Salinas Valley: Eastside Aquifer Subbasin Groundwater Sustainability Plan

VOLUME 2

Chapter 5. Groundwater Conditions
Chapter 6. Water Budgets
Chapter 7. Monitoring Networks
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Prepared for:

Salinas Valley Basin Groundwater Sustainability Agency

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ACRONYMS AND ABBREVIATIONS

$/AF ....dollar per acre-foot
AF ....acre-foot or acre-feet
AF/yr. ....acre-feet per year
ALCO ....Alisal Water Company
ASR................Aquifer Storage and Recovery
Basin ....Salinas Valley Groundwater Basin
Basin Plan ......Water Quality Control Plan for the Central Coastal Basin
BLM...............U.S. Bureau of Land Management
BMPs..............Best Management Practices
Caltrans ....California Department of Transportation
CASGEM.......California Statewide Groundwater Elevation Monitoring
CCC................California Coastal Commission
CCGC.............Central Coast Groundwater Coalition
CCRWQCB....Central Coast Regional Water Quality Control Board
CCWG............Central Coast Wetlands Group
CDFW............California Department of Fish and Wildlife
CEQA.............California Environmental Quality Act
cfs...................cubic feet per second
COC ....constituents of concern
CPE Actions...Communication and Public Engagement Actions
CPUC ....California Public Utilities Commission
CSD................Community Services District
CSIP ....Castroville Seawater Intrusion Project
DACs..............Disadvantage Communities
DDW..............Division of Drinking Water
DEM...............Digital Elevation Model
DMS...............Data Management System
D-TAC ....Drought Technical Advisory Committee
DTSC ....California Department of Toxic Substances Control
DWR..............California Department of Water Resources
EDF................Environmental Defense Fund
EIR.................Environmental Impact Report
EPA................Environmental Protection Agency
ET...................evapotranspiration
eWRIMS ....Electronic Water Rights Information Management System
GAMA ....Groundwater Ambient Monitoring and Assessment Program
GDE ....groundwaterdependent ecosystem

GEMS ....Monterey County Groundwater Extraction Management System
GIS ....Geographic Information System
GMP ....Groundwater Management Plan
gpm ....gallons per minute
GSA ....Groundwater Sustainability Agency/Agencies
GSP or Plan....Groundwater Sustainability Plan
HCM ....hydrogeologic conceptual model
HCP ....Habitat Conservation Plan
ILRP ....Irrigated Lands Regulatory Program
InSAR ....Interferometric Synthetic Aperture Radar
IRWMP..........Integrated Regional Water Management Plan
ISW ....interconnected surface water
JPA ....Joint Powers Authority
LID ....low impact development
MAR ....managed aquifer recharge
MBARD.........Monterey Bay Air Resources District
MBNMS.........Monterey Bay National Marine Sanctuary
MCLs ....Maximum Contaminant Levels
MCWRA ....Monterey County Water Resources Agency
MTBE ....methyl-tertiary-butyl ether
NAVD88 ....North American Vertical Datum of 1988
NCCAG..........Natural Communities Commonly Associated with Groundwater
NEPA ....National Environmental Policy Act
NMFS.............National Marine Fisheries Service
NOAA ....National Oceanic & Atmospheric Administration
NPDES ....National Pollutant Discharge Elimination System
O&M ....operations and maintenance
OSWCR ....Online System for Well Completion Report
RCDMC ....Resource Conservation District of Monterey
RMA ....Routine Maintenance Agreement
RMS ....Representative Monitoring Sites
ROW ....Right of Way
RWMG...........Greater Monterey County Regional Water Management Group
SAGBI............Soil Agricultural Groundwater Banking Index
SDACs ....Severely Disadvantaged Communities
SGMA ....Sustainable Groundwater Management Act
SMC ....Sustainable Management Criteria
SMCLs ....Secondary Maximum Contaminant Levels
SMP................Salinas River Stream Maintenance Program
SRDF..............Salinas River Diversion Facility
Subbasin.........Eastside Aquifer Subbasin

SVBGSA........Salinas Valley Basin Groundwater Sustainability Agency
SVIHM...........Salinas Valley Integrated Hydrologic Model
SVOM............Salinas Valley Operational Model
SWIG ....Seawater Intrusion Working Group
SWRCB..........State Water Resources Control Board
URCs..............Underrepresented Communities
TAC................Technical Advisory Committee
TDS................total dissolved solids
USACE ..........U.S.Army Corps of Engineers
USFWS ..........U.S. Fish and Wildlife Service
USGS .............U.S. Geological Survey
UWMP...........Urban Water Management Plan

5 GROUNDWATER CONDITIONS

This chapter describes the historical and current groundwater conditions in the Eastside Aquifer Subbasin in accordance with the GSP Regulations § 354.16. In this GSP, current conditions are any conditions occurring after January 1, 2015. 2019 was chosen as the representative current year where possible. By implication, historical conditions are any conditions occurring prior to January 1, 2015. The chapter focuses on information required by the GSP Regulations, and information that is important for developing an effective plan to achieve sustainability. This chapter provides a description of current and historical groundwater conditions at a scale and level of detail appropriate for meeting the GSP sustainability requirements under SGMA.

This chapter is organized to align the groundwater conditions descriptions with the 6 sustainability indicators relevant to this Subbasin, including:

1. Chronic lowering of groundwater levels
2. Changes in groundwater storage
3. Seawater intrusion
4. Groundwater quality
5. Subsidence
6. Depletion of ISW

5.1 Groundwater Elevations

5.1.1 Data Sources

The assessment of groundwater elevation conditions is largely based on data collected by MCWRA from 1944 through the present. MCWRA's monitoring programs are described in Chapter 3.

5.1.2 Groundwater Elevation Contours and Horizontal Groundwater Gradients

Groundwater elevation data are analyzed and presented with 3 sets of graphics:

- Maps of groundwater elevation contours show the geographic distribution of groundwater elevations at a specific time. These contours represent the elevation of the groundwater in feet, using the NAVD88 vertical datum. The contour interval is 10 feet, meaning each blue line represents an area where groundwater elevations are either 10 feet higher or 10 feet lower than the next blue line (Figure 5-1 to Figure 5-8).
- Hydrographs of individual wells show the variations in groundwater elevations at individual wells over an extended period (Figure 5-9).

- Vertical hydraulic gradients in a single location assess the potential for vertical groundwater flow and its direction, as discussed in Section 5.1.4.

MCWRA annually produces groundwater elevation contour maps for the Salinas Valley Groundwater Basin using data from their annual August trough and fall measurement programs. August groundwater elevations are contoured to assess the driving force of seawater intrusion because this is usually when the aquifer is the most stressed. The August measurements represent seasonal low conditions in the Subbasin in this GSP. MCWRA also contours fall groundwater elevations because these measurements are taken from mid-November to December after the end of the irrigation season and before seasonal recharge from winter precipitation increases groundwater levels. MCWRA does not produce groundwater elevation contour maps in the spring. Therefore, new maps of spring groundwater levels were developed for this GSP. Spring groundwater elevation maps were developed from data collected between January and March for 2019 and 1995. The period from January to March usually reflects seasonal high groundwater levels in the Salinas Valley Groundwater Basin (MCWRA, 2015). The MCWRA Quarterly Salinas Valley Water Conditions report demonstrates that in 2019, the seasonal high groundwater elevations occurred in February (MCWRA, 2019a). In 1995, data collected in March were more representative of seasonal high groundwater elevations.

The following 8 maps present the Current (2019) and Historical (1995) groundwater elevation contours.

Table 5-1. Figures Showing Current and Historical Groundwater Elevation Contours for the Eastside Aquifer

Figure #	Year	Season	Zone
Figure 5-1	Current (2019)	Spring	Shallow
Figure 5-2	Current (2019)	August Trough	Shallow
Figure 5-3	Current (2019)	Spring	Deep
Figure 5-4	Current (2019)	August Trough	Deep
Figure 5-5	Historical (1995)	Spring	Shallow
Figure 5-6	Historical (1995)	August Trough	Shallow
Figure 5-7	Historical (1995)	Spring	Deep
Figure 5-8	Historical (1995)	August Trough	Deep

The groundwater elevation contours only cover the portions of the Subbasin monitored by MCWRA. Contours do not always extend to subbasin margins.

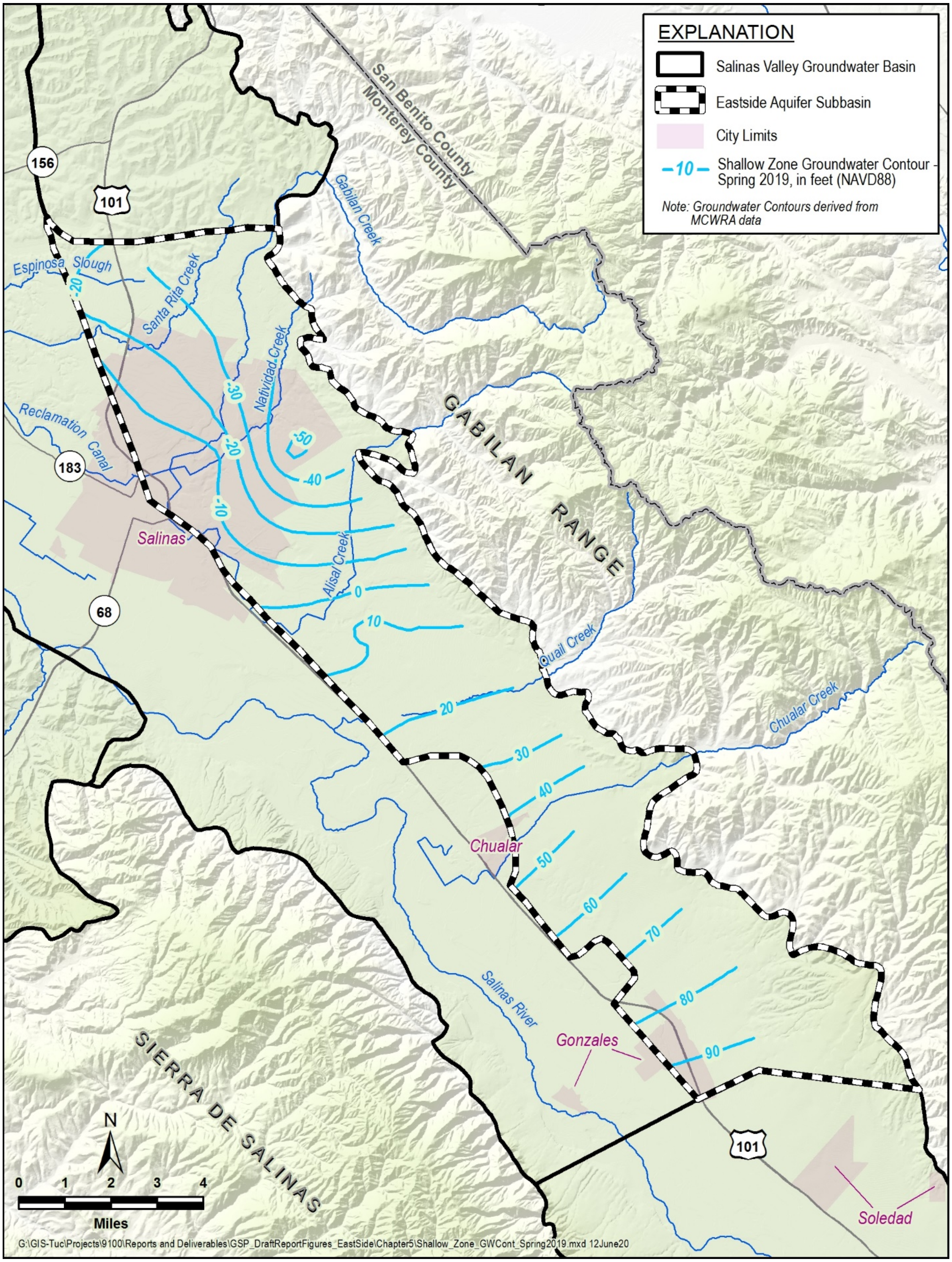

Figure 5-1. Spring 2019 Shallow Zone Groundwater Elevation Contours

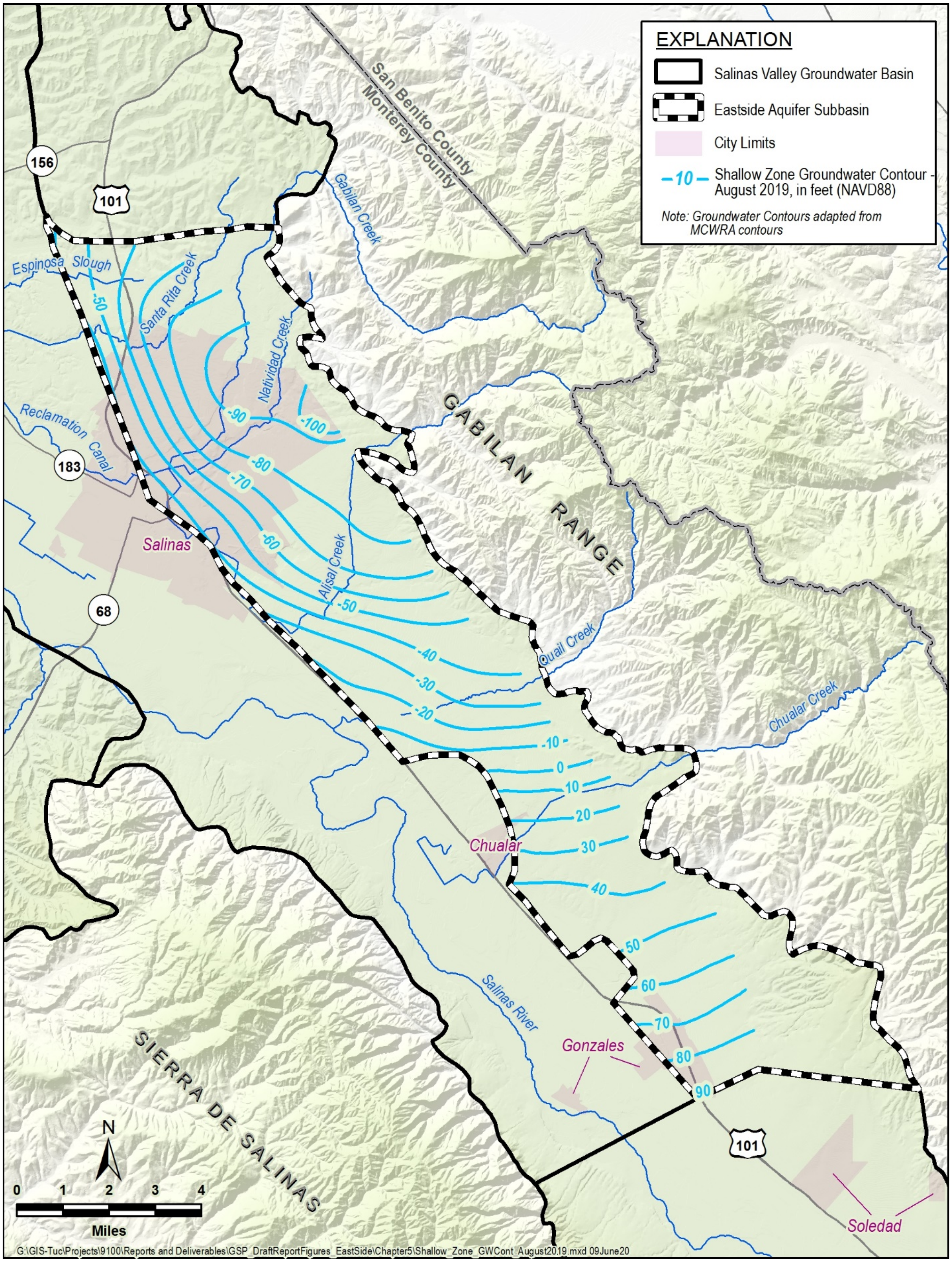

Figure 5-2. August 2019 Shallow Zone Groundwater Elevation Contours

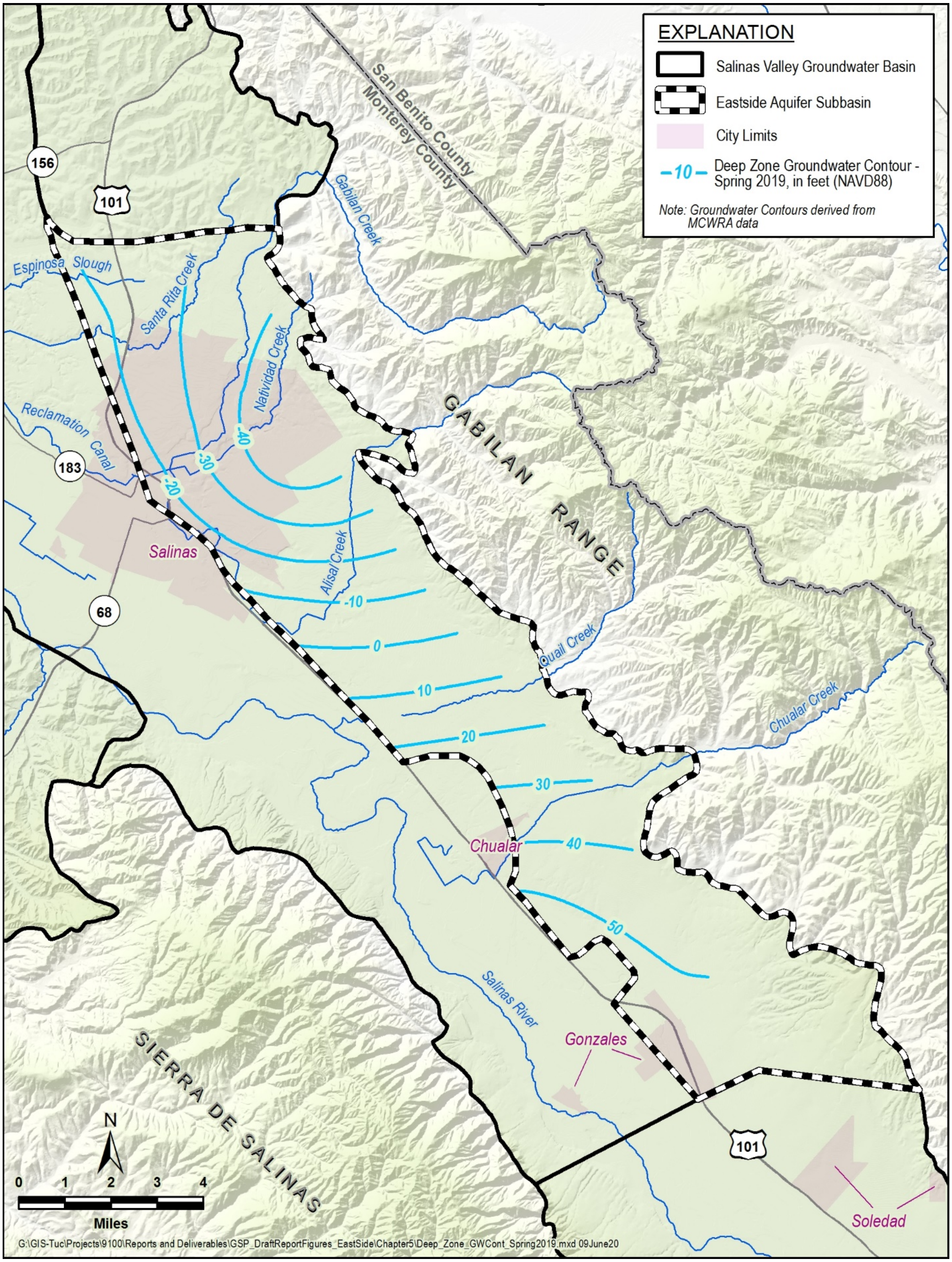

Figure 5-3. Spring 2019 Deep Zone Groundwater Elevation Contours

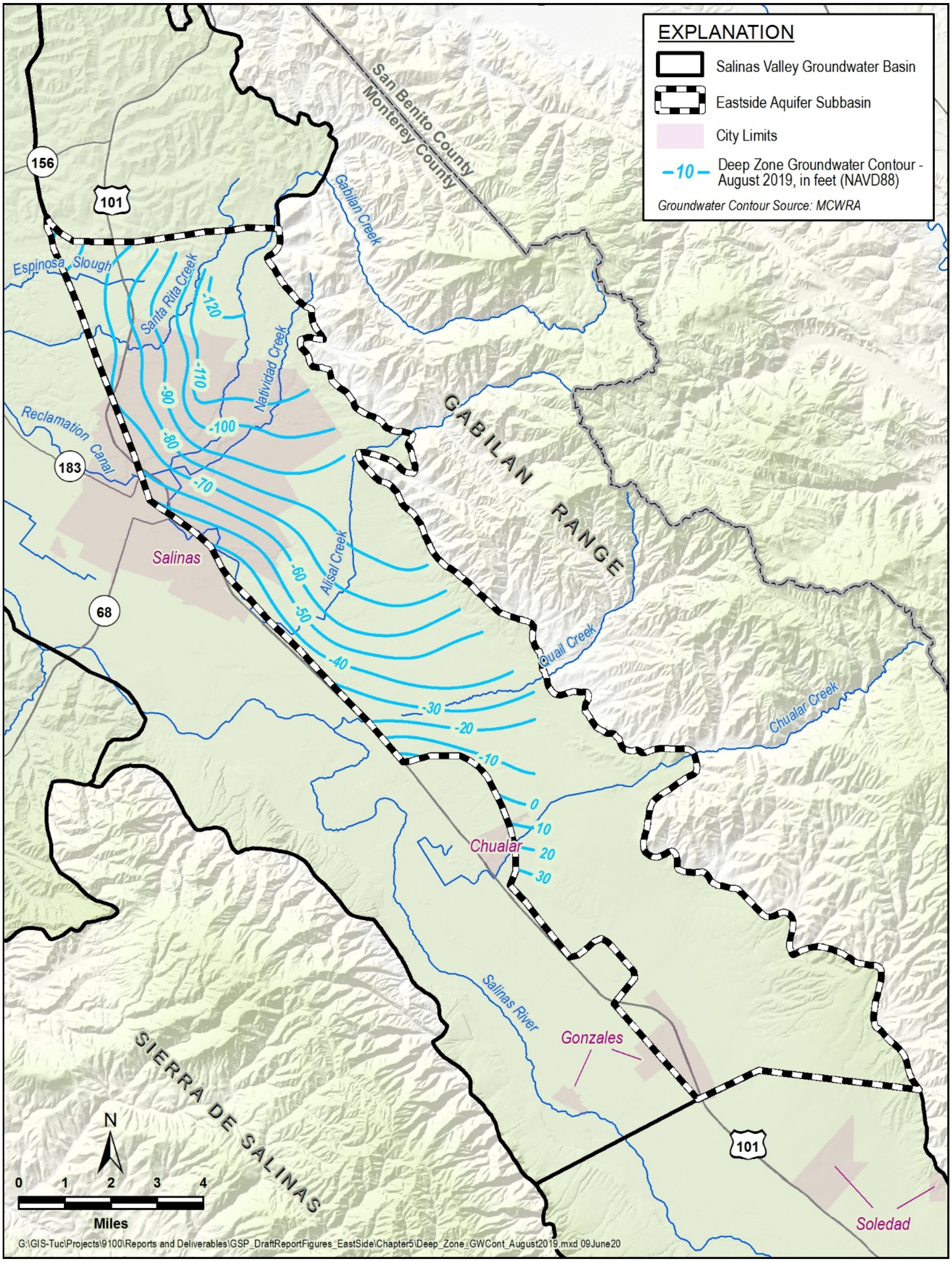

Figure 5-4. August 2019 Deep Zone Groundwater Elevation Contours

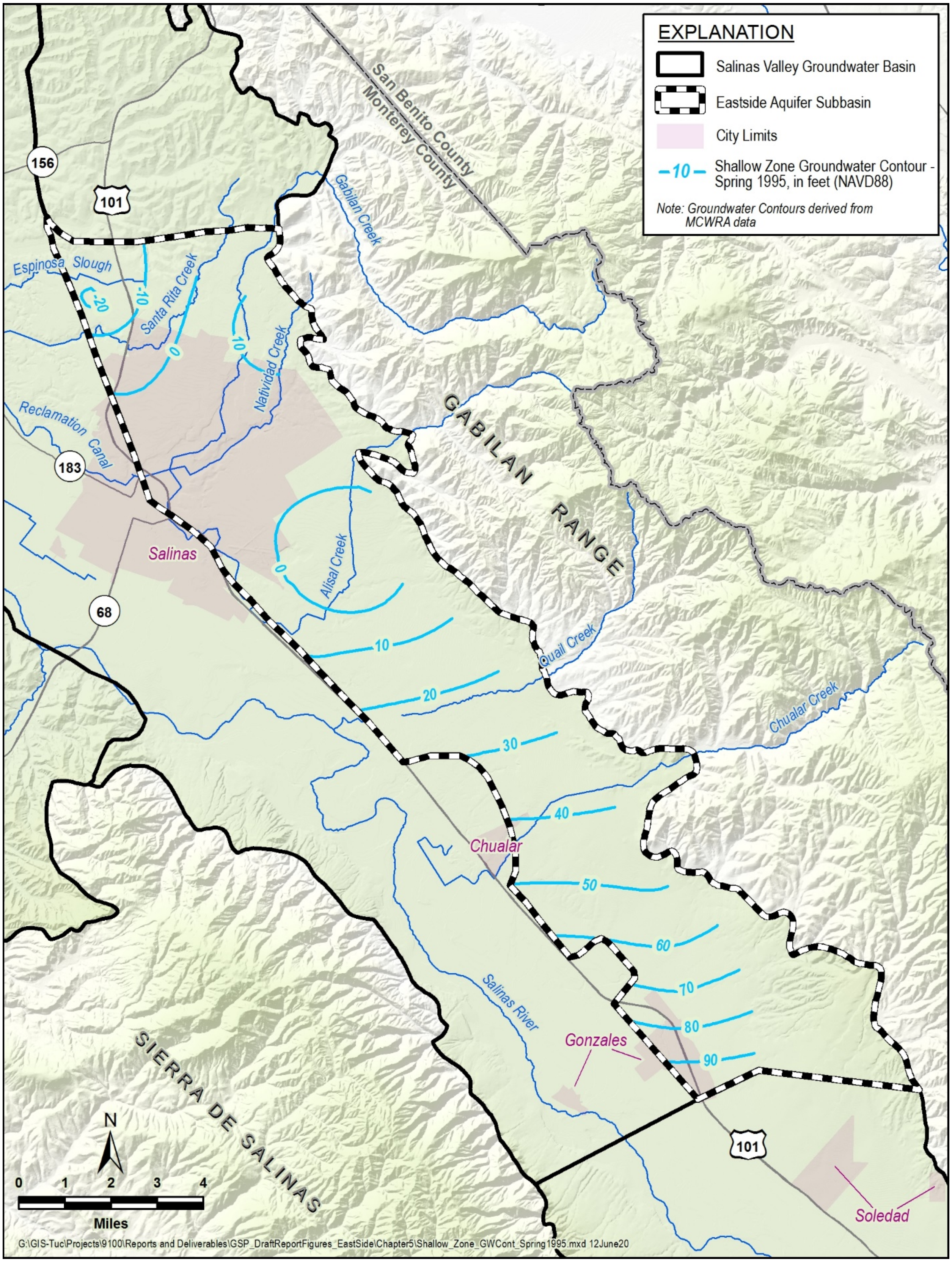

Figure 5-5. Spring 1995 Shallow Zone Groundwater Elevation Contours

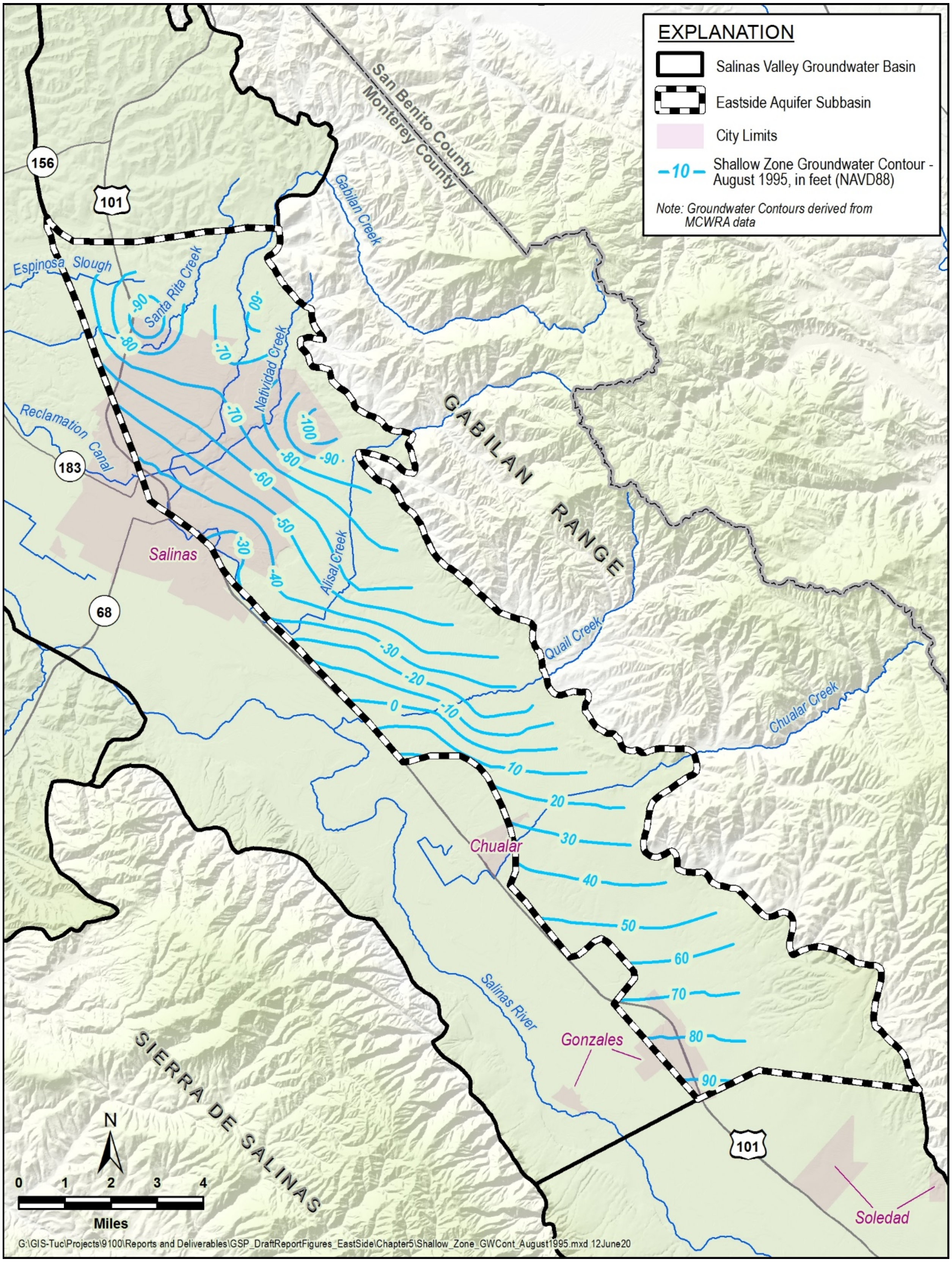

Figure 5-6. August 1995 Shallow Zone Groundwater Elevation Contours

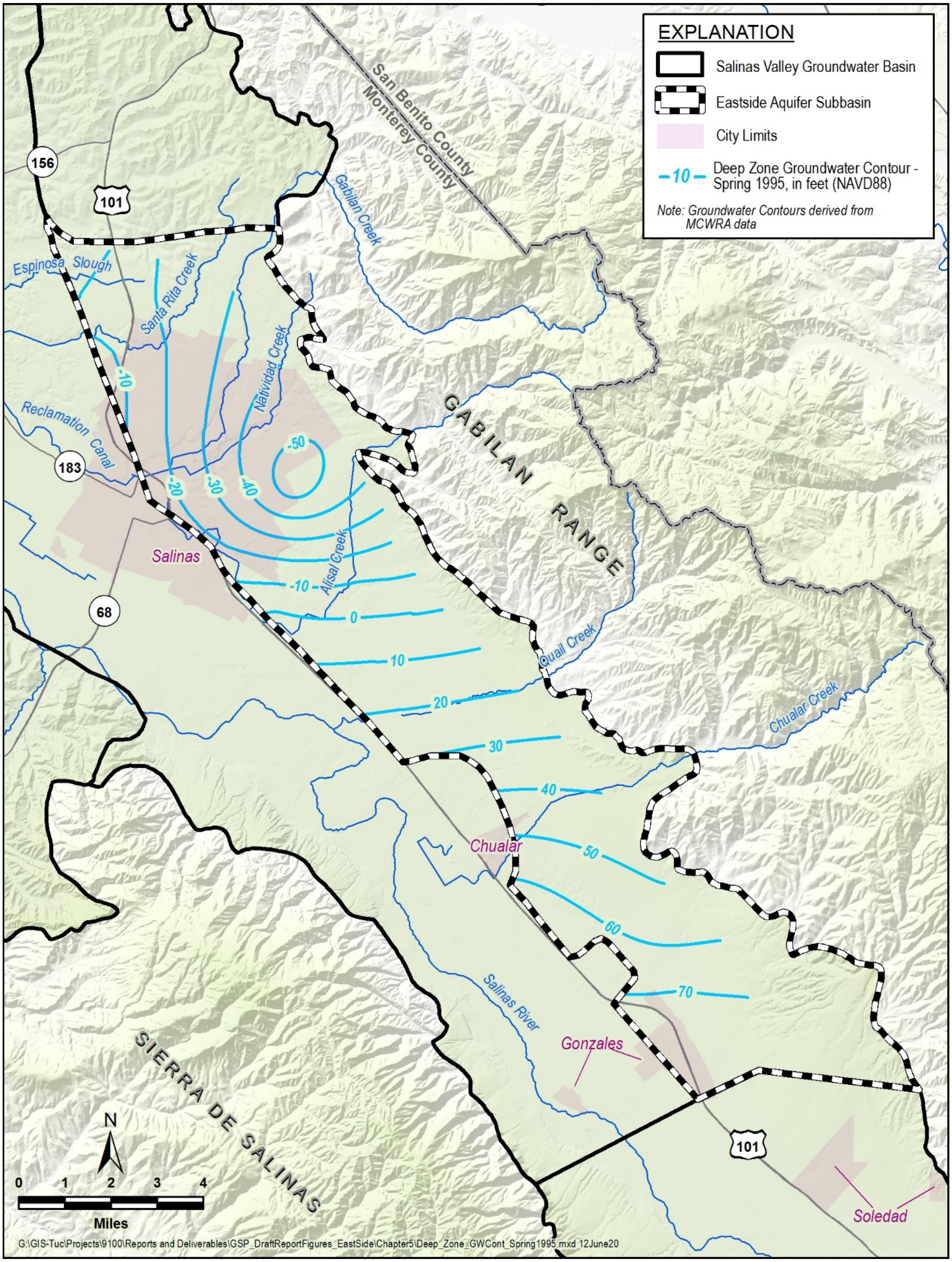

Figure 5-7. Spring 1995 Deep Zone Groundwater Elevation Contours

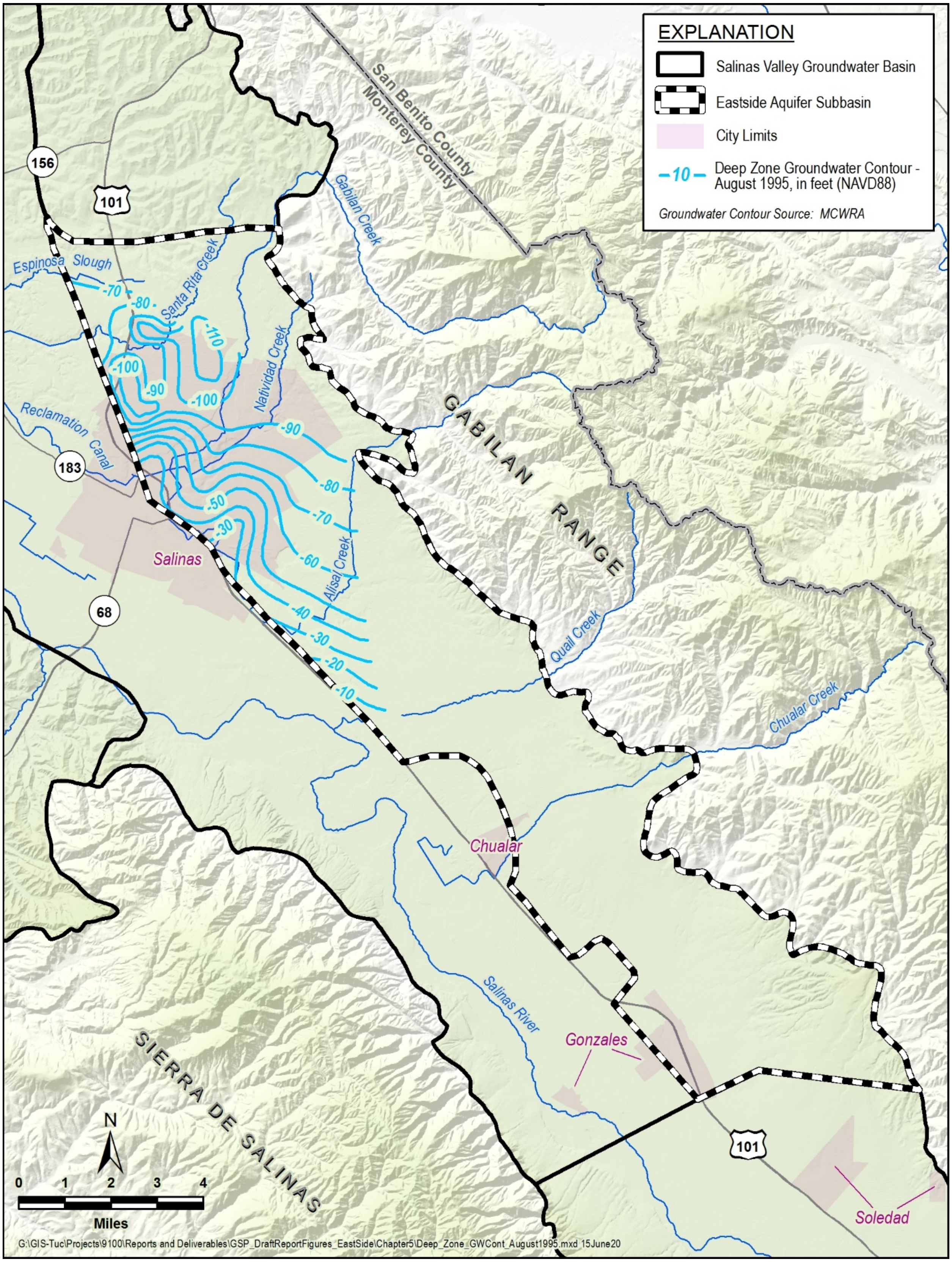

Figure 5-8. August 1995 Deep Zone Groundwater Elevation Contours

Groundwater generally flows from the south and from adjacent basins toward the north-northwest, with localized depressions around the pumping centers. The most notable pumping depression is located east of the City of Salinas. The contours indicate that groundwater flow directions are similar in the Shallow and Deep Zones of the Eastside Aquifer. However, based on these contours, groundwater elevations in the Deep Zone are generally lower than groundwater elevations in the Shallow Zone during both 1995 and 2019.

Under current conditions (Figure 5-1 to Figure 5-4, groundwater elevations in the northern two-thirds of the Subbasin are below sea level, estimated as zero feet NAVD88, as indicated by the negative values on the contour lines. The lowest groundwater elevations in the Subbasin occur in the pumping depression east of the City of Salinas. In the Shallow Zone, minimum groundwater elevations are approximately -50 feet NAVD88 during the Spring measurements (Figure 5-1) and -100 feet NAVD88 during the August measurements (Figure 5-2). In the Deep Zone, minimum groundwater elevations are approximately -40 feet NAVD88 during the Spring measurements (Figure 5-3) and -120 feet NAVD88 during the August measurements (Figure 5-4). The hydraulic gradient steepens in the vicinity of the pumping trough; however, gradients are difficult to quantify based on highly variable groundwater elevations throughout the subbasin.

Groundwater elevations in the Eastside Subbasin increase to the west toward the boundary with the adjacent 180/400 Foot Aquifer Subbasin. They also increase toward the southern boundary with the aquifer in the Forebay Subbasin where groundwater elevations are greater than 90 feet NAVD88 in the Shallow Zone (Figure 5-1 and Figure 5-2) and greater than 50 feet NAVD88 in the Deep Zone (Figure 5-3 and Figure 5-4). The Shallow and Deep Zones represent productive zones that are intermittently confined as a result of the characteristic alluvial fan sediment deposition in the Eastside Subbasin, which transitions to more fluvial-dominated sediments near the boundary with the Forebay Subbasin.

Under the historical conditions of 1995, a similar flow pattern to that of current conditions was present in both the Shallow and Deep Zones of the Eastside Aquifer; however, the magnitude of the pumping trough has varied over time. A discussion of historical groundwater elevation changes is presented in Section 5.1.3.

5.1.3 Hydrographs

Representative temporal trends in groundwater elevations can be assessed with hydrographs that plot changes in groundwater elevations over time. Groundwater elevation data from wells within the Subbasin are available from monitoring conducted and reported by MCWRA.

Figure 5-9 depicts the locations and hydrographs of example monitoring wells in the Subbasin. Larger versions of the hydrographs for these wells, as well as all representative monitoring wells, are included in Appendix 5A. The locations of all the representative monitoring wells are shown on Figure 5-10. Chapter 7 provides more information specific to the wells and the monitoring system.

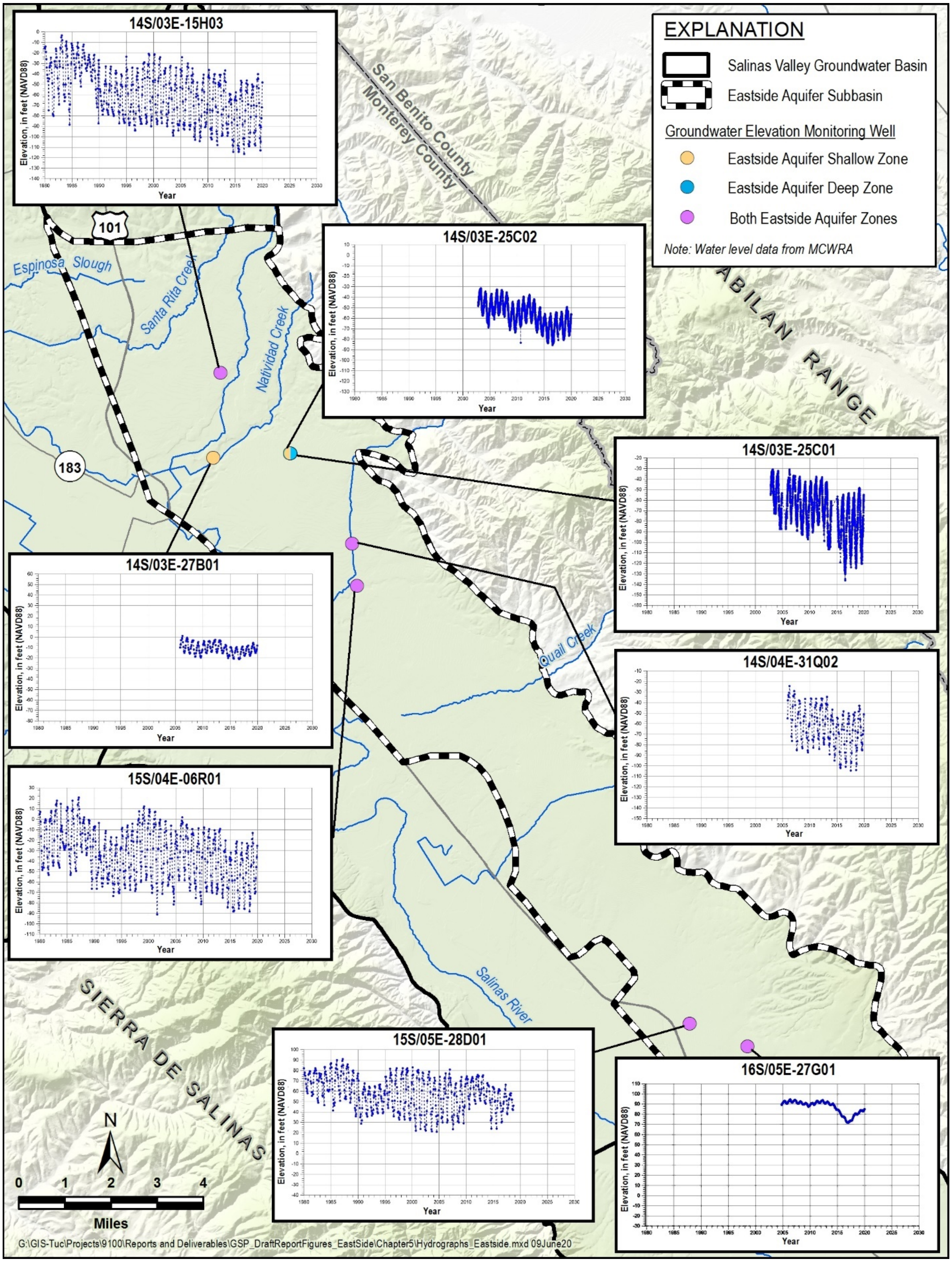

Figure 5-9. Map of Example Hydrographs

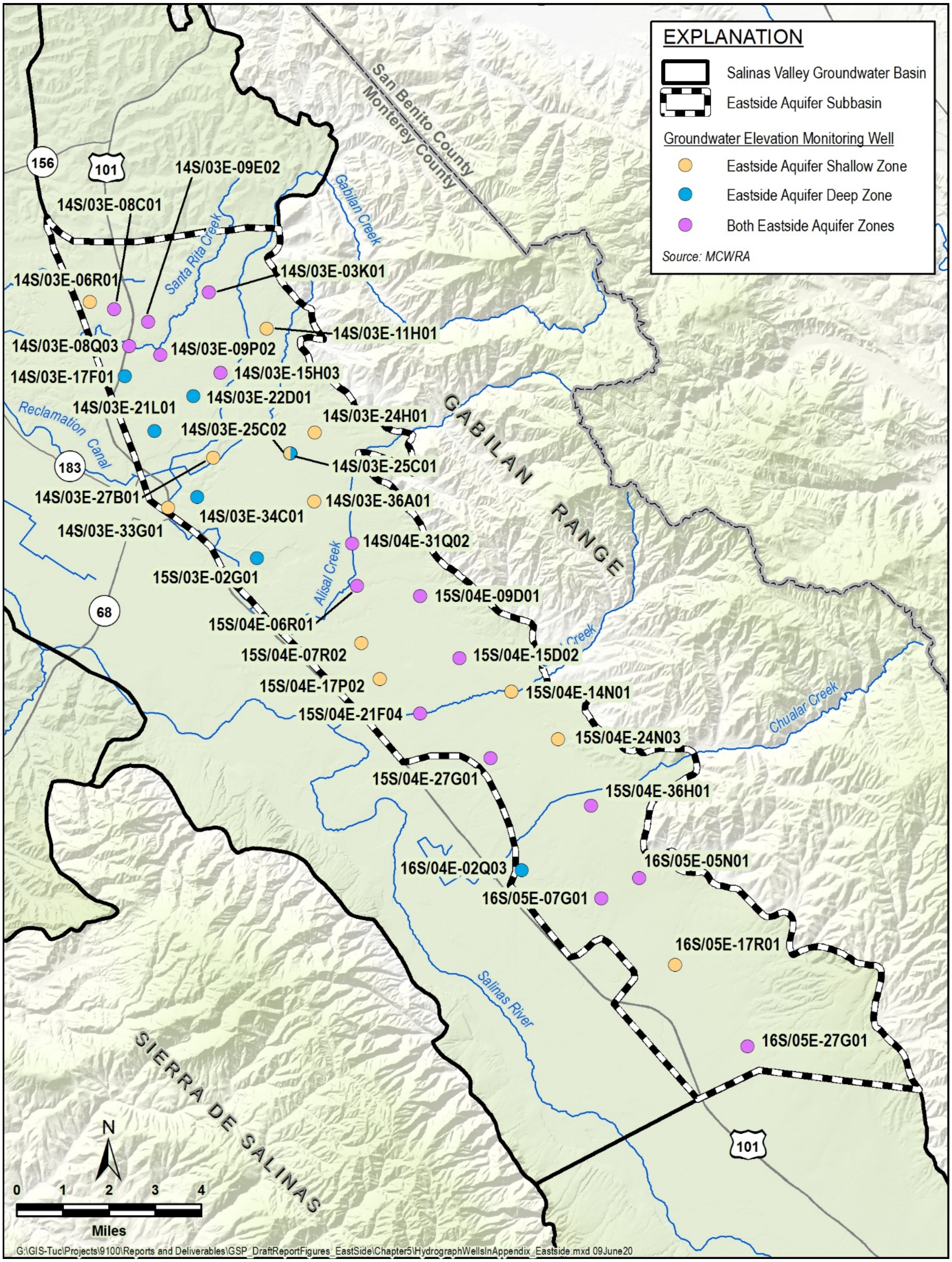

Figure 5-10. Locations of Wells with Hydrographs Included in Appendix 5A

Figure 5-11 presents a graph of cumulative groundwater elevation change for the Eastside Subbasin. The graph was initially developed by MCWRA and is based on averaged change in fall groundwater elevations for designated wells in the Eastside Subarea each year. MCWRA uses the Eastside Subarea for its groundwater elevation change analyses, which overlaps the Eastside Subbasin, as well as parts of the 180/400-Foot Aquifer and most of the Langley Subbasins, as shown on Figure 5-12. The figure was adapted to reflect the cumulative change in groundwater elevations specific to the Eastside Subbasin.

Fall measurements occur at the end of the irrigation season and before groundwater levels increase due to seasonal recharge by winter rains. These measurements record annual changes in storage reflective of groundwater recharge and withdrawals in the Subbasin. The cumulative groundwater elevation change plot is therefore an estimated average hydrograph for wells in the Subbasin. Although this plot does not reflect the groundwater elevation change at any specific location, it provides a general illustration of how the average groundwater elevation in the Subbasin changes in response to climatic cycles, groundwater extraction, and water resources management at the subbasin scale.

The cumulative elevation change graph and the specific hydrographs presented in Appendix 5A show that groundwater elevations in the Subbasin show a long-term decline over time.

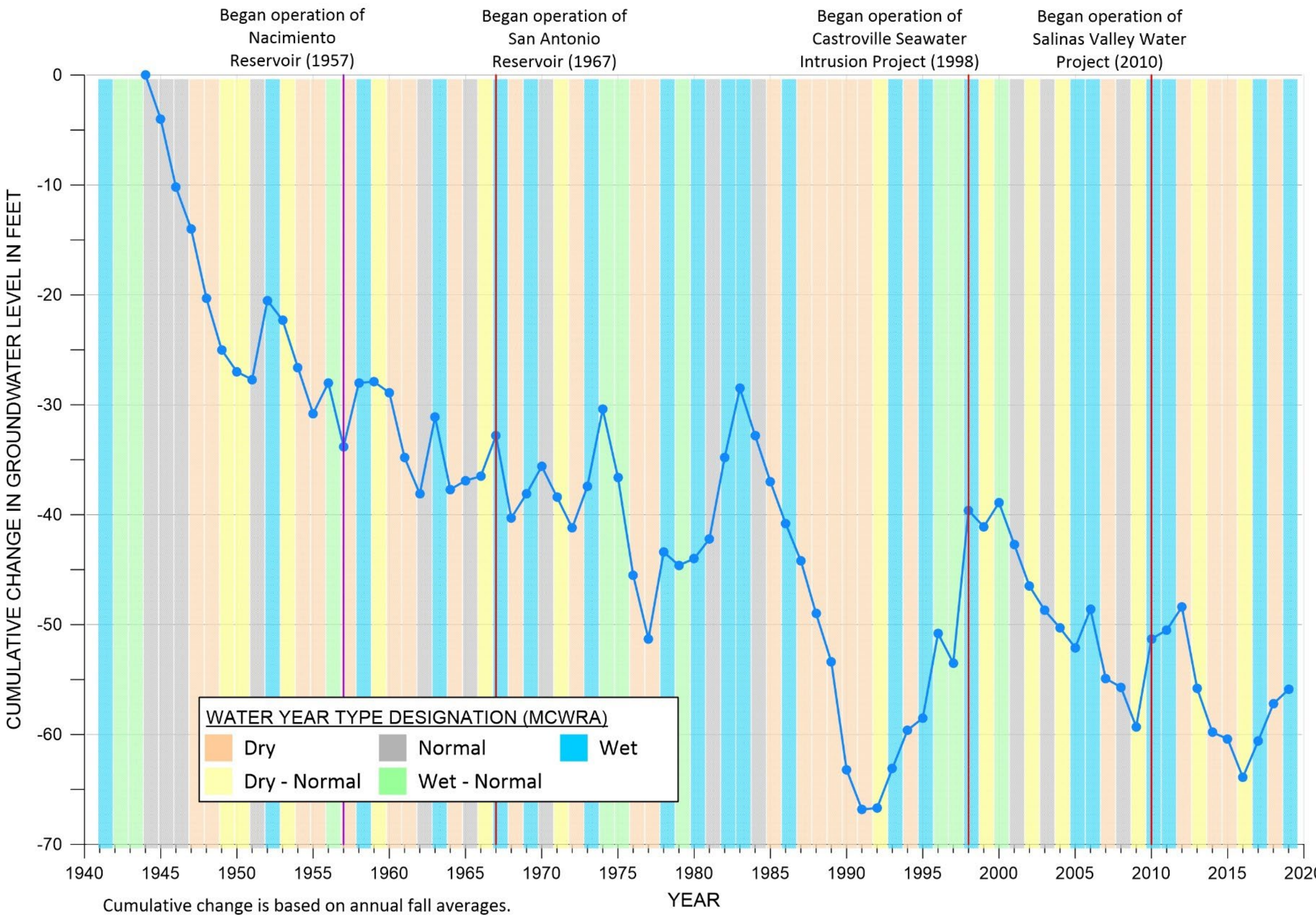

Figure 5-11. Cumulative Groundwater Elevation Change Graph for the Eastside Subbasin (adapted from MCWRA, 2018a, personal communication)

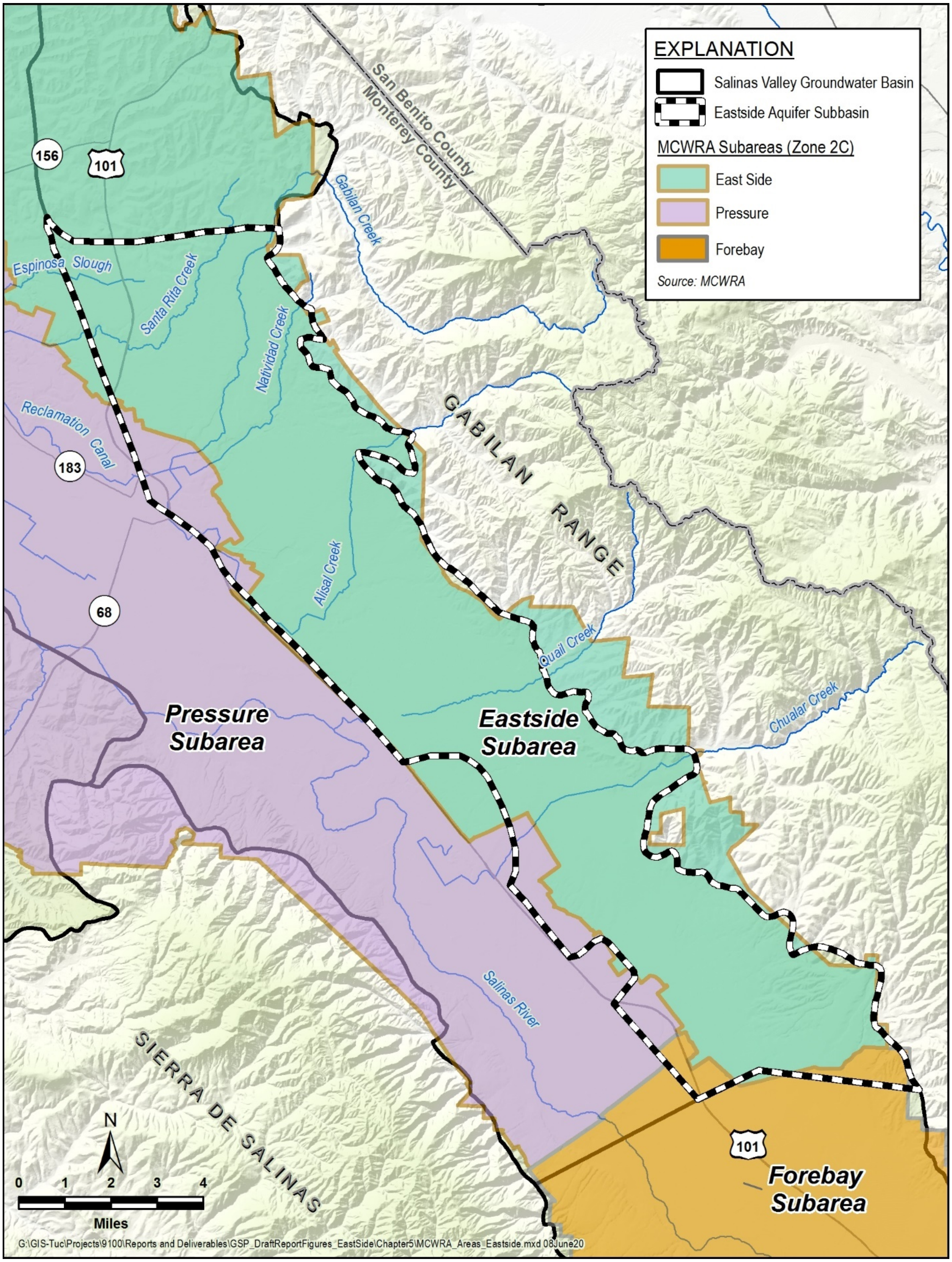

Figure 5-12. MCWRA Management Subareas

5.1.4 Vertical Groundwater Gradients

The Eastside Subbasin is considered a single aquifer with 2 generalized water-bearing zones. There is no identifiable, extensive aquitard separating the 2 zones. Figure 5-13 shows groundwater elevations at 2 well pairs in the Subbasin. The well pair consists of 2 adjacent wells with different well depths, 1 shallow (14S/03E-25C02 and 16S/05E-17R01) and the other deep (14S/03E-25C01 and 16S/05E-20R01). The northern well pair has different groundwater elevations at the 2 depths; however, both wells demonstrate similar seasonal fluctuations in groundwater elevations. The related seasonal fluctuations are indicative of the connection between the 2 zones. These hydrographs also show that the groundwater elevations in the Shallow Zone are generally higher than in the Deep Zone. This corroborates the data shown on the groundwater elevation contour maps. The southern well pair shows similar trends in groundwater elevations, despite the seasonal fluctuations of the deeper well (16S/05E-20R01) suggesting that these wells are also hydraulically connected.

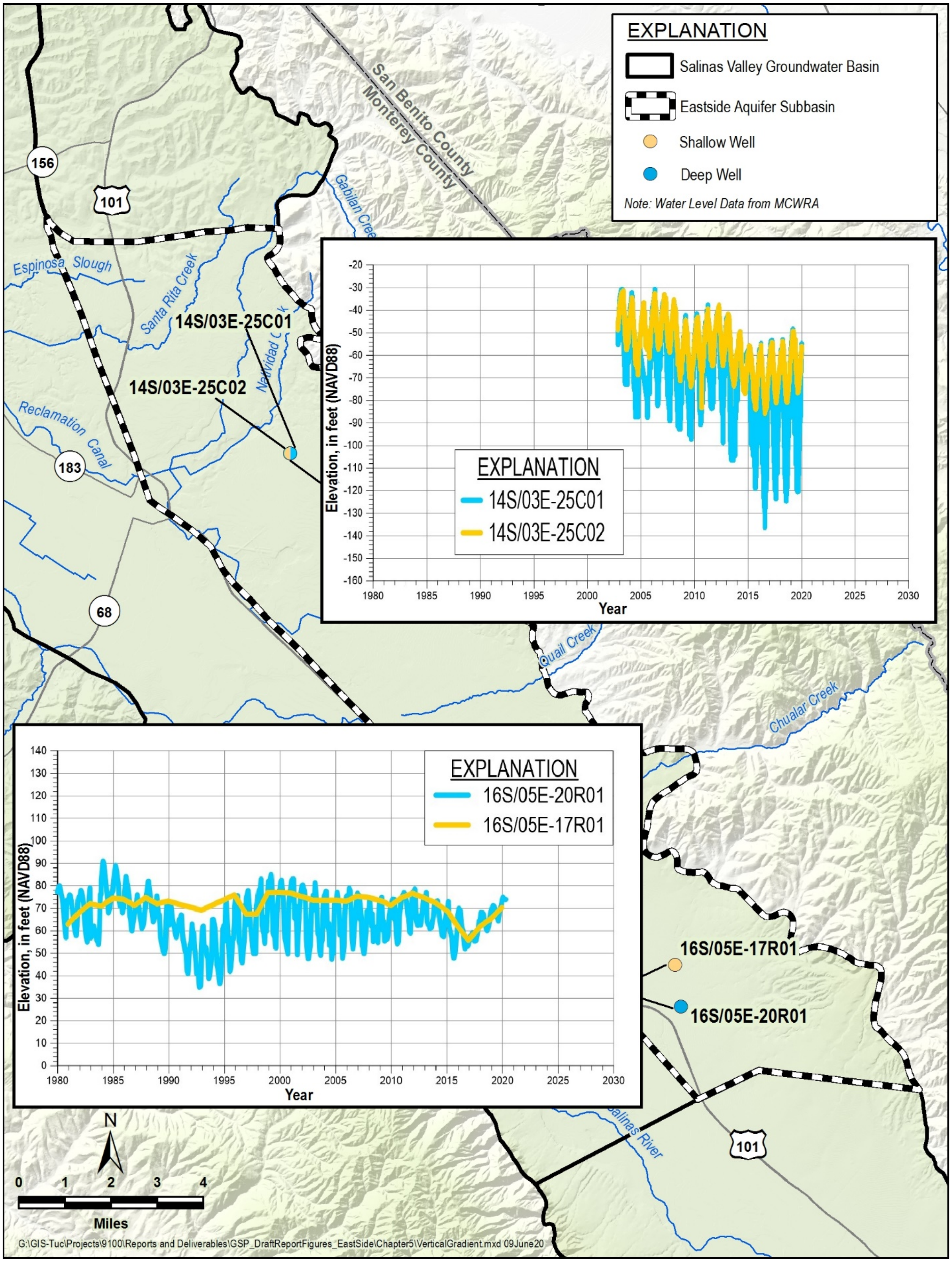

Figure 5-13. Vertical Gradients

5.2 Change in Groundwater Storage

5.2.1 Data Sources

Change in storage is developed based on MCWRA's fall groundwater elevation measurements. This includes historical groundwater elevations used to develop the cumulative change in groundwater elevation graph (Figure 5-11) that is used to estimate change in groundwater storage over time. Groundwater elevation measurements are also used to create fall groundwater elevation contour maps; MCWRA's fall 1995 and fall 2019 contour maps are used to determine the spatial distribution of storage change. Fall groundwater elevation contour maps are used rather than spring contour maps to retain consistency with the cumulative change in groundwater elevation graph.

5.2.2 Change in Groundwater Storage

Change in groundwater storage is derived from change in groundwater elevations in the Subbasin in 2 ways: 1) using the cumulative subbasin-wide average change in groundwater elevations and 2) subtracting the fall 1995 from the and fall 2019 groundwater elevation maps. Both approaches rely on observed groundwater elevation changes that provide a measure of the gain and loss of groundwater in storage each year. The change in storage is calculated by multiplying a change in groundwater elevation by a storage coefficient. Storage coefficients depend on the hydraulic properties of the aquifer materials and are commonly measured through long-term pumping tests or laboratory tests. The storage coefficient for the Eastside Subbasin was estimated at 0.08 based on the State of the Basin Report (Brown and Caldwell, 2015). The area of the Eastside Subbasin is approximately 57,500 acres.

Both approaches for calculating the change in storage using groundwater elevation changes are based on the following relationship:

$$\Delta S = \Delta WL \times A \times SC$$

Where: ΔS = Annual change in storage volume in the Subbasin (AF/yr.)

ΔWL = Annual change in average groundwater elevation in the Subbasin (ft/yr.)

A = Land area of Subbasin (acres)

SC = Storage coefficient (ft^3/ft^3)

Figure 5-14 shows estimated cumulative change in groundwater storage in the Eastside Subbasin from 1944 through 2019. This graph is based on MCWRA's cumulative change in fall groundwater elevation data (Figure 5-11). The magnitudes of the groundwater storage changes are calculated by multiplying the annual groundwater elevation change by the storage coefficient and size of the Subbasin. Figure 5-14 shows that the Eastside Subbasin has experienced a long-term decline in groundwater storage due to lowering groundwater elevations. Based on Figure 5-14, the average annual storage loss due to lowering groundwater elevations in the Eastside Subbasin between 1944 and 2019 is approximately 3,400 AF/yr. However, other analyses have estimated greater declines in storage (Brown and Caldwell, 2015). Groundwater elevations have fluctuated over this time period. The change in storage calculation is a reflection of groundwater elevations in the start and end years, which captures the chronic lowering of groundwater levels in the Subbasin. As noted in Section 6.3, uncertainties exist in all estimates of change in storage. Based on prior reports, groundwater elevations, and modeling, this GSP considers the average historical overdraft to be approximately 10,000 AF/yr.

Figure 5-15 shows the fall 1995 and fall 2019 groundwater elevation contours for the shallow zone of the Eastside Aquifer. Figure 5-16 shows the estimated change in groundwater storage in the Shallow Zone calculated by subtracting the 2 fall groundwater elevation maps. Similarly, Figure 5-17 shows the Fall 1995 and Fall 2019 groundwater elevation contours for the Deep Zones of the Eastside Aquifer; and Figure 5-18 show the associated Deep Zone change in groundwater storage from Fall 1995 to fall 2019. The 2 maps of change in groundwater storage show calculated change in storage for areas of approximately 32,000 acres rather than the total Subbasin area because that is the approximate area of the Subbasin that is contoured for both the Shallow and Deep Zones.

A loss in groundwater storage occurred in both the Shallow and Deep Zones in the northern portion of the Subbasin, south and east of the City of Salinas. Within the Salinas City boundaries, the loss in storage ranges from 0 to 2 AF per acre over an area of approximately 8,500 acres in the Shallow Zone and 0 to 2 AF per acre over an area of approximately 6,000 acres in the Deep Zone. Other noticeable areas with groundwater storage change are seen around the Cities of Chualar and Gonzales.

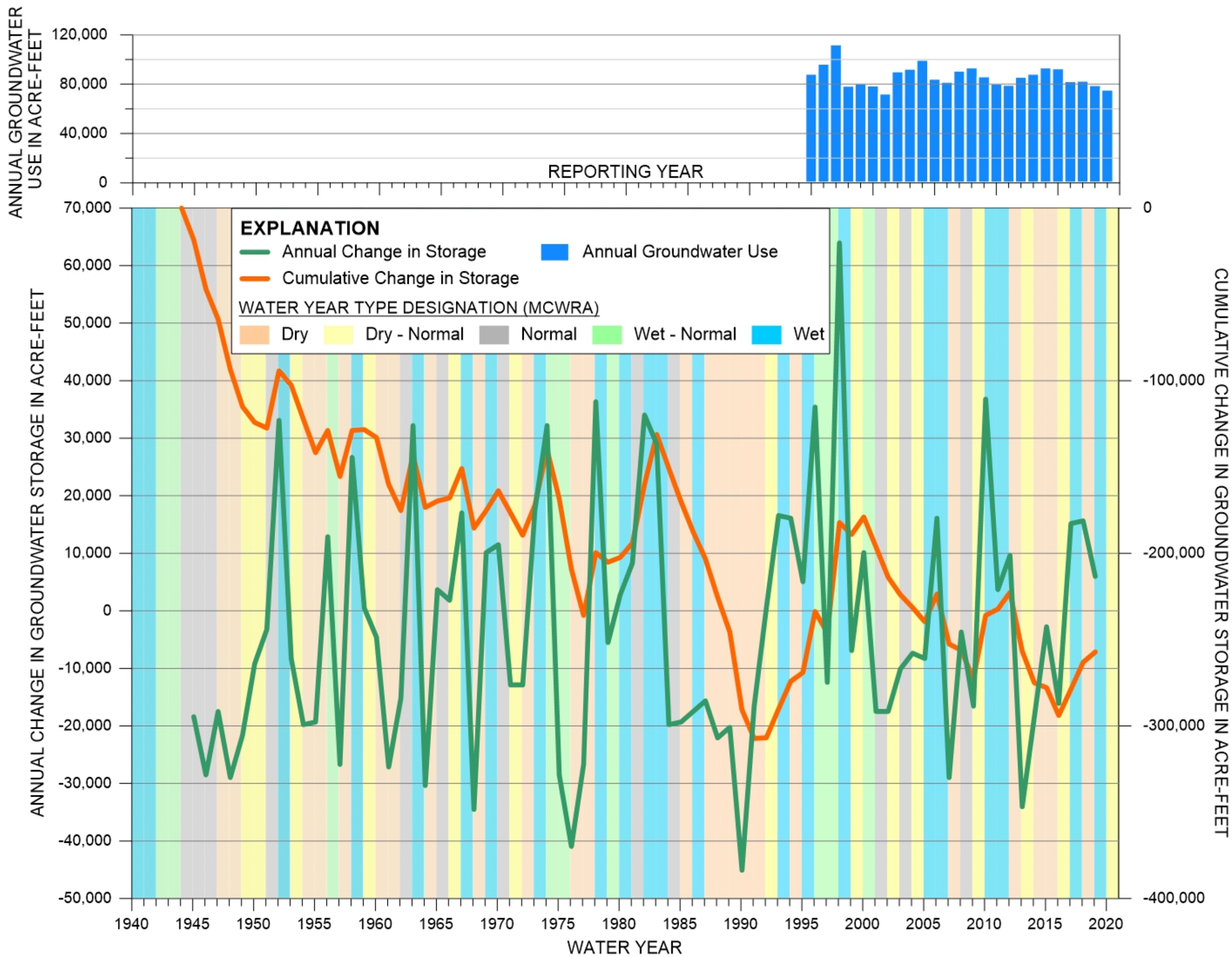

Figure 5-14. Annual and Cumulative Change in Groundwater Storage and Total Annual Groundwater Extraction in the Eastside Subbasin, Based on Groundwater Elevations (adapted from MCWRA, 2018a, personal communication)

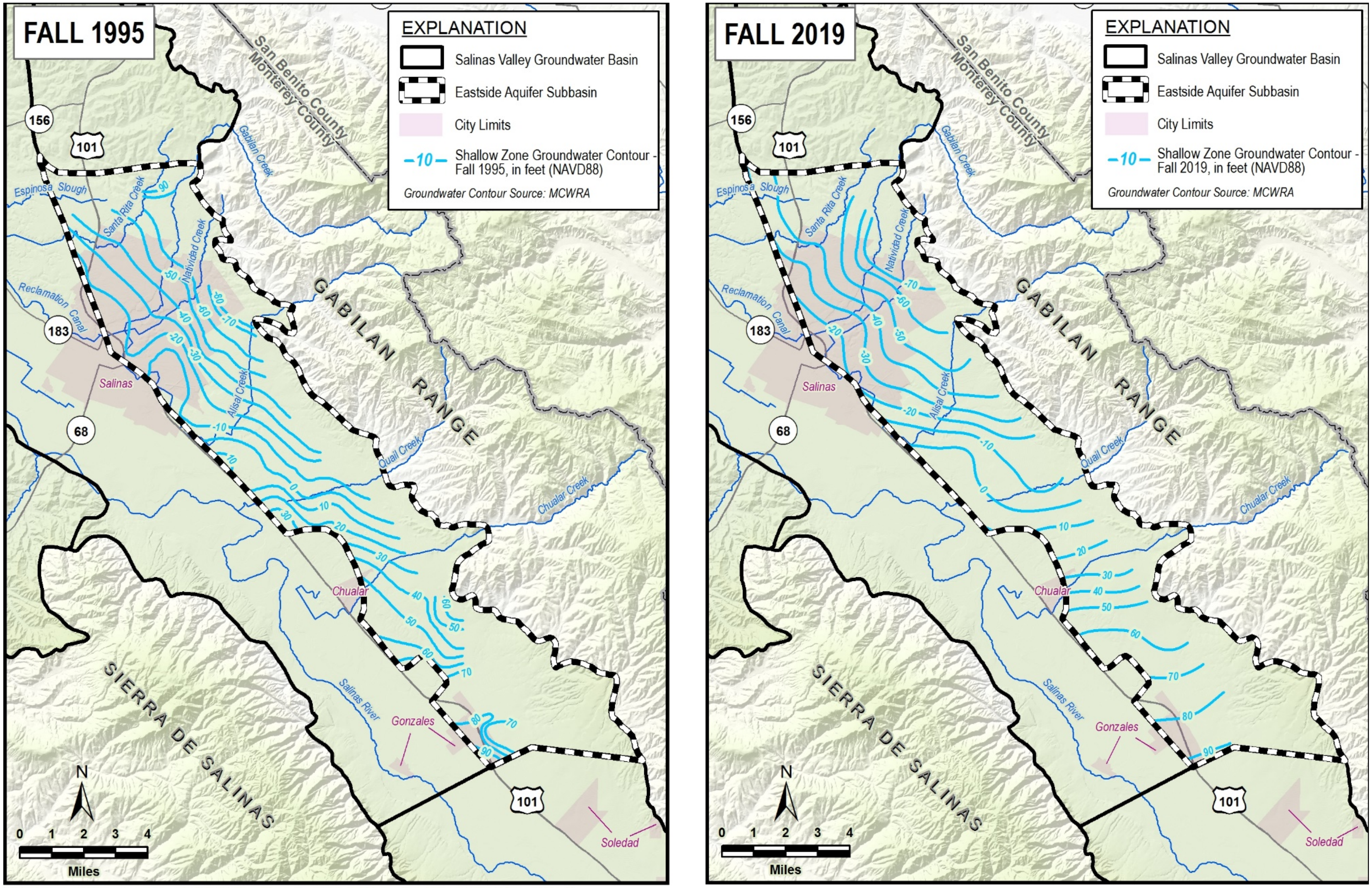

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Figure 5-15. Fall 1995 (left) and Fall 2019 (right) Shallow Zone Groundwater Elevation Contours

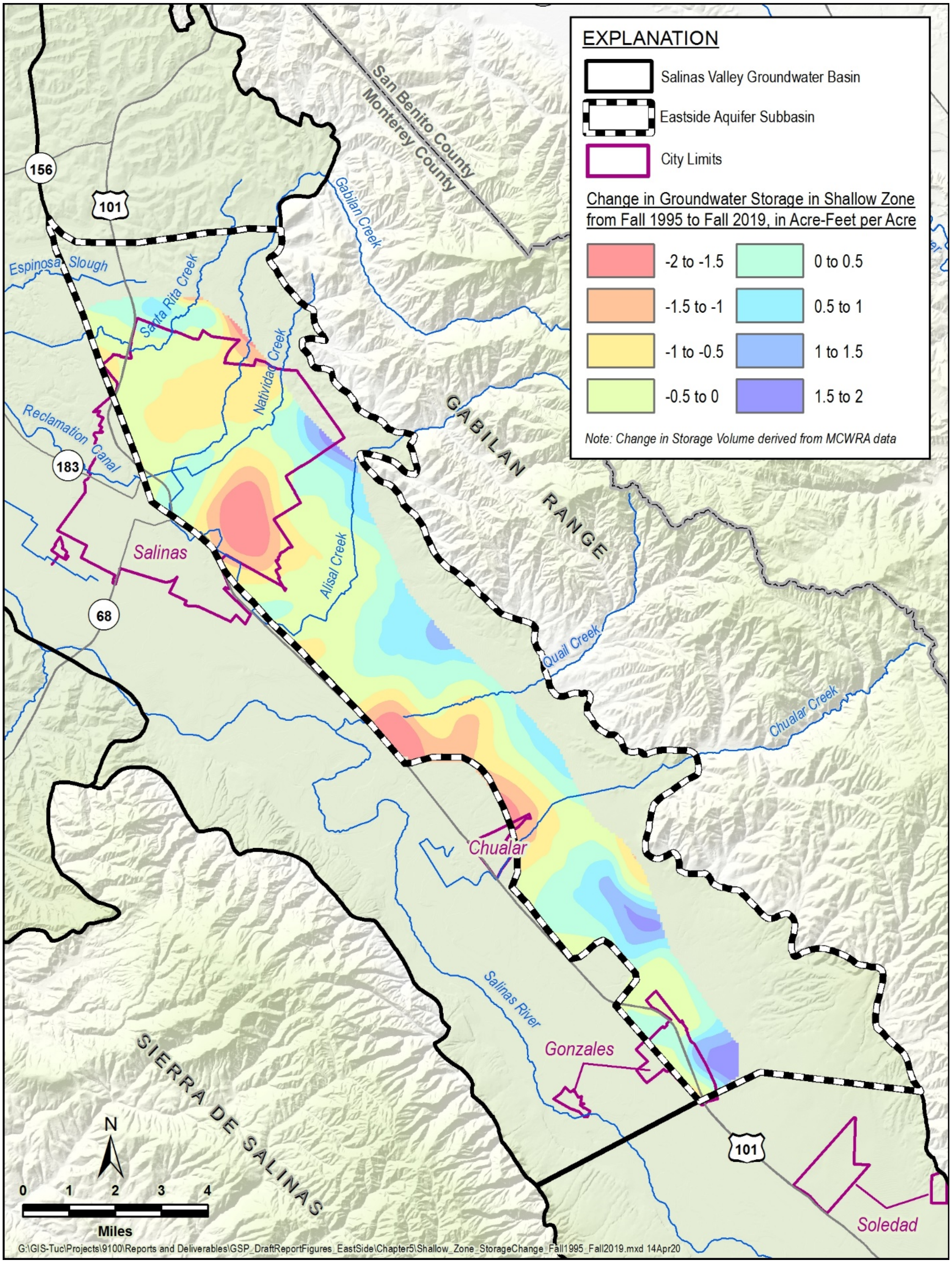

Figure 5-16. Change in Groundwater Storage in the Shallow Zone from Fall 1995 to Fall 2019

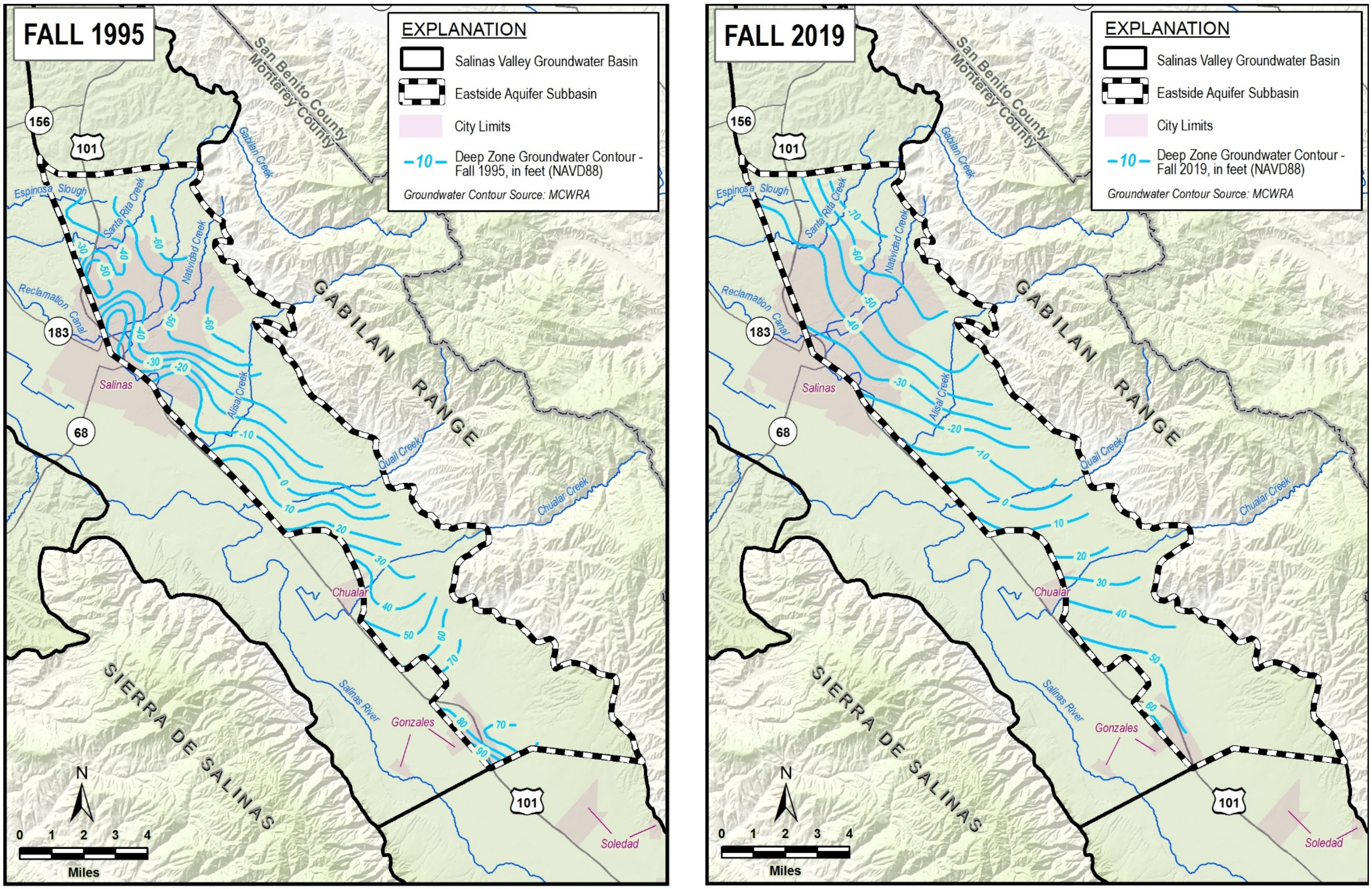

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Figure 5-17. Fall 1995 (left) and Fall 2019 (right) Deep Zone Groundwater Elevation Contours

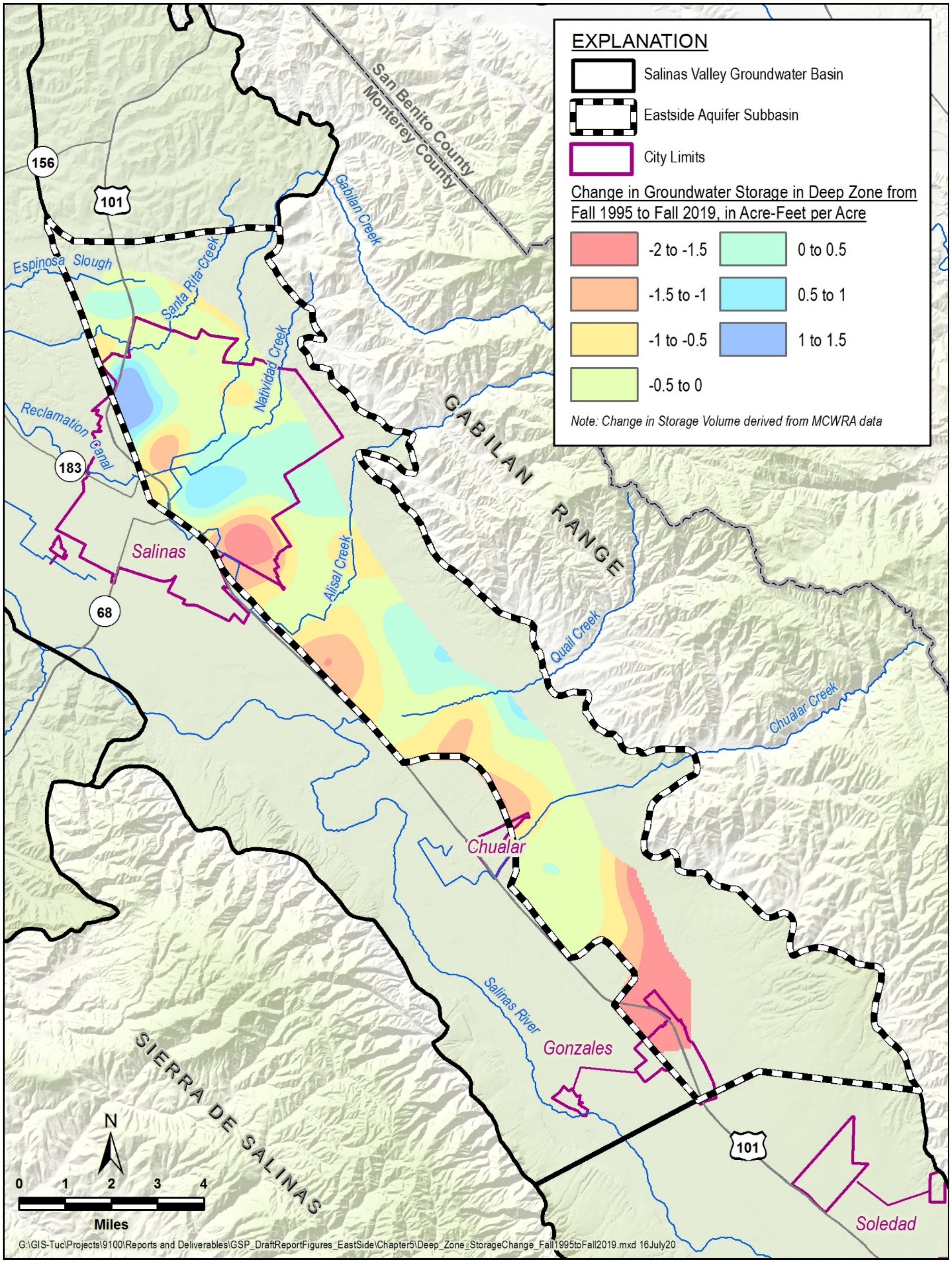

Figure 5-18. Change in Groundwater Storage in the Deep Zone from Fall 1995 to Fall 2019

5.3 Seawater Intrusion

There is currently no seawater intrusion in the Eastside Subbasin. However, the adjacent 180/400-Foot Aquifer Subbasin has been subject to seawater intrusion for more than 70 years. The negative impact of seawater intrusion on local water resources and the agricultural economy has been the primary motivation for many studies dating back to 1946 (DWR, 1946). The seawater intrusion in the 180/400-Foot Aquifer Subbasin is close enough to the Eastside Subbasin that seawater intrusion is considered an ongoing threat.

5.3.1 Data Sources

The extent and advance of seawater intrusion are monitored and reported by MCWRA. Monitoring seawater intrusion has been ongoing since the Agency formed in 1947, and currently includes a network of 151 dedicated monitoring and production wells that are sampled twice annually in June and August. Most of the wells are located in the 180/400-Foot Aquifer Subbasin; however, 2 monitoring wells are located within the Eastside Subbasin. The water samples are analyzed for general minerals; and the analytical results are used by MCWRA to analyze and report the following:

- Maps and graphs of historical chloride and specific conductivity trends
- Stiff diagrams and Piper diagrams
- Plots of chloride concentration vs. Na/Cl molar ratio trends

MCWRA publishes estimates of the extent of seawater intrusion every year. The MCWRA maps define the extent of seawater intrusion as the location of the 500 mg/L chloride concentration isocontour. This chloride concentration is significantly lower than the 19,000 mg/L chloride concentration typical of seawater; however, it represents a concentration that may begin to impact beneficial uses. The 500 mg/L threshold is considered the Upper Limit SMCL for chloride as defined by the EPA and is approximately 10 times the concentration of naturally occurring groundwater in the Subbasin.

5.3.2 Seawater Intrusion Maps and Cross Section

Figure 5-19 and Figure 5-20show the MCWRA mapped extents of current and historical seawater intrusion near the Eastside Subbasin and in the neighboring 180/400-Foot Aquifer Subbasin. Two maps are shown, equating the 180-Foot Aquifer and the 400-Foot Aquifer in the neighboring Subbasin. In each of the 2 figures, the maximum extent of the shaded contours represents the extent of groundwater with chloride exceeding 500 mg/L during the 2019 monitoring period. The historical progression of the 500 mg/L extent is also illustrated on these figures through the colored overlays that represent the extent of seawater intrusion observed during selected years. These 2 maps show that seawater intrusion is close to the Eastside Subbasin but is not observed in the Subbasin.

Figure 5-19 and Figure 5-20 also show the mapped August 2019 groundwater elevations for the Eastside Aquifer and the adjacent 180/400-Foot Aquifer Subbasin. These maps show the groundwater elevations that are persistently below sea levels that, when paired with a pathway, enable seawater intrusion. The groundwater elevation contours show that groundwater travels toward the depression at the northern end of the Eastside Subbasin in both the Shallow and Deep Zones. If the magnitude of this depression increases, it may draw seawater intrusion into the Subbasin. However, the contours themselves are not fully representative of flow between the subbasins. The gradient relationship is not the only influence to groundwater flow between the 180/400-Foot and Eastside Subbasins, and needs to be considered along with all subsurface characteristics. The sediment relationships between the 180/400-Foot Aquifer Subbasin and the Eastside Subbasin demonstrate a dynamic environment where different sediments were deposited over time and subsequently, impact groundwater flow. The boundary between these two subbasins generally represents the furthest extents of the alluvial fans that are characterized by clays and other fine sediments. These sediments frequently act as an impediment to flow, if not fully a barrier in certain locations. The groundwater flow relationship between the Eastside and 180/400-Foot Subbasins are largely uncharacterized as a result of a lack of data both about the sediment changes and the groundwater elevations in the area. This is a data gap that will be addressed during implementation.

Because there is no seawater intrusion in the Subbasin, no cross sections are presented showing the vertical extent of seawater intrusion.

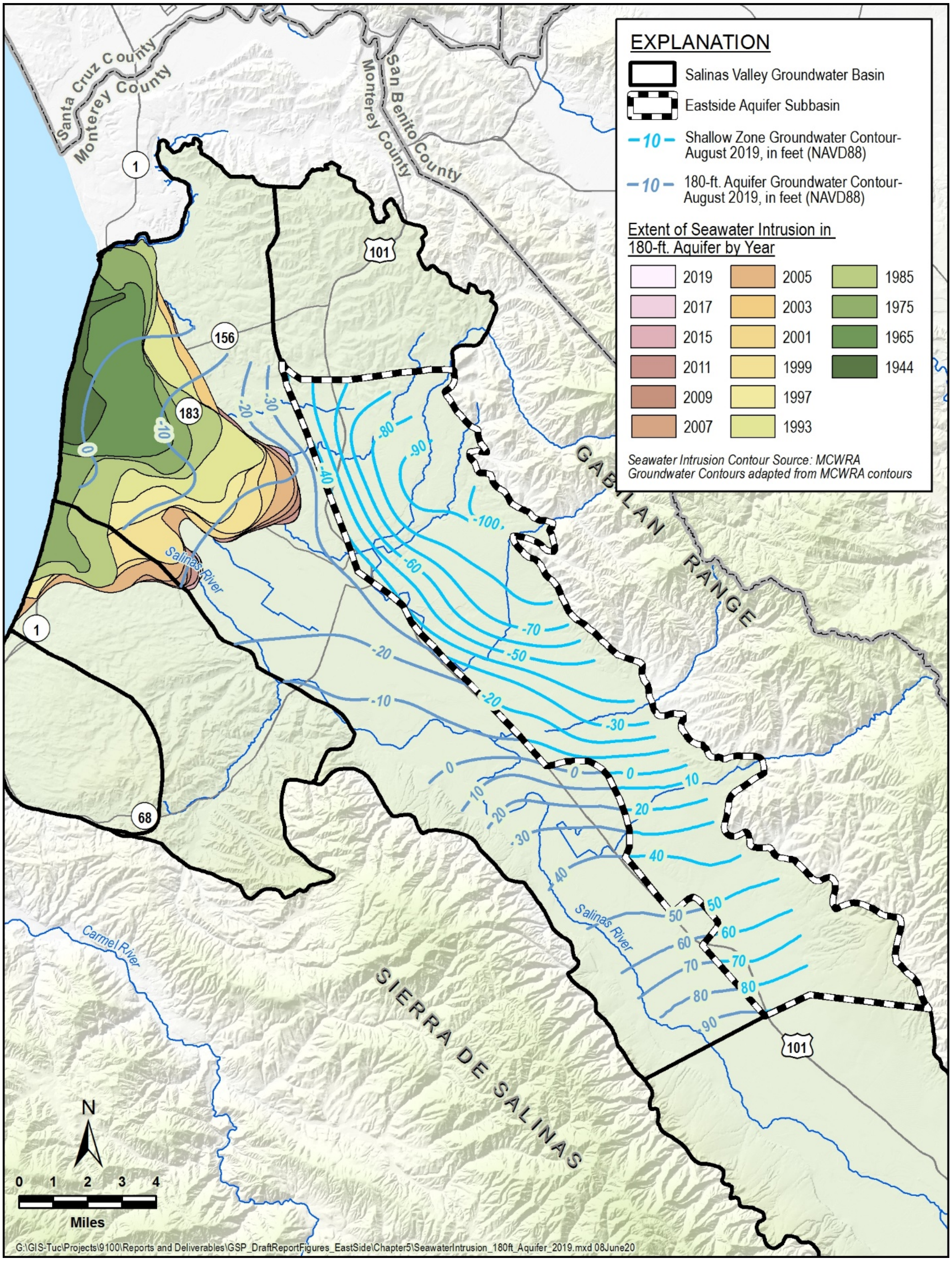

Figure 5-19. Seawater Intrusion in the 180-Foot Aquifer

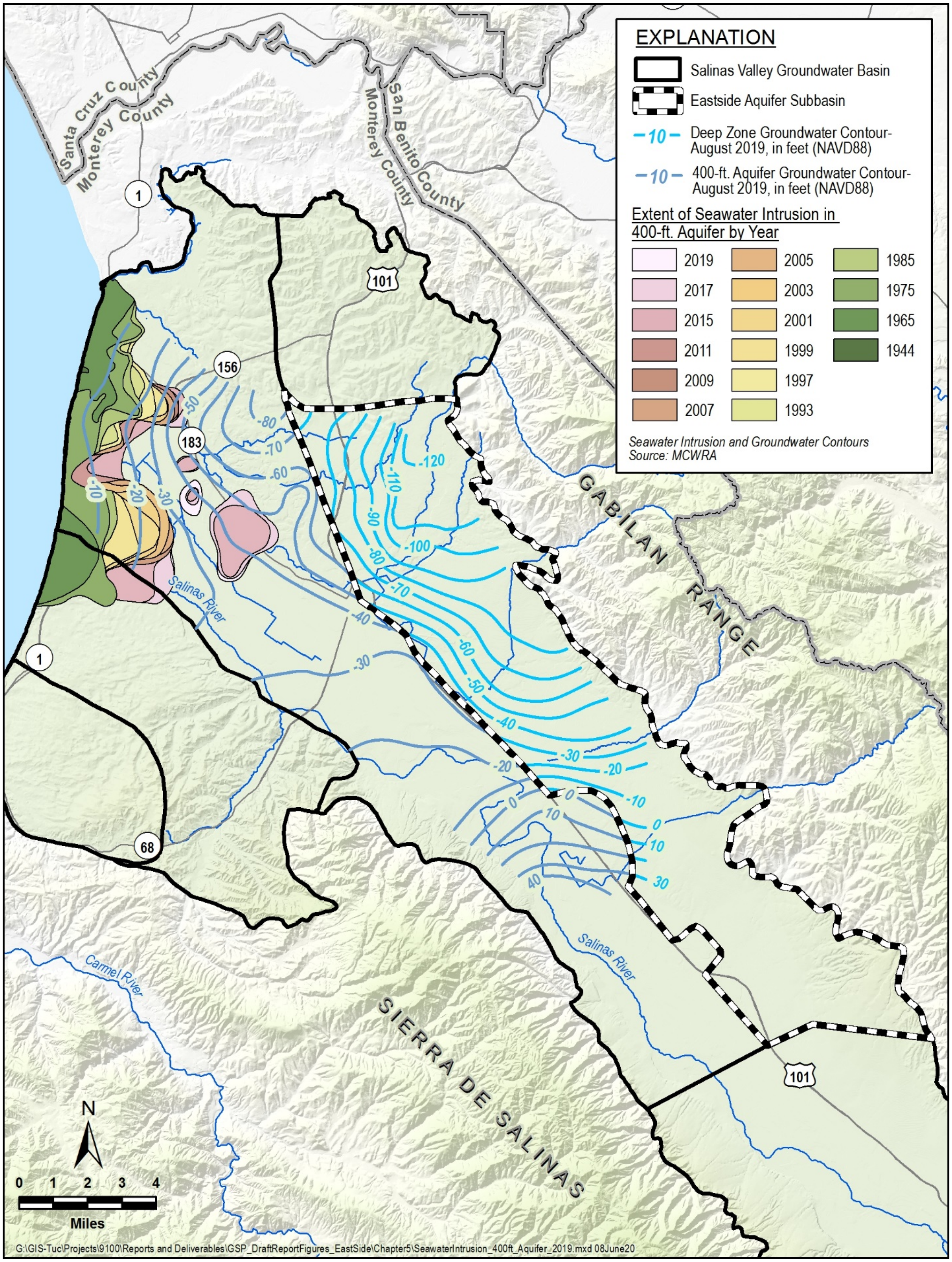

Figure 5-20. Seawater Intrusion in the 400-Foot Aquifer

5.4 Groundwater Quality Distribution and Trends

The SVBGSA does not have sole regulatory authority over groundwater quality and is not charged with improving groundwater quality in the Salinas Valley Groundwater Basin. Projects and actions implemented by the SVBGSA are not required to improve groundwater quality; however, they must not further degrade it.

5.4.1 Data Sources

Groundwater quality samples have been collected and analyzed in the Subbasin for various studies and programs. Groundwater quality samples have also been collected on a regular basis for compliance with regulatory programs. Groundwater quality data for this GSP were collected from:

- The Northern Counties Groundwater Characterization report (CCGC, 2015)
- The USGS' Groundwater Ambient Monitoring and Assessment Program (GAMA) reports (Kulongoski and Belitz, 2005; Burton and Wright, 2018)
- State Water Resources Control Board's GeoTracker Data Management System (SWRCB, 2020a)
- State Water Resources Control Board's GAMA Groundwater Information System (SWRCB, 2020b)
- The California Department of Toxic Substances Control's EnviroStor data management system (DTSC, 2020)

5.4.2 Point Sources of Groundwater Contaminants

Clean-up and monitoring of point source pollutants may be under the responsibility of either the Central Coast Regional Water Quality Control Board (CCRWQCB) or the Department of Toxic Substances Control (DTSC). The locations of these clean-up sites are visible in SWRCB's GeoTracker database map, publicly available at: https://geotracker.waterboards.ca.gov/. The GeoTracker database is linked to the DTSC's EnviroStor data management system that is used to track clean-up, permitting, and investigation efforts. Table 5-2 and Figure 5-21 provide a summary of the active clean-up sites within the Subbasin. Table 5-2 does not include sites that have leaking underground storage tanks, which are not overseen by DTSC or the CCRWQCB.

Table 5-2. Active Cleanup Sites

Label	Site Name	Site Type	Status	Constituents of Concern (COC)	Address	City
1	Salinas Community School	School	Active	metals, organochlorine pesticides, polychlorinated biphenyls (PCBs)	615 Leslie Drive	Salinas
2	Berman Steel-Salinas	State Response or National Priorities List	Certified / Operation & Maintenance	copper and compounds, lead, PCBs, zinc	Highway 101 At Spence Road	Salinas

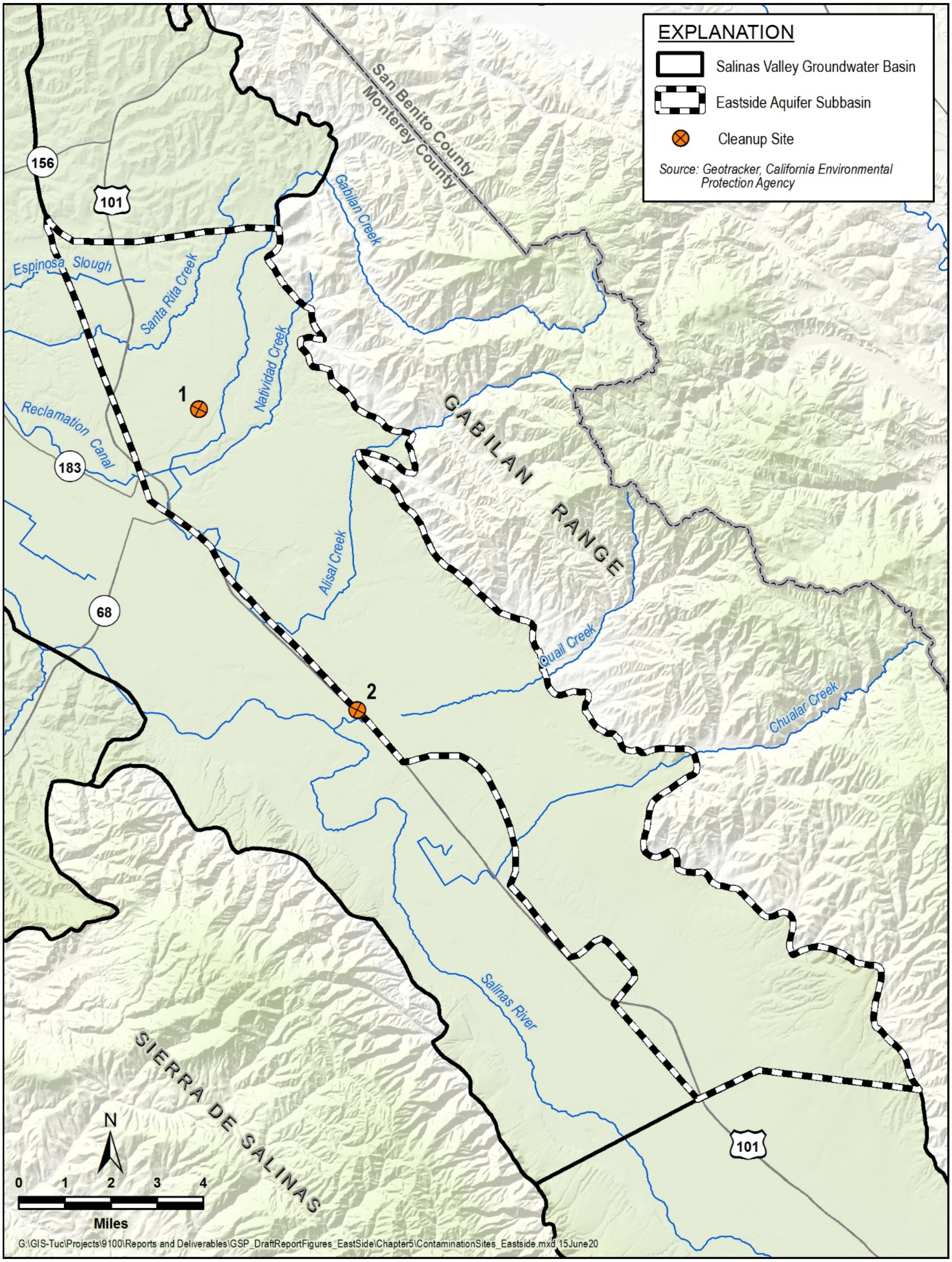

Figure 5-21. Active Cleanup Sites

5.4.3 Distribution and Concentrations of Diffuse or Natural Groundwater Constituents

In addition to the point sources described above, the CCRWQCB monitors and regulates activities and discharges that can contribute to non-point pollutants that are released to groundwater over large areas. In the Subbasin, the most prevalent non-point water quality concern is nitrate. The current distribution of nitrate was extensively monitored and evaluated by the CCGC and documented in a report submitted to the CCRWQCB (CCGC, 2015).

Figure 5-22 shows a map of nitrate distribution in the Subbasin prepared by CCGC. The orange and red areas illustrate the portions of the Subbasin where groundwater has nitrate concentrations above the drinking water MCL of 45 mg/L NO_3.

Figure 5-23 shows maps of measured nitrate concentration from 6 decades of monitoring for the entire Salinas Valley Groundwater Basin. These maps, prepared by MCWRA, indicate that elevated nitrate concentrations in groundwater were locally present in the 1960s, but significantly increased in 1970s and 1980s. Extensive distribution of nitrate concentrations above the drinking water MCL, as shown on Figure 5-22, has been present in the Eastside Subbasin for 20 to 30 years.

A May 2018 staff report to the CCRWQCB included a summary of nitrate concentrations throughout the Central Coast Region, including the Salinas Valley Groundwater Basin. The staff report includes data from 2008 to 2018, collected at 2,235 wells in the Salinas Valley Groundwater Basin, during Agricultural Orders 2.0 and 3.0 sampling events. The report states that 58% of on-farm domestic wells in the Eastside Subbasin exceeded the drinking water MCL, with a mean concentration of 139.4 mg/L NO_3. In addition, 61% of irrigation supply wells in the Subbasin exceeded this MCL with a mean concentration of 96.6 mg/L NO_3 (CCRWQCB, 2018).

Some COC can be concentrated at various aquifer depths. Nitrate is a surficial constituent derived from such sources as fertilizer, livestock, and septic systems. Because the sources are all near the surface, nitrate is usually highest near ground surface and decreases with depth. Raising groundwater levels may mobilize additional nitrate. By contrast, arsenic concentrations usually increase with depth, and lowering groundwater levels may mobilize additional arsenic. The distribution and concentrations of COC can be further complicated by location and rate of groundwater pumping. The extent to which pumping affects groundwater quality depends on aquifer properties, distance to contamination, constituent characteristics and transport rate, and the time at which contaminants entered the subsurface. The extent to which these general relationships are experienced within the Subbasin is unknown. No strong statistical correlation between groundwater elevations and the concentrations of COC has been established in the Subbasin. However, additional data is necessary to form more concrete conclusions.

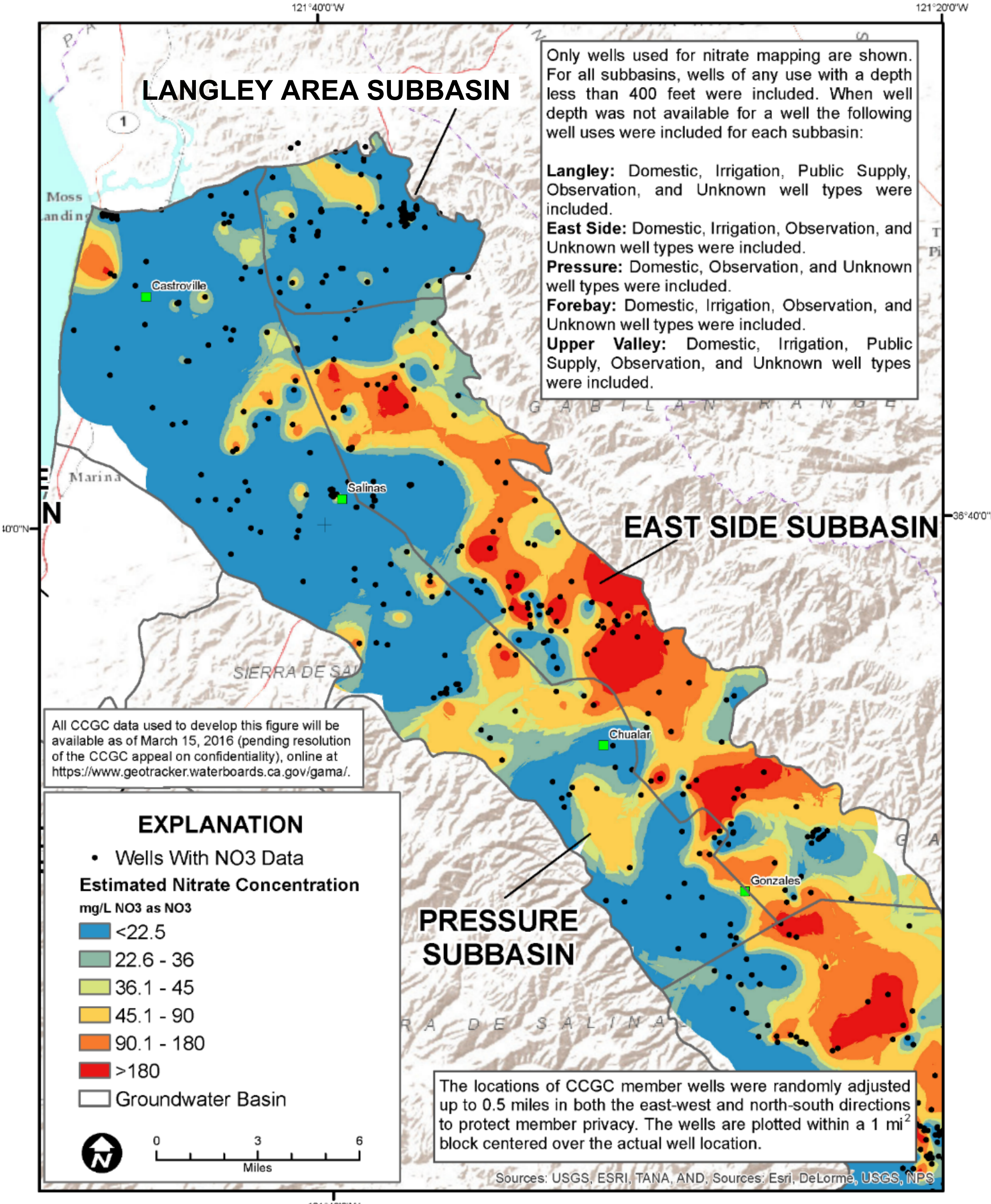

Figure 5-22. Estimated Nitrate Concentrations (from CCGC, 2015)

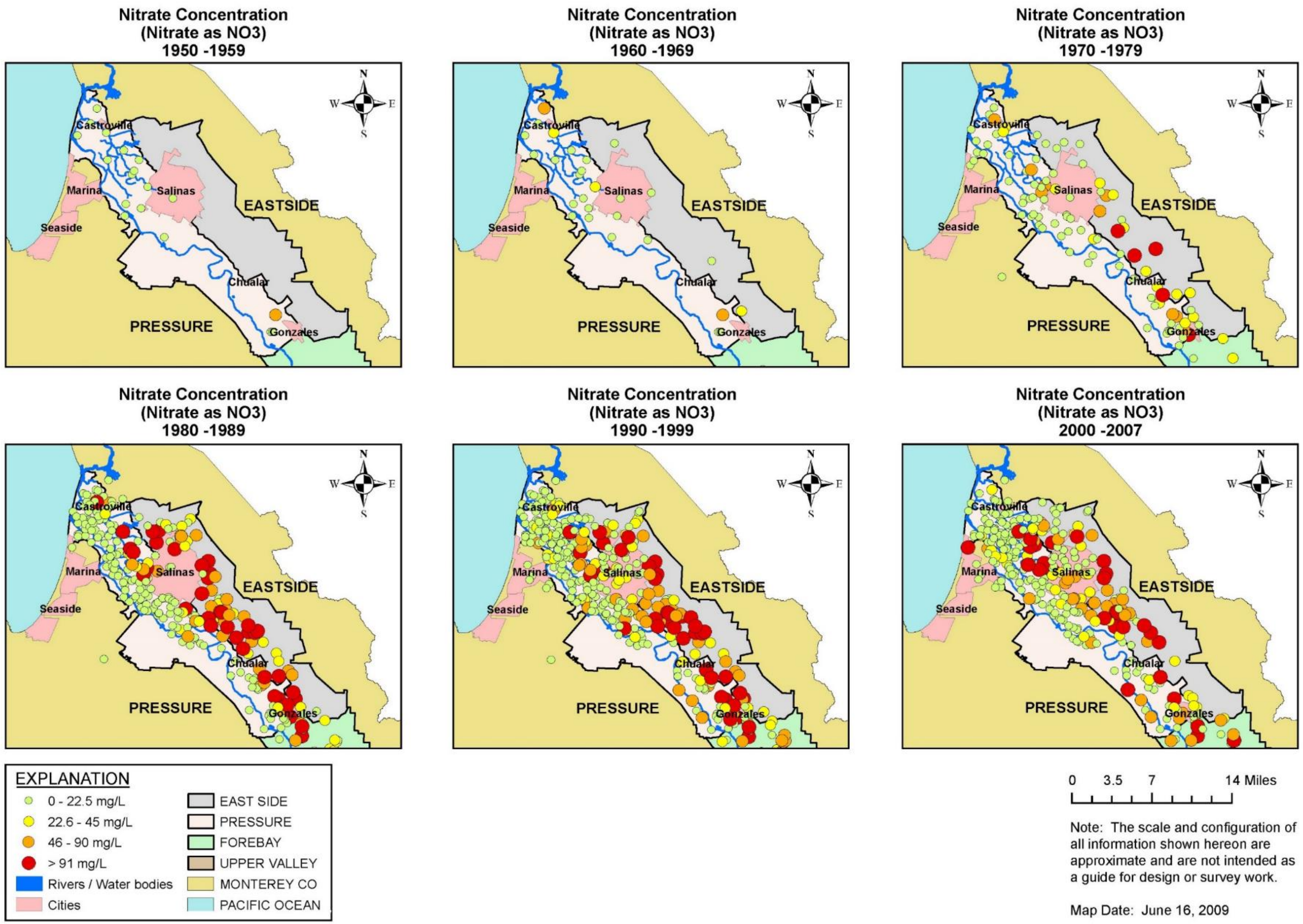

Figure 5-23. Nitrate Concentrations, 1950 to 2007
(modified from MCWRA data)

Additional groundwater quality conditions in the Basin are summarized in 2 USGS water quality studies in the Salinas Valley. The USGS 2005 GAMA study characterized deeper groundwater resources used for public water supply (Kulongoski and Belitz, 2005). The USGS 2018 GAMA study focused on domestic well water quality (Burton and Wright, 2018). The source data used in these 2 studies and additional publicly available water quality data can be accessed through the SWRCB GAMA groundwater information system at: https://gamagroundwater.waterboards.ca.gov/gama/datadownload.

The GAMA groundwater information system includes groundwater quality data for public water system supply wells from the SWRCB Division of Drinking Water (DDW), and on-farm domestic wells and irrigation supply wells from CCRWQCB's Irrigated Lands Regulatory Program (ILRP). This GSP relies on established thresholds for constituents of concern (COC): Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs) established by the State's Title 22 drinking water standards for public water system supply wells and on-farm domestic wells, and COC levels that may lead to reduced crop production for irrigation supply wells, as outlined in the CCRWQCB's Basin Plan (CCRWQCB, 2019).

Table 5-3 reports the COC in the Eastside Subbasin based on GAMA groundwater information system data up to 2019. The number of wells that exceed the regulatory standard for any given COC is based on the latest sample for each well in the monitoring network. Not all wells have been sampled for all COC. Therefore, the percentage of wells with exceedances is the number of wells that exceed the regulatory standard divided by the total number of wells that have ever been sampled for that COC. Additionally, Table 5-3 does not report all of the constituents that are monitored under Title 22 or the Basin Plan; it only includes the constituents that exceed a regulatory standard. The total list of constituents sampled in the water quality monitoring network are listed in Table 8-4. Maps with the locations of wells that exceeded the regulatory standard for any of the COC listed in Table 5-3 from 2013 to 2019 are provided in Appendix 5B.

Table 5-3. Water Quality Constituents of Concern and Exceedances

Constituent of Concern	Regulatory Exceedance Standard	Standard Units	Number of Wells Sampled for COC	Number of Wells Exceeding Regulatory Standard from latest sample	Percentage of Wells with Exceedances
DDW Wells (Data from December 1982 to December 2019)					
Arsenic	**10**	**UG/L**	**75**	**4**	**5%**
Lindane	0.2	UG/L	42	1	2%
Di(2-ethylhexyl) phthalate	4	UG/L	63	1	2%
Benzo(a)Pyrene	0.2	MG/L	62	1	2%
1,2 Dibromo-3-chloropropane	0.2	UG/L	53	3	6%
Dinoseb	7	UG/L	71	3	4%
Iron	300	UG/L	68	5	7%
Hexachlorobenzene	1	UG/L	41	1	2%
Manganese	50	UG/L	70	2	3%
Nitrate (as nitrogen)	10	MG/L	89	8	9%
Specific Conductance	1600	UMHOS/CM	76	1	1%
1,2,3-Trichloropropane	0.005	UG/L	78	10	13%
Total Dissolved Solids	1000	MG/L	70	3	4%
Vinyl Chloride	0.5	UG/L	91	8	9%
ILRP On-Farm Domestic Wells (Data from March 2013 to December 2019)					
Chloride	**500**	**MG/L**	**109**	**3**	**3%**
Iron	300	UG/L	18	4	22%
Manganese	50	UG/L	18	1	6%
Nitrate (as nitrogen)	10	MG/L	119	91	76%
Nitrate + Nitrite (sum as nitrogen)	10	MG/L	28	17	61%
Specific Conductance	1600	UMHOS/CM	114	27	24%
Sulfate	500	MG/L	109	2	2%
Total Dissolved Solids	1000	MG/L	96	22	23%
ILRP Irrigation Supply Wells (Data from May 2013 to December 2019)					
Chloride	**350**	**MG/L**	**206**	**4**	**2%**
Iron	5	MG/L	68	1	1%
Manganese	0.2	MG/L	68	2	3%

5.4.4 Groundwater Quality Summary

Based on the water quality information for the DDW and ILRP wells from GAMA groundwater information system, the following are the COC for drinking water supply wells in the Subbasin and will be included in the GSP monitoring program:

- 1,2 dibromo-3-chloropropane
- 1,2,3-trichloropropane
- arsenic
- benzo(a)pyrene
- chloride
- di(2-ethylhexyl) phthalate
- dinoseb
- hexachlorobenzene
- iron
- lindane
- manganese
- nitrate (as nitrogen)
- nitrate + nitrite (sum as nitrogen)
- specific conductance
- sulfate
- total dissolved solids
- vinyl chloride

The COC for agricultural supply wells that occur in the Subbasin and are known to cause reductions in crop production when irrigation water includes them in concentrations above agricultural water quality objectives include:

- chloride
- iron
- manganese

The COC for active cleanup sites listed in Table 5-2 are not part of the monitoring network described in Chapter 7. However, the status of these constituents at these sites will continue to be monitored by the DTSC or the CCRWQCB. Furthermore, the COC at these sites that have a regulatory standard under Title 22 for drinking water wells, or the Basin Plan for irrigation supply wells will be monitored in the DDW and ILRP wells that are part of the monitoring network.

This GSP relies on data from existing monitoring programs to measure changes in groundwater quality. Therefore, the GSA is dependent on the monitoring density and frequency of the DDW and ILRP. The monitoring system is further defined in Chapter 7.

5.5 Subsidence

Land subsidence is the lowering of the ground surface elevation. This is often caused by pumping below thick clay layers. Land subsidence can be elastic or inelastic. Elastic subsidence consists of small, lowering and rising of the ground surface is reversible, while inelastic subsidence is generally irreversible and is the focus of this GSP.

5.5.1 Data Sources

To estimate subsidence, DWR has made Interferometric Synthetic Aperture Radar (InSAR) satellite data available on their SGMA Data Viewer web map: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub. These are the only data used for estimating subsidence in this GSP.

5.5.2 Subsidence Mapping

Figure 5-24 presents a map showing the average annual InSAR subsidence data in the Eastside Subbasin between June 2015 and June 2019 (DWR, 2020c). The yellow area on the map is the area with measured average annual changes in ground elevation of between -0.1 and 0.1 foot. As discussed in Section 8.9.2.1, because of measurement error in this methodology, any measured ground level changes between -0.1 and 0.1 foot are not is considered subsidence. The white areas on the map are areas with no available data. The map shows that no measurable subsidence has been recorded anywhere in the Subbasin.

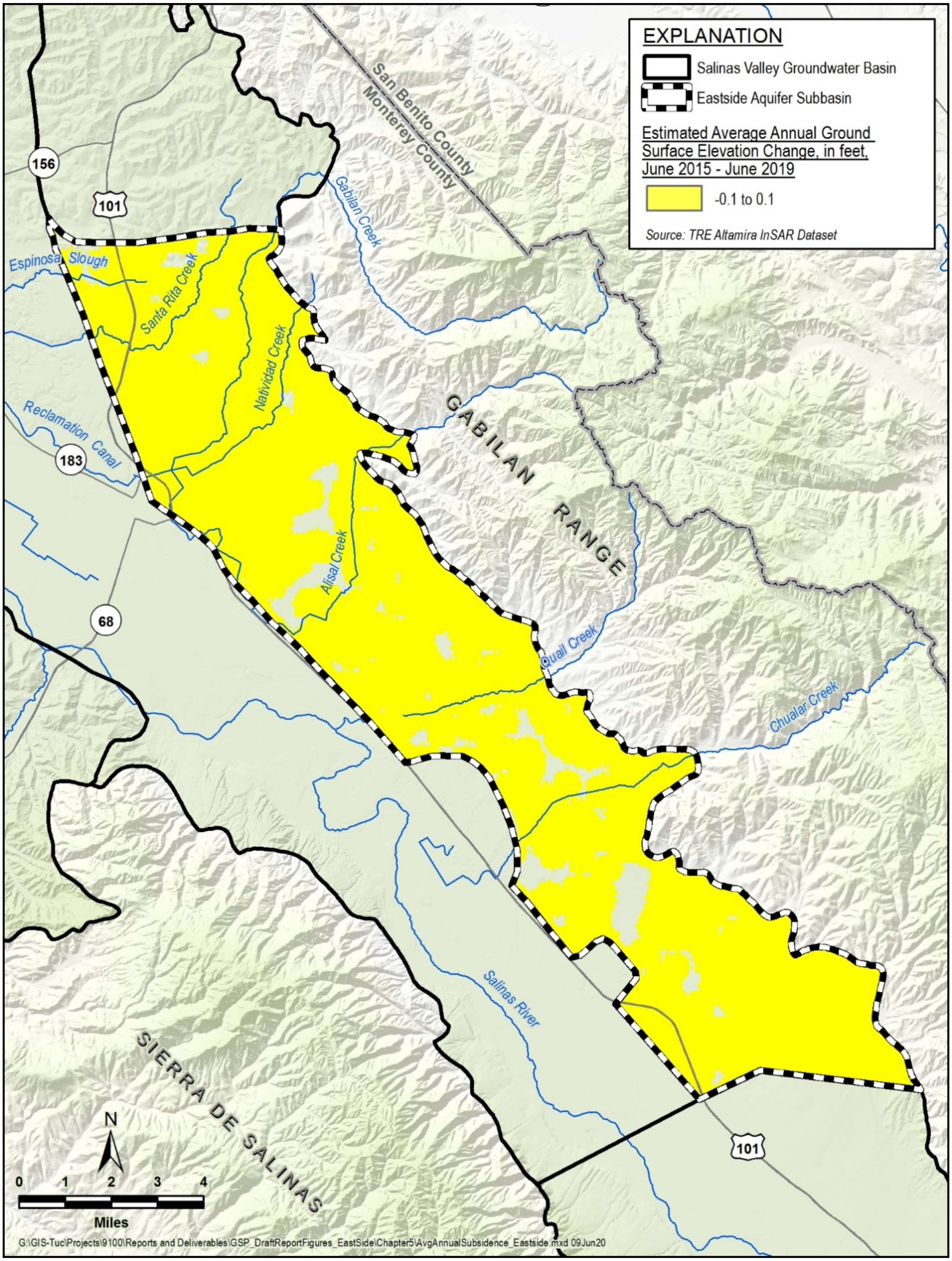

Figure 5-24. Estimated Average Annual InSAR Subsidence in Subbasin

5.6 Interconnected Surface Water

ISW is surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completed. If groundwater elevations are higher than the water level in the stream, the stream is said to be a gaining stream because it gains water from the surrounding groundwater. If the groundwater elevation is lower than the water level in the stream, it is termed a losing stream because it loses water to the surrounding groundwater. If the groundwater elevation is below the streambed elevation, the stream and groundwater are disconnected. SGMA does not require that disconnected stream reaches be analyzed or managed. These concepts are illustrated on Figure 5-25.

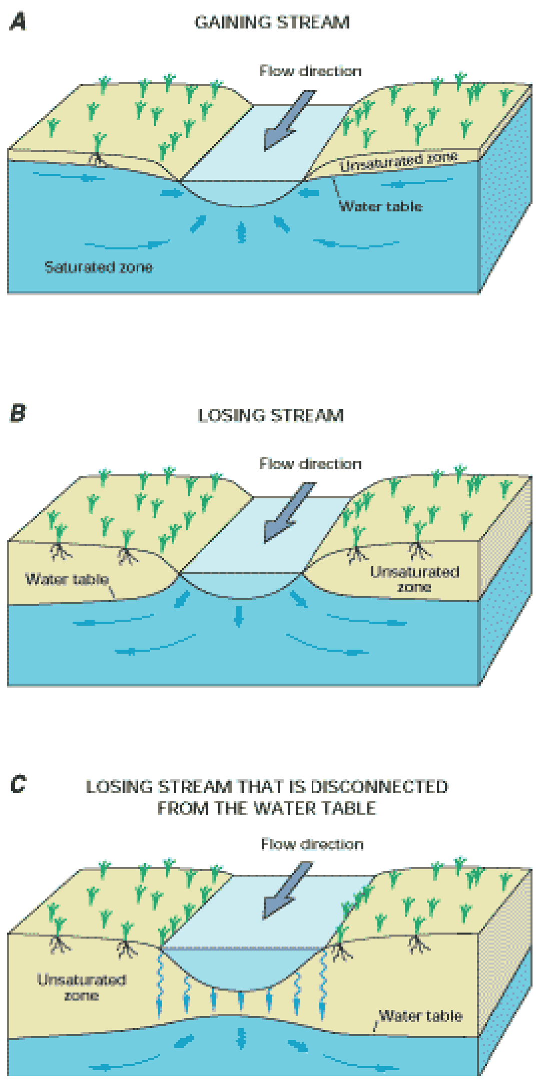

Figure 5-25. Conceptual Representation of Interconnected Surface Water (Winter, *et al.*, 1999)

5.6.1 Data Sources

The preliminary SVIHM is used to map the potential locations of ISW, as described in Chapter 4. As shown in Figure 4-9, there are currently no locations of ISW in the Eastside Subbasin; however, this GSP describes the process that would be used to evaluate surface water and groundwater interconnection should it exist in the future. There is no data that verifies the location and extent of surface water connection to groundwater, nor the extent to which groundwater extraction depletes surface water. Therefore, this section describes the hydraulic principles that establish the relationship between surface water and groundwater, upon which the current conditions and monitoring network are based.

5.6.2 Evaluation of Surface Water and Groundwater Interconnection

Groundwater extraction can alter flows between surface water and groundwater. Flow changes related to interconnected surface and groundwater could be due to reductions in groundwater discharge to surface water or increases in surface water recharge to groundwater. These 2 changes together constitute the change in the amount of surface water depletion.

Depletion of ISW is estimated by evaluating the change in the modeled stream leakage with and without pumping (i.e., water flowing from the stream into the groundwater system). A model simulation without any groundwater pumping in the model (i.e., SVIHM with no pumping) was compared to the model simulation with groundwater pumping (i.e., SVIHM with pumping). The difference in stream depletion between the 2 models is the depletion caused by the groundwater pumping. This comparison was undertaken for the entire area of the Salinas Valley included in the model and also for the Subbasin. The methodology for quantifying stream depletion is described in detail by Barlow and Leake (2012). There are no interconnected segments in the Subbasin, as shown in Figure 4-9, but if there is interconnection in the future the stream depletion differences would be estimated for the interconnected segments only.

6 WATER BUDGETS

This chapter summarizes the estimated water budgets for the Eastside Subbasin, including information required by the GSP Regulations and information that is important for developing an effective plan to achieve sustainability. In accordance with the GSP Regulations § 354.18, this water budget provides an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the basin, including historical, current, and projected water budget conditions, and the change in the volume of groundwater in storage. Water budgets are reported in graphical and tabular formats, where applicable.

6.1 Overview of Water Budget Development

The water budgets are presented in 2 subsections: (1) historical and current water budgets, and (2) future water budgets. Within each subsection a surface water budget and groundwater budget are presented.

Historical and current water budgets are developed using a provisional version of the Salinas Valley Integrated Hydrologic Model (SVIHM)[1], developed by the United States Geological Survey (USGS). The SVIHM is a numerical groundwater-surface water model that is constructed using version 2 of the MODFLOW-OWHM code (Boyce *et al.*, 2020). This code is a version of the USGS groundwater flow code MODFLOW that estimates the agricultural supply and demand, through the Farm Process.

The model area covers the Salinas Valley Groundwater Basin from the Monterey-San Luis Obispo County Line in the south to the Pajaro Basin in the north, including the offshore extent of the major aquifers. The model includes operations of the San Antonio and Nacimiento reservoirs. The SVIHM is supported by 2 sub models: a geologic model known as the Salinas Valley Geologic Model (SVGM) and a watershed model known as the Salinas Valley Watershed Model (SVWM) which uses the Hydrologic Simulation Program – Fortran (HSPF) code. The SVIHM is not yet released by the USGS. Details regarding source data, model construction and calibration, and results for historical and current water budgets will be summarized in more detail once the model and associated documentation are available. Appendix 6A includes an overview of the development and progress of the SVIHM.

[1] These data (model and/or model results) are preliminary or provisional and are subject to revision. This model and model results are being provided to meet the need for timely best science. The model has not received final approval by the U.S. Geological Survey (USGS). No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the model and related material nor shall the fact of release constitute any such warranty. The model is provided on the condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the model.

Future water budgets are being developed using an evaluation version of the Salinas Valley Operational Model (SVOM), developed by the USGS and Monterey County Water Resources Agency (MCWRA). The SVOM is a numerical groundwater-surface water model constructed with the same framework and processes as the SVIHM. However, the SVOM is designed for simulating future scenarios and includes complex surface water operations in the Surface Water Operations (SWO) module. The SVOM is not yet released by the USGS. Appendix 6A includes an overview of the SVOM, its development, and inputs.

In accordance with GSP Regulations § 354.18, an integrated groundwater budget is developed for each principal aquifer for each water budget period. The Eastside Subbasin is pumped from only 1 principal aquifer.

6.1.1 Water Budget Components

The water budget is an inventory of the Subbasin's surface water and groundwater inflows and outflows. Some components of the water budget can be measured, such as groundwater pumping from metered wells, precipitation, and surface water diversions. Other components are not easily measured and can be estimated using groundwater models, such as the SVIHM; these include unmetered agricultural pumping, recharge from precipitation and applied irrigation, and change of groundwater in storage. Figure 6-1 presents a general schematic diagram of the hydrogeologic conceptual model that is included in the water budget (DWR, 2020d). Figure 6-2 delineates the zones and boundary conditions of the SVIHM.

The water budgets for the Subbasin are calculated within the following boundaries:

- **Lateral boundaries.** The perimeter of the Eastside Subbasin within the SVIHM is shown on Figure 6-2.
- **Bottom.** The base of the groundwater subbasin is described in the Hydrogeologic Conceptual Model and is defined as the base of the usable and productive unconsolidated sediments (Durbin *et al.* 1978). This ranges from less than 200 feet below ground surface along the Gabilan Range to almost 1,600 feet deep along the Subbasin's western edge. The water budget is not sensitive to the exact definition of this base elevation because the base is defined as a depth below where there is not significant inflow, outflow, or change in storage.
- **Top.** The top of the water budget area is above the ground surface, so that surface water is included in the water budget.

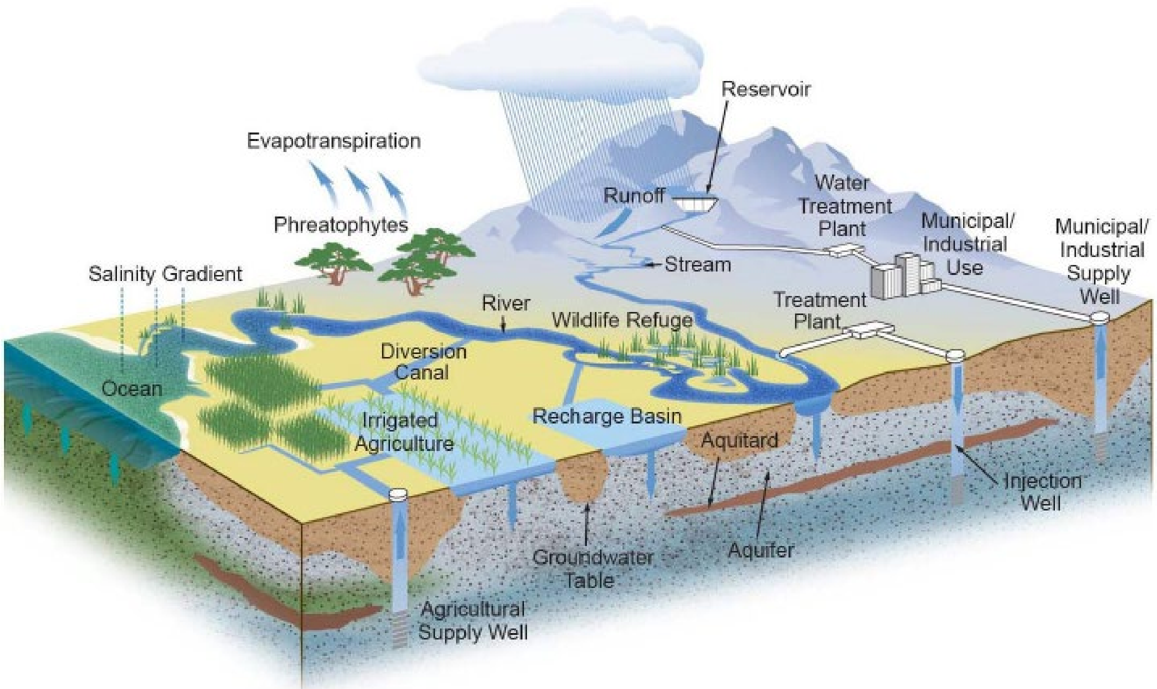

Figure 6-1. Schematic Hydrogeologic Conceptual Model (from DWR, 2020d)

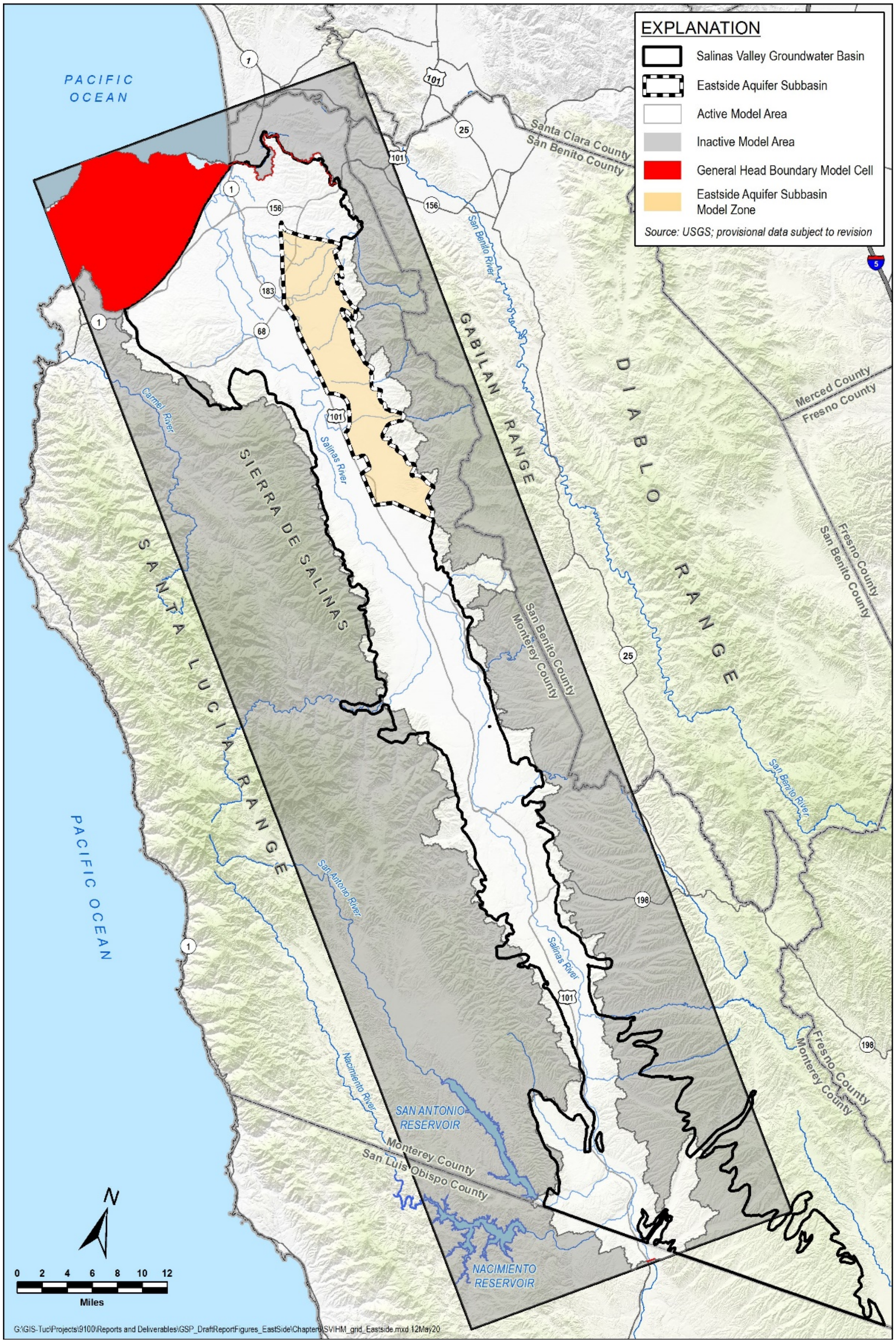

Figure 6-2. Zones and Boundary Conditions for the Salinas Valley Integrated Hydrologic Model

The Eastside Subbasin water budget includes the following components:

Surface Water Budget:

- Inflows
  - Runoff of precipitation
  - Surface water inflows from streams that enter the subbasin, including Chualar Creek, Quail Creek, Alisal Creek, Natividad Creek, Gabilan Creek, Santa Rita Creek, and several other smaller creeks
  - Groundwater discharge to streams
- Outflows
  - Stream discharge to groundwater
  - Outflow to neighboring subbasins along Gabilan Creek, Santa Rita Creek, and other smaller streams

Groundwater Budget:

- Inflows
  - Deep percolation from precipitation and applied irrigation
  - Stream discharge to groundwater
  - Subsurface inflows, including:
    - Inflow from the Forebay Subbasin
    - Inflow from the Langley Subbasin
    - Inflow from the 180/400-Foot Aquifer Subbasin
    - Inflow from the surrounding watershed that are not in other DWR subbasins
- Outflows
  - Crop and riparian evapotranspiration (ET)
  - Groundwater pumping, including urban, industrial, and agricultural
  - Groundwater discharge to streams
  - Groundwater discharge to drains
  - Subsurface outflows, including:
    - Outflow to the Forebay Subbasin

- Outflow to the Langley Subbasin
- Outflow to the 180/400-Foot Aquifer Subbasin
- Outflows to the surrounding watershed that are not in other DWR subbasins

The difference between groundwater inflows and outflows is equal to the change of groundwater in storage.

6.1.2 Water Budget Time Frames

Time periods must be specified for each of the 3 required water budgets. The GSP Regulations require water budgets for historical conditions, current conditions, and projected conditions, as follows:

- The historical water budget is intended to evaluate how past land use and water supply availability has affected aquifer conditions and the ability of groundwater users to operate within the sustainable yield. GSP Regulations require that the historical water budget include at least the most recent 10 years of water budget information. DWR's Water Budget Best Management Practices (BMP) document further states that the historical water budget should help develop an understanding of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability to operate the basin within the sustainable yield. Accordingly, historical conditions should include the most reliable historical data that are available for GSP development and water budgets calculations.
- The current water budget is intended to allow the GSA and DWR to understand the existing supply, demand, and change in storage under the most recent population, land use, and hydrologic conditions. Current conditions are generally the most recent conditions for which adequate data are available and that represent recent climatic and hydrologic conditions. Current conditions are not well defined by DWR but can include an average over a few recent years with various climatic and hydrologic conditions.
- The projected water budget is intended to quantify the estimated future baseline conditions. The projected water budget estimates the future baseline conditions concerning hydrology, water demand, and surface water supply over a 50-year planning and implementation horizon. It is based on historical trends in hydrologic conditions which are used to project forward 50 years while considering projected climate change and sea level rise if applicable.

Although there is a significant variation between wet and dry seasons, the GSP does not consider separate seasonal water budgets for the groundwater budget. All water budgets are developed for complete water years. Selected time periods for the historical and current water budgets are summarized in Table 6-1 and on Figure 6-3. and described in Sections 6.1.2.1 and 6.1.2.2.

Table 6-1. Summary of Historical and Current Water Budget Time Periods

Time Period	Proposed Date Range	Water Year Types Represented in Time Period	Rationale
Historical	Water years 1980 through 2016	Dry: 11 Dry-Normal: 7 Normal: 5 Wet-Normal: 3 Wet: 11	Provides insights on water budget response to a wide range of variations in climate and groundwater use over an extensive period of record. Begins and ends in years with average precipitation.
Current	Water Year 2016	Dry-Normal: 1	Best reflection of current land use and water use conditions based on best available data.

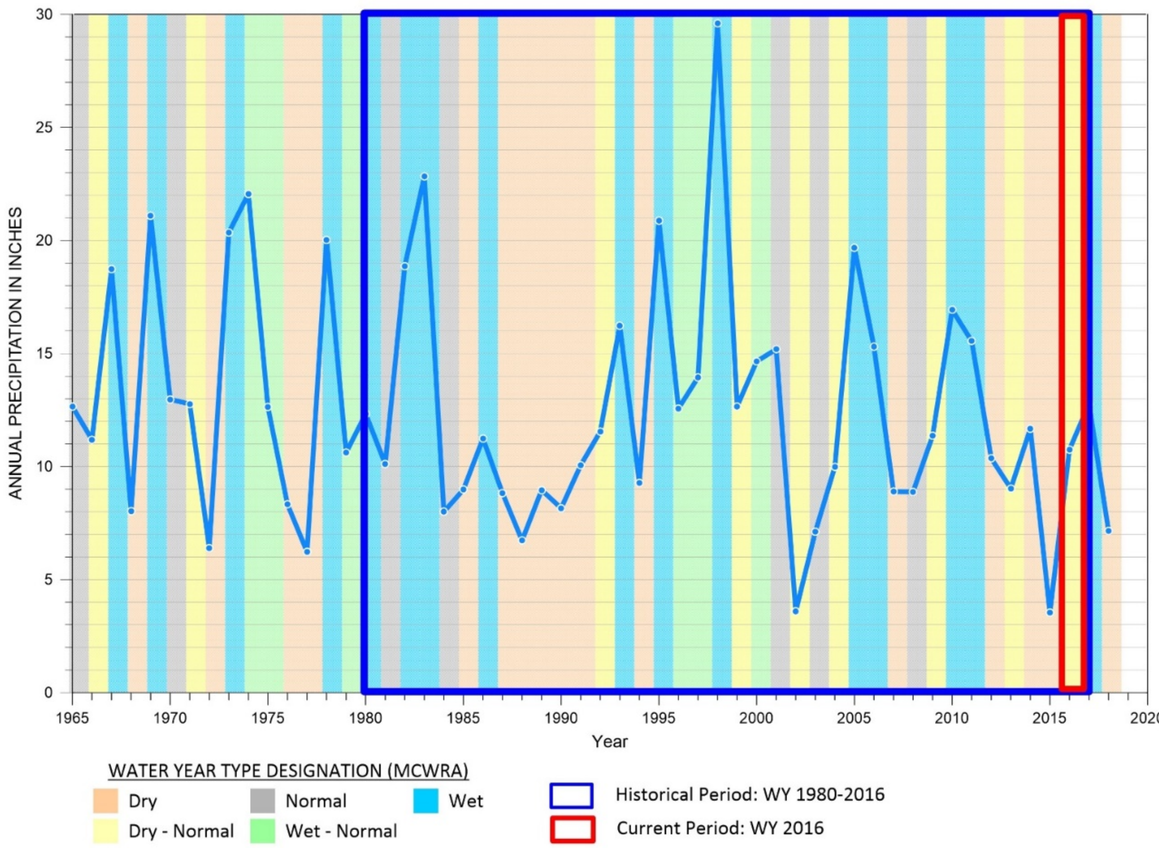

Figure 6-3. Climate and Precipitation for Historical and Current Water Budget Time Periods

6.1.2.1 Historical Water Budgets Time Period

GSP Regulations § 354.18 require that the historical water budget be based on at least 10 years of data. The water budget is computed using results from the SVIHM numerical model for the time period from October 1980 through September 2016. The SVIHM simulation covers water years 1967 through 2017; however, model results for years prior to 1980 and the year 2017 were not used for this water budget due to potential limitations and uncertainties in the provisional SVIHM. Water years 1980 through 2016 comprise a representative time period with both wet and dry periods in the Subbasin (Table 6-1, Figure 6-3).

6.1.2.2 Current Water Budget Time Period

The current water budget time period is also computed using the SVIHM numerical model and is based on water year 2016. Water year 2016 is classified as dry-normal and is reflective of current and recent patterns of groundwater use and surface water use. Although Water Year 2016 appropriately meets the regulatory requirement for using the "…most recent hydrology, water supply, water demand, and land use information" (23 California Code of Regulations § 354.18 (c)(1)), it is noted that water year 2016 was preceded by multiple dry or dry-normal years.

6.1.2.3 Future Projected Water Budgets Time Period

Future projected conditions are based on model simulations using the SVOM numerical flow model, using current reservoir operations rules, projected climate-change scenario, and estimated sea level rise. The projected water budget represents 47 years of future conditions. Following DWR guidance on implementing climate change factors, the future water budget simulations do not simulate a 47-year projected future, but rather simulate 47 likely hydrologic events that may occur in 2030, and 47 likely hydrologic events that may occur in 2070.

6.2 Overview of Data Sources for Water Budget Development

Table 6-2 provides the detailed water budget components and known model assumptions and limitations for each. A few water budget components are directly measured, but most water budget components are either estimated as input to the model or simulated by the model. Both estimated and simulated values in the water budgets are underpinned by certain assumptions. These assumptions can lead to uncertainty in the water budget. However, inputs to the preliminary SVIHM were carefully selected by the USGS and cooperating agencies using best available data, reducing the level of uncertainty.

In addition to the model assumptions, additional uncertainty stems from any model's imperfect representation of natural condition and level of calibration. The water budgets for the Eastside Subbasin are based on a preliminary version of the SVIHM, with limited documentation of model construction. The model is in internal review at the USGS, and a final version will likely not be released to the SVBGSA until after the GSP is submitted. Nonetheless, the SVIHM's calibration error is within reasonable bounds. Therefore, the model is the best available tool for estimating water budgets for the GSP.

As GSP implementation proceeds, the SVIHM will be updated and recalibrated with new data to better inform model simulations of historical, current, and projected water budgets. Model assumptions and uncertainty will be described in future updates to this chapter after model documentation is released by the USGS.

Table 6-2. Summary of Water Budget Component Data Source from the Salinas Valley Integrated Hydrologic Model

Water Budget Component	Source of Model Input Data	Limitations
Precipitation	Incorporated in calibrated model as part of land use process	Estimated for missing years
Surface Water Inflows		
Inflow from Streams Entering Basin	Simulated from calibrated model for all creeks	Not all creeks are gauged
Groundwater Discharge to Streams	Simulated from calibrated model	Based on calibration of streamflow to available data from gauged creeks
Overland Runoff	Simulated from calibrated model	Based on land use, precipitation, and soils specified in model
Surface Water Outflows		
Streambed Recharge to Groundwater	Simulated from calibrated model	Based on calibration of streamflow to available data from gauged creeks and groundwater level data from nearby wells
Diversions	Model documentation not available at this time	Based on calibration of streamflow to available data from gauged creeks
Outflow to Streams Leaving Basin	Simulated from calibrated model for all creeks	Not all creeks are gauged
Groundwater Inflows		
Streambed Recharge to Groundwater	Simulated from calibrated model	Based on calibration of streamflow to available data from gauged creeks and groundwater level data from nearby wells
Deep percolation of irrigation water	Simulated from demands based on crop, acreage, temperature, and soil zone processes	No measurements available; based on assumed parameters for crops and soils
Subsurface Inflow from neighboring basins	Simulated from calibrated model	Limited groundwater calibration data at adjacent subbasin boundaries
Subsurface Inflow from surrounding watershed other than neighboring basins	Simulated from calibrated model	Limited groundwater calibration data at adjacent subbasin boundaries
Groundwater Outflows		
Groundwater Pumping	Reported data for historical municipal and agricultural pumping, and some small water systems. Model documentation not available at this time.	Water budget pumping reported herein is from the SVIHM and might contain errors. Domestic pumping not simulated in model
Groundwater Discharge to Streams	Simulated from calibrated model	Based on calibration of streamflow to available data from gauged creeks and groundwater level data from nearby wells
Subsurface Outflow to Adjacent Basins	Simulated from calibrated model	Limited calibration data at adjacent subbasin boundaries
Riparian ET	Simulated from calibrated model	Based on representative plant group and uniform extinction depth

6.3 Historical and Current Water Budgets

Water budgets for the historical and current periods are presented below. The surface water budgets are presented first, followed by the groundwater budgets. These water budgets are based on the provisional SVIHM and are subject to change in the future. Water budgets will be updated in future GSP updates after the SVIHM is formally released by the USGS.

6.3.1 Historical and Current Surface Water Budget

The surface water budget accounts for the inflows and outflows for the streams within the Subbasin. This includes streamflows of rivers and tributaries entering and exiting the Subbasin, overland runoff to streams, and stream-aquifer interactions. Evapotranspiration by riparian vegetation along stream channels is estimated by the provisional SVIHM as part of the groundwater system and is accounted for in the groundwater budget.

Figure 6-4 shows the surface water network simulated in the provisional SVIHM. The model accounts for surface water flowing in and out across the subbasin boundary. For this water budget, boundary inflows and outflows are the sum of all locations that cross the Subbasin boundary. In some instances, a simulated stream might enter and exit the Subbasin boundary at multiple locations, such as Natividad Creek and Alisal Creek.

Figure 6-5 shows the surface water budget for the historical period, which also includes the current period. Table 6-3 shows the average values for components of the surface water budget for the historical and current periods. Positive values are inflows into the stream system, and negative values are outflows from the stream system. The 4 components of the surface water budget shown in Table 6-3 are roughly similar in magnitude. The flow between surface water and groundwater in the Subbasin is generally net negative, which indicates more deep percolation of streamflow to groundwater than groundwater discharge to streams.

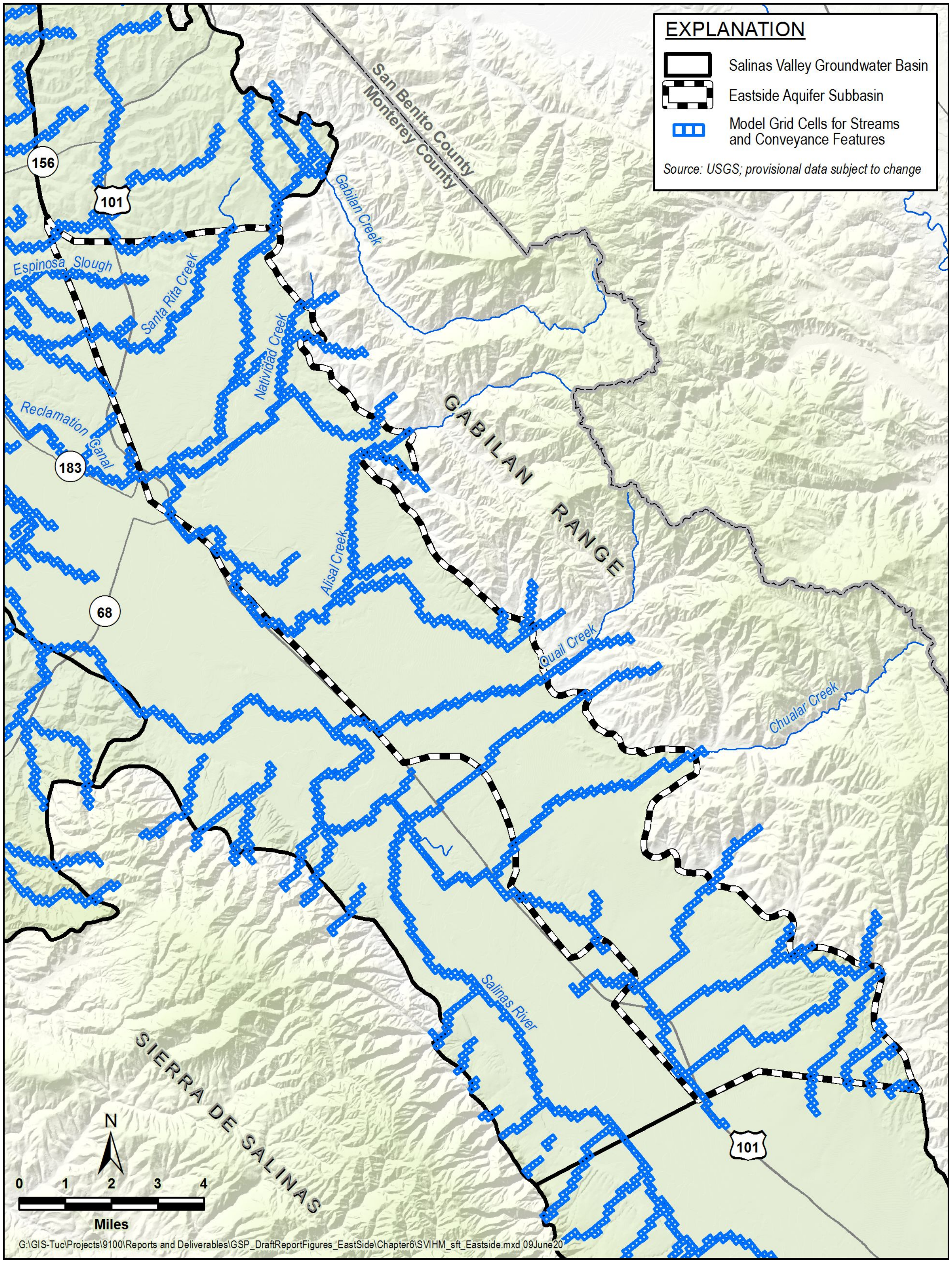

Figure 6-4. Surface Water Network in the Eastside Aquifer Subbasin from the Salinas Valley Integrated Hydrologic Model

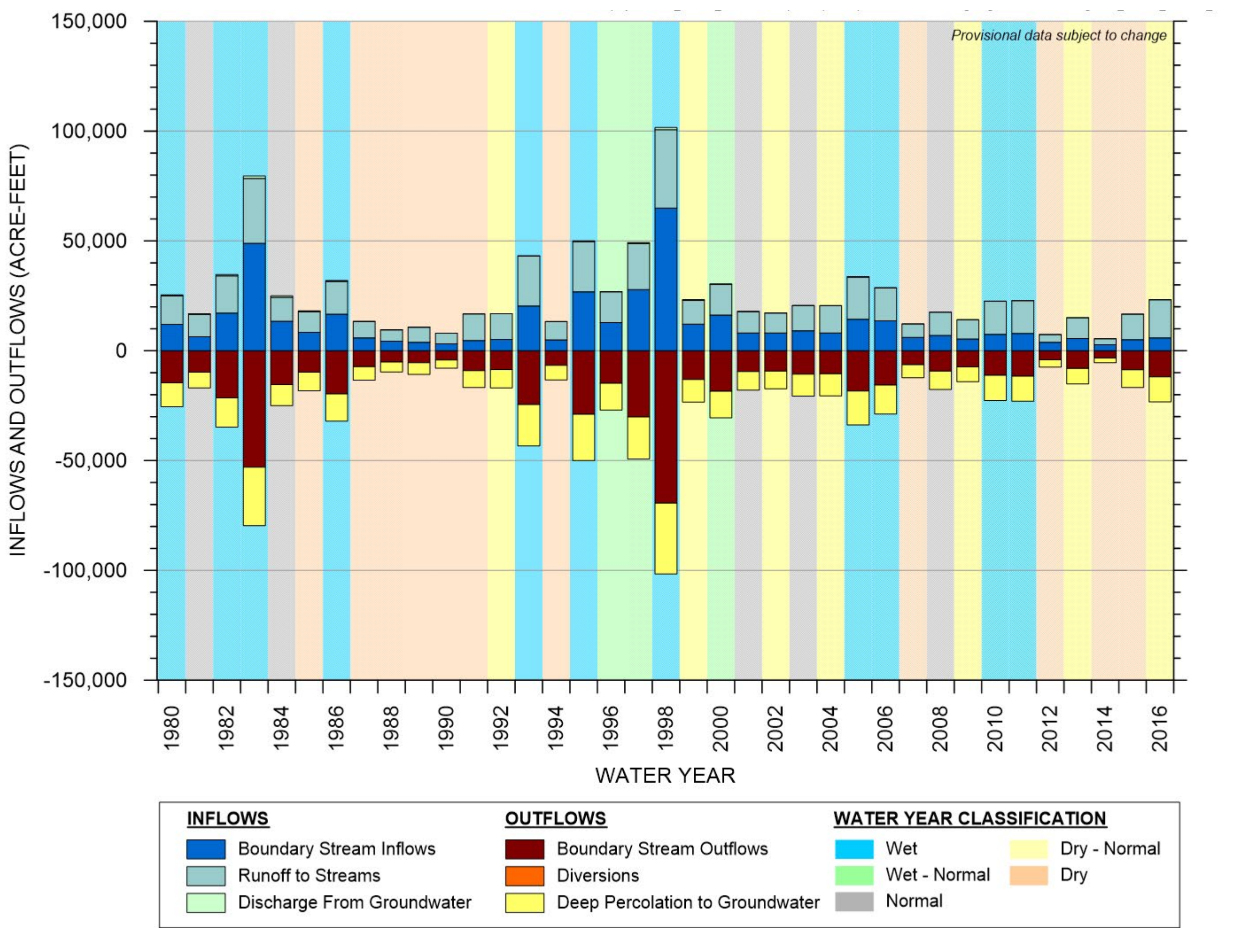

Figure 6-5. Historical and Current Surface Water Budget

Table 6-3. SVIHM Simulated Surface Water Budget Summary (AF/yr.)

	Historical Average (WY 1980-2016)	Current (WY 2016)
Overland Runoff to Streams	12,900	17,400
Boundary Stream Inflows	12,300	5,900
Net Flow between Surface Water and Groundwater	-10,500	-11,400
Boundary Stream Outflows	-14,700	-11,900

Note: provisional data subject to change.

6.3.2 Historical and Current Groundwater Budget

The groundwater budget accounts for the inflows and outflows to and from the Subbasin's aquifers, based on results from the SVIHM. This includes subsurface inflows and outflows of groundwater at the Subbasin boundaries, recharge, pumping, evapotranspiration, and net flow between surface water and groundwater.

Figure 6-6 shows SVIHM estimated annual groundwater inflows for the historical and current time periods. Inflows vary substantially from year to year. Table 6-4 provides average groundwater inflows for the historical and current period. The biggest inflow component is deep percolation of precipitation and applied irrigation, which ranged from about 8,000 AF in 2014 to more than 80,000 AF in 1998, with a historical average of about 33,000 AF/yr. The estimated historical average deep percolation of streamflow is about 11,000 AF/yr. The most consistent groundwater flows into the Subbasin are from the subsurface, which are almost always between 15,000 and 20,000 AF/yr. Total recharge for the current period is greater than average total recharge over the historical period.

Figure 6-7 shows the SVIHM estimated groundwater outflows for the historical and current time periods. Outflows vary from year to year; however, the annual variation is dampened compared to the inflows. Table 6-5 provides the SVIHM estimated average groundwater outflows of the historical and current periods. In both periods, pumping accounted for almost 90% of groundwater outflow in the Subbasin. Total average annual groundwater outflow was about 84,000 AF for the historical period and 75,000 AF for the current period. All outflows are shown as negative values.

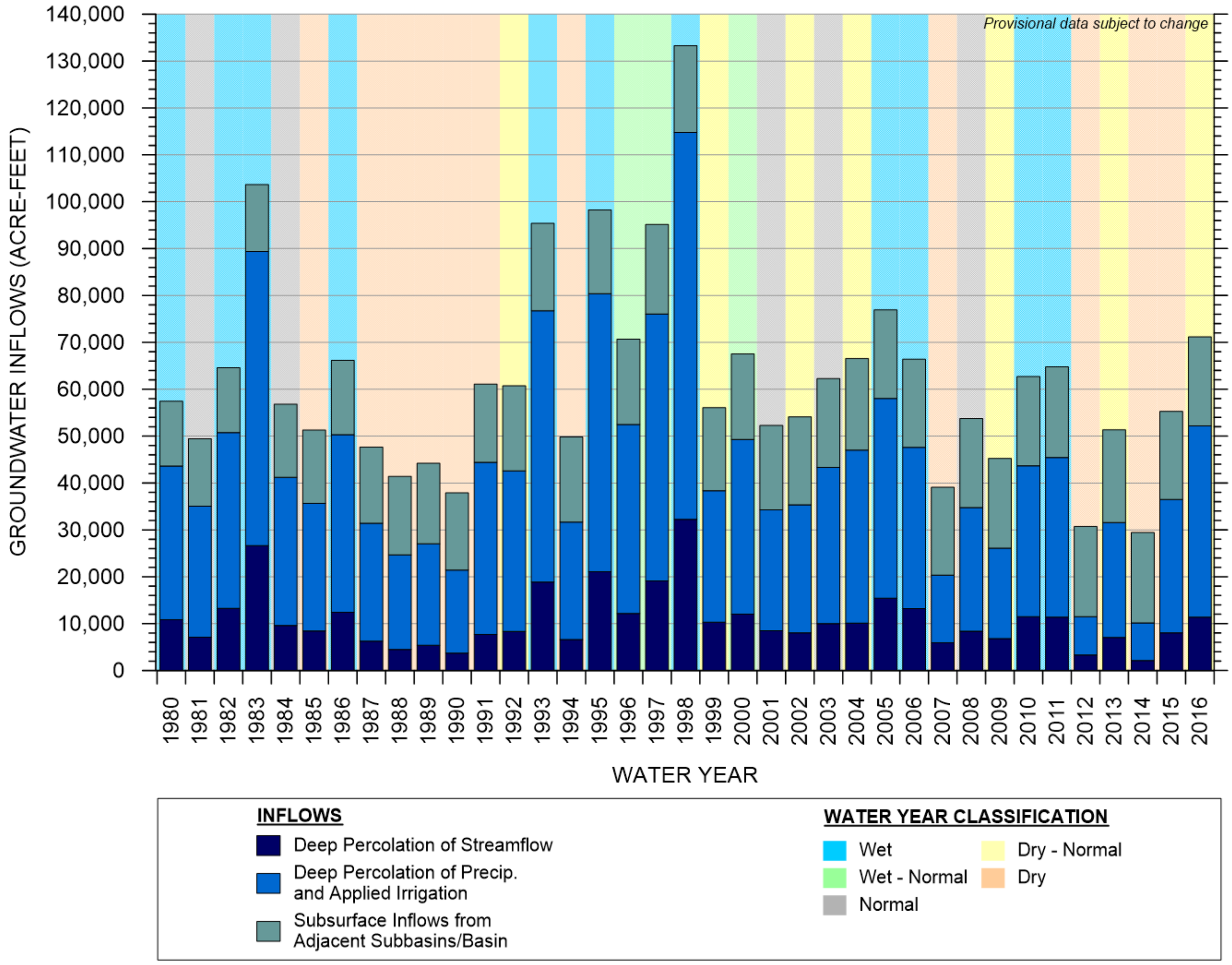

Figure 6-6. SVIHM Simulated Inflows to the Groundwater System

Table 6-4. SVIHM Simulated Groundwater Inflows Summary (AF/yr.)

	Historical Average (WY 1980-2016)	Current (WY 2016)
Deep Percolation of Streamflow	10,800	11,400
Deep Percolation of Precipitation and Applied Irrigation	33,400	40,800
Subsurface Inflow from Adjacent Subbasins/Basin	17,700	19,000

Note: provisional data subject to change.

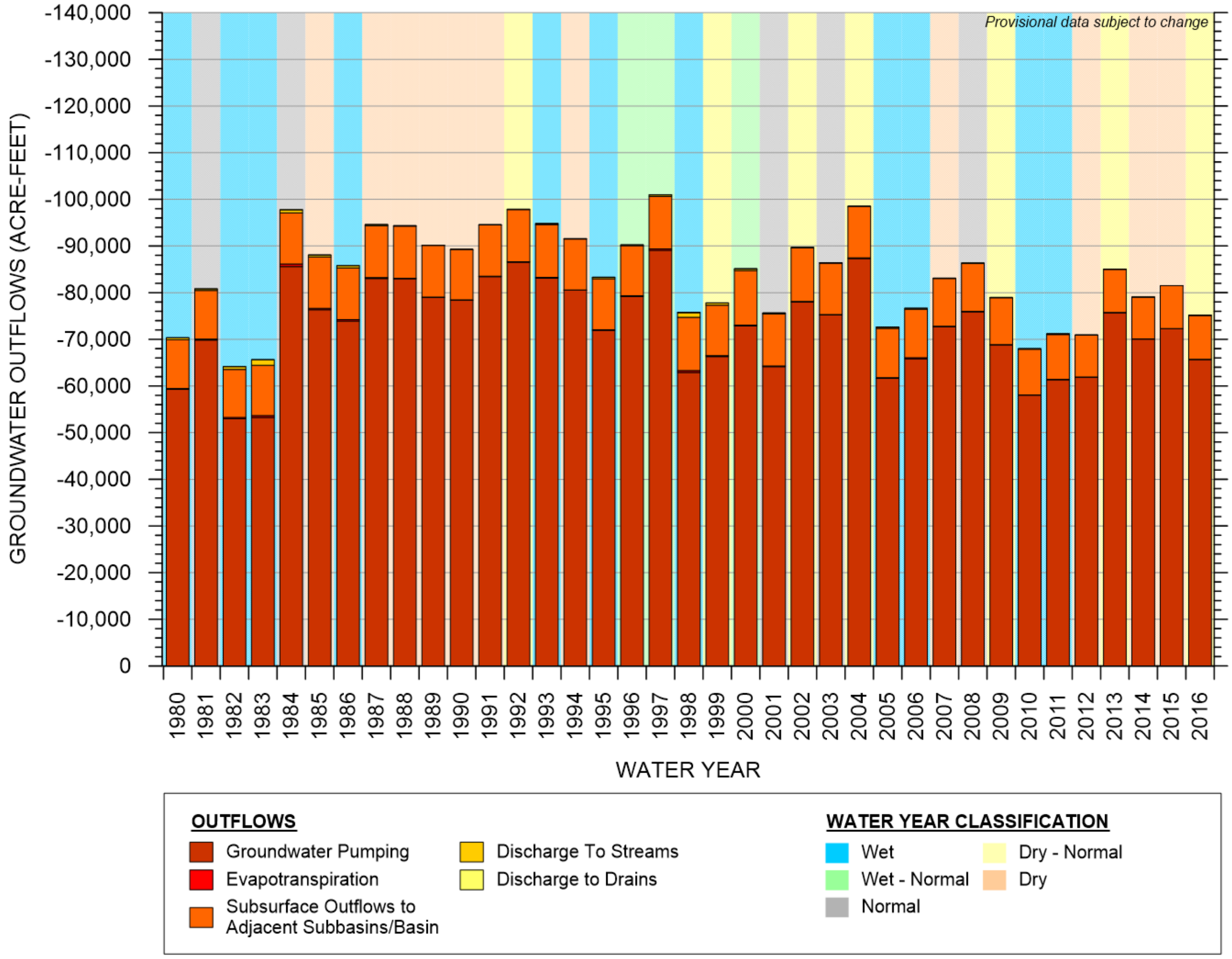

Figure 6-7. SVIHM Simulated Outflows from the Groundwater System

Table 6-5. SVIHM Simulated and Adjusted Groundwater Outflows Summary (AF/yr.)

	Simulated		Adjusted	
	Historical Average (WY 1980-2016)	Current (WY 2016)	Historical Average (WY 1980-2016)	Current (WY 2016)
Groundwater Pumping	-72,600	-65,600	-90,600	-82,000
Groundwater Evapotranspiration	-200	-100	-200	-100
Subsurface Outflow to Adjacent Subbasins/Basin	-10,600	-9,400	-10,600	-9,400
Discharge to Streams	-200	0	-200	0
Discharge to Drains	0	0	0	0

Note: provisional data subject to change.

Adjusted pumping is described below.

Comparing SVIHM output to Groundwater Extraction Management System (GEMS) data reveals that, on average, the preliminary SVIHM estimates only approximately 80% of the pumping reported in the GEMS database for the Subbasin between 1995 and 2016. The historical average of extraction reported to GEMS is 88,000 AF/yr., and the current extraction is 82,700 AF/yr. These GEMS data are likely more representative of historical conditions than the model generated pumping numbers; however, reliable GEMS data are only available since 1995. To accurately estimate groundwater extraction for the full historical period, this 80% ratio was applied to the SVIHM simulated historical pumping shown in Table 6-5, yielding an adjusted historical average pumping rate of 89,600 AF/yr.

Figure 6-8 and Table 6-6 show SVIHM simulated groundwater pumping by water use sector. More than 80% of groundwater pumping in the Subbasin is used for agricultural purposes. Groundwater pumping varies from year to year; however, total pumping in the Subbasin has generally decreased since the early 1990s. Urban and agricultural pumping are simulated in the SVIHM; however, domestic pumping is not included in the model, including pumping that occurs from a well with a discharge pipe of less than 3 inches. The SVIHM does not simulate domestic pumping because it is a relatively small portion of overall groundwater pumping in Salinas Valley Basin, and it is not included in the Eastside Subbasin water budget. The simulated historical average in Table 6-6 is not strictly comparable to the GEMS historical average because the time periods used to calculate the averages are different; however, the ratio between these values is used to adjust simulated pumping to be more consistent with GEMS data.

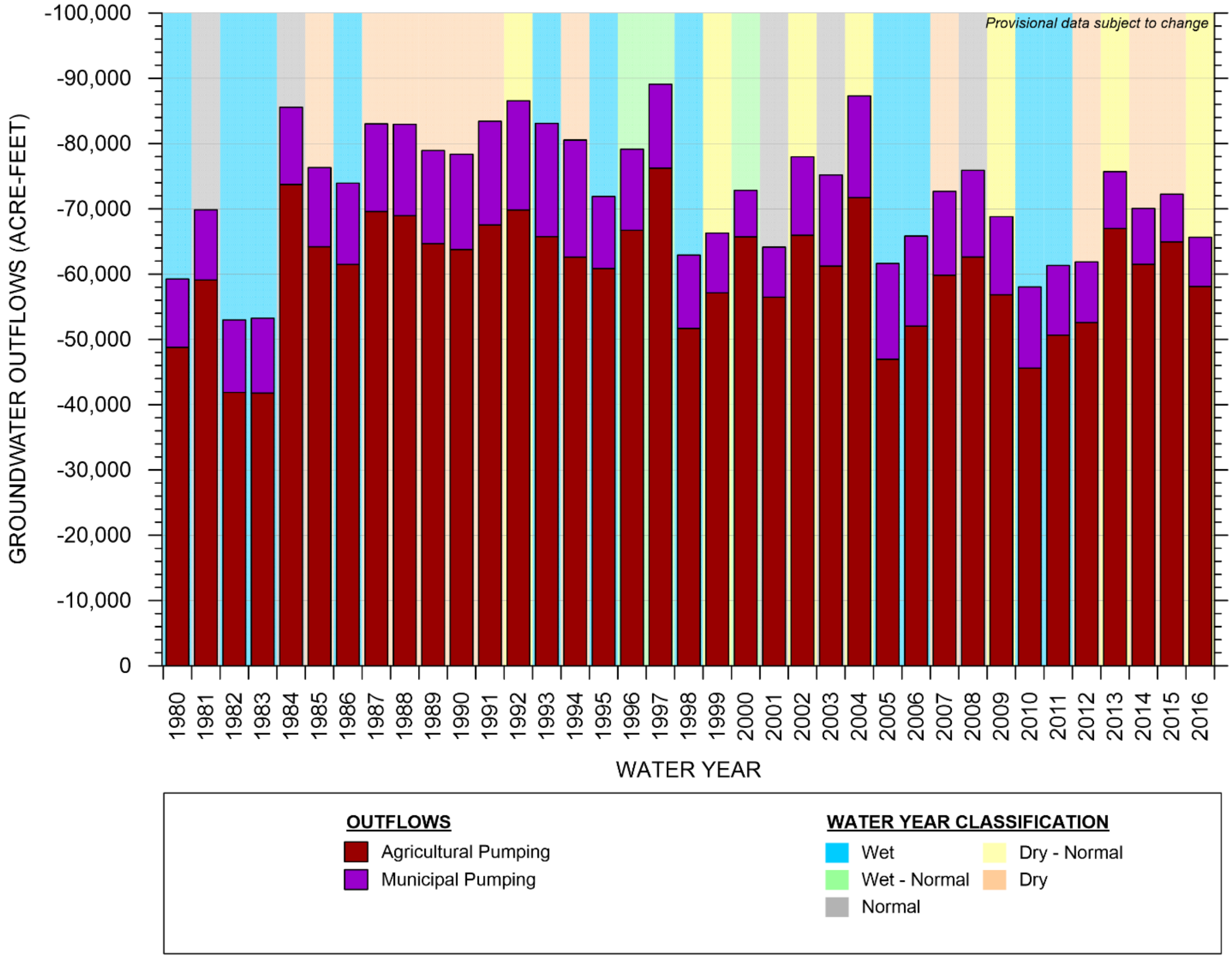

Figure 6-8. SVIHM Simulated Groundwater Pumping by Water Use Sector

Table 6-6. SVIHM Simulated and Adjusted Groundwater Pumping by Water Use Sector (AF/yr.)

	Simulated		GEMS		Adjusted[1]	
	Historical Average (WY 1980-2016)	Current (WY 2016)	Historical Average (WY 1995-2016)	Current (WY 2016)	Historical Average (WY 1980-2016)	Current (WY 2016)
Municipal & Industrial	-12,100	-7,500	-13,500	-11,000	-15,100	-9,400
Agricultural	-60,400	-58,100	-74,300	-71,700	-75,500	-72,600
Uncategorized	0	0	-400	0	0	0
Total Pumping	-72,500	-65,600	-88,200	-82,700	-90,600	-82,000

Note: provisional data subject to change.

1 Adjusted agricultural pumping is based on the ratio between SVIHM and GEMS agricultural pumping, as described in text above.

Figure 6-9 shows the SVIHM estimated net subsurface flows entering and exiting the Subbasin by watershed and neighboring subbasin. In most years of the historical period, the Subbasin's subsurface inflows are about 50% larger than its subsurface outflows. Table 6-7 shows SVIHM estimated historical mean and current year subsurface flows. Net subsurface flow is positive from all 4 neighboring areas, indicating net subsurface flow into the Subbasin. The Langley Subbasin, the Forebay Subbasin, and the Gabilan Range that is listed as Other Areas in Table 6-7, are hydraulically upgradient from the Eastside Subbasin. Groundwater pumping near the city of Salinas has created a cone of depression (Figure 5-1 through Figure 5-4) that draws in groundwater into the Eastside Subbasin from the 180/400-Foot Aquifer Subbasin, which is naturally slightly downgradient in the Salinas area. Estimated groundwater inflows from the 180/400-Foot Aquifer Subbasin have increased by about 40% since 1980.

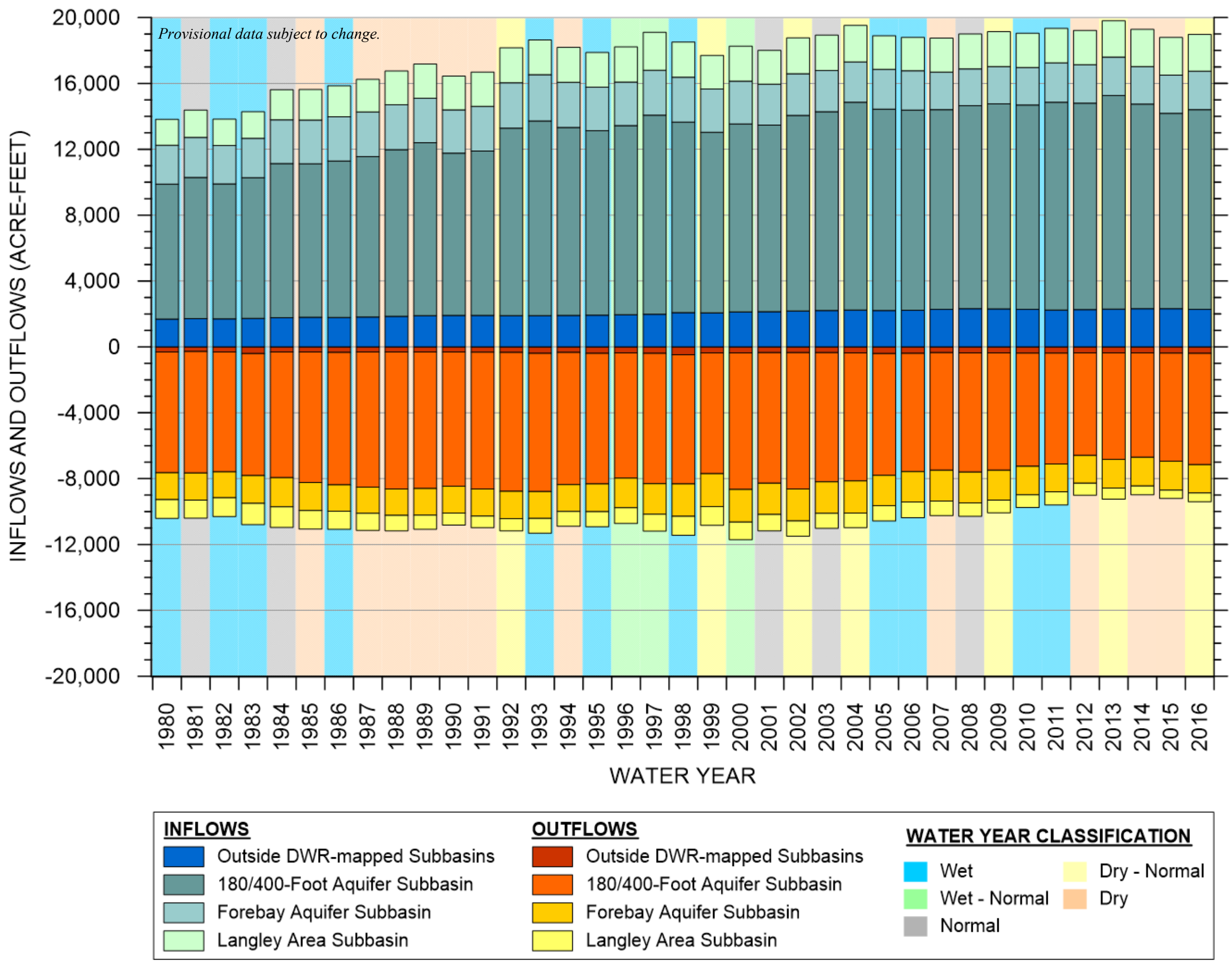

Figure 6-9. SVIHM Simulated Subsurface Inflows and Outflows from Watershed Areas and Neighboring Basins/Subbasins

Table 6-7. SVIHM Simulated Net Subbasin Boundary Flows (AF/yr.)

	Historical Average (WY 1980-2016)	Current (WY 2016)
Langley Area Subbasin	1,100	1,700
180/400-Foot Aquifer Subbasin	3,600	5,400
Forebay Aquifer Subbasin	800	600
Outside Areas	1,700	1,900

Note: provisional data subject to change.

Change in groundwater storage is equal to total inflows to storage (such as deep percolation) minus total outflows from storage (such as pumping). A negative change in groundwater storage value indicates groundwater storage depletion associated with lower groundwater levels; while a positive value indicates groundwater storage accretion associated with higher groundwater levels. Averaged over the historical period, the preliminary SVIHM estimates that the Eastside Subbasin is in overdraft by 21,700 AF/yr. However, this simulated overdraft contains significant variability and uncertainty. Figure 6-10 shows considerable variability in change in storage from one year to the next. In water year 1998, inflows exceeded outflows by more than 50,000 AF, while in 1988 outflows exceeded inflows by roughly 50,000 AF. These annual rates are snap shots in time showing variability within the model simulation and are not necessarily representative of actual current conditions.

Assuming a specific yield of 0.13 over the entire 57,500 acres of the Subbasin, the 21,700 AF/yr. simulated overdraft equates to a groundwater elevation drop of approximately 35 inches per year, or approximately 110 feet over the historical period. While groundwater elevations have dropped nearly 100 feet at some wells, measurements from most wells in the Subbasin have not shown this level of decline. Simulated change in groundwater storage is likely overestimated, possibly as a result of uncertainties in simulated aquifer properties.

The decline in groundwater storage based on measured groundwater elevations from 1944 through 2019 is estimated to be 3,400 AF/yr. in the Subbasin, as described in Section 5.2.2. Furthermore, the State of the Basin report (Brown and Caldwell, 2015) reports that groundwater storage in the Eastside Subarea decreased at an average rate of 5,000 AF/yr. from 1944 through 2013, based on analysis of measured groundwater elevations. During the drought years of 1984 through 1991, the State of the Basin report states that groundwater storage in the Eastside Subarea is estimated to have declined by 25,000 to 35,000 AF/yr. The SVIHM simulated change in groundwater storage is more consistent with drought year estimates than the long-term historical average estimates. These reported values are not fully comparable with SVIHM estimates because the 2 studies use slightly different study areas, this GSP representing the Eastside Subbasin and the State of the Basin study encompassing the Eastside Subarea, which includes both the Eastside and Langley Subbasins delineated in DWR Bulletin 118. Uncertainties exist in groundwater storage estimates from both the SVIHM and the analyses using groundwater level measurements. The more reliable estimate is unclear at this time. Therefore, based on the average of these reported values, this GSP considers 10,000 AF as the average annual decline in storage.

6.3.3 Historical and Current Groundwater Budget Summary

The main groundwater inflows into the Subbasin are: (1) deep percolation of precipitation and irrigation water, (2) subsurface inflow from adjacent DWR groundwater basins and subbasins, and (3) stream recharge. Groundwater pumping is the predominant groundwater outflow. The smaller outflow terms are subsurface outflows to adjacent subbasins, evapotranspiration, discharge to streams, and flows to drains.

Figure 6-10 shows the entire groundwater water budget from the SVIHM and includes annual change in groundwater storage. Changes in groundwater storage are strongly correlated with changes in deep percolation of precipitation and stream flows. For example, 1983 and 1998 were comparatively very wet years and represent the greatest increases in deep percolation and, correspondingly, the greatest increases in groundwater storage over the historical period. Estimated cumulative change in groundwater storage has steadily declined over time with slight increases in response to wet periods.

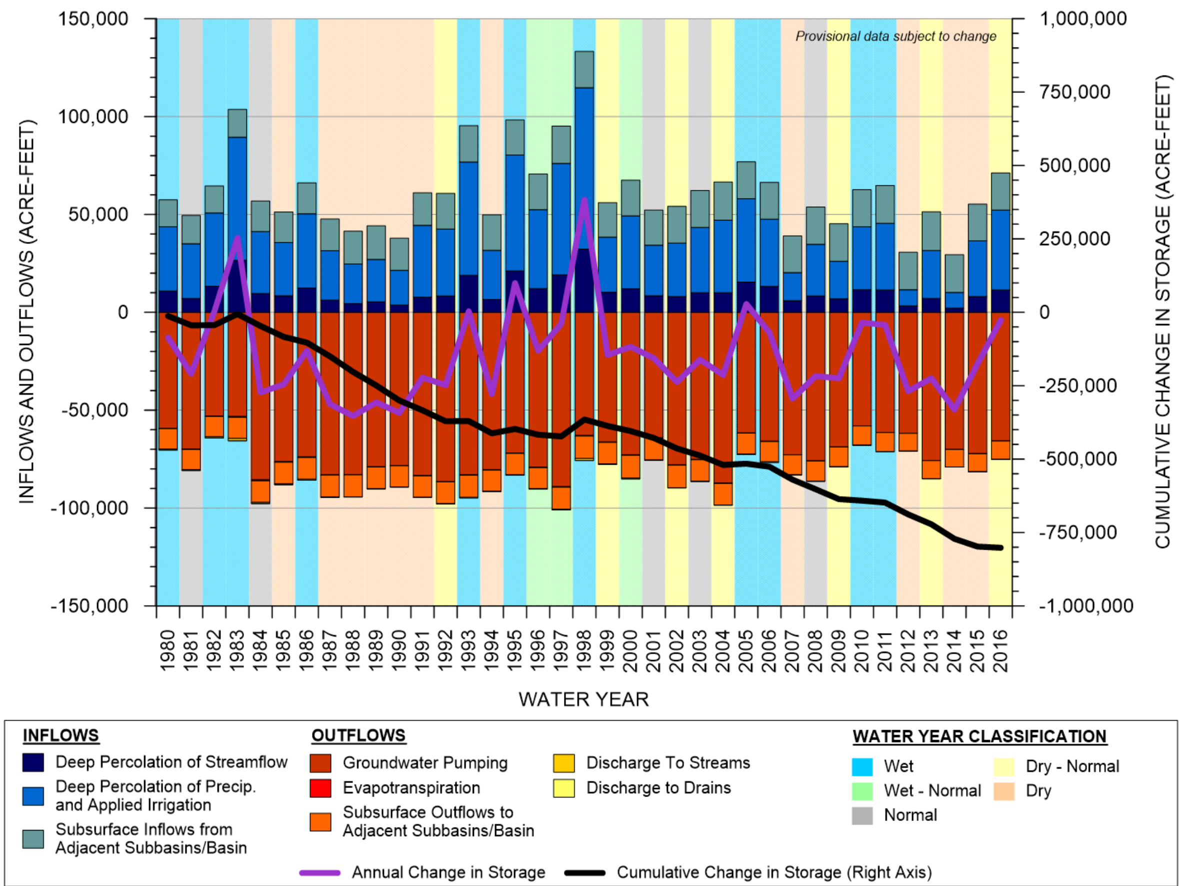

Figure 6-10. SVIHM Simulated Historical and Current Groundwater Budget

The SVIHM estimated the historical annual decline in storage to be 21,700 AF/yr. However, this decline is greater than estimated in previous reports, and this GSP considers the average annual historical decline in storage to be 10,000 AF/yr., as explained above.

A comparison of the historical and current groundwater budgets is shown in Table 6-8. The values in the table are based on the inflows and outflows presented in previous tables and reflect the adjustment to change in groundwater storage for the historical average. Negative values indicate outflows or depletions. This table is informative in showing the relative magnitude of various water budget components; however, these results are based on a provisional model and will be updated in future updates to this GSP after the SVIHM is completed and released by the USGS.

Table 6-8. Summary of Groundwater Budget (AF/yr.)

	Historical Average (WY 1980-2016)	Current (WY 2016)
Groundwater Pumping	-90,600	-82,000
Flows to Drains	0	0
Net Stream Exchange (gain from streams)	10,500	11,400
Deep Percolation of Precipitation and Applied Irrigation	33,400	40,800
Net flow to Adjacent Subbasins/Basin	7,100	9,600
Groundwater Evapotranspiration	-200	-100
Net Storage Gain (+) or Loss (-)	-10,000	-4,000

Note: provisional data subject to change.

The net storage value is the estimated historical overdraft based on observed groundwater levels, as described in Sections 5.2.2 and 6.3.2. Water budget error, as reflected in change in storage, for the historical average period is 48%, which is considered unreasonably large and will be addressed and improved in future updates to the GSP.

6.3.4 Historical and Current Sustainable Yield

The historical and current sustainable yields reflect the amount of Subbasin-wide pumping reduction needed to balance the water budget, resulting in no net decrease in storage. The sustainable yield can be estimated as:

$$\text{Sustainable yield} = \text{pumping} + \text{change in storage}$$

Table 6-9 provides a likely range of sustainable yields based on the GEMS derived historical pumping.

This range represents the average GEMS reported pumping from 1995 to 2016, as shown in Table 6-7, plus and minus 1 standard deviation. In addition, the adjusted loss in groundwater storage of 10,000 AF/yr., described in Section 6.3.2, is used for this calculation. These values are the likely range of the sustainable yield of the subbasin. This GSP adopts this range of likely sustainable yields as the best estimate for the Subbasin.

Table 6-9. Historical Sustainable Yield for the Eastside Subbasin Derived from GEMS and Observed Groundwater Levels (AF/yr.)

	Low Historical Average (1995-2016)	High Historical Average (1995-2016)
Total Subbasin Pumping	79,300	96,700
Change in Storage	-10,000	-10,000
Estimated Sustainable Yield	69,300	86,700

Note: Pumping is shown as positive value for this computation. Change in storage value is based on observed groundwater measurements, as previously described in the text.

6.4 Projected Water Budgets

Projected water budgets are extracted from the SVOM, which simulates future hydrologic conditions with anticipated climate change. Two projected water budgets are presented, one incorporating estimated 2030 climate change projections and one incorporating estimated 2070 climate change projections.

The climate change projections are based on data provided by DWR (2018). Projected water budgets are useful for showing that sustainability will be achieved in the 20-year implementation period and maintained over the 50-year planning and implementation horizon. However, the projected water budgets are based on a provisional version of the SVOM and are subject to change. Model information and assumptions summarized in this section of the report are based on provisional documentation on the model. Additional information will be provided in future GSP updates after the model is released by the USGS.

6.4.1 Assumptions Used in Projected Water Budget Development

The assumptions incorporated into the SVOM for the projected water budget simulations include:

- Land Use: The land use is assumed to be static, aside from a semi-annual change to represent crop seasonality. The annual pattern is repeated every year in the model. Land use specified in the model by USGS reflects the 2014 land use.
- No urban growth is included in this simulation to remain consistent with USGS assumptions. If urban growth is infill, this assumption may result in an underestimate of net pumping increases and an underestimate of the Subbasin's future overdraft. If urban growth replaces agricultural irrigation, the impact may be minimal because the urban growth will replace existing agricultural water use.
- Reservoir Operations: The reservoir operations reflect MCWRA's current approach to reservoir management.
- Stream Diversions: The SVOM explicitly simulates only 2 stream diversions in the Salinas Valley Basin: Clark Colony and the Salinas River Diversion Facility (SRDF).

The Clark Colony diversion is located along Arroyo Seco and diverts stream water to an agricultural area nearby. The SRDF came online in 2010 and diverts water from the Salinas River to the Castroville Seawater Intrusion Project (CSIP) area. Clark Colony diversions are repeated from the historical record to match the water year. SRDF diversions are made throughout the duration of the SVOM whenever reservoir storage and streamflow conditions allow during the period from April through October. For purposes of the projected water budgets, SRDF diversions are specified at a rate of 18 cubic feet per second.

- Recycled Water Deliveries: Recycled water has been delivered to the CSIP area since 1998 as irrigation supply. The SVOM includes recycled water deliveries throughout the duration of the model.

6.4.1.1 Future Projected Climate Assumptions

Several modifications were made to the SVOM in accordance with recommendations made by DWR in their *Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development* (2018). Three types of datasets were modified to account for 2030 and 2070 projected climate change: climate data including precipitation and potential evapotranspiration, streamflow, and sea level.

Climate Data. This GSP uses the climate change datasets provided by DWR for use by GSAs. The climate scenarios were derived by taking the historical interannual variability from 1915 through 2011 and increasing or decreasing the magnitude of events based on projected changes in precipitation and temperature from general circulation models. These datasets of climate projections for 2030 and 2070 conditions were derived from a selection of 20 global climate projections recommended by the Climate Change Technical Advisory Group as the most appropriate projections for California water resources evaluation and planning. Because the DWR climate datasets are only available through December 2011 and the SVOM uses a climate time series through December 2014, monthly change factors for January 2012 to December 2014 are assumed. DWR provided climate datasets for central tendency scenarios, as well as extreme wet and dry scenarios; the future water budgets described herein are based on the DWR central tendency scenarios for 2030 and 2070. Historical data were analyzed from the Salinas Airport precipitation gauge record to identify years from 1968 to 2011 that were most similar to conditions in 2012, 2013 and 2014. Based on this analysis, climate data from 1981, 2002, and 2004 are applied as the climate inputs for 2012, 2013, and 2014, respectively.

The modified monthly climate data for the entire model period are applied as inputs to the model, which reads precipitation and potential evapotranspiration data on a monthly basis.

Streamflow. DWR provided monthly change factors for unimpaired streamflow throughout California. For the Salinas Valley and other areas outside of the Central Valley, these change factors are provided as a single time series for each major watershed. Streamflows along the margins of the Basin are modified by the monthly change factors. As with the climate data, an assumption is required to extend the streamflow change factor time series through December 2014. It is assumed that the similarity in rainfall years at the Salinas Airport rainfall gauge could reasonably be expected to produce similar amounts of streamflow; therefore, the same years of 1981, 2002, and 2004 are repeated to represent the 2012, 2013, and 2014 streamflows.

Sea Level. DWR guidance recommends using a single static value of sea level rise for each of the climate change scenarios (DWR, 2018). For the 2030 climate change scenario, the DWR-recommended sea level rise value of 15 centimeters is used. For the 2070 climate change scenario, the DWR-recommended sea level rise value of 45 centimeters is used. The amount of sea level rise is assumed to be static throughout the duration of each of the climate change scenarios.

6.4.2 Projected Surface Water Budget

Average projected surface water budget inflows and outflows for the future simulation period with 2030 and 2070 climate change assumptions are quantified in Table 6-10. As with the current water budget, the 4 components of the projected surface water budget are similar in magnitude.

Table 6-10. SVOM Simulated Average Surface Water Inflow and Outflow Components for Projected Climate Change Conditions (AF/yr.)

Projected Climate Change Timeframe	2030	2070
Overland Runoff to Streams	13,600	14,400
Boundary Inflows	13,600	15,100
Flow Between Surface Water and Groundwater	-13,800	-14,400
Boundary Outflows	13,400	15,100

Note: provisional data subject to change.

6.4.3 Projected Groundwater Budget

Average projected groundwater budget inflows for the future simulation period with 2030 and 2070 climate change assumptions are quantified in Table 6-11. In both the 2030 and 2070 simulations, the biggest contributors to groundwater inflows are deep percolation of stream flow, and deep percolation of precipitation and irrigation.

Table 6-11. SVOM Simulated Average Groundwater Inflow Components for Projected Climate Change Conditions (AF/yr.)

Projected Climate Change Timeframe	2030	2070
Deep Percolation of Stream Flow	13,900	14,500
Deep Percolation of Precipitation and Irrigation	33,200	36,000
Underflow from Forebay Subbasin	2,400	2,500
Underflow from Langley Area Subbasin	2,000	2,000
Underflow from 180/400-Foot Subbasin	11,100	11,300
Underflow from Surrounding Watersheds	1,900	2,000
Total Inflows	**64,500**	**68,300**

Note: provisional data subject to change.

Average SVOM projected groundwater budget outflows for the future simulation period with 2030 and 2070 climate change assumptions are quantified in Table 6-12. As in the historical and current water budgets, the greatest outflow is groundwater pumping. Negative values are shown in Table 6-12 to represent outflows. Projected pumping is summarized below in Section 6.4.4.

Table 6-12. SVOM Simulated and Adjusted Average Groundwater Outflow Components for Projected Climate Change Conditions (AF/yr.)

Projected Climate Change Timeframe	Simulated		Adjusted	
	2030	2070	2030	2070
Groundwater Pumping	-72,300	-75,600	-90,400	-94,500
Flows to Drains	-100	-100	-100	-100
Flow to Streams	-100	-100	-100	-100
Groundwater Evapotranspiration	-700	-800	-700	-800
Underflow to Forebay Subbasin	-1,800	-2,000	-1,800	-2,000
Underflow to 180/400-Foot Subbasin	-8,400	-8,800	-8,400	-8,800
Underflow to Langley Area Subbasin	-1,100	-1,100	-1,100	-1,100
Underflow to Surrounding Watersheds	-400	-400	-400	-400
Total Outflows	**-84,900**	**-88,900**	**-103,000**	**-107,800**

Note: provisional data subject to change.

1 Adjusted pumping is based on the ratio between historical average SVIHM and GEMS agricultural pumping, as described in Section 6.3.2.

As described for the historical water budget, data indicate that the Subbasin has historically been in overdraft (on the order of 10,000 AF/yr. decline), as described in Section 5.2.2. Even though the SVOM anticipates -20,400 AF/yr. change in storage for both 2030 and 2070, the historical decline in storage is used with the adjusted pumping estimates to provide a likely more reasonable estimate for projected sustainable yield. The model includes increased precipitation from climate change; however, it does not account for the frequency and magnitude of storm events. If storm events concentrate precipitation within short periods, more water may run off than infiltrate. More analysis needs to be done with regards to future recharge. Therefore, this projected water budget adopts the historical annual change in storage as the most reasonable estimate, assuming extraction continues. This is reflected in the adjusted average change in storage in Table 6-13, which is set to a decline of 10,000 AF/yr.

Combining Table 6-11 and Table 6-12 yields the SVOM simulated net groundwater inflow and outflow data for the future simulation with 2030 and 2070 climate change assumptions. These flows are shown in Table 6-13. Negative values indicate outflows or depletions.

Table 6-13. Average SVOM Simulated and Adjusted Annual Groundwater Budget for Projected Climate Change Conditions (AF/yr.)

Projected Climate Change Timeframe	Simulated		Adjusted[1]	
	2030	2070	2030	2070
Groundwater Pumping	-72,300	-75,600	-90,400	-94,500
Flow to Drains	-100	-100	-100	-100
Net Stream Exchange	13,800	14,400	13,800	14,400
Deep Percolation	33,200	36,000	33,200	36,000
Net Flow to Forebay Subbasin	700	500	700	500
Net Flow to Surrounding Watersheds	1,600	1,600	1,600	1,600
Net Flow to Langley Area Subbasin	900	900	900	900
Net Flow to 180/400-Foot Subbasin	2,700	2,500	2,700	2,500
Groundwater Evapotranspiration	-700	-800	-700	-800
Net Storage Gain (+) or Loss (-)	-20,400	-20,400	-10,000	-10,000

Note: provisional data subject to change.

Based on the adjusted change in storage, which is the historical average decline as described in the text, model error is 44% for 2030 and 43% for 2070; these error values are unreasonably large and will be addressed and improved in future updates to the GSP.

[1] Adjusted pumping is based on the ratio between historical average SVIHM and GEMS agricultural pumping, as described in Section 6.3.2.

SVOM projected groundwater pumping by water use sector is summarized in Table 6-14. Because the model assumes no urban growth, future municipal pumping was assumed to be equal to current municipal pumping. Future agricultural pumping is then calculated as the total projected pumping minus the current municipal pumping. The 2030 and 2070 model simulations predict that agriculture will account for about 90% of pumping. Similar to the SVIHM, domestic pumping is not included in the SVOM future projections simulation.

Table 6-14. SVOM Simulated Projected Annual Groundwater Pumping by Water Use Sector (AF/yr)

Water Use Sector	Simulated		Adjusted[1]	
	2030	2070	2030	2070
Urban Pumping	-7,500	-7,500	-9,400	-9,400
Agricultural Pumping	-64,800	-68,100	-81,000	85,100
Total Pumping	-72,300	-75,600	-90,400	-94,500

Note: provisional data subject to change.

[1] Adjusted pumping is based on the ratio between historical average SVIHM and GEMS agricultural pumping, as described in Section 6.3.2.

6.4.4 Projected Sustainable Yield

Projected sustainable yield is the long-term pumping that can be sustained once all undesirable results have been addressed. However, it is not the amount of pumping needed to stop undesirable results before sustainability is reached. The SVBGSA recognizes that depending on the success of various proposed projects and management actions there may be some years when pumping must be held at a lower level to achieve necessary rises in groundwater elevation. The actual amount of allowable pumping from the Subbasin will be adjusted in the future based on the success of projects and management actions.

To retain consistency with the historical sustainable yield, projected sustainable yield can be estimated by summing all the average groundwater extractions and subtracting the average loss in storage. This represents the change in pumping that results in no change in storage, assuming no other projects or management actions are implemented. For this sustainable yield discussion and associated computations, groundwater pumping outflows are reported as positive values, which is opposite of how the values are reported in the water budget tables. As discussed earlier, the current, preliminary version of the SVIHM, and by inference the SVOM, appears to overestimate the historical overdraft in the Subbasin and therefore underestimate the historical sustainable yield. The sustainable yield value will be updated in future GSP updates as more data are collected and additional analyses are conducted.

Table 6-15 provides estimates of the future sustainable yield using estimated future pumping calculated in Table 6-14 and a correction for change in groundwater storage. As described for the historical water budget, data indicate that the Subbasin has historically been in overdraft (on the order of 10,000 AF/yr. decline), as described in Section 5.2.2. This historical decline in storage is used with the adjusted SVOM pumping estimates to provide a likely more reasonable estimate for projected sustainable yield. Therefore, although change in storage projected by the preliminary SVOM is -20,400 AF/yr., the average change in storage in Table 6-15 is set to a decline of 10,000 AF/yr.

Table 6-15. Adjusted Projected Sustainable Yields (AF/yr.)

	2030 Projected Sustainable Yield	2070 Projected Sustainable Yield	Historical Sustainable Yield Range
Groundwater Pumping	90,400	94,500	79,300 to 96,700
Change in Storage	-10,000	-10,000	-10,000
Projected Sustainable Yield	80,400	84,500	69,300 to 86,700

Table 6-15 includes the adjusted estimate of historical sustainable yield for comparison purposes. Although the sustainable yield values provide guidance for achieving sustainability, simply reducing pumping to within the sustainable yield is not proof of sustainability. Sustainability must be demonstrated through the SMC. The sustainable yield value will be modified and updated as more data are collected, and more analyses are performed.

6.4.5 Uncertainties in Projected Water Budget Simulations

Models are mathematical representations of physical systems. They have limitations in their ability to represent physical systems exactly and due to limitations in the data inputs used. There is also inherent uncertainty in groundwater flow modeling itself, since mathematical (or numerical) models can only approximate physical systems and have limitations in how they compute data. However, DWR (2018) recognizes that although models are not exact representations of physical systems because mathematical depictions are imperfect, they are powerful tools that can provide useful insights.

There is additional inherent uncertainty involved in projecting water budgets with projected climate change based on the available scenarios and methods. The recommended 2030 and 2070 central tendency scenarios that are used to develop the projected water budgets with the SVIHM provide a dataset that can be interpreted as what might be considered the most likely future conditions; there is an approximately equal likelihood that actual future conditions will be more stressful or less stressful than those described by the recommended scenarios (DWR, 2018).

As stated in DWR (2018):

> *"Although it is not possible to predict future hydrology and water use with certainty, the models, data, and tools provided [by DWR] are considered current best available science and, when used appropriately should provide GSAs with a reasonable point of reference for future planning."*

6.5 Subbasin Water Supply Availability and Reliability

Water is not imported into the Eastside Subbasin from other basins, and the Salinas River does not flow through the Eastside. The Salinas River recharges the groundwater upgradient of the Eastside Subbasin. This upgradient recharge is derived from reservoir releases that regulate Salinas River streamflow. The historical water budget incorporates years when there was little availability of surface water flow. The annual variability of stream flow does not directly affect the annual Eastside groundwater elevations and therefore does not directly affect the ability to operate within the sustainable yield. Although there is not a direct effect, Salinas River flows do affect long-term water supply availability. The projected water budgets are developed with the SVOM, which is based on historical surface water flows and groundwater conditions, and therefore projected water budgets incorporate reasonable fluctuations in water supply availability. MCWRA plans to revise the Habitat Conservation Plan (HCP) for the Salinas River, which may change the current reservoir release schedule. A revised reservoir release schedule could influence the reliability of groundwater recharge.

6.6 Uncertainties in Water Budget Calculations

The level of accuracy and certainty is highly variable between water budget components. A few water budget components are directly measured, but most water budget components are either estimated inputs to the model or simulated by the model. Additional model uncertainty stems from an imperfect representation of natural condition and is reflected in model calibration error. However, inputs to the models are carefully selected using best available data, the model's calculations represent established science for groundwater flow, and the model calibration error is within acceptable bounds. Therefore, the models are the best available tools for estimating water budgets. The model results are provisional and subject to change in future GSP updates after the models are released by the USGS.

The following list groups water budget components in increasing order of uncertainty.

- Measured: metered municipal, agricultural, and some small water system pumping
- Estimated: domestic pumping, including depth, rate, and location
- Simulated primarily based on climate data: precipitation, evapotranspiration, irrigation pumping
- Simulated based on calibrated model: all other water budget components

Simulated components based on calibrated model have the most uncertainty because those simulated results encompass uncertainty of other water budget components used in the model in addition to model calibration error.

7 MONITORING NETWORKS

This chapter describes the networks that will monitor the SMC explained further in Chapter 8. This description of the monitoring network has been prepared in accordance with the GSP Regulations § 354.32 *et seq.* 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.
- Quantify annual changes in water budget components.

7.1.2 Approach to Monitoring Networks

Monitoring networks are developed for each of the 6 sustainability indicators that are relevant to the Subbasin:

1. Chronic lowering of groundwater levels
2. Reduction in groundwater storage
3. Seawater intrusion
4. Degraded water quality
5. Land subsidence
6. Depletion of ISW

Other monitoring networks, such as groundwater extraction, that are necessary to comply with GSP Regulations are also included in this chapter. Representative Monitoring Sites (RMS) are a subset of the monitoring network and are limited to sites with data that are publicly available and not confidential.

The SVBGSA estimated the density of monitoring sites and the frequency of measurements required to demonstrate short-term, seasonal, and long-term trends. If the required monitoring site density does not currently exist, the SVBGSA will expand monitoring networks during GSP implementation. Filling data gaps and developing more extensive and complete monitoring networks will improve the 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. The SVBGSA will review the monitoring network in each 5-year assessment, including a determination of uncertainty and whether there are remaining data gaps that could affect the ability of the Plan to achieve the sustainability goal for the Subbasin.

7.1.3 Management Areas

No management areas have been defined for the Eastside Subbasin.

7.2 Groundwater Level 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.

Figure 7-1 shows 63 wells in the Subbasin monitored by MCWRA for groundwater elevations that are used to develop groundwater elevation contours and have publicly available data on the SVBGSA Web Map.

Of the wells shown in Figure 7-1, 35 are selected for inclusion in the groundwater level monitoring network as RMS wells, and are shown on Figure 7-2. Criteria for selecting wells as part of the RMS network include:

- RMS wells must have known depths and well completion data.
- RMS wells should have a relatively long period of historical data.
- Hydrographs of RMS wells should be visually representative of the hydrographs from surrounding wells. Appendix 5A includes the hydrograph comparisons used to establish that RMS wells are representative of surrounding wells.
- RMS locations must cover the basin and provide data near basin boundaries.
- RMS should be selected for each aquifer. There is only1 aquifer in the Eastside Subbasin.
- Data from RMS wells is public data and will be used for groundwater elevation maps and analysis. SVBGSA notified well owner of intent to include well in monitoring network.

The RMS wells in the water level monitoring network are listed in Table 7-1. The need for any additional wells is discussed in Section 7.2.2. Appendix 5A presents well construction information and historical hydrographs for each RMS well.

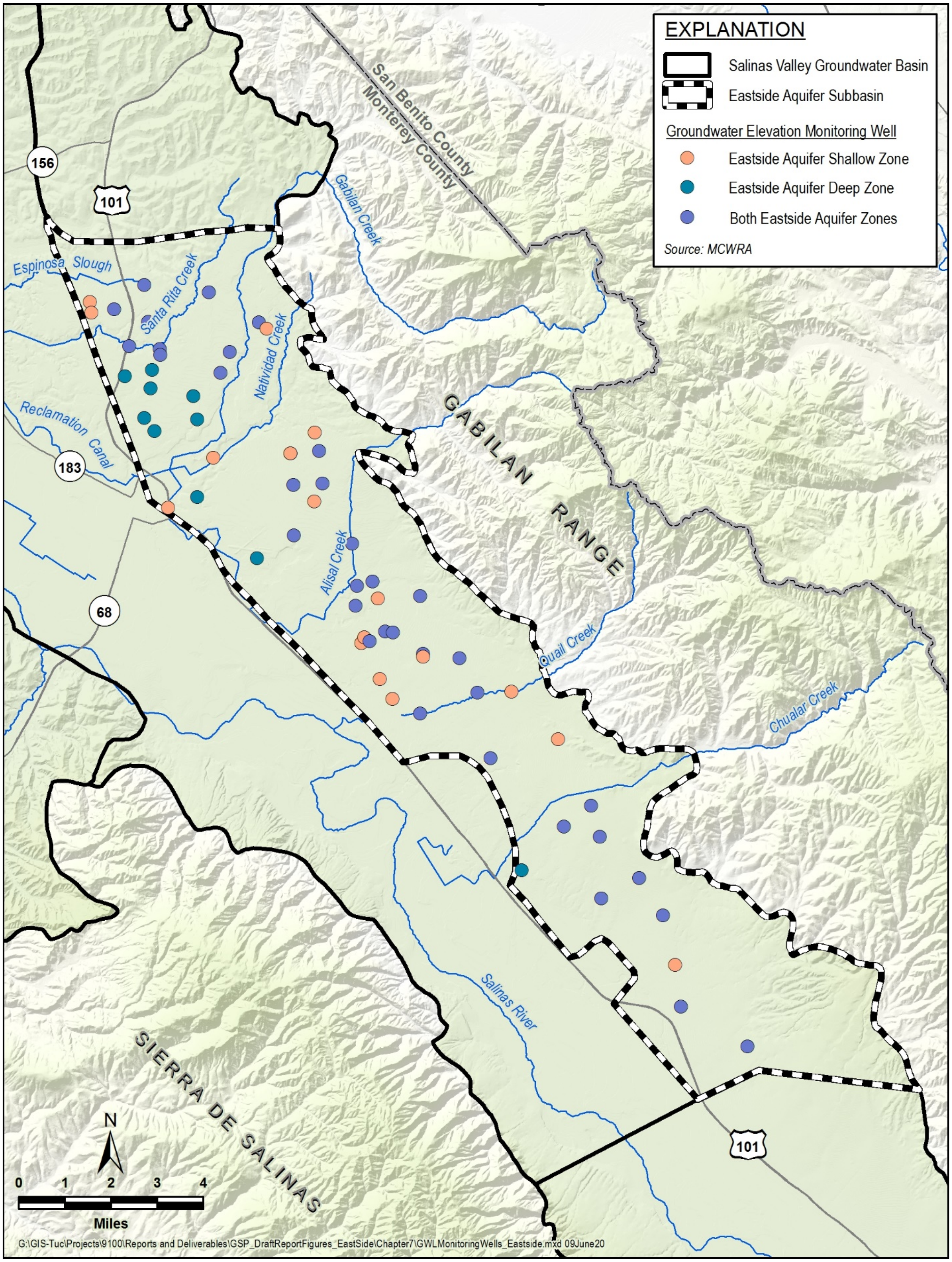

Figure 7-1. Eastside Aquifer Monitoring Network for Groundwater Levels

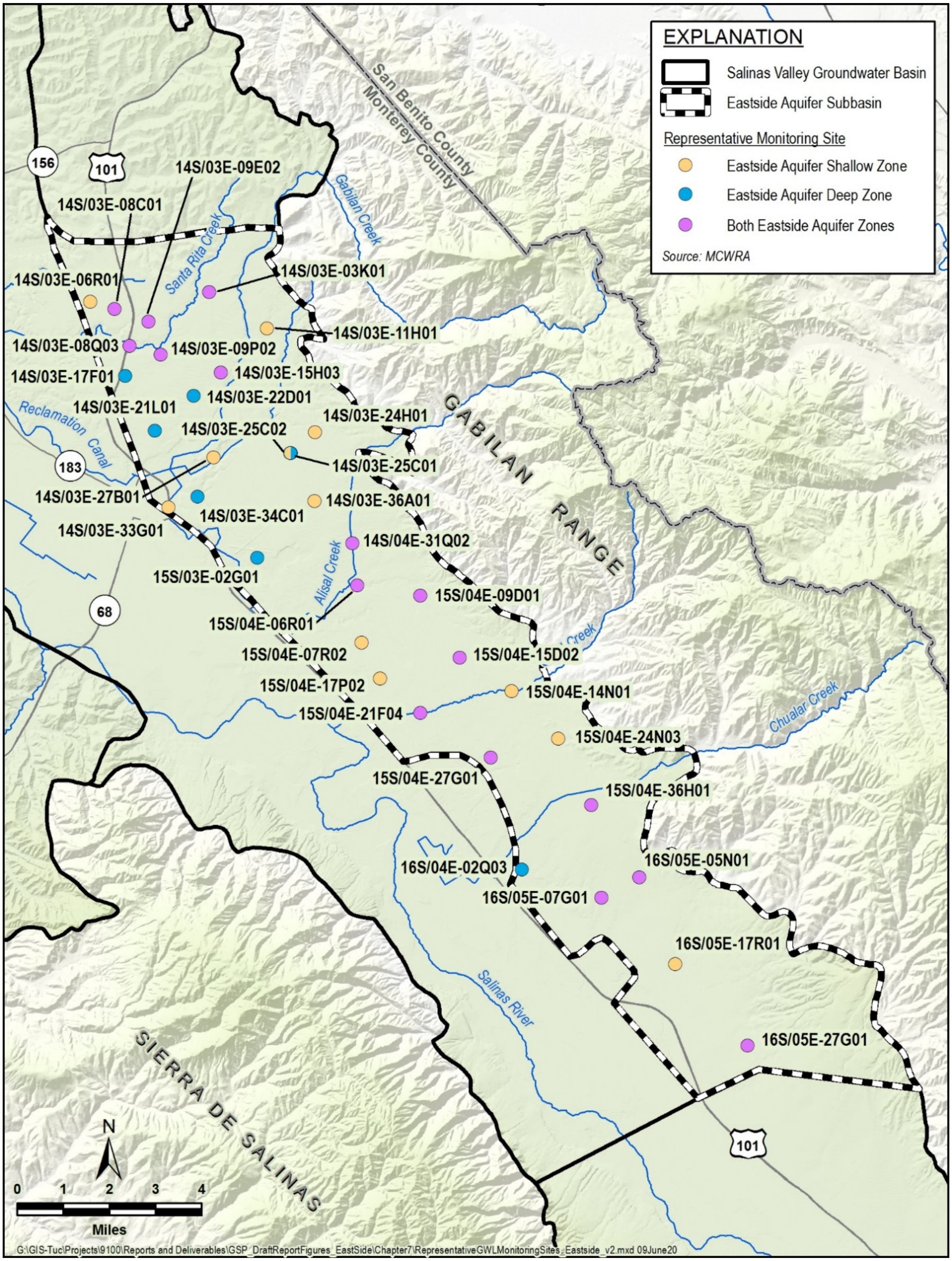

Figure 7-2. Eastside Aquifer Representative Monitoring Network for Groundwater Levels

Table 7-1. Eastside Aquifer Groundwater Level Representative Monitoring Site Network

State Well Number	CASGEM Well Number	Local Well Designation	Well Use	Total Well Depth (ft)	Reference Point (ft, NAVD88)	Latitude (NAD 83)	Longitude (NAD 83)	Period of Record (years)
Shallow Zone								
14S/03E-06R01	N/A	901	Irrigation	385	91.9	36.73863	-121.67404	24
14S/03E-11H01	N/A	2330	Other	390	142.3	36.73235	-121.59659	24
14S/03E-24H01	N/A	1974	Irrigation	375	156	36.69942	-121.58495	24
14S/03E-25C02	366927N1215940W001	FALA22619	Observation	370	141	36.69273	-121.59403	17
14S/03E-27B01	366906N1216242W001	15126	Irrigation	348	42	36.69061	-121.62420	61
14S/03E-33G01	N/A	595	Municipal	331	45	36.67462	-121.64126	24
14S/03E-36A01	N/A	1577	Irrigation	490	139.9	36.66688	-121.59191	24
15S/04E-07R02	N/A	10343	Irrigation	304	80	36.63365	-121.56449	24
15S/04E-14N01	N/A	709	Irrigation	400	240	36.61971	-121.50558	74
15S/04E-17P02	N/A	2260	Irrigation	467	97	36.62258	-121.55684	24
15S/04E-24N03	N/A	16343	Irrigation	370	272	36.60506	-121.48682	62
16S/05E-17R01	N/A	10410	Irrigation	299	181	36.53513	-121.43898	88
Deep Zone								
14S/03E-17F01	**N/A**	1825	Municipal	620	92	36.71552	-121.65950	24
14S/03E-21L01	N/A	671	Municipal	668	80	36.69859	-121.64738	24
14S/03E-22D01	N/A	1969	Municipal	550	102	36.70994	-121.63268	24
14S/03E-25C01	366928N1215941W001	FALB22618	Observation	680	141	36.69275	-121.59406	17
14S/03E-34C01	N/A	686	Municipal	580	67	36.67812	-121.63009	24
15S/03E-02G01	N/A	685	Municipal	630	74	36.65946	-121.60600	24
16S/04E-02Q03	N/A	1303	Irrigation	1023	136	36.56360	-121.49969	24
Both Zones								
14S/03E-03K01	N/A	574	Irrigation	668	168.8	36.74267	-121.62760	24
14S/03E-08C01	N/A	867	Irrigation	785	109.5	36.73652	-121.66438	24
14S/03E-08Q03	N/A	57	Irrigation	806	75	36.72506	-121.65818	24

State Well Number	CASGEM Well Number	Local Well Designation	Well Use	Total Well Depth (ft)	Reference Point (ft, NAVD88)	Latitude (NAD 83)	Longitude (NAD 83)	Period of Record (years)
14S/03E-09E02	N/A	1831	Municipal	650	121	36.73275	-121.65105	24
14S/03E-09P02	N/A	1572	Irrigation	755	114.5	36.72259	-121.64592	24
14S/03E-15H03	367174N1216222W001	752	Irrigation	784	126	36.71741	-121.62217	61
14S/04E-31Q02	366661N1215694W001	806	Irrigation	710	104	36.66611	-121.56939	14
15S/04E-06R01	366517N1215669W001	1726	Irrigation	786	93.7	36.65172	-121.56693	66
15S/04E-09D01	N/A	1678	Irrigation	461	127	36.64892	-121.54205	24
15S/04E-15D02	N/A	1599	Irrigation	510	185.7	36.62978	-121.52612	24
15S/04E-21F04	N/A	1235	Irrigation	498	127	36.61197	-121.54079	24
15S/04E-27G01	N/A	773	Irrigation	608	189	36.59853	-121.51298	24
15S/04E-36H01	N/A	294	Irrigation	488	334.2	36.58446	-121.47331	24
16S/05E-05N01	N/A	633	Irrigation	550	248	36.56205	-121.45384	24
16S/05E-07G01	N/A	1345	Irrigation	476	193	36.55535	-121.46851	24
16S/05E-27G01	365122N1214080W001	2519	Irrigation	1122	272	36.51224	-121.40796	15

7.2.1 Groundwater Level Monitoring Protocols

Chapter 4 of the MCWRA CASGEM monitoring plan includes a description of existing groundwater elevation monitoring procedures (MCWRA, 2015). The CASGEM groundwater elevation monitoring protocols established by MCWRA are adopted by this GSP and are included in Appendix 7A. Groundwater elevation measurements will be collected at least 2 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. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.2.2 Groundwater Level Monitoring Network Data Gaps

Based on GSP Regulations and BMPs published by DWR on monitoring networks (DWR, 2016b), a visual analysis of the existing monitoring network was performed using professional judgment to evaluate whether there are data gaps in the groundwater level monitoring network.

While there is no definitive requirement on monitoring well density, the BMP cites several studies (Heath, 1976; Sophocleous, 1983; Hopkins and Anderson, 2016) 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 Eastside Subbasin encompasses 90 square miles. If the BMP guidance recommendations are applied to the Subbasin, the well network should include between 1 and 9 wells. The current network includes 35 wells. The number of groundwater elevation monitoring wells in the Subbasin exceeds the range of the BMP guidance. Furthermore, visual inspection of Figure 7-2 shows that wells in the RMS network are adequately distributed across the Subbasin, and there is no significant spatial data gap in the network.

Groundwater elevation measurements for most of the wells in the monitoring network in the Subbasin occur only once a year. SVBGSA will work with MCWRA to have groundwater levels collected at least twice a year, as outlined in Section 7.2.1. Furthermore, some of the wells in the monitoring network have unknown well construction information and that is a data gap that will be addressed during GSP implementation.

7.3 Groundwater Storage Monitoring Network

As discussed in Chapter 8, the sustainability indicator for reduction of groundwater storage is measured using groundwater elevations as proxies. Thus, the groundwater storage monitoring network is the same as the groundwater level monitoring network.

7.4 Seawater Intrusion Monitoring Network

The sustainability indicator for seawater intrusion is evaluated using the location of a chloride isocontour, based on chloride concentration measured at an existing network of monitoring wells. MCWRA develops annual maps of the 500 mg/L chloride isocontour (Figure 5-21 and Figure 5-22). Seawater intrusion does not exist in this Subbasin but does exist in the adjacent 180/400-Foot Aquifer Subbasin. Should seawater intrusion enter the Subbasin, the SVBGSA's Seawater Intrusion Working Group (SWIG) will consider expanding the existing seawater intrusion monitoring network.

Table 7-2 lists the wells currently used by MCWRA to monitor seawater intrusion in the Subbasin. All the wells used by MCWRA are part of the RMS network. Figure 7-2 shows the locations of these wells.

Table 7-2. Eastside Aquifer Seawater Intrusion Well Network

State Well Number	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)
14S/03E-06F01	Unknown	36.7457	-121.6804
14S/03E-21M54	550	36.6954	-121.6478

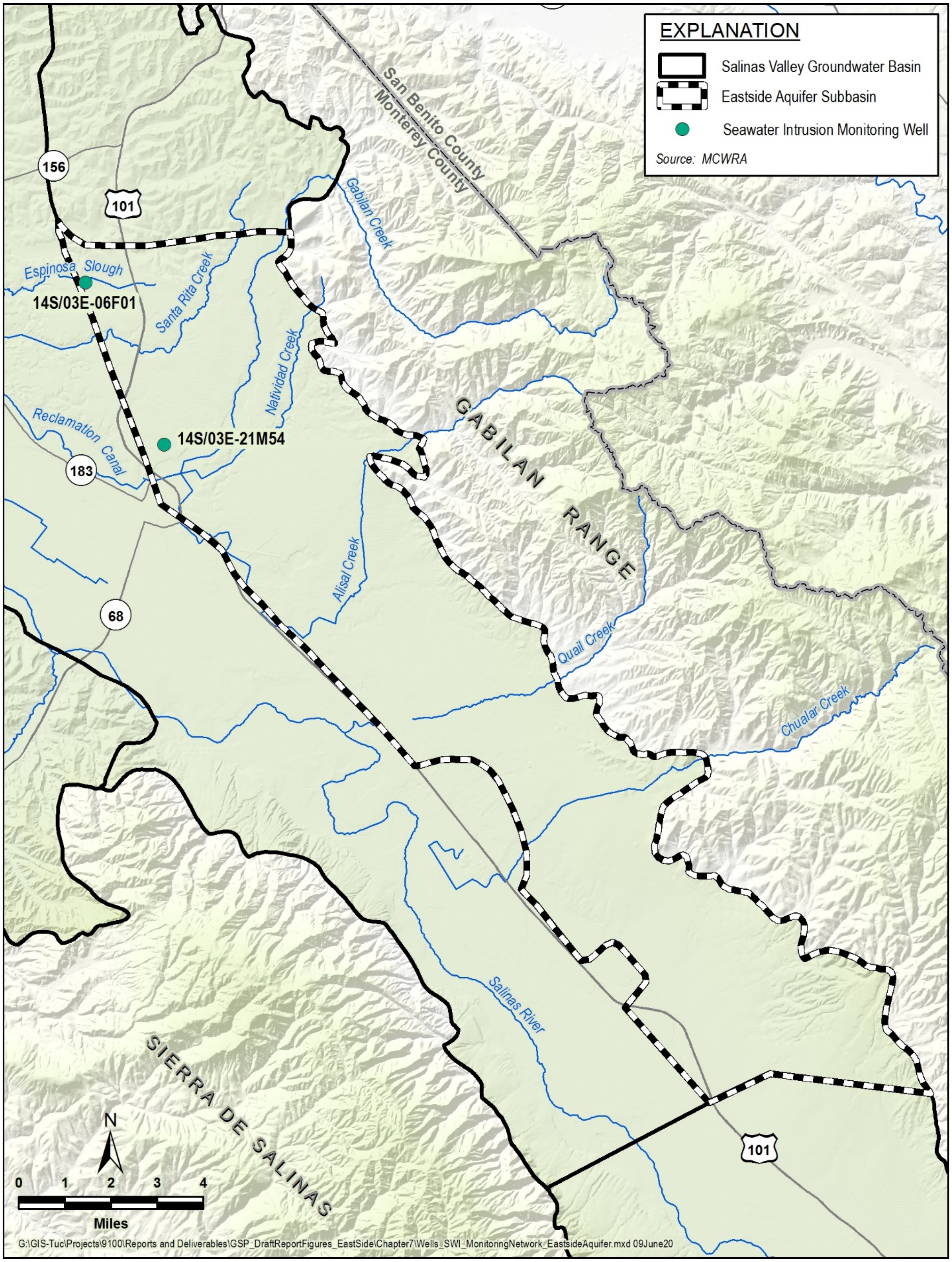

Figure 7-3. Eastside Aquifer Monitoring Network for Seawater Intrusion

7.4.1 Seawater Intrusion Monitoring Protocols

The protocols established by MCWRA for collecting groundwater quality data from monitoring wells and analyzing those data for seawater intrusion are adopted by this GSP. The groundwater quality data and seawater intrusion monitoring protocols are available in the Monterey County Quality Assurance Project Plan (QAPP),and included in Appendix 7B. MCWRA also established chloride data contouring protocols to establish the isocontour map, provided in Appendix 7C. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.4.2 Seawater Intrusion Monitoring Data Gaps

There are no data gaps in the seawater intrusion monitoring program.

7.5 Groundwater Quality Monitoring Network

The sustainability indicator for degraded water quality is evaluated by adopting the SWRCB DDW and CCRWQCB ILRP groundwater quality networks. The water quality monitoring network for the Subbasin is composed of public water system supply wells monitored under DDW, and on-farm domestic wells and irrigation supply wells monitored under ILRP.

As described in Chapter 8, separate minimum thresholds are set for the COC for public water system supply wells, on-farm domestic wells, and irrigation supply wells. Therefore, although there is a single groundwater quality monitoring network, different wells in the network are reviewed for different constituents. COC for drinking water are assessed at public water supply wells and on-farm domestic wells, and COC for crop health are assessed at agricultural supply wells. The COC for the 3 sets of wells are listed in Chapter 5.

The public water system supply wells included in the monitoring network were identified by reviewing data from the SWRCB 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. The RMS network consists of 70 DDW wells, as shown on Figure 7-4 and listed in Appendix 7D.

All on-farm domestic wells and irrigation supply wells that have been sampled through the CCRWQCB’s IRLP are included in the RMS network. Under the existing Ag Order, there are 358 ILRP wells, consisting of 225 irrigation supply wells and 133 on-farm domestic wells that are all part of the RMS network. The locations of these wells are shown on Figure 7-5 and listed in Appendix 7D. The SVBGSA assumes that Ag Order 4.0 will have a similar representative geographic distribution of wells within the Subbasin. The agricultural groundwater quality monitoring network will be revisited and revised when the Ag Order 4.0 monitoring network is finalized.

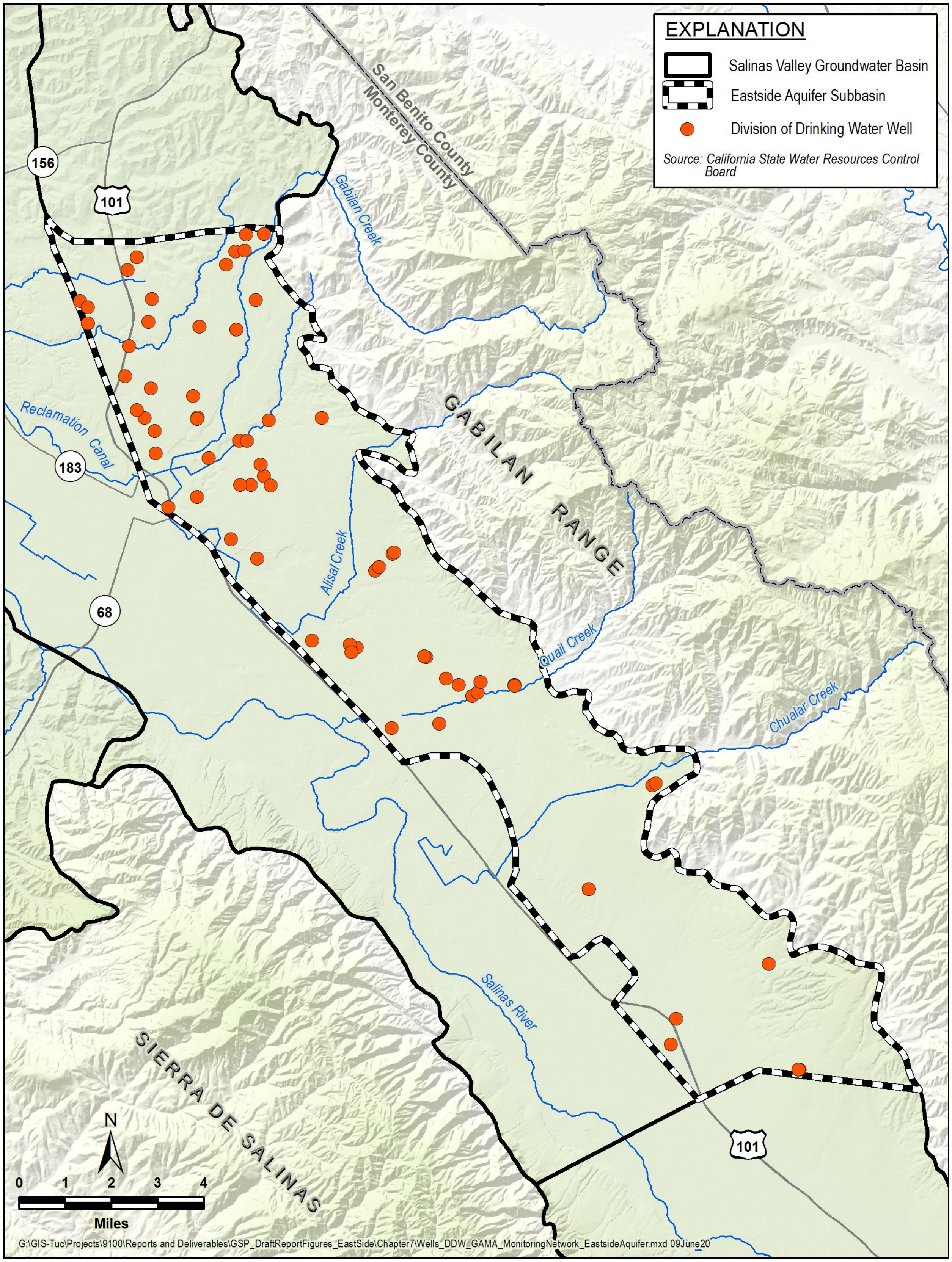

Figure 7-4. DDW Public Water System Supply Wells in the Groundwater Quality Monitoring Network

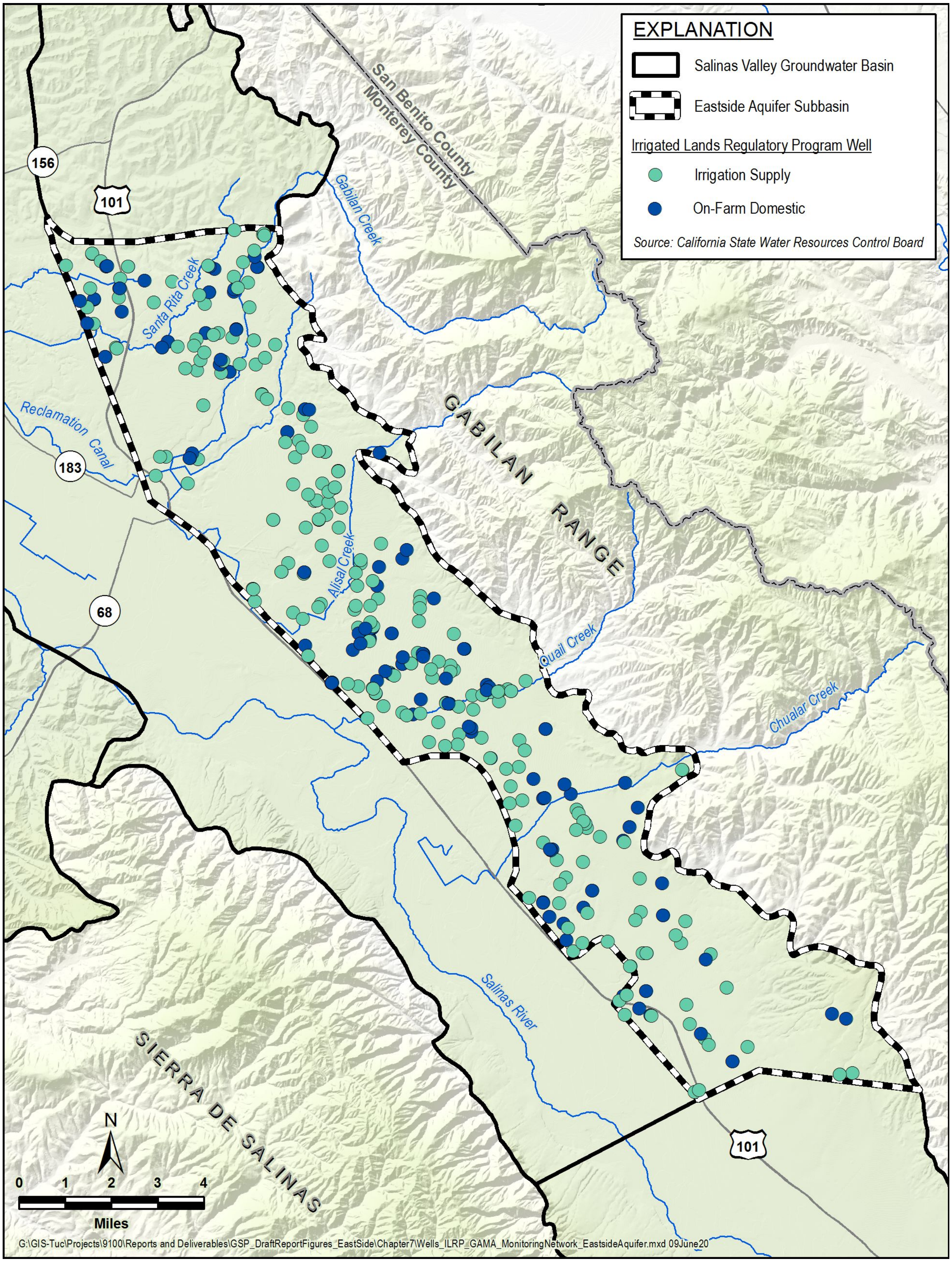

Figure 7-5. ILRP Wells in the Groundwater Quality Monitoring Network

7.5.1 Groundwater Quality Monitoring Protocols

The SVBGSA does not independently sample wells for any COC. Instead, the GSA analyzes water quality data that are collected through the DDW and ILRP. Therefore, the GSA is dependent on the monitoring density and frequency of DDW and ILRP.

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 CCRWQCB Ag Order 3.0. ILRP samples are collected under the Tier 1, Tier 2, or Tier 3 monitoring and reporting programs. Under Ag Order 4.0, ILRP data will be collected in 3 phases and each groundwater basin within the Central Coast Region has been assigned to one or more of these phases. The designated phase for each ILRP well is provided in SWRCB's GeoTracker database and is publicly accessible at: https://geotracker.waterboards.ca.gov/. Ag Order 4.0 will take effect in the Subbasin beginning in 2025. Copies of the Ag Orders 3.0 and 4.0 monitoring and reporting programs are included in Appendix 7E and are incorporated into this GSP. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.5.2 Groundwater Quality Monitoring Data Gaps

The DDW and ILRP monitoring network provide sufficient spatial and temporal data to determine groundwater quality trends for water quality indicators to address known water quality issues. Additionally, there is adequate spatial coverage in the water quality monitoring network to assess impacts to beneficial uses and users.

7.6 Land Subsidence Monitoring Network

As described in Section 5.5, DWR collects land subsidence data using InSAR satellite data and makes these data available to GSAs. This subsidence dataset represents the best available science for the Eastside Subbasin and is therefore used as the subsidence monitoring network.

7.6.1 Land Subsidence Monitoring Protocols

Land Subsidence monitoring protocols are the ones used by DWR for InSAR measurements and interpretation. DWR adapted their methods to measure subsidence on hard surfaces only and interpolate between them to minimize the change in land surface elevation captures in soft surfaces that are likely not true subsidence. The cell size of this interpolated surface is 302 feet by 302 feet. 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 groundwater elevations, and whether a reasonable causality can be established. These protocols are consistent with data and reporting standards described in GSP Regulation § 352.4.

7.6.2 Land Subsidence Data Gaps

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

7.7 Interconnected Surface Water Monitoring Network

The primary tool for assessing depletion of ISW due to pumping will be shallow monitoring wells adjacent to streams in the Subbasin. The SVIHM did not identify any locations of ISW in the Subbasin, as shown in Figure 4-9. However, there is a location of ISW along the Gabilan Creek just north of the Eastside Subbasin, and there could potentially be connection between surface water and groundwater in the Eastside Subbasin in the future. Figure 7-6 shows the location of a proposed new monitoring well along Gabilan Creek that will help monitor the ISW within the Langley Subbasin. This well will be located within the Eastside Subbasin so that it can be paired with the USGS gauge on Gabilan Creek shown on Figure 7-6. All ISW monitoring wells are RMS. More information on the development of the ISW monitoring network is provided in Appendix 7F.

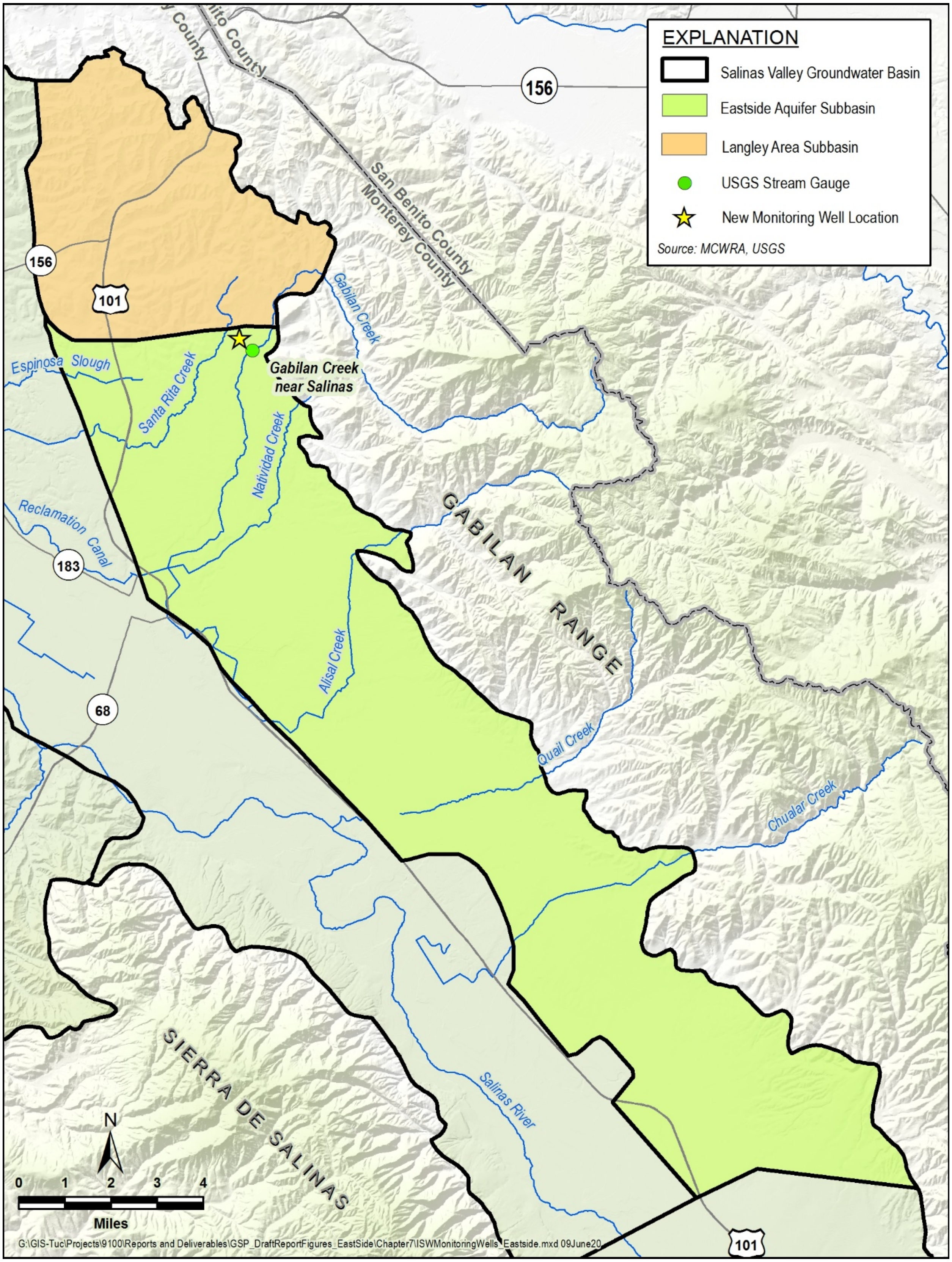

Figure 7-6. Interconnected Surface Water Monitoring Network

7.7.1 Interconnected Surface Water Monitoring Protocols

Monitoring protocols for shallow wells monitoring ISW will be identical to MCWRA's current groundwater elevation monitoring protocols, included in Appendix 7A. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4. Additionally, each well that is added to the monitoring network will be equipped with a data logger that will allow SVBGSA to access if seasonal pumping is resulting in streamflow depletions.

7.7.2 Interconnected Surface Water Data Gaps

There are no data gaps in the ISW monitoring network in the Eastside Subbasin, but the data gap in the Langley Subbasin will be filled with a new well added along the Gabilan Creek, as discussed in Chapter 10. The new shallow well will be added to MCWRA's groundwater elevation monitoring program.

7.8 Other Monitoring Networks

7.8.1 Groundwater Extraction Monitoring Network

SGMA requires that Annual Reports include annual groundwater extraction for the Subbasin. MCWRA's GEMS will be used to monitor urban and agricultural extraction in the Subbasin. Under Monterey County Ordinance No. 3717, public water systems and agricultural pumpers using wells with an internal discharge pipe greater than 3 inches within Zones 2, 2A, and 2B report extractions annually to GEMS. Extraction is self-reported by well owners or operators. Agricultural wells report their data based on MCWRA's reporting year that runs from November 1 through October 31 Urban and industrial wells report extraction on a calendar year basis. When extraction data is summarized annually, MCWRA combines industrial and urban extractions into a single urban water use. As depicted in Figure 3-3, these zones provide sufficient coverage of the Eastside Subbasin.

SVBGSA will work with MCWRA to obtain the GEMS data through a coordinated reporting program such that wells owners can provide a single annual reporting to fulfill the requirements of both the GSP and the existing County Ordinances No. 3717 and No. 3718.

7.8.1.1 Groundwater Extraction Monitoring Protocols

Groundwater extraction monitoring is accomplished using the GEMS data provided by MCWRA. Existing GEMS protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.8.1.2 Groundwater Storage Monitoring Data Gaps

Accurate assessment of the amount of pumping requires an accurate count of the number of municipal, agricultural, and domestic wells in the GSP area. As proposed in Chapter 9, SVBGSA will undertake well registration during implementation to develop a database of existing and active groundwater wells. This database will draw from the existing MCWRA database, DWR's OSWCR database, and the Monterey County Health Department database of state small and local small water systems. As part of the assessment, the SVBGSA will verify well completion information and location, and whether the well is active, abandoned, or destroyed as is discussed further in Chapter 9.

The accuracy and reliability of groundwater pumping reported through GEMS is constantly being updated. SVBGSA will work with MCWRA to evaluate methods currently in place to assure data reliability. Based on the results of that evaluation, the protocols for monitoring may be revised and a protocol for well meter calibration may be developed. SVBGSA will work with MCWRA to consider the value of developing protocols for flowmeter calibration and other potential enhancements to the GEMS programs that are discussed in Chapter 9.

7.8.2 Salinas River Watershed Diversions

Salinas River watershed monthly diversion data are collected annually in the SWRCB's Electronic Water Rights Information Management System (eWRIMS). eWRIMS is used track information of water rights in the state and is publicly accessible at: https://ciwqs.waterboards.ca.gov/ciwqs/ewrims/reportingDiversionDownloadPublicSetup.do. These data include diversions from tributaries of the Salinas River.

7.8.2.1 Salinas River Watershed Diversions Monitoring Protocols

Salinas River watershed diversion monitoring protocols are those that the SWRCB has established for the collection of water right information. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.8.2.2 Salinas River Watershed Diversions Monitoring Data Gaps

These data are lagged by a year because the reporting period does not begin until February of the following year.

7.9 Data Management System and Data Reporting

The SVBGSA has developed a DMS in adherence to GSP Regulations § 352.6 and § 354.40 that is used to store, review, and upload data collected as part of the GSP development and implementation.

The SVBGSA DMS consists of 2 SQL databases. The HydroSQL database stores information about each well and time-series data for water level and extraction. Fields in the HydroSQL database include:

- Subbasin
- Cadastral coordinates
- Planar coordinates
- Well owner
- Well name
- Well status
- Well depth
- Screened interval top and bottom
- Well type
- Water level elevation
- Annual pumping volume

Well owner and annual pumping information will be stored in HydroSQL; however, neither will be publicly accessible due to confidentiality requirements. Streamflow gauge data from the USGS is stored in the HydroSQL database similarly to the well water level information.

Water quality data are stored in the EnviroSQL database, which is linked to the HydroSQL database for data management purposes. Fields in the EnviroSQL database include:

- Station
- Parameter
- Sample Date
- Detection (detect or non-detect)
- Value
- Unit

The data used to populate the SVBGSA DMS are listed in Table 7-3. Categories marked with an X indicate datasets that were used in populating the DMS, including data that are publicly accessible or that are available to SVBGSA from MCWRA . Some data, such as groundwater extraction is confidential, and cannot be made publicly accessible by SVBGSA unless aggregated. Additional datasets will be added in the future as appropriate, such as recharge or diversion data.

Table 7-3. Datasets Available for Use in Populating the DMS

Data Sets	Data Category					
	Well and Site Information	Well Construction	Water Level	Groundwater Extraction [1]	Streamflow	Water Quality
DWR (CASGEM)	X	X				
MCWRA	X	X	X	X		
GAMA Groundwater Information System	X					X
USGS Gauge Station					X	

[1] Pumping data not publicly accessible

Data are compiled and reviewed to comply with quality objectives. The review included the following checks:

- Removing or flagging questionable data being uploaded in the DMS. This includes identifying outliers that may have been introduced during the original data entry process and plotting each well hydrograph to identify and remove anomalous data points.
- Loading into the database and checking for errors and missing data.

In the future, well log information will be entered for selected wells and other information will be added as needed to satisfy the requirements of the SGMA regulations.

The DMS also includes a publicly accessible web map hosted on the SVBGSA website; accessible at https://svbgsa.org/gsp-web-map-and-data/. This web map gives interested parties access to non-confidential technical information used in the development of the GSP and annual reports, and includes public well data and analysis such as water level contour maps and seawater intrusion, as well as various local administrative boundaries. In addition, the web-map has functionalities to graph time series of water levels and search for specific wells in the database. This web-map will be regularly updated as new information is made available to the SVBGSA.

8 SUSTAINABLE MANAGEMENT CRITERIA

This chapter defines the conditions that constitute sustainable groundwater management; and establishes minimum thresholds, measurable objectives, and undesirable results for each sustainability indicator. The minimum thresholds, measurable objectives, and undesirable results detailed in this chapter define the Subbasin's future conditions and commit the GSA to actions that will meet these criteria. This chapter includes adequate data to explain how SMC were developed and how they influence all beneficial uses and users.

The chapter is structured to address all the GSP Regulations § 354.22 *et. seq* regarding SMC. To retain an organized approach, the SMC are grouped by sustainability indicator. The discussion of each sustainability indicator follows a consistent format that contains all the information required by the GSP Regulations, and as further clarified in the SMC BMP (23 CCR § 352.22 *et seq.*; DWR, 2017).

8.1 Definitions

The SGMA legislation and GSP Regulations contain terms relevant to the SMC. The definitions included in the GSP Regulations are repeated below. Where appropriate, additional explanatory text is added in italics. This explanatory text is not part of the official definitions of these terms.

- **Sustainability indicator** refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in California Water Code § 10721(x).

  The 6 sustainability indicators relevant to this subbasin include chronic lowering of groundwater levels; reduction of groundwater storage; degraded water quality; land subsidence; seawater intrusion; and depletion of ISW.

- **Significant and unreasonable**

  Significant and unreasonable is not defined in the Regulations. However, the definition of undesirable results states, "Undesirable results occur when significant and unreasonable effects … are caused by groundwater conditions…." This GSP adopts the phrase significant and unreasonable to be the qualitative description of undesirable conditions due to inadequate groundwater management. Minimum thresholds are the quantitative measurement of the significant and unreasonable conditions.

- **Minimum threshold** refers to a numeric value for each sustainability indicator used to define undesirable results.

  Minimum thresholds are indicators of an unreasonable condition.

- **Measurable objective** refers to a specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin.

  Measurable objectives are goals that the GSP is designed to achieve.

- **Interim milestone** refers to a target value representing measurable groundwater conditions, in increments of 5 years, set by an Agency as part of a Plan.

  Interim milestones are targets such as groundwater elevations that will be achieved every 5 years to demonstrate progress towards sustainability.

- **Undesirable result**

  Undesirable result is not defined in the Regulations. However, the description of undesirable result states that it should be a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the subbasin. An example undesirable result is more than 10% of the measured groundwater elevations being lower than the minimum thresholds. Undesirable results should not be confused with significant and unreasonable conditions. Significant and unreasonable conditions are qualitative descriptions of conditions to be avoided; an undesirable result is a quantitative assessment based on minimum thresholds.

8.2 Sustainability Goal

The sustainability goal of the Eastside Aquifer Subbasin is to manage groundwater resources for long-term community, financial, and environmental benefits to the Subbasin's residents and businesses. The goal of this GSP is to ensure long-term viable water supplies while maintaining the unique cultural, community, and business aspects of the Subbasin. It is the express goal of this GSP to balance the needs of all water users in the Subbasin.

Several projects and management actions are included in this GSP and detailed in Chapter 9. It is not necessary to implement all projects and actions listed in this GSP to achieve sustainability. However, some combination of these will be implemented to ensure the Subbasin is operated within its sustainable yield and achieves sustainability. These projects include 2 recharge projects, 3 projects that divert surface water for in lieu use or recharge, and 4 projects are alternative water supplies, 2 of which are multi-subbasin. Chapter 9 also includes the options of promoting conservation and agricultural BMPs, land fallowing, and pumping allocations and controls, which provide for demand management if necessary. Three projects involve the Salinas River and will likely have indirect benefits for the Eastside Subbasin and may reduce the need for projects within the Subbasin. Finally, Chapter 9 includes implementation actions that do not directly help meet the SMC, but contribute to GSP implementation through data collection, assistance to groundwater users, and collaboration with partner agencies. This suite of projects and management actions provide sufficient options to achieve sustainability in the Eastside Subbasin throughout GSP implementation.

The management actions and projects are designed to achieve sustainability within 20 years by one or more of the following means:

- Educating stakeholders and prompting changes in behavior to improve chances of achieving sustainability.
- Increasing awareness of groundwater pumping impacts to promote voluntary reductions in groundwater use through improved water use practices or fallowing crop land.
- Increasing basin recharge.
- Developing new alternative water supplies for use in the Subbasin to offset groundwater pumping.

8.3 Achieving Long-Term Sustainability

The GSP addresses long-term groundwater sustainability. Correspondingly, the SVBGSA intends to develop SMC to avoid undesirable results under future hydrologic conditions. The understanding of future conditions is based on historical precipitation, evapotranspiration, streamflow, and reasonable anticipated climate change, which have been estimated on the basis of the best available climate science (DWR, 2018). These parameters underpin the estimated future water budget over the planning horizon (see Section 6.4). The average hydrologic conditions include reasonably anticipated wet and dry periods. Groundwater conditions that are the result of extreme climatic conditions and are worse than those anticipated do not constitute an undesirable result. However, SMC may be modified in the future to reflect observed future climate conditions.

The GSA will track hydrologic conditions during GSP implementation. These observed hydrologic conditions will be used to develop a value for average hydrologic conditions, which will be compared to predicted future hydrologic conditions. This information will be used to interpret the Subbasin's performance against SMC. Year-by-year micro-management is not the intent of this GSP; this GSP is developed to avoid undesirable results with long-term, deliberate groundwater management. For example, groundwater extractions may experience variations caused by reasonably anticipated hydrologic fluctuations. However, under average hydrologic conditions, there will be no chronic depletion of groundwater storage.

Further, since the GSP addresses long-term groundwater sustainability, exceedance of some SMC during an individual year does not constitute an undesirable result. Pursuant to SGMA regulations (California Water Code § 10721(w)(1)), "Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods." Therefore, groundwater levels may temporarily exceed minimum thresholds during prolonged droughts, which could be more extreme than those that have been anticipated based on historical data and anticipated climate change conditions. Such temporary exceedances do not constitute an undesirable result.

The SMC presented in this chapter are developed on the basis of historically observed hydrologic conditions and, in most cases, reasonably anticipated climate change. These SMC may be updated in future drafts to reflect changes in anticipated climate conditions and climate change based upon groundwater modeling results.

8.4 General Process for Establishing Sustainable Management Criteria

The SMC presented in this chapter were developed using publicly available information, feedback gathered during public meetings including subbasin committee meetings, hydrogeologic analysis, and meetings with SVBGSA staff and Advisory Committee members. The general process included:

- Presenting to subbasin committees on the general SMC requirements and implications. These presentations outlined the approach to developing SMC and discussed initial SMC ideas.
- Providing supplemental data to the subbasin committees to guide the approach to setting SMC.
- Polling and receiving feedback from the subbasin committees to establish preferences for establishing SMC.
- Obtaining additional input on SMC from with GSA staff and GSA Board Members.
- Modifying minimum thresholds and measurable objectives based on input from the public, GSA staff, and GSA Board Members, if needed.

8.5 Sustainable Management Criteria Summary

Table 8-1 provides a summary of the SMC for each of the 6 sustainability indicators. Measurable objectives are the goals that reflect the Subbasin's desired groundwater conditions for each sustainability indicator. These provide operational flexibility above the minimum thresholds. The minimum thresholds are quantitative indicators of the Subbasin's locally defined significant and unreasonable conditions. The undesirable result is a combination of minimum threshold exceedances that show a significant and unreasonable condition across the Subbasin as a whole. This GSP is designed to not only avoid undesirable results, but to achieve the sustainability goals within 20 years, along with interim milestones every 5 years that show progress. The management actions and projects provide sufficient options for reaching the measurable objectives within 20 years and maintaining those conditions for 30 years for all 6 sustainability indicators. The rationale and background for developing these criteria are described in detail in the following sections.

The SMC are individual criteria that will each be met simultaneously, rather than in an integrated manner. For example, the groundwater elevation and seawater intrusion SMC are 2 independent SMC that will be achieved simultaneously. The groundwater elevation SMC do not hinder the seawater intrusion SMC, but also, they do not ensure the halting of seawater intrusion by themselves. The SMC presented in Table 8-1 are part of the GSA's 50-year management plan: SGMA allows for 20 years to reach sustainability and requires the Subbasin have no undesirable results for the subsequent 30 years.

Table 8-1. Sustainable Management Criteria Summary

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result
Chronic lowering of groundwater levels	Measured through groundwater level representative monitoring well network.	Minimum thresholds are set to 2015 groundwater elevations. See Table 8-2.	Measurable objectives are set to 1999 groundwater elevations. See Table 8-2	More than 15% of groundwater elevation minimum thresholds are exceeded. Allows for 4 exceedances per year in the Eastside Subbasin.
Reduction in groundwater storage	Measured by proxy through groundwater level representative monitoring well network.	Minimum thresholds are established by proxy using groundwater elevations. The reduction in groundwater storage minimum thresholds are the same as the chronic lowering of groundwater levels minimum thresholds.	Measurable objectives are established by proxy using groundwater elevations. The reduction in groundwater storage measurable objectives are the same as the chronic lowering of groundwater levels measurable objectives.	More than 15% of groundwater elevation minimum thresholds are exceeded. The undesirable result for reduction in groundwater storage is established by proxy using groundwater elevations.
Seawater intrusion	Seawater intrusion maps developed by MCWRA.	Minimum threshold is the 500 mg/L chloride isocontour at the Subbasin boundary.	Measurable objective is identical to the minimum threshold, resulting in no seawater intrusion in the Eastside Subbasin.	Any exceedance of the minimum threshold, resulting in mapped seawater intrusion within the Subbasin boundary.
Degraded groundwater quality	Groundwater quality data downloaded annually from GAMA groundwater information system.	Minimum threshold is zero additional exceedances of either the regulatory drinking water standards (potable supply wells) or the Basin Plan objectives (irrigation supply wells) for groundwater quality COC. Exceedances are only measured in public water system supply wells and ILRP on-farm domestic and irrigation supply wells. See Table 8-4.	Measurable objective is identical to the minimum threshold.	Future or new minimum thresholds exceedances are caused by a direct result of GSA groundwater management action(s), including projects or management actions and regulation of groundwater extraction.
Land subsidence	Measured using DWR provided InSAR data.	Minimum threshold is zero net long-term subsidence, with no more than 0.1 foot per year of estimated land movement to account for InSAR errors.	Measurable objective is identical to the minimum threshold, resulting in zero net long-term subsidence.	There is an exceedance of the minimum threshold for subsidence due to lowered groundwater elevations.
Depletion of interconnected surface water	Groundwater elevations in shallow wells adjacent to locations of ISW identified using the SVIHM.	Minimum thresholds are established by proxy using shallow groundwater elevations observed in 2015 near locations of ISW.	Measurable objectives are established by proxy using shallow groundwater elevations observed in 1999 near locations of ISW.	There is an exceedance of the minimum threshold in a shallow groundwater monitoring well used to monitor ISW.

8.6 Chronic Lowering of Groundwater Levels SMC

8.6.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable groundwater elevations in the Subbasin are those that:

- Are at or below the observed groundwater elevations in 2015. Public and stakeholder input identified these historical groundwater elevations as significant and unreasonable.
- Cause low groundwater elevations in a significant number of domestic and small water system wells that lead to inadequate water production
- Interfere with other sustainability indicators

These significant and unreasonable conditions were determined based on input collected during Subbasin Committee meetings and discussions with GSA staff.

8.6.2 Minimum Thresholds

> *The minimum thresholds for chronic lowering of groundwater levels are set to 2015 groundwater elevations in this Subbasin.*

The minimum threshold values for each well within the groundwater level representative monitoring network are provided in Table 8-2. The minimum threshold contour maps, along with the RMS well locations for the Eastside Subbasin are shown on Figure 8-1 and Figure 8-2 for the Shallow and Deep Zones, respectively.

As indicated in Table 8-2, 16 out of 35 RMS are screened in both the Shallow and Deep Zones of the Eastside Aquifer. Depending on the year, these wells could be more representative of either the Shallow or Deep Zone. Thus, these wells are shown on the minimum threshold and measurable objective maps for both the Shallow and Deep Zones.

Table 8-2. Chronic Lowering of Groundwater Levels Minimum Thresholds and Measurable Objectives

Monitoring Site	Minimum Threshold (ft)	Measurable Objective (ft)
Shallow Zone		
14S/03E-06R01	-29.7	-24.9*
14S/03E-11H01	25.2	88.3
14S/03E-24H01	-84.1	-54.5
14S/03E-25C02	-65.4	-42.2*
14S/03E-27B01	-12.8	-5.0*
14S/03E-33G01	-18.0	-6.9*
14S/03E-36A01	-55.2	-29.7
15S/04E-07R02	-4.6	17.8
15S/04E-14N01	-34.6	14.0*
15S/04E-17P02	-18.0	17.5
15S/04E-24N03	-15.8	26.0
16S/05E-17R01	61.9	77.1
Deep Zone		
14S/03E-17F01	-44.0	-27.5*
14S/03E-21L01	-36.0	-22.6*
14S/03E-22D01	-62.0	-50.0
14S/03E-25C01	-64.9	-41.7*
14S/03E-34C01	-31.0	-13.3*
15S/03E-02G01	-36.0	-8.8*
16S/04E-02Q03	32.5	57.8
Both Zones		
14S/03E-03K01	-63.1	-40.7
14S/03E-08C01	-31.5	-48.0
14S/03E-08Q03	-31.0	-41.0
14S/03E-09E02	-54.0	-38.2*
14S/03E-09P02	-19.7	-33.1
14S/03E-15H03	-55.3	-36.7
14S/04E-31Q02	-61.0	-25.6*
15S/04E-06R01	-30.5	-4.1
15S/04E-09D01	-52.0	-29.2
15S/04E-15D02	-26.5	-0.2
15S/04E-21F04	-12.2*	16.5*
15S/04E-27G01	3.8	33.5
15S/04E-36H01	12.9	56.2
16S/05E-05N01	29.1	62.5
16S/05E-07G01	38.7	69.3
16S/05E-27G01	77.7	88.4*

*Groundwater elevation was estimated.

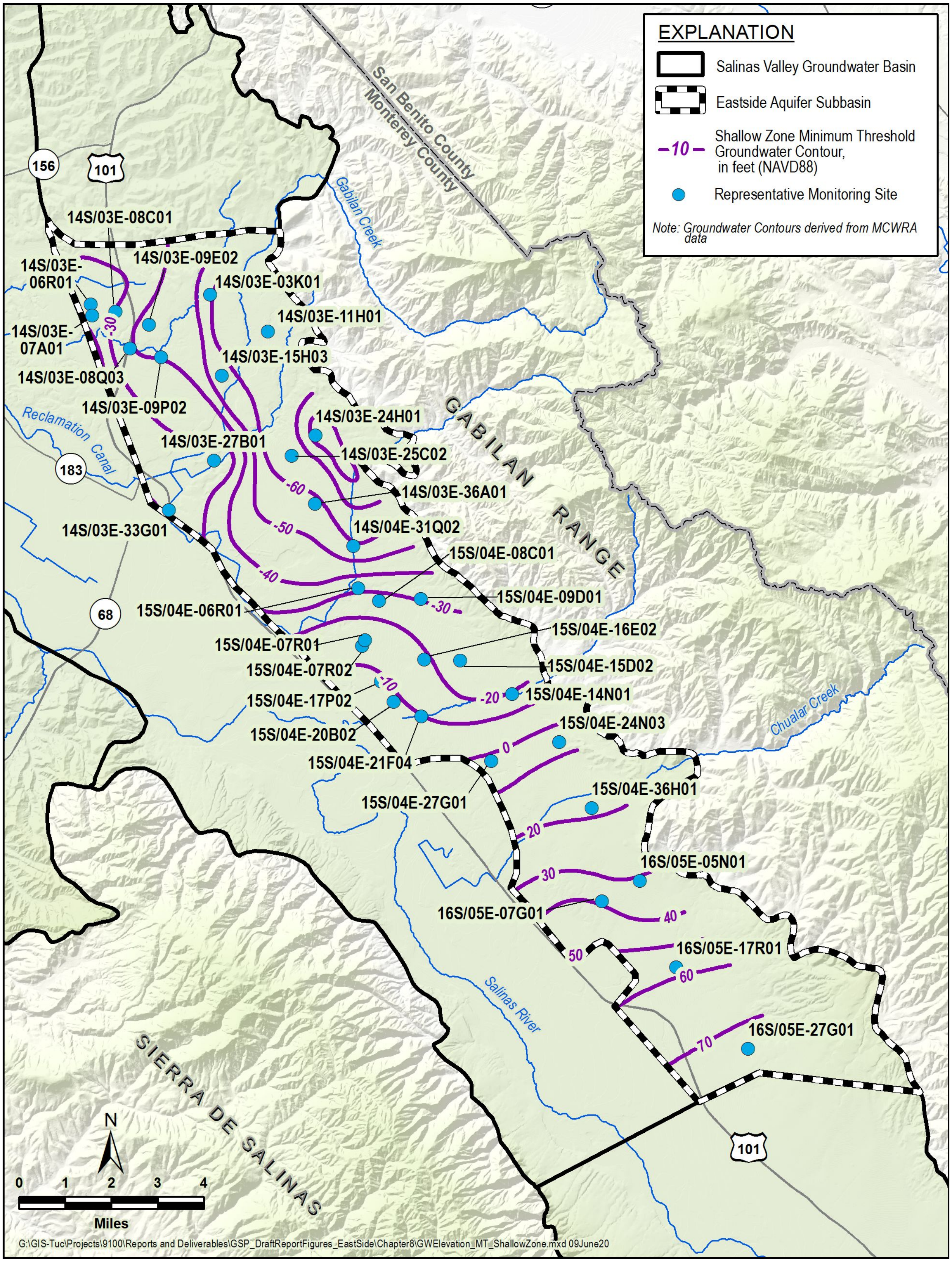

Figure 8-1. Groundwater Level Minimum Threshold Contour Map for the Shallow Zone of the Eastside Aquifer

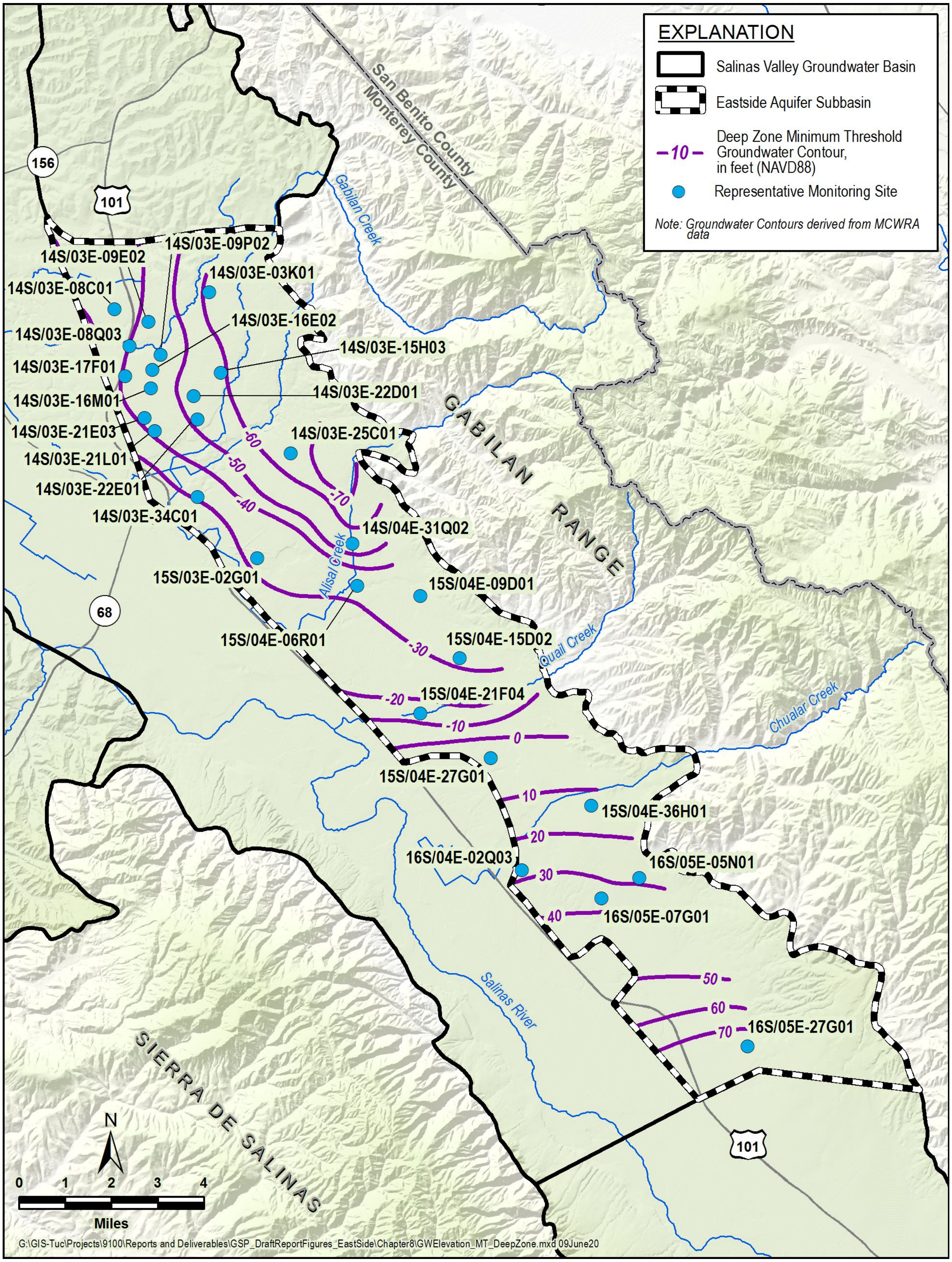

Figure 8-2. Groundwater Level Minimum Threshold Contour Map for the Deep Zone of the Eastside Aquifer

8.6.2.1 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

The development of both minimum thresholds and measurable objectives followed similar processes and are described in this section. The information used includes:

- Feedback from discussions with the Subbasin Committee on challenges and goals
- Historical groundwater elevation data and hydrographs from wells monitored by the MCWRA
- Maps of current and historical groundwater elevation data
- Analysis of the impact of groundwater elevations on domestic wells

The general steps for developing minimum thresholds and measurable objectives were:

1. The Subbasin Committee selected an approach and criteria for to setting the groundwater level minimum thresholds and measurable objectives.
2. SVBGSA used MCWRA's average groundwater elevation change hydrographs to select representative years that could define minimum thresholds and measurable objectives for the Subbasin. Groundwater elevations like those experienced during the representative climatic cycle between 1967 and 1998 were used to identify minimum thresholds and measurable objectives to ensure that they were achievable under reasonably expected climatic conditions. This representative period corresponds to important water management milestones for the Salinas Valley Groundwater Basin; water year 1967 marks the beginning of operations at San Antonio Reservoir, with first water releases in November 1966. The Castroville Seawater Intrusion Project (CSIP) began operating in 1998.

   The average groundwater elevation change hydrograph with minimum threshold and measurable objectives lines for the Eastside Subbasin are shown on Figure 8-3. The average 2015 groundwater elevations in the Eastside Subbasin are considered significant and unreasonable. When looking at the groundwater elevation changes within the representative climatic cycle, the historical lowest elevations occurred in 1991, at approximately 6 feet lower than 2015 elevations. The minimum thresholds were therefore set to the 2015 groundwater elevations. The measurable objective is set to 1999 groundwater elevations, which is an achievable goal for the Subbasin under reasonably expected climatic conditions.

3. SVBGSA identified the appropriate minimum thresholds and measurable objectives on the respective monitoring well hydrographs. Each hydrograph was visually inspected to check if the minimum threshold and measurable objective was reasonable. If an RMS did not have measurements from the minimum threshold or

measurable objective years, the SMC were interpolated from the groundwater elevation contours. The RMS location was intersected with groundwater elevation contour maps to estimate the minimum thresholds and measurable objectives. Moreover, if the minimum threshold seemed unreasonable for an RMS, it was adjusted to be more reflective of recently low groundwater elevations and changes in groundwater elevations experienced due to climatic cycles. Additionally, measurable objectives were revised in order to set a more realistically achievable goal based on historic water levels. The interpolated or adjusted minimum thresholds and measurable objectives are indicated by an asterisk in Table 8-2.

Hydrographs with well completion information showing minimum thresholds for each RMS are included in Appendix 8A.

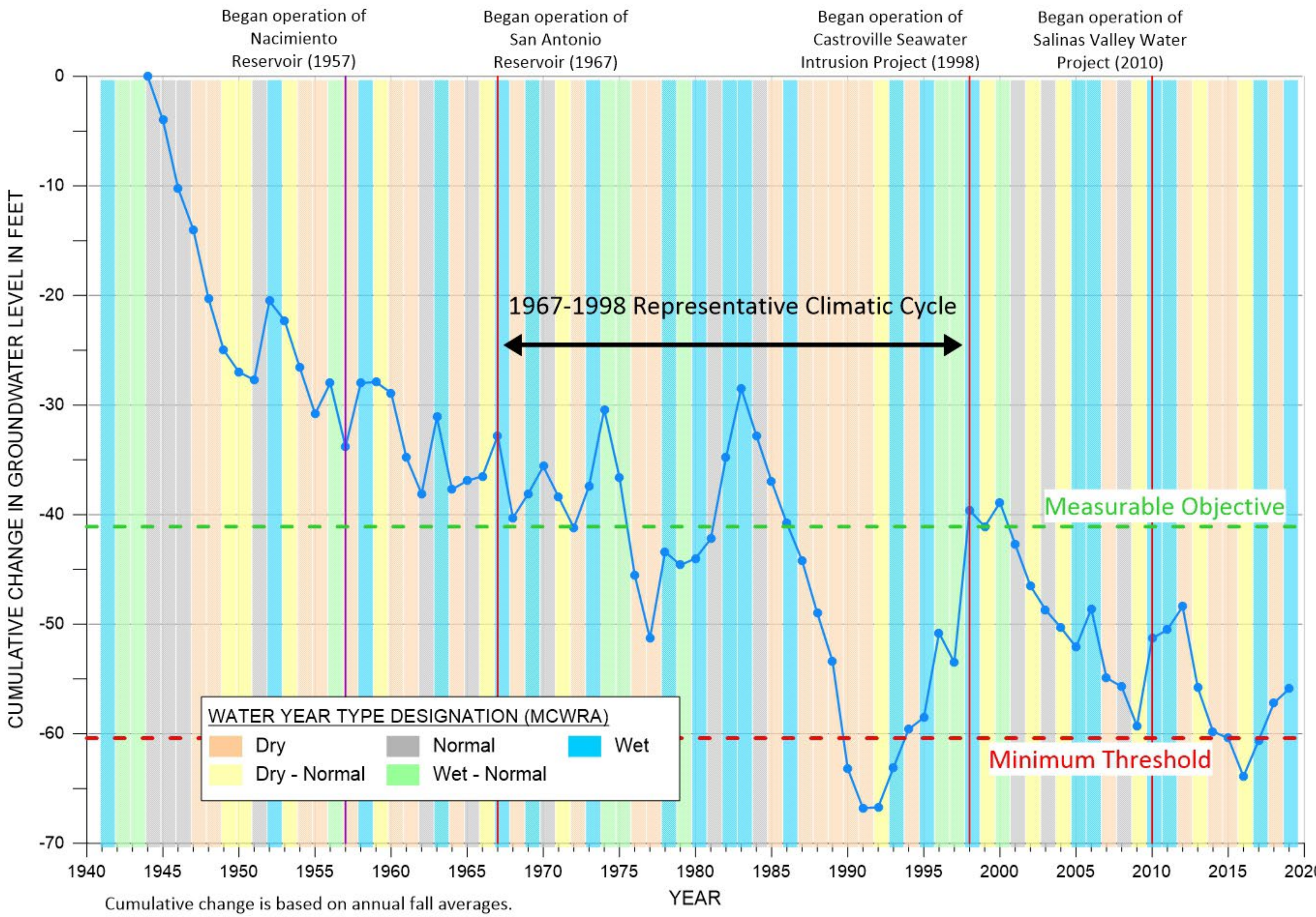

Figure 8-3. Cumulative Groundwater Elevation Change Hydrograph with Selected Measurable Objective and Minimum Threshold for the Eastside Aquifer Subbasin

8.6.2.2 Minimum Thresholds Impact on Domestic Wells

To address the human right to water, minimum thresholds for groundwater levels are compared to the range of domestic well depths in the Subbasin using DWR's Online System for Well Completion Reports (OSWCR) database. This check was done to assure that the minimum thresholds maintain operability in a reasonable percentage of domestic wells. The proposed minimum thresholds for groundwater levels do not necessarily protect all domestic wells because it is impractical to manage a groundwater basin in a manner that fully protects the shallowest wells. The average computed depth of domestic wells in the Subbasin is 361 feet using the Public Land Survey System sections data in the OSWCR database.

While this approach is reasonable, there are some adjustments that had to be made to improve the accuracy of the analysis. These include:

- The OSWCR database does not eliminate wells that have been abandoned, destroyed, or replaced, such as if the user switched to a water system, and abandoned or destroyed wells would have no detrimental impacts from lowered groundwater levels. For example, the Subbasin experienced a prolonged drought from 1986 to 1992, causing many new wells to be drilled. Thus, wells drilled prior to 1991 are likely abandoned if they were not modified.
- Only wells likely to be in the principal aquifer were considered, since some domestic wells may draw water from shallow, perched groundwater that is not managed under this GSP.
- Only wells that had accurate locations were included, since some wells in the OSWCR database are not accurately located, it could lead to inaccurate estimations of depth to water in the wells.
- The depth to water is derived from a smoothly interpolated groundwater elevation contour map. Errors in the map may result in errors in groundwater elevation at the selected domestic wells.

Given the limitations listed above, the analysis included 20 wells out of the total 206 domestic wells in the OSWCR database. The analysis of domestic wells showed that in the Eastside Subbasin all domestic wells will have at least 25 feet of water in them as long as groundwater elevations remain above minimum thresholds; therefore, all domestic wells will have at least 25 feet of water in them when measurable objectives are achieved. These percentages were considered reasonable despite the limitations of this analysis. Since data for the analysis is limited, further assessment may be done when more data becomes available.

8.6.2.3 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The SVBGSA compared minimum thresholds between RMSs to understand the relationship between RMSs (i.e., describe why or how a water level minimum threshold set at a particular RMS is similar to or different from water level thresholds in nearby RMS). The groundwater level minimum thresholds are derived from historical and/or smoothly interpolated groundwater elevations in the Subbasin. Therefore, the minimum thresholds are unique at every well, but when combined represent a reasonable and potentially realistic groundwater elevation map. Because the underlying groundwater elevation map is a reasonably achievable condition, the individual minimum thresholds at RMSs do not conflict with each other.

Groundwater level minimum thresholds can influence other sustainability indicators. SVBGSA reviewed the groundwater level minimum thresholds' relationship with each of the other sustainability indicators' minimum thresholds to ensure a groundwater level minimum threshold would not trigger an undesirable result for any of the other sustainability indicators. The groundwater level minimum thresholds are selected to avoid undesirable results for other sustainability indicators.

- **Reduction in groundwater storage.** The chronic lowering of groundwater levels minimum thresholds are identical to the groundwater storage minimum thresholds. Thus, the groundwater level minimum thresholds will not result in an undesirable loss of groundwater storage.
- **Seawater intrusion.** The chronic lowering of groundwater level minimum thresholds are set above historical lows. Therefore, the groundwater elevation minimum thresholds are intended to not exacerbate, and may help control, the rate of seawater intrusion.
- **Degraded water quality.** The chronic lowering of groundwater levels minimum could affect groundwater quality through 2 processes:
    1. Changes in groundwater elevation could change groundwater gradients, which could cause poor quality groundwater to flow toward production and domestic wells that would not have otherwise been impacted. These groundwater gradients, however, are only dependent on differences between groundwater elevations, not on the groundwater elevations themselves. Therefore, the minimum threshold groundwater levels do not directly lead to a significant and unreasonable degradation of groundwater quality in production and domestic wells.
    2. Decreasing groundwater elevations can mobilize COC that are concentrated at depth, such as arsenic. The groundwater level minimum thresholds are near or above historical lows. Therefore, any depth dependent constituents have previously been mobilized by historical groundwater levels. Maintaining groundwater elevations

above the minimum thresholds assures that no new depth dependent COC are mobilized and are therefore protective of beneficial uses and users.

- **Land subsidence.** The chronic lowering of groundwater levels minimum thresholds are set at or above recent low groundwater elevations. Thus, avoiding the dewatering and compaction of clay-rich sediments that causes subsidence in response to lowering groundwater elevations.
- **Depletion of ISW.** The chronic lowering of groundwater levels minimum thresholds are identical to the ISW minimum thresholds. Therefore, the groundwater level minimum thresholds will not result in a significant or unreasonable depletion of ISW, including GDEs.

8.6.2.4 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The Eastside Subbasin has 3 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Forebay Subbasin to the south
- The 180/400-Foot Aquifer Subbasin to the west

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The 180/400-Foot Aquifer Subbasin submitted a GSP in 2020 and the Langley and Forebay Subbasins are in the process of GSP development for submittal in January 2022. Minimum thresholds for the Eastside Subbasin will be reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

8.6.2.5 Effects on Beneficial Users and Land Uses

The groundwater level minimum thresholds may have several effects on beneficial users and land uses in the Subbasin.

Agricultural land uses and users. The groundwater level minimum thresholds prevent continued lowering of groundwater elevations in the Subbasin. Unless sufficient recharge projects are undertaken, this may have the effect of limiting the amount of groundwater pumping in the Subbasin. Limiting the amount of groundwater pumping may limit the amount and type of crops that can be grown in the Subbasin. The groundwater level minimum thresholds could therefore limit expansion of the Subbasin's agricultural economy. This could have various effects on beneficial users and land uses:

- Agricultural land currently under irrigation may become more valuable as bringing new lands into irrigation becomes more difficult and expensive.
- Agricultural land not currently under irrigation may become less valuable because it may be too difficult and expensive to irrigate.

Urban land uses and users. The groundwater level minimum thresholds may reduce the amount of groundwater pumping in the Subbasin. This may limit urban growth or result in urban areas obtaining alternative sources of water. This may result in higher water costs for public drinking water system users.

Domestic land uses and users. The groundwater level minimum thresholds are intended to protect most domestic wells, including small state and small local system wells. Therefore, the minimum thresholds will likely have an overall beneficial effect on existing domestic land uses by protecting the ability to pump from domestic wells. However, extremely shallow domestic wells may become dry, requiring owners to drill deeper wells. Additionally, the groundwater level minimum thresholds may limit the number of new domestic wells or small state and small local system wells that can be drilled to limit future declines in groundwater elevations.

Ecological land uses and users. The groundwater level minimum thresholds may limit the amount of groundwater pumping in the Subbasin and may limit both urban and agricultural growth. This outcome may benefit ecological land uses and users by curtailing the conversion of native vegetation to agricultural or domestic uses, and by reducing pressure on existing ecological land caused by declining groundwater elevations.

8.6.2.6 Relevant Federal, State, or Local Standards

No federal, state, or local standards exist for chronic lowering of groundwater levels.

8.6.2.7 Method for Quantitative Measurement of Minimum Thresholds

Groundwater level minimum thresholds will be directly measured from the representative monitoring well network. The groundwater elevation monitoring will be conducted in accordance with the monitoring plan outlined in Chapter 7. Furthermore, the groundwater elevation monitoring will meet the requirements of the technical and reporting standards included in the GSP Regulations.

As noted in Chapter 7, the current groundwater level representative monitoring network in the Subbasin includes 30 wells. Data gaps were identified in Chapter 7 and will be resolved during implementation of this GSP.

8.6.3 Measurable Objectives

The measurable objectives for chronic lowering of groundwater levels represent target groundwater elevations that are higher than the minimum thresholds. These measurable objectives provide operational flexibility to ensure that the Subbasin can be managed sustainably over a reasonable range of hydrologic variability.

> *The measurable objectives for the chronic lowering of groundwater levels are set to 2011 groundwater elevations.*

The measurable objectives are summarized in Table 8-2 and are also shown on the hydrographs for each RMS in Appendix 8A.

8.6.3.1 Methodology for Setting Measurable Objectives

The methodology for establishing measurable objectives is described in detail in Section 8.6.2.1. A year from the relatively recent past was selected for setting measurable objectives to ensure that objectives are achievable. Groundwater elevations from 1999 were selected as representative of the measurable objectives for the Eastside Subbasin. The measurable objective contour maps for the Eastside Subbasin along with the representative monitoring network wells are shown on Figure 8-4 and Figure 8-5 for the Shallow and Deep Zones, respectively.

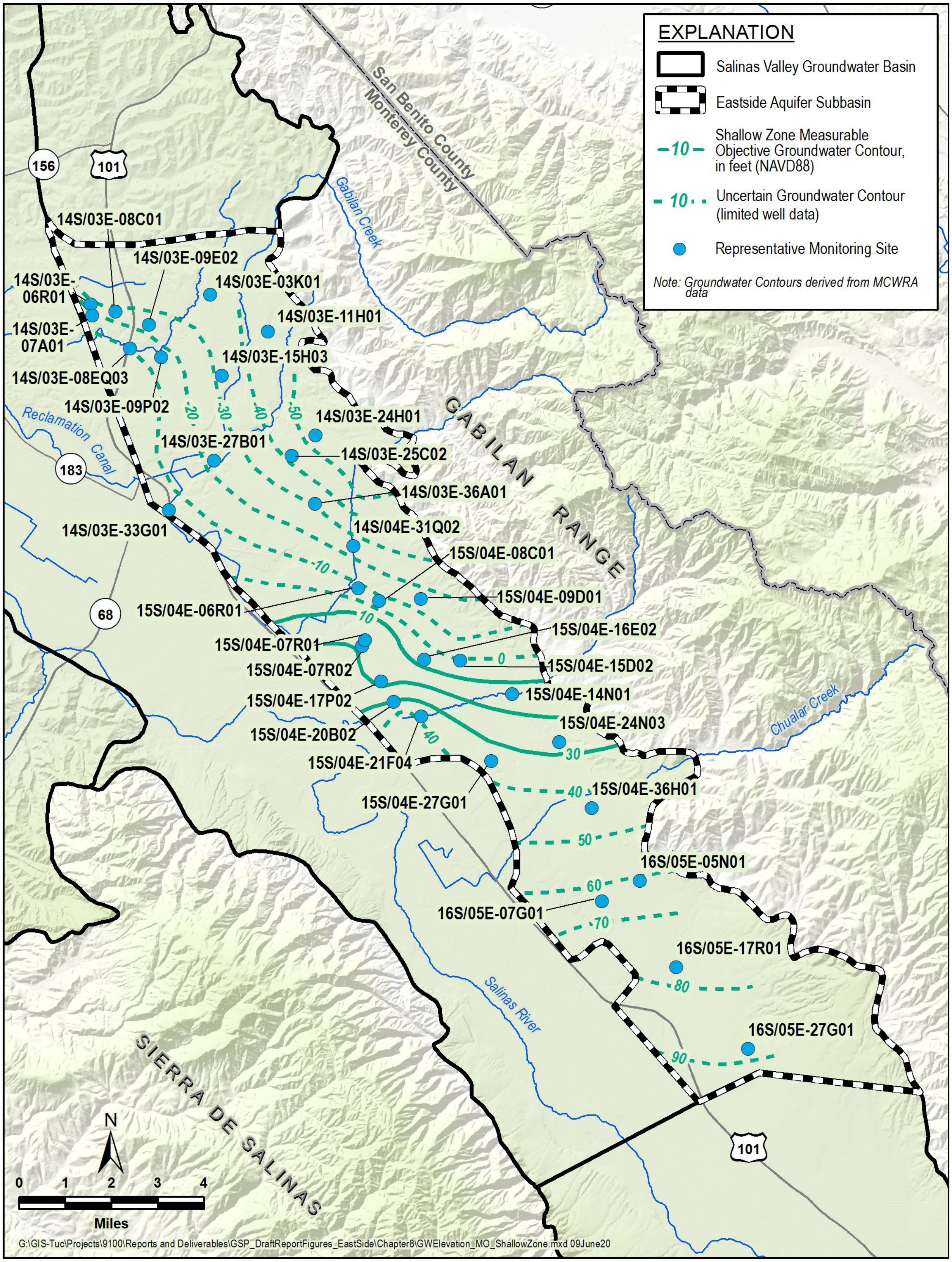

Figure 8-4. Groundwater Level Measurable Objective Contour Map for the Shallow Zone of the Eastside Aquifer

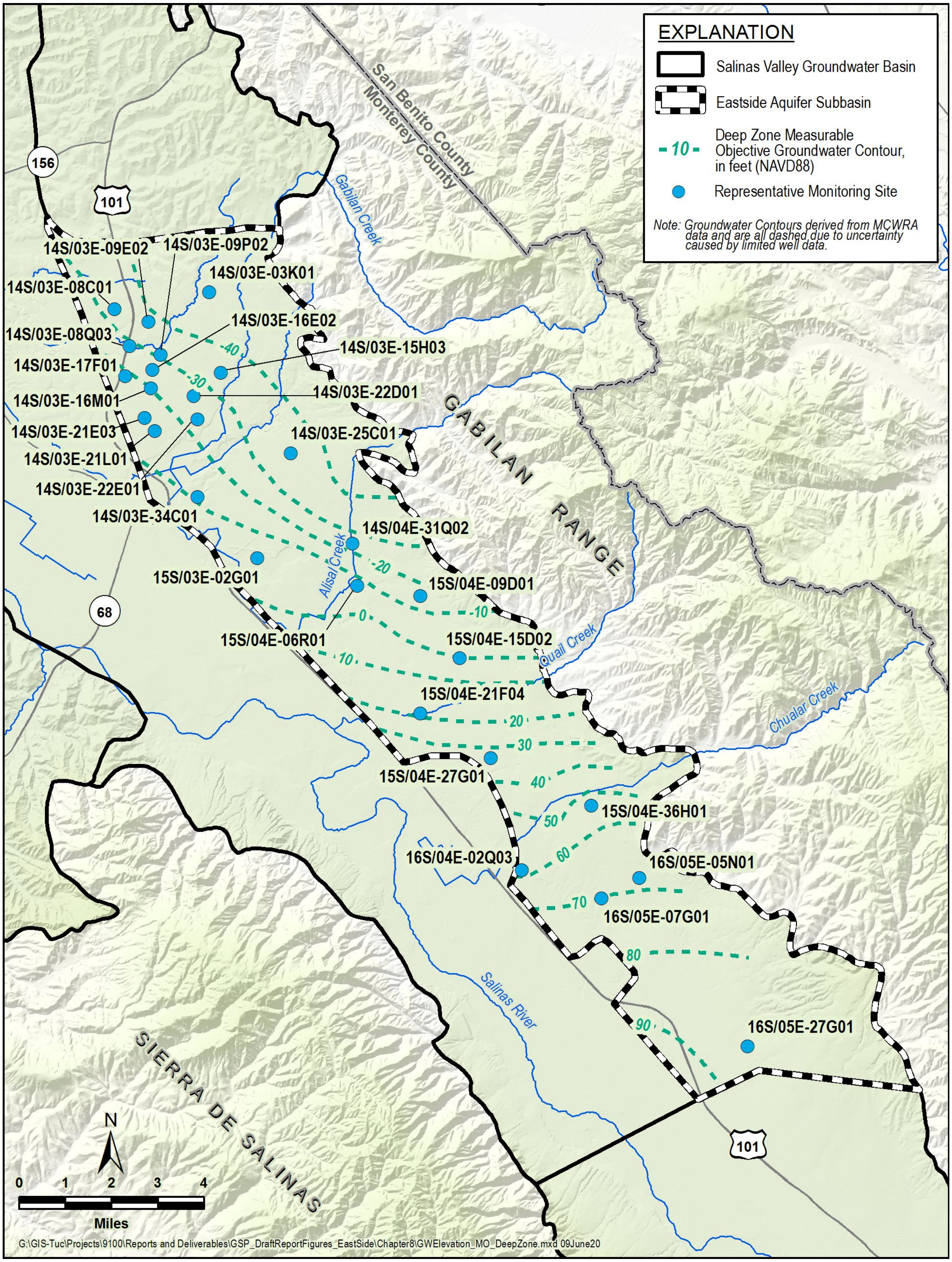

Figure 8-5. Groundwater Level Measurable Objective Contour Map for the Deep Zone of the Eastside Aquifer

8.6.3.2 Interim Milestones

Interim milestones for groundwater levels are shown in Table 8-3. These are only initial estimates of interim milestones. Interim milestones for groundwater levels will be modified as better data, analyses, and project designs become available.

Table 8-3. Chronic Lowering of Groundwater Levels Interim Milestones

Monitoring Site	Current Groundwater Elevation (ft)	Interim Milestone at Year 2027 (ft)	Interim Milestone at Year 2032 (ft)	Interim Milestone at Year 2037 (ft)	Measurable Objective (ft) (goal to reach at 2042)
Shallow Zone					
14S/03E-06R01	-26.5	-32.2	-32.2	-29.1	-24.9*
14S/03E-11H01	66.2	59.0	67.5	76.0	88.3
14S/03E-24H01	-77.6	-84.3	-84.3	-72.0	-54.5
14S/03E-25C02	-59.4	-71.5	-71.5	-59.5	-42.2*
14S/03E-27B01	-8.2	-13.1	-13.1	-9.7	-5.0*
14S/03E-33G01	-13.0	-15.8	-15.8	-12.1	-6.9*
14S/03E-36A01	-49.4	--56.8	-56.8	-45.5	-29.7
15S/04E-07R02	6.4	-5.8	-5.8	4.0	17.8
15S/04E-14N01	-37.4*	-42.0	-42.0	-19.0	14.0*
15S/04E-17P02	1.2	-14.2	-14.2	-1.0	17.5
15S/04E-24N03	-10.3	-23.5	-23.5	-3.1	26.0
16S/05E-17R01	70.4	62.1	62.1	68.3	77.1
Deep Zone					
14S/03E-17F01	-36.0	-45.0	-45.0	-37.8	-27.5*
14S/03E-21L01	-32.0	-42.8	-42.8	-34.5	-22.6*
14S/03E-22D01	-48.0	-50.0	-50.0	-50.0	-50.0*
14S/03E-25C01	-61.2	-76.3	-76.3	-62.0	-41.7*
14S/03E-34C01	-27.0	-31.5	-31.5	-24.0	-13.3*
15S/03E-02G01	-23.0	-31.4	-31.4	-22.0	-8.8*
16S/04E-02Q03	40.5	26.0	26.0	39.0	57.8
Both Zones					
14S/03E-03K01	-58.8	-67.1	-67.1	-56.3	-40.7
14S/03E-08C01	-48.1	-38.1	-36.1	-34.2	-31.5
14S/03E-08Q03	-46.0	-48.3	-43.4	-38.1	-31.0*
14S/03E-09E02	-48.0	-65.3	-65.3	-54.2	-38.2*
14S/03E-09P02	-24.8	-32.3	-32.3	-27.0	-19.7
14S/03E-15H03	-48.1	-59.7	-59.7	-50.3	-36.7
14S/04E-31Q02	-51.2	-65.3	-65.3	-49.0	-25.6*

Monitoring Site	Current Groundwater Elevation (ft)	Interim Milestone at Year 2027 (ft)	Interim Milestone at Year 2032 (ft)	Interim Milestone at Year 2037 (ft)	Measurable Objective (ft) (goal to reach at 2042)
15S/04E-06R01	-25.3	-39.1	-39.1	-24.5	-4.1
15S/04E-09D01	-43.2	-55.4	-55.4	-44.7	-29.2
15S/04E-15D02	-21.1	-33.3	-33.3	-19.5	-0.2
15S/04E-21F04	-0.2	-12.0	-12.0	-0.2	16.5*
15S/04E-27G01	15.4	0.7	0.7	14.5	33.5
15S/04E-36H01	22.3	8.6	8.6	28.5	56.2
16S/05E-05N01	38.7	26.0	26.0	41.0	62.5
16S/05E-07G01	51.7	37.5	37.5	50.8	69.3
16S/05E-27G01	84.9	76.0	76.0	81.0	88.4*

*Groundwater elevation was estimated.

8.6.4 Undesirable Results

8.6.4.1 Criteria for Defining Chronic Lowering of Groundwater Levels Undesirable Results

The chronic lowering of groundwater levels undesirable result is a quantitative combination of groundwater level minimum threshold exceedances. The undesirable result is:

More than 15% of the groundwater elevation minimum thresholds are exceeded.

Since the GSP addresses long-term groundwater sustainability, exceedances of groundwater levels minimum thresholds during a drought do not constitute an undesirable result. Pursuant to SGMA Regulations (California Water Code § 10721(w)(1)), "Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods." Therefore, groundwater levels may temporarily exceed minimum thresholds during droughts, and do not constitute an undesirable result, as long as groundwater levels rebound.

Undesirable results provide flexibility in defining sustainability. Increasing the percentage of allowed minimum threshold exceedances provides more flexibility but may lead to significant and unreasonable conditions for some beneficial users. Reducing the percentage of allowed minimum threshold exceedances ensures strict adherence to minimum thresholds but reduces flexibility due to unanticipated hydrogeologic conditions. The undesirable result was set at 15% to balance the interests of beneficial users with the practical aspects of groundwater management under uncertainty.

The 15% limit on minimum threshold exceedances in the undesirable result allows for 4 exceedances in the 35 existing representative monitoring wells. This was considered a reasonable number of exceedances given the hydrogeologic uncertainty of aquifer characteristics of the Subbasin. As the monitoring system grows, additional exceedances will be allowed. One additional exceedance will be allowed for approximately every 7 new monitoring wells.

8.6.4.2 Potential Causes of Undesirable Results

An undesirable result for chronic lowering of groundwater levels does not currently exist, since groundwater elevations in 32 out of 35 representative monitoring wells (91%) in the Subbasin were above the minimum threshold in the Fall 2019 groundwater elevation measurements. Conditions that may lead to an undesirable result include the following:

- **Localized pumping clusters**. Even if regional pumping is maintained within the sustainable yield, clusters of high-capacity wells may cause excessive localized drawdowns that lead to undesirable results.
- **Expansion of *de minimis* pumping**. Individual *de minimis* pumpers do not have a significant impact on groundwater elevations. However, many *de minimis* pumpers are often clustered in specific residential areas. Pumping by these *de minimis* users is not regulated under this GSP. Adding additional domestic *de minimis* pumpers in these areas may result in excessive localized drawdowns and undesirable results.
- **Departure from the GSP's climatic assumptions, including extensive, unanticipated drought**. Minimum thresholds were established based on historical groundwater elevations and reasonable estimates of future climatic conditions and groundwater elevations. Departure from the GSP's climatic assumptions or extensive, unanticipated droughts may lead to excessively low groundwater elevations and undesirable results.

8.6.4.3 Effects on Beneficial Users and Land Uses

The primary detrimental effect on beneficial users from allowing multiple exceedances occurs if more than 1 exceedance occurs in a small geographic area. Allowing 15% exceedances is reasonable if the exceedances are spread out across the Subbasin, and as long as any 1 well does not regularly exceed its minimum threshold. If the exceedances are clustered in a small area, it will indicate that significant and unreasonable effects are being borne by a localized group of landowners.

8.7 Reduction in Groundwater Storage SMC

8.7.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable conditions in groundwater storage in the Subbasin are those that:

- Lead to chronic, long-term reduction in groundwater storage, or
- Interfere with other sustainability indicators

These significant and unreasonable conditions were determined based on input collected during Subbasin Committee meetings and discussions with GSA staff.

8.7.2 Minimum Thresholds

The minimum thresholds for reduction in groundwater storage are established by proxy using groundwater elevations. The reduction in groundwater storage minimum thresholds are identical to the chronic lowering of groundwater levels minimum thresholds.

Although not the metric for establishing change in groundwater storage, the GSAs are committed to pumping at or less than the Subbasin's long-term sustainable yield. SGMA allows 20 years to reach sustainability.

8.7.2.1 Information and Methodology Used to Establish Minimum Thresholds

Since groundwater storage and groundwater elevation minimum thresholds are identical, the methodology used to the establish minimum thresholds for reduction in groundwater storage are detailed in Section 8.6.2.1.

The general relationship between groundwater storage and groundwater elevations is described in greater detail in Chapter 4, Section 4.4.2. The Subbasin-specific data analysis to establish the proxy relationship between groundwater storage and groundwater is discussed below.

The GSP Regulations § 354.28(d) states that: "an Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.".

Figure 8-6 compares the Subbasin's cumulative change in storage, plotted on the black line, with the average annual change in groundwater elevation, plotted on the blue line. The groundwater elevation change data are derived from the groundwater elevation network; the cumulative change in groundwater storage is derived from the SVIHM. Although the data come from 2 sources, the data show similar patterns between 1998 and 2016. The decrease in storage modeled by the SVIHM from 1983 to 1998 is not reflected in the change in groundwater elevations blue line, because the modeled storage is dependent on the simulated groundwater elevations in the SVIHM.

Figure 8-7 shows a scatter plot of cumulative change in storage and average change in groundwater elevation. The blue data points show data for the entire model period from 1980 to 2016 and the orange data points show data from 1998 to 2016. Although, the data for the entire model period demonstrate a weak correlation (R^2=0.4512), a more significant positive correlation exists between groundwater elevations and the amount of groundwater in storage between 1998 and 2016 (R^2=0.8149). The correlation for the 1998 to 2016 period is sufficient to show that groundwater elevations are an adequate proxy for groundwater storage.

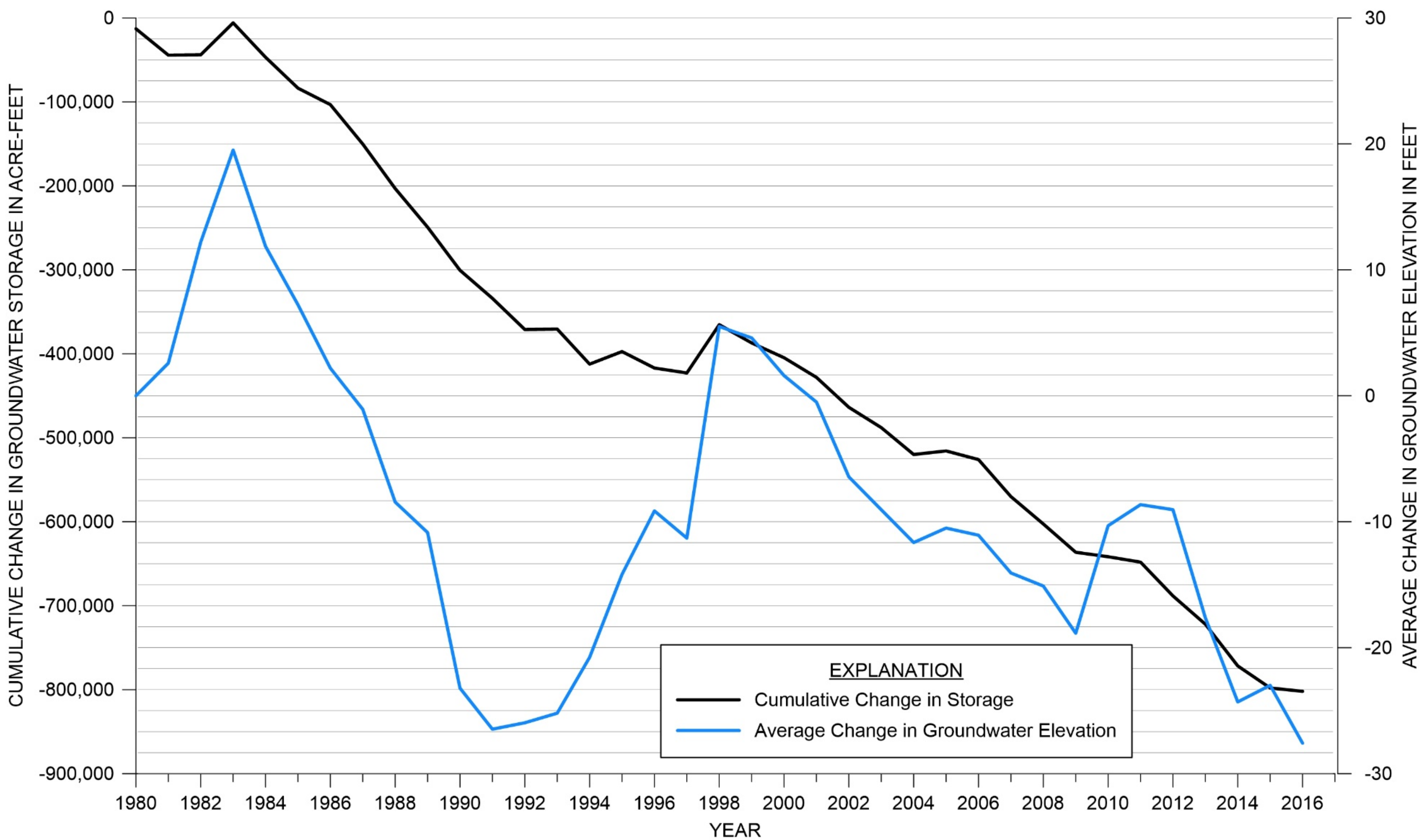

Figure 8-6. Cumulative Change in Storage and Average Change in Groundwater Elevation in the Eastside Aquifer Subbasin

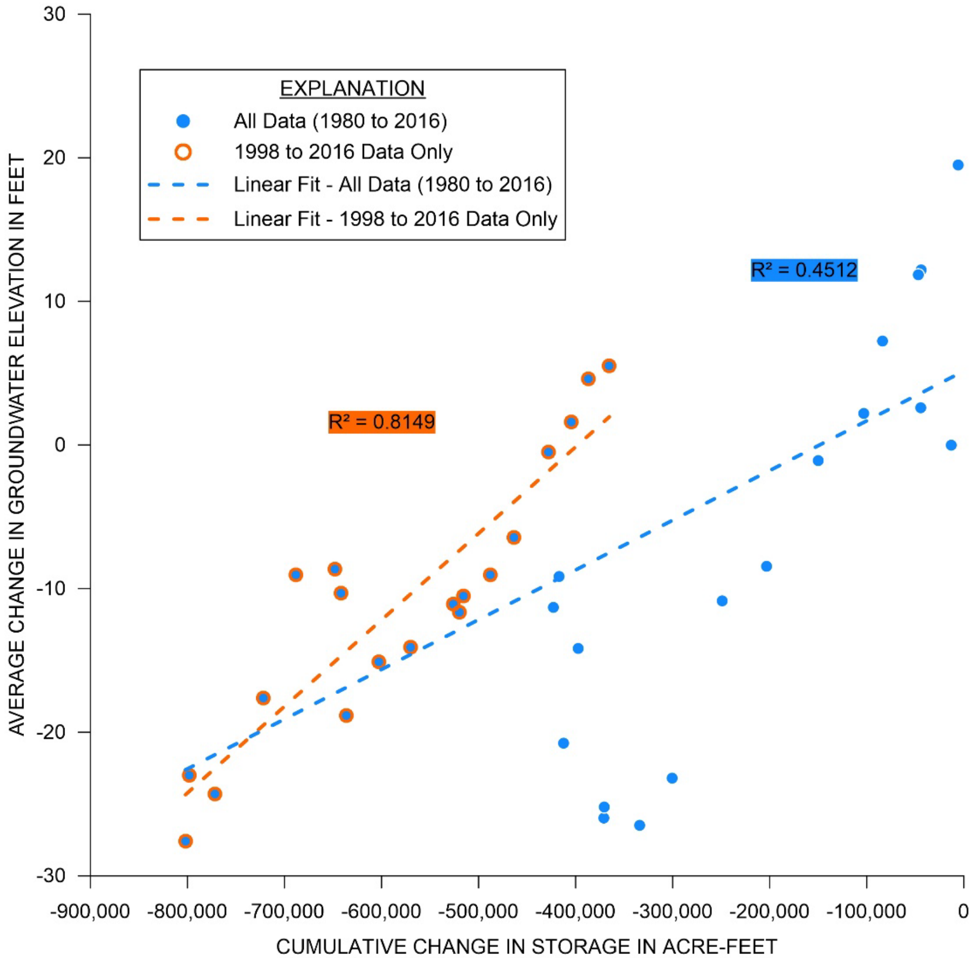

Figure 8-7. Correlation Between Cumulative Change in Storage and Average Change in Groundwater Elevation

8.7.2.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The groundwater storage minimum thresholds are identical to groundwater level minimum thresholds, which are consistent with other sustainability indicators, as described in Section 8.6.2.3.

8.7.2.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The Eastside Subbasin has 3 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Forebay Subbasin to the south
- The 180/400-Foot Aquifer Subbasin to the west

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The 180/400-Foot Aquifer Subbasin submitted a GSP in 2020 and the Langley and Forebay Subbasins are in the process of GSP development for submittal in January 2022. Minimum thresholds for the Eastside Subbasin will be reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

8.7.2.4 Effect on Beneficial Uses and Users

Because the groundwater storage minimum thresholds are defined based on groundwater level minimum thresholds, the effects of groundwater storage minimum threshold on beneficial uses and users are identical to those described in Section 8.6.2.5.

8.7.2.5 Relation to State, Federal, or Local Standards

No federal, state, or local standards exist for reductions in groundwater storage.

8.7.2.6 Method for Quantitative Measurement of Minimum Threshold

The groundwater level minimum thresholds will be used as proxies for reduction of groundwater storage, therefore, the measurement of change in groundwater storage will be measured as outlined in Section 8.6.2.7 using the groundwater level monitoring network described in Chapter 7.

8.7.3 Measurable Objectives

> *The measurable objectives for reduction in groundwater storage are established by proxy using groundwater elevations. The reduction in groundwater storage measurable objectives are identical to the chronic lowering of groundwater levels measurable objectives.*

8.7.3.1 Methodology for Setting Measurable Objectives

As stated in Section 8.6.3, the groundwater level measurable objectives for chronic lowering of groundwater levels provide an adequate margin of operational flexibility for managing the Subbasin. Therefore, the change in storage measurable objectives were set to be identical to the groundwater level measurable objectives: providing the same margin of operation flexibility.

8.7.3.2 Interim Milestones

The groundwater level interim milestones described in Table 8-3 and Section 8.6.3.2 will serve as proxies for the reduction of groundwater storage interim milestones.

8.7.4 Undesirable Results

8.7.4.1 Criteria for Defining Reduction in Groundwater Storage Undesirable Results

The criteria used to define undesirable results for reduction of groundwater storage are based on minimum thresholds established for chronic lowering of groundwater levels. The reduction of storage undesirable result is:

> *More than 15% of groundwater elevation minimum thresholds are exceeded. The undesirable result for reduction in groundwater storage is established by proxy using groundwater elevations.*

Since the GSP addresses long-term groundwater sustainability, exceedances of groundwater storage minimum thresholds during a drought do not constitute an undesirable result. Pursuant to SGMA Regulations (California Water Code § 10721(w)(1)), "Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods." Therefore, groundwater storage may temporarily exceed minimum thresholds during droughts, and do not constitute an undesirable result, as long as groundwater levels rebound.

8.7.4.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result for the reduction in groundwater storage sustainability indicator include the following:

- **Expansion of agricultural or municipal pumping.** Additional agricultural or municipal pumping may result in exceedance of the long-term sustainable yield, an undesirable result.
- **Expansion of *de minimis* pumping.** Pumping by *de minimis* users is not regulated under this GSP. Adding domestic *de minimis* pumpers in the Subbasin may result in excessive pumping and exceedance of the long-term sustainable yield, an undesirable result.
- **Departure from the GSP's climatic assumptions, including extensive, unanticipated drought.** Minimum thresholds are established based on reasonable anticipated future climatic conditions and groundwater elevations. Departure from the GSP's climatic assumptions or extensive, unanticipated droughts may lead to excessively low groundwater recharge and unanticipated high pumping rates that could cause an exceedance of the long-term sustainable yield.

8.7.4.3 Effects on Beneficial Users and Land Use

The practical effect of the reduction in groundwater storage undesirable result is no chronic, long-term net change in groundwater storage. Therefore, beneficial uses and users will have access to a similar amount of water in storage, and the undesirable result will not have an additional negative effect on the beneficial users and uses of groundwater. However, pumping at the long-term sustainable yield during dry years will temporarily reduce the amount of groundwater in storage. If this occurs, there could be short-term impacts from a reduction in groundwater in storage on all beneficial users and uses of groundwater.

8.8 Seawater Intrusion SMC

8.8.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable seawater intrusion in the Subbasin is defined as follows:

- Any seawater intrusion in the Subbasin is significant and unreasonable.

This significant and unreasonable condition was determined based on input collected during Subbasin Committee meetings and discussions with GSA staff.

8.8.2 Minimum Thresholds

> *The minimum threshold for seawater intrusion is defined as the 500 mg/L chloride concentration isocontour at the Subbasin boundary.*

Figure 8-8 presents the minimum threshold, shown in red, for seawater intrusion in the Eastside Subbasin as represented by the 500 mg/L chloride concentration isocontour. The purple line shows the current extent of seawater intrusion in the 180-Foot Aquifer. The minimum threshold in this GSP applies to any seawater intrusion into the Subbasin and does not apply to seawater intrusion outside of the Subbasin.

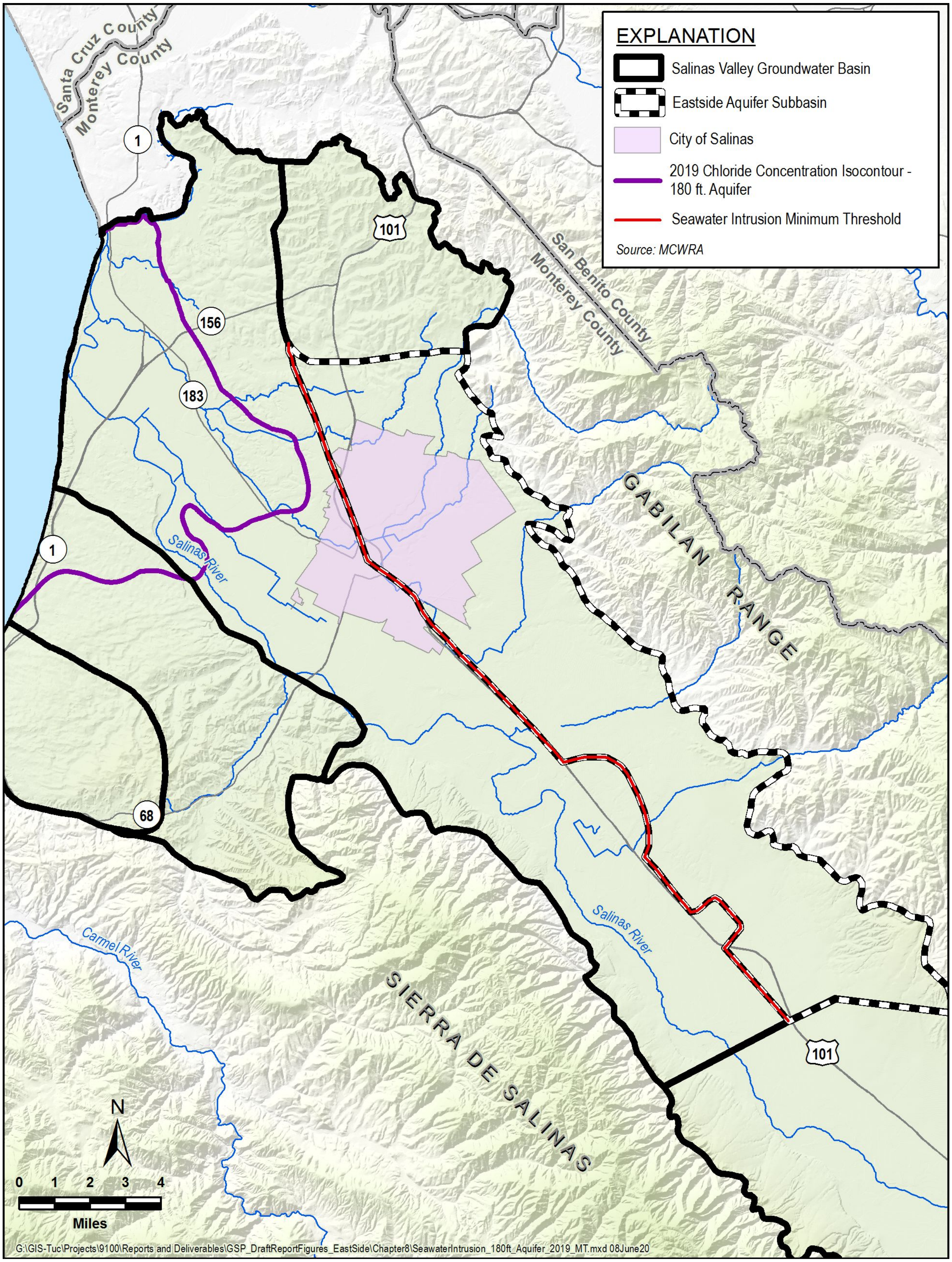

Figure 8-8. Minimum Threshold for Seawater Intrusion in the Eastside Aquifer Subbasin

8.8.2.1 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

The seawater intrusion minimum threshold is based on seawater intrusion maps developed by MCWRA. MCWRA publishes estimates of the extent of seawater intrusion every year. The MCWRA maps define the extent of seawater intrusion as the inferred location of the 500 mg/L chloride isocontour. These maps are developed through analysis and contouring of groundwater quality measured at privately-owned wells and dedicated monitoring wells near the coast. The map of current and historical seawater intrusion is included in Chapter 5.

The groundwater model that will be used to assess the effectiveness of projects and management actions on seawater intrusion specifically incorporates assumptions for future sea level rise. Therefore, the actions to avoid undesirable results will address sea level rise.

8.8.2.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The relationship between the seawater intrusion minimum threshold and other sustainability indicators are as follows:

- **Chronic lowering of groundwater levels.** The seawater intrusion minimum threshold does not promote additional pumping that could cause groundwater elevations to decrease in the Subbasin. Therefore, the seawater intrusion minimum threshold will not result in significant or undesirable groundwater elevations.
- **Reduction in groundwater storage.** The seawater intrusion minimum threshold does not promote additional pumping in excess of the sustainable yield. Therefore, the seawater intrusion minimum threshold will not result in an exceedance of the groundwater storage minimum threshold. Groundwater storage, as measured by pumping, will not be affected by the seawater intrusion minimum thresholds.
- **Degraded water quality.** The seawater intrusion minimum threshold does not promote decreasing groundwater elevations that could lead to exceedances of groundwater quality minimum thresholds. In fact, the seawater intrusion minimum threshold may have a beneficial impact on groundwater quality by preventing increases in chloride concentrations in supply wells.
- **Land Subsidence.** The seawater intrusion minimum threshold does not promote additional pumping that could cause subsidence. Therefore, the seawater intrusion minimum threshold will not result in an exceedance of the subsidence minimum threshold.
- **Depletion of ISW.** The seawater intrusion minimum threshold does not promote additional pumping or lower groundwater elevations adjacent to ISW. Therefore, the

seawater intrusion minimum threshold will not result in a significant or unreasonable depletion of ISW.

8.8.2.3 Effect of Minimum Threshold on Neighboring Basins and Subbasin

The Eastside Subbasin has 3 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Forebay Subbasin to the south
- The 180/400-Foot Aquifer Subbasin to the west

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The 180/400-Foot Aquifer Subbasin submitted a GSP in 2020 and the Langley and Forebay Subbasins are in the process of GSP development for submittal in January 2022. Minimum thresholds for the Eastside Subbasin will be reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

8.8.2.4 Effects on Beneficial Users and Land Uses

Agricultural land uses and users. The seawater intrusion minimum threshold generally provides positive benefits to the Subbasin's agricultural water users. Preventing seawater intrusion into the Subbasin ensures that a supply of usable groundwater will exist for agricultural use.

Urban land uses and users. The seawater intrusion minimum threshold generally provides positive benefits to the Subbasin's urban water users. Preventing seawater intrusion into the Subbasin will help ensure an adequate supply of groundwater for municipal supplies.

Domestic land uses and users. The seawater intrusion minimum threshold generally provides positive benefits to the Subbasin's domestic water users. Preventing seawater intrusion into the Subbasin will help ensure an adequate supply of groundwater for domestic supplies.

Ecological land uses and users. Although the seawater intrusion minimum threshold does not directly benefit ecological uses, it can be inferred that the seawater intrusion minimum thresholds provide generally positive benefits to the Subbasin's ecological water uses. Preventing seawater intrusion into the Subbasin will help prevent unwanted high salinity levels from impacting ecological groundwater uses.

8.8.2.5 Relevant Federal, State, or Local Standards

No federal, state, or local standards exist for seawater intrusion.

8.8.2.6 Method for Quantitative Measurement of Minimum Threshold

Chloride concentrations are measured in groundwater samples collected from the MCWRA's seawater intrusion monitoring network. These samples are used to develop the inferred location of the 500 mg/L chloride isocontour. The methodology and protocols for collecting samples and developing the 500 mg/L chloride isocontour are detailed in Appendix 7B and Appendix 7C.

8.8.3 Measurable Objectives

The measurable objective for seawater intrusion is identical to the minimum threshold that is shown on Figure 8-8.

> *The measurable objective for seawater intrusion is defined as the 500 mg/L chloride concentration isocontour at the Subbasin boundary.*

8.8.3.1 Methodology for Setting Measurable Objectives

In the Eastside Subbasin, the measurable objective for the seawater intrusion SMC is the same as the minimum threshold: preventing the 500 mg/L chloride isocontour from entering the Subbasin. The methodology used to set measurable objectives is discussed in Section 8.8.2.1.

8.8.3.2 Interim Milestones

The interim milestones for seawater intrusion are the same as the measurable objective, which is no exceedance of the 500 mg/L chloride isocontour at the subbasin boundary.

8.8.4 Undesirable Results

8.8.4.1 Criteria for Defining Seawater Intrusion Undesirable Results

The seawater intrusion undesirable result is a quantitative combination of chloride concentrations minimum threshold exceedances. Because even localized seawater intrusion is not acceptable, the subbasin-wide undesirable result is zero exceedances of the minimum threshold. For the Subbasin, the seawater intrusion undesirable result is:

> *Any exceedance of the minimum threshold, resulting in mapped seawater intrusion within the Subbasin boundary.*

8.8.4.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result include the following:

- Increased pumping in the Eastside Subbasin
- Increased coastal pumping in the adjacent 180/400-Foot Aquifer Subbasin that could draw seawater farther inland
- Unanticipated high sea level rise

8.8.4.3 Effects on Beneficial Users and Land Use

The primary detrimental effect on beneficial users and land uses from allowing seawater intrusion to occur in the Subbasin is that the pumped groundwater may become saltier. Thus, preventing seawater intrusion into the Subbasin prevents impacts to domestic, municipal, and agricultural wells and associated land uses.

8.9 Degraded Water Quality SMC

8.9.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable changes in groundwater quality in the Subbasin are increases in a COC caused by a direct result of a GSA groundwater management action that either:

- Results in groundwater concentrations in a potable water supply well above an established MCL or SMCL, or
- Lead to significantly reduced crop production

These significant and unreasonable conditions were determined based on input from the Subbasin Committee and discussions with GSA staff.

8.9.2 Minimum Thresholds

> *The minimum thresholds for degraded water quality are zero additional exceedances of the regulatory drinking water standards (potable supply wells) or Basin Plan objectives (irrigation supply wells) beyond those observed in 2019 for groundwater quality constituents of concern.*

The minimum thresholds for DDW public water system supply wells and ILRP on-farm domestic wells reflect California's Title 22 drinking water standards. The minimum thresholds for irrigation supply wells are based on the water quality objectives listed in the Basin Plan (CCRWQCB, 2019). The minimum threshold values for the COC for all 3 sets of wells are provided in Table 8-4 and are based on data up to 2019. Full discussion of these current conditions is included in Chapter 5. Because the minimum thresholds reflect no additional exceedances, the minimum thresholds are set to the number of existing exceedances. Surpassing the number of existing exceedances for any of the listed constituents will lead to an undesirable result. Not all wells in the monitoring network are sampled for every COC.

Table 8-4. Degradation of Groundwater Quality Minimum Thresholds

Constituent of Concern (COC)	Minimum Threshold/Measurable Objective – Number of Wells Exceeding Regulatory Standard from latest sample (May 1985 to December 2019)
DDW Wells	
Arsenic	4
Lindane	1
Di(2-ethylhexyl)phthalate	1
Benzo(a)Pyrene	1
1,2 Dibromo-3-chloropropane	3
Dinoseb	3
Iron	5
Hexachlorobenzene	1
Manganese	2
Nitrate (as nitrogen)	8
Specific Conductance	1
1,2,3-Trichloropropane	10
Total Dissolved Solids	3
Vinyl Chloride	8
ILRP On-Farm Domestic Wells	
Chloride	3
Iron	4
Manganese	1
Nitrate (as nitrogen)	91
Nitrate + Nitrite (sum as nitrogen)	17
Specific Conductance	27
Sulfate	2
Total Dissolved Solids	22
ILRP Irrigation Supply Wells	
Chloride	4
Iron	1
Manganese	2

8.9.2.1 Information and Methodology Used to Establish Water Quality Minimum Thresholds and Measurable Objectives

As noted in the GSP Regulations, minimum thresholds are based on a degradation of groundwater quality, not an improvement of groundwater quality (23 CCR § 354.28 (c)(4)). Therefore, this GSP is designed to avoid taking any action that may inadvertently move groundwater constituents already in the Subbasin in such a way that the constituents have a significant and unreasonable impact that would not otherwise occur. COC must meet 2 criteria:

1. They must have an established level of concern such as an MCL or SMCL for drinking water, or a level known to affect crop production.
2. They must have been found in the Subbasin at levels above the level of concern.

Based on the review of groundwater quality in Chapter 5, the COC that may affect drinking water supply wells include those for DDW and ILRP on-farm domestic wells listed in Table 8-4. The COC that are known to cause reductions in crop production are those for ILRP irrigation supply wells listed in Table 8-4.

As discussed in Chapter 7, 3 existing water quality monitoring networks were reviewed and used for developing SMC:

- Public water system supply wells regulated by the SWRCB DDW.
- On-farm domestic wells monitored as part of CCRWQCB ILRP. This dataset was obtained from the SWRCB through the GAMA groundwater information system. The ILRP data were separated into 2 data sets, 1 for on-farm domestic wells and the other for irrigation supply wells (discussed below) for purposes of developing initial draft minimum thresholds and measurable objectives for each type of well. The monitoring well network for the ILRP will change when the monitoring network for Ag Order 4.0 is finalized. At that time, the new ILRP domestic monitoring network will be incorporated into this GSP, replacing the current network, for water quality monitoring.
- Irrigation supply wells monitored as part of ILRP. As mentioned above, this dataset was obtained from the SWRCB through the GAMA groundwater information system. Like the on-farm domestic well dataset, the IRLP irrigation supply monitoring network will change when Ag Order 4.0 is finalized.

Each of these well networks are monitored for a different set of water quality parameters. Furthermore, some groundwater quality impacts are detrimental to only certain networks. For example, high nitrates are detrimental to public water system supply wells and on-farm domestic wells but are not detrimental to irrigation supply wells. The constituents monitored in each well network are indicated by an X in Table 8-5. An X does not necessarily indicate that the constituents have been found above the regulatory standard in that monitoring network.

Table 8-5. Summary of Constituents Monitored in Each Well Network

Constituent	Public Water System Supply	On-Farm Domestic[1]	Irrigation Supply
Boron	X	X	X
Chloride	X	X	X
Iron	X	X	X
Manganese	X	X	X
Nitrite	X	X	X

Constituent	Public Water System Supply	On-Farm Domestic[1]	Irrigation Supply
Nitrate (as nitrogen)	X	X	X
Nitrate + Nitrite (sum as nitrogen)		X	X
Specific Conductance	X	X	X
Sulfate	X	X	X
Total Dissolved Solids	X	X	X
Silver	X		
Aluminum	X		
Alachlor	X		
Arsenic	X		
Atrazine	X		
Barium	X		
Beryllium	X		
Lindane	X		
Di(2-ethylhexyl) phthalate	X		
Bentazon	X		
Benzene	X		
Benzo(a)Pyrene	X		
Toluene	X		
Cadmium	X		
Chlordane	X		
Chlorobenzene	X		
Cyanide	X		
Chromium	X		
Carbofuran	X		
Carbon Tetrachloride	X		
Copper	X		
Dalapon	X		
1,2 Dibromo-3-chloropropane	X		
1,1-Dichloroethane	X		
1,2-Dichloroethane	X		
1,2-Dichlorobenzene	X		
1,4-Dichlorobenzene	X		
1,1-Dichloroethylene	X		
cis-1,2-Dichloroethylene	X		
trans-1,2-Dichloroethylene	X		
Dichloromethane (a.k.a. methylene chloride)	X		
1,2-Dichloropropane	X		
Dinoseb	X		
Diquat	X		
Di(2-ethylhexyl) adipate	X		
Ethylbenzene	X		
Endrin	X		
Fluoride	X		
Trichlorofluoromethane	X		
1,1,2-Trichloro-1,2,2-Trifluoroethane	X		
Foaming Agents (MBAS)	X		
Glyphosate	X		
Hexachlorocyclopentadiene	X		
Hexachlorobenzene	X		
Heptachlor	X		
Mercury	X		
Molinate	X		

Constituent	Public Water System Supply	On-Farm Domestic[1]	Irrigation Supply
Methyl-tert-butyl ether (MTBE)	X		
Methoxychlor	X		
Nickel	X		
Oxamyl	X		
1,1,2,2-Tetrachloroethane	X		
Perchlorate	X		
Polychlorinated Biphenyls	X		
Tetrachloroethene	X		
Pentachlorophenol	X		
Picloram	X		
Antimony	X		
Selenium	X		
2,4,5-TP (Silvex)	X		
Simazine	X		
Styrene	X		
1,1,1-Trichloroethane	X		
1,1,2-Trichloroethane	X		
1,2,4-Trichlorobenzene	X		
Trichloroethene	X		
1,2,3-Trichloropropane	X		
Thiobencarb	X		
Thallium	X		
Toxaphene	X		
Vinyl Chloride	X		
Xylenes	X		
Zinc	X		

[1]Basin plan states domestic wells are monitored for Title 22 constituents; however, GAMA groundwater information system only provides data for the constituents listed above.

8.9.2.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

Preventing degradation of groundwater quality may affect other sustainability indicators or may limit activities needed to achieve minimum thresholds for other sustainability indicators as described below:

- **Chronic lowering of groundwater levels.** The degradation of groundwater quality minimum thresholds could influence groundwater level minimum thresholds by limiting the types of water that can be used for recharge to maintain or raise groundwater elevations. Water used for recharge cannot exceed any groundwater quality standards.
- **Reduction in groundwater storage.** The degradation of groundwater quality minimum thresholds do not promote lower groundwater elevations. Therefore, the groundwater quality minimum thresholds will not result in an exceedance of the groundwater storage minimum threshold.
- **Seawater intrusion.** The degradation of groundwater quality minimum thresholds do not promote additional pumping that could exacerbate seawater intrusion. Therefore, the

groundwater quality minimum thresholds will not result in an exceedance of the seawater intrusion minimum threshold.

- **Land subsidence.** The degradation of groundwater quality minimum thresholds do not promote additional pumping that could cause subsidence. Therefore, the groundwater quality minimum thresholds will not result in an exceedance of the subsidence minimum threshold.
- **Depletion of ISW.** The degradation of groundwater quality minimum thresholds do not promote additional pumping or lower groundwater elevations adjacent to ISW. Therefore, the groundwater quality minimum thresholds will not result in a significant or unreasonable depletion of ISW.

8.9.2.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The Eastside Subbasin has 3 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Forebay Subbasin to the south
- The 180/400-Foot Aquifer Subbasin to the west

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The 180/400-Foot Aquifer Subbasin submitted a GSP in 2020 and the Langley and Forebay Subbasins are in the process of GSP development for submittal in January 2022. Minimum thresholds for the Eastside Subbasin will be reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

8.9.2.4 Effect on Beneficial Uses and Users

Agricultural land uses and users. The groundwater quality minimum thresholds generally provide positive benefits to the Subbasin's agricultural water users. Preventing any GSA actions that would result in additional agricultural supply wells exceeding levels that could reduce crop production ensures that a supply of usable groundwater will exist for beneficial agricultural use.

Urban land uses and users. The groundwater quality minimum thresholds generally provide positive benefits to the Subbasin's urban water users. Preventing any GSA actions that would result in COC in additional drinking water supply wells exceeding MCLs or SMCLs ensures adequate groundwater quality for public water system supplies.

Domestic land uses and users. The groundwater quality minimum thresholds generally provide positive benefits to the Subbasin's domestic water users. Preventing any GSA actions that would result in COC in additional drinking water supply wells exceeding MCLs or SMCLs ensures adequate groundwater quality for domestic supplies.

Ecological land uses and users. Although the groundwater quality minimum thresholds do not directly benefit ecological uses, it can be inferred that the degradation of groundwater quality minimum thresholds provide generally positive benefits to the Subbasin's ecological water uses. Preventing any GSA actions that would result in COC migrating will prevent unwanted contaminants from impacting ecological groundwater uses.

8.9.2.5 Relation to State, Federal, or Local Standards

The groundwater quality minimum thresholds specifically incorporate state and federal standards for drinking water and basin plan objectives.

8.9.2.6 Method for Quantitative Measurement of Minimum Thresholds

Degradation of groundwater quality minimum thresholds will be directly measured from existing public water system supply wells, on-farm domestic wells, and irrigation supply wells. Groundwater quality will be measured with SWRCB GAMA groundwater information system data submitted through existing monitoring programs—DDW and ILRP—as discussed in Chapter 7.

- Exceedances of MCLs and SMCLs in public water system supply wells will be monitored with annual water quality data submitted to the DDW.
- Exceedances of MCLs and SMCLs in on-farm domestic wells will be monitored with ILRP data.
- Exceedances of water quality objectives for crop production will be monitored with ILRP data.

Initially, the review of drinking water MCLs, SMCLs, and water quality objectives that maintain adequate crop production will be centered around the COC identified above. If during review of the water quality data additional constituents appear to exceed any of the regulatory standards, these additional constituents will be added to the list of COC for the Subbasin.

8.9.3 Measurable Objectives

The measurable objectives for degradation of groundwater quality represent target groundwater quality distributions in the Subbasin. SGMA does not mandate the improvement of groundwater quality. Therefore, the measurable objectives are based on no groundwater quality degradation and are identical to the minimum thresholds, as defined in Table 8-4.

The measurable objectives for degraded water quality are zero additional exceedances of the regulatory drinking water standards (potable supply wells) or Basin Plan objectives (irrigation supply wells) beyond those observed in 2019 for groundwater quality constituents of concern.

8.9.3.1 Methodology for Setting Measurable Objectives

As described above, measurable objectives are set to be identical to the minimum thresholds and therefore follow the same method as detailed in Section 8.8.2.1.

8.9.3.2 Interim Milestones

There is no anticipated degradation of groundwater quality during GSP implementation that results from the implementation of projects and actions as described in Chapter 9. Therefore, the expected interim milestones are identical to current conditions.

8.9.4 Undesirable Results

8.9.4.1 Criteria for Defining Undesirable Results

The degradation of groundwater quality becomes an undesirable result when a quantitative combination of groundwater quality minimum thresholds is exceeded. For the Subbasin, the exceedance of minimum thresholds is unacceptable as a direct result of GSP implementation. Some groundwater quality changes are expected to occur independent of SGMA activities; because these changes are not related to SGMA activities, nor GSA management, they do not constitute an undesirable result. Additionally, SGMA states that GSAs are not responsible for addressing water quality degradation that was present before January 1, 2015 (California Water Code § 10727.2(b)(4)). Therefore, the degradation of groundwater quality reaches an undesirable result when:

Future or new minimum thresholds exceedances are caused by a direct result of GSA groundwater management action(s), including projects or management actions and regulation of groundwater extraction.

The groundwater level SMC is designed and intended to help protect groundwater quality. Setting the groundwater level minimum thresholds at or above historical lows assures that no new depth dependent constituents of water quality concern are mobilized. The GSA may pursue projects or management actions to ensure that groundwater levels do not fall below groundwater level minimum thresholds.

This undesirable result recognizes there is an existing regulatory framework in the form of the California Porter Cologne Act and the federal Clean Water Act that addresses water quality management; and considers existing federal, state, and local groundwater quality standards, which were used in the development of minimum thresholds in the

GSP. SVBGSA is not responsible for enforcing drinking water requirements or for remediating violations of those requirements that were caused by others (Moran and Belin, 2019). The existing regulatory regime does not require nor obligate the SVBGSA to take any affirmative actions to manage or control existing groundwater quality. However, SVBGSA is committed to monitoring and disclosing changes in groundwater quality and ensuring its groundwater management actions do not cause drinking water or irrigation water to be unusable.

SVBGSA will work closely with the Central Coast Regional Water Quality Control Board and other entities that have regulatory authority over water quality. SVBGSA will lead the Water Quality Coordination Group, as described in Chapter 9, which includes meeting annually with these partner agencies to review the status of water quality data and discuss any action needed to address water quality degradation.

If the GSA has not implemented any groundwater management actions in the Subbasin, including projects, management actions, or pumping management, no such management actions constitute an undesirable result. If minimum thresholds are exceeded after the GSA has implemented actions in the Subbasin, the GSA will review groundwater quality and groundwater gradients in and around the project areas to assess if the exceedance resulted from GSA actions to address sustainability indicators, or was independent of GSA activities. Both the implementation of actions and assessment of exceedances will occur throughout the GSP timeframe of 50 years as required by SGMA. The general approach to assess if a minimum threshold exceedance is due to GSA action will include:

- If no projects, management actions, or other GSP implementation actions have been initiated in a subbasin, or near the groundwater quality impact, then the impact was not caused by any GSA action.
- Many projects will likely include a new monitoring network. If data from the project-specific monitoring network do not show groundwater quality impacts, this will suggest that the impact was not caused by any GSA actions.
- If a GSA undertakes a project that changes groundwater gradients, moves existing constituents, or results in the exceedance of minimum thresholds, SVBGSA will undertake a more rigorous technical study to assess local, historical groundwater quality distributions, and the impact of the GSA activity on that distribution.

For SGMA compliance, undesirable results for groundwater quality are not caused by (1) lack of action; (2) GSA required reductions in pumping; (3) exceedances in groundwater quality minimum thresholds that occur, if there are fewer exceedances than if there had been a lack of management; (4) exceedances in groundwater quality minimum thresholds that would have occurred independent of projects or management actions implemented by the GSA; (5) past harm.

8.9.4.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result include the following:

- **Required Changes to Subbasin Pumping.** If the location and rates of groundwater pumping change as a result of projects implemented under the GSP, these changes could alter hydraulic gradients and associated flow directions, and cause movement of one of the COC towards a supply well at concentrations that exceed relevant standards.
- **Groundwater Recharge.** Active recharge of imported water or captured runoff could modify groundwater gradients and move one of the COC towards a supply well in concentrations that exceed relevant limits.
- **Recharge of Poor-Quality Water.** Recharging the Subbasin with water that exceeds an MCL, SMCL, or level that reduces crop production could lead to an undesirable result.

8.9.4.3 Effects on Beneficial Users and Land Use

The undesirable result for degradation of groundwater quality is avoiding groundwater degradation caused by a direct result of a GSA groundwater management action. Therefore, the undesirable result will not impact the use of groundwater and will not have a negative effect on the beneficial users and uses of groundwater. This undesirable result does not apply to groundwater quality changes that occur due to other causes.

8.10 Land Subsidence SMC

8.10.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable subsidence in the Subbasin is defined as follows:

- Any inelastic land subsidence that is caused by lowering of groundwater elevations in the Subbasin or
- Any inelastic subsidence that causes an increase of flood risk.

These significant and unreasonable conditions were determined based on input collected during Subbasin Committee meetings and discussions with GSA staff.

Subsidence can be elastic or inelastic. Elastic subsidence is the small, reversible lowering and rising of the ground surface. Inelastic subsidence is generally irreversible. This SMC only concerns inelastic subsidence.

8.10.2 Minimum Thresholds

The minimum threshold for land subsidence is zero net long-term subsidence, with no more than 0.1 foot per year of estimated land movement measured subsidence to account for InSAR measurement errors.

8.10.2.1 Information Used and Methodology for Establishing Subsidence Minimum Thresholds

The minimum threshold was established using InSAR data available from DWR. The general minimum threshold is for no long-term irreversible subsidence in the Subbasin. The InSAR data provided by DWR, however, is subject to measurement error. DWR stated that, on a statewide level, for the total vertical displacement measurements between June 2015 and June 2019, the errors are as follows (DWR, 2019, personal communication):

1. The error between InSAR data and continuous GPS data is 16 mm (0.052 foot) with a 95% confidence level.
2. The measurement accuracy when converting from the raw InSAR data to the maps provided by DWR is 0.048 foot with 95% confidence level.

By adding errors 1 and 2, the combined error is 0.1 foot. While this is not a robust statistical analysis, it does provide an estimate of the potential error in the InSAR maps provided by DWR.

Additionally, the InSAR data provided by DWR reflects both elastic and inelastic subsidence. While it is difficult to compensate for elastic subsidence, visual inspection of monthly changes in ground elevations suggest that elastic subsidence is largely seasonal. To minimize the influence of elastic subsidence on the assessment of long-term, permanent subsidence, changes in ground level will only be measured annually from June of one year to June of the following year.

8.10.2.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The subsidence minimum threshold has little or no impact on other minimum thresholds, as described below:

- **Chronic lowering of groundwater levels.** The land subsidence minimum threshold will not decrease groundwater elevations and therefore will not result in significant or unreasonable groundwater elevations.
- **Reduction in groundwater storage.** The land subsidence minimum threshold will not change the amount of pumping and therefore will not result in a significant or unreasonable change in groundwater storage.
- **Seawater intrusion.** The land subsidence minimum threshold does not promote additional pumping that could exacerbate seawater intrusion. Therefore, the subsidence

minimum threshold will not induce additional advancement of seawater intrusion along the coast.

- **Degraded water quality.** The land subsidence minimum threshold does not promote decreasing groundwater elevations that lead to exceedance of groundwater quality minimum thresholds and therefore will not result in significant of unreasonable degradation of water quality.
- **Depletion of ISW.** The land subsidence minimum threshold does not promote additional pumping or lower groundwater elevations adjacent to ISW. Therefore, the subsidence minimum threshold will not result in a significant or unreasonable depletion of ISW.

8.10.2.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The Eastside Subbasin has 3 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Forebay Subbasin to the south
- The 180/400-Foot Aquifer Subbasin to the west

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The 180/400-Foot Aquifer Subbasin submitted a GSP in 2020 and the Langley and Forebay Subbasins are in the process of GSP development for submittal in January 2022. Minimum thresholds for the Eastside Subbasin will be reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

8.10.2.4 Effects on Beneficial Uses and Users

The subsidence minimum threshold is set to prevent any long-term inelastic subsidence. Available data indicate that there is currently no long-term subsidence occurring in the Subbasin, and therefore the minimum threshold has no impact on current pumping rates. The subsidence minimum threshold does not require any additional reductions in pumping and there is no negative impact on any beneficial user. Increased pumping, however, could initiate subsidence and require pumping restrictions.

8.10.2.5 Relation to State, Federal, or Local Standards

There are no federal, state, or local regulations related to subsidence.

8.10.2.6 Method for Quantitative Measurement of Minimum Threshold

The minimum threshold will be assessed using DWR-supplied InSAR data.

8.10.3 Measurable Objectives

The measurable objective for subsidence represents a target subsidence rates in the Subbasin. Because the minimum threshold of zero net long-term subsidence is the best achievable outcome, the measurable objective is identical to the minimum threshold.

> *The measurable objective for land subsidence is zero net long-term subsidence, with no more than 0.1 foot per year of estimated land movement measured subsidence to account for InSAR measurement errors.*

8.10.3.1 Methodology for Setting Measurable Objectives

The measurable objective will be assessed using DWR-supplied InSAR data.

8.10.3.2 Interim Milestones

The subsidence measurable objective is set at current conditions of no long-term subsidence. There is no change between current conditions and sustainable conditions. Therefore, the interim milestones are identical to current conditions of zero long-term subsidence, and annual measurements of no more than 0.1 foot of subsidence per year.

8.10.4 Undesirable Results

8.10.4.1 Criteria for Defining Undesirable Results

By regulation, the land subsidence undesirable result is a quantitative combination of subsidence minimum threshold exceedances. For the Subbasin, no long-term subsidence is acceptable. Therefore, the land subsidence undesirable result is:

> *There is an exceedance of the minimum threshold for land subsidence due to lowered groundwater elevations.*

Should potential subsidence be observed, the SVBGSA will first assess whether the subsidence may be due to elastic subsidence. If the subsidence is not elastic, the SVBGSA will undertake a program to assess whether the subsidence is caused by lowered groundwater elevations. The first step in the assessment will be to check if groundwater elevations have dropped below historical lows. If groundwater elevations remain above historical lows, the GSA shall assume that any observed subsidence was not caused by lowered groundwater levels. If groundwater levels have dropped below historical lows, the GSA will attempt to correlate the observed subsidence with measured groundwater elevations. Additionally, if the Subbasin experiences subsidence in multiple consecutive years that are due to InSAR measurement error, the GSAs will confirm if the error is not actually net long-term subsidence.

8.10.4.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result include a shift in pumping locations. A significant increase in the amount of pumping in an area that is susceptible to subsidence could trigger subsidence that has not been observed before.

8.10.4.3 Effects on Beneficial Users and Land Use

The undesirable result for subsidence does not allow any subsidence to occur in the Subbasin. Therefore, there is no negative effect on any beneficial uses and users.

8.11 Depletion of Interconnected Surface Water SMC

Areas with ISW occur where shallow groundwater may be connected to the surface water system. This SMC applies only to locations of ISW, and as shown on Figure 4-9, there are currently no locations of ISW in the Eastside Subbasin. This section describes the locally defined significant and unreasonable conditions, how minimum thresholds and measurable objectives will be set, and undesirable results if locations of ISW are identified in the future.

The SVIHM is used to identify the locations of ISW and to develop an estimate of the quantity and timing of stream depletions due to pumping during current and historical groundwater conditions. Shallow groundwater and surface water levels simulated by the SVIHM are used to identify the location of interconnection and evaluate the frequency with which different stream reaches are connected with groundwater in the underlying aquifer. The process for evaluating the magnitude of stream depletions in relation to shallow groundwater elevations in interconnected reaches is described in Chapter 5.

8.11.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable depletion of ISW in the Subbasin is defined as:

- Depletions from groundwater extraction that would result in a significant and unreasonable impact on other beneficial uses and users such as riparian water rights holders, appropriative surface water rights holders, ecological surface water users, and recreational surface water uses.
- Depletion from groundwater extraction more than observed in 2015, as measured by shallow groundwater elevations near locations of interconnected surface water. While a documented determination of whether past depletions was significant is not available, staying above 2015 depletions was determined to be a reasonable balance for all the beneficial uses and users.

These significant and unreasonable conditions were determined based on input collected Subbasin Committee meetings and discussions with GSA staff. There is currently no data that determines what level of depletion from groundwater extraction has a significant adverse effect on a beneficial use or user of ISW. Should there be a determination regarding what level of depletion from groundwater extraction is significant, SVBGSA will take that into consideration as it reviews how it locally defines significant and unreasonable conditions for the SMC in the 5-Year Update.

8.11.2 Minimum Thresholds

The minimum thresholds are established to maintain consistency with the chronic lowering of groundwater elevation and reduction in groundwater storage minimum thresholds, which are also established based on groundwater elevations.

> *The minimum thresholds for depletion of interconnected surface water are established by proxy using shallow groundwater elevations observed in 2015 near locations of interconnected surface water.*

The locations of ISW identified with the SVIHM are based on best available data but contain uncertainty, which is discussed in Chapters 4, 5, and 6. Additional stream and groundwater level data are needed to reduce uncertainty, verify with observed conditions, and track changes over time. The shallow groundwater monitoring well will be used to supplement the analysis of locations of connectivity provided by the SVIHM. These monitoring point will also become part of the ISW monitoring network that is discussed in Chapter 7. Data from the ISW monitoring network will be used to monitor and evaluate the interconnection through time.

As discussed in Chapter 7, a monitoring network for ISW composed of shallow groundwater monitoring wells is in the process of development. A new shallow well will be added to the monitoring network. The monitoring network is dependent on the location and magnitude of stream reaches determined by the SVIHM. Once the monitoring well is installed, if it indicates that groundwater and surface water are connected, SMC will be determined using the wells' groundwater elevations during the minimum threshold and measurable objective years, or interpolated values from the groundwater elevation contour maps for wells that do not have shallow groundwater elevation measurements for those years.

8.11.2.1 Information Used and Methodology for Establishing Depletion of Interconnected Surface Water Minimum Thresholds and Measurable Objectives

8.11.2.1.1 Establishing Groundwater Elevations as Proxies

The GSP Regulations § 354.28(d) states that: "an Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence."

The evaluation of ISW in the Salinas Valley Groundwater Basin is based on an approach recommended by the Environmental Defense Fund (EDF, 2018) that uses groundwater elevations as surrogates for streamflow depletion rates caused by groundwater use. Basic hydraulic principles state that groundwater flow is proportional to the difference between groundwater elevations at different locations along a flow path. Using this basic principle, groundwater flow to a stream, or conversely seepage from a stream to the underlying aquifer, is proportional to the difference between water elevation in the stream and groundwater elevations at locations away from the stream. Assuming the elevation in the stream is relatively stable, changes in interconnectivity between the stream and the underlying aquifer is determined by changes in groundwater levels in the aquifer. Thus, the change in hydraulic gradient between stream elevation and surrounding groundwater elevations is representative of change in interconnection between surface water and groundwater. Monitoring the hydraulic gradient in the aquifer adjacent to the stream monitors the interconnectivity between stream and aquifer. Therefore, the gradient can be monitored by measuring and evaluating groundwater elevations at selected shallow monitoring wells near streams. No existing estimations of the quantity and timing of depletions of ISW exist, nor data available to make estimations, so the hydraulic principles provide the best available information.

8.11.2.1.2 Review of Beneficial Uses and Users of Surface Water

The various beneficial uses and users of surface waters were addressed when setting the ISW depletion minimum thresholds. The classes of beneficial uses and users that were reviewed include riparian rights holders, appropriative rights holders, ecological surface water users, and recreational surface water users. This is not a formal analysis of public trust doctrine, but it is a reasonable review of all uses and users in an attempt to balance all interests. This was not an assessment about what constitutes a reasonable beneficial use under Article X, Section 2 of the California Constitution. The minimum thresholds for depletion of ISW are developed using the definition of significant and unreasonable conditions described above, public information about critical habitat, locations of ISW derived from the SVIHM, and public information about water rights described below.

Riparian water rights holders. Table 8-6 provides a summary of water diversions reported to the SWRCB by water rights holders on the Salinas River and its tributaries within the Eastside Subbasin. The diversion data were obtained from queries of the SWRCB eWRIMS water rights management system. The diversion data are self-reported by water rights holders with points of diversion located within the Subbasin. Any riparian rights holders are reported in Table 8-6.

The SVBGSA is not aware of any current water rights litigation or water rights enforcement complaints by any riparian water rights holders in the Subbasin. Therefore, SVBGSA assumes that the current level of depletion has not injured any riparian water rights holders in the Subbasin.

Table 8-6. Reported Annual Surface Water Diversions in the Eastside Aquifer Subbasin

Diversions (Acre-Feet)	2011	2012	2013	2014	2015	2016	2017	2018	2019
Statement of Diversion and Reported Riparian Diversion	5	0	1,039	1,018	902	751	598	644	548

Appropriative water rights holders. There are no appropriative water right holders in the Eastside Subbasin. The SVBGSA is not aware of any current water rights litigation or water rights enforcement complaints by any appropriative rights holders in the Subbasin. Therefore, SVBGSA assumes that the current level of depletion has not injured any appropriative water rights holders in the Subbasin.

Ecological surface water users. There are no known flow prescriptions on any surface water bodies in the Subbasin. Therefore, the current level of depletion has not violated any ecological flow requirements. This is not meant to imply that depletions do not impact potential species living in or near surface water bodies in the Subbasin. However, any impacts that may be occurring have not risen to the level that triggers regulatory intervention. Therefore, the impacts from current rates of depletion on ecological surface water users is not unreasonable.

Recreational surface water users. No recreational activities such as boating regularly occur on surface water bodies in the Subbasin.

As shown by the analysis above, the current rate of surface water depletion is not having an unreasonable impact on the various surface water uses and users in the Subbasin. Therefore, the minimum thresholds are based on 2015 groundwater elevations, when surface water depletions were not unreasonable.

8.11.2.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The minimum thresholds for depletion of ISW will be set to 2015 groundwater elevations in the shallow monitoring wells within the Subbasin. The minimum thresholds all reference the same historical year and have existed simultaneously in the past. Therefore, no conflict exists between minimum thresholds measured at various locations within the Subbasin.

The depletion of ISW minimum thresholds could influence other sustainability indicators as follows:

- **Chronic lowering of groundwater levels.** The depletion of ISW minimum thresholds are identical to the groundwater level minimum thresholds. Therefore, the ISW minimum thresholds will not result in chronic lowering of groundwater elevations.
- **Reduction in groundwater storage.** The depletion of ISW minimum threshold are identical to the change in storage minimum thresholds, which are the same as the groundwater level minimum thresholds. Therefore, the depletion of ISW interconnected minimum thresholds will not result in an undesirable loss of groundwater storage.
- **Seawater intrusion.** The depletion of ISW minimum thresholds do not promote additional pumping that could exacerbate seawater intrusion. Therefore, seawater intrusion will not be affected by the ISW minimum thresholds.
- **Degraded water quality.** The depletion of ISW minimum thresholds do not promote decreasing groundwater elevations that lead to exceedance of groundwater quality minimum thresholds. Therefore, groundwater quality will not be affected by the ISW minimum thresholds.
- **Land subsidence.** The depletion of ISW minimum thresholds do not promote additional pumping that could cause subsidence. Therefore, subsidence will not be affected by the ISW minimum thresholds.

8.11.2.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The Eastside Subbasin has 3 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Forebay Subbasin to the south
- The 180/400-Foot Aquifer Subbasin to the west

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The 180/400-Foot Aquifer Subbasin submitted a GSP in 2020 and the Langley and Forebay Subbasins are in the process of GSP development for submittal in January 2022. Minimum thresholds for the Eastside Subbasin will be reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

8.11.2.4 Effect on Beneficial Uses and Users

The depletion of ISW minimum thresholds may have varied effects on beneficial users and land uses in the Subbasin. Creeks in the Eastside Subbasin are ephemeral, so uses and users of any ISW are seasonal.

Agricultural land uses and users. The depletion of ISW minimum thresholds prevent lowering of groundwater elevations adjacent to certain parts of streams beyond historical lows. While the measurable objectives are higher, this leaves flexibility for needed groundwater extraction during droughts. If the minimum thresholds were higher than these historical levels, it might affect the quantity and type of crops that can be grown in the land adjacent to streams and the ability of crops to withstand droughts.

Urban land uses and users. The depletion of ISW minimum thresholds prevent lowering of groundwater elevations adjacent to certain parts of streams beyond historical lows. While the measurable objective is higher, this leaves flexibility for needed groundwater extraction during droughts. If the minimum thresholds were higher than these historical levels, it may limit the amount of urban pumping near streams, which could limit urban growth in these areas to historical levels. Also, if pumping is limited beyond historical levels, municipalities may have to obtain alternative sources of water to achieve urban growth goals. If this occurs, this may result in higher water costs for municipal water users.

Domestic land uses and users. The depletion of ISW minimum thresholds protect existing domestic land users and uses near locations of ISW from groundwater elevation declines below historical lows by maintaining shallow groundwater elevations near streams and protecting the operability of relatively shallow domestic wells.

Ecological land uses and users. The depletion of ISW minimum thresholds address ecological uses and users by preventing depletion of ISW from groundwater pumping beyond what was historically experienced. Additionally, by setting future groundwater levels at or above recent lows, there should be less impact to ecological users than has been seen to date.

8.11.2.5 Relation to State, Federal, or Local Standards

There are no explicit federal, state, or local standards for depletion of ISW. However, both state and federal provisions call for the protection and restoration of conditions necessary for endangered and threatened species.

8.11.2.6 Method for Quantitative Measurement of Minimum Threshold

The SVIHM is used to preliminarily identify areas of ISW. Groundwater elevations measured in shallow wells adjacent to these areas of potential ISW will serve as the primary approach for monitoring depletion of ISW. As discussed in Chapter 7, an existing shallow well will be added, or a new shallow well will be installed to monitor groundwater elevations adjacent to surface water bodies during GSP implementation.

The new shallow monitoring well installed pursuant to the GSP will not have data from 2015. A minimum threshold for that well will be estimated by either correlation with nearby deeper wells with water-level records that include 2015, or from groundwater model results.

8.11.3 Measurable Objectives

The measurable objectives for depletion of ISW target groundwater elevations that are higher than the minimum thresholds. The measurable objectives are established to maintain consistency with the chronic lowering of groundwater elevation and reduction in groundwater storage minimum thresholds, which are also established based on groundwater elevations.

> *The measurable objectives for depletion of interconnected surface water are established by proxy using shallow groundwater elevations observed in 1999 near locations of interconnected surface water.*

8.11.3.1 Method for Setting Measurable Objectives

The depletion of ISW measurable objectives are set to be identical to the groundwater level measurable objectives. The methodology for establishing measurable objectives is outlined in Section 8.6.2.1. Groundwater elevations from 1999 were selected as representative of the measurable objectives for the Eastside Subbasin.

8.11.3.2 Interim Milestones

The interim milestones leading to the depletion of ISW measurable objectives will be added when the monitoring network is established if the monitoring well indicates that groundwater and surface water are connected.

8.11.4 Undesirable Results

8.11.4.1 Criteria for Defining Undesirable Results

By regulation, the depletion of ISW undesirable result is a quantitative combination of minimum threshold exceedances. The undesirable result for depletion of ISW is:

> *There is an exceedance of the minimum threshold in a shallow groundwater monitoring well used to monitor interconnected surface water.*

Streamflow depletion in the Subbasin is complicated by many factors, such as recharge of the aquifer from streamflow, losses to vegetation, and evapotranspiration. The ISW SMC applies to depletion of ISW from groundwater use. For SGMA compliance purposes, the default assumption is that any depletions of surface water beyond the level of depletion that occurred prior to 2015, as evidenced by reduction in groundwater levels, represent depletions that are significant and unreasonable. Any additional depletions of surface water flows caused by groundwater conditions in excess of conditions as they were in 2015 would likely be an undesirable result that must be addressed under SGMA.

8.11.4.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result for the depletion of ISW include the following:

- **Localized pumping increases.** Even if the Subbasin is adequately managed at the Subbasin scale, increases in localized pumping near ISW bodies could reduce shallow groundwater elevations.
- **Expansion of riparian water rights.** Riparian water rights holders often pump from wells adjacent to streams. Pumping by these riparian water rights holder users is not regulated under this GSP. Additional riparian pumpers near interconnected reaches of rivers and streams may result in excessive localized surface water depletion.
- **Departure from the GSP's climatic assumptions, including extensive, unanticipated drought.** Minimum thresholds were established based on anticipated future climatic conditions. Departure from the GSP's climatic assumptions or extensive, unanticipated droughts may lead to excessively low groundwater elevations that increase surface water depletion rates.

8.11.4.3 Effects on Beneficial Users and Land Use

The depletion of ISW undesirable result is to have no net increase in surface water depletion due to groundwater use, as determined by shallow groundwater elevations. The effects of undesirable results on beneficial users and land use are the same as the effects of minimum thresholds on beneficial uses and users, as described in Section 8.11.2.4.

SVBGSA will collaborate with partner agencies and organizations to further evaluate the effects of the ISW measurable objectives, minimum thresholds, and undesirable results on surface water flows and beneficial users.

REFERENCES

American Society of Farm Managers & Rural Appraisers, California Chapter (ASFMRA). 2020. 2020 Trends in Agricultural Land & Lease Values. 124 p. https://calasfmra.com/product/2020-trends-report-2/.

Barlow, Paul M., and Stanley A. Leake. 2012. Streamflow Depletion by Wells – Understanding and Managing the Effects of Groundwater Pumping on Streamflow. U.S. Geological Circular 1376. 84 p. https://pubs.usgs.gov/circ/1376/.

Boyce, Scott E., Randall T. Hanson, Ian Ferguson, Wolfgang Schmid, Wesley R. Henson, Thomas Reimann, Steffen W. Mehl, and Marisa M. Earll. 2020. One-Water Hydrologic Flow Model: A MODFLOW Based Conjunctive-Use Simulation Software. U.S. Geological Survey Techniques and Methods 6-A60. https://pubs.er.usgs.gov/publication/tm6A60.

Boyle Engineering Corporation. 1991. Water Capital Facilities Plan Volume 1 Report. Prepared for MCWRA. 118 p. https://www.co.monterey.ca.us/home/showdocument?id=73378.

Brown and Caldwell. 2015. State of the Salinas River Groundwater Basin - Hydrology Report. Monterey County Water Resources Agency Water Reports. http://digitalcommons.csumb.edu/hornbeck_cgb_6_a/21.

Bureau of Land Management (BLM). 2020. BLM National Surface Management Agency Area Polygons - National Geospatial Data Asset (NGDA). Updated April 16, 2020. https://data.doi.gov/dataset/blm-national-surface-management-agency-area-polygons-national-geospatial-data-asset-ngda.

Burton, Carmen A., and Michael T. Wright. 2018. Status and Understanding of Groundwater Quality in the Monterey-Salinas Shallow Aquifer Study Unit, 2012–13: California GAMA Priority Basin Project. U.S. Geological Survey. Scientific Investigations Report 20185057. Prepared in cooperation with the California State Water Resources Control Board.132p.

California Invasive Plant Council (Cal-IPC). 2011. Arundo donax: Distribution and Impact Report. Agreement No. 06-374-559-0. Submitted to State Water Resources Control Board. https://www.cal-ipc.org/wp-content/uploads/2017/11/Arundo_Distribution_Impact_Report_Cal-IPC_March-2011_small.pdf.

California Water Service. 2016. 2015 Urban Water Management Plan, Salinas District. https://www.calwater.com/docs/uwmp2015/sln/2015_Urban_Water_Management_Plan_Final_(SLN).pdf.

Carpenter, E.J. and S. Cosby. 1925. Soil Survey of the Salinas Area, California. U.S. Department of Agriculture, Bureau of Chemistry and Soils. no. 11.

Central Coast Groundwater Coalition (CCGC). 2015. Northern Counties Groundwater Characterization: Salinas Valley, Pajaro Valley and Gilroy-Hollister Valley. Submitted to the Central Coast Regional Water Quality Control Board on June 1, 2015. Salinas, CA Prepared by Luhdorff & Scalmanini Consulting Engineers. 454 p.

Central Coast Regional Water Quality Control Board (CCRWQCB). 2018. Groundwater Quality Conditions and Agricultural Discharges in the Central Coast Region. Staff Report for Regular Meeting of May 10-11, 2018.

_____. 2019. Water Quality Control Plan for the Central Coast Basin. 595 p. https://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/docs/2019_basin_plan_r3_complete_webaccess.pdf.

_____. 2021. Proposed General Waste Discharge Requirements for Discharges from Irrigated Lands. Order R3-2021-0040. https://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/ag_order4_renewal/2021april/pao4_order_clean.pdf.

Clark, Joseph C., Earl E. Brabb, and Lewis I. Rosenberg. 2000. Geologic Map and Map Database of the Spreckels 7.5-Minute Quadrangle, Monterey County, California. https://pubs.usgs.gov/mf/2001/2349/.

Department of Toxic Substances Control (DTSC). 2020. Envirostar Website. Accessed June 27, 2020. https://www.envirostor.dtsc.ca.gov/public/.

Department of Water Resources (DWR). 1946. Salinas Basin Investigation Summary Report. Bulletin 52-B. https://www.co.monterey.ca.us/home/showpublisheddocument/19576/636232667537000000.

_____. 2003. California's Ground Water. Bulletin 118. Update 2003. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/Statewide-Reports/Bulletin_118_Update_2003.pdf.

_____. 2004. Salinas Valley Groundwater Basin, Eastside Aquifer Subbasin. Bulletin 118 Interim Update 2004. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/2003-Basin-Descriptions/3_004_02_EastsideAquiferSubbasin.pdf.

_____. 2016a. California's Groundwater. Bulletin 118 Interim Update 2016. https://cawaterlibrary.net/document/bulletin-118-californias-groundwater-interim-update-2016/.

______. 2016b. Monitoring Networks and Identification of Data Gaps. Best Management Practices for the Sustainable Management of Groundwater. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-2-Monitoring-Networks-and-Identification-of-Data-Gaps_ay_19.pdf.

______. 2017. Sustainable Management Criteria. Best Management Practices for the Sustainable Management of Groundwater. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT_ay_19.pdf.

______. 2018. Guidance for Climate Change Data During Groundwater Sustainability Plan Development. 101 p. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Resource-Guide-Climate-Change-Guidance_v8_ay_19.pdf.

______. 2019. Email sent by Benjamin Brezing (DWR) on May 30, 2019. Subject: Error bounds on subsidence raster.

______. 2020a. Well Completion Report Map Application. Accessed April 2020. https://www.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da28f8623b37.

______. 2020b. Natural Communities Commonly Associated with Groundwater (NCCAG) – GIS Data Set. Data queried and downloaded from California Department of Water Resources GIS Map Server on 4/29/2020. https://gis.water.ca.gov/app/ncdatasetviewer/sitedocs/.

______. 2020c. SGMA Data Viewer Map Application. Accessed July 2020. https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer.

______. 2020d. Handbook for Water Budget Development With or Without Models. 446 p. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Water-Budget-Handbook.pdf?la=en&hash=30AD0DFD02468603F21C1038E6CC6BFE32381233.

______. 2021. Household Water Supply Shortage Reporting System web form. Accessed July 16, 2021. https://mydrywatersupply.water.ca.gov/report/.

Durbin, Timothy J. 1974. Digital simulation of the effects of urbanization on runoff in the upper Santa Ana Valley, California. U.S. Geological Survey Water Resources Investigations. no.73-41. https://pubs.usgs.gov/wri/1973/0041/report.pdf.

Durbin, Timothy J., G.W. Kapple, and J.R. Freckleton. 1978. Two-Dimensional and Three-Dimensional Digital Flow Models of the Salinas Valley Ground-Water Basin, California. U.S. Geological Survey. Water Resources Investigations Report 78-113. Prepared in cooperation with the U.S. Army Corps of Engineers. 134 p.

Environmental Defense Fund (EDF). 2018. Addressing Regional Surface Water Depletions in California, A Proposed Approach for Compliance with the Sustainable Groundwater Management Act. 12 p.

Environmental Science Associates (ESA). 2009. California American Water Company Coastal Water Project Final Environmental Impact Report. 523 p.

Greater Monterey County Integrated Regional Water Management Group (RWMG). 2018. Greater Monterey County Integrated Regional Water Management Plan. http://www.greatermontereyirwmp.org/documents/plan/.

Hansford Economic Consulting. 2019. 2018 Regulatory Fee Study. Prepared for Salinas Valley Basin Groundwater Sustainability Agency.

Heath, R. C. 1976. "Design of ground-water level observation-well programs." *Ground Water*. v. 14, no. 2, p. 71-77.

Highland Economics. 2017. Rotational Cover Crop Plan Economic Analysis: Private Costs and Public Benefits of Cover Crop Fallowing in the Pajaro Valley and Potential Incentive Structures. Prepared for RCDSCC. 78 p. http://www.communitywaterdialogue.org/images/coveredfallow/Pajaro_Valley_Covered_Fallow_Plan_Economic_Analysis_final2.pdf.

Hopkins, J. and B. Anderson. 2016. A Field Manual for Groundwater-level Monitoring at the Texas Water Development Board. User Manual 52, 26 p. https://www.twdb.texas.gov/groundwater/docs/UMs/UM-52.pdf.

Hunt J.W., S.M. Robinson, R.P. Clark, C.A. Endris, J.N. Gregory, K.K. Hammerstrom, K.A. Null, and K.C. O'Connor. 2019. Storm Water Resource Plan for the Greater Monterey County Integrated Regional Water Management Region. California State Water Resources Control Board. 288 p. http://www.greatermontereyirwmp.org/wp-content/uploads/2019/08/Greater-Monterey-County-SWRP_Final-Plan_2019_06_27-low-res-v2-Aug-2019.pdf.

HydroFocus, Inc. 2014. Distribution of Groundwater Nitrate Concentrations, Salinas Valley, California. 30 April. 42 p.

Jennings, C.W., with modifications by C. Gutierrez, W. Bryant, G. Saucedo, and C. Wills, 2010. Geologic map of California: California Geological Survey, Geologic Data Map No. 2, scale 1:750,000. https://www.conservation.ca.gov/cgs/Pages/Program-RGMP/2010_geologicmap.aspx.

Johnson, Michael J., Clark J. Londquist, Julie Laudon, and Hugh T. Mitten. 1988. Geohydrology and Mathematical Simulation of the Pajaro Valley Aquifer System, Santa Cruz and Monterey Counties, California. U.S. Geological Survey Water-Resources Investigations Report 87-4281. https://pubs.usgs.gov/wri/1987/4281/report.pdf.

Kennedy/Jenks. 2004. Hydrostratigraphic Analysis of the Northern Salinas Valley. Prepared for Monterey County Water Resources Agency. 113 p.

Kulongoski, Justin T. and Kenneth Belitz. 2005. Ground-Water Quality Data in the Monterey Bay and Salinas Valley Basins, California, 2005 - Results from the California GAMA Program. U.S. Geological Survey. Scientific Investigations Report 2011-5058. Prepared in in cooperation with the California State Water Resources Control Board. 98 p.

Melton, F. and M. Hang. 2021. Remote Sensing of Evapotranspiration from Arundo donax in the Salinas River Channel. Prepared for the Resources District of Monterey County by California State University Monterey Bay & NASA Ames Research Center, Cooperative for Research in Earth Science Technology. March 31, 2021.

Mittelbach, H., F. Casini, I. Lehner, A. Teuling, and S. Seneviratne. 2011. "Soil moisture monitoring for climate research: Evaluation of a low-cost sensor in the framework of the Swiss Soil Moisture Experiment (SwissSMEX) campaign." *Journal of Geophysical Research*. 116. 11. 10.1029/2010JD014907. https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2010JD014907.

Monterey County Agricultural Commissioner. 2018. 2018 Monterey County Crop Report. Accessed September 26, 2018. https://www.co.monterey.ca.us/home/showdocument?id=78579.

Monterey County Board of Supervisors. 2018. Ordinance 5302: An Interim Ordinance of the County of Monterey, State of California, Adopted Pursuant to Government Code Section 65858, Temporarily Prohibiting New Wells in Seawater Intruded Aquifers, With Specified Exemptions, Pending the County's Study and Consideration of Regulations. https://www.co.monterey.ca.us/home/showpublisheddocument/76746/636900588655270000.

Monterey County Housing and Community Development. 2010. Monterey County General Plan, Chapter 5. https://www.co.monterey.ca.us/home/showpublisheddocument/45810/636389938521570000.

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

______. 2015. CASGEM Monitoring Plan for High and Medium Priority Basins in the Salinas Valley Groundwater Basin.

______. 2016. Salinas River Stream Maintenance Program Permit Application Supplemental Attachment. 229 p.

______. 2018a. Email sent by Tamara Voss (MCWRA) on August 9, 2018. Subject: Data Request from MCWRA - GWL Change and Website Link for Extraction Reports.

______. 2018b. New Source Water Supply Study. Prepared by Raftelis. September 28, 2018.

______. 2018c. Nacimiento Dam Operation Policy. https://www.co.monterey.ca.us/Home/ShowDocument?id=63151.

______. 2019a. 2019 Quarterly Salinas Valley Water Conditions Report. https://www.co.monterey.ca.us/home/showpublisheddocument/83768/637074353956330000.

______. 2019b. 2018 Groundwater Extraction Summary Report. 20 p. https://www.co.monterey.ca.us/Home/ShowDocument?id=85416.

______. 2020. Interlake Tunnel Progress Report. Presented to MCWRA Board of Directors on May 18, 2020 and presented to MCWRA Board of Supervisors on June 9, 2020.

Moran, Tara, and Alletta Belin. 2019. "A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act." Stanford Water in the West. Available at https://stacks.stanford.edu/file/druid:dw122nb4780/A%20Guide%20to%20Water%20Quality%20Requirements%20under%20SGMA.pdf.

O'Geen, A.T., M.B.B. Saal, H. Dahlke, D. Doll, R. Elkins, A. Fulton, G. Fogg, T. Harter, J.W. Hopmans, C. Ingels, F. .Niederholzer, S. Sandovol Solis, P. Verdegaal, and M. Walkinshaw. 2015. "Soil suitability index identifies potential areas for groundwater banking on agricultural lands." *California Agriculture* 69:75-84.

Resource Conservation District of Santa Cruz County (RCDSCC). 2018. Pajaro Valley Covered Fallow Plan. 44 p. http://www.communitywaterdialogue.org/images/coveredfallow/Covered_Follow_Plan_FINAL_LowRes.pdf.

Rivas, T. 2006. Erosion Control Treatment Selection Guide. U.S. Forest Service National Technology & Development Program: 7700 Transportation Management. United States

Department of Agriculture. 0677 1203—SDTDC. https://www.fs.fed.us/t-d/pubs/pdf/hi_res/06771203hi.pdf.

Rosenberg, Lewis I. 2001. Digital Geologic Map of Monterey County, California, 1934-2001. Monterey County (Calif.) Planning Department. http://purl.stanford.edu/cm427jp1187.

Sophocleous, M. 1983. "Groundwater observation network design for the Kansas groundwater management districts, USA." *Journal of Hydrology*, 61: 371-389.

State Water Resources Control Board (SWRCB). 2019. Salinas Valley Water Coalition vs. Monterey County Water Resources Agency Report of Referee.

______. 2020a. GeoTracker Website. Accessed June 27, 2020. https://geotracker.waterboards.ca.gov/.

______. 2020b. Groundwater Ambient Monitoring and Assessment Program (GAMA) Groundwater Information System Website. Accessed June 27, 2020. https://gamagroundwater.waterboards.ca.gov/gama/datadownload.

Tracking California. 2020. Water System Service Areas. Accessed April 2020. https://trackingcalifornia.org/water-systems/water-systems-landing.

U.S. Census Bureau. 2018. TIGER/Line Geodatabases. Accessed December 2018. https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-geodatabase-file.html.

U.S. Department of Agriculture, Natural Resources Conservation Service. 2018. National Soil Survey Handbook. Title 430-VI. Accessed September 30, 2019. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054242.

U.S. Fish and Wildlife Service (USFWS). 2017. Critical Habitat: What is it? https://www.fws.gov/endangered/esa-library/pdf/critical_habitat.pdf.

Winter, T.C., J.W. Harvey, O.L. Franke, and W.M. Alley. 1999. Ground water and surface water- A Single Resource. U.S. Geological Survey Circular 1139. 88 p.

WRIME, Inc. 2003. Deep Aquifer Investigation – Hydrogeologic Data Inventory, Review, Interpretation and Implications. Technical Memorandum.

Yates, Eugene B. 1988. Simulated Effects of Ground-Water Management Alternatives for the Salinas Valley, California. U.S. Geological Survey Water-Resources Investigations Report 87-4066.