Groundwater Sustainability Plan

Monterey Subbasin

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

DRAFT Chapter 7

Monitoring Networks

September 2021

List of Tables

List of Figures

List of Appendices

7 MONITORING NETWORKS

This chapter describes the monitoring networks that will be used to assess sustainable management criteria (SMCs) explained further in Chapter 8. This description of monitoring networks has been prepared in accordance with the GSP Regulations §354.32 to include monitoring objectives, monitoring protocols, and data reporting requirements.

7.1 Introduction

7.1.1 Monitoring Network Objectives

SGMA requires monitoring networks to collect data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the Subbasin, and to evaluate changing conditions that occur as the Plan is implemented. The monitoring networks are intended to:

- Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds;
- Demonstrate progress toward achieving measurable objectives;
- Monitor impacts to the beneficial uses or users of groundwater; and
- Quantify annual changes in water budget components.

7.1.2 Approach to Monitoring Networks

Monitoring networks are developed for each of the six sustainability indicators that are relevant to the Subbasin:

- Chronic lowering of groundwater levels
- Reduction in groundwater storage
- Seawater intrusion
- Degraded water quality
- Land subsidence
- Depletion of interconnected surface water

In accordance with GSP Regulations, the monitoring networks are primarily based on existing monitoring sites. Representative Monitoring Sites (RMS) are a subset of the monitoring network and are focused on monitoring changes in groundwater conditions relative to Undesirable Results described further in Chapter 8. These are also limited to sites with data that are publicly available and not confidential.

MCWD GSA and SVBGSA established the density of monitoring sites and the frequency of measurements to demonstrate short-term, seasonal, and long-term trends. If the monitoring site density is determined to be inadequate, MCWD GSA and SVBGSA will expand monitoring networks as needed during GSP implementation. Filling data gaps and developing more extensive

and complete monitoring networks will improve MCWD GSA and SVBGSA's ability to demonstrate sustainability and refine the existing conceptual and numerical hydrogeologic models. Chapter 10 provides a plan and schedule for resolving data gaps. MCWD GSA and SVBGSA will review the monitoring network in each five-year assessment. This review will include an evaluation of uncertainty and assess remaining data gaps that could affect the ability of the GSP to achieve the sustainability goal for the Subbasin.

7.1.3 Management Areas

If management areas are established, SGMA regulations require that the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the Subbasin setting and sustainable management criteria specific to that area.

As introduced in Section 1.4, this GSP establishes two Management Areas within the Subbasin including the Marina-Ord Area and the Corral de Tierra Area. These Management Areas have been developed to facilitate GSP implementation in these areas. As such, an adequate number of representative monitoring sites for each sustainability indicator have been identified for each Management Area. In Chapter 8, a basin-wide approach is taken for establishing Undesirable Results, however; where the drivers of Undesirable Results are different between Management Areas, SMCs are developed separately for each Management Area. Therefore, Management Area-specific monitoring networks are identified in this Chapter.

7.2 Representative Monitoring Sites

Representative monitoring sites (RMS) are defined in the regulations as a subset of monitoring sites that are representative of conditions in the Subbasin and will be used to establish Sustainable Management Criteria (SMCs). The sections below discuss the existing monitoring sites in the Subbasin as well as the RMS networks for each sustainability indicator. The monitoring networks for chronic lowering of groundwater levels and seawater intrusion will be used as a proxy to monitor reduction in groundwater storage, as described in Chapter 8.

7.3 Groundwater Elevation Monitoring Network

The sustainability indicator for chronic lowering of groundwater levels is evaluated by monitoring groundwater elevations in designated monitoring wells. The regulations require a network of monitoring wells sufficient to demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features.

Management Area-specific groundwater elevation monitoring networks are identified for monitoring of chronic lowering of groundwater levels within the Subbasin. The groundwater elevation monitoring network comprises over 390 wells monitored by U.S. Army, MCWRA, or MPMWD in the Marina-Ord Area; and 18 wells monitored by MCWRA in the Corral de Tierra Area. Of these wells that are actively monitored by a local agency, 35 are selected as groundwater elevation RMS wells in the Marina-Ord Area and 13 are selected as groundwater elevation RMS wells in the Corral de Tierra Area. Figure 7-1 through Figure 7-6 show the locations of the

groundwater elevation monitoring network and wells selected for the RMS network 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 Chapters 4 and 5, the 180-Foot Aquifer is separated into a "upper" and a "lower" portion by a thin 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 is selected to additionally distinguish the upper 180-Foot Aquifer and the lower 180-Foot Aquifer. Known seawater intrusion conditions in the lower 180-Foot and 400-Foot Aquifers are included on Figure 7-7 to demonstrate the selected groundwater elevation and seawater intrusion RMS Network.

The RMS wells within each Management Area have been selected to facilitate monitoring of significant and unreasonable groundwater conditions identified in Chapter 8. The groundwater elevation RMS network in the Marina-Ord area has been coordinated with the seawater intrusion RMS network (Section 7.5). Groundwater elevation data will be utilized in conjunction with salinity data from these wells to monitor potential expansion of the seawater intrusion front. Criteria for selecting wells as part of the RMS network include:

- RMS wells should facilitate monitoring of groundwater elevations within each principal aquifer;
- RMS wells should cover areas of the basin where beneficial uses of groundwater are occurring (e.g., groundwater extraction, groundwater dependent ecosystems, etc.);
- RMS wells should facilitate monitoring along the existing seawater intrusion front to verify that water levels in these areas are not declining and increasing the risk of seawater intrusion.
- RMS wells that could be included in both the groundwater elevation and seawater intrusion RMS Networks are preferred;
- RMS wells should be located on public parcels or on properties where access agreements have been negotiated;
- RMS wells must have known depths and well completion data;
- RMS wells should have relatively long periods of historical data (i.e., greater than 10 years and/or 50 water level measurements) and exhibit high-quality groundwater elevation data;
- RMS well hydrographs should be visually representative of the hydrographs from surrounding wells; and
- RMS wells should not be influenced by nearby infiltration, groundwater pumping, or groundwater remediation activities at Fort Ord.

Data from RMS wells will be considered public and will be used for groundwater elevation maps and analyses unless the owner of the RMS well opts out through correspondence with MCWD GSA or SVBGSA.[1]

Visual inspection of the geographic distribution of the well network indicates there are no wells in the south-eastern portion of Marina-Ord Area (i.e., the Fort Ord hills). However, no monitoring of groundwater levels is needed in this area because:

- It is undeveloped and overseen by the Bureau of Land Management (BLM) and has no current or likely future groundwater use or extraction.
- It is far from the ocean and therefore not subject to seawater intrusion.
- It is part of the Federal land area not subject to SGMA.

The RMS wells included in the groundwater level monitoring network are listed by Management Area in Table 7-1. The need for any additional wells is discussed in Section 7.3.2. Appendix 8A presents well construction information and historical hydrographs for each RMS well.

[1] If an owner opts out of public data reporting, another well will be identified for RMS monitoring.

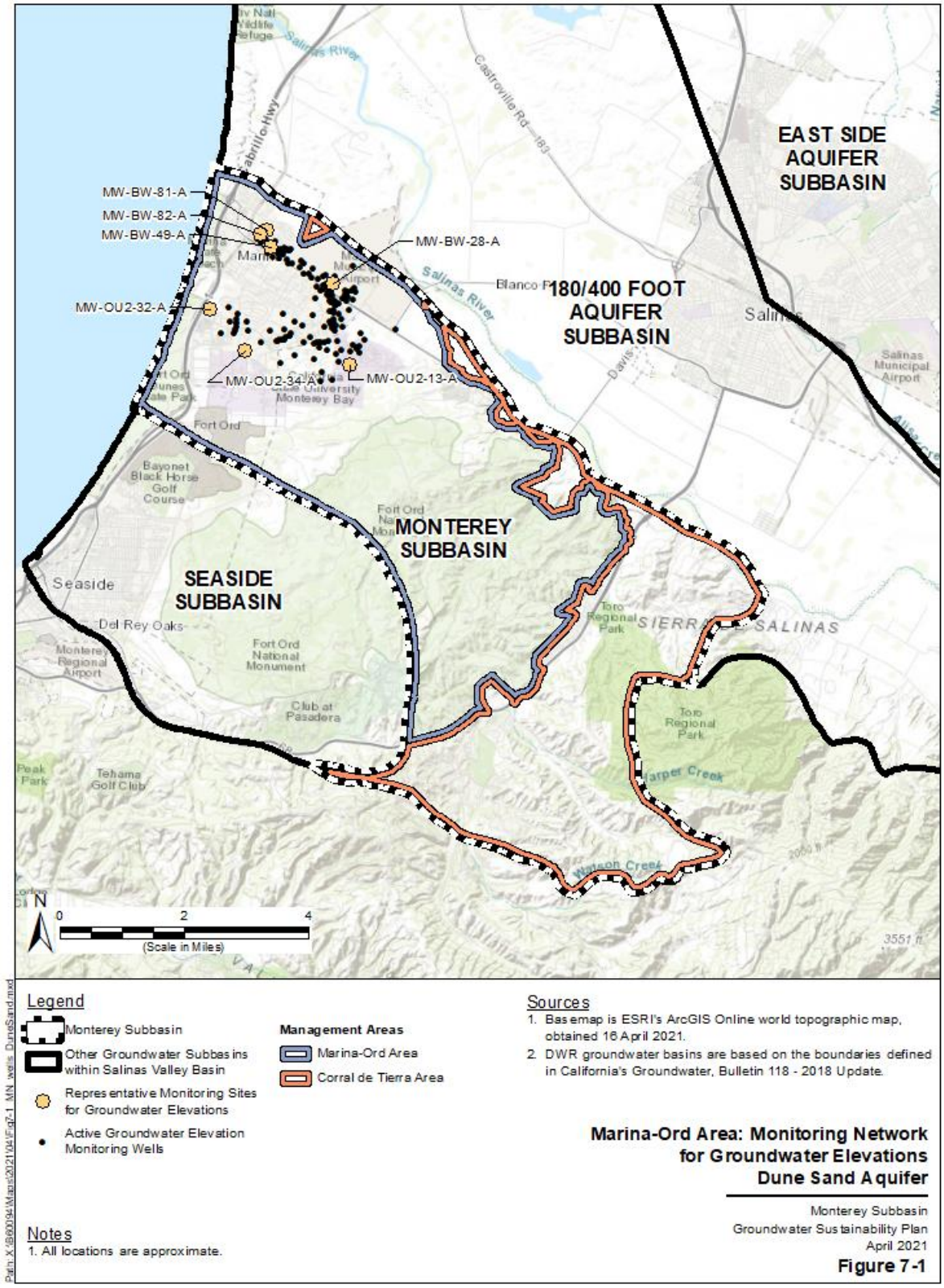


Figure 7-1. Marina-Ord Area: Monitoring Network for Groundwater Elevations, Dune Sand Aquifer

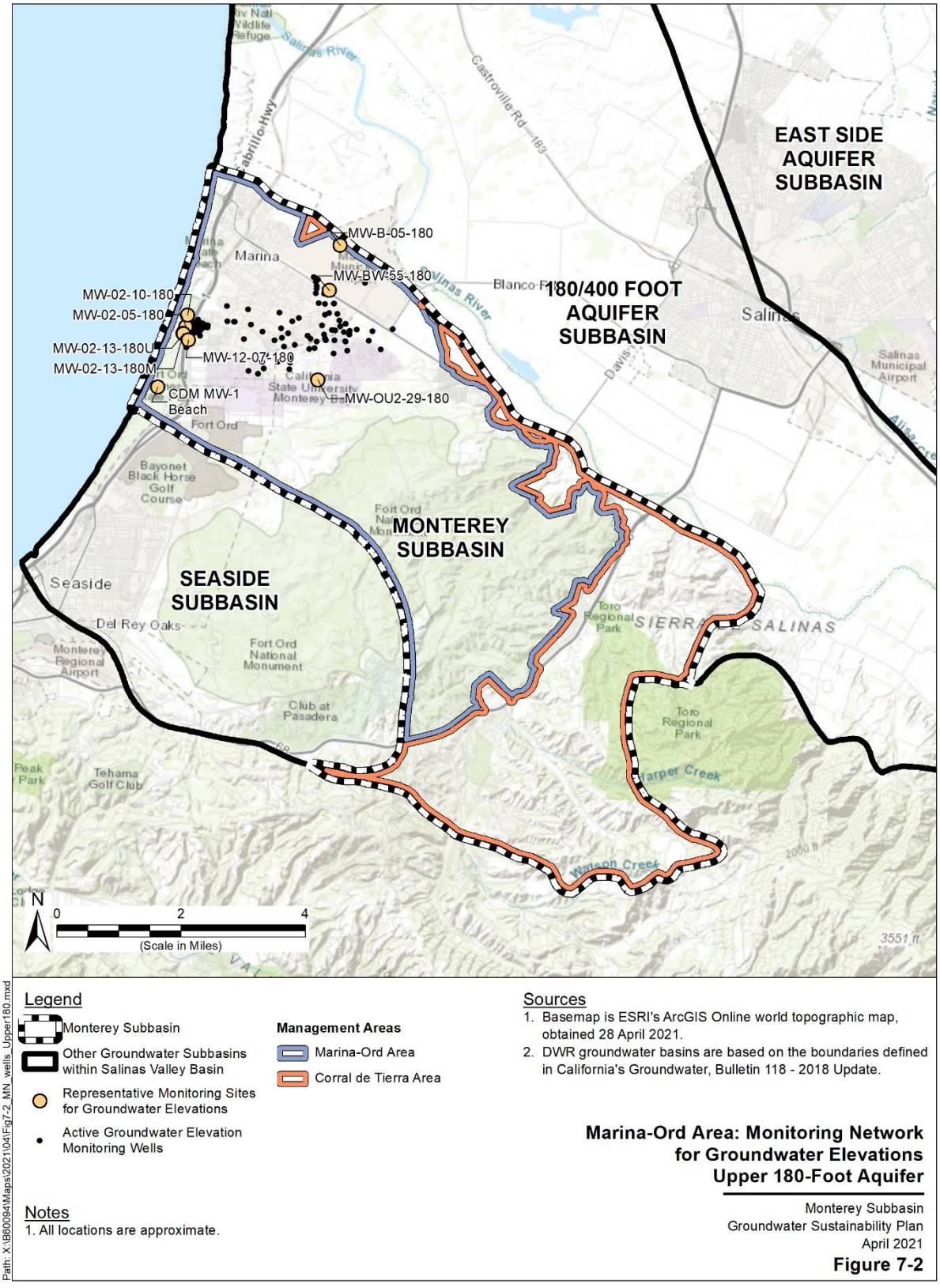


Figure 7-2. Marina-Ord Area: Monitoring Network for Groundwater Elevations, Upper 180-Foot Aquifer

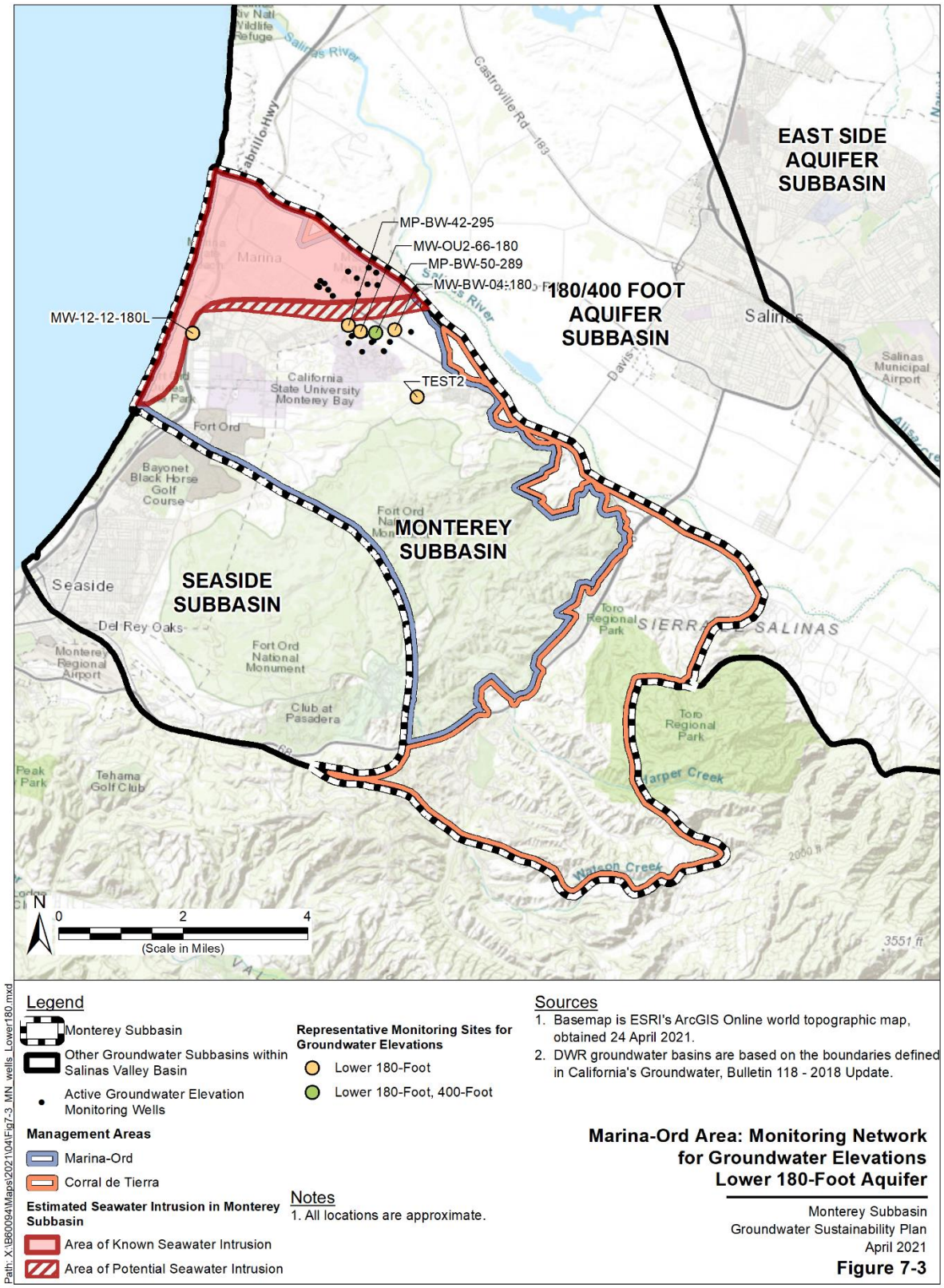


Figure 7-3. Marina-Ord Area: Monitoring Network for Groundwater Elevations, Lower 180-Foot Aquifer

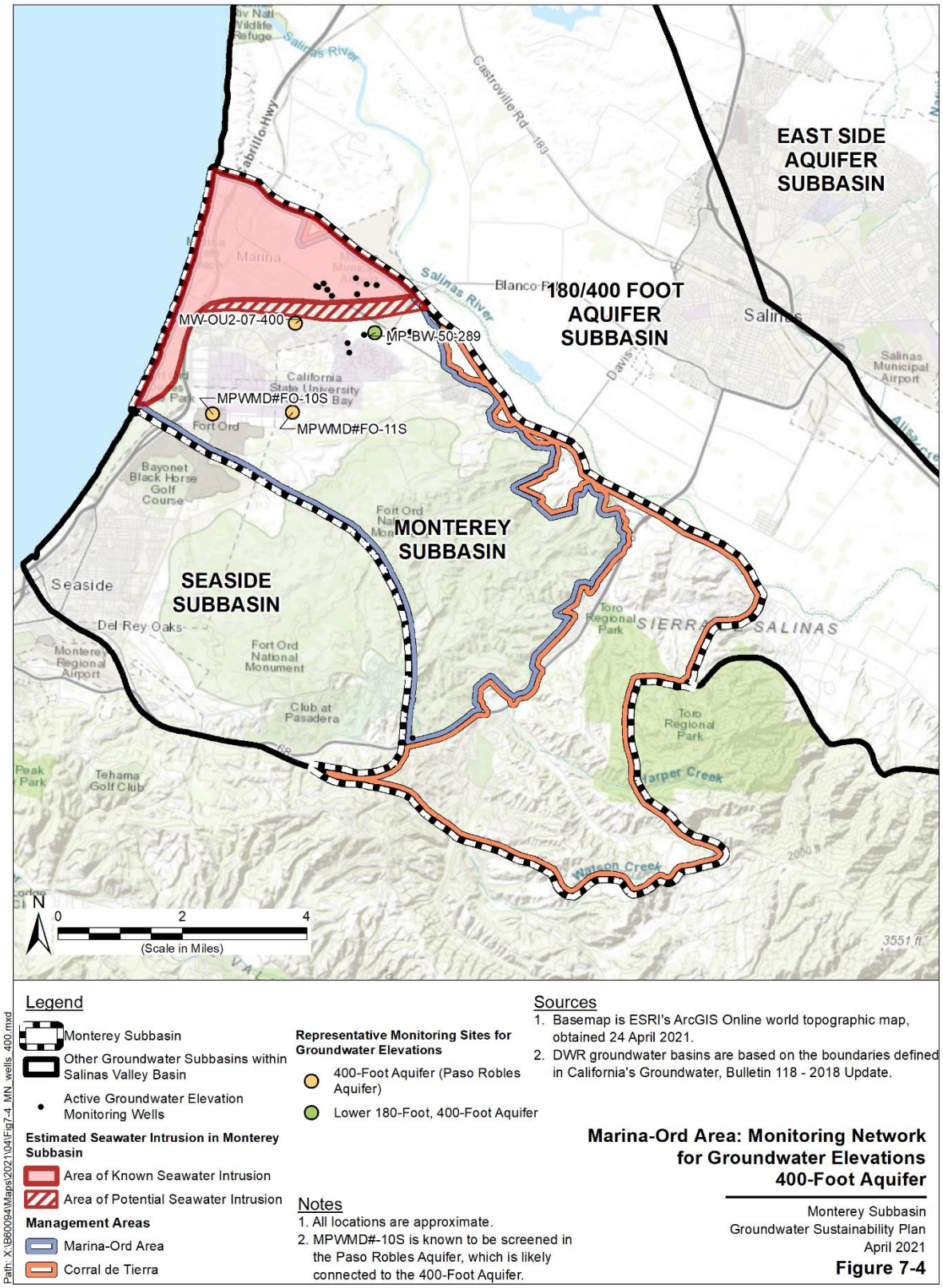


Figure 7-4. Marina-Ord Area: Monitoring Network for Groundwater Elevations, 400-Foot Aquifer

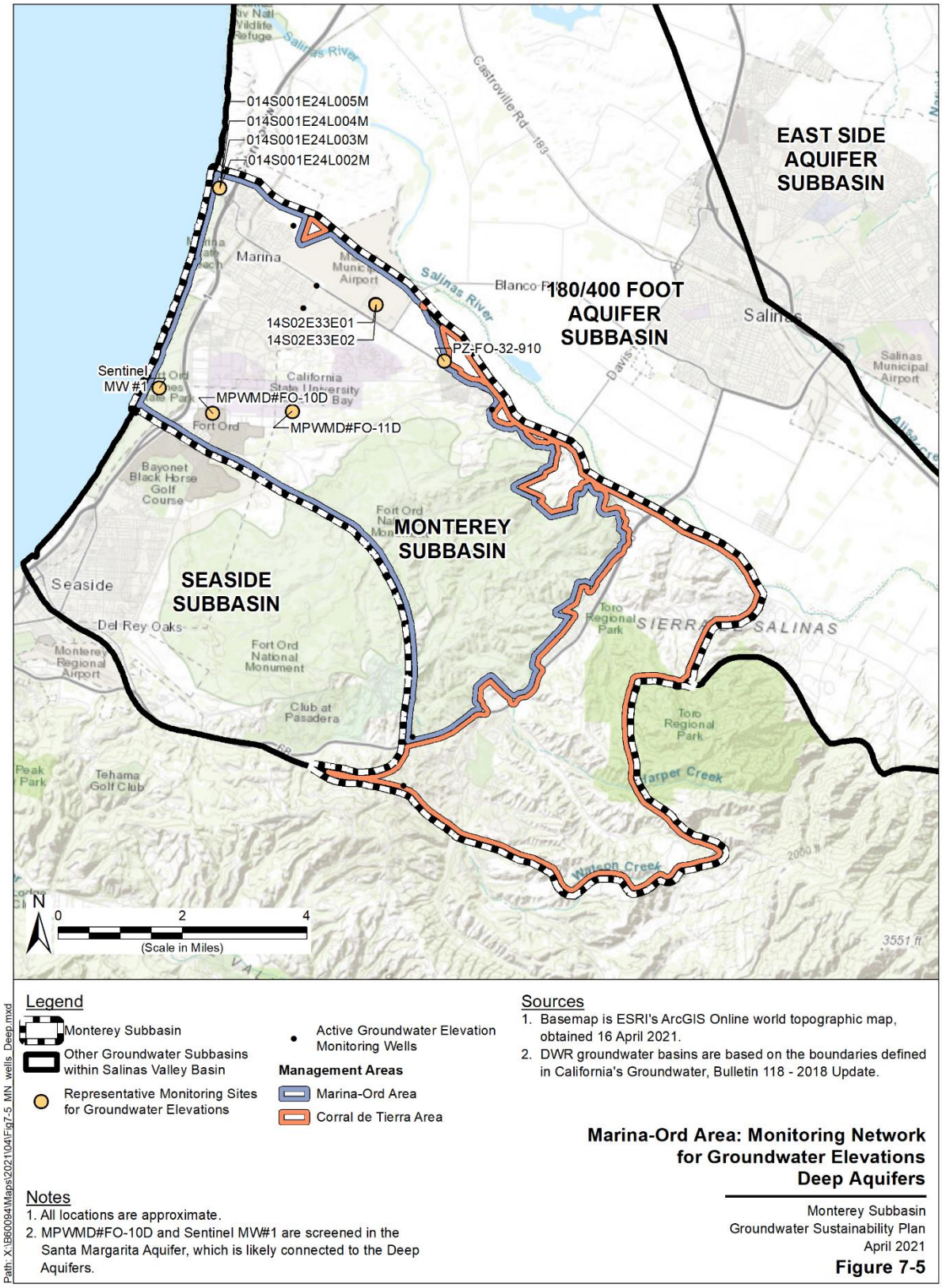


Figure 7-5. Marina-Ord Area: Monitoring Network for Groundwater Elevations, Deep Aquifers

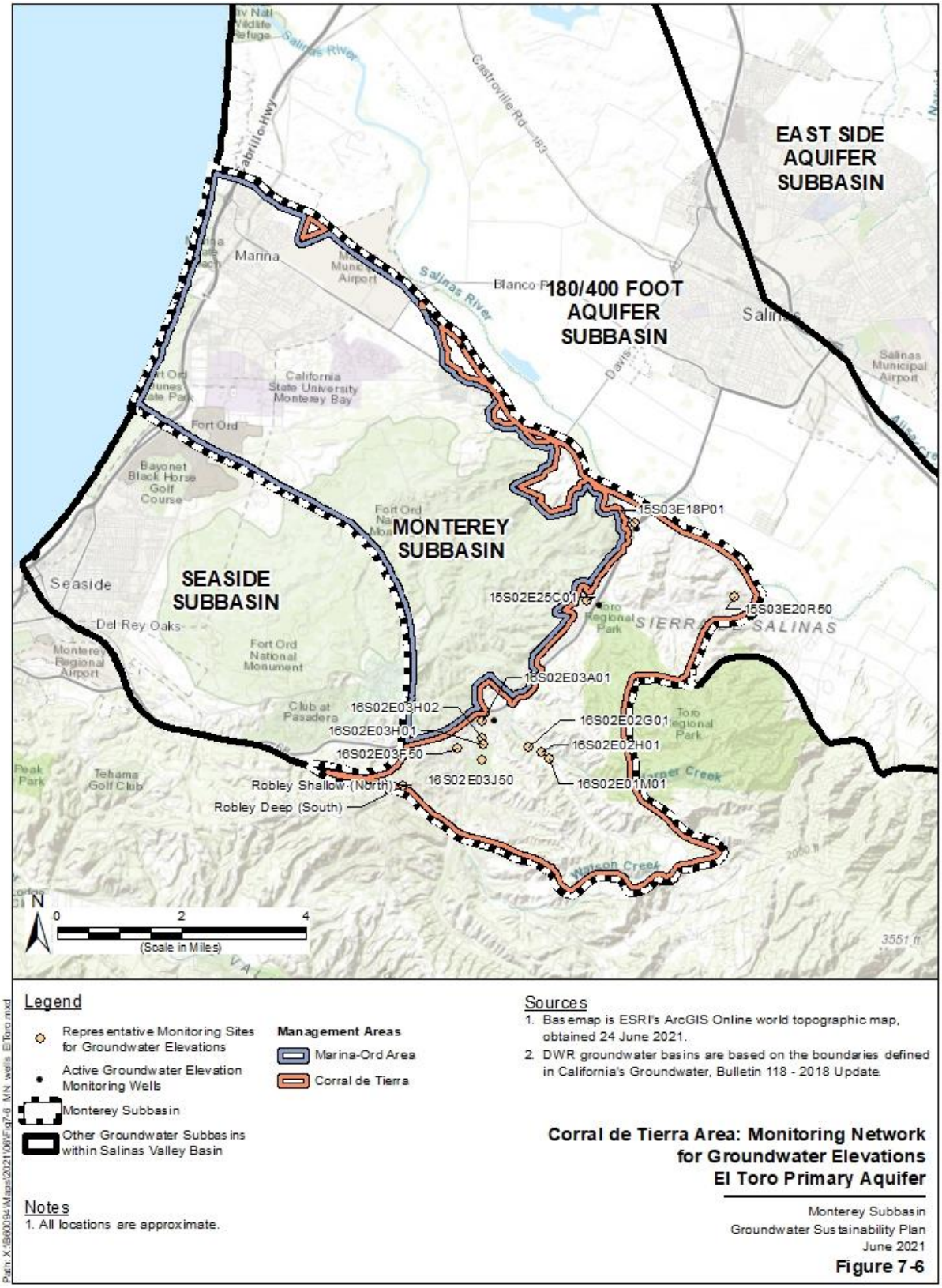


Figure 7-6. Corral de Tierra Area: Monitoring Network for Groundwater Elevations

Table 7-1. Monterey Subbasin Groundwater Elevation Representative Monitoring Sites

Site Name	Aquifer	CASGEM Well Number (c)	Local Well Designation	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)	Period of WL Record (years)
Marina/Ord Area								
MW-BW-28-A	Dune Sand Aquifer	--	--	Monitoring	104	36.6775	-121.7744	19
MW-BW-49-A	Dune Sand Aquifer	--	--	Monitoring	62	36.6854	-121.7928	18
MW-BW-81-A	Dune Sand Aquifer	--	--	Monitoring	82	36.6893	-121.7942	12
MW-BW-82-A	Dune Sand Aquifer	--	--	Monitoring	74	36.6886	-121.7961	12
MW-OU2-13-A	Dune Sand Aquifer	--	--	Monitoring	146	36.6584	-121.7689	32
MW-OU2-32-A	Dune Sand Aquifer	--	--	Monitoring	140	36.6705	-121.8098	27
MW-OU2-34-A	Dune Sand Aquifer	--	--	Monitoring	166	36.6613	-121.7993	27
CDM MW-1 Beach	Upper 180-Foot Aquifer (a)	366521N1218236W001	MW-1 Beach	Monitoring	140	36.6521	-121.8236	13
MW-02-05-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	69	36.6664	-121.8159	27
MW-02-10-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	64	36.6691	-121.8155	25
MW-02-13-180M	Upper 180-Foot Aquifer (a)	--	--	Monitoring	137	36.6648	-121.8167	21
MW-02-13-180U	Upper 180-Foot Aquifer (a)	--	--	Monitoring	78	36.6648	-121.8166	21
MW-12-07-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	96	36.6633	-121.8152	25
MW-B-05-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	210	36.6865	-121.7719	27
MW-BW-55-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	202	36.6758	-121.7747	16
MW-OU2-29-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	286	36.6548	-121.7772	27
MP-BW-42-295	Lower 180-Foot Aquifer (a)	--	--	Monitoring	467	36.6682	-121.7695	16
MW-12-12-180L	Lower 180-Foot Aquifer (a)	--	--	Monitoring	179	36.6652	-121.8146	21
MW-BW-04-180	Lower 180-Foot Aquifer (a)	--	--	Monitoring	364	36.6674	-121.7560	20

Site Name	Aquifer	CASGEM Well Number (c)	Local Well Designation	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)	Period of WL Record (years)
MW-OU2-66-180	Lower 180-Foot Aquifer (a)	--	--	Monitoring	339	36.6667	-121.7661	20
TEST2	Lower 180-Foot Aquifer (a)	--	--	Monitoring	425	36.6519	-121.7490	18
MP-BW-50-289	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	8
MPWMD#FO-10S	400-Foot Aquifer (a) (b)	366466N1218 079W001	Fort Ord 10 - Shallow	Monitoring	650	36.6466	-121.8079	22
MPWMD#FO-11S	400-Foot Aquifer (a)	366474N1217 847W002	FO-11-Shallow	Monitoring	740	36.6474	-121.7847	22
MW-OU2-07-400	400-Foot Aquifer (a)	--	--	Monitoring	580	36.6683	-121.7847	32
014S001E24L002M	Deep Aquifers	--	USGS DMW1--1	Monitoring	1880	36.6993	-121.8077	22
014S001E24L003M	Deep Aquifers	--	USGS DMW1--2	Monitoring	1430	36.6993	-121.8077	22
014S001E24L004M	Deep Aquifers	--	USGS DMW1--3	Monitoring	1080	36.6993	-121.8077	22
014S001E24L005M	Deep Aquifers	--	USGS DMW1--4	Monitoring	970	36.6993	-121.8077	22
14S02E33E01	Deep Aquifers	--	Airport Well 2'' Shallow	Monitoring	1095	36.6730	-121.7615	17
14S02E33E02	Deep Aquifers	--	Airport Well 3" DEEP	Monitoring	1760	36.6730	-121.7614	17
PZ-FO-32-910	Deep Aquifers	--	MCWRA_21356	Monitoring	910	36.6604	-121.7413	13
MPWMD#FO-10D	Deep Aquifers (b)	366466N1218 079W002	MPWMD #FO-10-Deep	Monitoring	1420	36.6466	-121.8079	22
MPWMD#FO-11D	Deep Aquifers	366474N1217 847W001	FO-11-Deep	Monitoring	1130	36.6474	-121.7847	22
Sentinel MW #1	Deep Aquifers (b)	366521N1218 236W002	SGB--MW #1	Monitoring	1500	36.6521	-121.8236	13
Corral de Tierra Area								
16S/02E-01M01	El Toro Primary Aquifer System	365680N1217 073W001	16797	Residential	294	36.5680	-121.7072	58
16S/02E-02G01	El Toro Primary Aquifer System	365705N1217 134W001	16820	Residential	440	36.5704	-121.7132	58
Robley Deep (South)	El Toro Primary Aquifer System	365608N1217 494W001	Robley Deep (South)	Monitoring	Confidential	36.5608	-121.7494	30
Robley Shallow (North)	El Toro Primary Aquifer System	365608N1217 494W002	Robley Shallow (North)	Monitoring	Confidential	36.5608	-121.7494	30
15S/02E-25C01	El Toro Primary	--	1840	Residential	680	36.6053	-121.6974	14

Site Name	Aquifer	CASGEM Well Number (c)	Local Well Designation	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)	Period of WL Record (years)
	Aquifer System							
15S/03E-18P01	El Toro Primary Aquifer System	--	1804	Monitoring	810	36.6235	-121.6845	14
16S/02E-02H01	El Toro Primary Aquifer System	--	16823	Residential	204	36.5696	-121.7094	56
16S/02E-03H02	El Toro Primary Aquifer System	--	20813	Irrigation	920	36.5724	-121.7267	14
15S/03E-20R50	El Toro Primary Aquifer System	--	22683	Public Supply	680	36.6070	-121.6548	10
16S/02E-03A01	El Toro Primary Aquifer System	--	16842	Irrigation	134	36.5763	-121.7271	58
16S/02E-03F50	El Toro Primary Aquifer System	--	21073	Residential	510	36.5700	-121.7339	21
16S/02E-03H01	El Toro Primary Aquifer System	--	16877	Irrigation	948	36.5710	-121.7264	55
16S/02E-03J50	El Toro Primary Aquifer System	--	16862	Irrigation	810	36.5672	-121.7266	14

Notes:

(a) The RMS network is selected to additionally 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 known to be 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.

(c) CASGEM well numbers are provided for existing CASGEM wells. It is the GSAs' understanding that the SGMA monitoring program will supersede the CASGEM program once the GSP is adopted and SGMA monitoring is in effect.

7.3.1 Groundwater Elevation Monitoring Protocols

Groundwater elevation measurements will be collected pursuant to the protocols identified in the following documents. These monitoring plans are included in Appendices 7A through 7C.

- Chapter 4 of the MCWRA CASGEM monitoring plan includes a description of existing MCWRA CASGEM groundwater elevation monitoring procedures (MCWRA, 2015b). Groundwater elevation measurements will be collected at least two times per year to represent seasonal low and seasonal high groundwater conditions. The monitoring protocols described in Appendix 7A cover multiple monitoring methods for collecting data by hand and by automated pressure transducers.
- MPWMD CASGEM monitoring plan (Appendix 7B) describes groundwater elevation monitoring procedures implemented by MPWMD (MPMWD, 2012). Groundwater elevation measurements will be collected twice a year, once at the end of September and once at the end of March. Groundwater elevation measurements will be taken by electric measuring tape to the nearest hundredth of a foot.
- Appendix A of the Quality Assurance Project Plan (QAPP; Appendix 7C) for the former Fort Ord includes a description of groundwater monitoring procedures at the former Fort Ord (U.S. Army, 2019). Groundwater elevation measurements will be collected at least semi-annually, subject to future monitoring program revisions, and in accordance with applicable Standard Operating Procedures covered in the QAPP.

These protocols are consistent with data and reporting standards described in GSP Emergency Regulations §352.4.

7.3.2 Groundwater Elevation Monitoring Network Data Gaps

Based on the SGMA regulations and the BMPs published by DWR on monitoring networks (DWR, 2016b), a visual analysis of the existing monitoring network was performed. This analysis was conducted using professional judgment to evaluate whether there are data gaps in the groundwater elevation monitoring network based upon potential significant and unreasonable conditions within the Subbasin.

While there is no definitive requirement on monitoring well density, the BMP cites several studies (Heath, 1976; Sophocleous, 1983; Hopkins, 1984) that recommend 0.2 to 10 wells per 100 square miles. The BMP notes that professional judgment should be used to design the monitoring network to account for high-pumping areas, proposed projects, and other subbasin-specific factors.

The Monterey Subbasin encompasses a total of 48.2 square miles. The Marina-Ord Area covers approximately 30.2 square miles and the Corral de Tierra Area covers approximately 18.0 square miles. If BMP guidance recommendations are applied to each of the areas, the well network should include between 1 and 3 wells in the Marina-Ord Area and between one and two wells in the Corral de Tierra Area. The current RMS network includes 35 wells in the Marina-Ord Area (2 to 6 wells per principal aquifer) and 13 wells in the Corral de Tierra Area. In addition, the monitoring network includes over 390 wells in the Marina-Ord Area and 17 wells in the Corral de Tierra Area that are regularly monitored by local agencies. Data from wells in the monitoring network will be used by the GSAs to assess groundwater conditions and inform SGMA implementation. The number of groundwater elevation monitoring wells in Monterey Subbasin therefore exceed the number recommended in BMP guidance.

As discussed above, although no wells exist in the south-eastern portion of Marina-Ord Area (i.e., the Fort Ord hills), no monitoring of groundwater levels is needed in this area because it is part of a Federal land area and has no current and future planned groundwater extraction. However, additional wells are necessary to provide additional groundwater elevation data near the ocean in areas subject to sea water intrusion.

For the Corral de Tierra Area, visual inspection of the geographic distribution of the well network indicates that additional wells are necessary to adequately monitor groundwater levels and characterize the Area. A higher density of monitoring wells is recommended near residential areas or other locations where groundwater withdrawal is significant.

The generalized locations for proposed new monitoring wells was based on addressing the criteria listed in the monitoring BMP including:

- Providing adequate data to produce seasonal potentiometric maps;
- Providing adequate data to map groundwater depressions and recharge areas;
- Providing adequate data to estimate change in groundwater storage; and
- Demonstrating conditions at Subbasin boundaries.

Figure 7-7 through Figure 7-9 show the locations of existing groundwater elevation monitoring wells and the generalized locations where additional monitoring wells are needed in the Monterey Subbasin. These areas include:

- Within the Lower 180-Foot, 400-Foot Aquifer in the Marina-Ord Area to address a lack of coverage near the central coastline;
- Within the Deep Aquifers in the Marina-Ord Area to address a lack of coverage near the central coastline; and
- Within the El Toro Primary Aquifer in the Corral de Tierra area to address lack of coverage near areas with substantial groundwater withdrawal

In the Marina-Ord Area, additional wells are also needed in the identified areas to augment the seawater intrusion monitoring network as discussed in Section 7.5.2. The data gap areas shown on Figure 7-7 through Figure 7-9 will be addressed during GSP implementation by either identifying an existing well in each area that meets the criteria for a valid monitoring well, or drilling a new well in each area, as further described in Chapter 10.

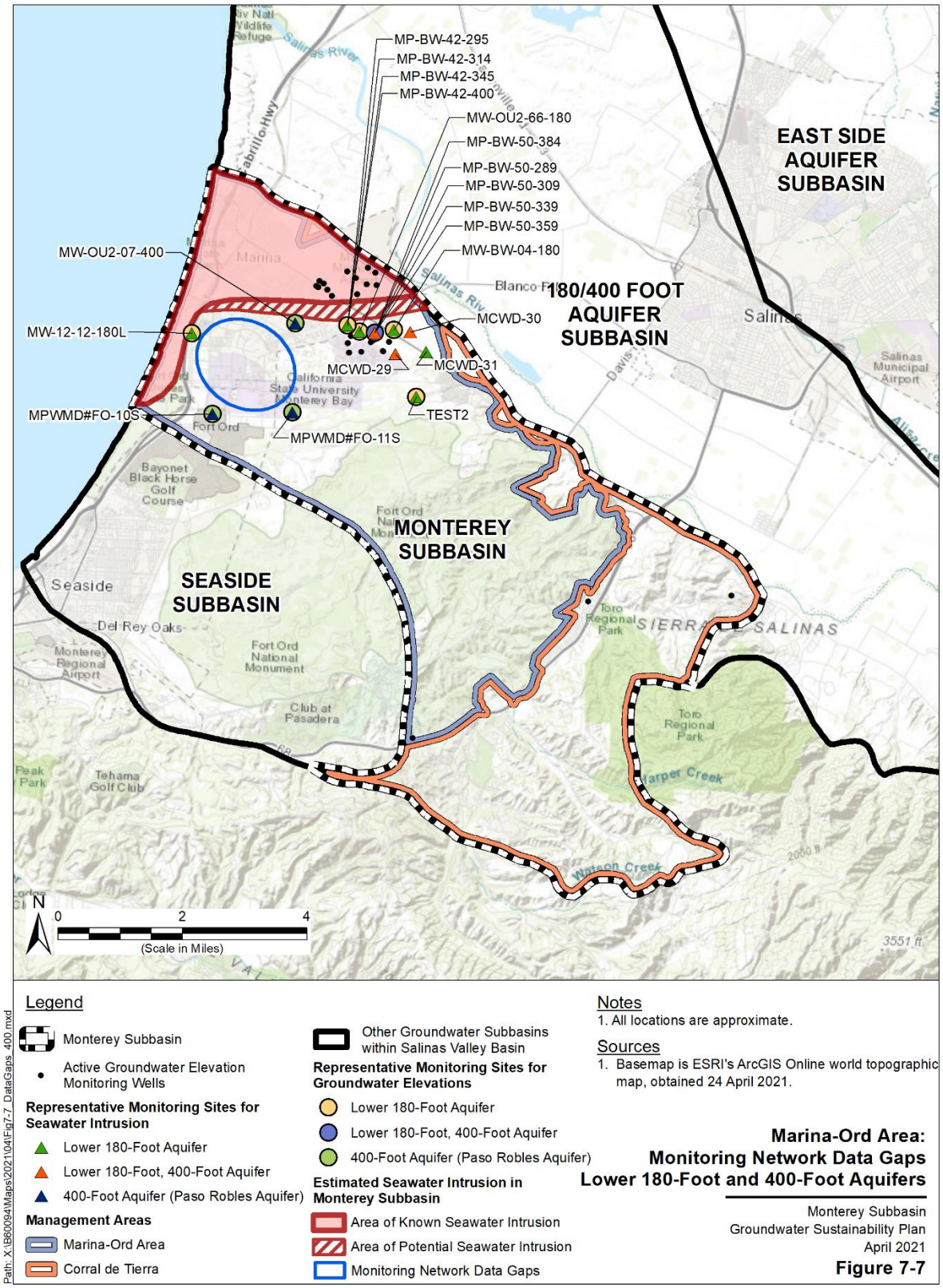


Figure 7-7. Marina-Ord Area: Monitoring Network Data Gaps, Lower 180-Foot and 400-Foot Aquifers

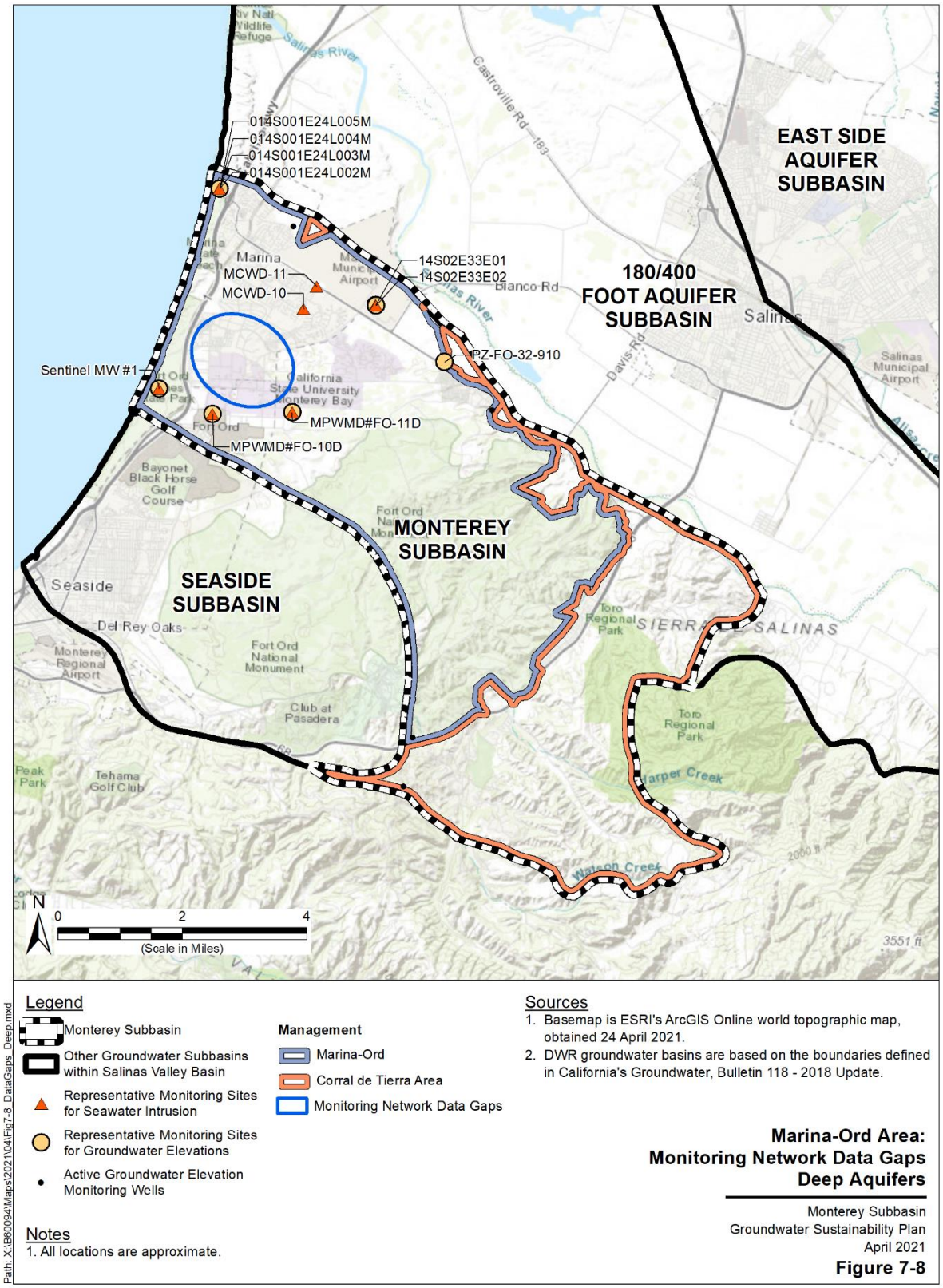


Figure 7-8. Marina-Ord Area: Monitoring Network Data Gaps, Deep Aquifers

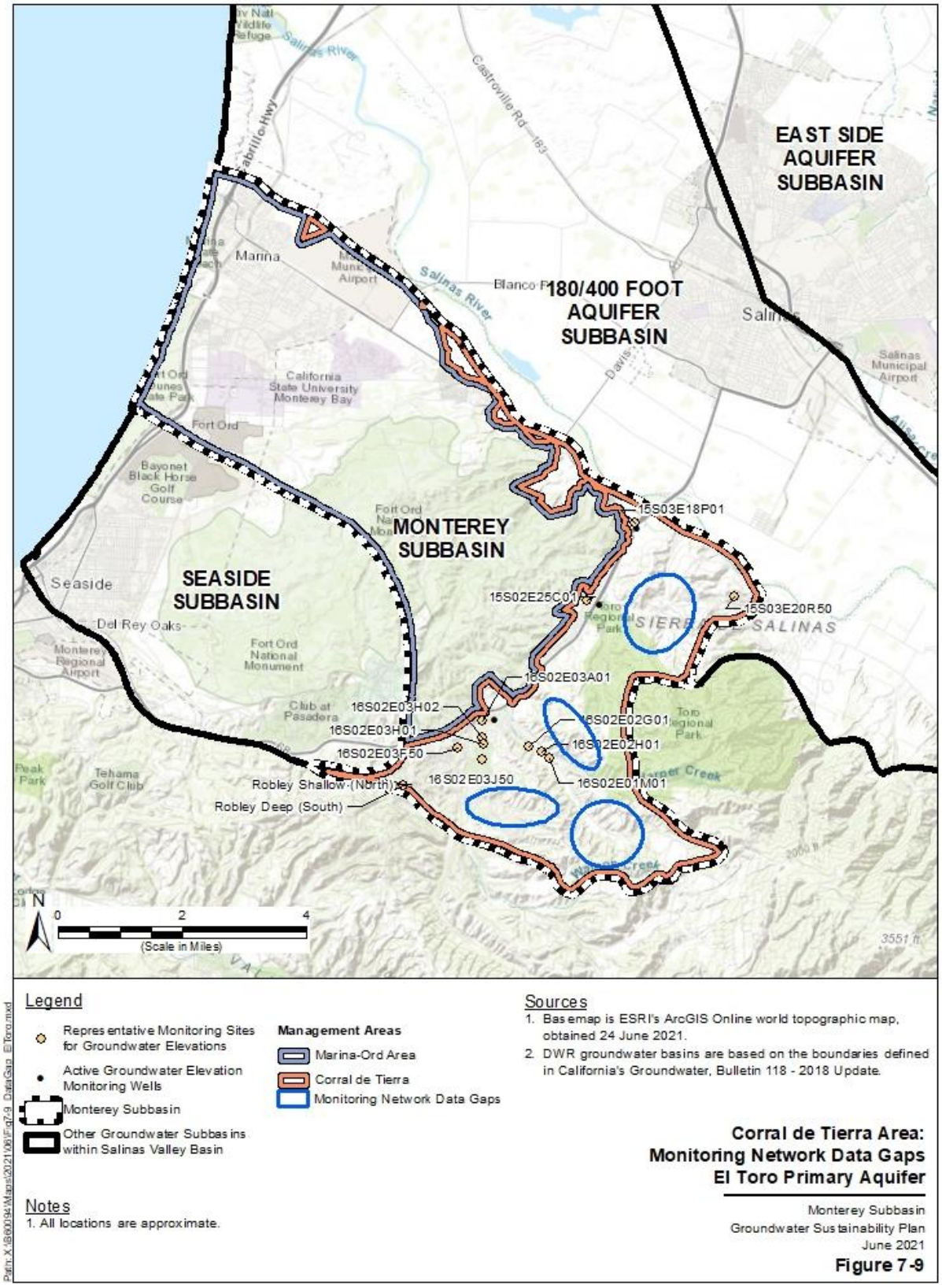


Figure 7-9. Corral de Tierra Area: Monitoring Network Data Gaps, El Toro Primary Aquifer

7.3.3 Protective Groundwater Gradient Monitoring

As discussed in Section 5.3.4, the hydraulic gradient and groundwater flow direction within the seawater intruded lower 180-Foot, 400-Foot Aquifer in the Marina-Ord Area is parallel to the current seawater intrusion front. It appears that, under the current hydraulic gradient and groundwater flow direction, there is minimal migration of seawater intrusion to inland areas of the Monterey Subbasin and that the lateral extent of seawater intrusion within the Subbasin has been relatively stable over the past two decades.

To ensure groundwater use within the Subbasin will not create groundwater gradients that actively draw intruding seawater inland within the Monterey Subbasin or into any adjacent subbasins, the MCWD GSA will also regularly evaluate the magnitude and direction of the hydraulic gradient from selected wells within the lower 180-Foot, 400-Foot Aquifer near the southern extent of the seawater intruded front. Specifically, selected wells will be assigned to groups of three. The magnitude and direction of the hydraulic gradient will be calculated for each group of wells. MCWD GSA will use this information to verify that the direction of the hydraulic gradient does not shift further to the south than has been measured over the last 10 years. This monitoring is conducted in addition to monitoring of groundwater elevations in the lower 180-Foot, 400-Foot Aquifer RMS located south of the seawater intruded front and ensure they meet the identified SMCs.

The wells selected for inland seawater intrusion protective groundwater gradient monitoring are listed in Table 7-2 and shown on Figure 7-10. The magnitude and direction of hydraulic gradient measured in the Fall of 2017 based on these wells are listed in Table 7-3 and illustrated on Figure 7-11. As shown in Table 7-3, the magnitude and direction of the hydraulic gradient was approximately 0.0015 ft/ft and 64 degrees due north, respectively.

These protective groundwater gradients focus on limiting the expansion of the seawater intrusion extent in the Lower 180-Foot, 400-Foot Aquifer within the Monterey Subbasin and in the adjacent Seaside Subbasin, consistent with seawater intrusion minimum thresholds and measurable objectives established in Chapter 8.

Table 7-2. Wells Selected for Protective Groundwater Gradient Monitoring

Site Name	X (ft NAD83 State Plane IV)	Y (ft NAD83 State Plane IV)	2017 Fall Groundwater Elevation (ft NAVD 88)
MP-BW-30-317	5747078.37	2141302.81	-9.064
MP-BW-34-292	5750371.95	2140709.06	-13.061
MW-OU2-66-180	5750538.4265	2137520.5686	-11.221
MW-BW-04-180	5753483.211	2137660.1282	-15.321

Table 7-3. Fall 2017 Hydraulic Gradient and Flow Direction

Group	Sites	Hydraulic Gradient (L/L)	Direction (deg)
Group 1	MP-BW-30-317 MP-BW-34-292 MW-OU2-66-180	0.001479	64.08
Group 2	MP-BW-34-292 MW-OU2-66-180 MW-BW-04-180	0.001508	64.54

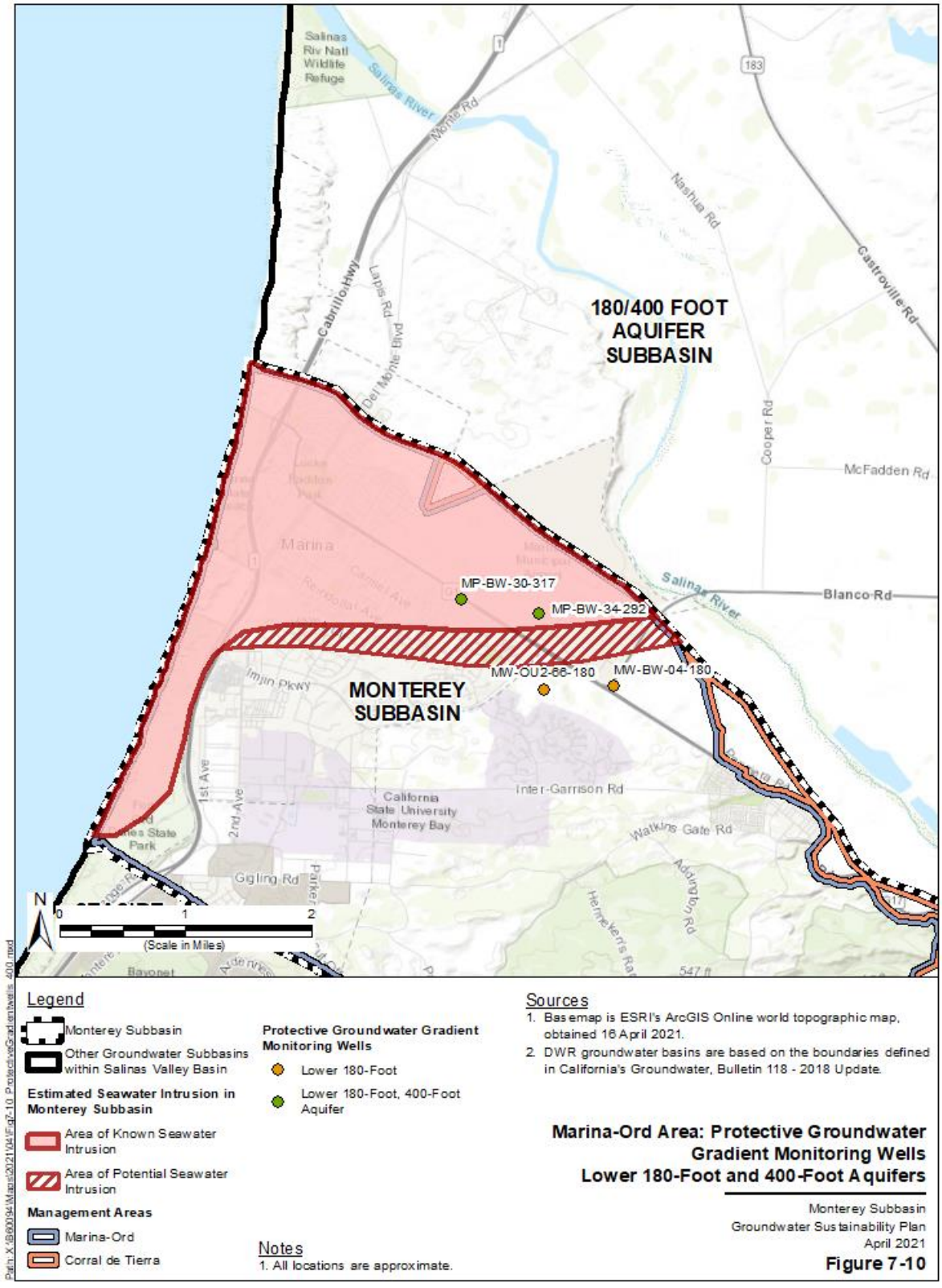
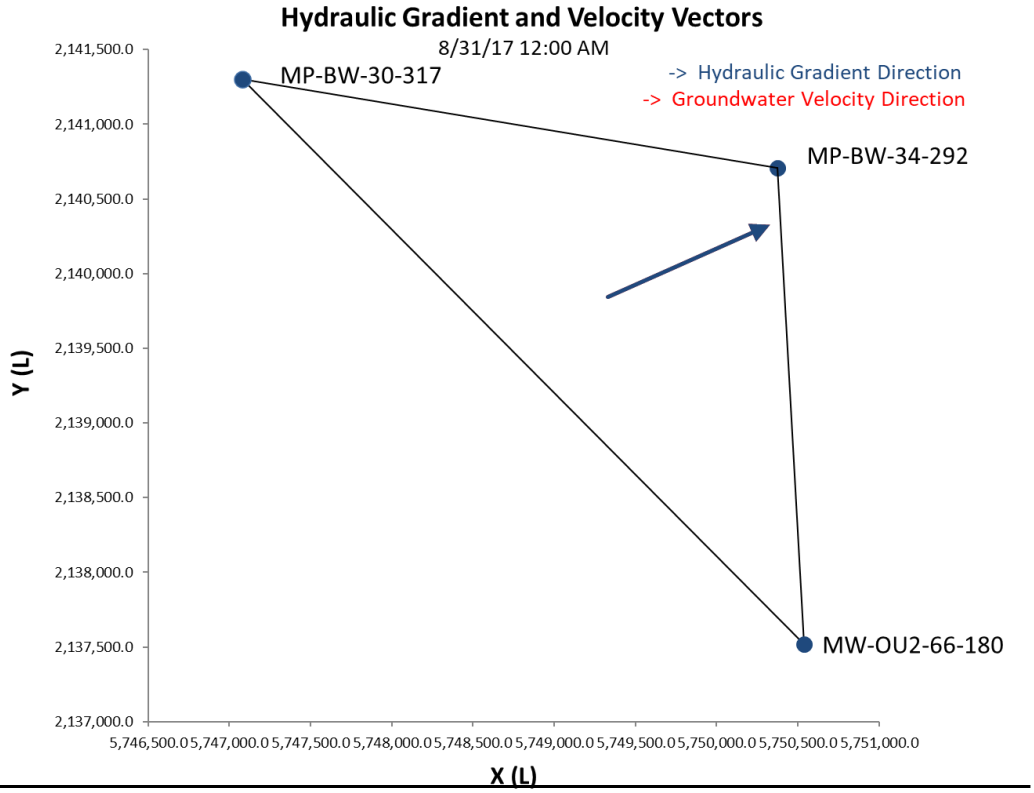
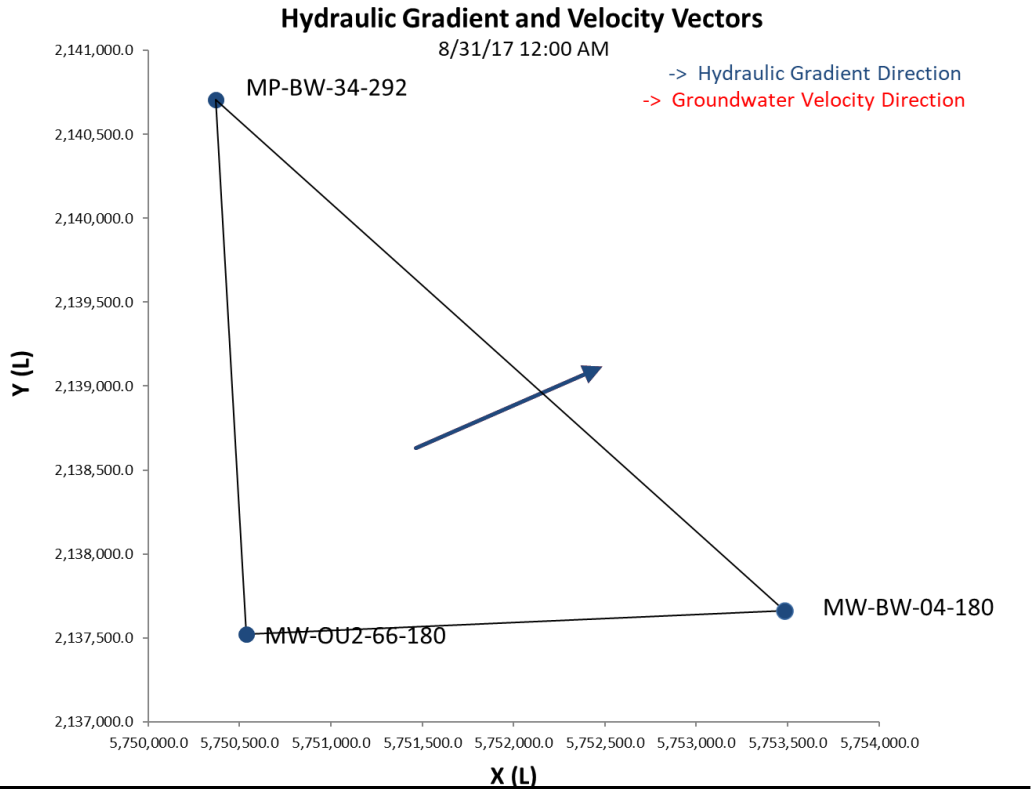


Figure 7-10. Marina-Ord Area: Protective Groundwater Gradient Monitoring Wells, Lower 180-Foot and 400-Foot Aquifers

Figure 7-11. Fall 2017 Hydraulic Gradient and Flow Direction





7.4 Groundwater Storage Monitoring Network

Data and minimum thresholds used to define undesirable results for chronic lowering of groundwater levels and seawater intrusion will also be used to assess reduction of groundwater storage (see Chapter 8). As such, the Reduction of Groundwater Storage Monitoring Network will consist of the same RMS wells as described in Sections 7.3 and 7.5. Minimum thresholds for chronic lowering of groundwater levels and seawater intrusion are sufficiently protective to ensure prevention of significant and unreasonable occurrences of reduction in groundwater storage.

7.5 Seawater Intrusion Monitoring Network

Pursuant to §354.34 of GSP Emergency Regulations, seawater intrusion should be monitored "using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated". The sustainability indicator for seawater intrusion is evaluated using the location of the 500 milligrams per liter (mg/L) chloride isoconcentration contour that is based on chloride concentrations, equivalent total dissolved solids (TDS) concentrations, and/or specific conductivity measurements (Figure 5-28).

The seawater intrusion monitoring network comprises 42 RMS wells monitored by MCWD, U.S. Army, MCWRA, or MPMWD in the Marina-Ord Area (see Figure 7-12 through Figure 7-16). All monitoring wells that are currently monitored for seawater intrusion in the Subbasin are included as part of the RMS network. Additional sites are added to the RMS network to facilitate monitoring of significant and unreasonable groundwater conditions identified in Chapter 8.

The seawater intrusion RMS Network in the Marina-Ord area has been coordinated with the groundwater elevation RMS Network (Section 7.3). Groundwater elevation data will be utilized in conjunction with salinity data from these wells to monitor potential expansion of the seawater intrusion front. The RMS wells within each management area have been selected to facilitate monitoring of significant and unreasonable groundwater conditions identified in Chapter 8. Criteria for selecting wells as part of the seawater intrusion RMS network include:

- RMS wells should facilitate monitoring seawater intrusion within all principal aquifers;
- RMS wells should be located near the coast in aquifer zones where seawater intrusion has not been identified (i.e., the Dune Sand Aquifer, the upper 180-Foot Aquifer, and the Deep Aquifers);
- RMS wells should be located near the coast and at the extent of the 500 mg/L chloride isoconcentration contour in aquifers where seawater intrusion has already occurred (i.e., the Lower 180-Foot/400-Foot Aquifer);
- RMS wells that could be included in both the groundwater elevation and seawater intrusion RMS Networks are preferred;
- RMS wells should be located on public parcels or on properties where access agreements have been negotiated;
- RMS wells must have known depths and well completion data;
- RMS wells should not be influenced by nearby infiltration or groundwater remediation activities;
- RMS wells with available historical chloride and groundwater elevation data are preferred, but wells without this information may be used where alternate wells are not available; and
- Available chloride and/or water level data for seawater intrusion RMS wells should be representative of similar data from nearby surrounding wells.

Data from seawater intrusion RMS wells will be considered public and will be used for seawater intrusion maps and analyses unless the owner of the well opts out through correspondence with MCWDGSA or SVBGSA.[2]

The RMS wells currently in the seawater intrusion monitoring network are listed in Table 7-4. The need for any additional wells is discussed in Section 7.5.2.

[2] If an owner opts out of public data reporting, another well will be identified for SWI monitoring.

[Not all selected seawater intrusion RMS wells are on an existing seawater intrusion monitoring schedule. MCWD GSA is reaching out to local monitoring agencies (MPMWD, MCWRA, and the U.S. Army) to include these wells in a regular monitoring program before 2022.]

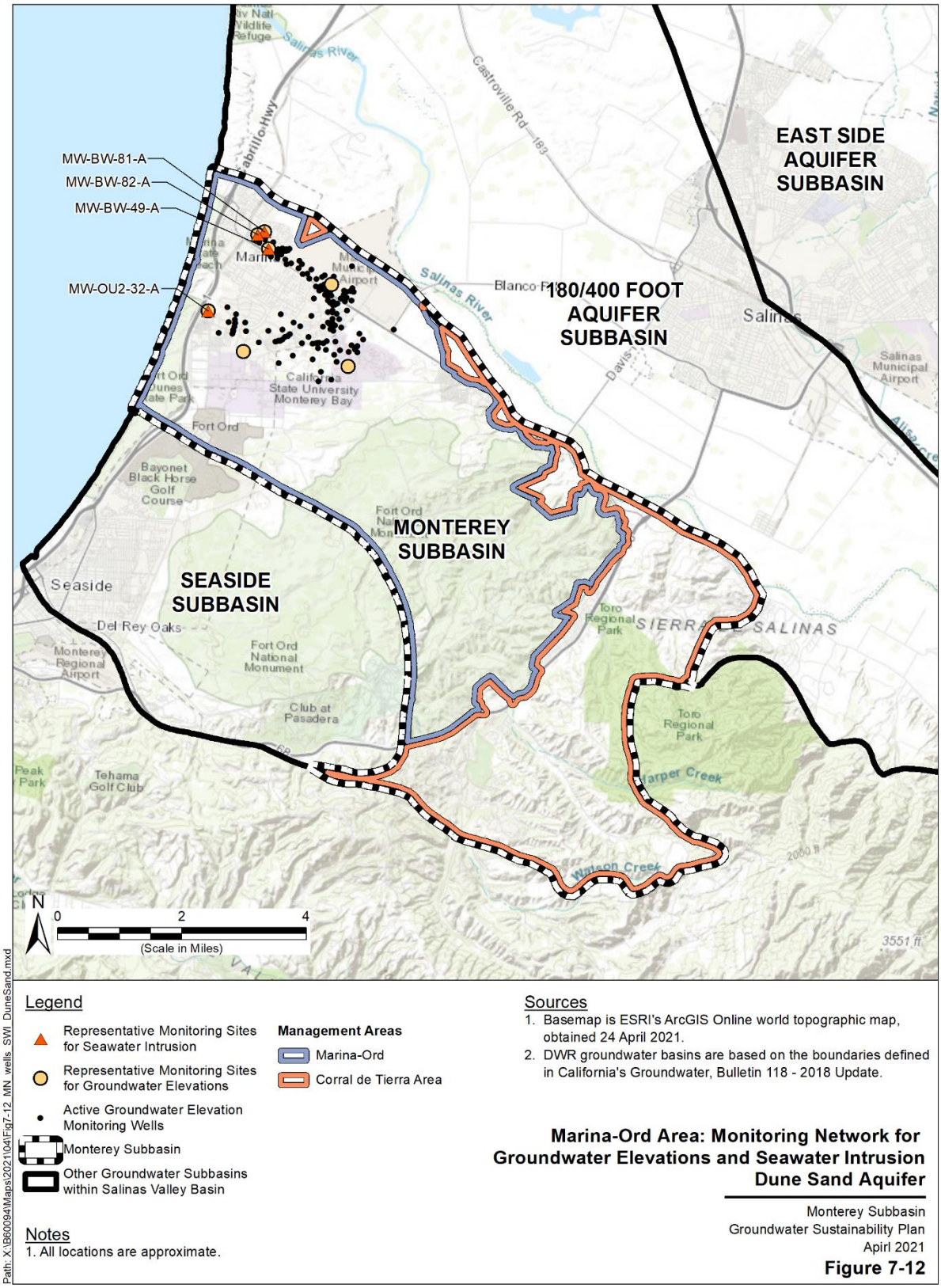


Figure 7-12. Marina-Ord Area: Monitoring Network for Groundwater Elevations and Seawater Intrusion, Dune Sand Aquifer

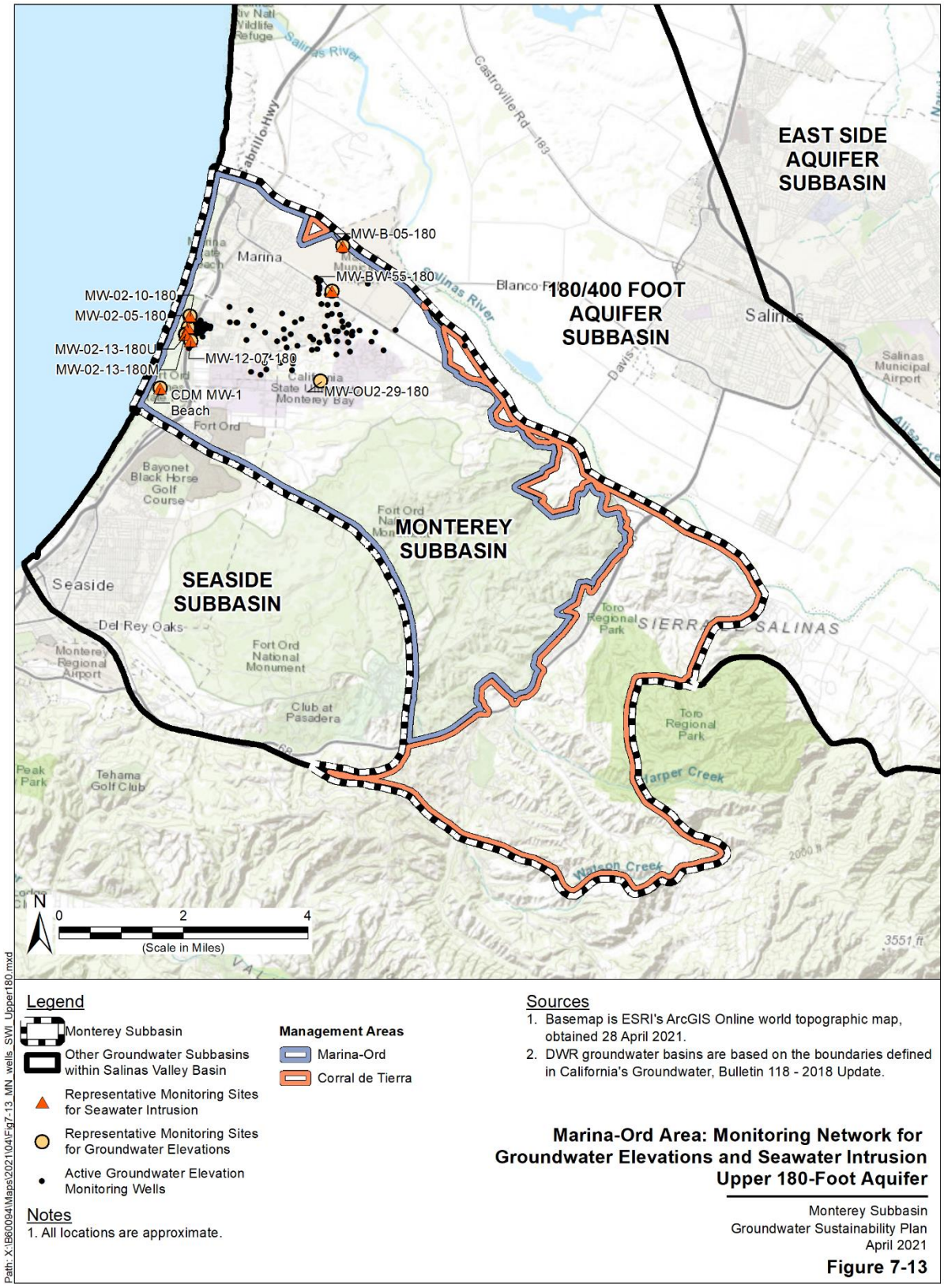


Figure 7-13. Marina-Ord Area: Monitoring Network for Groundwater Elevations and Seawater Intrusion, Upper 180-Foot Aquifer

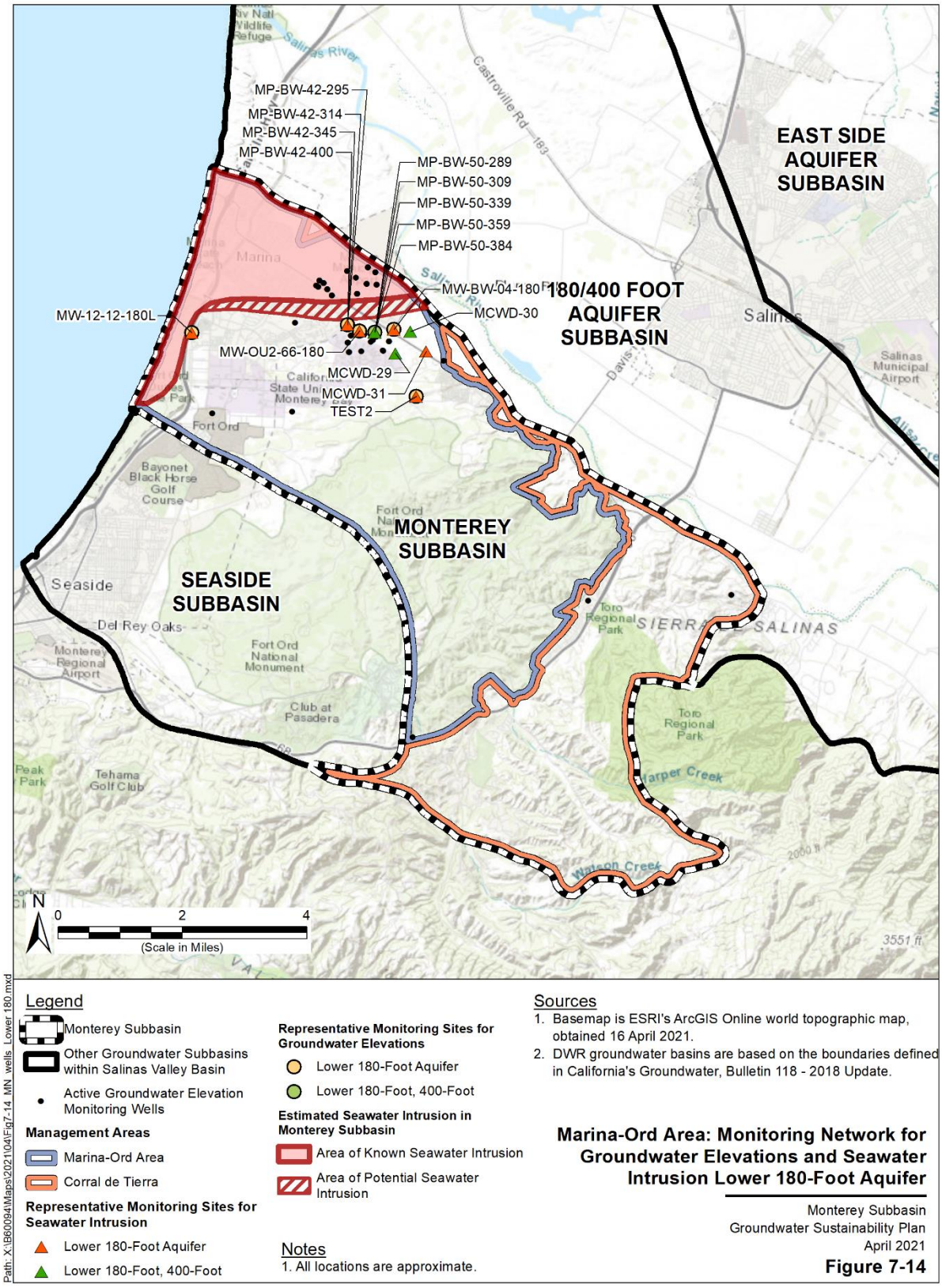


Figure 7-14. Marina-Ord Area: Monitoring Network for Groundwater Elevations and Seawater Intrusion, Lower 180-Foot Aquifer

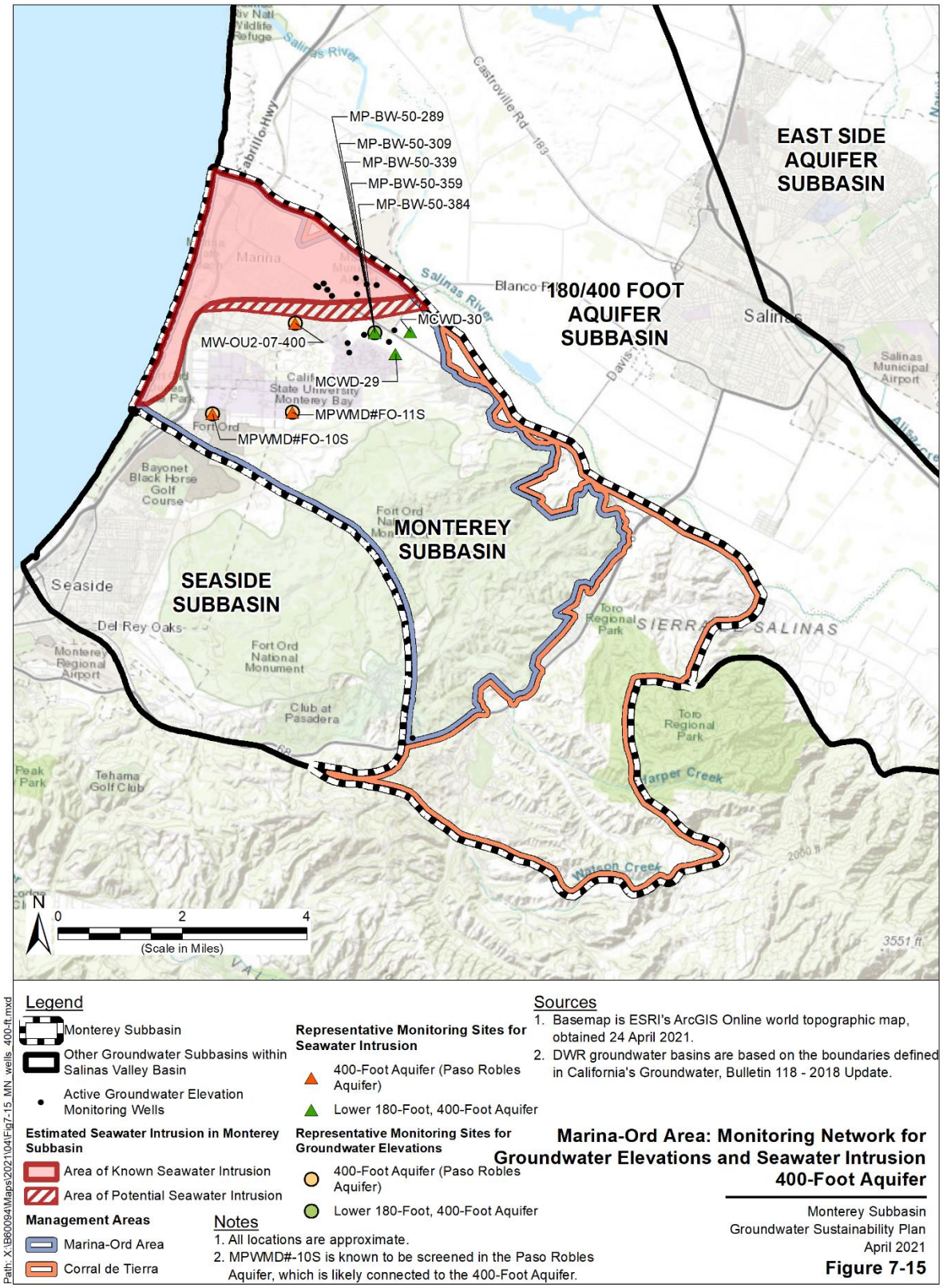


Figure 7-15. Marina-Ord Area: Monitoring Network for Groundwater Elevations and Seawater Intrusion, 400-Foot Aquifer

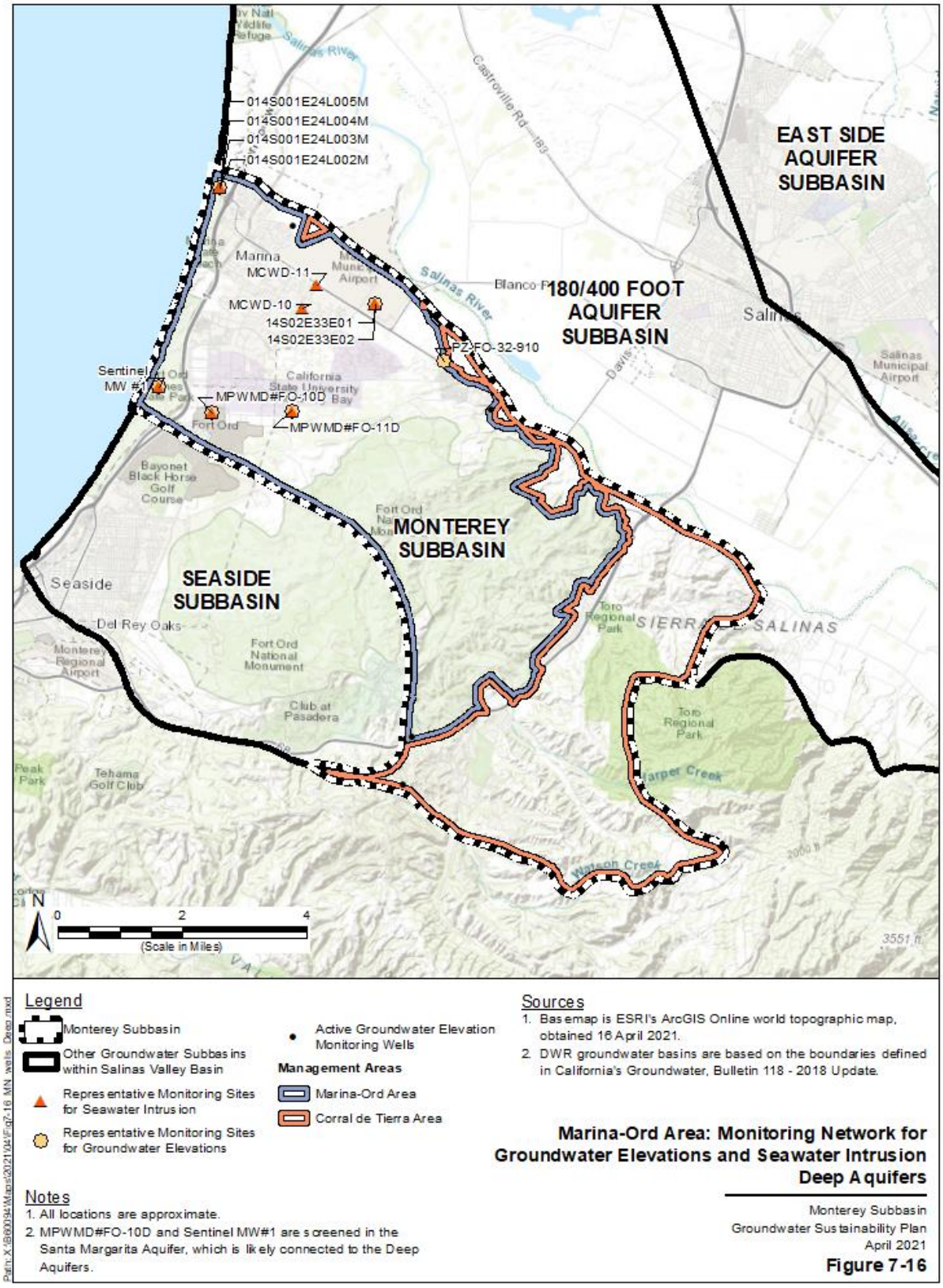


Figure 7-16. Marina-Ord Area: Monitoring Network for Groundwater Elevations and Seawater Intrusion, Deep Aquifers

Table 7-4. Monterey Subbasin Seawater Intrusion Representative Monitoring Sites

Site Name	Aquifer	CASGEM Well Number	Local Well Designation	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)	Period of TDS/Cl Record (years)
MW-BW-49-A	Dune Sand Aquifer	--	--	Monitoring	62	36.6854	-121.7928	1
MW-BW-81-A	Dune Sand Aquifer	--	--	Monitoring	82	36.6893	-121.7942	NA
MW-BW-82-A	Dune Sand Aquifer	--	--	Monitoring	74	36.6886	-121.7961	NA
MW-OU2-32-A	Dune Sand Aquifer	--	--	Monitoring	140	36.6705	-121.8098	6
CDM MW-1 Beach	Upper 180-Foot Aquifer (a)	366521N1218 236W001	MW-1 Beach	Monitoring	140	36.6521	-121.8236	NA
MW-02-05-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	69	36.6664	-121.8159	27
MW-02-10-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	64	36.6691	-121.8155	17
MW-02-13-180M	Upper 180-Foot Aquifer (a)	--	--	Monitoring	137	36.6648	-121.8167	22
MW-02-13-180U	Upper 180-Foot Aquifer (a)	--	--	Monitoring	78	36.6648	-121.8166	5
MW-12-07-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	96	36.6633	-121.8152	19
MW-B-05-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	210	36.6865	-121.7719	6
MW-BW-55-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	202	36.6758	-121.7747	1
MCWD-31	Lower 180-Foot Aquifer (a)	--	Well 31	Public Supply	490	36.6625	-121.7465	36
MP-BW-42-295	Lower 180-Foot Aquifer (a)	--	--	Monitoring	467	36.6682	-121.7695	6
MP-BW-42-314	Lower 180-Foot Aquifer (a)	--	--	Monitoring	467	36.6682	-121.7695	6
MP-BW-42-345	Lower 180-Foot Aquifer (a)	--	--	Monitoring	467	36.6682	-121.7695	6
MP-BW-42-400	Lower 180-Foot Aquifer (a)	--	--	Monitoring	467	36.6682	-121.7695	6
MW-12-12-180L	Lower 180-Foot Aquifer (a)	--	--	Monitoring	179	36.6652	-121.8146	9
MW-BW-04-180	Lower 180-Foot Aquifer (a)	--	--	Monitoring	364	36.6674	-121.7560	9
MW-OU2-66-180	Lower 180-Foot Aquifer (a)	--	--	Monitoring	339	36.6667	-121.7661	9
TEST2	Lower 180-Foot Aquifer (a)	--	--	Monitoring	425	36.6519	-121.7490	NA

Site Name	Aquifer	CASGEM Well Number	Local Well Designation	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)	Period of TDS/Cl Record (years)
MCWD-29	Lower 180-Foot, 400-Foot Aquifer (a)	--	Well 29	Public Supply	557	36.6618	-121.7553	36
MCWD-30	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Public Supply	552	36.6670	-121.7513	36
MP-BW-50-289	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	1
MP-BW-50-309	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	1
MP-BW-50-339	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	1
MP-BW-50-359	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	1
MP-BW-50-384	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	1
MPWMD#FO-10S	400-Foot Aquifer (a) (b)	366466N1218 079W001	Fort Ord 10 - Shallow	Monitoring	650	36.6466	-121.8079	24
MPWMD#FO-11S	400-Foot Aquifer (a)	366474N1217 847W002	FO-11-Shallow	Monitoring	740	36.6474	-121.7847	1
MW-OU2-07-400	400-Foot Aquifer (a)	--	--	Monitoring	580	36.6683	-121.7847	16
014S001E24L002M	Deep Aquifers	--	USGS DMW1--1	Monitoring	1880	36.6993	-121.8077	4
014S001E24L003M	Deep Aquifers	--	USGS DMW1--2	Monitoring	1430	36.6993	-121.8077	4
014S001E24L004M	Deep Aquifers	--	USGS DMW1--3	Monitoring	1080	36.6993	-121.8077	4
014S001E24L005M	Deep Aquifers	--	USGS DMW1--4	Monitoring	970	36.6993	-121.8077	4
14S02E33E01	Deep Aquifers	--	Airport Well 2'' Shallow	Monitoring	1095	36.6730	-121.7615	NA
14S02E33E02	Deep Aquifers	--	Airport Well 3" DEEP	Monitoring	1760	36.6730	-121.7614	NA
MCWD-10	Deep Aquifers	--	Marina 10	Public Supply	1550	36.6717	-121.7824	36
MCWD-11	Deep Aquifers	--	Marina 11	Public Supply	1660	36.6770	-121.7788	35
MPWMD#FO-10D	Deep Aquifers (b)	366466N1218 079W002	MPWMD #FO-10-Deep	Monitoring	1420	36.6466	-121.8079	13
MPWMD#FO-11D	Deep Aquifers	366474N1217 847W001	FO-11-Deep	Monitoring	1130	36.6474	-121.7847	NA
Sentinel MW #1	Deep Aquifers (b)	366521N1218 236W002	SGB--MW #1	Monitoring	1500	36.6521	-121.8236	NA

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 known to be 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.

7.5.1 Seawater Intrusion Monitoring Protocols

Groundwater quality data or specific conductivity measurements will be collected pursuant to the following protocols as applicable to the monitoring agency of each well. These monitoring plans are included in appendices hereto.

- The Monterey County Quality Assurance Project Plan (QAPP; Appendix 7D) describes existing MCWRA groundwater quality data monitoring protocols.
- The Seaside Basin Watermaster Monitoring and Management Program (SBWMMP, revision date September 5, 2006; Appendix 7E) describes MPMWD groundwater monitoring protocols conducted on behalf of the Seaside Watermaster. Groundwater quality measurements for wells within the Monterey Subbasin are collected annually. Sentinel MW#1 is also monitored by the Seaside Groundwater Basin Watermaster via induction logging and datalogger groundwater elevation monitoring.
- Appendix A of the Quality Assurance Project Plan (QAPP; Appendix 7C) for the former Fort Ord includes a description of groundwater monitoring procedures at the former Fort Ord (U.S. Army, 2019). Groundwater quality or specific conductivity measurements will be collected annually and in accordance with applicable Standard Operating Procedures covered in the QAPP.

Additionally, groundwater quality data will be collected from MCWD production wells pursuant to Title 22 Drinking Water Program requirements.

These protocols are consistent with data and reporting standards described in GSP Emergency Regulations §352.4.

7.5.2 Seawater Intrusion Monitoring Network Data Gaps

There is no definitive requirement regarding seawater intrusion monitoring well density. The current network includes 2 to 10 seawater intrusion monitoring wells in the aquifers with no evidence of seawater intrusion and a total of 13 seawater intrusion monitoring wells in the lower 180-Foot, 400-Foot Aquifer where seawater intrusion has occurred. Additional seawater intrusion monitoring wells may be appropriate at the following locations:

- Within the 400-Foot Aquifer to address lack of coverage near the central coastline between wells MCWD-09 and MPWMD#FO-10S; and
- Within the Deep aquifers to address a lack of coverage near the central coastline between MCWD-10 and MPWMD#FO-10D.

These locations are consistent with data gap locations identified as part of the groundwater elevation monitoring network within the Marina-Ord area, which also focuses on preventing seawater intrusion as shown on Figure 7-7 and Figure 7-8 above.

The data gap areas shown on Figure 7-7 and Figure 7-8 will be addressed during GSP implementation by either identifying an existing well in each area that meets the criteria for a valid monitoring well, or drilling a new well in each area, as further described in Chapter 10.

7.6 Water Quality Monitoring Network

The sustainability indicator for degraded water quality is evaluated by monitoring groundwater quality at a network of existing water supply wells. The regulations require sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators to address known water quality issues.

As described in Chapter 8, separate minimum thresholds are set for the constituents of concern for public water system supply wells, on-farm domestic wells, and agricultural supply wells. Therefore, although there is a single groundwater quality monitoring network, different wells in the network are reviewed for different constituents. Constituents of concern for drinking water are assessed at public water supply wells and on-farm domestic wells, and constituents of concern for crop health are assessed at agricultural supply wells. The constituents of concern for the three sets of wells are listed in Chapter 5.

The municipal public water system supply wells included in the monitoring network were identified by reviewing data from the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW). The SWRCB collects data for municipal systems; community water systems; non-transient, non-community water systems; and non-community water systems that provide drinking water to at least 15 service connections or serve an average of at least 25 people for at least 60 days a year. Eight DDW wells have been chosen to be part of the RMS network in the Ord Area and 24 wells in the Corral de Tierra Area. These wells are shown on Figure 7-17 and listed in Appendix 7F.

The on-farm domestic wells and agricultural supply wells included in the monitoring network will be a subset of those that have been sampled through the CCRWQCB's Irrigated Lands Regulatory Program. Under the existing, temporary orders, 10 ILRP wells have been chosen as part of the RMS network in the Corral de Tierra Area. The locations of these wells are shown on Figure 7-17 and listed in Appendix 7F. No active ILRP wells exist within the Fort Ord Area. The MCWDGSA and SVBGSA assume that Ag Order 4.0, anticipated in 2021, will have a similar representative geographic distribution of wells within the Subbasin. The agricultural groundwater quality monitoring network will be revisited and revised when Ag Order 4.0 is issued.

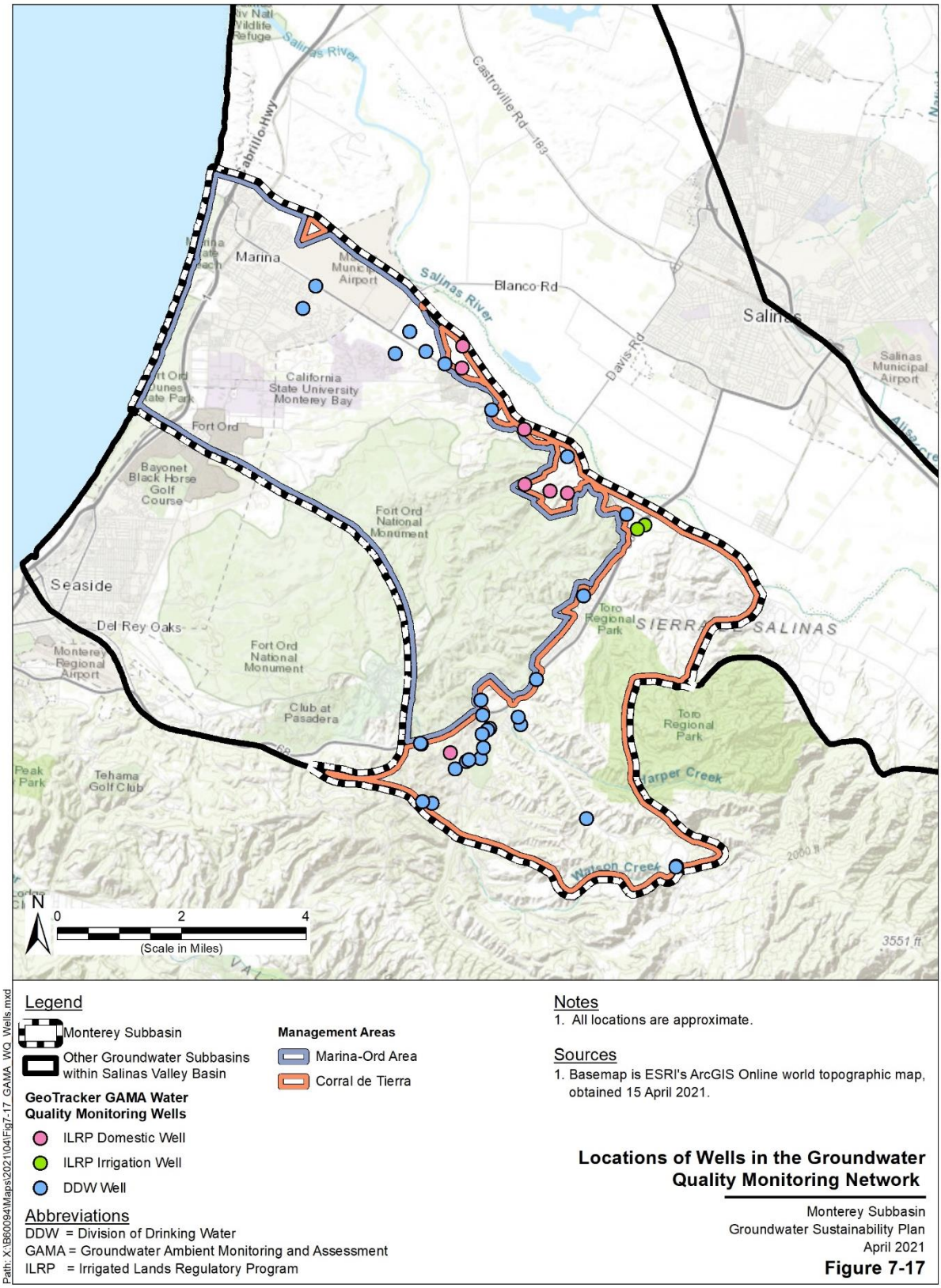


Figure 7-17. Locations of Wells in the Groundwater Quality Monitoring Network

7.6.1 Groundwater Quality Monitoring Protocols

Water quality data from public water systems are collected, analyzed, and reported in accordance with protocols that are reviewed and approved by the SWRCB, DDW, in accordance with the state and federal Safe Drinking Water Acts. Monitoring protocols may vary by agency.

ILRP data are currently collected under Central Coast RWQCB Ag Order 3.0. ILRP samples are collected under the Tier 1, Tier 2, or Tier 3 monitoring and reporting programs. Copies of these monitoring and reporting programs are included in Appendix 7D and are incorporated into this GSP. These protocols are consistent with data and reporting standards described in GSP Emergency Regulations §352.4.

7.6.2 Groundwater Quality Monitoring Data Gaps

There is adequate spatial coverage to assess impacts to beneficial uses and users for the DDW monitoring program. Because the monitoring network relies on existing supply wells, the network cannot be expanded by drilling new monitoring wells. As new domestic and agricultural supply wells are added to Ag Order 4.0, they will be added to this monitoring program.

7.7 Land Subsidence Monitoring Network

As described in Section 5.5, DWR has, and will be, collecting land subsidence data using InSAR satellite data, and will make these data available to GSAs. This subsidence dataset represents the best available data for the Monterey Subbasin and will therefore be used as the subsidence monitoring network.

7.7.1 Land Subsidence Monitoring Protocols

The land subsidence monitoring protocols are the ones used by DWR for InSAR measurements and interpretation. If the annual monitoring indicates subsidence is occurring at a rate greater than the minimum thresholds, then additional investigation and monitoring may be warranted. In particular, the GSAs will implement a study to assess if the observed subsidence can be correlated to declining groundwater elevations, and whether a reasonable causality can be established. These protocols are consistent with data and reporting standards described in GSP Emergency Regulations §352.4.

7.7.2 Land Subsidence Data Gaps

There are no data gaps associated with the subsidence monitoring network.

7.8 Interconnected Surface Water Monitoring Network

As detailed in Chapter 8, shallow groundwater elevations near locations of interconnected surface water will be used as a proxy metric for this indicator. As such, the interconnected surface water monitoring network will be comprised of RMS sites adjacent to potential interconnected surface waters where minimum thresholds and measurable objectives based on shallow groundwater levels are developed for depletion of interconnected surface water.

As described in Section 5.6 of this GSP, potential interconnected surface water locations identified within the subbasin are (1) the ponds and lakes located within the City of Marina (Figure 5-35), (2) the lower reaches of the El Toro Creek where groundwater within 20 feet of land surface has been recorded (Figure 5-36), (3) two locations along the Salinas River near the Monterey-180/400-Foot Aquifer Subbasin boundary. These areas may require additional evaluation of potential hydraulic interaction between surface water elevations and groundwater extractions.

The primary tool for assessing depletions of interconnected surface water will be shallow monitoring wells adjacent to the Subbasin's interconnected surface water locations. Groundwater elevations measured in shallow wells adjacent to interconnected surface water bodies will serve as the primary approach for monitoring depletion of surface water.

One RMS well is included in the interconnected surface water monitoring network in the Marina-Ord Area, as shown in Table 7-5 and on Figure 7-18. As discussed in Chapter 8, given the stable groundwater patterns in the Dune Sand Aquifer, there is no significant and unreasonable depletion of interconnected surface water under current conditions. In the event that future groundwater activities in the Subbasin or the adjacent 180/400-Foot Aquifer Subbasin may influence the condition of the Marina vernal ponds and/or the Dune Sand Aquifer, the GSAs will work with project proponents to install additional shallow groundwater monitoring wells.

There are currently no RMS wells included in the interconnected surface water monitoring network near the El Toro Creek or Salinas River. As described in Section 5.6, the level of interconnection between the El Toro Creek to the principal aquifer is unclear. As shown on Figure 7-19, an analysis of shallow groundwater levels is used to identify areas of potential interconnection between surface water and groundwater. Additionally, the SVBGSA will work to install one shallow well near El Toro Creek into the interconnected surface water monitoring network and will work with the United States Geological Survey (USGS) to reactivate the stream gauge along Toro Creek. The conjunctive data collection will help correlate the potential seasonal flows with shallow groundwater and assess both the interconnectivity as well as the relationship with deeper wells in the area.

Table 7-5. Monterey Subbasin Interconnected Surface Water Representative Monitoring Sites

State Well Number	Aquifer	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)
Marina-Ord Area					
MW-BW-82-A	Dune Sand Aquifer	Monitoring	74	36.6886	-121.7961

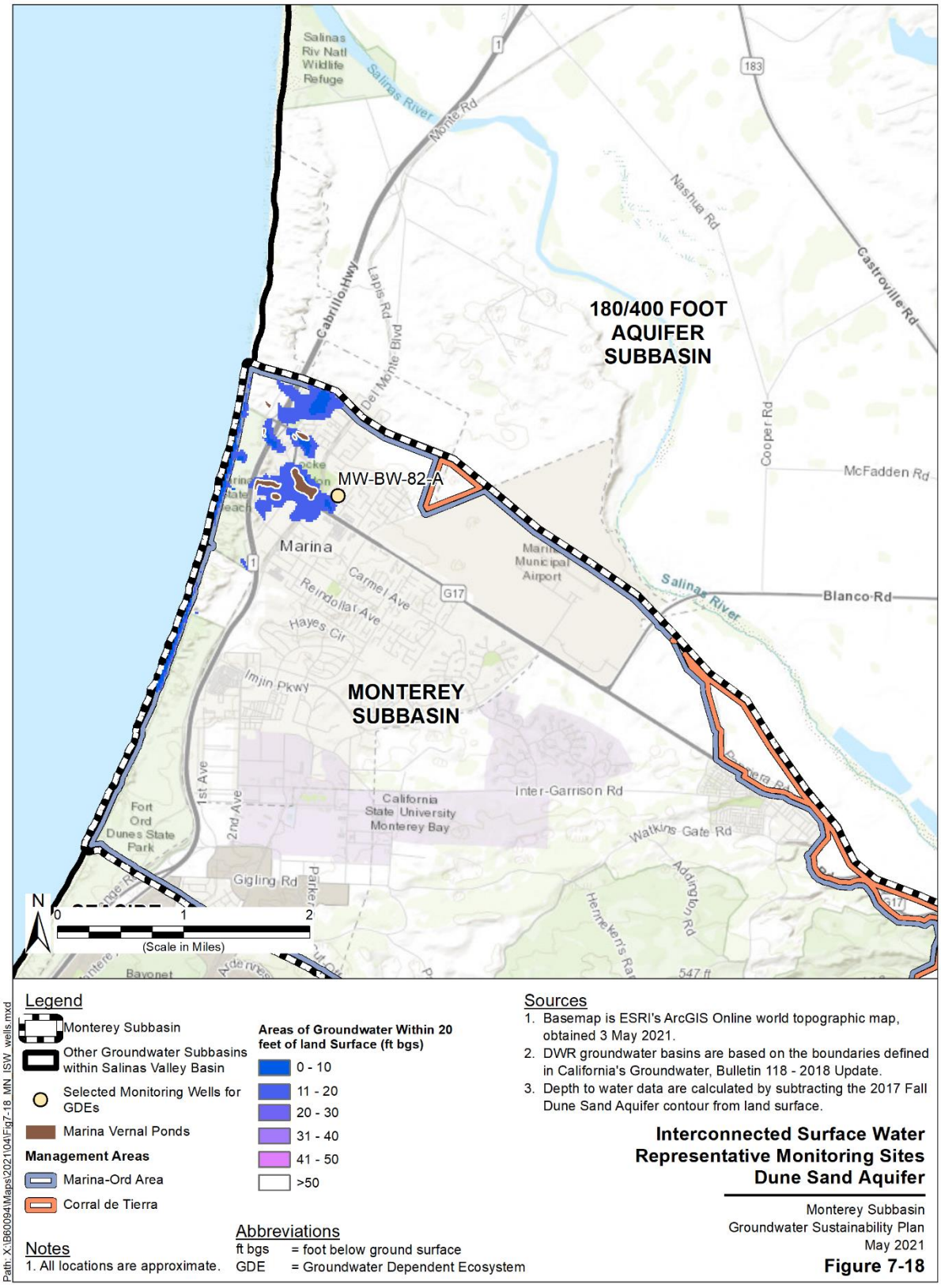


Figure 7-18. Interconnected Surface Water Representative Monitoring Sites, Dune Sand Aquifer

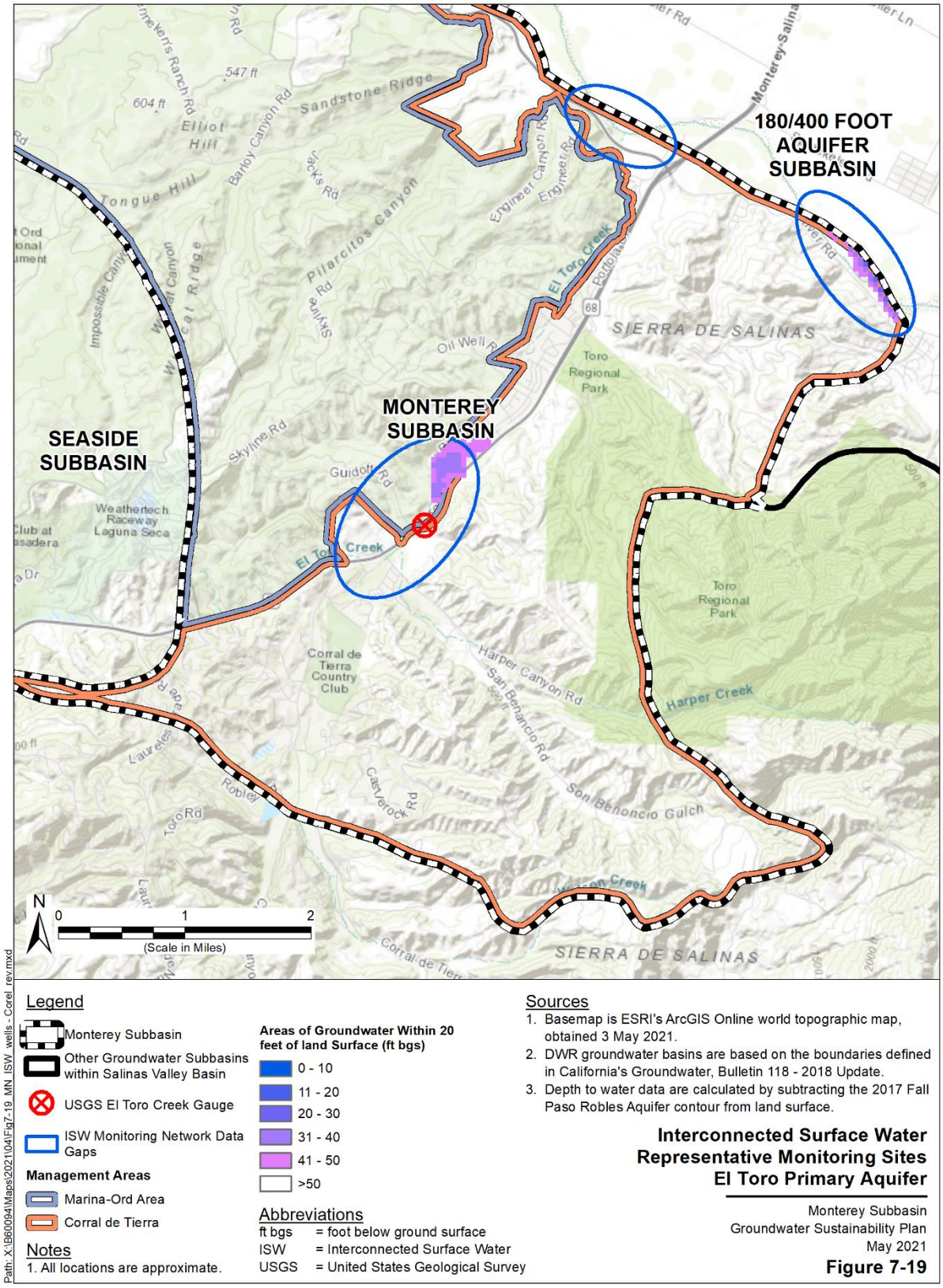


Figure 7-19. Interconnected Surface Water Representative Monitoring Sites, El Toro Primary Aquifer

7.9 Data Management System and Data Reporting

Data collected from the SGMA Monitoring Network will be uploaded to a Data Management System to be established and managed for the Monterey Subbasin and reported to the DWR in accordance with the Monitoring Protocols developed for the Subbasin, as described in the appendices hereto. Additional data collected as part of the Subbasin's other monitoring programs may be used in conjunction with data collected from the SGMA Monitoring Network to meet compliance with requirements regarding annual reporting (GSP Emergency Regulations §356.2) or as otherwise deemed necessary by the GSAs.