

Appendix 7-A

MCWRA CASGEM Monitoring Plan

CASGEM Monitoring Plan for High and Medium Priority Basins in the Salinas Valley Groundwater Basin

March 10, 2015



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List of Acronyms and Abbreviations

CASGEM	California Statewide Groundwater Elevation Monitoring
DWR	California Department of Water Resources
MCWRA	Monterey County Water Resources Agency
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WY	Water Year

1.0 Introduction

This monitoring plan has been developed by the Monterey County Water Resources Agency (MCWRA) to meet requirements of the California Department of Water Resources (DWR) California Statewide Groundwater Elevation Monitoring (CASGEM) program. The plan covers monitoring of groundwater elevations within high and medium priority alluvial subbasins identified in DWR Bulletin 118 that are located in Monterey County, and for which a Monitoring Entity has not yet been designated. This monitoring plan provides information on the groundwater basins, the wells to be sampled, and the monitoring schedule and methods.

1.1 Scope and Purpose

The monitoring plan presents descriptions of the groundwater subbasins; monitoring schedule and well network distribution; procedures for collecting and reporting the groundwater elevation data; and a description of the monitoring plan rationale.

This groundwater monitoring plan can be revised as necessary when refinements are made to the monitoring network to address program needs and data gaps. Revisions will be submitted to DWR when additions or removal of wells from the monitoring network occur.

2.0 Groundwater Basin Descriptions and Hydrogeology

Monterey County is located in the Central Coast Hydrologic Region. Thirteen basins and subbasins are identified in DWR Bulletin 118 as being partially or fully located within Monterey County (Figure 1).

This monitoring plan addresses seven of the subbasins in the Salinas Valley Groundwater Basin, specifically those which DWR has prioritized as “high” or “medium” (Table 1). Three of the basins - Cholame Valley (3.5), Lockwood Valley (3-6), and Peach Tree Valley (3-32) - have been prioritized as “low” or “very low” and will be covered by a subsequent monitoring plan.

Table 1 - DWR Basin Nomenclature, Numbering, and Prioritization		
Subbasin Name	Basin/Subbasin Number	Basin Prioritization
180/400 Foot Aquifer	3-4.01	High
East Side Aquifer	3-4.02	High
Forebay Aquifer	3-4.04	Medium
Upper Valley Aquifer	3-4.05	Medium
Paso Robles Area	3-4.06	High
Langley Area	3-4.09	Medium
Corral de Tierra Area	3-4.10	Medium

The remaining three basins in Monterey County - Carmel Valley (3-7), Pajaro Valley (3-2), and the Seaside Area (3-4.08) - have a designated Monitoring Entity. The Monterey Peninsula Water Management District (MPWMD) is the Monitoring Entity for the Carmel Valley and Seaside basins; Santa Cruz County Environmental Health Services is the Monitoring Entity for the Pajaro Valley basin. The Paso Robles Area will be monitored both by MCWRA and the San Luis Obispo County Flood Control & Water Conservation District, with monitoring split along the county lines.

2.1 Overall Setting

The Salinas Valley is an intermontane alluvial basin extending 120 miles southeast from the Monterey Bay to Paso Robles. Although the valley fill is as thick as 15,000 feet, all of the principal water-bearing sediments lie within 2,000 feet of the ground surface (Showalter et al, 1983). These water-bearing sediments consist of Tertiary and Quaternary marine and terrestrial sediments, including the Pliocene Purisima Formation, the Plio-Pleistocene Paso Robles Formation, the Pleistocene Aromas Formation, and the Pleistocene to Holocene Valley Fill.

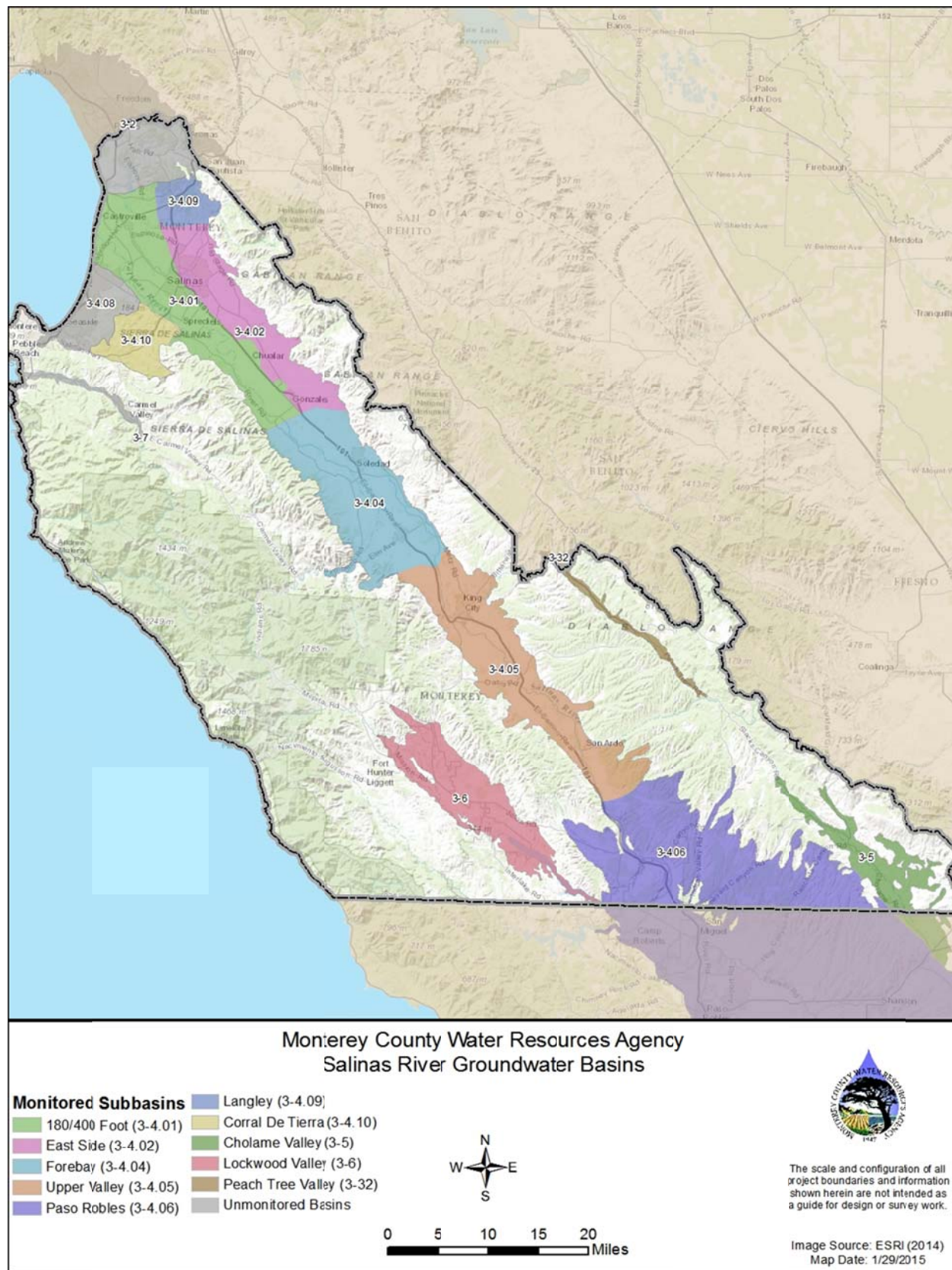
2.2 180/400 Foot Aquifer

The 180/400 Foot Aquifer subbasin is located in the northwestern part of the Salinas Valley basin. The northeastern boundary of the 180/400 Foot Aquifer subbasin is shared with the East Side Aquifer subbasin; the Forebay Aquifer subbasin lies on southeastern boundary, near the City of Gonzales. Monterey Bay abuts the northwestern boundary of the 180/400 Foot Aquifer subbasin.

The 180-Foot Aquifer ranges from 50 to 150 feet in thickness and is confined by an overlying blue clay layer, known as the Salinas Aquitard, which ranges from 25 to 100 feet thick. The Salinas Aquitard thins to the east and south of the subbasin and is present only in this subbasin. The 180-Foot Aquifer consists of interconnected layers of sand, gravel, and clay that are separated from the 400-Foot Aquifer by blue marine clay and other discontinuous aquifers and aquitards ranging from 10 to 70 feet in thickness. The 400-Foot Aquifer has an average thickness of 200 feet and consists of sands, gravels, and clay lenses (DWR, 2003). The blue marine clay aquitard has been reported to be absent in some areas of the 180/400 Foot Aquifer subbasin (Kennedy/Jenks, 2004).

There is a third water-bearing unit underlying the 180/400 Foot Aquifer subbasin, often referred to as the Deep Aquifer, which is separated from the overlying 400-Foot Aquifer by a blue marine clay aquitard (DWR, 2003). The Deep Aquifer is a confined unit that has been less developed than the 180-Foot and 400-Foot Aquifers, but wells are increasingly being drilled into this unit, so it will be included in the monitoring plan for this subbasin.

Figure 1 – Groundwater Basins and Subbasins in Monterey County



2.3 East Side Aquifer

The East Side Aquifer subbasin is located in the northeastern portion of the Salinas Valley basin, bounded by the foothills of the Gabilan Range to the northeast and Highway 101 to the southwest (Kennedy/Jenks 2004).

The East Side Aquifer subbasin is dominated by poorly bedded sequences of gravel, silt, sand, gravelly/sandy clay, and clay. In portions of the East Side Aquifer subbasin, decomposed granite is a prominent component of the sediments (Kennedy/Jenks, 2004). The primary water-bearing units of the East Side Aquifer subbasin are the same units that are present in the 180/400 Foot Aquifer subbasin. However, the near-surface Salinas Aquitard is not present in the East Side Aquifer subbasin, and the aquitard that separates the 180-Foot and 400-Foot Aquifers is less continuous in the East Side Aquifer subbasin, leading to semi-confined to unconfined conditions for much of the groundwater (DWR, 2003).

2.4 Forebay Aquifer

The Forebay Aquifer subbasin is located in the central portion of the Salinas Valley basin, bounded by the Sierra de Salinas and Gabilan Range to the west and east, respectively. The Forebay subbasin is bounded to the north by the 180/400 Foot Aquifer and East Side Aquifer subbasins. The southern boundary of the Forebay Aquifer subbasin is shared with the Upper Valley Aquifer subbasin (DWR, 2003).

Many of the same hydrostratigraphic units that comprise the 180/400 Foot Aquifer subbasin are present in the Forebay Aquifer subbasin, though the aquitard separating the two water bearing units in the northern subbasin is absent in the Forebay Aquifer subbasin. Groundwater in the Forebay Aquifer subbasin is unconfined and occurs in lenses of sand and gravel that are interbedded with massive units of finer grained material (DWR, 2003).

2.5 Upper Valley Aquifer

The Upper Valley Aquifer subbasin occupies a stretch of the Salinas Valley groundwater basin from just south of Greenfield, CA to San Ardo, CA. The northern border of the Upper Valley Aquifer subbasin is shared with the Forebay Aquifer subbasin, while the southern border is shared with the Paso Robles Area subbasin.

Groundwater in the Upper Valley Aquifer subbasin is unconfined and is derived primarily from an aquifer of unconsolidated to semi-consolidated and interbedded gravel, silt, sand, and alluvial fan and river deposits (DWR, 2003).

2.6 Paso Robles Area

The Paso Robles Area subbasin is partially located in Monterey County, though the majority of the subbasin is located in San Luis Obispo County. The Upper Valley Aquifer subbasin forms the northern boundary of the Paso Robles Area subbasin.

Groundwater in the Paso Robles Area subbasin is found in two formations: Holocene age alluvium and the Pleistocene age Paso Robles Formation. Groundwater in the fine- to coarse-grained sand, pebbles, and boulders of the alluvium is unconfined while groundwater in the Paso Robles Formation is generally confined (DWR, 2003).

The Paso Robles Groundwater Basin Computer Model (Model) has characterized flow in the basin using four vertical groundwater zones: one in the alluvium and three within the Paso Robles Formation (SLOCFCWD, 2014).

2.7 Langley Area

The Langley Area subbasin is located in the northeastern part of the Salinas Valley groundwater basin. Portions of the Langley Area subbasin are underlain by granitic bedrock that is not considered to be a viable water-bearing unit. In the remaining areas of the Langley Area subbasin, the groundwater supply is derived from shallow, well-sorted sands separated by confining layers of interbedded clays and silty clays (DWR, 2003).

A study of hydrogeology in northern Monterey County was conducted by Fugro West, Inc. (Fugro) and included most of the Langley Area subbasin. The Fugro study further divided the subbasin, as it is defined by DWR, into hydrogeologic subareas using factors such as well yields, depth to bedrock, volume of groundwater storage, and sources of recharge (Fugro, 1995). Two of the hydrogeologic subareas defined by the Fugro study are coincident with approximately 75% of the Langley Area subbasin: Highlands South and Granite Ridge (Figure 2).

The Highlands South subarea consists of saturated Aromas Sands (interbedded sands, clay, and gravel) overlying the Purisima Formation (semi-consolidated units of fine sand, clay, and silt), which has not proved a viable aquifer (Fugro, 1995). The Highlands South hydrogeologic subarea, as defined by the Fugro report, covers approximately 46% of the Langley Area subbasin.

The Granite Ridge subarea is characterized by a thin layer of Aromas Sands overlying granitic bedrock or weathered granite. Wells in the Granite Ridge subarea are typically completed in either granular materials (Aromas Sands and weathered granite); fresh granite; or other consolidated formations (Fugro, 1995). Approximately 29% of the Langley Area is coextensive with the Granite Ridge subarea.

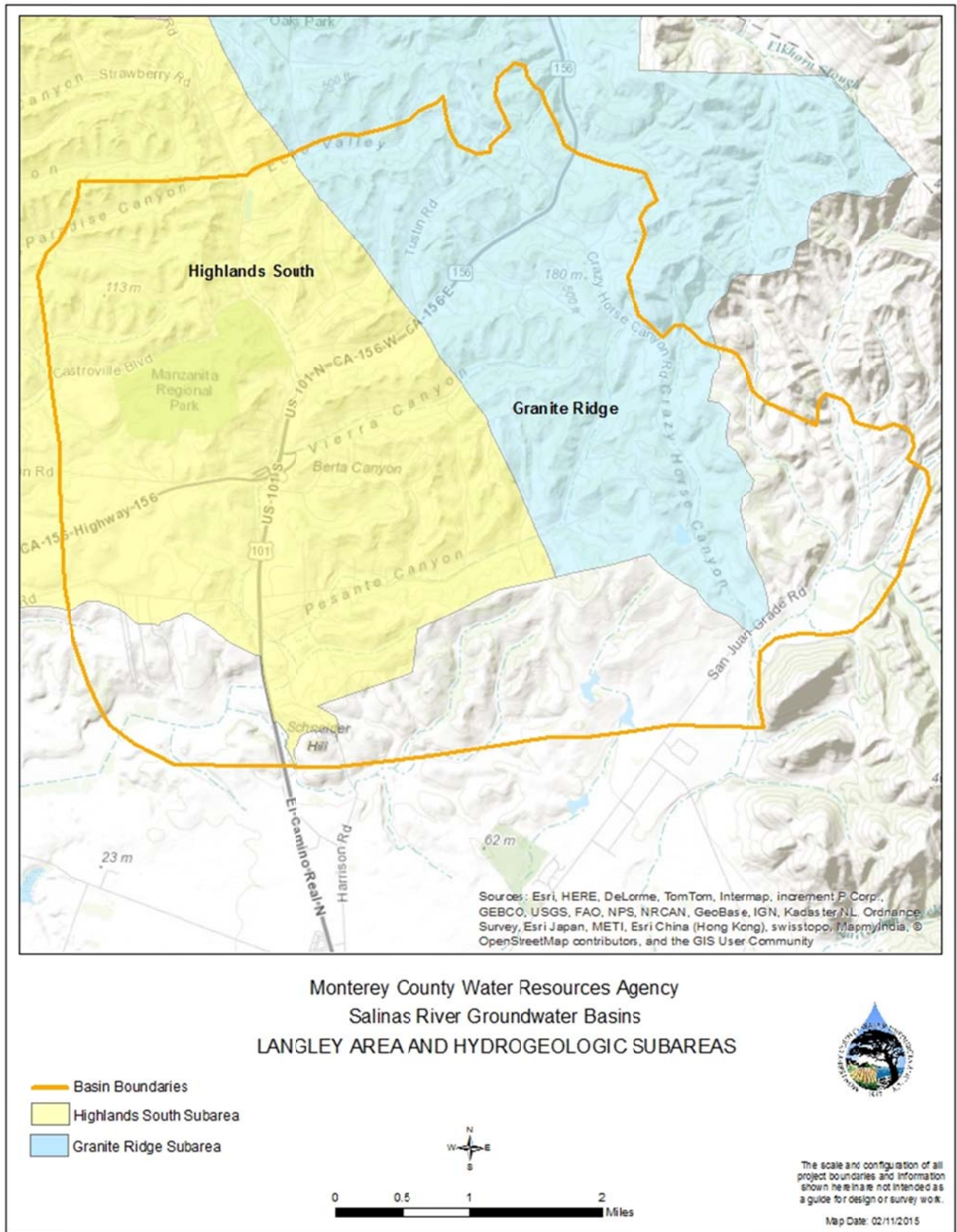
The transition between hydrogeologic conditions of the Highlands South and Granite Ridge subareas is gradual and occurs slightly east of the center of the Langley Area. The transition is characterized by the thinning of saturated sediments to the east, eventually thinning to the extent that the granitic bedrock is above regional saturation (Fugro, 1995).

2.8 Corral de Tierra Area

The Corral de Tierra Area subbasin is located to the west of the 180/400 Foot Aquifer subbasin and contains portions of the former Fort Ord and other unincorporated areas. It is bounded to the northwest by the Seaside Area subbasin.

Groundwater in the Corral de Tierra Area subbasin comes primarily from the Paso Robles Formation, which consists of sand, gravel, and clay interbedded with minor calcareous beds. The poorly consolidated marine sandstone of the Santa Margarita Formation also yields water in the Corral de Tierra Area subbasin (DWR, 2003). A previous study which included the Corral de Tierra Area found that although there are thick sequences of low permeability material in some areas of the subbasin that may limit vertical hydraulic communication between aquifer units, a comparison of water level data shows general consistency between wells screened in different units (Geosyntec, 2007).

Figure 2 – Langley Area Subbasin and Hydrogeologic Subareas



3.0 Groundwater Level Monitoring

The following sections discuss the history of groundwater level monitoring in the Salinas Valley groundwater basin; current monitoring activities in the basin; and the proposed network of CASGEM monitoring wells. Data gaps in the monitoring network are also identified and discussed.

3.1 Monitoring History

Groundwater level measurements in the Salinas Valley groundwater basin have been ongoing, in some form, since the 1940s. Presently, MCWRA conducts monthly and annual surveys of groundwater levels to monitor fluctuations in water level and determine relative changes in storage over time. Data collected through the MCWRA groundwater level monitoring program also contributes to analysis of seawater intrusion in coastal groundwater zones.

MCWRA maintains a small network of dedicated monitoring wells where groundwater level data is recorded by a pressure transducer on an hourly basis. However, the distribution of the dedicated monitoring wells is limited; much of the groundwater level data is collected from privately-owned agricultural production wells where owners have granted permission to MCWRA. MCWRA collects groundwater level measurements from over four hundred wells on an annual basis; on a monthly basis, groundwater levels are measured in about one quarter of these wells.

3.2 Monitoring Network Rationale

The CASGEM network is of a combination of dedicated monitoring wells that are owned by MCWRA and wells that are owned by private individuals who elected to participate in the CASGEM program.

The MCWRA-owned monitoring wells were selected for inclusion in the program due to their distribution throughout Monterey County, the availability of detailed and reliable well construction data, and relative ease of data collection.

In the selection of privately owned wells, preference was given to wells that are in the MCWRA monthly groundwater level monitoring program, since the minimum number of data points for CASGEM reporting are already being gathered. MCWRA also considered wells that are in the annual groundwater level monitoring program. Wells in the annual program are currently measured only once per year, so additional staff effort will be required to schedule a second visit in order to satisfy the biannual measurement criteria for CASGEM reporting.

Additional privately owned wells were sought in areas where dedicated monitoring wells are not available. MCWRA filled as many data gaps as possible with privately owned wells, working toward a target minimum density of 10 wells per 100 square miles of groundwater basin.

Approximately one third of the land in the Corral de Tierra Area is federal property. MCWRA has reached out to the United States Army Corps of Engineers (USACE), which owns the property, seeking participation in the CASGEM program (Appendix A). As of the date of this monitoring plan, USACE has not responded to MCWRA's letter. As such, the land owned by USACE is considered a

data gap in the Corral de Tierra Area. The following subbasin-specific discussions address data gaps in the MCWRA CASGEM network in more detail.

MCWRA considered the availability of reliable well construction data choosing CASGEM wells. Where appropriate, wells were also selected to provide coverage of vertically distinct aquifers.

Table 2 - Recommended Monitoring Well Network Density by Subbasin			
Subbasin Name	Subbasin Area in Monterey County (mi²)	Federal Land Area of Subbasin (mi²)	Wells Needed for Target Minimum Density
High and Medium Priority (10 wells per 100 mi²)			
180/400 Foot Aquifer	132	0	13
East Side Aquifer	90	0	9
Forebay Aquifer	147	0	15
Upper Valley Aquifer	153	0	15
Paso Robles Area	221	0	22
Langley Area	24	0	2
Corral de Tierra Area	35	12	4
Total wells in High and Medium Priority Subbasins			80

3.3 CASGEM Monitoring Network and Data Gaps

This section describes the number and distribution of wells in the CASGEM monitoring network of each subbasin, identifies data gaps in some of the monitored subbasins, and outlines the approach for addressing data gaps where applicable.

As shown in Table 3, the CASGEM network meets the target minimum density in some subbasins, while additional wells are required in other subbasins in order to meet the target.

Table 3 - CASGEM Network Compared to Target Minimum Density Numbers				
Subbasin Name	Target Minimum Density	CASGEM Wells	Voluntary Wells	Wells Remaining to Meet Target Minimum Density
180/400 Foot Aquifer	13	22	1	0 ^a
East Side Aquifer	9	8	0	1
Forebay Aquifer	15	9	2	11 ^b
Upper Valley Aquifer	15	3	0	12
Paso Robles Area	22	1	0	21
Langley Area	2	3	0	0 ^c
Corral de Tierra Area	4	2	0	2
TOTAL	80	48	3	47
Notes (a) Additional wells will be sought to address a data gap in the vertical distribution of the well network as funding is available. (b) Forebay Aquifer CASGEM wells include multiple well clusters, so only four geographic locations are covered by the nine wells. (c) Additional wells will be sought to address data gaps in horizontal distribution of the well network as funding is available.				

3.3.1 180/400 Foot Aquifer

The CASGEM well network for the 180/400 Foot Aquifer subbasin is shown on Figure 3. MCWRA has fifteen (15) dedicated monitoring wells in the 180/400 Foot Aquifer subbasin, all of which will be included in the CASGEM network. Some of the monitoring wells consist of clusters of multiple nested wells at a single location, with each well in the cluster monitoring a different aquifer. The CASGEM well network includes seven (7) privately owned wells; where the well owner has granted permission for MCWRA to include his/her well in the CASGEM program. There is also one (1) voluntary well in the 180/400 Foot Aquifer subbasin.

Data Gaps – Horizontal Distribution of Wells

The 180/400 Foot Aquifer subbasin is 132 square miles. Based on the target minimum density of ten (10) wells per 100 square miles, this subbasin should have 13 monitoring wells to meet the needs of the CASGEM program. MCWRA has met the target minimum density in the 180/400 Foot Aquifer subbasin with a network distributed throughout the basin, as shown in Figure 3.

Data Gaps – Vertical Distribution of Wells

As discussed in Section 2.2, the 180/400 Foot Aquifer subbasin has three distinct water-bearing zones, each separated by a blue marine clay aquitard. All three aquifers will be monitored by the wells in the CASGEM network, as shown in Table 4.

Table 4 - Vertical Distribution of Wells in 180/400 Foot Aquifer			
Aquifer Zone	Dedicated Monitoring Wells	Privately Owned CASGEM Wells	Total Wells
180-Foot Aquifer	8	1	9
400-Foot Aquifer	3	5	8
180/400 Foot Aquifers	4	0	4
Deep Aquifer	0	1	1
TOTAL	15	7	22

As shown in Table 4, eight (8) of the MCWRA dedicated monitoring wells are constructed with screens in the 180-Foot Aquifer, as is one (1) of the privately owned wells. Three (3) of the MCWRA monitoring wells are constructed with screens in the 400-Foot Aquifer, as are five (5) of the privately owned wells. Groundwater elevations in the Deep Aquifer will be monitored at one (1) well location where permission has been granted by the well owner.

Two sets of the MCWRA dedicated monitoring wells (four total wells) are constructed in areas recognized as hydrogeologic transition zones between the 180/400 Foot Aquifer and the East Side Aquifer, and between the 180/400 Foot Aquifer and the Forebay Aquifer. The transition zone between the 180/400 Foot Aquifer and the East Side Aquifer is distinguished by a shift from predominantly fluvial facies, common to the 180/400 Foot Aquifer, to predominately alluvial fan facies (Kennedy/Jenks, 2004). The transition from the 180/400 Foot Aquifer to the Forebay Aquifer

is characterized by thinning and/or pinching out of the near surface confining unit, the Salinas Aquitard (DWR, 2003).

Although the site-specific geology at these monitoring wells suggests that the wells are more representative of the East Side Aquifer or Forebay Aquifer, MCWRA has assigned these four wells to the 180/400 Foot Aquifer subbasin because they are geographically located in this basin, as directed by DWR (staff communication, 2015). If an opportunity arises in the future to adjust the groundwater basin/subbasin boundaries, wells like these will be useful for defining transitional zones and aligning basin boundaries with known hydrogeology.

Though MCWRA has met the target minimum density in the 180/400 Foot Aquifer, there is only one well monitoring the Deep Aquifer Zone, which suggests a data gap in the CASGEM network. MCWRA will address this data gap by evaluating the possibility of including new privately owned wells in the CASGEM program, and will reach out to well owners seeking participation when an appropriate well is found. Additionally, while there are no funds accessible at present to drill new monitoring wells, MCWRA will consider this option if funding becomes available.

3.3.2 East Side Aquifer

The CASGEM network for the East Side Aquifer subbasin is shown on Figure 4. MCWRA has two (2) dedicated monitoring wells in the East Side Aquifer subbasin, both of which will be included in the CASGEM network. The CASGEM well network also includes six (6) privately owned wells in the East Side Aquifer subbasin.

Data Gaps – Horizontal Distribution of Wells

The East Side Aquifer subbasin has an approximate area of 90 square miles, suggesting that the subbasin should have nine (9) monitoring wells to meet the CASGEM program target minimum density. The CASGEM network in this monitoring plan, which consists of eight (8) wells, is one well short of this target minimum density.

There remains an area in the central portion of the subbasin of approximately 26 square miles (29% of the subbasin area) where there are no monitoring wells. MCWRA continues to seek suitable privately owned wells in this area for inclusion in the CASGEM program. Additionally, as funding opportunities become available, MCWRA will consider the installation of new monitoring wells in this area of the East Side Aquifer subbasin.

Data Gaps – Vertical Distribution of Wells

Groundwater in the East Side Aquifer is semi-confined to unconfined, as discussed in Section 2.3 of this document. For purposes of monitoring in this subbasin, MCWRA distinguishes the unconfined (shallow) portion of the aquifer from the semi-confined (deeper) portion, though there is not a continuous confining layer present at all locations within the subbasin.

Recognizing this distinction, the East Side Aquifer CASGEM network includes wells that are screened in both unconfined and semi-confined water-bearing zones: two (2) of the wells are screened in the shallow zone and one (1) is screened in the deeper zone.

Five (5) of the wells in the CASGEM network have screens in both zones. These wells have been included in the CASGEM network because there are few MCWRA program wells (i.e. potential CASGEM wells) in this subbasin that are screened in a discrete aquifer zone. Despite having screened intervals in both the shallow and deep zones, viable groundwater elevation data can be gleaned from these wells. Trends in the groundwater elevation data from these dual-screened wells is compared to that from wells that are screened in a discrete zone, and professional judgment is used to determine which zone is best represented by the dual-screened well and how the data fits with overall data trends seen in other wells across the basin.

MCWRA will evaluate the possibility of including additional privately owned wells, including ones that may not currently be in a monitoring program, to resolve data gaps in the East Side Aquifer. Preference will be given to wells that are screened in a single water-bearing zone. As funding becomes available, the option to install new monitoring wells will also be considered.

3.3.3 Forebay Aquifer

The CASGEM network for the Forebay Aquifer subbasin is shown on Figure 5. MCWRA has nine (9) dedicated monitoring wells in the Forebay Aquifer subbasin, all of which will be included in the CASGEM network. The nine (9) monitoring wells cover four (4) geographic locations within the basin, divided as follows: three (3) clusters of two (2) nested wells each and one (1) cluster of three (3) nested wells. The Forebay Aquifer subbasin also includes two (2) voluntary wells.

Data Gaps – Horizontal Distribution of Wells

The Forebay Aquifer subbasin is approximately 147 square miles, indicating a need for 15 monitoring wells in order to achieve the target minimum density. For the purposes of horizontal distribution, the CASGEM network in the Forebay Aquifer subbasin will cover four (4) locations due to the nested construction at some of the monitoring well pairs. An additional 11 wells are required to meet the target minimum density for this subbasin.

MCWRA does not currently have funding to support installation of an additional 11 monitoring wells in the Forebay Aquifer subbasin. However, as funding opportunities become available, MCWRA will review the possibility of installing additional wells to address data gaps in the CASGEM network. In the meantime, MCWRA will continue to evaluate existing privately owned wells and, as deemed appropriate, entreat the permission of the well owners for inclusion of more wells into the CASGEM network.

Data Gaps – Vertical Distribution of Wells

The Forebay Aquifer is considered to be an unconfined aquifer. As such, there are no data gaps in the vertical distribution of the CASGEM network. The current wells, and any additional wells that may be incorporated in the future, will be monitoring the same vertical water-bearing zone.

3.3.4 Upper Valley Aquifer

The CASGEM network for the Upper Valley Aquifer subbasin is shown on Figure 6. The CASGEM network will include the three (3) wells: one (1) dedicated monitoring well owned by MCWRA in the Upper Valley Aquifer subbasin and two (2) privately owned wells.

Data Gaps – Horizontal Distribution of Wells

The Upper Valley Aquifer subbasin is 153 square miles; therefore, 15 monitoring wells are required to meet the target minimum density for the subarea. To meet this target, the Upper Valley Aquifer subbasin will require an additional 12 wells.

MCWRA does not currently have plans or funding to install any additional monitoring wells in the Upper Valley Aquifer subbasin to alleviate the data gap in this subbasin. However, should funding become available, MCWRA will explore the installation of dedicated monitoring wells where data gaps exist in the CASGEM network. Until such funding becomes available, MCWRA will seek additional participation from private well owners whose wells are deemed suitable to achieve the needs of the CASGEM program.

Data Gaps – Vertical Distribution of Wells

The Upper Valley Aquifer is considered to be an unconfined aquifer. As such, there are no data gaps in the vertical distribution of the CASGEM network. The current wells, and any additional wells that may be incorporated in the future, will be monitoring the same vertical water-bearing zone.

Figure 3 - 180/400 Foot Aquifer Subbasin

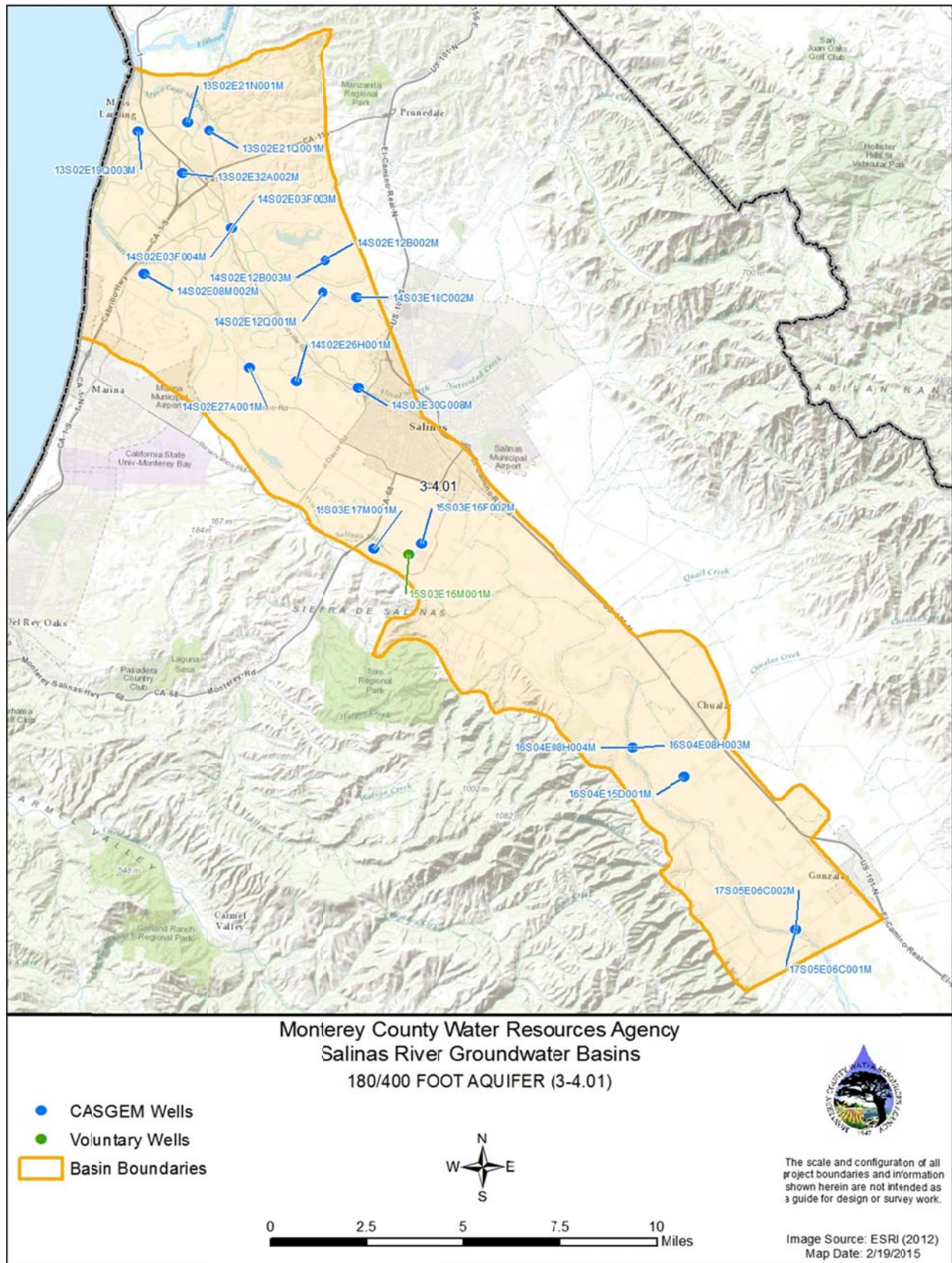


Figure 4 – East Side Aquifer Subbasin

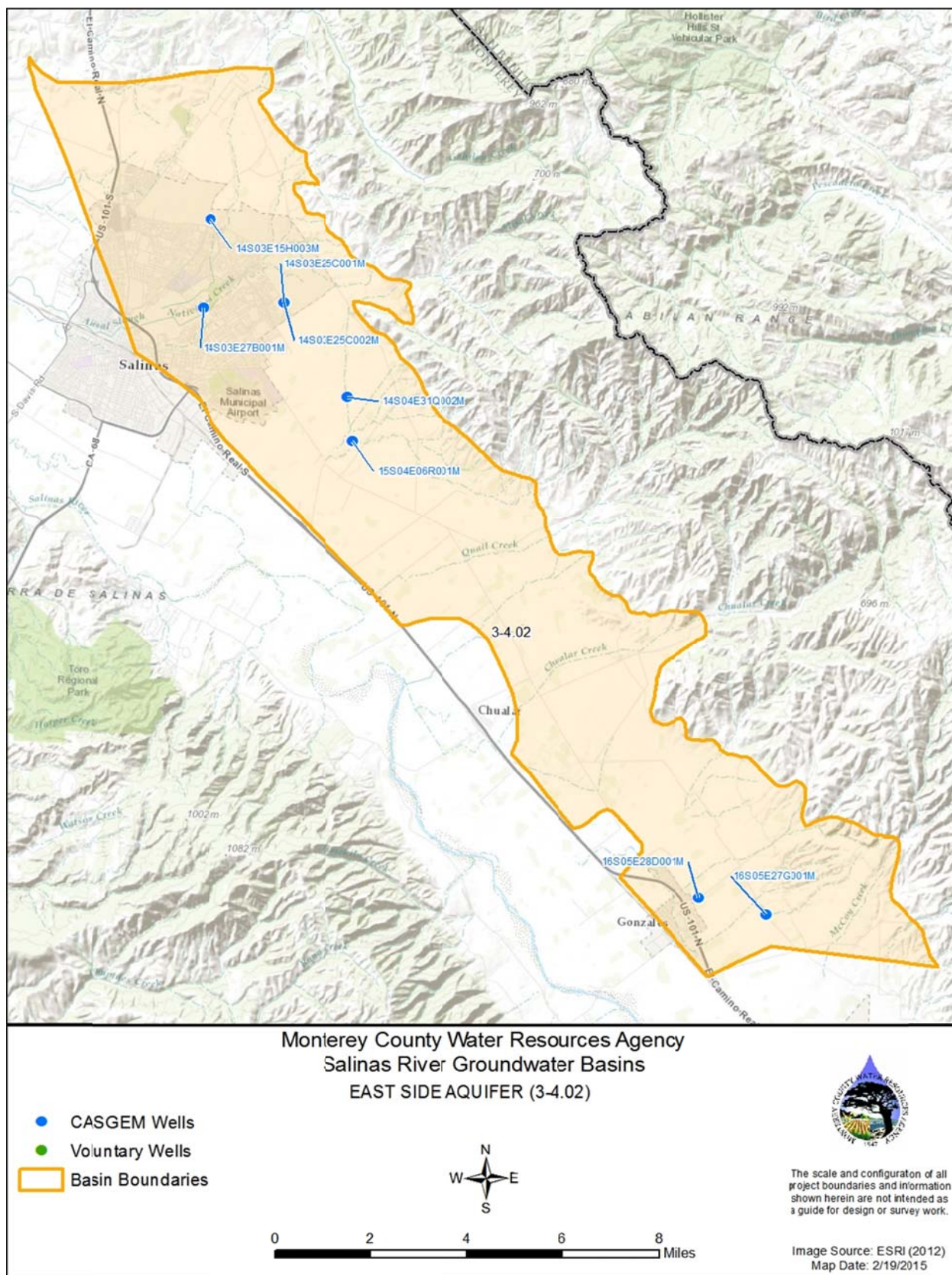


Figure 5 – Forebay Aquifer Subbasin

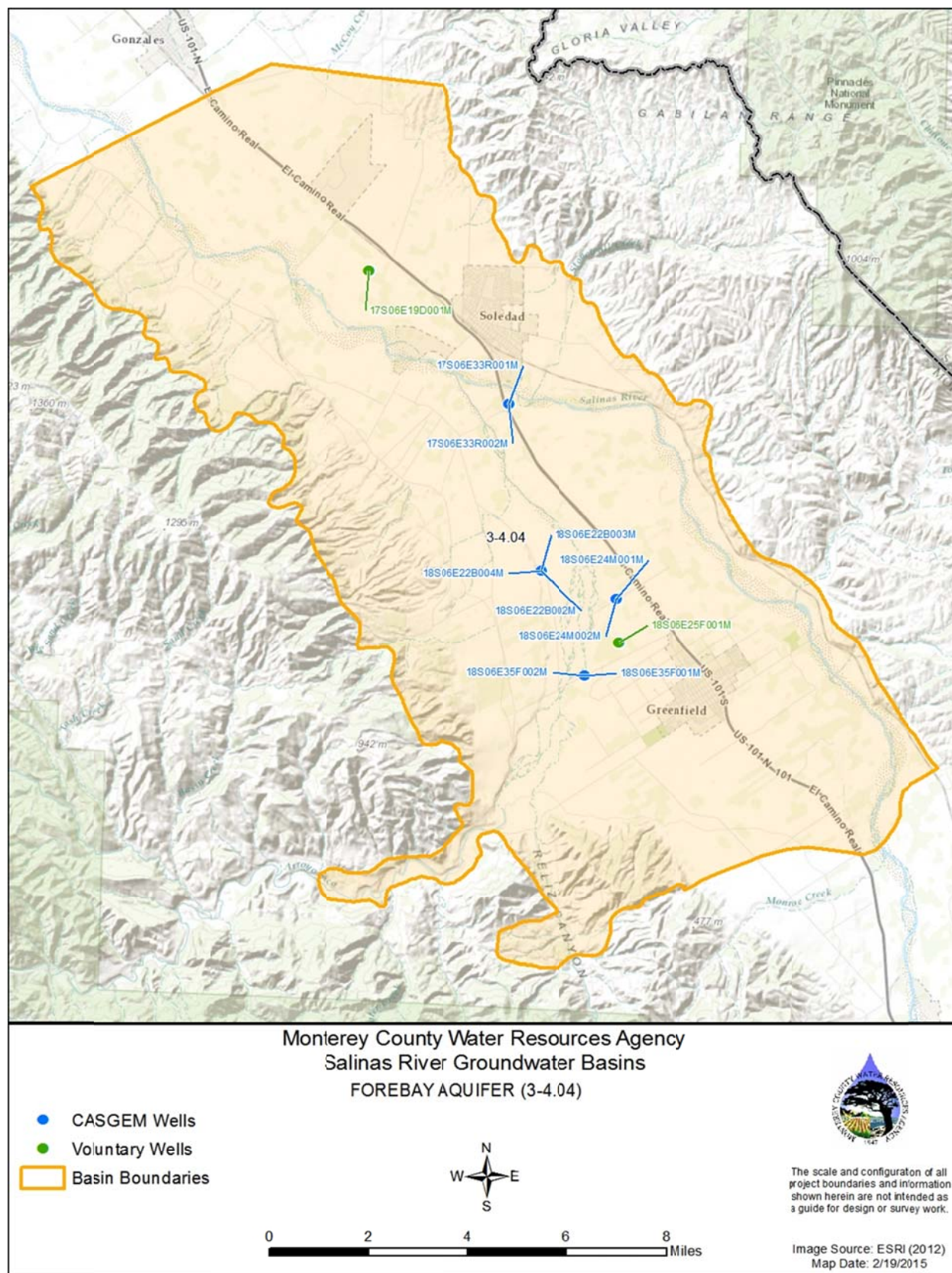
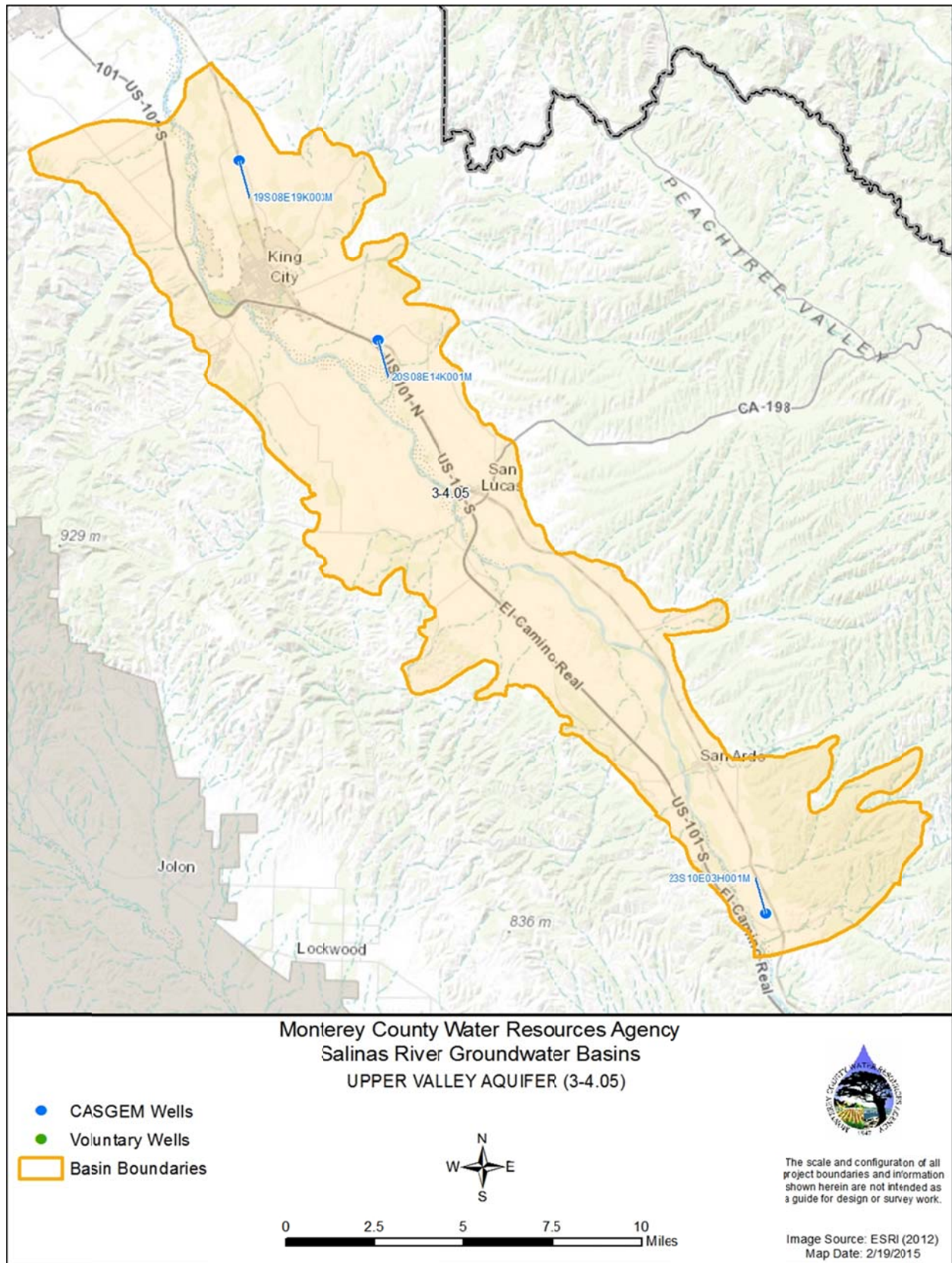


Figure 6 – Upper Valley Aquifer Subbasin



3.3.5 Paso Robles Area

The Paso Robles Area subbasin is located in both Monterey and San Luis Obispo counties, as shown on Figure 7. The subbasin is split by the county lines, with approximately 221 square miles of the Paso Robles Area located in Monterey County. Based on the area within Monterey County, 22 monitoring wells would be required to meet the target minimum density for the subarea. The remainder of the Paso Robles Area subbasin will be monitored by the San Luis Obispo County Flood Control & Water Conservation District.

MCWRA has one (1) dedicated monitoring well in the Paso Robles Area subbasin, which will be included in the CASGEM network (Figure 7). The San Luis Obispo County portion of the Paso Robles Area is currently monitored by fourteen (14) wells, as shown on Figure 7 (SLOCFCWD, 2014); one of these wells is very close to the Monterey County/San Luis Obispo County line.

MCWRA does not currently have plans or funding to install any additional monitoring wells in the Paso Robles Area Subbasin, though if funding becomes available, the construction of new monitoring wells will be explored as a mechanism for addressing this data gap in the CASGEM network. Consideration will be given to the San Luis Obispo County CASGEM network when evaluating installation of new wells or incorporation of privately owned wells from the subbasin in the CASGEM network, as it is monitoring of the basin as a whole that is the priority.

Data Gaps – Horizontal Distribution of Wells

With only one well located in the Paso Robles Area, there is a data gap to address in this subbasin; 21 additional wells are required to meet the target minimum density. MCWRA will continue to investigate the possibility of locating privately owned wells for the CASGEM program, while also considering the installation of additional monitoring wells should a funding mechanism become available. As discussed above, the existing CASGEM network in the San Luis Obispo County portion of the subbasin will be considered when evaluating augmentation of the monitoring network in the Monterey County portion of the subbasin.

Data Gaps – Vertical Distribution of Wells

As discussed in Section 2.6 of this Monitoring Plan, the Paso Robles Groundwater Basin Computer Model (Model) has characterized flow in the basin using four vertical groundwater zones: one in the alluvium and three within the Paso Robles Formation (SLOCFCWD, 2014).

The one (1) monitoring well that currently comprises the CASGEM network in this subbasin is monitoring the unconfined alluvial unit. Any future wells that are brought into the CASGEM program will be evaluated and selected with consideration given to the zone that is monitored by the well. Similarly, any new monitoring wells that may be installed in this area will be designed such that all of the zones defined by the Model are monitored.

3.3.6 Langley Area

The Langley Area subbasin is approximately 24 square miles in area. Based on the target minimum density, the CASGEM network for this subbasin should include two (2) wells. MCWRA does not have any dedicated monitoring wells in the Langley Area subbasin, but three (3) CASGEM wells have been located for this subbasin (Figure 8).

Data Gaps – Horizontal Distribution of Wells

The three (3) CASGEM wells in the Langley Area are located in the eastern half of the subbasin, leaving a data gap in the western portion of the subbasin, near the boundary with the 180/400 Foot Aquifer subbasin. MCWRA has identified possible privately owned wells that are located in the data gap area and continues to work with the well owners toward inclusion of these wells in the CASGEM program. In addition, should funding become available, MCWRA will consider this area as a candidate for installation of new monitoring wells.

Data Gaps – Vertical Distribution of Wells

The dominant water-bearing unit in the Langley Area is the Aromas Red Sands. Based on the depth of the CASGEM wells, the Aromas Red Sands are being monitored, so there are no apparent vertical data gaps to address. Other geologic units present in the Langley Area are neither alluvial nor considered to be water-bearing.

3.3.7 Corral de Tierra Area

The Corral de Tierra subbasin is approximately 35 square miles in area, so four (4) monitoring wells are required to meet the target minimum density for the subarea. MCWRA does not have any dedicated monitoring wells in the Corral de Tierra subbasin; however, MCWRA has identified two (2) CASGEM wells in this subbasin (Figure 9).

Data Gaps – Horizontal Distribution of Wells

Land that is part of the former Fort Ord, now owned by the United States Army Corps of Engineers (USACE), occupies the northwestern, and part of the northeastern, areas in the Corral de Tierra Area subbasin. MCWRA has contacted USACE seeking their participation in the CASGEM program, but has yet to receive a response (Appendix A). MCWRA cannot access the USACE land, therefore, the CASGEM network will be limited to the eastern/southeastern areas of the subbasin. The two (2) CASGEM wells are located in the south-central part of the Corral de Tierra Area, leaving a data gap in the eastern part of the subbasin.

Though MCWRA does not currently have funding to install any additional monitoring wells in the Corral de Tierra Area subbasin, this will be explored as a possibility if funding becomes available. MCWRA has been unable to secure approval for participation from the well owners contacted in this portion of the subbasin, but staff continues to look for privately owned wells and will assess the feasibility of incorporating such wells into the CASGEM network as a means of addressing data

gaps. In addition, MCWRA will coordinate with USACE if that agency becomes willing to allow access to wells on the federal land at some point in the future.

Data Gaps – Vertical Distribution of Wells

Previous studies indicate that there is no significant limitation on vertical communication between the two water-bearing units in this subbasin and that wells screened in both units exhibit similar water levels (Geosyntec, 2007). Any additional wells added to the network to address horizontal data gaps will simply enhance monitoring of the same units.

Figure 7 – Paso Robles Area Subbasin

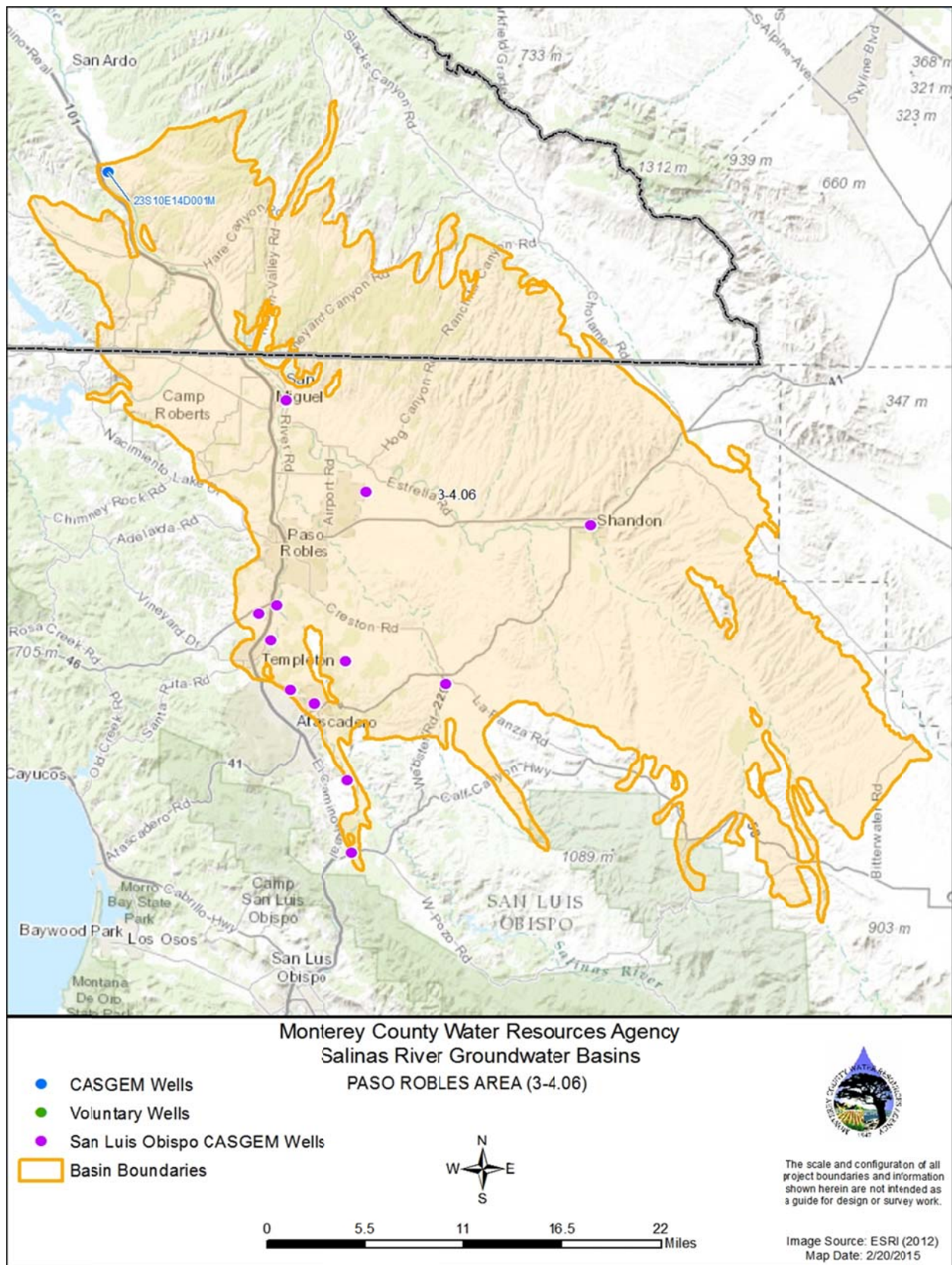


Figure 8 - Langley Area Subbasin

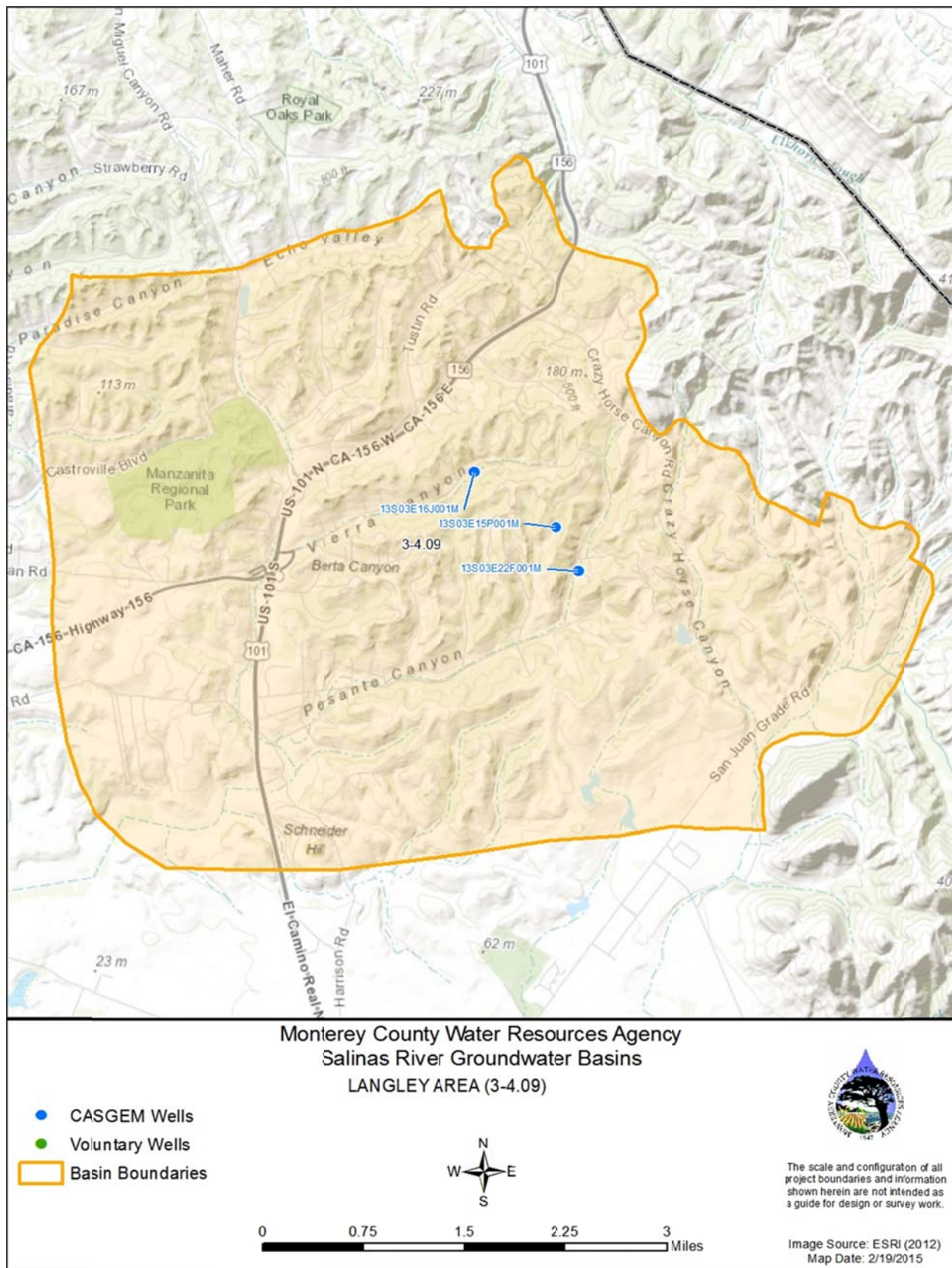
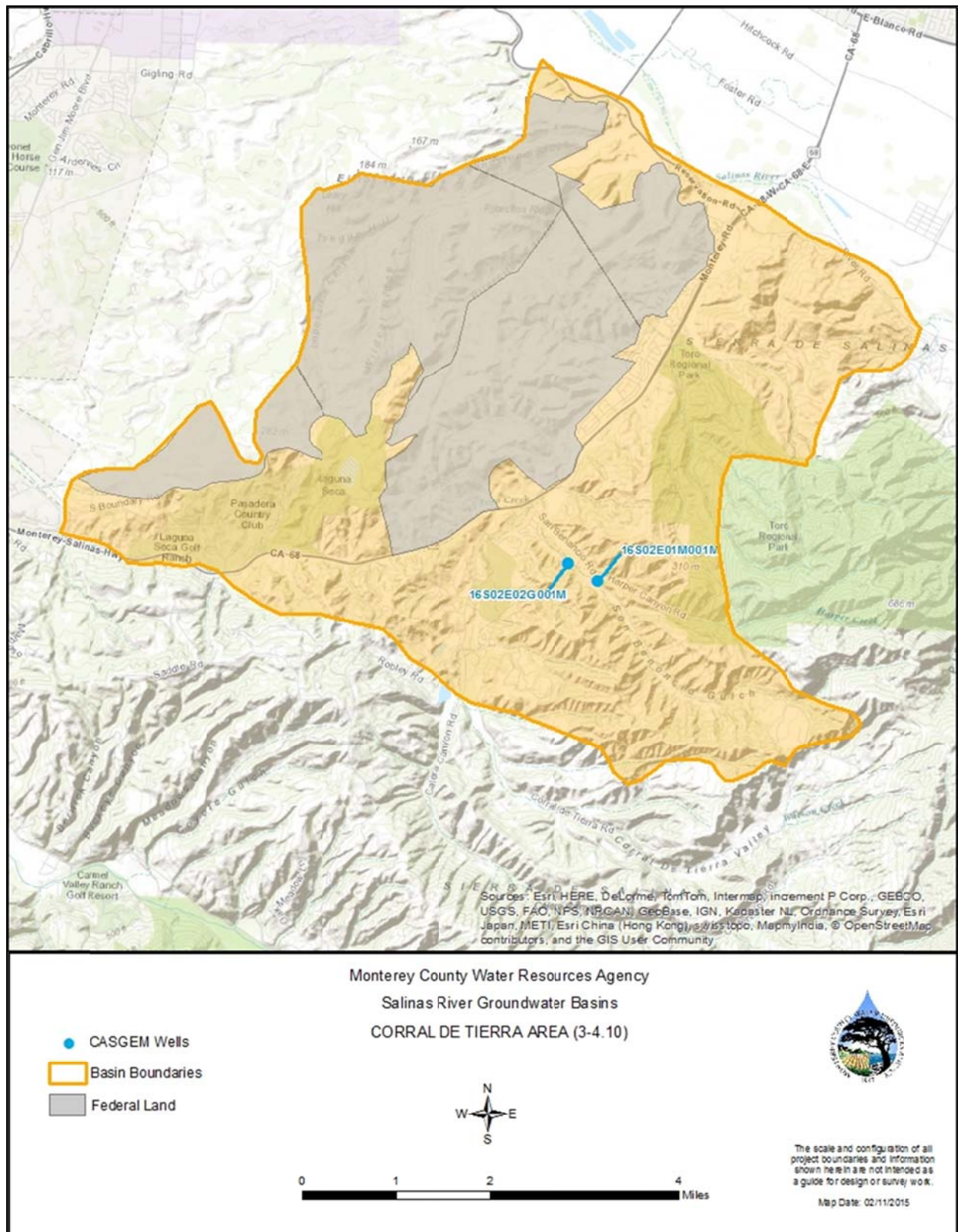


Figure 9 - Corral de Tierra Area Subbasin



4.0 Monitoring Procedures

This section addresses the various procedures and protocols involved in collecting, processing, and reporting data from wells in the CASGEM network.

4.1 Monitoring Frequency and Timing

Nineteen (19) of the CASGEM wells are currently, and will continue to be, measured on a monthly basis. The three (3) voluntary wells are also measured monthly. MCWRA will use the monthly measurements from August and either January, February, or March to satisfy the biannual CASGEM reporting criteria.

To determine the monthly distribution of seasonal high and low groundwater elevations, MCWRA analyzed measurements from approximately 50 wells throughout the Salinas Valley Groundwater Basin. This included wells in the 180/400 Foot Aquifer, East Side Aquifer, Forebay Aquifer, and Upper Valley Aquifer. The measurements were collected during eight (8) different Water Years (WY): WY 1985, representative of near normal conditions; WY 1991, representative of dry conditions; and the six most recent Water Years, WY 2009 through WY 2014. MCWRA reports this data on a quarterly basis; a sample report is included in Appendix B.

Based on this analysis of historical data, August is typically representative of seasonal low conditions (Figure 10). A relaxation of groundwater levels, or seasonal high conditions, is evident during the period from January to March (Figure 11). Data from these three months will be evaluated and the highest groundwater elevation from that series will be submitted to the CASGEM online submittal system. The month chosen to be representative of the seasonal high groundwater conditions will be consistent across all data groups.

Nineteen (19) of the CASGEM wells are equipped with pressure transducers which collect depth to water data on an hourly basis. This data will be synthesized so that biannual measurements representing seasonal high and low conditions are available for CASGEM reporting. The groundwater level measurement collected at noon on the fifteenth day of the month will be selected and compared to other monthly data to ensure that it is a representative value. Data from the month of August will be used to represent the seasonal low and a fall/winter measurement from either January, February, or March will be used to represent the seasonal high; the same month will be used as was selected based on monthly well measurements, as discussed above.

Four (4) of the wells in the CASGEM network are currently measured once per year, during the period from November to January. Based on the recent analysis of seasonal groundwater highs, this period will be shifted to cover the months from January through March. An additional measurement event will be added during the month of August for these wells in order to also capture the seasonal groundwater low.

Appendix C contains a summary of the frequency and timing of measurement of wells in the CASGEM network. Any new wells that are brought into the CASGEM program will be monitored on a

biannual basis, with data collection occurring on the same schedule as the other wells that are measured twice a year.

4.2 Well Locations

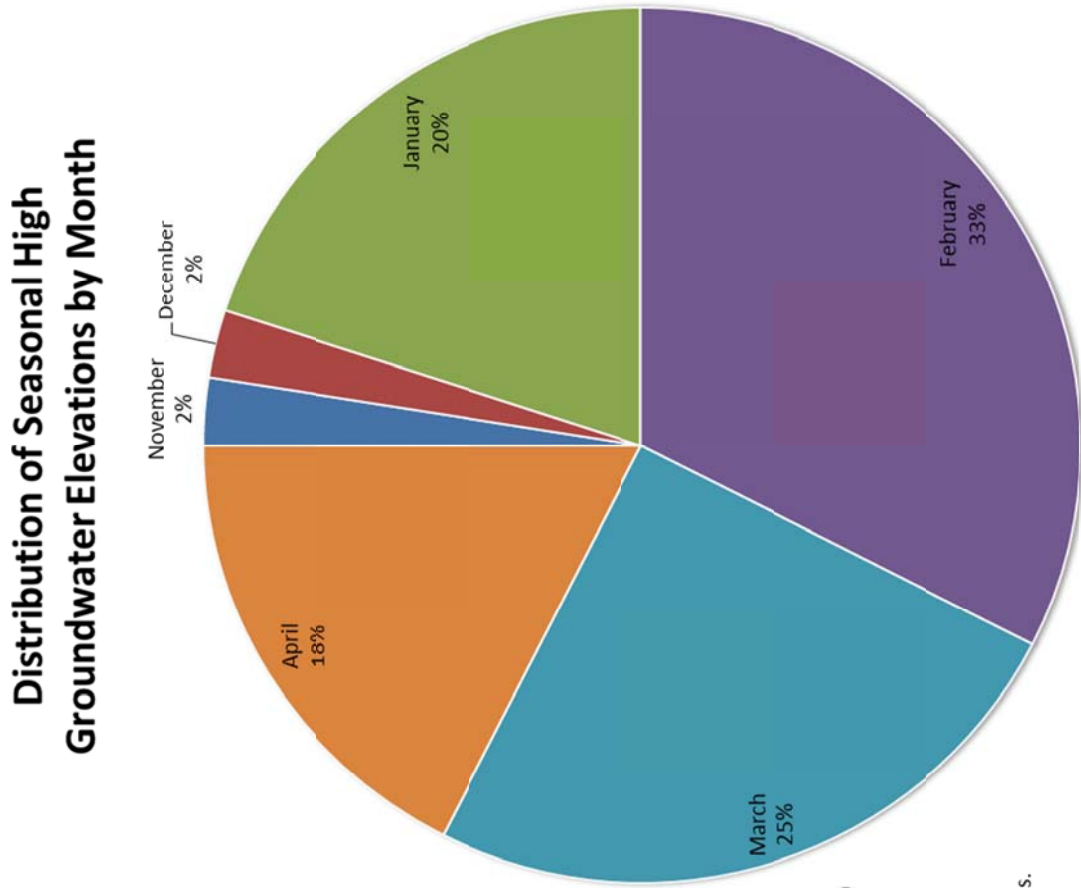
The latitude and longitude of each well was collected using a handheld GPS unit, which has accuracy to within one (1) meter. Coordinates for wells in the CASGEM network are shown in Appendix A. Any wells incorporated into the CASGEM network in the future will be geographically located using a similar method.

4.3 Reference Points

All of the wells that comprise the CASGEM network described herein are currently part of a groundwater level monitoring program conducted by MCWRA. As part of the existing monitoring programs, reference points (RP) have been established for all of the wells. To ensure consistency in measuring depth to water, a description of each well's RP is recorded in a field data collection notebook. In many cases, photographs have also been taken of the RP. Reference point elevations have been determined for all wells that are currently in a monitoring program; this data is listed in Appendix A.

A reference point will be determined for any new wells that are brought into the CASGEM network. Reference point elevations are determined using a digital elevation model from the United States Geological Survey (USGS) with a cell size of 32 feet by 32 feet.

Figure 10 – Distribution of Seasonal High Groundwater Elevations by Month



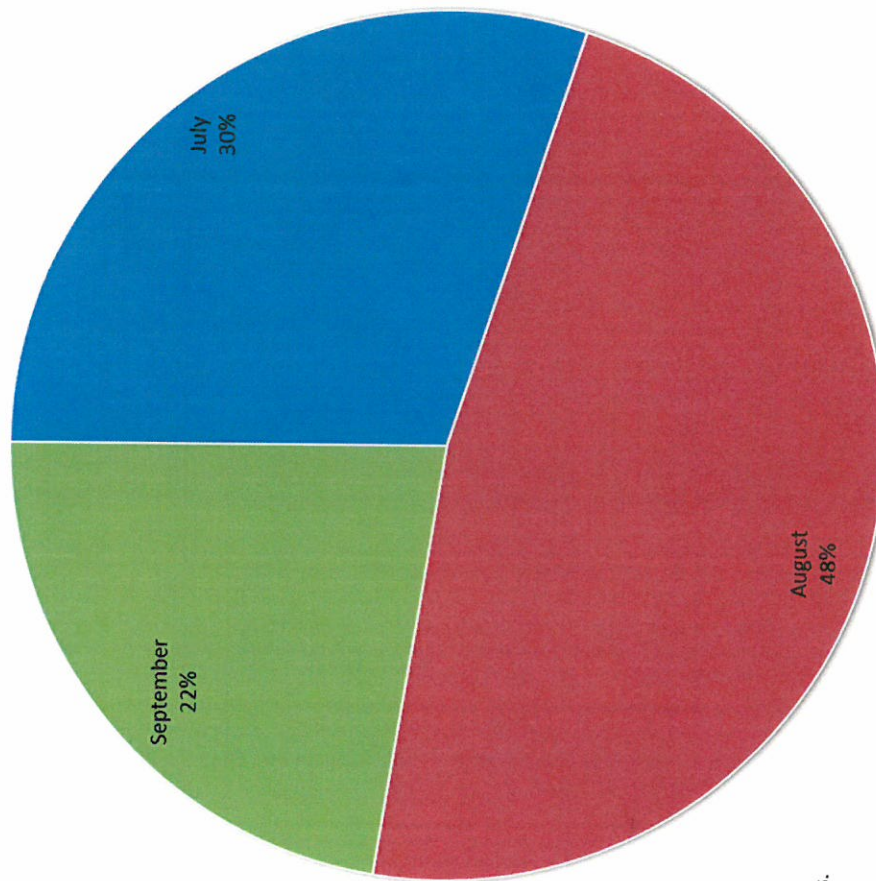
Notes

(1) Chart reflects data from the following subbasins of the Salinas Valley Groundwater Basin: 180/400 Foot Aquifer, East Side Aquifer, Forebay Aquifer, and Upper Valley Aquifer.

(2) Water Years 1985, 1991, and 2009-2014 were used in this analysis. These years represent near normal conditions (WY85), dry conditions (WY91), and the six most recent water years.

Figure 11 – Distribution of Seasonal Low Groundwater Elevations by Month

Distribution of Seasonal Low Groundwater Elevations by Month



Notes

(1) Chart reflects data from the following subbasins of the Salinas Valley Groundwater Basin: 180/400 Foot Aquifer, East Side Aquifer, Forebay Aquifer, and Upper Valley Aquifer.

(2) Water Years 1985, 1991, and 2009-2014 were used in this analysis. These years represent near normal conditions (WY85), dry conditions (WY91), and the six most recent water years.

4.4 Field Methods

Groundwater elevation data collected from wells in the CASGEM network is intended to reflect static conditions. Best efforts will be made to ensure that wells have not recently been pumped prior to collecting a data point. Depth to water measurements will be made using one or more of the methods discussed in the following sections. Measurement methods described in the following sections are based on the Department of Water Resources document *Groundwater Elevation Monitoring Guidelines* (December 2010) with some alterations specific to wells in the monitored basins/subbasins described in this Monitoring Plan.

4.4.1 Graduated steel tape

Prior to measurement:

- Ensure that the reference point on the well can be clearly determined. Check notes in the field data collection notebook.
- Review the notes and comments for previous measurements in the field data collection notebook to determine if there are any unique circumstances at this well.
- Take note of whether oil has previously been present at this well; this will be recorded in the comments section of the data form.

Making a measurement:

- Use the previous depth to water measurement to estimate a length of tape that will be needed.
- Lower the tape into the well, feeling for a change in the weight of the tape, which typically indicates that either (a) the tape has reached the water surface or (b) the tape is sticking to the side of the well casing.
- Continue lowering the tape into the well until the next whole foot mark is at the reference point. This value on the tape should be recorded in the field data collection notebook.
- Bring the tape to the surface and record the number of the wetted interval to the nearest foot.
- If an oil layer is present, read the tape at the top of the oil mark to the nearest foot. Note in the comments section of the data form that oil was present.
- Repeat this procedure a second time and note any differences in measurement in the field data collection notebook.

4.4.2 Electric water level meter

This method of measurement employs a battery-powered water level meter and a small probe attached to a ruled length of cable. Depth to water measurements collected using this equipment are recorded to the nearest tenth of an inch. This instrument is sometimes referred to as a “sounder”.

Prior to measurement:

- Review the field data sheet for the well and note whether oil has been present at this well in the past. The electric water level meter should not be used in wells where oil is present.
- Ensure that the reference point on the well can be clearly determined. Check notes in the field data collection notebook.
- Confirm that the water level meter is functioning and is turned on so that the beeping indicator will operate properly.

Making a measurement:

- Review previous depth to water measurements for the well to estimate the length of tape that will be needed.
- Lower the electrode into the well until the indicator sounds, showing the probe is in contact with the water surface.
- Place the tape against the reference point and read the depth to water to the nearest 0.1 foot. Record this value on the field data sheet.
- Make a second measurement and note any differences in measurement in the field data collection notebook.

4.4.3 Sonic water level meter

This meter uses sound waves to measure the depth to water in a well. The meter must be adjusted to the air temperature outside the well; there is a card with reference temperatures in the case with the sonic meter.

Making a measurement:

- Insert the meter probe into the access port and push the power-on switch. Record the depth from the readout.
- Record the depth to water measurement in the field data collection notebook.

4.4.4 Pressure transducer

Automated water-level measurements are made with a pressure transducer attached to a data logger. Pressure transducers are lowered to a depth below the water level in the well and fastened to the well head at a reference point. Data points are logged on an hourly basis. MCWRA uses factory-calibrated, vented pressure transducers (Appendix D). MCWRA staff collects the pressure transducer data once per quarter. During the data collection process, data loggers are stopped, and the data is downloaded onto a laptop, and then the data logger is reactivated and scheduled to begin collecting data again on the next hour. Upon return from the field, data is processed and reviewed for errors.

4.5 Data Collection, Processing, and Reporting

Following completion of all fieldwork, data is transcribed from field data sheets and checked for errors before being loaded into MCWRA's Oracle platform database. All data will be stored in the MCWRA database before being uploaded to the CASGEM website. Submittal of data to the CASGEM website will occur at a minimum of twice per year, no later than January 1 and July 1, per DWR CASGEM program guidelines.

Bi-annual submittal of data to the CASGEM website will include the following for each well in the CASGEM network, as described in the DWR document *CASGEM Procedures for Monitoring Entity Reporting*:

- Well identification number
- Measurement date
- Reference point and land surface elevation, in feet, using NAVD88 vertical datum
- Depth to water, in feet
- Method of measuring water depth
- Measurement quality codes
- Measuring agency identification
- Comments about measurement, if applicable

The following information will also be submitted to the CASGEM online system, as it is required by DWR unless otherwise noted:

- Monitoring Entity name, address, telephone number, contact person name and email address, and any other relevant contact information
- Groundwater basins being monitored (both entire and partial basins)
- State Well Identification number (recommended)
- Decimal latitude/longitude coordinates of well (NAD83)
- Groundwater basin or subbasin
- Reference point elevation of the well, in feet, using NAVD88 vertical datum
- Elevation of land surface datum at the well, in feet, using NAVD88 vertical datum
- Use of well
- Well completion type (e.g. single well, nested well, or multi-completion well)
- Depth of screened interval(s) and total depth of well, in feet, if available
- Well Completion Report number (DWR Form 188), if available

5.0 References

Department of Water Resources, 2010. *California Statewide Groundwater Elevation Monitoring (CASGEM) Program Procedures for Monitoring Entity Reporting*.

Department of Water Resources, 2010. *Groundwater Elevation Monitoring Guidelines*.

Fugro West, Inc., 1995. *North Monterey County Hydrogeologic Study, Volume I, Water Resources*.

Geosyntec Consultants, 2007. *El Toro Groundwater Study, Monterey County, California*.

Kennedy/Jenks Consultants, 2004. *Final Report - Hydrostratigraphic Analysis of the Salinas Valley*.

San Luis Obispo County Flood Control & Water Conservation District, 2014. *CASGEM Monitoring Plan for High and Medium Priority Groundwater Basins in the San Luis Obispo County Flood Control and Water Conservation District*.

Showalter, P., Akers, J.P., and Swain, L.A., 1983, Design of a ground-water quality monitoring network for the Salinas River Basin, California: U.S. Geological Survey Water-Resources Investigation Report 83-4049, 74 p.

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Appendix A

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MONTEREY COUNTY

WATER RESOURCES AGENCY

PO BOX 930
SALINAS , CA 93902
(831)755-4860
FAX (831) 424-7935

DAVID E. CHARDAVOYNE
GENERAL MANAGER



STREET ADDRESS
893 BLANCO CIRCLE
SALINAS, CA 93901-4455

David Eisen
United States Army Corps of Engineers
Fort Ord BRAC Office
PO Box 5008
Monterey, CA 93944-504

February 13, 2015

Dear Mr. Eisen:

On behalf of the Monterey County Water Resources Agency (MCWRA) I am writing to request the U.S. Army Corps of Engineers' voluntary participation in the California Statewide Groundwater Elevation Monitoring (CASGEM) program.

On November 4, 2009, the State Legislature amended the California Water Code with Senate Bill SBx7-6, which resulted in development of the CASGEM program by the California Department of Water Resources (DWR). As part of the CASGEM program, MCWRA is the designated Monitoring Entity for certain groundwater basins in Monterey County, including the Salinas Valley Groundwater Basin.

The U.S. Army Corps of Engineers (USACE) owns multiple parcels of land, specifically portions of the former Fort Ord, which are located in the Salinas Valley Groundwater Basin. MCWRA is seeking USACE's voluntary participation in the CASGEM program because the existing monitoring well network does not extend to this area of the groundwater basin.

MCWRA has no specific knowledge as to the location of monitoring wells on USACE property, so consent to participate in the CASGEM program would require disclosure of well information and either permission for MCWRA to access these wells or an arrangement wherein USACE would provide data to MCWRA. If USACE is considering participation, MCWRA can discuss this in more detail as needed.

As part of the CASGEM program, MCWRA would submit certain data about USACE wells to DWR for inclusion in a statewide database. The database will be available to the public for local and state entities to evaluate and monitor groundwater conditions. MCWRA will report the following to DWR for any well included in the CASGEM program:

- Depth to static (non-pumping) groundwater level, reported two times per year, beginning in 2015
- Approximate well location, within 1,000 feet of the actual well location
- Screened interval(s) and depth of the well as provided on the well log
- General category of well use (i.e. monitoring, public supply, domestic)

MCWRA sincerely appreciates your consideration of voluntary participation in the CASGEM program. Please feel free to contact MCWRA at 831-755-4860 if you have any questions. Additional information about the CASGEM program is also available from DWR at www.water.ca.gov/groundwater/casgem.

Regards,

A handwritten signature in blue ink that reads "David E. Chardavoyne". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

David E. Chardavoyne
General Manager

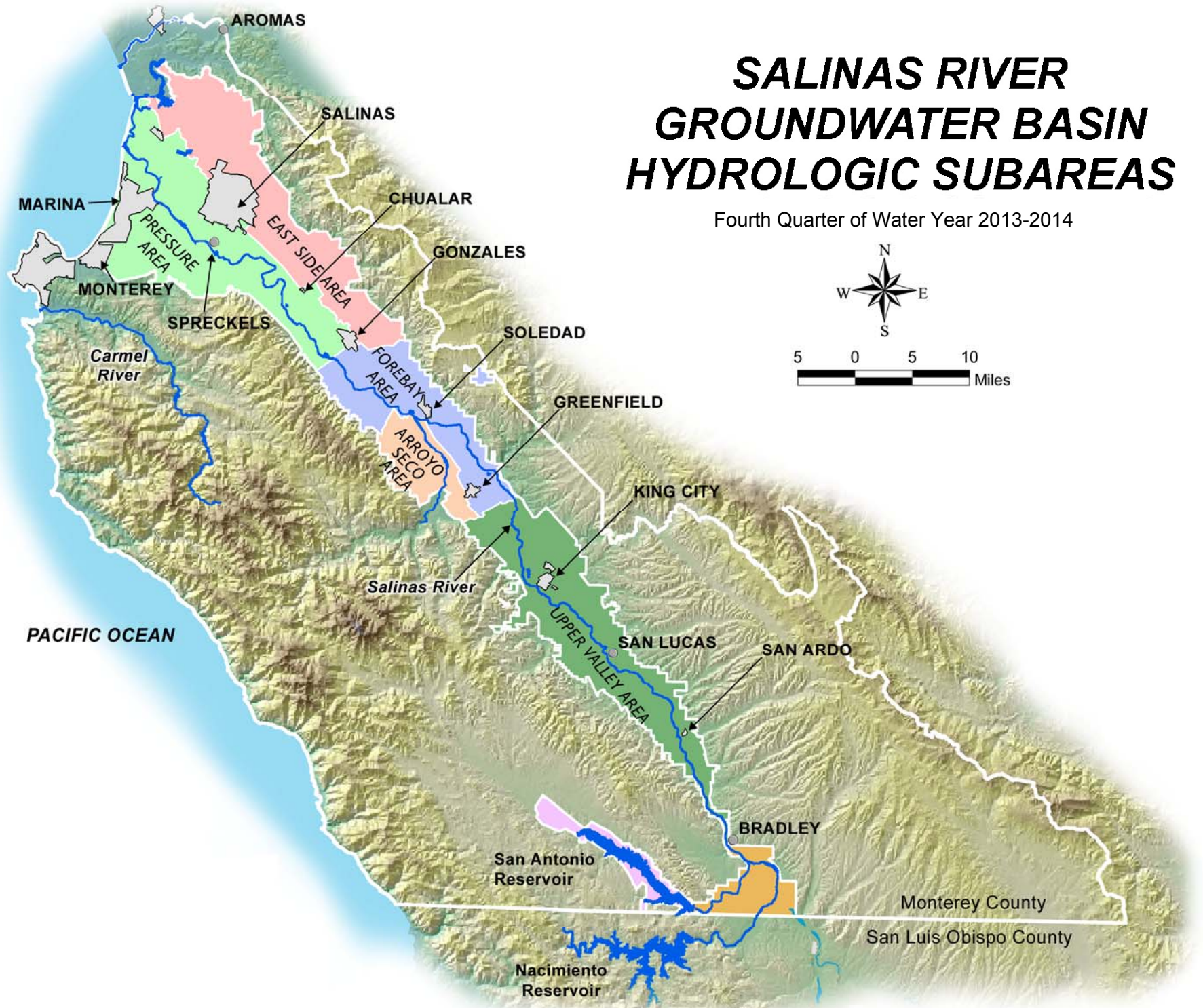
Cc: California Department of Water Resources - C. Michael McKenzie, PG

Appendix B

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SALINAS RIVER GROUNDWATER BASIN HYDROLOGIC SUBAREAS

Fourth Quarter of Water Year 2013-2014



**MONTEREY COUNTY WATER RESOURCES AGENCY
BOARD OF DIRECTORS**

MEETING DATE:	October 27, 2014	AGENDA ITEM:	
AGENDA TITLE:	RECEIVE REPORT ON SALINAS VALLEY WATER CONDITIONS FOR THE FOURTH QUARTER OF WATER YEAR 2013-2014		
Consent (X) Action () Information ()			
SUBMITTED BY:	Robert Johnson	PREPARED BY:	Peter Kwiek, Jess Barreras
PHONE:	755-4860	PHONE:	755-4860
DEADLINE FOR BOARD ACTION:		October 27, 2014	

RECOMMENDED BOARD ACTION:

Receive report on Salinas Valley water conditions for the fourth quarter of Water Year 2013-2014.

PRIOR RELEVANT BOARD ACTION:

A report was last presented to the Board on September 22, 2014, covering the third quarter of Water Year 2013-2014.

DISCUSSION/ANALYSIS:

This report covers the fourth quarter of Water Year 2013-2014 (WY14), July through September, 2014. It provides a brief overview of water conditions in the Salinas Valley with discussion of precipitation, reservoir storage, and ground water level trends. Data for each of these components are included as graphs and tables in Attachments A through I.

Precipitation – The fourth quarter of WY14 brought less than normal rainfall to Salinas and King City. Cumulative totals for the quarter were 0.11 inches (55% of normal rainfall for the quarter) at the Salinas Airport, while no measurable rainfall was logged in King City, which, on average, receives a total of 0.17 inches during the months of July through September.

Attachment A contains graphs for both stations showing monthly and cumulative precipitation data for the current and a normal water year. Tables with precipitation values shown on the graphs and percent of normal precipitation are also presented in Attachment A.

Rainfall data for Salinas and King City should be considered preliminary until verified by National Weather Service data at a later date.

Reservoirs - The following table compares fourth quarter storage at Nacimiento and San Antonio reservoirs for the past two years. Storage in Nacimiento Reservoir is 46,763 acre-feet lower than in September 2013, while storage in San Antonio Reservoir is 8,547 acre-feet lower.

Reservoir	September 30, 2014 (WY14) Storage in acre-feet	September 30, 2013 (WY13) Storage in acre-feet	Difference in acre-feet
Nacimiento	63,850	110,613	-46,763
San Antonio	12,266	20,813	-8,547

Graphs for both reservoirs showing daily storage for the last five water years and average daily storage are included as Attachments B and C.

Ground Water Levels – More than 80 wells are measured monthly throughout the Salinas Valley to monitor seasonal ground water level fluctuations. Data from approximately 50 of these wells is used in the preparation of this report. The measurements are categorized by hydrologic subarea, averaged, and graphed to compare current water levels with selected past conditions. Graphs for individual subareas, showing the current year's water level conditions, last year's conditions (WY13), dry conditions (WY91), and near-normal conditions (WY85), are found in Attachments D through H. Attachment I is a summary of water level changes for all subareas.

Ground water level measurements indicate that, by the end of the fourth quarter of WY14, water levels were recovering in the Pressure and East Side Subareas, but not in the Forebay or Upper Valley Subareas. Over the past month, average ground water levels rose by four feet in the Pressure 180-Foot Aquifer, two feet in the Pressure 400-Foot Aquifer, and one foot in the East Side Subarea while declining by two feet in the Forebay Subarea and one foot in the Upper Valley Subareas.

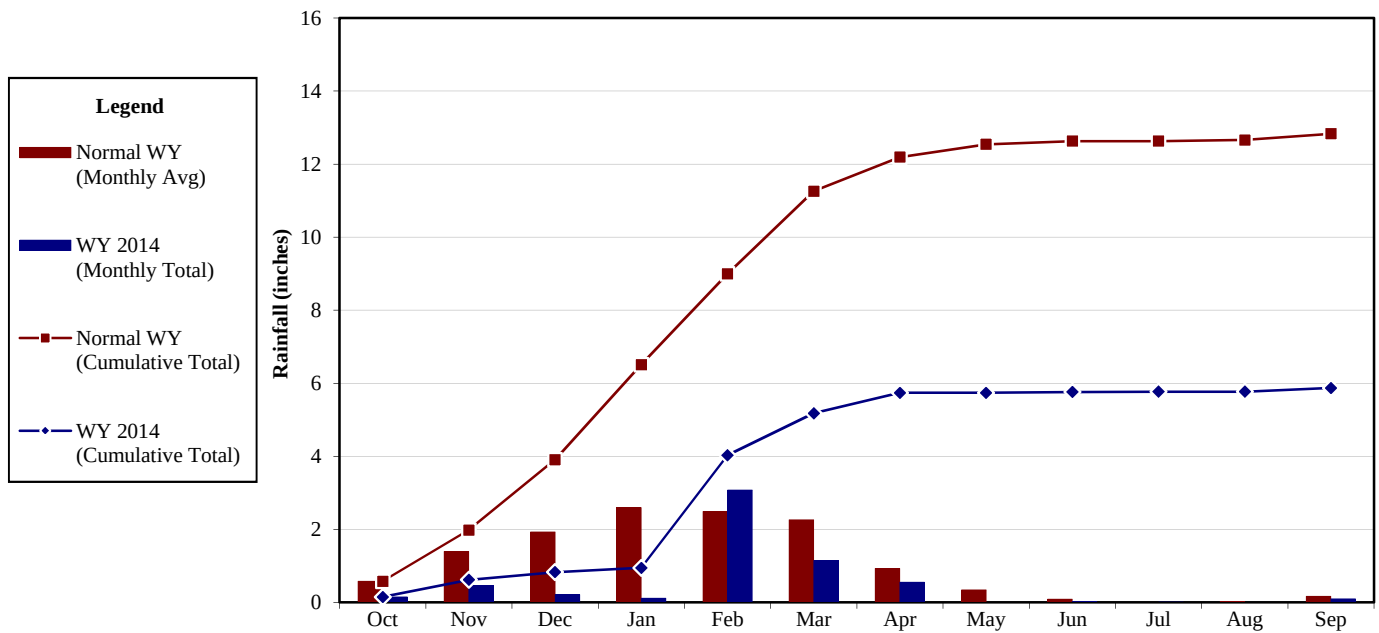
Compared to September 2013, average ground water levels in September 2014 were eight to twelve feet lower in all subareas, as shown in Attachment I.

When compared to WY85, which is considered to be a year of near normal ground water conditions, current water levels are 25 feet lower in the East Side Subarea, 10 feet lower in the Pressure 180-Foot Aquifer, eight feet lower in the Forebay Subarea and six feet lower in the Upper Valley Subarea. Water levels in the Pressure 400-Foot Aquifer are two feet higher than in WY85.

Average ground water levels for the fourth quarter of WY14 have fallen to WY91 levels in the Forebay Subarea, while falling below WY91 levels in both the East Side and Upper Valley Subareas. In the Pressure 180-Foot Aquifer, water levels equaled WY91 levels in August 2014 before recovering by two feet by the end of the quarter. By contrast, throughout the fourth quarter, water levels in the Pressure 400-Foot Aquifer remained eight to 10 feet higher than in WY91.

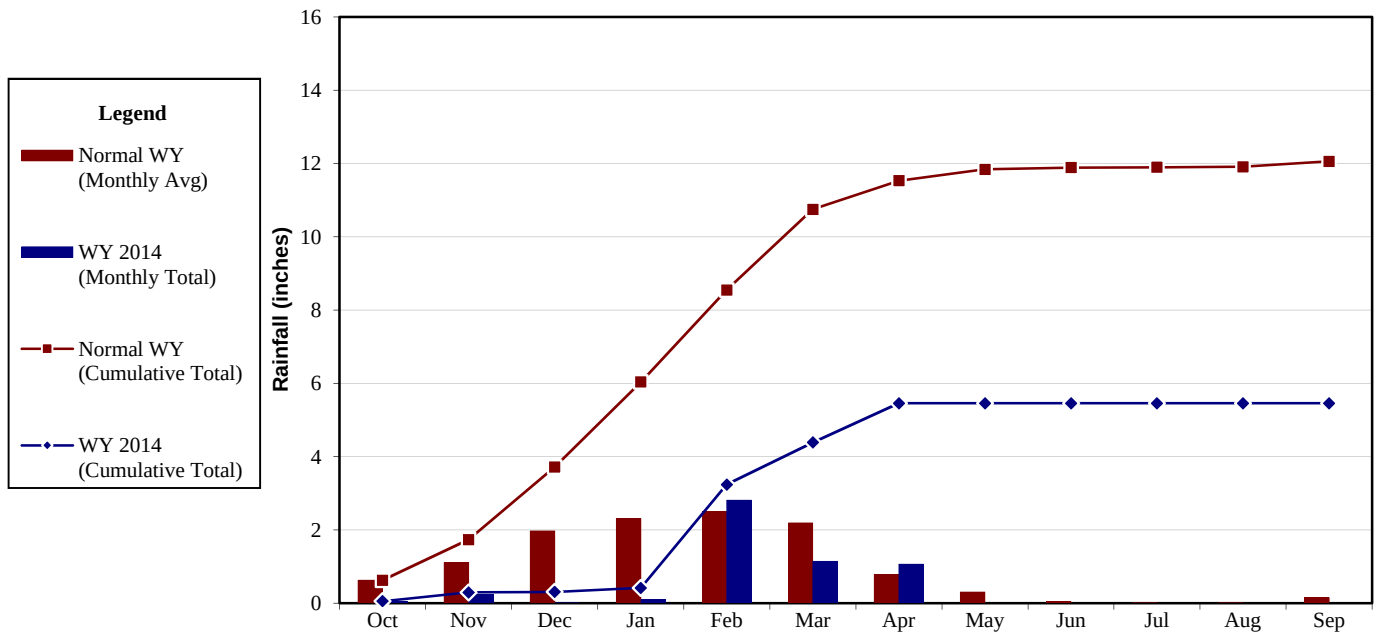
FINANCIAL IMPACT:	YES () NO (X)
FUNDING SOURCE:	
COMMITTEE REVIEW AND RECOMMENDATION:	None
ATTACHMENTS:	1. Salinas Valley Hydrologic Subareas Map 2. Salinas and King City Precipitation Graphs, Attachment A 3. Nacimiento and San Antonio Reservoir Graphs, Attachments B and C 4. Salinas Valley Monthly Water Level Graphs for Each Subarea, Attachments D through H 5. Generalized Ground Water Trends, Attachment I.
APPROVED:	General Manager Date

SALINAS AIRPORT RAINFALL WATER YEAR 2014



Monthly Rainfall (WY 2014)	0.15	0.47	0.21	0.12	3.08	1.15	0.56	0.00	0.02	0.01	0.00	0.10
Monthly Rainfall (Normal WY*)	0.58	1.40	1.93	2.60	2.49	2.26	0.93	0.35	0.09	0.00	0.03	0.17
Percent of Normal for Month	26%	34%	11%	5%	124%	51%	60%	0%	22%	N/A	0%	59%
Cumulative Rainfall (WY 2014)	0.15	0.62	0.83	0.95	4.03	5.18	5.74	5.74	5.76	5.77	5.77	5.87
Cumulative Rainfall (Normal WY*)	0.58	1.98	3.91	6.51	9.00	11.26	12.19	12.54	12.63	12.63	12.66	12.83
Percent of Cumulative Normal	26%	31%	21%	15%	45%	46%	47%	46%	46%	46%	46%	46%

KING CITY RAINFALL WATER YEAR 2014

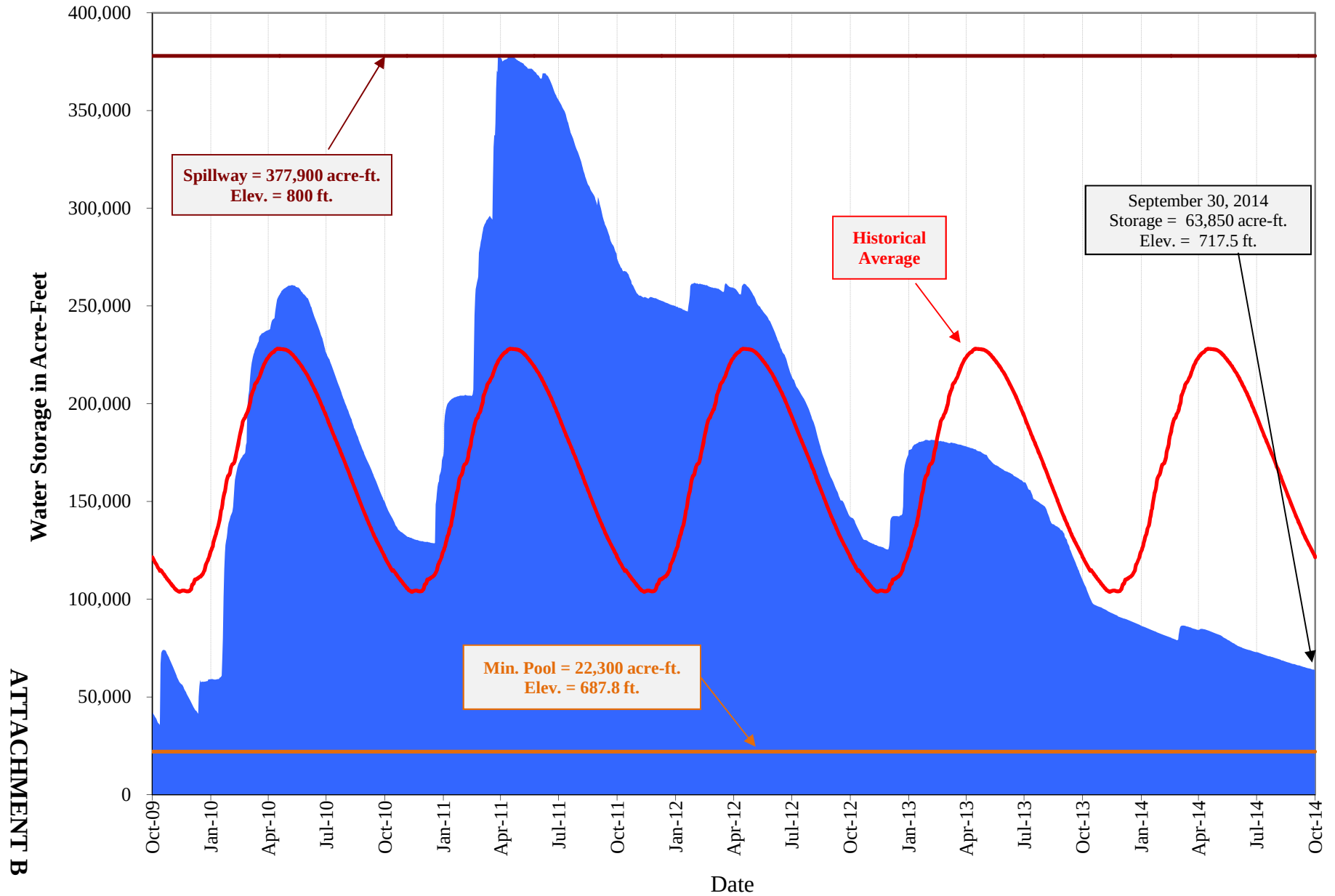


Monthly Rainfall (WY 2014)	0.06	0.24	0.01	0.11	2.82	1.15	1.07	0.00	0.00	0.00	0.00	0.00
Monthly Rainfall (Normal WY*)	0.63	1.11	1.98	2.32	2.51	2.20	0.78	0.31	0.05	0.01	0.01	0.15
Percent of Normal for Month	10%	22%	1%	5%	112%	52%	137%	0%	0%	0%	0%	0%
Cumulative Rainfall (WY 2014)	0.06	0.30	0.31	0.42	3.24	4.39	5.46	5.46	5.46	5.46	5.46	5.46
Cumulative Rainfall (Normal WY*)	0.63	1.74	3.72	6.04	8.55	10.75	11.53	11.84	11.89	11.90	11.91	12.06
Percent of Cumulative Normal	10%	17%	8%	7%	38%	41%	47%	46%	46%	46%	46%	45%

*Average precipitation over the most recent 30-year period ending in a decade (1981-2010)

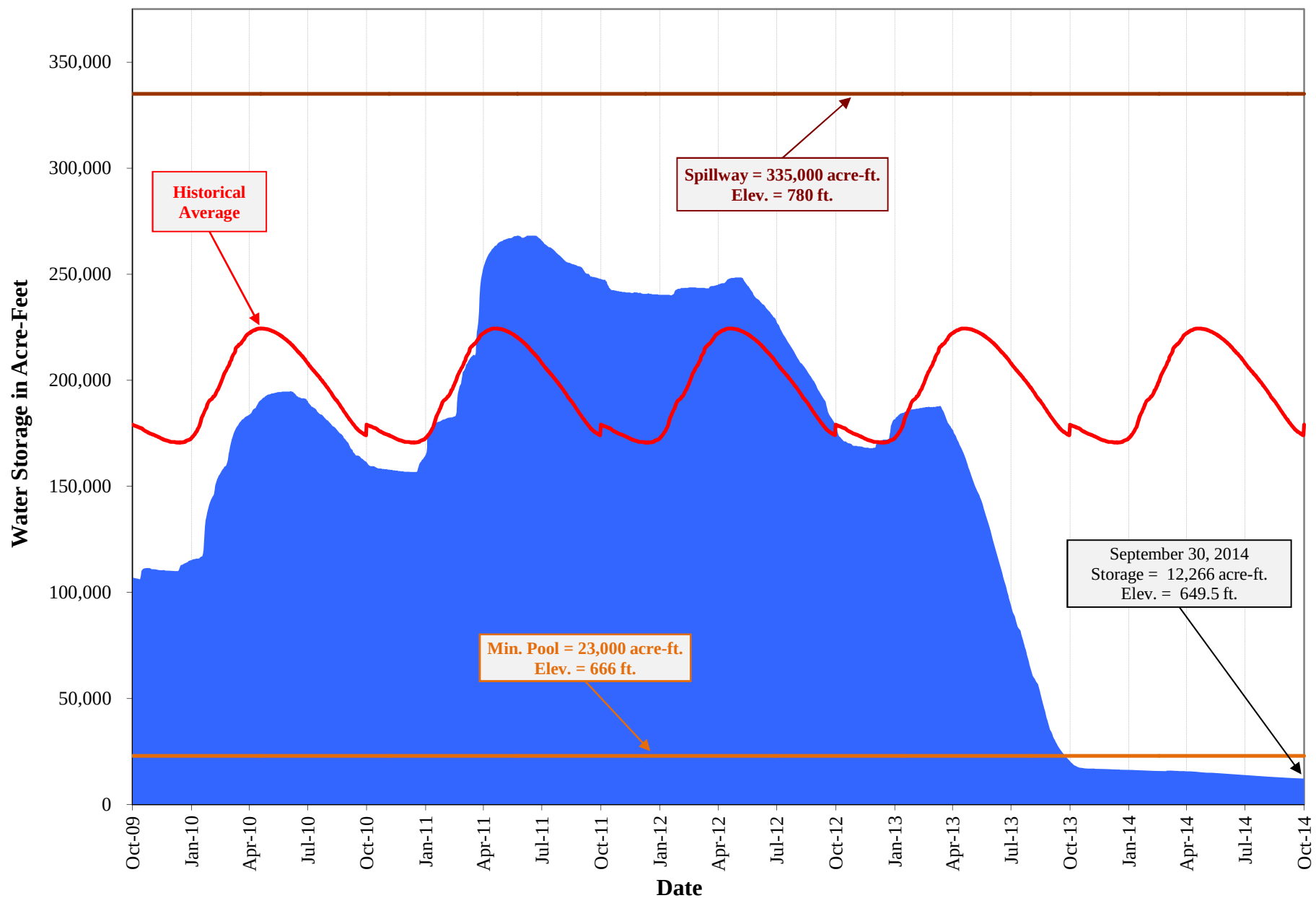
ATTACHMENT A

NACIMIENTO RESERVOIR DAILY STORAGE



SAN ANTONIO RESERVOIR DAILY STORAGE

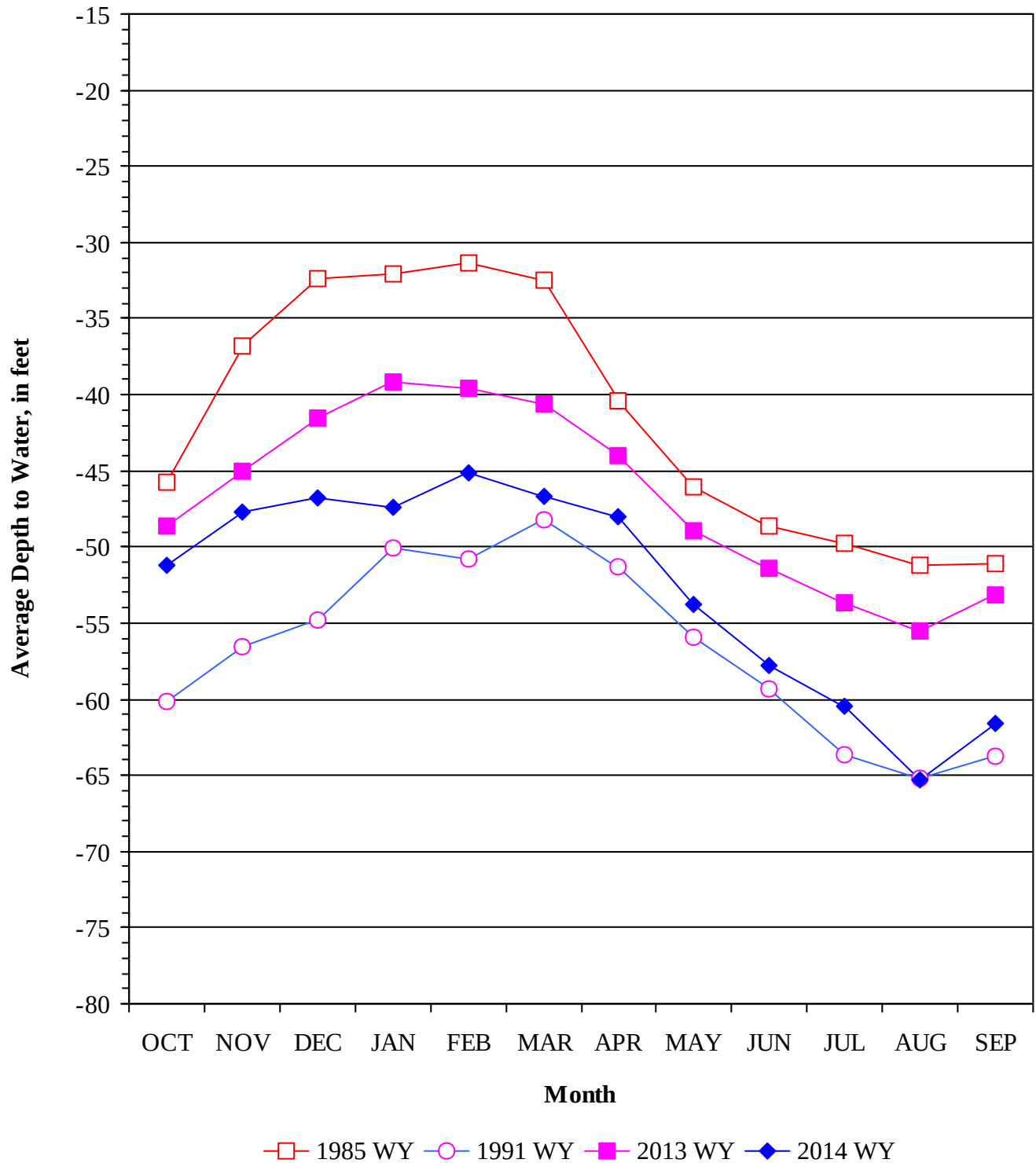
ATTACHMENT C



HISTORIC GROUND WATER TRENDS

PRESSURE 180-FOOT AQUIFER

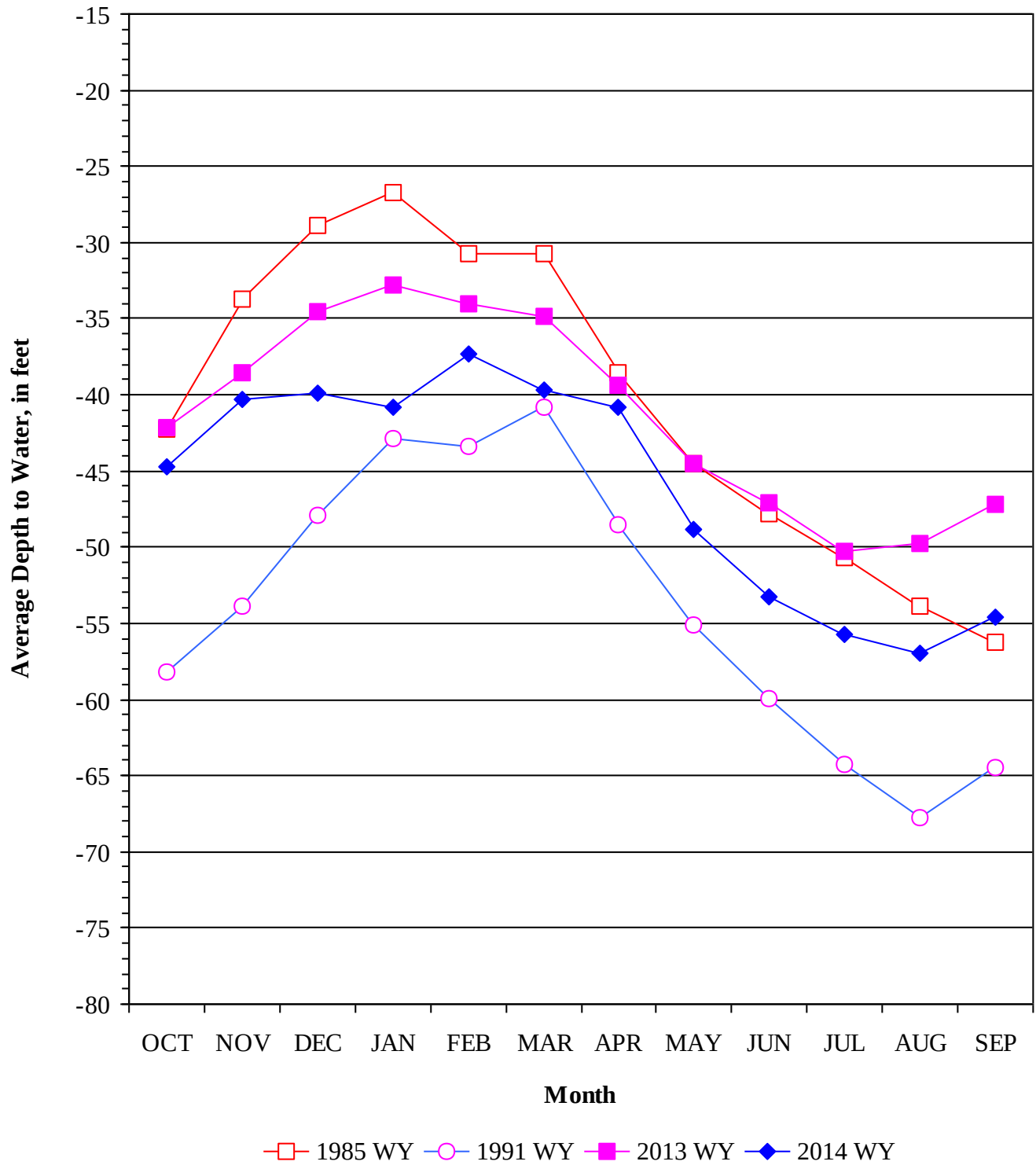
5 Wells



HISTORIC GROUND WATER TRENDS

PRESSURE 400-FOOT AQUIFER

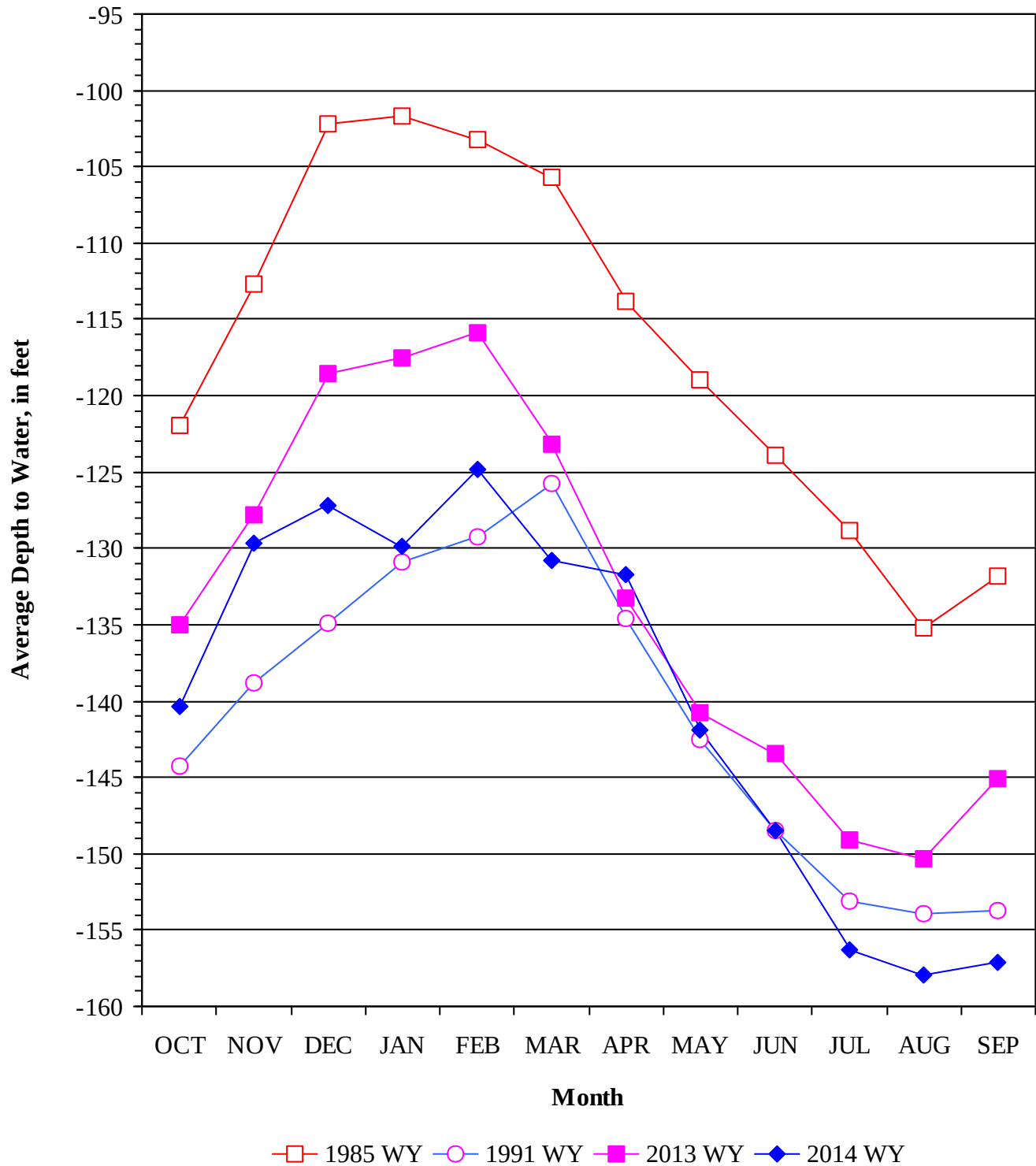
11 Wells



HISTORIC GROUND WATER TRENDS

EAST SIDE SUBAREA

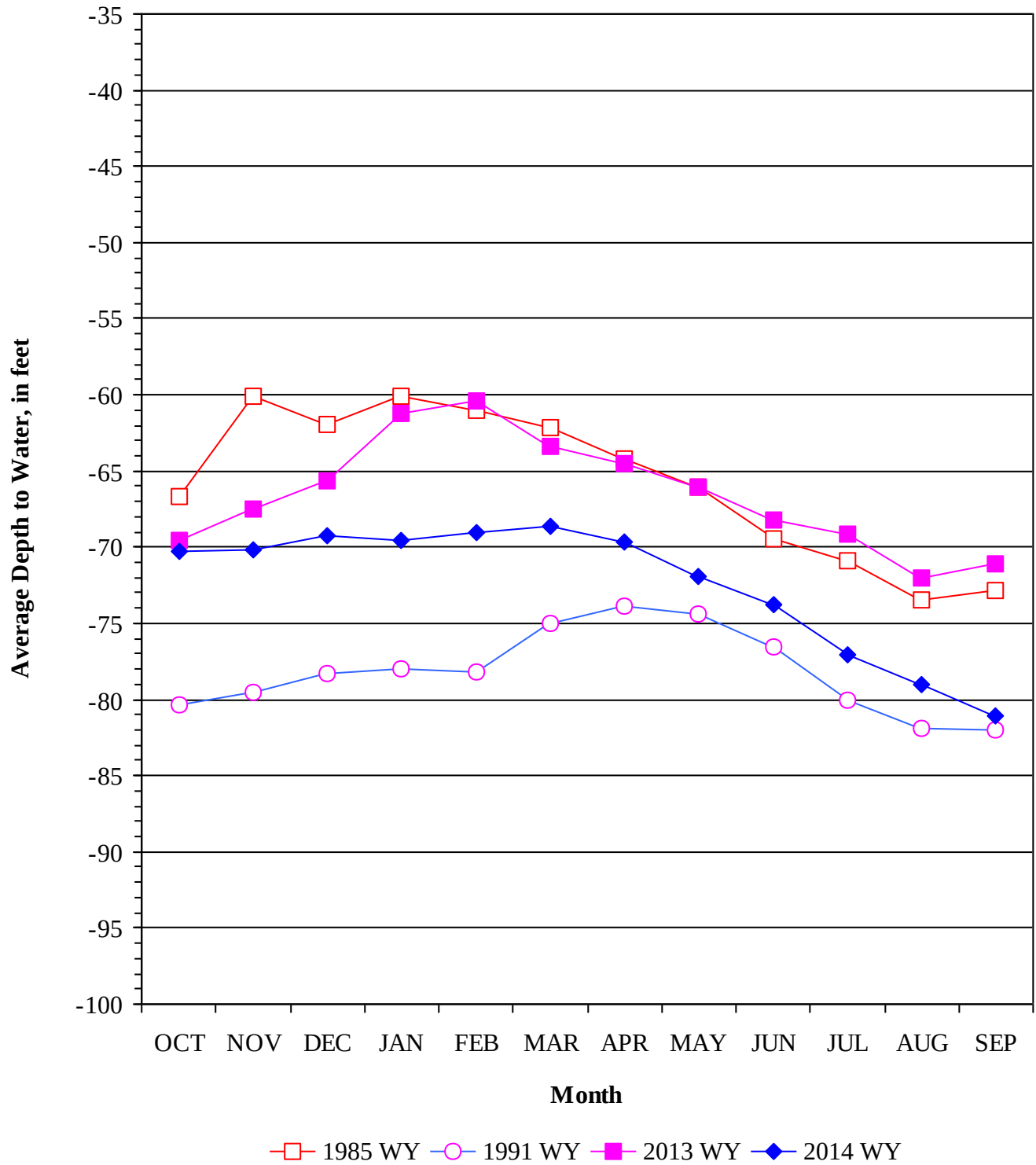
11 Wells



HISTORIC GROUND WATER TRENDS

FOREBAY SUBAREA

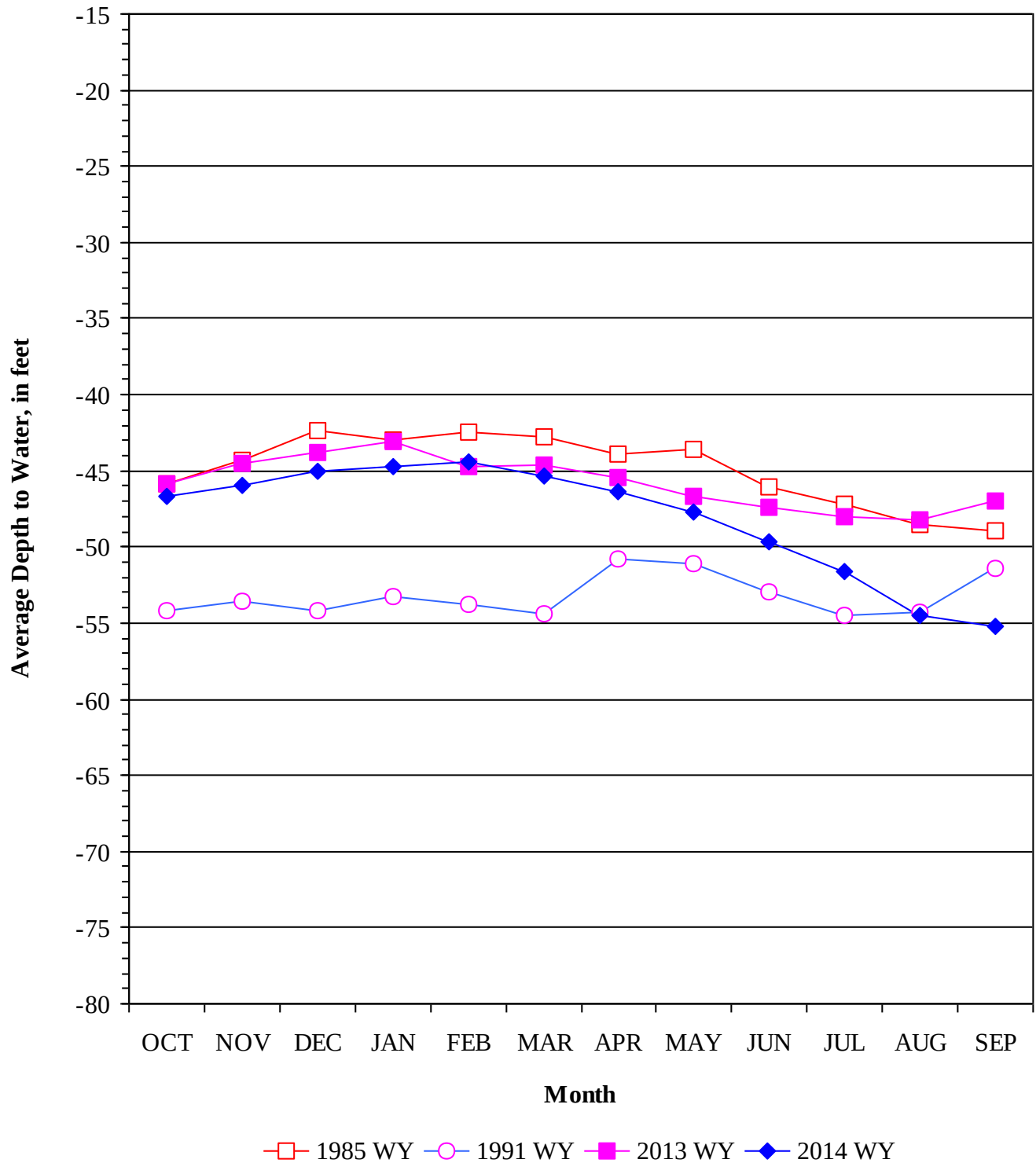
10 Wells



HISTORIC GROUND WATER TRENDS

UPPER VALLEY SUBAREA

9 Wells



Generalized Ground Water Trends

September 2014

Area	September 2014 Depth to Water	1 Year Change	Change From WY 1985	1 Month Change
Pressure 180-Foot Aquifer	62'	down 8'	down 10'	up 4'
Pressure 400-Foot Aquifer	55'	down 7'	up 2'	up 2'
East Side Subarea	157'	down 12'	down 25'	up 1'
Forebay Subarea	81'	down 10'	down 8'	down 2'
Upper Valley Subarea	55'	down 8'	down 6'	down 1'

September water levels, compared to last year, range from 12' lower to 7' lower.

September water levels, compared to WY 1985, range from 25' lower to 2' higher.

September changes in water levels over the last month range from 2' lower to 4' higher.

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Appendix C

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Table C.1 - CASGEM Network Well Data Summary

Associated Basin/Subbasin	State Well Identification Number	Local Well Designation	Latitude	Longitude	Reference Point Elevation (NAVD88, ft)	Ground Surface Elevation (NAVD88, ft)	Well Use	Well Completion Type	Depth of Screened Interval (ft-bgs)	Total Depth (ft-bgs)	Well Completion Report Number (DWR Form 188)	Frequency of Measurements	Timing of Measurements to be Submitted
3-4.01 180/400 Foot Aquifer	13S02E19Q003M	75	36.780798	-121.784687	18	not available	irrigation	single	1220-1550	1562	071658	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	13S02E21N001M	2432	36.784731	-121.761804	17.3	16.7	irrigation	single	369-550	550	not available	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	13S02E21Q001M	SELA22633	36.781644	-121.751387	12.4	12.8	dedicated monitoring	single	105-155	157	E011401	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	13S02E32A002M	10161	36.765339	-121.763589	10.6	not available	irrigation	single	300-600	600	not available	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E03F003M	ESPB22635	36.745480	-121.739493	28.2	28.7	dedicated monitoring	single	420-450	455	E011400	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E03F004M	ESPA22636	36.745391	-121.739314	24.2	24.7	dedicated monitoring	single	154-204	205	E011399	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E08M002M	239	36.727523	-121.780250	14.6	13.5	irrigation	single	314-325, 367-399, 426-456	500	71883	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E12B002M	RODA14455	36.734316	-121.695850	55.5	56.1	dedicated monitoring	single	210-260	265	338411	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E12B003M	RODB14456	36.734282	-121.695864	55.9	56.1	dedicated monitoring	single	350-380	390	338410	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E12Q001M	1707	36.722108	-121.696473	64	62	domestic	single	273-280, 288-292	619	not available	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E26H001M	AMST22651	36.688875	-121.707934	37.7	38.1	dedicated monitoring	single	287-337	339	E011403	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E27A001M	MCFD22632	36.693296	-121.729435	24.7	25.1	dedicated monitoring	single	240-290	293	E011398	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S03E18C001M	BORA15009	36.720722	-121.680556	54.8	55.1	dedicated monitoring	single	165-215	225	201242	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S03E18C002M	BORB15010	36.720736	-121.680531	54.9	55.1	dedicated monitoring	single	270-320, 365-385	395	201241	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S03E30G008M	MKTC22650	36.686880	-121.678517	44.3	44.8	dedicated monitoring	single	240-290	293	E011402	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	15S03E16F002M	1862	36.629202	-121.647449	59.5	58.5	irrigation	single	427-445, 485-570	592	81037	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	15S03E16M001M*	1359	36.624978	-121.653213	59.5	58.2	irrigation	single	not available			monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	15S03E17M001M	1480	36.626540	-121.669184	49.2	47.6	irrigation	single	128-160, 165-180	271	25902	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	16S04E08H003M	CHEB21205	36.555033	-121.546546	91.5	88.9	dedicated monitoring	nested	240-290	295	491023	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	16S04E08H004M	CHEA21208	36.555022	-121.546558	90.6	88.8	dedicated monitoring	nested	85-135	140	491023	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	16S04E15D001M	BRME10389	36.544407	-121.522009	102	103.3	dedicated monitoring	single	170-189, 314-358	384	100604	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	17S05E06C001M	GZWB21201	36.488323	-121.468404	119.7	120.1	dedicated monitoring	nested	250-290	300	491020	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	17S05E06C002M	GZWA21202	36.488324	-121.468395	119.7	120.105	dedicated monitoring	nested	60-110	115	491020	hourly	(1) August (2) Jan. to Mar.

Notes
ft = feet
ft-bgs = feet below ground surface
* = voluntary well

Table C.1 - CASGEM Network Well Data Summary

Associated Basin/Subbasin	State Well Identification Number	Local Well Designation	Latitude	Longitude	Reference Point Elevation (NAVD88, ft)	Ground Surface Elevation (NAVD88, ft)	Well Use	Well Completion Type	Depth of Screened Interval (ft-bgs)	Total Depth (ft-bgs)	Well Completion Report Number (DWR Form 188)	Frequency of Measurements	Timing of Measurements to be Submitted
3-4.02 East Side Aquifer	14S03E15H003M	752	36.717412	-121.622173	126	not available	irrigation	single	200-775	784	38491	monthly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	14S03E25C001M	FALB22618	36.692754	-121.594058	143.8	144.2	dedicated monitoring	single	570-670	680	773476	hourly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	14S03E25C002M	FALA22619	36.692725	-121.594032	143.8	144.2	dedicated monitoring	single	175-195, 240-260, 300-360	370	768985	hourly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	14S03E27B001M	15126	36.690611	-121.624200	42	42	Irrigation	single	60-335	348	not available	monthly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	14S04E31Q002M	806	36.666105	-121.569391	104	103	irrigation	single	250-390, 400-550, 580-640, 690-710	710	552493	monthly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	15S04E06R001M	1726	36.651722	-121.566933	93.7	92.5	irrigation	single	190-270, 345-390, 430-776	786	not available	monthly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	16S05E27G001M	2519	36.512244	-121.407957	272	271.5	irrigation	single	281-322, 368-410, 512-543, 565-631, 694-757, 793-930, 966-1,091	1,122	50822	monthly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	16S05E28D001M	871	36.516669	-121.432772	169	168	irrigation	single	200-215, 242-368, 408-425, 448-460, 480-508, 639-695, 754-762, 798-808	832	not available	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	17S06E19D001M*	1485	36.442444	-121.368184	170	170	irrigation	single	not available	170	not available	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	17S06E33R001M	VidaDeep21209	36.404756	-121.316169	197.4	198.0	dedicated monitoring	nested	200-250	260	491019	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	17S06E33R002M	VidaShallow21210	36.404723	-121.316163	197.6	198.0	dedicated monitoring	nested	50-115	120	491019	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E22B002M	LosCochesC18449	36.356198	-121.303324	227.4	227.9	dedicated monitoring	nested	510-580	590	490996	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E22B003M	LosCochesB21066	36.356178	-121.303292	228.5	229.0	dedicated monitoring	nested	220-270	280	490996	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E22B004M	LosCochesA21314	36.356206	-121.303260	227.8	228.3	dedicated monitoring	nested	40-90	95	490996	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E24M001M	HUD B18467	36.348507	-121.275550	232.5	233.0	dedicated monitoring	nested	193-243	253	490994	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E24M002M	HUD A21067	36.348475	-121.275639	232.5	233.0	dedicated monitoring	nested	70-120	130	490994	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E25F001M*	1495	36.335895	-121.274486	254.5	not available	irrigation	single	not available	120	not available	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E35F001M	THNB18502	36.325857	-121.286318	265.6	266.1	dedicated monitoring	nested	198-248	258	490995	hourly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E35F002M	THNA21068	36.325833	-121.286378	265.7	266.1	dedicated monitoring	nested	60-110	120	490995	hourly	(1) August (2) Jan. to Mar.

Notes
ft = feet
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Associated Basin/Subbasin	State Well Identification Number	Local Well Designation	Latitude	Longitude	Reference Point Elevation (NAVD88, ft)	Ground Surface Elevation (NAVD88, ft)	Well Use	Well Completion Type	Depth of Screened Interval (ft-bgs)	Total Depth (ft-bgs)	Well Completion Report Number (DWR Form 188)	Frequency of Measurements	Timing of Measurements to be Submitted
3-4.05 Upper Valley Aquifer	19S08E19K003M	1379	36.261416	-121.143185	282	not available	irrigation	single	130-178	212	114600	monthly	(1) August (2) Jan. to Mar.
3-4.05 Upper Valley Aquifer	20S08E14K001M	1735	36.190341	-121.071326	347.2	not available	irrigation	single	115-145, 148-205	236	43828	monthly	(1) August (2) Jan. to Mar.
3-4.05 Upper Valley Aquifer	23S10E03H001M	SArdoN19447	35.959280	-120.871501	463.6	461	dedicated monitoring	single	72-132	142	490983	monthly	(1) August (2) Jan. to Mar.
3-4.06 Paso Robles Area	23S10E14D001M	SArdoS19450	35.936241	-120.866068	465.8	463.1	dedicated monitoring	single	72-132	142	490086	monthly	(1) August (2) Jan. to Mar.
3-4.09 Langley Area	13S03E15P001M	13572	36.795258	-121.63002	365.1	364	domestic	single	300-430	430	199702	biannual	(1) August (2) Jan. to Mar.
3-4.09 Langley Area	13S03E16J001M	13625	36.801055	-121.641165	270	270	domestic	single	104-244	252	38447	biannual	(1) August (2) Jan. to Mar.
3-4.09 Langley Area	13S03E22F001M	13950	36.790570	-121.626689	236.2	235	domestic	single	260-270, 280-290, 310-320	334	22780	biannual	(1) August (2) Jan. to Mar.
3-4.10 Corral de Tierra Area	16S02E01M001M	16797	36.568031	-121.707315	406	405	domestic	single	80-120, 160-180	294	43634	biannual	(1) August (2) Jan. to Mar.
3-4.10 Corral de Tierra Area	16S02E02G001M	16820	36.570536	-121.713413	371	370	domestic	single	320-340, 360-440	448	38099	monthly	(1) August (2) Jan. to Mar.

Notes
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* = voluntary well

Appendix D

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Level **TROLL**® 400, 500 & 700 Data Loggers

Get water level data the way you want it, when you want it with industry-leading water level/pressure and temperature data loggers. By partnering with In-Situ® Inc., you receive durable Level TROLL® Data Loggers that provide years of service, accurate results, intuitive software, and real-time functionality.

Be Effective

- **Increase productivity:** Reduce training and installation time with In-Situ Inc.'s intuitive software platform and integrated components. Patented twist-lock connectors, included on Level TROLL Loggers and RuggedCable® Systems, ensure error-free deployments.
- **Set up real-time networks:** Access data 24/7 and receive event notifications when you connect data loggers to telemetry systems, radios, or other third-party data collection platforms. Control gates, pumps, alarms, and other equipment by using built-in Modbus/RS485, SDI-12, or 4-20 mA communication protocols.
- **Streamline analysis and reporting:** Automate water level corrections and post-processing, graph data, and accelerate report generation with Win-Situ® Software. Easily export data to Excel®, a web-based management service, or data analysis software.

Be Reliable

- **Deploy in all environments:** Install loggers in fresh water, saltwater, and contaminated waters. Solid titanium, sealed construction outperforms and outlasts specially-coated data loggers.
- **Log accurate data:** Get optimal accuracy under all operating conditions. Sensors undergo NIST®-traceable factory calibration across the full pressure and temperature range. For applications requiring the highest levels of accuracy, use a vented (gauged) system.
- **Get long-lasting operation:** Reduce trips to the field with low-power loggers that typically operate for 10 years.

Be In-Situ

- Receive **free**, 24/7 technical support and online resources.
- Order data loggers and accessories from the In-Situ e-store.
- Get guaranteed 7-day service for maintenance (U.S.A. only).

Applications

- Aquifer characterization: slug tests & pumping tests
- Coastal: tide/harbor levels & wetland/estuary research
- Hydrologic events: crest stage gages, storm surge monitoring, & flood control systems
- Long-term, real-time groundwater & surface water monitoring
- Mining & remediation

Level TROLL® 400, 500 & 700 Data Loggers

General	Level TROLL 400	Level TROLL 500	Level TROLL 700	BaroTROLL
Temperature ranges¹	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)
Diameter	1.83 cm (0.72 in.)	1.83 cm (0.72 in.)	1.83 cm (0.72 in.)	1.83 cm (0.72 in.)
Length	21.6 cm (8.5 in.)	21.6 cm (8.5 in.)	21.6 cm (8.5 in.)	21.6 cm (8.5 in.)
Weight	197 g (0.43 lb)	197 g (0.43 lb)	197 g (0.43 lb)	197 g (0.43 lb)
Materials	Titanium body; Delrin® nose cone	Titanium body; Delrin nose cone	Titanium body; Delrin nose cone	Titanium body; Delrin nose cone
Output options	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA
Battery type & life²	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings
External power	8-36 VDC	8-36 VDC	8-36 VDC	8-36 VDC
Memory	2.0 MB	2.0 MB	4.0 MB	1.0 MB
Data records³	130,000	130,000	260,000	65,000
Data logs	50	50	50	2
Log types	Linear, Fast Linear, and Event	Linear, Fast Linear, and Event	Linear, Fast Linear, Linear Average, Event, Step Linear, True Logarithmic	Linear
Fastest logging rate	2 per second	2 per second	4 per second	1 per minute
Fastest output rate	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second
Real-time clock	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period
Sensor Type/ Material	Piezoresistive; titanium	Piezoresistive; titanium	Piezoresistive; titanium	Piezoresistive; titanium
Range	<i>Absolute (non-vented)</i> 30 psia: 11 m (35 ft) 100 psia: 60 m (197 ft) 300 psia: 200 m (658 ft) 500 psia: 341 m (1120 ft)	<i>Gauged (vented)</i> 5 psig: 3.5 m (11.5 ft) 15 psig: 11 m (35 ft) 30 psig: 21 m (69 ft) 100 psig: 70 m (231 ft) 300 psig: 210 m (692 ft) 500 psig: 351 m (1153 ft)	<i>Absolute (non-vented)</i> 30 psia: 11 m (35 ft) 100 psia: 60 m (197 ft) 300 psia: 200 m (658 ft) 500 psia: 341 m (1120 ft) 1000 psia: 693 m (2273 ft) <i>Gauged (vented)</i> 5 psig: 3.5 m (11.5 ft) 15 psig: 11 m (35 ft) 30 psig: 21 m (69 ft) 100 psig: 70 m (231 ft) 300 psig: 210 m (692 ft) 500 psig: 351 m (1153 ft)	30 psia (usable up to 16.5 psi; 1.14 bar)
Burst pressure	Max. 2x range; burst > 3x range	Max. 2x range; burst > 3x range	Max. 2x range; burst > 3x range	Vacuum/over-pressure above 16.5 psi damages sensor
Accuracy @ 15° C⁴	±0.05% full scale (FS)	±0.05% FS	±0.05% FS	±0.05% FS
Accuracy (FS)⁵	±0.1% FS	±0.1% FS	±0.1% FS	±0.1% FS
Resolution	±0.005% FS or better	±0.005% FS or better	±0.005% FS or better	±0.005% FS or better
Units of measure	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH ₂ O, inH ₂ O Level: in., ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH ₂ O, inH ₂ O Level: in., ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH ₂ O, inH ₂ O Level: in., ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH ₂ O, inH ₂ O
Temperature Sensor	Silicon	Silicon	Silicon	Silicon
Accuracy & resolution	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better
Units of measure	Celsius or Fahrenheit	Celsius or Fahrenheit	Celsius or Fahrenheit	Celsius or Fahrenheit
Warranty⁶	3 years	3 years	3 years	3 years
Notes	¹ Temperature range for non-freezing liquids. ² Typical battery life when used within the factory-calibrated temperature range. ³ 1 data record = date/time plus 2 parameters logged (no wrapping) from device within the factory-calibrated temperature range. ⁴ Across factory-calibrated pressure range. ⁵ Across factory-calibrated pressure and temperature ranges. ⁶ Up to 5-year (total) extended warranties are available for all sensors—call for details. Delrin is a registered trademark of E.I. du Pont de Nemours and Company.			

Every Application & Budget

Use maintenance-free, non-vented systems for long-term monitoring and at flood-prone or high-humidity sites.

Use high-accuracy, vented systems to conduct aquifer tests and to view barometrically compensated water level data in real time.

Forgot to set a level reference at the beginning of a deployment? Automate level corrections by using Win-Situ Software's post-level correction Wizard.

BaroTROLL® Data Logger

Using a non-vented system? Collect barometric pressure and temperature data with a titanium BaroTROLL Data Logger in order to compensate data for barometric pressure fluctuations.

Calculating barometric efficiency? Use the BaroTROLL Logger with vented systems.

Win-Situ® Baro Merge® Software automates post correction of water level data.



Specifications are subject to change without notice.