand Aquifer

As discussed in Chapter 4 of the Monterey Subbasin GSP and the Dune Sand Aquifer only exists in the Marina-Ord Area in the western portion of the Subbasin. Groundwater elevations and flow directions observed in the Dune Sand Aquifer in Fall 2020 and Spring 2021 of WY 2021 are presented on Figure 4-2 and Figure 4-3 and are generally consistent with those observed in the recent past.

- Groundwater elevations in the Dune Sand Aquifer in WY 2021 were highest in the central portion of the Marina-Ord Area, where a groundwater divide exists (Figure 4-2 and Figure 4-3). At the top of this divide, groundwater elevations were approximately 96 feet (ft) North American Vertical Datum of 1988 (NAVD 88). Groundwater elevations were lowest at the coast at approximately 8 ft NAVD 88 where the Dune Sand Aquifer merges with the upper 180-Foot Aquifer west of the SVA. Groundwater level data for the Dune Sand Aquifer are limited in the southern portion of the Marina-Ord Area near the Monterey-Seaside Subbasin boundary and at the eastern extent of the Dune Sand Aquifer.
- West of the groundwater divide, groundwater in the Dune Sand Aquifer flows westward towards the Pacific Ocean and recharges the 180-Foot Aquifer where the SVA pinches out. Upon entering the 180-Foot Aquifer, groundwater abruptly reverses direction and flows eastward (i.e., inland). East of the groundwater divide, groundwater in the Dune Sand Aquifer flows to the northeast toward the 180/400-Foot Aquifer Subbasin and the Salinas River.
- Limited seasonal variations were observed in groundwater elevations within Dune Sand Aquifer during WY 2021.

180-Foot Aquifer

In the coastal portion of the Marina-Ord Area, the 180-Foot Aquifer is subdivided into the upper-180 Foot Aquifer and the lower-180-Foot Aquifer. Conditions in both portions of the 180-

Foot Aquifer in WY 2021 were generally consistent with those observed in the recent past and are described below.

Upper 180-Foot Aquifer

- Groundwater elevations in the upper 180-Foot Aquifer are highest at the coastline and generally decrease inland to the east/northeast. Flow directions are generally to the northeast toward the 180/400-Foot Aquifer Subbasin (Figure 4-2 and Figure 4-3).
- In WY 2021, groundwater elevations in the upper 180-Foot Aquifer were approximately 7 ft NAVD 88 at the coastline and generally decreased inland to the east/northeast, where groundwater elevations were approximately -8 ft NAVD 88.
- Groundwater elevations observed in Spring 2021 were generally higher than those observed in Fall 2020, but the variation in groundwater levels between these two time periods is limited to a few feet. The observed increase in groundwater levels between these two time periods is likely the result of increased recharge and seasonal reductions in pumping in the greater Salinas Valley Basin.
- Groundwater elevations are near sea level at the coastline and are below sea level further inland. This inland gradient allows high salinity water to flow into the Subbasin. However, inflow from the Dune Sand Aquifer protects the upper 180-Foot Aquifer from seawater intrusion.

Lower 180-Foot Aquifer

As discussed in Subbasin GSP Chapter 4, the lower 180-Foot Aquifer is hydraulically connected to the 400-Foot Aquifer in the Marina-Ord Area due to the discontinuous nature of the 180/400-Foot Aquitard within this region. As such, groundwater elevations and gradients in the lower 180-Foot Aquifer are similar to those in the 400-Foot Aquifer in the Marina Ord Area of the Subbasin, further described below.

400-Foot Aquifer

Groundwater elevations observed in the 400 Foot Aquifer in Fall 2020 and Spring 2021 of WY 2021 are presented on Figure 4-2 and Figure 4-3, respectively. The elevations and flow directions observed in WY 2021 are generally consistent with those observed in the recent past. Groundwater elevations in this aquifer have been plotted in combination with groundwater elevations observed within the Paso Robles Aquifer identified in the adjacent Seaside Subbasin. Available data indicate that these aquifers are potentially hydraulically connected; however, there is also a possible connection between the Seaside Subbasin Paso Robles Aquifer with the upper portion of the Deep Aquifers in the Monterey Subbasin.

- In WY 2021, groundwater elevations in the 400-Foot Aquifer were highest in the southern portion of the Monterey Subbasin and generally decreased to the north and east (Figure 4-2 and Figure 4-3). Flow directions are generally toward the northeast and the 180/400-Foot Aquifer Subbasin. A flow divide occurs along the Monterey-Seaside Subbasin boundary.

- A local groundwater depression exists just north of the Monterey-Seaside Subbasin boundary, where a potential connection between the 400-Foot Aquifer and the Deep Aquifers may be located.
- In Fall 2020, groundwater elevations in the Marina-Ord Area ranged from 4 ft NAVD 88 at the coast to approximately -10 ft NAVD 88 at the Monterey- 180/400-Foot Aquifer Subbasin boundary. Groundwater elevations in Fall 2020 and Spring 2021 were almost identical in the Marina-Ord Area, except for a decline in water levels observed near a well located near the Monterey- 180/400-Foot Aquifer Subbasin boundary.
- Groundwater elevations are near sea level at the coastline and below sea level further inland. As discussed in Chapter 4 of the GSP, the formations that make up this aquifer extend offshore and likely outcrop beneath a veneer of Pleistocene or Holocene marina sediments that is thin (i.e., less than 5 meters) across much of the offshore shelf but thicker (i.e., up to 32 meters) near the Salinas River Delta (Johnson et al., 2016). These conditions allow high salinity water to flow into this aquifer in the northern portion of the Subbasin.

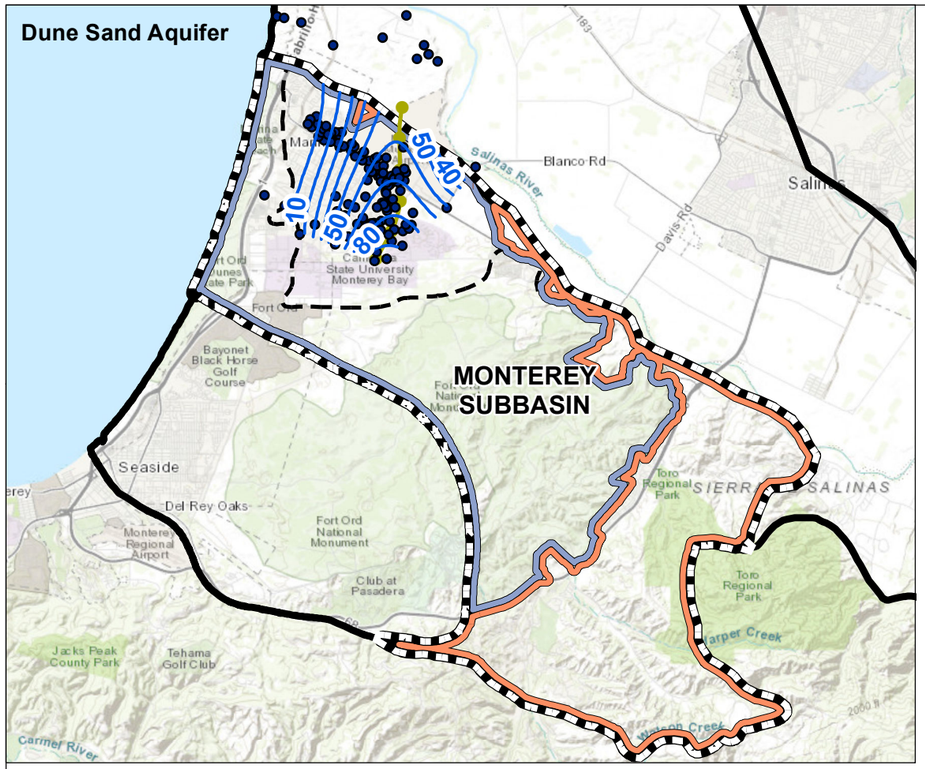
Deep Aquifers

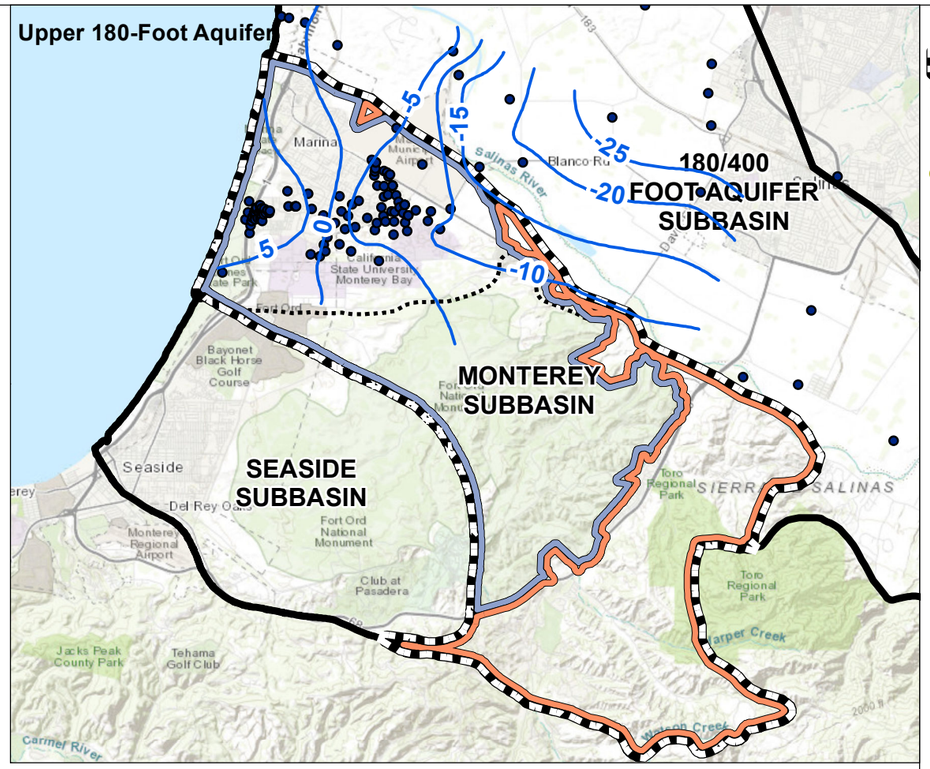
As discussed in Subbasin GSP Chapter 4, the Deep Aquifers consist of multiple water-bearing zones and aquitards that appear to be somewhat hydraulically connected. Given the absence of data for the multiple layers that make up this aquifer, this assessment generally describes conditions in the Deep Aquifers as a whole. Groundwater elevations in the Deep Aquifers have been plotted with groundwater elevations within the Santa Margarita Aquifer in the Seaside Subbasin. Groundwater elevations observed in the Deep Aquifers in Fall 2020 and Spring 2021 of WY 2021 are presented on Figure 4-2 and Figure 4-3, respectively. The elevations and flow directions observed in WY 2021 are generally consistent with those observed in the recent past.

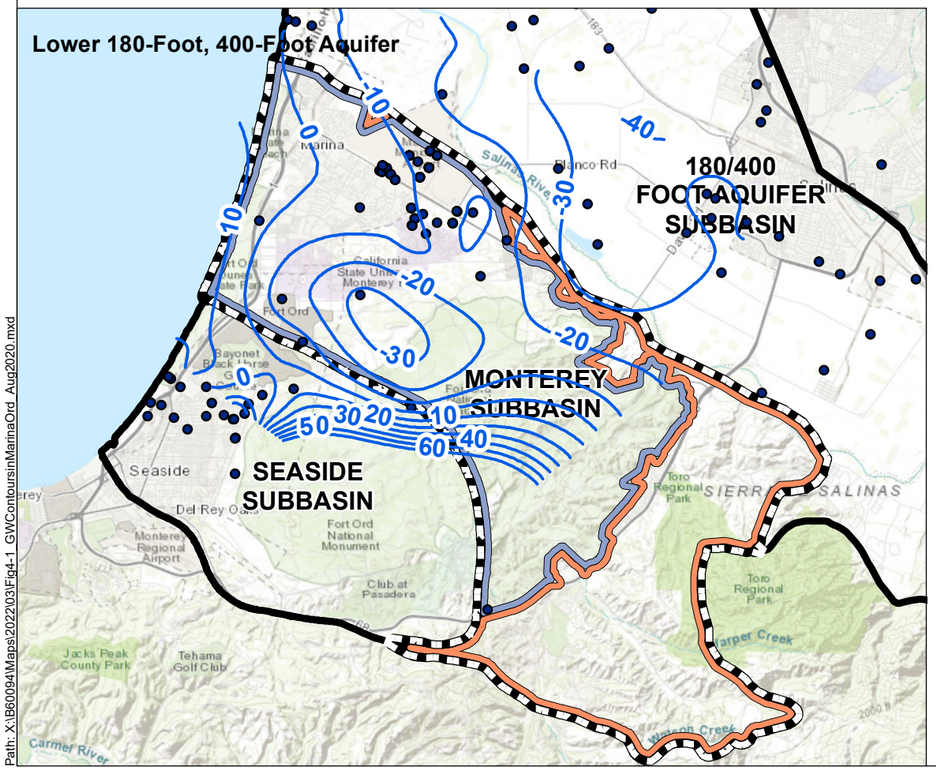
- In WY 2021, groundwater elevations in the Deep Aquifers were highest in the southeastern portion of the Marina-Ord Area and generally decreased toward the northwest (Figures 4-2 and 4-3). Flow directions were generally toward the north, suggesting some recharge occurs in mountain ranges south of the Subbasin. Groundwaters flow toward a pumping trough located in the 400-Foot Aquifer Subbasin y near West Blanco Road and Nashua Road. A local groundwater high exists just north of the Monterey-Seaside Subbasin boundary between the Seaside Subbasin and Monterey-180/400-Foot Aquifer Subbasin pumping centers.
- In Fall 2020, groundwater elevations ranged from 155 ft NAVD 88 near the southeastern Subbasin boundary to -61 ft NAVD 88 in the north near the Monterey-180/400-Foot Aquifer Subbasin boundary. Groundwater elevations were generally higher a few feet higher in Spring 2021 than in Fall 2021 in the Marina-Ord Area.

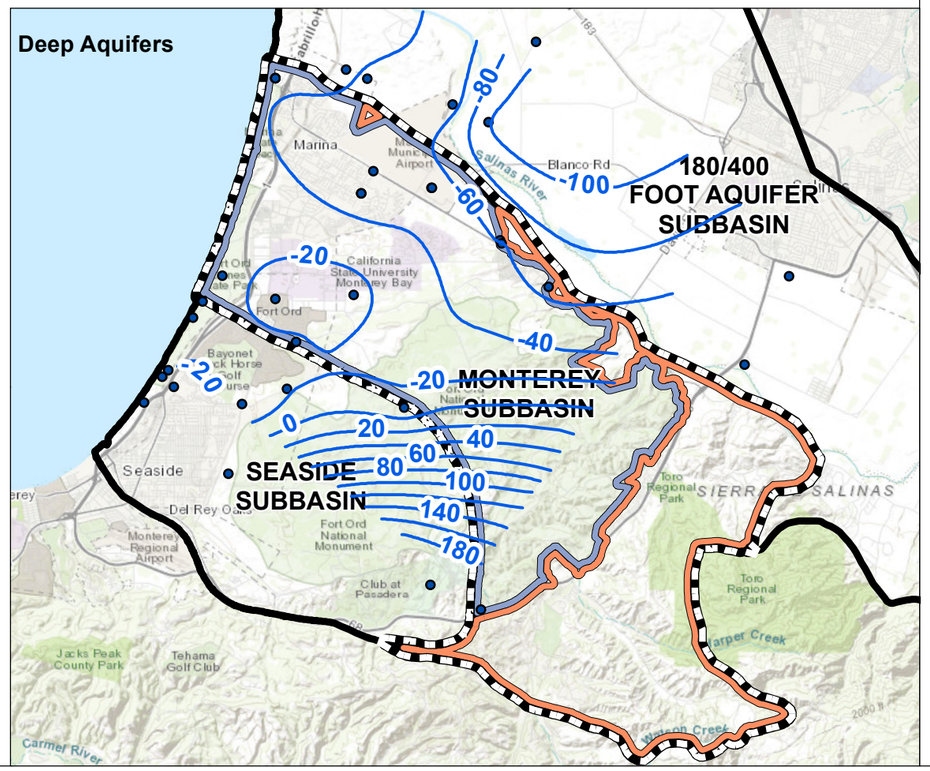
4.1.1.2 Corral de Tierra Area

Figure 4-4 shows the Fall 2020 groundwater elevation contours within the El Toro Primary Aquifer System in the Corral de Tierra Area. Groundwater in the El Toro Primary Aquifer System generally flows from the south toward the north, northwest, and northeast. A potential groundwater flow divide occurs near the Monterey-Seaside Subbasin boundary in the Laguna Seca area. There may be localized depressions around pumping centers, but there is insufficient data to show them in the groundwater elevation contours in the following Figure 4-4 and Figure 4-5. Additionally, the Monterey Formation, which is the bottom of the Subbasin, is uplifted in this locale due to structural deformation, and may impact flow direction. In Fall 2020, the groundwater elevations in the El Toro Primary Aquifer System ranged from approximately 1000 ft to -40 ft NAVD88 from south to north. Groundwater elevations contours for August 2021 are provided in Figure 4-5 and show similar flow patterns to the Fall 2020 groundwater elevation contours.









Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley
- Southern Extent of FO-SVA (Harding ESE, 2001)
- Dune Sand Groundwater Divide
- Southern Extent of Valley Fill Deposits (Harding ESE, 2001)
- August 2020 Groundwater Contours
- GWE Measurement Locations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. MPWMD#FO-10D and Sentinel MW#1 are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 23 March 2022.
2. Groundwater contours are drawn using kriging method with groundwater elevation measurements collected during August 2020. Only static water levels are plotted.

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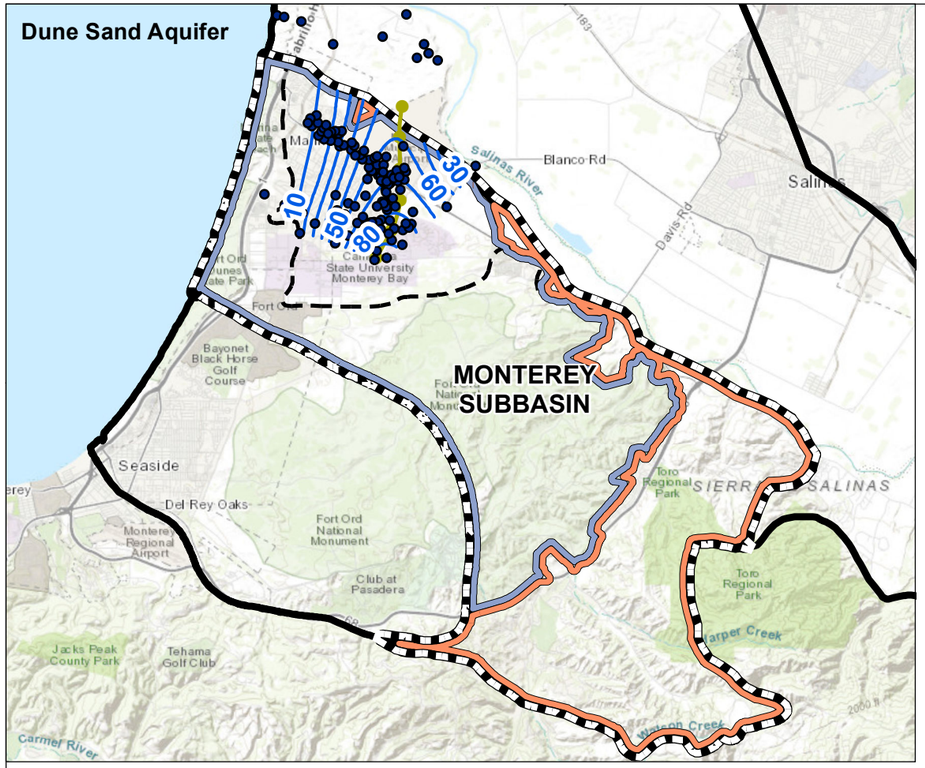
0 2.5 5

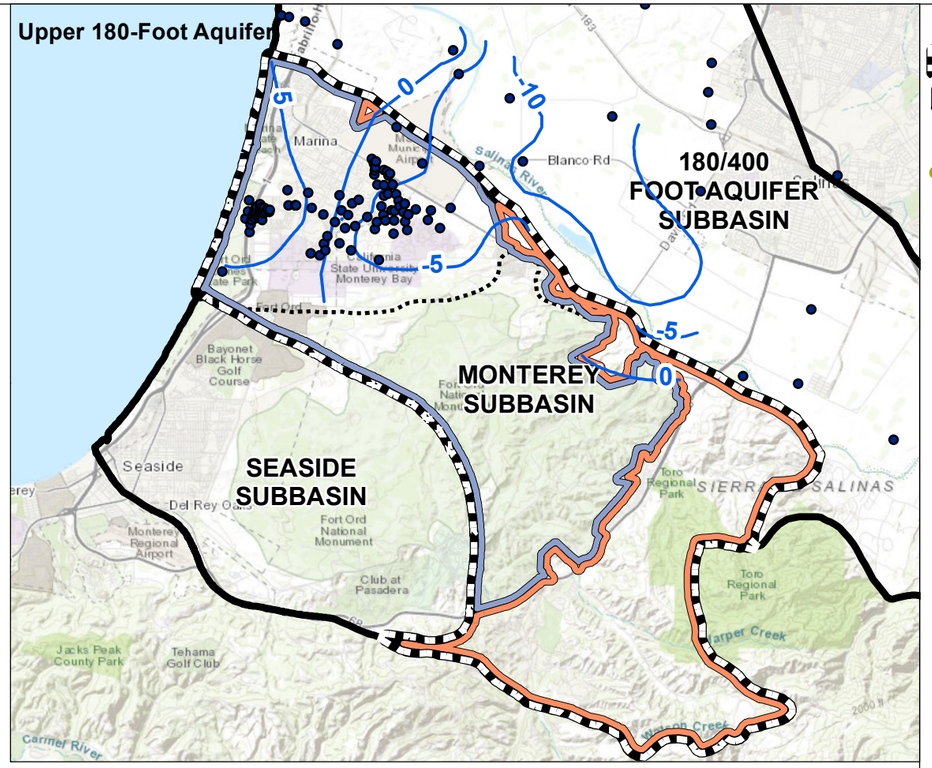
(Scale in Miles)

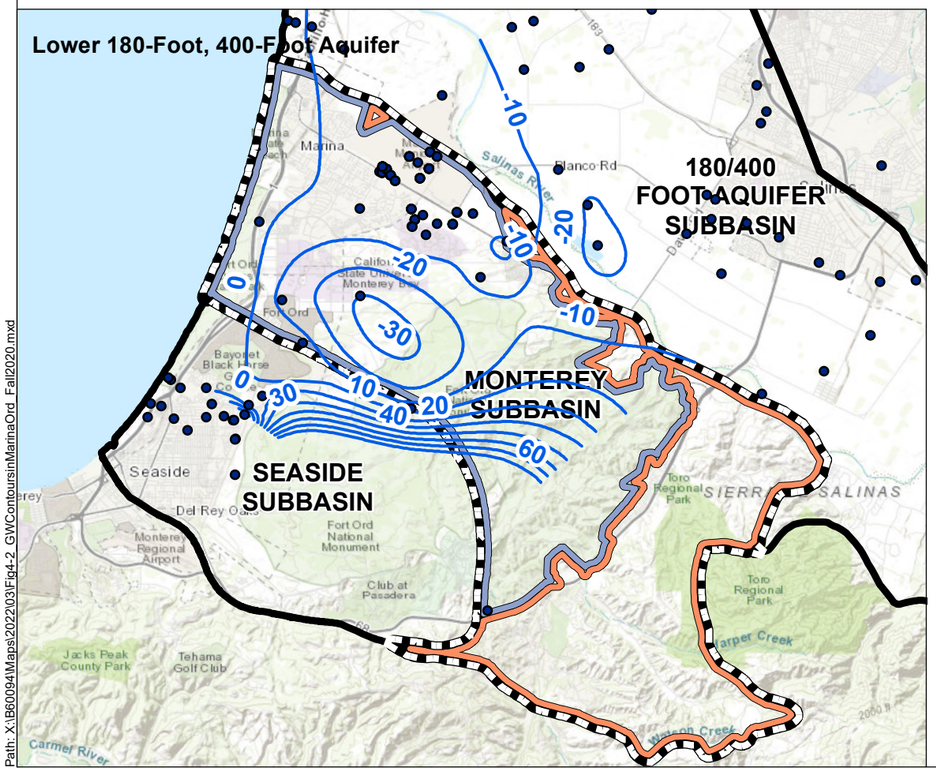
Groundwater Level Contours in the Marina-Ord Area - August 2020

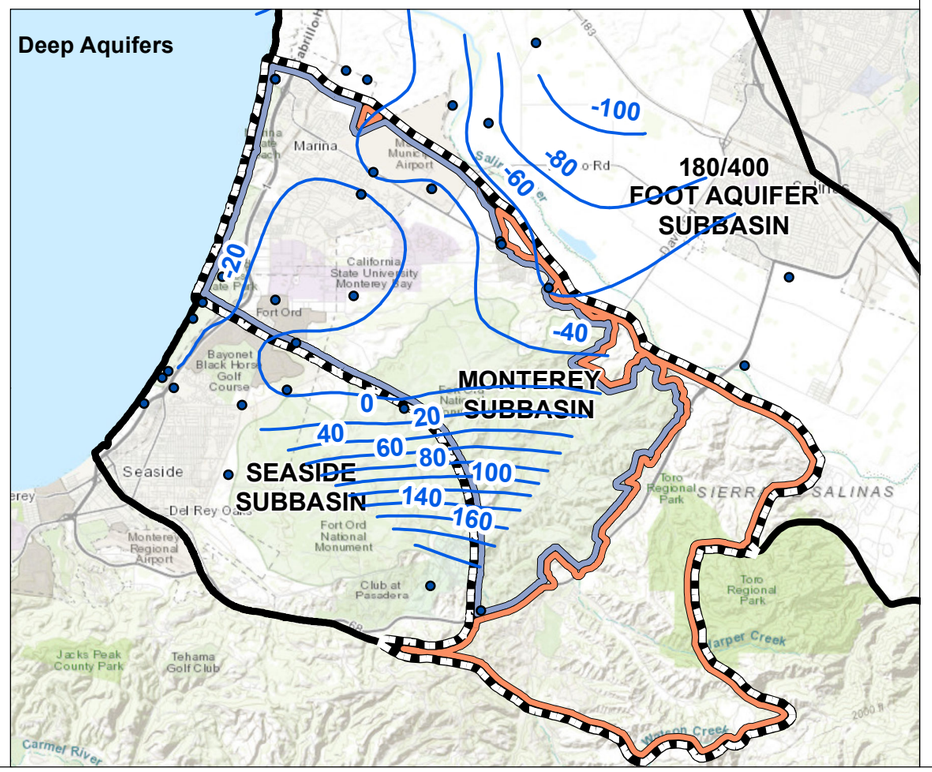
Monterey Subbasin
WY 2021 Annual Report
March 2022
Figure 4-1

Path: X:\B60094\Maps\2022\03\Fig4-1_GWContoursMarinaOrd_Aug2020.mxd









Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley
- Southern Extent of FO-SVA (Harding ESE, 2001)
- Dune Sand Groundwater Divide
- Southern Extent of Valley Fill Deposits (Harding ESE, 2001)
- Fall 2020 Groundwater Contours
- GWE Measurement Locations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. MPWMD#FO-10D and Sentinel MW#1 are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 23 March 2022.
2. Groundwater contours are drawn using kriging method with groundwater elevation measurements collected during Fall 2020. Only static water levels are plotted.

N

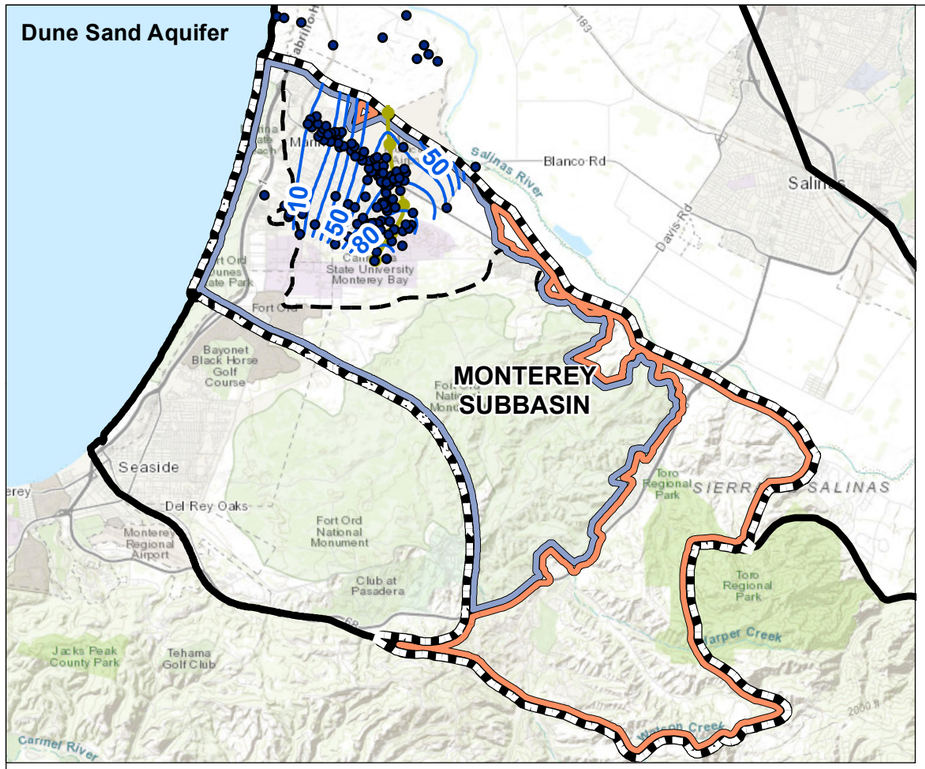
0 2.5 5

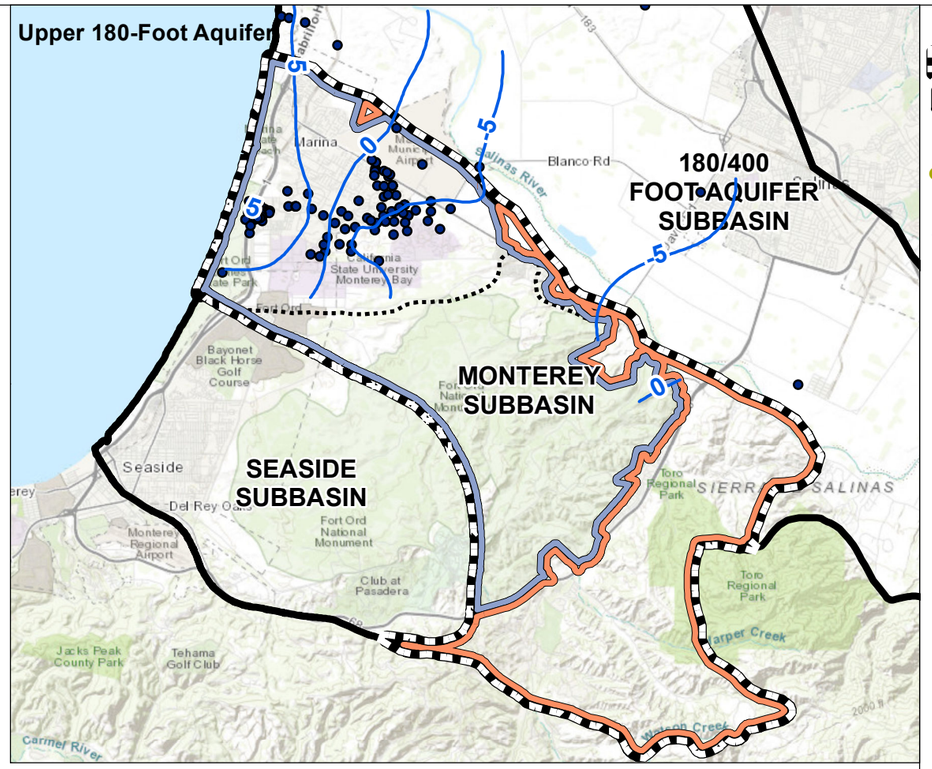
(Scale in Miles)

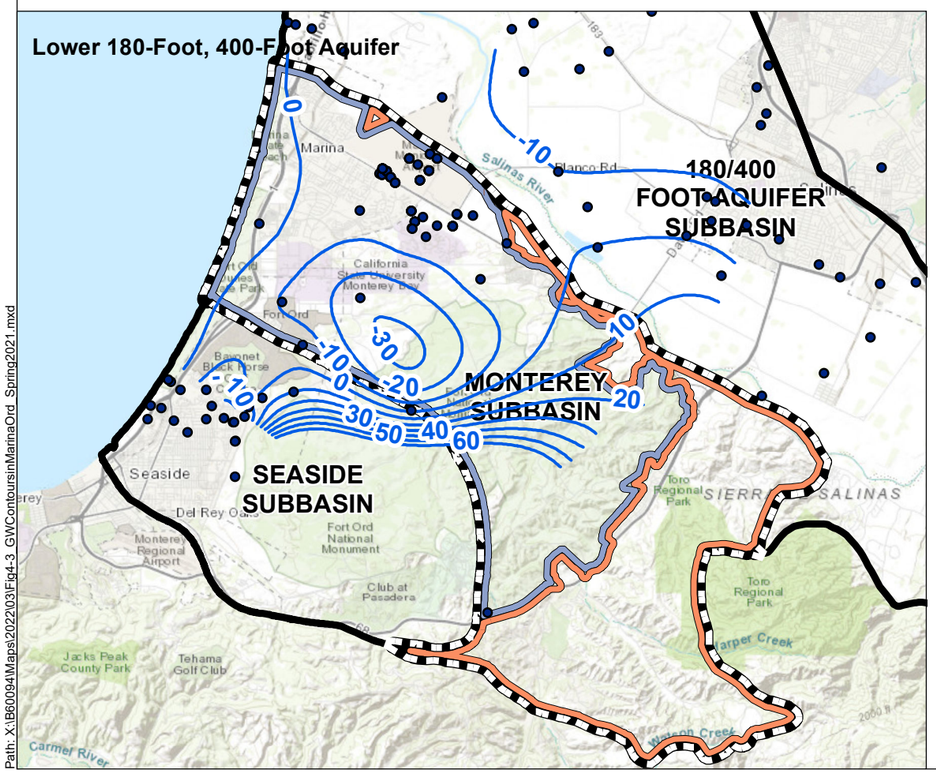
Groundwater Level Contours in the Marina-Ord Area - Fall 2020

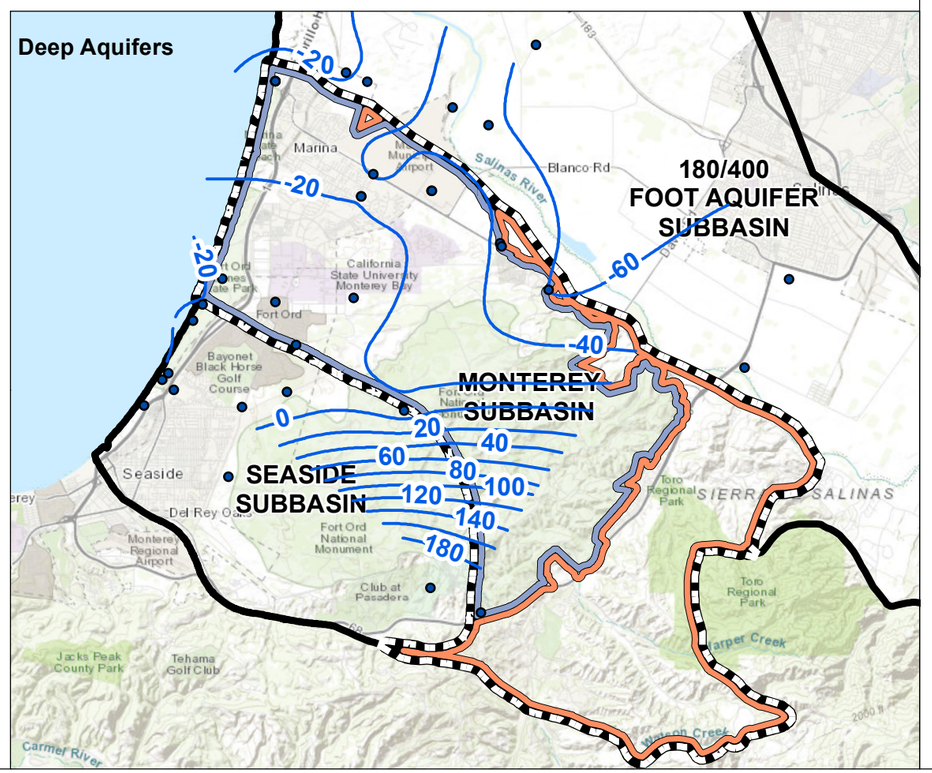
Monterey Subbasin
WY 2021 Annual Report
March 2022
Figure 4-2

Path: X:\B60094\Maps\2022\03\Fig4-2_GWContoursinMarinaOrd_Fall2020.mxd









Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley
- Southern Extent of FO-SVA (Harding ESE, 2001)
- Dune Sand Groundwater Divide
- Southern Extent of Valley Fill Deposits (Harding ESE, 2001)
- Spring 2021 Groundwater Contours
- GWE Measurement Locations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. MPWMD#FO-10D and Sentinel MW#1 are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 23 March 2022.
2. Groundwater contours are drawn using kriging method with groundwater elevation measurements collected during Spring 2021. Only static water levels are plotted.

N

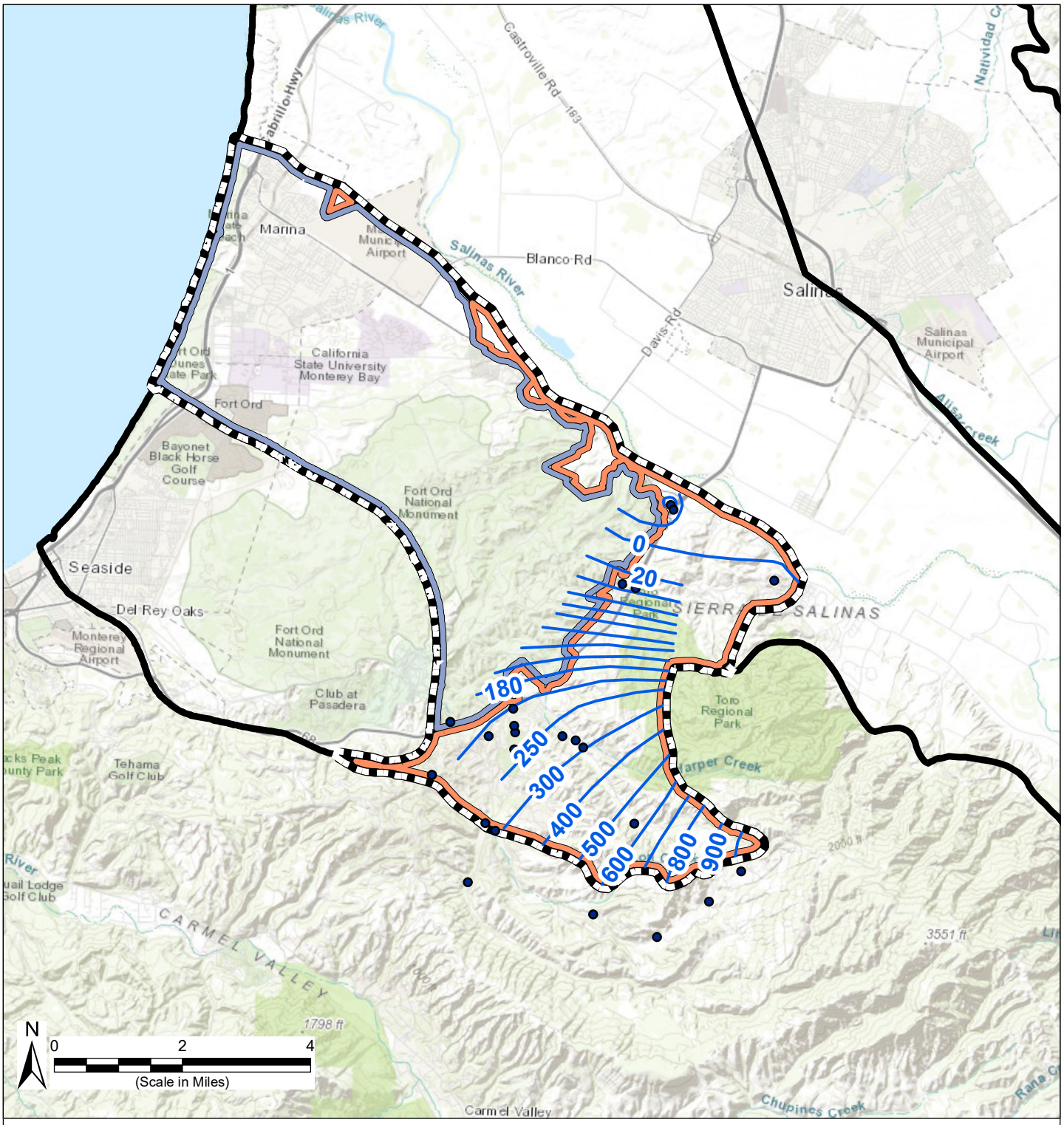
0 2.5 5

(Scale in Miles)

Groundwater Level Contours in the Marina-Ord Area - Spring 2021

Monterey Subbasin
WY 2021 Annual Report
March 2022
Figure 4-3

Path: X:\B60094\Maps\2022\03\Fig4-3_GWContoursinMarinaOrd_Spring2021.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- GWE Measurement Locations
- Fall 2020 Groundwater Contours

Management Areas

- Marina-Ord Area
- Corral de Tierra

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.

Sources

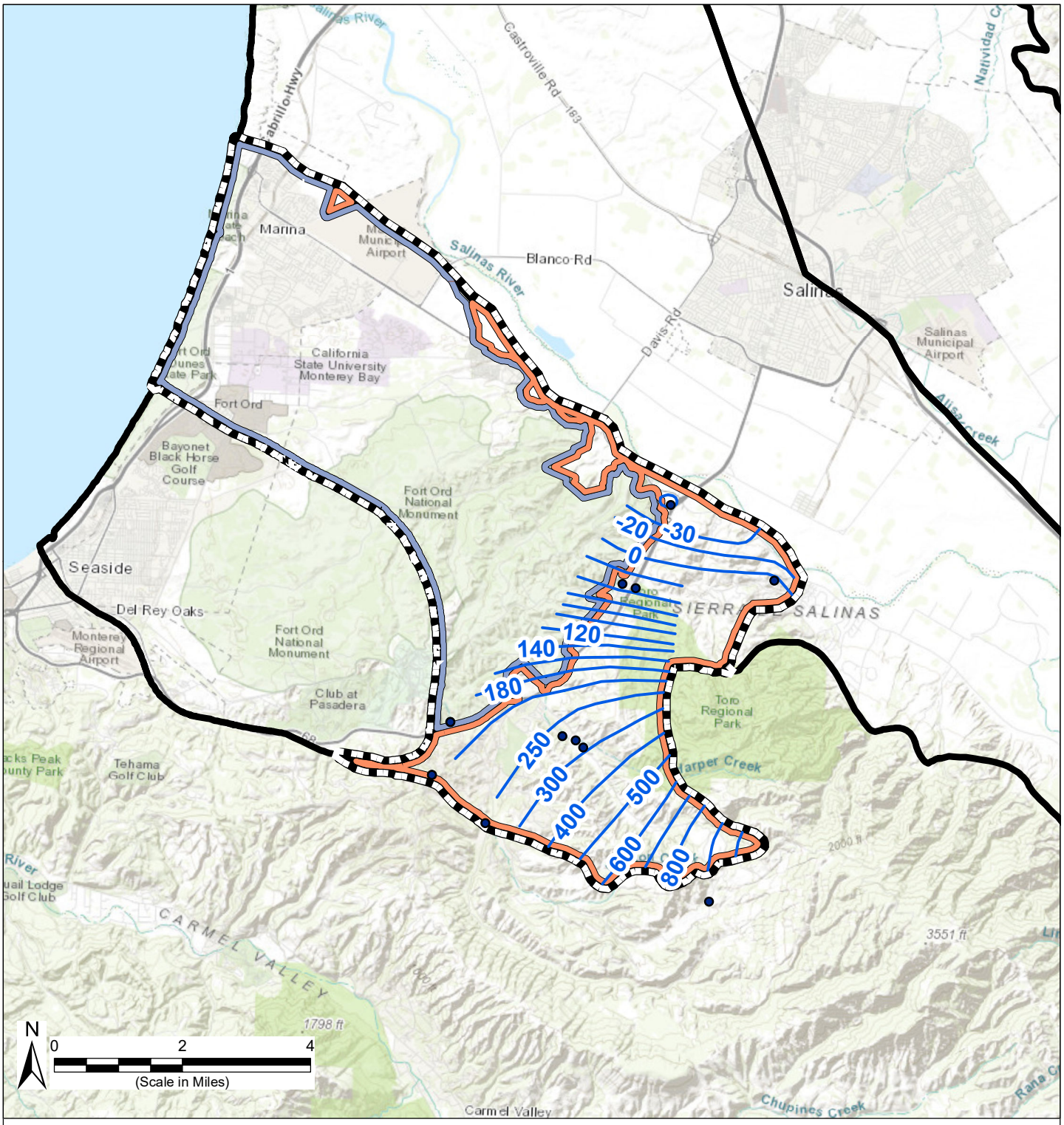
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 April 2022.
2. Groundwater contours are drawn using kriging method with groundwater elevation measurements collected during Fall 2020. Only static water levels are plotted.

Groundwater Level Contours in the El Toro Primary Aquifer System - Fall 2020

Monterey Subbasin
WY 2021 Annual Report
March 2022

Figure 4-4

Path: X:\B60094\Maps\2022\03\Fig4-4-CoralFall2020.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- GWE Measurement Locations
- August 2021 Groundwater Contours

Management Areas

- Marina-Ord Area
- Corral de Tierra

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 April 2022.
2. Groundwater contours are drawn using kriging method with groundwater elevation measurements collected during August 2021. Only static water levels are plotted.

Groundwater Level Contours in the El Toro Primary Aquifer System - August 2021

Monterey Subbasin
WY 2021 Annual Report
March 2022
Figure 4-5

Path: X:\B60094\Maps\2022\03\Fig4-5-Coral_August_2021.mxd

4.1.2 Long-Term Groundwater Elevation Trends

Temporal trends in groundwater elevations can be assessed with hydrographs that plot changes in groundwater elevations over time. Hydrographs for selected monitoring wells within the Monterey Subbasin are shown on Figure 4-6 through Figure 4-11.

Marina-Ord Area

Dune Sand Aquifer

- Groundwater elevations in the Dune Sand Aquifer have been generally stable for over three decades and do not show significant seasonal variations. A slight increasing trend was observed between WY 2017 and WY 2021, likely due to a series of above-normal precipitation years.

180-Foot Aquifer

Upper 180-Foot Aquifer

- Groundwater elevations have been generally stable in the upper 180-Foot Aquifer for the past thirty years. Groundwater elevations showed an increasing trend between WY 2017 and WY 2021, likely due to a series of above-normal precipitation years.

Lower 180-Foot Aquifer

- Groundwater elevations have been stable in the lower 180-Foot Aquifer for the past thirty years. Groundwater elevations showed an increasing trend between WY 2017 and WY 2021, likely due to a series of above-normal precipitation years.

400-Foot Aquifer

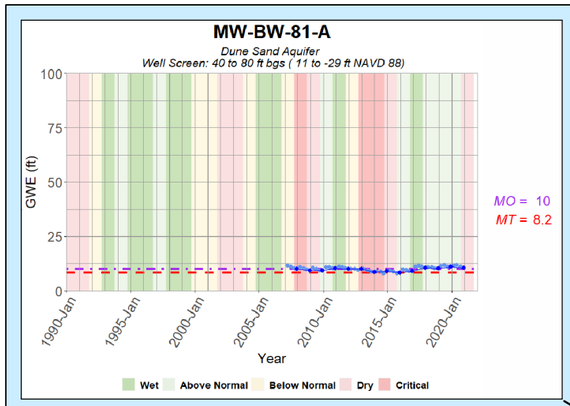
- Groundwater elevations have been stable for the past thirty years in 400-Foot Aquifer wells in the northern Marina-Ord Area. However, groundwater elevations have been declining consistently near the southern Marina-Ord Area near wells MPWMD#FO-10S and MPWMD#FO-11S. As discussed in Section 4.1.1.1, this local depression in the groundwater table could be due to a potential connection between the 400-Foot Aquifer and the Deep Aquifers. However, since the cause of this local depression is not known, no mitigation measures have been identified or implemented to date. Further information regarding groundwater conditions in this area is being obtained as part of the Deep Aquifer Study, as discussed in Section 5.1.3.

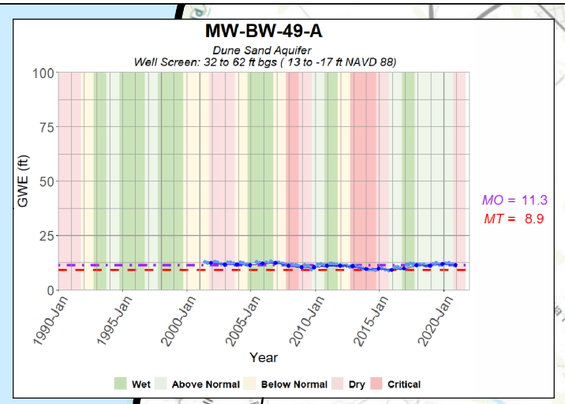
Deep Aquifers

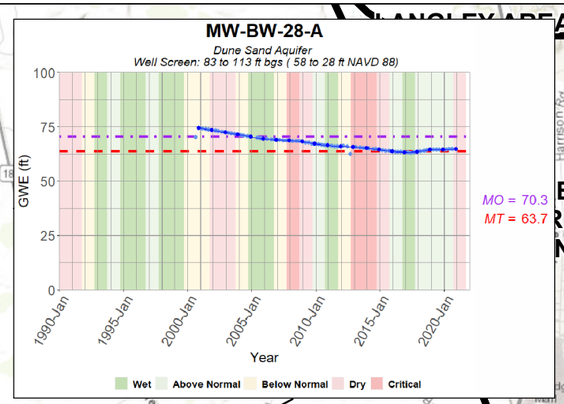
- Groundwater elevations have been decreasing gradually in the Deep Aquifers since 2000. The rate of decline has increased since 2015.

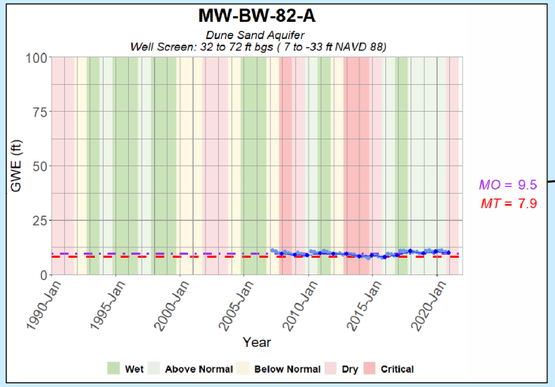
4.1.2.1 Corral de Tierra Area

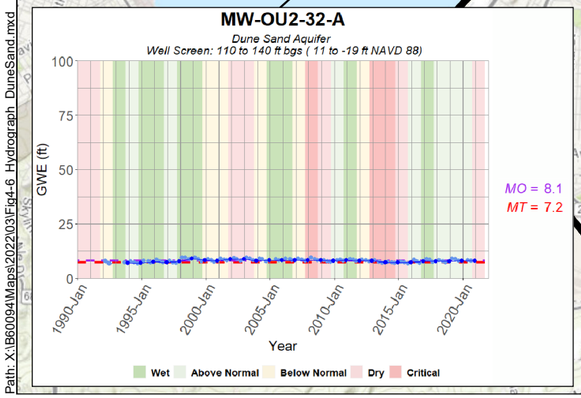
Figure 4-11 and Figure 4-12 show example hydrographs for RMS in the Corral de Tierra Area. The Monterey Subbasin GSP includes hydrographs with data up to 2019. Since 2019, groundwater elevations have continued to decrease throughout the Corral de Tierra Area.

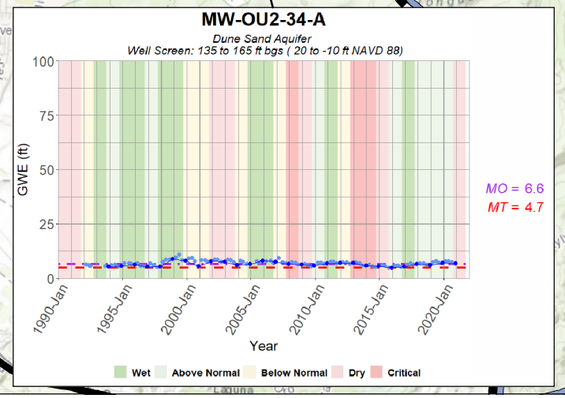


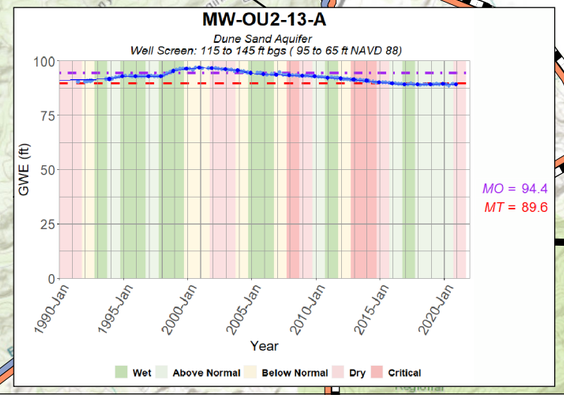












Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- Measurable Objectives
- Minimum Thresholds
- Interim Milestones
- Current Measurement

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 28 March 2022.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N

0 1.5 3

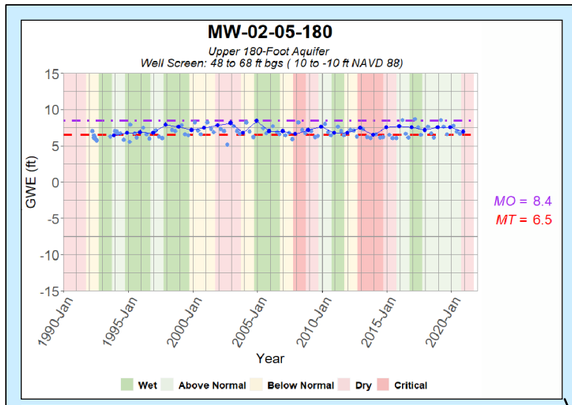
(Scale in Miles)

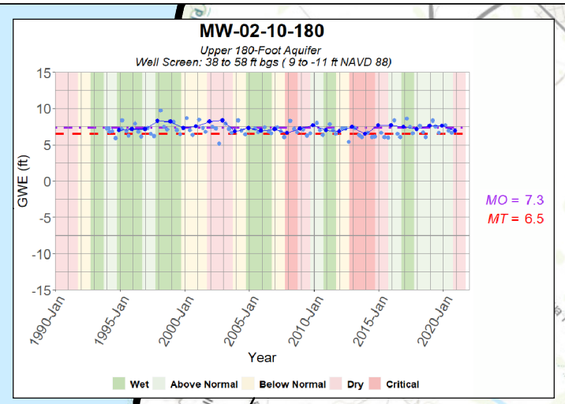
Representative Groundwater Elevation Hydrographs in the Dune Sand Aquifer

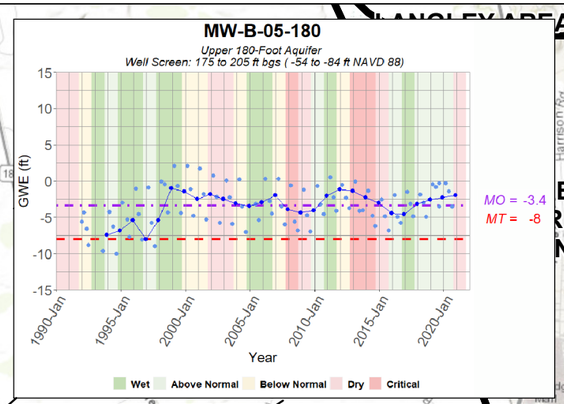
Monterey Subbasin
WY 2021 Annual Report
March 2022

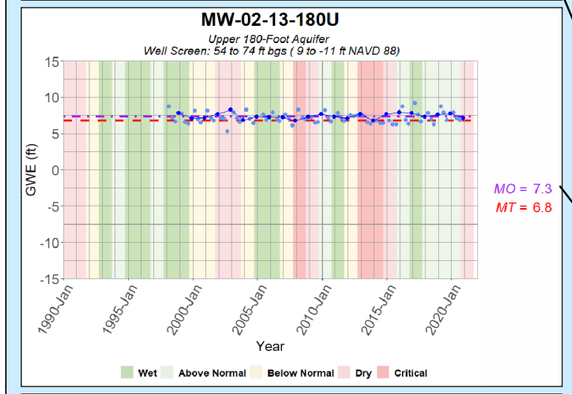
Figure 4-6

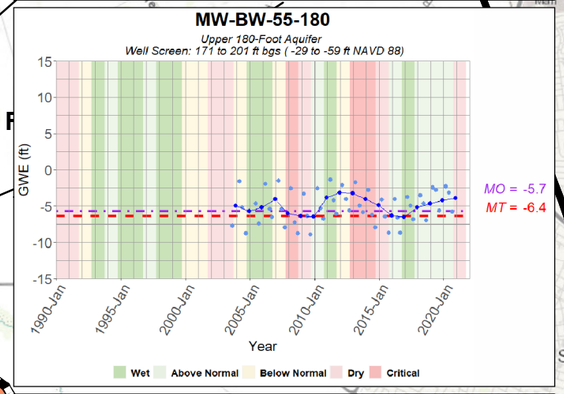
Path: X:\B60094\Maps\2022\03\Fig4-6 Hydrograph DuneSand.mxd

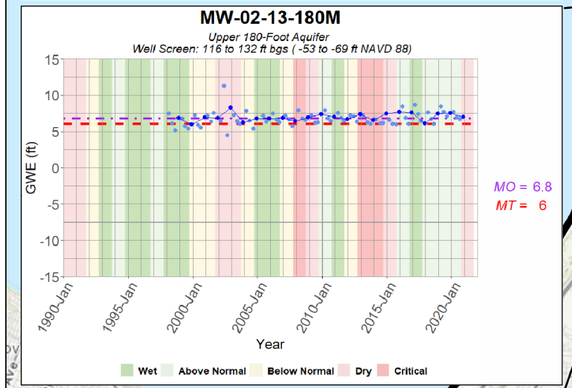


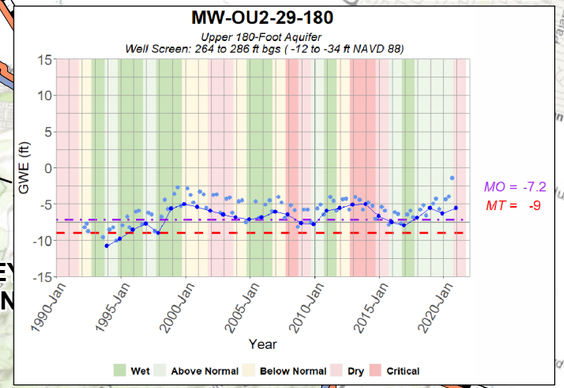


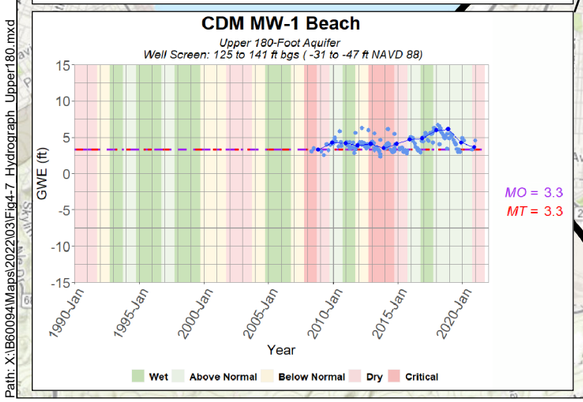


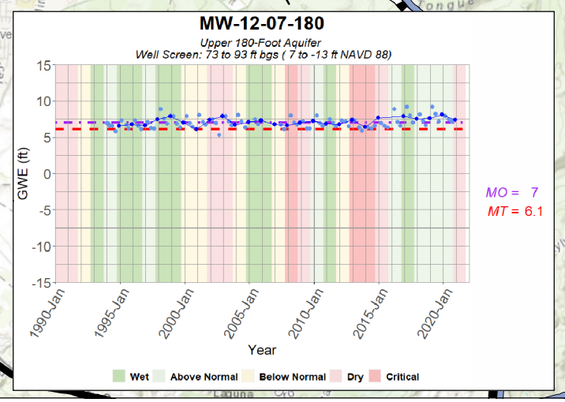












Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 28 March 2022.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N

0 1.5 3

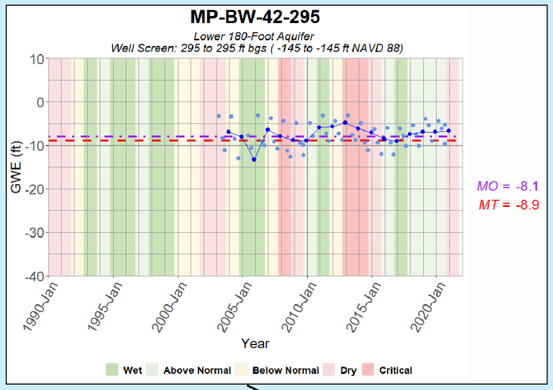
(Scale in Miles)

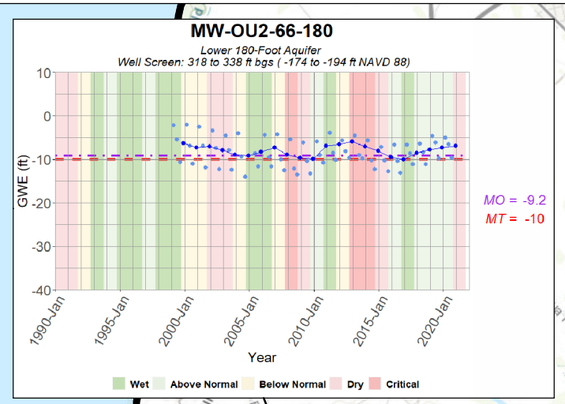
Representative Groundwater Elevation Hydrographs in the Upper 180-Foot Aquifer

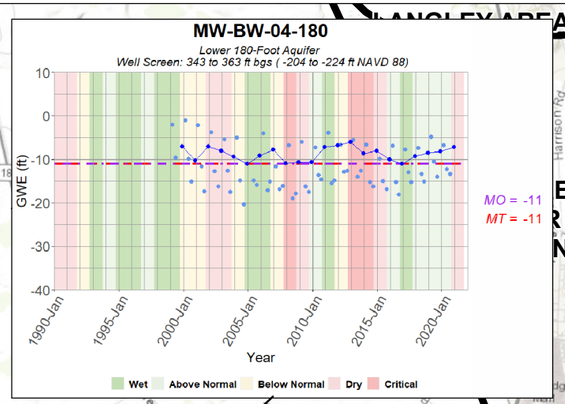
Monterey Subbasin
WY 2021 Annual Report
March 2022

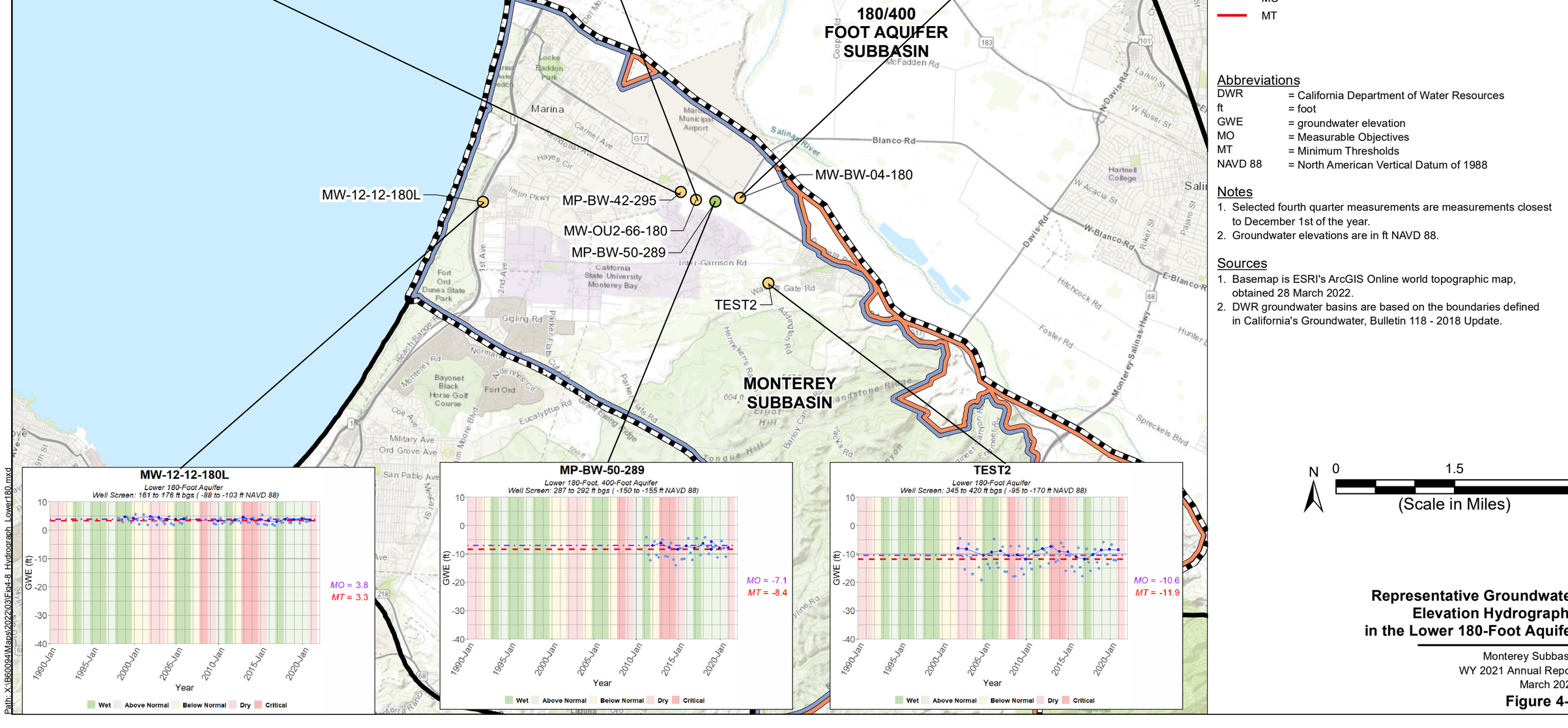
Figure 4-7

Path: X:\B60094\Maps\2022\03\Fig4-7 Hydrograph Upper180.mxd









Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

- Lower 180-Foot Aquifer
- Lower 180-Foot, 400-Foot Aquifer

Management Areas

- Marina-Ord
- Corral de Tierra

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 28 March 2022.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N

0 1.5 3

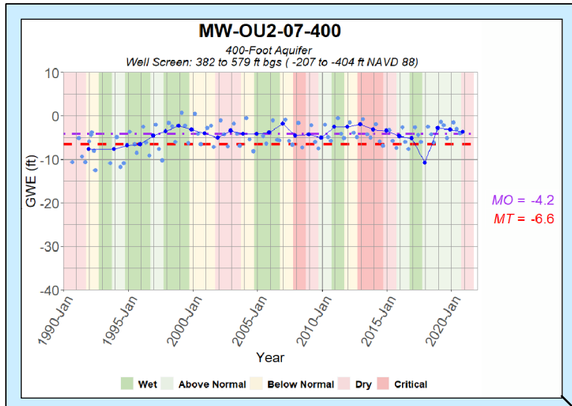
(Scale in Miles)

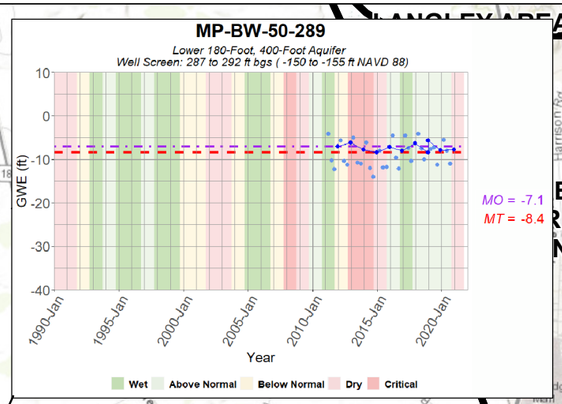
Representative Groundwater Elevation Hydrographs in the Lower 180-Foot Aquifer

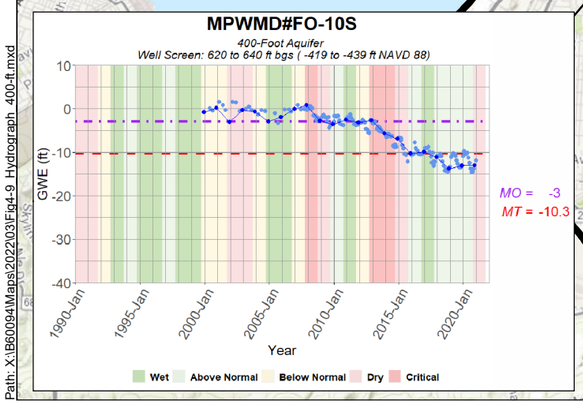
Monterey Subbasin
WY 2021 Annual Report
March 2022

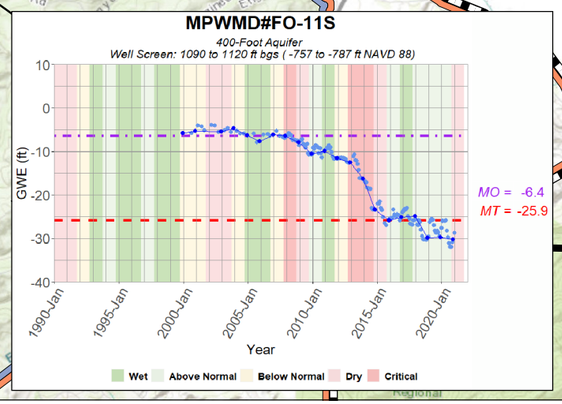
Figure 4-8

Path: X:\E60094\Maps\2022\03\Fig4-8_Hydrograph_Lower180.mxd









Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

- 400-Foot Aquifer (Paso Robles)
- Lower 180-Foot, 400-Foot Aquifer

Management Areas

- Marina-Ord Area
- Corral de Tierra

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 28 March 2022.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N

0 1.5 3

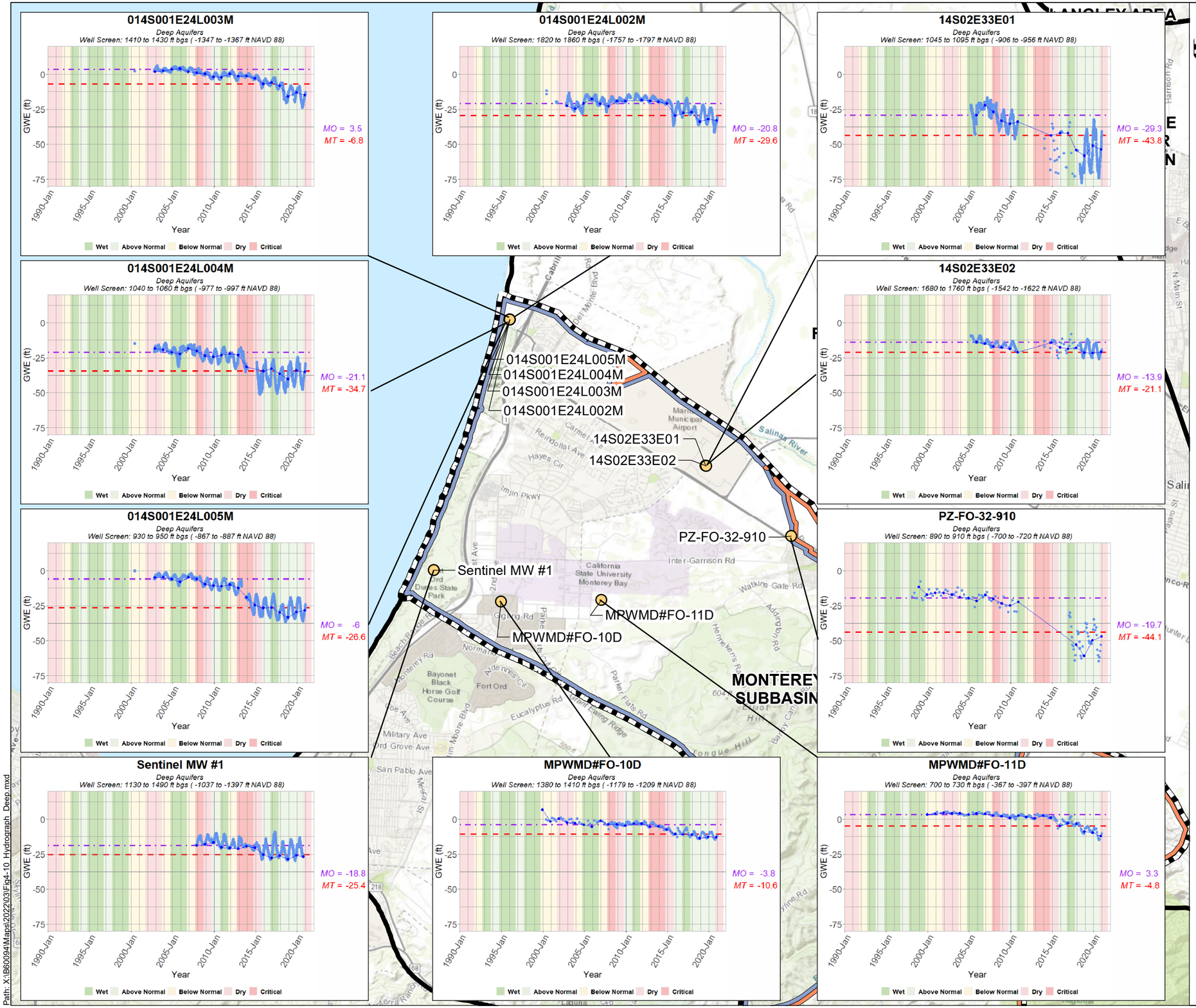
(Scale in Miles)

Representative Groundwater Elevation Hydrographs in the 400-Foot Aquifer

Monterey Subbasin
WY 2021 Annual Report
March 2022

Figure 4-9

Path: X:\B60094\Maps\2022\03\Fig4-9 Hydrograph 400-ft.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 28 March 2022.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N

0 1.5 3

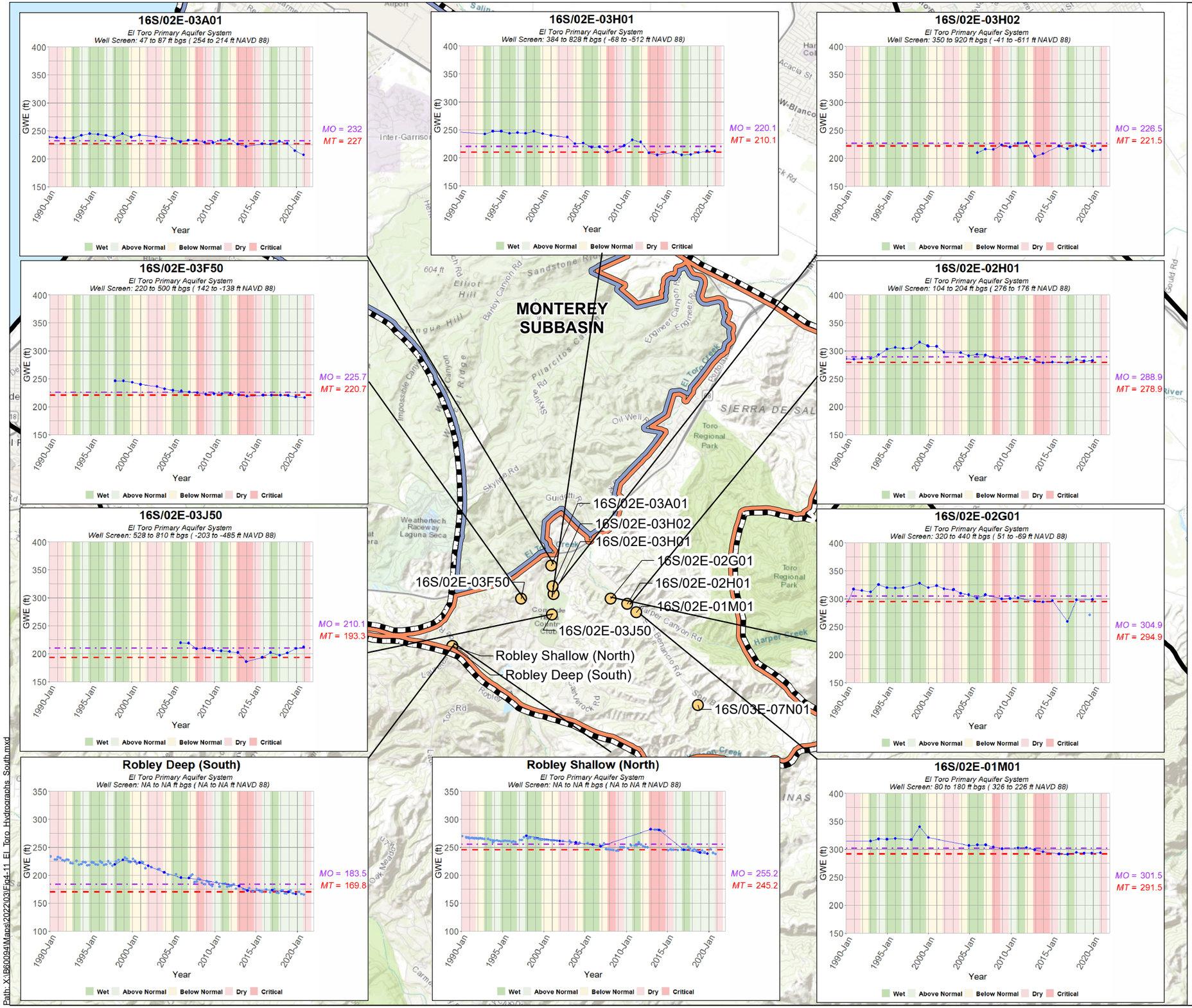
(Scale in Miles)

Representative Groundwater Elevation Hydrographs in the Deep Aquifers

Monterey Subbasin
WY 2021 Annual Report
March 2022

Figure 4-10

Path: X:\B60094\Maps\2022\03\Fig4-10_Hydrograph_Deep.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 April 2022.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N

0 1.5 3

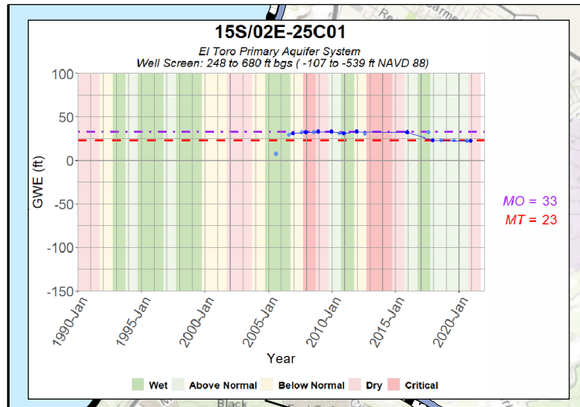
(Scale in Miles)

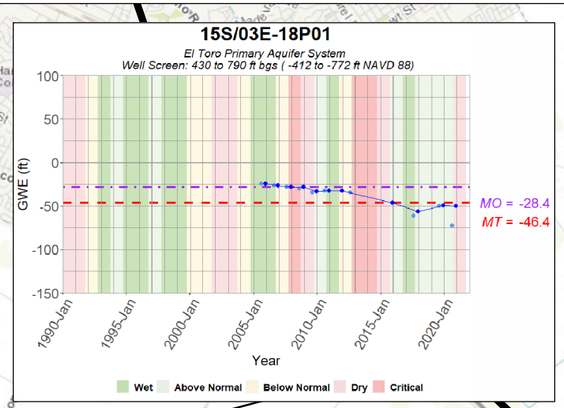
Representative Groundwater Elevation Hydrographs in the El Toro Primary Aquifer (South)

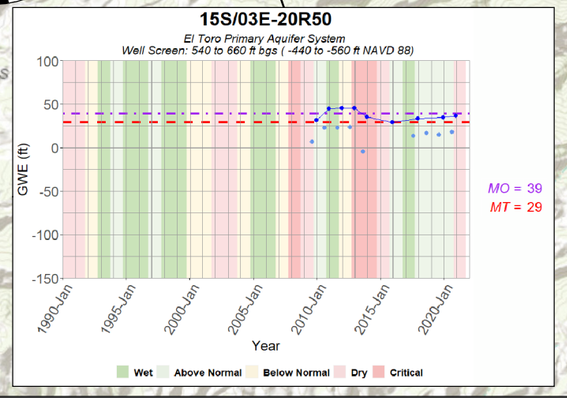
Monterey Subbasin
WY 2021 Annual Report
March 2022

Figure 4-11

Path: X:\B60094\Maps\2022\03\Fig4-11_El_Toro_Hydrographs_South.mxd







Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord
- Corral de Tierra

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 April 2022.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N

0 1.5 3

(Scale in Miles)

Representative Groundwater Elevation Hydrographs in the El Toro Primary Aquifer (North)

Monterey Subbasin
WY 2021 Annual Report
March 2022

Figure 4-12

Path: X:\B60094\Maps\2022\03\Fig4-12_El_Toro_Hydrographs_North.mxd

4.2 Water Use and Supply

Water use in the Monterey Subbasin primarily includes municipal, domestic, and agricultural uses. Groundwater is the primary water source in the Monterey Subbasin.

4.2.1 Groundwater Extraction

Table 4-1 and Table 4-2 show groundwater extraction rates within each Management Area by sector.

Groundwater extraction within the Marina-Ord Area is primarily conducted by MCWD for municipal water use. A small volume of groundwater is extracted by the U.S. Army for remediation purposes at the former Fort Ord and is then returned to the groundwater basin. MCWD is the sole water purveyor within the Marina-Ord Area. MCWD collects groundwater extraction data by metering its production wells.

Water use sectors in the Corral de Tierra Area include municipal water use supplied by various small and large water systems and agricultural and rural domestic water use. Agricultural water use is derived from pumping reported as part of the MCWRA GEMS. Urban water use in the Corral de Tierra Area is calculated based on extraction reported through GEMS and the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW).

Table 4-1. Groundwater Extraction by Sector in WY 2021 in the Marina-Ord Area

Water Use Section	Groundwater Extraction (AF)	Method of Measurement	Accuracy of Measurement
Urban	2,757	Direct/Meter	Estimated to be +/- 5%.

Table 4-2. Groundwater Extraction by Sector in WY 2021 in the Corral de Tierra Area

Water Use Sector	Groundwater Extraction (AF)	Method of Measurement	Accuracy of Measurement
Rural Domestic	334	Estimated based on non-agricultural irrigation area and number of households outside of water systems, including parks and the golf courses.	Accurate within a range of ±5% to ±10%
Urban	432	In the Corral de Tierra Area, 84% of the extractions monitored by GEMS and 69% of the water systems that reported pumping to the SWRCB were measured using a flowmeter. Additionally, 16% of the GEMS data used electrical meters. The remaining reported pumping to the SWRCB was not metered.	Flowmeters monitored by GEMs and SWRCB, as well as electrical meters monitored by GEMs, are accurate within a range of ±5%.
Agricultural	369		
Total	**1,135**	--	

4.2.2 Total Water Use

Total water use is the sum of groundwater extraction and recycled water use and is summarized in Table 4-3. In addition to groundwater, wastewater is recycled and used to irrigate development lawns in Las Palmas residential area within the Corral de Tierra Area.

Table 4-3. Total Water Use in WY 2021 in the Monterey Subbasin

Management Area	Water Use Sector	Groundwater Extraction (AF)	Recycled Water (AF)	Total Use by Sector (AF)
Marina-Ord Area	Urban	2,757		2,757
Corral de Tierra Area	Rural Domestic	334		334
Corral de Tierra Area	Urban	432	68	500
Corral de Tierra Area	Agricultural	369		369
	Total	**3,892**	**68**	**3,960**

4.3 Groundwater Storage

The total change in groundwater storage within the Subbasin is equivalent to the change in storage due to groundwater elevation changes and the change in storage due to seawater intrusion. The change in groundwater storage is calculated for the Marina-Ord Area Water Budget Zone (WBZ) and the Corral de Tierra Area WBZ, as presented below[4].

4.3.1 Marina-Ord Area WBZ

The groundwater storage change in the Marina-Ord Area WBZ was estimated by (a) comparing the estimated water level surface in August 2017 with the estimated water level surface in August 2020 for each Principal Aquifer and (b) calculating the change in storage based on the observed change in water levels and the estimated storage coefficient within the contoured portion of the Marina-Ord Area WBZ. The estimated storage coefficient was based on the calibrated Monterey Subbasin Groundwater Flow Model (MBGWFM). As described in Sections 4.4 and 5.2.3 below, an update of the seawater intrusion extent was not prepared for this Annual Report. Therefore, the change in groundwater storage estimated herein is based on the estimated change in storage due to groundwater elevation changes.

Specifically, geospatial (raster) surfaces of groundwater elevations were created from the August 2017 water level contours (presented in the Subbasin GSP) and August 2020 contours (shown in this document) and associated with the MBGWFM grid. Average water levels within each grid cell were subsequently compared to the top and bottom elevations of each Principal Aquifer unit defined in the MBGWFM and were multiplied by their respective storage

[4] The Marina-Ord Area WBZ includes the Marina-Ord Area as well as the Reservation Road portion of the Corral de Tierra Area, as they share the same principal aquifers; The Corral de Tierra WBZ includes the main portion of the Corral de Tierra Area underlain by the El Toro Primary Aquifer System.

coefficients to determine the total unconfined and confined storage volume at the cell during each bookend date. Cell-specific storage volumes were then summed for cells located within the contoured areas of the Marina-Ord WBZ to calculate the groundwater available in storage within each Principal Aquifer unit in August 2017 and August 2020. Total storage volumes were then compared to calculate the change in groundwater storage within each Principal Aquifer between August 2017 and August 2020. The calculation was performed for cells outside the seawater intruded area.

The estimated change in groundwater storage for each principal aquifer in the Marina-Ord Area WBZ is shown in Table 4-4 and Figure 4-13. The estimated groundwater elevation changes in the Marina-Ord Area are shown on Figure 4-14. The calculated loss in storage due to changes in elevation in individual aquifers ranges from +39 AFY in the 180-Foot Aquifer to -538 AFY in the 400-Foot Aquifer.

Table 4-4 Estimate Change in Groundwater Storage in the Marina-Ord Area WBZ

Aquifer	Total Change in Groundwater Storage, Fall 2017 – Fall 2020 (AF)	Average Annual Change in Groundwater Storage (AFY)
Dune Sand Aquifer	-515	-172
180-Foot Aquifer	118	39
400-Foot Aquifer	-1,615	-538
Deep Aquifers	-243	-81
Total Marina-Ord Area WBZ	**-2,255**	**-752**

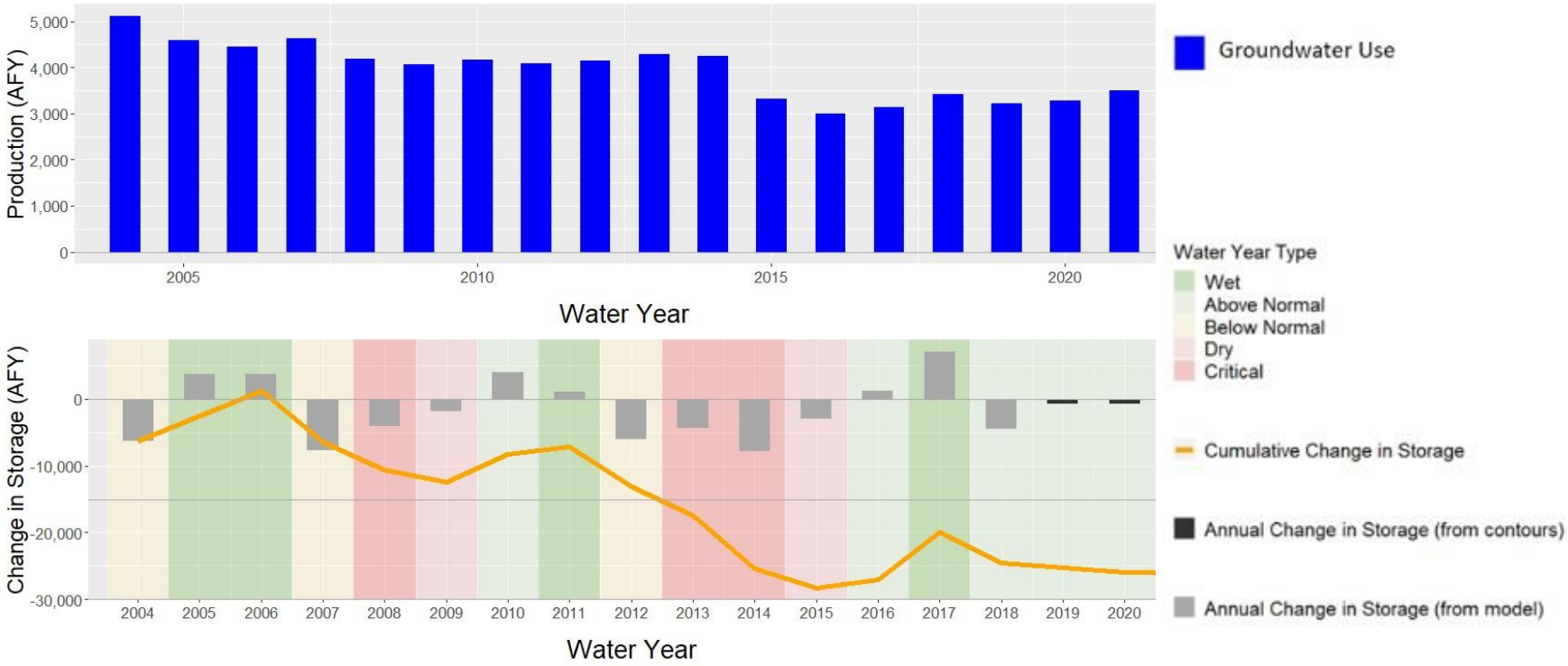
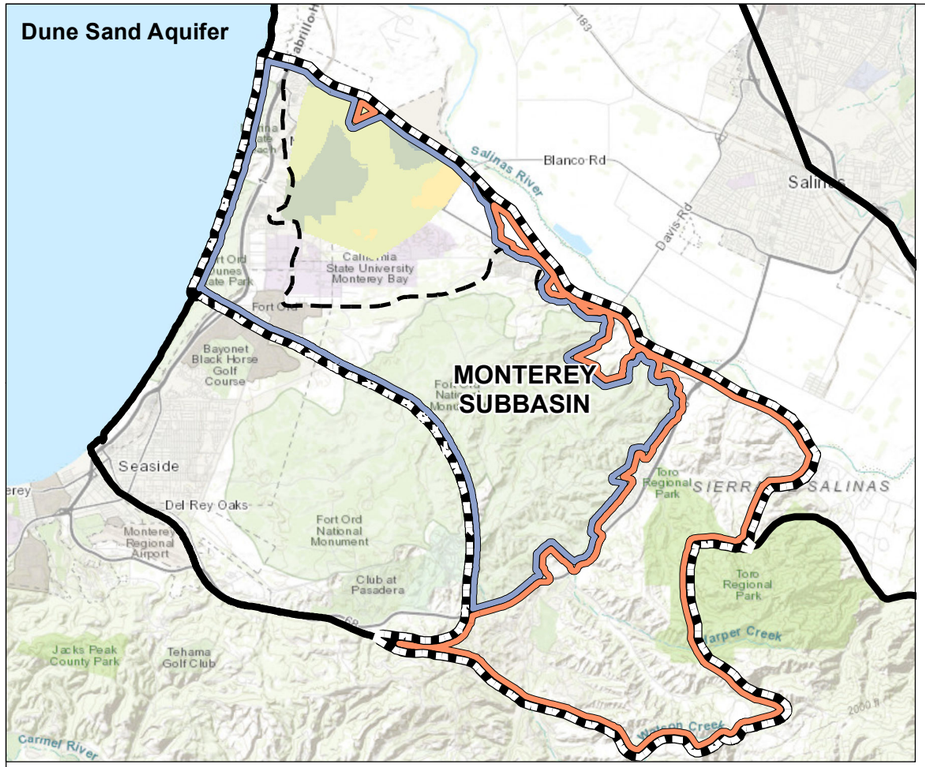
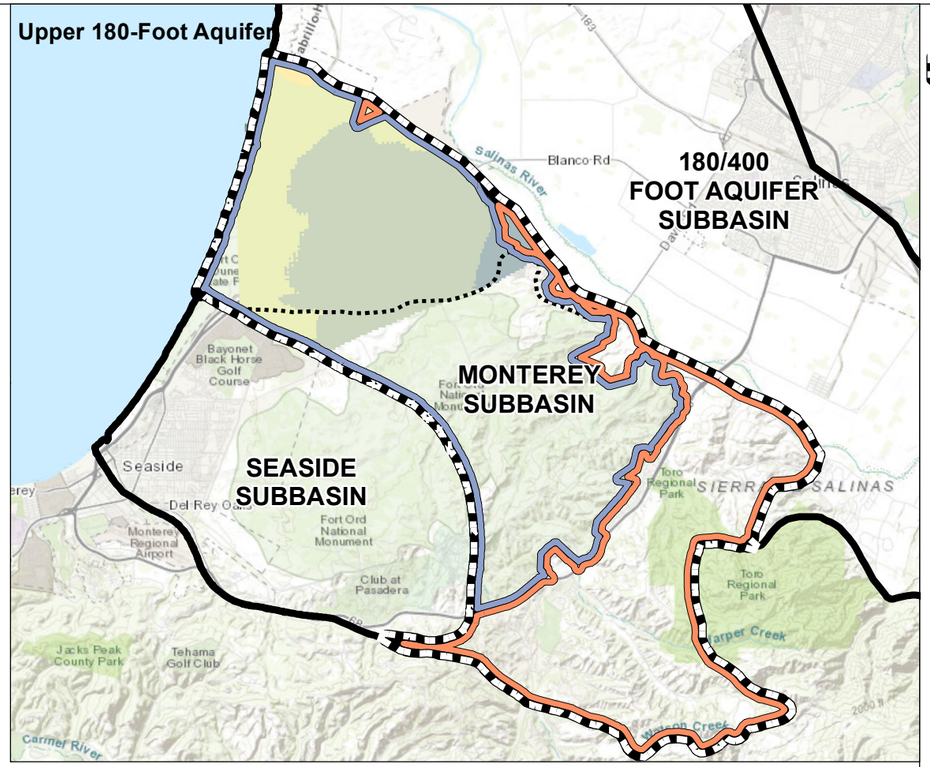
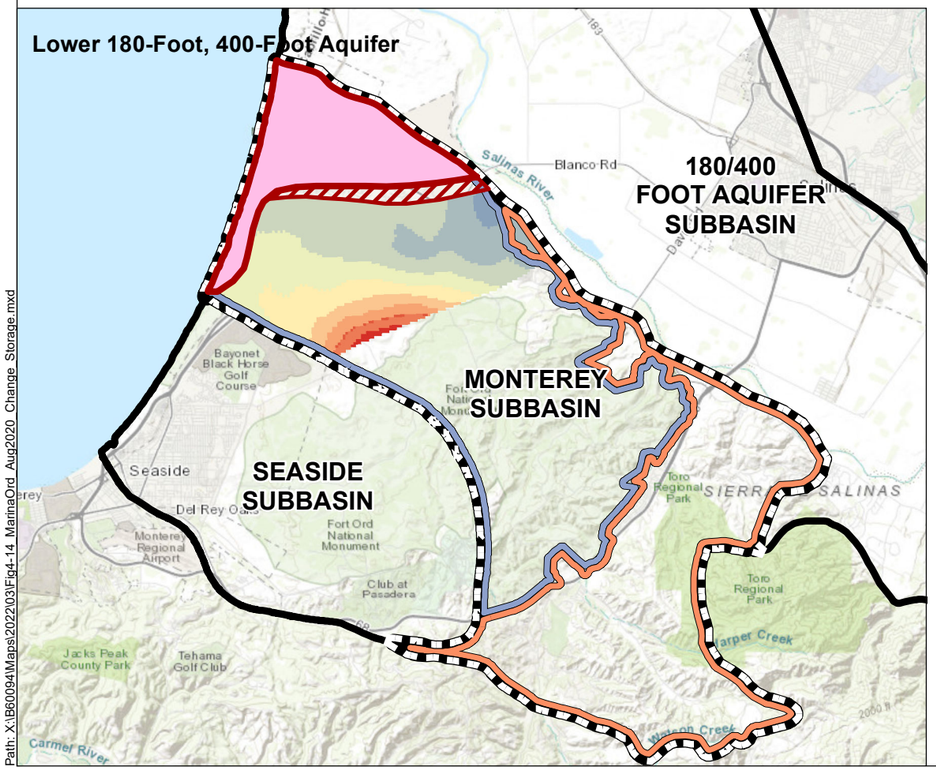
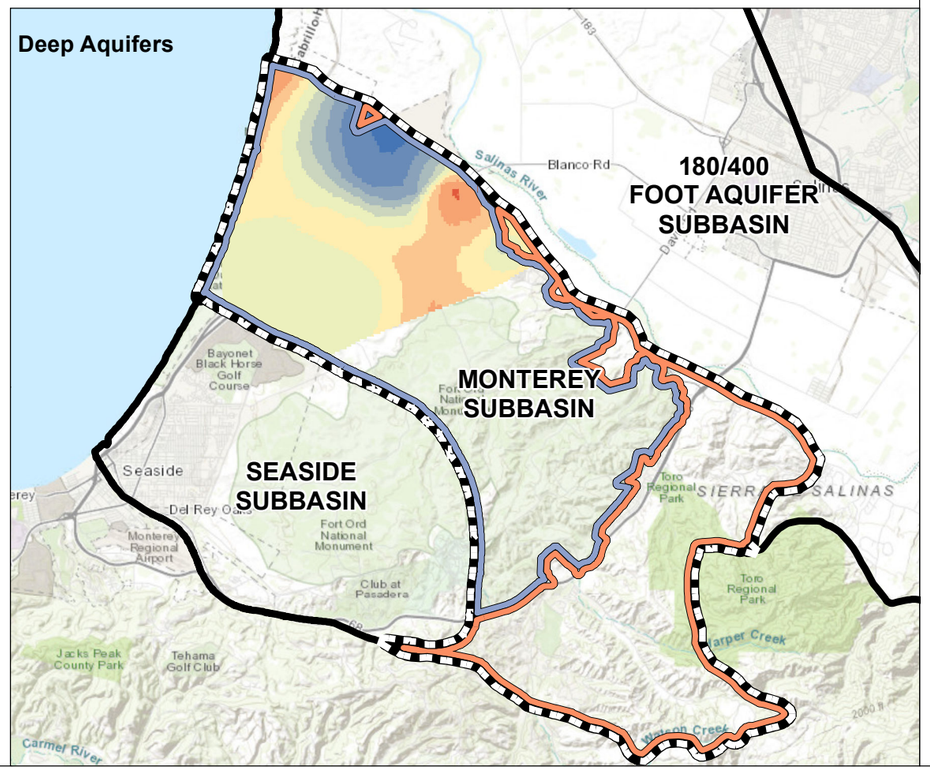


Figure 4-13. Cumulative and Annual Change in Storage in the Marina-Ord Area









Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley
- Southern Extent of FO-SVA (Harding ESE, 2001)
- Southern Extent of Valley Fill Deposits (Harding ESE, 2001)

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Estimated Seawater Intrusion in Monterey

- Area of Known Seawater
- Area of Potential Seawater

Change in Groundwater Elevations

- -30 - -25
- -24.9 - -20
- -19.9 - -15
- -14.9 - -10
- -9.9 - -5
- -4.9 - 0
- 0.1 - 5
- 5.1 - 10
- 10.1 - 15
- 15.1 - 20
- 20.1 - 25

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. The change in groundwater elevation reflects the changes from August 2017 to August 2020.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 April 2022.

N

0 2.5 5

(Scale in Miles)

Change in Groundwater Elevations in the Marina-Ord Area, August 2017 to August 2020

Monterey Subbasin
WY 2021 Annual Report
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Figure 4-14

Path: X:\B60094\Maps\2022\03\Fig4-14 MarinaOrd Aug2020 Change Storage.mxd

4.3.2 Corral de Tierra WBZ

Groundwater storage change in the Corral de Tierra WBZ was estimated by comparing groundwater elevation data at two bookend dates. The change in storage is calculated by multiplying a change in groundwater elevation by a storage coefficient and the land area of the contoured portion of the Corral de Tierra WBZ. The estimated groundwater elevation changes in the Corral de Tierra Area are shown on Figure 4-16. A storage coefficient of 0.1 is used to calculate the change in storage for the El Toro Primary Aquifer (GeoSyntec, 2007). The average change in groundwater elevation from Fall 2017 to Fall 2021 was calculated using the average change in groundwater elevations observed in the Corral de Tierra Area RMS wells. Since there are data gaps within the RMS network, the storage change was not calculated in the areas that were not contoured and not covered by the RMS network.

A summary of components used for estimating the change in groundwater storage due to groundwater elevation changes in the Corral de Tierra WBZ is shown in Table 4-5 and Figure 4-15. The estimated groundwater elevation changes in the Corral de Tierra Area are shown on Figure 4-16. Annual groundwater storage changes due to changes in groundwater elevation from Fall 2017 to Fall 2020 decreased at an annual average rate of 670 AFY in the Corral de Tierra Area. The negative signs indicate a decline in groundwater levels or loss in storage.

Table 4-5. Estimated Change in Groundwater Storage in the Corral de Tierra WBZ

Component	Values
Area of contoured portion of Subbasin (acres)	9,464
Storage coefficient	0.1
Average change in groundwater elevation from fall 2017 to fall 2020 (ft)	-2.95
Change in groundwater storage from fall 2017 to fall 2020 (AF)	-2,800
Total annual change in groundwater storage (AF/year)	**-670**

Note: Negative values indicate loss, positive values indicate gain.

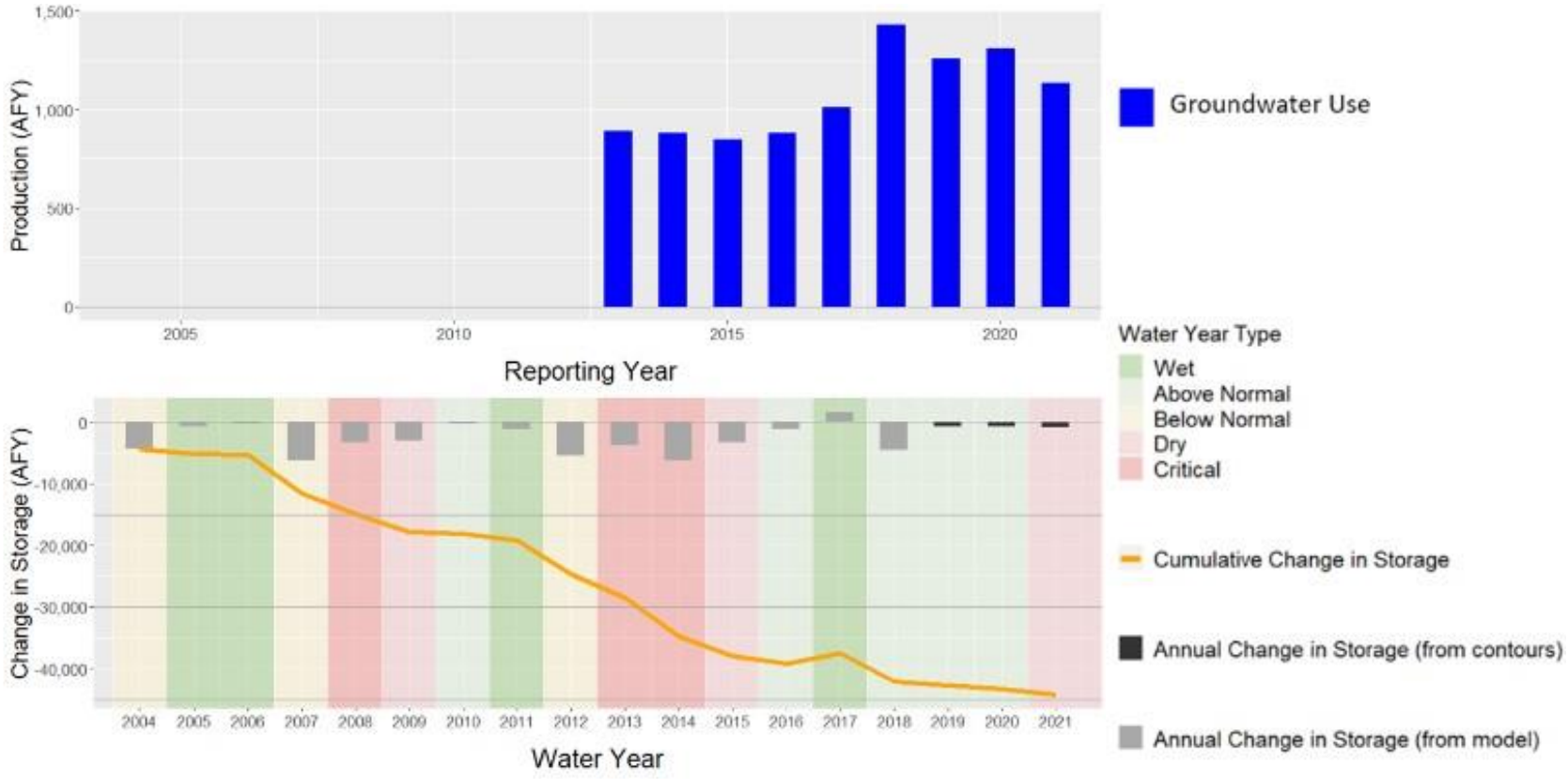
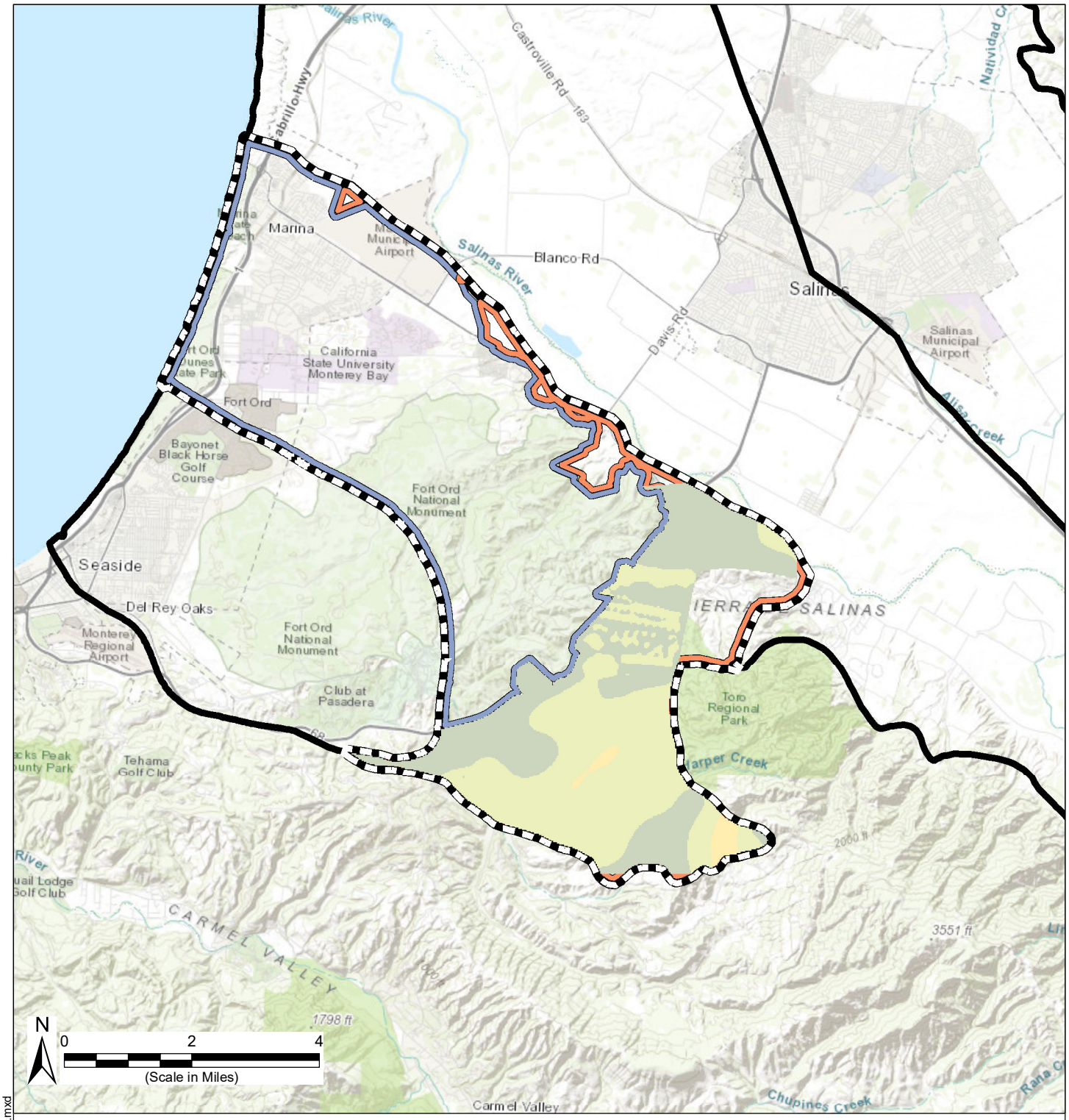


Figure 4-15. Cumulative and Annual Change in Storage in the Corral de Tierra Area



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Change in Groundwater Elevation in the El Toro Aquifer System

- -9.9 - -5
- -4.9 - 0
- 0.1 - 5

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. The change in groundwater elevation reflects the changes from Fall 2017 to Fall 2020.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 April 2022.

Change in Groundwater Elevations in the El Toro Primary Aquifer System, Fall 2017 to Fall 2020

Monterey Subbasin
WY 2021 Annual Report
March 2022
Figure 4-16

Path: X:\B60094\Maps\2022\03\Fig4-16-Coral_ChangeInStorage.mxd

4.4 Seawater Intrusion

MCWD GSA started but did not complete seawater intrusion monitoring for the current reporting period. As shown in Table 4-6, only 15 out of 42 seawater intrusion RMS wells have been sampled for total dissolved solids (TDS) and chloride (Cl) since 2017. Among the seawater intrusion monitoring sites sampled recently, only one well (MW-02-13-180M) exceeded the Subbasin GSP's 500 milligram per liter (mg/L) of chloride or 1,000 mg/L of TDS, which is used as a surrogate where chloride data are unavailable. The well is screened the intermediate 180-Foot Aquifer and has been seawater intruded since the late 1990s. As such, the presence of chloride concentrations above 500 mg/L in this well does not represent an exceedance of the MT for seawater intrusion, but rather confirms that this area is still seawater intruded.

Table 4-6. Monterey Subbasin Seawater Intrusion Representative Monitoring Sites

Site Name	Aquifer	Collection Agency	Latest Cl Concentration (mg//L)	Latest TDS Concentration (mg//L)
MW-02-05-180	Upper 180-Foot Aquifer	MCWD	124 (2019)	474 (2017)
MW-02-13-180M	Upper 180-Foot Aquifer	MCWD	4,630 (2021)	13,700 (2017)
MCWD-31	Lower 180-Foot Aquifer	MCWD	79 (2021)	360 (2021)
MW-12-12-180L	Lower 180-Foot Aquifer	MCWD	43.3 (2018)	--
MCWD-29	Lower 180-Foot, 400-Foot Aquifer	MCWD	86 (2021)	410 (2021)
MCWD-30	Lower 180-Foot, 400-Foot Aquifer	MCWD	110 (2021)	460 (2021)
MP-BW-50-289	Lower 180-Foot, 400-Foot Aquifer	MCWD	--	426 (2018)
MP-BW-50-309	Lower 180-Foot, 400-Foot Aquifer	MCWD	--	358 (2018)
MP-BW-50-339	Lower 180-Foot, 400-Foot Aquifer	MCWD	--	510 (2018)
MP-BW-50-359	Lower 180-Foot, 400-Foot Aquifer	MCWD	--	532 (2018)
MP-BW-50-384	Lower 180-Foot, 400-Foot Aquifer	MCWD	--	486 (2018)
MPWMD#FO-10S	400-Foot Aquifer	Seaside Basin Watermaster	92.8 (2021)	296 (2021)
MCWD-10	Deep Aquifers	MCWD	56 (2021)	300 (2021)
MCWD-11	Deep Aquifers	MCWD	73 (2021)	400 (2021)
MPWMD#FO-10D	Deep Aquifers	Seaside Basin Watermaster	64.9 (2021)	222 (2021)

Notes:

(a) The RMS network is selected to distinguish the upper 180-Foot Aquifer and the lower 180-Foot Aquifer since conditions in the upper 180-Foot are distinct from those in the lower 180-Foot Aquifer, as described in Chapter 5.

(b) Wells MPWMD#FO-10S, MPWMD#FO-10D, and Sentinel MW#1 are monitored by MPWMD on behalf of the Seaside Watermaster. MPWMD#FO-10S is screened in the Paso Robles Aquifer, which is likely connected to the 400-Foot Aquifer; MPWMD#FO-10D, and Sentinel MW#1 are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

4.5 Water Quality

The water quality monitoring network consists of existing water supply wells in the Monterey Subbasin. As described in Subbasin GSP Chapter 8, separate MTs are set for the COCs for public water system supply wells, on-farm domestic wells, and irrigation supply wells. COCs for drinking water are assessed at public water supply wells and on-farm domestic wells, and COCs for crop health are assessed at agricultural supply wells. The municipal public water system supply wells included in the monitoring network were identified by reviewing data from the SWRCB DDW. All on-farm domestic wells and agricultural supply wells have been sampled through the Central Coast Regional Water Quality Control Board's (CCRWQCB's) ILRP.

Table 4-7 shows the number of wells in the identified water quality monitoring network that were sampled and exceeded regulatory standards in WY 2021 for the COCs identified in the Subbasin GSP. As shown on this table, no water supply wells sampled in the Marina Ord Area had any COCs that exceeded regulatory drinking water standards. Nine wells in the Corral de Tierra Area exceeded the regulatory drinking water standard for arsenic and four wells exceeded the regulatory drinking water standards for iron and manganese.

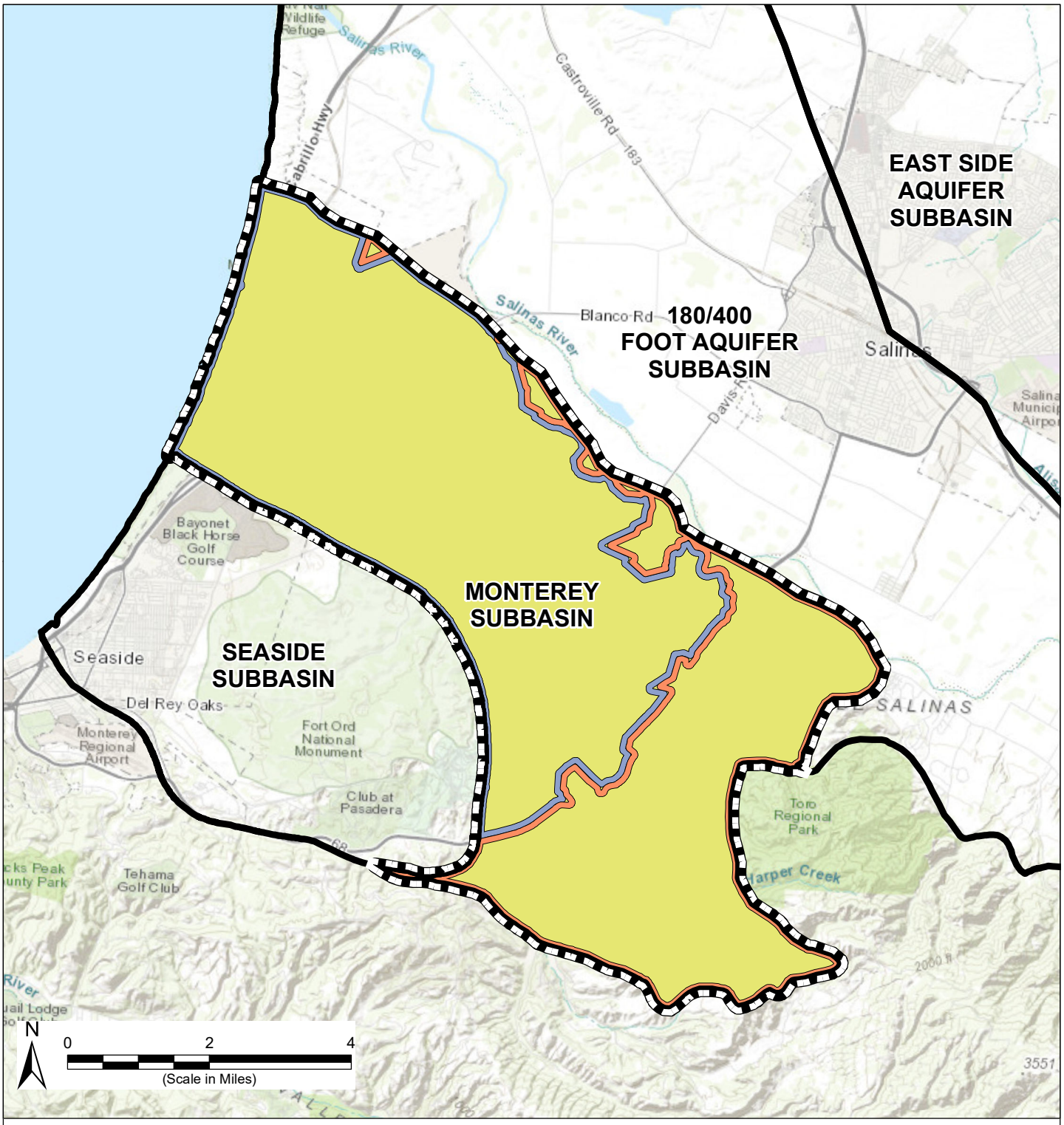
Table 4-7. Water Quality in WY 2021

Constituent of Concern (COC)	Regulatory Exceedance Standard	Standard Units	Number of Wells Sampled for COC in WY 2021	Number of Wells Exceeding Regulatory Standard in WY 2021
Marina-Ord Area				
DDW Wells				
Carbon Tetrachloride	0.5	UG/L	7	0
Trichloroethene (TCE)	5	UG/L	7	0
Corral de Tierra Area				
DDW Wells				
1,2,3-Trichloropropane (1,2,3 TCP)	0.005	UG/L	6	0
1,2-Dibromo-3-chloropropane	0.2	UG/L	0	0
Arsenic	10	UG/L	11	9
Benzo(a)pyrene	0.2	MG/L	1	0
Chromium	50	UG/L	2	0
Dinoseb	7	UG/L	1	0
Hexachlorobenzene (HCB)	1	UG/L	--	--
Iron	300	UG/L	7	4
Manganese	50	UG/L	6	4
Nickel	100	UG/L	1	0
Specific Conductance	1600	UMHOS/CM	2	0
Total Dissolved Solids	1000	MG/L	2	0
Vinyl Chloride	0.5	UG/L	1	0
Zinc	5	MG/L	1	0
ILRP On-Farm Domestic Wells				
Total Dissolved Solids	1000	MG/L	0	0

Abbreviations:
MG/L = milligram per liter
UG/L = microgram per liter
UMHOS/CM = micromhos per centimeter

4.6 Land Subsidence

Subsidence is measured using InSAR data. These data are provided by DWR on the SGMA data viewer portal (DWR, 2021a). Figure 4-17 shows the annual subsidence for the Subbasin from October 2020 to October 2021. Data continue to show negligible subsidence. All land movement was within the estimated error of measurement of +/- 0.1 foot.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Rate of Land Subsidence

- -0.1 to 0.1 ft/yr

Abbreviations

ft/yr = foot per year

Notes

1. All locations are approximate.
2. This figure shows the annual land subsidence rate between October of 2020 and October of 2021.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 31 March 2022.
2. InSAR subsidence data, "SAR/Vertical_Displacement_TRE_ALTAMIRA_v2021_Annual_Rate_20201001_20211001 (ImageServer)." Created by DWR and and obtained from ArcGIS REST Services Directory.

Estimated InSAR Subsidence

Monterey Subbasin
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March 2022

Figure 4-17

Path: X:\B60094\Maps\2022\03\Fig4-17_InSARSubsidence.mxd

4.7 Interconnected Surface Water

4.7.1 Marina-Ord Area

As stated in the GSP, the MT for the depletion of ISW is set to the minimum shallow groundwater elevations historically observed between 1995 and 2015 near locations of ISW. As shown in Table 4-8, the groundwater elevation at the RMS during Fall 2020 and Spring 2021 is higher than its representative MT and MO.

Table 4-8. Marina-Ord Area Interconnected Surface Water Representative Monitoring Sites

Site Name	Aquifer	Collection Agency	Fall 2020	Spring 2021	MT	MO
Marina-Ord Area						
MW-BW-82-A	Dune Sand Aquifer	Fort Ord	10.3	10.7	7.9	7.9

4.7.2 Corral de Tierra Area

SVBGSA is in the process of establishing a monitoring network for the depletion of ISW in the Corral de Tierra Area and plans to install one new shallow well along El Toro Creek. Once the shallow monitoring well is installed, SVBGSA will use a historical groundwater level contour map to interpolate the MT, MO, and interim milestones.

5 ANNUAL PROGRESS TOWARDS IMPLEMENTATION OF THE GSP

5.1 WY 2021 GSP Implementation Activities

This section details groundwater management activities in WY 2021 associated with GSP implementation. These include activities of MCWD GSA and SVBGSA that promote groundwater sustainability and are important for reaching the GSP sustainability goal.

In WY 2021, MCWD GSA and SVBGSA undertook activities in the following four main categories: coordination and engagement, data and monitoring, and project and implementation activities.

5.1.1 Coordination and Engagement

The basin GSAs coordinated regularly through staff and consultant meetings during the reporting period. Additionally, the GSAs coordinated and engaged with stakeholders and agencies in their respective management areas described below.

5.1.1.1 Marina-Ord Area

The MCWD GSA practices stakeholder engagement through its GSA website (http://mcwd.org/) and through public meetings and workshops, which were held online during WY 2021 while health-protective restrictions due to coronavirus disease of 2019 (COVID-19) were in force. During the reporting period, MCWD GSA held (a) stakeholder workshops on November 17, 2020, and March 11, 2021, and MCWD Board of Director public meetings on February 16, 2021, and August 16, 2021. The GSA will continue to meet regularly in WY 2022.

Additionally, MCWD GSA held as-needed meetings with individual stakeholders and agencies to coordinate. These included meetings with:

- The Seaside Watermaster regarding comments on draft GSP chapters, water quality, and video logging of monitoring wells MPWMD#FO-09 and MPWMD#FO-10;
- MCWRA to coordinate data transmittal for DWR's AEM study and P&MAs planning; and
- Monterey One Water (M1W) to confirm recycled water availability for MCWD's Recycled Water Reuse Through Landscape Irrigation and IPR Project (Project M3).

5.1.1.2 Corral de Tierra Area

SVBGSA continued robust stakeholder engagement and strengthened collaboration with key agencies and partners. SVBGSA worked with the Monterey Subbasin Planning Committee throughout the year to develop the Corral de Tierra portion of the Monterey Subbasin GSP, submitted to DWR in January 2022. SVBGSA engaged the eight members of the Committee and public attendees in an iterative process of chapter development: first educating the Committee on chapter topics, then facilitating discussions on each topic, and finally reviewing draft chapters. Stakeholders were involved in understanding the Subbasin, setting SMC, and

developing a list of potential P&MAs. It received public comments throughout the process, and in September 2021, it initiated a 60-day public comment period for the full GSP. At the conclusion of the planning process, SVBGSA held more than 34 planning meetings and technical workshops on each aspect of the Forebay Subbasin GSP.

In addition to regularly scheduled committee meetings, SVBGSA held a series of Valley-wide workshops, as detailed in Table 5-1. These workshops were informational for committee members, stakeholders, and the general public and covered pertinent topics to be included in the GSPs. Workshops were timed to specific chapter development for the GSP. Subject matter experts were brought in as necessary to provide the best available information to Subbasin Planning Committee members.

Table 5-1. Subject Matter Workshops Held During GSP Preparation

Topic	Date
Brown Act and Conflict of Interest	22-Jul-20
Sustainable Management Criteria	28-Jul-20
Water Law	10-Aug-20
Salinas Valley Watershed Overview	26-Aug-20
Web Map Workshop	30-Sep-20
Town Hall – Domestic Wells & Drinking Water	28-Oct-20
Pumping Allocations	18-Nov-20
Funding Mechanisms	27-Jan-21
Water Budgets	24-Feb-21
Communications and Implementation	31-Mar-21
Technical Modeling Workshop – SVIHM & SVOM	30-Jun-21

Abbreviations:
SVIHM = Salinas Valley Integrated Hydrologic Model
SVOM = Salinas Valley Operational Model

In addition to the Subbasin Committee, SVBGSA identified the need for an Integrated Implementation Committee to guide development of an Integrated Implementation Plan for 6 Subbasins within the Salinas Valley. The Integrated Implementation Committee will provide input on basin-wide and regional P&MAs and resolve neighboring basin concerns. The intent of the Committee is to ensure the Salinas Valley Basin is on a cohesive path to sustainability. Throughout WY 2021, SVBGSA held 12 Valley-wide Board meetings and 11 Valley-wide Advisory Committee Meetings.

SVBGSA and MCWRA also increased coordination and collaboration through weekly meetings between agency leads and consultants. This resulted in increased awareness of each other's activities, objectives, and challenges. MCWRA and SVBGSA have scoped the roles of the two agencies and are developing a Memorandum of Understanding (MOU) to be reviewed by each agency Board. The MOU will further outline how the two agencies will coordinate through the implementation of the GSPs.

SVBGSA conducted meetings throughout the year to reach out to additional agencies and stakeholders to coordinate. These included meetings with:

- National Marine Fisheries Service (NMFS) on the effect of groundwater extraction on surface water depletion and steelhead and its habitat.
- Monterey County Health on data and the existing well permitting and water quality monitoring programs.
- CCRWQCB on data and future coordination with the multiple agencies involved in water quality.
- Integrated Regional Water Management Plan (IRWMP), including coordinating with Central Coast Wetlands Group (CCWG) on watershed coordinator grant.

The SVBGSA contracted with Consensus Building Institute (CBI) to conduct a work program to help the SVBGSA better define a meaningful engagement strategy with disadvantaged communities (DACs) and to develop a work plan that aligned with GSP development and ultimately with SVBGSA long term goals around groundwater sustainability. CBI conducted interviews to gage primary groundwater issues of concern in DACs, identified possible SVBGSA focus with DACs, confirmed barriers to engagement with DACs, and identified outreach and education materials and approaches to achieve success with these communities over the long term. DACs are important stakeholders for the SVBGSA to develop meaningful and long-term relationships with regard to groundwater sustainability.

5.1.2 Data and Monitoring

Both GSAs undertook efforts to move data collection and monitoring forward in their respective management areas. During WY 2021:

- MCWD GSA initiated discussions with Seaside and MCWRA on expanding seawater intrusion monitoring in existing wells.
- SVBGSA and MCWRA began discussions on expanding and enhancing the GEMS program. This effort will primarily take place in 2022 and 2023. These early discussions focused on understanding the challenges of changing the program and the steps involved.

5.1.3 Project and Implementation Activities

Due to the limited timeframe between the Monterey Subbasin GSP submittal in January 2022 and preparation of this 1st Annual Report in April 2022, the GSAs have had limited time to implement significant projects or management actions beyond those described in the GSP.

The Monterey Subbasin GSP outlined 26 P&MAs that will be further developed and prioritized. Prioritization will occur during the first few years of GSP implementation, along with the

completion of further feasibility studies. A brief description and progress towards implementing these P&MAs is provided below.

Multi-subbasin Projects

- R1 – Seasonal Releases from Reservoirs This project entails modifying reservoir releases for the MCWRA's Conservation Program and Salinas River Diversion Facility (SRDF) diversions to maximize annual diversions at the SRDF. P&MA R1 has not yet been initiated.
- R2 – Regional Municipal Supply Project This project would construct a regional desalination plant to treat the brackish water extracted from the proposed seawater intrusion barrier in the 180/400-Foot Aquifer Subbasin. P&MA R2 has not yet been initiated.
- R3 – Multi-benefit Stream Channel Improvements This project takes a three-pronged approach to stream channel improvements. First, it removes dense vegetation and reduces the height of sediment bars that impede streamflow in designated maintenance channels. Second, the project removes the invasive species Arundo donax (Arundo) and Tamarix sp. (tamarisk) throughout the Salinas River watershed. Third, it enhances the recharge potential of floodplains along the Salians River. P&MA R3 has not yet been initiated.

Marina-Ord Area Local Projects & Management Actions

- M1 – MCWD Demand Management Measures MCWD continues to implement conservation efforts within its service area to meet and exceed new legislative requirements as part of the "Making Water Conservation a California Way of Life" framework. P&MA M1 is ongoing, and additional information on the conservation effort can be found in the 2020 MCWD Urban Water Management Plan[5].
- M2 – Stormwater Recharge Management The Cities of Marina and Seaside, the two major municipalities within the Marina-Ord Area, have policies to facilitate additional stormwater catchment and infiltration beyond existing efforts as development and redevelopment occurs. P&MA M2 is ongoing, and other information can be found on the city websites (https://www.ci.seaside.ca.us/436/Stormwater and https://cityofmarina.org/757/Stormwater-Management-Program).
- M3 – Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse The project consists of recycled water reuse through landscape irrigation and/or IPR within MCWD's service area. MCWD began providing recycled water for irrigation to the

[5] The 2020 MCWD Urban Water Management Plan could be found in the District website: https://www.mcwd.org/docs/2021_uwmp/DRAFT_MCWD_2020_UWMP_v20210520.pdf

Seaside Golf Course and other customers in WY 2021 and is continuing its Recycled Water Feasibility Study to assess the possibility of implementing an IPR project.

- M4 – Drill and Construct Monitoring Wells This project includes drilling and construction of monitoring wells screened in the 400-Foot Aquifer and the Deep Aquifers near the southwestern portion of the Subbasin. P&MA M4 has not yet been initiated.

Corral de Tierra Area Local Projects & Management Actions

- C1 – Pumping Allocations and Controls Pumping allocations are one demand-side approach to managing and controlling pumping. Given limited supply-side options in the Monterey Subbasin, pumping allocations provide a management action to proactively determine how extraction should be fairly divided and controlled if needed. P&MA C1 has not yet been initiated.
- C2 – Check Dams This project will install small/temporary dams along Watson Creek to increase recharge in streambeds with high recharge potential. P&MA C2 has not yet been initiated.
- C3 – Recharge Basins from Surface Water Diversions This project will divert surface water in the El Toro Creek watershed from the small tributaries and reroute it to recharge basins to enhance storage, infiltration, and recharge opportunities. P&MA C3 has not yet been initiated.
- C4 – Wastewater Recycling for Indirect Potable Use This project will reclaim up to 232 AFY of treated wastewater. This water will be disinfected at tertiary levels for beneficial reuse within the Corral de Tierra Area. P&MA C4 has not yet been initiated.
- C5 – Decentralized Residential In-Lieu Recharge Projects This project is a set of initiatives that incentivize homeowners to install decentralized in lieu recharge projects, such as rainwater harvesting, greywater reuse, and recharge features on their properties. Harvested rainwater can be used for residential landscaping and domestic animal water purposes and reduce groundwater pumping, thereby functioning as in-lieu recharge. P&MA C5 has not yet been initiated.
- C6 – Decentralized Stormwater Recharge Projects This project promotes the installation of stormwater collection features in neighborhood locations downstream of typical flooding spots for groundwater recharge. P&MA C6 has not yet been initiated.
- C7 – Increase Groundwater Production in the Upper Corral de Tierra Valley for Distribution to Lower Corral de Tierra Valley This project undertakes additional groundwater production in the Upper Corral de Tierra Valley for distribution in the Lower Corral de Tierra Valley for supplementary water supply. P&MA C7 has not yet been initiated.

Implementation Actions

- I1 – 180/400-Foot Aquifer Subbasin GSP Implementation and Seaside Watermaster Actions This action includes MCWD's continued support of projects implemented in the 180/400 Subbasin and in the larger Salinas Valley Basin, particularly those that address regional seawater intrusion, provides recharge or alternative water supplies to coastal areas, and/or improve Deep Aquifer conditions near the Monterey-180/400 Subbasin boundary. MCWD is supporting SVBGSA's 2022 GSP Update to the 180/400-Foot Aquifer Subbasin GSP, anticipated to be completed by June 2022.
- I2 – Deep Aquifers Investigation This Study focuses on describing the geology, hydrogeology, and extents of the Deep Aquifers, the water budget, and guidance for management. In WY 2021, SVBGSA solicited contributions from local agencies and stakeholders to fund the Deep Aquifers Study. In October 2021, SVBGSA secured the $850,000 needed for the Study when the Board approved the Agreement for Contribution to Funding the Deep Aquifer Investigation to be entered into with the following agencies and entities for the Deep Aquifer Study: Monterey County; MCWRA; Castroville Community Services District; MCWD; City of Salinas; Alco Water; California Water Service; and irrigated agriculture entities include the Salinas Valley Water Coalition. SVBGSA drafted the Request for Qualifications and released it in September 2021. In WY 2022, SVBGSA selected a proposal and initiated the Study.
- I3 – Support Monterey County's Final Well Construction Ordinance to Protect Deep Aquifers The ordinance prohibited the acceptance or processing of any applications for new Deep Aquifers Wells beneath areas impacted by seawater intrusion, with stated exceptions, including municipal wells and replacement wells. Currently, there are no updates on P&MA I3, and SVBGSA and MCWD will continue to collaborate and provide input to Monterey County as they finalize the proposed modifications to the well construction ordinance.
- I4 – Adopt 2022/2023 Priority Actions for Deep Aquifers in Absence of New Well Construction Ordinance if Conditions Threaten Sustainability in Near Term Priority management actions for the Deep Aquifers will be developed based on findings reported from the Deep Aquifers Study. Currently, there are no updates on P&MA I4.
- I5 – Seawater Intrusion Working Group (SWIG) The SWIG membership comprises nine agencies and municipalities and multiple stakeholders to develop consensus on the current understanding of seawater intrusion in the Subbasin and adjacent subbasins subject to seawater intrusion, identify data gaps, and develop a broad-based plan for controlling seawater intrusion. Additionally, the SWIG provides a platform for understanding Deep Aquifers issues that accompanies seawater intrusion in the coastal Subbasins. MCWD GSA and SVBGSA worked throughout WY2021 with the SWIG and SWIG Technical Advisory Committee (SWIG TAC). The SWIG aims to develop consensus on the science of seawater intrusion in the SVGB and ultimately develop a

comprehensive set of P&MAs that control seawater intrusion while providing cost-effective water supplies for the region. After creating working guidelines for themselves and understanding the landscape of current projects occurring to stop seawater intrusion, in WY 2021, the SWIG and SWIG TAC meetings focused on reviewing and better understanding additional projects that could stop seawater intrusion in the 180/400-Foot Aquifer Subbasin. The SWIG discussed and provided input on demand management approaches and reviewed the various project types, including specific project ideas and examples such as an extraction barrier and aquifer storage and recovery. The SWIG completed the development of a Request for Qualifications for the Deep Aquifer Study and recommended tasks for the Deep Aquifer Study.

- I6 – Future Modeling of Seawater Intrusion and Projects The model uses three-dimensional variable-density modeling code compatible with the U.S. Geological Survey modular finite-difference flow model (MODFLOW) modeling platform. Development of this model includes compiling all the concentration data available and mapping it to determine initial conditions and boundary conditions, calibrating to water levels and concentration (i.e., seawater intrusion), and developing predictive scenarios. In WY 2021, SVBGSA began the development of this Seawater Intrusion Model in the Monterey Subbasin through a Proposition 68 grant; however, most of the seawater-intruded area of the Valley is within the 180/400-Foot Aquifer Subbasin. SVBGSA and Monterey County decided to co-fund the expansion of the Model to cover the entire intruded or potentially intruded area within the SVGB to allow the modeling of regional projects to address seawater intrusion. This variable density USG-TRANSPORT model will provide a critical tool in assessing which P&MAs can adequately address seawater intrusion and assist with scoping them in the Monterey Subbasin and the greater SVGB.
- I7 – Well Registration Well registration is intended to establish a relatively accurate count of all the active wells in the Subbasin. This implementation action will help gain a better understanding of the wells in active use versus those decommissioned. P&MA I7 has not yet been initiated.
- I8 – GEMS Expansion and Enhancement The MCWRA GEMS collects groundwater extraction data from certain areas in the Salinas Valley. The system was enacted in 1993 under Ordinance 3663 and was later modified by Ordinances 3717 and 3718. The MCWRA provides the SVBGSA annual GEMS data that can be used for groundwater management. P&MA I8 has not yet been initiated. SVBGSA and MCWRA began discussions on P&MA I8. These early discussions on expanding and enhancing the GEMS program began with understanding the challenges and steps of changing the program.
- I9 – Dry Well Notification System The program could include a notification system whereby well owners can notify the GSAs or relevant partner agencies if their well goes dry, such as the Household Water Supply Shortage System. P&MA I9 has not yet been initiated.

- I10 – Water Quality Coordination Group The Water Quality Coordination Group will include the CCRWQCB, local agencies and organizations, water providers, domestic well owners, technical experts, and other stakeholders. The purpose of the Coordination Group is to coordinate amongst and between agencies that regulate water quality directly and the GSAs, which have an indirect role to monitor water quality and ensure their management does not cause undesirable water quality results. P&MA I10 has not yet been initiated.
- I11 – Land Use Jurisdiction Coordination Program The Land Use Jurisdiction Coordination Program outlines how the SVBGSA and MCWD GSA review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity. The goal is to ensure that GSAs and Land Use Jurisdiction efforts are aligned. P&MA I11 has not yet been initiated.
- I12 – Arsenic Implementation Action This implementation action provides additional analysis of the relationship between arsenic and groundwater conditions in the Corral de Tierra Area. P&MA I12 has not yet been initiated.

5.2 Sustainable Management Criteria

The Monterey Subbasin GSP includes descriptions of significant and unreasonable conditions, MTs, interim milestones, MOs, and undesirable results for DWR's six sustainability indicators. This section describes the Subbasin's progress towards achieving the first interim milestone (IM5) and avoiding undesirable results based on data presented in Section 4.

5.2.1 Chronic Lowering of Groundwater Levels

Table 5-2 compares Fall 2021 groundwater elevations to interim milestones set at RMS established for chronic lowering of groundwater levels in the Monterey Subbasin GSP. For SGMA monitoring purposes, fall measurements are those collected during the fourth quarter (i.e., October, November, and December) and correspond to the measurements used to define the Subbasin's SMCs.

The MT value for each well within the groundwater elevation monitoring network is provided in **Table** 5-2. Fall groundwater elevation data are color-coded on this table: orange cells indicate the groundwater elevation is below the MT, yellow cells indicate the groundwater elevation is above the MT but below the MO, and green cells indicate the groundwater elevation is above the MO.

Table 5-2. Groundwater Elevations and Relevant Sustainable Management Criteria for Chronic Lowering of Groundwater Levels Sustainability Criteria

Site Name	Aquifer	Collection Agency	Fall 2020	MT	MO	IM5
Marina-Ord Area						
MW-BW-28-A	Dune Sand Aquifer	Fort Ord	64.6	63.7	70.3	70.3
MW-BW-49-A	Dune Sand Aquifer	Fort Ord	11.3	8.9	11.3	11.3
MW-BW-81-A	Dune Sand Aquifer	Fort Ord	10.6	8.2	10	10
MW-BW-82-A	Dune Sand Aquifer	Fort Ord	9.9	7.9	9.5	9.5
MW-OU2-13-A	Dune Sand Aquifer	Fort Ord	89.0	89.6	94.4	94.4
MW-OU2-32-A	Dune Sand Aquifer	Fort Ord	8.0	7.2	8.1	8.1
MW-OU2-34-A	Dune Sand Aquifer	Fort Ord	6.9	4.7	6.6	6.6
CDM MW-1 Beach	Upper 180-Foot Aquifer (a)	Seaside Basin Watermaster	3.6	3.3	3.3	3.3
MW-02-05-180	Upper 180-Foot Aquifer (a)	Fort Ord	6.9	6.5	8.4	8.4
MW-02-10-180	Upper 180-Foot Aquifer (a)	Fort Ord	7.0	6.5	7.3	7.3
MW-02-13-180M	Upper 180-Foot Aquifer (a)	Fort Ord	7.0	6	6.8	6.8
MW-02-13-180U	Upper 180-Foot Aquifer (a)	Fort Ord	7.2	6.8	7.3	7.3
MW-12-07-180	Upper 180-Foot Aquifer (a)	Fort Ord	7.4	6.1	7	7
MW-B-05-180	Upper 180-Foot Aquifer (a)	Fort Ord	-2.0	-8	-3.4	-3.4
MW-BW-55-180	Upper 180-Foot Aquifer (a)	Fort Ord	-3.9	-6.4	-5.7	-5.7
MW-OU2-29-180	Upper 180-Foot Aquifer (a)	Fort Ord	-5.5	-9	-7.2	-7.2
MP-BW-42-295	Lower 180-Foot Aquifer (a)	Fort Ord	-6.7	-8.9	-8.1	-8.1
MW-12-12-180L	Lower 180-Foot Aquifer (a)	Fort Ord	3.5	3.3	3.8	3.8
MW-BW-04-180	Lower 180-Foot Aquifer (a)	Fort Ord	-7.1	-11	-11	-11.0
MW-OU2-66-180	Lower 180-Foot Aquifer (a)	Fort Ord	-6.9	-10	-9.2	-9.2
TEST2	Lower 180-Foot Aquifer (a)	Fort Ord	-8.5	-11.9	-10.6	-10.6
MP-BW-50-289	Lower 180-Foot, 400-Foot Aquifer (a)	Fort Ord	-7.8	-8.4	-7.1	-7.1
MPWMD#FO-10S	400-Foot Aquifer (a) (b)	Seaside Basin Watermaster	-13.1	-10.3	-3	-20.4
MPWMD#FO-11S	400-Foot Aquifer (a)	Seaside Basin Watermaster	-30.2	-25.9	-6.4	-44.4
MW-OU2-07-400	400-Foot Aquifer (a)	Fort Ord	-3.7	-6.6	-4.2	-4.2
014S001E24L002M	Deep Aquifers	USGS	-30.3	-29.6	-20.8	-34.9
014S001E24L003M	Deep Aquifers	USGS	-12.3	-6.8	3.5	-18.9

Site Name	Aquifer	Collection Agency	Fall 2020	MT	MO	IM5
014S001E24L004M	Deep Aquifers	USGS	-32.3	-34.7	-21.1	-41.6
014S001E24L005M	Deep Aquifers	USGS	-25.6	-26.6	-6	-39.7
14S02E33E01	Deep Aquifers	MCWRA	-53.7	-43.8	-29.3	-69.9
14S02E33E02	Deep Aquifers	MCWRA	-20.8	-21.1	-13.9	-22.6
PZ-FO-32-910	Deep Aquifers	MCWRA	-47.1	-44.1	-19.7	-65.6
MPWMD#FO-10D	Deep Aquifers (b)	Seaside Basin Watermaster	-12.9	-10.6	-3.8	-18.7
MPWMD#FO-11D	Deep Aquifers	Seaside Basin Watermaster	-12.2	-4.8	3.3	-15.7
Sentinel MW #1	Deep Aquifers (b)	Seaside Basin Watermaster	-26.8	-25.4	-18.8	-37.8
Corral de Tierra Area						
15S/02E-25C01	El Toro Primary Aquifer System	MCWRA	22.0	23	33	21
15S/03E-18P01	El Toro Primary Aquifer System	MCWRA	-50.4	-46.4	-28.4	-53
15S/03E-20R50	El Toro Primary Aquifer System	MCWRA	36.5	29	39	37
16S/02E-01M01	El Toro Primary Aquifer System	MCWRA	293.6	291.5	301.5	295.3
16S/02E-02G01	El Toro Primary Aquifer System	MCWRA	296.4	294.9	304.9	299.2
16S/02E-02H01	El Toro Primary Aquifer System	MCWRA	279.5	278.9	288.9	282
16S/02E-03A01	El Toro Primary Aquifer System	MCWRA	206.9	227	232	188
16S/02E-03F50	El Toro Primary Aquifer System	MCWRA	215.9	220.7	225.7	211
16S/02E-03H01	El Toro Primary Aquifer System	MCWRA	211.7	210.1	220.1	213.6
16S/02E-03H02	El Toro Primary Aquifer System	MCWRA	215.0	221.5	226.5	205
16S/02E-03J50	El Toro Primary Aquifer System	MCWRA	211.8	193.3	210.1	210.1
Robley Deep (South) (a)	El Toro Primary Aquifer System	Seaside Basin Watermaster	164.7	169.8	183.5	160.5
Robley Shallow (North) (a)	El Toro Primary Aquifer System	Seaside Basin Watermaster	237.6	245.2	255.2	230.7

Abbreviations:

IM5 = Interim milestone in 5 years after GSP Implementation

Notes:

(a) Wells MPWMD#FO-10S, MPWMD#FO-10D, and Sentinel MW#1 in the Marina Ord Area, and the Robley wells in the Corral de Tierra Area are monitored by MPWMD on behalf of the Seaside Watermaster. MPWMD#FO-10S and Robley Shallow (North) are known to be screened in the Paso Robles Aquifer, which is likely connected to the 400-Foot Aquifer; MPWMD#FO-10D, Sentinel MW#1, and Robley Deep (South) are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

(b) Only annual fall measurements are collected by MCWRA in the Corral de Tierra Area. SVBGSA is working with MCWRA to begin collecting groundwater elevation measurements biannually.

5.2.1.1 Minimum Thresholds

In the Monterey Subbasin, the MT was set to minimum groundwater elevations historically observed between 1995 and 2015 in the Marina-Ord Area and groundwater elevations observed in 2015 in the Corral de Tierra Area. In WY 2021, two wells in the 400-Foot Aquifer, nine wells in the Deep Aquifers, and 11 wells in the El Toro Primary Aquifer System exceeded their MTs, as indicated by the orange cells.

5.2.1.2 Measurable Objectives and Interim Milestones

The MOs for chronic lowering of groundwater levels represent target groundwater elevations higher than the MTs. These MOs provide operational flexibility to ensure that the Subbasin can be managed sustainably over a reasonable range of hydrologic variability. Four RMS wells in the Dune Sand Aquifer, six in the Upper 180-Foot Aquifer, four in the Lower 180-Foot Aquifer, one in the 400-Foot Aquifer, and one in the El Toro Primary Aquifer System had groundwater elevations higher than their MO in WY 2021, as represented by the green cells in Table 5-2**.** No RMS well in the Deep Aquifer had groundwater elevations higher than their MO.

To help reach MOs, the MCWD GSA and SVBGSA set interim milestones at 5-year intervals. The 2027 interim milestones (IM5) for groundwater elevations are also shown in Table 5-2. The WY 2021 groundwater elevations in 35 wells are already higher than the 2027 interim milestones[6].

5.2.1.3 Undesirable Result

The chronic lowering of groundwater levels undesirable result is a quantitative combination of groundwater elevation MT exceedances. For the Subbasin, the groundwater elevation undesirable result is:

Over the course of any one year, exceedance of more than 20% of the groundwater level MTs in either:

a) both the Dune Sand Aquifer and Upper 180-Foot Aquifer, or

b) both the Lower 180 Foot and 400 Foot aquifer, or

c) the Deep Aquifers, or

d) the El Toro Primary Aquifer System.

Marina-Ord Area

Dune Sand Aquifer and Upper 180-Foot Aquifer

[6] The interim milestones at the Deep Aquifers were lower than MT since most P/MAs will not be implemented by 2027, and the water levels at the Deep Aquifers were assumed to decrease until 2032.

- One RMS well exceeded its MT in the Dune Sand Aquifer, which represents 6% of the total RMS wells in the Dune Sand and upper 180-Foot Aquifers. Since the difference between the Fall 2020 measurement and MT at this well (MW-OU2-13-A) was within 1-foot, the exceedance was likely due to seasonal fluctuations and dryer climate conditions in 2021.

Lower 180-Foot and 400-Foot Aquifer

- Two wells out of nine RMS wells, or 22%, that screened the Lower 180-Foot and 400-Foot Aquifers exceeded their MTs.

Deep Aquifers

- Seven out of 10 RMS wells, or 69%, that screened the Deep Aquifers exceeded their MTs.

Corral de Tierra Area

- Seven out of 13 RMS wells, or 54%, in the El Toro Primary Aquifer exceeded their MTs.

The WY 2021 conditions in the lower 180-Foot and 400-Foot Aquifer, the Deep Aquifers, and the El Toro Primary Aquifer, as described above, would constitute an undesirable result in 2042 per the Subbasin GSP. Due to the conditions in the Marina-Ord Area and Corral de Tierra Area, SVBGSA will work to implement P&MAs to improve groundwater conditions.

5.2.2 Reduction in Groundwater Storage

The SMCs for chronic lowering of groundwater levels and seawater intrusion are proxies for the reduction in groundwater storage SMC. As discussed in Section 5.2.1 above, groundwater levels that would constitute an undesirable result in 2042 have been observed in WY 2021, and therefore, by definition, it would constitute an undesirable result in 2042 for reduction in groundwater storage.

5.2.3 Seawater Intrusion

Due to the absence of TDS and Cl measurements in WY 2021, an updated seawater intrusion extent could not be prepared for this annual report. The GSAs will conduct additional water quality sampling in WY 2022 and update the seawater intrusion map in the following annual report.

5.2.4 Water Quality

The MT values for each well within the groundwater quality monitoring network are provided in **Table** 5-3. **Table** 5-3 also shows the WY 2021 exceedances of the regulatory standard previously discussed in Section 4.5 and the running total of regulatory standard exceedances used to measure against the MTs. Only the latest sample for each COC at each well is used for the running total. The MTs are set at zero additional exceedances of each constituent, based on the

exceedances in 2019. These conditions were determined to be significant and unreasonable because groundwater quality in exceedance of these values will cause a financial burden on groundwater users. Public water systems with COC concentrations above the Maximum Contaminant Level (MCL) or Secondary Maximum Contaminant Level (SMCL) are required to add treatment to the drinking water supplies or drill new wells. Agricultural wells with COCs that significantly reduce crop production will reduce grower's yields and profits.

In WY 2021, there were two exceedances of the MTs established for DDW public water system supply wells and none for the ILRP on-farm domestic and irrigation wells in the Corral de Tierra Area. There are no exceedances of the MTs in the Marina-Ord Area. The last column in **Table** 5-3 includes the number of exceedances above the MTs, the COCs that exceeded the MT are highlighted in orange. The negative numbers in the last column indicate wells that once exceeded the regulatory limit are no longer exceeding the limit.

The degradation of groundwater quality undesirable result is a quantitative combination of groundwater quality MT exceedances. Any groundwater quality degradation as a direct result of GSP implementation is unacceptable. Some groundwater quality changes are expected to occur independent of SGMA activities; because these changes are not related to SGMA activities they do not constitute an undesirable result.

Table 5-3. Water Quality Exceedances in WY 2021

Constituent of Concern (COC)	Minimum Threshold/ Measurable Objective (existing exceedances of Regulatory Standard in 2019)	WY 2021 Exceedances of Regulatory Standard (new exceedances based on wells monitored in WY2021)	Total of Exceedances of Regulatory Standard	Number of Exceedances above Minimum Threshold
Marina-Ord Area				
DDW Wells				
Carbon Tetrachloride	0	0	0	0
Trichloroethane	0	0	0	0
Corral de Tierra Area				
DDW Wells				
1,2,3-Trichloropropane (1,2,3 TCP)	1	0	1	0
1,2-Dibromo-3-chloropropane	2	0	2	0
Arsenic	7	9	14	7
Benzo(a)pyrene	1	0	0	-1
Chromium	2	0	2	0
Dinoseb	3	0	2	-1
Hexachlorobenzene (HCB)	1	0		-1
Iron	13	4	15	2
Manganese	11	4	10	-1
Nickel	1	0	1	0
Specific Conductance	2	0	0	-2
Total Dissolved Solids	2	0	1	-1
Vinyl Chloride	3	0	3	0
Zinc	1	0	1	0
ILRP On-Farm Domestic Wells				
Total Dissolved Solids	1	0	1	0

Note: highlighted cells indicate the exceedance of MT.

5.2.5 Land Subsidence

Accounting for measurement errors in the InSAR data, the MT for land subsidence in the GSP is zero net long-term subsidence, with no more than 0.1 foot per year of estimated land movement to account for InSAR errors. Because the MTs of zero net long-term subsidence are the best achievable outcome, the MOs and interim milestones are identical to the MTs. The land subsidence undesirable result for the Subbasin is defined as zero exceedances of the MTs for subsidence in any one year.

Annual subsidence data from October 2020 to October 2021 demonstrated land subsidence of less than 0.1 feet/year, as shown on Figure 18. Therefore, the land subsidence interim milestone and MO are being met, and the Subbasin has not experienced a land subsidence undesirable result.

5.2.6 Interconnected Surface Water

Groundwater elevation is used as a proxy in ISW RMS wells to monitor the potential depletion of ISW and the health of Groundwater dependent ecosystems (GDEs) located near the City of Marina. As shown in Section 4.7 and Table 4-6, groundwater elevation in Fall 2017 was above the MT and MO set at the ISW RMS monitoring well. Once SVBGSA installs the shallow monitoring well along Toro Creek, SVBGSA will use it to monitor ISW in the Corral de Tierra Area.

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