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APPENDICES

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LIST OF ABBREVIATIONS & ACRONYMS

AF	Acre- Feet
amsl	above mean sea level
bgs	Below Ground Surface
CAO	Clean-up and Abatement Order
CCID	Central California Irrigation District
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CFS	Cubic Feet per Second
CGS	California Geological Survey
CIMIS	California Irrigation Management Information System
Cr	Chino loam
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
DM	Delta Mendota
DMC	Delta Mendota Canal
DMS	Data Management System
DO	Dissolved Oxygen
DTW	Depth to Water
DWR	Department of Water Resources
EC	Electrical Conductivity
EIS	Environmental Impact Statement
ET	Evapotranspiration
ft	Feet
ft/day	Feet per day
FWD	Farmers Water District
FCGP	Fresno County General Plan
GDE	Groundwater Dependent Ecosystem

GDEi	Groundwater Dependent Ecosystem indicator
GPS	Global Positioning System
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWE	Groundwater Elevations
In/hr	Inches per Hour
JPA	Joint Powers Authority
KDSA	Kenneth D. Schmidt & Associates
LSCE	Luhdorff & Scalmanini Consulting Engineers
MDL	Minimum Detection Limit
mg/L	Milligrams per Liter
MO	Measurable Objective
MOA	Memorandum of Agreement
MPG	Mendota Pool Group
msl	Mean Sea Level
MT	Minimum Threshold
MWA	Mendota Wildlife Area
NAIP	National Agricultural Imagery Program
NAVD 88	The North American Vertical Datum of 1988
NRCS	Natural Resources Conservation Service
ORP	Oxidation-Reduction Potential
PBO	Plate Boundary Observation
PMAs	Projects and Management Actions
QA/QC	Quality Assurance/Quality Control
RP	Reference Point
RPE	Reference Point Elevation
Pool	Mendota Pool
SGMA	Sustainable Groundwater Management Act
SI	Sustainability Indicator

SJR	San Joaquin River
SJREC	San Joaquin River Exchange Contractors
SJRI	San Joaquin River Index
SJRRP	San Joaquin River Restoration Program
SLDMWA	San Luis Delta Mendota Water Authority
SMC	Sustainable Management Criteria
SSURGO	Soil Survey Geographic Database
SWRCB	California State Water Resources Control Board
TDS	Total Dissolved Solids
TM	Technical Memoranda
TNC	The Nature Conservancy
umhos/cm	Micromhos per Centimeter
USGS	United States Geologic Survey
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
Valley	San Joaquin Valley
WO	Wonder Orchards
WWD	Westlands Water District

EXECUTIVE SUMMARY

CHAPTER 1 – INTRODUCTION

The Sustainable Groundwater Management Act (SGMA) was signed into law in 2014 for the purpose of protecting California's groundwater resources. SGMA requires all high and medium priority basins to develop a Groundwater Sustainability Plan (GSP) to prevent overdraft and achieve sustainability in the utilization of groundwater resources. The Delta-Mendota Subbasin (Basin 5-022.07 in the California Department of Water Resources (DWR) Bulletin 118) (Subbasin) is a high priority Subbasin that has been assigned a critical overdraft designation by DWR. The Subbasin consists of 24 Groundwater Sustainability Agencies (GSA) who together created six individual GSA groups, each preparing a GSP in a coordinated manner as required by SGMA. The County of Fresno elected to serve as the GSA for County areas within the Subbasin that are not included in other GSAs. The GSP group consists of two individual GSA's ~~This GSA includes~~ Management Area A (MAA) and Management Area B (MAB) and are collectively referred to as Fresno County Management Areas (FCMA). ~~These management areas were developed to represent unique areas within the County GSA.~~

This GSP includes a description of groundwater conditions and basin settings of the Subbasin that is common to all six of the GSPs developed for the Delta-Mendota Subbasin in addition to describing the hydrogeologic conditions and management practices in the area of FCMA. It also contains the steps that will be taken to achieve sustainability over the next 20 years by preventing undesirable results by monitoring for the following sustainability indicators as defined by SGMA:

- Chronic Lowering of Groundwater Levels
- Reduction in Groundwater Storage
- Degraded Water Quality
- Subsidence
- Depletion of Interconnected Surface Water
- Seawater Intrusion

All but seawater intrusion applies to the FCMA and each applicable sustainability indicator will be addressed in this GSP and is integrated into the Subbasin-wide and FCMA monitoring program. Measurable objectives and minimum thresholds have been set for each sustainability indicator based on projected hydrologic conditions through the use of a numerical groundwater flow model. This GSP, in coordination with the five other GSPs for the Subbasin, will result in sustainability and the preservation of groundwater resources for all beneficial users of groundwater.

~~The GSA contains management areas (MAA and MAB) for two of the five applicable sustainability indicators: degraded water quality and interconnected surface waters. Water quality issues exist in both of the management areas. MAA is defined as a management area due to the existence of the Meyers Farm water banking program (Water Bank) and the former Spreckels Sugar Plant located adjacent to the Water Bank MAB is defined as a management area due the occurrence of naturally~~

~~occurring saline water and to a majority of its land use designation as Open Space as represented by the Mendota Wildlife Area (MWA). MAA and MAB will each incorporate different monitoring, minimum thresholds, and measurable objectives under the implementation of this GSP for water quality. Both MAA and MAB are designated as a single management area for interconnected surface waters due to the management of water levels in the Mendota Pool by the US Bureau of Reclamation and the San Luis Delta-Mendota Water Authority.~~

CHAPTER 2 – PLAN AREA

The FCMA is located in the southern portion of the Delta-Mendota Subbasin adjacent to the Kings and Westside Subbasins (**Figure ES-1**). Adjacent GSAs include Farmers Water District, Tranquility Irrigation District, City of Mendota, the San Joaquin River Exchange Contractors Water Authority (SJREC), Westlands Water District, McMullin Area GSA, and James Irrigation District. Portions of FCMA MAB are located within the boundaries of the SJREC GSA along the San Joaquin River. The SJREC GSA agreed to include this area in their GSP through a memorandum of understanding between FCMA and the SJREC GSA. MAB contains the MWA which is state controlled land which is managed by the California Department of Fish and Wildlife (CDFW).

Prior to the existence of SGMA, the FCMA and surrounding area has been extensively monitored by existing Mendota Pool Group Monitoring Program. The Mendota Pool Group is a group of landowners, which includes farming interests located within MAA and MAB, that are involved in an exchange program under the US Bureau of Reclamation and in irrigated farming activities within the FCMA. The exchange program involves the discharge of groundwater into the Fresno Slough portion of the Mendota Pool for use by the Bureau of Reclamation in exchange for Central Valley Project (CVP) water deliveries to MPG-owned lands in San Luis Water District and Westlands Water District. Annual reports are produced in compliance with *Agreement No. 2 for Mendota Pool Transfer Pumping Project* (Agreement No. 2), the annual extension of Agreement No. 2, and the Environmental Impact Statement (EIS) entitled *Mendota Pool 10-Year Exchange Agreements* (USBR, 2005). The purpose of the monitoring program and annual reporting is to identify the effects of transfer pumping on local water supplies in the vicinity of the Mendota Pool and adjacent areas.

CHAPTER 3 – BASIN SETTING

Hydrogeologic Conceptual Model

The Hydrogeologic Conceptual Model (HCM) provides an overview of regional and local geologic conditions and conditions that govern the response of groundwater conditions to groundwater management. The depositional environments that created the subsurface conditions that the FCMA now overlie was a combination of alluvial and lacustrine settings. Lacustrine, or lake settings, created thick deposits of clays that created the confining units in the subsurface. The alluvial setting provided the larger grain materials that constitute the groundwater producing aquifers. The FCMA and the Delta-Mendota Subbasin consists of two principal aquifers, the Upper and Lower Aquifers separated by the

Corcoran Clay. The Upper Aquifer is a semi-confined to unconfined aquifer due to the presence of intermitted clay layers such as the A-Clay and C-Clay. The Lower Aquifer is a confined aquifer due to the presence of the Corcoran Clay which underlies all of MAA and MAB and the Delta-Mendota Subbasin.

General groundwater quality conditions are described for the region surrounding the FCMA. Groundwater quality concerns in the FCMA are related to the transport and fate of salts measured as electrical conductivity of total dissolved solids.

The primary surface water features in the vicinity of the FCMA include the San Joaquin River (SJR), the Fresno Slough, the Mendota Pool (Pool), and several canals including the Chowchilla Bypass, Delta-Mendota Canal (DMC), the Firebaugh Intake Canal, the Columbia Canal,- the Central California Irrigation District (CCID) Main Canal, and the CCID Outside Canal. FCMA also consists of the Meyers Water Bank in MAA and the Terra Linda Recharge Canal in MAB.

The FCMA consists of one data gap and is the MWA portion of MAB (**Figure ES-2**).

Groundwater Conditions

Groundwater conditions are described with a focus on the historic and current period. The historic period is defined as 2003 to 2012 and the current water year is 2013. The trend of groundwater levels and quality over the historic period provide the basis for establishing sustainable conditions. Historic groundwater levels have been generally stable in the FCMA in the Upper Aquifer, where declines in groundwater elevations are observed during extended dry periods and rapid recovery during wet and normal conditions (**Figure ES-3**). The historic record of the Lower Aquifer has shown a continual decline where groundwater levels do not fully recovery after extended dry periods (**Figure ES-4**).

Groundwater in the flow in the Upper Aquifer is generally to the northeast. Groundwater flow in the Lower Aquifer is to the southwest. Seasonal high and seasonal low conditions differ, but the regional groundwater flow remains consistent.

The FCMA has historically had groundwater quality that was suitable for agricultural purposes. However, groundwater quality values in the FCMA are still of higher quality as compared to other areas in the region due to the migration of the Steffens Plume and naturally occurring saline water. Salinity, measured as Electrical Conductivity (EC) and Total Dissolved Solids (TDS), has shown an increase in recent years within the FCMA.

Subsidence, as a result of groundwater extraction, is a common problem throughout the Central Valley. Near the FCMA, subsidence is measured as Upper Aquifer compaction and total and subsidence. The difference between the two is Lower Aquifer compaction. Historic data indicates that a majority of land subsidence is the result of Lower Aquifer compaction. Historically, all known groundwater extraction in FCMA has been from the Upper Aquifer.

Water Budget

Groundwater flow models were developed in a coordinated effort amongst the six GSAs in the Subbasin. FCMA developed a numerical flow model utilizing the United States Geological Survey's MODFLOW-NWT. The groundwater model was used to calculate a water budget over three different time periods: historic (2003 through 2012), current (2013), and projected (2014 through 2070). The water budgets consist of a land surface budget and groundwater budget which each have designated inflows and outflows. The land surface budget inflows include precipitation, applied water (groundwater and imported water), and surface water, and the outflows include evapotranspiration, deep percolation, surface water outflows, surface water seepage, and recharge ponds/canals. The groundwater budget inflows include subsurface inflows, deep percolation, surface water seepage, and recharge ponds/canals. Groundwater budget outflows include subsurface outflows and groundwater extractions. These budgets aided in the quantification of overdraft and sustainable yield estimate. The Upper Aquifer sustainable yield estimate at 403,000 ~~was between 320,000 to 450,000~~ AF/year for the entire subbasin and a Lower Aquifer sustainable yield of 101,000 ~~0.33~~ AF/acre. The historic and current groundwater budget exhibited a correlation between the groundwater budget and year type, as dry years typically resulted in a decline in groundwater storage due to an increase demand for groundwater pumping. It also showed an increase in storage in the Upper and Lower aquifer over the historic period. The current water budget for 2013, a dry year, showed a slight decline in storage in both aquifers. Results for the groundwater budget component of each water budget period are presented in **Table ES-1**

Table ES-1: Groundwater Budget Results

Aquifer	Average Annual Upper Aquifer Extraction (AF)	Average Upper Aquifer Storage Change (AF)	Average Lower Aquifer Storage Change (AF)
Historic/Current	18,000	0	-1,700
~~**Projected Baseline**~~	~~18,000~~	~~2,300~~	~~-100~~
Projected Climate Change	18,000	-10 ~~70~~	-100

CHAPTER 4 – SUSTAINABLE MANAGEMENT CRITERIA

Sustainable Management Criteria (SMC) were developed for five of the six sustainability indicators: chronic lowering of groundwater elevation, reduction of groundwater storage, degraded water quality, land subsidence, and interconnected surface waters. Given the location of the FCMA, in a non-coastal subbasin, seawater intrusion was not an applicable sustainability indicator. For each of these sustainability indicators, measurable objectives (MO), interim milestones (IM), and minimum thresholds (MT) were set based on undesirable conditions that are considered significant and unreasonable. SMC were established for both principal aquifers but the focus of management in FCMA will be on the Upper

Aquifer where all beneficial users utilize groundwater. These conditions were defined by interactions with local stakeholders and analysis of historic and projected groundwater conditions.

Sustainability Goal

The coordinated Sustainability Goal for the Delta-Mendota Subbasin is as follows:

> *The Delta-Mendota Subbasin will manage groundwater resources for the benefit of all users of groundwater in a manner that allows for operational flexibility, ensures resource availability under drought conditions, and does not negatively impact surface water diversions and conveyance and delivery capabilities. The goal will be achieved through the implementation of the proposed projects and management actions to reached identified measurable objectives and milestones through the implementation of the GSP(s), and through continued coordination with neighboring subbasin to ensure the absence of undesirable results by 2040.*

The Sustainability Goal is based on information presented in the basin settings and should include measures that will be taken to operate within the basin's Sustainable Yield. Two principal aquifers, the Upper and Lower, were identified in the FCMA GSP and Common Chapters for the Subbasin. The hydrogeologic properties of these aquifer and responses to different groundwater management practices were evaluated in the Basin Settings chapters of the FCMA GSP and Common Chapters. Sustainable yields were for the entire subbasin for both the Upper and Lower Aquifer based on historic conditions. The conditions used to calculate sustainable yield and define undesirable results were under the same historic conditions. At the local level, FCMA will manage groundwater resources in a manner that results in the absence of undesirable results for the Upper Aquifer by the year 2040. This will be accomplished in FCMA by operating within historic groundwater management practices and maintain water levels within the historic hydrograph. FCMA is not expected to extract groundwater from the Lower Aquifer over the projected water budget period. Lower Aquifer conditions will be monitored and managed in coordination with other entities that utilize the Lower Aquifer as a source of groundwater. Sustainability will be accomplished through the continuation of existing monitoring, data collection and inter-basin coordination to improve our understanding of regional influences on Lower Aquifer conditions. Coordination and communication with surrounding GSAs will be conducted to implement management actions that will prevent over extraction of groundwater and maintain stable conditions for each of the sustainability indicators in the Upper and Lower Aquifers.

~~FCMA will manage groundwater resources in a manner that results in the absence of undesirable results for the Upper Aquifer by the year 2040. FCMA is not expected to extract groundwater from the Lower Aquifer over the projected water budget period. Lower Aquifer conditions will be monitored and managed in coordination with other entities that utilize the Lower Aquifer as a source of groundwater. Sustainability will be accomplished through the continuation of existing monitoring and data collection and intra-basin and inter-basin coordination to improve our understanding of regional influences on Lower Aquifer conditions. Coordination and communication with surrounding GSAs will be conducted to~~

~~implement management actions that will prevent over extraction of groundwater and maintain stable conditions for each of the applicable sustainability indicators in the Upper and Lower Aquifers.~~

~~FCMA has exhibited sustainable conditions during normal hydrogeologic conditions when the average change in storage is slightly positive and groundwater levels are generally stable over the historic period. Extended dry periods, such as those during 2012 through 2016, exhibited significant reductions in groundwater storage and conditions that are not sustainable. Using the current understanding of groundwater conditions in the FCMA as they relate to variable hydrogeologic conditions, the FCMA plan area will be managed and monitored to ensure the sustainability goal is met by 2040. Further investigation of existing data gap areas and development of future projects and management actions will ensure that sustainable conditions are maintained through the planning and implementation horizon (2040 through 2070).~~

Measurable Objectives and Interim Milestones

MOs quantify groundwater conditions that are representative of sustainable conditions for each sustainability indicator, and IMs represent the trend of groundwater conditions, in 5-year increments, required to reach sustainable conditions over the 20-year implementation period. MOs and IMs were established for each of the applicable sustainability indicators as follows:

Chronic Lowering of Groundwater Levels

MOs were selected for four~~ive~~ representative monitoring sites to provide an even distribution of coverage of the area included in the GSP and the ability of each well to capture general groundwater trends. Three~~Four~~ of these wells monitor the conditions in the Upper Aquifer, with one well monitoring condition in the Lower Aquifer (located outside of the FCMA). MOs were set based on seasonal high conditions observed in 2015, and IMs are narratives developed at Subbasin level that outline how SMCs will be refined as more data are collected and that groundwater levels will be maintained at or above MO levels. ~~IM were set as a linear projection between recent (post 2016) groundwater elevations and MO levels representing 2040~~ (**Table ES-2**).

Table ES-2: Groundwater Elevation Measurable Objectives and Interim Milestones

Well Name	Aquifer	Interim Milestone 5 Years	Interim Milestone 10 Years	Interim Milestone 15 Years	Measurable Objective (ft NAVD88)
7C1	Upper	Gather data and complete	Maintain groundwater	Maintain groundwater	121

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MW-7	Upper	the establishment of seasonal low and seasonal high elevations at representative monitoring sites in the Lower Aquifer. Develop a coordinated methodology and complete the establishment of acute groundwater elevations thresholds. Identify chronic lowering of groundwater levels cause by pumping outside the Subbasin.	levels at MOs Where chronic lowering of groundwater levels is cause by pumping outside of the Subbasin, seek remedies in coordination with DWR and neighboring GSAs	levels at MOs Where chronic lowering of groundwater levels is cause by pumping outside of the Subbasin, seek remedies in coordination with DWR and neighboring GSAs	103
31J6	Lower				-27
TL-HS-3	Upper				116

~~Well Name~~	~~Aquifer~~	~~Interim Milestone 5 Years (ft NAVD88)~~	~~Interim Milestone 10 Years (ft NAVD88)~~	~~Interim Milestone 15 Years (ft NAVD88)~~	~~Measurable Objective (ft NAVD88)~~
~~7C1~~	~~Upper~~	~~126~~	~~124~~	~~122~~	~~121~~
~~MW-7~~	~~Upper~~	~~107~~	~~104~~	~~102~~	~~99~~
~~31J6~~	~~Lower~~	~~0~~	~~-9~~	~~-18~~	~~-27~~
~~KRCDA06~~	~~Upper~~	~~118~~	~~118~~	~~117~~	~~116~~
~~TL-HS-3~~	~~Upper~~	~~123~~	~~120~~	~~118~~	~~116~~

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Reduction in Groundwater Storage

MO values for Reduction in Groundwater Storage are based on MOs set for the chronic lowering of ground water levels for the Upper Aquifer. For the Lower Aquifer, subsidence will be used as a proxy for groundwater storage and the MO is set based on no allowable land subsidence past 2040 ~~MO values for reduction in groundwater storage for the Upper Aquifer and Lower Aquifer are based on the difference between the recent groundwater water levels (post 2016) and MO values for groundwater levels. The MO for decline in groundwater storage is the estimated cumulative decline in storage that the GSP area is able to experience while maintaining sustainable conditions over the next 20 years. The MO is subject to change based on most recent groundwater elevations, and, with increasing groundwater levels, more loss of storage will be allowed over the SGMA implementation period. The Interim Milestones for groundwater storage are the projection between recent levels and the MO in 5-year increments~~ (**Table ES-3**).

Table ES-3: Groundwater Storage Measurable Objectives and Interim Milestones

Aquifer	Interim Milestone 5 Years	Interim Milestone 10 Years	Interim Milestone 15 Years	Measurable Objective (AF)
Upper	Maintain groundwater levels in accordance with the MOs. Identify reductions in groundwater storage caused by pumping outside the Subbasin.	Maintain groundwater levels in accordance with MOs. Reduction in groundwater storage is cause by pumping outside the Subbasin, seek remedies in coordination with DWR and neighboring GSAs	Maintain groundwater levels in accordance with MOs. Reduction in groundwater storage is cause by pumping outside the Subbasin, seek remedies in coordination with DWR and neighboring GSAs	0
Lower				0

~~Aquifer~~	~~Interim Milestone 5 Years (AF)~~	~~Interim Milestone 10 Years (AF)~~	~~Interim Milestone 15 Years (AF)~~	~~Measurable Objective (AF)~~
~~**Upper**~~	~~-12,000~~	~~-23,000~~	~~-35,000~~	~~-0~~
~~**Lower**~~	~~-1,100~~	~~-2,200~~	~~-3,300~~	~~0~~

Subsidence

MO for Upper Aquifer~~s and IMs for subsidence and~~ compaction is~~are~~ based on the rates observed during the historic conditions (prior to the most recent drought) for the Fordel Extensometer ~~and P304~~. The MO for total land subsidence was to not allow additional subsidence past 2040. IMs were set as decreasing amounts of allowable subsidence in each 5-year period for SGMA. The focus for Subsidence

monitoring in FCMA will be for the ~~will only be monitored for the~~ Upper Aquifer, as the FCMA does not extract groundwater from the Lower Aquifer and is not responsible for Lower Aquifer compaction. ~~IMs were set at the same rate as the MO~~ (**Table ES-4**).

Table ES-4: Subsidence Measurable Objectives and Interim Milestones

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Monitoring Site	Interim Milestone 5 Years (ft/year)	Interim Milestone 10 Years (ft/year)	Interim Milestone 15 Years (ft/year)	Measurable Objective (ft/year)
Fordel	No More than 1 foot of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the first 5-year period of SGMA implementation.	No more than 0.5 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the second 5-year period of SGMA implementation, for a cumulative total of 1.5 feet in the first 10 years.	No more than 0.25 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the third 5-year period of SGMA implementation, for a cumulative total of 1.75 feet in the first 15 years.	0.002
P304				0
~~**Monitoring Site**~~	~~Interim Milestone 5 Years (ft/year)~~	~~Interim Milestone 10 Years (ft/year)~~	~~Interim Milestone 15 Years (ft/year)~~	~~Measurable Objective (ft/year)~~
~~**Fordel**~~	~~0.002~~	~~0.002~~	~~0.002~~	~~0.002~~
~~**P304**~~	~~0.036~~	~~0.036~~	~~0.036~~	~~0.036~~

Degraded Water Quality

Degraded Water Quality SMC were developed in a coordinated manner with the goal of protecting water quality in unimpaired areas. Unimpaired areas are defined as the locations where TDS concentrations have not exceeded a Total Dissolved Solids (TDS) concentration of less than 1,000 mg/L as of Water Year 2016. The MO for all unimpaired WQ site is a TDS concentration less than 1,000 mg/L. Water quality will be monitored at sites with impaired water quality but without set MO's. ~~The two primary water quality concerns in the FCMA are the migration of the Steffens Plume affecting MAA and naturally occurring high saline water affecting MAB. MOs and Interim Milestones were based on historic levels of TDS. Monitoring sites in MAA surround the current extent of the Steffens Plume, and monitoring sites in MAB are located along the edge of naturally occurring saline water. MOs were~~

~~developed in MAA based on the background concentration listed in the Spreckels Cleanup and Abatement Order (CAO) (Regional Board, 2018). MOs for MAB were established based historic trends of increasing TDS plus the maximum annual increase for salinity in the Water Quality Control Plan for the Tulare Lake Basin (Regional Board, 2015). IMs for MAA were set based on a linear interpretation between the MO and MT and IMs for MAB were set at the same rate as the MOs (~~(**Table ES-5**).

Table ES-5: Degraded Groundwater Quality Measurable Objectives and Interim Milestones

Well Name	Interim Milestone 5 Years	Interim Milestone 10 Years	Interim Milestone 15 Years	Measurable Objective (TDS)
SPREC-MW-1	Maintain salinity consistent with measurable objectives. Participate in , provide data for, and track and report on compliance with orders and objectives adopted by the SWRCB and CVRWQB and smilar regulatory agencies. Develop correlations between groundwater quality and groundwater levels in order to establish methodology for use of groundwater levels as proxy for groundwater quality	Maintain water quality consistent with measurable objectives. Continue monitoring and publishing groundwater quality data, and tracking and reporting on compliance with regulatory orders and objectives. Where water quality impairments are caused by activities outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Utilizing the methodology developed by the Year 5	Maintain water quality consistent with measurable objectives. Continue monitoring and publishing groundwater quality data, and tracking and reporting on compliance with regulatory orders and objectives. Where water quality impairments are caused by activities outside the Subbasin, seek remedies in coordination with DWR and neighboring GSAS.	Impaired
SPRECK-MW-32				<1,000 mg/L
SPRECK-MW-20				Impaired
SPRECK-PW-12				Impaired
SPRECK-PW-10				Impaired
SPRECK-PW-9				Impaired
SPRECK-MW-11				Impaired
TLF-6D				Impaired
TLF-12D				Impaired
SC-4B				Impaired

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		Interim Milestone, develop Minimum thresholds and measurable objectives for groundwater quality that utilize groundwater elevations as a proxy for monitoring.		
MF-P-1				Impaired

~~Well Name~~	~~Interim Milestone 5 Years (TDS)~~	~~Interim Milestone 10 Years (TDS)~~	~~Interim Milestone 15 Years (TDS)~~	~~Measurable Objective (TDS)~~
~~SPREC-MW-1~~	~~2,692mg/L~~	~~2,185mg/L~~	~~1,678mg/L~~	~~1,170 mg/L~~
~~SPRECK-MW-32~~	~~592 mg/L~~	~~507 mg/L~~	~~422 mg/L~~	~~362 mg/L~~
~~SPRECK-MW-20~~	~~2,150 mg/L~~	~~1,680 mg/L~~	~~1,210 mg/L~~	~~740 mg/L~~
~~SPRECK-PW-12~~	~~920 mg/L~~	~~740 mg/L~~	~~560 mg/L~~	~~380 mg/L~~
~~SPRECK-PW-10~~	~~818mg/L~~	~~696 mg/L~~	~~575 mg/L~~	~~453 mg/L~~
~~SPRECK-PW-9~~	~~1,988 mg/L~~	~~1,476 mg/L~~	~~965 mg/L~~	~~453 mg/L~~
~~SPRECK-MW-11~~	~~1,775 mg/L~~	~~1,550 mg/L~~	~~1,325 mg/L~~	~~1,100 mg/L~~
~~TLF-6D~~	~~48 mg/L/year~~	~~48 mg/L/year~~	~~48 mg/L/year~~	~~48 mg/L/year~~
~~TLF-12D~~	~~36 mg/L/year~~	~~36 mg/L/year~~	~~36 mg/L/year~~	~~36 mg/L/year~~
~~SC-4B~~	~~24 mg/L/year~~	~~24 mg/L/year~~	~~24 mg/L/year~~	~~2.24 mg/L/year~~

~~FS-5~~	~~12 mg/L/year~~	~~12 mg/L/year~~	~~12 mg/L/year~~	~~12 mg/L/year~~
~~MF-P-1~~	~~56 mg/L/year~~	~~56 mg/L/year~~	~~56 mg/L/year~~	~~56 mg/L/year~~
~~KRCDA06~~	~~920 mg/L~~	~~740 mg/L~~	~~560 mg/L~~	~~380 mg/L~~

Interconnected Surface Waters

Interconnected Surface Waters have been identified as a data gap in the Subbasin. As an interim measurable objective, the use of Chronic Lowering of Groundwater levels will be used as a proxy for interconnected Surface waters. In the original GSP submitted in January 2020, the MO for interconnected surface waters was established based on the average stage conditions in the Mendota Pool. To develop SMCs for ISW that is consistent with the rest of the Subbasin, FCMA has modified SMCs for this indicator from the original GSP submittal. Utilizing the groundwater monitoring network in the Subbasin and the monitoring network for the San Joaquin River Restoration Program, data will be collected and analyzed to establish a monitoring network specifically for interconnected Surface Waters and establish MOs in terms of a rate or volume of losses or gains to the San Joaquin River and the Mendota Pool (**Table ES-6**). ~~The MO for interconnected surface waters was established based on average stage conditions in the Mendota Pool. IMs were established using a linear projection between the MT and MO (**Table ES-6**).~~

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Table ES-6: Measurable Objectives and Interim Milestones for Interconnected Surface Waters~~**Interconnected Surface Waters Measurable Objectives and Interim Milestones**~~

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Interim Milestone 5 Years	Interim Milestone 10 Years	Interim Milestone 15 Years	Measurable Objective (ft)
Fill data gaps, establish, and manage groundwater use to avoid the rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and	Gather and analyze data from the Subbasin's established monitoring network sites. Also gather and analyze available data in cooperation with neighboring subbasin, USBR SJRRP, USGS, and CDEC, to estimate the influence on gains and losses in the San Joaquin River. Establish minimum	Monitor and maintain interconnected surface waters in accordance with revised minimum thresholds and measurable objectives. Where increased interconnected surface water losses are caused by pumping outside of the	See Chronic Lowering of Water Level MO

may lead to undesirable results. The Subbasin	thresholds and MO as a rate or volume of surface water depleitons that have adverse impacts on beneficial uses and users that may lead to undesirable results.	Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.	

~~Monitoring Site~~	~~Interim Milestone 5 Years (ft)~~	~~Interim Milestone 10 Years (ft)~~	~~Interim Milestone 15 Years (ft)~~	~~Measurable Objective (ft)~~
~~Mendota Pool Staff Gage~~	~~14~~	~~14~~	~~14~~	~~14~~

Minimum Thresholds

MTs refer to a numeric value for each sustainability indicator used to define undesirable results. The GSP must establish MTs to quantify groundwater conditions for each applicable sustainability indicator at each monitoring site, and it must represent a point in the subbasin that, if exceeded, may cause undesirable results. MTs for the applicable sustainability indicators are as follows:

Chronic Lowering of Groundwater Levels

MTs for Chronic Lowering of Groundwater Levels shall be the groundwater level indicating a depletion of supply at a given location that may lead to undesirable results. These undesirable results are based on the Subbasin wide definition of significant and unreasonable for Chronic Lowering of Groundwater Levels. MT values were determined through coordination with other GSAs in the Subbasin and by evaluating historic water levels trends. MTs for individual monitoring sites were established as a water level lower than the historic seasonal low measurement using data prior to the end of WY 2016 ~~To establish MTs, the annual maximum groundwater elevation for each year was determined for the historic period of record. This was used to determine the largest continual decline in groundwater elevation throughout the GSP area which was applied to the MO to establish a MT for each monitoring site~~ (**Table ES-7**).

Tables ES-7: Groundwater Elevation Minimum Thresholds

Well Name	Aquifer	Minimum Threshold (ft NAVD 88)
7C1	Upper	109.4
MW-7	Upper	98.2
31J6	Lower	-59.0
TL-HS-3	Upper	48.6

~~Well Name~~	~~Aquifer~~	~~Minimum Threshold (ft NAVD 88)~~
~~7C1~~	~~Upper~~	~~103~~
~~MW-7~~	~~Upper~~	~~76~~
~~31J6~~	~~Lower~~	~~-98~~
~~KRCDA06~~	~~Upper~~	~~106~~
~~TL-HS-3~~	~~Upper~~	~~102~~

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Reduction in Groundwater Storage

The MTs set for Chronic Lower of Groundwater Levels will serve as a proxy for the MT for Reduction in Groundwater Storage for the Upper Aquifer. The actual volume of water that this represents will vary depending on seasonal high-water levels. With increasing groundwater levels, the available volume of water will increase. The MT for Subsidence will serve as a proxy for the MT for Reduction in Groundwater Storage for the Lower Aquifer. There is minimal coverage for Lower Aquifer groundwater level monitoring across the Subbasin. A volume of water that will serve as the MT for the Lower Aquifer was determined at the Subbasin level. **Table ES-8** shows the estimated volumes for Reduction in Groundwater Storage based on the SMC's for Chronic Lowering of Groundwater Levels for the Upper Aquifer and Subsidence for the Lower Aquifer ~~The MT for reduction of groundwater storage is the total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Change in storage will be regularly estimated based on the Subbasin water budget or monitoring results derived from analysis of groundwater elevations and aquifer properties (monitoring protocols for data collection and monitoring). Annual changes in storage will be estimated based on changes between seasonal high contours. For the initial estimation of MT values for change in storage, the most recent water level elevations were compared to the MT for groundwater elevation in~~

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~~the Upper Aquifer and Lower Aquifer. The average change in groundwater elevation from current level to the MT level for all representative sites was used to calculate a change in storage over the entire GSP area (Tables ES-8)~~.

Table ES-8: Groundwater Storage Minimum Thresholds

Aquifer	Difference Between MO and MT (ft)	GSP Area (Acres)	Specific Yield (Upper)	Total Storage Change (AF)
Upper	-28	22353	0.21	-120,000
Lower (Subbasin)	N/A	N/A	N/A	-1,100,000

~~Aquifer~~	~~Total Storage Change (AF)~~
~~Upper~~	~~-110,000~~
~~Lower~~	~~-38,000~~

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Subsidence

MTs for land subsidence were based on conditions observed during historic groundwater conditions. The MT was established as the maximum rate of subsidence or compaction that occurred during historic groundwater conditions. These values coincided with the greatest decline in groundwater elevation which occurred between the years of 2011 and 2016. The Subbasin wide MT for subsidence was set at a cumulative value of 2 feet by 2040. IM for subsidence allow for less subsidence in each 5-year period of SGMA, but the MT for FCMA for total subsidence is consistent with the rest of the Subbasin as 0.1 ft/year is equal to 2 feet by 2020 (**Table ES-9**).

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~~MTs for land subsidence were based on conditions observed during the historic groundwater period. The MT was established based on the maximum rate of subsidence or compaction that occurred during the historic groundwater period (Tables ES-9).~~

Tables ES-9: Subsidence Minimum Thresholds

GSA	Monitoring Site	Monitoring Type	Minimum Threshold (ft/year)
A & B	Fordel	Upper Aquifer Compaction	0.011
A & B	P304	Land Subsidence	0.1
Subbasin	All Sites	Land Subsidence	2 feet (Cumulative to 2040)
~~**Management Area**~~	~~Monitoring Site~~	~~Monitoring Type~~	~~Minimum Threshold (ft/year)~~
~~**A & B**~~	~~Fordel~~	~~Upper Aquifer Compaction~~	~~0.011~~
~~**A & B**~~	~~P304~~	~~Land Subsidence~~	~~0.1~~

Degraded Water Quality

~~Wells within the monitoring network affected by naturally occurring high saline water had MT values set based on the observed maximum annual change which is applied to projected rate of increase, and wells affected by the Steffens Plume (primarily MAA) had MT values set at a fixed concentration of TDS based on background on the maximum observed concentration (**Tables ES-10**).~~ Degraded Water Quality Minimum Thresholds were set at a value greater than 1,000 mg/L TDS for unimpaired sites (**Table ES-10**). Impaired water quality sites will be monitored but without minimum threshold values.

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Tables ES-10: Degraded Water Quality Minimum Thresholds

Well Name	Minimum Threshold (TDS)
SPRECK-MW-1	N/A
SPRECK-MW-32	1,000 mg/L
SPRECK-MW-20	N/A
SPRECK-PW-9	N/A
SPRECK-MW-11	N/A
TLF-6D	N/A
TLF-12D	N/A
SC-4B	N/A

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MF-P-1	N/A
~~Well Name~~	~~Minimum Threshold (TDS)~~
~~SPRECK-MW-1~~	~~3,200 mg/L~~
~~SPRECK-MW-32~~	~~700 mg/L~~
~~SPRECK-MW-20~~	~~2,620 mg/L~~
~~SPRECK-PW-12~~	~~1,200 mg/L~~
~~SPRECK-PW-10~~	~~940 mg/L~~
~~SPRECK-PW-9~~	~~2,500 mg/L~~
~~SPRECK-MW-11~~	~~2,100 mg/L~~
~~KRCDA06~~	~~1,200 mg/L~~
~~TLF-6D~~	~~290 mg/L/year~~
~~TLF-12D~~	~~55 mg/L/year~~
~~SC-4B~~	~~430 mg/L/year~~
~~FS-5~~	~~135 mg/L/year~~
~~MF-P-1~~	~~420 mg/L/year~~

Interconnected Surface Waters

Interconnected Surface Waters have been identified as a data gap in the Subbasin. As an interim MT, the use of Chronic Lowering of Groundwater levels will be used as a proxy for interconnected Surface waters. In the original GSP submitted in January 2020, the MT for interconnected surface waters was determined from the average historic decline for stage in the Mendota Pool. To develop SMCs for ISW that is consistent with the rest of the Subbasin, FCMA has modified SMCs for this indicator from the original GSP submittal. Utilizing the groundwater monitoring network in the Subbasin and the monitoring network for the San Joaquin River Restoration Program, data will be collected and analyzed to establish a monitoring network specifically for interconnected Surface Waters and establish MTs in terms of a rate or volume of losses or gains to the San Joaquin River and the Mendota Pool ~~The MT for Interconnected Surface Waters is based on stage values in the Mendota Pool. FCMA has no control over the flow and stage level in the Mendota Pool which was designated as a "Management Area," but MT values were established based on the projected trend of decline from historic data~~ (**Tables ES-11**). ~~Historically, stage values in the Mendota Pool have been very consistent with a gradual decline. The MT will be quantitatively measured using the stage measurement in the Mendota Pool.~~

Tables ES-11: Interconnected Surface Waters Minimum Threshold

Well Name	Minimum Threshold
N/A	See Water Level MTs

~~Well Name~~	~~Minimum Threshold (ft)~~
~~Mendota Pool Staff Gage~~	~~13~~

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Undesirable Results

Undesirable results occur when the effects caused by groundwater conditions throughout the basin cause significant and unreasonable impacts to any of the six sustainability indicators. Over extraction during extended dry periods will lead to undesirable results for groundwater elevation, groundwater storage, and subsidence. Groundwater quality undesirable results will occur in accordance with continued migration of the Steffens Plume in MAA and the naturally occurring high saline water in MAB and continued extraction from wells that exceed their MT. Undesirable results for each applicable sustainability indicator are as follows:

- **Chronic lowering of groundwater** – Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater.
- **Reduction in groundwater storage** - A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater.
- **Degraded water quality** – Degradation of groundwater quality as a result of groundwater management activities that cause significant and unreasonable impacts to beneficial uses and users of groundwater.
- **Land Subsidence** – Changes in ground surface elevation that cause damage to critical infrastructure, including significant and unreasonable reductions of conveyance capacity, impacts to natural resource areas, or conditions that threaten public health and safety.
- **Depletions of interconnected surface water –** Depletions of interconnected surface water as a direct result of groundwater pumping that causes significant and unreasonable impacts on natural resources or downstream beneficial uses and users.

The following are the definitions of significant and unreasonable for each of the individual sustainability indicators.

Chronic Lowering of Groundwater Levels

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Significant and unreasonable impacts to beneficial uses and users of groundwater are substantially increase costs associated with higher total pumping lift, lowering pumps, drilling deeper wells, or otherwise modifying wells to access groundwater, securing alternative water sources or required mitigation of groundwater dependent ecosystems. Significant and unreasonable is quantitatively defined as exceeding the MT at more than 50% of representative monitoring sites by aquifer in a GSP area. ~~Undesirable results occur when more than 25% of wells in the Upper Aquifer exceed the established minimum threshold value for two consecutive years. There is an even distribution of groundwater elevation monitoring sites and the exceedance of MT at one location could be reflective of localized conditions. Multiple exceedances of groundwater elevation are more reflective of regional conditions. FCMA will monitor the Lower Aquifer but is not responsible for its conditions. In the event of undesirable results for the Upper Aquifer, FCMA will develop projects and management actions to prevent future MT exceedances.~~

Reduction in Groundwater Storage

A significant and unreasonable impact to beneficial uses and users of groundwater is insufficient water storage to maintain beneficial use and natural resource areas in the Subbasin, including conjunctive use of groundwater. ~~Groundwater storage calculation will be made with groundwater elevation measurements collected at multiple sites. Undesirable results occur when groundwater storage exceeds the MT for the Upper Aquifer for two consecutive years. Storage changes will be calculated for the Lower Aquifer, but FCMA actions are not responsible for these conditions. In the event of undesirable results for the Upper Aquifer, FCMA will develop projects and management actions to prevent future MT exceedances.~~

Subsidence

Significant and unreasonable damage to conveyance capacity from inelastic land subsidence is structural damage that creates an unmitigated and unmanageable reduction of design capacity or freeboard. Significant and unreasonable impacts to natural resource areas from inelastic land subsidence are unmitigated decreases in the ability to flood or drain such areas by gravity. Significant and unreasonable threats to public health and safety from inelastic land subsidence are those that cause an unmitigated reduction of freeboard that allows for flooding, or unmitigated damage to roads and bridges.~~Undesirable results for subsidence will occur when the rate of compaction for the Upper Aquifer exceeds MT rate for two consecutive years. Similar to groundwater level and storage, FCMA only extracts groundwater from the Upper Aquifer and is not responsible for Lower Aquifer compaction. Historic subsidence data has indicated that Upper Aquifer compaction is only responsible for a fraction of the total subsidence. In the event of undesirable results for the Upper Aquifer, FCMA will develop projects and management action to prevent future MT exceedances.~~

Degraded Groundwater Quality

Significant and unreasonable impacts to beneficial uses and users of groundwater as a result of groundwater management activities are the migration of contaminant plumes or elevated concentrations of constituents of concern that reduce groundwater availability, and the degradation of surface water quality as a result of groundwater migration that substantially impair an existing beneficial use. Significant and unreasonable is quantitatively defined as exceeding the MT at more than 50% of representative monitoring sites by aquifer in a GSP area where current groundwater quality (as established in the Subbasins GSPs) does not exceed 1,000 mg/L TDS.~~Undesirable Results occur when more than 25% of wells in MAA or MAB exceed the established MT for two consecutive years. Within each of the Management Areas, the area of concern has been delineated by the monitoring network. Multiple exceedances indicate that the migration of contaminates is expanding and impacting a larger area causing impact to beneficial users of groundwater outside of the Management Areas. In the event of undesirable results for the Upper Aquifer in MAA, FCMA will work with the Regional Board who is overseeing existing cleanup efforts to prevent future MT exceedances. For MAB, FCMA will develop projects and management actions.~~

Interconnected Surface Water

Significant and unreasonable impacts on natural resources or downstream beneficial uses and users of groundwater are a reduction in available surface water supplies for natural resource areas, and reductions in downstream water availability as a result of increased streamflow depletions along the San Joaquin River when compared to similar historic water year types.~~Undesirable results occur when stage values drop below the MT for two consecutive years. FCMA will not implement any projects or management actions in the event of undesirable results for interconnected surface waters but instead will manage groundwater elevations to sustainable levels.~~

Monitoring Network

The FCMA monitoring network consists of 15~~20~~ sites that will monitor conditions for each of the five applicable sustainability indicators across the plan area (**Figure ES-5**). The individual monitoring sites were selected to have an even distribution over the plan area where groundwater management practices vary. The monitoring network for each of the applicable sustainability indicators is described below and information on the individual monitoring sites are presented in **Table ES-12**.

Groundwater Elevation Monitoring Network

The groundwater elevation monitoring network consists of four~~ive~~ monitoring sites. Three~~Four~~ of the sites are screened to monitor conditions in the Upper Aquifer, and one is screened to monitor conditions in the Lower Aquifer. The one Lower Aquifer well is located outside of the FCMA GSP area. Groundwater elevation measurements will be made twice a year to capture seasonal high and seasonal lows.

Groundwater Storage Monitoring Network

Groundwater storage monitoring is the same as the groundwater level monitoring network for the Upper Aquifer. Groundwater storage monitoring for the Lower Aquifer is the same as the Subsidence monitoring network. ~~Groundwater storage calculations will be made by creating groundwater elevation contours and taking the difference between current and previous water year. These contours will be created from the seasonal high groundwater elevation measurements throughout the GSP area.~~

Subsidence Monitoring Network

The subsidence monitoring network will utilize one USGS extensometer and one UNAVCO GPS monitoring site. The UANVCO GPS monitoring site (P304) measures the total amount of subsidence due to compaction in both the Upper and Lower Aquifer.

Groundwater Quality Monitoring Network

The groundwater quality monitoring consists of nine~~13~~ monitoring sites all screened in the Upper Aquifer. TDS samples will be collected at each monitoring site between May and August each year for annual reporting purposes.

Interconnected Surface Waters Monitoring Network

Interconnected surface waters monitoring network is the same as the water level monitoring network. This will be updated as data gaps for interconnected surface waters are filled. ~~Interconnected surface water will be monitored by the Mendota Pool staff gage. Stage levels will be reported semi-annually corresponding with seasonal high and seasonal low groundwater elevation.~~

Table ES-12: Fresno County Monitoring Network

Sustainability Indicator	Monitoring Site	Monitoring Frequency	Monitoring Time Frame	Existing Monitoring Program
Groundwater Elevation	USGS 31J6	Semi Annual	Season High: (February-April) Season Low: (September-October)	USGS
	SPRECK-MW-7			Spreckels Semi-Annual
	~~KRCDA06~~			CASGEM
	TL-HS-3			MPG
	HANS-7C1			MPG
Groundwater Quality	MF-P-1	Annual	May-August	MPG
	SPRECK-MW-1			Spreckels Semi-Annual
	SPRECK-MW-11			Spreckels Semi-Annual
	SPRECK-MW-20			Spreckels Semi-Annual
	SPRECK-MW-32			Spreckels Semi-Annual
	SPRECK-PW-9			Spreckels Semi-Annual

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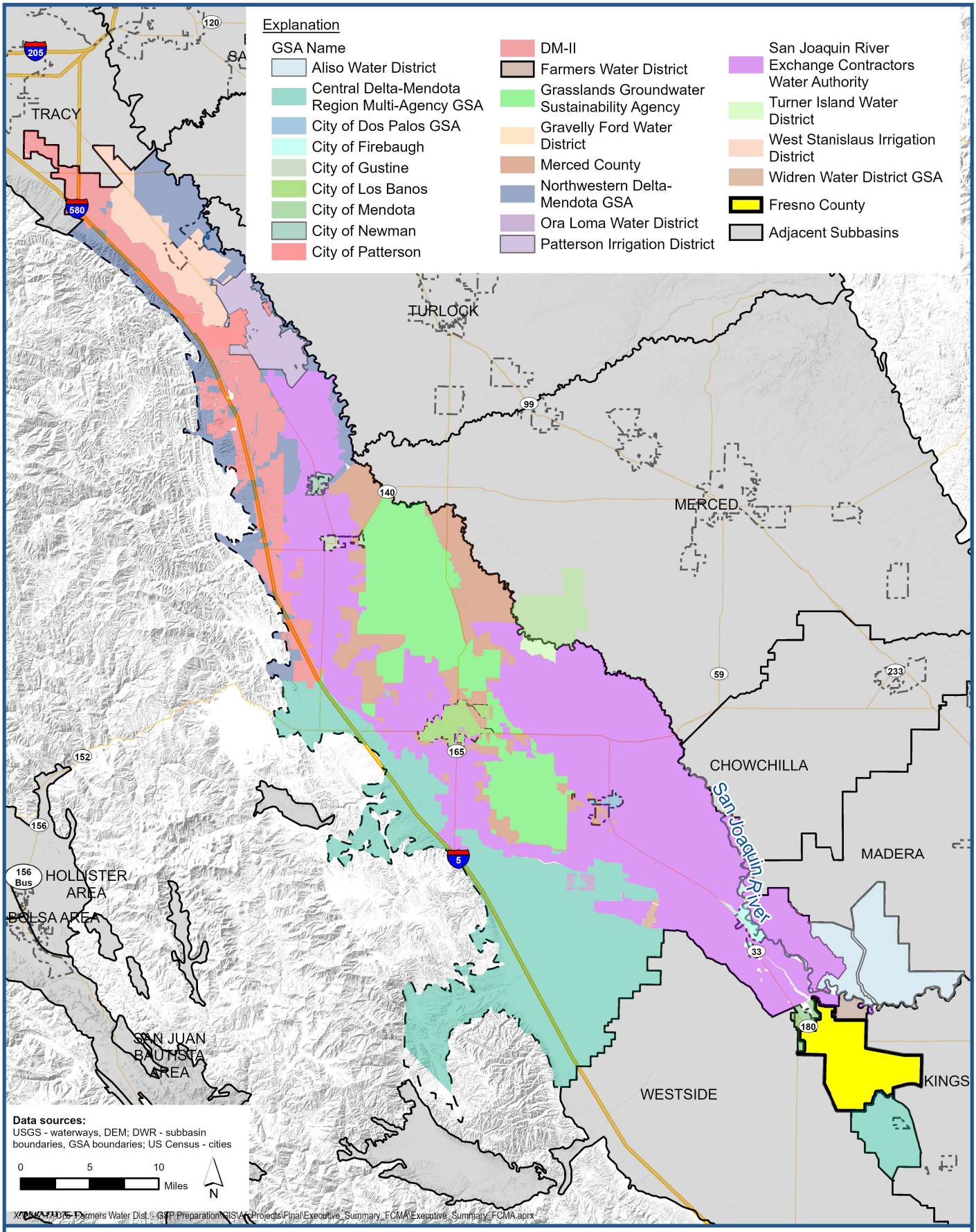
	~~SPRECK-PW-10~~			~~Spreckels Semi-Annual~~
	~~SPRECK-PW-12~~			~~Spreckels Semi-Annual~~
	~~FS-5~~			~~MPG~~
	~~KRCDA06~~			~~No Existing Program~~
	SC-4B			MPG
	TLF-6d			MPG
	TLF-12d			MPG
Subsidence	Fordel-Ext	Annual	Annual High: (January-May)	USGS
	P304-PBO			UNAVCO
~~**Interconnected Surface Waters**~~	~~Mendota Pool Staff Gage~~	~~Semi Annual~~	~~Season High: (February-April) Season Low: (September-October)~~	~~SLDMWA~~

CHAPTER 5 – PROJECTS AND MANAGEMENT ACTIONS

The FCMA has not formally developed any projects or management actions. Projected conditions indicate the FCMA will operate under sustainable conditions. In the event of undesirable results, the FCMA will work with local stakeholders to develop targeted pumping reductions to achieve sustainable conditions for the Upper Aquifer.

CHAPTER 6 – PLAN IMPLEMENTATION

GSP costs are estimated to be about $5.3 million dollars over the next 20 years with an annual average of $250,000. These costs include annual reporting to DWR and five-year updates to the GSP accounting for inflation. The GSP will be implemented in accordance with SGMA, with annual updates and 5-year updates submitted to DWR by April 1st and January 31st on the years they are due, respectively.



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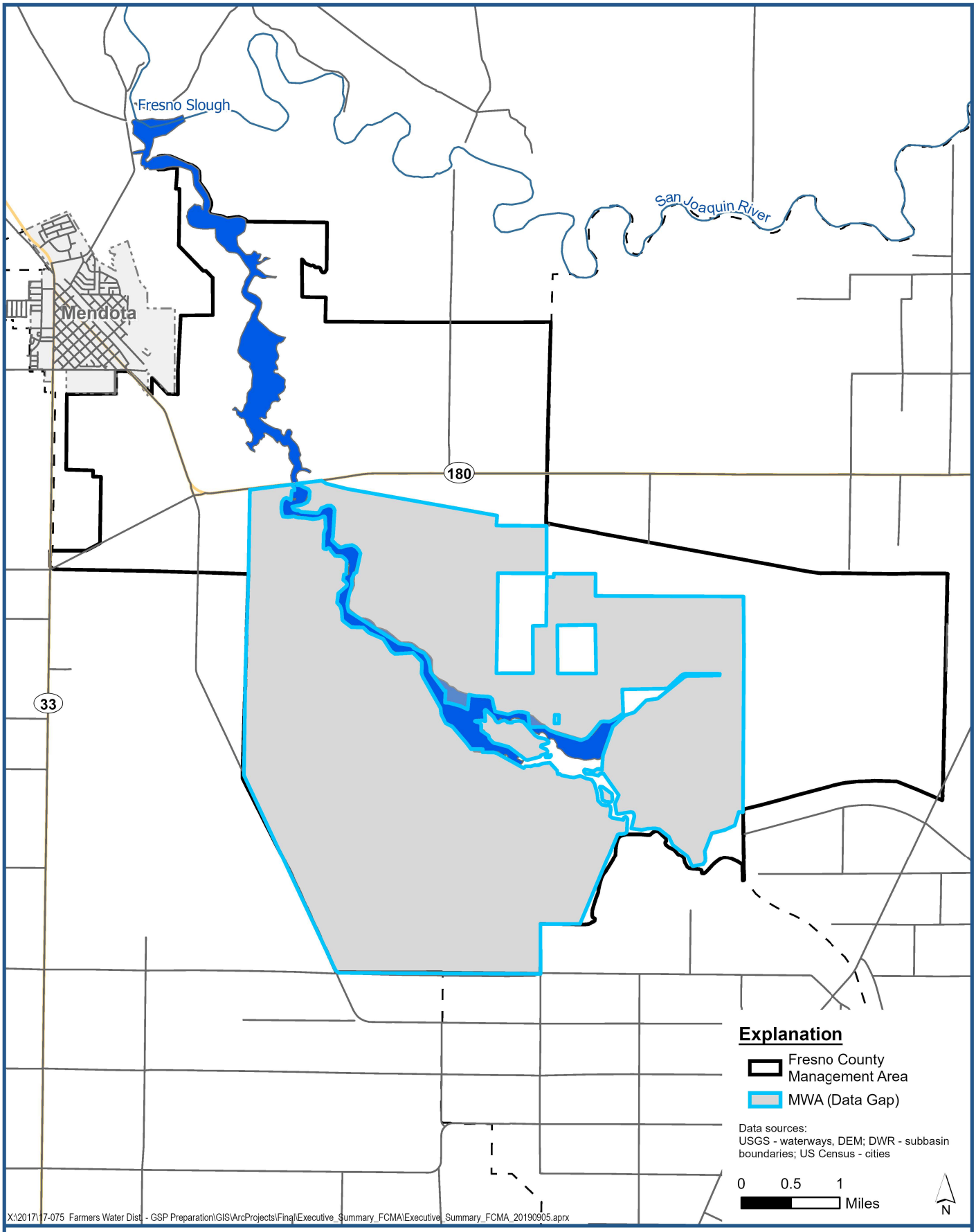
Delta-Mendota GSAs and Surrounding Subbasins

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure ES-1



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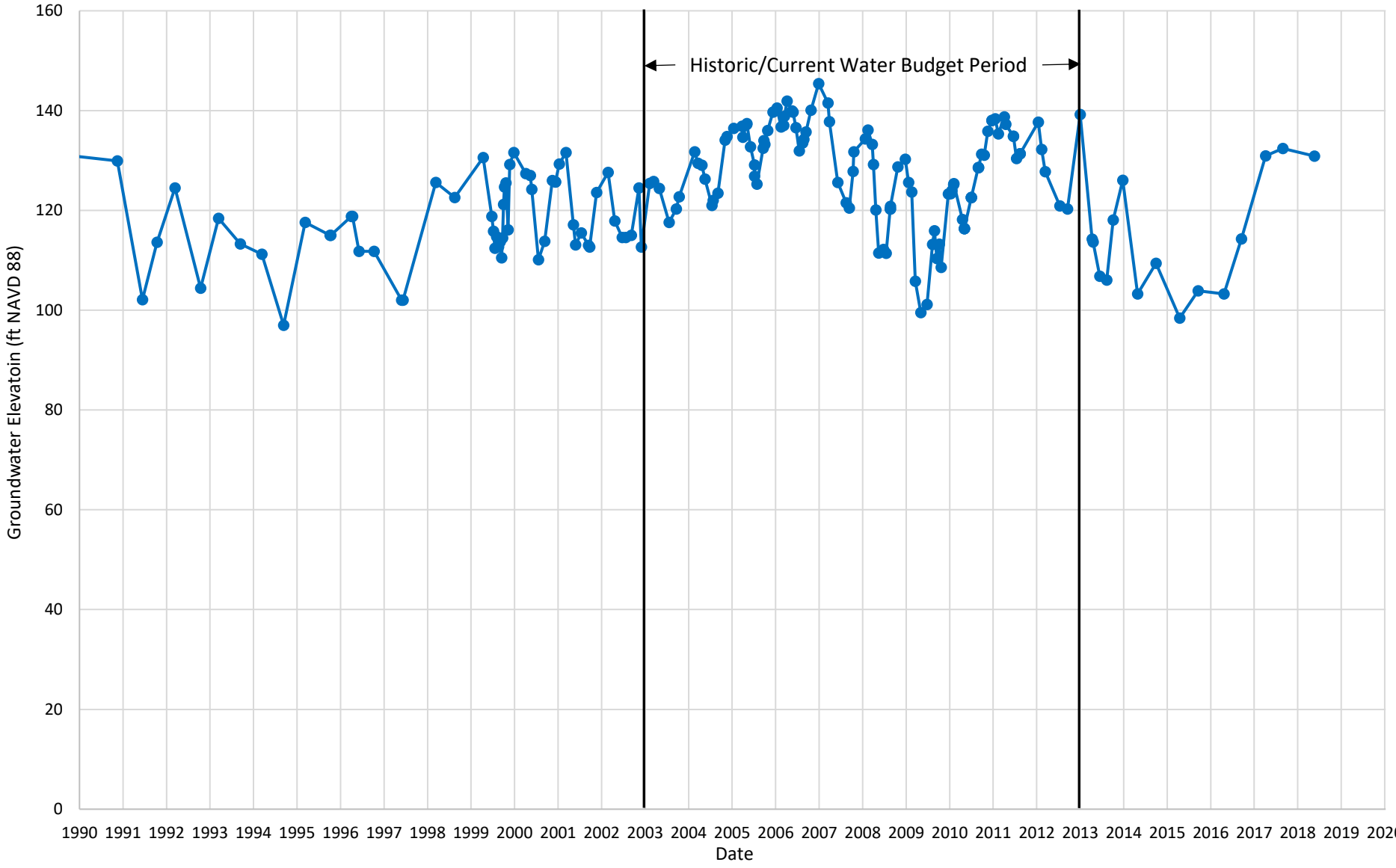
Fresno County Management Area Data Gaps

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure ES-2



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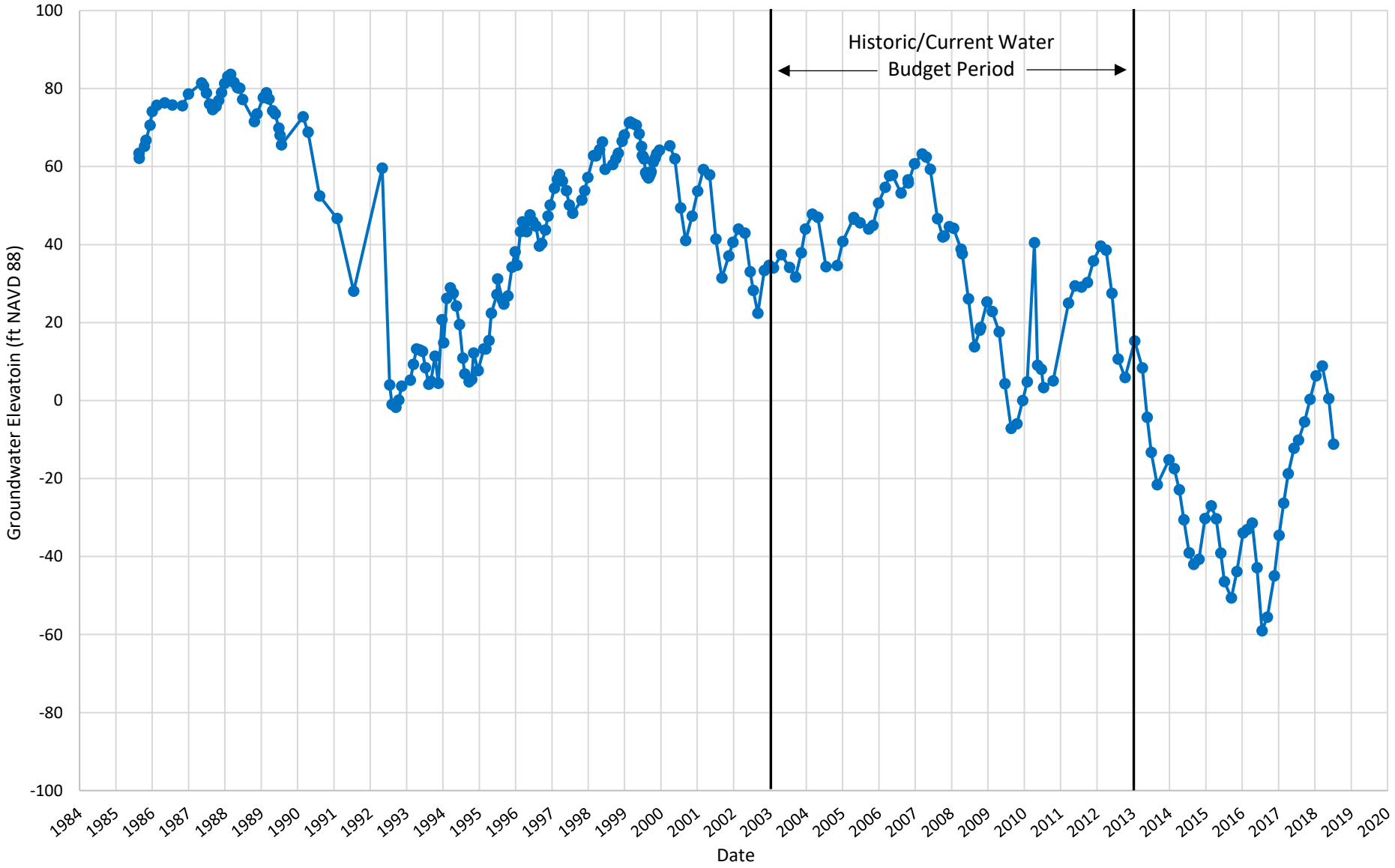
SPRECK MW-11 Upper Aquifer Deep Zone Hydrograph

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure ES-3



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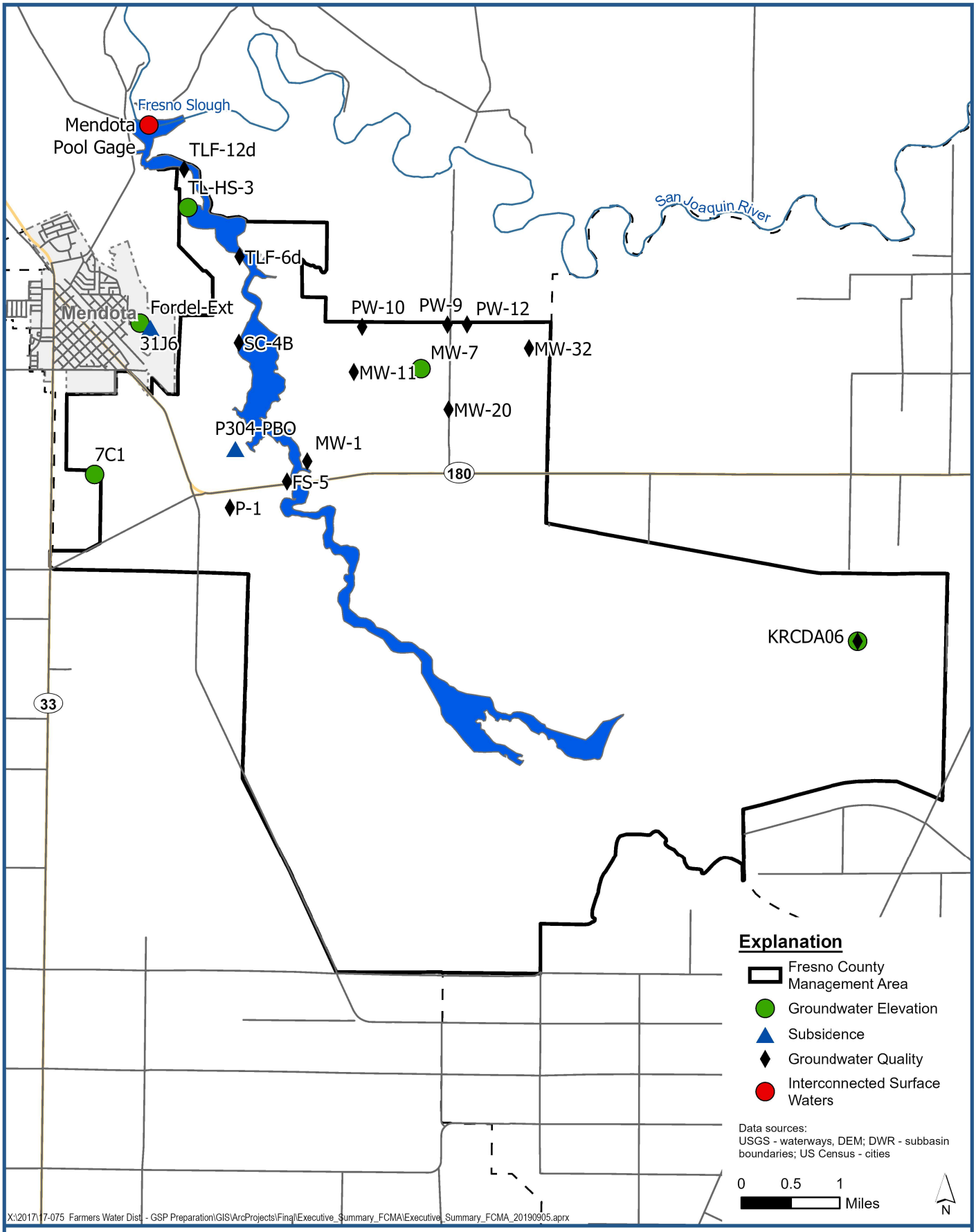
USGS 31J6 Lower Aquifer Hydrograph

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure ES-4



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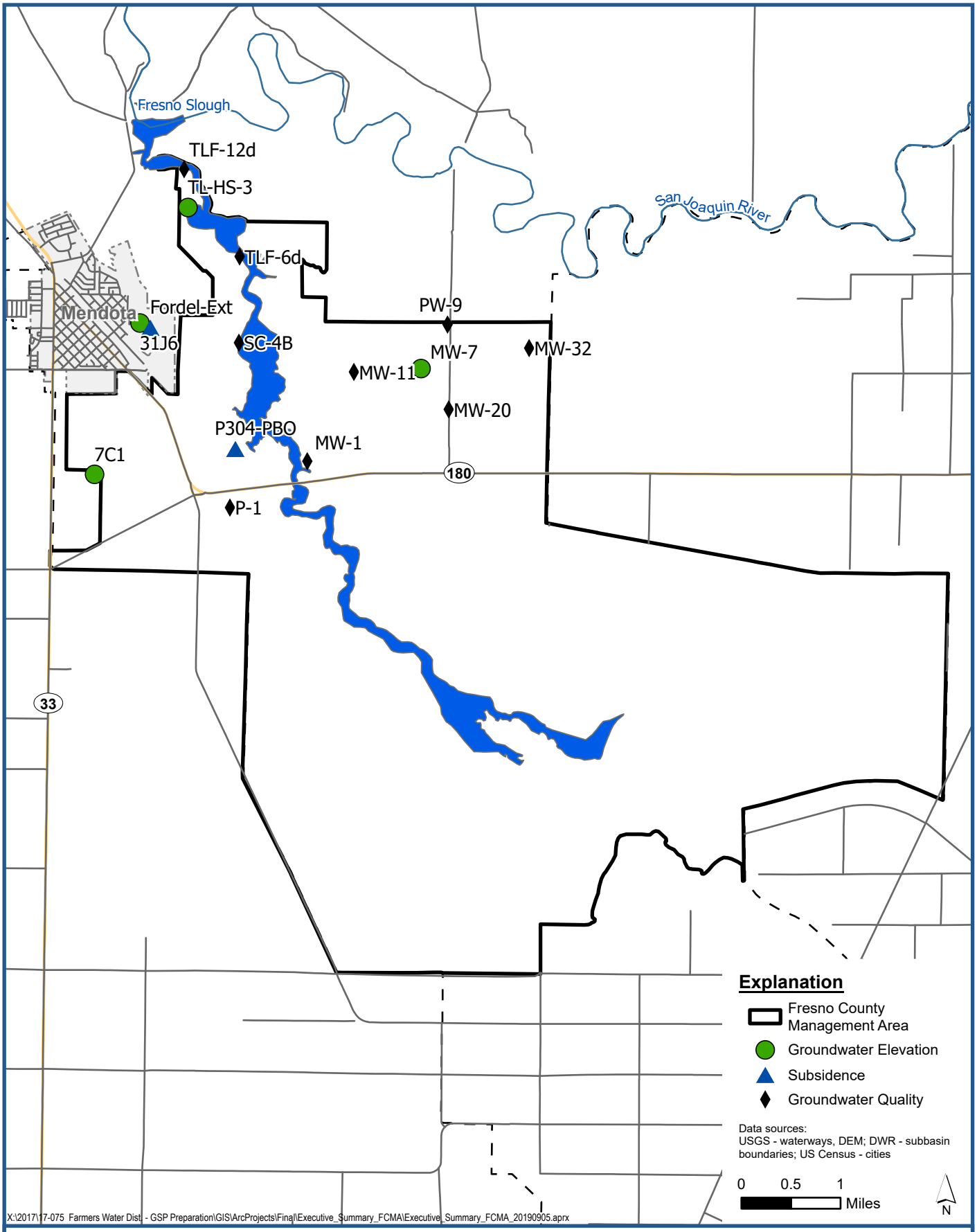
Fresno County Monitoring Network

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure ES-5



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Fresno County Monitoring Network

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure ES-5

1 INTRODUCTION

1.1 Purpose of Groundwater Sustainability Plan

The Sustainable Groundwater Management Act (SGMA) was signed into law in 2014 for the purposes of protecting California's groundwater resources. SGMA requires all high and medium priority basins to develop Groundwater Sustainability Plans (GSP) to prevent overdraft and achieve sustainability in the utilization of groundwater resources. The Delta-Mendota Subbasin (Basin 5-022.07 in the California Department of Water Resources Bulletin 118) (Subbasin) is a high priority Subbasin that has a critical overdraft designation. This Subbasin is a very important agricultural region of the State and the protection of groundwater is vital to the economy and environment in the San Joaquin Valley. The Subbasin consists of 24 Groundwater Sustainability Agencies (GSA) who together created six individual GSA groups, each preparing a GSP. Each individual GSP contains a "common chapter" that covers required elements related to the entire subbasin (Groundwater Sustainability Plan: Common Chapters). This common chapter was developed by Woodard Curran. This plan contained information on the entire subbasin including governance, subbasin setting, sustainable management criteria, subbasin monitoring network, and stakeholder outreach (**Appendix A**). A coordination agreement between all the GSAs and GSP groups was finalized on December 18, 2018 (**Appendix B**).

Fresno County chose to create two~~a~~ GSA's for County areas within the Subbasin that were not located within existing GSAs. Small areas of the Fresno County Management Area B GSA that are located north of the Farmers Water District (FWD) GSA are covered in the San Joaquin River Exchange Contractors (SJREC) GSP as part of a Memorandum of Understanding agreement between Fresno County and the SJREC. This GSP covers the southern portion of the Subbasin south of the San Joaquin River (SJR). Fresno County's GSA was formed on 05/02/2017 (**Appendix C**). The MOU with the SJREC is attached as **Appendix D**. The County formed two GSA's, Management Area A (MAA) and Management Area B (MAB). This GSP covers both MAA and MAB and is collectively referred to as Fresno County Management Areas (FCMA). ~~MAA and MAB are considered management areas within the Subbasin and were developed to represent unique areas within the Subbasin.~~ The MAA and MAB are shown in **Figures 1-1 and 1-2**.

SGMA requires that when multiple GSPs are developed for a single groundwater basin or subbasin that each GSP is developed using the same data and methodologies. Eight technical memoranda (TM) were developed by the Delta-Mendota Technical Working Group to ensure that GSPs are consistent across the Subbasin. The following is a list of TMs developed for GSP development in the Subbasin. Each of the TMs are attached in **Appendix E**.

- TM 1 – Common Datasets and Assumptions used in the Delta-Mendota Subbasin GSPs
- TM 2 – Assumptions for the Hydrogeological Conceptual Model of the Delta-Mendota Subbasin
- TM 3 – Assumptions for the Historic, Current, and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check and Sustainable Yield

- TM 4 – Assumptions for the Delta-Mendota Subbasin Management Areas, Sustainable Management Criteria
- TM 5 – Assumptions for the Delta-Mendota Subbasin Monitoring Network
- TM 6 – Coordination of the Delta-Mendota Subbasin Data Management System
- TM 7 – Adoption and Use of the Subbasin Coordination Agreement
- TM 8 – Coordinated Noticing, Communication, and Outreach Activities in the Delta-Mendota Subbasin

This GSP describes the existing hydrogeologic conditions and current management practices in the area of FCMA. It also contains the steps that will be taken to achieve sustainability over the next 20 years by preventing undesirable results by monitoring for the following sustainability indicators as defined by SGMA:

- Chronic Lowering of Groundwater Levels
- Reduction in Groundwater Storage
- Degraded Water Quality
- Subsidence
- Depletion of Interconnected Surface Water
- Seawater Intrusion

All but seawater intrusion applies to the FCMA and each applicable sustainability indicator will be addressed in this GSP and be integrated into the GSP monitoring program. The Subbasin is not located adjacent to the Pacific Coast and therefore seawater intrusion cannot occur. Measurable objectives and minimum thresholds have been set for each sustainability indicator based on projected hydrologic conditions through the use of a numerical groundwater flow model. This GSP, in coordination with the five other GSPs for the Subbasin, will result in sustainability and the preservation of groundwater resources for all beneficial users of groundwater.

1.1.1 Justification for Management Areas

No management areas are designated in the FCMA. ~~As mentioned above, the County of Fresno has designated two management areas within the Delta-Mendota Subbasin. The justification for each is described below. Each area is to be treated as a separate management area for reasons of land use, existing water management, groundwater quality, and monitoring programs that are unique to each management area.~~

~~#### 1.1.1.1 Management Area A~~

~~MAA is defined as a management area due to the presence and operation of the Meyers Farm Water Bank and separately, impaired water quality underlying the former Spreckels Sugar Plant that has migrated northward to the southerly portion of the FWD GSA (**Figure 1-1**). The Meyers Farm Water Bank (Water Bank) is permitted by the Bureau of Reclamation and stores surface water in the Upper Aquifer for use by Meyers Farms or for exchange with the U.S. Bureau of Reclamation (USBR). The Water Bank is~~

~~a beneficial recharge facility in this portion of the Subbasin. The former Spreckels Sugar Company, whose historical sugar beet processing activities involved the discharge of sugar beet processing waste that was discharged to areas surrounding the processing plant. The discharges resulted in an increase in salinity concentrations in the quality of the groundwater in the Upper Aquifer to concentrations above background concentrations. The plume of saline-impacted groundwater is migrating in a northerly/northeasterly direction. Remediation activities to address the impacts to groundwater quality are currently under development to contain and remediate the contamination resulting from the historical discharge activities. This area will need continued monitoring to ensure the contamination is contained and remediated. Due to the existing conditions, MAA will require different minimum thresholds and measurable objectives than the Subbasin as a whole in order to facilitate Plan implementation and to address the groundwater quality sustainability indicator. Clean-up of the Steffens Plume is currently under the purview of the Central Valley Regional Water Quality Control Board (Regional Board).~~

~~1.1.1.2 Management Area B~~

~~MAB is defined as a management area due to water quality issues resulting from the easterly migration of groundwater that has naturally high concentrations of total dissolved solids (TDS) and a majority of its land use is designated as Open Space as represented by the Mendota Wildlife Area (MWA) that is owned and managed by the State of California Department of Fish and Wildlife (CDFW) (**Figure 1-2**). Under California law, Open Space areas are protected for the purpose of protecting natural resources. The remaining areas of MAB are either domestic parcels, agricultural or private recreational in contrast to MAA. A portion of the Alkali Ecological Reserve is also present in MAB. The Mendota Pool portion of the Fresno Slough is present in MAB, which is utilized by the SJREC for the the distribution of surface water supplies discharged into the Mendota Pool from the Delta-Mendota Canal and by the USBR for several groundwater exchange programs and as a conveyance facility for MAB landowners (and other landowners) to convey water to disconnected parcels for irrigation purposes. Due to the exchange programs and Open Space designation for the MWA, the MAB will incorporate monitoring and different minimum thresholds and measurable objectives as compared to MAA in order to implement this GSP.~~

1.2 Sustainability Goal

The coordinated Sustainability Goal for the Delta-Mendota Subbasin is as follows:

The Delta-Mendota Subbasin will manage groundwater resources for the benefit of all users of groundwater in a manner that allows for operational flexibility, ensures resource availability under drought conditions, and does not negatively impact surface water diversions and conveyance and delivery capabilities. The goal will be achieved through the implementation of the proposed projects and management actions to reach identified measurable objectives and milestones through the implementation of the GSP(s), and through continued coordination with neighboring subbasins to ensure the absence of undesirable results by 2040.

The Sustainability Goal is based on information presented in the basin settings and should include measures that will be taken to operate within the basin's Sustainable Yield. Two principal aquifers, the Upper and Lower, were identified in the FCMA GSP and Common Chapters for the Subbasin. The hydrogeologic properties of these aquifers and responses to different groundwater management practices were evaluated in the Basin Settings chapters of the FCMA GSP and Common Chapters. Sustainable yields were for the entire subbasin for both the Upper and Lower Aquifer based on historic conditions. The Sustainable Yield numbers were based on historic pumping practices and the absence of undesirable results based on historic conditions. At the local level, FCMA will manage groundwater resources in a manner that results in the absence of undesirable results for the Upper Aquifer by the year 2040. This will be accomplished in FCMA by operating within historic groundwater management practices and maintain water levels within the historic hydrograph. FCMA is not expected to extract groundwater from the Lower Aquifer over the projected water budget period. Lower Aquifer conditions will be monitored and managed in coordination with other entities that utilize the Lower Aquifer as a source of groundwater. Sustainability will be accomplished through the continuation of existing monitoring, data collection and inter-basin coordination to improve our understanding of regional influences on Lower Aquifer conditions. Coordination and communication with surrounding GSAs will be conducted to implement management actions that will prevent over extraction of groundwater and maintain stable conditions for each of the sustainability indicators in the Upper and Lower Aquifers.

~~FCMA will manage groundwater resources in a manner that results in the absence of undesirable results for the Upper Aquifer by the year 2040. FCMA is not expected to extract groundwater from the Lower Aquifer over the projected water budget period. Lower Aquifer conditions will be monitored and managed in coordination with other entities that utilize the Lower Aquifer as a source of groundwater. Sustainability will be accomplished through the continuation of existing monitoring and data collection and intra-basin and inter-basin coordination to improve our understanding of regional influences on Lower Aquifer conditions. Coordination and communication with surrounding GSAs will be conducted to implement management actions that will prevent over extraction of groundwater and maintain stable conditions for each of the applicable sustainability indicators in the Upper and Lower Aquifers.~~

~~FCMA has exhibited sustainable conditions during normal hydrogeologic conditions when the average change in storage is slightly positive and groundwater levels are generally stable over the historic period. Extended dry periods, such as those during 2012 through 2016, exhibited significant reductions in groundwater storage and conditions that are not sustainable. Using the current understanding of groundwater conditions in the FCMA as they relate to variable hydrogeologic conditions, the FCMA plan area will be managed and monitored to ensure the sustainability goal is met by 2040. Further investigation of existing data gap areas and development of future projects and management actions will ensure that sustainable conditions are maintained through the planning and implementation horizon (2040 through 2070).~~

1.3 Agency Information

The FCMA is the County of Fresno Water and Natural Resources Division which is under the Department of Public Works and Planning. The location of the Agency is provided below.

1.3.1 Organization Management and Structure of GSA

The Fresno County Board of Supervisors and Augustine Ramirez~~Glenn Allen~~ (~~Division Manager of Water~~Senior Engineer of the Water and Natural Resources Division of the Department of Public Works and Planning) are the persons with management authority for implementation for the GSP.

County of Fresno
Department of Public Works and Planning
Water and Natural Resources Division
2220 Tulare Street. 6th Floor
Fresno, CA 93721

Plan Manager: ~~Glenn Allen~~Augustine Ramirez
Phone: (559) 600-4022~~292~~
Email: auramirez@fresnocountyca.gov

1.3.2 Legal Authority of the GSA

Fresno County has water supply, water management, and land use responsibilities and authorities in the portion of the Subbasin located within Fresno County and therefore, can decide to become a GSA.

The following are powers in addition to authorities granted to GSAs by SGMA (Water Code §§ 10725 *et seq*.):

- Adopt standards for measuring and reporting water use
- Adopt rules, regulations, policies and procedures to govern the adoption and implementation of the GSP, as authorized by SGMA including funding of the GSA, and the collection of fees or charges as may be applicable
- Develop and implement conservation best management practices
- Develop and implement metering, monitoring and reporting related to groundwater pumping
- Hire consultants as determined necessary or appropriate by the GSA
- Prepare a budget

Fresno County's Board of Supervisors adopted two resolutions (No. 17-274 and 17-276) and was recognized as the GSA in Management Areas A and B in the unmanaged areas of the Delta Mendota Subbasin (**Appendix C**).

1.3.3 Estimated Cost of Implementing the GSP

The County pursued grant funding opportunities in coordination with other GSAs in the Subbasin for a portion of GSP preparation costs. The Subbasin received additional funding to develop the GSP from a landowner's donations to the County. The County has expended approximately $550,000 on GSP development and related activities.

FCMA will fund GSP implementation through a combination of extraction and land-based fees applied to land owners in the plan area. Annual administration costs for the GSP are estimated to be $120,000. The ongoing costs of GSP implementation will be subject to further planning and GSA approvals for future actions, including but not limited to monitoring, metering, measurement, well inventory survey, and other activities. The total estimated costs of GSP implementation is $5.5 million over the next 20 years.

1.4 GSP Organization

SGMA requires that each GSP include a table that catalogs all GSP requirements and their location in the document.

Table 1-1: Preparation Checklist for GSP Submittal

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) or Page Number(s) in the GSP
Article 3. Technical and Reporting Standards				
352.2		Monitoring Protocols	- Monitoring Protocols adopted by the GSA for data collection and management - Monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence for basins for which subsidence has been identified as a potential problem, and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin	Section 4.6, Pg. 80
Article 5. Plan Contents, Subarticle 1. Administrative Information				
354.4		General Information	- Executive Summary - List of References and Technical Studies	Executive Summary: ES-1 References: Section 7, Pg. 97
354.6		Agency Information	- GSA Mailing Address - Organization and Management Structure - Contact Information of Plan Manager - Legal Authority of GSA - Estimate of Implementation Costs	Section 1.3, Pg. 4

354.8.(a)	10727.2.(a).4	Map(s)	- Area covered by GSP - Adjudicated areas, other agencies within the basin, and areas covered by an Alternative - Jurisdictional boundaries of federal or State land - Existing Land Use Designations - Density of wells per square mile	Section 2.1, Pg. 11
354.8.(b)		Description of the Plan Area	- Summary of jurisdictional areas and other features	Section 2.1, Pg. 11
354.8.(c)(d)(e)	10727.2(g)	Water Resource Monitoring and Management Programs	- Description of water resources monitoring and management programs - Description of how the monitoring networks of those plans will be incorporated into the GSP - Description of how those plans may limit operational flexibility in the basin - Description of conjunctive use programs	Section 2.2, Pg. 12
354.8.(f)	10727.2(g)	Land Use Elements or Topic Categories of Applicable General Plans	- Summary of general plans and other land use plans - Description of how implementation of the GSP may change water demands or affect achievement of sustainability and how the GSP addresses those effects - Description of how implementation of the GSP may affect the water supply assumptions of relevant land use plans - Summary of the process for permitting new or replacement wells in the basin - Information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management	Section 2.3, Pg. 12
354.8.(g)	10727.4	Additional GSP Contents	**Description of Actions related to:** - Control of saline water intrusion - Wellhead protection - Migration of contaminated groundwater - Well abandonment and well destruction program - Replenishment of groundwater extractions - Conjunctive use and underground storage - Well construction policies - Addressing groundwater contamination cleanup, recharge, diversions to storage, conservation, water recycling, conveyance, and extraction projects - Efficient water management practices - Relationships with state and federal regulatory agencies - Review of land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity	Section 2.4, Pg. 13

			- Impacts on groundwater dependent ecosystems	
354.10		Notice and Communication	- Description of beneficial uses and users - List of public meetings - GSP comments and responses - Decision-making process - Public engagement - Encouraging active involvement - Informing the public on GSP implementation progress	Section 2.5, Pg. 16
Article 5. Plan Contents, Subarticle 2. Basin Setting				
354.14		Hydrogeologic Conceptual Model	- Description of the Hydrogeologic Conceptual Model - Two Scaled Cross-Sections - Map(s) of Physical Characteristics: topographic information, surficial geology, soil characteristics, surface water bodies, source and point of delivery for imported water supplies	Section 3.1, Pg. 25
354.14.(c).4	10727.2.(a).5	Map of Recharge Areas	- Map delineating existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas	Section 3.1.5, Pg. 30
354.14.(c).4	10727.2.(d).4	Recharge Areas	- Description of how recharge areas identified in the plan substantially contribute to the replenishment of the basin	Section 3.1.5, Pg. 30
354.16	10727.2.(a).1, 10727.2.(a).2	Current and Historical Groundwater Conditions	- Groundwater elevation data - Estimate of groundwater storage - Seawater intrusion conditions - Groundwater quality issues - Land subsidence conditions - Identification of interconnected surface water systems - Identification of groundwater -dependent ecosystems	Section 3.2, Pg. 34

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354.18	10727.2.(a).3	Water Budget Information	- Description of inflows, outflows, and change in storage - Quantification of overdraft - Estimate of sustainable yield - Quantification of current, historical, and projected water budgets	Section 3.3, Pg. 44
354.18	10727.2.(d).5	Surface Water Supply	- Description of surface water supply used or available for use for groundwater recharge or in-lieu use	Section 3.3.7, Pg. 51
354.20		Management Areas	- Reason for creation of each Management Area - Minimum Thresholds and Measurable Objectives for each Management Area - Level of monitoring and analysis - Explanation of how management of Management Areas won't cause undesirable results outside the Management Area - Description of Management Areas	Section 3.4, Pg. 54
Article 5. Plan Contents, Subarticle 3. Sustainable Management Criteria				
354.24		Sustainability Goal	- Description of the Sustainability Goal	Section 4.1, Pg. 57
354.26		Undesirable Results	- Description of Undesirable Results - Cause of Groundwater Conditions that would lead to Undesirable Results - Criteria used to define Undesirable Results for each sustainability indicator - Potential effects of Undesirable Results on beneficial uses and users of groundwater	Section 4.4, Pg. 74
354.28	10727.2.(d).1, 10727.2.(d).2	Minimum Thresholds	- Description of each minimum threshold and how they were established for each sustainability indicator - Relationship for each sustainability indicator - Description of how selection of the Minimum Threshold may affect beneficial uses and users of groundwater - Standards related to sustainability indicators - How each minimum threshold will be quantitatively measured	Section 4.3, Pg. 64
354.30	10727.2.(b).1, 10727.2.(b).2, 10727.2.(d).1 10727.2.(d).2	Measurable Objectives	- Description of establishment of the measurable objectives for each sustainability indicator - Description of how a reasonable margin of safety was established for each measurable objective - Description of a reasonable path to achieve and maintain the sustainability goal, including a description of IM	Section 4.2, Pg. 57
Article 5. Plan Contents, Subarticle 4. Monitoring Networks				

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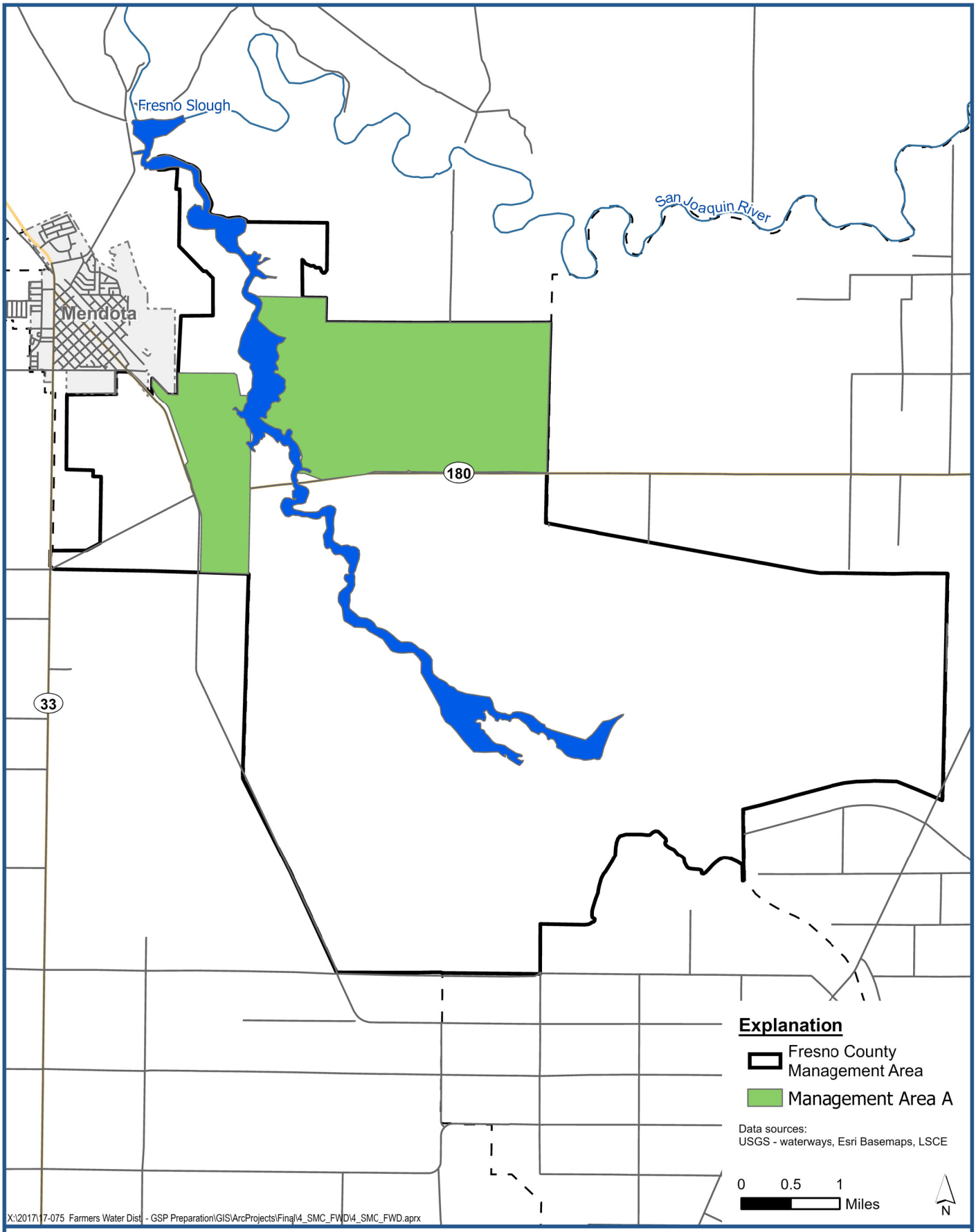
354.34	10727.2.(d).1, 10727.2.(d).2, 10727.2.(e), 10727.2.(f)	Monitoring Network	- Description of Monitoring network - Description of Monitoring network objectives - Description of how the monitoring network is designed to: demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features; estimate the change in annual groundwater in storage; monitor seawater intrusion; determine groundwater quality trends; identify the rate and extent of land subsidence; and calculate depletions of surface water caused by groundwater extractions - Description of how the monitoring network provides adequate coverage of sustainability indicators - Density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends	Section 4.5, Pg. 77
			- Scientific rational (or reason) for site selection - Consistency with data and reporting standards - Corresponding sustainability indicator, minimum threshold, measurable objective, and interim milestone - Location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used - Description of technical standards, data collection methods, and other procedures or protocols to ensure comparable data and methodologies	Section 4.5, Pg. 77
354.36		Representative Monitoring	- Description of representative sites - Demonstration of adequacy of using groundwater elevations as proxy for other sustainability indicators - Adequate evidence demonstrating site reflects general conditions in the area	N/A
354.38		Assessment and Improvement of Monitoring Network	- Review and evaluation of the monitoring network - Identification and description of data gaps - Description of steps to fill data gaps - Description of monitoring frequency and density of sites	Section 4.5.2, Pg. 77
Article 5. Plan Contents, Subarticle 5. Projects and Management Actions				

354.44		Projects and Management Actions	- Description of projects and management actions that will help achieve sustainability goal - Measurable objective that is expected to benefit from each project and management actions - Circumstances for implementation - Public noticing - Permitting and regulatory process - Time-table for initiation and completion, and the accrual of expected benefits - Expected benefits and how they will be evaluated - How the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall be included. - Legal authority required - Estimated costs and plans to meet those costs - Management of groundwater extractions and recharge	Section 5, Pg. 79
354.44.(b).2	10727.2.(d).3		- Overdraft mitigation projects and management actions	Section 5, Pg. 86



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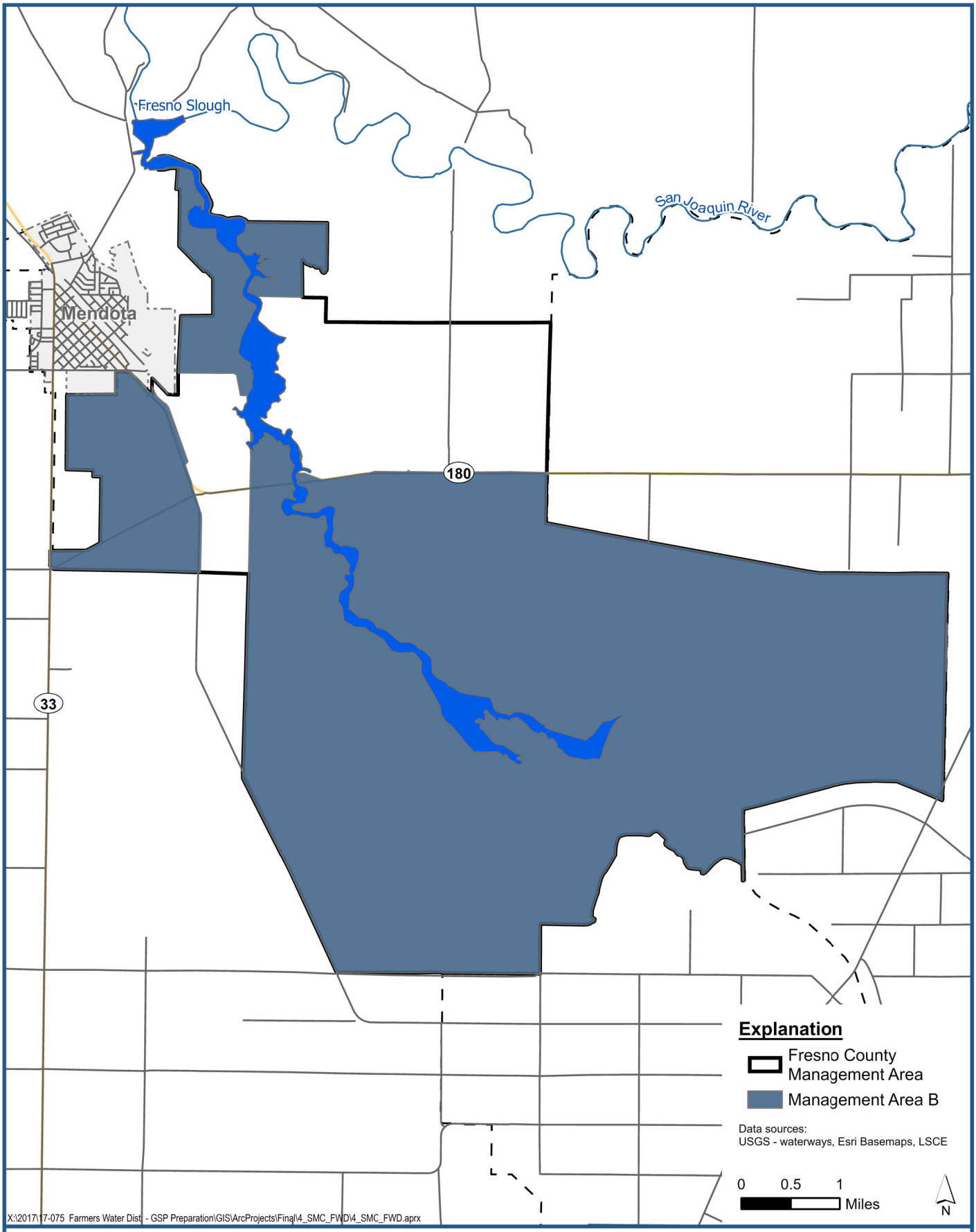
Fresno County Management Area A

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 1-1



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Fresno County Management Area B

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 1-2

2 PLAN AREA

2.1 Summary of Jurisdictional Areas and Other Features

The FCMA are located in the southern portion of the Subbasin (**Figure 2-1**) adjacent to the Kings and Westside Subbasins. Adjacent GSAs include Farmers Water District GSA, Tranquility Irrigation District (a member of the North-Central Delta-Mendota Region Multi-Agency GSA), City of Mendota, the SJREC, Westland Water District, McMullin Area GSA, and James Irrigation District (**Figure 2-2**). As mentioned in Chapter 1, small portions of the Fresno County MAB are located within the boundaries of the SJREC GSA along the San Joaquin River. In a Memorandum of Understanding (MOU) with the SJREC (**Appendix D**), the SJREC agreed to incorporate areas of MAB north of MAA and the City of Mendota into the SJREC-prepared GSP. This area is referred to as "County Islands" in the MOU (**Figure 2-3**). Jurisdictional boundaries of State land can be seen in **Figure 2-4**. State Land in this area is controlled by the CDFW. This area is the MWA. All other lands are privately owned (BLM, 2016).

2.1.1 Existing Well Types and Density

Well types, well depth data, and well distribution data were downloaded from DWR's Well Completion Report Map Application (DWR, 2018). DWR categorizes wells in this mapping application as either domestic, production, or public supply. These categories are based on the well use information submitted with the well logs to DWR. **Table 2-1** summarizes the types of well by use for all well logs submitted to DWR. Since most of the wells in the subbasin are used for agriculture, it is assumed that most of the well logs that are categorized as production wells are used for agriculture.

Table 2-1: Types of Wells[1]

Type of Well	Total Wells
Domestic	60
Production	207
Public Supply	1
TOTAL	**368**

[1]DWR SGMA Data Viewer – Well Reports Statistics in FCMA; downloaded on December 10, 2018

Figures 2-5 through **2-7** show the density of wells in the FCMA GSP area by their type of use. These figures show the well density data on a grid made of one square mile segments. The DWR data used to develop these maps is not necessarily the same set of well data held by Fresno County. DWR data was used to develop maps of well densities because they are organized for easy mapping of well density per square mile. These maps should be considered representative of well distribution, but not definitive.

2.2 Water Resources Monitoring and Management Programs

2.2.1 Mendota Pool Group

Existing water management programs include the Mendota Pool Group Monitoring and Reporting Program. The Mendota Pool Group (MPG) is a group of landowners, which includes farming interests located within MAA and MAB, that are involved in an exchange program with the USBR and in irrigated farming activities within the FCMA. The exchange program involves the discharge of groundwater into the Fresno Slough portion of the Mendota Pool (Pool) for use by the USBR in exchange for Central Valley Project (CVP) water deliveries to MPG-owned lands in San Luis Water District and Westlands Water District. Annual reports are produced in compliance with *Agreement No. 2 for Mendota Pool Transfer Pumping Project* (Agreement No. 2), the annual extension of Agreement No. 2, and the Environmental Impact Statement (EIS) entitled *Mendota Pool 10-Year Exchange Agreements* (USBR, 2005). The purpose of the monitoring program and annual reporting is to identify the effects of transfer pumping on local water supplies in the vicinity of the Mendota Pool and adjacent areas.

The MPG Monitoring Program was established in 1999, and over the past two decades of annual reporting has created an extensive record of groundwater, surface water, and geologic data. Some of the MPG monitoring data applicable to the FCMA GSP effort will be used to develop and implement the GSP for FCMA. Existing monitoring location (e.g. Wells, Extensometers, Surface Water Sampling Locations) will be incorporated, as necessary, into the Subbasin and FCMA monitoring network.

2.3 Land Use Elements or Topic Categories of Applicable General Plans

Land use for current conditions can be seen in **Figure 2-8**. FCMA is primarily designated as agriculture and riparian vegetation. The three water use sectors are agricultural, managed recharge, and native vegetation (environmental). The surrounding area is made up of agricultural land use with a significant fallowed land. The significance between agricultural and nonagricultural is the effect of applied irrigation. The depicted land use conditions were used for the projected water budget. Land use data is a representation of the year utilized for the GSP current water budget year (2013) and was derived from multiple sources, including the Land IQ (LandIQ, 2014) and DWR land use surveys of Fresno County (DWR, 2000; 2009). Adjustments were made to the land use data sets based on historic aerial imagery and input from landowners. Land use designations under the Fresno County General Plan are summarized below.

Existing land use plans are not expected to significantly change water demands or affect FCMA's ability to achieve sustainability.

2.3.1 Fresno County General Plan

The Fresno County General Plan (FCGP) was last updated in 2000. The FCGP is a blueprint for land use and development. Under the FCGP, all of FCMA is designated as "Agricultural" with the exception of MWA designated as "Open Space". Both of these designations limit the number potential residential

units that could be built within FCMA. As a result of the land use designations in the FCGP for the FCMA, there are no plans or expectations that current land uses will change during the planning and implementation horizon of this GSP. As a result, water demands for domestic uses are not expected to change (Fresno County, 2000). In FCMA areas designated as "Agriculture", some agriculture uses that do not require a special permit are crop and livestock production, packing and sale of crops produced on premises, sale of livestock raised on premises, residence, home occupation, and certain oil and gas development. None of these uses are expected to change water demands that will affect the ability of FCMA to achieve sustainability. Water demands are not expected to change in the "Open Space" area as this designation is intended to preserve natural resources (Fresno County, 2000).

2.3.1.1 Water Supply Assumptions

The FCGP states that the County is to develop a water budget to determine long-term needs and to determine whether existing planned water resource enhancements will meet the county's needs over the next 20 years. This water budget has not yet been developed, therefore there are currently no long-term water supply assumptions for FCMA.

The County produces annual water conservation reports in compliance with Ordinance No. 14-019, approved by the Board of Supervisors on September 30, 2014. Part of these annual reports are to report on water supply and water for areas serviced by the County. This Ordinance does not apply to or limit the use of private wells within FCMA.

2.4 Additional GSP Elements

2.4.1 Well Construction, Well Destruction, and Abandonment Policies

Fresno County Department of Public Health (Environmental Health Division) provides information on its website (https://www.co.fresno.ca.us/departments/public-health/environmental-health/water-surveillance-program/water-well-permitting-program) regarding well construction, destruction, and abandonment. Well standards are consistent with California Well Standards (Bulletins 74-81 and 74-90). Landowners located in an unincorporated area such as the FCMA must obtain a well permit from the Fresno County Environmental Health Division for well related activities. Permits are required to construct new wells, reconstruct, repair, deepen existing wells, and to destroy abandoned wells. Well Permit forms must be submitted to the Environmental Health Division by a contractor who possess an active C-57 Water Well Contractors License, and, after 30 days of completion of work on a well, a well driller's log must be submitted to the Environmental Health Division.

Wells are considered abandoned if they are not used for one year and must be destroyed unless the owner can demonstrate his intention to use the well again for supplying water. Forms and guidelines provided by Fresno County are included in **Appendix F**.

2.4.2 Control of Saline Water Intrusion

Saline water is present in some areas of FCMA and west of the FCMA as the result of natural occurrence of marine sediments which have high levels of naturally occurring salts (Hotchkiss et al., 1971). This saline groundwater is primarily located in some portions of the aquifer zones of the Upper Aquifer which is the primary source of groundwater in the FCMA. Some wells completed in the Upper Aquifer located west of the Mendota Pool and the western margins of the Subbasin show generally increasing trends in salinity due to the occurrence of the naturally occurring saline water that is sourced from the marine sediments. The regional movement of this saline front is governed primarily by the regional groundwater flow gradients influenced by groundwater pumping east of the FCMA in Madera County. The gradients of groundwater flow generally are to the northeast and east toward Madera County. On a local scale, groundwater pumping in the vicinity of the Mendota Pool may influence the concentrations of salinity (TDS) in supply wells located in the Upper Aquifer.

2.4.3 Migration of Contaminated Groundwater and Cleanup Activities

Within MAA, the former Spreckels Sugar Company operated in Mendota from 1961 to 2008. To process sugar, the company used the Steffens Process which produces a non-toxic filtrate but has a very high concentration of salt. Until 1990, this filtrate was disposed to onsite ponds (125 acres) and had significant impacts on soil and groundwater quality. The site now consists of 33 monitoring wells that are monitored semi-annually for groundwater levels and quality. The monitoring and mitigation of contaminated groundwater in this area is under the purview of the Central Valley Regional Water Quality Control Board (Regional Board). To address the issue, the regional board has issued cleanup and abatement orders to the parties responsible (**Appendix G**).

A subset of the existing monitoring network on the former Spreckels Sugar Company will be incorporated in the SGMA monitoring network. The Steffens plume could potentially limit operational flexibility in the FCMA portion of the Subbasin depending on how the effectiveness of planned remediation and containment efforts. Currently, the horizontal and vertical extent of the plume is being characterized. Groundwater influenced by the plume is located in both the MAA and the southern portion of the FWD GSA, located north of the MAA.

2.4.4 Activities implementing, opportunities for, and removing impediments to, conjunctive use or underground storage.

Ongoing activities related to underground storage include the Meyers Water Bank. The Meyers Farm Water Bank is privately owned and located east of the Fresno Slough branch of the Mendota Pool. It was first established in 2002 as a pilot program with temporary storage of 4,000 acre-feet. The existence and operation of the Water Bank has undergone environmental review with Environmental Assessments (USBR, 2011). The purpose of the Water Bank is to recharge and store water when surface water supplies are available in normal and above normal precipitation years, with recovery of stored water for use during years with below normal surface water supplies. The Water Bank operations include a five

percent leave behind to the Subbasin's aquifer system. The Water Bank prepares and submits reports to USBR periodically on Water Bank operations.

Under the Fresno County General Plan, it is the County's policy to encourage groundwater recharge when economic, environmentally and technically feasible (Fresno County, 2000).

2.4.5 Efficient Water Management Practices

Existing efficient water management practices in Fresno County include utilizing the maximum amount of surface water for agricultural purposes to reduce the amount of groundwater extraction (Policy PF-C.22) and to encourage agricultural water conservation where economically, environmentally, and technically feasible (Policy PF-C328) (Fresno County, 2000).

2.4.6 Wellhead Protection and Planned Recharge Projects

There are no wellhead protection areas or plans for new recharge projects in FCMA.

2.4.7 Efforts to Develop Relationships with State and Federal Regulatory Agencies

The County has reached out to state and federal agencies as part of stakeholder outreach efforts to ensure that these agencies understand the GSP development process and to provide information critical to understanding how GSP implementation will affect state and federal land and water operations within the FCMA. In particular, the County has reached out to the CDFW on several occasions to understand operations within the MWA and to request permission to construct monitoring wells to fill data gaps in the GSP monitoring program. The CDFW manage the MWA. In addition, outreach to the Bureau of Reclamation and the San Luis and Delta Mendota Water Authority regarding monitoring activities in the Mendota Pool and the San Joaquin River. Other stakeholders within FCMA include landowners who are members of the MPG. Outreach efforts to obtain data and determine landowner interest in GSP development was conducted as part of a landowner survey in 2018. Out of 56 letters that the County distributed to parcel landowners in the FCMA, only three responses were received that expressed interest in the GSP development process. An additional four responses were received in County areas located in the island areas that are being covered by the SJREC GSP.

2.4.8 Impacts on Groundwater Dependent Ecosystems

The areas of Groundwater Depended Ecosystems (GDE) are contained within the MWA and along the Mendota Pool (**Figure 2-9**). These GDEs were identified using the Natural Communities Commonly Associated with Groundwater (NCCAG) data set provide by DWR and The Nature Conservancy (TNC). GDEs were determined by identifying areas of mapped vegetation where the water table depth was within 30 ft of the ground surface. Further discussion on the identification and locations of GDEs in FCMA is located in Section 3.2.7.

In the development of this GSP, GDEs were considered as they are a beneficial user of groundwater. A majority of GDEs are located in the MWA which receives surface water deliveries for environmental

purposes. Since 2005, surface water deliveries have averaged over 26,000 acre-feet per year (AFY). Unless unanticipated reductions in surface water deliveries to the MWA and a corresponding substantial increase in groundwater pumping that results in a reduction in groundwater levels are experienced (which they are not anticipated to occur), there will likely be minimal impacts to GDEs in the MWA. The understanding of the impact of groundwater management has on GDEs will be refined as monitoring is improved in the FCMA and the MWA. GDEs are also present along the Fresno Slough north of the MWA and historically have not been impacted due to the continual presence of surface water. Unless management of the Mendota Pool and Fresno Slough significantly change, there will likely be minimal impact to these GDEs north of the MWA.

2.5 Notice and Communication

2.5.1 Beneficial Uses and Users of Groundwater

Beneficial uses of groundwater in FCMA include agricultural, domestic, and environmental. There are no municipal beneficial users in the FCMA. Agricultural landowners are likely to be the most effected by implementing the GSP. Many farmers are entirely dependent on groundwater for irrigation and will be adversely affected if pumping restrictions are put in place during an extended drought period. Domestic beneficial users include six potential wells that have been identified through the review of the DWR well completion report (WCR) data set. Of these six wells, one has been confirmed by surveys sent out to landowners. Environmental beneficial users include the MWA, the Alkali Sink Ecological Reserve, and GDEs along the Fresno Slough and throughout the MWA.

2.5.2 Opportunities for Public Engagement

To encourage the active involvement of diverse social, cultural, and economic elements of Subbasin residents and interests, public meetings were held to inform the public of the status of GSP development and how they could be involved in the process. A list of public meetings can be seen in the table below (**Table 2-2**). This table includes Coordination Committee meetings intended to discuss plan development between GSA representatives and technical consultants which were open to the public, and public workshops that are posted in the FCMA website which were held for the sole purpose of public engagement in GSP development. The following message is on the FCMA website describing the purpose of the meeting:

> *You are invited to come learn how this landmark legislation may affect you and your property, what we are doing about it, and how you can participate. Collaborating local agencies are hosting a series of public workshops about SGMA. Representatives from local GSA's will be available to answer questions.*

Table 2-2: Opportunities for Public Engagement

Event Name	Date	Location
Joint Workshop of the Coordination Committee and Technical Working Group	Tuesday, June 18, 2019	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Public Workshop	Monday, May 20, 2019	Patterson City Hall, Patterson, CA
Delta-Mendota Public Workshop	Tuesday, May 21, 2019	College Greens Building, Los Banos, CA
Delta-Mendota Public Workshop	Wednesday, May 22, 2019	Romero Elementary School, Gustine, CA
Delta-Mendota Public Workshop	Thursday, May 23, 2019	Mendota Branch Library, Mendota, CA
Delta-Mendota Subbasin Coordination Committee	Monday, May 13, 2019	SLDMWA Admin Offices, Los Banos, CA
Joint Workshop of the Coordination Committee and Technical Working Group	Tuesday, April 16, 2019	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Monday, April 8, 2019	SLDMWA Admin Offices, Los Banos, CA
Joint Workshop of the Coordination Committee and Technical Working Group	Tuesday, March 19, 2019	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Monday, March 11, 2019	SLDMWA Admin Offices, Los Banos, CA
Joint Workshop of the Coordination Committee and Technical Working Group	Tuesday, February 19, 2019	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Monday, February 11, 2019	SLDMWA Admin Offices, Los Banos, CA
Special Joint Meeting of the Delta-Mendota Subbasin Coordination Committee and Technical Working Group	Monday, January 28, 2019	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Monday, January 14, 2019	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Monday, December 10, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Tuesday, October 16, 2018	SLDMWA Admin Offices, Los Banos, CA

Delta-Mendota Subbasin Coordination Committee	Monday, September 10, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Monday, August 13, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Monday, June 11, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Public Workshop	Monday, May 14, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Public Workshop	Thursday, May 17, 2018	Mendota Branch Library, Mendota, CA
Delta-Mendota Subbasin Coordination Committee	Thursday, May 24, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Thursday, April 26, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Thursday, March 22, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Thursday, February 22, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Thursday, January 25, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Thursday, February 22, 2018	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Wednesday, December 13, 2017	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Tuesday, October 10, 2017	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Wednesday, September 13, 2017	SLDMWA Admin Offices, Los Banos, CA
Delta-Mendota Subbasin Coordination Committee	Monday, August 14, 2017	SLDMWA Admin Offices, Los Banos, CA
Fresno County Board of Supervisors	Tuesday, May 2, 2017	Board Chambers, Hall of Records, Fresno CA
Fresno County Board of Supervisors	Monday, July 11, 2022	Board Chambers, Hall of Records, Fresno CA

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FCMA will continue to list opportunities for public engagement on the FCMA website:

https://www.co.fresno.ca.us/departments/public-works-planning/divisions-of-public-works-and-planning/water-and-natural-resources-division/fresno-county-management-areas-a-b

2.5.3 Comments on the Plan

Comment letters received are included in **Appendix H**. Comments were provided from four entities:

1. The Nature Conservancy
2. California Department of Fish and Wildlife
3. Audubon California
4. Spreckels Sugar Company, Inc.

The individual comments were numbered, and the corresponding responses are in the following sections. Pease refer to **Appendix H** to review the comment letters.

2.5.3.1 The Nature Conservancy

Comment 1-1: Beneficial users have been updated in section 2.5.1. Environmental users have been specifically listed as the MWA, the Alkali Ecological Reserve, and other GDEs present in the GSP area.

Comment 1-2: Existing stream flow monitoring has not considered the protection of interconnected surface waters.

Comment 1-3:

- (a) The Fresno County General Plan is being updated for the year 2020. Future GSP updates will consider the goals of the updated Fresno County General Plan.
- (b) No Habitat Conservation Plans or Natural Community Conservation Plans are in the FCMA. GSP regulations do not require the identification of individual species.
- (c) GSP regulations do not require the identification of individual species. Almost all GDEi provided in the NCCAG dataset have been identified as GDEs which is intended to account for all species that may occupy a GDE.

Comment 1-4: Comment noted

Comment 1-5: GSP §354.14 (c) The hydrogeological model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin. The A-Clay has been identified in the cross-sections which is a stratigraphic feature that separates the shallow zone from the rest of the Upper Aquifer. The regulations do not require that we develop a cross-section to depict the interaction of shallow groundwaters with the surface water features.

Comment 1-6: The base of fresh water is well below the Corcoran Clay. No known wells in the FCMA are screened below the Corcoran Clay.

Comment 1-7: The purpose of this section was to identify principal aquifers. The shallow zone has not been identified as a principal aquifer, but part of the Upper Aquifer which is a principal aquifer.

Comment 1-8: Section 3.1.7. updated. One of the remaining wetland data sets one identified as Palustrine. The remaining areas in the wetland's data are designated as Riverine.

Comment 1-9: Comment noted.

Comment 1-10:

- (a) Definition of GDE updated.
- (b) Comment noted
- (c) Comment noted
- (d) Comment noted
- (e) GSP regulations do not require the identification of potential vegetation
- (f) By referencing the level of inundation, we are making a distinction between the wetlands dataset and the vegetation dataset. In these areas where wetlands were removed, depth to groundwater during 2015 and during most years is greater than 30 ft. In this same area, we chose to designate the vegetation as GDEs as the vegetation from aerial imagery is evident and has persisted over time. Section 3.2.7.1 has been updated that in addition to these areas appearing dry, the vegetation is sparse.
- (g) Figure 3-37 updated. Acreage of GDEs maintained and removed not required by regulations.
- (h) Table reference in section 3.2.7.2 updated.

Comment 1-11: Regulations do not require the identification of individual species.

Comment 1-12: Comment noted.

Comment 1-13

- (a) The expanded boundary that extends beyond FCMA boundary serves to characterize conditions that will affect groundwater levels and flow in the FCMA.
- (b) The term natural vegetation does include riparian vegetation
- (c) Table 3-5 has been updated which identifies recharge ponds and canals as "other direct recharge".

Comment 1-14: Comment noted.

Comment 1-15: MOs have been set based on 2015 conditions, corresponding with the year water level data was used to identify existing GDEs. The MO beyond the year 2040 is intended to serve as a floor for groundwater conditions which is intended to protect environmental beneficial users.

Comment 1-16: Naturally occurring high saline water is present in the westside of the FCMA. Measurable objectives have been set based on the naturally occurring increase in TDS concentrations within the FCMA while accounting for the maximum allowed increased in TDS due to anthropomorphic activities based on the *Water Quality Control Plan for the Tulare Lake Basin Second Edition.* Areas impacted by the Steffens Plume have had MOs set based on the determined background concentration.

Comment 1-17: Comment noted.

Comment 1-18:

- (a) The intent of the minimum threshold is to allow for operational flexibility while the FCMA works towards sustainability.
- (b) Section 3.1.8 describes how FCMA will attempt to fill the existing data gap.

Comment 1-19: MT for water quality have been established to allow for operational flexibility while the FMCA works toward sustainability.

Comment 1-20: Comment noted.

Comment 1-12: Comment noted.

Comment 1-21: Comment noted.

Comment 1-22: Statement added to section 4.4.1.5

Comment 1-23:

- (a) Section 4.5.2 states, "Groundwater elevation data are limited in the MWA area and FCMA will work with CDFW to improve monitoring in the area."
- (b) Any additional monitoring wells would likely be nested and would include a monitoring well in the Lower Aquifer
- (c) ISWs and GDEs will be protected once additional monitoring is installed in the existing data gaps. A majority of GDEs are located in the data gap area. Other areas where GDEs are present have a significant number of shallow zone wells which as described in Section 3.2, have generally shown stable groundwater levels.

Comment 1-24: Comment noted.

2.5.3.2 California Department of Fish and Wildlife

Comment 2-1: Comment noted.

Comment 2-2: Comment noted.

Comment 2-3:

- (a) Comment noted.
- (b) The additional monitoring well would assist with monitoring groundwater conditions that could affect GDEs and Lower Aquifer groundwater elevations which could be used to better understand and monitor for subsidence.
- (c) Comment noted.
- (d) The comment states that, "Mendota WA is one of the few net contributors of groundwater within the GSP Area, and the Central Region has concerns that adding monitoring wells in the Mendota WA would skew groundwater recharge availability with the GSP area." We have interpreted this to mean that higher groundwater elevations in the Mendota WA would be exploited as additional resources for other beneficial users of groundwater in the surrounding area. The potential monitoring site would be a representative site which would include measurable objectives and minimum thresholds. These objectives and thresholds would be set maintain steady groundwater elevations to protect the exiting groundwater dependent ecosystems. In no way would an additional monitoring be used to exploit the fact that the Mendota WA is a net contributor of groundwater. A lack of groundwater monitoring is more likely to skew groundwater recharge and availability in the GSP area.

Comment 2-4: Comment noted.

Comment 2-5: Additional monitoring in the Mendota WA would help better characterize the relationship between shallow groundwater management and surface water levels in the Fresno Slough.

Comment 2-6:

MAA

Only a few areas from the NCCAG were removed from MAA based on stakeholder feedback and historic groundwater elevations. The areas that were removed in MAA were classified as Wetlands. Shallow wells in this area have a long-term record of water levels well below the ground surface. All vegetation in the NCCAG data have been identified as GDEs with the exception of one area which was removed based on stakeholder feedback.

MAB

No GDEs in MAB were removed and GDE and CDFW were contacted on the mapped GDE in MAB. GDEs were added based on the recommendation of CDFW staff. No historic shallow zone groundwater level data are available south of Whitesbridge Road where most of the GDEs are located. For this area, we assumed all mapped GDEs were correct due to the surface water deliveries and persistence of vegetation.

Comment 2-7:

- (a) FCMA will work to fill existing data gaps south of Whitesbridge Road to install shallow zone monitoring while will allow for environmental monitoring to improve the understanding of SMC impacts on GDEs.
- (b) Figure 3-25 has been updated. USGS 31J6 is a Lower Aquifer Well.

Comment 2-8: Comment noted.

2.5.3.3 Audubon

Comment 3-1: Comment noted.

Comment 3-2: Comment noted.

Comment 3-3: Comment noted.

2.5.3.4 Spreckels Sugar Company

Comment 4-1: Section 1.1.1.1 updated to be consisted with section 3.2.1.1.1.

Comment 4-2: Comment noted

Comment 4-3: Language added to section 3.2.1.1.1 stating that, "[h]igher groundwater elevations in the form of a mound are also present near Meyers Water Bank in MAA.

Comment 4-4: Comment noted.

Comment 4-5: Section 3.4.2.1 updated. References KDSA, 2018.

Comment 4-6:

- (a) Section 4.3.4.1 is correct. The executive summary has been updated.
- (b) MT values for PW-12 and MW-11 have been updated to reflect the most recent measurement

Comment 4-7: Two sites in the west, 3 sites in the central, 2 sites in the east.

Comment 4-8: Appendix I is now appendix J. Comment noted.

Comment 4-9:

- (a) The focus of modeling was on seasonal high measurements. All sustainable management criteria for groundwater elevations are based on seasonal highs.
- (b) Comment noted.

Comment 4-10: Section removed; calibration described in section 6.

Comment 4-11: Section removed. "The groundwater flow model was calibrated largely by manually adjusting assigned aquifer parameters to achieve an agreeable fit between simulated and observed water levels at wells located in the model domain."

Comment 4-12: Comment noted.

Comment 4-13: Comment noted.

Comment 4-14: No. Future GSP updates will likely include this level of analysis.

Comment 4-15:

- (a) Comment noted
- (b) Comment noted

Comment 4-16: Refer to table 6-3 in the model report for the porosities of layers 1-6. Porosity is equal to specific yield. Layers 7-9, porosity is equal to 0.2.

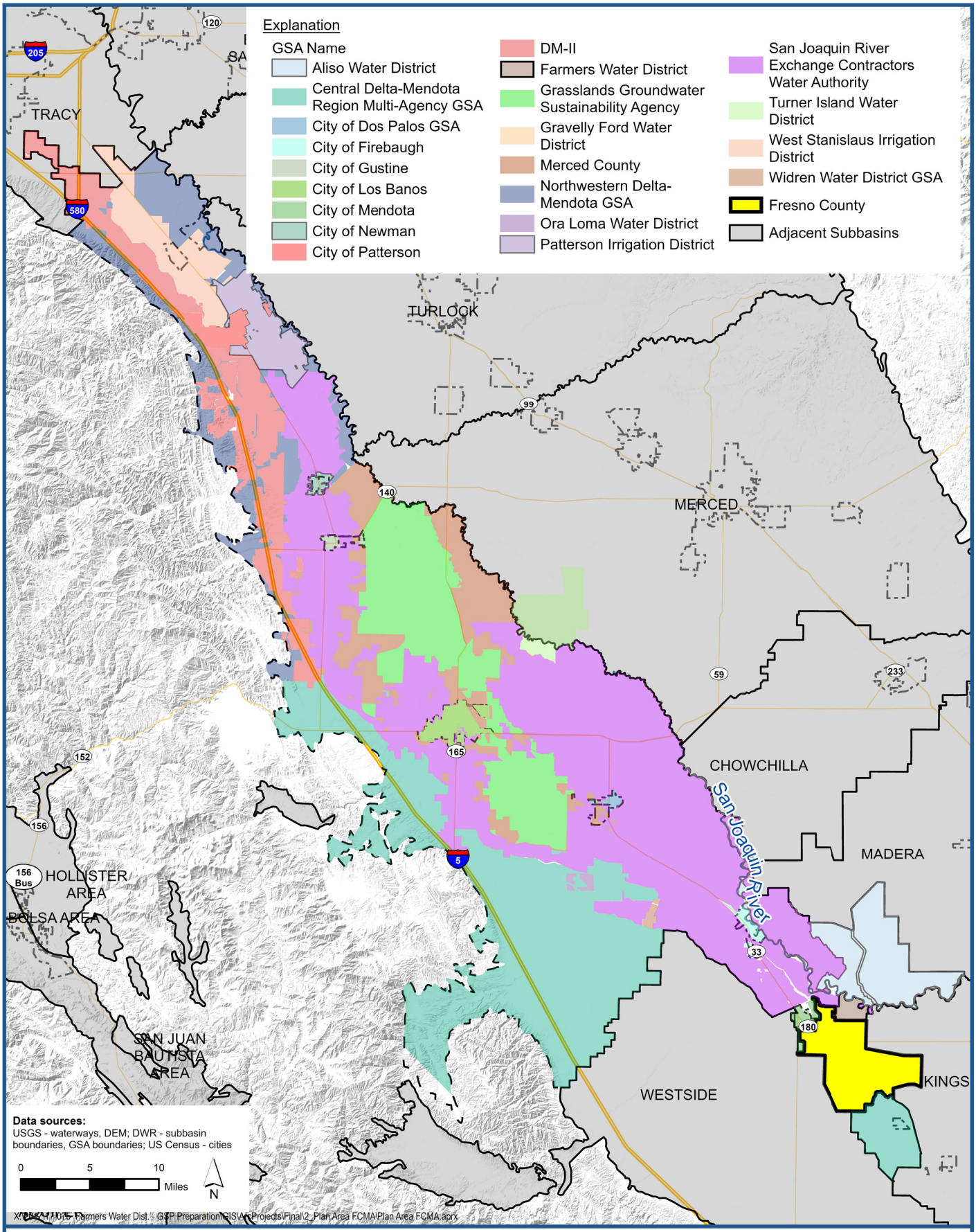
Comment 4-17: It is reasonable to assume for the purposes of modeling that all flow through the clay layers is vertical.

Comment 4-18: No. All data that was available was used

Comment 4-19: Section has been updated.

2.5.4 Agencies Decision Making Process

Many aspects of the GSP were determined by coordinating with other GSAs in the Delta-Mendota Subbasin. Meetings of the *Coordination Committee* and the *Technical Working Group Subcommittee* along with the Coordination Agreement provided the platform for the GSAs to work together in order to make sure all required components of the GSPs were consistent. Internally, FCMA made decision by working with their consultant and FCMA stakeholders. All items of the Plan were approved by the County of Fresno Board of Supervisors.

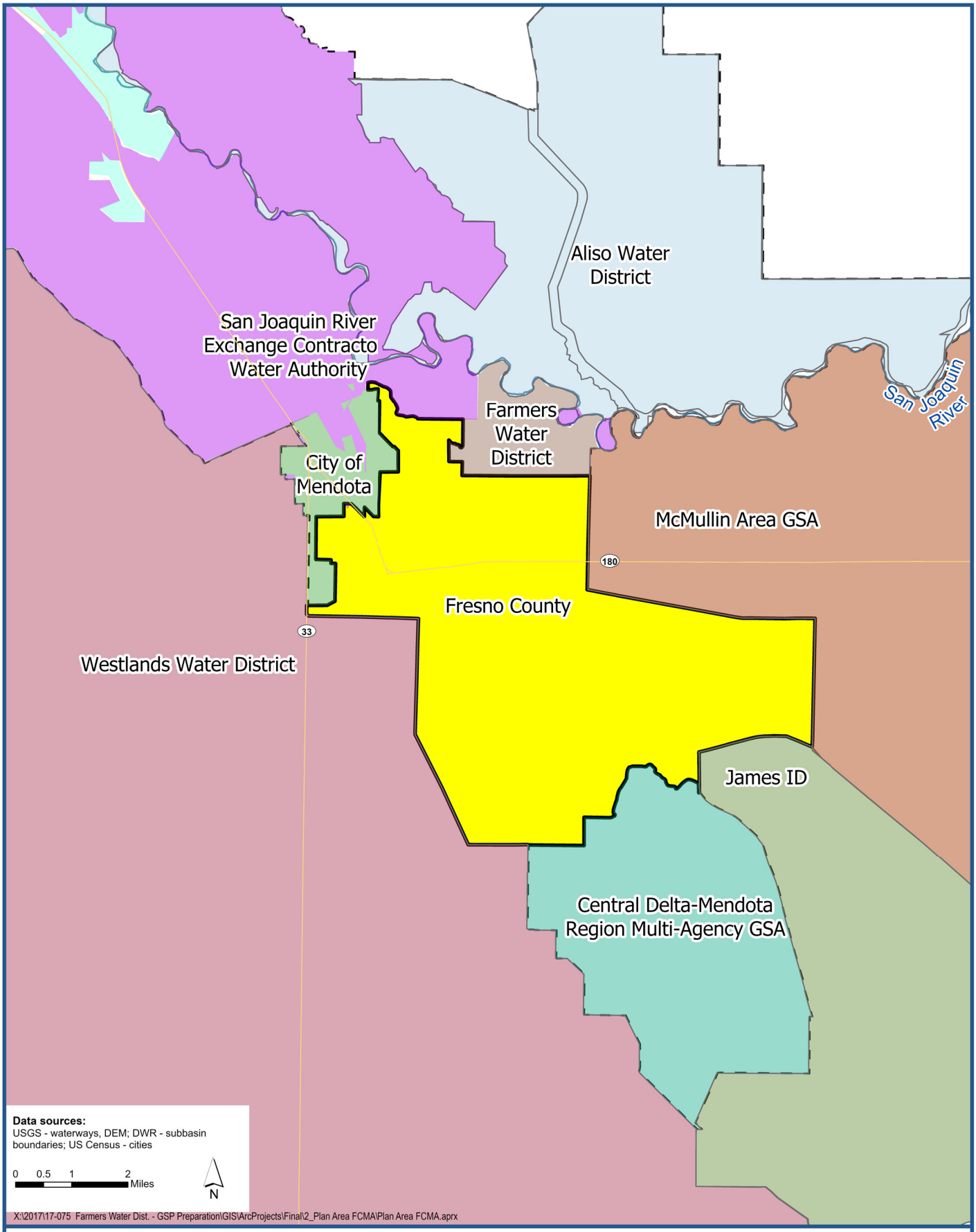


Luhdorff & Scalmanini Consulting Engineers

Delta-Mendota GSAs and Surrounding Subbasins

Figure 2-1

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

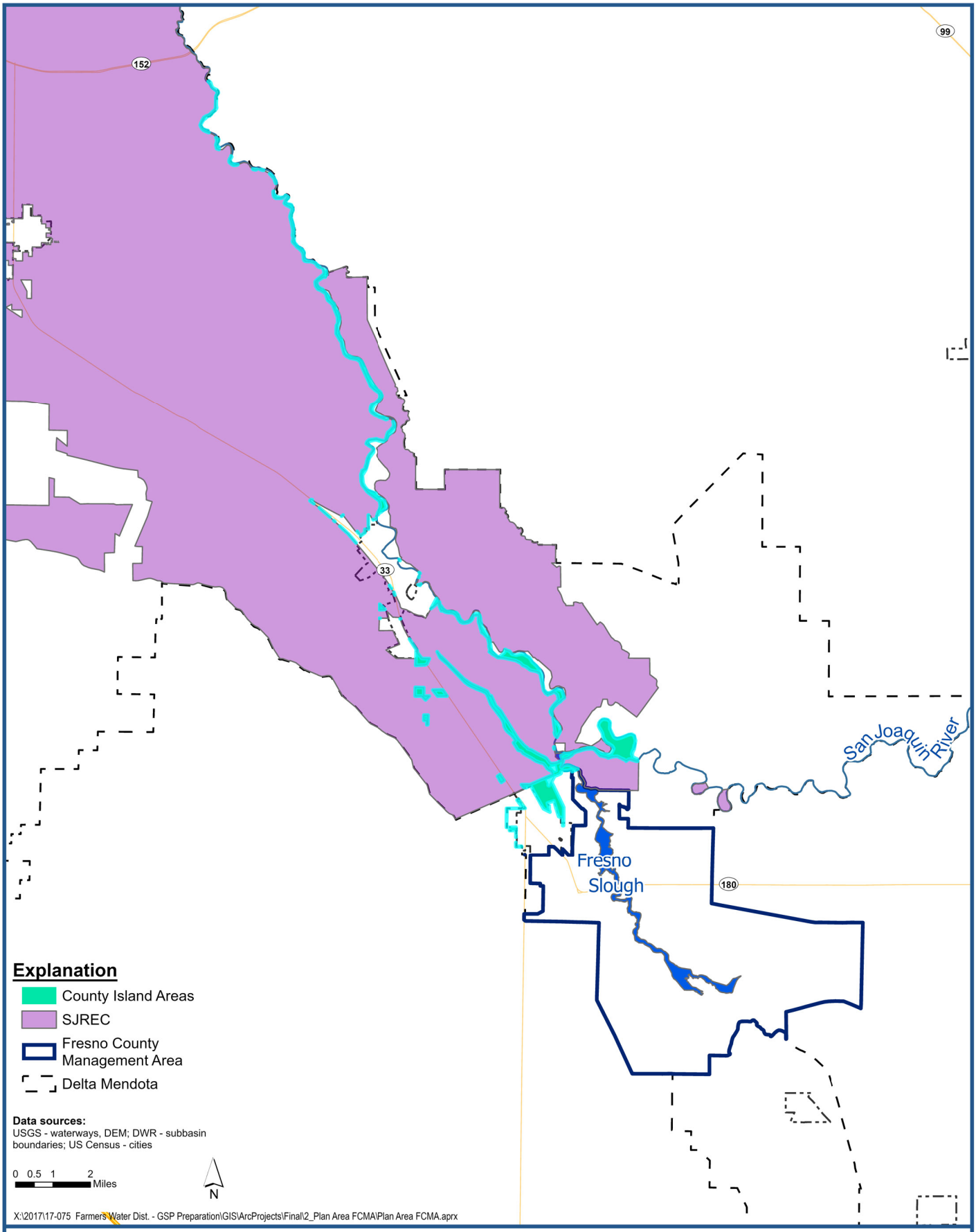


Luhdorff & Scalmanini Consulting Engineers

Fresno County and Adjoining GSAs

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 2-2



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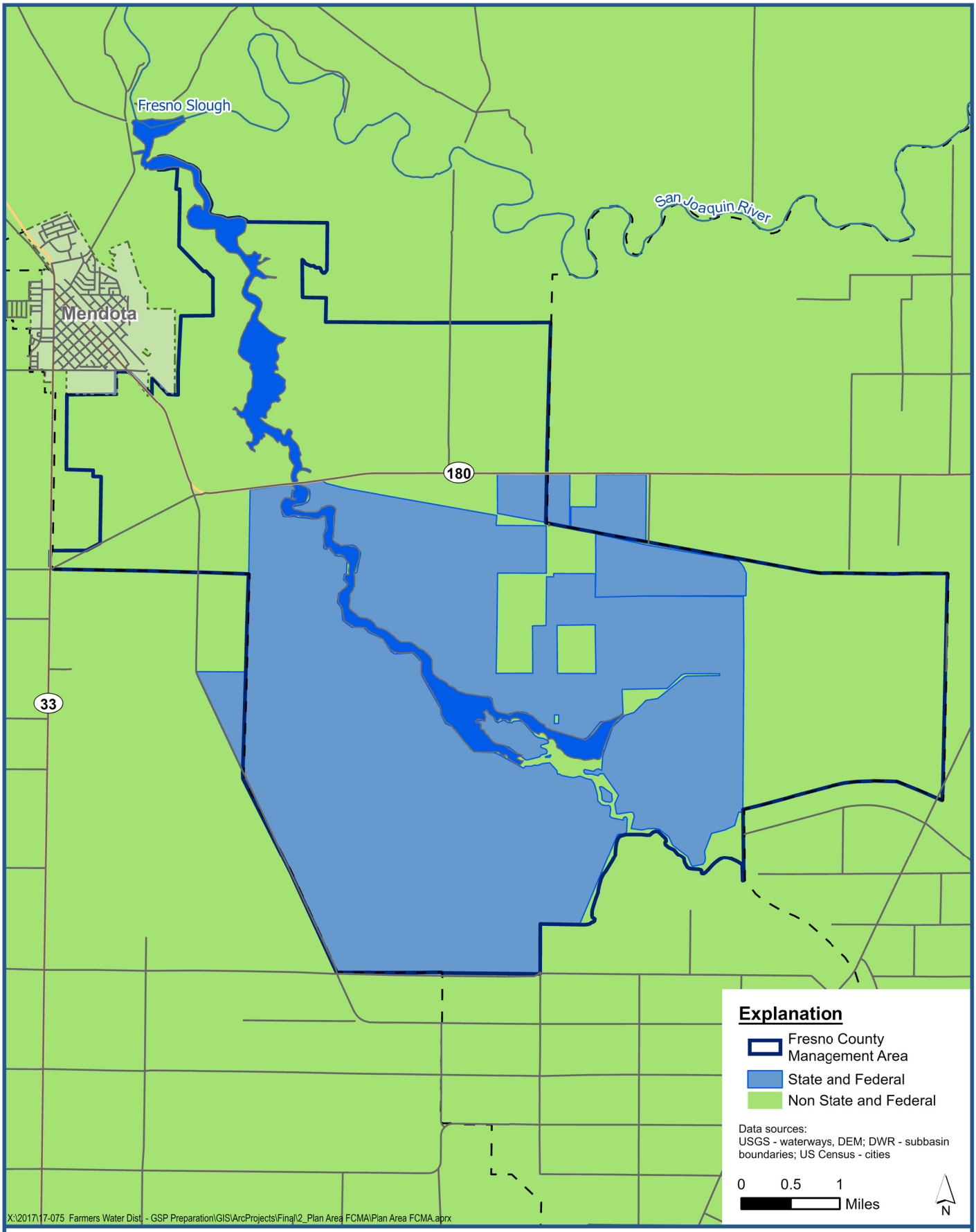
County Island Areas

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 2-3



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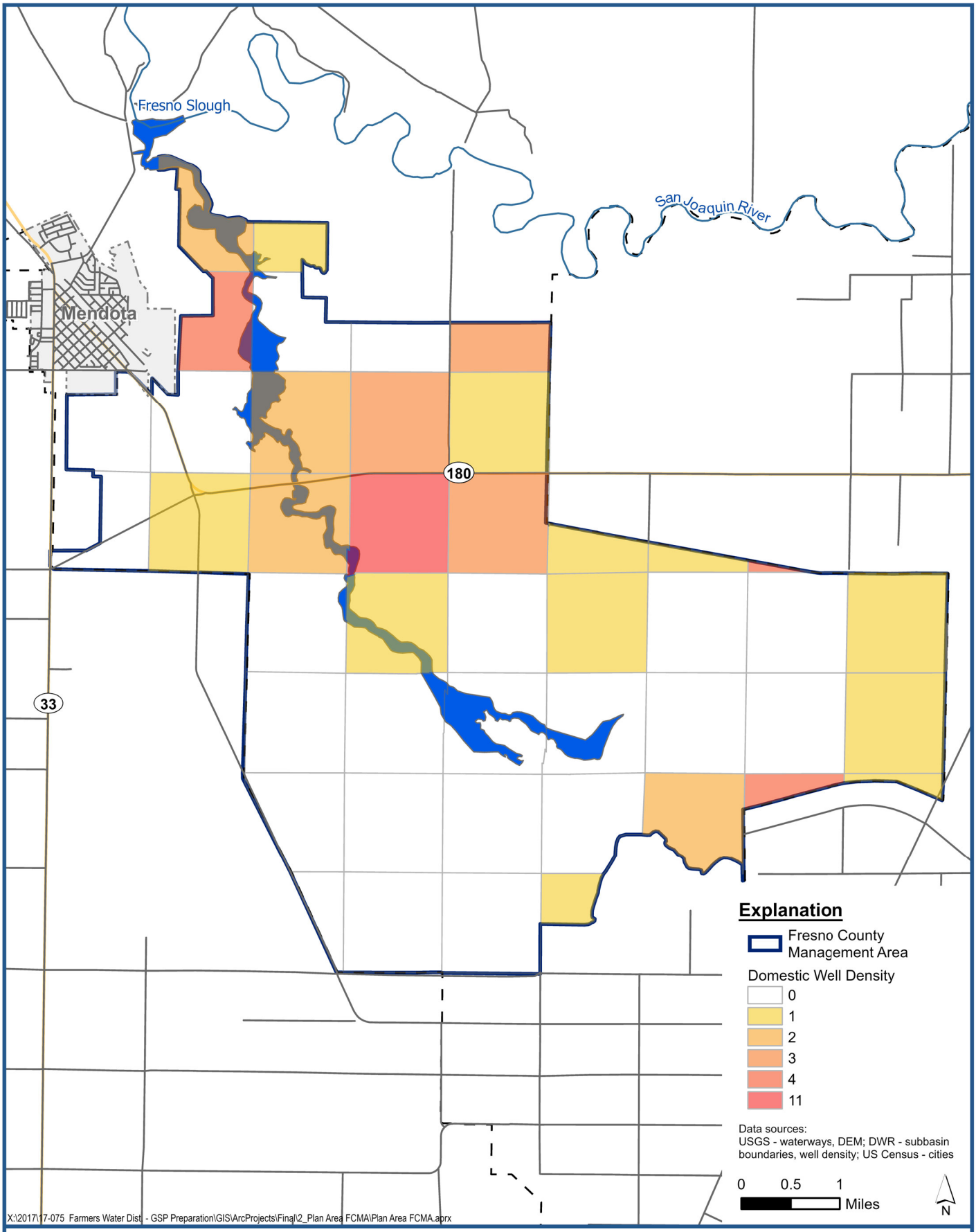
Land Status

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 2-4



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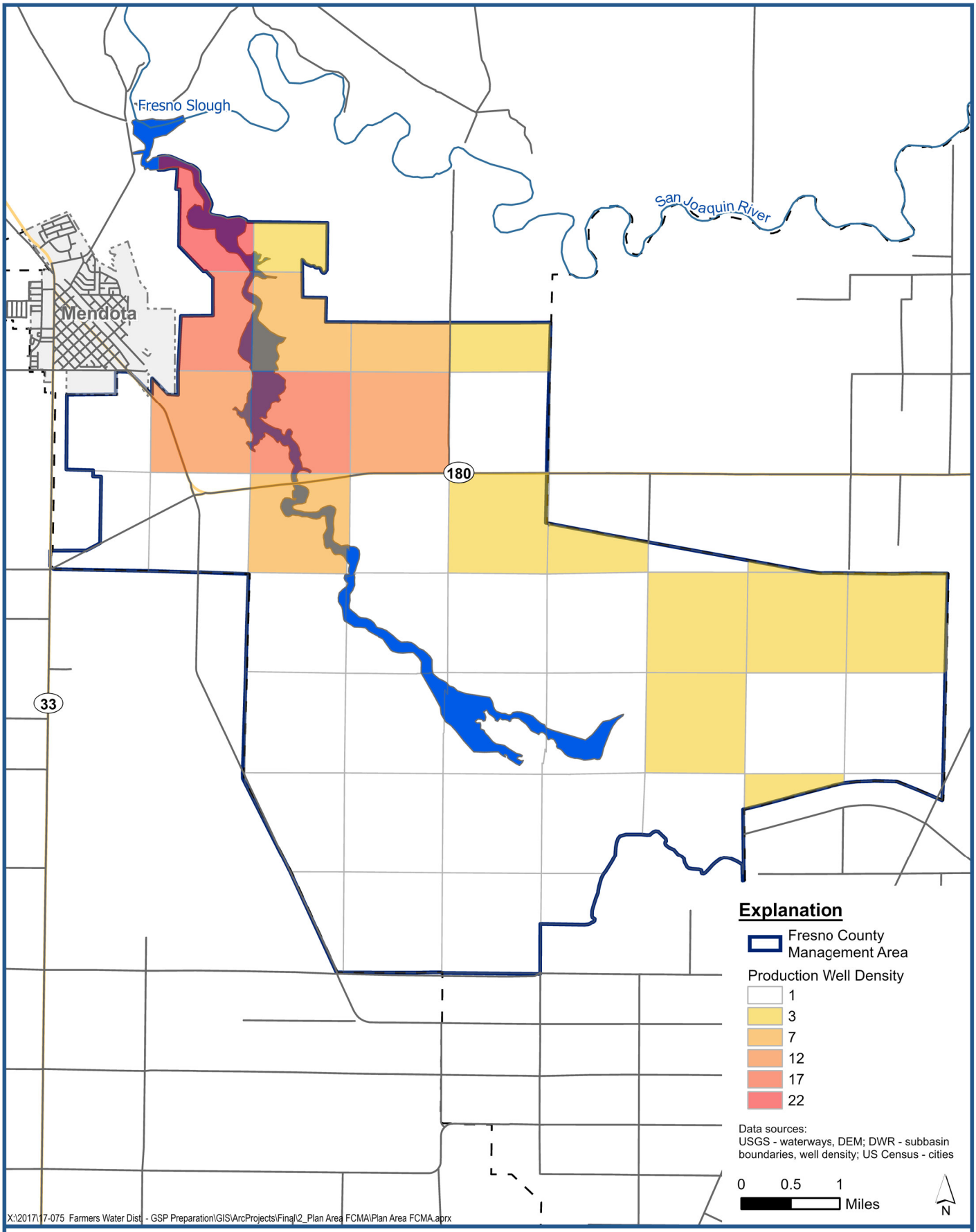
Domestic Well Density

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 2-5



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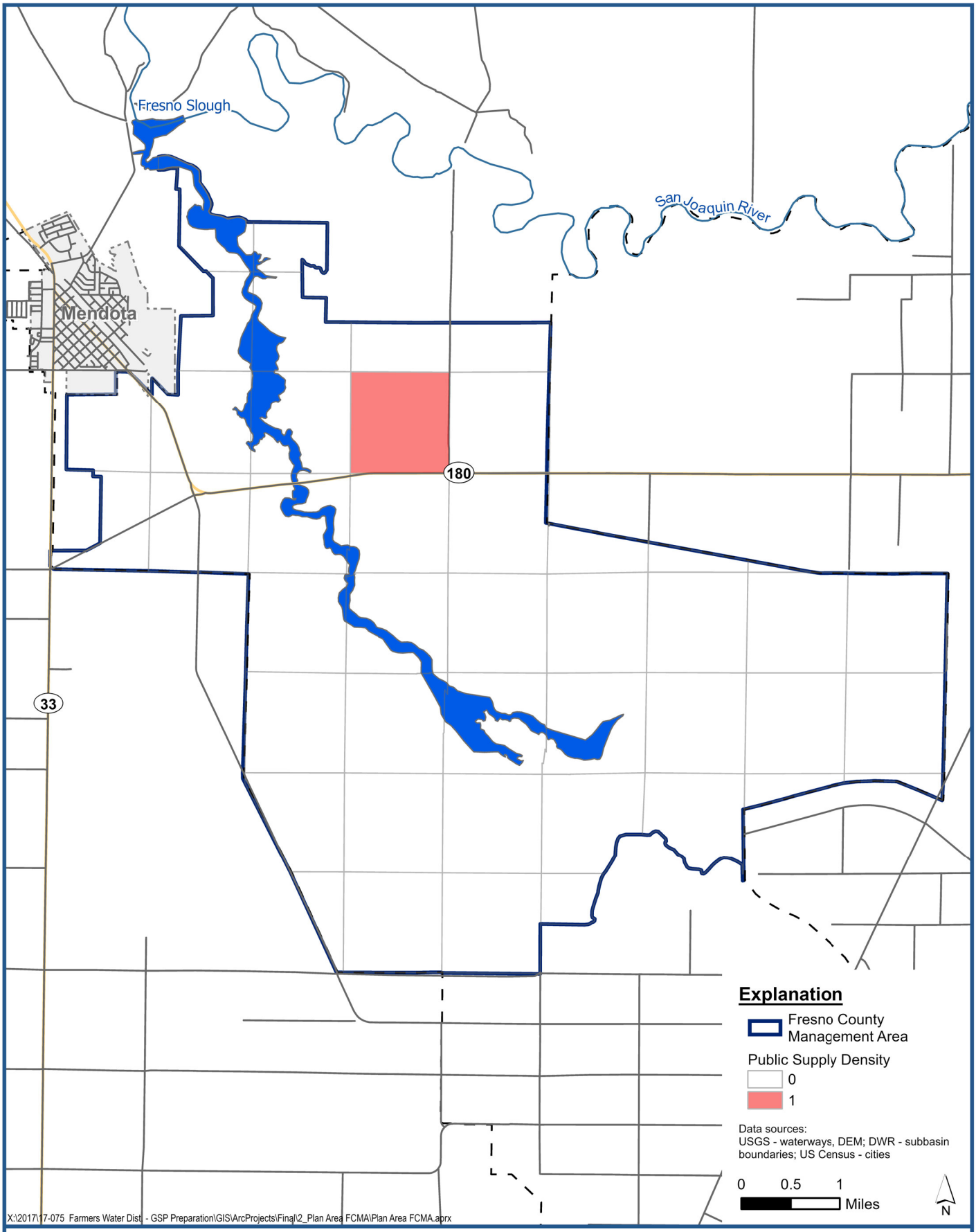
Production Well Density

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 2-6



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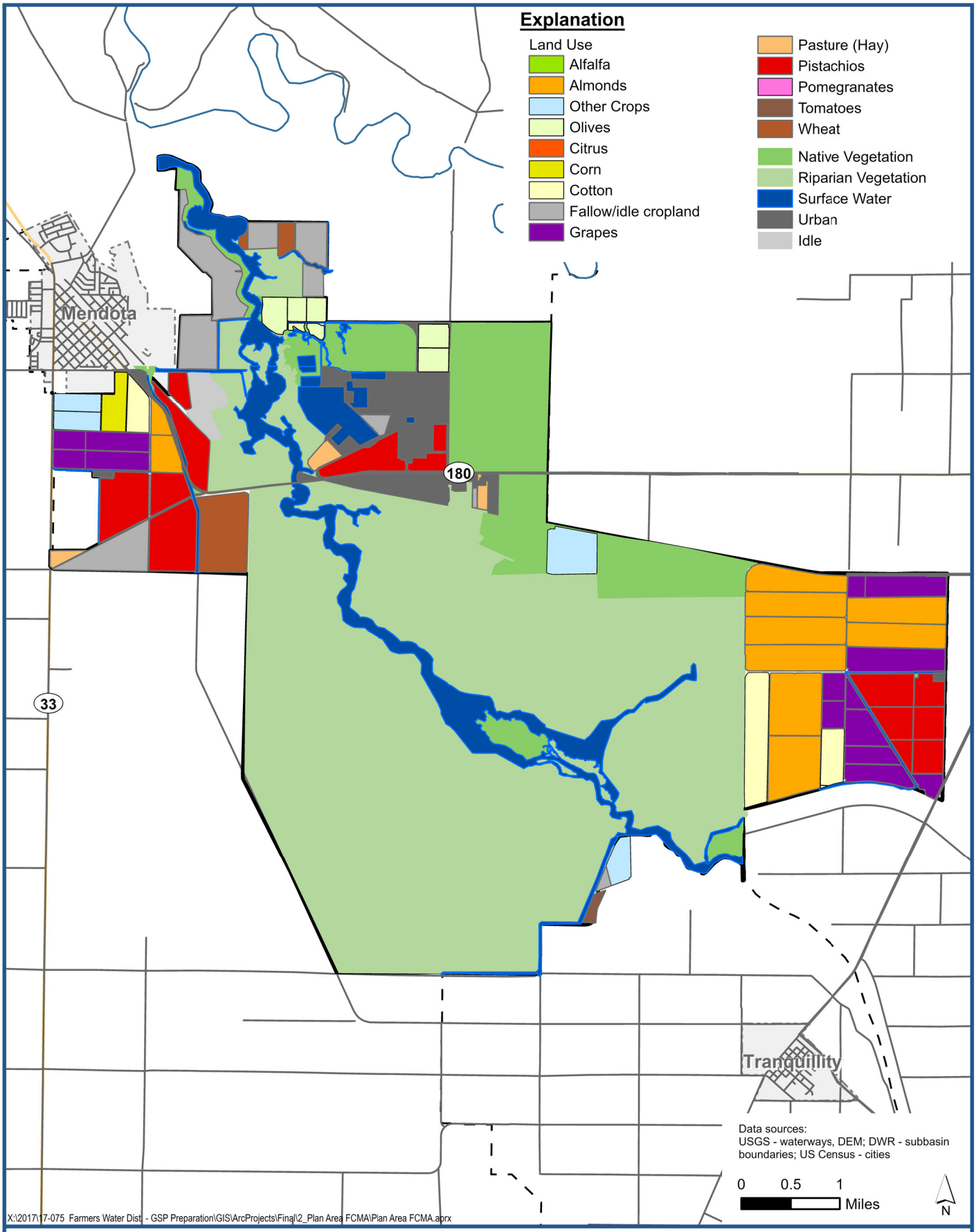
Public Supply Well Density

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 2-7



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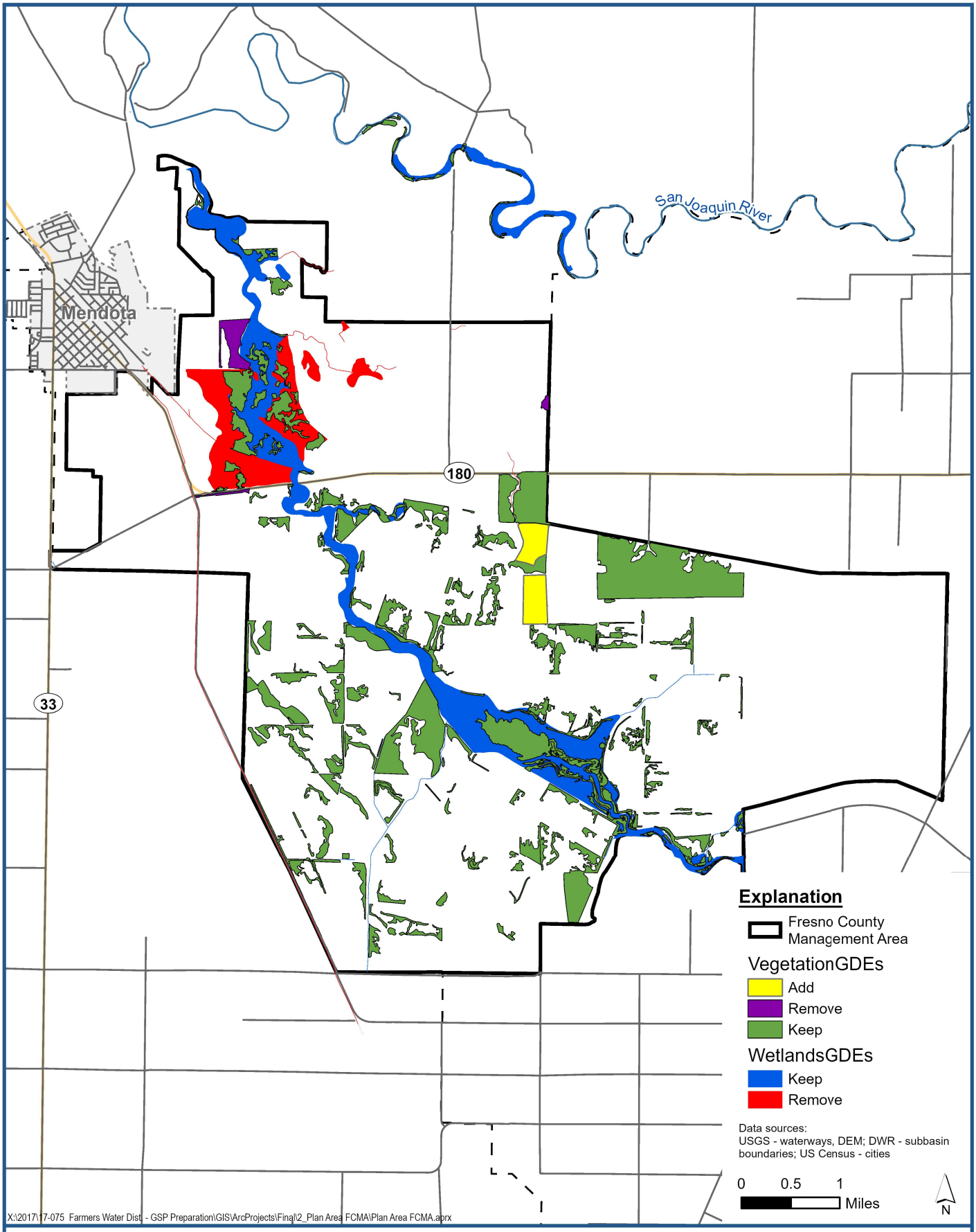
Land Use

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 2-8



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Groundwater Dependent Ecosystems

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 2-9

3 BASIN SETTING

3.1 Hydrogeologic Conceptual Model (354.14)

3.1.1 Regional Geologic

The following is a summary on the regional geologic conditions for the Subbasin with a focus on FCMA and the surrounding area. A more complete description of the regional geology can be found in a United States Geological Survey document (Croft, 1972) and in **Appendix A**.

FCMA is located within the San Joaquin Valley geologic province (Valley). The Valley is a large structural trough bounded by the Sierra Nevada to the east and the Coast Range to the west. The Sierra Nevada area primarily composed of consolidated igneous and metamorphic rocks of pre-Tertiary age, overlain in the foothills by metamorphosed Tertiary age marine and non-marine sedimentary rocks. The Coast Range is composed of complexly folded and faulted, consolidated, marine and non-marine sedimentary rocks of Jurassic, Cretaceous, and Tertiary age. The Valley floor consists primarily of unconsolidated deposits of late Pliocene to Holocene age. Surficial geology for most of the Subbasin is mapped as alluvium with some consolidated sedimentary units on the western edge of the Subbasin where the Valley meets the Coast Range. The surficial geology of the entire FCMA region is mapped as alluvium (**Figure 3-1**) (USGS and CGS, 2005). This unconsolidated material can be upwards of 4,000 feet (ft) thick near the axis of the Valley and primarily consists of alluvium/fluvium sourced from the Sierra Nevada and Coast Range. These materials are subdivided into informal units by extensive fine-grained lacustrine deposits.

Most of the Subbasin has a ground surface elevation less than 200 ft NAVD88 with elevations sloping downward toward the SJR. Elevation and slope are greatest along the western edge of the Subbasin near the Coast Range. The entire FCMA area is gently sloping with elevations between 100 to 200 ft NAVD88 (**Figure 3-2**).

3.1.2 Local Geologic Setting

As noted in Croft (1972), the characterization of sediments which make up the water-bearing units of the FCMA is dependent upon a few controlling factors:

1) depositional environment,
2) type of rock in the source area, and
3) competence of the streams that transport sediment to the region surrounding FCMA.

Oxidized sediments are present within the FCMA and are characterized by red, brown, and yellow coloration. These oxidized sediments suggest areal deposition, most likely along fluvial systems and continental fans. Coarse-grained incised valley fill deposits, channel sands, and sand splays are common in this environment. Soil formation along the surface of alluvial fans is also common, oftentimes resulting in extensive, relatively impermeable paleosols upon burial and compaction. Reduced

sediments, which are typically finer-grained, exhibit characteristic dark green, blue, and gray coloration. These sediments were generally deposited in flood basins, lakes, and marshes with coarser-grained sediments deposited in plains and deltas along the edges of these water features. Regional cross sections for FCMA can be seen in **Figure 3-3**.

Cross section A-A' was modified from Miller et al. (1971) (**Figure 3-4**). A-A' has been modified with data from well logs near FCMA to show the clay layers in the Upper Aquifer that create semi-confined conditions. The A -Clay is present near the Fresno Slough and pinches out to the northeast near the SJR and FWD well R-7 which is adjacent to the SJR. The thickness of the Corcoran Clay was also modified based on an examination of DWR Drillers Reports (well logs) near FCMA. Based on the lithologic descriptions of three well logs used, the Corcoran clay thickness was modified to be slightly thicker than was depicted in Miller et al. (1971).

Cross section B-B' was modified from Croft (1972) (**Figure 3-5**). The FCMA area only constitutes a small portion of this cross section but shows the relevant units that comprise the Upper and Lower Aquifers in the FCMA area. The Corcoran Clay, also referred to as the E-Clay, is present from FCMA to the Tulare Lake Beds. The A- and C-Clays are intermittent in the Upper Aquifer creating semi-confined conditions near FCMA, and unconfined conditions more to the south. In this figure, the base of fresh water is at a depth of approximately 800-ft below msl.

Sedimentary deposits derived from the igneous and metamorphic rocks of the Sierra Nevada have been primarily deposited by the major rivers and streams which flow into the eastern margin of the San Joaquin Valley. Fluvial deposition from the Sierra Nevada has also been strongly influenced by Plio-Pleistocene cyclical glaciation which produced significantly increased competence and sediment load during periods of glacial melt (Weissmann et. Al., 2004). Deposits derived from the marine and non-marine sedimentary units of the Coastal Range are largely deposited by ephemeral streams which have significantly lower flows than those draining the Sierra Nevada. Sediments from these two sources inter-finger west of the axis of the valley and mix with fluvial sediments deposited along the axis of the valley where drainage turns to the north.

In the FCMA and surrounding area, the distribution of sediments is consistent with the general trends described above, with the greatest propensity for coarse sediments within close vicinity to the current and historical flow path of the SJR. Additional coarse-grained sediment deposits are found in various locations east and west of FCMA, generally consistent with the locations of present surface water features. The distribution of fine-grained sediments is also consistent with patterns expected along fluvial systems and alluvial fans.

Unconsolidated deposits of late Tertiary and Quaternary age contain most of the useable groundwater in near FCMA and throughout the southern part of the Valley. The principal aquifers found within the FCMA consist of coarse oxidized continental and alluvial deposits of the Coast Ranges and the continental deposits and alluvium from the Sierra Nevada. Within these deposits, are intervals of fine

grade lacustrine clay. Lacustrine deposits consist of impermeable to semi-permeable gypsiferous fine sand, silt and clay. Three such units, identified within the FCMA and surrounding area, are referred to by Croft (1972) and others as the E-, C-, and A-clays. These units make up the main aquitard subsurface within FMCA. The depth, thickness, and extent of these clays were defined within the model domain based on data from available geophysical logs, DWR Well Completion Reports, and conversations with Ken Schmidt of KDSA.

The E-clay, also known as the Corcoran Clay, underlies the A- and C-clays, and is an extensive confining unit identified throughout the Subbasin and the Valley and is identified as the Corcoran Clay Member of the Tulare Formation. The extent of this clay unit is well represented in **Figure 3-5**. This unit is a distinct marker of Pleistocene age material consisting primarily of dark greenish gray-blue diatomaceous silty-clay. The Corcoran Clay generally subdivides the Valley aquifer system into two distinct regional hydrologic units referred to as the "upper water-bearing zone" and the "lower water-bearing zone" described further below. The "lower water-bearing zone" is referred to as the Lower Aquifer in the FCMA and Subbasin. The Lower Aquifer is confined and is composed of a series of interbedded sand and clay beds that is hundreds of feet thick. In some localized areas within the FCMA area the uppermost portion of the Lower Aquifer has beds of coarse sands and gravels that directly underlie the Corcoran Clay. There are few wells in the region area that are solely screened in the Lower Aquifer, however, there are several wells located in the region that are screened in portions of the Upper and Lower Aquifers making composite wells. The depth below ground surface to the top of the Corcoran Clay near FCMA is shown in **Figure 3-6**. The depth to the Corcoran Clay within the FCMA ranges from about 400 to 500 feet below ground surface (ft bgs). The depth to the Corcoran Clay increases in a north to south direction in FCMA.

The C-Clay overlies the Corcoran Clay and is a fine-grained lacustrine deposit of Pleistocene age consisting primarily of bluish-gray silt and clay. The estimated depth to the top of the C-Clay and extent of this unit near FCMA is shown in **Figure 3-7**. The depth to the top of the C-Clay ranges from about 220 to 230 feet bgs with the greatest depths in the southern portion of FCMA. The extent of the C-Clay or equivalent fine-grained materials extend east toward the eastern extent of the FCMA. The C-Clay is not always well defined or described on well logs. This is often the result of either the lack of availability of lithologic data near or the quality of the description of subsurface materials on the wells logs. In some areas vertical variations in groundwater quality (salinity) was used to help identify the location of the C-Clay if lithologic data was not adequate or unavailable (KDSA personal communication, 2013). This clay layer acts as a semi-confining layer within the Deep Zone of the Upper Aquifer which is bound by the Corcoran and A-Clay.

The A-Clay overlies the C-Clay and is a fine-grained lacustrine or paludal deposit of Pleistocene and Holocene age consisting of blue or dark greenish-gray, plastic, highly organic clay. The extent and the depth to the top of the A-clay, or its equivalent, is shown in **Figure 3-8**. The depth to the top of the A-Clay ranges from about 80 to 120 ft bgs. The depth to the A-Clay is deepest in the western portion of the

FCMA and decrease in depth in a west to east direction. In some areas, the A-Clay is composed of two or three clay units separated by several feet of sand. In FCMA, the A-Clay represents the boundary between two water-bearing zones; the shallow and deep zones of the Upper Aquifer. The shallow zone overlies the A-Clay and the deep zone is located between the A-Clay and the Corcoran Clay. The shallow zone is primarily composed of fine to coarse sand and gravel and is considered an unconfined unit. The deep zone is also composed primarily of fine to coarse sand and gravel with some interbedded clays. The vertical hydraulic conductivity of the A-Clay can be quite variable throughout the FCMA, exhibiting apparent gaps which could be post-depositional erosional features, or the result of poorly constructed deep zone wells completed below the A-Clay.

The structural geology of the San Joaquin Valley and FCMA area is described by Page (1986). Page describes the large, asymmetrical, northwest trending trough of the Central Valley is the principal structure responsible for the movement of groundwater in the area. The confining deposits near the flanks of the Valley tend to be thinner than those that underlie the axis of the Valley, resulting in a majority of the confined ground water to occur near the axis where deposits are the greatest. The flanks of the Valley are at a higher elevation than the valley floor where the axis is located, allowing tributaries and rivers to produce higher heads of water than at the axis. The difference in head causes groundwater to move from the flanks towards the axis. Within the southern portion of the Valley, anticline folds can be found that restrict groundwater movement, but such folds occur well beyond the GSA boundary. Two faults are located to the northeast of the FCMA, however, Page (1986) noted that they have not been shown to cause a definitive restriction of groundwater movement.

3.1.3 Principal Aquifers and Aquitards

DWR Bulletin 118 defines three water-bearing zones within the Subbasin. These include the lower zone (defined as the Lower Aquifer), which contains confined fresh water in the lower section of the Tulare Formation, an upper zone (defined as the Upper Aquifer) which contains confined, semi-confined, and unconfined water in the upper section of the Tulare Formation and younger deposits, and a shallow zone which contains unconfined water within about 25 feet of the land surface (Davis 1959). This GSP defines two principal aquifers. The Lower Aquifer which is defined as the lower zone in Bulletin 118, and the Upper Aquifer which consists of the upper zone.

Aquifer properties which govern the movement and storage of groundwater were determined from field observations and existing technical studies. Hydraulic conductivity is the rate at which water flows through a porous medium. Storativity is the amount of water an aquifer can release or take into storage given a unit change in hydraulic head. When available, aquifer tests were used to quantify both parameters. Most of the time aquifer parameters were assigned using generally accepted values for sediment textures or the type of aquifer that is present, and where possible constrained using what limited aquifer test data may be available. Seasonal variation in groundwater levels, geology and well construction features were used in estimating the type of aquifer and storage coefficient in the absence of aquifer test data.

3.1.3.1 Upper Aquifer

The Upper Aquifer which lies above the Corcoran Clay, is an unconfined to semi-confined aquifer due the presence of the A and C-Clays. As described above, the A-Clay separates the Upper Aquifer into two zones, the shallow zone and the deep zone. The C-Clay, where present, further divides the deep zone into the upper deep zone and the lower deep zone. The focus of this description will be on the shallow and deep zone separated by the A-Clay as these aquifer zones have greater importance for groundwater management and production in the FCMA. There are existing management programs regulating groundwater pumping by some landowners in the FCMA as a condition of exchange programs with the Bureau of Reclamation.

The shallow zone of the Upper Aquifer within the FCMA is above the A-Clay. The beneficial water uses in the shallow zone are for irrigation, environmental, and domestic purposes. Regional pump test data shows a range of hydraulic conductivity values in the shallow zone. In the northern portion of FCMA, near the Meyers Water Bank and the former Spreckels Sugar Company, there are a significant number of pumping tests where hydraulic conductivity (K) values range between 50 to 500 ft/day, with an average of 230 ft/day. To the northwest of FCMA, values range between 400 to 600 ft/day. Technical studies in the area have reported a range of values for the Shallow Zone between 10 to 230 ft/day, with the highest values occurring along the SJR (150 to 230 ft/day), and the lowest values west of the Fresno Slough and SJR (10 to 50 ft/day) (LSCE, 2018).

The deep zone of the Upper Aquifer is overlain by the A-Clay and extends to the top of the underlying Corcoran Clay. The primary use for this aquifer is irrigation with a small amount use for domestic purposes. There are a significant number of pumping test results for the area within the northwest portion of the FCMA in MAA. Values in MAA range from 20 to 170 ft/day with an average of 70 ft/day. Values to the west near the City of Mendota range from 50 to 250 ft/day. Values to the north near CCID, WO, and CCC have values that range from 30 to 260 ft day. Technical studies in the area have reported a range of hydraulic conductivity values between 50 to 330 ft/day with higher values generally occurring in the lower portion of the deep zone between the C-Clay and Corcoran Clay (LSCE, 2018).

~~For the purpose of calculating change in storage, T~~the Upper Aquifer is treated as an unconfined aquifer. Specific yield values have been estimated to be between 0.18 to 0.24.

3.1.3.2 Lower Aquifer

The Lower Aquifer is overlain by the Corcoran Clay. This aquifer is not utilized for groundwater production in FCMA; however, this aquifer is utilized for groundwater production in neighboring GSAs and Subbasins through the use of composite wells that are screened both above and below the Corcoran Clay.

There are a total of five wells screened in the Lower Aquifer in the vicinity of FCMA resulting in a limited amount of data. There are no available aquifer test data for the lower aquifer in the vicinity of the

FCMA. Hydraulic conductivity values in the area generally range from 10 to 100 ft/day. Values near the FCMA are slightly lower with values ranging between 10 to 50 ft/day (LSCE, 2018).

The Lower Aquifer is a confined aquifer and the estimated~~. A~~ storativity value is~~of~~ 4.1 x 10^{-3} ~~was used estimated to develop estimates of change in storage~~.

3.1.4 General Groundwater Quality

Current groundwater quality monitoring programs include the MPG's annual monitoring program and the Groundwater Monitoring Report for the former Spreckels Sugar Beet Processing Facility. These programs monitor for general minerals and trace elements. The primary concern of groundwater contamination in FCMA is high salinity due to the former Spreckels Sugar Company processing operations and the natural occurrence of saline water in some portions of the FCMA ~~ea~~west of the Mendota Pool. Other than the plume identified in MAA, there are no other contamination sites that have been identified by the Regional Water Quality Control Board in the FCMA. The impact of the Steffens plume will be discussed further in Section 3.2.3. The table below provides a summary of groundwater quality conditions for those constituents which are of concern for agricultural and other beneficial users and provide beneficial uses within FCMA. Those constituents of interest are electrical conductivity (EC) and total dissolved solids (TDS) for both the Upper and Lower Aquifers (**Table 3-1**). No other constituents are at concentrations that would impact beneficial uses of groundwater within FCMA. For the Upper Aquifer, there are historical EC and TDS records for over 130 wells. Measurements date back to 1962, but most of the measurements were made since 1990. Water Quality data are limited for the Lower Aquifer, where groundwater extraction does not occur and no known wells in FCMA are present that are solely screened below the Corcoran Clay. ~~, and there are only two wells located in Aliso Water District that have measurements for the constituents of interest.~~

Table 3-1: General Groundwater Quality

Constituent	Mean	Max	Min	Count
Upper Aquifer				
EC (umhos/cm)	2730	39,000	88	3370
TDS (mg/L)	1771	32,000	44	3401
Lower Aquifer				
EC (umhos/cm)	2598	4,080	1200	6
TDS (mg/L)	1370	2,000	740	2

3.1.5 Soil Characteristics

Soil types in FCMA were obtained from the USDA Natural Resources Conservation Service Web Soil Survey (Soils Survey Staff, 2018). The soil types in FCMA are presented in **Figure 3-9A and 3-9B** and generally describe the upper five feet of the subsurface. The FCMA contains 48 different map units.

Nearly all soils in the area are floodplain and alluvial deposits derived from granite bedrock. Soils range in size from clays to sandy loams. Almost 66 percent of the soils are on land classified by DWR as natural vegetation or natural riparian vegetation, with the remaining third used mainly for agriculture. An important component of physical soil properties relative to groundwater management is the soils ability to transmit water. Soils have been grouped into infiltration classes based on their conductivity values. Infiltration classes for FCMA include Low to Moderately Low (0 to 0.06 in/hr), Moderately Low to Moderately High (0.06 to 0.2 in/hr), Moderately High (0.2 to 0.6 in/hr), High (2 to 6 in/hr), and High to Very High (2 to 20 in/hr). The rate of infiltration is controlled by the grain size of a given soil unit. Finer materials such as clays will have a lower infiltration rate while coarser grain materials such as sands will have higher infiltration rates. A majority of FCMA is classified as Low to Moderately Low and Moderately low to Moderately High (**Figure 3-10**). Areas of high to very high soil conductivity values have been highlighted as areas where recharge potential is the greatest.

A full description of each soil unit can be seen in **Appendix I**.

3.1.6 Definable Bottom of Basin

For the FCMA, the definable basin bottom is at the base of useable freshwater, or the depth below which only saline water is available. Page (1973) defines freshwater as water with the maximum specific conductance of 3000 micromhos per centimeter, approximately 2000 mg/L dissolved solids. In the FCMA area, this area is between -400 to -600 feet msl (**Figure 3-11**).

3.1.7 Surface Water Features

The primary surface water features in the vicinity of FCMA include the San Joaquin River (SJR), the Fresno Slough and Mendota Pool (Pool), and several canals including the Chowchilla Bypass, Delta-Mendota Canal (DMC), the Firebaugh Intake Canal, the Columbia Canal, the Central California Irrigation District (CCID) Main Canal, and the CCID Outside Canal (**Figure 3-12**). The Pool is contained within the Fresno Slough south of the Mendota Dam. There are three locations that monitor streamflow on the SJR and have the most comprehensive datasets. These gages are located at Gravelly Ford, downstream of the Chowchilla Bypass, and downstream of the Mendota Dam. The major canals have flows recorded near the discharge at the Pool (DMC at Check 21) or at the intakes from the Pool (the Firebaugh Intake Canal, the CCID Outside Canal, the CCID Main Canal, and Columbia Canal). FCMA also consists of the Meyers Water Bank in MAA and the Terra Linda Recharge Canal in MAB.

Also represented in **Figure 3-12** are surface water diversion points in FCMA. One point is located in MAA and is used to provide water to the Meyers Water Bank. Another is located west of the MWA in Traction Ranch where groundwater conveyed via the Pool is used for agricultural purposes. Several diversion points are located in the MWA where surface water deliveries are used for the wildlife refuge and other water users.

Runoff from the Sierra Nevada provides surface water to all the major tributaries of the SJR, flowing west southwest into the Millerton Reservoir. Discharge from Millerton flows into the SJR and flows west to the north end of the Pool. Prior to the Pool, the SJR is bifurcated at the Chowchilla Bypass. This bypass is used to divert flood flows that are beyond the capacity limits of the SJR below the Mendota Dam. The SJR continues north of the Mendota Dam and flows to the Sacramento-San Joaquin River Delta. Examination of flow data on the SJR at the Gravelly Ford and chowchilla Bypass gage location indicates the SJR is a losing river with that recharge to groundwater. Historically, the SJR had minimal to no flow between Gravelly Ford and the Pool during the irrigation season until the San Joaquin River Restoration Program (SJRRP) initiated interim flows in the San Joaquin River on October 1, 2009 as stipulated in the Settlement Judgement (Natural Resources Defense Council et al., 2006).

The Pool is a small manmade reservoir utilized for discharge and extraction of both surface water from the DMC and the SJR along with groundwater from areas around the Pool. Flood flows from the Kings River via the James Bypass into the Fresno Slough also occurs during wet periods. The primary canals that extract water from the Pool are located at the north end of the Pool. Groundwater discharged into the Pool by the MPG and other landowners and districts for exchange with USBR occurs and the Pool is also used as a conveyance to move water from one location to another for irrigation of lands adjacent to the Pool. The San Luis Delta Mendota Water Authority (SLDMWA) oversees the operations of the Pool along with the Bureau of Reclamation and the SJREC. The SLDMWA monitors the inflows and outflows of the DMC and other major canals, along with groundwater discharged to the Pool, and water pumped from the Pool.

The DMC is an open, concrete-lined canal that conveys water that is pumped from the Sacramento-San Joaquin River Delta by the Bill Jones Pumping Plant near Tracy to the Pool, where the water is discharged with some of the water pumped into several irrigation canals at the north end of the Pool: CCID Main Canal and Outside Canal, the Firebaugh Intake Canal, and the Columbia Canal. There are several parties that divert water from the southern end of the Pool, including the MWA, James Irrigation District, and others.

During flood events on the Kings River, flood flows are directed north into the Fresno Slough portion of the Pool (Fresno Slough or southern branch of the Pool) creating a northerly flow regime. Outside of these flood events, flow in Pool is generally to the south towards the MWA, however, there are many locations in the MWA area of the Pool where there are substantial amounts of water discharge into and pumped form the Pool. The elevation of water in the Pool is managed by the San Joaquin River Exchange Contractors and is generally stable with stage fluctuations of approximately 0.25 feet. The maintenance of relatively stable stage in the Pool by other parties besides for FCMA prevents any control over the surface water flows and stage in the Pool by FCMA and influence on GDEs.

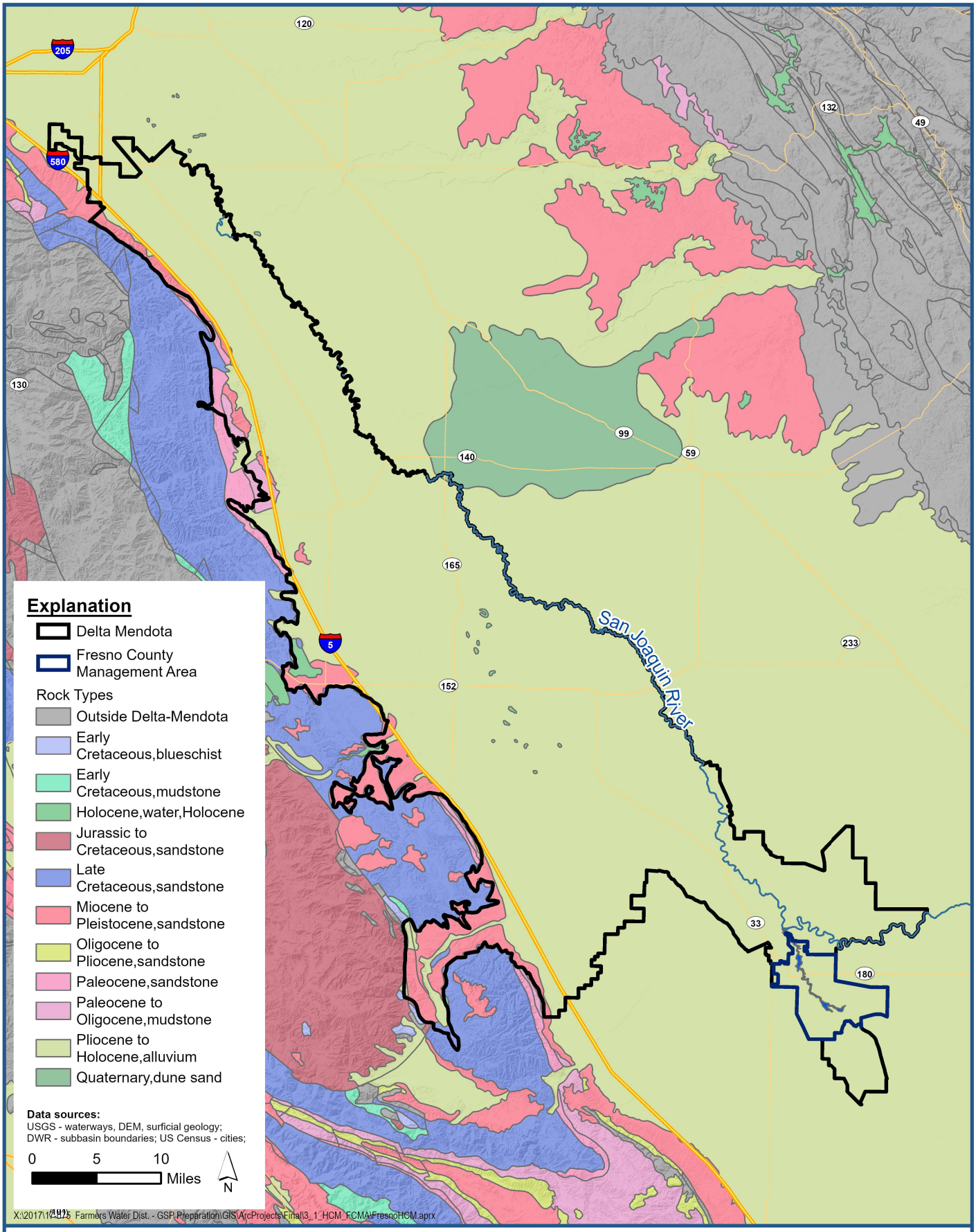
Based on the NCCAG dataset, there is one potential wetland along the Fresno Slough. The rest of the wetland's dataset has been mapped as riverine.

3.1.8 Data Gaps

The only data gap within FCMA is the MWA portion of MAB south of Whitesbridge Road (**Figure 3-13**). The northern part of MAB along the Fresno Slough and MAA have existing monitoring networks with a long-term record of water levels, water quality, and land subsidence. One CASGEM monitoring well in the Upper Aquifer is located east of the MWA, but upon further investigation and correspondence with the Kings River Conservation District the well has likely collapsed and is not reflective of groundwater conditions. Within the MWA, there are no wells with construction information that have been identified and located. Below are the steps that the FCMA has taken and will continue to pursue to fill the data gaps in the MWA area of the FCMA.

1. FCMA attempted to fill in this data gap by reaching out to private landowners in MAB and to the CDFW. Survey's sent out by FCMA to private landowners inquiring about information on existing wells did not provide any useful information for filling in the MWA data gap. CDFW identified two known wells (Check Station and Becks Well) in and around the MWA, but neither had known construction information. These wells are represented as black squares in **Figure 3-13**. A site visit was conducted on October 5, 2018 to Becks Well where the total depth of the well was determined to be 74 feet. This was an inactive production well that did not have power connected to the pump and had recently been flooded based on field observations of debris located around an open area of the well casing adjacent to the pump housing. Video log surveys would need to be conducted to incorporate this well into the FCMA monitoring network, however, it likely is an Upper Aquifer well. The Check Station well was located near the northern boundary of the MWA and was not located in an area identified as a data gap. DWR Technical Support Services (TSS) funds were sought to drill and construct a Lower Aquifer monitoring well adjacent to the existing Beck well, however, the landowner and the County could not agree on access agreement conditions.
2. FCMA reviewed all available well completion reports (WCR) within and around the MWA. WCRs that were identified and located based on the location description are represented as red triangles in **Figure 3-13**. Some of these locations could address some of the existing data gap if locations were verified by a field survey and video logs are conducted.
3. As mentioned above, FCMA attempted to utilize the TSS Funds provided by DWR to install a monitoring well in the MWA. Local CDFW management of the MWA were contacted about the potential of putting a monitoring well site on MWA property. At this time CDFW has not granted access. CDFW provided FCMA with the contact information of private duck clubs who were contacted by FCMA about locating new monitoring wells on the club's properties if they were located in areas identified as data gaps. Attempts to work with private duck clubs within the desired data gap area were unsuccessful.

The FCMA will continue to try to communicate with CDFW to gain access for new monitoring well construction sites within the MWA.



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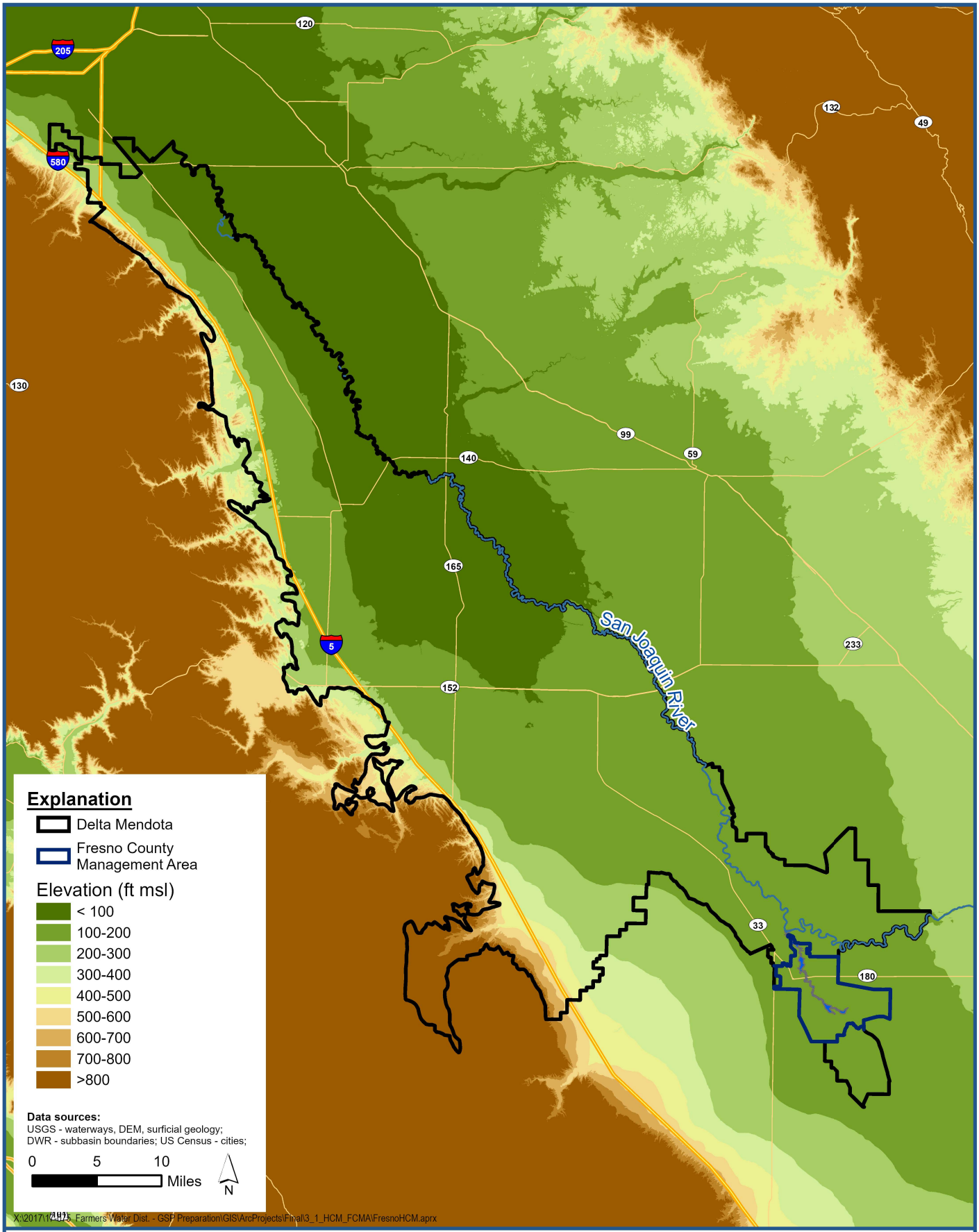
Surficial Geology

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-1



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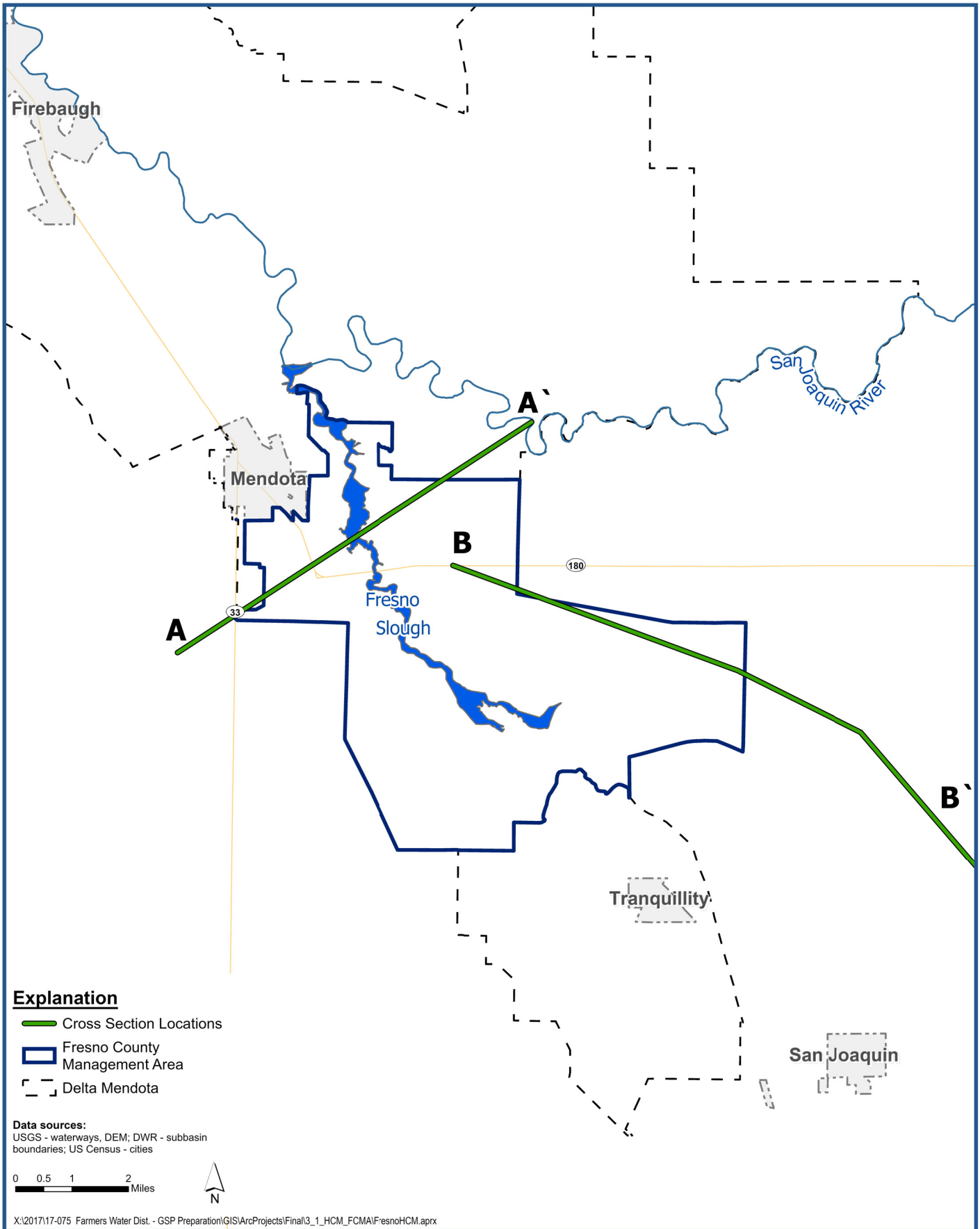
Ground Surface Elevation

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-2



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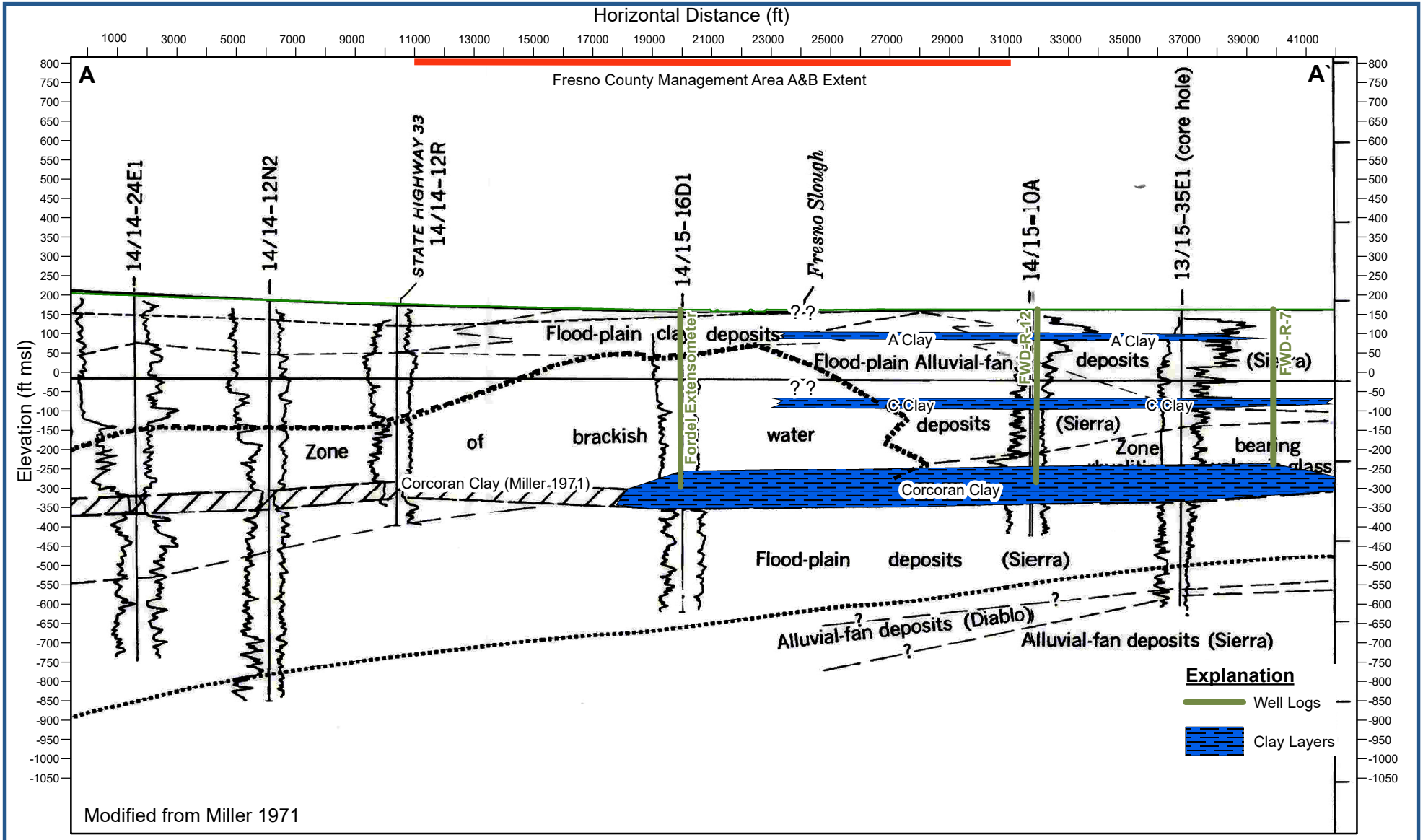
Geologic Cross-Section Locations

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-3



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Cross Section A-A'

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-4

B Fresno County Management Area Extent

NORTH

B' SOUTH

TULARE LAKE BED

14S/15E-10A | 14S/16E-8N | 14S/16E-24N | 15S/17E-5F | 15S/17E-16H1 | 15S/17E-23A | 16S/18E-16A, section A-A' | 16S/18E-26E | 17S/19E-6N | 17S/19E-20D | 17S/19E-35N | 18S/19E-12Z | 18S/19E-36D | 19S/19E-24D1 | 20S/19E-24D1 | 20S/19E-35C1, section B-B' | 21S/20E-19D1 | 22S/20E-17K | 23S/21E-13E, section C-C'

600' 400' 200' SEA LEVEL 200' 400' 600' 800' 1000' 1200' 1400' 1600' 1800' 2000' 2200' 2400' 2600' 2800' 3000'

Qas

A clay

B clay

C clay

D clay

E clay

F clay

Upper Water-Bearing Zone

Lower WB Zone

Sierra Nevada Sourced

5 th Sand

4 th Sand

3rd Sand

2nd Sand

1st Sand

Lower Water-Bearing Zone

//// bfw

Pleistocene Sierra Nevada Sourced

TQsn

Pliocene to Pleistocene Sierra Nevada Sourced

Tm/nm Pliocene & Older Marine & Nonmarine

Sierra Nevada & Some Coast Range Sourced

0-30

0-10

s~

Upper Tb

Qlb

Corcoran Clay

Tulare Lake Beds

Middle Tb

TQlb

Tlb

Lower Tb

Tm

Pliocene Marine

Horizontal Scale

0 5 10 15 Miles

EXPLANATION

UNCONSOLIDATED DEPOSITS

Pleistocene and Holocene — Coast Ranges

Tehachapi and San Emigdio Mountains: Qat — Alluvium

Sierra Nevada: Qas — Alluvium

QUATERNARY

Pliocene to Holocene — Coast Ranges: QTcc — Continental and alluvial deposits

QTf A clay — Flood-basin, lacustrine, and marsh deposits (A through F clays shown by denser pattern)

Pliocene and Pleistocene(?) — Tehachapi and San Emigdio Mountains: QTct — Continental deposits

Sierra Nevada: QTcs — Continental deposits

TERTIARY AND QUATERNARY(?)

CONSOLIDATED ROCKS

Tmn — Marine and nonmarine sedimentary rocks

pTb — Basement complex

TERTIARY

PRE-TERTIARY

Lithologic contact

O/R — Generalized contact between oxidized (O) and reduced (R) deposits

0-30 Resistivity scale

s~ Top Saline Water – LSCE

//// bfw Base Fresh Water Page 1973

Modified From: Croft, 1972, Plate 3, G-G'

CAD FILE: G:\Projects\Westlands Water\15-1-104\Geologic Cross Section 1-1' (R).dwg DATE: 8/1/2018 12:44 PM

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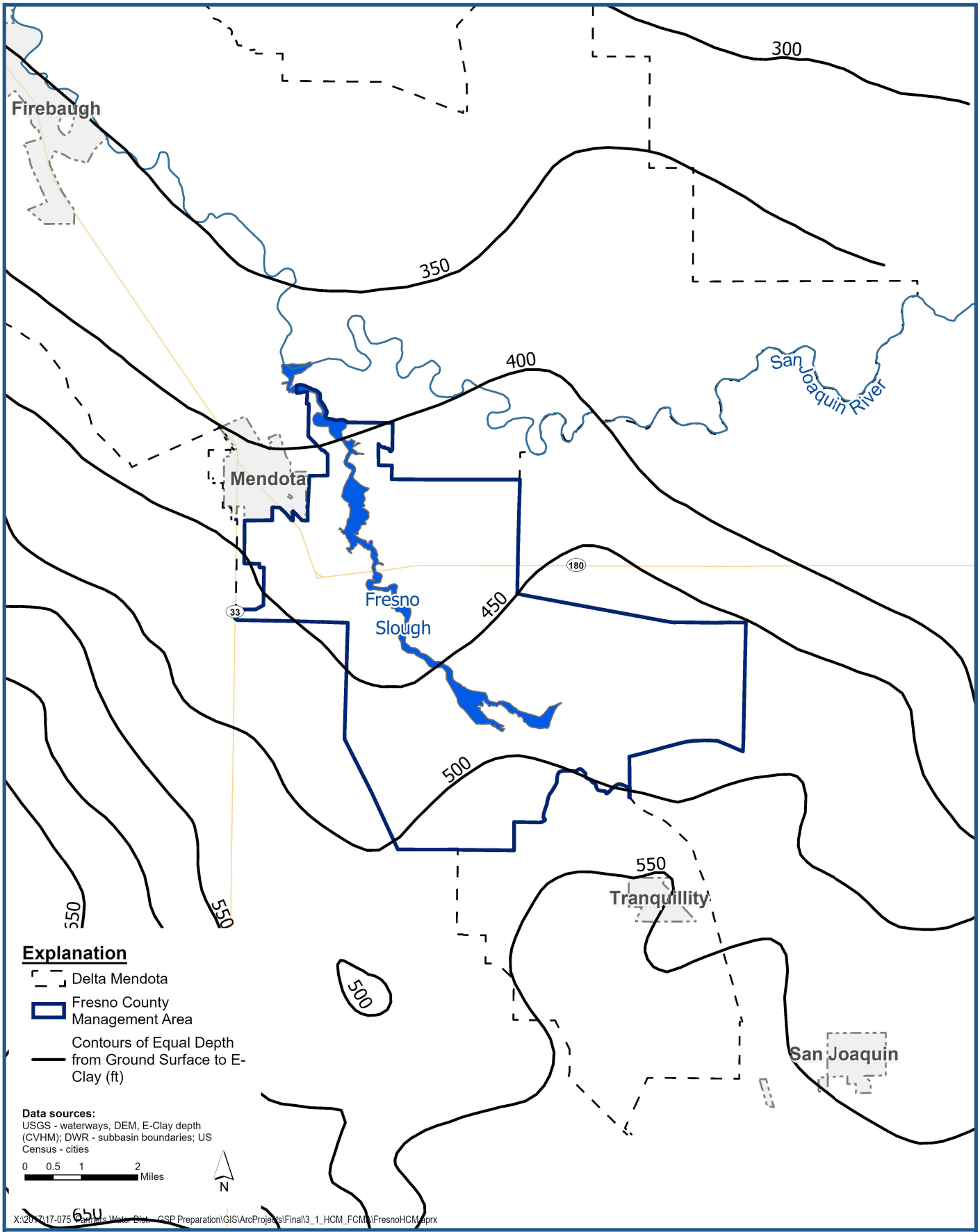
FIGURE 3-5
B-B' (North-South)Geologic Cross Section

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin



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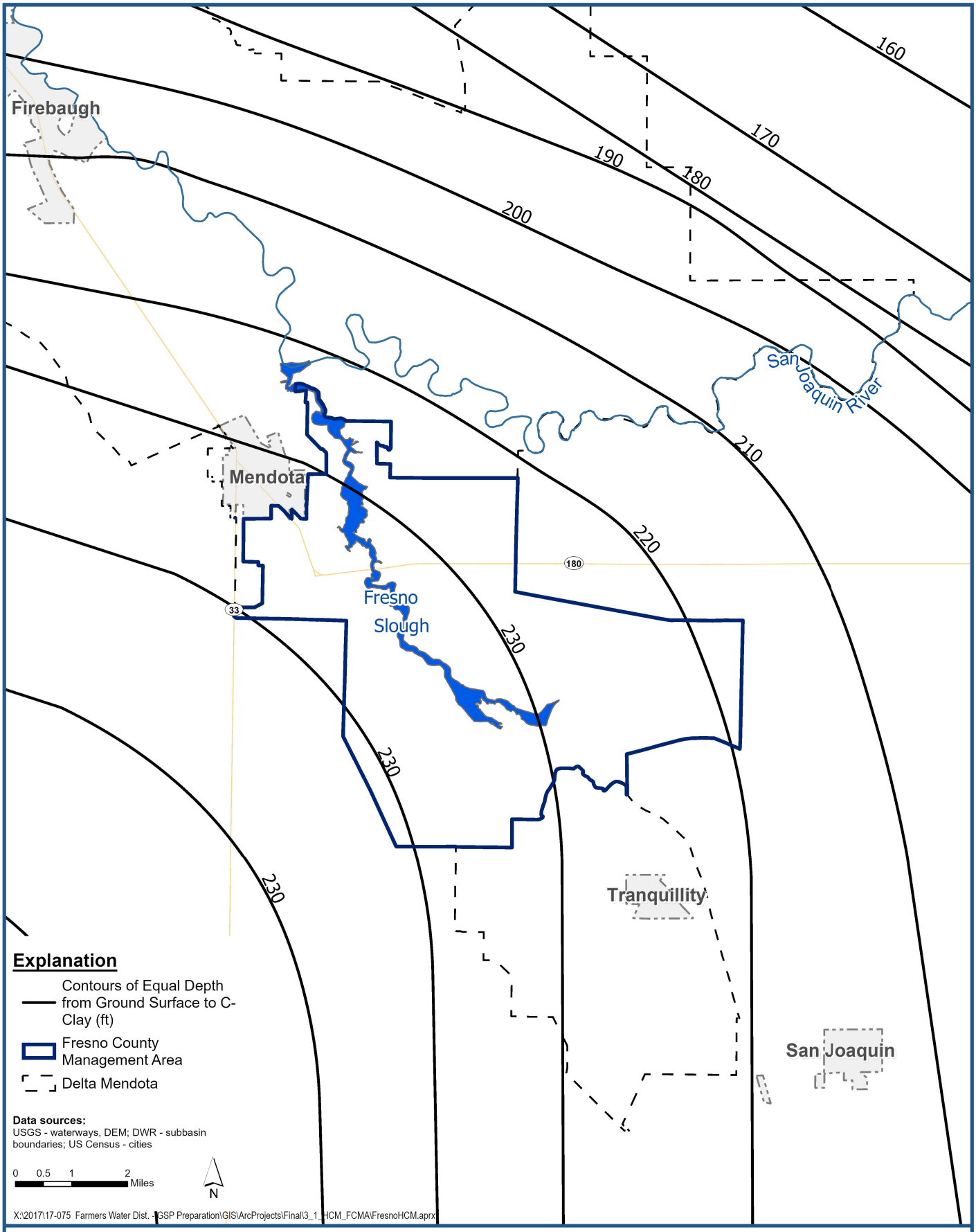
Depth to E-Clay (Corcoran)

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-6



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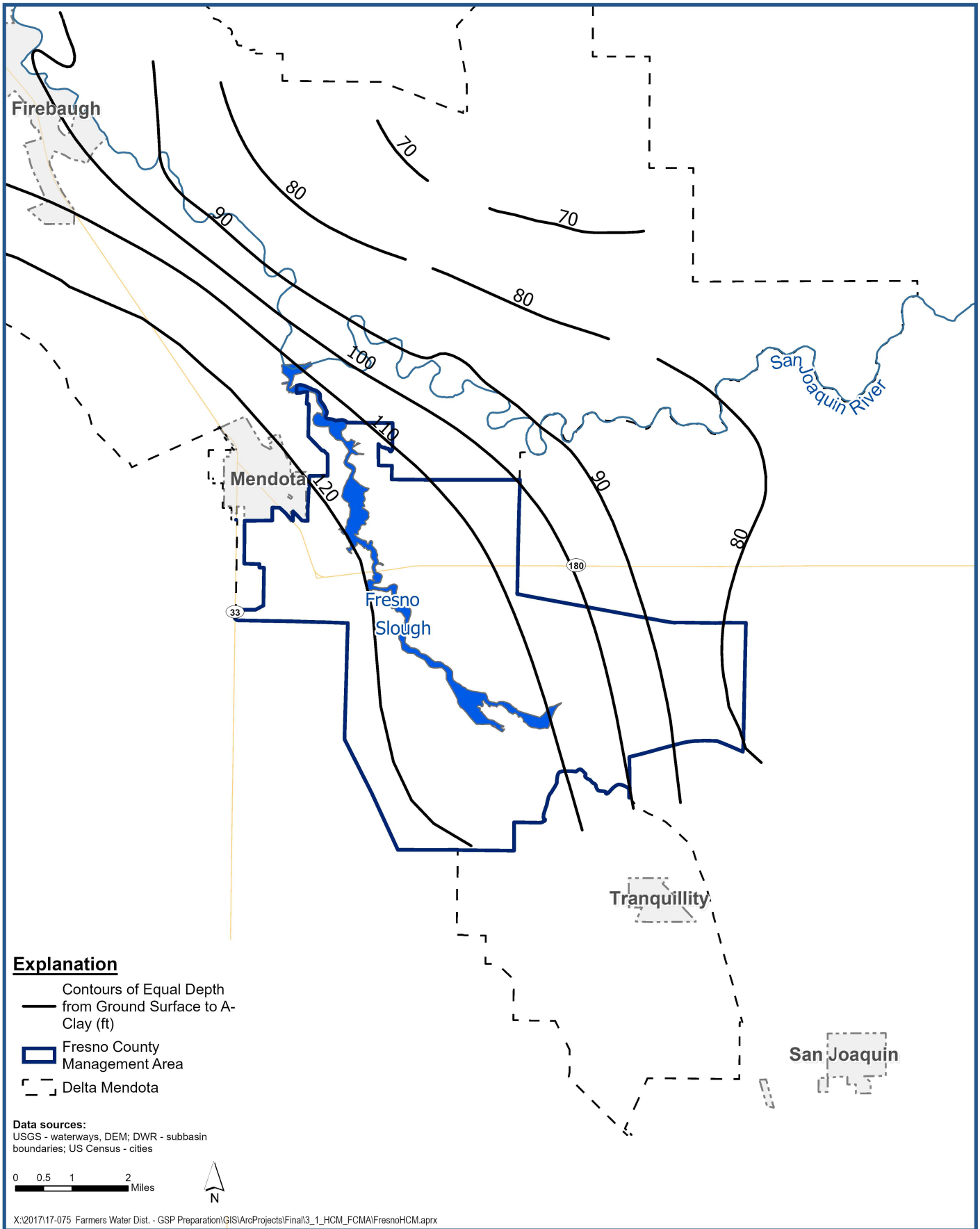
Depth to C-Clay

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-7



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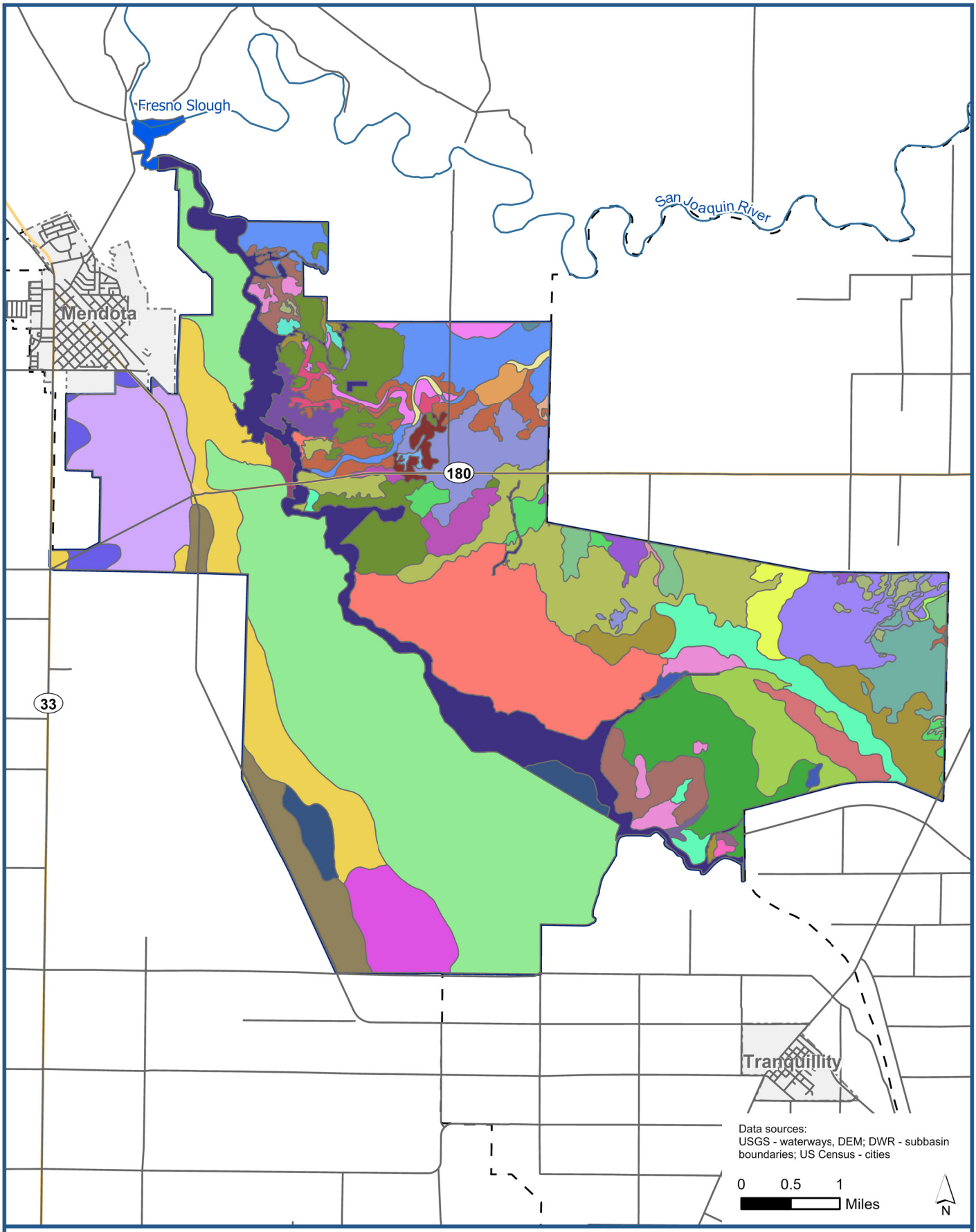
Depth to A-Clay

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-8



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Soils Map, Fresno County Management Areas A & B

Figure 3-9A

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Explanation

Fresno County Management Area

Delta Mendota

FCMA Soil Units

- 101,Armona loam, partially drained, 0 to 1 percent slopes
- 282,Tachi clay, 0 to 1 percent slopes
- 282wf,Tachi clay, 0 to 1 percent slopes
- 284,Lillis clay, 0 to 1 percent slopes
- 285,Tranquillity-Tranquillity, wet, complex, saline-sodic, 0 to 1 percent slopes
- 286,Tranquillity clay, saline-sodic, wet, 0 to 1 percent slopes
- 320,Elnido sandy loam, drained, 0 to 1 percent slopes
- 375,Lethent silt loam, 0 to 1 percent slopes, poorly drained, MLRA 17
- 475,Posochanet clay loam, saline-sodic, wet, 0 to 1 percent slopes
- 482,Calflax clay loam, saline-sodic, wet, 0 to 1 percent slopes, MLRA 17
- 981,Sewage disposal pond
- Cb,Cajon loamy coarse sand, saline-alkali
- Cd,Cajon coarse sandy loam, saline alkali
- Cl,Chino sandy loam
- Cm,Chino sandy loam, saline-alkali
- Cn,Chino fine sandy loam
- Cr,Chino loam
- Cs,Chino loam, saline-alkali
- DA,Denied access
- Ga,Grangeville sandy loam
- Gf,Grangeville fine sandy loam, 0 to 1 percent slopes, MLRA 17
- Hsc,Hesperia coarse sandy loam, saline-alkali
- Hse,Hesperia sandy loam, saline-alkali
- Mf,Merced clay loam
- Mg,Merced clay loam, slightly saline
- Mh,Merced clay
- Mk,Merced clay, slightly saline
- Ml,Merced clay, moderately saline
- Mm,Merced clay, saline-alkali
- Pl,Playas
- Pr,Pond sandy loam
- Pt,Pond fine sandy loam
- Pu,Pond fine sandy loam, moderately deep
- Pv,Pond loam
- Pw,Pond loam, moderately deep
- Ro,Rossi fine sandy loam
- Rs,Rossi clay loam
- Td,Temple clay loam
- Te,Temple clay loam, saline
- Tg,Temple clay
- Tr,Traver sandy loam
- Ts,Traver sandy loam, moderately deep
- Tt,Traver fine sandy loam
- Tu,Traver fine sandy loam, moderately deep
- TzbA,Tujunga loamy sand, 0 to 3 percent slopes
- W,Water
- Wa,Waukena fine sandy loam
- We,Waukena loam

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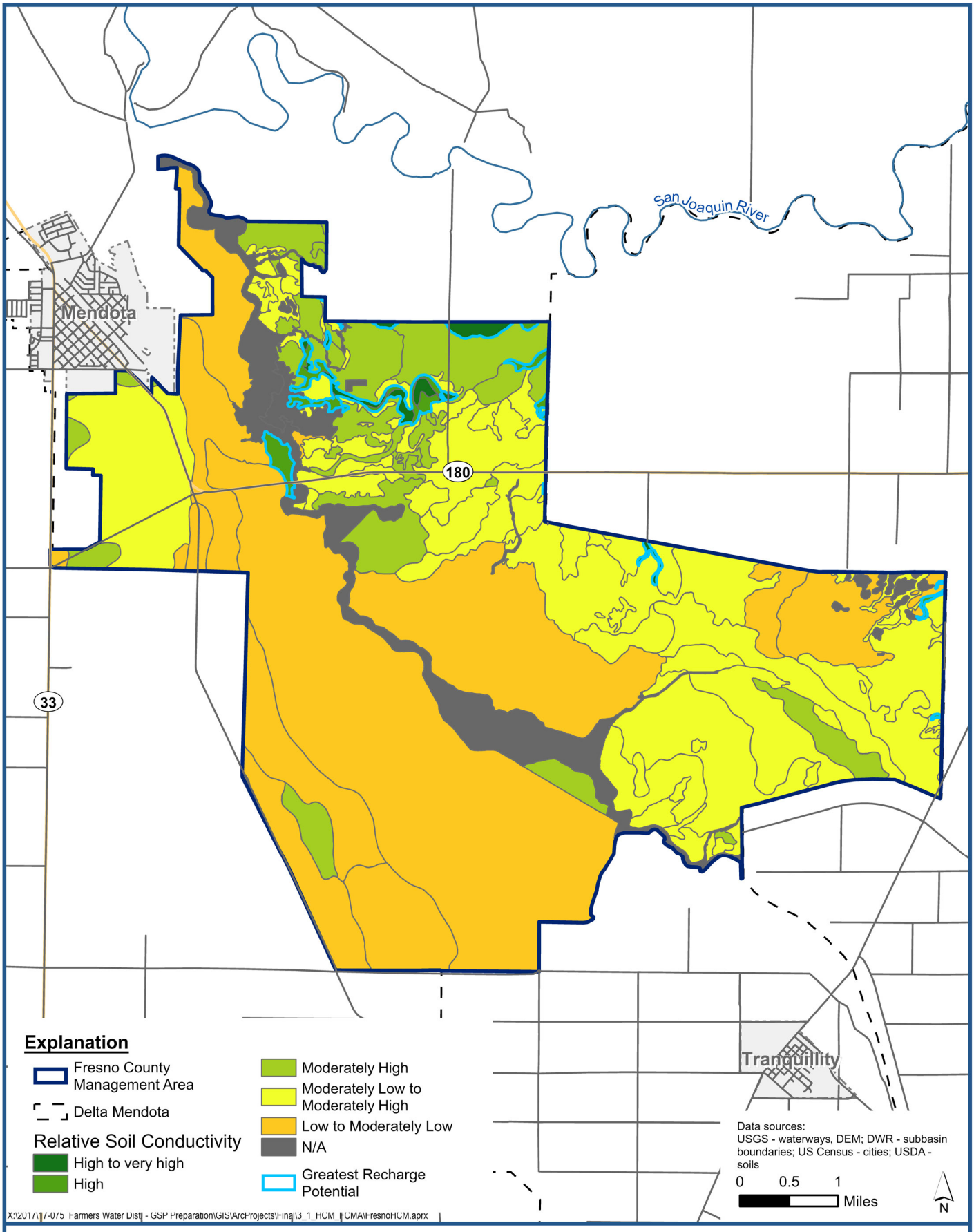
Soils Map Explanation

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-9B



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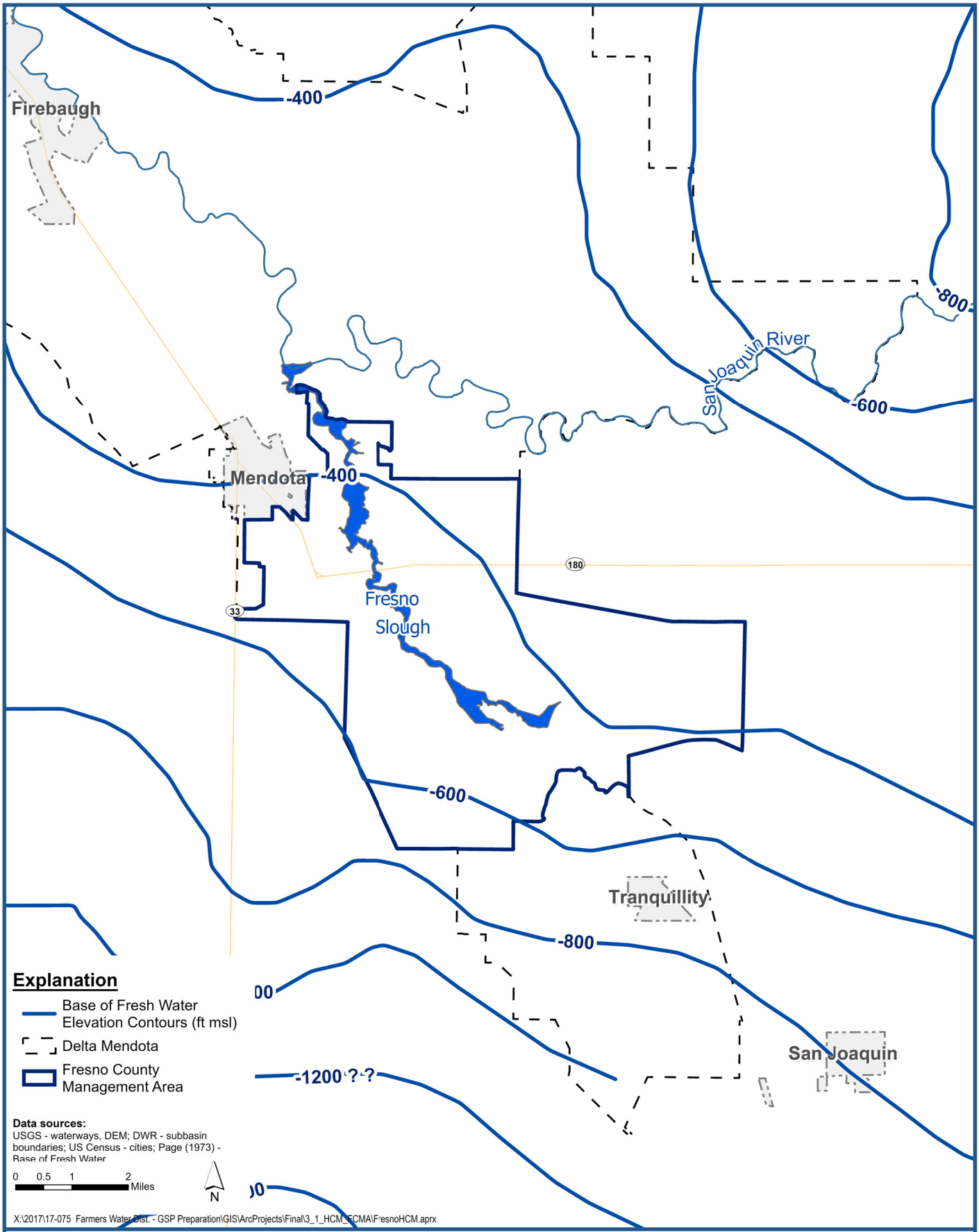
Relative Soil Infiltration Rates

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-10



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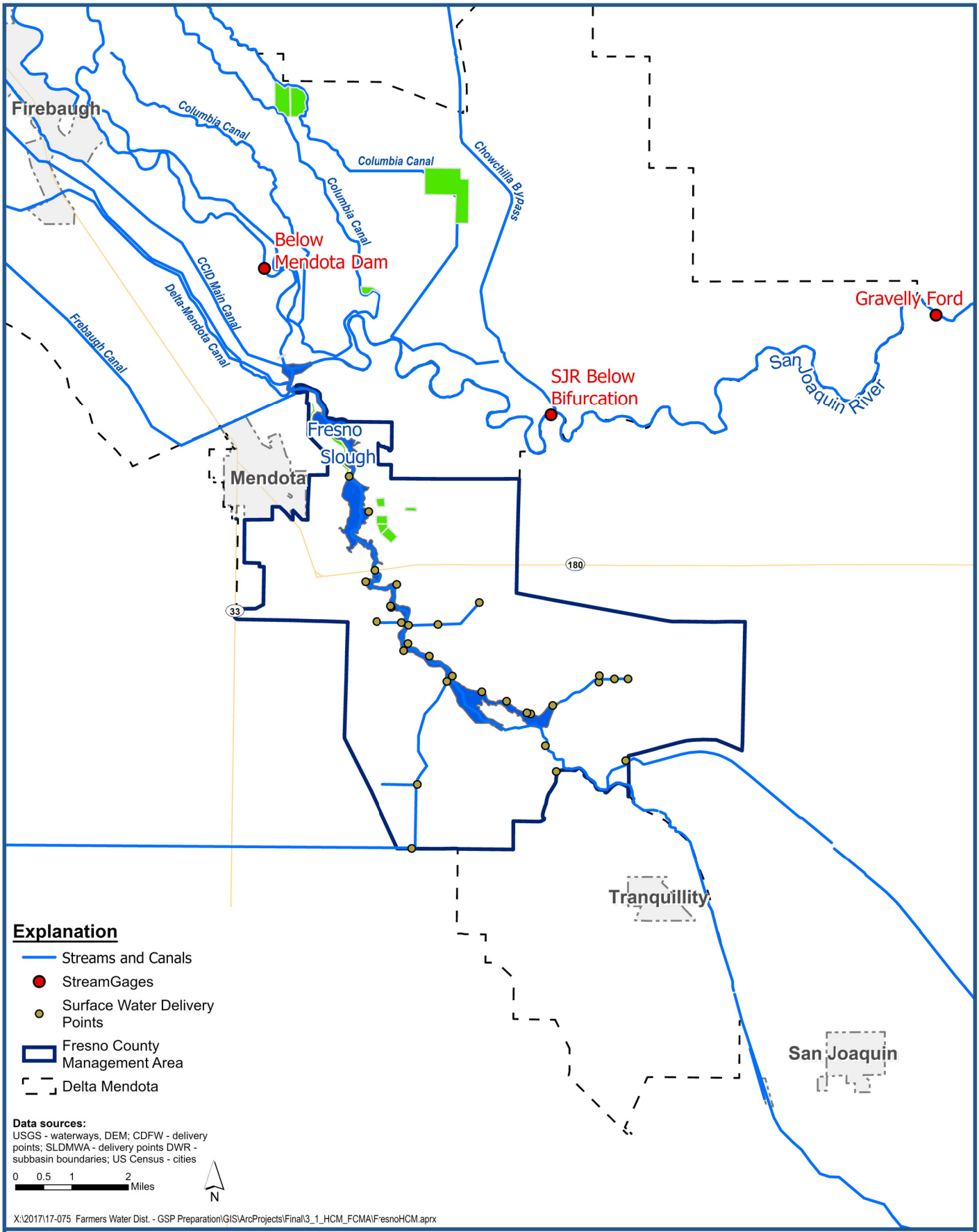
Base of Fresh Water

Figure 3-11

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin



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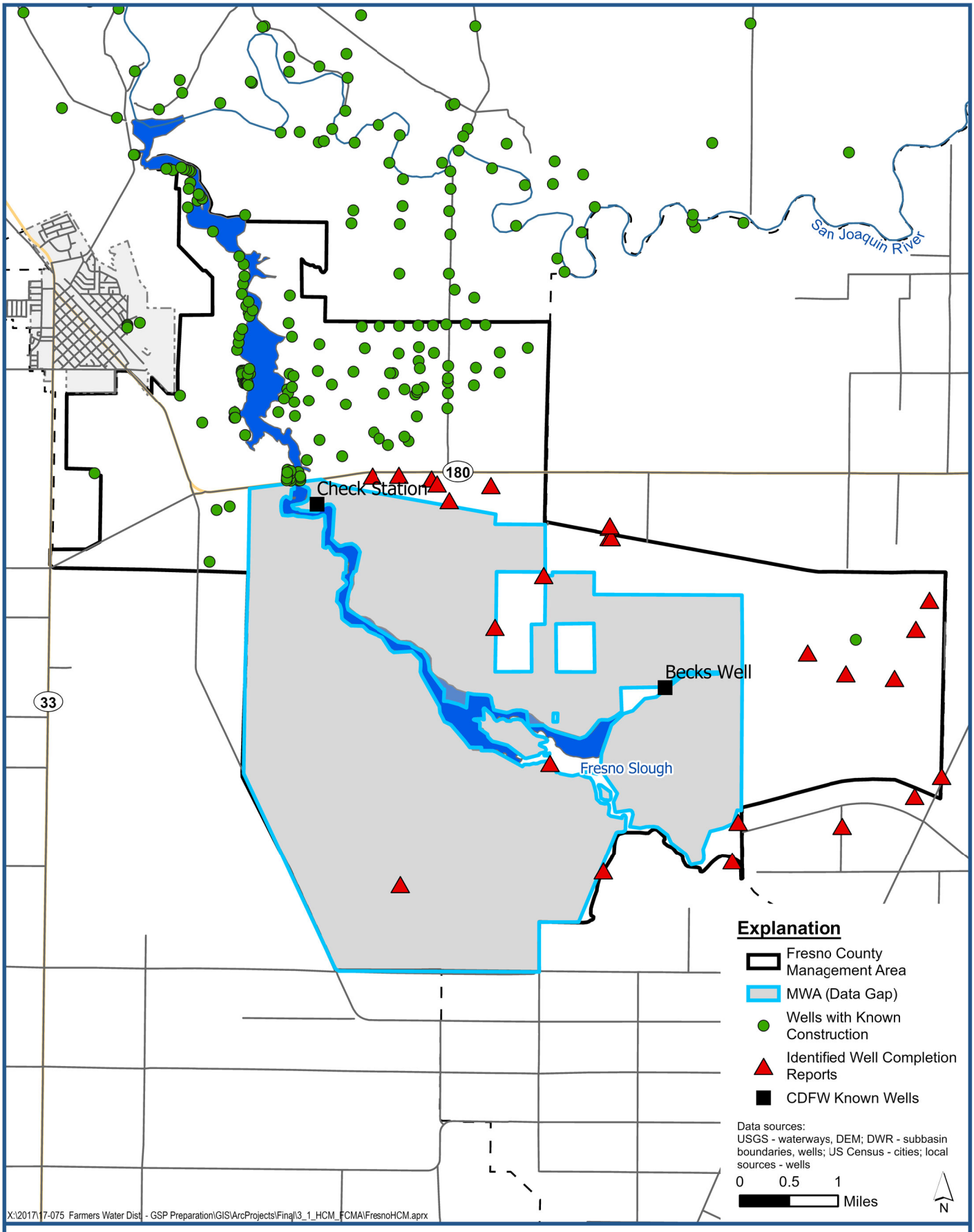
Surface Water Features

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-12



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Fresno County Management Area Data Gaps

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-13

For the entire Delta-Mendota Subbasin, Interconnected Surface Waters have been identified as a Data Gap. FCMA along with the rest of the Subbasin is going to utilize publicly available data from the San Joaquin River Restoration Program to assist in the development of a monitoring network for interconnected Surface Waters. Additional wells in the MWA will be useful for the this network.

3.2 Current and Historic Groundwater Conditions

Groundwater conditions, both levels and quality, were evaluated to understand the temporal and spatial trends on an aquifer specific basis in the FCMA and in the Subbasin. Subbasin scale groundwater conditions are presented in the common chapter (**Appendix A)**. The focus of this discussion will be on the Upper and Lower Aquifers within FCMA which are divided by the Corcoran Clay. Groundwater elevations (GWE) and groundwater quality constituents TDS and EC data were gathered from various state and federal agency websites including DWR, California Department of Public Health (CDPH), California State Water Resources Control Board (SWRCB), and local sources of monitored data. The historic water budget period for evaluation of groundwater conditions in FCMA ranged from 2003 through 2012, consistent with the other GSPs in the Subbasin. The current water budget year was selected to be 2013. Groundwater conditions from 2014 through 2017 will be discussed with the projected water budget period that spans from 2014 through 2070.

3.2.1 Groundwater Levels and Flow Direction (354.16 a)

The characterization of groundwater levels and direction of flow is essential to understanding groundwater conditions including the flow directions, trends in levels over time, seasonal highs and lows, areas integral to recharge and those involved in discharge, and other hydrogeologic conditions. To characterize groundwater levels in FCMA, data from federal, state, and local sources were used. Most of the groundwater level data available is from the Upper Aquifer with a limited amount of data is available for the Lower Aquifer. Lower Aquifer data that was evaluated was located adjacent to and outside the FCMA. The locations of wells and other monitoring sites referenced and in this section are depicted in **Figure 3-14**.

3.2.1.1 Upper Aquifer

The Upper Aquifer in the vicinity of FCMA lies above the Corcoran Clay and is comprised of two water bearing zones; the shallow and the deep. The shallow and deep zones are separated by the A-Clay. Both zones will be discussed in the section, with the shallow zone characteristics that support the understanding of surface water and groundwater interactions and the presence of GDEs. The deep zone allows an understanding of subsurface flows between adjacent GSAs within and outside of the Subbasin. Both season high and season low groundwater elevation data for 2013 were used for this evaluation of groundwater levels and flow direction. The A-Clay is limited in extent in the Subbasin and therefore, the principal aquifer delineations in the Subbasin do not include a subdivision of the Upper Aquifer into two or more zones.

3.2.1.1.1 Shallow Zone

Contours of seasonal high and low groundwater elevations in the Shallow Zone for the current water budget year are shown in **Figures 3-15** and **3-16**, respectively. Seasonal high and seasonal low groundwater elevation contours for the current water year, 2013, were used to determine the groundwater flow direction. The seasonal high contours, which generally occur during the winter through early spring, show groundwater generally flowing to the northeast with the highest levels occurring near the SJR. Higher groundwater elevations in the form of a mound are also present near the Meyers Water Bank in MAA. Contours of seasonal low groundwater elevation in the shallow zone of the Upper Aquifer are similar to the seasonal high pattern. Groundwater elevations along the SJR are fairly consistent with seasonal high levels. Shallow zone groundwater elevations vary between season high and season low conditions. Seasonal high conditions are generally 10 to 30 ft higher than seasonal low conditions for 2013. Two areas where groundwater level decline occurs are near the City of Mendota and north of the SJR.

Historical trends in groundwater elevations are depicted in hydrographs that show groundwater elevation measurements over time. Two shallow zone well hydrographs in the FCMA were selected to represent the historical variability in shallow zone groundwater levels (**Figures 3-17 and 3-18**). The locations of these wells can be seen on **Figure 3-14**. The first hydrograph is TLF-7s which is located at the north point on FCMA. The second hydrograph, MW-32, is on the northeastern border of FCMA. As displayed by the hydrographs for these wells, Shallow Zone groundwater levels have declined during historical droughts and recovered during wet periods with no long-term trend of groundwater decline.

During seasonal high conditions in the shallow zone, the lateral gradient of groundwater flow, based on the groundwater elevation contours, is approximately 11 ft per mile in a northeast direction, and the vertical gradient from the shallow to deep zone of the Upper Aquifer is approximately 0.2 ft/ft with flow in the downward direction. During the seasonal low, the horizontal gradient is approximately 12 ft/mile in the northeast direction, and the vertical gradient is 0.3 ft/ft with downward flow. The vertical gradients were determined using water level measurements from wells MW-09-55 and MW-09-55b, a set of nested wells in the Shallow Zone (**Figure 3-14**). These gradient values may vary locally due to recharge from surface water or localized pumping.

3.2.1.1.2 Deep Zone

Groundwater levels in the deep zone are generally under semi-confined conditions below the A-Clay. Contours of seasonal high and low groundwater elevations for the current water year, 2013, are depicted in **Figure 3-19** and **3-20**, respectively. **Figure 3-19** shows that, similar to the groundwater in the shallow zone, seasonal high groundwater contours generally flow to the northeast. A mound of groundwater is also present in the central-northern portion of FCMA potentially due to recharge from the Meyers Water Bank. **Figure 3-20** shows the season low flow to the northeast but with cones of depression appearing north of the SJR. Deep Zone groundwater elevations within FCMA range from 120 to 150 ft NAVD 88 during the season high and 50 to 150 ft NAVD 88 during the season low. Groundwater

levels in the Deep Zone tend to exhibit greater seasonal variations than groundwater levels in the Shallow Zone due to lower storage coefficients of the aquifer material.

Two representative hydrographs of deep zone wells, screened between the A-Clay and Corcoran Clay, were selected to show the seasonal variations and range of groundwater levels during dry and wet periods (**Figures 3-21** and **3-22**). The location of these wells is displayed in **Figure 3-14.** The first well, MW-11, is located in the north-central portion of FCMA. This hydrograph displays seasonal variation between 10 to 20 ft and is sensitive to wet and dry periods as represented by high and low multi-year groundwater levels. The second well, KRCDA06, which is part of the CASGEM network, is located in the eastern portion of FCMA. This well has maintained very consistent water levels since the early 2000's. The hydrographs for both MW-11 and KRCDA06 show that overall, groundwater levels have not exhibited a long-term trend of groundwater decline.

Based on the groundwater elevation contours, the lateral hydraulic gradient is approximately 9 ft/mile in a northeast direction, and the vertical gradient is approximately 0.018 ft/ft in downward direction during seasonal high conditions. The vertical gradient was determined by groundwater elevation measurements at USGS 31J3 and 31J5, which are screened in the Deep Zone at different depths in roughly the same locations west of the FCMA (**Figure 3-14**).During seasonal low conditions of 2013, the horizontal flow gradient is approximately 12 ft/mile in a northeast direction, with a vertical gradient of 0.16 ft/ft in a downward direction

3.2.1.2 Lower Aquifer

There are no known Lower Aquifer wells in FCMA to collect groundwater level data, primarily because FCMA does not target the Lower Aquifer for groundwater production. Due to the lack of Lower Aquifer wells within FCMA, the assessment of Lower Aquifer groundwater conditions within FCMA was estimated by evaluating data from Lower Aquifer wells located in nearby GSAs to provide adequate coverage for evaluating groundwater levels and water level contours. The data that are available prevents a high-resolution level of analysis in understanding groundwater conditions in the Lower Aquifer. From this limited data, Lower Aquifer groundwater levels are lower than groundwater levels in the Upper Aquifer, resulting in a downward hydraulic gradient from the Upper Aquifer to the Lower Aquifer. Lower Aquifer groundwater levels in the in the vicinity of FCMA appear to be more sensitive to regional variations in pumping as compared to the shallow and deep zones due to the confined nature and associated lower storage coefficients associated with the Lower Aquifer. The season high and season low groundwater elevations for the current water year, 2013, are shown in **Figure 3-23** and **3-24**, respectively. Groundwater elevations that are estimated to occur within FCMA range from 40 to 10 ft NAVD 88 during seasonal high conditions. The seasonal low conditions show similar conditions with flow groundwater levels predominately to the south and southwest in areas near FCMA. The lateral gradient in the Lower Aquifer during seasonal high conditions was approximately 8 ft/mile to the southwest. Seasonal low groundwater levels range between 10 to 50 ft NAVD 88. The lateral gradient during

seasonal low conditions was the same as the seasonal high. Data were not available to calculate a vertical gradient within the Lower Aquifer.

A hydrograph of USGS 31J6, as shown in **Figure 3-25**, located just northwest of FCMA in the City of Mendota, shows that groundwater levels in the Lower Aquifer are generally decreasing ranging from approximately 80 to -60 (ft NAVD 88) from the late 1980s through 2016. In recent years groundwater levels have increased to approximately 30 (ft NAVD 88). Over the historic and current water budget period, water levels ranged from about 60 ft NAVD 88 to about -5 ft NAVD 88.

The gradient between the Upper and Lower Aquifer was determined with the data from wells USGS 31J5 and 31J6 located just northwest of FCMA in the City of Mendota. Since data has been collected, starting in 1985, there has been a downward vertical gradient with flow from the Upper Aquifer to the Lower Aquifer with the gradient increasing over time (**Figure 3-26**). The negative gradient is likely the result of over extraction from the Lower Aquifer which is more sensitive to seasonal pumping due to its confined nature. Currently, groundwater extraction in the vicinity of FCMA is entirely from the Upper Aquifer. Therefore, the continued trend of an increasing downward or negative gradient is not due to the actions of beneficial groundwater users in FCMA.

3.2.2 Change in Storage (354.16 b)

The total change in storage over the historic (WY2003 – 2012) and current (WY 2013) water budget periods ~~years of 2003 through 2013~~ for both the Upper and Lower Aquifers were estimated based groundwater flow modeling results (inflows-outflows), which will be discussed further in section 3.3. Annual measurements were determined based on seasonal high measurements typically occurring in the late winter when groundwater levels in this area of the Subbasin generally represent seasonal highs The Upper Aquifer cumulative (total over the entire time period) change in storage over the historic through current water year was stable at approximately 0 AF (**Figure 3-27**). Annual change in storage values over this period ranged from a storage increase of 19,000 AF to a storage decline of 15,500 AF. The annual storage change for the Lower Aquifer ranged from an increase of +2,000 AF to a decline of -6,000 AF. The total change in storage for the Lower Aquifer was approximately a reduction of 19,000 AF resulting in an average annual decline of -1,700 AFY (**Figure 3-28**). The range in annual change in storage tends to correlate with the water year type, according to the San Joaquin River Index (SJRI). Over the water budget period, there were five “dry” years, three “normal” years, and three “wet” years.

3.2.3 Groundwater Quality (354.16 d)

Since 1999, the MPG has produced an annual report on groundwater quality conditions, and, since 2008, Spreckels Sugar Company has produced semiannual reports on groundwater quality conditions. As discussed in Section 3.1.4, the primary groundwater quality issue within FCMA is the fate and transport of salts. Salinity, measured as either TDS or EC, is naturally present in subsurface materials of the western portion of the FCMA. Regionally, the major source of saline groundwater is marine sediments which have high levels of naturally occurring salts (Hotchkiss, et al., 1971). In some areas of FCMA,

salinity can also be attributed to percolated wastewater from the former Spreckels Sugar Company plant.

Groundwater in some areas of the shallow and deep zones west of the Mendota Pool and Fresno Slough has naturally high TDS concentrations which has resulted in groundwater pumping in the Upper Aquifer being constrained without implementing management actions. Some wells west of the Pool show a gradual increase in salinity due to the presence of the naturally occurring high saline water produced from the marine sediments deposited from the Coast Range. In addition to EC and TDS, FCMA and the surrounding area have been monitored for trace elements which include boron, arsenic, barium, copper, iron, manganese, molybdenum, selenium, and zinc. The concentrations of these elements are generally low in the Upper Aquifer in the FCMA, with the exception of elevated concentration of manganese, primarily in the shallow zone of the Upper Aquifer (LSCE and KDSA, 2018a). The occurrence of naturally occurring concentrations of saline groundwater is not a result of actions from human-based activities and therefore is not considered degraded water quality as defined by SGMA; which represents degraded water quality as human caused contamination plumes.

The primary location of degraded water quality is the occurrence and migration of the Steffens Plume that underlies the former Spreckels Sugar Company located in FCMA and has migrated northward into the southern portion of the FWD GSA. Throughout the operations of the Spreckels Sugar Company plant, high salinity byproducts have been discharged into unlined ponds resulting in high EC values in the Upper Aquifer.

Contours of EC were generated from 2015 groundwater quality measurements for both the shallow and deep zones. In both zones, high EC levels are present at the former Steffens waste ponds and west of the Pool. Data from 2015 was used instead of the current water year, 2013, due to the availability of data. In the shallow zone, EC values are highest west of FCMA near the city of Mendota and the lowest values occur along the Fresno Slough (**Figure 3-29**). Similar to the shallow zone, the highest levels of EC in the deep zone occurred west of FCMA near the City of Mendota with the lowest values along the Fresno Slough (**Figure 3-30**). Groundwater quality trends have varied depending on location, with some areas experiencing increasing trends and others experiencing declining or stable trends. Well MW-7, located centrally in the MAA, is an example of an area with gradually increasing trends in EC over the historic and current period. Shallow zone groundwater quality in the MAA is very good with low EC values in the western portion of the MAA. Well MF-7 has shown significant improvement in water quality due to the presence of the Meyers Water Bank. Over the historic and current water budget period EC measurements declined from 4,000 uhmos/cm to under 1,000 uhmos/cm. Groundwater quality of each of these wells are displayed in **Figure 3-31**. Locations are displayed in **Figure 3-14.**

In addition to the monitoring of TDS and EC, the MPG Annual Report monitors for boron and eight trace elements: arsenic, barium, copper, iron, manganese, molybdenum, selenium, and zinc. All of these have been generally low, with the exception of manganese which has been higher, primarily in the shallow

zone. The highest reported value of manganese in the Shallow Zone of the Upper Aquifer was 19 mg/L in October of 2015 (LSCE and KDSA, 2018).

3.2.4 Seawater Intrusion (354.16 c)

Due to the location of FCMA and the Delta-Mendota Subbasin in the San Joaquin Valley and the Subbasin being physically separated from the Pacific Ocean by the Coast Range, seawater intrusion cannot occur in FCMA and the Subbasin and therefore, does not pose a risk to the beneficial uses or users of groundwater.

3.2.5 Subsidence (354.16 e)

Subsidence is the gradual lowering of ground surface elevation due to the over extraction of groundwater in a confined or semi-confined aquifer. The extraction of groundwater results in a reduction of pressure within the void space between grains in an aquifer. As this pressure is reduced, the compaction of aquifer materials, primarily fine-grained sediments such as clay. Coarser-grained aquifer materials such as sands and gravels are not impacted by the reduction in pressure reducing the void space and altering the granular orientation of clays, causing the clay sediments to compact which results in subsidence at the land surface. Subsidence is the sum total of all aquifer compaction. Monitoring of subsidence, especially inelastic or permanent subsidence as compared to seasonal or elastic subsidence, is important for groundwater management and preventing damage to existing infrastructure.

The important part of subsidence is its inelastic component, or the amount of permanent subsidence. On a seasonal basis, subsidence has an elastic component which corresponds with seasonal high and seasonal low groundwater elevation. Inelastic subsidence is observed on an annual or multi-year basis between seasonal high measurements that typically are best measured in the winter and early spring months when groundwater production is the lowest and elastic subsidence is generally absent.

In FCMA and surrounding areas, there are two extensometers (Fordel and Yearout Ranch) that measure Upper Aquifer compaction. Fordel is located west of the Fresno Slough and Yearout Ranch is located north of FCMA (**Figure 3-32**). Both extensometers are monitored by the USGS and are reported in the MPG annual report. There is also a Plate Boundary Observation site (P304) within FCMA area which measures total subsidence. P304 is monitored by UNAVCO which is a non-profit university-governed consortium. Data from these sites were used to evaluate subsidence conditions over the historic and current period.

Results from the Yearout Ranch Extensometer are displayed in **Figure 3-33**. The period of record extends from the end of 1999 to 2018. Data are limited between 2009 through 2012 due to questionable measurements. Based on the data observed at Yearout over the historic and current water budget period, the total inelastic compaction for the Upper Aquifer was approximately 0.08 ft. This value was obtained from the seasonal high values observed in 2003 and 2013. Even with gaps in data between

2009 through 2012, the entire period of record generally shows a consistent trend of compaction over time. One exception during the historic and current period was from 2004 through 2007 when there was almost no observed compaction. The absence of compaction during this period corresponded with two consecutive wet years in 2005 and 2006.

The Fordel Extensometer generally shows a trend of long-term compaction but with more variation than the Yearout Extensometer (**Figure 3-34**). Fordel Extensometer has a more complete record than Yearout with no extended gaps in data collection. Over the historic and current period, the total amount of Upper Aquifer compaction was approximately 0.02 ft. Compaction values at Fordel correspond very well with year type. Similar to Yearout, from 2004 through 2007 there is no observed compaction. Fordel also displays no observed compaction from 2010 through 2011 due to a normal and wet conditions.

The total measured subsidence at P304 is displayed in **Figure 3-35**. The period of record for this monitoring site does not cover the entire historic and current period as data collection began in 2004. The data from Fordel is also depicted in this figure to show Upper Aquifer compaction in relation to total subsidence. Based on the observed data since 2004, Upper Aquifer compaction constitutes a very small portion of total subsidence. Over the historic and current period, the total amount of subsidence was approximately 0.3 ft. Total subsidence is an order of magnitude greater than Upper Aquifer compaction. The total subsidence generally corresponds to year type. Similar to both the Extensometers, minimal subsidence is observed from 2004 through 2007 due to the wet conditions in 2004 and 2005. A consistent trend of subsidence occurs from 2007 through 2010 which consisted of dry and normal conditions. 2011 saw no subsidence due to wet conditions, followed by consecutive dry years resulting in continued subsidence.

An important aspect of **Figure 3-35** is the difference between total subsidence and Upper Aquifer compaction. The reason compaction in the Lower Aquifer is so much greater is due to the confined conditions, the occurrence of clays susceptible to compaction and local and regional groundwater pumping influences from composite and Lower Aquifer wells. The Upper Aquifer is generally semi-confined to unconfined and groundwater levels have generally been stable (rather than declining) which promotes conditions that prevent the occurrence of subsidence. FCMA extraction of groundwater from the Upper Aquifer has not resulted in significant declines in groundwater levels, therefore, is not a significant cause of subsidence in the FCMA. There is some pumpage from the Lower Aquifer (below the Corcoran Clay) near FCMA, however, the amounts can only be inferred and estimated based on historical subsidence patterns and locations of composite wells and overlying land use. There is one composite well to the north in Farmers Water District, 11 composite wells in Aliso Water District, and an unknown number of composite and Lower Aquifer wells in Tranquility Irrigation District, McMullin GSA, and James Irrigation District GSAs in the Kings Subbasin. The Westside Subbasin borders the western boundary of a portion of FCMA, however, groundwater pumping is not allowed in a large portion of the Westside Subbasin land bordering the FCMA due to the retirement of approximately 100,000 acres in total along the eastern boundary of the Westside Subbasin. There are a few parcels of land in the

Westside Subbasin adjacent to the FCMA which are not retired and may have some limited amount of groundwater pumping from the Lower Aquifer. Most of the wells in adjacent GSAs within the Subbasin have perforated intervals that are above the Corcoran Clay. It is difficult to identify the causes of the subsidence in the Mendota area due to incomplete well construction records in neighboring GSAs and well by well pumping information from composite wells. There could also be some influence from regional pumping from the lower aquifer in other subbasins. Regardless of the potential causes of subsidence in the FCMA, in general, historical subsidence in this area of the San Joaquin Valley has been relatively small compared to areas located south, east, and north of the FCMA in other GSAs and subbasins.

3.2.6 Interconnected Surface Water Systems (354.16 f)

Interconnected surface water systems are the locations where groundwater and surface water are hydrologically connected. The Fresno Slough, which runs through FCM~~a~~A~~MAB~~, is considered an interconnected surface water system based on local water elevation in the Shallow Zone of the Upper Aquifer. Based on historic water levels, the Fresno Slough loses water to the groundwater system. LSCE and KDSA (2000) developed seepage rates from the slough to the groundwater system. While this is a losing surface water system with water levels below the base of the Fresno Slough, there is likely still a zone of saturation between the base of the slough and the water table due to the continual presence of surface water in the Fresno Slough. The rate of seepage is controlled by water levels in the slough and the fine-grained sediments that compose the bottom of the Mendota Pool.

Interconnected Surface waters will be monitored at the northern part of the Fresno Slough at the Mendota Pool Staff Gage (**Figure 3-14**). Water levels in Fresno Slough have been very consisted over the historic period but have recently shown a gradual decline (**Figure 3-36**). These values are measured at the Mendota Pool Staff gage which is located at the northern end of MAB. Stage has consistently been around 14 ft unless the Pool is drained for maintenance, which occurred six times during the historic and current period and once more at the end of 2016.

Water levels in the Fresno Slough are controlled by the SJREC and USBR in coordination with the San Luis Delta-Mendota Water Authority (SLDMWA). Groundwater elevation in shallow zone are discussed in section 3.2.2.1. **Figure 3-17** represent the Shallow Zone groundwater elevation along the Fresno Slough.

Based on the information presented in this section, the estimated annual seepage amounts were developed and are presented in **Table 3-2**.

Table 3-2 Seepage from Fresno Slough to Upper Aquifer

Year	2003 (N)	2004 (D)	2005 (W)	2006 (W)	2007 (D)	2008 (D)	2009 (N)	2010 (N)	2011 (W)	2012 (D)	2013 (D)
AF/year	26,000	26,000	20,000	16,000	17,000	25,000	28,000	28,000	19,000	21,000	29,000

CFS	36	35	28	21	23	34	38	38	26	29	39

3.2.7 Identification of Groundwater Dependent Ecosystems (354.16 g)

GSP regulation (§ 351 *m*) defines GDEs as ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring within near the ground surface. GDEs are considered a beneficial user of groundwater and must be identified and considered in the GSP of a Subbasin. The potential occurrence of GDEs were initially identified in FCMA from the NCCAG dataset by the Nature Conservancy (TNC) which contained mapped vegetation and wetlands representing groundwater dependent ecosystem indicators (GDEi) (Rohde and other, 2018). The TNC datasets were often based on data that was several decades old and not representative is more recent (2015) baseline conditions. As a result, additional evaluation of GDE occurrence was conducted using the methodologies described below to supplement the TNC work.

1. For the vegetation data set, GDEs were first evaluated by using depth to water (DTW) measurements from Spring 2015 from Shallow Zone wells (screened above the A-Clay). Based on a water level threshold of 30 ft below ground surface (ft bgs), areas with water levels greater than 30 ft bgs were removed as containing GDEs, and areas with water levels shallower than the threshold were kept as GDEs. Areas with insufficient data were considered data gaps for water levels and were evaluated based on observed vegetative health from local stakeholders. The 30 ft bgs threshold did not apply vegetation GDEs that were adjacent to surface water that was continually present and classified as interconnected surface water. For the wetland's datasets, areas that were not saturated on a continual basis were removed.
2. Aerial imagery from USDA National Agricultural Imagery Program (NAIP) was used to verify the existence of GDEs and the presence of surface water. The areas that were classified as GDEs were then compared to the most recent imagery to see if there was a change in land use or if vegetation was still present. The GDEi dataset contained mapped vegetation and wetlands from sources dating back to 1987.
3. Evaluation of GDE health from past imagery.
4. GDEs were also determined by speaking with local stakeholders (CDFW) who are familiar with the area.

3.2.7.1 Final GDE Map

The final GDE map for FCMA with depth to groundwater contours can be seen in **Figure 3-37**. This map contains the areas that have been removed, kept, and added as GDEs in FCMA. For the vegetation dataset, most GDEi were designated as GDEs even with Spring 2015 water levels occurring below 30 ft bgs. A majority of the vegetation GDEi were along the Fresno Slough which is classified as an interconnected surface water. Even with the depth to groundwater exceeding 30 ft, there is a hydrologic connection between surface water and groundwater. Based on historic water level data and historic aerial imagery, vegetation along the banks of the Fresno remained through extended dry periods when

the water table is well below 30 ft bgs. One area north of Whitesbridge Road (SR 180) was removed as a vegetation GDE based on input from local stakeholders. Areas south of Whitesbridge Road (SR 180) were classified as GDEs due to a lack of data a lack of data and input from local stakeholders.

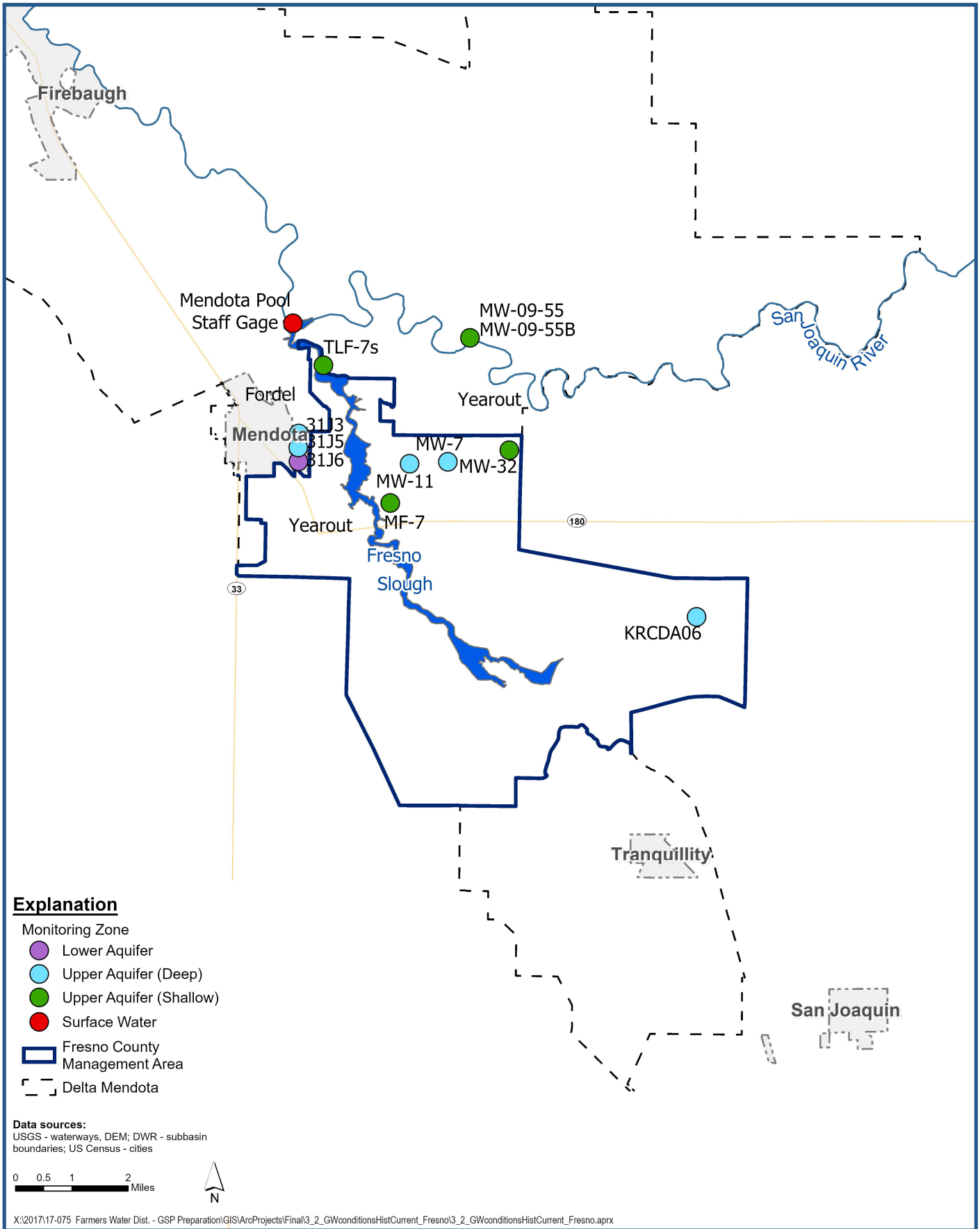
For the wetland's dataset, the areas of the Fresno Slough that were continually saturated based on historic imagery were designated as GDEs. The Fresno Slough runs through the entire FCMA. The banks of the Fresno Slough were classified as GDEi in the wetlands data set. Based on historic imagery these areas contain minimal vegetation are only saturated during wet years such as 2011 and 2017. These areas were removed as GDEs. Areas beyond the banks of the Fresno Slough and where depth to water exceeded 30 ft were removed as GDEs. There was one exception in the northern part of FCMA, one of the NCCAG polygons disconnected from the Fresno Slough has remained flooded over time and has been designated as a GDE. This polygon is the one area identified as a wetland in section 3.1.7.

3.2.7.2 Ecological Conditions

Ecological conditions were assessed to determine the conservation value of GDEs near FCMA. Using publicly available datasets recommended by TNC (Rohde and others, 2018), **Figure 3-38** shows the mapped critical habitats near FCMA obtained from the US Fish and Wildlife Service's (USFWS) Environmental Conservation Online System. One critical habitat has been identified within the FCMA GSP area. This area is located in the MWA portion which is designated as Open Space and protected under California Law (Section 5901, PRC).

3.2.7.3 Impacts to GDEs

Based on the presence of GDEs during extended dry periods, the future activities within FCMA will not impact existing GDEs. Currently, mapped GDEs have been maintained during a varying hydrologic conditions and water table depths. There is also significant seepage from the Mendota Pool to the Shallow Zone of the Upper Aquifer which helps maintain GDEs (**Table 3-2**). Vegetation in FCMA has remained due to the continued surface water flows in the Fresno slough and surface water deliveries in the MWA. Unless there are land management changes outside the activities of FCMA, GDEs will not be impacted.



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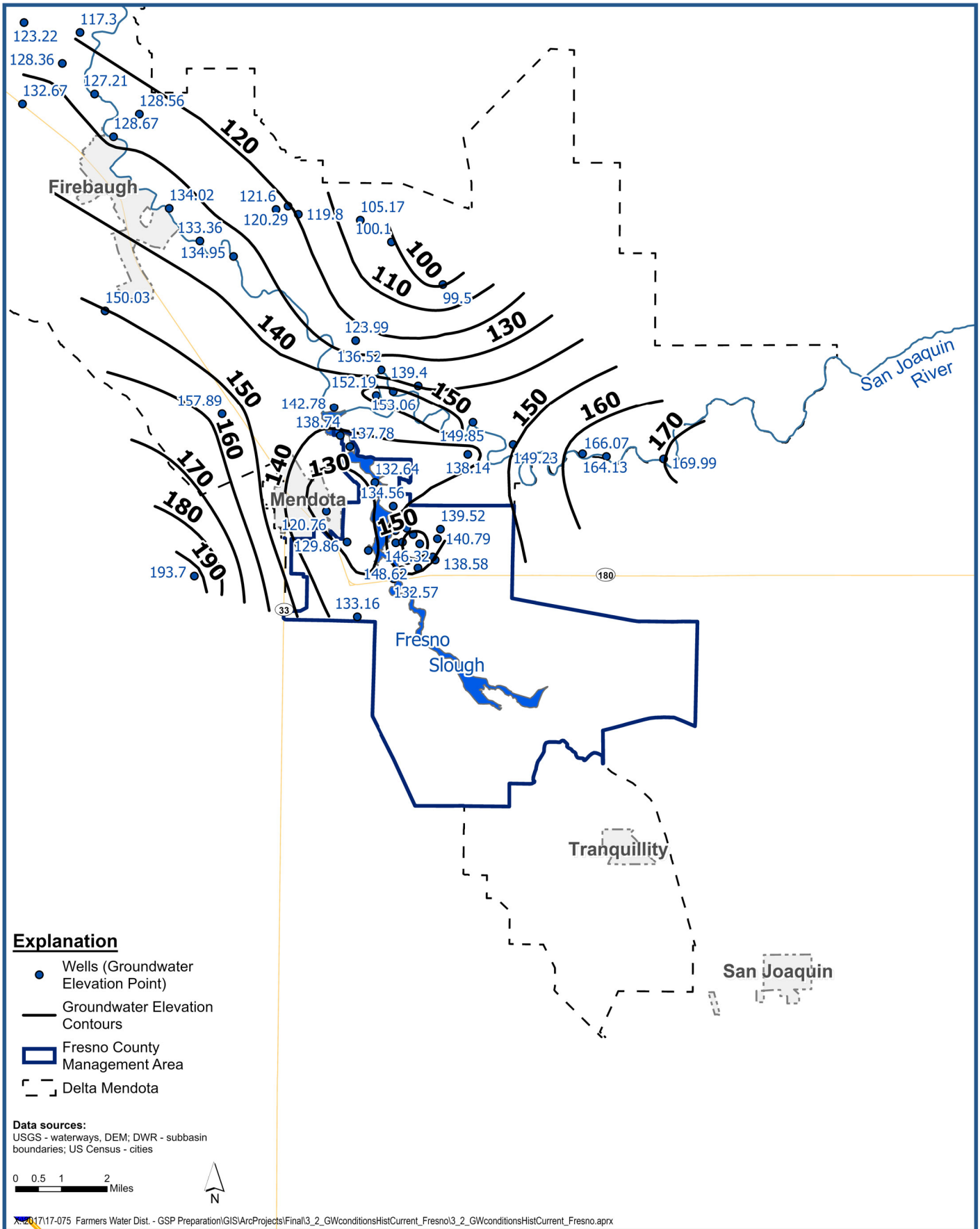
Water Level and Water Quality Monitoring Locations

Figure 3-14

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin



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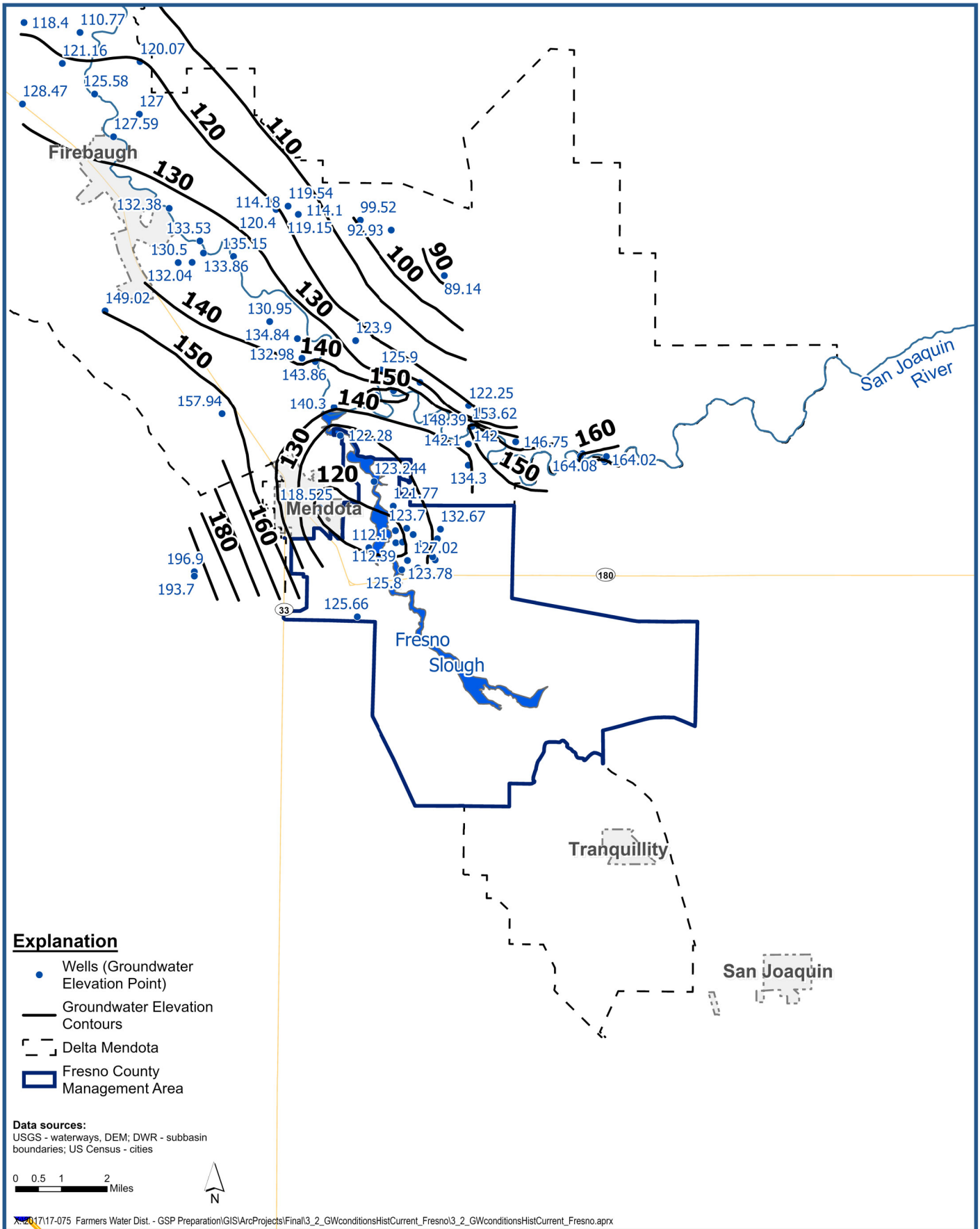
Shallow Zone Groundwater Elevation Contours
Season High 2013

Figure 3-15

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin



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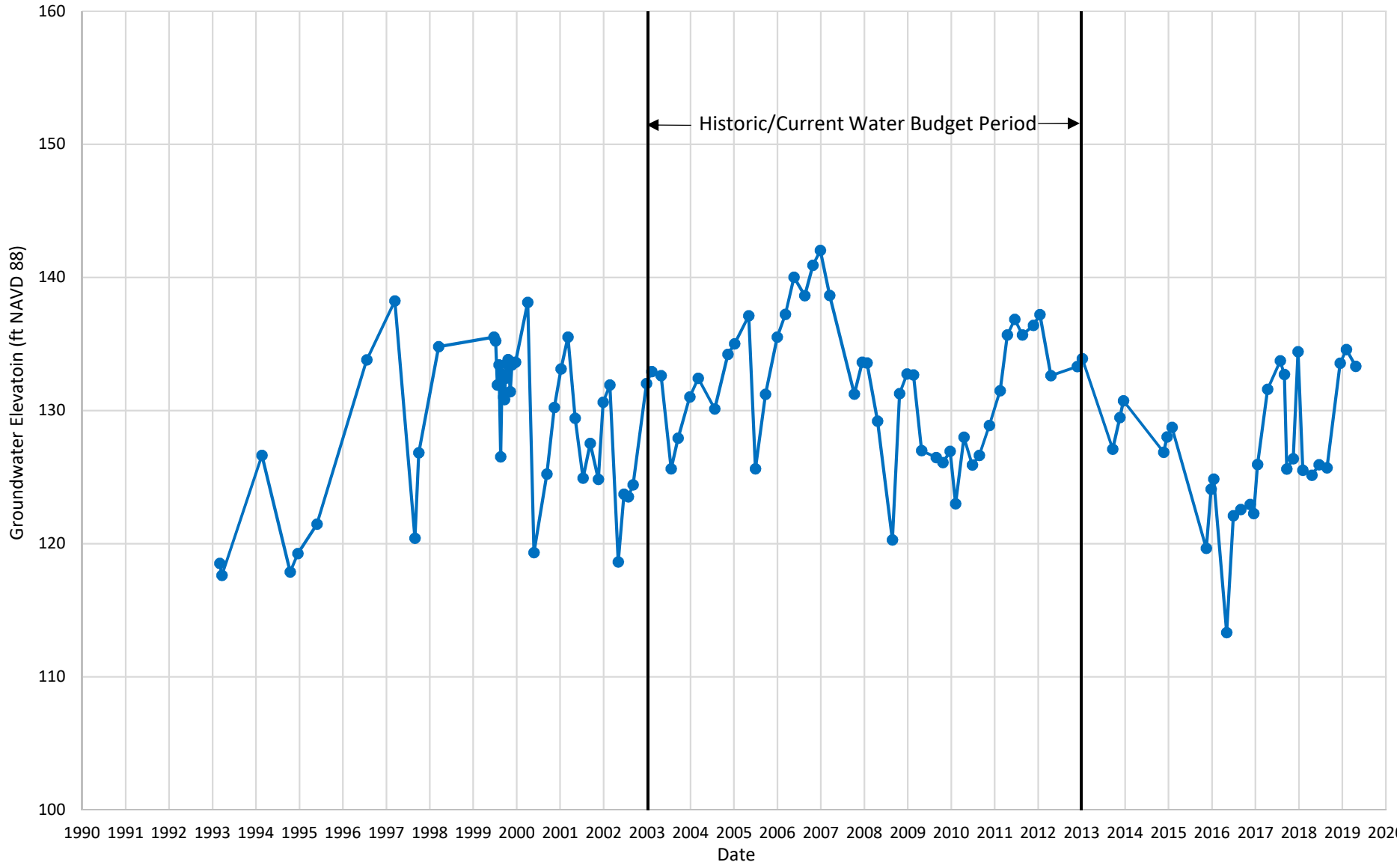
Shallow Zone Groundwater Elevation Contours
Season Low 2013

Figure 3-16

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin



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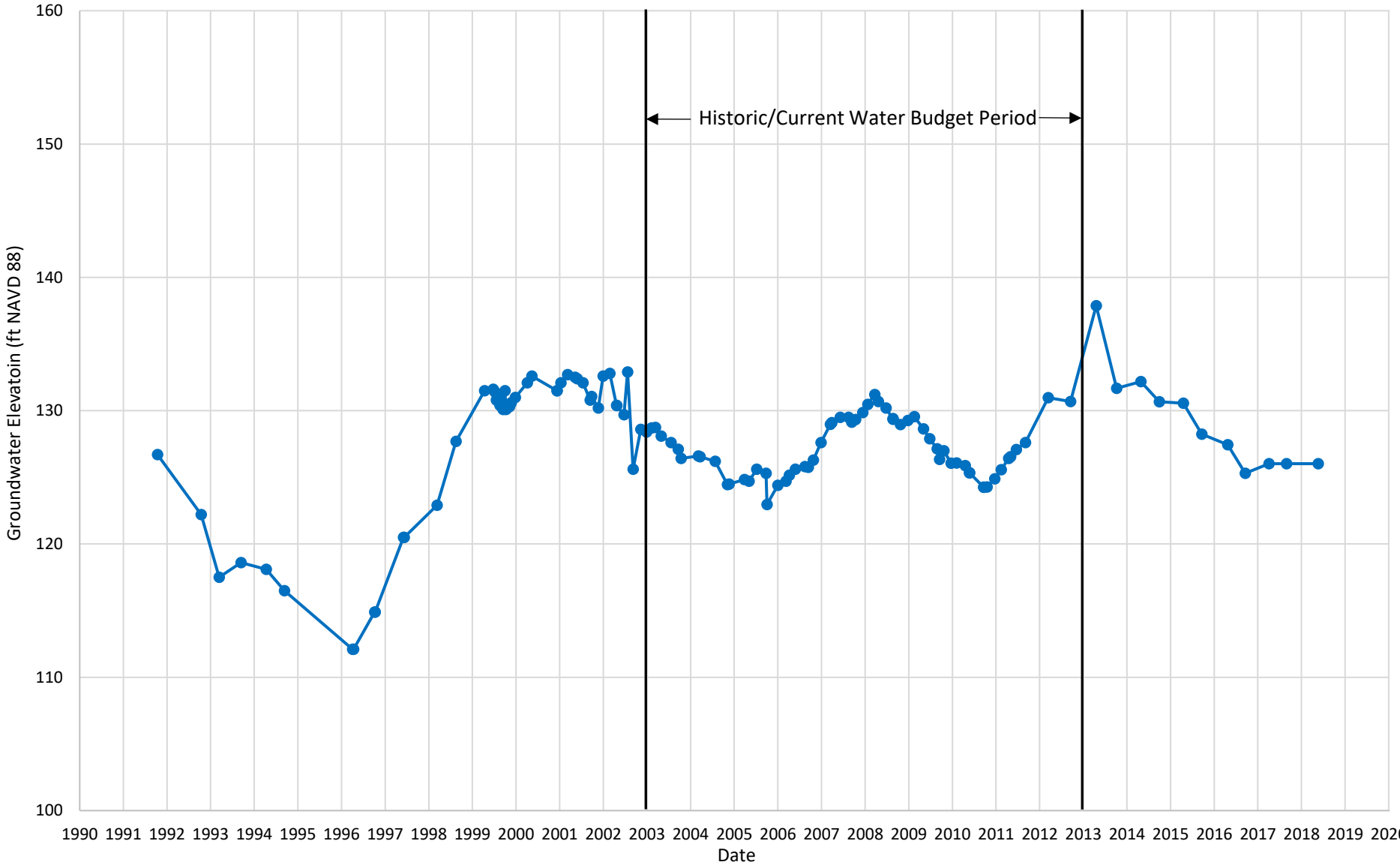
TLF-7s Upper Aquifer Shallow Zone Hydrograph

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-17



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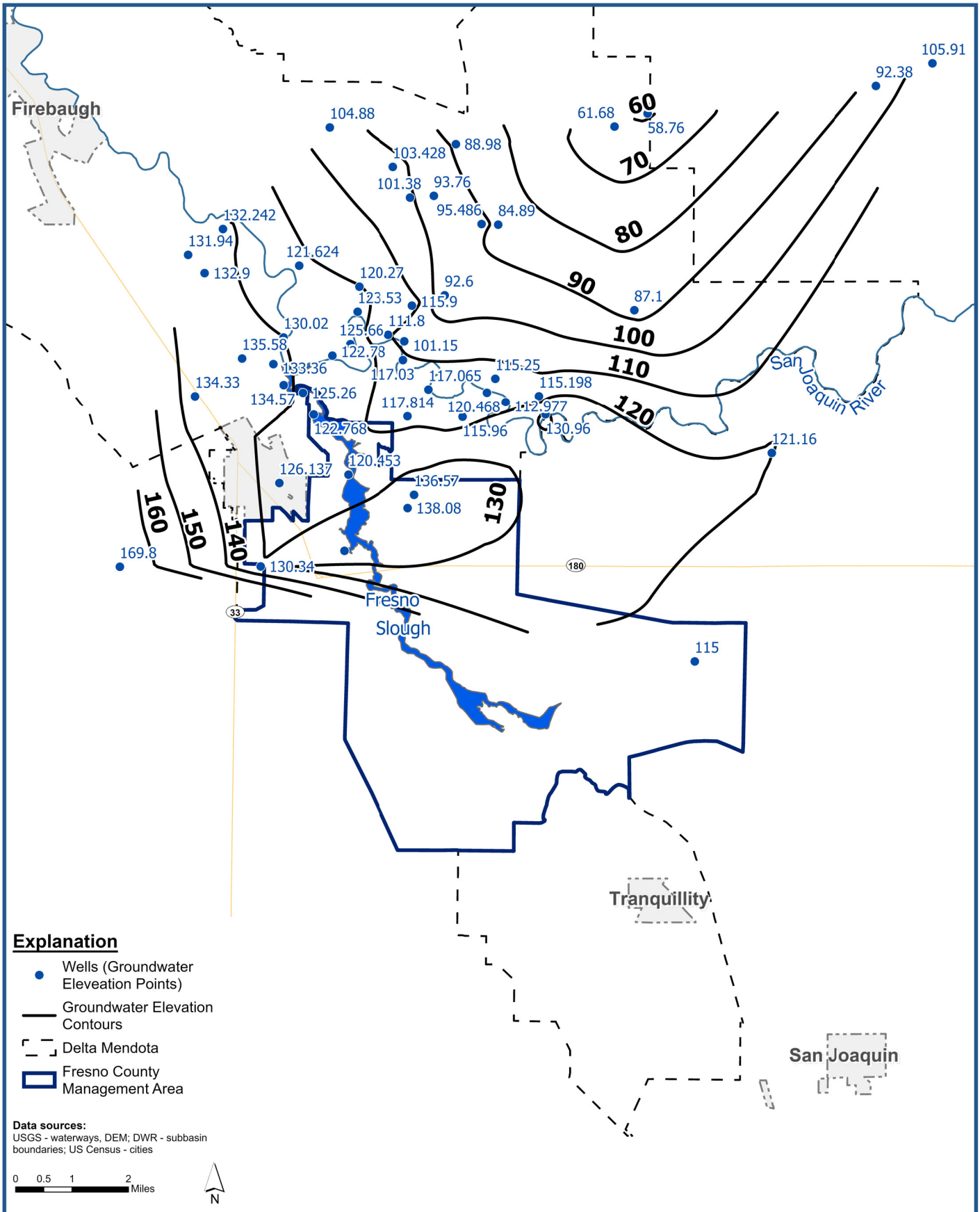
SPRECK MW-32 Upper Aquifer Shallow Zone Hydrograph

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-18



X:\2017\17-075 Farmers Water Dist. - GSP Preparation\GIS\ArcProjects\Final\3_2_GWconditionsHistCurrent_Fresno\3_2_GWconditionsHistCurrent_Fresno.aprx

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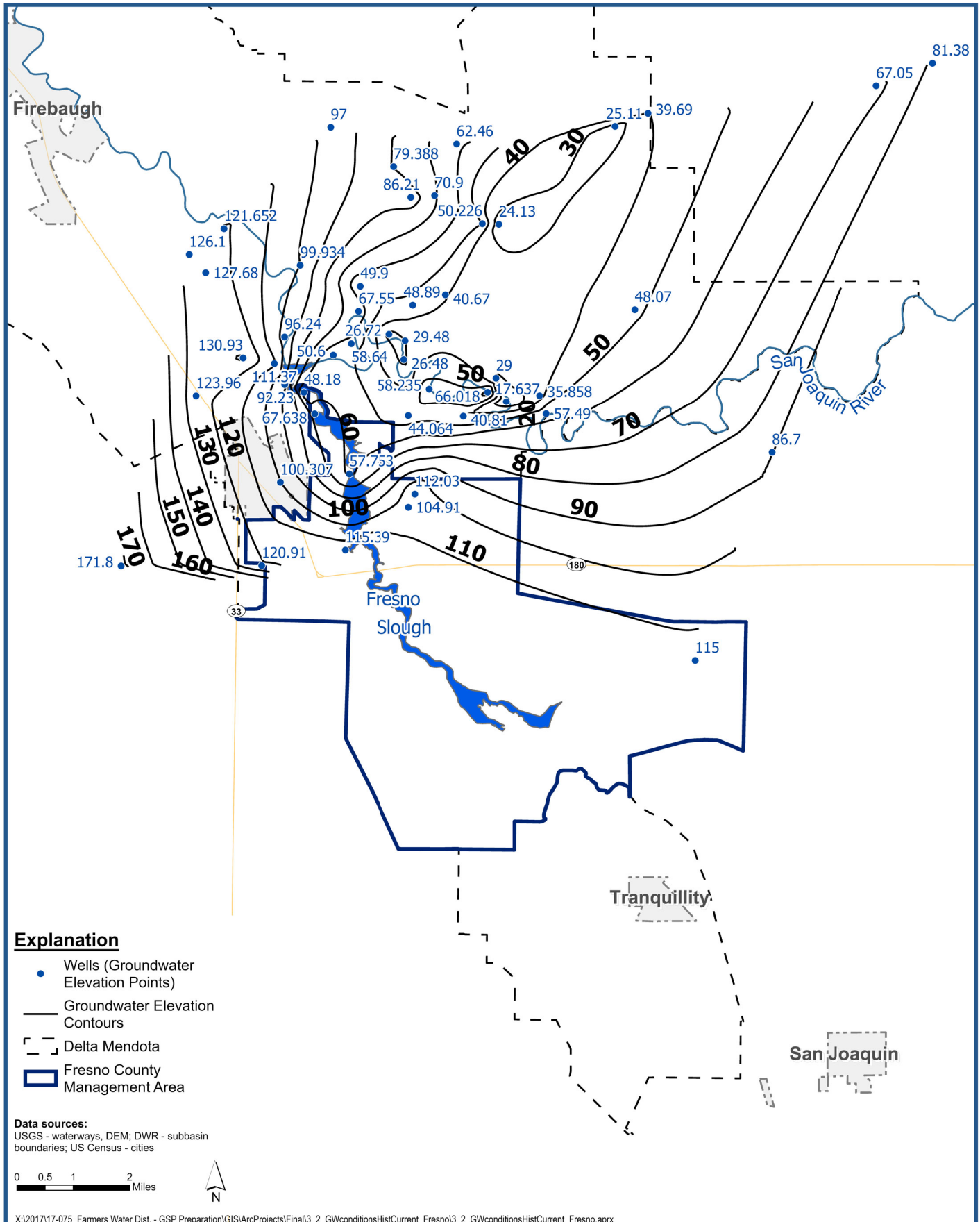
Deep Zone Groundwater Elevation Contours
Season High 2013

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-19



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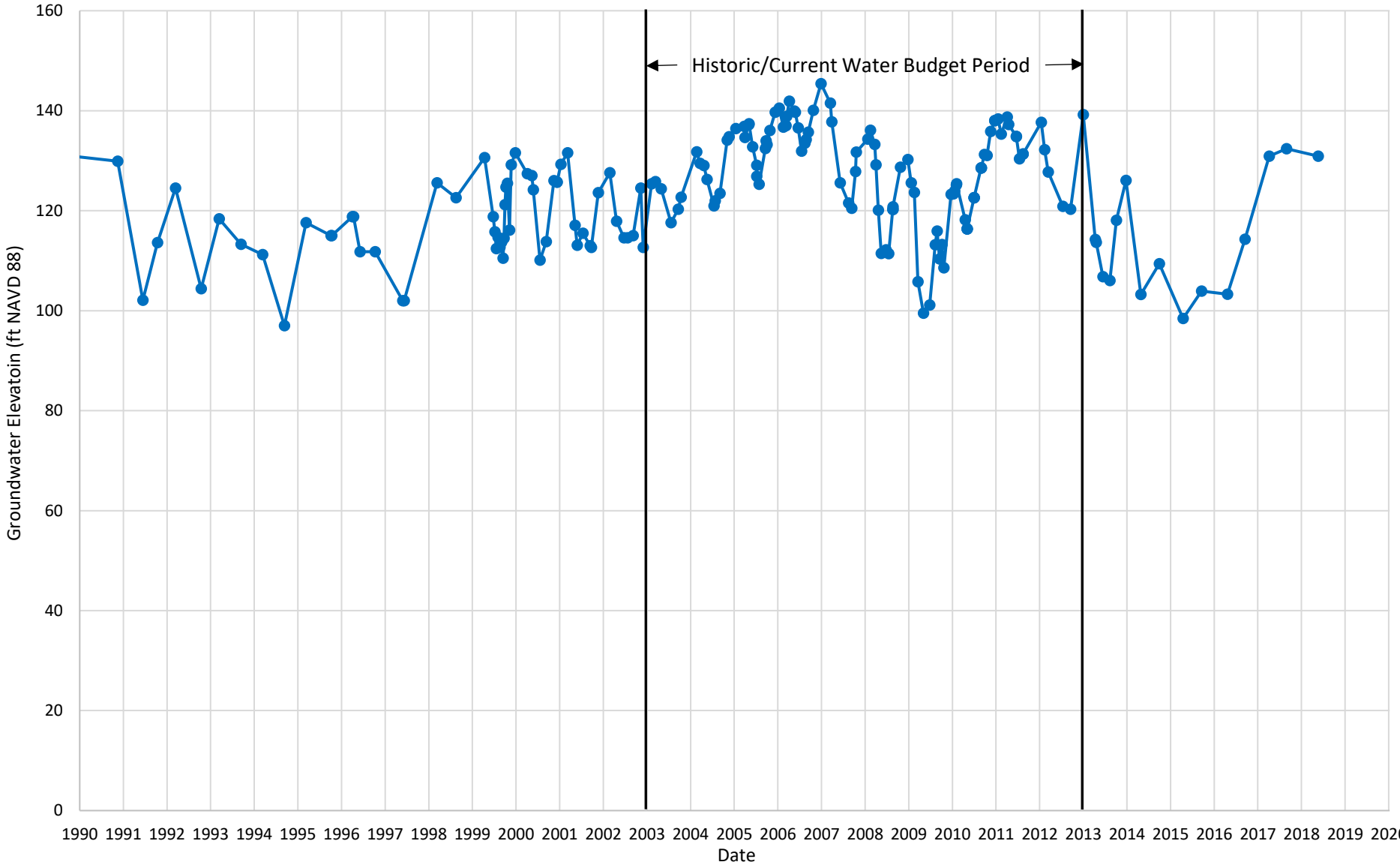
Deep Zone Groundwater Elevation Contours
Season Low 2013

Figure 3-20

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin



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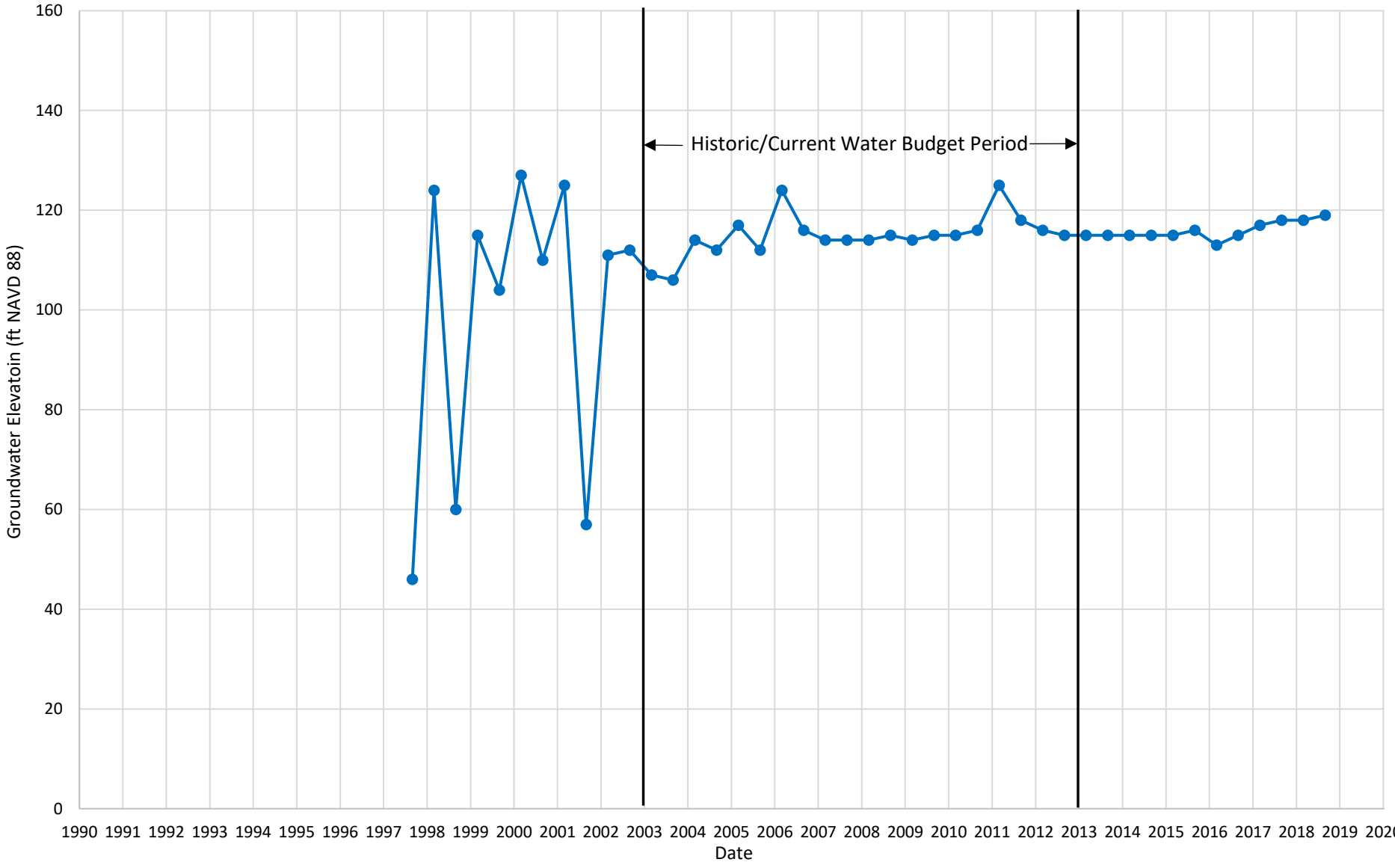
SPRECK MW-11 Upper Aquifer Deep Zone Hydrograph

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-21



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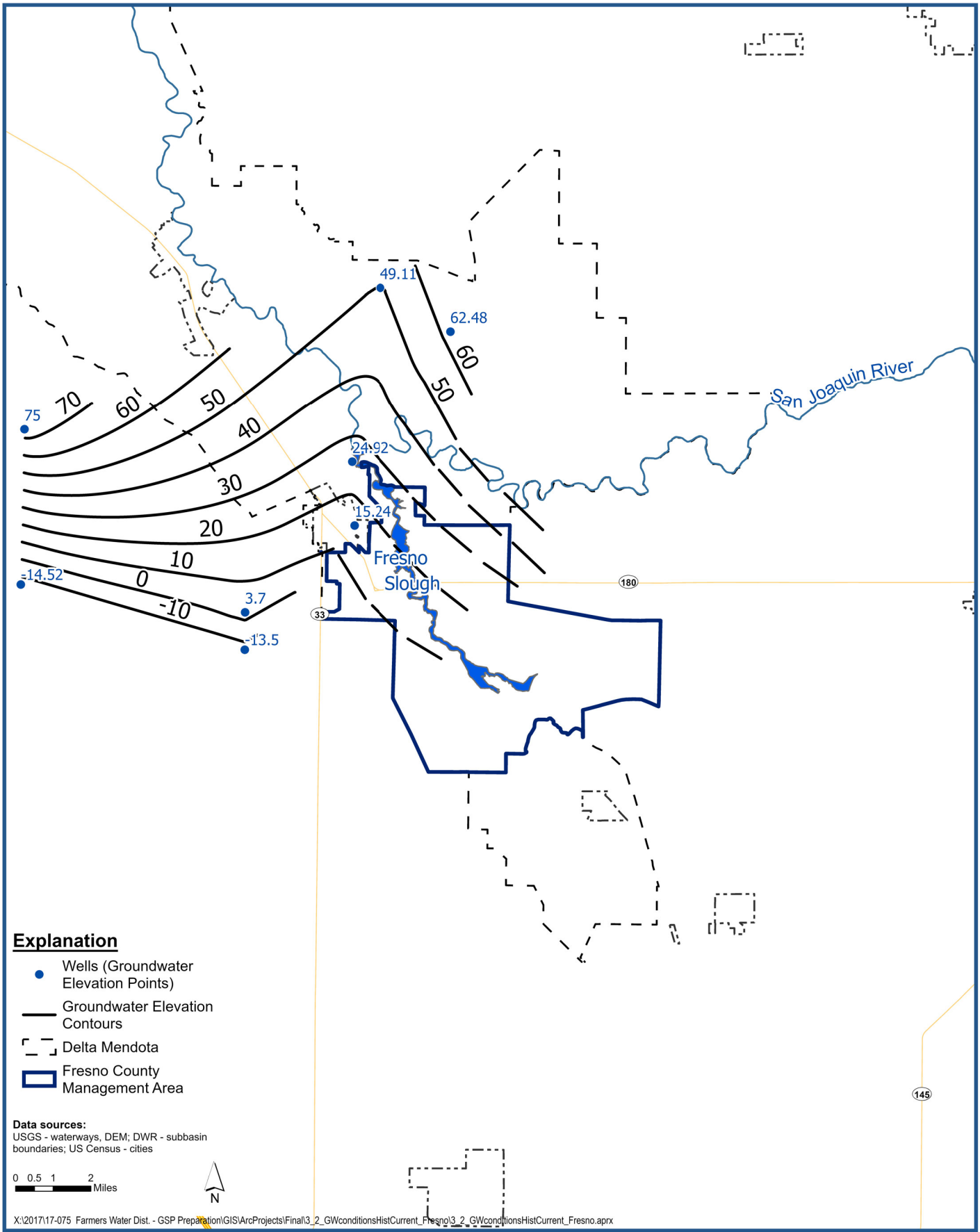
KRCDA06 Upper Aquifer Deep Zone Hydrograph

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-22



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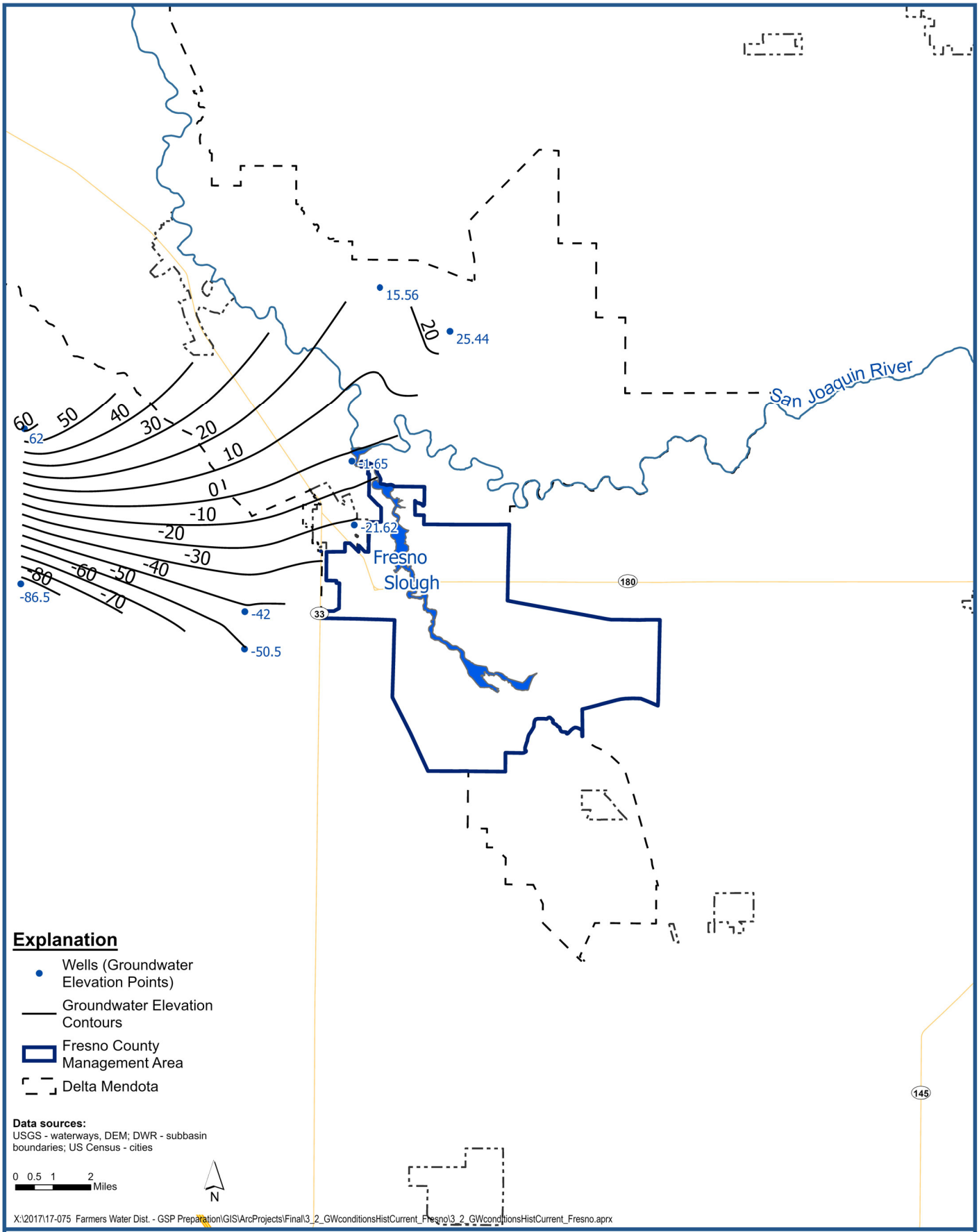
Lower Aquifer Groundwater Elevation Contours
Season High 2013

Figure 3-23

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin



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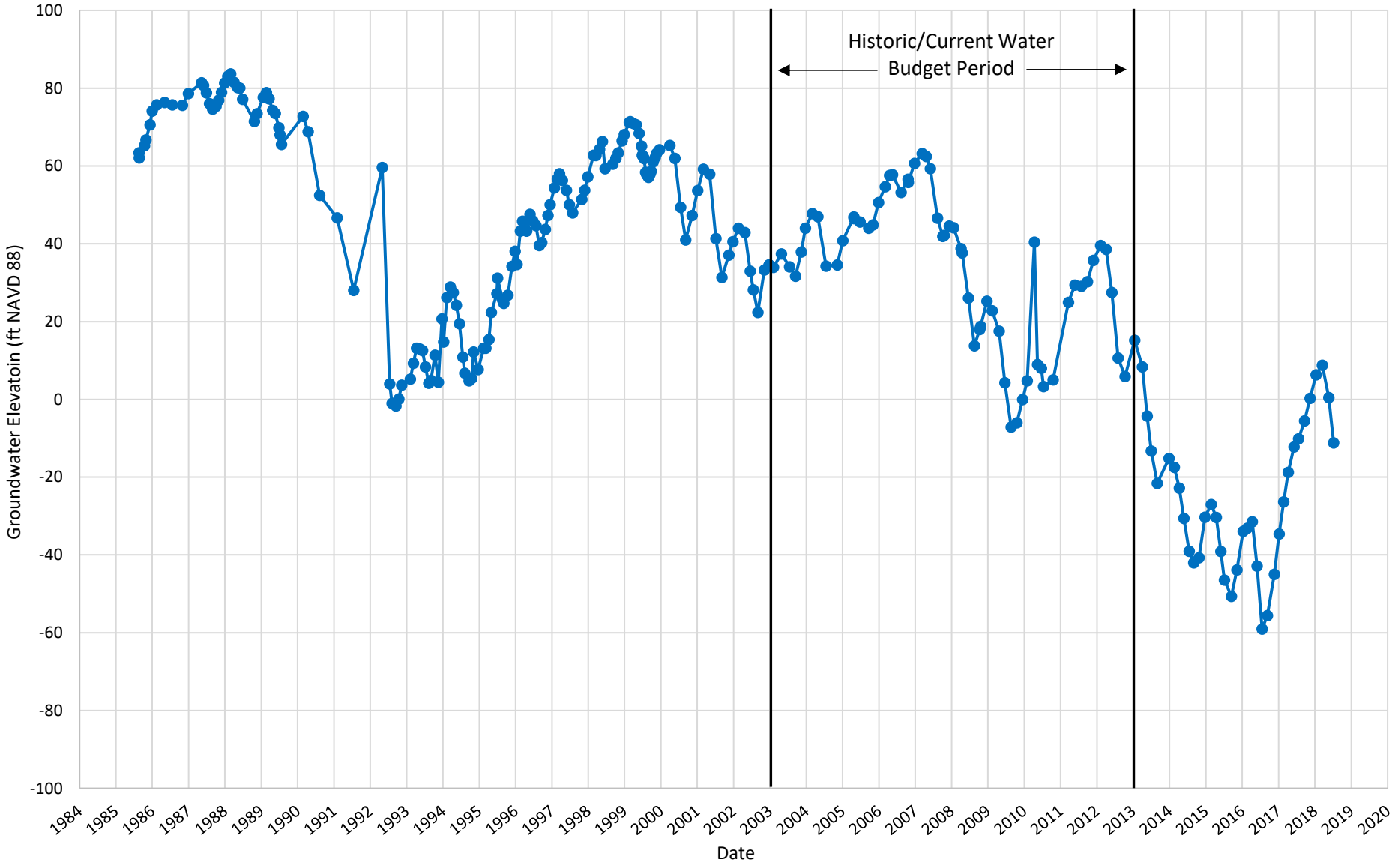
Lower Aquifer Groundwater Elevation Contour
Season Low 2013

Figure 3-24

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin



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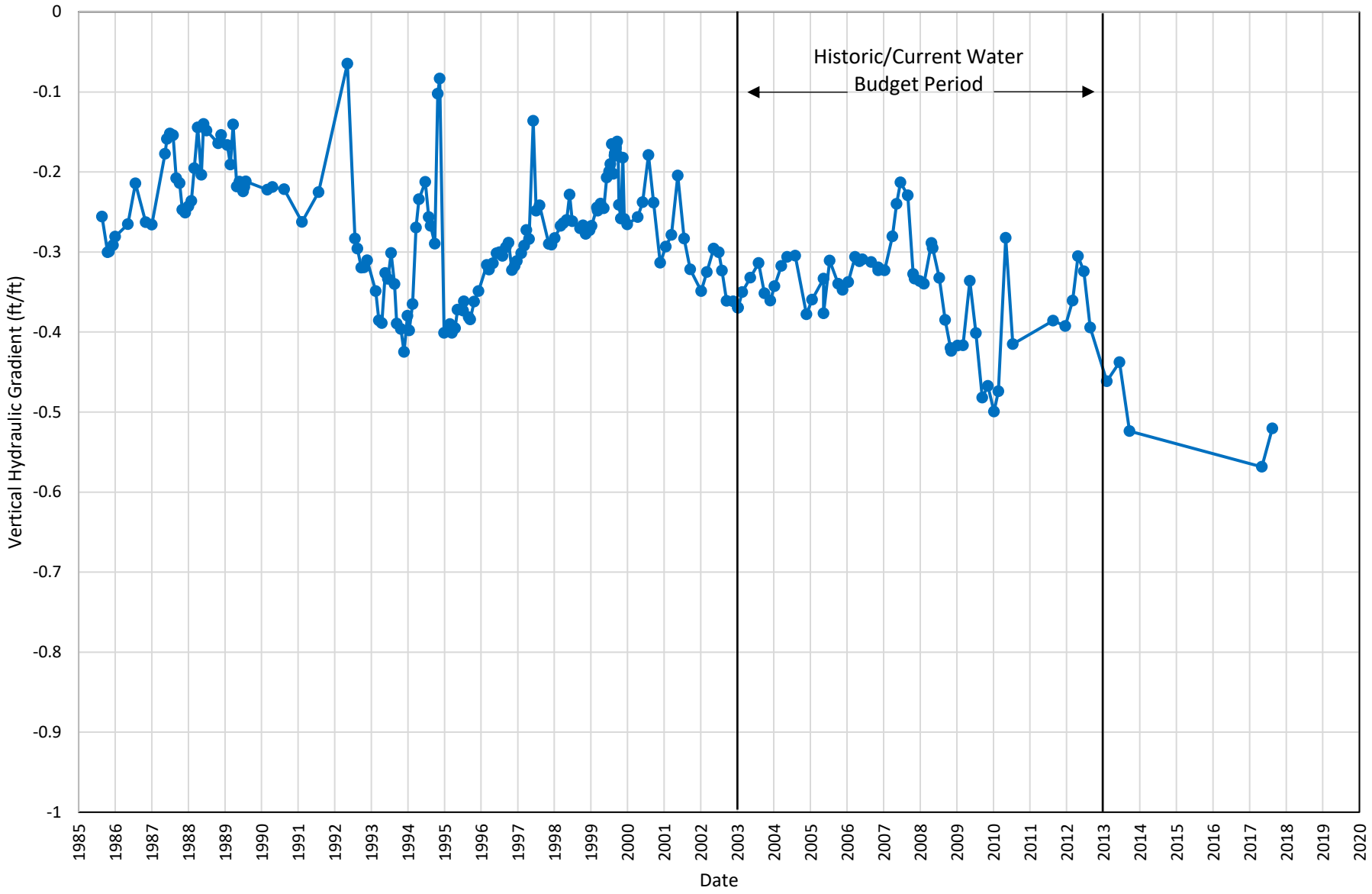
USGS 31J6 Lower Aquifer Hydrograph

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

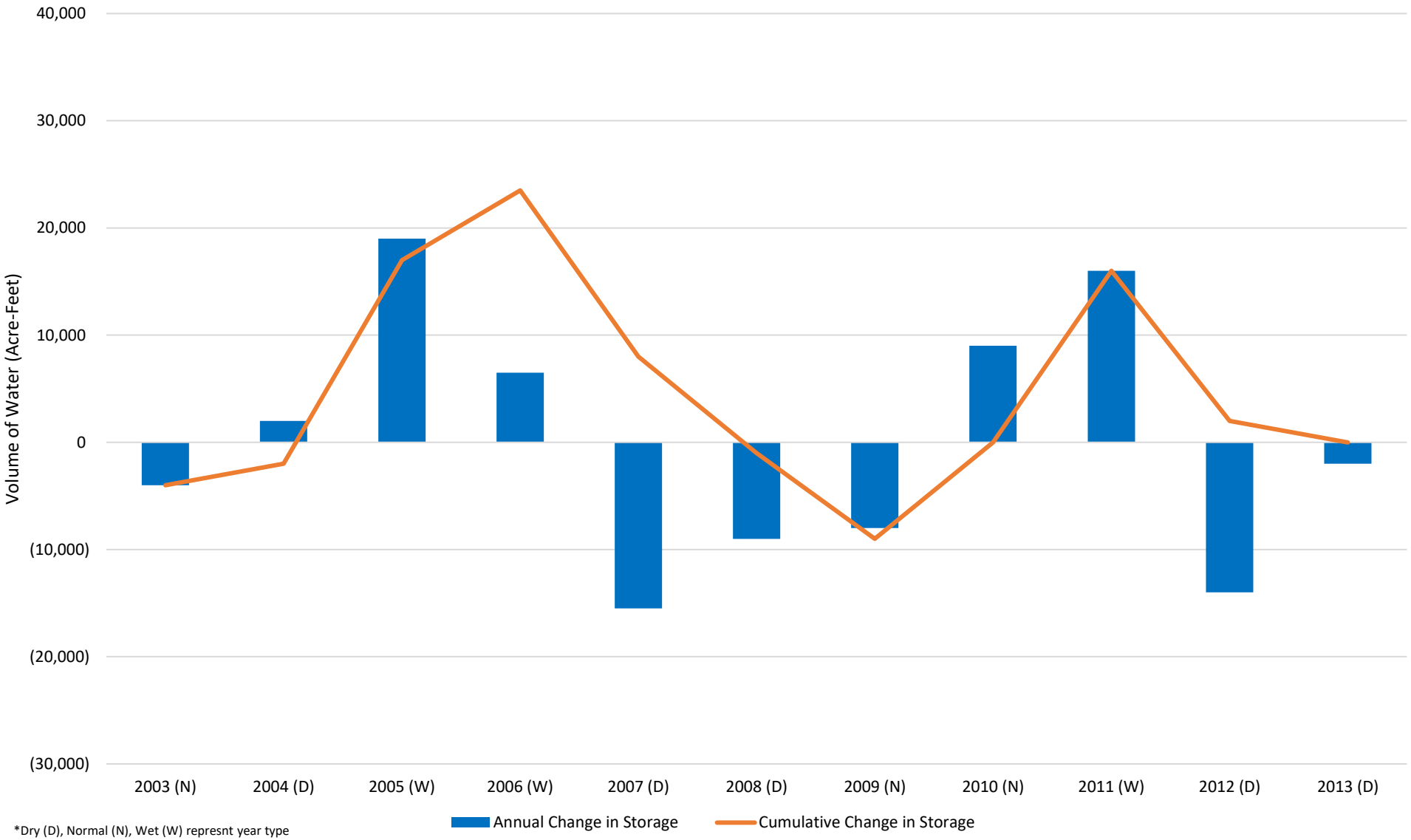
Figure 3-25



Vertical Hydraulic Gradient Between Upper and Lower Aquifer

Figure 3-26

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin



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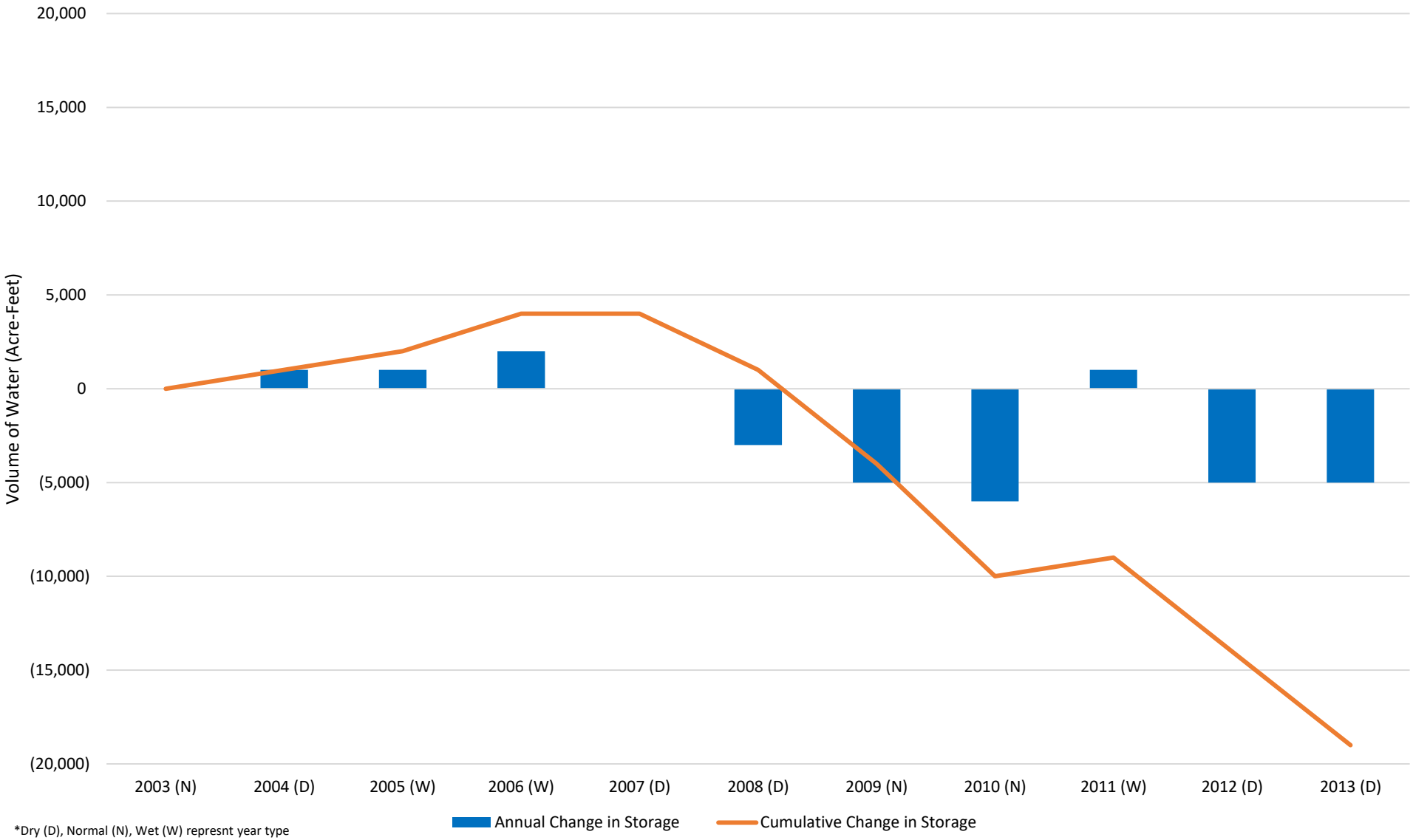
Upper Aquifer Annual and Cumulative Change in Storage

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-27



*Dry (D), Normal (N), Wet (W) represnt year type

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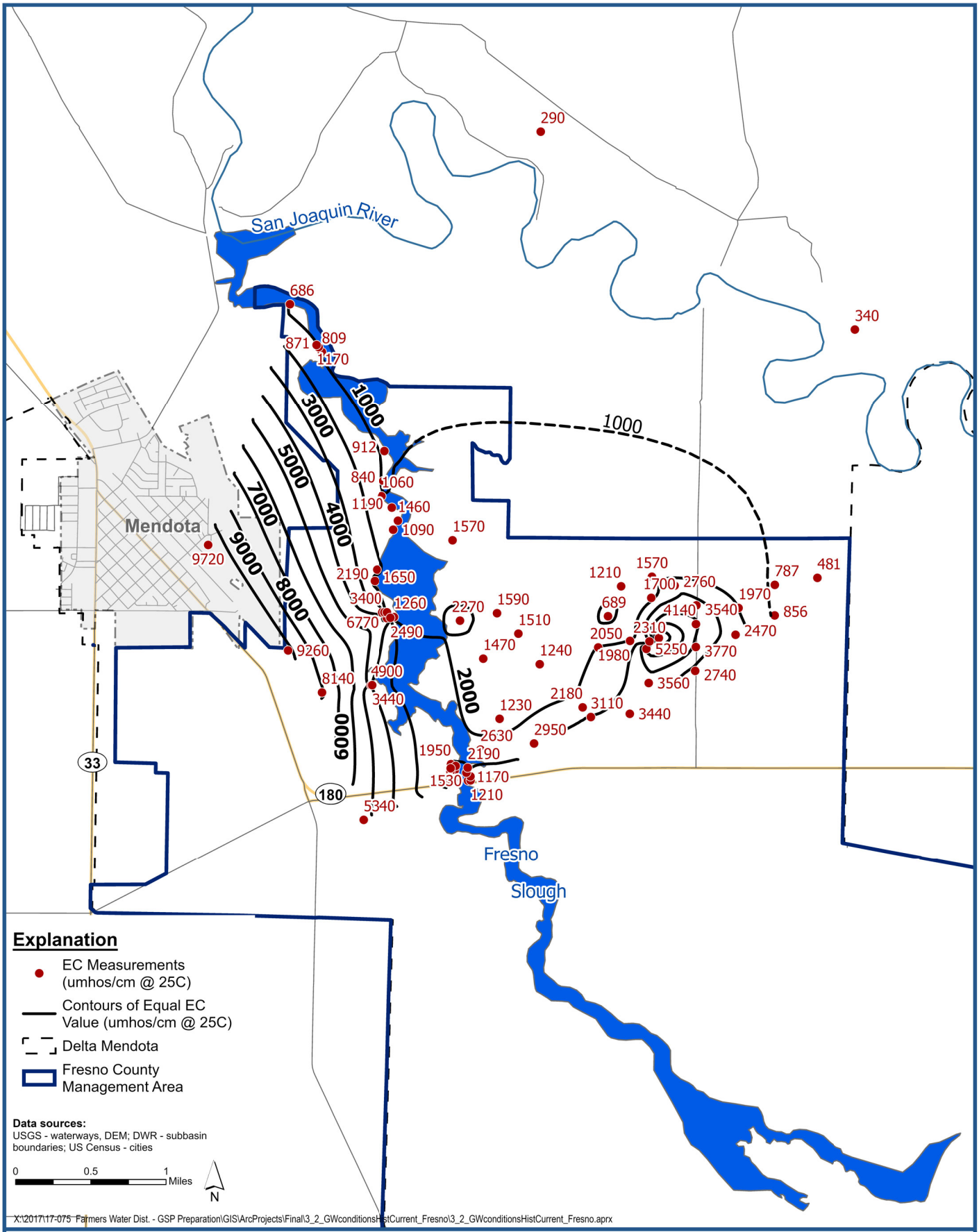
Lower Auqifer Annual and Cumulative Change in Storage

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-28



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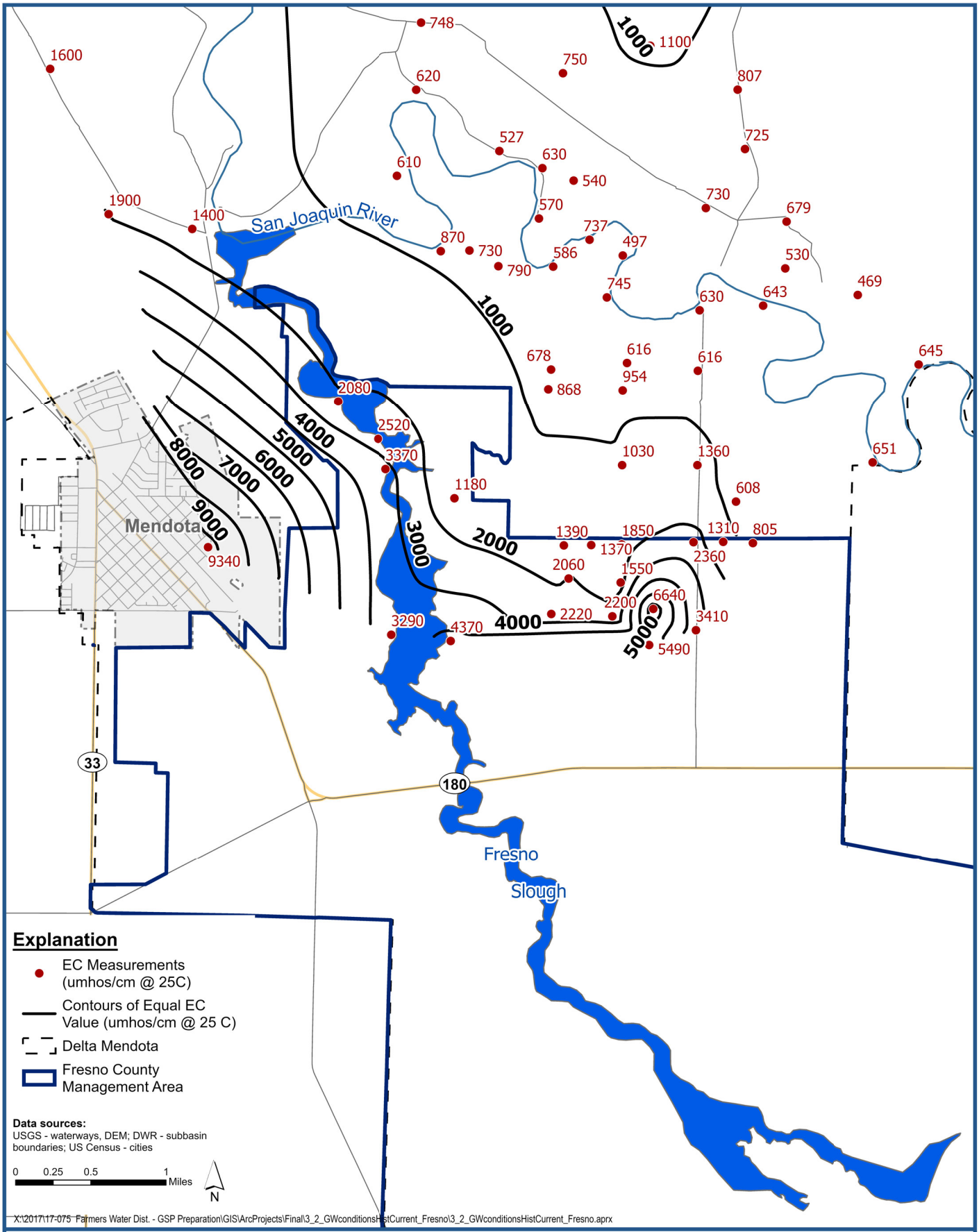
2015 Maximum EC Values
Upper Aquifer Shallow Zone

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-29



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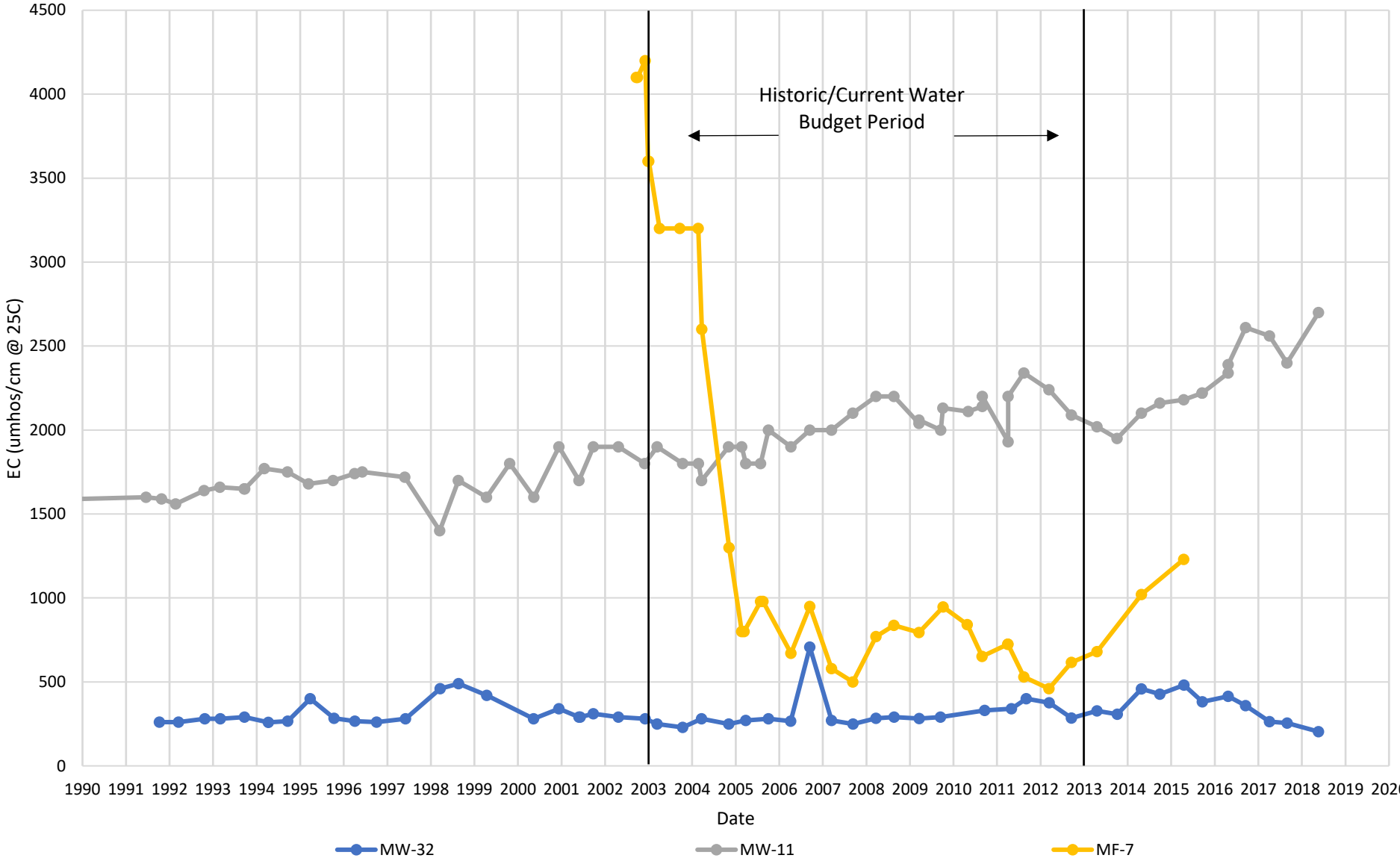
2015 Maximum EC Values
Upper Aquifer Deep Zone

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-30



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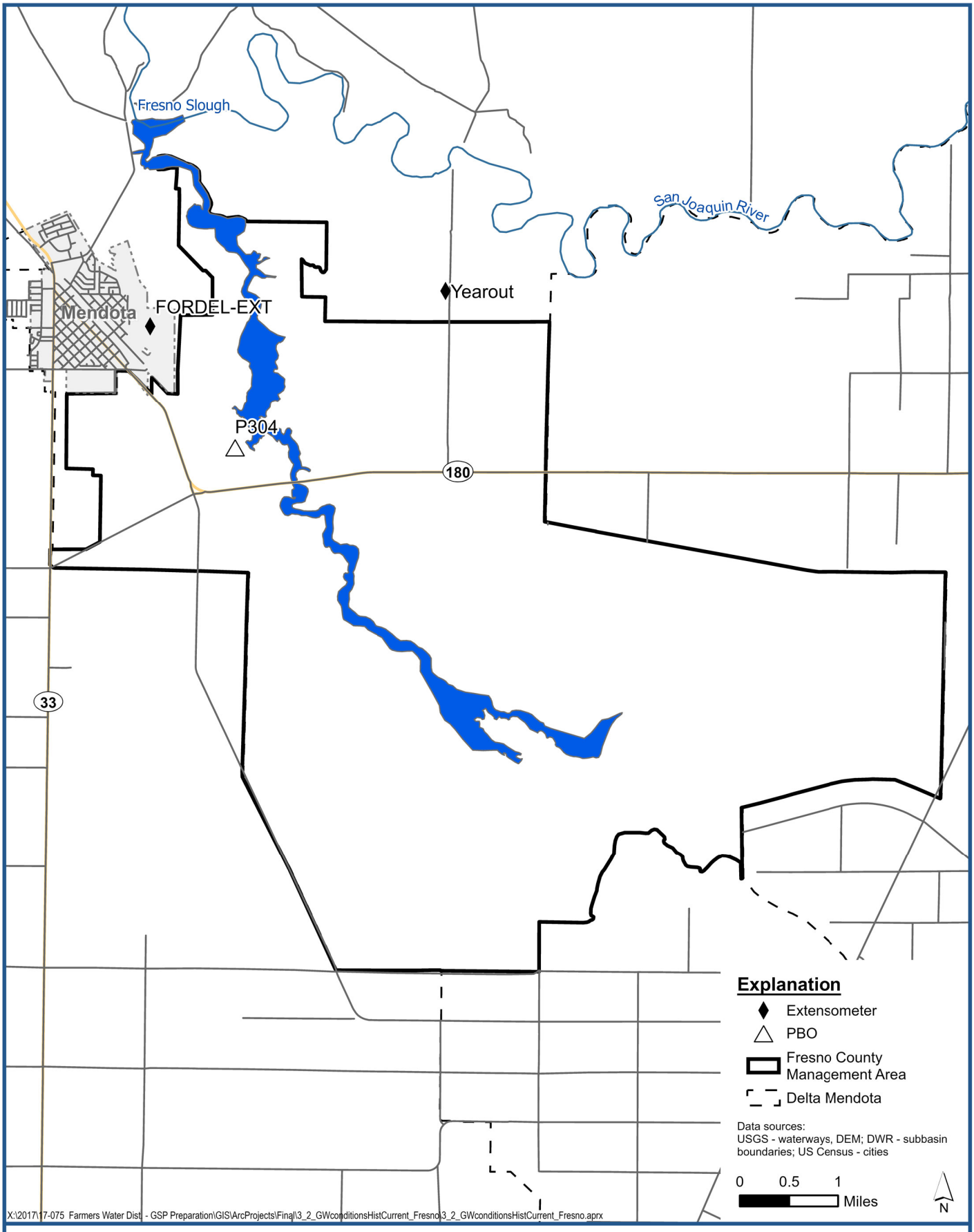
Upper Aquifer EC Measurements
Shallow and Deep Zones

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-31



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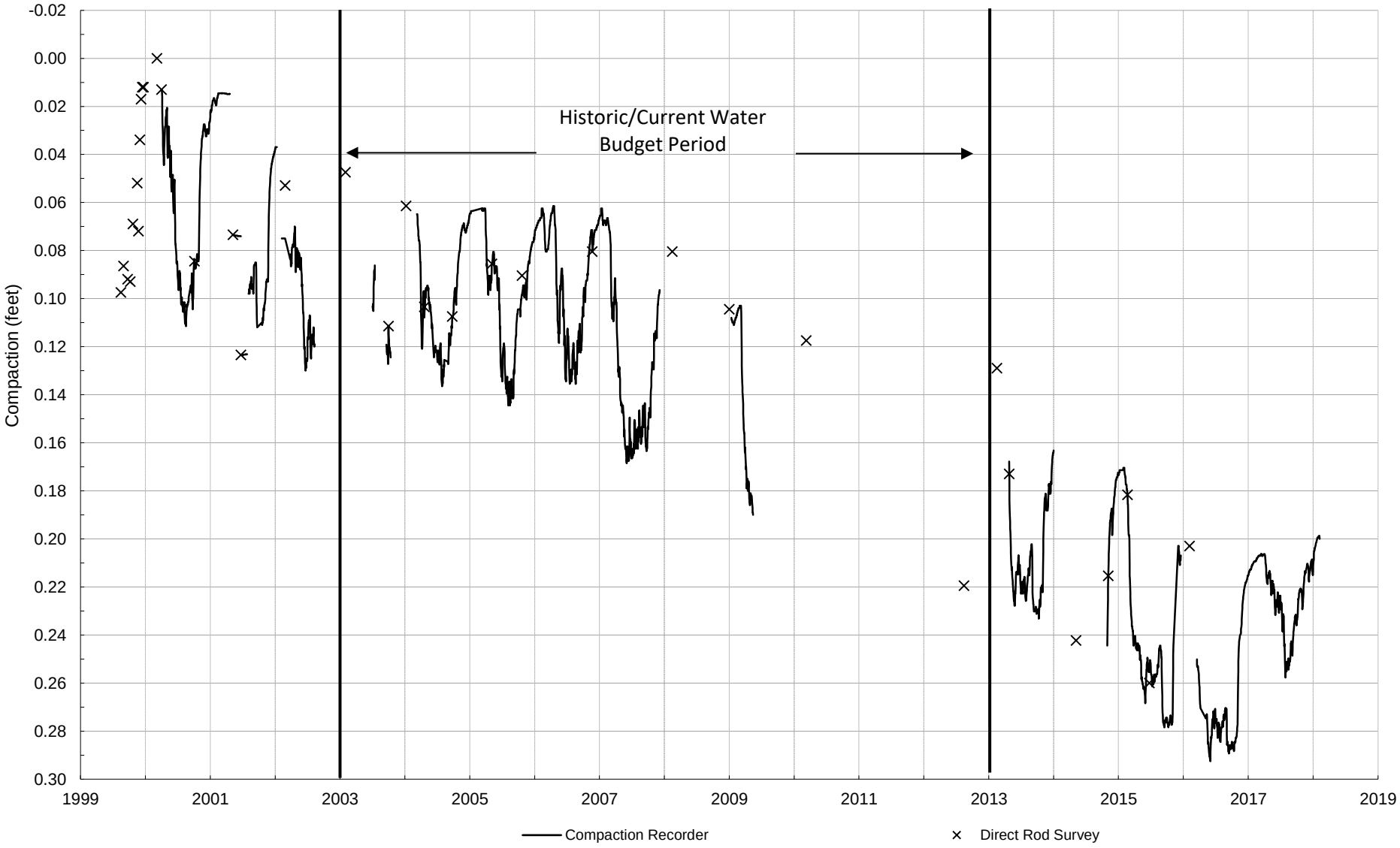
Compaction and Subsidence Monitoring Sites

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-32



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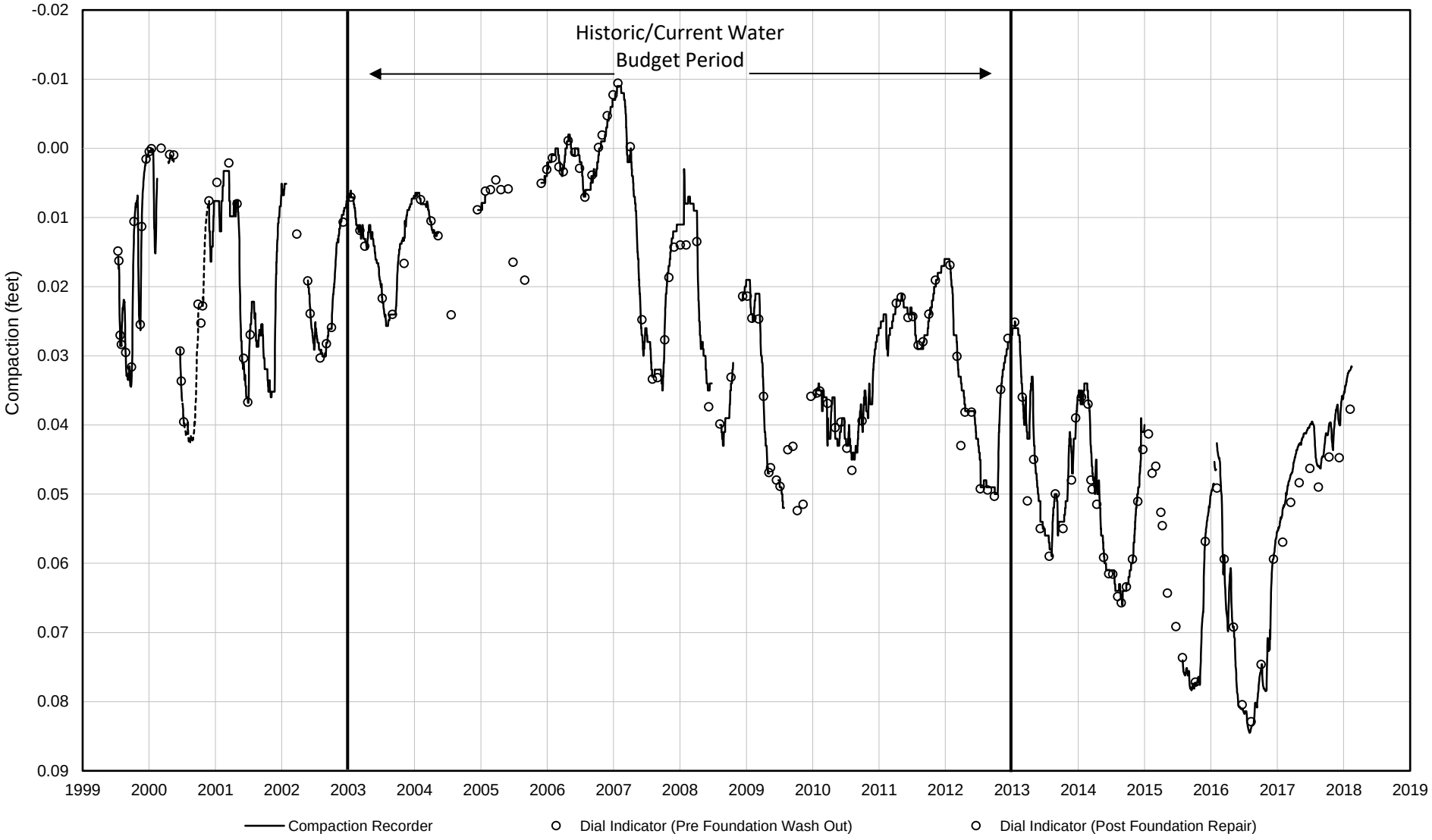
Compaction at Yearout Ranch Extensometer

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-33



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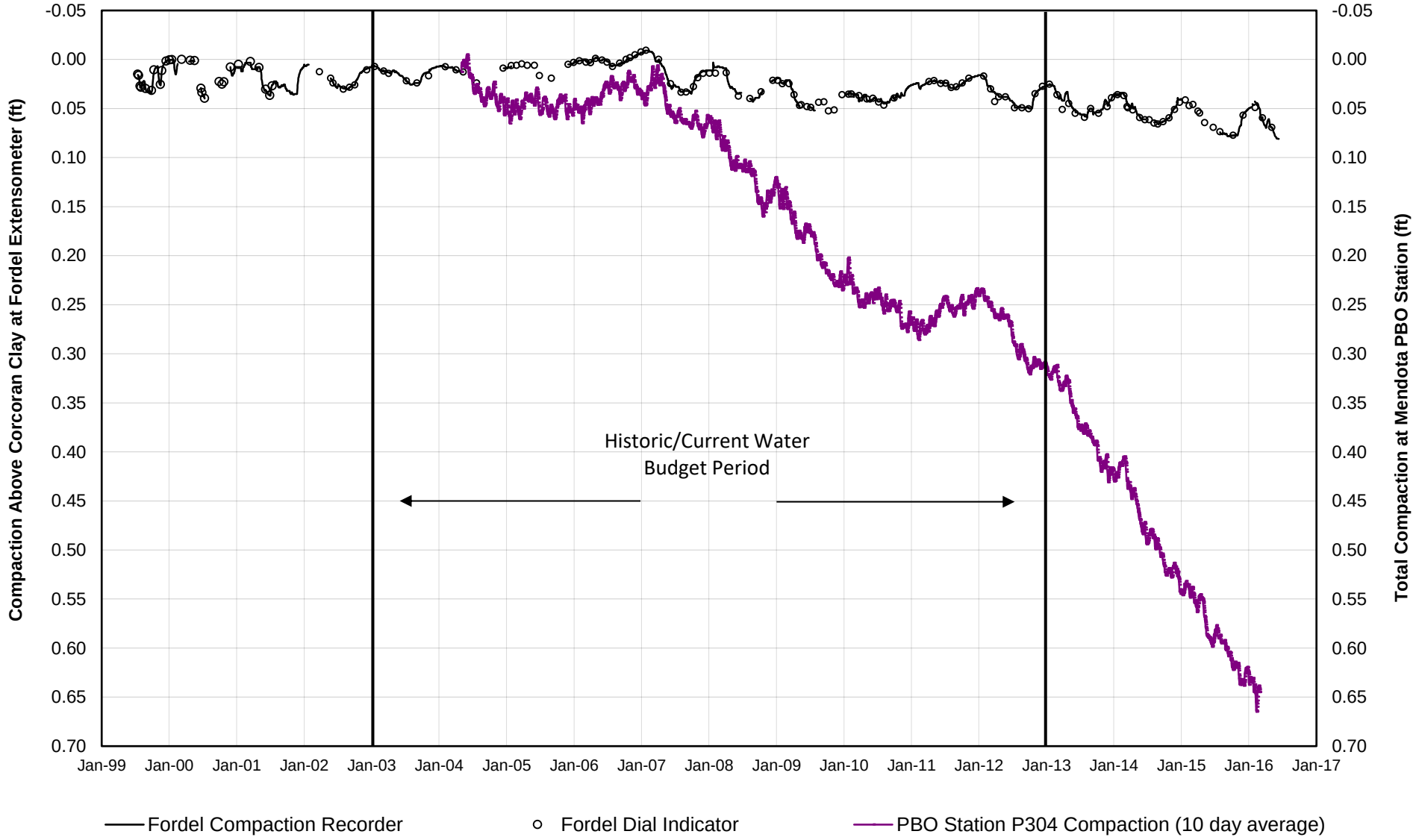
Compaction at Fordel Extensometer

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

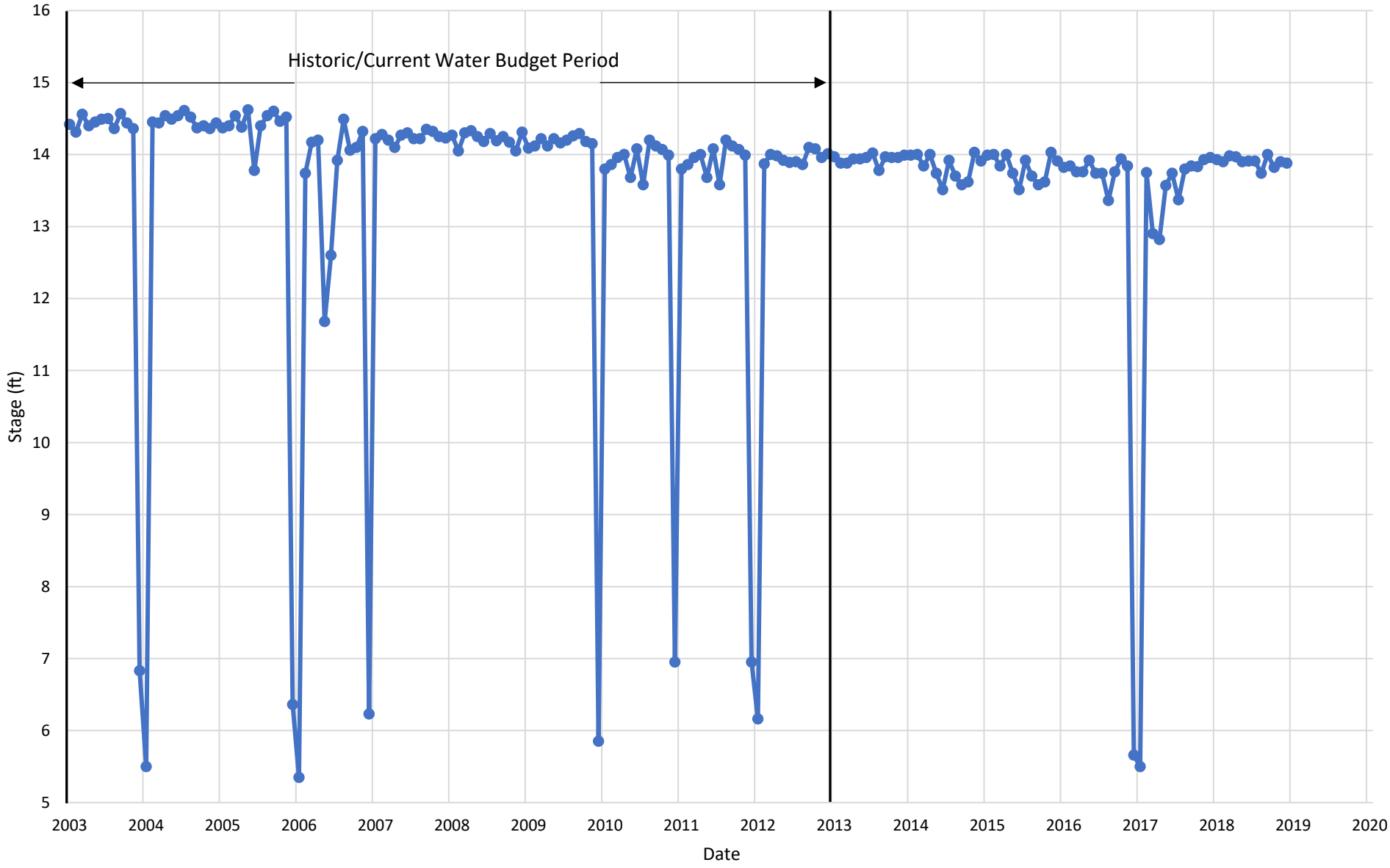
Figure 3-34



P304 Subsidence

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-35



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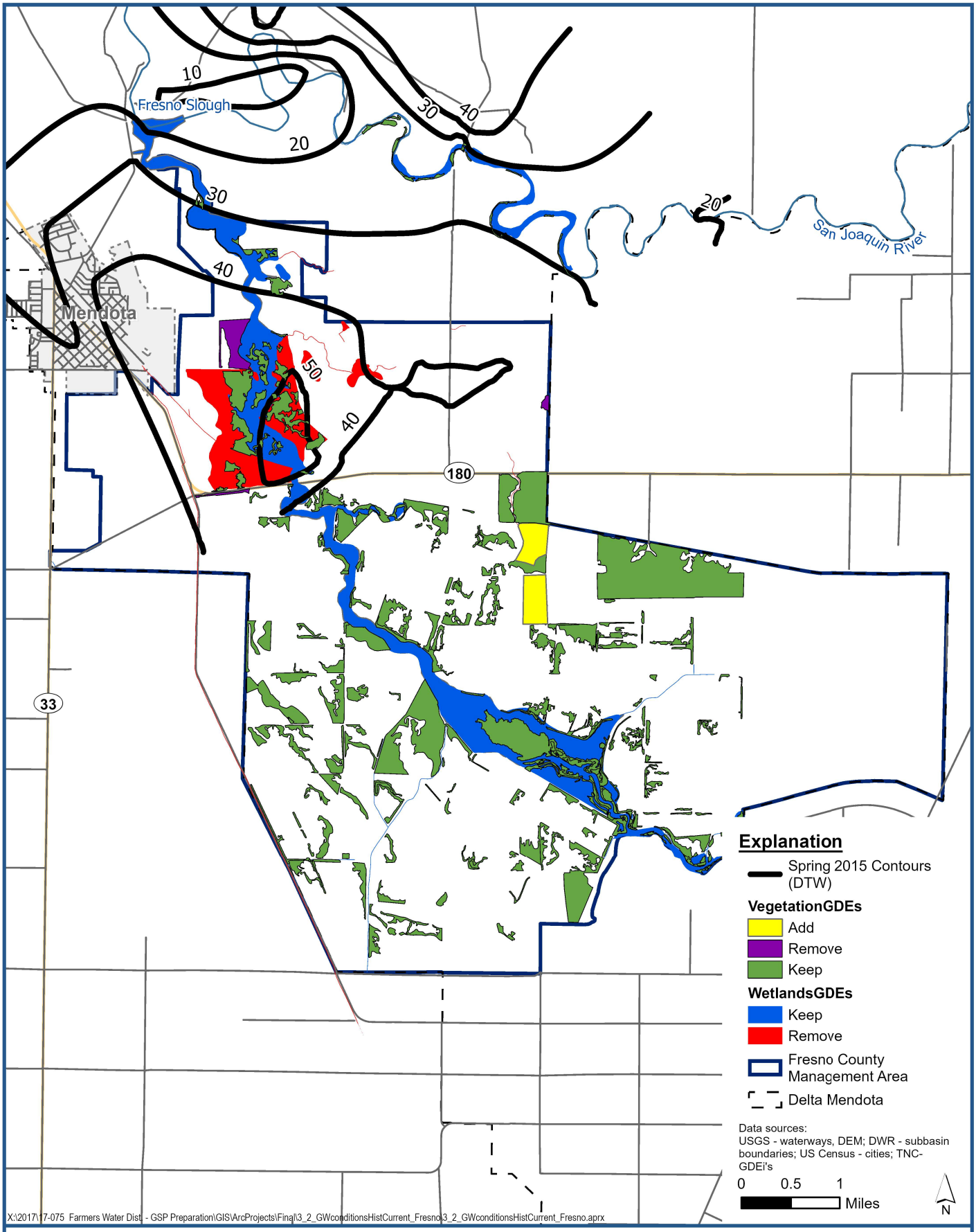
Mendota Pool Staff Gage

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-36



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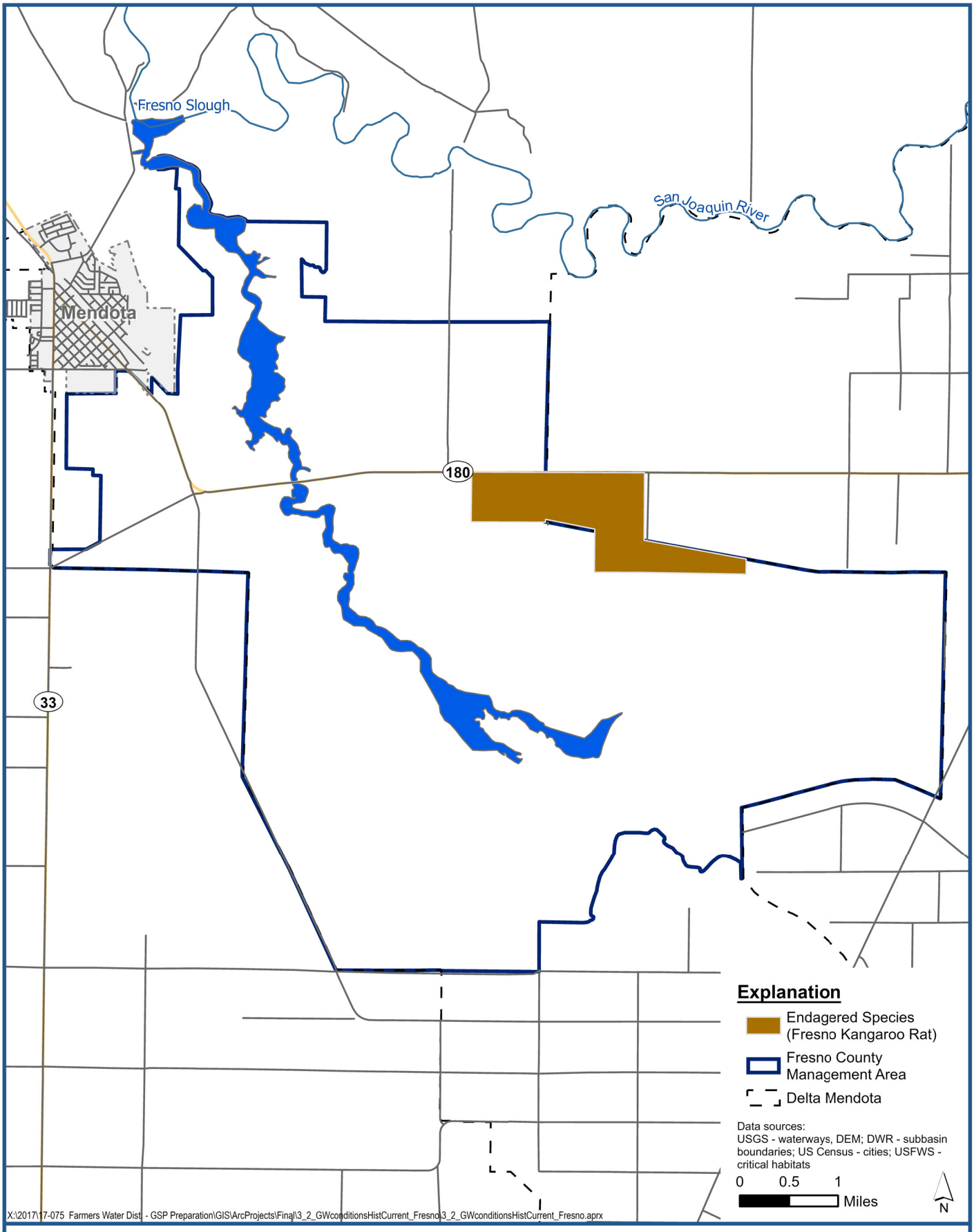
2015 Depth to Groundwater
Groundwater Dependent Ecosystems

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-37



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Ecological Conditions
Critical Habitats

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 3-38

3.3 Water Budget

Analytical and numerical groundwater flow models were developed in a coordinated effort among the six GSP groups in the Subbasin using the same methodologies to quantify groundwater conditions for the Subbasin and local GSP group areas. For the FCMA ~~GSA~~ in the DM Subbasin, a numerical model tool was developed utilizing the United States Geological Survey's MODFLOW-NWT and used to simulate the geographic extent of the FCMA and adjacent areas. The extent of the model domain is illustrated in **Figure 3-39**. The model domain extends well beyond the boundaries of FCMA and outside of the Delta-Mendota Subbasin in order to accurately represent regional groundwater conditions in and around the FCMA. The model was developed based on the regional geology and historic groundwater conditions in the southern portion of the Subbasin. The purpose of the groundwater model was to use historic groundwater data and conditions to develop the required water budgets (historical, current and projected) and predict a future groundwater conditions based on assumptions of climate and groundwater management.

The groundwater model was used to calculate a water budget over three different time periods: historic (2003 through 2012), current (2013), and projected (2014 through 2070). The historic period was selected to meet the minimum 10-year GSP requirement and the current water year of 2013 was selected based on the availability of data for other GSP groups in the Subbasin and it follows the historic water budget period. The historic and current water budget along with the associated year types are in **Table 3-3**. Also presented are the Delta-Mendota Year types which consolidates critical and dry years as "dry", and below normal and above normal as "normal''.

Groundwater conditions during the historic and current periods were used to calibrate the groundwater model by adjusting aquifer parameters that control the aquifer's ability to store and transmit water. The adjustments were constrained to ensure that the calibrated aquifer parameters represented observed geologic and hydrogeologic conditions within the model domain. Parameters such as hydraulic conductivity were adjusted so that simulated groundwater elevations in the model match measured data. The adjusted conditions in the groundwater model are then used to project groundwater conditions by superimposing a historic hydrologic sequence which includes factors such as precipitation, streamflow, land use, evapotranspiration and planned groundwater management to simulate future groundwater conditions. The projected period was from 2014 through 2070. Actual data were used to simulate conditions from 2014 through 2017, and conditions from 2018 through 2070 were simulated using a sequence of historical time periods. For the simulated period, a historic sequence was used to represent future hydrologic and climatic conditions. Planned groundwater management was based on the land use of the current water year 2013. **Table 3-4** shows the projected water budget period and the associated hydrologic sequence. Two model runs were conducted for the projected period; a baseline run with comparable historic conditions, and a modified version of the baseline run that incorporated climate change factors on rainfall, evapotranspiration, and streamflow. Additional information on the numerical model is presented in **Appendix J**. The following is a discussion on the individual components of the water budget and results from the historic, current, and projected periods.

Table 3-3: Delta-Mendota Historic/Current Year types

Year	SJR Index	DM Year Type
2003	Below Normal	Normal
2004	Dry	Dry
2005	Wet	Wet
2006	Wet	Wet
2007	Critical	Dry
2008	Critical	Dry
2009	Below Normal	Normal
2010	Above Normal	Normal
2011	Wet	Wet
2012	Dry	Dry
2013	Critical	Dry

Table 3-4: Delta-Mendota Projected Year types

Projected year	Historic Sequence	SJR Index	DM Year Type
2014	2014	Critical	Dry
2015	2015	Critical	Dry
2016	2016	Dry	Dry
2017	2017	Wet	Wet
2018	1979	Above Normal	Normal
2019	1980	Wet	Wet
2020	1981	Dry	Dry
2021	1982	Wet	Wet
2022	1983	Wet	Wet
2023	1984	Above Normal	Normal
2024	1985	Dry	Dry
2025	1986	Wet	Wet
2026	1987	Critical	Dry
2027	1988	Critical	Dry
2028	1989	Critical	Dry
2029	1990	Critical	Dry
2030	1991	Critical	Dry
2031	1992	Critical	Dry
2032	1993	Wet	Wet
2033	1994	Critical	Dry
2034	1995	Wet	Wet
2035	1996	Wet	Wet

2036	1997	Wet	Wet
2037	1998	Wet	Wet
2038	1999	Above Normal	Normal
2039	2000	Above Normal	Normal
2040	2001	Dry	Dry
2041	2002	Dry	Dry
2042	2003	Below Normal	Normal
2043	2004	Dry	Dry
2044	2005	Wet	Wet
2045	2006	Wet	Wet
2046	2007	Critical	Dry
2047	2008	Critical	Dry
2048	2009	Below Normal	Normal
2049	2010	Above Normal	Normal
2050	2011	Wet	Wet
2051	2012	Dry	Dry
2052	2013	Critical	Dry
2053	2014	Critical	Dry
2054	2015	Critical	Dry
2055	2016	Dry	Dry
2056	2017	Wet	Wet
2057	1965	Wet	Wet
2058	1966	Below Normal	Normal
2059	1967	Wet	Wet
2060	1968	Dry	Dry
2061	1969	Wet	Wet
2062	1970	Above Normal	Normal
2063	1971	Below Normal	Normal
2064	1972	Dry	Dry
2065	1973	Above Normal	Normal
2066	1974	Wet	Wet
2067	1975	Wet	Wet
2068	1976	Critical	Dry
2069	1977	Critical	Dry
2070	1978	Wet	Wet

3.3.1 Description of inflows, outflows and change in storage

The water budget components that comprise inflow and outflow are listed in **Table 3-5**. The complete water budget consisted of two components, a land surface budget and the groundwater budget.

Table 3-5: Land Surface and Groundwater Budget Components

Land Surface Budget	
Inflows	***Outflows***
Precipitation	Evapotranspiration
Applied Water ~~-~~ Groundwater	Deep Percolation ~~(applied water and precipitation)~~
~~Applied Water - Imported~~	Surface Water Outflows
Surface Water Inflows	~~Surface Water Seepage~~
	~~Recharge Ponds/Canals Seepage~~
Groundwater Budget	
Inflows	***Outflows***
Subsurface Inflows	Subsurface Outflows
Deep Percolation	Groundwater Extractions
~~Surface Water Seepage~~	
~~Recharge Ponds/Canals Seepage (Other direct recharge)~~	

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3.3.2 Land Surface Budget

The land surface budget represents the total amount of water entering and leaving the FCMA GSA on the ground surface. The following sections describe each land surface budget component.

3.3.2.1 Surface Water (Inflows/Outflows)

For the historic, current and projected periods, surface water flow values used in the flow model are based on flow of SJR measured values downstream of Gravelly Ford (USGS #11253058), as well as downstream of the Chowchilla Bypass intake (USGS #11253115) to account for diversion of excess flood water of SJR through the Chowchilla Bypass. Surface water flows values are also based on the USBR Central Valley Operations (CVO) tables which account for all water flowing in and out of the Mendota Pool.

Surface water inflows and outflows represent the total amount of water entering and leaving FCMA in streams or canals~~.~~. The total surface ~~water~~ water inflows serve as the source for all seepage to the underlying aquifer and accounts for all applied surface water for irrigation and environmental purposes. The total surface water outflow is comprised inflows not lost to deep percolation and transfer pumping that is not used as applied groundwater within FCMA. The primary surface water features in the vicinity of the FCMA are the Mendota Pool (the Pool) consisting of the San Joaquin River branch and the Fresno Slough, San Joaquin River (SJR) upstream of the Pool, James Bypass, and several major irrigation canals (**Figure 3-10**~~). and~~ The Pool receives surface water from the SJR, ~~d~~Delta Mendota Canal (DMC), and flood flows in the~~of~~ Kings River via James Bypass/ ~~f~~Fresno Slough. Furthermore, pumped groundwater is also discharged into the Pool by entities~~the MPG~~ adjacent to the Pool ~~and others~~ for exchange programs with BOR and for irrigation of lands adjacent to the Pool using the Pool as a conveyance. Under normal conditions, flow in the Pool (the Fresno Slough portion) is to the south towards the southern end of the FCMA. During flood events of the Kings River, flood flows are directed north into the Fresno Slough portion of the Pool creating a northerly flow condition. The primary canals that convey water from the

northern end of the Pool are the CCID Main Canal, CCID Outside Canal, Firebaugh Intake Canal, and Columbia Canal. Several parties divert water from the southern end of the Pool via Lateral 6 and Lateral 7 canals.

The flow model calculated the flow of SJR to the Pool using SJR flow values measured downstream of Gravelly Ford (USGS #11253058), as well as downstream of the Chowchilla Bypass intake (USGS #11253115) to account for diversion of excess flood water of SJR through the Chowchilla Bypass. Flow of James Bypass that is measured near San Joaquin (USGS #11253500, CDEDC JBP) was used to calculate its flow that enters the Pool. Flow of the DMC was specified based on data available from the San Luis Delta Mendota Water Authority (SLDMWA). Diversions from the Pool to the Firebaugh Canal, CCID Outside Canal, CCID Main Canal, and Columbia Canal were specified based monthly diversion volumes provided by the USBR CVO.

~~3.3.2.2 Applied water- Imported (Inflow)~~

~~Water is imported into the FCMA for agricultural use, environmental use, and recharge projects. Monthly diversion volumes were obtained from the historic USBR CVP reports. Similar to surface water flow, in the historic and current water budget values were obtained from historic USBR CVP reports.~~

~~3.3.2.3~~3.3.2.2 Applied water- Groundwater (Inflow)

A component of the land surface budget is the groundwater extracted from the subsurface and used to irrigate crops. The total amount of applied groundwater~~amount of water required to irrigate a crop is~~ was determined from flow meter data, power bills (electricity from pumping wells), and consumptive use based on the water demand of that crop type and the climatic conditions (evapotranspiration and precipitation). The amount of groundwater needed to meet the irrigation demand that was not met with precipitation and surface water deliveries was estimated based on land use data, climatic data and known surface water deliveries. In the projected water budget, the amount of applied groundwater was calculated based on the current year (2013) land use data.

~~3.3.2.4~~3.3.2.3 Precipitation values (Inflow)

Precipitation values used in the model were obtained from the PRISM Climate Group at Oregon State University. This data set provides monthly precipitation data for the FCMA for the historic, current, and projected water budgets.

~~3.3.2.5~~3.3.2.4 Evapotranspiration (Outflow)

Evapotranspiration (ET) is the amount of water evaporated from soil or other surfaces and consumed by vegetation through transpiration. The amount of ET is based on crop type and climatic conditions. The ET was determined with data from the California Irrigation Management Information System (CIMIS) at the Firebaugh/Telles station (Station ID 7) and Westlands station (Station ID 105). Crop demand was determined from (Snyder et al, 2000 and 2008)) and (Allen et al., 1998).

~~3.3.2.6~~3.3.2.5 Deep Percolation, ~~Surface Water Seepage, and Groundwater Recharge Projects~~ (Outflow)

Deep percolation ~~a~~is an outflow component of the land surface budget~~, includes surface water seepage,~~ These components of the land surface budget are direct recharge to the groundwater budget. Deep percolation accounts for all of the water that infiltrates to groundwater from precipitation and applied irrigation. Surface water seepage is the loss of water from the Mendota Pool to the groundwater system. Values for deep percolation and surface water seepage are not directly measured but calculated in the model based on physical and hydrologic properties.

There are currently two groundwater recharge projects in FCMA, the Meyers Water Bank and the Terra Linda Recharge Canal. The Meyers Water Bank receives Central Valley Project (CVP) water along with other surface water supplies, and the Terra Linda Recharge Canal receives flood flows from the Kings River. Monthly pond infiltration volumes during historical and current periods were estimated from reported monthly diversions to ponds/canal after subtracting 4% for evaporative loss. Monthly infiltration volumes for the projected period were estimated based on reported historical data.

3.3.3 Groundwater Budget

The groundwater budget represents the total amount of water entering and leaving the FCMA GSA in the subsurface. Below is a brief description of each component.

3.3.3.1 Deep Percolation (Inflow)

This component of the groundwater budget is directly linked to the deep percolation from the land surface budget. This accounts for all water that infiltrates from precipitation, applied irrigation, and surface water seepage.

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~~3.3.3.1~~3.3.3.2 Subsurface Inflows/Outflows

Subsurface inflows and outflows are influenced by regional and local groundwater pumping patterns, recharge, aquifer properties, and structural boundaries. The flow model calculated lateral subsurface flows between adjacent GSAs through different aquifer zones, as well as vertical flow between aquifer zones using hydraulic properties of the aquifers and simulated hydraulic heads.

~~3.3.3.2~~3.3.3.3 Groundwater Extraction (Outflow)

The total amount of extracted groundwater is composed of groundwater used to irrigate crops in FCMA (adjacent pumping) or pumped into the Mendota Pool for delivery to other GSAs in the Subbasin (transfer pumping). These activities in MPG areas have been well documented on a monthly basis for the entire historic/ current water budget periods. For the simulations of historic and current periods, known groundwater pumping (both adjacent and transfer) was assigned to some known wells in FCMA, where records of pumping were available on monthly basis. For areas where known adjacent pumping was not sufficient to meet the demand of groundwater for irrigation, required additional pumpage was estimated using land use and climatic data. In the projected water budget, groundwater pumping for irrigation purposes is based on the current year (2013) land use and groundwater pumped for discharge

into the Mendota Pool is based on the MPG Exchange Program EIR/EIS (LSCE, 2019). All groundwater pumping in FCMA is from the Upper Aquifer, and all pumping wells simulated in the model are located outside the MWA because groundwater was not used for irrigation in MWA.

3.3.4 Quantification of Overdraft

GSP regulations state the water budget shall include a quantification of overdraft over a period of years over which water supply conditions approximate average conditions. For purposes of this GSP, the FCMA has not had a substantial amount of historical pumping that has resulted in overdraft occurring in the form of a chronic decline in groundwater levels or change in aquifer storage or unreasonable impacts on other sustainability indicators other than groundwater quality in MAA. Overdraft in the form of long-term decline in storage of a significant amount (change in storage greater than five percent of groundwater pumping) has not occurred in the FCMA in the Upper Aquifer as shown in **Table 3-7**. Nor is overdraft projected to occur under the Projected Baseline and Projected Baseline with Climate Change Factors presented in **Table 3-7**.

Overdraft conditions were only determined for the Upper Aquifer as there is no known pumping in the FCMA from the Lower Aquifer, therefore any change in storage or overdraft conditions that may exist in the Lower Aquifer are due to regional influences out of the control of the FCMA. **Table 3-6** outlines overdraft conditions over each of the water budget periods, all of which represent average annual conditions based on the distribution of year types. In each of the water budget periods, change in storage is zero to slightly positive, indicating that overdraft is not occurring and is not projected to occur at local level under normal conditions.

Table 3-6: Upper Aquifer Overdraft

Water Budget Period	Groundwater Extraction (AFY)	Δ Storage (AFY)	Overdraft (AFY)
Historic/Current	18,000	0	0
~~**Projected Baseline**~~	~~18,000~~	~~2,300~~	~~0~~
Projected Climate Change	18,000	-1470	0

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3.3.5 Estimate of Sustainable Yield

Upper Aquifer sustainable yield for the entire Subbasin was estimated~~s for the entire Subbasin~~ at 403,000 AFY and is described in **Appendix A** ~~and ranges between 320,000 and 450,000 AFY~~. The estimate of sustainable yield for the Lower Aquifer ~~sustainable yield estimates~~ for the Subbasin was~~were~~ set at 101,000 AFY based on the basin wide extractions from the Lower Aquifer during WY2015~~0.33 AF/acre~~ and are also~~further~~ described in **Appendix A**.

3.3.6 Quantification of Current, Historic, and Projected Water Budget

3.3.6.1 Historic and Current Water Budget

The historic and current land surface budget can be seen in **Table 3-7**. Activities in FCMA rely on a combination of groundwater extraction and surface water imports. Surface water is used for environmental purposes in the MWA, a recharge project, and irrigation. The largest components of the land surface budget are the surface water inflows and outflows. Surface water in this area is dynamic due to the variable hydrology. There are several points of inflow and outflow and the direction of flow in the southern part of FCMA is a function of year type, with water flowing south during dry and normal years and north during wet years. Numbers in the land surface budget do not correlate very well with year types. Precipitation and surface water inflows/outflows are the only two components of the surface water budget that are directly related to year type, with greater values during wet years. Parts of the land surface budget that recharge the groundwater are variable based on year type.

The historic and current groundwater budget can be seen in **Table 3-8**, Groundwater production in the FCMA is entirely from the Upper Aquifer, therefore FCMA management actions only impact Upper Aquifer conditions. Unlike the surface water budget, there is a correlation between the groundwater budget and year type. Dry years typically resulted in a decline in groundwater storage due to an increase demand for groundwater pumping. Storage change for the upper and lower aquifer increase over the historic period. The current water year, which was a dry year shows a slight decline in storage in both the Upper and Lower Aquifer. Storage change in the Upper Aquifer ranged from (-15,500) AF to (+19,000) AF with an average of 0 AFY. Storage change for the Lower Aquifer ranged from (-6,000) AF to (+2,000) AF with an average of -1,700 AFY.

3.3.6.2 Projected Water Budget

FCMA projected water budget was calculated under ~~two different conditions. The first was under the Baseline Conditions, which took the historic hydrologic conditions as is with projected land use (Current year 2013) and pumping practices. The second was the~~ climate change conditions, where historic precipitation and ET values were adjusted with climate change factors provided by DWR (CCTAG, 2015). Historic data were used for the years 2014 through 2017 with simulated conditions from 2018 through 2070.

Results for the projected ~~baseline and~~ climate change land surface budgets is presented~~are~~ in **Table~~s~~ 3-9 ~~and 3-10, respectively~~**. ~~Both projections reveal similar results with small variations.~~ Results from the projected ~~baseline and~~ climate change groundwater budgets can be seen in **Table~~s~~ 3-101~~ and 3-12~~**, respectively. Results are summarized based on the simulated period of 2018-2070. ~~The baseline budget shows a positive trend in Upper Aquifer groundwater storage with an average increase of 2,300 AF/year.~~ The climate change budget shows a slightly negative trend with an average decrease of ~~-170~~ -200 AF/year. The average change in storage for the Upper Aquifer was a loss of just over 100 AF/year~~ Both water budgets reveal similar results with the Upper Aquifer showing an increase in storage between 200-300 AFY~~. Lower Aquifer storage ~~for both~~the projected water budget~~s~~ showed a loss of storage of

just under~~approximately~~ 100~~0~~ AFY. Year types dictated storage change with dry years resulting in a loss, wet years in a gain, and normal years showing both losses and gains. Extraction from the Upper Aquifer was consistent with the historic average (18,000 AFY). The projected water budgets show that planned management actions will likely result in sustainable conditions.

Subbasin wide changes in storage are described in section 4.3 and depicted graphically in Figure CC-64 in the Common Chapters (**Appendix A**).

3.3.7 Description of Surface Water Supplies Used or Available for Use for Groundwater Recharge or In-Lieu Use

3.3.7.1 Surface Water Availability for Groundwater Recharge Projects

Surface water deliveries are used in Management Area A for recharge to the Meyers Water Bank (Bank). The Bank is entitled to has been operational since 2001 and as of 2017 has banked a total of 76,000 AF. Of this amount, 30,000 AF has been extracted for use. The Bank is required to leave a total of 5% (2,290 AF) meaning 43,000 AF of available water is stored in the Bank. The cumulative total amount of banked water allowed in the Bank is 60,000 AF.

The Bank utilizes several sources of water during wet years when surface water supplies are abundant. The Bank is under contract with the USBR until 2032 and in any year is able to bank 10,000 AF from CVP and non-CVP water. Sources of water for the Bank include CVP supplies, Kings River flood releases, Section 215 temporary supplies from the Friant Division, and pre- 1914 non CVP water (USBR, 2011). **Table 3-13** shows the total amount of surface water that has been recharged and extracted from the water bank.

Table 3-1~~2~~13: Meyers Bank Banked Water Recharge and Extraction (AF)

Year	Banked	Extracted
2001	49	0
2002	1431	0
2003	2502	0
2004	4804	0
2005	4976	0
2006	4714	0
2007	2008	-655
2008	5078	-2105
2009	1	-5771
2010	12798	-13
2011	5741	0
2012	5660	-193
2013	2714	-4889

2014	2837	-6604
2015	2533	-6489
2016	7266	-3544
2017	10931	0
Total	76043	-30263

Table 3-13 shows the total amount of surface water that has been recharged to the groundwater bank.

Surface Water is also used for recharge in MAB. The Terra Linda Recharge Canal which has been operational since 2011 utilizes Kings River Flood water. In 2011, a total of 1,500 AF of flood water was recharged and it is estimated that over the next 20 year could provide total of over 4,000 AF (USBR, 2018).

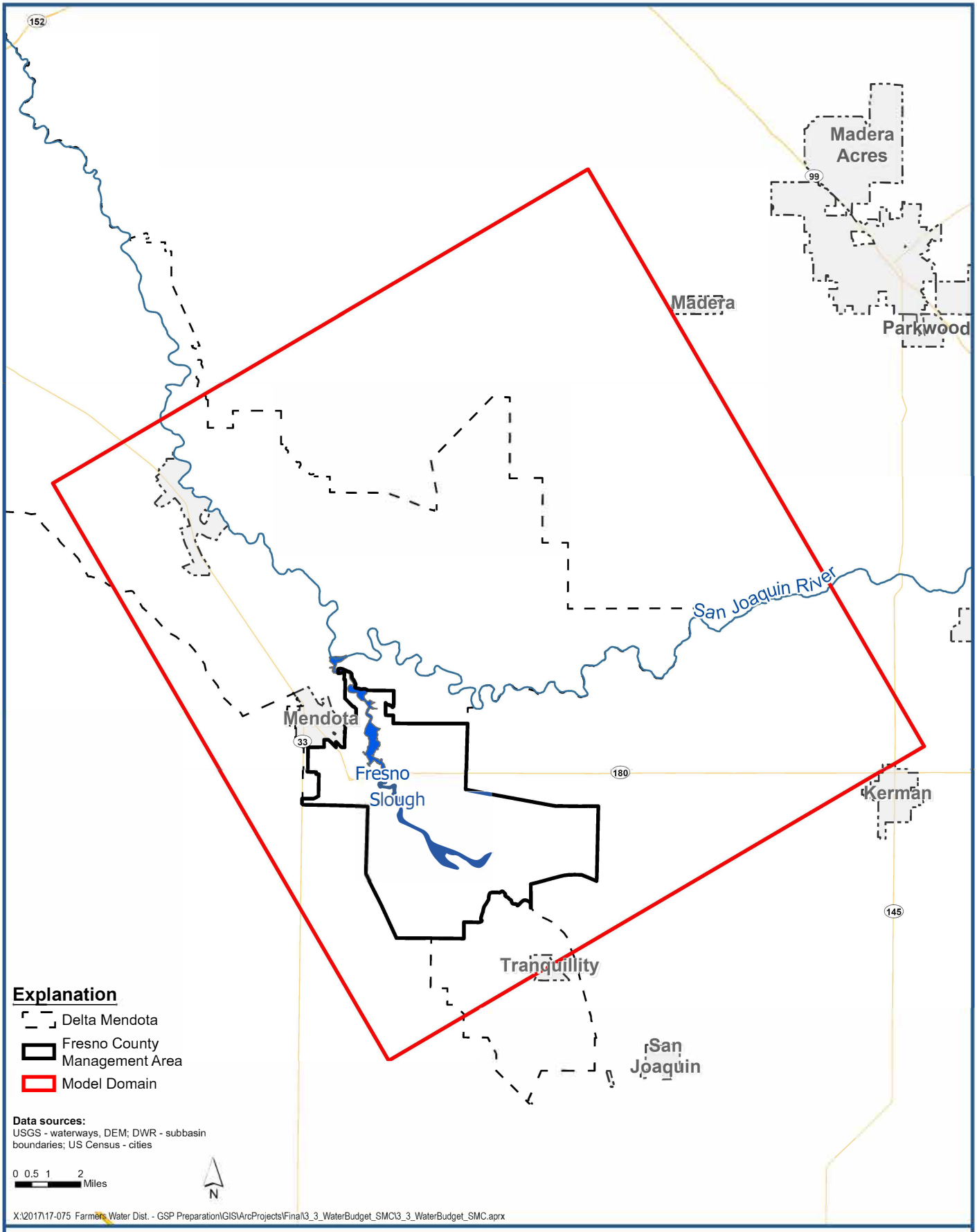
3.3.7.2 Surface Water Availability

Other entities that receive groundwater include the MWA and Coehlo Family Trust. Surface water delivers to these entities were obtained from the USBR website (https://www.usbr.gov/mp/cvo/95deliv.html). The annual surface water delivers for these entities including a complete record of Meyers Surface water deliveries are displayed in **Table 3-14**.

Table 3-142: Annual Surface Water Deliveries (AF)

Year	Coehlo Family Trust	MWA	Meyers Farming
1990	723	12,264	
1991	588	13,952	
1992	1,023	17,169	
1993	1,682	17,948	
1994	3,587	2,777	
1995	1,919	7	
1996	3,033	16,324	
1997	5,357	15,347	
1998	3,312	8	
1999	6,582	10	
2000	8,620	10	
2001	7,080	105	
2002	8,539	63	
2003	8,494	10	

2004	8,388	95	
2005	6,879	23,675	4,647
2006	8,105	28,015	5,524
2007	9,833	27,473	2,856
2008	8,268	26,851	6,275
2009	8,096	26,504	298
2010	7,043	27,124	13,108
2011	6,554	29,002	5,843
2012	7,415	33,078	5,783
2013	7,953	28,467	3,252
2014	6,290	17,772	3,249
2015	6,293	19,155	3,014
2016	5,687	27,414	7,760
2017	5,916	26,173	10,931



Luhdorff & Scalmanini
Consulting Engineers

Model Domain

Groundwater Sustainability Plan
County of Fresno

Figure 3-39

Table 3-7

Land Surface Budget									
		Inflows				Outflows			
		Precipitation	Applied Water - Groundwater	Applied Water - Imported Surface Water	**Total Inflows**	Runoff	Evapotranspiration	Deep Percolation	**Total Outflows**
2003	N	17,500	13,000	986,000	**1,016,500**	963,500	20,000	21,000	**1,004,500**
2004	D	11,500	15,000	934,000	**960,500**	912,500	17,000	28,000	**957,500**
2005	W	32,000	11,000	999,000	**1,042,000**	978,500	28,000	40,000	**1,046,500**
2006	W	21,000	7,000	1,515,000	**1,543,000**	1,500,000	24,000	25,500	**1,549,500**
2007	D	8,500	26,000	942,000	**976,500**	937,000	18,000	16,500	**971,500**
2008	D	13,500	27,000	883,000	**923,500**	869,500	22,000	27,000	**918,500**
2009	N	13,000	27,000	814,000	**854,000**	787,500	24,000	28,000	**839,500**
2010	N	23,500	15,000	1,016,000	**1,054,500**	989,500	25,000	39,000	**1,053,500**
2011	W	30,500	7,000	1,375,000	**1,412,500**	1,357,500	28,000	41,000	**1,426,500**
2012	D	15,000	26,000	951,000	**992,000**	935,000	27,000	24,000	**986,000**
2013	D	11,500	28,000	1,000,000	**1,039,500**	968,500	28,000	39,000	**1,035,500**

Table 3-8

Groundwater Budget													
		Inflows				**Outflows**						**Change in Storage**		
		Infiltration	Lateral Subsurface Flow		**Total Inflows**	Groundwater Extraction		Lateral Subsurface Flow		**Total Outflows**		Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*		Upper Aquifer	Lower Aquifer	*Upper Aquifer*	*Lower Aquifer*			*Upper Aquifer*	*Lower Aquifer*	*Total*
2003	N	21,000	24,000	26,000	**71,000**	13,000	0	36,000	26,000	**75,000**		(4,000)	0	(4,000)
2004	D	28,000	28,000	24,000	**80,000**	15,000	0	39,000	23,000	**77,000**		2,000	1,000	3,000
2005	W	40,000	24,000	25,000	**89,000**	11,000	0	34,000	24,000	**69,000**		19,000	1,000	20,000
2006	W	25,500	17,000	23,000	**65,500**	7,000	0	29,000	21,000	**57,000**		6,500	2,000	8,500
2007	D	16,500	29,000	20,000	**65,500**	26,000	0	35,000	20,000	**81,000**		(15,500)	0	(15,500)
2008	D	27,000	31,000	23,000	**81,000**	27,000	0	40,000	26,000	**93,000**		(9,000)	(3,000)	(12,000)
2009	N	28,000	35,000	28,000	**91,000**	28,000	0	43,000	33,000	**104,000**		(8,000)	(5,000)	(13,000)
2010	N	39,000	26,000	29,000	**94,000**	15,000	0	41,000	35,000	**91,000**		9,000	(6,000)	3,000
2011	W	41,000	15,000	26,000	**82,000**	7,000	0	33,000	25,000	**65,000**		16,000	1,000	17,000
2012	D	24,000	30,000	26,000	**80,000**	26,000	0	42,000	31,000	**99,000**		(14,000)	(5,000)	(19,000)
2013	D	39,000	32,000	29,000	**100,000**	28,000	0	45,000	34,000	**107,000**		(2,000)	(5,000)	(7,000)

Table 3-9

Land Surface Budget															
		Inflows							Outflows						
		Precipitation	Applied Water - Groundwater	Applied Water - Imported Surface Water (Inflows)	Applied Water - Groundwater (Project Effects) - NCDM Only	Applied Water - Imported Surface Water (Project Effects) - NCDM Only	Project Effects - All GSP Groups	**Total Inflows**	Runoff (Outflows)	Evapotranspiration	Crop Evaporanspiration - Aliso Only	Canal/Reservoir Evaporation - Aliso Only	Deep Percolation	Runoff (Project Effects) - NCDM Only	Project Effects - All GSP Groups	**Total Outflows**
2014	SC	7,800	23,000	420,000	N/A	N/A		**450,800**	390,000	21,000	N/A	N/A	27,000	N/A		**438,000**
2015	SC	9,500	21,000	250,000	N/A	N/A		**280,500**	220,000	20,000	N/A	N/A	32,000	N/A		**272,000**
2016	D	24,000	17,000	300,000	N/A	N/A		**341,000**	260,000	36,000	N/A	N/A	47,000	N/A		**343,000**
2017	W	23,000	4,500	1,700,000	N/A	N/A		**1,727,500**	1,600,000	35,000	N/A	N/A	59,000	N/A		**1,694,000**
2018	N	7,700	14,000	1,000,000	N/A	N/A		**1,021,700**	980,000	30,000	N/A	N/A	43,000	N/A		**1,053,000**
2019	W	21,000	15,000	1,300,000	N/A	N/A		**1,336,000**	1,300,000	34,000	N/A	N/A	47,000	N/A		**1,381,000**
2020	D	15,000	22,000	560,000	N/A	N/A		**597,000**	540,000	34,000	N/A	N/A	35,000	N/A		**609,000**
2021	W	21,000	14,000	1,400,000	N/A	N/A		**1,435,000**	1,300,000	38,000	N/A	N/A	43,000	N/A		**1,381,000**
2022	W	29,000	15,000	1,400,000	N/A	N/A		**1,444,000**	1,400,000	37,000	N/A	N/A	50,000	N/A		**1,487,000**
2023	N	11,000	16,000	970,000	N/A	N/A		**997,000**	960,000	31,000	N/A	N/A	38,000	N/A		**1,029,000**
2024	D	14,000	23,000	550,000	N/A	N/A		**587,000**	540,000	33,000	N/A	N/A	33,000	N/A		**606,000**
2025	W	23,000	14,000	1,400,000	N/A	N/A		**1,437,000**	1,300,000	37,000	N/A	N/A	45,000	N/A		**1,382,000**
2026	D	13,000	22,000	510,000	N/A	N/A		**545,000**	500,000	32,000	N/A	N/A	35,000	N/A		**567,000**
2027	D	14,000	21,000	490,000	N/A	N/A		**525,000**	470,000	35,000	N/A	N/A	35,000	N/A		**540,000**
2028	D	14,000	21,000	530,000	N/A	N/A		**565,000**	500,000	33,000	N/A	N/A	37,000	N/A		**570,000**
2029	D	13,000	20,000	510,000	N/A	N/A		**543,000**	490,000	34,000	N/A	N/A	37,000	N/A		**561,000**
2030	SC	17,000	20,000	510,000	N/A	N/A		**547,000**	490,000	30,000	N/A	N/A	43,000	N/A		**563,000**
2031	SC	19,000	19,000	490,000	N/A	N/A		**528,000**	470,000	28,000	N/A	N/A	44,000	N/A		**542,000**
2032	W	26,000	13,000	1,400,000	N/A	N/A		**1,439,000**	1,300,000	33,000	N/A	N/A	54,000	N/A		**1,387,000**
2033	D	15,000	21,000	500,000	N/A	N/A		**536,000**	490,000	35,000	N/A	N/A	39,000	N/A		**564,000**
2034	W	27,000	13,000	1,400,000	N/A	N/A		**1,440,000**	1,300,000	36,000	N/A	N/A	53,000	N/A		**1,389,000**
2035	W	17,000	14,000	1,300,000	N/A	N/A		**1,331,000**	1,300,000	32,000	N/A	N/A	46,000	N/A		**1,378,000**
2036	W	22,000	16,000	1,400,000	N/A	N/A		**1,438,000**	1,400,000	32,000	N/A	N/A	48,000	N/A		**1,480,000**
2037	W	38,000	14,000	1,400,000	N/A	N/A		**1,452,000**	1,400,000	39,000	N/A	N/A	53,000	N/A		**1,492,000**
2038	N	12,000	16,000	1,000,000	N/A	N/A		**1,028,000**	1,000,000	32,000	N/A	N/A	35,000	N/A		**1,067,000**
2039	N	19,000	16,000	970,000	N/A	N/A		**1,005,000**	970,000	34,000	N/A	N/A	41,000	N/A		**1,045,000**
2040	D	20,000	23,000	570,000	N/A	N/A		**613,000**	570,000	38,000	N/A	N/A	31,000	N/A		**639,000**
2041	D	14,000	22,000	510,000	N/A	N/A		**546,000**	500,000	31,000	N/A	N/A	35,000	N/A		**566,000**
2042	N	18,000	14,000	1,000,000	N/A	N/A		**1,032,000**	1,000,000	36,000	N/A	N/A	42,000	N/A		**1,078,000**
2043	D	12,000	22,000	490,000	N/A	N/A		**524,000**	480,000	30,000	N/A	N/A	36,000	N/A		**546,000**
2044	W	31,000	14,000	1,400,000	N/A	N/A		**1,445,000**	1,400,000	40,000	N/A	N/A	49,000	N/A		**1,489,000**
2045	W	22,000	14,000	1,400,000	N/A	N/A		**1,436,000**	1,300,000	36,000	N/A	N/A	43,000	N/A		**1,379,000**
2046	D	9,000	23,000	510,000	N/A	N/A		**542,000**	500,000	27,000	N/A	N/A	28,000	N/A		**555,000**
2047	D	13,000	22,000	480,000	N/A	N/A		**515,000**	470,000	25,000	N/A	N/A	36,000	N/A		**531,000**
2048	N	12,000	14,000	1,000,000	N/A	N/A		**1,026,000**	1,000,000	32,000	N/A	N/A	42,000	N/A		**1,074,000**
2049	N	22,000	14,000	1,000,000	N/A	N/A		**1,036,000**	1,000,000	35,000	N/A	N/A	50,000	N/A		**1,085,000**
2050	W	27,000	15,000	1,300,000	N/A	N/A		**1,342,000**	1,300,000	36,000	N/A	N/A	47,000	N/A		**1,383,000**
2051	D	13,000	22,000	480,000	N/A	N/A		**515,000**	470,000	30,000	N/A	N/A	29,000	N/A		**529,000**
2052	D	11,000	22,000	520,000	N/A	N/A		**553,000**	500,000	27,000	N/A	N/A	36,000	N/A		**563,000**
2053	SC	7,900	21,000	510,000	N/A	N/A		**538,900**	490,000	29,000	N/A	N/A	35,000	N/A		**554,000**
2054	SC	9,500	20,000	490,000	N/A	N/A		**519,500**	470,000	24,000	N/A	N/A	37,000	N/A		**531,000**
2055	D	25,000	19,000	460,000	N/A	N/A		**504,000**	450,000	36,000	N/A	N/A	48,000	N/A		**534,000**
2056	W	27,000	13,000	1,300,000	N/A	N/A		**1,340,000**	1,300,000	35,000	N/A	N/A	56,000	N/A		**1,391,000**
2057	W	18,000	14,000	1,300,000	N/A	N/A		**1,332,000**	1,300,000	36,000	N/A	N/A	43,000	N/A		**1,379,000**
2058	N	13,000	15,000	1,000,000	N/A	N/A		**1,028,000**	970,000	33,000	N/A	N/A	41,000	N/A		**1,044,000**
2059	W	15,000	15,000	1,300,000	N/A	N/A		**1,330,000**	1,300,000	31,000	N/A	N/A	44,000	N/A		**1,375,000**
2060	D	17,000	22,000	490,000	N/A	N/A		**529,000**	490,000	33,000	N/A	N/A	38,000	N/A		**561,000**
2061	W	25,000	14,000	1,400,000	N/A	N/A		**1,439,000**	1,400,000	37,000	N/A	N/A	48,000	N/A		**1,485,000**
2062	N	18,000	15,000	1,000,000	N/A	N/A		**1,033,000**	1,000,000	33,000	N/A	N/A	44,000	N/A		**1,077,000**
2063	N	14,000	15,000	990,000	N/A	N/A		**1,019,000**	980,000	34,000	N/A	N/A	37,000	N/A		**1,051,000**
2064	D	11,000	23,000	500,000	N/A	N/A		**534,000**	490,000	31,000	N/A	N/A	30,000	N/A		**551,000**
2065	N	24,000	14,000	1,000,000	N/A	N/A		**1,038,000**	1,000,000	38,000	N/A	N/A	47,000	N/A		**1,085,000**
2066	W	14,000	15,000	1,300,000	N/A	N/A		**1,329,000**	1,300,000	32,000	N/A	N/A	37,000	N/A		**1,369,000**
2067	W	16,000	15,000	1,400,000	N/A	N/A		**1,431,000**	1,300,000	36,000	N/A	N/A	36,000	N/A		**1,372,000**
2068	D	17,000	23,000	520,000	N/A	N/A		**560,000**	510,000	31,000	N/A	N/A	35,000	N/A		**576,000**
2069	D	10,000	22,000	490,000	N/A	N/A		**522,000**	470,000	26,000	N/A	N/A	35,000	N/A		**531,000**
2070	W	40,000	13,000	1,500,000	N/A	N/A		**1,553,000**	1,400,000	40,000	N/A	N/A	61,000	N/A		**1,501,000**

Table 3-10

Groundwater Budget																				
		Inflows							Outflows							Change in Storage		
		Infiltration	Lateral Subsurface Flow		Seepage Through Corcoran Clay - SJREC Only	Applied Water Infiltration (Project Effects) - NCDM Only	Deep Percolation (Project Effects) - NCDM Only	Project Effects	Total Inflows	Groundwater Extraction		Lateral Subsurface Flow		Flow to Lower Aquifer - Grassland Only	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow - Grassland Only	Total Outflows	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*						*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*				*Upper Aquifer*	*Lower Aquifer*	*Total*
2014	SC	27,000	15,000	29,000	N/A	N/A	N/A		**71,000**	26,000	0	52,000	38,000	N/A	N/A	**116,000**	(36,000)	(9,000)	(45,000)
2015	SC	32,000	10,000	28,000	N/A	N/A	N/A		**70,000**	22,000	0	56,000	49,000	N/A	N/A	**127,000**	(36,000)	(21,000)	(57,000)
2016	D	47,000	9,600	27,000	N/A	N/A	N/A		**83,600**	17,000	0	57,000	45,000	N/A	N/A	**119,000**	(17,400)	(18,000)	(35,400)
2017	W	59,000	11,000	24,000	N/A	N/A	N/A		**94,000**	4,500	0	63,000	34,000	N/A	N/A	**101,500**	2,500	(10,000)	(7,500)
2018	N	43,000	18,000	22,000	N/A	N/A	N/A		**83,000**	14,000	0	36,000	19,000	N/A	N/A	**69,000**	11,000	3,000	14,000
2019	W	47,000	25,000	20,000	N/A	N/A	N/A		**92,000**	15,000	0	38,000	18,000	N/A	N/A	**71,000**	19,000	2,000	21,000
2020	D	35,000	11,000	21,000	N/A	N/A	N/A		**67,000**	22,000	0	43,000	26,000	N/A	N/A	**91,000**	(19,000)	(5,000)	(24,000)
2021	W	43,000	28,000	21,000	N/A	N/A	N/A		**92,000**	14,000	0	36,000	16,000	N/A	N/A	**66,000**	21,000	5,000	26,000
2022	W	50,000	28,000	21,000	N/A	N/A	N/A		**99,000**	15,000	0	36,000	21,000	N/A	N/A	**72,000**	27,000	0	27,000
2023	N	38,000	15,000	24,000	N/A	N/A	N/A		**77,000**	16,000	0	37,000	28,000	N/A	N/A	**81,000**	0	(4,000)	(4,000)
2024	D	33,000	9,600	22,000	N/A	N/A	N/A		**64,600**	23,000	0	47,000	23,000	N/A	N/A	**93,000**	(27,400)	(1,000)	(28,400)
2025	W	45,000	24,000	21,000	N/A	N/A	N/A		**90,000**	15,000	0	38,000	17,000	N/A	N/A	**70,000**	16,000	4,000	20,000
2026	D	35,000	10,000	22,000	N/A	N/A	N/A		**67,000**	22,000	0	47,000	27,000	N/A	N/A	**96,000**	(24,000)	(5,000)	(29,000)
2027	D	35,000	9,800	20,000	N/A	N/A	N/A		**64,800**	21,000	0	47,000	21,000	N/A	N/A	**89,000**	(23,200)	(1,000)	(24,200)
2028	D	37,000	10,000	19,000	N/A	N/A	N/A		**66,000**	21,000	0	48,000	20,000	N/A	N/A	**89,000**	(22,000)	(1,000)	(23,000)
2029	D	37,000	11,000	18,000	N/A	N/A	N/A		**66,000**	20,000	0	47,000	19,000	N/A	N/A	**86,000**	(19,000)	(1,000)	(20,000)
2030	SC	43,000	11,000	17,000	N/A	N/A	N/A		**71,000**	20,000	0	46,000	18,000	N/A	N/A	**84,000**	(12,000)	(1,000)	(13,000)
2031	SC	44,000	11,000	17,000	N/A	N/A	N/A		**72,000**	20,000	0	46,000	18,000	N/A	N/A	**84,000**	(11,000)	(1,000)	(12,000)
2032	W	54,000	30,000	17,000	N/A	N/A	N/A		**101,000**	13,000	0	40,000	13,000	N/A	N/A	**66,000**	31,000	4,000	35,000
2033	D	39,000	10,000	18,000	N/A	N/A	N/A		**67,000**	21,000	0	42,000	23,000	N/A	N/A	**86,000**	(14,000)	(5,000)	(19,000)
2034	W	53,000	30,000	19,000	N/A	N/A	N/A		**102,000**	13,000	0	38,000	14,000	N/A	N/A	**65,000**	32,000	5,000	37,000
2035	W	46,000	30,000	20,000	N/A	N/A	N/A		**96,000**	15,000	0	37,000	20,000	N/A	N/A	**72,000**	24,000	0	24,000
2036	W	48,000	30,000	20,000	N/A	N/A	N/A		**98,000**	16,000	0	40,000	20,000	N/A	N/A	**76,000**	22,000	0	22,000
2037	W	53,000	27,000	23,000	N/A	N/A	N/A		**103,000**	14,000	0	34,000	23,000	N/A	N/A	**71,000**	32,000	0	32,000
2038	N	35,000	14,000	26,000	N/A	N/A	N/A		**75,000**	16,000	0	36,000	30,000	N/A	N/A	**82,000**	(3,000)	(4,000)	(7,000)
2039	N	41,000	24,000	28,000	N/A	N/A	N/A		**93,000**	16,000	0	39,000	27,000	N/A	N/A	**82,000**	10,000	1,000	11,000
2040	D	31,000	9,300	23,000	N/A	N/A	N/A		**63,300**	23,000	0	50,000	25,000	N/A	N/A	**98,000**	(32,700)	(2,000)	(34,700)
2041	D	35,000	8,300	20,000	N/A	N/A	N/A		**63,300**	23,000	0	49,000	20,000	N/A	N/A	**92,000**	(28,700)	0	(28,700)
2042	N	42,000	25,000	23,000	N/A	N/A	N/A		**90,000**	14,000	0	41,000	20,000	N/A	N/A	**75,000**	12,000	3,000	15,000
2043	D	36,000	9,200	20,000	N/A	N/A	N/A		**65,200**	23,000	0	49,000	23,000	N/A	N/A	**95,000**	(26,800)	(3,000)	(29,800)
2044	W	49,000	25,000	20,000	N/A	N/A	N/A		**94,000**	14,000	0	39,000	15,000	N/A	N/A	**68,000**	21,000	5,000	26,000
2045	W	43,000	25,000	22,000	N/A	N/A	N/A		**90,000**	15,000	0	36,000	21,000	N/A	N/A	**72,000**	17,000	1,000	18,000
2046	D	28,000	9,600	21,000	N/A	N/A	N/A		**58,600**	23,000	0	47,000	26,000	N/A	N/A	**96,000**	(32,400)	(5,000)	(37,400)
2047	D	36,000	8,600	19,000	N/A	N/A	N/A		**63,600**	22,000	0	48,000	19,000	N/A	N/A	**89,000**	(25,400)	0	(25,400)
2048	N	42,000	16,000	21,000	N/A	N/A	N/A		**79,000**	14,000	0	40,000	20,000	N/A	N/A	**74,000**	4,000	1,000	5,000
2049	N	50,000	16,000	22,000	N/A	N/A	N/A		**88,000**	14,000	0	39,000	22,000	N/A	N/A	**75,000**	13,000	0	13,000
2050	W	47,000	26,000	21,000	N/A	N/A	N/A		**94,000**	15,000	0	38,000	17,000	N/A	N/A	**70,000**	20,000	4,000	24,000
2051	D	29,000	10,000	21,000	N/A	N/A	N/A		**60,000**	22,000	0	46,000	26,000	N/A	N/A	**94,000**	(29,000)	(5,000)	(34,000)
2052	D	36,000	8,600	18,000	N/A	N/A	N/A		**62,600**	22,000	0	46,000	19,000	N/A	N/A	**87,000**	(23,400)	(1,000)	(24,400)
2053	SC	35,000	9,300	17,000	N/A	N/A	N/A		**61,300**	21,000	0	46,000	18,000	N/A	N/A	**85,000**	(22,700)	(1,000)	(23,700)
2054	SC	37,000	9,600	16,000	N/A	N/A	N/A		**62,600**	21,000	0	46,000	17,000	N/A	N/A	**84,000**	(20,400)	(1,000)	(21,400)
2055	D	48,000	10,000	16,000	N/A	N/A	N/A		**74,000**	20,000	0	45,000	16,000	N/A	N/A	**81,000**	(7,000)	0	(7,000)
2056	W	56,000	32,000	17,000	N/A	N/A	N/A		**105,000**	13,000	0	42,000	12,000	N/A	N/A	**67,000**	33,000	5,000	38,000
2057	W	43,000	31,000	18,000	N/A	N/A	N/A		**92,000**	15,000	0	40,000	18,000	N/A	N/A	**73,000**	19,000	0	19,000
2058	N	41,000	32,000	21,000	N/A	N/A	N/A		**94,000**	16,000	0	42,000	23,000	N/A	N/A	**81,000**	15,000	(2,000)	13,000
2059	W	44,000	30,000	21,000	N/A	N/A	N/A		**95,000**	15,000	0	39,000	18,000	N/A	N/A	**72,000**	20,000	3,000	23,000
2060	D	38,000	8,600	21,000	N/A	N/A	N/A		**67,600**	22,000	0	43,000	26,000	N/A	N/A	**91,000**	(18,400)	(5,000)	(23,400)
2061	W	48,000	28,000	21,000	N/A	N/A	N/A		**97,000**	15,000	0	39,000	16,000	N/A	N/A	**70,000**	22,000	5,000	27,000
2062	N	44,000	26,000	25,000	N/A	N/A	N/A		**95,000**	16,000	0	39,000	28,000	N/A	N/A	**83,000**	15,000	(3,000)	12,000
2063	N	37,000	27,000	25,000	N/A	N/A	N/A		**89,000**	16,000	0	41,000	24,000	N/A	N/A	**81,000**	7,000	1,000	8,000
2064	D	30,000	9,700	21,000	N/A	N/A	N/A		**60,700**	23,000	0	49,000	24,000	N/A	N/A	**96,000**	(32,300)	(3,000)	(35,300)
2065	N	47,000	15,000	23,000	N/A	N/A	N/A		**85,000**	14,000	0	40,000	22,000	N/A	N/A	**76,000**	8,000	1,000	9,000
2066	W	37,000	26,000	21,000	N/A	N/A	N/A		**84,000**	16,000	0	40,000	18,000	N/A	N/A	**74,000**	7,000	3,000	10,000
2067	W	36,000	26,000	22,000	N/A	N/A	N/A		**84,000**	16,000	0	38,000	21,000	N/A	N/A	**75,000**	8,000	1,000	9,000
2068	D	35,000	8,900	22,000	N/A	N/A	N/A		**65,900**	23,000	0	47,000	27,000	N/A	N/A	**97,000**	(26,100)	(5,000)	(31,100)
2069	D	35,000	7,400	18,000	N/A	N/A	N/A		**60,400**	22,000	0	47,000	19,000	N/A	N/A	**88,000**	(26,600)	(1,000)	(27,600)
2070	W	61,000	21,000	19,000	N/A	N/A	N/A		**101,000**	14,000	0	35,000	14,000	N/A	N/A	**63,000**	33,000	5,000	38,000

3.4 Management Areas

~~3.4~~ There are no management areas within FCMA.

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~~3.4.1 Reason for Creation of each Management Area~~

~~FCMA elected to become a management area for two of the five applicable sustainability indicators, degraded water quality and Interconnected Surface Waters. A management area was created for degraded water quality due to the existing contamination and Regional Board regulatory requirements for the Steffens plume in MAA. A management area for interconnected surface waters for MAB was developed because levels in the Fresno Slough are managed by SJREC, SLDMWA and USBR and not a function of naturally occurring conditions. The standards for these sustainability indicators will be further refined as more data is available. The justification for each MAA and MAB is groundwater quality for MAA and interconnected surface waters for MAB.~~

~~3.4.1.1 Groundwater Quality~~

~~FCMA has been significantly affected by water quality issues. As discussed in section 2.4.2, MAA contains the Steffens plume. A CAO has been issued to the Spreckels Sugar Company and the current status of addressing the groundwater quality degradation is in the development of a "Site Assessment" report which will define the extent of the Steffens plume in the Upper Aquifer in 2019. Within 180 days of its submittal, a "Feasibility and Remedial Options Evaluation" is to be submitted to the Regional Board. Within 120 days of that, the a "Cleanup Plan" is to be submitted. Given all the regulatory activities outside of SGMA and this GSP to address the Steffens plume, it is not the intent of FCMA to mandate or impose additional cleanup requirements. FCMA and the stakeholders in MAA will work with the Regional Board to prevent any additional undesirable results due to the Steffens plume.~~

~~MAB as previously described in section 3.2 has experienced degraded water quality due to a naturally occurring saline water due to marine sediments west of the FCMA. It is expected that TDS concentrations will continue to rise because of naturally occurring conditions and regional groundwater gradients, therefore a management area was created to differing sustainable management criteria from the rest of the subbasin.~~

~~3.4.1.2 Interconnected Surface Waters~~

~~As described in section 3.2.8, The only surface water system connected to groundwater in FCMA is the Fresno Slough. The interaction of surface water and groundwater are a function of both surface water elevations and groundwater elevations. Water levels in the Fresno Slough are under the management of SJREC, SLDMWA and USBR, therefore FCMA can only manage groundwater levels to sustainable levels.~~

~~3.4.2 Level of monitoring and analysis~~

~~3.4.2.1 Degraded Water Quality~~

~~The focus of the water quality monitoring network will be on transport of salts measured as EC or TDS. Other water quality constituents have been evaluated and found not to impact beneficial uses. The~~

monitoring for water quality occurs at a much greater density than any of the other sustainability indicators due to the variable nature of groundwater quality data. The degraded water quality monitoring network will incorporate two existing monitoring programs including the MPG annual report and Spreckels semi-annual report. For SGMA, groundwater quality sampled are to be collected on annual basis utilizing the existing programs. The selection of wells to serve as monitoring sites were based on the location of the Steffen Plume (KDSA, 2018). Given the current conditions, no additional monitoring will be required beyond the annual groundwater sampling and existing monitoring programs. Additional monitoring may be necessary if conditions exceed minimum thresholds, which are discussed in the following section.

3.4.2.2 Interconnected Surface Waters

The monitoring of interconnected surface water will utilize monitoring data from SLDMWA. SLDMWA monitors the stage of the Mendota Pool on a daily basis. This data is included in the MPG annual report. Water levels in the Mendota Pool have been historically stable, therefore no additional monitoring of the surface water component of interconnected surface waters is necessary. If additional monitoring sites can be installed in the existing data gap areas (**Figure 3-13**), further evaluation of surface water-groundwater interactions will be conducted.

3.4.3 Explanation of how management of management areas will not cause undesirable results outside the management area.

The management of groundwater quality in MAA will result in addressing existing undesirable results once a cleanup plan approved by the Regional Board is implemented. In the meantime, degraded groundwater quality will continue to impact agricultural beneficial uses in the MAA and the southern portion of the FWD GSA. Water quality will also be closely monitored to slow the increasing TDS concentrations due to naturally occurring conditions. The FCMA will be closely monitoring the implementation of the CAO through correspondence with the Regional Board and by monitoring groundwater conditions in the MAA. The FCMA will also continue outreach efforts with the FWD GSA as part of future GSP implementation efforts involving the Steffens plume. Water quality will also be closely monitored in MAB to slow the increasing TDS concentrations due to naturally occurring conditions.

FCMA will work with SLDMWA and the SJREC to prevent undesirable results for interconnected surface water by managing levels in the Mendota Pool to levels that will not impact beneficial users of interconnected surface water.

4 SUSTAINABLE MANAGEMENT CRITERIA

This chapter of the GSP describes the Sustainable Management Criteria (SMC) for the FCMA GSP. Other areas of the Subbasin are covered by Common Chapters (**Appendix A**) and the five other individual GSPs prepared in the Subbasin. The purpose of SMC is to establish standards that allow a subbasin or GSP area to reach sustainable conditions. Each GSP is required to create a sustainability goal which defines the absence of undesirable results of groundwater conditions. Undesirable results occur when conditions for any six sustainability indicators become significant and unreasonable which is to be defined by the GSA. The six sustainability indicators (SI) are listed below:

- Chronic Lowering of Groundwater Elevation
- Reduction of Groundwater Storage
- Seawater Intrusion
- Degraded Groundwater Quality
- Land Subsidence
- Depletions of Interconnected Surface Waters

All SI apply to FCMA with the exception of seawater intrusion since the subbasin is not a coastal basin. A monitoring network has been established for each of these sustainability indicators that serve as a basis for Minimum Thresholds (MT) and Measurable Objectives (MO) to be set in order to avoid Undesirable Results and achieve sustainability. This chapter provides a discussion on the development of all SMC components for the FCMA GSA area.

The SMC were established by the following process:

- Hydrogeologic Analysis
- Coordination with adjacent GSAs
- Input from local stakeholders and interested parties

The information obtained from this process was used to define what is considered significant and unreasonable, and what is sustainable for the five applicable ~~sustainability indicators~~SI. Significant and unreasonable conditions are quantified by MTs. Significant and unreasonable was defined for each SI at the subbasin level. These definitions for each SI are provided in the sections below. ~~conditions occur when more than 25 percent of the MT are exceeded for two consecutive years for each individual monitoring network.~~ Analysis of historic and projected hydrogeologic conditions provided insight into what conditions were and are likely to be experienced. The projected conditions and regulatory requirements were used to determine MOs. Coordination with adjacent GSAs was to ensure established MTs and MOs were not significantly different. Finally, input from stakeholders was utilized to ensure that established MTs and MOs would not significantly impact planned groundwater management. The

following provides further description of the process used to develop each of the components that make up SMC.

4.1 Coordinated Sustainability Goal (354.24) and Undesirable Results

The coordinated Sustainability Goal for the Delta-Mendota Subbasin is as follows:

The Delta-Mendota Subbasin will manage groundwater resources for the benefit of all users of groundwater in a manner that allows for operational flexibility, ensures resource availability under drought conditions, and does not negatively impact surface water diversions and conveyance and delivery capabilities. The goal will be achieved through the implementation of the proposed projects and management actions to reach~~ed~~ identified measurable objectives and milestones through the implementation of the GSP(s), and through continued coordination with neighboring subbasins to ensure the absence of undesirable results by 2040.

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The Sustainability Goal is based on information presented in the basin settings and should include measures that will be taken to operate within the basin's Sustainable Yield. ~~Description of the Goal: FCMA will manage groundwater resources in a manner that results in the absence of undesirable results for the Upper Aquifer by the year 2040.~~Two principal aquifers, the Upper and Lower, were identified in the FCMA GSP and Common Chapters for the Subbasin. The hydrogeologic properties of these aquifers and responses to different groundwater management practices were evaluated in the Basin Settings chapters of the FCMA GSP and Common Chapters. Sustainable yields were for the entire subbasin for both the Upper and Lower Aquifer based on historic conditions. The Sustainable Yield numbers were based on historic pumping practices and the absence of undesirable results based on historic conditions. At the local level, FCMA will manage groundwater resources in a manner that results in the absence of undesirable results for the Upper Aquifer by the year 2040. This will be accomplished in FCMA by operating within historic groundwater management practices and maintain water levels within the historic hydrograph. FCMA is not expected to extract groundwater from the Lower Aquifer over the projected water budget period. Lower Aquifer conditions will be monitored and managed in coordination with other entities that utilize the Lower Aquifer as a source of groundwater. Sustainability will be accomplished through the continuation of existing monitoring, data collection and inter-basin coordination to improve our understanding of regional influences on Lower Aquifer conditions. Coordination and communication with surrounding GSAs will be conducted to implement management actions that will prevent over extraction of groundwater and maintain stable conditions for each of the sustainability indicators in the Upper and Lower Aquifers.

The definition for "undesirable results" for each of the sustainability indicators were agreed upon for the entire Delta-Mendota Subbasin:

- **Chronic lowering of groundwater** – Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater.
- **Reduction in groundwater storage -** A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater.
- **Degraded water quality** – Degradation of groundwater quality as a result of groundwater management activities that cause significant and unreasonable impacts to beneficial uses and users of groundwater.
- **Land Subsidence** – Changes in ground surface elevation that cause damage to critical infrastructure, including significant and unreasonable reductions of conveyance capacity, impacts to natural resource areas, or conditions that threaten public health and safety.
- **Depletions of interconnected surface water –** Depletions of interconnected surface water as a direct result of groundwater pumping that causes significant and unreasonable impacts on natural resources or downstream beneficial uses and users.

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The historic period showed that under normal hydrologic conditions, the FCMA plan area operates sustainably where the average change in storage is slightly positive and groundwater levels are generally stable. Extended dry periods similar to 2012 through 2016 results in conditions that are not sustainable due to significant reductions in groundwater storage. Using the current understanding of groundwater conditions in the FCMA as it relates to variable hydrologic conditions, the FCMA plan area will be managed and monitored to ensure the sustainability goal is met by 2040. Further investigation of existing data gap areas and development of future projects and management actions will ensure that sustainable conditions are maintained through the planning and implementation horizon (2040 through 2070).

4.2 Measurable Objectives and Interim Milestones

MOs quantify groundwater conditions that are representative of sustainable conditions for each sustainability indicator. The interim milestones (IM) represent the intended plan of action to meet measurable objectives and refine SMCs with additional data collection, ~~trend of groundwater conditions required,~~ in 5-year increments, to reach sustainable conditions over the 20-year implementation period. In addition, the GSP includes descriptions of each objective and how each objective is intended to achieve the sustainability goal for the Subbasin for the long-term beneficial uses. The GSP regulations define MO as specific, quantifiable goals for the maintenance or improvement of specific groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the plan area.

Per GSP Regulations (§354.30):

1. Each Agency shall establish measurable objectives, including IMs in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to

continue to sustainably manage the groundwater basin over the planning and implementation horizon.

2. Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metric and monitoring sites as are used to define the minimum thresholds.
3. Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.
4. An Agency may establish a representative measurable objective 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 measurable objectives as supported by adequate evidence. Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of Ims for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years.

The measurable objectives developed for each applicable sustainability indicator in this GSP are based on the current understanding of the Plan Area and Basin Setting as discussed in Chapters 2 and 3.

4.2.1 Measurable Objectives for Chronic Lowering of Water Levels

4.2.1.1 Description of Measurable Objective

Chronic Lowering of Water Levels~~Groundwater elevation~~ SMC were developed in a coordinated manner with the rest of the Subbasin based on historic measurements and a sustainability goal of preventing a long-term trend of declining groundwater levels. MOs were set at each of the four~~ive~~ monitoring sites (**Figure 4-1**). These sites were selected in order to provide an even distribution of coverage over the GSP and based on each individual well's ability to capture the general groundwater trend for other wells in their vicinity. Three~~Four~~ of these wells monitor groundwater conditions in the Upper Aquifer and one well monitor conditions in the Lower Aquifer. The Lower Aquifer well is located outside of FCMA as there are no Lower Aquifer wells in the GSP area. There are limited data in MAB in the MWA, and it is currently designated as a data gap. MOs were set based on seasonal high conditions observed in 2015. Under SGMA, undesirable results prior to 2015 do not have to be addressed. IM~~m~~s are narratives developed at Subbasin level that outline how SMCs will be refined as more data are collected and that groundwater levels will be maintained at or above MO levels. ~~were set as a linear projection between recent groundwater elevation and MO levels representing 2040~~. Monitoring sites and their associated MO's are shown in **Table 4-1**.

4.2.1.2 Reasonable Margin of Safety for Operational Flexibility

The established MOs for C~~c~~hronic L~~l~~owering of W~~ groundw~~ater Levels~~elevation~~ allows for a reasonable margin of safety as these water levels are based on 2015 water levels which are near historic lows. Recent (post 2016) and historic water levels have generally remained above these levels. Based on the

information described in section 3.2.1, dry periods have resulted in decline of groundwater elevation followed by recovery during wet and normal years.

4.2.1.3 Path to Achieve and Maintain the Sustainability Goal

The Sustainability Goal for Chronic Lowering of Water Levels was determined at the Subbasin level:

Maintain groundwater levels that are comparable to existing conditions (historic low conditions as of Water Year 2016) in order to continue meeting the demand of beneficial uses and users of groundwater and prevent a trend of declining groundwater levels. The Delta-Mendota Subbasin will continue successful and ongoing coordination with neighboring Subbasin to address chronic lowering of groundwater levels caused by pumping outside of the Subbasin.

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At the local level, h~~H~~istoric trends and planned groundwater extraction and management actions provide a reasonable path to maintain the sustainability goal with stable groundwater elevation. Recent water levels remain above the MO. Therefore, since recent groundwater levels are higher than the MO set to recent hydrological conditions, a recovery of groundwater elevation is not needed to reach the sustainability goal. The IMs served to maintain the existing sustainable conditions. The sustainability goal for groundwater elevation is to prevent a trend of declining water levels. Planned management actions in conjunction with coordination of SMC with adjacent GSAs will ensure the MO for groundwater elevation are met.

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Table 4-1: Measurable objectives and Interim Milestones for the Chronic Lower of Water Elevations

~~Management Area~~	Well Name	Aquifer	Interim Milestone 5 Years ~~(ft NAVD88)~~	Interim Milestone 10 Years ~~(ft NAVD88)~~	Interim Milestone 15 Years ~~(ft NAVD88)~~	Measurable Objective (ft NAVD88)
~~B~~	7C1	Upper	Gather data and complete the establishment of seasonal low and seasonal high elevations at representative monitoring sites in the Lower Aquifer. Develop a coordinated methodology and complete the	Maintain groundwater levels at MOs Where chronic lowering of groundwater levels is cause by pumping outside of the Subbasin, seek remedies in coordination with DWR and	Maintain groundwater levels at MOs Where chronic lowering of groundwater levels is cause by pumping outside of the Subbasin, seek remedies in coordination with DWR and	121
~~A~~	MW-7	Upper				~~99~~103
~~A & B~~	31J6	Lower				-27

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~~B~~	~~KRCDA06~~	~~Upper~~	establishment of acute groundwater elevations thresholds. Identify chronic lowering of groundwater levels cause by pumping outside the Subbasin. ~~126 107 0 118 123~~	neighboring GSAs ~~124 104 -9 118 120~~	neighboring GSAs ~~122 102 -18 117 118~~	~~116~~
~~B~~	TL-HS-3	Upper				116

4.2.2 Measurable Objectives for Reduction in Groundwater Storage

4.2.2.1 Description of Measurable Objective

MO values for R~~r~~eduction in G~~g~~roundwater S~~s~~torage are based on MOs set for the chronic lowering of ground water levels for the Upper Aquifer. For the Lower Aquifer, the MO is set based on no allowable land subsidence past 2040. ~~the projected water budget baseline results which indicate~~ For both the Upper and Lower Aquifers, ~~that~~ long term change in storage will be stable at approximately 0 AFY. ~~The Ims will be the difference between the recent water levels and MO values for groundwater elevation~~ (**Table 4-2**). For the Upper Aquifer, ~~The~~the MO for reduction~~decline~~ in groundwater storage will be reached once the cumulative decline in storage over the next 20 years (the path from recent groundwater levels/storage to 2015 groundwater levels/storage) that the GSP area will experience while maintaining sustainable conditions. For the Lower Aquifer, the MO for Reduction in Groundwater Storage will be reached once subsidence is equal to zero feet per year. ~~This value is subject to change as it is based on the most recent groundwater elevations. With increasing groundwater levels, more loss of storage will be allowed over the SGMA implementation period.~~ IMs for groundwater storage, are narratives developed at Subbasin level that outline how SMCs will be refined as more data are collected and that groundwater levels/storage will be maintained at or above MO levels. ~~similar to groundwater elevation are the projection between recent levels and the MO. The IMs are the decline in storage based on the recent groundwater elevations and the IMs for groundwater elevation at each five-year interval.~~

4.2.2.2 Reasonable Margin of Safety for Operational Flexibility

As described above, groundwater storage MO are based on recent water levels and the MO for groundwater elevation. For the reasons stated in section 4.1.2.2, the MOs for groundwater storage provide a reasonable margin of safety. Groundwater elevations are projected to remain above MO levels.

4.2.2.3 Path to achieve and Maintain the Sustainability Goal

The Sustainability Goal for Reduction in Groundwater Storage was determined at the Subbasin level:

Maintain historic groundwater storage volumes in order to continue meeting the demand of beneficial uses and users of groundwater and to provide a 3-year drought buffer. Minimize reduction in groundwater storage during extended dry periods. Work with neighboring Subbasins to address reduction in groundwater storage caused by pumping outside of the Subbasin.

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Groundwater elevations and storage are currently above sustainable levels due to recent wet hydrologic conditions that resulted in an increase in groundwater levels and storage above 2015 levels. Under the planned groundwater management and projected groundwater conditions, it is expected that sustainable conditions will be reached over the next 20 years. For the Upper Aquifer, water budget results discussed in section 3.3.6 show that for both the historic conditions and projected baseline conditions change in storage was generally near zero. Under the projected climate change conditions, the annual change in storage was negative but subsurface outflows were double subsurface inflows. With surrounding Subbasins moving towards sustainability, subsurface outflows will decrease resulting in less decline in storage. For the Lower Aquifer, water budget results for historic, current and the projected show decline in storage exceeding the MO. FCMA will monitoring Lower Aquifer conditions and coordinate with adjacent GSAs to help achieve sustainable conditions.

Table 4-2: Measurable Objectives and Interim Milestones for Reduction in Groundwater Storage

Aquifer	Interim Milestone 5 Years ~~(AF)~~	Interim Milestone 10 Years ~~(AF)~~	Interim Milestone 15 Years ~~(AF)~~	Measurable Objective (AF)
Upper	Maintain groundwater levels in accordance with the MOs. Identify reductions in groundwater storage caused by pumping outside the Subbasin.~~-12,000 -1,100~~	Maintain groundwater levels in accordance with MOs. Reduction in groundwater storage is cause by pumping outside the Subbasin, seek remedies in coordination with DWR and neighboring GSAs~~-23,000 -2,200~~	Maintain groundwater levels in accordance with MOs. Reduction in groundwater storage is cause by pumping outside the Subbasin, seek remedies in coordination with DWR and neighboring GSAs ~~-35,000 -3,300~~	0
Lower				0

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4.2.3 Measurable Objectives for Subsidence

4.2.3.1 Description of Measurable Objective

The MO and IMs values for total inelastic land subsidence (Upper and Lower Aquifer Compaction) ~~subsidence and compaction~~ were developed in a coordinated manner ~~are~~ based historic observations and to prevent undesirable results. Inelastic subsidence for the Upper Aquifer were based on the rate observed during historic conditions prior to the most recent drought for the Fordel extensometer ~~and P304~~ (**Figure 4-2**). The primary focus of management for subsidence in the FCMA area will be on Upper Aquifer compaction. FCMA does not contain any know wells that extract groundwater from the Lower Aquifer and is not responsible for Lower Aquifer compaction. As described in section 3.2.7 , Upper Aquifer compaction is only a small fraction of total land subsidence (Figure 3-35). IM were set as the same rate as the MO for Upper Aquifer compaction. For the total inelastic land Subsidence, IMs were set as the allowable amounts for each 5-year interval for SGMA implementation. The MO and IMs for FCMA can be seen in **Table 4-3**. The MOs for subsidence are based on inelastic subsidence.

4.2.3.2 Reasonable Margin of Safety for Operational Flexibility

The MOs for subsidence allows for a reasonable margin of safety as the MO value is a rate based on historic and current conditions. During this time, there were generally average groundwater conditions with wet and dry periods. Using a value consistent with this time period allows for a rate of subsidence as a result of groundwater extraction that will be consistent with the sustainability goal of the Subbasin and will not impact the operations of any infrastructure to a significant and unreasonable degree.

4.2.3.3 Path to achieve and Maintain the Sustainability Goal

The Sustainability Goal for inelastic land subsidence determined at the Subbasin level is as follows:

Minimize inelastic land subsidence by ramping down allowable subsidence caused by groundwater extraction in the Subbasin, with no additional subsidence after 2040. Working with neighboring Subbasin to address inelastic land subsidence caused by groundwater extraction outside the Subbasin.

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Managing groundwater elevations to MO levels will result in the stabilizing of groundwater conditions. Inelastic subsidence is the result of continual groundwater decline and long-term stable groundwater elevations should prevent additional inelastic subsidence.

Table 4-3: Measurable Objectives and Interim Milestones for Subsidence

~~Management Area~~	Monitoring Site	Interim Milestone 5 Years (ft/year)	Interim Milestone 10 Years (ft/year)	Interim Milestone 15 Years (ft/year)	Measurable Objective (ft/year)

~~A & B~~	Fordel	No More than 1 foot of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the first 5-year period of SGMA implementation.~~0.002 0.036~~	No more than 0.5 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the second 5-year period of SGMA implementation, for a cumulative total of 1.5 feet in the first 10 years. ~~0.002 0.036~~	No more than 0.25 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the third 5-year period of SGMA implementation, for a cumulative total of 1.75 feet in the first 15 years. ~~0.002 0.036~~	0.00~~2~~5
~~A & B~~	P304				~~0.036~~0

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4.2.4 Measurable Objectives for Degraded Water Quality.

4.2.4.1 Description of Measurable Objective

Degraded Water Quality SMC were developed in a coordinated manner with the goal of protecting water quality in unimpaired areas. Unimpaired areas are defined as the locations with TDS concentrations less than 1,000 mg/L as of Water Year 2016. ~~There are two primary groundwater quality concerns in FCMA which include the migration of the Steffens plume affecting MAA and FWD GSA and the natural occurrence of high TDS groundwater in some areas of MAB. The SMC for groundwater quality is based on the historic levels of TDS.~~ The wells selected to serve as monitoring sites, provide coverage over the GSP area and also delineate the areas of concern for water quality (**Figure 4-3**). Wells on this map are identified as either "impaired" or "unimpaired". The MO of less than 1,000 mg/L TDS will apply on to unimpaired wells. All monitoring sites are screened in the Upper Aquifer. Monitoring sites in MAA include wells in the vicinity of the Steffens plume (KDSA, 2018). Monitoring sites in MAB are located west of the Fresno Slough to monitor variations in groundwater quality and potential impacts that may arise from future human activities in MAB. IMs are narratives developed at Subbasin level that outline how SMCs will be refined as more data are collected and that groundwater quality will be at or below MO TDS concentrations. ~~MOs were developed in MAA based on the background concentration listed in the Spreckels CAO (Regional Board, 2018). These values were developed in a comment letter for the Steffen's Ponds Closure Plan (LSCE, 2009). MOs for MAB were established based on an analysis of projected trends in TDS concentrations from a review of historical data through the year 2040. This trend was augmented by adding in the maximum annual increase for salinity in the Water Quality Control Plan for the Tulare Lake Basin (Regional Board, 2015) to account for influences on groundwater quality from agricultural activities. For wells with MOs set as a fixed TDS concentration, IMs were set based on a linear interpretation between the MO and recent TDS concentrations. For wells~~

~~with MOs set at as a rate of degradation, IMs were set at the same rate as the MOs.~~ MOs and IMs for each well are displayed in **Table 4-4.**

4.2.4.2 Reasonable Margin of Safety for Operational Flexibility

MO values allow for a reasonable margin of safety as values as these values only apply to areas that are unimpaired. ~~are based on existing studies and groundwater quality plans (Regional Board, 2015) (LSCE, 2009). MO values for MAA are subject to change pending final the "Site Assessment" and "Cleanup Plan" of the CAO~~.

4.2.4.3 Path to achieve and Maintain the Sustainability Goal

The sustainability goal for Degraded Water Quality was determined at the Subbasin level:

> *Minimize further impairment of water supplies resulting from groundwater management activities that cause the migration or contaminant plumes or the increased rate of movement or concentrations of constituents of concern. Coordinate with and support compliance with existing regulatory groundwater quality orders and objectives for drinking water, agricultural irrigation, and managed wetlands. Work with Neighboring Subbasin to address existing or potential impairment of groundwater quality in the Subbasin caused by groundwater management activities outside the Subbasin.*

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In MAA, a path to sustainability will be achieved by continued monitoring and remediation action of the Steffens plume. Remediation actions are still pending the final "Cleanup Plan" of the CAO. Existing recharge projects have and will continue to improve water quality in the Upper Aquifer in the MAA.

In MAB, a path to sustainability will be achieved by continued monitoring of the groundwater quality trends and utilizing wells of higher water quality. Management action will likely include targeted pumping reduction to limit the use of groundwater with TDS concentrations that impact beneficial uses. Existing plans for recharge west of the Fresno Slough will improve water quality in the Upper Aquifer.

~~4.2.4.4 Management Area Status~~

~~MAA and MAB are designated as separate management areas. The rationale for setting these values for each management area was based on the existing groundwater quality studies and regulatory guidelines. MAA will be able to operate under different MOs and not cause undesirable results outside the management area as steps are already being taken to address the Steffens plume. MAB will operate under different MOs because of increasing salinity levels due to naturally occurring conditions. To prevent undesirable results outside the MAB, the rate of degradation will be closely monitored and managed to be consistent with Regional Board standards.~~

Table 4-4: Measurable Objectives and Interim Milestones for Degraded Water Quality

Management Area	Well Name	Interim Milestone 5 Years (TDS)	Interim Milestone 10 Years (TDS)	Interim Milestone 15 Years (TDS)	Measurable Objective (TDS)
A	SPREC-MW-1	Maintain salinity consistent with measurable objectives. Participate in , provide data for, and track and report on compliance with orders and objectives adopted by the SWRCB and CVRWQB and similar regulatory agencies. Develop correlations between groundwater quality and groundwater levels in order to establish methodology for use of groundwater levels as proxy for groundwater quality 2,692mg/L 616 mg/L 2,150 mg/L 920 mg/L 818mg/L 1,988 mg/L 1,775 mg/L 48 mg/L/year 36 mg/L/year 24 mg/L/year	Maintain water quality consistent with measurable objectives. Continue monitoring and publishing groundwater quality data, and tracking and reporting on compliance with regulatory orders and objectives. Where water quality impairments are caused by activities outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Utilizing the methodology developed by the Year 5 Interim Milestone, develop Minimum thresholds and measurable objectives for groundwater quality that utilize groundwater elevations as a proxy for monitoring. 2,185mg/L 531 mg/L 1,680 mg/L 740 mg/L 696 mg/L	Maintain water quality consistent with measurable objectives. Continue monitoring and publishing groundwater quality data, and tracking and reporting on compliance with regulatory orders and objectives. Where water quality impairments are caused by activities outside the Subbasin, seek remedies in coordination with DWR and neighboring GSAS. 1,678mg/L 446 mg/L 1,210 mg/L 560 mg/L 575 mg/L 965 mg/L 1,325 mg/L 48 mg/L/year	1,170 mg/L Impaired
A	SPRECK-MW-32				<1,000362 mg/L
A	SPRECK-MW-20				740 mg/L Impaired
A	SPRECK-PW-12				380 mg/L Impaired
A	SPRECK-PW-10				Impaired453 mg/L
A	SPRECK-PW-9				Impaired453 mg/L
A	SPRECK-MW-11				1 Impaired,100 mg/L
B	TLF-6D				Impaired48 mg/L/year
B	TLF-12D				Impaired36 mg/L/year
B	SC-4B				Impaired24 mg/L/year

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			1,476 mg/L 1,550 mg/L 48 mg/L/year 36 mg/L/year 24 mg/L/year	36 mg/L/year 24 mg/L/year	
B	FS-5	12 mg/L/year	12 mg/L/year	12 mg/L/year	12 mg/L/year
A	MF-P-1	56 mg/L/year	56 mg/L/year	56 mg/L/year	56 mg/L/yearImpaired
B	KRCDA06	920 mg/L	740 mg/L	560 mg/L	380 mg/L

4.2.5 Measurable Objectives for Interconnected Surface Waters.

4.2.5.1 Description of Measurable Objective

Interconnected Surface Waters have been identified as a data gap in the Subbasin. As an interim MO, the use of Chronic Lowering of Groundwater levels will be used as a proxy for interconnected Surface waters. In the original GSP submitted in January 2020, the MO for Interconnected Surface Waters interconnected surface waters was established based on the average stage conditions in the Mendota Pool. To develop SMCs for Interconnected Surface Waters that is consistent with the rest of the Subbasin, FCMA has modified SMCs for this SI indicator from the original GSP submittal. Utilizing the groundwater monitoring network in the Subbasin and the monitoring network for the San Joaquin River Restoration Program, data will be collected and analyzed to establish a monitoring network specifically for interconnected Surface Waters and establish MOs in terms of a rate or volume of losses or gains to the San Joaquin River and the Mendota Pool. not including times when the pool was drained for maintenance (**Figure 4-4**). IMs were set at the same level as MO representing the historic average. MO and IMs are presented in **Table 4-5.** Water levels in the Fresno Slough and Mendota Pool are managed by the SJREC and USBR in coordination with SLDMWA. Historically, values have been very consistent but have shown a gradual decline. MO and IMs values were selected to maintain historic conditions.

4.2.5.2 Reasonable Margin of Safety for Operational Flexibility

Consistent with the MOs for Chronic Lowering of Groundwater levels, the established MOs for Interconnected Surface Waters allows for a reasonable margin of safety as these water levels are based on 2015 water levels which are near historic lows. Recent (post 2016) and historic water levels have generally remained above these levels. Based on the information described in section 3.2.1, dry periods have resulted in decline of groundwater elevation followed by recovery during wet and normal years.

Values were set based on the historic average of stage in the Fresno Slough to allow for continued use of pump intakes without alteration. Continued decline of levels in the Fresno Slough could affect those that extract surface water from the slough. FCMA will work with local stakeholders and adjacent GSAs to monitoring conditions of the slough and to current operations are not significantly interrupted by declining water levels.

4.2.5.3 Path to achieve and Maintain the Sustainability

~~Stage values are currently at a sustainable level as defined by the measurable objective. FCMA will monitor stage levels in the Fresno Slough but will achieve sustainability by managing groundwater levels to sustainable levels.~~

The sustainability goal for Interconnected Surface Waters was determined at the Subbasin level:

Maintain interconnected surface comparable to existing conditions (historic low conditions as of Water Year 2016) in order to prevent a trend of increasing interconnected surface water losses from the San Joaquin River. Work with neighboring Subbasins to address increased interconnected surface water losses caused by pumping outside of the Subbasin.

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At the local level, historic trends and planned groundwater extraction and management actions provide a reasonable path to maintain the sustainability goal with stable groundwater elevation. Recent water levels remain above the MO. Therefore, since recent groundwater levels are higher than the MO set to recent hydrological conditions, a recovery of groundwater elevation is not needed to reach the sustainability goal. The IMs served to maintain the existing sustainable conditions. The sustainability goal for groundwater elevation is to prevent a trend of declining water levels. Planned management actions in conjunction with coordination of SMC with adjacent GSAs will ensure the MO for groundwater elevation are met.

~~4.2.5.4 Management Area Status~~

~~FCMA has been designated as a management area for interconnected surface waters because the flow of surface water is under the control of entities outside of FCMA. Standards were set in a manner consisted with other sustainability indicators based on historic conditions, but FCMA does not intend to implement management actions in the event of undesirable results for interconnected surface waters. This area has been designated as a management area because it has no control over water levels in the Fresno Slough. FCMA will prevent undesirable results to surrounding areas by managing groundwater elevations to sustainable levels. If additional monitoring sites can be installed in the existing data gaps in the MWA, shallow groundwater levels in the area will be used to further our understanding of interconnected surface waters in this area.~~

Table 4-5: Measurable Objectives and Interim Milestones for Interconnected Surface Waters

~~Management Area~~	Interim Milestone 5 Years ~~(ft)~~	Interim Milestone 10 Years ~~(ft)~~	Interim Milestone 15 Years ~~(ft)~~	Measurable Objective (ft)
~~A & B~~	Fill data gaps, establish, and manage groundwater use to avoid the rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and may lead to undesirable results. The Subbasin ~~14~~	Gather and analyze data from the Subbasin's ~~established~~ monitoring network sites. Also gather and analyze available data in cooperation with neighboring subbasin, USBR SJRRP, USGS, and CDEC, to estimate the influence on gains and losses in the San Joaquin River. Establish minimum thresholds and MO as a rate or volume of surface water depleitons that have adverse impacts on beneficial uses and users that may lead to undesirable results. ~~14~~	Monitor and maintain interconnected surface waters in accordance with revised minimum thresholds and measurable objectives. Where increased interconnected surface water losses are caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.~~14~~	See Chronic Lowering of Water Level MO~~14~~

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4.3 Minimum Thresholds

MTs refer to a numeric value for each sustainability indicator used to define undesirable results. A GSP must establish MTs that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site. The numeric value used to define the MT shall represent a point in the Subbasin that, if exceeded may cause undesirable results. A GSA may establish a representative MT, such as groundwater elevation (GWE) to serve as the value for multiple sustainability indicators, if the GSA can demonstrate the representative value is a reasonable proxy for multiple individual MTs, as supported by adequate evidence. MTs are not required for sustainability indicators that are not present and not likely to occur in the plan area.

The description of MTs shall include the following (§354.28):

1. The information and criteria relied upon to establish and justify the MT for each sustainability indicator. The justification for the MT shall be supported by information provided in the Basin Setting, and other data or models as appropriate and qualified by uncertainty in the understanding of basin setting.
2. The relationship between the MTs for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each MT will avoid undesirable results from each sustainability indicator.
3. How MT have been selected to avoid causing undesirable results in adjacent basins or affecting adjacent basins ability to achieve sustainability goals.
4. How MT may affect the interests of beneficial users and users of groundwater or land uses and property interests.
5. How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.
6. How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements.

4.3.1 Minimum Thresholds for Chronic Lowering of Groundwater Levels

4.3.1.1 Description of Minimum Threshold

MTs for Cehronic Llowering of Ggroundwater Llevels shall be the groundwater level indicating a depletion of supply at a given location that may lead to undesirable results. These undesirable results are based on the ~~local~~ Subbasin wide definition of significant and unreasonable for Chronic Lowering of Ground-water Llevels. Utilizing information from section 3.2, MT values were determined through coordination with other GSAs in the Subbasin and by evaluating historic water levels trends.~~, trends of groundwater elevation, and the potential effects on other sustainability indicators.~~ MTs for individual monitoring sites were established as a water level lower than the historic seasonal low measurement using data prior to the end of WY 2016.~~To establish MTs, the annual maximum groundwater elevation for each year was determined for the historic period of record. This was used to determine the largest continual decline in groundwater elevation throughout the GSP area. The largest decline in groundwater elevations occurred between the period of 2011 through 2016. The magnitude of decline observed during this period was applied to the MO to establish a MT. The likelihood of reaching MT values were evaluated in the projected model results.~~ The MT established for each of the monitoring sites are in **Table 4-6**. Historic ~~and projected~~ groundwater elevation relative to established MT can be observed in **Figures 4-~~45~~** through **4-~~89~~.**

4.3.1.2 Quantitative Measurements

Chronic Llowering of Ggroundwater ~~elevation~~Levels will be quantitatively ~~be~~ measured by taking depth to ground-water measurements from a surveyed reference point. These measurements will be collected to capture seasonal highs and lows. MTs are based on seasonal low~~high~~ measurements. Further discussion on the collection of groundwater elevation data are presented in section 4.6.

Table 4-6: Management Area A&B Groundwater Level Minimum Thresholds

~~Management Area~~	Well Name	Aquifer	Minimum Threshold (ft NAVD 88)
~~B~~	7C1	Upper	~~103~~109.4
~~A~~	MW-7	Upper	~~76~~98.2
~~A & B~~	31J6	Lower	~~-98~~59.0
~~B~~	~~KRCDA06~~	~~Upper~~	~~106~~
~~B~~	TL-HS-3	Upper	~~102~~48.6

4.3.1.3 Existing local, State, or Federal Standards

No standards currently exist for groundwater levels~~elevation~~.

4.3.1.4 Avoidance of Undesirable Results in Adjacent Subbasins

The established MTs were developed based on the observation of historic conditions. The criteria used for the development of water level MTs were consistent with other sustainability indicators. During the development of MT values, FCMA met with adjacent GSAs and subbasins to ensure values did not significantly differ.

4.3.1.5 Affects to the beneficial uses and users of groundwater

For agricultural beneficial uses of groundwater, water levels exceeding the established MT for groundwater levels~~elevation~~ could have economic implication. When MT values are exceeded, the cost of for pumping groundwater will increase due to higher lifts and energy costs. The additional costs could result in reductions of irrigated land.

For the small number of domestic beneficial users of groundwater within FCMA, MTs for groundwater levels~~elevation~~ were evaluated to ensure known domestic wells can continue to operate. Only one domestic well in FCMA has been confirmed by outreach to landowners. In review of well completion reports, six potential domestic wells were identified all of which are screened in the Upper Aquifer. Based on the construction information of these wells, MT for groundwater levels~~elevations~~ likely do not affect the beneficial uses of groundwater **(Table 4-7)**. The MT for TL-HS-3 is below the screen interval for one of the domestic wells based on the well completion report (WCR1977-002771) for that domestic well. However, TL-3 is~~s but is~~ located ~~on the west side of the Pool away~~approximately ~~XX~~3 miles from the domestic well and the influence of pumping that would create an exceedance of the MT will likely not extend to the domestic well. Nonetheless, FCMA will conduct an evaluation of the effects of any MT exceedance on domestic wells in the vicinity of the exceedance and take measures to ensure the ability of the domestic beneficial users to beneficially use groundwater. ~~a~~The MT at TL-HS-3 is not expected to

impact the beneficial use of groundwater from other domestic wells in FCMA~~ll of the potential domestic wells~~ (Figure 3-13). ~~All MT values for groundwater elevation are well above the perforation intervals for identified domestic wells. The seasonal variation in groundwater elevation was also considered which is described in section 3.2.1. Seasonal variations of groundwater elevations are displayed in **Figures 3-15,16,19, and 20**.~~ The MT for all other monitoring sites are above the screen intervals for identified well completion reports.

Table 4-7: Identified Well Completion reports in Fresno County Management Areas A&B

WCR Number	Legacy No	Date Completed	Aquifer	Top Perforation (ft NAVD 88)	Bottom Perforation (ft NAVD 88)
WCR1977-002771	21618	1977-03-11	Upper	83	63
WCR0206546	58475	1960-04-28	Upper	67	43
WCR0126503	510136	1997-08-15	Upper	3	-37
WCR0132197		2006-05-17	Upper	61	41
WCR1988-012060	165400	1988-12-15	Upper	68	8
WCR0234107	119424	1966-06-01	Upper	-49	-73

The impact of MT's for groundwater levels~~elevation~~ on the environmental beneficial users of groundwater (i.e. GDEs) are not well understood but could potentially have negative affects if MT levels are sustained or exceeded for an extended period of time. As described in the section 3.2.7, GDEs were identified based on groundwater levels~~elevations~~ in the year 2015. For most of the FCMA, there was either no groundwater level~~elevation~~ data present where GDEs are present, primarily the MWA, or groundwater elevations were at a depth that exceeded the 30 ft threshold which was used to identify GDEs. For areas in the MWA where historic groundwater levels~~elevations~~ are not present, it was assumed that these areas were GDEs based on the annual surface water deliveries for refuge purposes. For areas with historic groundwater level~~elevation~~ data, most of the mapped vegetation was assumed to be GDEs based on their location along the Fresno Slough. In these areas, there is a continual presence of surface water from flow in the Fresno Slough. Based on the current availability of data, it is assumed that there is not a zone of unsaturation between the land surface and the water table. If water levels are ever to drop to MT levels, which is not projected to occur, further analysis of the vertical gradient in the Shallow Zone of the Upper Aquifer will be necessary to better understand the potential impacts to GDEs.

4.3.2 Minimum Thresholds for Reduction in Groundwater Storage

4.3.2.1 Description of Minimum Thresholds

The MT for R~~r~~eduction in~~of~~ G~~g~~roundwater S~~s~~torage is the total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Reduction in groundwater storage is not a parameter that can be directly measured; rather, change in storage will be regularly estimated based on either the Subbasin water budget or monitoring results derived from

analysis of groundwater elevations and aquifer properties (monitoring protocols for data collection and monitoring) or land subsidence.

The MTs set for Chronic Lower of Groundwater Levels will serve as a proxy for the MT for Reduction in Groundwater Storage for the Upper Aquifer. The actual volume of water that this represents will vary depending on seasonal high-water levels. With increasing groundwater levels, the available volume of water will increase. The MT for Subsidence will serve as a proxy for the MT for Reduction in Groundwater Storage for the Lower Aquifer. There is minimal coverage for Lower Aquifer groundwater level monitoring across the Subbasin. A volume of water that will serve as the MT for the Lower Aquifer was determined at the Subbasin level. ~~Annual changes in storage will be estimated based on changes between seasonal high contours. For the initial estimation of MT values for change in storage, the most recent water level elevations were compared to the MT for groundwater elevation. The average change in groundwater elevation from recent levels to the MT level for all monitoring sites was used to calculate a change in storage over the entire GSP area.~~ ~~**Table**~~ **Table 4-8** show the estimated volumes for Reduction in Groundwater Storage based on the SMC's for Chronic Lowering of Groundwater Levels for the Upper Aquifer and Subsidence for the Lower Aquifer. ~~MT values for each Principal Aquifer~~. To provide an approximate volume for Reduction in Groundwater Storage, the Upper Aquifer value is based on the average change between MO and MT values multiplied by the GSP area and a storage coefficient representative of Upper Aquifer conditions. The Subbasin wide MT for Lower Aquifer storage was estimated at 1.1 million AF based on an additional two feet of allowable subsidence. A GSP specific volume of water was only determined for the Upper Aquifer as FCMA does not pump from the Lower Aquifer thus does not contribute to decline in Lower Aquifer storage. ~~The Upper Aquifer estimate is likely more accurate than the Lower Aquifer estimate due to well coverage and available data.~~ These~~is~~ value are~~is~~ subject to change as more data are collected and the understanding of the aquifer systems continue to improve, especially for the Lower Aquifer which is a large data gap with FCMA and across the Subbasin. ~~based on current water levels. With increasing GWE the MT for change in storage will increase.~~

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4.3.2.2 Quantitative Measurements

Reduction in G~~g~~roundwater S~~s~~torage for the Upper Aquifer will be quantitatively measured by taking depth to groundwater measurements from a survey reference point at RMS for Chronic Lowering of Groundwater Levels. An exceedance in Chronic Lower of Groundwater Level MTs will correspond with and exceedance for Upper Aquifer Reduction in Groundwater Storage. ~~creating contour maps for seasonal high groundwater elevations and taking the difference between the current and preceding water year~~. ~~Contour maps will be developed with groundwater elevation measurements collected at wells throughout the plan area.~~ Reduction in Groundwater Storage for the Lower Aquifer will be quantitatively measured by utilizing the available subsidence data from UNAVCO station P304. Exceedances of Subsidence MT (Section 4.3.3) will correspond with an exceedance for Lower Aquifer Reduction in Groundwater Storage. ~~-~~Until there is a greater spatial distribution of Lower Aquifer

monitoring wells, Lower Aquifer storage change will be monitored by subsidence. ~~calculated based on changes in the hydrograph of the one monitoring site (USGS 31J6).~~

Table 4-8: Reduction in Groundwater Storage ~~Minimum Threshold~~Volume Estimates

Aquifer	Difference Between ~~MO and~~ MT ~~and Current GWE~~ (ft)	GSP Area (Acres)	Specific Yield (Upper)~~/ Storativity (Lower – Inelastic + Elastic)~~	Total Storage Change (AF)
Upper	~~-23~~ 28	22353	0.21	~~-110~~120,000
Lower ~~(Subbasin)~~	N/A~~-98~~	~~22535~~N/A	~~0.0041 + 0.058~~N/A	~~-38,000~~ 1,100,000

4.3.2.3 Existing local, State, or Federal Standards

There are currently no standards for reduction in groundwater storage.

4.3.2.4 Avoidance of Undesirable Results in Adjacent Subbasins

Groundwater storage MTs were developed based on the groundwater elevation MTs for the Upper Aquifer, and Subsidence MTs for the Lower ~~,~~Aquifer. The established MT values for groundwater storage will avoid Undesirable Results for the same reasons described in ~~-~~section 4.3.1.4 and 4.3.3.4.

4.3.2.5 Affects to the beneficial uses and users of groundwater

The affects to the beneficial uses and users of groundwater due to the MT for groundwater storage will be the same reasons described in section 4.3.1.5.

4.3.3 Minimum Thresholds for Subsidence

4.3.3.1 Description of Minimum Thresholds

MTs for land subsidence were based on conditions observed during historic groundwater conditions. The MT was established as the maximum rate of subsidence or compaction that occurred during historic groundwater conditions (**Table 4-9**). These values coincided with the greatest decline in groundwater elevation which occurred between the years of 2011 and 2016. Historic subsidence values in relation to established SMC are displayed in **Figures 4-~~8~~10**. The Subbasin wide MT for subsidence was set at a cumulative value of 2 feet by 2040. IM for subsidence allow for less subsidence in each 5-year period of SGMA, but the MT for FCMA for total subsidence is consistent with the rest of the Subbasin as 0.1 ft/year is equal to 2 feet by 2020.

4.3.3.2 Quantitative Measurements

FCMA will utilize data collected by the USGS for the Fordel monitoring site and data collected by UNAVCO for P304. Upper Aquifer compaction measurements will be made with an extensometer and total land subsidence will be measured with continuous GSP monitoring.

Table 4-9: Subsidence/Compaction Minimum Thresholds

Management Area	Monitoring Site	Monitoring Type	Minimum Threshold (ft/year)
A & B	Fordel	Upper Aquifer Compaction	0.011
A & B	P304	Land Subsidence	0.1 (2 feet max)
Subbasin	All Sites	Land Subsidence	2 feet (Cumulative to 2040)

4.3.3.3 Existing local, State, or Federal Standards

There are currently no standards for subsidence.

4.3.3.4 Avoidance of Undesirable Results in Adjacent Subbasins

The MT values for subsidence in the Upper Aquifer will prevent undesirable results for adjacent subbasins as its rates is based on conditions observed during the last dry period, with the maximum rate of subsidence occurring throughout 2015-2016. This corresponds with the conditions that were used to establish groundwater elevation MTs, for which FCMA compared values with adjacent subbasins. If water level MTs are not exceeded, there should be no additional subsidence. Water Level MTs are based on historic seasonal lows which represents critical head or the point at which land subsidence is triggered by lowering water levels. By managing groundwater to prevent conditions consistent with the historical average, undesirable results will be avoided. As previous described in the section ~~3.2.5 ,~~3.2.5, most land subsidence is the result of Lower Aquifer compaction which is not cause by FCMA.

4.3.3.5 Affects to the Beneficial Uses and Users of Groundwater

Subsidence will not likely impact the agricultural beneficial uses and users of groundwater in FCMA. Rates of subsidence in excess of the established MT for total land subsidence at P304 could result in issues with conveyance of water supplies outside of the GSA.

Subsidence will not likely impact the domestic beneficial users and uses of groundwater in FCMA. The use of domestic water does not rely on a conveyance system like certain agricultural users.

For the environmental beneficial users and uses of groundwater, historic subsidence rates have disrupted operation in the MWA. Water from the Mendota Pool is delivered to the MWA for the habitat preservation and recreational use. Many of the fields in the MWA have been flooded by gravity in order to be useable by waterfowl and shorebirds. Subsidence near the Mendota Pool has restricted the flooding of fields in the MWA leading to emergent vegetation growth and an increased mosquito population. This has led to an increase in maintenance costs through additional installation of low lift pumps and mosquito abatement (S. Brueggemann, personal communication, 2018).

4.3.4 Minimum Thresholds for Groundwater Quality

4.3.4.1 Description of Minimum Thresholds

The criteria~~MTs~~ for degraded groundwater quality MTs were determined at the Subbasin level. The MT for water quality at all unimpaired sites was set at a TDS concentration of 1000 mg/L. With the presence of the Western Saline Front and the Spreckels Plume in FCMA, there is one site that is unimpaired (TDS <1,000 mg/L) and eight sites that are impaired (TDS 1,000 mg/L). MTs will not be set at impaired sites but will continue to be monitored to determine if water quality is continuing to degrade. ~~were set by two different methods depending on the cause of degraded groundwater. Wells along the west side of the Fresno Sough affected by naturally occurring saline water had values set based on the maximum annual change in TDS concentration, and wells in areas where groundwater quality is affected by the Steffens Plume were set at a fixed concentration of TDS. For wells on the west side of the Fresno Slough, MT exceedances will occur if TDS concentrations increase by the historic maximum annual change while accounting for the projected increased. The one exception for wells in MAB was KRCDA06 which was assigned an absolute TDS concentration in a method consistent with the wells in MAA. Wells located in MAA were assigned MT values based on the maximum observed TDS concentration. The one exception for MAA was the well MF-P-1 which is the located near the Fresno Slough MT values for degraded water quality can be seen in **Table 4-10**.~~ Historic groundwater quality relative to established SMC are displayed in **Figures 4-11** through **4-19~~22~~**.

4.3.4.2 Quantitative Measurement

Water quality MT's will be measured by collecting water quality samples to be sampled at an accredited water quality testing facility.

Table 4-10: Degraded Water Quality Minimum Thresholds

Management Area	Well Name	Minimum Threshold (TDS)
A	SPRECK-MW-1	~~3,200 mg/L~~N/A
A	SPRECK-MW-32	1,0~~7~~00 mg/L
A	SPRECK-MW-20	N/A~~2,620 mg/L~~
~~**A**~~	~~SPRECK-PW-12~~	~~1,200 mg/L~~
~~**A**~~	~~SPRECK-PW-10~~	~~940 mg/L~~
A	SPRECK-PW-9	N/A~~2,500 mg/L~~
A	SPRECK-MW-11	N/A~~1,800 mg/L~~
~~**B**~~	~~KRCDA06[1]~~	~~1,200 mg/L~~
B	TLF-6D	N/A~~290 mg/L/year~~

B	TLF-12D	N/A~~55 mg/L/year~~
B	SC-4B	N/A~~430 mg/L/year~~
~~**B**~~	~~FS-5~~	~~135 mg/L/year~~
B	MF-P-1	N/A~~420 mg/L/year~~

~~1. TDS data were available and MT values were based on values from closest well in the same zone of the Upper Aquifer.~~

4.3.4.3 Existing local, State, or Federal standards

EPA secondary standards for drinking water for TDS is 500 mg/L (EPA, 2017). These are non-enforceable guidelines and do not apply to FCMA as it is a Management Area for groundwater quality. ~~The finalized "Cleanup Plan" of the CAO will determine water quality standards in MAA are still pending and will need to be approved by the Regional Board.~~

~~State standards include the allowed rate of degradation based on the Water Quality control Plan for the Tulare Lake Basin Second Edition (Regional Board, 2015).~~

4.3.4.4 Affect to beneficial uses and users of groundwater

Poor water quality could impact the irrigation of crops. The salt tolerance can vary based upon crop type. Maas (1993) reports a range of salinity tolerance from approximately 800 to 7700 mg/L TDS for different crop types include in the current year land use in FCMA. Further degradation of groundwater quality could limit the types of crops that could be grown in FCMA or will require additional surface water supplies to dilute high TDS groundwater.

Limited groundwater quality data is available for the areas where domestic wells have been identified. All identified domestic wells are outside of the areas impacted by naturally occurring saline water and the Steffens Plume. FCMA will continue to work with landowner to obtain information on water quality for areas with domestic wells including whether well water is used for drinking water and if domestic users have a filtration system.

The impact high salinity in groundwater could have on freshwater aquatic plants and animals is not well understood in the San Joaquin Valley (USBR, 2018). GDEs in the FCMA rely on a combination of groundwater and surface water, and MT for degraded water quality are based on historic groundwater conditions. For MAA, MT values for water quality are based on historic highs and should not cause any additional undesirable results. For MAB, limited water quality is available in the MWA which will require future data collection and analysis. In MAB north of Whitesbridge Road, Shallow Zone wells such as ~~FS-5 and~~ SC-4B along the Fresno Slough have shown overall better water quality and a slow rate of degradation than Deep Zone wells such as TLF-6D and TLF-12D (Figure 4-18 through 4-22). Shallow Zone wells better characterize conditions that affect GDEs. Historically, vegetation along the Fresno Slough and in the MWA have persistent and if negative impacts to are occur to the GDEs, further analysis of

groundwater quality in the area of GDEs will be conducted. In addition, past environmental impact statements regarding activities in the Mendota Pool have established that groundwater discharged into the Mendota Pool must be below 1,600 mg/L in TDS concentration in order to protect the beneficial uses of groundwater in the MWA (USBR, 2018).

4.3.4.5 Avoidance of Undesirable Results to Adjacent Subbasins

In areas impacted by the naturally occurring saline water and the Steffens Plume, undesirable results are already occurring. To prevent the continuing migration of the Western Saline Front and the Steffens Plume, SMCs are focused on unimpaired areas where TDS is less than 1,000 mg/L. The movement of these impaired areas are affected by naturally occurring water level gradients and can be enhanced by localize cones of depression. To protect areas that are currently unimpaired and to prevent undesirable results outside the Subbasin, IMs for Degraded Water Quality include the development of water levels that are intended to prevent increasing horizontal water level gradients that will enhance the migration of degraded water. ~~For this reason, FCMA has been designated as management area for degraded groundwater quality. For wells outside of the areas affected by saline water, further undesirable results will be prevented by development of future targeted pumping reductions from wells with increasing TDS values. For wells outside of the areas affected by the Steffens Plume, implementation of the CAO will prevent further undesirable results.~~

~~4.3.4.6 Management Area Status~~

~~MAA has been established as a Management Area due to the presence of the Water Bank and the Steffens plume groundwater quality issues where TDS concentrations are above background levels.~~

~~MAA has values set based on values higher historic high TDS measurements. TDS concentrations slightly higher than (+100 mg/L) than historic high concentrations were selected for each monitoring site. Specific sites were selected to be included in the monitoring network due to their location surrounding the area of contamination. The rationale for setting these specific sites and TDS concentrations was to highlight the area of concern and to allow for continued operations while cleanup actions are still being developed. The eventual implementation of CAO's will prevent undesirable results from occurring in areas outside of the GSA.~~

~~MAB MT values have been set at the historic rate of increase in TDS concentration plus the maximum annual change in TDS concentration, with the exception of one site in east of the MWA. Increases in TDS are due to naturally occurring conditions and setting a MT at fixed level would limit operational flexibility over the GSP implementation period. MAB will operate under different MT and work to prevent the spread of undesirable results to areas outside to GSA. Undesirable results of high TDS groundwater are possible to areas outside of MAB due to the naturally occurring high saline conditions and the natural flow and gradient of groundwater in the region. By closely monitoring the rate of increase of TDS for wells affected by saline waters, FCMA will work with adjacent GSAs to prevent undesirable results outside the GSA.~~

4.3.5 Minimum Thresholds for Interconnected Surface Waters.

4.3.5.1 Description of Minimum Threshold

Interconnected Surface Waters have been identified as a data gap in the Subbasin. As an interim MT, the use of Chronic Lowering of Groundwater levels will be used as a proxy for interconnected Surface waters. In the original GSP submitted in January 2020, the MT for interconnected surface waters was determined from the average historic decline for stage in the Mendota Pool. To develop SMCs for ISW that is consistent with the rest of the Subbasin, FCMA has modified SMCs for this indicator from the original GSP submittal. Utilizing the groundwater monitoring network in the Subbasin and the monitoring network for the San Joaquin River Restoration Program, data will be collected and analyzed to establish a monitoring network specifically for interconnected Surface Waters and establish MTs in terms of a rate or volume of losses or gains to the San Joaquin River and the Mendota Pool ~~The MT for interconnected surface waters is based on the historic decline in stage values in the Mendota Pool and Fresno Slough. The historic average stage was set as the MO and the MT was determined from the average historic decline of 0.5 ft/year from the MO which corresponds with recent stage levels. MT values of Interconnected Surface Water are presented in (**Table 4-10**). Historically stage values in the Mendota Pool have been very consistent with a gradual decline. The historic stage data relative to established SMC are displayed in **Figure 4-23**.~~

4.3.5.2 Quantitative Measurement

Interconnected Surface waters will be quantitatively measured by taking depth to groundwater measurements from a surveyed reference point at ARMS for Chronic Lowering of Groundwater Levels.~~stage measurement in the Mendota Pool.~~

Table 4-11: Minimum Threshold of Interconnected Surface Waters.

Management Area	Well Name	Minimum Threshold ~~(ft)~~
A & B	~~Mendota Pool Staff Gage~~N/A	~~13~~See Water Level MTs

4.3.5.3 Exiting local, State, or Federal standards

No standards exist for Interconnected surface waters.

4.3.5.4 Avoidance of Undesirable Results in Adjacent Subbasins

The established MTs for water levels were developed based on the observation of historic conditions. The criteria used for the development of water level MTs were consistent with other sustainability indicators. During the development of MT values, FCMA met with adjacent GSAs and subbasins to ensure values did not significantly differ.

~~The MT for interconnected surface was established based on the historic decline of stage in the Mendota Pool. Values have remained generally consistent with a slight decline with no large variation based on climatic conditions. As previously stated, FCMA does not control water levels in the Mendota Pool and Fresno Slough and therefore is not directly responsible all conditions related to interconnected surface waters. FCMA will prevent undesirable results by managing groundwater elevations to sustainable levels. If water levels remain consistent with historic values along with sustainable groundwater elevations, undesirable results to interconnected surface waters will not extend downstream or impact adjacent subbasins.~~

4.3.5.5 Affects to the beneficial uses and users of groundwater

See section 4.3.1.5 for description on how water level MTs could impact the beneficial uses of groundwater.

~~The interaction of surface water and groundwater will not directly impact the agricultural beneficial users who extract groundwater well below this interface. But, the water levels in the Fresno Slough will impact the agricultural beneficial users of surface water if levels drop below pump in takes. If water levels drop below the historic average, agricultural beneficial users may have to adjust intakes to lower levels in the Fresno Slough (J. Dean, personal communication, 2019).~~

~~MT values for interconnected surface waters will not impact the domestic beneficial users of groundwater who only utilize groundwater below the surface water-groundwater interface.~~

~~MT values for interconnected surface waters could impact the environmental beneficial uses of groundwater if MT values remain for an extended period of time along with decline groundwater elevations. In addition to what is described in section 4.3.1.5, lower stage levels in the Fresno Slough~~

~~could contribute to the loss of available water for GDEs and could potentially have negative affect. MT values could harm GDEs if MT stage values coincide with MT values for groundwater elevation.~~

~~4.3.5.6 Management Area Status~~

~~The MT value for Interconnected Surface Waters was established based on the projected decline of stage levels based on historic data. These levels are not the result of natural conditions but management actions of the agencies that control water levels in the Mendota Pool. FCMA will not cause undesirable results for interconnected surface waters as they have no control over the management of surface water elevation.~~

4.3.6 Relationship Between Sustainability Indicator Minimum Thresholds.

The governing sustainability indicator is the chronic lowering of groundwater elevation. Lower groundwater levels will result in a reduction in storage for each the Upper and Lower Aquifers. Lower groundwater levels in the Upper Aquifer have a direct relationship to depletion of interconnected surface waters. The Upper Aquifer is unconfined and lower groundwater levels will increase the rate of depletion for losing reaches and potential disconnect groundwater from surface water bodies. Lower groundwater levels in both the Upper and Lower Aquifer have a direct relationship with land subsidence. Lower groundwater levels and reduction of storage may cause irreversible compaction of aquifer materials. Subsidence caused by lower groundwaters and reduction in storage is more prevalent in the Lower Aquifer where compaction values are greater than two orders of magnitude.

The one sustainability indicator that is not directly impacted or cause by the others is degraded water quality. Groundwater quality can be influenced by reduction of storage and lower groundwater elevation but is primarily controlled by other factors. Sources of degraded groundwater quality can be naturally occurring or result from human activities. In the area of Fresno County, the source of groundwater contamination in MAA is due to human activities and naturally occurring saline sediments in MAB. Lower groundwater levels outside of effected areas can cause groundwater contamination to expand.

4.4 Undesirable Results

According to GSP Regulations, the GSP's description of undesirable results is to include the following:

1. The cause of groundwater conditions occurring throughout the basin that would lead to or has led to the undesirable results based on information described in the basin setting, and other data or models as appropriate.
2. The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.
3. Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

Under SGMA, undesirable results occur when the effects caused by groundwater conditions occurring throughout the basin cause significant and unreasonable impacts to any of the six sustainability indicators. That is "significant and unreasonable occurrence of any of the six sustainability indicators constitutes an undesirable result". These sustainability indicators are:

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

4.4.1 Description of Significant and Unreasonable~~Undesirable Results~~

A description of undesirable results for each of the sustainability indicators are summarized below.

4.4.1.1 Groundwater Elevation

Significant and unreasonable impacts to beneficial uses and users of groundwater are substantially increase costs associated with higher total pumping lift, lowering pumps, drilling deeper wells, or otherwise modifying wells to access groundwater, securing alternative water sources or required mitigation of groundwater dependent ecosystems. Significant and unreasonable is quantitatively defined as exceeding the MT at more than 50% of representative monitoring sites by aquifer in a GSP area. ~~Undesirable results occur when more than 25% of wells in the Upper Aquifer exceed the established MT value for two consecutive years. There is an even distribution of groundwater elevation monitoring sites, the exceedance of MT at one location could be reflective of localized conditions. Multiple exceedances of groundwater elevation over consecutive years are more reflective of long-term regional conditions. FCMA will only implement management actions when undesirable results occur for the Upper Aquifer.~~

4.4.1.2 Groundwater Storage

~~Groundwater storage calculation will be made with groundwater elevation measurements collected at multiple sites. Undesirable results occur when groundwater storage exceeds the MT for the Upper Aquifer for two consecutive years. Storage changes will be calculated for the Lower Aquifer, but FCMA actions are not responsible for these conditions.~~ A significant and unreasonable impact to beneficial uses and users of groundwater is insufficient water storage to maintain beneficial use and natural resource areas in the Subbasin, including conjunctive use of groundwater.

4.4.1.3 Subsidence

~~Undesirable results for subsidence will occur when the rate of compaction for the Upper Aquifer exceeds MT rate for two consecutive years. Similar to groundwater level and storage, FCMA only extracts groundwater from the Upper Aquifer and is not responsible for Lower Aquifer compaction.~~

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~~Based on the information presented in the *Basin Setting*, Upper Aquifer compaction is only responsible for a fraction of the total subsidence. FCMA will only implement management actions when undesirable results occur for the Upper Aquifer.~~ Significant and unreasonable damage to conveyance capacity from inelastic land subsidence is structural damage that creates an unmitigated and unmanageable reduction of design capacity or freeboard. Significant and unreasonable impacts to natural resource areas from inelastic land subsidence are unmitigated decreases in the ability to flood or drain such areas by gravity. Significant and unreasonable threats to public health and safety from inelastic land subsidence are those that cause an unmitigated reduction of freeboard that allows for flooding, or unmitigated damage to roads and bridges.

4.4.1.4 Groundwater Quality

~~Undesirable Results occur when more than 25% of wells in MAA or MAB exceed the established MT for two consecutive years. Within each of the Management Areas, the area of concern has been delineated by the monitoring network. Multiple exceedances indicate that the migration of contaminates is expanding and impacting a larger area causing impact to beneficial users of groundwater outside of the Management Areas. For MAA, undesirable results for groundwater quality will not trigger any type of management action as clean-up actions are under the purview of the Regional Board.~~ Significant and unreasonable impacts to beneficial uses and users of groundwater as a result of groundwater management activities are the migration of contaminant plumes or elevated concentrations of constituents of concern that reduce groundwater availability, and the degradation of surface water quality as a result of groundwater migration that substantially impair an existing beneficial use. Significant and unreasonable is quantitatively defined as exceeding the MT at more than 50% of representative monitoring sites by aquifer in a GSP area where current groundwater quality (as established in the Subbasins GSPs) does not exceed 1,000 mg/L TDS.

4.4.1.5 Interconnected Surface Waters

Significant and unreasonable impacts on natural resources or downstream beneficial uses and users of groundwater are a reduction in available surface water supplies for natural resource areas, and reductions in downstream water availability as a result of increased streamflow depletions along the San Joaquin River when compared to similar historic water year types. ~~Undesirable results occur when stage values drop below the MT for two consecutive years. Undesirable results for interconnected surface waters will not trigger any management action as FCMA has no control over water levels in the Fresno Slough. The impacts to GDEs due to potential undesirable results will be further evaluated as more data is collected and data gaps are filled~~.

4.4.2 Cause of Groundwater Conditions that Lead to Undesirable Results

Over extraction of groundwater during extended dry periods will likely lead to short term undesirable results for groundwater elevation, groundwater storage, and subsidence. These three sustainability indicators are directly tied together. Lower groundwater elevations lead to reduction in storage and the compaction of aquifer materials. The MT values that were set were based on condition that occurred from the end of 2011 through 2016 which consisted of high amounts of pumping over five consecutive dry years.

In MAA, undesirable results will occur as a result of continued expansion and migration of the Steffens Plume. Over extraction from wells outside the current extent of contamination could influence

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additional migration contaminated groundwater. In MAB, the influence of the naturally occurring saline water is much larger than the Steffens Plume. Continued extraction from wells that exceed their MT will enhance migration of the higher saline groundwater and cause undesirable results.

4.4.3 Criteria Used to Define Undesirable Results based on Minimum Thresholds

The criteria used to define Undesirable Results and Significant and Unreasonable were determined at the Subbasin level, coordinated by each of the GSA's and GSP groups. ~~The subsidence and interconnected surface water monitoring networks only contain one monitoring site. The single MT value for their single monitoring site was used to define undesirable results. Given the relatively small coverage of FCMA, the values set at the single monitoring site are representative of conditions over the entire GSP area.~~

~~Groundwater elevation contain multiple sites over the GSP area. Given all of the influences on groundwater elevation within FCMA, there is more spatial variability with this sustainability indicator as compared to others. The exceedance of more than 25% of the monitoring sites two consecutive years was defined as undesirable as this reflects conditions more representative long-term regional conditions. A single exceedance could be reflective of localized over pumping or impacts originating from outside of the FCMA plan area.~~

~~Groundwater quality used the same criteria as groundwater elevation to define undesirable results with two MT exceedances for two consecutive years. Groundwater quality in this area shows greater variability than areas unaffected by contamination issues. The point source nature of the contaminates creates a need for a greater degree of monitoring, and individual wells are not entirely representative of a regional area.~~

4.4.4 Potential Effects on the Beneficial Users of Groundwater

For agricultural beneficial users of groundwater, the most significant undesirable results are groundwater levels, groundwater storage, groundwater quality, and subsidence. The undesirable results for interconnected surface waters will not have a direct impact on agriculture. Undesirable results for any of the sustainability indicators of concern will limit the ability of agricultural users of to extract groundwater and irrigate crops.

For domestic beneficial users of groundwater, the most significant undesirable results are groundwater levels, groundwater storage, and groundwater quality. Undesirables results for any of these three sustainability indicators could potentially restrict the ability of households to use water for domestic purposes. Subsidence and interconnected surface waters will not have direct impact on domestic users.

For environmental beneficial uses of groundwater in FCMA, the most significant undesirable results subsidence and interconnected surface waters. Continued subsidence in the FCMA area will restrict the

ability to flood areas in the MWA. Interconnected surface waters also are important to the beneficial uses of groundwater, but stage levels in the Mendota Pool have not historically show significant decline.

4.5 Monitoring Network (354.34)

4.5.1 Description of Monitoring Network

The FCMA monitoring network consists of ~~20~~ 15 sites that will monitor conditions for each of the five applicable sustainability indicators across the plan area. Each of monitoring sites includes established SMC. The individual monitoring sites were selected to have an even distribution over the plan area where groundwater management practices vary. The monitoring schedule for each sustainability indicator was developed in order to utilize existing monitoring programs as much as possible and capturing the relevant seasonal, short-term, and long-term trends (**Table 4-12**). Below is a brief description on each of the individual sustainability indicator monitoring networks.

Table 4-12: Fresno County Management Areas Monitoring Schedule

Sustainability Indicator	Monitoring Site	Management Area	Monitoring Frequency	Monitoring Time Frame	Existing Monitoring Program
Groundwater Level~~Elevation~~	USGS 31J6	A & B	Semi Annual	Season High: (February-April) Season Low: (September-October)	USGS
	SPRECK-MW-7	A			Spreckels Semi-Annual
	~~KRCDA06~~	B			CASGEM
	TL-HS-3				MPG
	HANS-7C1				MPG
Groundwater Quality	MF-P-1	A	Annual	January - September	MPG
	SPRECK-MW-1				Spreckels Semi-Annual
	SPRECK-MW-11				Spreckels Semi-Annual
	SPRECK-MW-20				Spreckels Semi-Annual
	SPRECK-MW-32				Spreckels Semi-Annual
	SPRECK-PW-9				Spreckels Semi-Annual
	~~SPRECK-PW-10~~				Spreckels Semi-Annual
	~~SPRECK-PW-12~~				Spreckels Semi-Annual
	~~FS-5~~	B			MPG
	~~KRCDA06~~				No Existing Program
	SC-4B				MPG
	TLF-6d				MPG
	TLF-12d				MPG
Subsidence	Fordel-Ext	A & B	Annual	Annual High: (January-May)	USGS
	P304-PBO	A & B			UNAVCO
Interconnected Surface Waters	~~Mendota Pool Staff Gage~~See Groundwater Level	A & B	Semi Annual	Season High: (February-April) Season Low: (September-October)	~~SLDMWA~~See Groundwater Level

4.5.2 Groundwater LevelElevation Monitoring Network

The groundwater elevation monitoring network consists of fourive monitoring sites (**Figure 4-1**). All of the selected sites have historic record that display they are generally consistent with the region and reflect climatic conditions on a year to year basis. Groundwater elevation data are limited in the MWA area and FCMA will work with CDFG to improve monitoring in the area (**Figure 3-13**). ThreeFour of the sites are screened to monitoring conditions in the Upper Aquifer and one is screened to monitoring conditions in the Lower Aquifer. The one Lower Aquifer well is located outside of the FCMA GSP area. It was determined that the five groundwater monitoring sites provided a sufficient over the GSP area based on information from the Monitoring Network BMPs provided by DWR. Hopkins (1984) recommend at least 4 wells per 100 mi^2 where over 10,000 AF/year of groundwater is extracted (DWR, 2016a). FCMA is approximately 35 mi^2 where over 10,000 AF/year of groundwater is extracted. Groundwater elevation measurements will be made twice a year to capture seasonal high and seasonal lows. Historic groundwater elevation measurements have shown that Seasonal high measurement occur in the early parts of the year (February-April) and seasonal low conditions occur in the fall (September-October). Based on this information and coordination with the other Subbasin GSPs, seasonal high measurements will be made between the months of February through April, and seasonal low measurements will be made in the months of September and October. Data that is to be reported for SGMA purposes will utilize existing monitoring programs that collect groundwater elevation data during these time frames.

4.5.3 Groundwater Storage Monitoring Network

Groundwater storage monitoring is the same as the groundwater level monitoring network for the Upper Aquifer (**Figure 4-1**). Groundwater storage monitoring for the Lower Aquifer is the same as the Subsidence monitoring network (Section 4.5.4). calculations will be made by creating groundwater elevation contour maps and evaluation of changes in groundwater elevation at each of the groundwater monitoring sites and taking the difference between current and previous water year. These calculations will be conducted from the seasonal high groundwater elevation measurements throughout the GSP area.

4.5.4 Subsidence Monitoring Network

The subsidence monitoring network will utilize one USGS extensometer and one UNAVCO GPS monitoring site (**Figure 4-2**). The USGS extensometer (Fordel-EXT) measuring the amount of compaction in the Upper Aquifer. The UANVCO GPS monitoring site (P304) measures the total amount of subsidence due to compaction in both the Upper and Lower Aquifer. Data are collected at these sites year-round, but, for SGMA, only seasonal high measurements will be reported. The purpose of monitoring subsidence is to capture the inelastic component that results in permanent subsidence. This is most accurately characterized by comparing seasonal high measurements when groundwater elevations are highest. For the GSP annual report, the highest measurement observed during the period of January through May will be provided. The sites selected are the only two subsidence monitoring stations in the

GSA and will provide sufficient coverage for the initial GSP implementation. FCMA will work to improve subsidence monitoring in the MWA portion of MAB where subsidence has reportedly impacted the environmental beneficial uses of groundwater.

4.5.5 Groundwater Quality Monitoring Network

The groundwater quality monitoring consists of ~~13~~ nine monitoring sites all screened in the Upper Aquifer (**Figure 4-3**). These sites were selected to provide an even coverage of the GSP area and delineate the areas of concern for groundwater contamination. Groundwater quality data are to be reported at least once per year. Samples are to be collected between May and August for annual reporting purposes. TDS concentrations will be reported for each monitoring site. Data that is to be reported for SGMA purposes will utilize existing monitoring programs. Data gaps for this monitoring network are currently present in the MWA portion of MAB (**Figure 3-13**).

4.5.6 Interconnected Surface Waters Monitoring Network

Interconnected surface waters monitoring network is the same as the water level monitoring network (Figure 4-1). This will be updated as data gaps for interconnected surface waters are filled. ~~For the FCMA plan area, interconnected surface water will be monitored by the Mendota Pool staff gage (**Figure 4-4**). The SLDMWA measures water levels in the Mendota Pool daily. Stage levels will be reported semi-annually corresponding with seasonal high and seasonal low groundwater elevation. The one monitoring site will be sufficient for monitoring conditions in the FCMA for the initial GSP implementation as it is currently the only staff gage in FCMA and the seepage in the pool has been studied in past reports (LSCE and KDSA, 2000). FCMA will work to improve this monitoring network by installing shallow groundwater monitoring wells in the MWA portion of MAB to be able to better characterize the relationship between GDEs and interconnected surface waters in this area (**Figure 3-13**).~~

4.6 Monitoring Protocols for Data Collection and Monitoring

The monitoring protocols developed for FCMA are largely based on the *Best Management Practices for the Sustainable Management of Groundwater: Monitoring Protocols, Standards, and Sites* produced by the DWR. The recommended monitoring protocols were adjusted and added to in order to fit the specific monitoring needs of FCMA to achieve sustainability. Monitoring protocols for seawater intrusion were not necessary as FCMA is roughly 100 miles from the coast. Monitoring protocols for measuring pumping amounts were added. Monitoring protocols regarding groundwater pumping were not described in the BMP document and accounting for groundwater pumping will be an integral part of achieving sustainability in FCMA and the Delta-Mendota Subbasin. Monitoring protocols for groundwater dependent ecosystems were also established. The monitoring protocols that are described in this document will provide the necessary data to track the minimum thresholds and measurable objectives for each of the sustainability indicators. The monitoring protocols established here are to be reviewed in five years as a part of periodic review of the GSP.

4.6.1 Protocols for Monitoring Sites

The following protocols will be applied to all monitoring sites:

- Long-term access agreements. Access agreements should include year-round site access to allow for increased monitoring frequency
- A unique identifier that includes a written description of the site location, date established, access instructions, type of data to be collected, latitude, longitude, and elevation.
- A modification log is to be kept in order to track all modifications to the monitoring site.

4.6.2 Groundwater Level Elevation

There has been a groundwater level monitoring network in the FCMA for the past 20 years as a part of existing groundwater resources monitoring programs. Wells from the existing network along with along with other wells in the area will be used for the SGMA monitoring network. The GSA will be responsible for collecting groundwater level elevation for which the following protocols will be in place:

4.6.2.1 Protocols for Measuring Groundwater Levels

- Measure depth to water in the well using procedures appropriate for the measuring device. Equipment must be operated and maintained in accordance with manufacturer's instructions. Groundwater levels should be measured to the nearest 0.~~0~~1 foot relative to the Reference Point (RP).
- For measuring wells that are under pressure, allow a period of time for the groundwater levels to stabilize. In these cases, multiple measurements should be collected to ensure the well has reached equilibrium such that no significant changes in water level are observed. Every effort should be made to ensure that a representative stable depth to groundwater is recorded. If a well does not stabilize, the quality of the value should be appropriately qualified as a questionable measurement. In the event that a well is artesian, site specific procedures should be developed to collect accurate information and be protective of safety conditions associated with a pressurized well. In many cases, an extension pipe may be adequate to stabilize head in the well. Record the dimension of the extension and document measurements and configuration.

• The sampler should calculate the groundwater elevation as:

$$GWE = RPE - DTW$$

Where:
GWE = Groundwater Elevation
RPE = Reference Point Elevation
DTW = Depth to Water

- The sampler must ensure that all measurements are in consistent units of feet, tenths of feet, and hundredths of feet. Measurements and RPEs should not be recorded in feet and inches.
- The sample should replace any well caps or plugs and lock a well buildings or cover

- Groundwater Level measurements are to be made on semi-annual basis

4.6.2.2 Recording Groundwater Level Measurements

- The sampler should record the well identifier, date, time (24-hour format), RPE, height of RP above or below ground surface, DTW, GWE, and comments regarding any factors that may influence the depth to water readings such as weather, nearby irrigation, flooding, potential for tidal influence, or well condition. If there is a questionable measurement or the measurement cannot be obtained, it should be noted. Standardized field forms should be used for all data collection.
- All data should be entered into the GSA data management system (DMS) as soon as possible. Care should be taken to avoid data entry mistakes and the entries should be checked by a second person.

4.6.2.3 Installing Pressure Transducers and Downloading Data

There are not currently any wells with pressure transducers in FCMA. If a pressure transducer is added to a well in the SGMA network, the following procedures will be followed in the installation of a pressure transducer and periodic data downloads:

- The sampler must use an electronic sounder or chalked steel tape and follow the protocols listed above to measure the groundwater level and calculate the groundwater elevation in the monitoring well to properly program and reference the installation. It is recommended that transducers record measured groundwater level to conserve data capacity; groundwater elevations can be calculated at a later time after downloading.
- The sampler must note the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and cable serial number.
- Transducers must be able to record groundwater levels with an accuracy of at least 0.1 foot. Professional judgment should be exercised to ensure that the data being collected is meeting the DQO and that the instrument is capable. Consideration of the battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers should be included in the evaluation.
- The sampler must note whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Vented cables are preferred, but non-vented units provide accurate data if properly corrected for natural barometric pressure changes. This requires the consistent logging of barometric pressures to coincide with measurement intervals.
- Follow manufacturer specifications for installation, calibration, data logging intervals, battery life, correction procedure (if non-vented cables used), and anticipated life expectancy to assure that DQOs are being met for the GSP.
- Secure the cable to the well head with a well dock or another reliable method. Mark the cable at the elevation of the reference point with tape or an indelible marker. This will allow estimates of future cable slippage.

- The transducer data should periodically be checked against hand measured groundwater levels to monitor electronic drift or cable movement. This should happen during routine site visits, at least annually or as necessary to maintain data integrity.
- The data should be downloaded as necessary to ensure no data is lost and entered into the basin's DMS following the QA/QC program established for the GSP. Data collected with non-vented data logger cables should be corrected for atmospheric barometric pressure changes, as appropriate. After the sampler is confident that the transducer data have been safely downloaded and stored, the data should be deleted from the data logger to ensure that adequate data logger memory remains.

4.6.3 Groundwater Storage Measurements

Groundwater storage for the upper aquifer will be made from groundwater elevation measurements. An MT exceedance and undesirable results for groundwater levels will result in the same for groundwater storage. But in order to estimate change in storage year to year unrelated to SMCs for groundwater storage, g~~G~~roundwater elevation contours will be created for each annual report where current year conditions will be compared to the previous year's groundwater contour. The change in groundwater elevation at each monitoring site will also be analyzed on a yearly basis to understand spatially where the greatest decline in storage is ~~occurrin~~occurring95~~g~~. Groundwater storage for the Upper Aquifer will be calculated with the equation below

$$\text{Change in Upper Aquifer Storage} = (\Delta H) \times (S_y) \times (A)$$

Where Δ H is change in head (or groundwater elevation) and S_y is the specific yield of the unconfined aquifer, and A is the surface area of FCMA.

Groundwater storage for the Lower Aquifer will be monitored by subsidence data throughout the subbasin. The decision to use subsidence as a proxy for groundwater storage in the Lower Aquifer was based on the lack of data throughout the subbasin. MT exceedance for subsidence will correspond to a MT exceedance for reduction in Lower Aquifer groundwater storage. But with Lower Aquifer data available in the FCMA GSP area, a storage change calculation unrelated to SMCs will be made based on the difference between seasonal high water level measurements. Lower Aquifer change in storage will be calculated with the equation below:

$$\text{Change in Lower Aquifer Storage} = (\Delta H) \times (S_s \times B) \times (A)$$

Where Δ H is change in head, S_s is the specific storage of the confined aquifer, B is the aquifer thickness, and A is the surface area of FCMA.

4.6.4 Groundwater Quality Measurements

There has been a groundwater quality monitoring network in the FCMA for the past 20 years as a part of existing groundwater resources monitoring programs. Wells from the existing network along with along

with other wells in the area will be used for the SGMA monitoring network. The GSA will be responsible for collecting groundwater quality samples for which the following protocols will be in place:

- Prior to sampling, the sampler must contact the laboratory to schedule laboratory time, obtain appropriate sample containers, and clarify any sample holding times or sample preservation requirements.
- Each well used for groundwater quality monitoring must have a unique identifier. This identifier must appear on the well housing or the well casing to avoid confusion.
- In the case of wells with dedicated pumps, samples should be collected at or near the wellhead. Samples should not be collected from storage tanks, at the end of long pipe runs, or after any water treatment.
- The sampler should clean the sampling port and/or sampling equipment and the sampling port and/or sampling equipment must be free of any contaminants. The sampler must decontaminate sampling equipment between sampling locations or wells to avoid cross-contamination between samples.
- The groundwater elevation in the well should be measured following appropriate protocols described above in the groundwater level measuring protocols.
- For any well not equipped with low-flow or passive sampling equipment, an adequate volume of water should be purged from the well to ensure that the groundwater sample is representative of ambient groundwater and not stagnant water in the well casing. Purging three well casing volumes is generally considered adequate. Professional judgment should be used to determine the proper configuration of the sampling equipment with respect to well construction such that a representative ambient groundwater sample is collected. If pumping causes a well to be evacuated (go dry), document the condition and allow well to recover to within 90% of original level prior to sampling.
- Field parameters of pH, electrical conductivity, and temperature should be collected for each sample. Field parameters should be evaluated during the purging of the well and should stabilize prior to sampling. Measurements of pH should only be measured in the field; lab pH analysis are typically unachievable due to short hold times. Other parameters, such as oxidation-reduction potential (ORP), dissolved oxygen (DO) (in situ measurements preferable), or turbidity, may also be useful for assessing purge conditions. All field instruments should be calibrated daily and evaluated for drift throughout the day.
- Sample containers should be labeled prior to sample collection. The sample label must include sample ID (often well ID), sample date and time, sample personnel, sample location, preservative used, and analytes and analytical method.
- Samples should be collected under laminar flow conditions. This may require reducing pumping rates prior to sample collection.
- All samples requiring preservation must be preserved as soon as practically possible, ideally at the time of sample collection. Ensure that samples are appropriately filtered as recommended for the specific analyte. Entrained solids can be dissolved by preservative

leading to inconsistent results of dissolve analytes. Specifically, samples to be analyzed for metals should be field filtered prior to preservation; do not collect an unfiltered sample in a preserved container.

- Samples should be chilled and maintained at 4 °C to prevent degradation of the sample. The laboratory's Quality Assurance Management Plan should detail appropriate chilling and shipping requirements.
- Samples must be shipped under chain of custody documentation to the appropriate laboratory promptly to avoid violating holding time restrictions.
- Instruct the laboratory to use reporting limits that are equal to or less than the regional water quality objectives/screening levels.
- Groundwater quality samples are to be collected on annual basis.
- All data will be entered into the GSA data management system (DMS) as soon as possible. Care should be taken to avoid data entry mistakes and the entries should be checked by a second person.

4.6.5 Groundwater Pumping Measurement

Significant pumping occurs in the area of FCMA during the irrigation season. The following protocols will be followed when recording groundwater pumping totals:

- Groundwater pumping amounts are to be reported on a monthly basis in the units of Acre-Feet
- Amounts are to be determined by a totalizer/flowmeter or calculated from electric consumption
- Groundwater pumping totals will be reported by owner

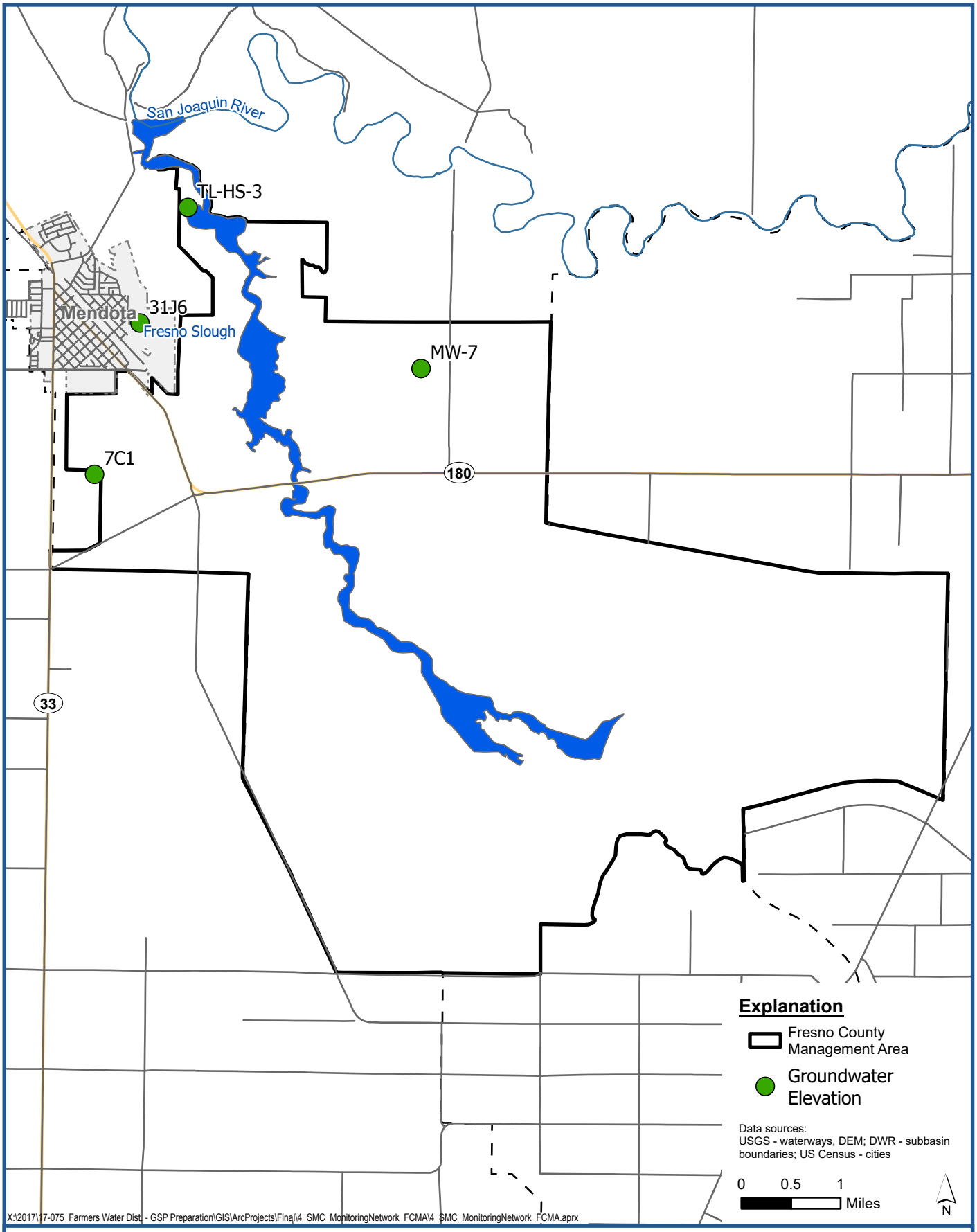
4.6.6 Subsidence Measurements

Subsidence in the Delta-Mendota Subbasin has been studied and documented in the past. Subsidence monitoring for FCMA will included an extensometer monitored and maintained by the USGS, and a UNAVCO GPS monitoring station. The GSA will not be responsible for collection subsidence data.

- Subsidence data will be downloaded on a monthly basis from the publicly available sources and uploaded the GSAs DMS.

4.6.7 Interconnected Surface Water Measurements

Interconnected surface water measurements ~~will be collected from SLDMWA who has historically recorded stage levels in the Mendota Pool.~~ are the same as groundwater level measurements. This will be updated as more monitoring stations are established and more data are collected.



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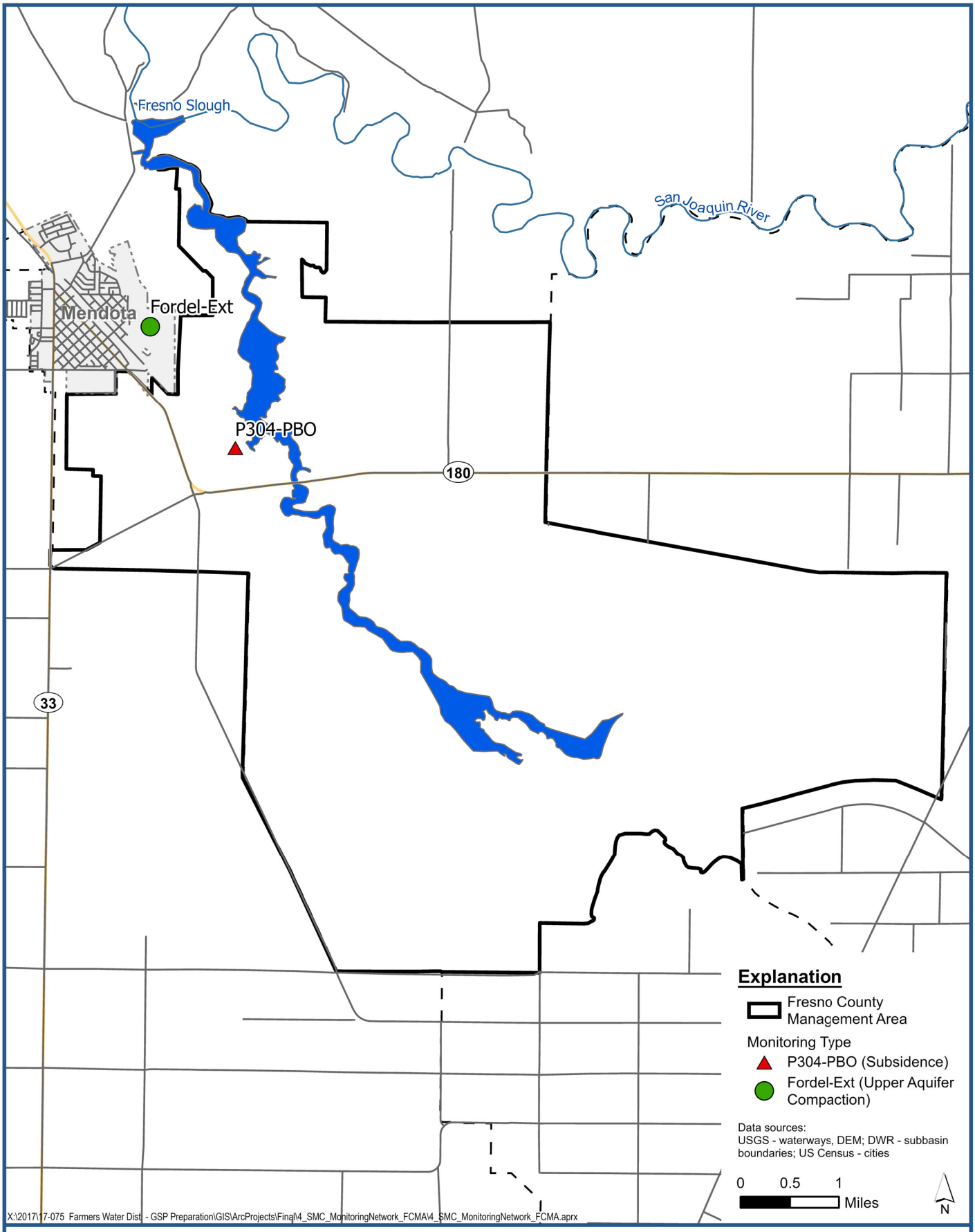
Groundwater Elevation Monitoring Network

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-1



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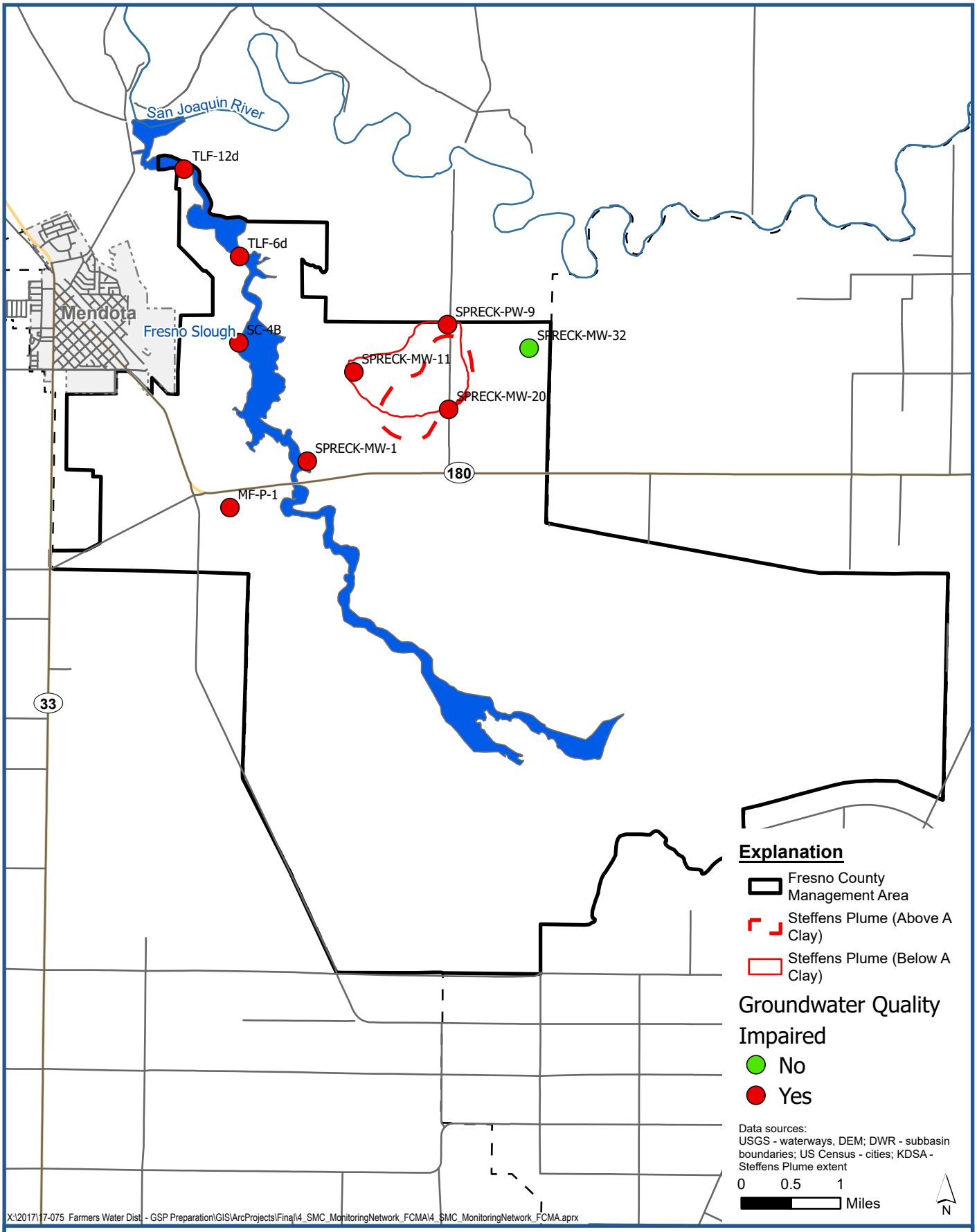
Subsidence Monitoring Network

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-2



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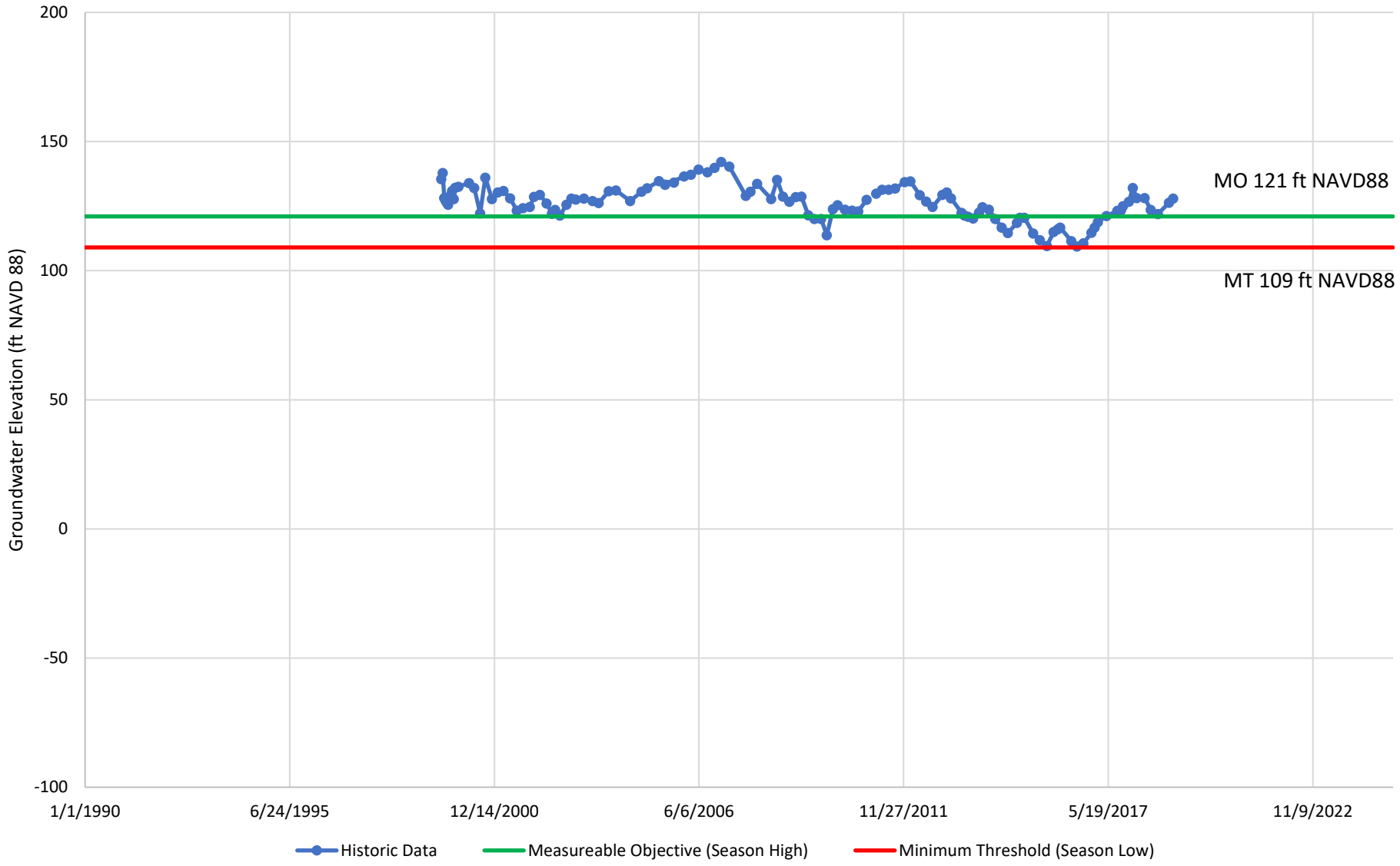
Groundwater Quality Monitoring Network

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-3



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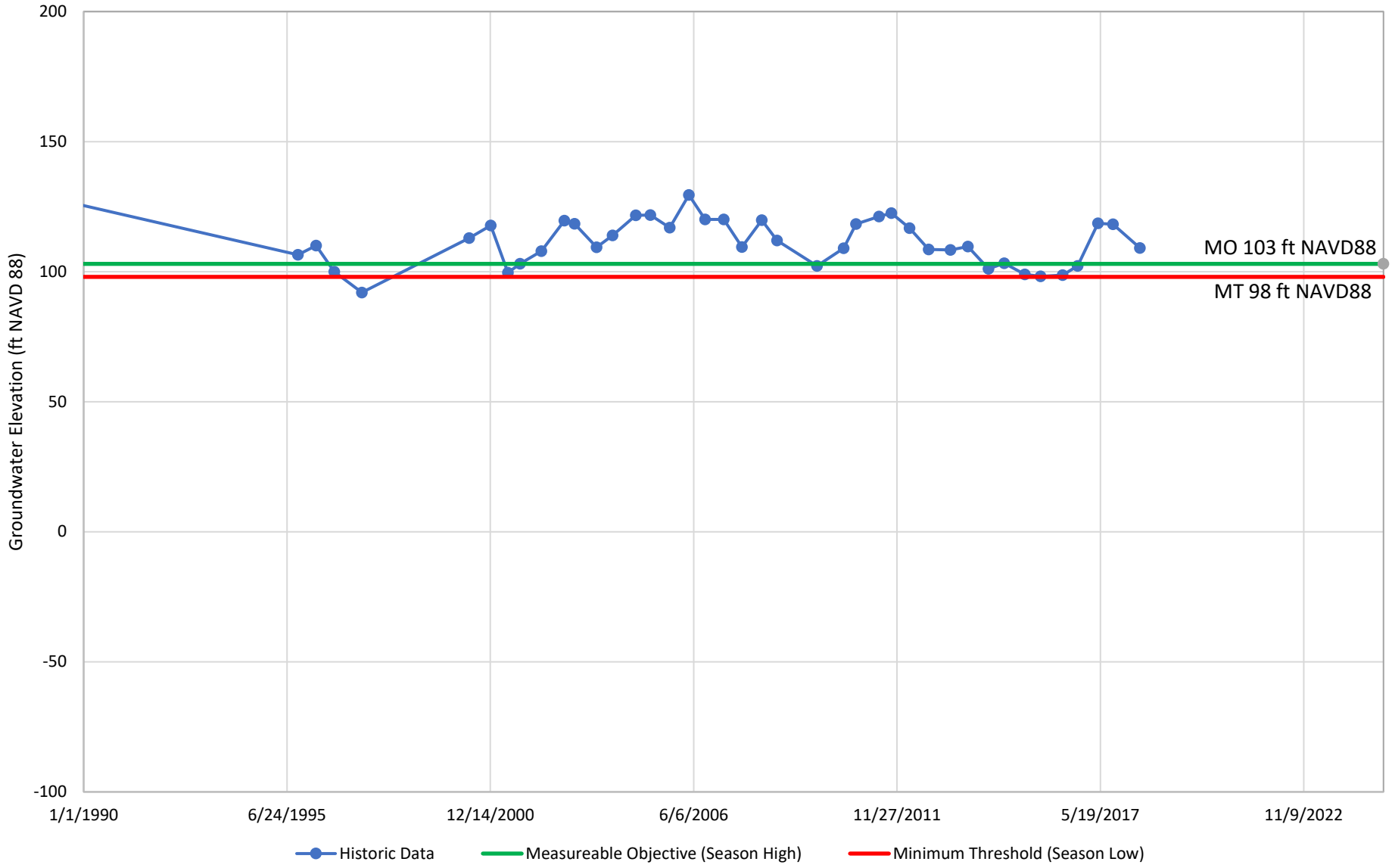
HANS-7C1 - Groundwater Elevation Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-4



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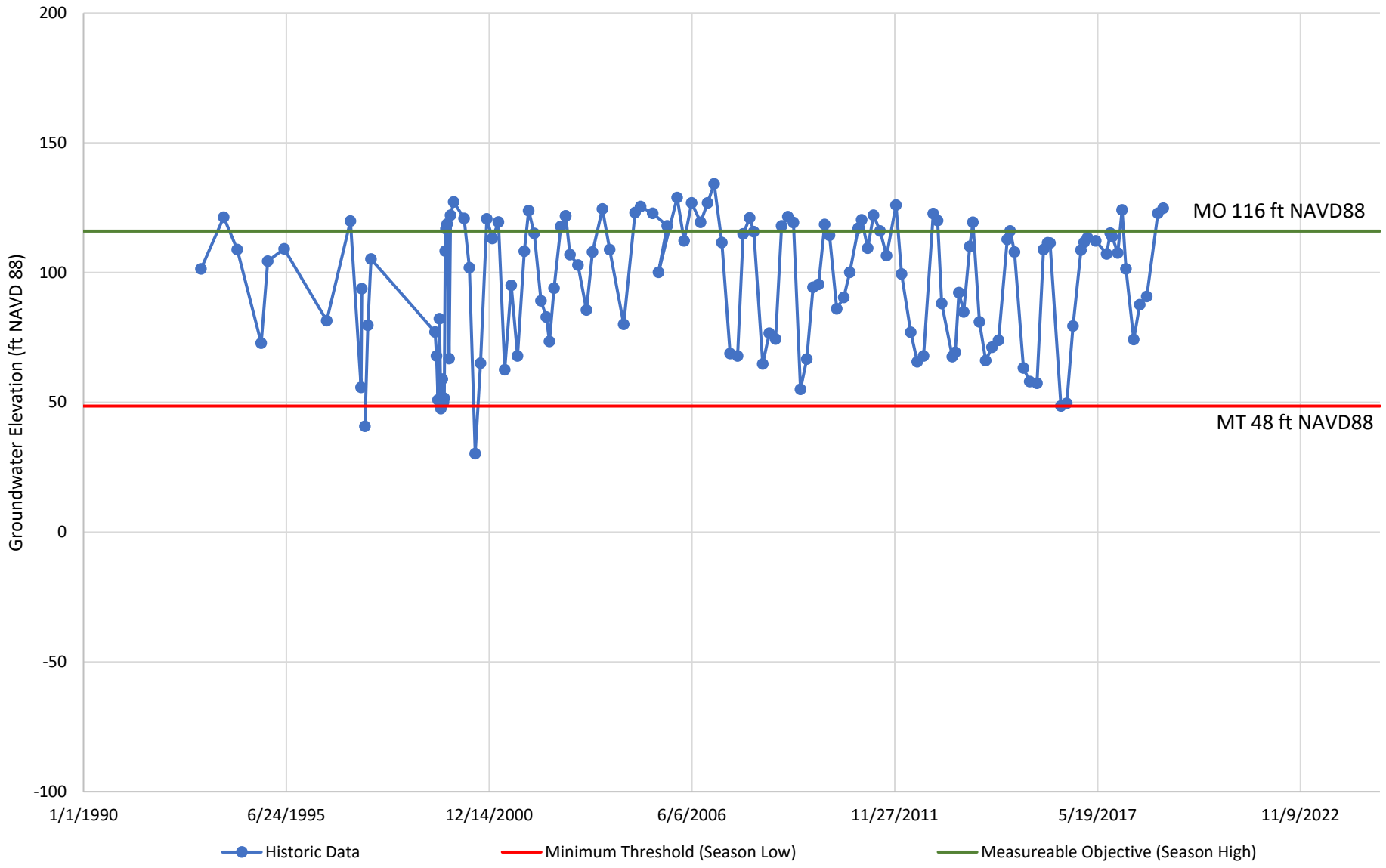
MW-7 - Groundwater Elevation
Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-5



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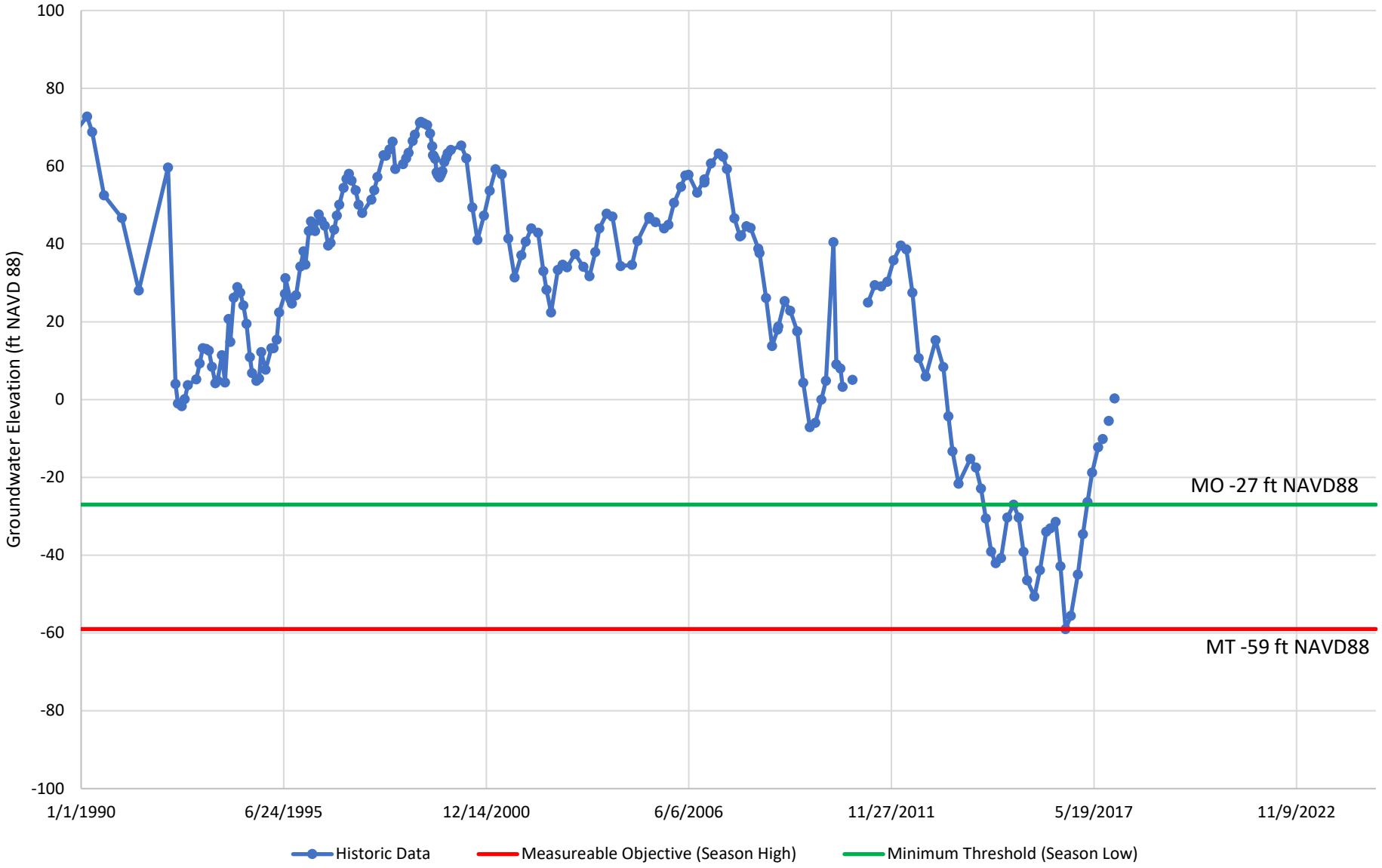
TL-HS-3 - Groundwater Elevation
Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-6



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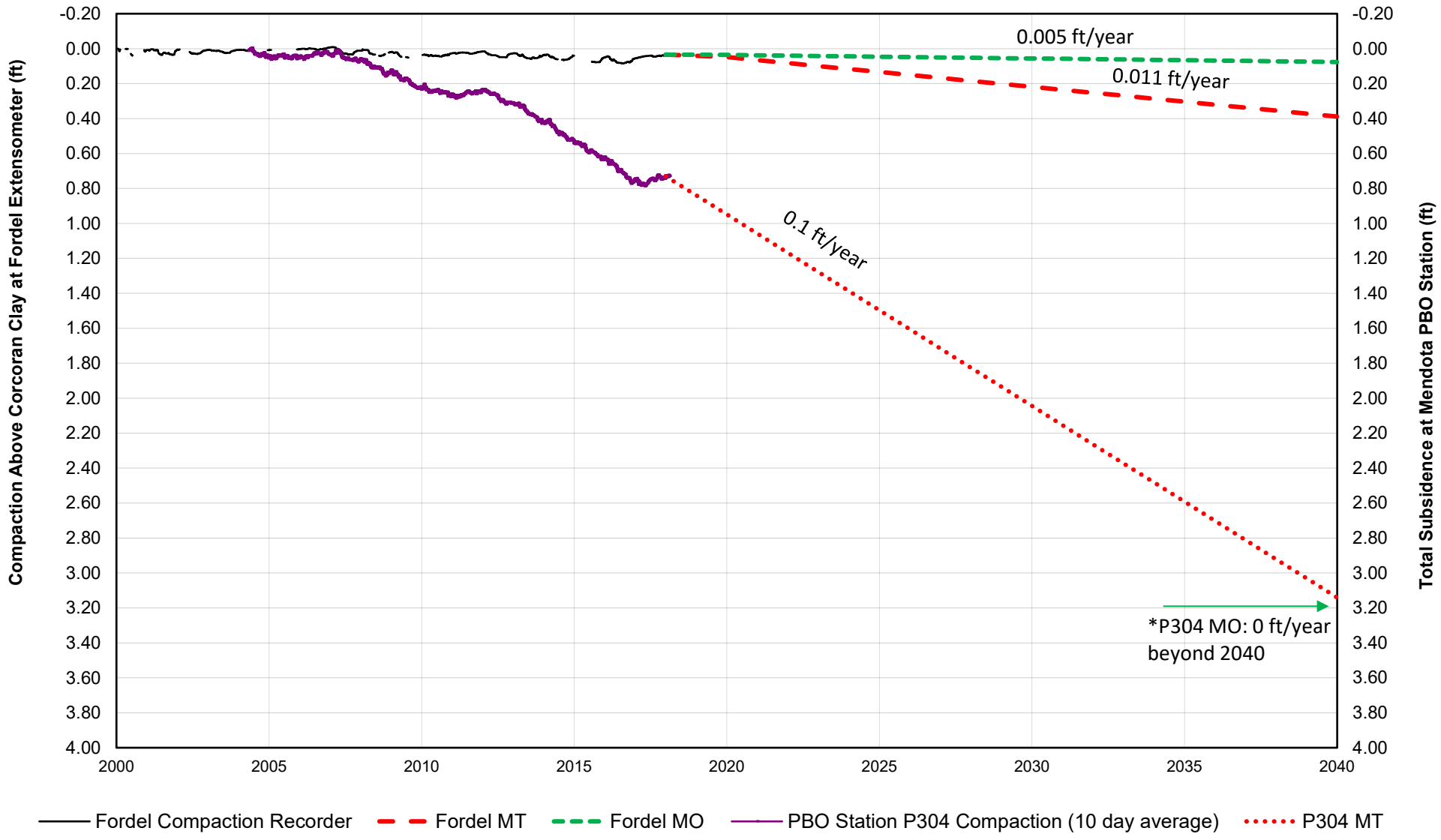
USGS-31J6 - Groundwater Elevation
Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-7



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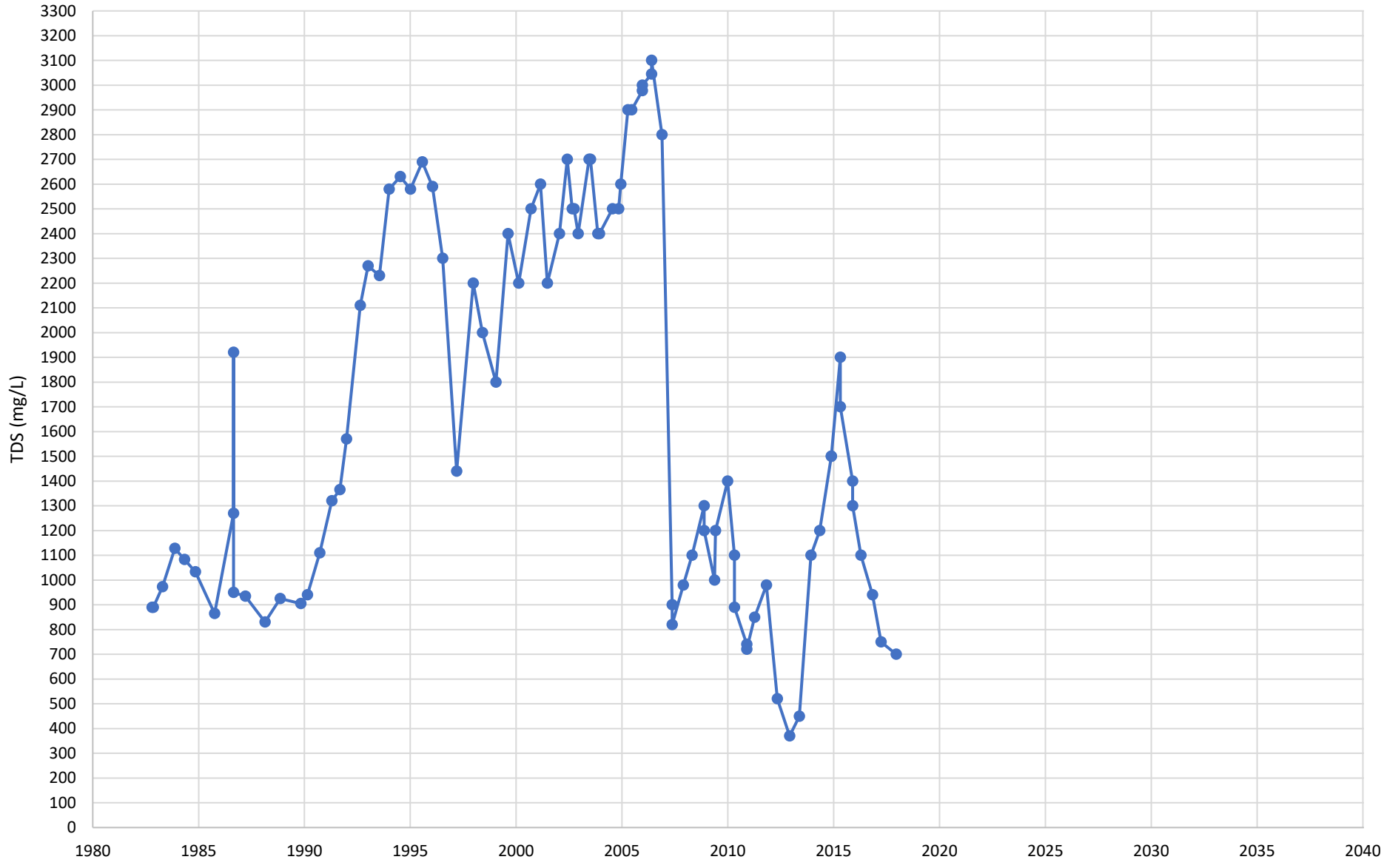
P304 and Fordel Extensometer Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Groundwater Sustainability Plan

Figure 4-8



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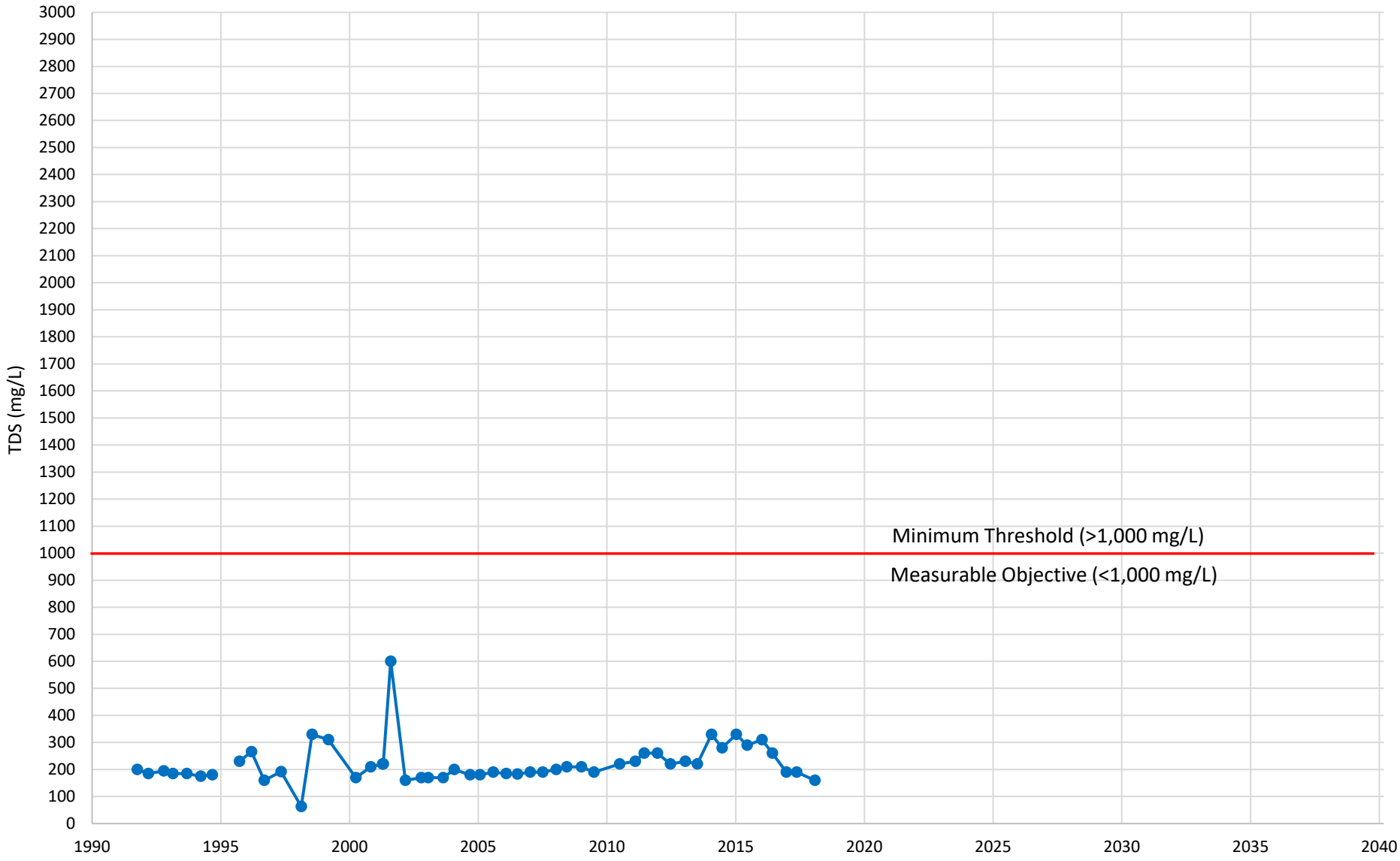
SPRECK-MW-1 Groundwater Quality
Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-9



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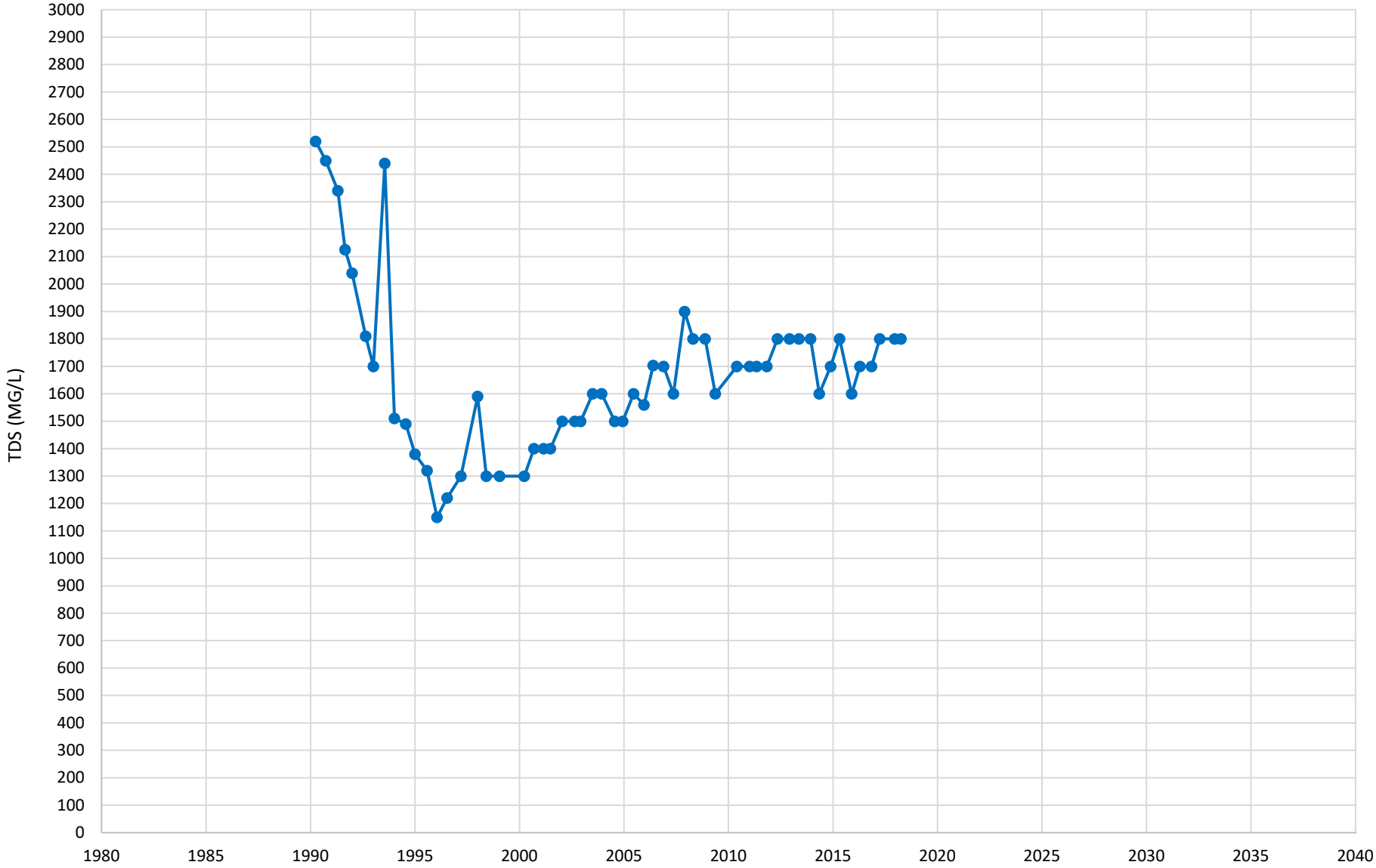
SPRECK-MW-32 Groundwater Quality
Sustainable Management Criteria (Unimpaired)

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-10



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SPRECK-MW-20 Groundwater Quality
Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-11



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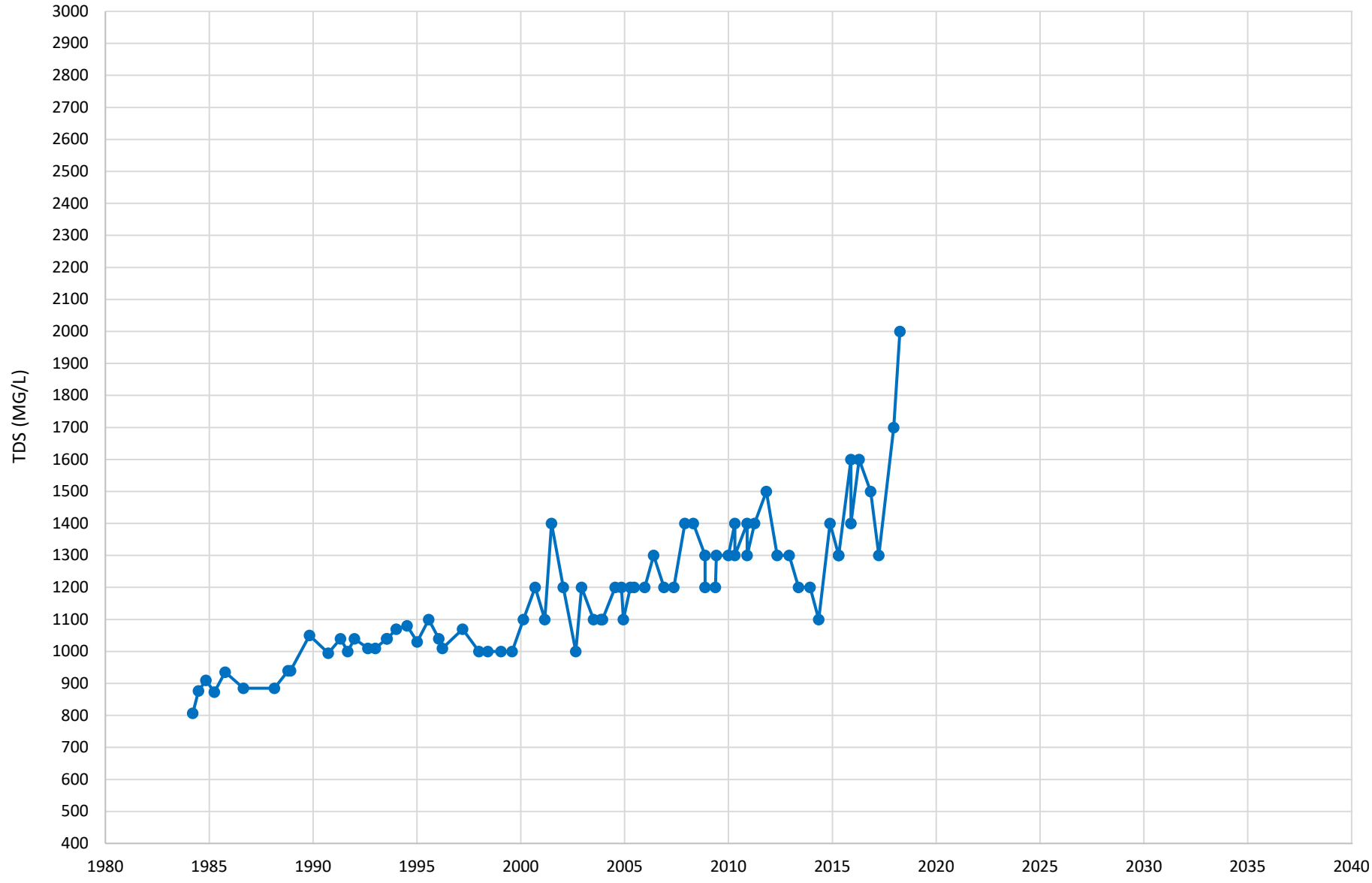
SPRECK-PW-9 Groundwater Quality
Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-12



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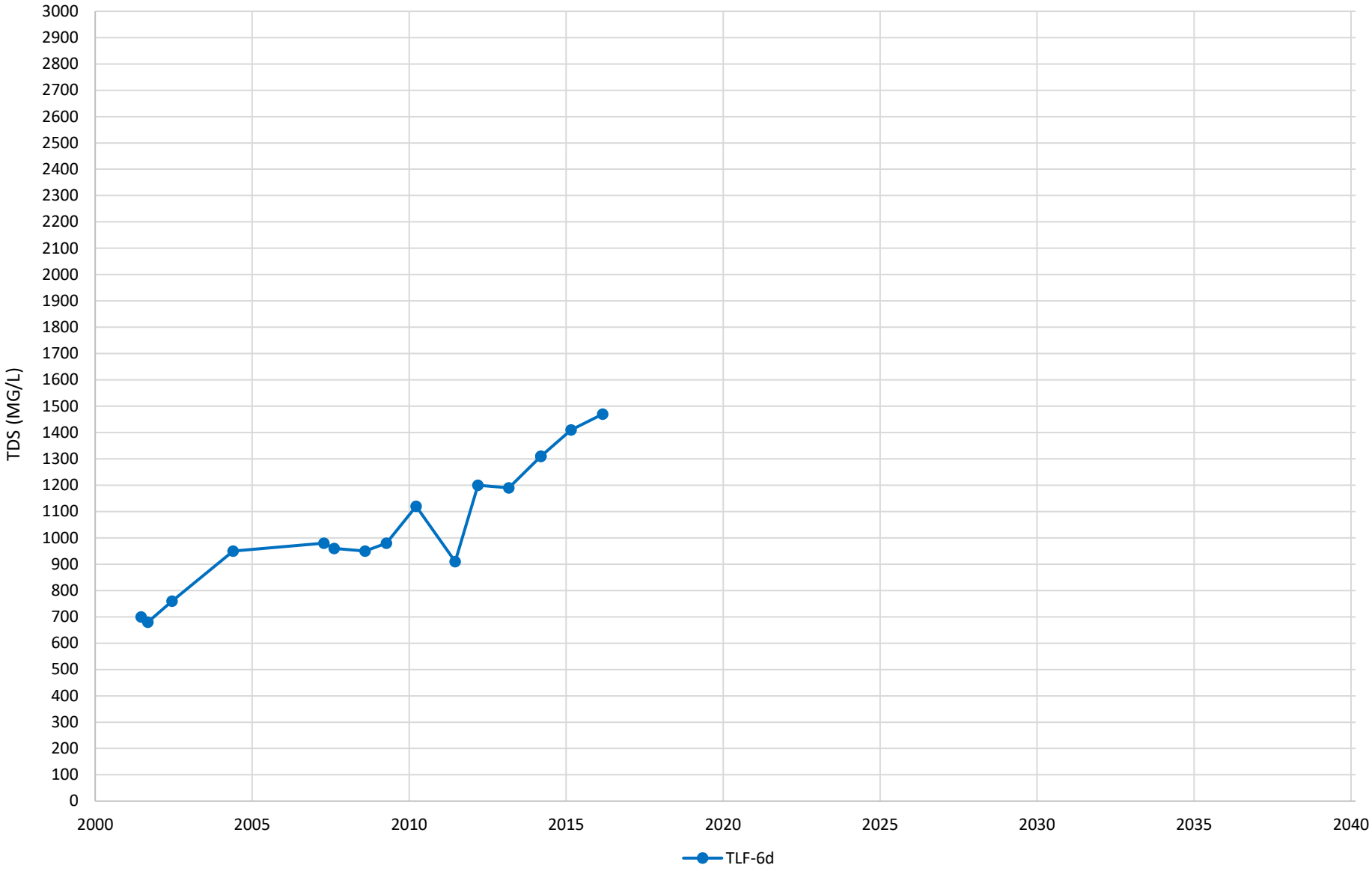
SPRECK-MW-11 Groundwater Quality
Sustainable Management Criteria (Impaired)

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-13



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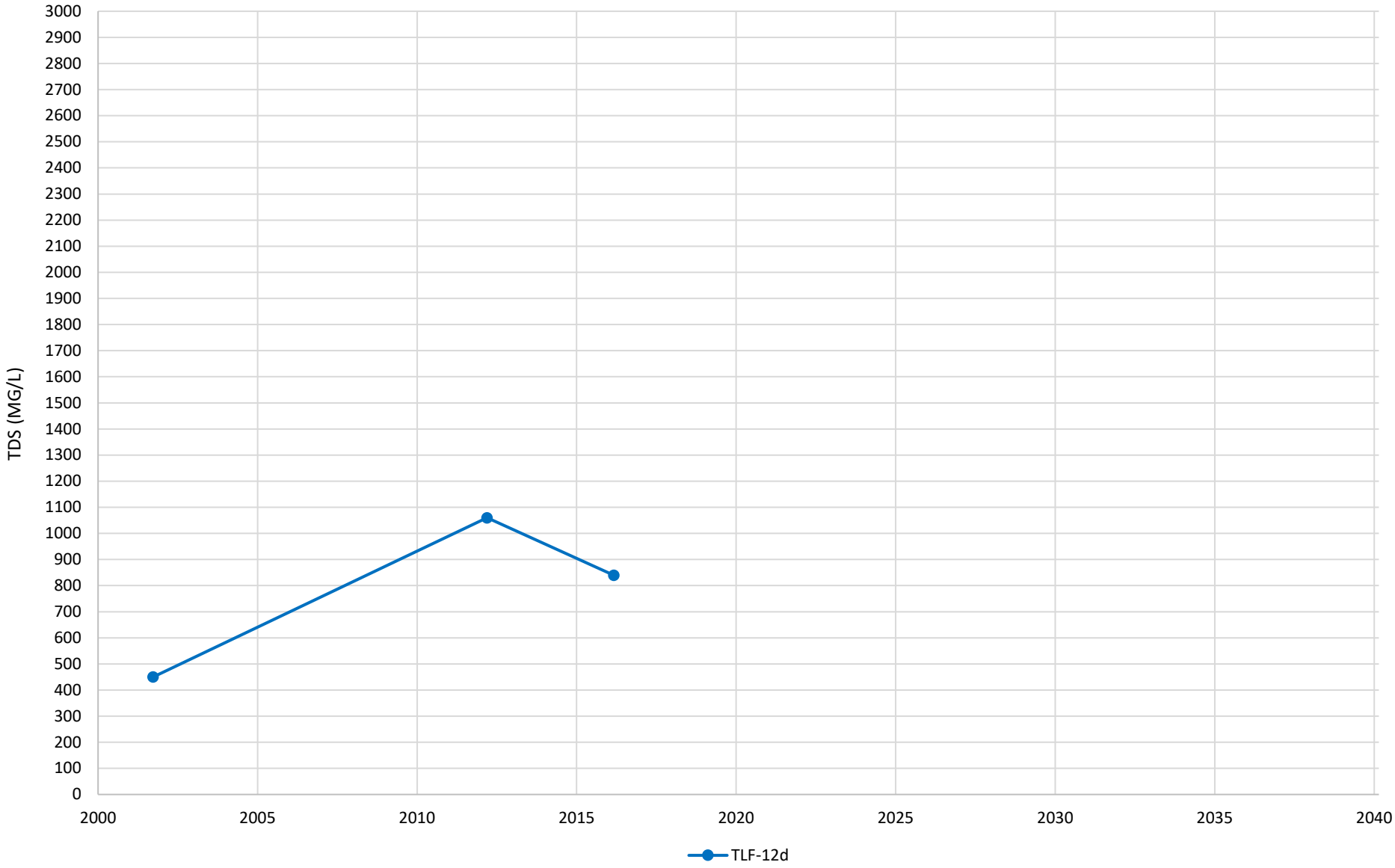
TLF 6D Groundwater Quality
Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-14



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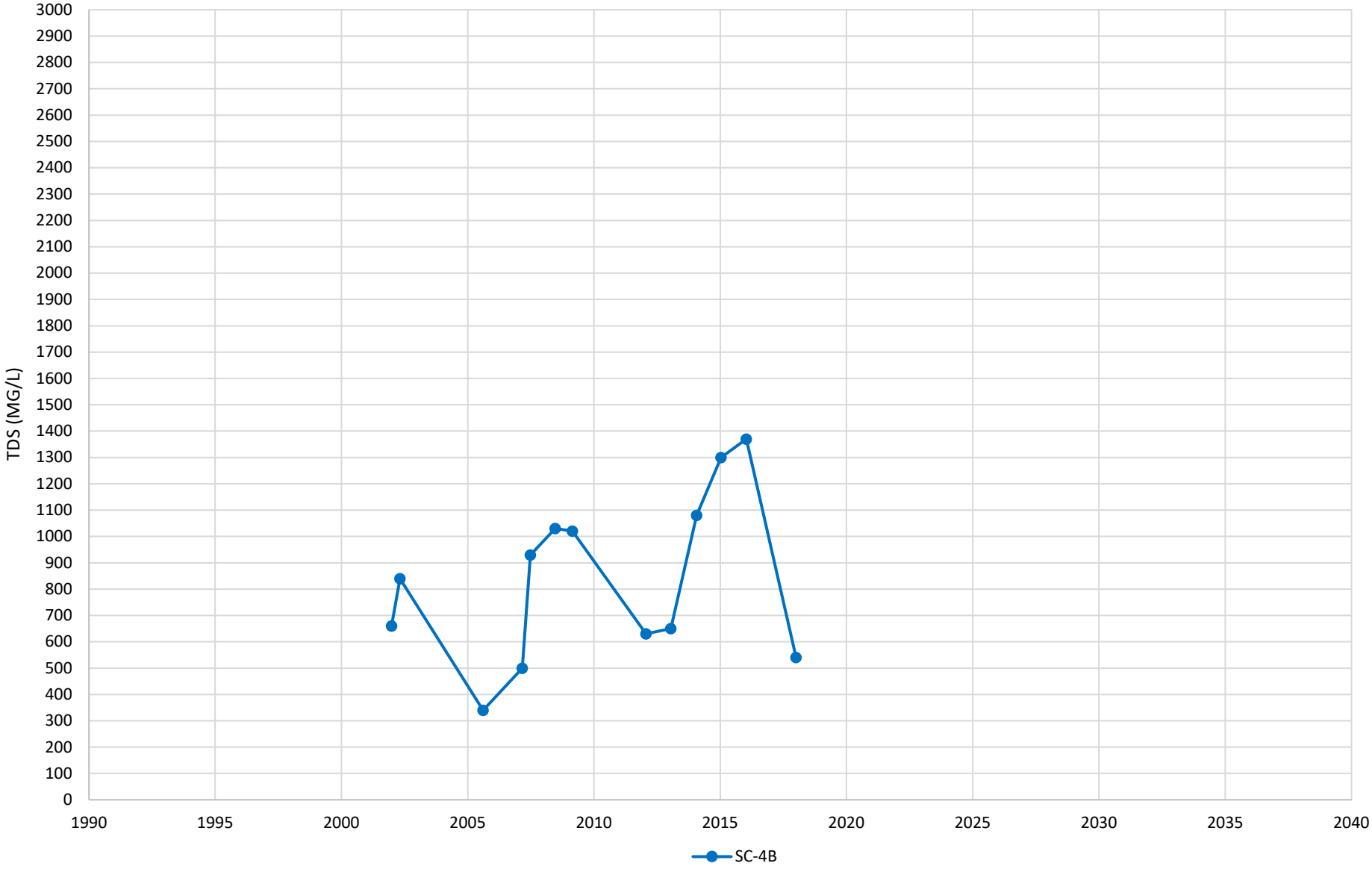
Consulting Engineers

TLF 12D Groundwater Quality
Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-15



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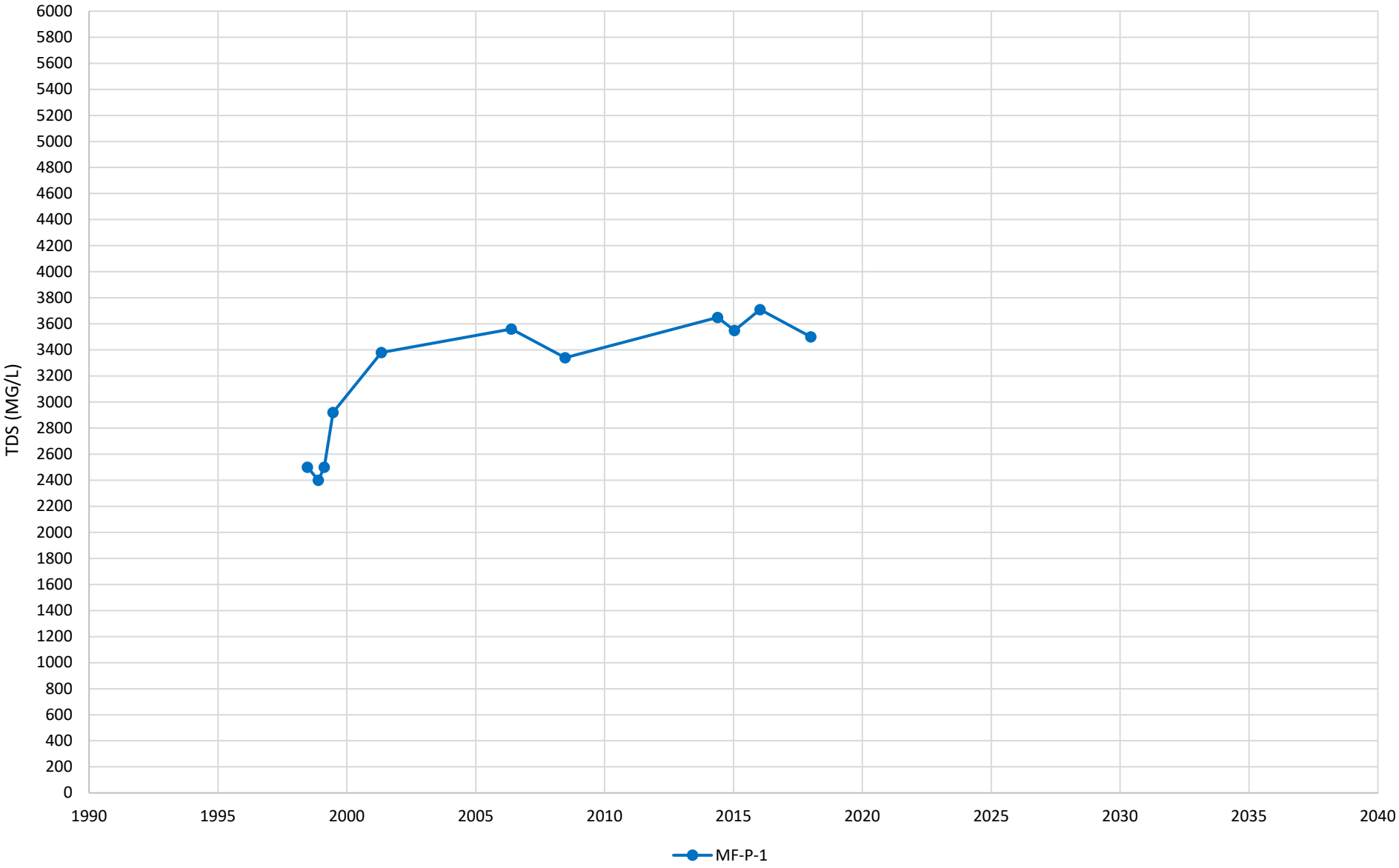
SC-4B Groundwater Quality
Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-16



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Consulting Engineers

MF-P-1 Groundwater Quality
Sustainable Management Criteria

Groundwater Sustainability Plan
County of Fresno
Delta-Mendota Subbasin

Figure 4-17

5 PROJECTS AND MANAGEMENT ACTIONS TO ACHIEVE SUSTAINABILITY GOAL (REG. § 354.44)

Projects and management actions (PMAs) were developed to address sustainability goals, MOs, and undesirable results identified in the Subbasin. The GSP Regulations require that a summary of the PMAs include the following:

a. "Each Plan shall include a description of the projects and management actions the GSA has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.

b. Each Plan shall include a description of the projects and management actions that include the following:

    1. A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent. The Plan shall include the following:

        A. A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management actions, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

B. The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

2. If overdraft conditions are identified through the analysis required by California Code of Regulations (CCR) Section 354.18 [Water Budget], the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.
3. A summary of the permitting and regulatory process required for each project and management action.
4. The status of each project and management action, including a timetable for expected initiation and completion, and the accrual of expected benefits.
5. An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.
6. An explanation of how the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall beincluded.
7. A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.
8. A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.
9. A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

c. Projects and management actions shall be supported by best available information and best available science.

d. An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions" (GSP Regulations §354.44).

At present, the FCMA GSA is projected to be sustainable during the planning and implementation period for all the sustainability indicators that are applicable to FCMA. As a result, no PMAs, other than continued coordination with neighboring GSAs and subbasins, have been formally developed for FCMA where public notices have been made, benefits have been analyzed, or costs associated with the projects have been estimated. The following is a description of the types of PMAs FCMA is likely to implement in the event of undesirable results. If undesirable results occur or are projected to occur over the GSP implementation period, subsequent GSP updates will consist of formally developed PMAs. For reference to other PMAs in other GSAs located in the Subbasin, please refer to the other coordinated GSPs prepared for the Subbasin.

5.1 Targeted Pumping Reductions

Based on current and projected groundwater conditions, overdraft conditions and minimum threshold exceedances are not anticipated over the GSP implementation period. Under the continuation of existing management of groundwater use, groundwater conditions are sustainable. Therefore, a targeted pumping reduction plan has not been formally developed. In the event of extremely dry conditions and groundwater extractions that exceed sustainable levels, FCMA will work to develop targeted pumping reductions to reduce undesirable results. The implementation of targeted pumping reductions will only apply as a result of undesirable results for groundwater levels, groundwater storage, and subsidence for all of FCMA.

5.1.1 Measurable objective that is expected to benefit from the project or management action

Targeted pumping reductions will likely benefit all sustainability indicators. Reductions in pumping will allow groundwater levels, groundwater storage, and subsidence to recover to sustainable levels. Targeted reductions will also be useful for preventing the migration of contaminated groundwater.

5.1.2 Circumstances for implementation

The circumstances for implementation will differ for MAA and MAB.

5.1.2.1 MAA

Targeted pumping reductions will occur when undesirable results occur for groundwater elevation, groundwater storage, or subsidence. This does not apply to water extracted from the Meyers Farm Water Bank. Undesirable results for groundwater quality will not trigger any management actions as current cleanup actions are under the purview of the Regional Board. Undesirable results for interconnected surface waters will also not trigger any management actions.

5.1.2.2 MAB

Targeted pumping reductions may occur when undesirable results occur for groundwater elevation, groundwater storage, subsidence, or groundwater quality. Undesirable results for interconnected surface waters will not trigger implementation.

5.1.3 Public noticing

No public notices have been made regarding targeted pumping reductions in the event of undesirable results. If undesirable results occur or are projected to occur, FCMA will notify all interested stakeholders and landowners of the intent of develop a plan for targeted pumping reductions. All interested parties will be provided with information on how to participate in the process of identifying the location and timing of pumping reductions in FCMA.

5.1.4 Permitting and regulatory process

Targeted pumping reductions will require not permits from any county, state or federal agency.

5.1.5 Timetable for initiation and completion, and the accrual of expected benefits

In the event of undesirable results, FCMA will work with local stakeholders and landowners to develop targeted pumping reductions for the year following the occurrence of undesirable results.

5.1.6 Expected benefits and how they will be evaluated

The purpose of targeted pumping reductions is to prevent further decline of conditions below MT levels and to prevent future MT exceedances for each of the applicable sustainability indicators.

The expected benefits of targeted pumping reductions will be evaluated by continued monitoring of the representative monitoring networks.

5.1.7 How the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall be included.

Targeted pumping reductions will be accomplished by outreach and coordination with local stakeholders and landowners. Current projects and management actions do not require a source of water from outside the jurisdiction of the GSA.

5.1.8 Legal authority required

The authority to implement mandatory pumping reductions in sensitive areas is provided to FCMA under Section 10726.4(a)(2) of the California Water Code which grants the GSA the authority to "control groundwater extractions by regulating, limiting, or suspending extractions from individual groundwater wells or extractions from groundwater wells in the aggregate…"

The authority to provide surface water in lieu of groundwater extractions is provided in Section 10726.2 (d) of SB-1168 which states that a GSA may:

> "Perform any acts necessary or proper to enable the agency to purchase, transfer, deliver, or exchange water or water rights of any type with any person that may be necessary or proper to carry out any of the purposes of this part, including, but not limited to, providing surface water in exchange for a groundwater extractor's agreement to reduce or cease groundwater extractions."

6 PLAN IMPLEMENTATION

The implementation of this GSP and associated costs are discussed in this chapter of the GSP. As discussed in previous chapters, implementation will include monitoring activities and further analysis of groundwater conditions during the implementation period from 2020 through 2040. The schedule for implementation is illustrated in **Table 6-1**. These activities and their associated costs for reporting are described below.

Table 6-1: Schedule for Implementation - Overview

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Submittal to DWR	●																				
Plan Adoption	●																				
CEQA Review	■	■	■																		
Operations & Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Management & Administration	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Plan Updates						●					●					●					●
Annual Reporting	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Periodic Evaluation and Reporting																			

6.1 Estimate of GSP Implementation Costs (354.6)

Costs associated with implementing the FCMA GSA and GSP will occur over the 20-year implementation period. These costs include operations, monitoring, reporting, management, and administration, with additional costs resulting from plan updates and periodic reporting. These costs are estimated on an annual basis and are presented herein.

6.1.1 Operations and Monitoring Costs

Monitoring tasks, as described in Chapter 4, will incur costs through semi-annual to annual data collection activities and review of groundwater levels, water quality, and surface water elevations and annual monitoring of subsidence and groundwater storage data, as necessary, for the entire monitoring network. Other related tasks, that will also result in annual costs, include data analysis and management, metering of groundwater extractions, five-year updates to the groundwater model, and annual reporting to DWR. These tasks are described in detail below with the estimated annual cost for each task presented in **Table 6-2**.

Operations and monitoring tasks can be described as follows:

1. **Data Collection:** Includes collecting data for each of the sustainability indicator monitoring networks for groundwater levels, groundwater quality, subsidence, and interconnected surface waters**.** Exiting monitoring programs will be utilized for this task.
2. **Data Analysis:** Data collected for each of the sustainability indicators will be evaluate for trends and compared to the established SMC.
3. **DMS Maintenance and Updates:** Data collected for the purposes of GSP annual reporting will be QA/QC and added to the FCMA DMS. This task includes maintaining and updating the DMS to improve functionality to help facilitate GSP implementation.
4. **Efforts to Fill Data Gaps:** FCMA will continue to work with CDFW to improve monitoring in the MWA.
5. **Annual Comprehensive DWR Reporting:** Annual reports will be prepared and submitted to DWR by April 1st of each year.
6. **Project Management and Coordination:** GSA and GSP management, correspondence between FCMA and adjacent GSAs, and stakeholder outreach will occur as necessary.

Table 6-2: Operations and Monitoring Costs

Task No.	Description	Estimated Annual Cost
1	Data Collection	$10,000
2	Data Analysis	$5,000
3	DMS Maintenance and Updates	$8,000
4	Efforts to Fill Data Gaps	$5,000
5	Annual Comprehensive DWR Reporting	$20,000
6	Project Management and Coordination	$8,800
	Total	**$56,800**

6.1.2 Fresno County Management and Administration Other Costs

The implementation of this GSP will result in additional administration and management costs. These costs will all vary depending on the implementation schedule, needs that arise during implementation, monitoring, and system management, thus additional evaluation will be needed throughout the implementation period. The estimated costs, on an annual basis, are shown in **Table 6-3** below.

Table 6-3: Management, Administration, and Other Costs

Task No.	Description	Estimated Annual Cost
1	Fresno County Administrative Costs	$40,000
2	Coordination and Outreach	$10,000
	Total	**$50,000**

6.1.3 Plan Update Costs

Every five years, and any instances when the GSP is amended during the implementation period, an update to the GSP will be prepared in coordination with the other GSAs in the Subbasin and submitted to DWR with the Annual Report for that year. The update will include additional costs for that year such as professional services needed for reviewing and updating the Water Budget, Sustainable Yield, overdraft, and the preparation the Plan Evaluation and Assessment Report to be submitted to DWR. The estimated values of these costs are summarized in **Table 6-4** below.

Table 6-4: Plan Update Costs

Task No.	Description	Estimated Additional Cost for 5-Year Plan Update
1	GSP Update	$300,000
2	Public Outreach and Coordination	$44,000
	Total	**$344,000**

6.1.4 Projects and Management Actions Development and Implementation Costs

FCMA has not formally developed any PMA's. The projected water budget indicates that sustainable conditions will exist over the GSP implantation period. If undesirable conditions are projected in GSP updates, PMA's along with associated costs will be developed. Ongoing coordination with adjacent GSAs is already included in the Public Outreach and Coordination costs presented in **Table 6-3**.

6.1.5 Total Costs

Annual implementation costs of this GSP are expected to vary based on implementation status, updates to data management and modeling systems, management needs, reporting requirements, professional services, and other various sources that could affect the cost. Since the GSP will be implemented over a 20-year period, an annual inflation value of 3% and 10% contingency was assumed for planning and budgeting purposes. The total estimated cost of implementing the FCMA GSP is approximately $5.3 million dollars as summarized in **Table 6-5** below.

Table 6-5: Project Management Actions Development Costs

Fiscal Year	Operations & Monitoring Costs	Management, Administration, & Other Costs	5-Year Annual Reviews & Updates	10% Contingency	Total
2020	$56,800	$50,000	$0	$10,680	$117,480
2021	$58,504	$51,500	$0	$11,000	$121,004
2022	$60,259	$53,045	$0	$11,330	$124,635
2023	$62,067	$54,636	$0	$11,670	$128,374
2024	$63,929	$56,275	$0	$12,020	$132,225
2025	$65,847	$57,964	$344,000	$46,781	$514,592
2026	$67,822	$59,703	$0	$12,752	$140,277
2027	$69,857	$61,494	$0	$13,135	$144,486
2028	$71,953	$63,339	$0	$13,529	$148,820
2029	$74,111	$65,239	$0	$13,935	$153,285
2030	$76,334	$67,196	$395,600	$53,913	$593,043
2031	$78,624	$69,212	$0	$14,784	$162,620

2032	$80,983	$71,288	$0	$15,227	$167,498
2033	$83,413	$73,427	$0	$15,684	$172,523
2034	$85,915	$75,629	$0	$16,154	$177,699
2035	$88,493	$77,898	$454,940	$62,133	$683,464
2036	$91,147	$80,235	$0	$17,138	$188,521
2037	$93,882	$82,642	$0	$17,652	$194,177
2038	$96,698	$85,122	$0	$18,182	$200,002
2039	$99,599	$87,675	$0	$18,727	$206,002
2040	$102,587	$90,306	$523,181	$71,607	$787,681
Total	**$1,628,824**	**$1,433,824**	**$1,717,721**	**$478,037**	**$5,258,407**

6.1.6 Funding Sources

The source of funding for GSP implementation will be a combination of extraction-based and land-based assessments on members of FCMA.

6.2 Reporting

The GSA will submit an Annual Report to DWR each year following the adoption of the GSP. Annual reporting will include the measurements for the preceding water year, as described in the Monitoring Plan, including groundwater levels, water quality, stage in the Mendota Pool, meter readings, meter calibration, and subsidence, as necessary. The Annual Report will also include any model and data management system updates and progress of the GSP implementation. Annual Reports will be prepared and submitted to DWR by April 1st every year in coordination with the five other GSAs in the Subbasin. GSP updates will be prepared and submitted by January 31 on 2025, 2030, 2035, and 2040. The Annual Report will include:

1. General Information: An executive summary will be prepared to discuss any significant findings or recommendations from the reporting period. A basin map, similar to or the same as the one provided in this GSP, will also be provided.

2. Monitoring Data: All data collected for the reporting period; groundwater levels, water quality, surface water levels, and subsidence will be provided. Groundwater elevation data will also be presented using contour maps that depict the seasonal high and seasonal low groundwater levels and hydrographs of current and historical conditions, with a written description of the interpretation of the data, observed data gaps, and recommendations, as needed.

3. Groundwater Extraction Data: Groundwater extraction data will be obtained from pumping records and metered extractions for the preceding water year and presented in tables, a map,

and a written description. The measurement method, accuracy of measurements, and locations and volume of groundwater extractions will also be presented and discussed.

4. Surface Water Supply: Surface water quantities, supplied or available, will be presented and discussed as necessary.

5. Total Water Use: Total water use within the GSA will be evaluated through direct and indirect methods such as production and delivery records and meter readings and Management Plans and other sources of estimation where necessary. This information will be presented in table that shows the water use by sector, method of measurement, and accuracy of the measurements.

6. Changes in Groundwater Storage: Estimated change in groundwater storage for each aquifer will be determined using the same method as presented earlier in this GSP. This information will be presented on a map of each aquifer and on graphs that show the water year type (wet, dry, or normal), groundwater use, annual change in storage, and cumulative change in storage.

7. Implementation Progress: Progress toward implementing the GSP will be evaluated, discussed, and updated as necessary; milestones, significant updates and changes, the implementation schedule, and implementation tasks and costs.

6.3 6.3 Periodic Evaluation and Reporting

FCMA will evaluate the GSP every five years, at a minimum, with additional evaluation if the plan is amended. A report will be provided to DWR which will include the elements of the Annual Reports, implementation progress, and progress toward reaching the sustainability goal. The periodic evaluations will also be available to stakeholders and the public. Periodic evaluations will be inclusive of annual report items and the following:

1. **Current Groundwater Conditions:** An evaluation and description of groundwater conditions over the reporting period relative to the IMs, MOs, MTs, and undesirable results will be presented via graphs, figures, and a written description.
2. **Implementation of Project and Management Actions:** Each PMA will be evaluated to determine the implementation status, progress toward reaching the GSP sustainability goal, and the effect of the PMA on groundwater conditions. Re-evaluation of the PMA will occur if necessary.
3. **Plan Elements:** The basin setting, management areas, and sustainable management criteria will be evaluated, as necessary, for any reconsiderations or revisions. This will also include the progress of the plan toward meeting the sustainability goal and IMs for each sustainability indicator.

4. **Basin Setting Evaluation:** The basin setting will be evaluated for any significant changes or new information that may have developed during the reporting period. This will include significant changes in water use and potential overdraft conditions.
5. **Monitoring Network:** The monitoring network will be evaluated for its functionality, potential data gaps, and areas that are not meeting data and reporting standards set by SGMA. This will also include a discussion of potential improvements and new data collection facilities, if necessary.
6. **New Information:** Any new information that may have developed since the Plan adoption, last amendment, or last periodic evaluation will be presented.
7. **Relevant Actions:** Any actions taken by the GSA that impact the implantation of the GSP such as regulations or ordinances related to the plan, development of new PMAs, or other changes will be provided.
8. **Enforcement or Legal Actions:** A description of any enforcement or legal actions taken by the GSA will be included.
9. **Plan Amendments:** Any amendments, completed or proposed, to the plan since the previous periodic evaluation will be discussed.
10. **Summary of Coordination:** A description of GSA coordination and land use agencies will be presented if necessary.
11. **Other Information:** Any other appropriate and relevant information pursuant to SGMA, the Plan Implementation, and DWR review will be included.

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Appendix A
Common Chapter

DELTA-
MENDOTA
SGMA

July 20, 2022

Paul Gosselin
California Department of Water Resources
715 P Street
Sacramento, CA 95814

Re: Response to 'Incomplete' Determination Letter for the Delta-Mendota Subbasin

Dear Mr. Gosselin:

The Delta-Mendota Subbasin (Subbasin) received a Consultation Initiation Letter (CIL) on January 21, 2022 from the California Department of Water Resources (DWR). The CIL identified four potential deficiencies across the six Subbasin Groundwater Sustainability Plans (GSPs) which may preclude DWR's approval of the GSPs, as well as potential corrective actions to address each potential deficiency. The CIL initiated consultation between DWR, the Basin Manager, GSP Managers, and the Subbasin's 23 Groundwater Sustainability Agencies (GSAs) on February 18, 2022 regarding the amount of time needed to address the potential deficiencies and corrective actions. Subsequent meetings with DWR were held on March 7, March 30, April 19, and May 24, 2022 to discuss the Subbasin's proposed approach to addressing the identified deficiencies.

This letter has been prepared in response to the deficiencies identified in the CIL, based on direction provided by the Delta-Mendota Subbasin Coordination Committee (Coordination Committee), the Delta-Mendota Technical Working Group (Technical Working Group), the Subbasin GSAs, and DWR. It is intended to document how the deficiencies identified in the CIL were addressed in the revised GSPs and associated Common Chapter, and where those revisions are addressed in the Common Chapter.

The four deficiencies identified in DWR's CIL are summarized as follows:

Potential Deficiency 1: The GSPs do not use the same data and methodologies.

Potential Deficiency 2: The GSPs have not established common definitions of undesirable results in the Subbasin.

Potential Deficiency 3: The GSPs in the Subbasin have not set sustainable management criteria in accordance with GSP regulations.

Potential Deficiency 4: The management areas established in the Plan have not sufficiently addressed the requirements specified in 23 CCR §354.20.

Response to Potential Deficiency 1

DWR's Deficiency 1 focused on the water budget (and associated water budget components), change in groundwater storage and sustainable yield as presented in the Common Chapter. For this deficiency, DWR stated that "...the Plan lacks detail and confirmation that the six GSPs not only consider the other

GSPs within and adjacent to the Subbasin but have addressed the regulatory aspects of Sustainable Groundwater Management Act (SGMA) in a manner that substantially complies with the GSP Regulations." Additionally, DWR stated that "Department staff find that the Plan for the Subbasin does not utilize same data and methodologies to support the various water budget, change in storage, and sustainable yield approaches; therefore, it is unclear how the GSAs will reach, let alone track, sustainability throughout the Subbasin in a coordinated manner." To address this deficiency, DWR recommended that "The 23 GSAs developing the six GSPs should provide supporting information that is sufficiently detailed and provide explanations that are sufficiently thorough and reasonable to explain how the various components of each GSP will together achieve the Subbasin's common sustainability goal. The explanation should describe how the sustainable management criteria established for each GSP (including management areas if applicable) relate to each other and how they are collectively informed by the basin setting, including the water budget, change in groundwater storage, and sustainable yield, on the Subbasin-wide level."

To address Deficiency 1, the Technical Working Group and Coordination Committee met on multiple occasions during the period from February through June of 2022 to clarify and explain how the six GSPs utilized common data and methodologies to develop the Subbasin water budget, change in groundwater storage, and sustainable yield.

Use of Common Data and Methodologies

The CIL indicates that "a statement that the GSPs are coordinated without accompanying explanation is not sufficient coordination" and goes on to state that "Department staff find that the Plan for the Subbasin does not utilize same data and methodologies to support the various water budget, change in storage, and sustainable yield approaches; therefore, it is unclear how the GSAs will reach, let alone track, sustainability throughout the Subbasin in a coordinated manner."

The following subsections summarize how the 23 GSAs and their respective six GSPs coordinated and used the same data and methodologies to support the "sum-of-the-parts" approach to compiling water budgets at the Subbasin-level using the same data and methods, as required by the SGMA and GSP Emergency Regulations, and is intended to explain and document revisions to the Common Chapter regarding the water budgets, change in storage, and calculation of Subbasin sustainable yields.

Water Budget

Regarding coordination and use of the same data and methodologies for water budget development, the CIL states that "while the categories of inflows and outflows were agreed upon by the Coordination Committee for the land surface budget and groundwater budget, each of the GSP areas prepared separate water budgets using different modeling methods while often relying upon customized hydrogeological conceptual models which were then 'rolled-up' to the Subbasin level." DWR stated that "it is uncertain whether the outflow from a particular GSP within the Subbasin is comparable to the inflow from an adjacent GSP area, as there is no coordinated explanation provided in the Plan." Additionally, the CIL states that "some of the GSP groups used numerical models to calculate the inflows and outflows from the respective GSP areas while others used non-numerical and spreadsheet models – there was no explanation in the Common Chapter that indicated how these differing modeling approaches used the same data or methodology." The CIL also references Technical Memoranda #1 and #3, *Common Datasets and Assumptions used in the Delta-Mendota Subbasin GSPs*

and *Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check and Sustainable Yield*, respectively.

The purpose of the eight Technical Memoranda appended to the Common Chapter is to document the use of common data and methodologies across the six Subbasin GSPs pursuant to Water Code Section 10727.6 and Title 23, California Code of Regulations (CCR), Section 357.4 and as described in the Subbasin Coordination Agreement. In preparing the water budgets, each GSP group coordinated use of publicly available data sets along with the best available data for their GSP region. While the same data sources were used, the terminology used to describe those data sets were not consistent across the Subbasin. The Delta-Mendota Subbasin GSAs acknowledge additional detail is needed to demonstrate that all water budget components across the six Subbasin GSPs utilize the same data sources and methodologies. As such, subsequent to receipt of the CIL, the Technical Working Group met to identify the specific data used and to develop a consistent terminology for the various water budget components. Additionally, the Technical Working Group attempted to simplify the presentation of the Subbasin water budgets.

During development of the original GSPs, the Technical Working Group met monthly to ensure modeling methods and approaches were comparable and consistent between the six Subbasin GSP water budgets, including using comparable inflows and outflows between GSP regions. (Please note that all meetings were held according to the Brown Act and meeting notes available at deltamendota.org). Technical Memorandum #1 appended to the Common Chapter states that "boundary flows were evaluated by comparing inflows and outflows assessed by each GSP Group's water budget analyses and associated data, as well as groundwater flow trends from groundwater contours and hydrogeologist input. Each set of neighboring GSP Groups had independent meetings to coordinate and compare their respective contributions to inflows and outflows, and the results were provided and discussed by the Technical Working Group and Coordination Committee." Regarding the use of numerical, analytical, and spreadsheet models by the six Delta-Mendota GSP groups, Technical Memorandum #3 appended to the Common Chapter documents meetings held in September and November 2017 with DWR representatives to discuss the use of numerical and analytical models in the Subbasin, demonstrating that the hydrologic principles and equations used for both types of modeling in the Delta-Mendota Subbasin are the same.

Following receipt of the CIL, the six Delta-Mendota GSP groups agreed to a set of common simplified definitions for water budget components, and mapped their prior water budget components to the new common definitions. Table CC-8 in the revised Common Chapter documents the data sources utilized in each of the six Subbasin GSPs' historical (Water Year [WY] 2003 to 2012) and current (WY 2013) water budgets according to the common simplified water budget component definitions, and Table CC-9 includes the same information for the projected (WY 2014-2070) water budget. No water budget data were modified during this mapping process. And, as previously noted, efforts were made to use the same data sources throughout the Subbasin where available, due to variability in data availability throughout the Subbasin, the best available data were used and characterized appropriately.

The revised water budgets contained in the redline version of the Common Chapter utilize the simplified list of coordinated water budget components that use the same data sources and methods as contained in the original water budgets, but mapped to the agreed-upon set of consistent terminology. The revised land surface budget and groundwater budget tables that align with the

revised data categories are presented respectively for the historical water budget in Tables CC-10 and CC-11, for the current water budget in Tables CC-12 and CC-13, and for the projected water budget with climate change factors and projects and management actions in Tables CC-14 and CC-15. Narrative describing the simplified set of water budget components can be found starting on page CC-131 of the revised Common Chapter.

Change in Storage

DWR's CIL states that "additional explanation of historical, current, and projected change in groundwater storage for the Subbasin is warranted, as well as a straightforward quantification of overdraft throughout the Subbasin. The compilation of water budgets and the estimation of change in groundwater storage for the Subbasin does not appear to use the same data and methodology, or the Plan lacks adequate explanation for how or why the various approaches in the GSPs can be considered as using the same data and methodologies."

Additionally, the CIL stated "The explanation related to coordinated change in storage calculations and water budgets is insufficient, especially since information presented in text, and data displayed in figures and tables, do not seem to correlate with each other and it is uncertain what the current loss of storage is throughout the Subbasin. Statements in Common Chapter Section 4.2.3, state that, 'For information on how change in storage was calculated, refer to Section 4.3.3 – *Water Budgets of this Common Chapter*.' However, Section 4.3.2 only states, 'Individual historical, current, and projected water budgets were developed by each GSP Group for their respective Plan Area. For more information on the development of those water budgets, as well as tabular and graphical representation of the results, refer to the respective sections of the individual GSPs.' This fragmented and multi-staged presentation of information is insufficient to demonstrate that the various GSPs are coordinated – Section 4.2.3 of the Common Chapter refers readers to Section 4.3.2, which then refers readers to six different GSP sections. For the Upper Aquifer, four methods [were] chosen by the respective GSP regions and summed to a subbasin total." The CIL also noted, for the Lower Aquifer, "... two methods [were] chosen by the respective GSP regions and summed to a Subbasin total."

The change in groundwater storage from the Upper Aquifer was calculated using the coordinated water budgets at the Subbasin level. Water level hydrographs and groundwater storage coefficients were used to cross-check the inputs to the water budget. All six GSPs used observed land subsidence to determine Lower Aquifer change in groundwater storage. Where data were available, water budgets for the Lower Aquifer were used as a cross-check. In response to both comments (Upper and Lower Aquifer changes in groundwater storage), please refer to Table CC-8 and Table CC-9 in the revised Common Chapter (with associated narrative found on pages CC-137 through CC-138) for information regarding the use of same data and methodologies used to calculate change in storage across the six Subbasin GSPs for the historical, current, and projected water budgets, respectively, with Subbasin-level change in storage presented in Table CC-11 for the historical water budget, Table CC-13 for the current water budget, and Table CC-15 for the projected water budget.

Finally, the CIL noted a discrepancy in compiled cumulative change in storage values presented in the Common Chapter. The text on page CC-98 of the Common Chapter has been edited to address a typographical error and provide the correct cumulative change in storage in each principal aquifer between WYs 2003 and 2013, which is -624,000 acre-feet in the Upper Aquifer and -375,000 acre-feet in the Lower Aquifer.

Sustainable Yield

The CIL states: "The Common Chapter (Section 4.3.4) and Technical Memoranda #3 address the methodology for calculating sustainable yield in the Subbasin. Of the six GSPs, three provide a sustainable yield specifically for the GSP area while the other three rely upon the estimate for the entire Subbasin." The CIL also notes that "as indicated throughout the Plan, a sustainable yield estimate is not established for each GSP area and those estimates are not correlated with undesirable results." The CIL also notes, under Deficiency 2, that common definitions for significant and unreasonable were not established at the Subbasin level and there were 17 management areas that created uncertainties as to how the SMCs were coordinated with the sustainable yield.

In response to these comments, the Subbasin has now established common definitions in response to Deficiency 2, and has removed the designation of management areas in response to Deficiency 4. Sustainable yield for each principal aquifer is discussed starting on page CC-150.

Additional Coordination Components

DWR's CIL also questions the use of same data and methodologies for groundwater elevation data, groundwater extraction data, surface water supply data, and total water use data (defined as evapotranspiration in the historical, current, and projected water budgets). All of these components are inputs into the coordinated water budget; see Tables CC-8 and CC-9 and the associated water budget narrative beginning on page CC-131 of this revised Common Chapter.

Response to Potential Deficiency 2

The CIL for potential deficiency 2 states, "The GSPs have not established common definitions of undesirable results in the Subbasin." To address this deficiency, DWR's recommended corrective action was that the GSAs "...should modify each of their respective GSPs, as well as any applicable coordination materials, to substantially comply with the GSP Regulations and define undesirable results in a manner that addresses groundwater conditions occurring throughout the Subbasin..."

The Technical Working Group and Coordination Committee met to develop, at a Subbasin level, coordinated definitions and methods for establishing sustainable management criteria (SMC) for each applicable sustainability indicator. These revised definitions, and the associated numeric SMC developed using the agreed-upon methodologies, are summarized in the revised Common Chapter (see Tables CC-16 through CC-23 and Figures CC-65 through CC-70) and in the respective Sustainable Management Criteria chapters of each Subbasin GSP. Additionally, see the Response to Potential Deficiency 3, below, for more information relative to the development of the coordinated SMC.

Response to Potential Deficiency 3

DWR's Deficiency 3 comments built on their Deficiency 2 comments, stating that the Subbasin did not comply with the Emergency GSP Regulations in establishing common definitions and methodologies for SMC. In response to these comments, the six individual GSPs have been revised to reflect the agreed-upon Subbasin-wide sustainability goal as stated on page CC-153 of the revised Common Chapter, and the Technical Working Group and Coordination Committee met to develop common definitions of significant and unreasonable impacts, common methodologies for establishing numeric MTs and MOs, and common interim milestones for each sustainability indicator. See Tables CC-16

through CC-23 for these revised SMC, and narrative describing the process starting on page CC-154 of the revised Common Chapter.

Response to Potential Deficiency 4

Deficiency 4, as detailed in DWR's CIL, pertains to the use of a total of 17 management areas in four of the six GSPs prepared for the Subbasin, stating "The Management Areas established in the Plan have not sufficiently addressed the requirements" ...defined in SGMA.

In response to the DWR comments, the Subbasin GSAs agreed to eliminate or rename the formerly identified management areas as monitoring zones throughout the six GSPs and Common Chapter, and to continue to monitor and manage groundwater use in these monitoring zones according to the metrics previously set forth. Therefore, in the six GSPs and Common Chapter, all management areas have been renamed monitoring zones.

Please feel free to contact me at (209) 826-1872 if there are any questions regarding our responses to the January 21, 2022 CIL, the work conducted by the Subbasin to prepare those responses, and revisions made to the six Subbasin GSPs and Common Chapter.

Sincerely,



John Brodie
Delta-Mendota Subbasin Plan Administrator

DELTA-
MENDOTA
SGMA

Common Chapter

For the Delta-Mendota Subbasin Groundwater Sustainability Plan

August 2019; revised June 2022



PROP 1 GOVERNOR EDMUND G. BROWN, JR. WATER BOND 2014 RELIABILITY | RESTORATION | RESILIENCE

DEPARTMENT OF WATER RESOURCES · STATE OF CALIFORNIA ·

San Joaquin River Exchange Contractors GSP Group

THE COUNTY OF FRESNO 1856

GRASSLAND WATER DISTRICT

NORTHERN & CENTRAL DELTA-MENDOTA

Aliso Water District Groundwater Sustainability Agency

FARMERS WATER DISTRICT

Delta-Mendota Groundwater Subbasin

Groundwater Sustainability Plan: Revised Common Chapter

Prepared by:

WOODARD &CURRAN

August 2019; Revised June 2022

Difficulty Accessing Material

If you have difficulty accessing any material in this document, please contact us in writing or via telephone and we will work with you to make the information available. You can direct your request to:

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842 6th Street
Los Banos, CA 93635
Telephone (209) 826-1872Email: john.brodie@sldmwa.org

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Appendices

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Appendix H – List of Stakeholders and Community Organizations Contacted

Acronyms

AB 3030	1992 California Assembly Bill 3030
AWMP	Agricultural Water Management Plan
BMP	Best Management Practice
CASGEM	California Statewide Groundwater Elevation Monitoring
CCC	Columbia Canal Company
CCF	Climate Change Factors
CCID	Central California Irrigation District
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
CVO	Central Valley Operations
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
DAC	Disadvantaged Community
DMC	Delta-Mendota Canal
DPWD	Del Puerto Water District
DWR	California Department of Water Resources
ET	Evapotranspiration
ET_c	Total Crop Evapotranspiration
ET_{iw}	Crop Evapotranspiration of Irrigation Water
ET_{misc}	Miscellaneous Evapotranspiration including; canal evaporation, consumptive use of phreatophytes, etc.
FCWD	Firebaugh Canal Water District
FNF	Full Natural Flow
GAMA	Groundwater Ambient Monitoring and Assessment
gpm	gallons per minute
GRCD	Grassland Resource Conservation District
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWD	Grassland Water District

Acronyms

HCM	Hydrogeologic Conceptual Model
HMRD	Henry Miller Reclamation District
IM	interim milestone
IRWM	Integrated Regional Water Management
JPA	Joint Powers Authority
KDSA	Kenneth D. Schmidt and Associates
MAF	million acre-feet
MO	measurable objective
MSL	Mean Sea Level
MT	minimum threshold
NASA JPL	National Aeronautics and Space Administration Jet Propulsions Laboratory
P&P	Provost and Pritchard Consulting Group
RCD	Resource Conservation District
RWQCB	Regional Water Quality Control Board
SB 372	2017 California Senate Bill 372
SGMA	Sustainable Groundwater Management Act
SGWP	Sustainable Groundwater Planning
SJREC	San Joaquin River Exchange Contractors
SJRECWA	San Joaquin River Exchange Contractors Water Authority
SJRIP	San Joaquin River Improvement Program
SJRRP	San Joaquin River Restoration Program
SLDMWA	San Luis & Delta-Mendota Water Authority
SMC	Sustainable Management Criteria
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TDS	Total Dissolved Solids
TIWD	Turner Island Water District
TNC	The Nature Conservancy
UNAVCO	University NAVSTAR Consortium

Acronyms

USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USF&WS	U.S. Fish & Wildlife Service
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
WDL	Water Data Library
WMP	Water Management Plan
WSIP	Water Storage Investment Program
WWD	Westlands Water District
WY	Water Year

DISCLAIMER

The work products presented in this Common Chapter and associated Technical Memoranda (Appendix B) are a compilation of work completed by the six (6) individual Groundwater Sustainability Plan (GSP) regions under the direction of a Professional Geologist (PG) or Professional Engineer (PE) as indicated by the stamps on the respective GSP Executive Summaries. The signature here represents work completed in compiling the Common Chapter from these individual GSPs, and the signing Professional Engineer assumes no responsibility for any errors or misleading statements presented therein. Compilation of the Common Chapter, exclusive of work conducted for the individual GSPs, and revisions to this Common Chapter have been prepared under the oversight of Leslie Dumas, P.E. and the signature below is specifically for that compilation.



1. INTRODUCTION

1.1 Purpose of Common Chapter

The 23 Groundwater Sustainability Agencies (GSAs) overlying the Delta-Mendota Subbasin (Subbasin) have prepared six Groundwater Sustainability Plans (GSPs) that, together, encompass the entire Subbasin area (**Figure CC-1**). These GSPs have been prepared in a coordinated manner under the oversight of the Delta-Mendota Subbasin Coordination Committee (Coordination Committee) and in accordance with the Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement) for the Subbasin. This Common Chapter has been prepared as means of integrating key parts of the six GSPs to meet subbasin-level requirements per the Sustainable Groundwater Management Act (SGMA) and the Emergency GSP regulations (DWR, 2016).

On January 21, 2022, the Subbasin received a Consultation Initiation Letter (CIL) from the California Department of Water Resources (DWR). The CIL identified four potential deficiencies across the six Subbasin GSPs which may preclude DWR's approval, as well as potential corrective actions to address each potential deficiency. The CIL thus initiated consultation between DWR, the Subbasin Point of Contact, Plan Managers, and the Subbasin's GSAs. This Common Chapter has been revised to incorporate changes required to reflect the Subbasin's response to the deficiencies identified in the CIL, based on direction provided by the Coordination Committee, the Delta-Mendota Technical Working Group (Technical Working Group), the Subbasin GSAs and DWR. This revised Common Chapter, along with the attached cover letter, are intended to document how the deficiencies identified in the CIL were addressed in the revised Subbasin GSPs and this revised Common Chapter.

This revised Common Chapter, along with the six Subbasin GSPs, Coordination Agreement (**Appendix A**) and Common Technical Memoranda (**Appendix B**), meets regulatory requirements established by DWR as shown in the completed *Preparation Checklist for GSP Submittal* (**Appendix C**). The Common Technical Memoranda summarize the common data sets, assumptions and methodologies used during preparation of the six Subbasin GSPs. The reader is referred to the individual GSP (and their associated Executive Summaries) for information, data, and GSP requirements specific to each GSP Plan Area.

1.2 Delta-Mendota Subbasin

The Delta-Mendota Subbasin (DWR Basin 5-022.07) is located in the San Joaquin Valley Groundwater Basin and adjoins nine (9) subbasins of the San Joaquin Valley Groundwater Basin. The Delta-Mendota Subbasin boundaries generally correspond to DWR's California's Groundwater Bulletin 118 – Update 2003 (Bulletin 118) groundwater basin boundaries. Changes made to the Subbasin boundaries as part of the SGMA planning process include the following:

- A jurisdictional internal boundary modification made in 2016 to extend the boundary of the Delta-Mendota Subbasin eastward to include all of Aliso Water District.
- A jurisdictional internal boundary modification made in 2016 to bring areas that straddle the Delta-Mendota Subbasin and adjacent subbasins fully within the Delta-Mendota Subbasin. This modification adjusted areas from the southern boundary of the Delta-Mendota Subbasin and the Westside Subbasin in coordination with Westlands Water District, and moved the eastern boundary of the Delta-Mendota Subbasin from the Madera Subbasin into the Delta-Mendota

Subbasin in coordination with Aliso Water District. The modification also moved areas from the Tracy Subbasin into the Delta-Mendota Subbasin so that Del Puerto Water District and West Stanislaus Irrigation District were fully within the Delta-Mendota Subbasin, and cleaned up boundaries between the Delta-Mendota Subbasin and the Kings Subbasin to conform with the boundaries of Tranquillity Irrigation District and the Traction Ranch property (bounded on the east by Mid-Valley Water District).

- A jurisdictional internal boundary modification made in 2018 to modify the boundary between the Delta-Mendota and the Chowchilla Subbasins to follow the western boundary of Triangle T Water District and the southern boundary of Clayton Water District. This modification moved approximately 700 acres of land from the Chowchilla Subbasin into the Delta-Mendota Subbasin.

The western San Joaquin Valley is a highly agricultural region with an economy dependent on that industry. There are no large cities or industries in the Delta-Mendota Subbasin to provide an alternative economic base; hence the availability of Central Valley Project (CVP) imported supplies and surface water supplies (primarily from the San Joaquin and Kings River) are essential elements to the economic health of the region. Other uses of CVP and surface water in the Subbasin are for municipal and industrial (M&I) purposes and wildlife refuge water supply.

Groundwater is a key component of overall water supplies in the Delta-Mendota Subbasin. Agricultural and wildlife refuge needs may be supplemented by groundwater for areas with access to CVP water. Other landowners within the Subbasin may rely wholly on groundwater for irrigation and/or potable purposes. Municipal and industrial (M&I) water use, which is a small share of total water use in the Subbasin, occurs primarily within the cities, and predominantly uses groundwater to meet those demands. The largest M&I use areas in the Delta-Mendota Subbasin, based on 2015 population estimates from the U.S. Census Bureau, are the cities of Patterson (population 21,498) and Los Banos (population 37,457) (U.S. Census Bureau, 2015).

As previously noted, most communities within the Delta-Mendota Subbasin have economies greatly dependent on agricultural production. These communities include Patterson, Grayson, Tranquillity, Mendota, Firebaugh, Dos Palos, Los Banos, Santa Nella, Newman, Gustine, Crows Landing, Westley, Volta, and Vernalis.

1.3 Disadvantaged Communities within the Delta-Mendota Subbasin

A disadvantaged community (DAC) is defined as a community with a Median Household Income (MHI) less than 80% of the California statewide MHI. The California Department of Water Resources (DWR) compiled U.S. Census Bureau's American Community Survey (ACS) data from 2012 to 2016; these data were used in GIS to identify DACs within the Delta-Mendota Subbasin. California's average statewide MHI from 2012 to 2016 is $63,783; thus, a community with an MHI less than or equal to $51,026 is considered a DAC. Based on these criteria, 93% of the geographic area of the Subbasin is considered disadvantaged. Furthermore, a community with an MHI of less than 60% of the California statewide MHI, meaning an MHI of less than or equal to $38,270, is considered a severely disadvantaged community (SDAC). According to the U.S. Census ACS 2012-2016 data, there are a number of SDACs throughout the Subbasin. See **Figure CC-2** for a map of the DACs and SDACs throughout the Delta-Mendota Subbasin.

As noted above, a significant portion of the Subbasin contains DACs. Of the total population of 117,120 within the Subbasin, 80% of the population lives within a DAC, with 93% of the Subbasin's total geographic area consisting of DACs. **Table CC-1** includes the proportion of DACs in the Subbasin based on population and geographic area.

Table CC-1: DACs as a Percentage of the Delta-Mendota Subbasin

Area	Geographic Area (Square Miles)	% Based on Geographic Area	Population	% Based on Population
DAC (including SDAC)	1,109	93%	93,786	80%
Delta-Mendota Subbasin	1,194		117,120	

Table CC-2 includes Census Designated Places that are DACs in the Delta-Mendota Subbasin, with their associated MHIs and percentage of the California MHI from the ACS 5-Year 2012-2016 average. Several DACs in the Subbasin have considerably lower MHI than 80% of the California Statewide MHI and are further designated as Severely Disadvantaged Communities (SDACs). In **Table CC-2**, SDACs are indicated in bold text. Note that according to the U.S. Department of the Interior Indian Affairs, as of January 2017, there are no listed federally recognized tribes within the Region (Mosley, 2017).

Table CC-2: DAC and SDAC Census Designated Places in Delta-Mendota Subbasin

Census Designated Place (CDP)	Median Household Income (MHI)	% of CA MHI
City of Dos Palos	**$36,509**	**57%**
City of Firebaugh	**$36,181**	**57%**
City of Gustine	**$37,770**	**59%**
City of Los Banos	$45,751	72%
City of Mendota	**$26,094**	**41%**
City of Newman	$52,783	83%
Crows Landing	**$26,786**	**42%**
Dos Palos Y (CDP)	**$16,656**	**26%**
Grayson	**$29,787**	**47%**
Madera County	$45,490	74%
Merced County	$43,066	70%
Fresno County	$45,963	72%
Santa Nella	**$27,778**	**44%**
South Dos Palos	$41,992	66%
Tranquillity	**$30,441**	**48%**
Volta	$48,250	76%
Westley	**$23,375**	**37%**

Data Sources:
1. U.S. Census ACS data from 2012 to 2016 provided by DWR Mapping Tool.

Census Designated Place (CDP)	Median Household Income (MHI)	% of CA MHI

2. MHI data are from the 2016 Census, and percent of CA MHI is calculated based on the 2012-2016 Statewide MHI. Bold rows indicate severely disadvantaged communities (less than 60% of CA Statewide MHI).

1.4 Economically Disadvantaged Areas within the Delta-Mendota Subbasin

An economically distressed area (EDA) is defined by the State of California as a "municipality with a population of 20,000 persons or less, a rural county, or a reasonably isolated and divisible segment of a larger municipality where the segment of the population is 10,000 persons or less, with an annual median household income that is less than 85% of the statewide median household income, and with one or more of the following conditions as determined by the (sic) Department of Water Resources:

1. Financial hardship
2. Unemployment rate at least two percent higher than the statewide average
3. Low population density (CA Assembly, 2014)."

U.S. Census GIS data provided by DWR were used to identify EDAs in the Delta-Mendota Subbasin. **Figure CC-3** shows the location of EDAs within the Delta-Mendota Subbasin

A significant portion of the Subbasin contains EDAs. Of the total population of 117,120 within the Subbasin, 87% live in areas that meet EDA Criterion 2, 20% live in areas that meet EDA Criterion 3, and 87% live in areas that meet Criteria 2 or 3. In all, 93% of the geographic area within the Subbasin consists of areas considered to meet either EDA Criteria 2 or 3. **Table CC-3** includes the proportion of EDAs in Subbasin based on population and geographic area.

Table CC-3: EDAs as a Percentage of the Delta-Mendota Subbasin

Area	Geographic Area (Square Miles)	% Based on Geographic Area	Population	% Based on Population
EDA Criterion 2	1,112	93%	102,407	87%
EDA Criterion 3	1,004	84%	23,688	20%
EDA Criteria 2 or 3	1,112	93%	102,407	87%
Delta-Mendota Subbasin	1,194		117,120	

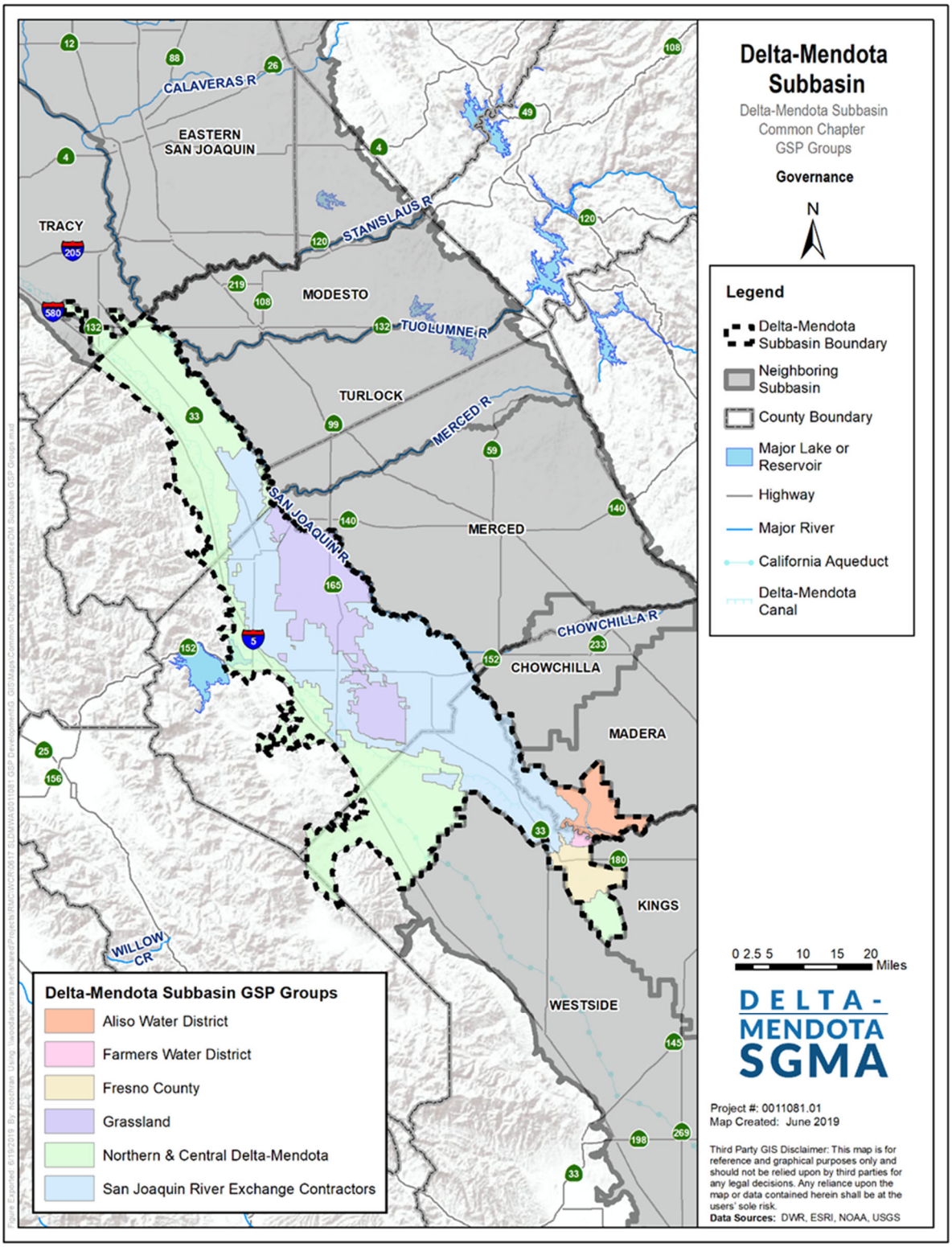


Figure CC-1: Delta-Mendota Subbasin and GSP Regions

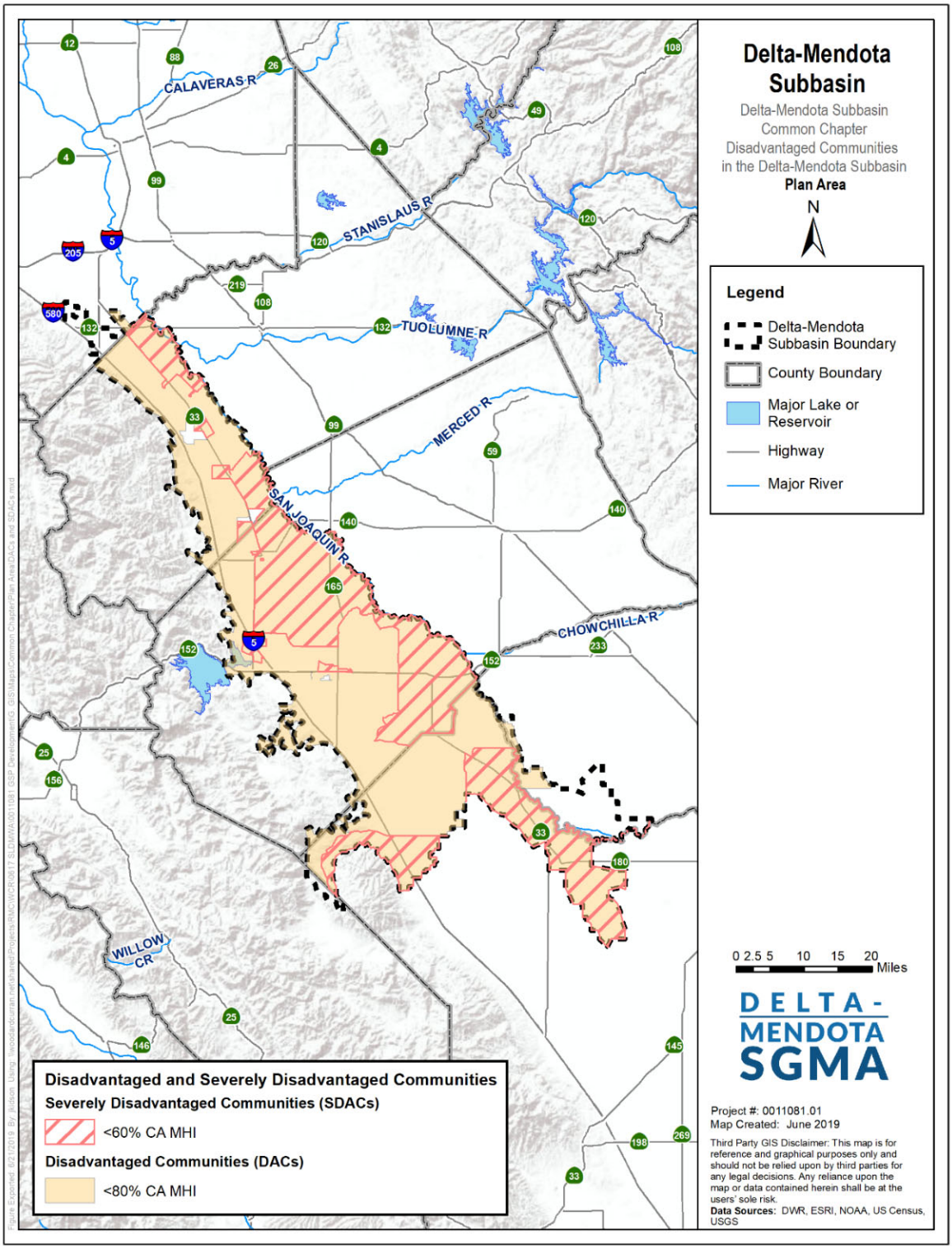


Figure CC-2: Disadvantaged and Severely Disadvantaged Communities in the Delta-Mendota Subbasin

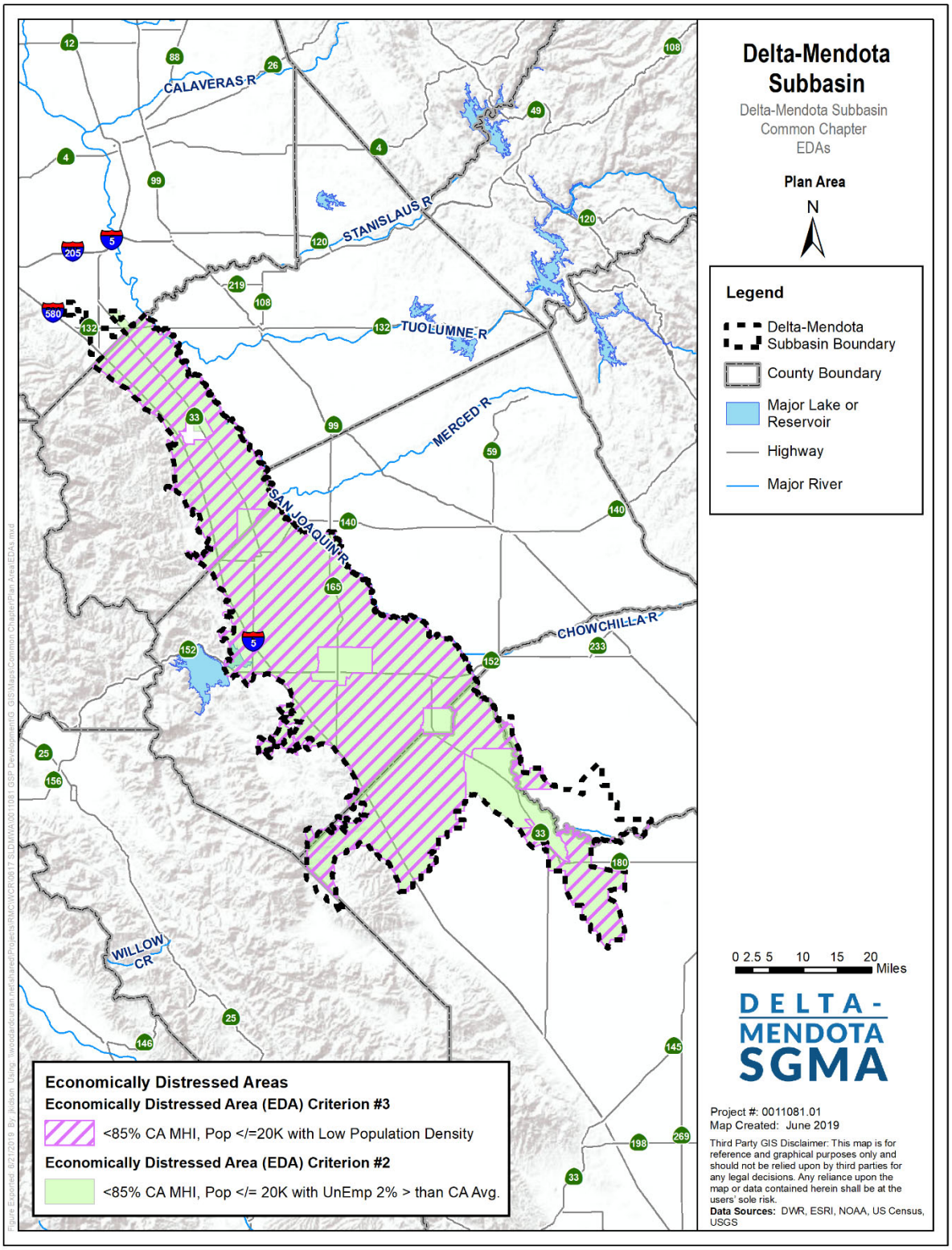


Figure CC-3: Economically Distressed Areas in the Delta-Mendota Subbasin

2. DELTA-MENDOTA SUBBASIN GOVERNANCE

This section includes information pursuant to Article 5. Plan Contents, Subarticle 1. Administrative Information, § 354.6 (Agency Information) as well as Subarticle 8. Interagency Agreements (§ 357.2 Interbasin Agreements and § 357.4 Coordination Agreements), as required by the Groundwater Sustainability Plan (GSP) Regulations. Agency Contact information for the Delta-Mendota Subbasin and the plan manager is included in this section. The organization and management structure, as well as the legal authority of each Groundwater Sustainability Agency (GSA) in the Delta-Mendota Subbasin, is detailed and accompanied by GSA boundary maps and a description of intra-basin and inter-basin coordination agreements in place for the development and implementation of the GSPs overlying the Delta-Mendota Subbasin.

Agency Contact Information

This Common Chapter to the six GSPs for the Delta-Mendota Subbasin has been prepared in a cooperative manner by the following GSAs in the Delta-Mendota Subbasin:

Northern & Central Delta-Mendota Region GSP

- Patterson Irrigation District GSA
- West Stanislaus Irrigation District GSA
- DM-II GSA
- City of Patterson GSA
- Northwestern Delta-Mendota GSA
- Central Delta-Mendota GSA
- Widren Water District GSA
- Oro Loma Water District GSA

San Joaquin River Exchange Contractors (SJREC) GSP

- San Joaquin River Exchange Contractors Water Authority GSA
- Turner Island Water District-2 GSA
- City of Mendota GSA
- City of Firebaugh GSA
- City of Los Banos GSA
- City of Dos Palos GSA
- City of Gustine GSA
- City of Newman GSA
- Madera County – 3 GSA
- Portion of Merced County – Delta-Mendota GSA
- Portion of Fresno County Management Area B GSA

Grassland GSP

- Grassland GSA
- Portion of Merced County – Delta-Mendota GSA

Aliso Water District GSP

- Aliso Water District GSA

Farmers Water District GSP

- Farmers Water District GSA

Fresno County GSP

- Fresno County Management Area A GSA
- Portion of Fresno County Management Area B GSA

The plan areas covered by each of the six Subbasin GSPs is show in **Figure CC-1**. **Figure CC-4** through **Figure CC-6** show the location of the GSAs comprising the six GSP regions. These GSAs are coordinating development and implementation of the six GSPs under the Coordination Agreement, as described below in Section 2.1.

The current Plan Manager for the coordinated Delta-Mendota Subbasin GSPs is John Brodie, Water Resources Program Manager for San Luis & Delta-Mendota Water Authority (SLDMWA). Mr. Brodie can be contacted as follows:

Mr. John Brodie, Plan Manager
Delta-Mendota Subbasin
842 6th Street
Los Banos, CA 93635
Phone: (209) 826-1872/ Fax (209) 833-1034
john.brodie@sldmwa.org

Contact information for each GSP plan administrator can be found in the respective GSPs. The DWR Point of Contact is shown below.

Department of Water Resources Point of Contact

The point of contact for the Delta-Mendota Subbasin is:

Christopher Olvera
Department of Water Resources
Christopher.Olvera@water.ca.gov
(559) 230-3373

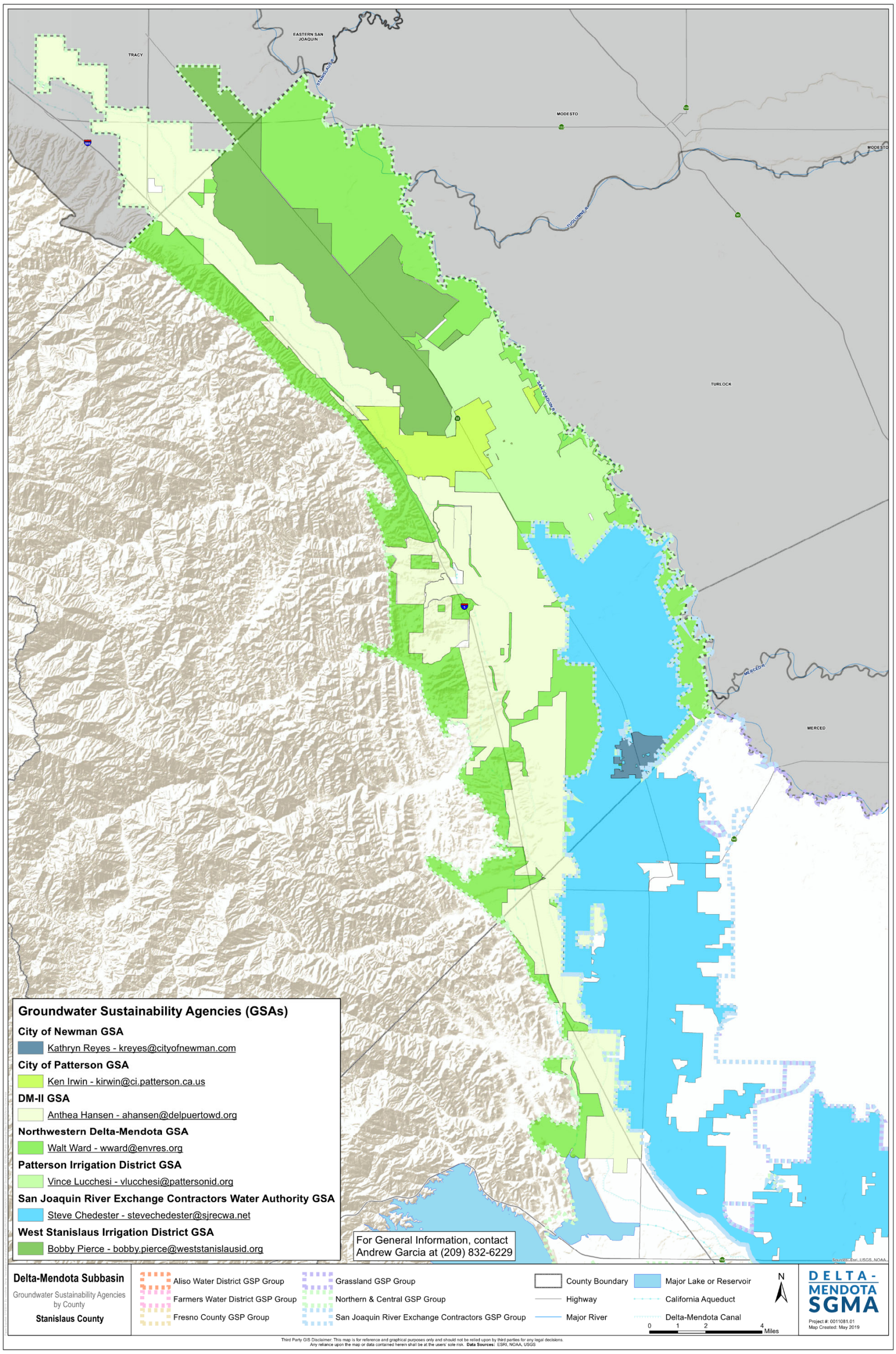


Figure CC-4: GSAs in the Delta-Mendota Subbasin – Stanislaus County

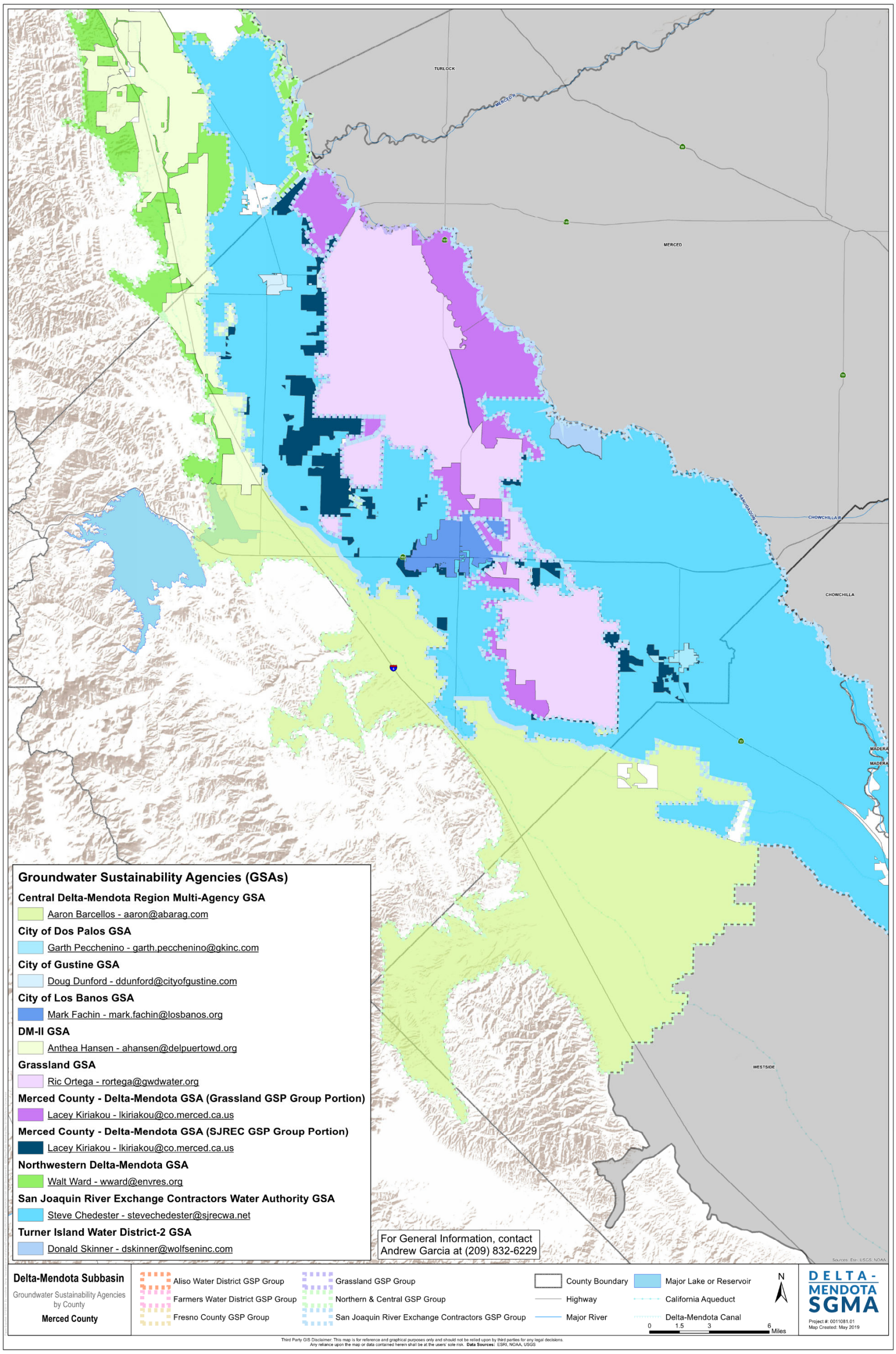


Figure CC-5: GSAs in the Delta-Mendota Subbasin – Merced County

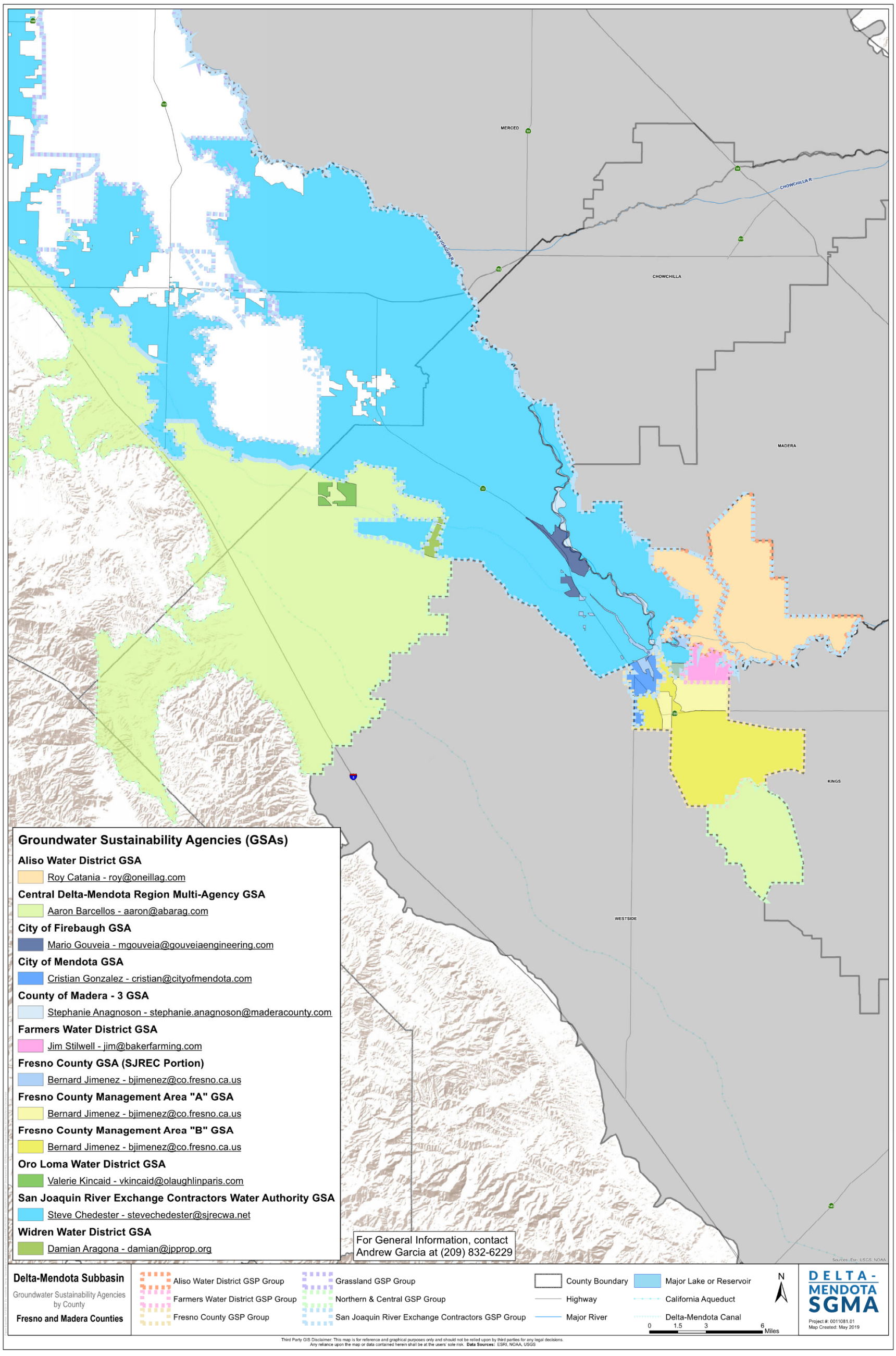


Figure CC-6: GSAs in the Delta-Mendota Subbasin – Fresno and Madera Counties

2.1 GSA and GSP Coordination and Governance

This section includes a description of intra-basin coordination agreements, which are required where there is more than one GSP prepared for a groundwater basin, and inter-basin coordination agreements, which are optional agreements between neighboring groundwater subbasins, pursuant to Article 8. Interagency Agreements, § 357.4. Coordination Agreements and § 357.2 Interbasin Agreements.

2.1.1 Delta-Mendota Subbasin SGMA Governance Structure

The GSAs within the Delta-Mendota Subbasin adopted and executed a Coordination Agreement on December 12, 2018 to comply with the SGMA requirement that multiple GSAs within a given subbasin must coordinate when developing and implementing their GSPs (see Intra-Agency Coordination subsection above for more information). Additionally, a Cost Sharing Agreement was signed and executed by the same parties on December 12, 2018. **Figure CC-5** shows the SGMA governance structure within the Delta-Mendota Subbasin. In addition to the two members appointed to represent each of the Northern & Central Delta-Mendota GSP Region and the San Joaquin River Exchange Contractors (SJREC) GSP Region on the Delta-Mendota Subbasin Coordination Committee as voting members, the Grassland GSP Region, Farmers Water District GSP Region, Fresno County Management Areas A & B GSP Region, and Aliso Water District GSP Region all have appointed one voting member each for a total of eight voting members.

Three working groups were formed under the auspices of the Delta-Mendota Subbasin Coordination Committee: the Technical Working Group, the Communications Working Group and the DMS Working Group. Representatives of each GSP region participate in each working group.

Table CC-4: Delta-Mendota Subbasin Coordination Committee Members

GSP		GSA	Agency	Coordination Committee Members	
				Primary	Alternate
Northern & Central Delta-Mendota Region GSP	Northern Delta Mendota Region Management Committee	Patterson Irrigation District GSA	Patterson Irrigation District	Vince Lucchesi	Walt Ward
			Twin Oaks Irrigation District		
		West Stanislaus Irrigation District GSA	West Stanislaus Irrigation District		
		DM-II GSA	Del Puerto Water District		
			Oak Flat Water District		
		City of Patterson GSA	City of Patterson		
		Northwestern Delta-Mendota GSA	Merced County		
			Fresno County		
	Central Delta-Mendota Region Management Committee	Central Delta-Mendota GSA	San Luis Water District	Ben Fenters	Lacey Kiriakou
			Panoche Water District		
			Tranquillity Irrigation District		
			Fresno Slough Water District		
			Eagle Field Water District		
			Pacheco Water District		
			Santa Nella County Water District		
			Mercy Springs Water District		
			Merced County		
			Fresno County		
		Widren Water District GSA	Widren Water District		
		Oro Loma Water District GSA	Oro Loma Water District		

GSP	GSA	Agency	Coordination Committee Members	
			Primary	Alternate
San Joaquin River Exchange Contractors GSP	San Joaquin River Exchange Contractors Water Authority GSA	Central California Irrigation District	Jarrett Martin, Alejandro Paolini	Chris White, John Wiersma
		Columbia Canal Company		
		Firebaugh Canal Water District		
		San Luis Canal Company		
	Turner Island Water District-2 GSA	Turner Island Water District		
	City of Mendota GSA	City of Mendota		
	City of Firebaugh GSA	City of Firebaugh		
	City of Los Banos GSA	City of Los Banos		
	City of Dos Palos GSA	City of Dos Palos		
	City of Gustine GSA	City of Gustine		
	City of Newman GSA	City of Newman		
	County of Madera – 3 GSA	County of Madera		
	Portion of Merced County – Delta-Mendota GSA	County of Merced		
	Portion of Fresno County Management Area B GSA	County of Fresno		
Grassland GSP	Grassland GSA	Grassland Water District	Ric Ortega	Ken Swanson
		Grassland Resource Conservation District		
	Portion of Merced County Delta-Mendota GSA	County of Merced		
Farmers Water District GSP	Farmers Water District GSA	Farmers Water District	Jim Stilwell	Don Peracchi
Fresno County GSP	Fresno County – Management Area A	County of Fresno	Buddy Mendes	Glenn Allen or Augustine Ramirez

GSP	GSA	Agency	Coordination Committee Members	
			Primary	Alternate
	Fresno County – Management Area B	County of Fresno		
Aliso Water District GSP	Aliso Water District GSA	Aliso Water District	Joe Hopkins	Board Secretary (Ross Franson)

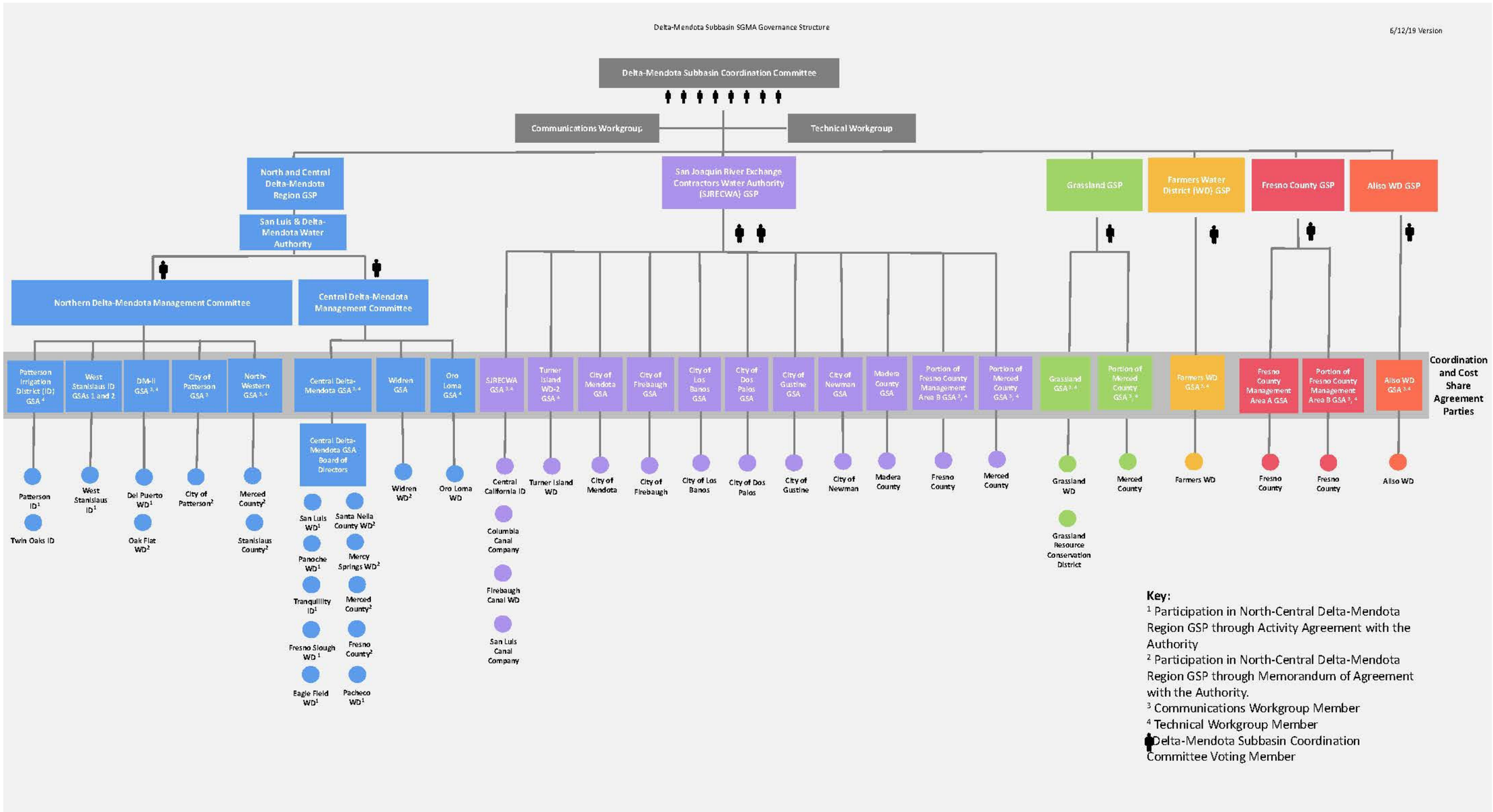


Figure CC-7: Governance Structure of the Delta-Mendota Subbasin

2.1.2 Intra-Basin Coordination

The Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement), effective as of December 12, 2018, has been signed by all participating agencies in the Delta-Mendota Subbasin; a copy of this agreement is included in **Appendix A**. The purpose of the Agreement, including technical reports to be developed after the initial execution of this Agreement, is to comply with SGMA requirements and to ensure that the multiple GSPs within the Subbasin are developed and implemented utilizing the same datasets, methodologies and assumptions, that the elements of the GSPs are appropriately coordinated to support sustainable subbasin management of groundwater resources, and to ultimately set forth the information necessary to show how the multiple GSPs in the Subbasin will achieve the sustainability goal as determined for the Subbasin in compliance with SGMA and its associated regulations.

A key goal of basin-wide coordination is to ensure that the Subbasin GSPs utilize the same data and methodologies during their plan development and that elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting, as required by SGMA and associated regulations. The Coordination Agreement defines how the coordinated efforts will be achieved and documented, and also sets out the process for identifying the Plan Manager. The Coordination Agreement is part of each individual GSP within the Delta-Mendota Subbasin.

The Coordination Agreement for the Delta-Mendota Subbasin covers the following topics:

1. Purpose of the Agreement, including:
    a. Compliance with SGMA and
    b. Description of Criteria and Function;
2. General Guidelines, including:
    a. Responsibilities of the Parties and
    b. Adjudicated or Alternative Plans in the Subbasin;
3. Role of San Luis & Delta-Mendota Water Authority (SLDMWA), including:
    a. Agreement to Serve,
    b. Reimbursement of SLDMWA, and
    c. Termination of SLDMWA's Services;
4. Responsibilities for Key Functions, including:
    a. Coordination Committee,
    b. Coordination Committee Officers,
    c. Coordination Committee Authorized Action and Limitations,
    d. Subcommittees and Workgroups,
    e. Coordination Committee Meetings, and
    f. Voting by Coordination Committee;
5. Approval by Individual Parties;
6. Exchange of Data and Information, including:
    a. Exchange of Information and
    b. Procedure for Exchange of Information;
7. Methodologies and Assumptions, including:
    a. SGMA Coordination Agreements,
    b. Pre-GSP Coordination, and

   c. Technical Memoranda Required;
8. Monitoring Network
9. Coordinated Water Budget
10. Coordinated Data Management System
11. Adoption and Use of the Coordination Agreement, including:
    a. Coordination of GSPs and
    b. GSP and Coordination Agreement Submission;
12. Modification and Termination of the Coordination Agreement, including:
    a. Modification or Amendment of Exhibit "A" (Groundwater Sustainability Plan Groups including Participation Percentages),
    b. Modification or Amendment of Coordination Agreement, and
    c. Amendment for Compliance with Law;
13. Withdrawal, Term, and Termination;
14. Procedures for Resolving Conflicts;
15. General Provisions, including:
    a. Authority of Signers,
    b. Governing Law,
    c. Severability,
    d. Counterparts, and
    e. Good Faith; and
16. Signatories of all Parties

Coordination During GSP Implementation

The Coordination Agreement ensures that the multiple GSAs are working cooperatively and collaboratively to ensure GSPs within the Subbasin are developed and implemented utilizing the same methodologies and assumptions and to ultimately establish the processes necessary to show how the multiple GSPs in the Subbasin will be sustainably managed to achieve the Delta-Mendota Subbasin's sustainability goal. The Coordination Committee intends to continue to meet and confer following the submittal of the Subbasin's GSPs and will develop guidelines for GSP implementation between the GSP Groups and update the Coordination Agreement as the Parties to the Agreement deem necessary.

The Coordination Committee will continue meeting regularly following submittal of the Subbasin GSPs in order to develop the guidelines for coordinated implementation of GSPs. The intent of the guidelines will be to outline processes that will ensure the GSAs are progressing toward the Subbasin sustainability goal, while meeting the Annual Reporting requirements or any other requirements agreed upon for purposes of coordination.

Agency Responsibilities

In meeting the terms of the Coordination Agreement, all Parties (meaning the Delta-Mendota Subbasin GSAs) agree to work collaboratively to meet the objectives of SGMA and the Coordination Agreement. Each Party to the Agreement is a GSA and acknowledges that it is bound by the terms of the Coordination Agreement as an individual party.

The Parties have established a Coordination Committee to provide a forum to accomplish the coordination obligations of SGMA. The Coordination Committee operates in full compliance with the Brown Act and is composed of a Chairperson and Vice Chairperson, Secretary, Plan Manager, and a GSP Group Representative and Alternate Representative for each of the six GSP groups. The Chairperson and Vice Chairperson are rotated annually among GSP Groups in alphabetical order. The Secretary assumes primary responsibility for Brown Act compliance. The GSP Group Representatives, who are identified in **Table CC-4**, are selected by each respective GSP Group at the discretion of the respective GSP Group, and such appointments are effective upon providing written notice to the Secretary and to each Group Contact. The Coordination Committee recognizes each GSP Group Representative and GSP Group Alternate Representative until the Group Contact provides written notice of removal and replacement to the Secretary and to every other Group Contact. Each GSP Group is required to promptly fill any vacancy created by the removal of its Representative or Alternate Representative so that each GSP Group has the number of validly designated representatives.

Each GSP Group Representative is entitled to one vote at the Coordination Committee, where the Alternate Representative is authorized to vote in the absence of the GSP Group Representative. The unanimous vote of the GSP Representatives from all GSP Groups is required on most items upon which the Coordination Committee is authorized to act, with the exception of certain ministerial and administrative items. Voting procedures to address a lack of unanimity take place upon a majority vote of a quorum of the Coordination Committee and include straw polls, provisional voting, and delay of voting (see Section 5.6.3 – *Voting Procedures to Address Lack of Unanimity* of the Coordination Agreement). Where the law or the Coordination Agreement require separate written approval by each of the Parties, such approval is evidenced in writing by providing the resolution, Motion, or Minutes of their respective Board of Directors to the Secretary of the Coordination Committee. Minutes of the Coordinate Committee are kept and prepared by the Secretary's appointee and maintained by the Secretary as Coordination Agreement records and are available to the Parties and the public upon request. Meeting agenda and minutes are posted on the Delta-Mendota website (www.deltamendota.org).

The Coordination Committee may appoint subcommittees, working groups, and otherwise direct staff made available by the Parties. Subcommittees or working groups may include qualified individuals possessing the knowledge and expertise to advance the goals of the Coordination Agreement on the topics being addressed by the subcommittee or working group, whether or not such individuals are GSP Group Representatives or Alternate Representatives. Tasks assigned to subcommittees, working groups, or staff made available by the Parties may include developing technical data, supporting information, and/or recommendations on specialized matters to the Coordination Committee. One GSP Group Representative or Alternate Representative is required to vote on behalf of the GSP Group at the subcommittee level. If no GSP Group Representative or Alternate Representative is present, one individual working on a subcommittee on behalf of the Parties in a GSP Group votes on behalf of the GSP Group. Subcommittees report voting results and provide information to the Coordination Committee but are not entitled to make determinations or decisions that are binding on the Parties.

The Coordination Committee is authorized to act upon the following items:

1. The Coordination Committee reviews, and consistent with the requirements of SGMA, approves the Technical Memoranda that compose the Common Chapter (see *Coordinated Data and Methodology*);
2. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda as needed; assuring submittal of annual reports; providing five-year assessments and recommending any needed revisions to the Coordination Agreement; and providing review and assistance with coordinated projects and programs, once the GSPs have been submitted to and approved by DWR;
3. The Coordination Committee reviews and approves work plans, and in accordance with the budgetary requirements of the respective Parties, approves annual budget estimates of Coordinated Plan Expenses presented by the Secretary and any updates to such estimates provided that such estimates or updates with supporting documentation are circulated to all Parties for comment at least thirty (30) days in advance of the meeting at which the Coordination Committee will consider approval of the annual estimate;
4. The Coordination Committee is authorized to approve changes to Exhibit "A" (Groundwater Sustainability Plan Groups including Participation Percentages) to the Agreement and to recommend amendments to terms of the Agreement;
5. The Coordination Committee may assign work to subcommittees and workgroups as needed, provide guidance and feedback and ensure that subcommittees and workgroups prepare work products in a timely manner;
6. The Coordination Committee directs the Plan Manager in the performance of its duties under SGMA; and
7. The Coordination Committee provides direction to its Officers concerning other administrative and ministerial issues necessary for the fulfillment of the above-enumerated tasks.

Additional information regarding the roles, responsibilities, and duties of the Coordination Committee can be found in Section 5 – *Responsibilities for Key Functions* of the Coordination Agreement.

Exchange of Information

Timely exchange of information is a critical aspect of GSP coordination. All parties to the Coordination Agreement have agreed to exchange public and non-privileged information through collaboration and/or informal requests made at the Coordination Committee level or through subcommittees designated by the Coordination Committee. To the extent it is necessary to make a written request for information to another Party, each Party designates a representative to respond to information requests and provides the name and contact information of the designee to the Coordination Committee. Requests may be communicated in writing and transmitted in person or by mail, facsimile machine, or other electronic means to the appropriate representative as named in the Coordination Agreement. The designated representative is required to respond in a reasonably timely manner. Nothing in the Agreement shall be construed to prohibit any Party from voluntarily exchanging information with any other Party by any other mechanism separate from the Coordination Committee.

The Parties agree that each GSP Group shall provide the data required to develop the Subbasin-wide coordinated water budget but, unless required by law, will not be required to provide individual well or parcel-level information in order to preserve confidentiality of individuals to the extent authorized by law, including but not limited to Water Code Section 10730.8, subdivision (b). To the extent that a court order,

subpoena, or the California Public Records Act is applicable to a party, the Party in responding to a request made pursuant to that Act for release of information exchanged from another Party shall notify each other Party in writing of its proposed release of information in order to provide the other Parties with the opportunity to seek a court order preventing such release of information.

Dispute Resolution

Procedures for conflict resolution have been established within the Coordination Agreement. In the event that a dispute arises among Parties as it relates to the Coordination Agreement, the disputing Party or Parties are to provide written notice of the basis of the dispute to the other Parties within thirty (30) calendar days of the discovery of the events giving rise to the dispute. Within thirty (30) days after such written notice, all interested Parties are to meet and confer in good faith to informally resolve the dispute. All disputes that are not resolved informally shall be settled by arbitration. In such an event, within ten (10) days following the failed informal proceedings, each interested Party is to nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties are to rank their top three among all nominated arbitrators, awarding three points to the top choice, two points to the second choice, and one point to the third choice and zero points to all others. Each interested Party will then forward its tally to the Secretary, who tabulates the points and notifies the interested Parties of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The Secretary may also develop procedures for approval by the Parties for selection of an arbitrator in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines to act. The arbitration is to be administered in accordance with the procedures set forth in the California Code of Civil Procedure, Section 1280, *et seq.*, and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring legal action relating to the controversy.

Coordinated Data and Methodology

Pursuant to SGMA, the Coordination Agreement ensures that the individual GSPs utilize the same data and methodologies for developing assumptions used to determine: 1) groundwater elevation; 2) groundwater extraction data; 3) surface water supply; 4) total water use; 5) changes in groundwater storage; 6) water budgets; and 7) sustainable yield. The Parties have agreed to develop agreed-upon methodologies and assumptions for the aforementioned items prior to or concurrent with the individual development of GSPs. This development is facilitated through the Coordination Committee's delegation to a subcommittee or working group of the technical staff provided by some or all of the Parties. The basis upon which the methodologies and assumptions have been developed includes existing data/information, best management practices, and/or best modeled or projected data available and may include consultation with DWR as appropriate.

The data and methodologies for assumptions described in Water Code §10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans are set forth in Technical Memoranda prepared by the Coordination Committee for each of the following elements: Data and Assumptions; Hydrogeologic Conceptual Model; Coordinated Water Budgets; Sustainable Management Criteria (SMC); Coordinated Monitoring Network; Coordinated Data Management System, and Adoption and Use of the Coordination Agreement. The Technical Memoranda have been subject to the unanimous approval of the Coordination Committee and once approved, have been attached to and incorporated by reference into the Coordination Agreement without formal amendment of the Coordination Agreement being required. The Parties have agreed that they will not submit this Coordination Agreement to DWR until the Technical Memoranda described herein have been added to the Coordination Agreement. The Technical Memoranda created pursuant to the Coordination Agreement are to be utilized by the Parties during the development and implementation of their individual GSPs in order to assure coordination of

the GSPs is in compliance with SGMA. The Technical Memoranda have been included as an appendix to this GSP as a part of the Common Chapter.

Plan Implementation and Submittal

Under the Coordination Agreement, the Parties have agreed to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. Subject to the subsequent attachment of the Technical Memoranda as appendices to the Common Chapter, the Parties intend that the described Coordination Agreement fulfill the requirements of providing an explanation of how the GSPs implemented together satisfy the requirements of SGMA for the entire Subbasin. The Coordination Agreement does not otherwise affect each Party's responsibility to implement the terms of its respective GSP in accordance with SGMA. Rather, this Coordination Agreement is the mechanism through which the Parties will coordinate their respective GSPs to the extent necessary to ensure that such GSP coordination complies with SGMA.

Each Party is responsible for ensuring that its own GSP complies with the statutory requirements of SGMA, including but not limited to the filing deadline. The Parties to this Coordination Agreement intend that their individual GSPs be coordinated together in order to satisfy the requirements of SGMA and to be in substantial compliance with the California Code of Regulations. The collective GSPs will satisfy the requirements of Water Code Sections 10727.2 and 10727.4 by providing a description of the physical setting and characteristics of the separate aquifer systems within the Subbasin, the measurable objectives for each such GSP, interim milestones (IMs), and monitoring protocols that together provide a detailed description of how the Subbasin as a whole will be sustainably managed.

The Parties agree to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. The Coordination Committee is responsible for assuring submittal of annual reports, five-year updates, and for providing assessments recommending any needed revisions to the Coordination Agreement.

Coordinated Data Management System

The Delta-Mendota Subbasin GSAs have developed and will maintain a coordinated Data Management System that is capable of storing and reporting information relevant to the reporting requirements and/or implementation of the GSPs and monitoring network of the Subbasin.

The Parties may also develop and maintain separate Data Management Systems. Each separate Data Management System developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

Adjudicated Areas and Alternative Plans

There are no adjudicated areas within the Delta-Mendota Subbasin, and no Alternative Plans have been submitted by the local agencies within the Subbasin.

Legal Bindings of the Delta-Mendota Subbasin Coordination Agreement

The Coordination Agreement, as contained herein, is reflected in the same manner and form as in the six Subbasin GSPs. All parties understand that the Delta-Mendota Subbasin Coordination Agreement is part of the GSPs for participating Subbasin GSAs and will be a primary mechanism by which the six Subbasin

GSPs will be implemented in a coordinated fashion. Further, all parties to the Coordination Agreement understand that DWR will evaluate the agreement for compliance with the procedural and technical requirements of GSP Regulations §357.4 (Coordination Agreement) to ensure that the agreement is binding on all parties and that provisions of the agreement are sufficient to address any disputes between or among parties to the agreement.

The Coordination Agreement will continue to be the framework under which the six Delta-Mendota Subbasin GSPs will be implemented and will be reviewed as part of the five-year assessment and revised as necessary, dated, and signed by all parties.

2.1.3 Inter-basin Agreements

SLDMWA, on behalf of the Northern and Central Delta-Mendota Regions, and the SJREC GSA executed inter-basin data sharing agreements with Westlands Water District (the lead entity encompassing the adjoining Westside Subbasin). The purpose of the agreement is to establish a set of common assumptions on groundwater conditions on either side of the boundary between the Westside Subbasin and the Delta-Mendota Subbasin to be used for the development of GSPs in support of implementation of SGMA. In this agreement, the parties agree to provide each other with recorded, measured, estimated, and/or simulated modeling data located within five (5) miles of the boundary between the Westside Subbasin and the Delta-Mendota Subbasin. A list of data types to be shared between the parties to the agreement can be found in **Appendix D**.

Data provided under this agreement are understood to be shared with consultants and other stakeholders in the respective basins (Delta-Mendota Subbasin and Westside Subbasin), and that the information will be made public through the development of the respective Parties' (meaning SLDMWA/SJREC and Westlands Water District) GSPs and the supporting documentation of the GSPs. Other than publishing information for those purposes, neither Party will disclose the other Party's information to any third party, except if the other Party determines, at its sole discretion, the disclosure is required by law. Each Party may review preliminary results before publishing the information.

It is recognized that many of the sustainability indicators, notably groundwater quality, inelastic land subsidence and change in storage, are regional issues that may require future inter-basin discussions and coordination. Memorandum of Intent (MOI) are being discussed with the surrounding subbasins to demonstrate/confirm the subbasins' desires to coordinate during GSP implementation. These agreements, to be discussed further following submittal of GSPs, will allow for thoughtful consideration of the intent, structure, and need for future coordination with respect to data collection, reporting, regular meetings, and updates prior to annual reporting.

3. DELTA-MENDOTA SUBBASIN PLAN AREA

This section describes the Delta-Mendota Subbasin, including major streams and creeks, institutional entities, agricultural and urban land uses, locations of state lands (including wetlands), and geographic boundaries of surface water runoff areas. The reader is referred to the individual Subbasin GSPs for descriptions of existing surface water and groundwater monitoring programs, existing water management programs, and general plans in the individual GSP Plan Areas. The information contained in this section reflects information from publicly available sources and may not reflect all information that will be used for GSP technical analysis.

This section of the GSP satisfies Section 354.8 of the SGMA regulations.

3.1 Plan Area Definition

The Plan Area for the six coordinated GSPs is the Delta-Mendota Subbasin (DWR Basin 5-022.07). As previously noted, the Delta-Mendota Subbasin is one of nine subbasins that lie completely within the San Joaquin Valley Hydrologic Region and adjoins the following subbasins (**Figure CC-8**):

- Tracy
- Eastern San Joaquin
- Modesto
- Turlock
- Merced
- Chowchilla
- Madera
- Kings
- Westside

As described in *California's Groundwater*, DWR Bulletin 1188 (2016), the Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley and includes portions of San Joaquin, Stanislaus, Merced, Fresno, San Benito, and Madera Counties. The northern boundary begins just south of Tracy in San Joaquin County, and the eastern boundary generally follows the San Joaquin River and Fresno Slough. The southern boundary is near the small town of San Joaquin, and the Subbasin is bounded on the west by the Coast Range. The Subbasin boundaries are further described in Section 4.1.5, Basin Boundaries, and is shown in relation to each of the six counties in **Figure CC-9**.

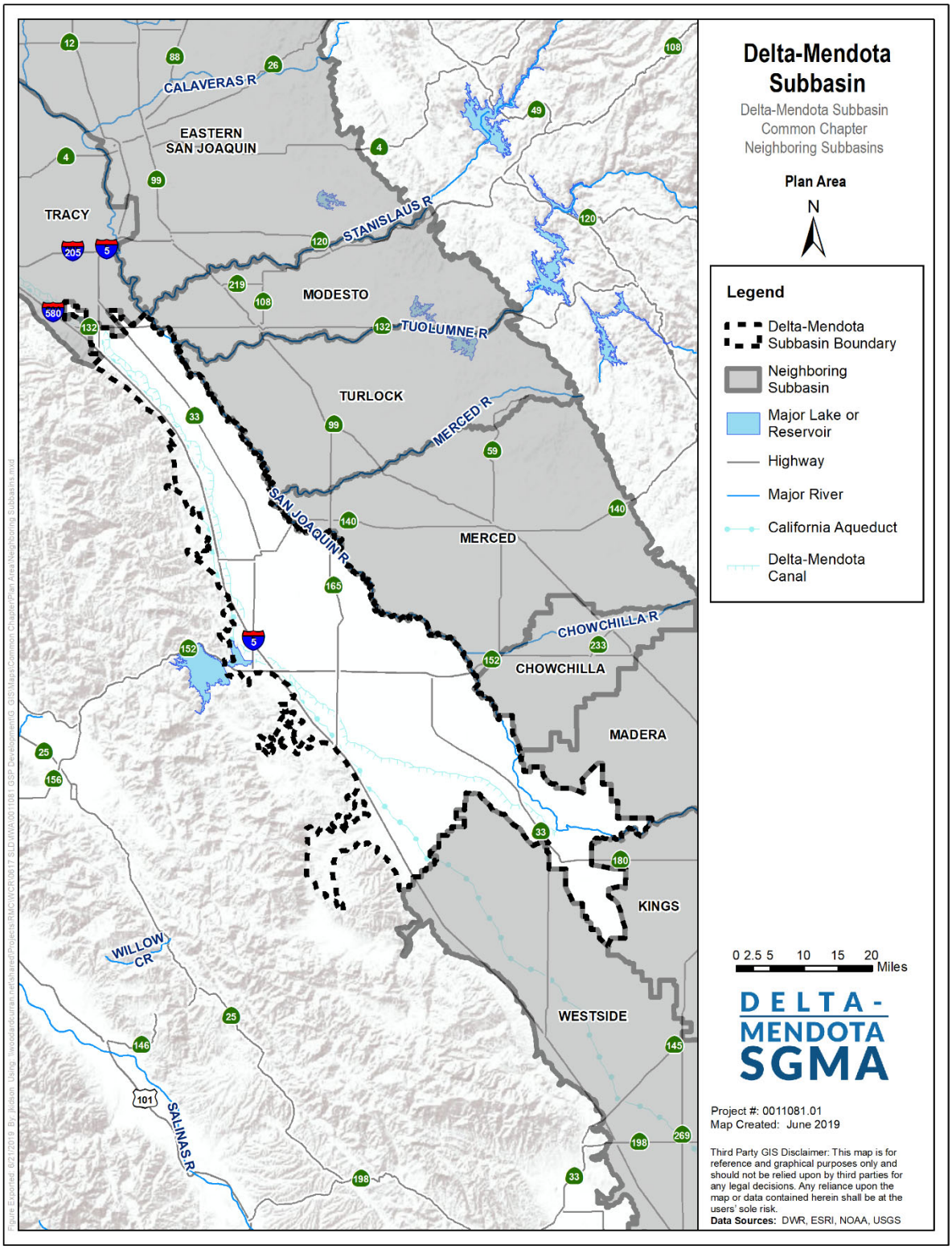


Figure CC-8: Neighboring Subbasins of the Delta-Mendota Subbasin

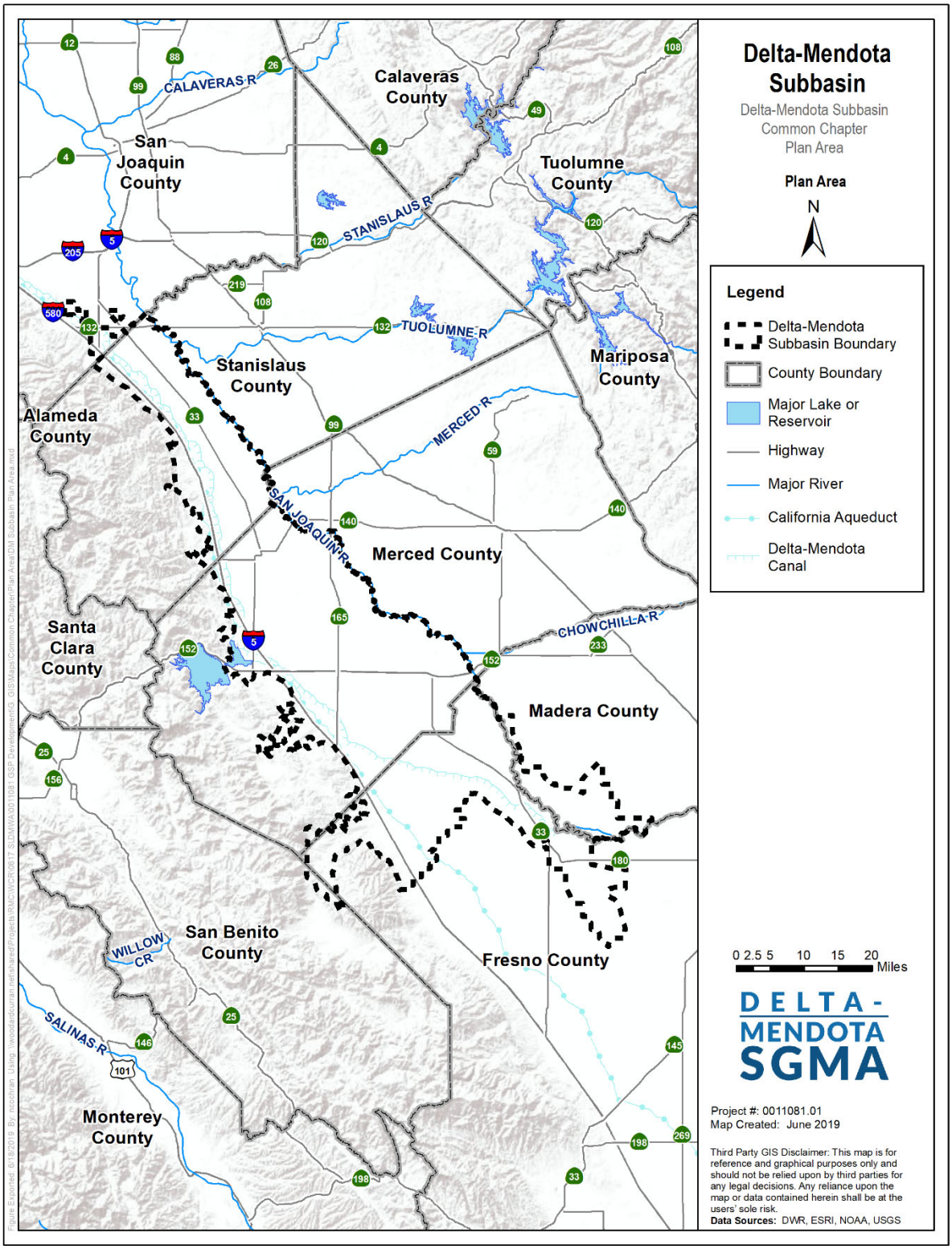


Figure CC-9: Delta-Mendota Groundwater Subbasin Plan Area

3.2 Plan Area Setting

As previously noted, the Delta-Mendota Subbasin lies along the western margin of the San Joaquin Valley. This valley is part of the large, northwest-to-southeast-trending asymmetric trough of the Central Valley, which has been filled with up to six vertical miles of sediment. This sediment includes both marine and continental deposits ranging in age from Jurassic to Holocene. The San Joaquin Valley lies between the Coast Range Mountains on the west and the Sierra Nevada on the east and extends northwestward from the San Emigdo and Tehachapi Mountains to the Sacramento-San Joaquin Delta (Delta) near the City of Stockton. The San Joaquin Valley is 250 miles long and 50 to 60 miles wide. The relatively flat alluvial floor is interrupted occasionally by low hills. Foothills adjacent on the west are composed of folded and faulted beds of mainly marine shale in the north and sandstone and shale in the south.

The San Joaquin Valley floor is divided into several geomorphic land types, including dissected uplands, low alluvial fans and plains, river floodplains and channels, and overflow lands and lake bottoms. Alluvial plains cover most of the valley floor and comprise some of the most intensely developed agricultural lands in the San Joaquin Valley. In general, alluvial sediments of the western and southern parts of the San Joaquin Valley tend to have lower permeability than east side deposits.

This section provides additional information relating to water resources in and around the Delta-Mendota Subbasin.

Watersheds

The Delta-Mendota Subbasin lies in the Middle San Joaquin-Lower Merced-Lower Stanislaus watershed and the Middle San Joaquin-Lower Chowchilla watershed (**Figure CC-10**). Historically, the San Joaquin Valley Basin was a large floodplain of the San Joaquin River that supported vast expanses of permanent and seasonal marshes, lakes, and riparian areas. Approximately 90 percent of the basin's wetlands have been lost, with approximately 58,000 flooded acres remaining on State, federal and private wildlife refuges. Approximately 100,000 acres of managed wetland, upland and riparian habitat is found within the Grassland Plan area, and together with the 12,000-acre Mendota Wildlife Area (found in the Fresno County Plan area), encompasses the vast majority of the remaining wetlands found in the basin (**Figure CC-11**).

The San Joaquin River Basin (Basin) includes the entire area drained by the San Joaquin River. The San Joaquin River Basin drains 13,513 square miles (mi^2) before it flows into the Sacramento-San Joaquin Delta near the town of Vernalis. The Merced, Tuolumne and Stanislaus Rivers are the three major tributaries that join the mainstream San Joaquin River from the east before it flows into the Delta.

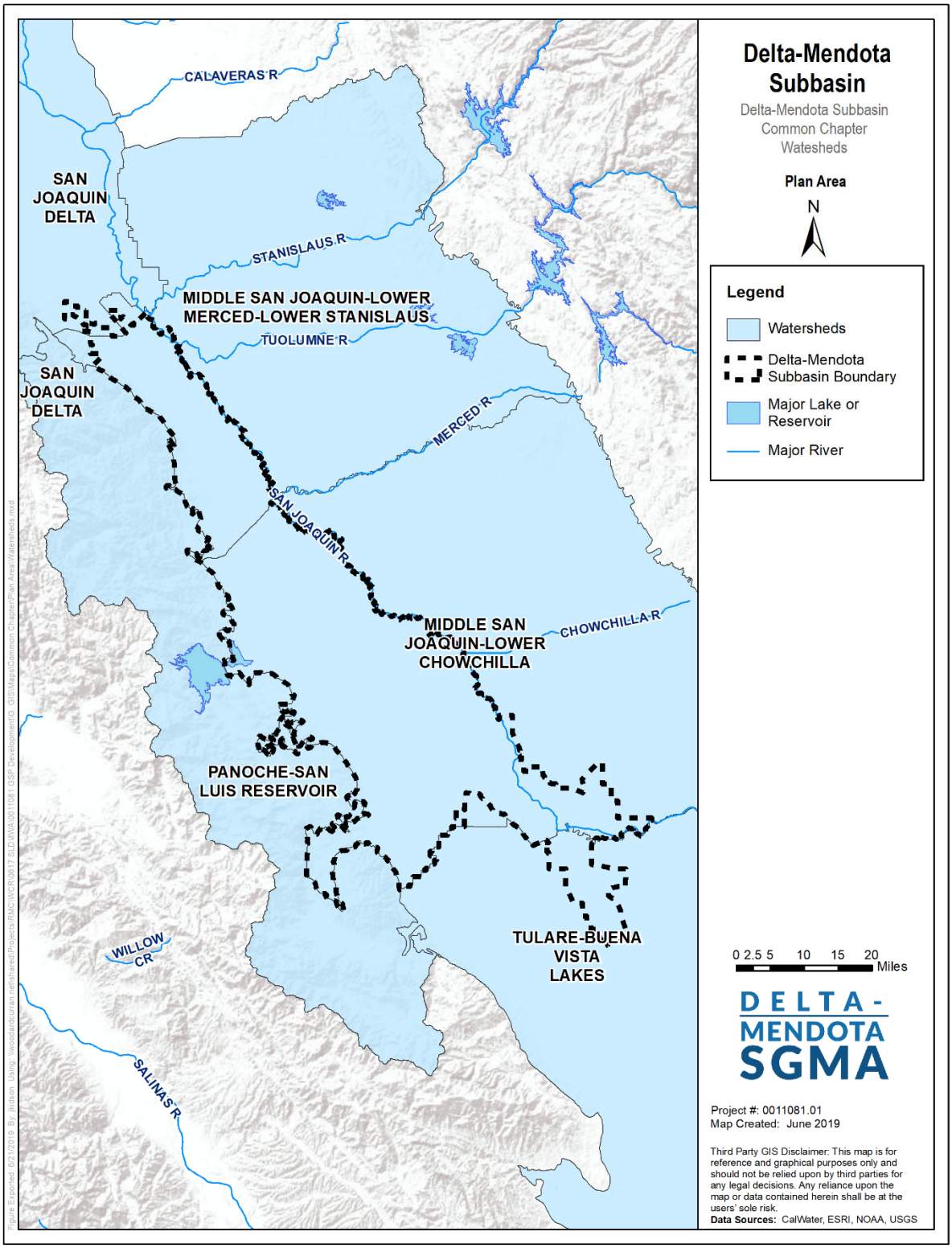


Figure CC-10: Local Watersheds

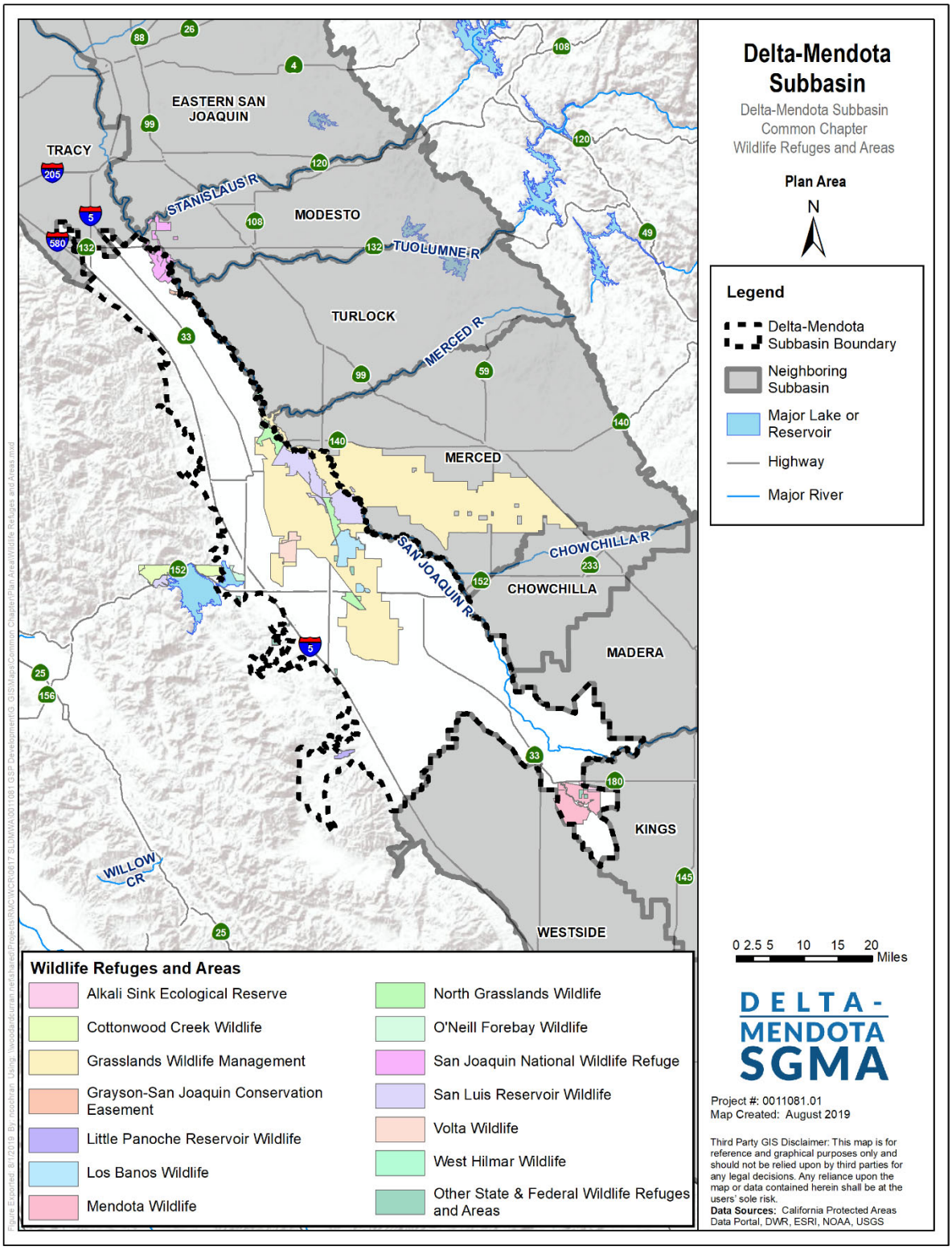


Figure CC-11: Wildlife Refuges and Wetland Habitat Areas in the Delta-Mendota Subbasin

Surface Water Use

Surface water is a primary water supply for agriculture within the Delta-Mendota Subbasin. Surface water supplies are brought into the Subbasin using an extensive series of water systems relied upon by multiple water agencies, cities, and private water users. Major water-related infrastructure in the Subbasin includes the facilities required to deliver Central Valley Project (CVP) supplies to CVP water supply contractors, in addition to key infrastructure of the State Water Project (SWP) utilized to deliver water to SWP water supply contractors and surface water diversions (e.g., intakes) to divert and distribute water from the San Joaquin and Kings Rivers.

The San Luis & Delta-Mendota Water Authority (SLDMWA) is a joint powers authority consisting of 28 member agencies that provide water to approximately 1.2 million acres of highly productive farmland, 2 million California residents, and millions of waterfowl dependent upon the nearly 200,000 acres of managed wetlands within this area of the Pacific Flyway. The SLDMWA operates and maintains portions of the CVP, including the Delta Cross Channel, the C.W. "Bill" Jones Pumping Plant, the Delta-Mendota Canal (DMC), O'Neill Pumping-Generating Plant, and the San Luis Drain, and provides emergency assistance when requested on the Delta Cross Channel and the Tracy Fish Collection Facility. The California Department of Water Resources (DWR) operates and maintains the SWP facilities, designed to deliver nearly 4.2 million acre-feet of water per year to 29 long-term SWP water supply contractors. Joint federal-state facilities include the California Aqueduct, Banks Pumping Plant, O'Neill Dam and Forebay, Sisk Dam and San Luis Reservoir, and Dos Amigos Pumping Plant. Surface water diversion facilities are owned and operated by individual water and irrigation districts and typically include some form of intake (e.g., fish screen, open water intake, flumes) plus facilities to convey the diverted surface water to a distribution system.

Groundwater Use

Groundwater is a key component of water supplies in the Delta-Mendota Subbasin. To protect the long-term sustainability of groundwater resources, pumping has significantly reduced in past years (2017-2019), allowing the groundwater levels in the Subbasin to recover to some extent. During the most recent drought period, groundwater was heavily relied upon throughout the Subbasin for irrigation as surface water deliveries were significantly severely reduced for many water users (especially those with junior surface water rights), resulting in increased groundwater pumping.

There are many communities within the Subbasin that are partially or completely reliant on groundwater for municipal and domestic water supplies, including the cities of Patterson, Newman, Gustine, Los Banos, Firebaugh, and Mendota and the communities of Grayson, Westley, Crows Landing, Santa Nella, Volta, Dos Palos Y, and Tranquillity (**Figure CC-12**). Other unincorporated areas of the Subbasin also rely on groundwater as the sole water supply source. There are several areas of *de minimis* groundwater extractors in the Subbasin, which are defined as well owners who extracts two acre-feet or less per year from a parcel for domestic purposes (SWRCB, n.d. (a)).

Figure CC-13, **Figure CC-14**, and **Figure CC-15** show the density per square mile (PLSS Section) of domestic, production, and public wells in the Delta-Mendota Subbasin as identified by DWR's Well Completion Report Map Application. Domestic wells are defined as individual domestic wells which supply water for the domestic needs of an individual residence or systems of four or less service connections (DWR, 1981). Within the Delta-Mendota Subbasin, the majority of PLSS Sections contain five or fewer domestic wells (**Figure CC-13**). Production well statistics include wells that are designated as irrigation, municipal, public, and industrial on well completion reports, generally indicating wells designed to obtain water from productive zones containing good-quality water (DWR, 1991). The majority of PLSS Sections in the Subbasin contain only zero, one, or two production wells (**Figure CC-**

14). The highest concentration of production wells can be found in the south of the Subbasin, near Mendota. Public wells are defined as wells that provide water for human consumption to 15 or more connections or regularly serves 25 or more people daily for at least 60 days out of the year (SWRCB, n.d. (b)). Compared to domestic and production wells, public wells are less common in the Subbasin. The status of the wells (e.g., active, abandoned, destroyed) contained in the DWR Well Completion Report Map Application has not been independently confirmed. Additionally, the reader is referred to each of the six Subbasin GSPs for more information regarding wells in the Delta-Mendota Subbasin.

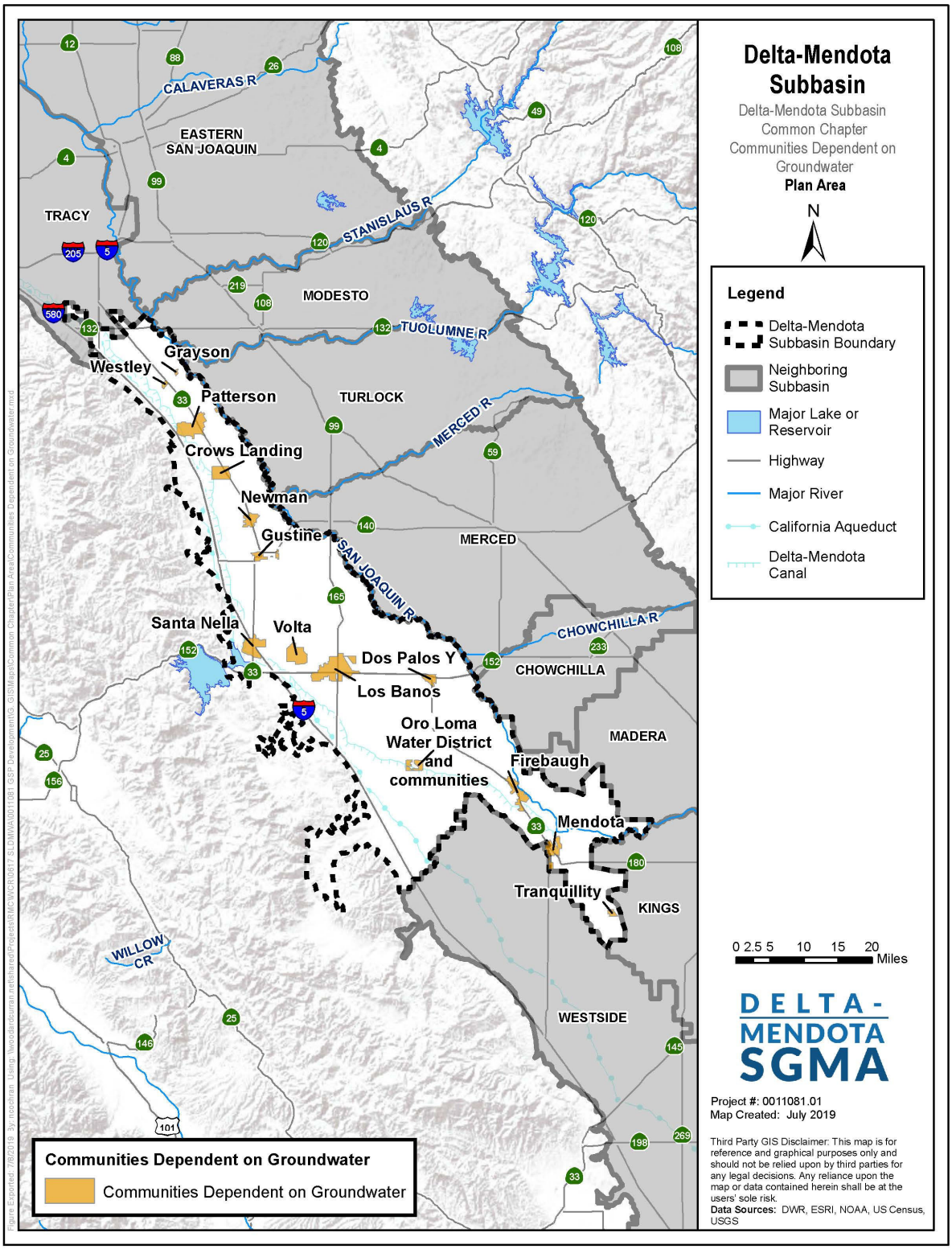


Figure CC-12: Communities Dependent on Groundwater

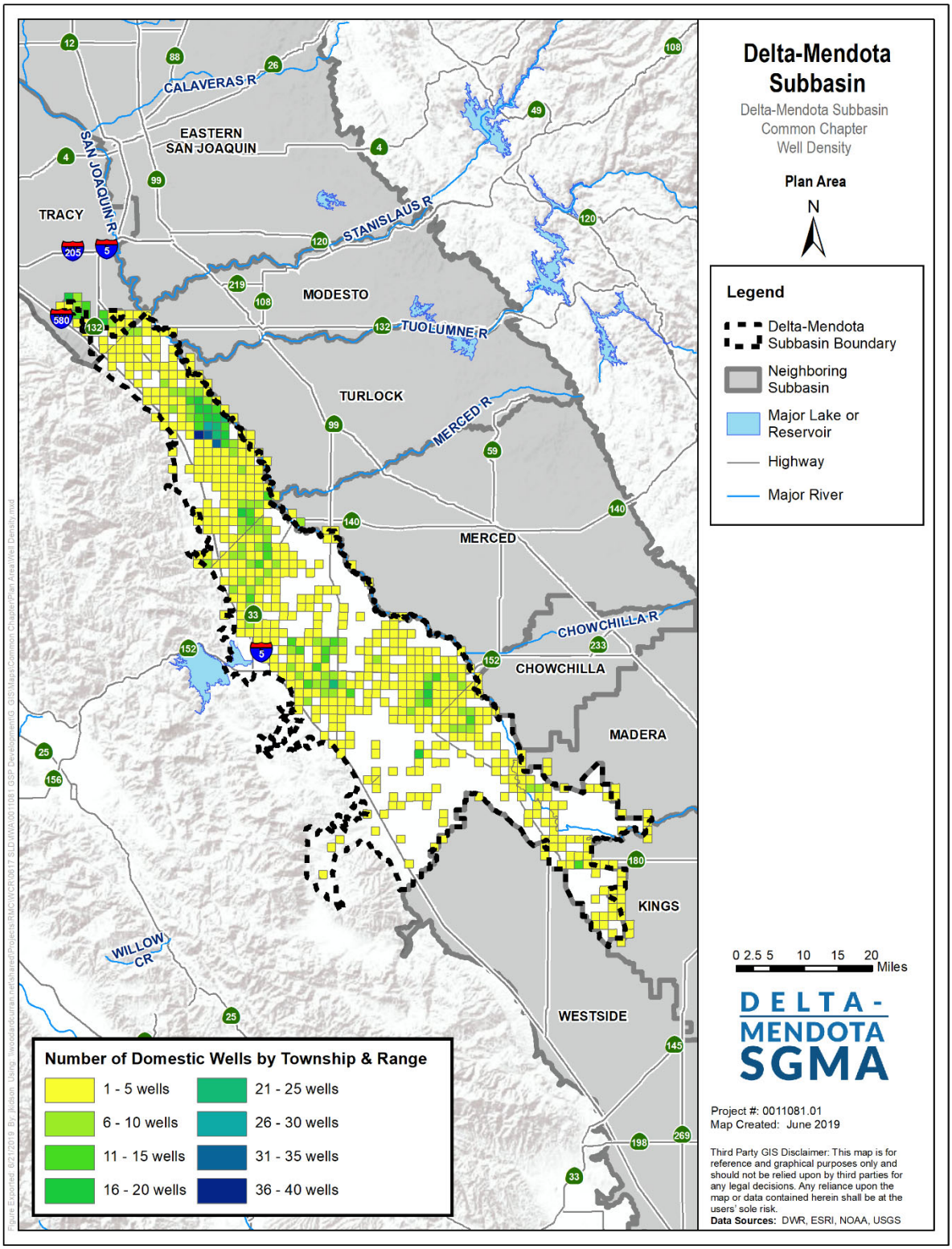


Figure CC-13: Domestic Well Density in the Delta-Mendota Subbasin

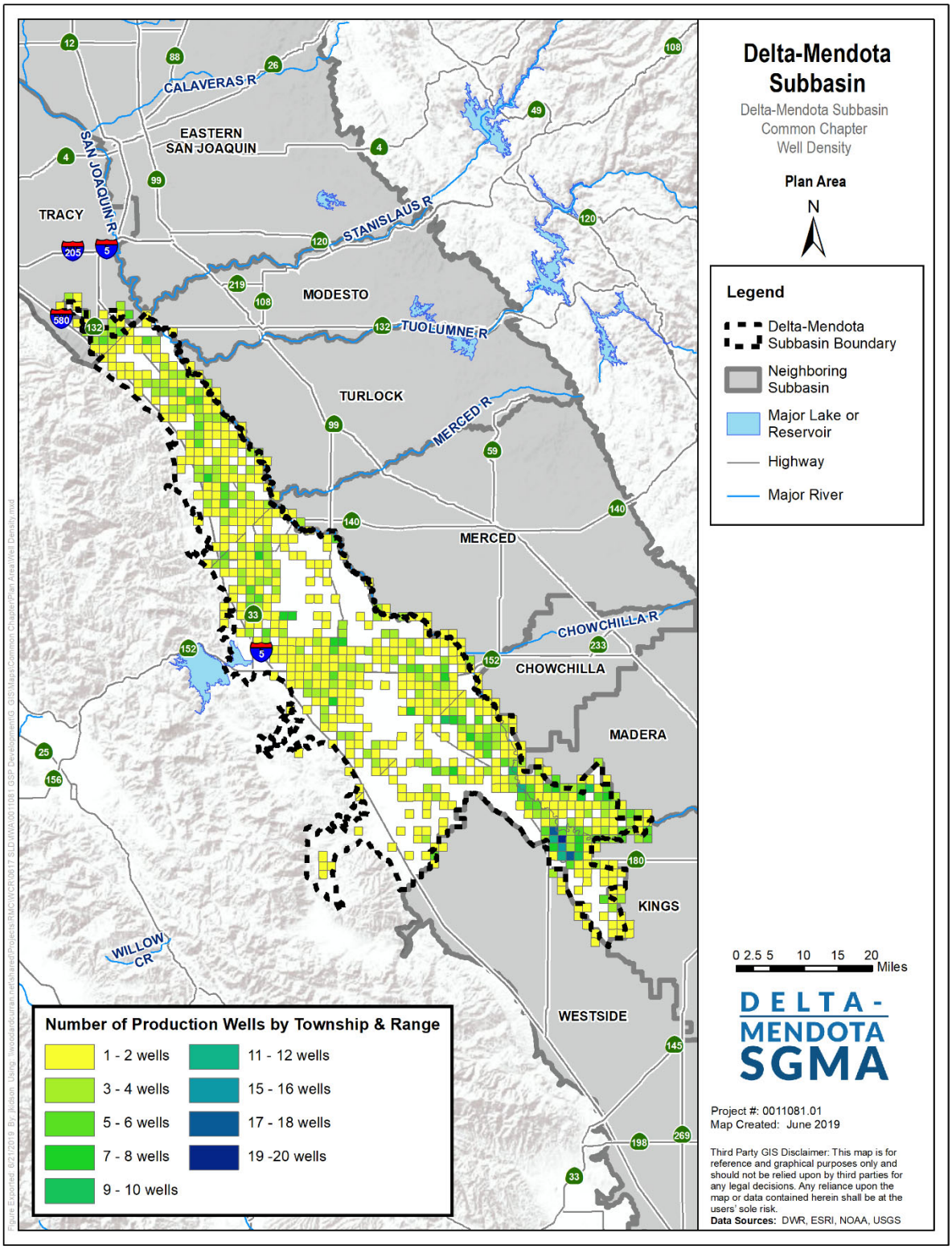


Figure CC-14: Production Well Density in the Delta-Mendota Subbasin

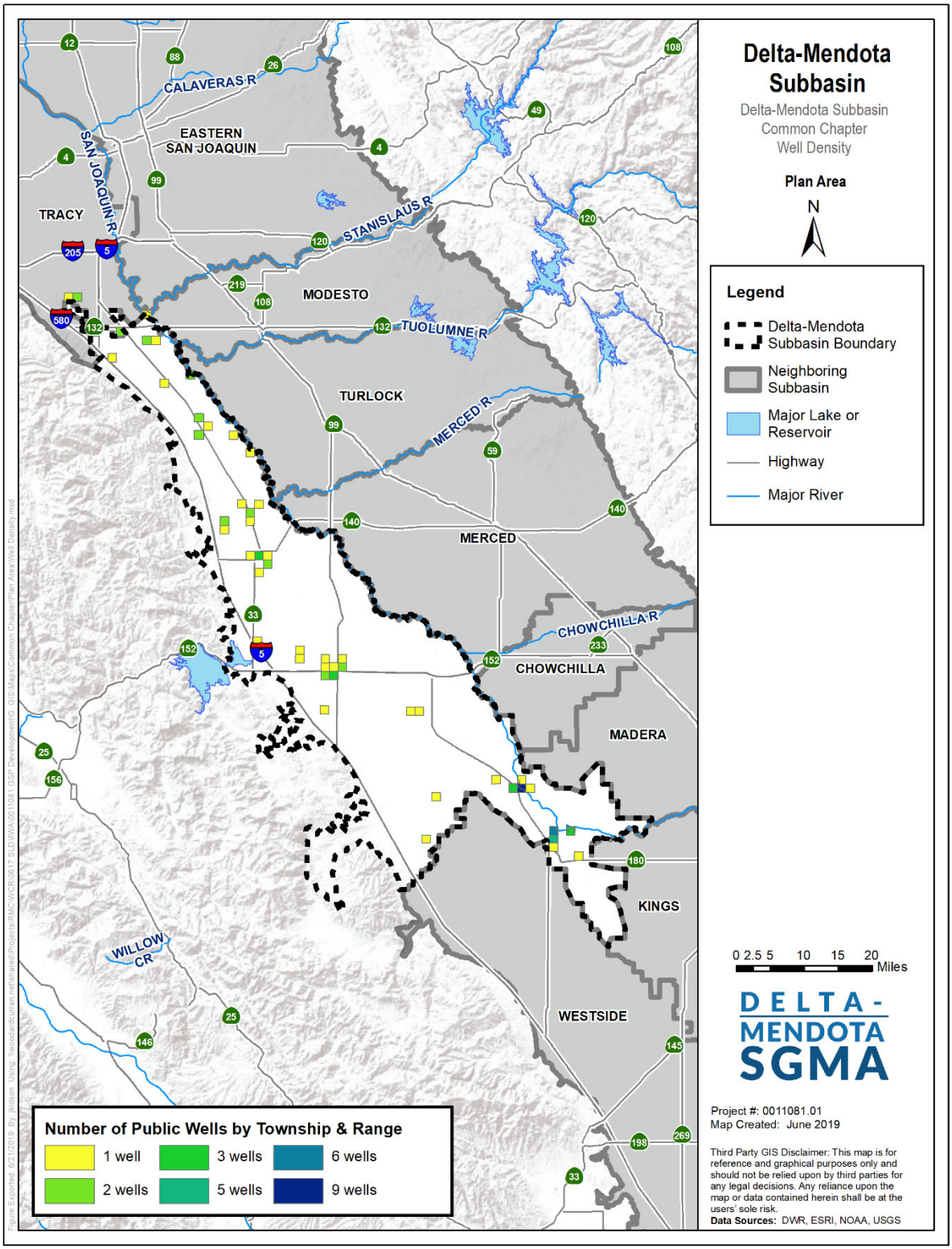


Figure CC-15: Public Well Density in the Delta-Mendota Subbasin

Flood Management

In general, the Delta-Mendota Subbasin slopes toward the San Joaquin River with steeper slopes along the western boundary (near the Coast Range), tapering off closer to the San Joaquin River. The flood management system in the San Joaquin Valley includes reservoirs to regulate snowmelt from elevations greater than 5,000 feet, bypasses at lower elevations, and levees that line major rivers.

Severe rain events in 1997/98, 2005/2006, 2011 and 2017 flooded communities, agricultural lands and refuges adjacent to the San Joaquin River in the Delta-Mendota Subbasin (specifically the communities of Firebaugh, Newman, Gustine and Mendota) and produced some localized flooding of farmland and refuges caused by runoff impoundment by elevated canal banks. Based on the recent historical events, the primary threat of flooding to urban areas will be for those along (and immediately adjacent to) the San Joaquin River. Areas within the 100-year floodplain within the Subbasin are shown in **Figure CC-16**.

Major Land Use Divisions

The Delta-Mendota Subbasin consists mostly of agricultural land use types (**Figure CC-17**). Typical land uses are described in the following sections and consist predominantly of the following:

- Pasture/Rangeland
- Agricultural Land (including rice, field crops and grains)
- Deciduous Forest
- Idle and Retired Farmland/Rangeland
- Riparian/Wetland
- Urban

The primary land use planning entities in the Delta-Mendota Subbasin include San Joaquin, Stanislaus, Merced, Fresno, and Madera Counties, as well as the cities of Patterson, Newman, Gustine, Los Banos, Dos Palos, Firebaugh, and Mendota, and Community of Santa Nella, as shown in **Figure CC-18**.

Pasture/Rangeland

Grasslands in the Central Valley were originally dominated by native perennial grasses such as needlegrass and alkali sacaton. Currently, grassland vegetation is characterized by a predominance of annual or perennial grasses in an area with few or no trees and shrubs. Annual grasses found in grassland vegetation include wild oats, soft chess, ripgut grass, medusa head, wild barley, red brome, and slender fescue. Perennial grasses found in grassland vegetation are purple needlegrass, Idaho fescue, and California oatgrass. Forbs commonly encountered in grassland vegetation include long-beaked filaree, redstem filaree, dove weed, clovers, Mariposa lilies, popcornflower, and California poppy. Vernal pools found in small depressions with an underlying impermeable layer are isolated wetlands within grassland vegetation. Pastures can consist of both irrigated and unirrigated lands dominated by perennial grasses used predominantly for grazing.

Rangeland communities are composed of similar grasses, grass-like plants, forbs, or shrubs which are grazed by livestock. Rangelands are classified into three basic types: shrub and brush rangeland, mixed rangeland, and herbaceous rangeland. The shrub and brush rangeland are dominated by woody vegetation and is typically found in arid and semiarid regions. Mixed rangelands are ecosystems where more than one-third of the land supports a mixture of herbaceous species and shrub or brush rangeland species. Herbaceous rangelands are dominated by naturally occurring grasses and forbs as well as some areas that have been modified to include grasses and forbs as their principal cover. Rangelands are, by definition, areas where a variety of commercial livestock are actively maintained.

Agricultural Land

General agricultural types occurring in the Delta-Mendota Subbasin include row crops, grains, orchards, and vineyards. Management of agricultural lands often includes intensive management, including soil preparation activities, crop rotation, grazing, and the use of chemicals.

Row Crops

Most row crops grown in the San Joaquin Valley and harvested for food are annual species and are managed with a crop rotation system. During the year, several different crops may be produced on a given parcel of land either concurrently or in succession. Typical crops grown in the Delta-Mendota Subbasin include tomatoes, melons, grain crops (such as barley, wheat, corn, and oats), rice, cotton, and beans.

Orchards and Vineyards

Orchard and vineyards consist of cultivated fruit or nut-bearing trees or grapevines. Orchards are typically open, single-species, tree-dominated habitats and are planted in a uniform pattern and intensively managed. Understory vegetation is usually sparse. Vineyards are typically managed in a similar manner for producing grapes for wine and/or direct consumption.

Deciduous Forest

Deciduous forests are composed of trees that lose their leaves in the winter. These include species such as the various California oaks, California buckeye, Fremont Cottonwoods, Goodding Willows, and California Sycamores. The interior live oak, which is not deciduous, is also found in deciduous forests. Valley oak woodlands are found in the Sacramento and San Joaquin Valleys and usually occur below elevations of 2,000 feet.

Idle or Retired Farmland/Rangeland

Lands of this category are similar to abandoned farmlands in ruderal (disturbed) areas. Plants on these parcels may consist of either native and/or non-native species.

Riparian/Wetland

Riparian and wetland communities are both natural and man-made. Managed wetlands are classified as riparian and are flooded for overwintering migratory bird habitat. In the spring the wetlands are drained to promote grasses such as swamp timothy and watergrass which are an important waterfowl food supply. Although some grazing continues on managed wetlands, historically, many of these lands were irrigated and used as rangeland throughout the summer months. Today, managed wetlands are irrigated in the spring to maximize wetland productivity and provide nesting and sensitive species habitat. Managed wetlands also contain emergent vegetation such as cattail and tule and are often adjacent to riparian corridors.

Urban

Urban land uses include cities and smaller communities, in addition to other lands used for industrial and/or commercial practices.

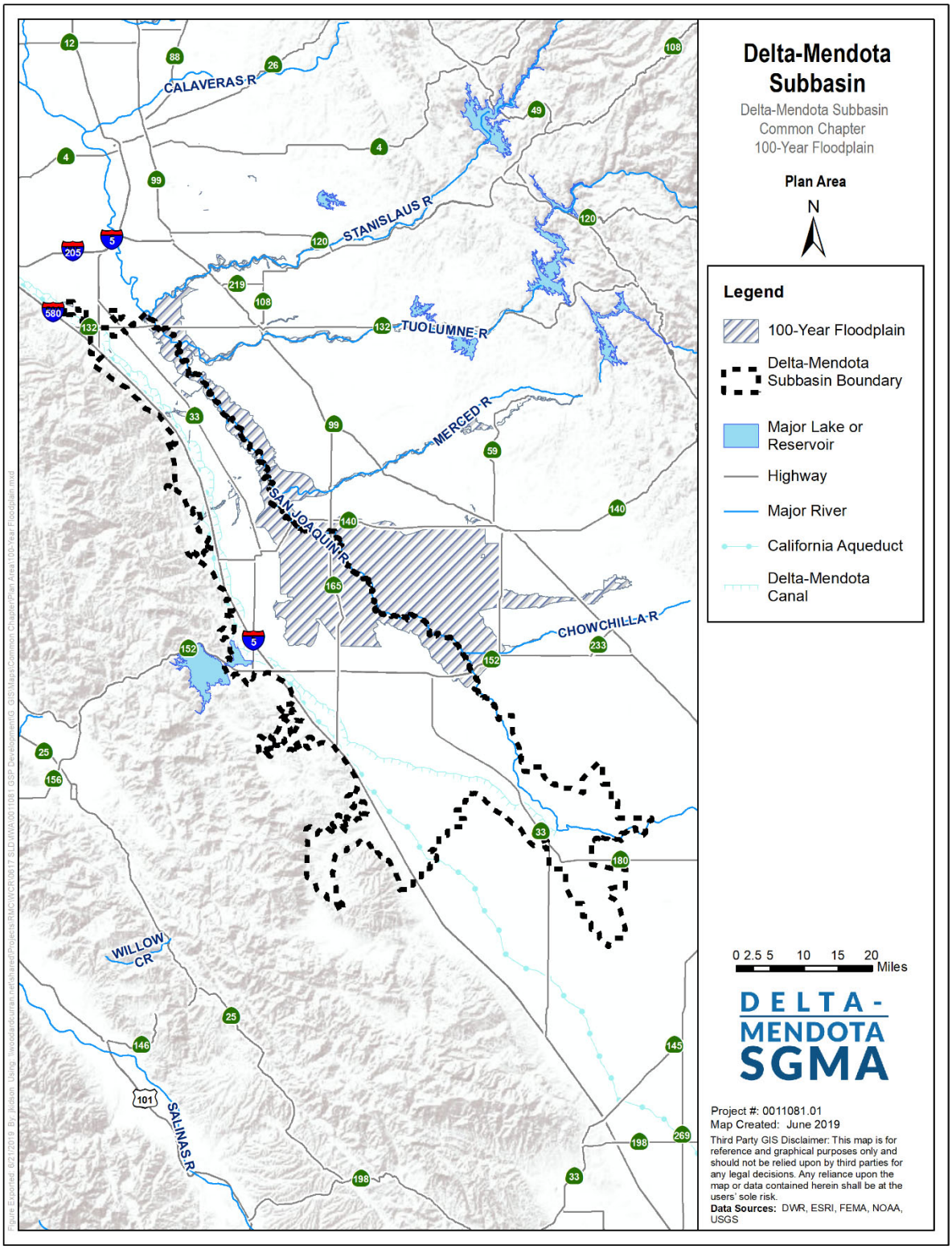


Figure CC-16: 100-Year Floodplain, Delta-Mendota Subbasin

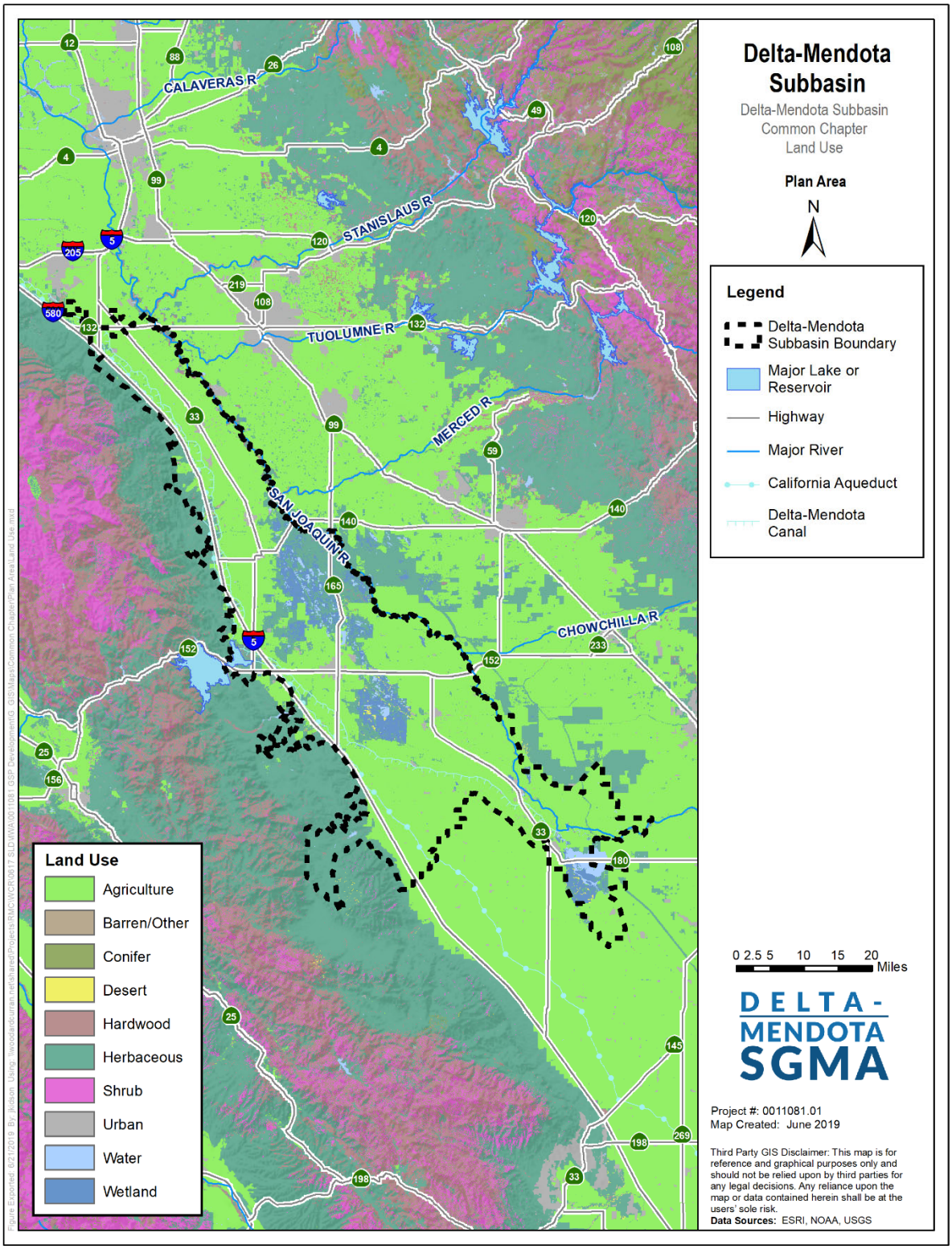


Figure CC-17: Typical Land Use

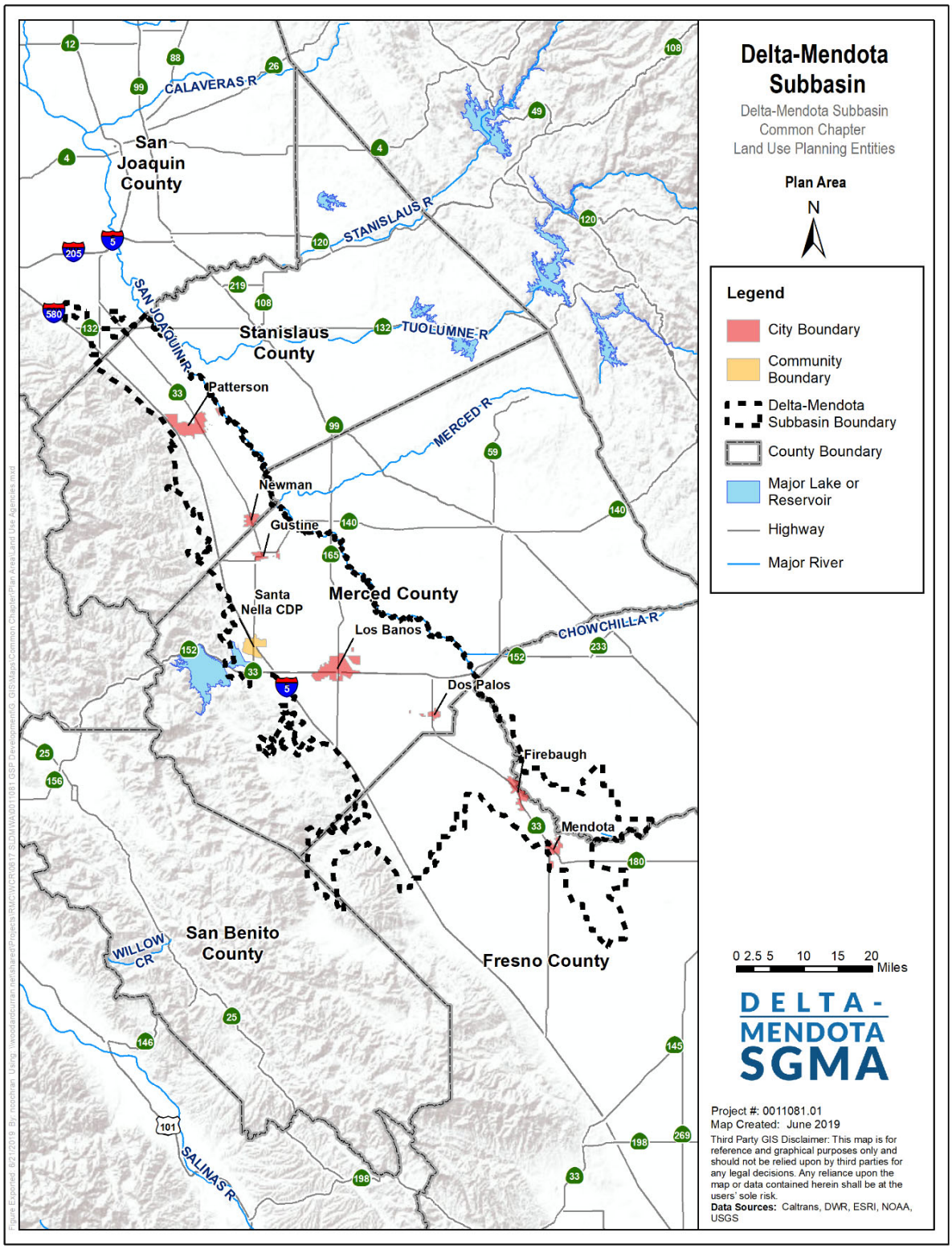


Figure CC-18: Land Use Planning Entities

Regional Economic Issues and Trends

The western San Joaquin Valley is a highly agricultural region. There are no large cities or industries in the Subbasin to provide an alternative economic base. The economy of this region is predominately driven by agricultural production and therefore, the availability of surface water supplies (predominantly in the form of CVP agricultural water and diversions from the San Joaquin and Kings Rivers) is an essential element to the economic health of the region. Other uses of surface water in the Subbasin are used for M&I purposes and wildlife refuge water supply.

Depending on water supply conditions, about 800,000 acres in the Delta-Mendota Subbasin are partially or solely irrigated with surface water. Other economic base industries include travel on the Interstate 5 (I-5) corridor, some petroleum extraction, and tourism. State, federal, and private wildlife refuges benefit local economies by attracting hunters, anglers, outdoor recreationists to the region. Managed wetland water conveyance infrastructure is maintained and improved by many contractors and local agency staff. Large scale conveyance improvements and habitat restoration projects, including mitigation banks, are also common throughout the Subbasin. M&I water use, which is a small share of total water use in the Subbasin, occurs primarily within the cities and smaller communities. The largest M&I use areas in the Delta-Mendota Subbasin, based on 2018 population estimates from the U.S. Census Bureau, are the cities of Patterson (population 22,352) and Los Banos (population 30,074) (U.S. Census Bureau, 2017).

All communities within the Delta-Mendota Subbasin have economies greatly dependent on agricultural production. These communities include Patterson, Tranquillity, Grayson, Mendota, Firebaugh, Dos Palos, Los Banos, Santa Nella, Newman, Gustine, Crows Landing, and Westley. All of these communities are strongly affected by the reliability of agricultural water supplies. Some of them are dependent upon groundwater for M&I use.

Plan Area Jurisdictional Boundaries

Jurisdictional areas within the Delta-Mendota Subbasin include counties, cities, water districts, irrigation districts, mutual water companies, and federal and state agencies. There are no federal- or state-recognized tribal communities in the Subbasin. Federal and State Lands are shown in **Figure CC-19**. More detail on specific jurisdictional areas within each GSP area can be found in the respective GSP.

In general, all municipal, water/irrigation districts and counties within the Delta-Mendota Subbasin are participating in GSP development either as a separate GSA or as members of a GSA. The California Department of Fish and Wildlife boundaries and the U.S. Fish and Wildlife Service boundaries overlay the wildlife refuges and areas and state parks within the Subbasin. DWR manages the SWP and the California Aqueduct, and the U.S. Bureau of Reclamation (USBR), through the SLDMWA, manages the CVP and the Delta-Mendota Canal. The California Department of Transportation (Caltrans) is responsible for managing the State and Interstate highways in the Subbasin, including Interstate- (I-) 5, and State Highways 132, 33, 140, 152, and 165.

Figure CC-9 depicts the Subbasin's extent relative to the boundaries of the various counties that overlie the Subbasin. Merced County has jurisdiction over the largest portion of the Subbasin (525 square miles), in the central portion of the Subbasin. Stanislaus County has jurisdiction over most of the area on the northern end of the Subbasin (covering 223 square miles). Fresno and Madera Counties have jurisdiction over the southern extent of the Delta-Mendota Subbasin (400 square miles). Finally, San Benito County covers the smallest portion of the Subbasin (5 square miles) in the southwestern portion of the Subbasin near San Luis Reservoir.

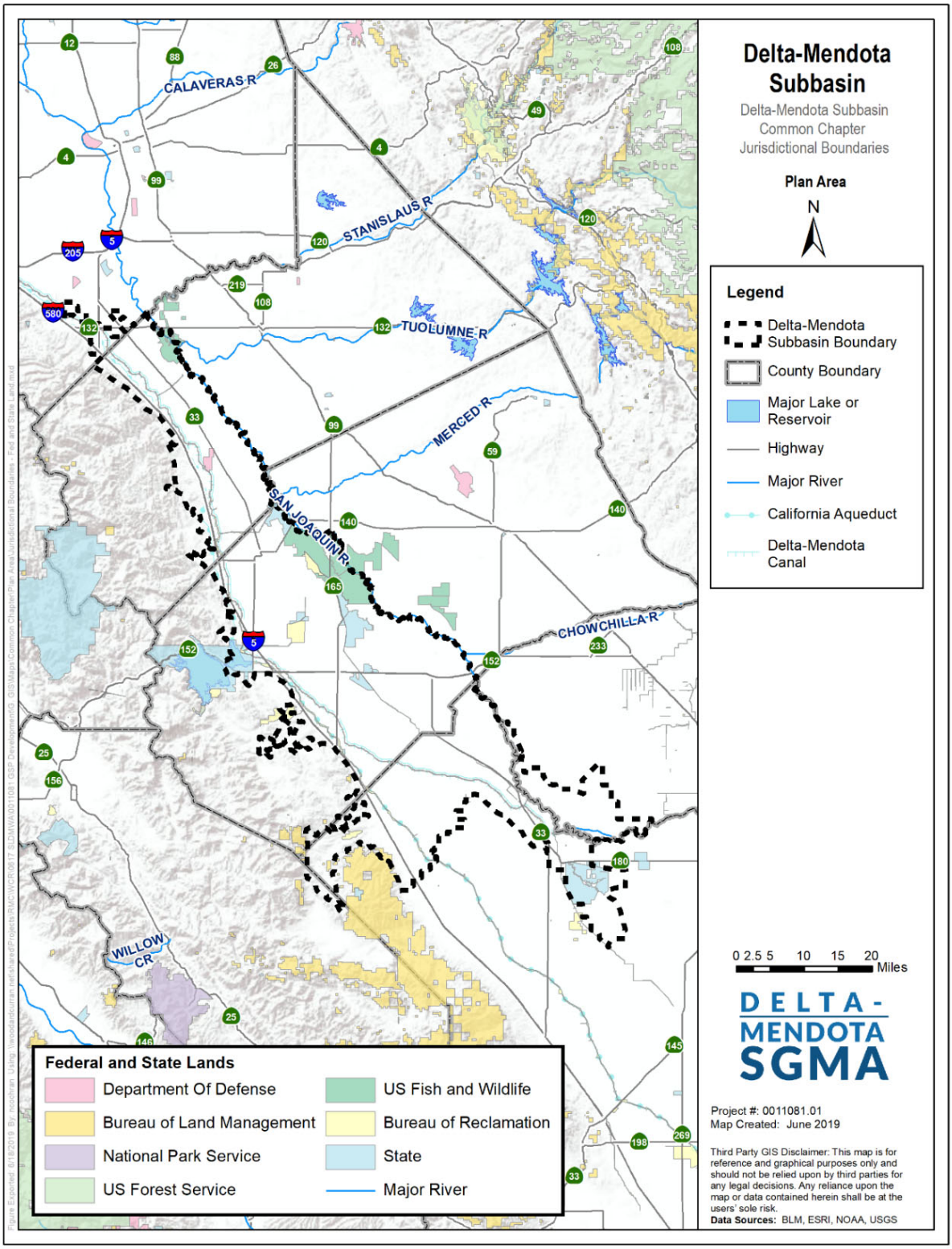


Figure CC-19: Federal and State Lands

Land Use Elements

Land use in the Delta-Mendota Subbasin is predominantly agricultural with wildlife habitat areas and areas of municipal, industrial, and commercial use. Predominant crops grown in the region include grain and hay crops, nut and fruit trees, and row crops. **Figure CC-20** shows the distribution of different land use types across the Delta-Mendota Subbasin.

Conjunctive use of surface water and groundwater is practiced throughout much of the Delta-Mendota Subbasin. Urban centers, such as the City of Patterson, and most unincorporated county areas rely solely on groundwater for their water supplies. Several water and irrigation districts hold water rights to divert from the San Joaquin River and/or the Kings Rivers. Other water purveyors receive water from the CVP and use groundwater and non-CVP-acquired surface waters to supplement demand, while some water districts rely solely on groundwater for their supplies. Refer to each GSP for detailed discussions of the water sources used by each agricultural, wetland, and urban water supplier.

Agriculture is the predominant water use sector throughout the Delta-Mendota Subbasin (**Figure CC-20**). Urban water uses are mostly concentrated within and surrounding cities (such as Patterson and Los Banos). Non-irrigated land includes any idle or native riparian land classifications, which are scattered throughout the Regions.

3.3 General Plans in Plan Area

Within each GSP, General Plans and/or Community Specific Plans overlie the area. These include County general plans for Fresno, Merced, San Benito, San Joaquin, Stanislaus, and Madera Counties, and specific plans for cities and communities. Each GSP contains a detailed list of General Plan policies and objectives relevant to water resources management in the applicable GSP area. Refer to discussions in the individual GSPs which satisfy §354.8(f) of the GSP Emergency Regulations under SGMA.

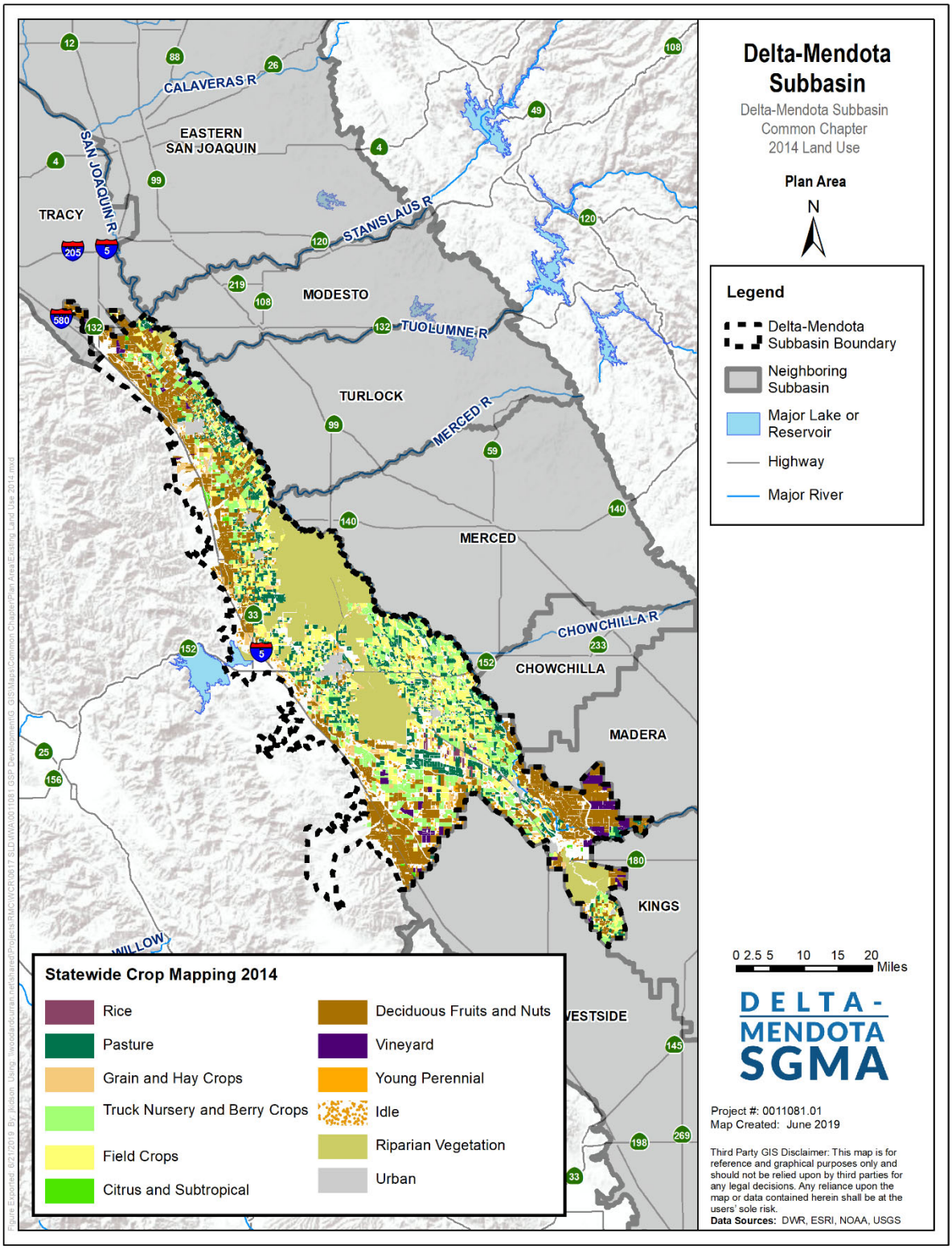


Figure CC-20: 2014 Land Use in the Delta-Mendota Subbasin

3.4 Existing Land Use Plans and Impacts to Sustainable Groundwater Management

Numerous policies in each County's and Community's General Plan compliment the GSPs' plans to conserve and sustainably manage groundwater resources. In general, the County and City General Plans guide future growth and development (and associated demands) within their respective jurisdictional areas. This additional growth may impact groundwater sustainability by placing additional demands on groundwater resources in an area where surface water resources are scarce or are otherwise unavailable. The General Plans also promote water conservation (in both the urban and agricultural sectors), which could potentially offset the additional demands associated with future urban development. In addition to conservation, some (though not all) General Plans promote groundwater recharge, the protection of recharge areas and wetlands, and the use of water transfers to further benefit groundwater sustainability.

Most General Plans within the Delta-Mendota Subbasin include goals focused on preserving agriculture, efficient use of existing and future water sources in both the urban and agricultural sectors, connecting smaller rural communities to larger water systems, and water quality protection. With respect to the protection of water quality and groundwater dependent ecosystems, the General Plans generally protect riparian and wetland habitats, encourage the protection of water quality (including through the remediation of contamination that may impact groundwater quality, requiring the use of septic systems in rural areas that are designed to be protective of groundwater quality and/or the use of community wastewater systems in urban areas), and promote flood control and management (including the associated impacts of erosion and sedimentation of surface water-courses).

The Fresno County General Plan, in particular, promotes sustainability by managing new wells in urban areas, supporting monitoring of water resources and associated habitats, and through the formation of a water resources document repository.

While the magnitude of impacts of these policies over the planning and implementation horizon are not known, such policies have been considered in this GSP, primarily through the use of the General Plans and associated zoning maps to identify future land use types and projected growth areas. These General Plans and mapping were used along with available water master plans, urban water management plans, agricultural water management plans, and other relevant planning documents to determine projected future land use and estimate future water demands by land use sector for use in the projected future water budgets.

Just as the General Plans complement the GSPs, the GSPs in the Delta-Mendota Subbasin may influence the General Plans' goals and policies. Sustainable management of groundwater resources through a GSP may change the pace, location, and type of development and/or land use that will occur in the Subbasin. GSP implementation is anticipated to be consistent with the General Plans' goals to sustainably manage land development and water resources in the Subbasin.

3.5 Existing Water Resources Monitoring and Management Programs

As required by §354.8I and (d) of the GSP Emergency Regulations, the following section describes key existing water resources-related management and monitoring programs, and a discussion of how these programs will either impact GSP implementation and/or will be incorporated into the GSPs. The information shown below is a high-level summary of key existing programs; please see the individual GSPs for additional relevant management and monitoring programs.

Irrigated Lands Regulatory Program (ILRP)

In 1999, the California Legislature passed Senate Bill 390, which eliminated a blanket waiver of water quality regulations for agricultural waste discharges. The Bill required the Regional Water Quality Control Boards to develop a program to regulate agricultural lands under the Porter-Cologne Water Quality Control Act. In 2003, the Central Valley Regional Water Quality Control Board (CV-RWQCB) issued an order that sets Waste Discharge Requirements (WDRs) for irrigated lands to protect both surface and groundwater throughout the Central Valley, primarily to address nitrates, pesticides, and sediment discharge. The resulting Irrigated Lands Regulatory Program (ILRP) regulates wastes from commercial irrigated lands that discharge into surface and groundwater. The program is administered by the CV-RWQCB working directly with a regional or crop-based coalition as well as directly with irrigators. The goal of the ILRP is to protect surface water and groundwater and to reduce impacts of irrigated agricultural discharges to waters of the State. As a result of the ILRP, monitoring reports, assessment reports, management plans, surface water quality data, and groundwater quality data are made available to the public.

Implementation of the IRLP in the Delta-Mendota Subbasin is managed primarily by the Westside San Joaquin River Watershed Coalition and the Grassland Drainage Area Coalition under the San Joaquin Valley Drainage Authority, a California Joint Powers Authority (JPA). This region specifically emphasizes nitrogen, sediment, and erosion control.

CV-SALTS

The Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) is an initiative to reduce salt and nitrate impacts, restore groundwater quality, and provide safe drinking water supplies. Developed by a group of stakeholders (federal, state, and local agencies, dischargers and growers, and environmental groups) called the Central Valley Salinity Coalition, the Central Valley Salt and Nitrate Management Plan (SNMP) was released in 2017.

The Central Valley SNMP recommends revised and flexible regulations for existing Basin Plans and includes recommended interim solutions for salt and nutrient management in high priority basins in addition to long-term salt management strategies. Under the Central Valley SNMP, dischargers are provided two compliance pathways: (1) traditional permitting as an individual discharger or as a coalition (i.e., irrigated lands coalition), or (2) groundwater management zone permitting. Zone permitting allows dischargers to work as a collective in collaboration with the CV-RWQCB to provide safe drinking water with the option to extend time to achieve nitrogen balance. At this time, the Central Valley SNMP is not currently enforced.

Integrated Regional Water Management Program

Three Integrated Regional Water Management Plans (IRWMPs) overlie the Delta-Mendota Subbasin. The Westside-San Joaquin IRWMP covers most of the Subbasin, while smaller portions of the Subbasin are covered by the East Stanislaus and Madera IRWM Plans.

Integrated Regional Water Management (IRWM) is a collaborative effort to identify and implement water management solutions on a regional scale that increase regional self-reliance, reduce conflict, and manage water to concurrently achieve social, environmental, and economic objectives. Developed by Regional Water Management Groups, the IRWMPs seek to deliver higher value for investments in water resources and management by considering all interests, providing multiple benefits, and working across jurisdictional boundaries. Examples of multiple benefits include improved water quality, better flood management, restored and enhanced ecosystems, and more reliable surface and groundwater supplies.

Please see the individual GSPs for additional details regarding the IRWM program in their GSP Plan areas.

California State Groundwater Elevation Monitoring Program (CASGEM)

Since 2009, the California Statewide Groundwater Elevation Monitoring (CASGEM) Program has tracked seasonal and long-term groundwater elevation trends in groundwater basins statewide. The program's mission is to establish a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins. This early attempt to monitor groundwater continues to exist as a tool to help achieve the goals set out under the Sustainable Groundwater Management Act (SGMA) with mandatory annual water elevation monitoring and reporting.

San Joaquin River Restoration Program (SJRR)

The San Joaquin River Restoration Program (SJRRP) is a comprehensive, long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply impacts from Restoration Flows. The program has two general goals resulting from the San Joaquin River Restoration Settlement reached in 2006:

- **Restoration:** To restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.
- **Water Management:** To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The program includes the implementation of projects, reintroduction activities and associated monitoring to assess progress towards achieving the Settlement goals.

USGS Land Subsidence Monitoring

The USGS maintains and monitors a large system of monitoring locations nationwide using interferometric synthetic aperture radar (InSAR), continuous GPS (CGPS) measurements, campaign global positioning system (GPS) surveying, and spirit-leveling surveying. Aquifer-system compaction is measured by using extensometers to aid in the understanding of the depths at which compaction is occurring. The USGS shares these results to support decision making relative to groundwater basin management with the goal of minimizing future inelastic land subsidence.

3.6 County Well Construction/Destruction Standards and Permitting

DWR has developed well standards for the state per California Water Code Sections 13700 to 13806. These standards have been adopted by the State Water Resources Control Board (SWRCB) into a statewide model well ordinance (Resolution No. 89-98) for use by the Regional Boards for enforcing well construction standards where no local well design ordinance exists that meets or exceeds the DWR standards. DWR's Well Standards are presented in Bulletin 74-81 and Bulletin 74-90.

Each GSP lists the counties within their GSP Plan areas and the respective permitting agencies and local ordinances for well construction and destruction standards. Discussion of these standards and the

respective permitting process as well as well abandonment and destruction procedures can be found in the individual GSPs.

3.7 Existing and Planned Conjunctive Use Programs

Conjunctive use programs in the Subbasin are currently implemented and planned by single agencies as well as through multi-agency partnerships. Maximizing the beneficial use of surface water, groundwater, and recycled water resources is of critical concern to water managers throughout the Delta-Mendota Subbasin with the ultimate goal of using all of these water sources more efficiently to avoid overdraft and to sustainably manage groundwater resources. Each GSP describes efforts to utilize existing water resources conjunctively and demonstrate feasibility to continue to implement conjunctive use projects in the future. These may include projects such as groundwater recharge and conveyance facilities, new wells, improved monitoring systems, improved delivery efficiency, water recycling, and water quality improvements and treatment.

Underground recharge and storage occur throughout the Delta-Mendota Subbasin through stormwater applied water and managed wetland recharge. Stormwater collects both naturally and artificially and eventually percolates through the ground and into aquifers for beneficial use for both urban and agriculture. Recharge from agricultural and wetland water conveyance and irrigation percolates into the ground and eventually into aquifers where it can be pumped again for use. This natural and unmanaged recharge creates future opportunities for conjunctive use programs; however, this recharge may decline as farmers move toward more precise and water efficient irrigation methods.

3.8 Plan Elements from California Water Code Section 10727.4

Each GSP may contain, as deemed appropriate, a detailed discussion of the additional plan elements as identified in California Water Code (CWC) Section 10727.4. These elements are:

- Control of saline water intrusion
- Wellhead protection areas and recharge areas
- Migration of contaminated groundwater
- Well abandonment and well destruction programs
- Activities implementing, opportunities for, and removing impediments to conjunctive use or underground storage
- Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance, and extraction projects
- Efficient Water Management Practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use
- Efforts to develop relationships with state and federal regulatory agencies
- Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risk to groundwater quality or quantity
- Impacts on Groundwater Dependent Ecosystems

4. SUBBASIN SETTING

This Delta-Mendota Subbasin Settings section contains three main subsections as follows:

- **Hydrogeologic Conceptual Model (HCM)** – The HCM section (Section 4.1) provides the geologic information needed to understand the framework that water moves through in the Subbasin. It focuses on geologic formations, aquifers, structural features, and topography.
- **Groundwater Conditions** – The Groundwater Conditions section (Section 4.2) describes and presents groundwater trends, levels, hydrographs and level contour maps, estimates changes in groundwater storage, identifies groundwater quality issues, addresses subsidence, and addresses surface water interconnection.
- **Water Budget** – The Water Budget section (Section 4.3) describes the data used to develop the water budget. Additionally, this section discusses how the budget was calculated, provides water budget estimates for historical conditions, and current conditions and projected conditions

4.1 Hydrogeologic Conceptual Model

This section describes the hydrogeologic conceptual model (HCM) for the Delta-Mendota Subbasin based on technical studies and qualified maps that characterize the physical components and interaction of the surface water and groundwater systems, pursuant to Article 5, Plan Contents, Subarticle 2, Basin Setting, § 354.14 Hydrogeologic Conceptual Model of the GSP Emergency Regulations. The physical description of the Delta-Mendota Subbasin is based on information originally published in the *Western San Joaquin River Watershed Groundwater Quality Assessment Report* (GAR) (LSCE, 2015), *Grassland Drainage Area Groundwater Quality Assessment Report* (LSCE, 2016), and *Groundwater Overdraft in the Delta-Mendota Subbasin* (KDSA, 2015).

4.1.1 Regional Geologic and Structural Setting

The Delta-Mendota Subbasin is located in the northwestern portion of the San Joaquin Valley Groundwater Basin within the southern portion of the Central Valley (**Figure CC-21**). The San Joaquin Valley is a structural trough up to 200 miles long and 70 miles wide filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and by erosion of the surrounding Sierra Nevada and Coast Range mountains, respectively (DWR, 2006). Continental deposits shed from the surrounding mountains form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough. This depositional axis is slightly west of the series of rivers, lakes, sloughs, and marshes which mark the current and historic axis of surface drainage in the San Joaquin Valley.

The Delta-Mendota Subbasin (DWR Basin No. 5-22.07) is bounded on the west by the tertiary and older marine sediments of the Coast Ranges, on the north generally by the San Joaquin-Stanislaus County line, on the east generally by the San Joaquin River and Fresno Slough, and on the south by the Tranquillity Irrigation District boundary near the community of San Joaquin. Surface waters converge from the Fresno, Merced, Tuolumne, and Stanislaus Rivers into the San Joaquin River, which drains to the north toward the Sacramento-San Joaquin Delta.

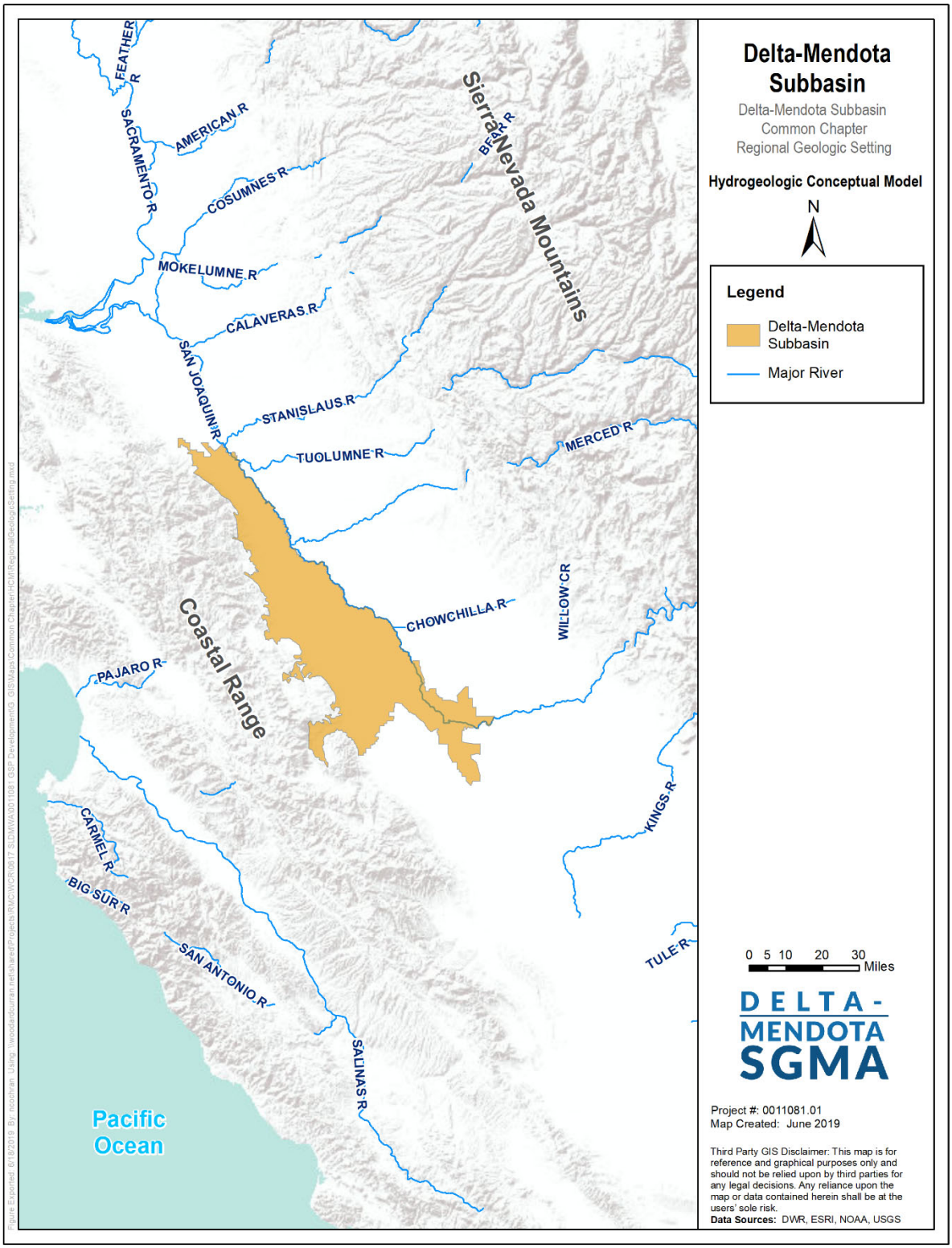


Figure CC-21: Regional Geologic Setting

4.1.2 Geologic History

Approximately three million years ago, tectonic movement of the Oceanic and Continental plates associated with the San Andreas Fault system resulted in the formation of the Coast Range which sealed off the Central Valley from the Pacific Ocean (LSCE, 2015). As this occurred, the floor of the San Joaquin Valley began to transition from a marine depositional environment to a freshwater system with ancestral rivers bringing alluvium to saltwater bodies (Mendenhall et al., 1916). The Coast Ranges on the western side of the San Joaquin Valley consist mostly of complexly folded and faulted consolidated marine and non-marine sedimentary and crystalline rocks ranging from Jurassic to Tertiary age, dipping eastward and overlying the basement complex in the region (Croft, 1972; Hotchkiss and Balding, 1971). The Central Valley Floor, in which the Delta-Mendota Subbasin lies, consists of Tertiary and Quaternary-aged alluvial and basin fill deposits (**Figure CC-22**). The fill deposits mapped throughout much of the valley extend vertically for thousands of feet, and the texture of sediments varies in the east-west direction across the valley. Coalescing alluvial fans have formed along the sides of the valley created by the continuous shifting of distributary stream channels over time. This process has led to the development of thick fans of generally coarse texture along the margins of the valley and a generally fining texture towards the axis of the valley (Faunt et al., 2009 and 2010).

Deposits of Coast Range and Sierra Nevada sources interfinger within the Delta-Mendota Subbasin. Steeper fan surfaces, with slopes as high as 80 feet per mile, exist proximal to the Coast Range, whereas more distal fan surfaces consist of more gentle slopes of 20 feet per mile (Hotchkiss and Balding, 1971). In contrast to the east side of the valley, the more irregular and ephemeral streams on the western side of the valley floor have less energy and transport smaller volumes of sediment resulting in less developed alluvial features, including alluvial fans which are less extensive, although steeper, than alluvial fan features on the east side of the valley (Bertoldi et al., 1991). Lacustrine and floodplain deposits also exist closer to the valley axis as thick silt and clay layers. Lakes present during the Pleistocene epoch in parts of the San Joaquin Valley deposited great thicknesses of clay sediments.

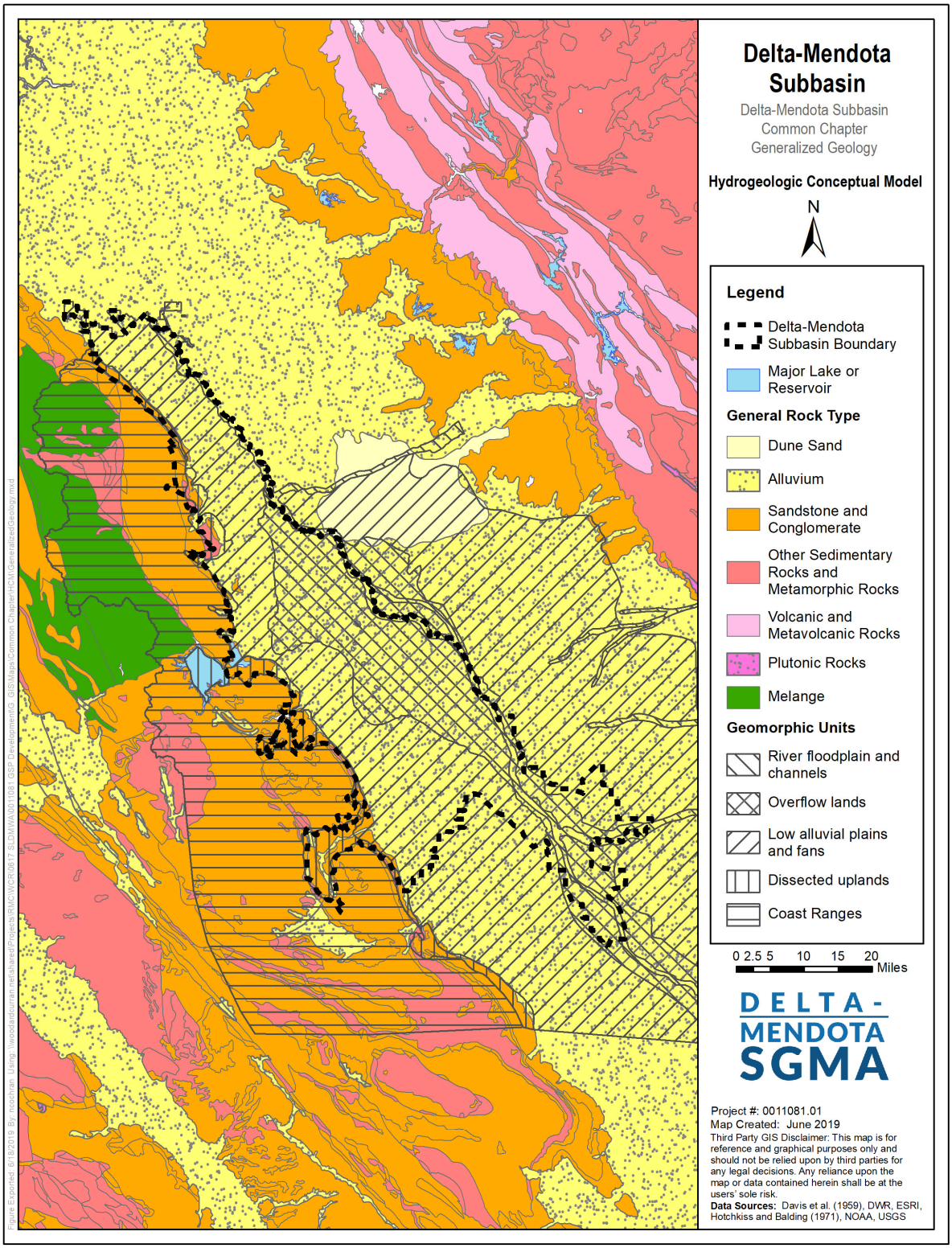


Figure CC-22: Generalized Geology

4.1.3 Geologic Formations and Stratigraphy

Distinct geomorphic units exist within the Delta-Mendota Subbasin defining areas of unique hydrogeologic environments. The geomorphic units are mapped and described by Hotchkiss and Balding (1971) and Davis et al. (1959) and are shown in **Figure CC-22**. The two primary geomorphic units within the Central Valley Floor area of the Delta-Mendota Subbasin include the overflow lands geomorphic unit and the alluvial fans and plains geomorphic unit. Overflow lands are defined as areas of relatively poorly draining soils with a shallow water table. The overflow lands geomorphic unit is located in the southeastern portion of the Subbasin and is dominated by finer-grained floodplain deposits that are the result of historical episodic flooding of this low-land area. This has formed poorly-draining soils with generally low hydraulic conductivity characteristics. In contrast, the alluvial fans and plains geomorphic unit is characterized by relatively better drainage conditions, with sediments comprised of coalescing and somewhat coarser-grained alluvial fan materials deposited by higher-energy streams flowing out of the Coast Range (Hotchkiss and Balding, 1971). The alluvial fans and plains geomorphic unit covers much of the Delta-Mendota Subbasin along the western margins of the Central Valley Floor at the base of the Coast Range.

The primary groundwater bearing units within the Delta-Mendota Subbasin consist of Tertiary and Quaternary-aged unconsolidated continental deposits and older alluvium of the Tulare Formation. Subsurface hydrogeologic materials covering the Central Valley Floor consist of lenticular and generally poorly sorted clay, silt, sand, and gravel that make up the alluvium and Tulare Formation. These deposits are thickest along the axis of the valley with thinning along the margins towards the Coast Range mountains (DWR, 2003; Hotchkiss and Balding, 1971). A zone of very shallow groundwater, generally within 25 feet of the ground surface, exists throughout large areas of the Subbasin, with considerable amounts (greater than 50 percent) of farmland in the area estimated to have very shallow depths to groundwater of less than 10 feet (Hotchkiss and Balding, 1971). Many of these areas are naturally swampy lands adjacent to the San Joaquin River.

The Tulare Formation extends to several thousand feet in depth and to the base of freshwater throughout most of the area and consists of interfingered sediments ranging in texture from clay to gravel of both Sierra Nevadan and Coast Range origin. The formation is composed of beds, lenses, and tongues of clay, sand, and gravel that have been alternatively deposited in oxidizing and reducing environments (Hotchkiss and Balding, 1971).

Terrace deposits of Pleistocene age lie up to several feet higher than present streambeds and are comprised of yellow, tan, and light-to-dark brown silt, sand, and gravel with a matrix that varies from sand to clay (Hotchkiss and Balding, 1971). The water table generally lies below the bottom of the terrace deposits; however, the relatively large grain size of the terrace deposits suggests their value as possible recharge sites. Alluvium is composed of interbedded, poorly to well-sorted clay, silt, sand, and gravel and is divided based on its degree of dissection and soil formation. The flood-basin deposits are generally composed of light-to-dark brown and gray clay, silt, sand, and organic material with locally high concentrations of salt and alkali. Stream channel deposits of coarse sand and gravel are also included.

The Tulare Formation also includes the Corcoran Clay (E-Clay) member, a diatomaceous clay or silty clay of lakebed origin which is a prominent aquitard in the San Joaquin Valley, separating the upper zone from the lower zone and distinguishing the semi-confined Upper Aquifer from the confined Lower Aquifer (Hotchkiss and Balding, 1971). The depth and thickness of the Corcoran Clay are variable within the Central Valley Floor, and it is not present in peripheral areas (outside the Central Valley Floor) of the Subbasin. Within the Upper Aquifer, additional clay layers exist and also provide varying degrees of confinement, including other clay members of the Tulare Formation and layers of white clay identified by Hotchkiss and Balding (1971). These clays are variable in extent and thickness, but the white clay is

noted to be as much as 60 feet thick in areas providing very effective confinement of underlying zones (Croft, 1972; Hotchkiss and Balding, 1971). The Tulare Formation is hydrologically the most important geologic formation in the Delta-Mendota Subbasin because it contains most of the fresh water-bearing deposits. Most of the natural recharge that occurs in the Subbasin is in the alluvial fan apex areas along Coast Range stream channels (Hotchkiss and Balding, 1971).

4.1.4 Faults and Structural Features

The valley floor portion of the Delta-Mendota Subbasin contains no known major faults and is fairly geologically inactive. There are few faults along the western boundary of the Subbasin within the Coast Range mountains, but they are not known to inhibit groundwater flow or impact water conveyance infrastructure (**Figure CC-23**).

4.1.5 Basin Boundaries

The Delta-Mendota Subbasin is defined by both geological and jurisdictional boundaries. The Delta-Mendota Subbasin borders all subbasins within the San Joaquin Valley Hydrologic Region with the exception of the Cosumnes Subbasin. The following subsections describe the lateral boundaries of the Subbasin, boundaries with neighboring subbasins, and the definable bottom of the Delta-Mendota Subbasin.

Lateral Boundaries

The Delta-Mendota Subbasin is geologically and topographically bounded to the west by the Tertiary and older marine sediments of the Coast Ranges, and to the east generally by the San Joaquin River. The northern, central, and southern portion of the eastern boundary are dictated by jurisdictional boundaries of water purveyors within the Delta-Mendota Subbasin.

As described in *California's Groundwater*, DWR Bulletin 118 (2016), the Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley. The northern boundary begins just south of Tracy in San Joaquin County. The eastern boundary generally follows the San Joaquin River and Fresno Slough. The southern boundary is near the small town of San Joaquin. The subbasin is bounded on the west by the coast range. The Subbasin boundary is defined by 20 segments detailed in the descriptions below. The Delta-Mendota Subbasin extends into six (6) counties: San Joaquin, Stanislaus, Merced, Fresno, San Benito, and Madera and is shown in relation to each of the six counties in **Figure CC-9**.

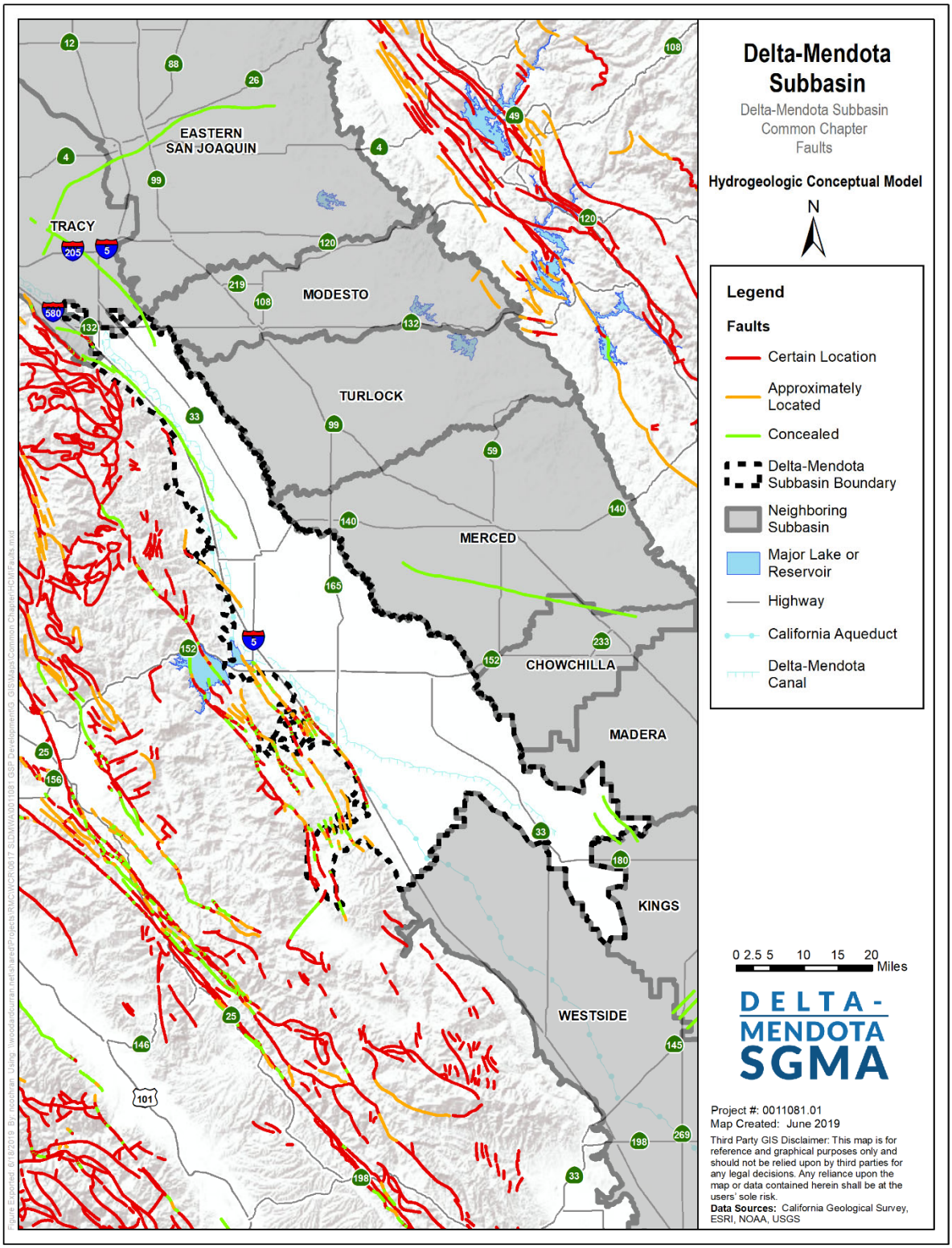


Figure CC-23: Subbasin Faults

4.1.6 Definable Bottom of Basin

In the San Joaquin Valley, the bottom of the Delta-Mendota Subbasin is defined as the interface of saline water of marine origin (base of fresh water) within the uppermost beds of the Tulare Formation. The Tulare Formation is characterized by blue and green fine-grained rocks and principally composed of fine-grained silty sands, silt, and clay (Foss and Blaisdell 1968). The Tulare Formation is predominantly marine in origin and is considered late Pliocene and possibly early Pleistocene in age. This formation is the upper shaley part of the Pliocene sequence. The top of the Tulare Formation is generally encountered around -2,000 feet mean sea level throughout the Delta-Mendota Subbasin. As agreed upon by the Delta-Mendota Subbasin GSP Groups, the base of freshwater is specifically defined by an electrical conductivity of 3,000 micromhos per centimeter at 25 °C, as presented by Page (1973). If and when significant use of water beyond the defined bottom takes place, the definition of the bottom will be revised appropriately.

4.1.7 Principal Aquifers and Aquitards

DWR's Groundwater Glossary defines an aquifer as "a body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells, and springs". There are two primary aquifers within the Delta-Mendota Subbasin: a semi-confined aquifer above the Corcoran Clay and a confined aquifer below the Corcoran Clay, with the Corcoran Clay acting as the principal aquitard within the Delta-Mendota Subbasin. **Figure CC-24** shows the locations of the representative cross-sections for the Delta-Mendota Subbasin, where **Figure CC-25** through **Figure CC-30** show the hydrostratigraphy of the representative cross-sections.

While the two-aquifer system described above is generally true across the Delta-Mendota Subbasin, there are portions of the Subbasin where the Corcoran Clay does not exist (predominantly along the western margin of the Subbasin) and hydrogeology is generally controlled by localized interfingering clays, and/or where local hydrostratigraphy results in shallow groundwater conditions that differ, to some extent, from that seen in the Subbasin as a whole. Additionally, in the southern portion of the Subbasin in the Mendota, Aliso and Tranquillity areas, there are A and C Clay layers in addition to the Corcoran Clay that inhibit vertical groundwater flow. However, while there are localized complexities throughout the Subbasin, the Corcoran Clay (or E Clay) extends through much of the Delta-Mendota Subbasin, generally creating a two-aquifer system.

Principal Aquifers

In the Delta-Mendota Subbasin, there are two primary aquifers composed of alluvial deposits separated by the Corcoran Clay (KDSA, 2015): a semi-confined Upper Aquifer (generally the ground surface to the top of the Corcoran Clay), and a confined Lower Aquifer starting at the bottom of the Corcoran Clay to the base of fresh water. However, as previously described, the localized presence of the A and C Clay layers in the southern portion of the Subbasin, the absence of the Corcoran Clay at the western margin of the Subbasin, and/or local hydrostratigraphy result in differing shallow groundwater conditions and/or perched groundwater conditions in some portions of the Subbasin. See the individual GSPs for more detailed descriptions of hydrostratigraphy in the respective Plan areas.

Upper Aquifer

The Upper Aquifer is represented by materials extending from the upper groundwater table to the top of the Corcoran Clay. The Upper Aquifer includes shallow geologic units of younger and older alluvium and upper parts of the Tulare Formation. Sediments within the upper Tulare Formation have variable sources, and subdivision of units can be distinguished between eastern and western sourced materials. Alluvial fan materials above the Corcoran Clay in the Delta-Mendota Subbasin are generally more extensive than older alluvial fan deposits within the Tulare Formation below the Corcoran Clay. As shown in Figure CC-31 by the depth to the top of the Corcoran Clay, the Upper Aquifer extends to depths ranging between approximately 150 feet and greater than 350 feet. Other notable mapped clay units also exist within the upper part of the Tulare Formation in the Delta-Mendota Subbasin, including the A and C Clay members of the Tulare Formation and a white clay mapped by Hotchkiss and Balding (1971).

Lower Aquifer

The Lower Aquifer is the portion of the Tulare Formation that is confined beneath the Corcoran Clay, extending downward to the underlying San Joaquin Formation and the interface of saline water of marine origin within its uppermost beds. The Lower Aquifer is generally characterized by groundwater that tends to be dominantly sodium-sulfate type, which is often of better quality than the Upper Aquifer (Davis et al., 1957; Hotchkiss and Balding, 1971). Exceptions to this quality do exist in the Subbasin, particularly in the southwestern portion of the Subbasin. Because of its relatively shallow depth within the Delta-Mendota Subbasin and lower salinity in areas when compared to other groundwater resources, the Lower Aquifer is heavily utilized as a source of groundwater for agricultural and drinking water uses within the Subbasin.

The base of the Lower Aquifer generally decreases from south to north, changing in depth from about 1,100 to 1,200 feet deep in the south to about 600 feet to the north. Depth to the top of the Corcoran Clay ranges from less than 100 feet on the west near Interstate 5 (I-5) to more than 500 feet in the area near Tranquillity. The Corcoran Clay pinches out or is above the water level near the California Aqueduct in the western part of the Subbasin, where the Upper and Lower Aquifers merge into interfingered layers of sand, gravel, and clay.

Corcoran Clay

The Corcoran Clay, as a regional aquitard, is a notable hydrogeologic feature throughout most of the Delta-Mendota Subbasin, impeding vertical flow between the Upper and Lower Aquifers. The Corcoran Clay is present at varying depths across most of the Central Valley floor (**Figure CC-31** and **Figure CC-33**). The depths to the top of the Corcoran Clay ranges between approximately 100 and 500 feet below the ground surface throughout most of the Subbasin, with a general spatial pattern of deepening to the south and east. In the far southeastern area of the Subbasin, in the vicinity of Mendota and Tranquillity, the top of the Corcoran Clay is at depths of greater than 350 feet (**Figure CC-31**). The thickness of the Corcoran Clay, which likely influences the degree of hydraulic separation between the Upper and Lower Aquifers, is greater than 50 feet across most of the Delta-Mendota Subbasin with thicknesses of more than 75 feet in central Subbasin areas in the vicinity of Los Banos and Dos Palos, and 140 feet in the eastern portions of the Subbasin. The Corcoran Clay appears thinner in areas north of Patterson, between Patterson and Gustine, and also in the vicinity of Tranquillity to the south (**Figure CC-33**). Along the westernmost portions of the Delta-Mendota Subbasin, the Corcoran Clay layer is generally non-existent or it exists as Corcoran-equivalent clays (clays existing at the same approximate depth but not part of the mapped aquitard).

Aquifer Properties

The following subsections include discussion of generalized aquifer properties within the Delta-Mendota Subbasin. These include hydraulic conductivity, transmissivity, specific yield and specific storage.

DWR defines hydraulic conductivity as the "measure of a rock or sediment's ability to transmit water" and transmissivity as the "aquifer's ability to transmit groundwater through its entire saturated thickness" (DWR, 2003). High hydraulic conductivity values correlate with areas of transmissive groundwater conditions with transmissivity generally equaling hydraulic conductivity times the saturated thickness of the formation. Storage of water within the aquifer system can be quantified in terms of the specific yield for unconfined groundwater flow and the storage coefficient for confined flow, respectively (Faunt et al., 2009). Specific yield represents gravity-driven dewatering of shallow, unconfined sediments at a declining water table, but also accommodates a rising water table. The specific yield is dimensionless and represents the volume of water released from or taken into storage per unit head change per unit area of the water table. Specific yield is a function of porosity and specific retention of the sediments in the zone of water-table fluctuation.

Where the aquifer system is confined, storage change is governed by the storage coefficient, which is the product of the thickness of the confined-flow system and its specific storage. The specific storage is the sum of two component specific storages – the fluid (water) specific storage and the matrix (skeletal) specific storage, which are governed by the compressibility of the water and skeleton, respectively (Jacob, 1940). Specific storage has units of 1 over length and represents the volume of water released from or taken into storage in a confined flow system per unit change in head per unit volume of the confined flow system (Faunt et al., 2009). Therefore, the storage coefficient of a confined flow system is dimensionless and, similar to specific yield, represents the volume of water released from or taken into storage per unit head change.

Hydraulic Conductivity

Figure CC-34 shows the saturated C-horizon hydraulic conductivity of surficial soils within the Delta-Mendota Subbasin based on the National Resource Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO). Soil survey data for counties within the Subbasin were combined using the weighted harmonic mean of these representative layers to depict the saturated hydraulic conductivity of the C-horizon for each soil map unit. The soil profile represented by these data is variable but commonly extends to a depth of six or more feet.

Floodplain deposits are evident as soils with relatively low hydraulic conductivity (less than 0.5 feet per day [ft/day]) blanket much of the Central Valley Floor, although localized areas of soils with higher hydraulic conductivity are present in association with modern and ancient surface waterways and alluvial fan features (**Figure CC-34**). Coarse soils of distributary alluvial fan sediments deposited by Del Puerto Creek, Orestimba Creek, Los Banos Creek, Ortigalita Creek, and Little Panoche Creek, in addition to other ephemeral northeasterly creek flows off the Coast Ranges, are notably apparent as areas of soils of high hydraulic conductivity located along active and inactive stream channels extending eastward from the fan apex areas along the Valley Floor margins to the current alignment of the San Joaquin River in the valley axis. Additionally, soils in areas adjacent to the active channel of the San Joaquin River also exhibit high hydraulic conductivities, including values of greater than 4 ft/day which are particularly apparent in an area north of Mendota. Soils of similarly high hydraulic conductivity trending as linear features in a general northwest-southeast alignment to the north of Dos Palos and Los Banos are likely the result of historical depositional processes and paleochannels associated with the San Joaquin River (**Figure CC-34**). In areas peripheral to the Central Valley floor, soils tend to be characterized by relatively low hydraulic conductivity, although soils of somewhat higher hydraulic conductivity

associated with distinct geologic units are mapped across much of the peripheral area to the west of Patterson and Gustine and also in localized bands associated with surface water courses.

Transmissivity

Transmissivity varies greatly above the Corcoran Clay, within the Corcoran Clay, and below the Corcoran Clay within the Delta-Mendota Subbasin, with transmissivities in the confined Lower Aquifer generally being larger than those in the semi-confined Upper Aquifer. Based on testing conducted at multiple locations within both the Upper and Lower Aquifers of the Delta-Mendota Subbasin, average transmissivities in the Subbasin are approximately 109,000 gallons per day per square foot (gpd/ft^2) (KDSA, 1997b).

Specific Yield

DWR defines specific yield as the "amount of water that would drain freely from rocks or sediments due to gravity and describes the proportion of groundwater that could actually be available for extraction" (DWR, 2003). Specific yield is a measurement specific to unconfined aquifers.

The estimated specific yield of the Delta-Mendota Subbasin is 0.118 (DWR, 2006). Within the southern portion of the Delta-Mendota Subbasin, specific yield ranges from 0.2 to 0.3 (Belitz et al., 1993). Specific yield estimates for the Delta-Mendota Subbasin are fairly limited in literature since the Upper Aquifer above the Corcoran Clay is semi-confined and the Lower Aquifer below the Corcoran Clay is confined. Therefore, specific yield values only characterize the shallow, unconfined groundwater within the Subbasin.

Specific Storage

Values for specific storage were extracted from the Central Valley Hydrologic Model 2 (CVHM2), which is currently under development by the United States Geological Survey (USGS) and includes refinements for the Delta-Mendota Subbasin. Specific storage varies above, within, and below the Corcoran Clay with CVMH2. Above the Corcoran Clay, specific storage ranges from 1.34×10^{-6} to 6.46×10^{-2} $meters^{-1}$ (m^{-1}) with average values ranging from 6.16×10^{-3} to 1.97×10^{-2} m^{-1}. Specific storage within the Corcoran Clay is considerably smaller than above the Corcoran Clay, ranging between 1.41×10^{-6} and 2.35×10^{-6} m^{-1} and average values between 1.96×10^{-6} and 2.02×10^{-6} m^{-1}. Below the Corcoran Clay, specific storage is comparable to within the Corcoran Clay with overall ranges the same as within the Corcoran Clay and average values ranging from 1.86×10^{-6} to 2.01×10^{-6} m^{-1}. Therefore, specific storage is greatest within the semi-confined aquifer overlying the Corcoran Clay layer, with considerably smaller specific storage values within the low permeability Corcoran Clay and confined aquifer underlying the Corcoran Clay layer.

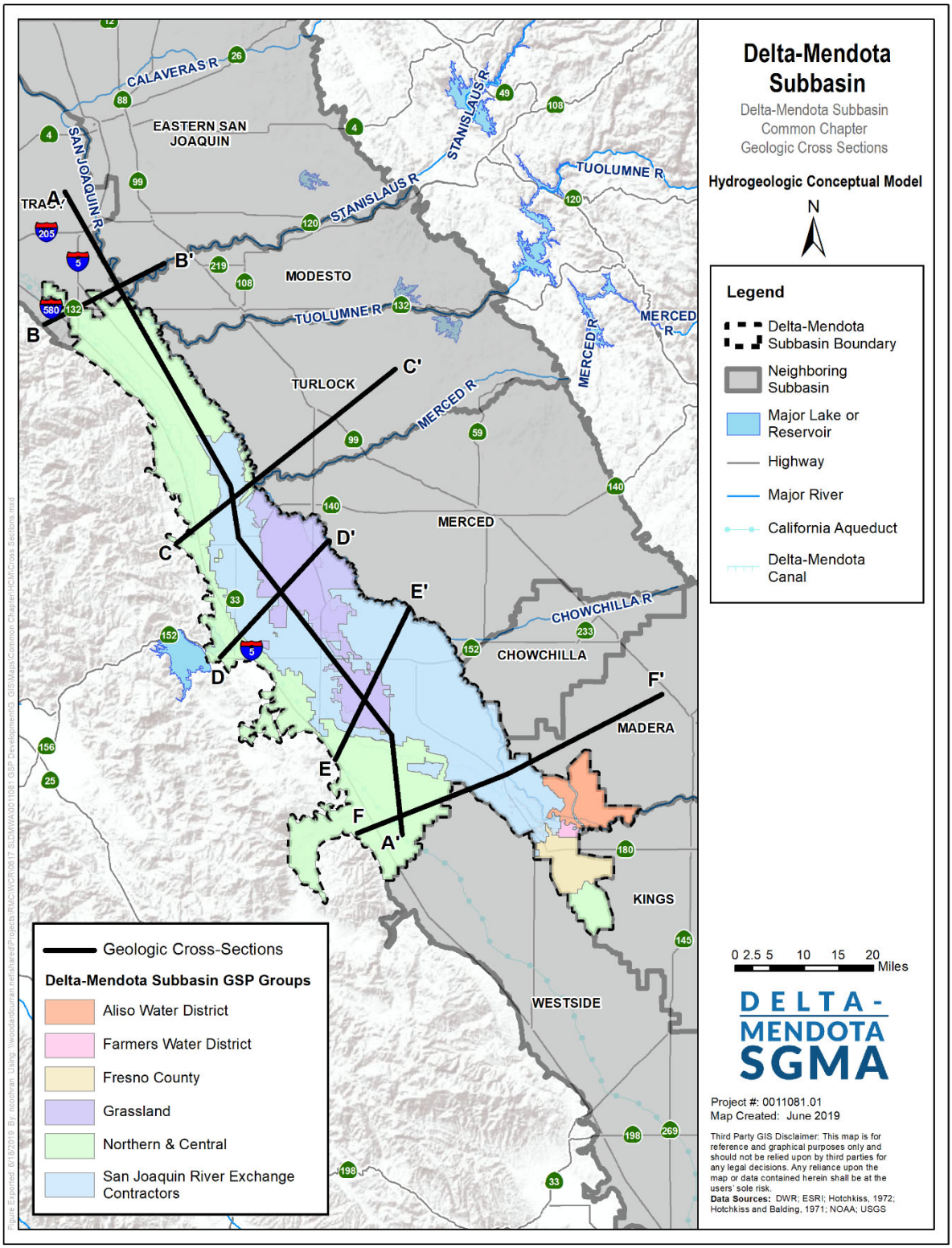


Figure CC-24: Representative Cross-Sections

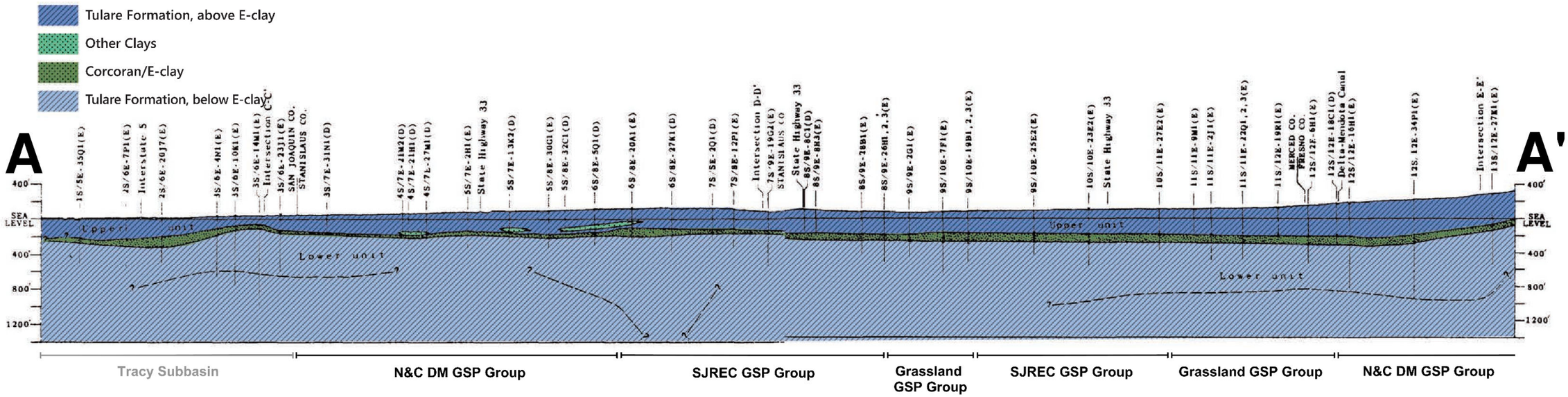


Figure CC-25: Cross-Section A-A' (Hotchkiss, 1972)

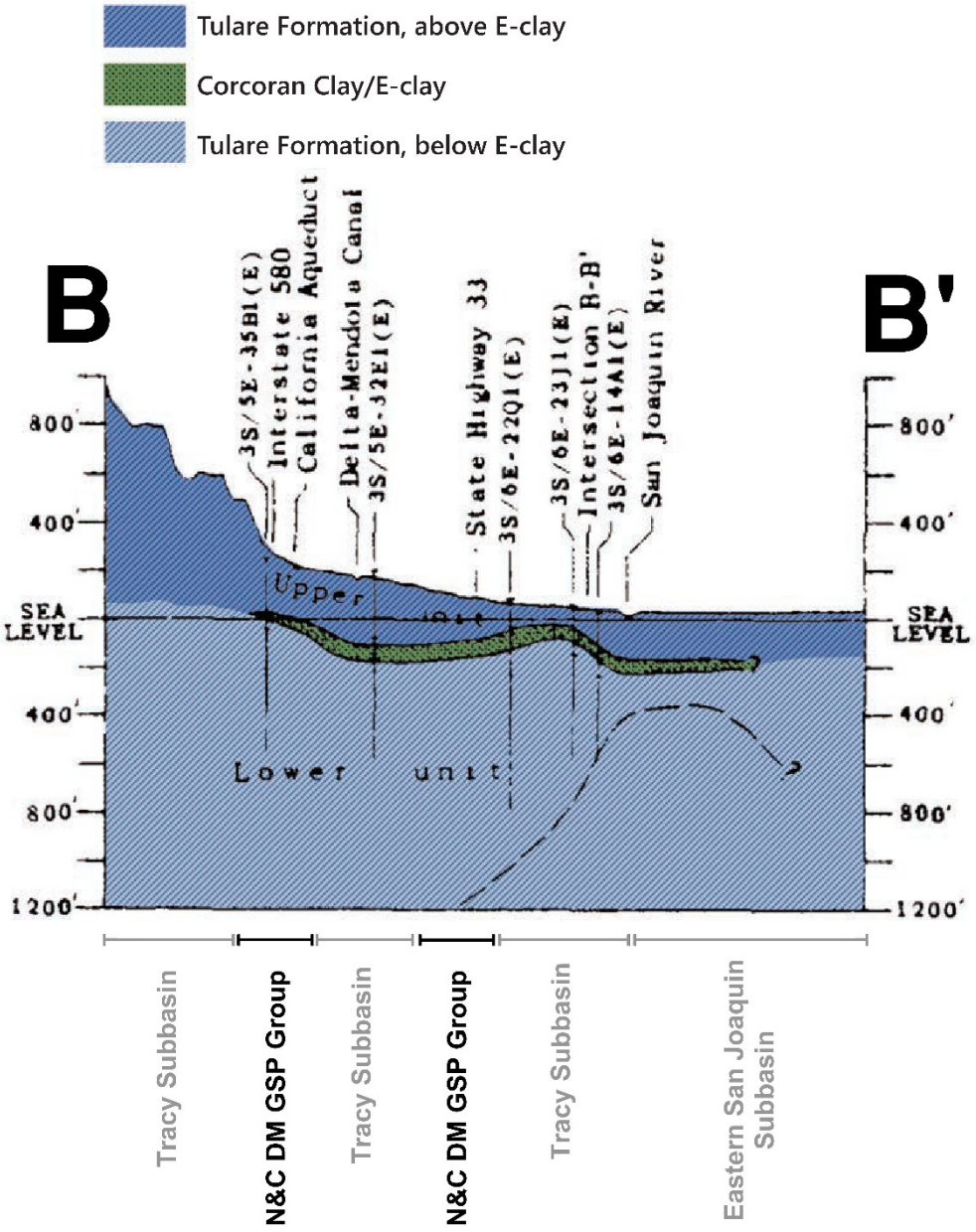


Figure CC-26: Cross-Section B-B' (Hotchkiss, 1972)

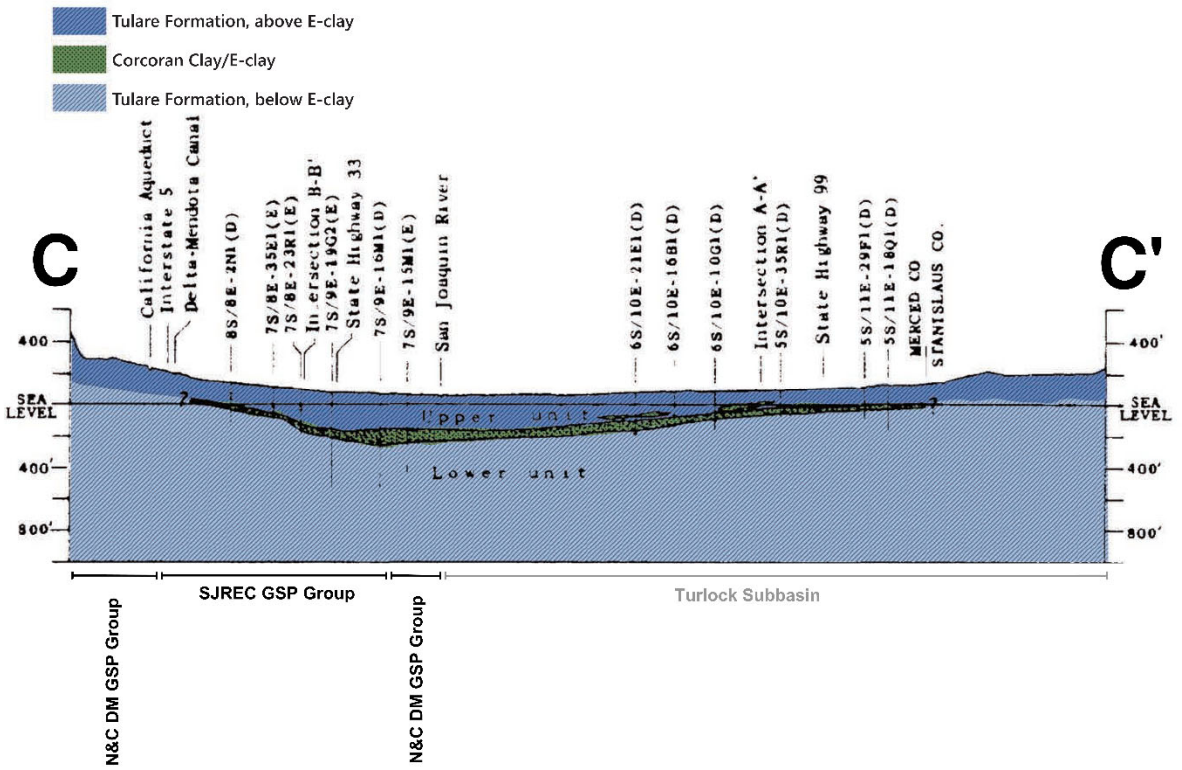


Figure CC-27: Cross-Section C-C' (Hotchkiss, 1972)

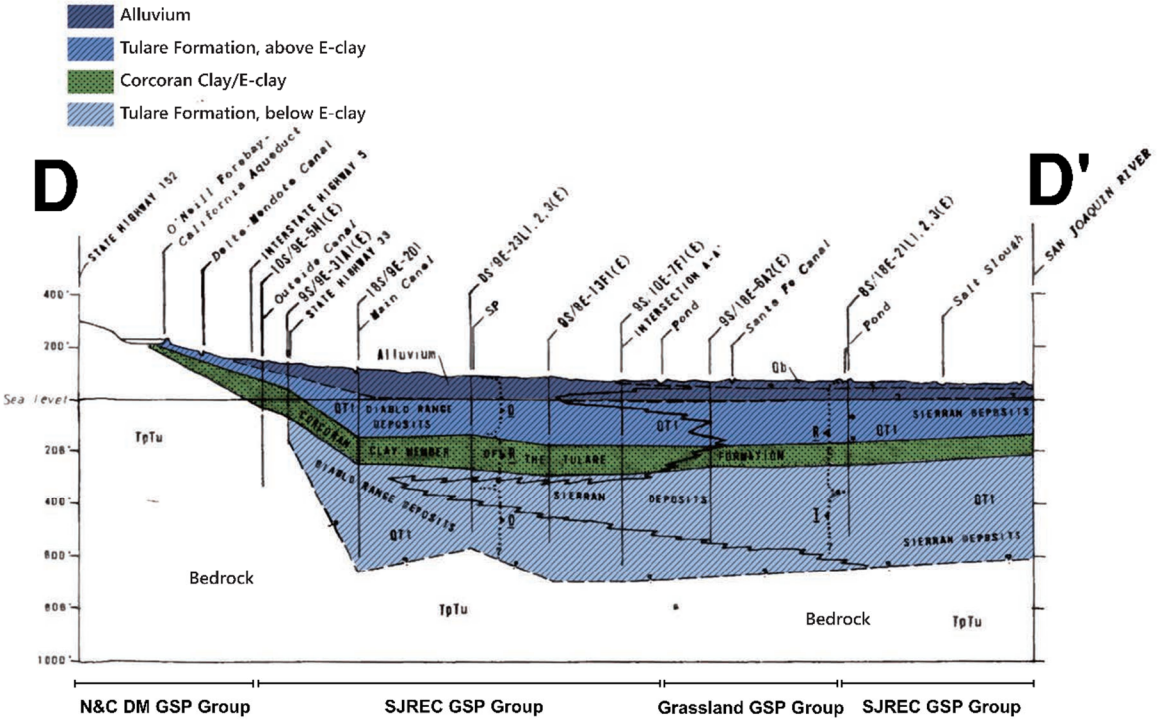


Figure CC-28: Cross-Section D-D' (Hotchkiss & Balding, 1971)

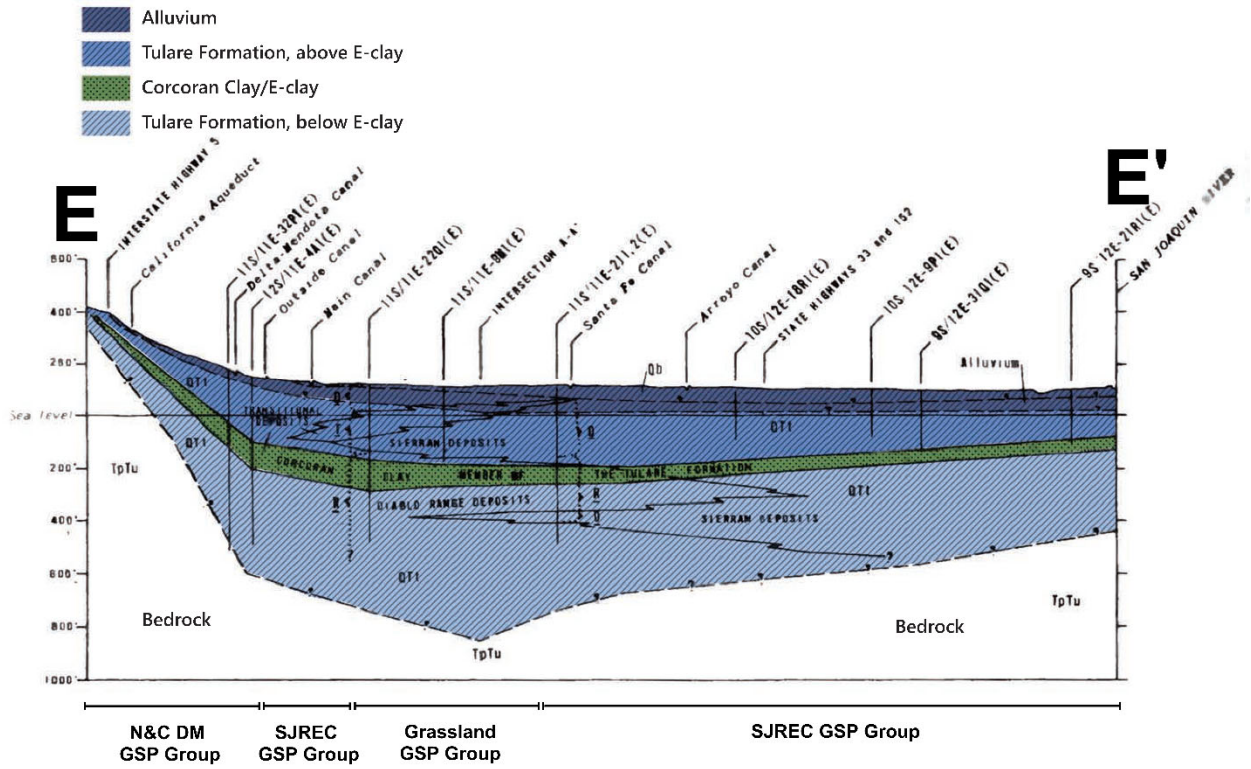


Figure CC-29: Cross-Section E-E' (Hotchkiss & Balding, 1971)

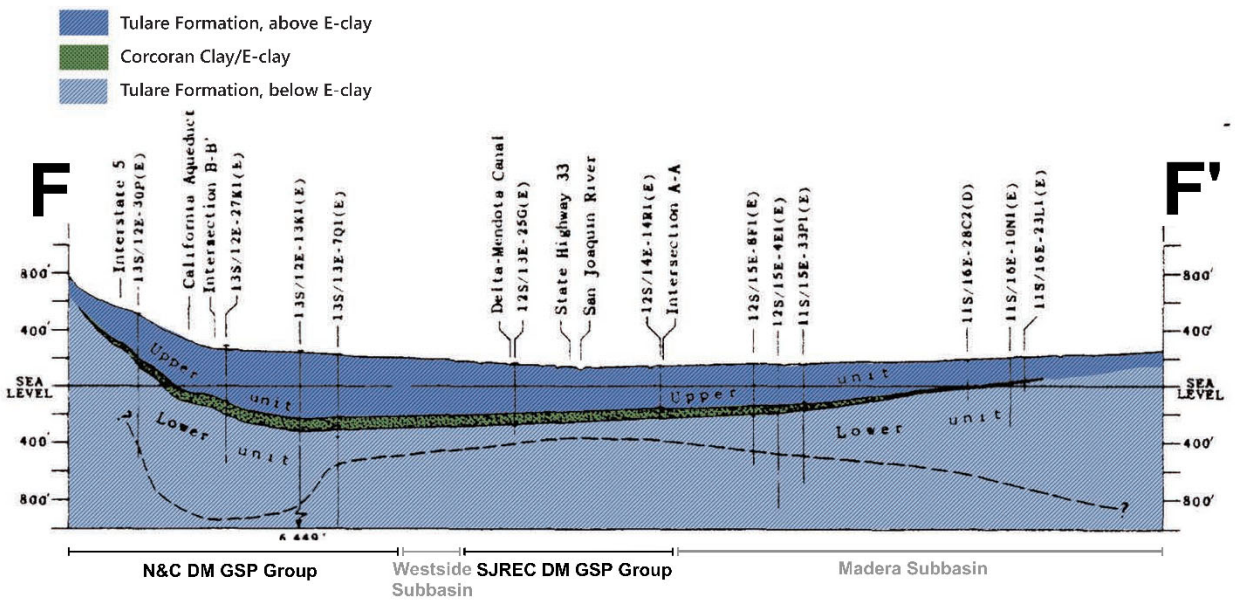


Figure CC-30: Cross-Section F-F' (Hotchkiss, 1972)

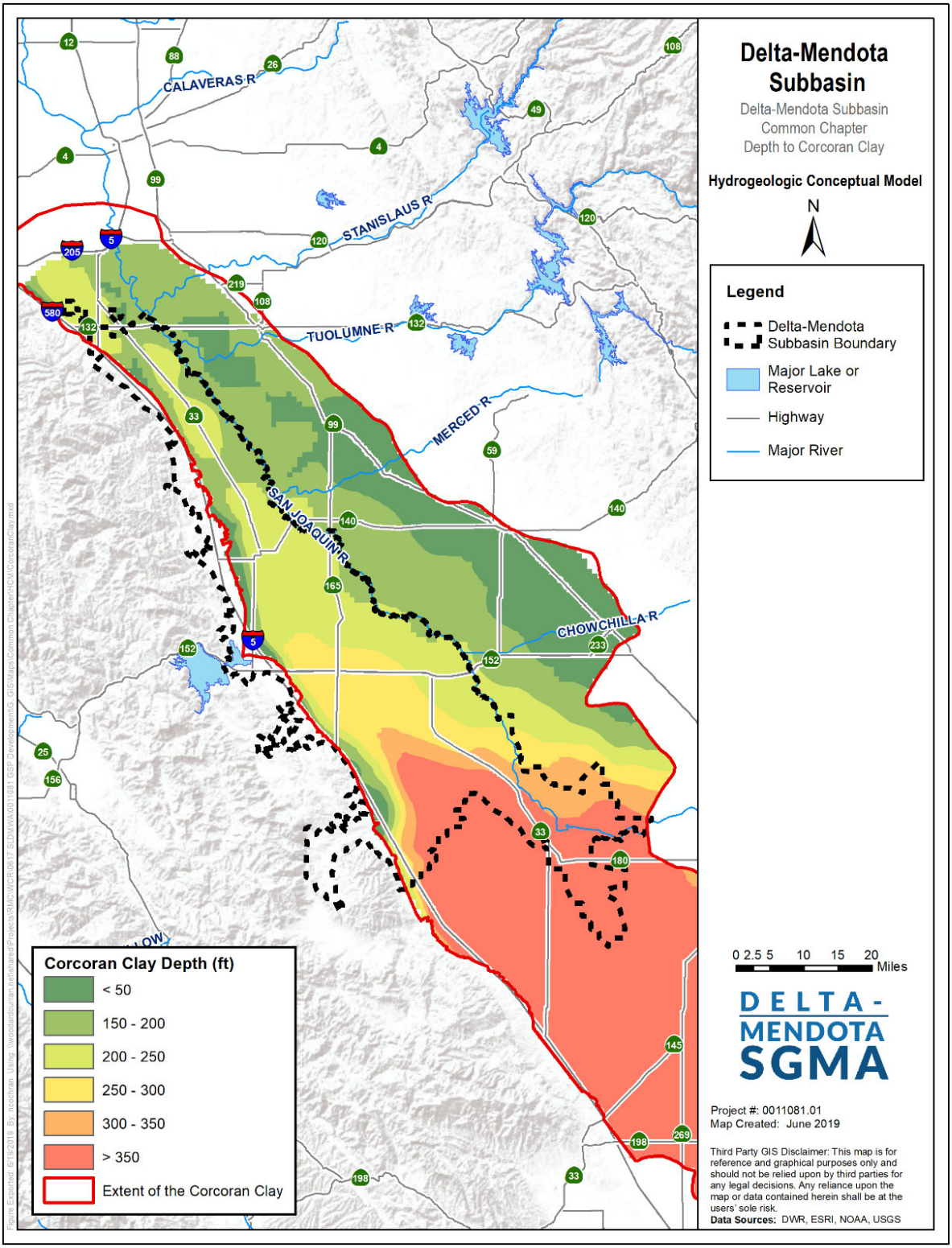


Figure CC-31: Depth to Corcoran Clay

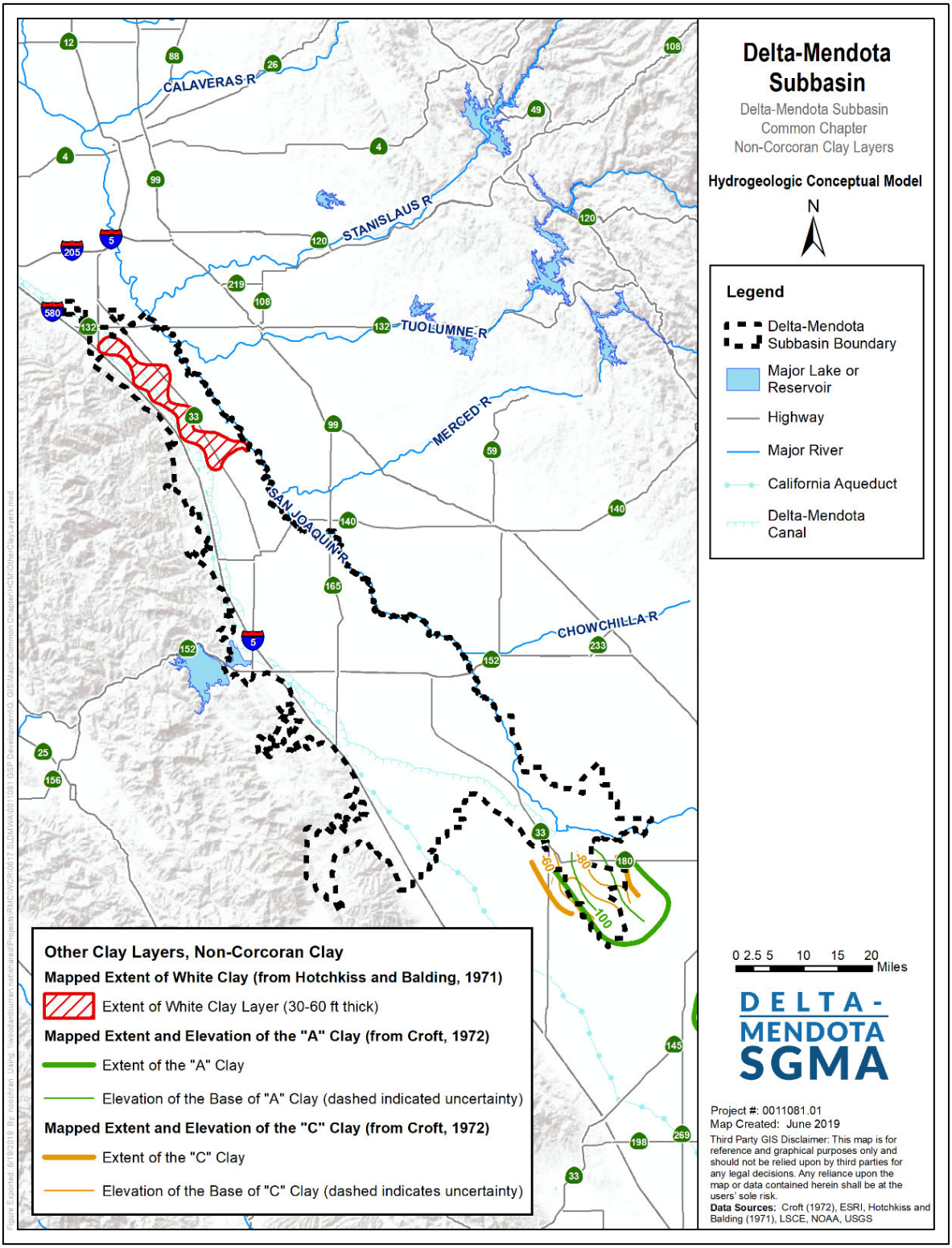


Figure CC-32: Non-Corcoran Clay Layers

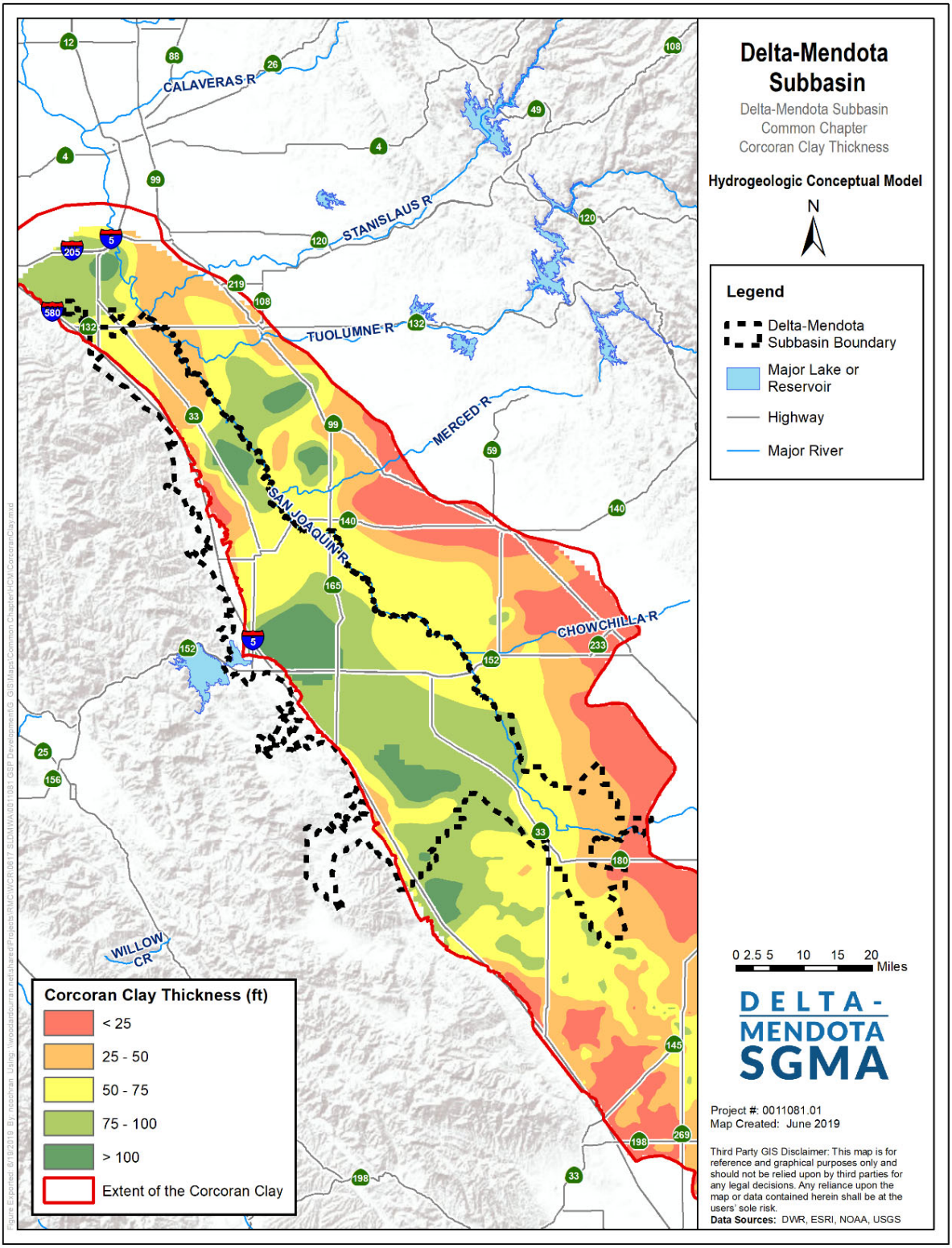


Figure CC-33: Thickness of Corcoran Clay

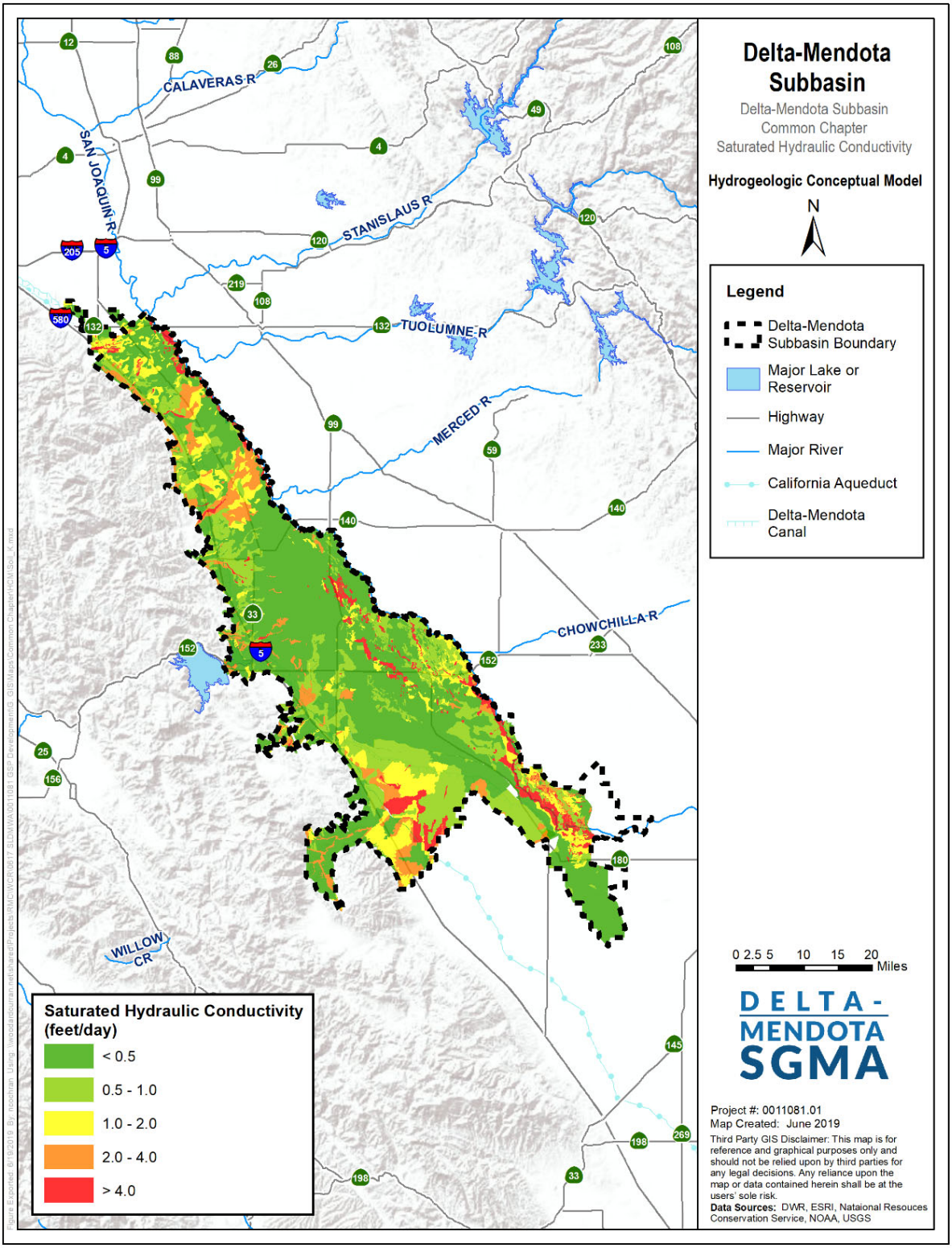


Figure CC-34: Soil Hydraulic Conductivity

4.1.8 Structural Properties and Restricted Groundwater Flow

Under natural (pre-development) conditions, the prevailing groundwater flow within the Upper and Lower Aquifer systems of the western San Joaquin Valley was predominantly in a generally northeasterly direction from the Coast Range towards and parallel to the San Joaquin River and the Sacramento-San Joaquin Delta (LSCE, 2015; Hotchkiss and Balding, 1971; KDSA, 2015). Historically, numerous flowing artesian wells within the Lower Aquifer existed throughout the Delta-Mendota Subbasin (Mendenhall et al., 1916) and the pressure gradient for groundwater flow was upward from the Lower Aquifer to the Upper Aquifer. These flowing artesian conditions have disappeared in many areas as a result of increased development of groundwater resources within the Tulare Formation (Hotchkiss and Balding, 1971). Additionally, the Delta-Mendota Subbasin has experienced periods of considerable decline in groundwater levels during which hydraulic heads in the Lower Aquifer decreased considerably in some areas due to heavy pumping (Bertoldi et al., 1991).

Despite the presence of local pumping depressions within parts of the Subbasin, the prevailing northeastward flow direction for groundwater in the Upper Aquifer within the region has remained (AECOM, 2011; DWR, 2010; Hotchkiss and Balding, 1971). Groundwater generally flows outward from the Delta-Mendota Subbasin, except along the southern and western margins where there is some recharge from local streams and canal seepage (KDSA, 2015), in addition to northward subbasin boundary flows. Within the Upper Aquifer, there are similar groundwater flow directions in most of the Subbasin with groundwater outflow to the northeast or towards the San Joaquin River in much of the Subbasin during wet and normal periods. One exception is in the Orestimba Creek area west of Newman where groundwater flows to the west during drought conditions and east during wet periods. Calculations based on aquifer transmissivity indicate the net groundwater outflow in the Upper Aquifer has been about three times greater during drought periods than during normal periods (KDSA, 1997a and 1997b).

Within the Lower Aquifer, there is a groundwater divide generally in the area between Mendota and the point near the San Joaquin River in the Turner Island area, northeast of Los Banos. Groundwater southwest of this divide generally flows southwest toward Panoche Water District and Westlands Water District. Groundwater northeast of this divide flows to the northeast into Madera and Merced Counties. Net groundwater outflow in the Lower Aquifer under drought conditions has been about two and a half times greater than for normal conditions (KDSA, 1997a and 1997b). Based on current and historical groundwater elevation maps, groundwater barriers do not appear to exist in the Delta-Mendota Subbasin (DWR, 2006).

The combined effect of pumping below the Corcoran Clay and increased leakage from the Upper Aquifer to the Lower Aquifer where the Corcoran Clay does not exist or has been perforated has developed a generally downward flow gradient in the Tulare Formation which changes with variable pumping and irrigation over time (Bertoldi et al., 1991). Periods of great groundwater level declines have also resulted in inelastic compaction of fine-grained materials in some locations, particularly between Los Banos and Mendota, potentially resulting in considerable decreases (between 1.5 and 6 times) in permeability of clay members within the Tulare Formation, including the Corcoran Clay (Bertoldi et al., 1991). However, the number of wells penetrating the Corcoran Clay may be enabling vertical hydraulic communication across the Corcoran Clay aquitard and other clay layers (Davis et al., 1959; Davis et al., 1964).

4.1.9 Water Quality

Groundwater in the Delta-Mendota Subbasin is characterized by mixed sulfate to bicarbonate water types in the northern and central portion of the Subbasin, with areas of sodium chloride and sodium sulfate waters in the central and southern portions (DWR, 2003). Total Dissolved Solids (TDS) values range from 400 to 1,600 mg/L in the northern portion, and 730 to 6,000 mg/L in the southern portion of the

Delta-Mendota Subbasin (Hotchkiss and Balding, 1971). The Department of Health Services (currently the Division of Drinking Water), which monitors Title 22 water quality standards, reports TDS values in 44 public supply wells in the Subbasin ranging in value from 210 to 1,750 mg/L, with an average value of 770 mg/L. Shallow, saline groundwater also occurs within about 10 feet of the ground surface over a large portion of the Delta-Mendota Subbasin. There are also localized areas of high iron, fluoride, nitrate, selenium, and boron in the Delta-Mendota Subbasin (Hotchkiss and Balding, 1971).

Alluvial sediments derived from west-side streams are composed of material from serpentine, shale, and sandstone parent rock, which results in soil and groundwater types entirely different from those on the east side of the San Joaquin Valley (LSCE, 2015). In contrast with the siliceous mineralogy of the alluvial sands and gravels on the eastern side of the Central Valley that are derived from the Sierra granitic rocks (which are coarser and more resistant to chemical dissolution), the sulfate and carbonate shales and sandstones of Coast Range sediments on the western side are more susceptible to dissolution processes. Some soils and sediments within the western San Joaquin Valley that are derived from marine rocks of the Coast Range have notably high concentrations of naturally-occurring nitrogen, with particularly higher nitrate concentrations in younger alluvial sediments (Strathouse and Sposito, 1980; Sullivan et al., 1979). These naturally-occurring nitrogen sources may contribute to nitrate concentrations in groundwater within the Delta-Mendota Subbasin, although it is not well known where this may occur and to what degree. Naturally high concentrations of TDS in groundwater are known to have existed historically within parts of the Subbasin due to the geochemistry of the Coast Range rocks and the marine depositional environment, the resulting naturally-high TDS of recharge derived from Coast Range streams, the dissolvable materials within the alluvial fan complexes, and the naturally-poor draining conditions which tend to concentrate salts in the system. The chemical quality of waters in the Coast Range streams can be closely correlated with the geologic units within their respective catchments. Groundwater flows discharging from these marine and non-marine rocks into streams introduce a variety of dissolved constituents resulting in variable groundwater types. The water quality and chemical makeup in westside streams can be highly saline, especially in more northern streams, including Corral Hollow, Panoche and Del Puerto Creeks, where historical baseflow TDS concentrations have typically exceeded 1,000 mg/L with measured concentrations as high as 1,790 mg/L (Hotchkiss and Balding, 1971). This is in contrast with TDS concentrations typically below 175 mg/L in streams draining from the Sierras. The contribution of water associated with these Coast Range sediments has resulted in naturally high salinity in groundwater within and around the Delta-Mendota Subbasin, which has been recognized as early as the 1900s (Mendenhall et al., 1916). Groundwater in some areas within the immediate vicinity of the San Joaquin River is influenced by lower-salinity surface water discharging from the east side of the San Joaquin Valley Groundwater Basin (Davis et al., 1957).

Areas of historical high saline groundwater documented by Mendenhall *et al*. (1916) indicate somewhat high TDS concentrations approaching or greater than 1,000 mg/L in wells sampled throughout many parts of the Delta-Mendota Subbasin. Areas of locally higher TDS concentrations (1,500-2,400 mg/L) have existed between Mendota and Los Banos; whereas the trend in deeper groundwater (average well depth of 450 feet) south of Mendota near Tranquillity indicates slightly lower historical salinity conditions, but still somewhat high with an average TDS concentration of greater than 1,000 mg/L. In the northern part of the Subbasin, north of Gustine, the average historical TDS concentration of wells was also relatively high (930 mg/L). Historically low TDS concentrations (<500 mg/L) existed in groundwater from wells with an average depth of 209 feet in the central Subbasin area between Los Banos and Gustine.

The general chemical composition of groundwater in the Subbasin is variable based on location and depth. Groundwater within the Upper Aquifer is largely characterized as transitional type with less area characterized as predominantly of chloride, bicarbonate, and sulfate water types. Transitional water types, in which no single anion represents more than 50 percent of the reactive anions, occurs in many different combinations with greatly ranging TDS concentrations. Chloride-type waters occur generally in grassland

areas east of Gustine and around Dos Palos, with sodium chloride water present in northern areas near Tracy and also extending south from Dos Palos. These waters also exhibit greatly varying salinity with typical TDS concentrations, ranging from less than 500 mg/L to greater than 10,000 mg/L and of high sodium makeup (50-75 percent of cations present) (Hotchkiss and Balding, 1971). Areas of bicarbonate groundwater within the Upper Aquifer of relatively lower TDS concentrations are directly associated with intermittent streams of the Coast Range near Del Puerto, Orestimba, San Luis, and Los Banos Creeks. Sulfate water in the central and southern Subbasin areas has TDS concentrations decreasing from west (1,200 mg/L) to east (700 mg/L) towards the San Joaquin River, similar to the bicarbonate water areas, although areas of sulfate water south of Dos Palos have much higher TDS concentrations (1,900 to 86,500 mg/L) (Hotchkiss and Balding, 1971).

Groundwater in the Lower Aquifer below the Corcoran Clay is also spatially variable, consisting of mostly transitional sulfate waters in the northern part of the Delta-Mendota Subbasin to more sodium-rich water further south in the grassland areas. In the northern part of the Delta-Mendota Subbasin, the Lower Aquifer exhibits relatively lower TDS concentrations, ranging from 400 to 1,600 mg/L, with a sulfate-chloride type makeup near the valley margin trending to sulfate-bicarbonate type near the valley axis. Farther south, TDS concentrations in the Lower Aquifer increase (Hotchkiss and Balding, 1971).

Natural conditions of groundwater salinity exist throughout the Upper and Lower Aquifers as a result of the contribution of salts from recharge off the Coast Range mountains. Surface water and groundwater flowing over and through Coast Range sediments of marine origin have dissolved naturally-occurring salts, contributing to the historical and current presence of salinity in groundwater within the Delta-Mendota Subbasin. In addition to natural salinity contributed from the Coast Range sediments, a number of other mechanisms are believed to further contribute to increased salinity in the groundwater in the region. Poorly draining soil conditions are extensive within some of the southern and eastern areas of the Subbasin, extending from the vicinity of Tranquillity to near Gustine, and these types of soil, combined with a shallow water table, contribute to a build-up of soil salinity.

4.1.10 Topography, Surface Water, Recharge, and Imported Supplies

This section describes the topography, surface water, soils, and groundwater recharge potential in the Delta-Mendota Subbasin.

Topography

As previously described, the Delta-Mendota Subbasin lies on the western side of the Central Valley and extends from the San Joaquin River on the east, along the axis of the Valley, to the Coast Range on the west side (LSCE, 2015). The Subbasin has ground surface elevations ranging from less than 100 feet above mean sea level (msl) along parts of the eastern edge to greater than 1,600 feet msl in the Coast Range mountains (**Figure CC-35**). Most of the lower elevation areas occur east of Interstate 5, in the eastern parts of the Delta-Mendota Subbasin; although some lower elevation areas also extend westward into the Coast Range, such as in Los Banos Creek Valley. Low elevation areas generally coincide with the extent of the Central Valley floor. Topography within the Delta-Mendota Subbasin consists largely of flat areas across the Central Valley floor, where slopes are generally less than 2 percent, with steepening slopes to the west. The topography outside of the Central Valley floor in the Coast Range mountains is characterized by steeper slopes, generally greater than 6 percent.

Surface Water Bodies

The San Joaquin River and its tributaries is the primary natural surface water feature within the Delta-Mendota Subbasin, flowing from south to north along the eastern edge of the Subbasin (LSCE, 2015).

During the 1960s, the San Joaquin River exhibited gaining flow conditions through much of the Subbasin (Hotchkiss and Balding, 1971). Numerous intermittent streams from the Coast Range enter the Delta-Mendota Subbasin from the west; however, none of these maintain perennial flow and only Orestimba Creek, Los Banos Creek and Del Puerto Creek have channels that extend eastward to a junction with the San Joaquin River. Most of the flow in other notable west-side creeks, including Quinto Creek, San Luis Creek, Little Panoche Creek, and Ortigalita Creek, is lost to infiltration (Hotchkiss and Balding, 1971). Flow from Los Banos and San Luis Creeks are impounded by dams on their respective systems. When flood releases are made from Los Banos Creek Reservoir, the vast majority of flows pass through Grassland Water District to the San Joaquin River as they tend to occur during times when agricultural and wetland demand is low. San Luis Reservoir on San Luis Creek, which is located along the western boundary of the Delta-Mendota Subbasin, is an artificial water storage facility for the Central Valley Project and California State Water Project and has no notable natural surface water inflows. Outflows from the reservoir go into the system of federal- and state-operated canals and aqueducts comprising the Central Valley and State Water Projects. Surface water use within the Delta-Mendota Subbasin is derived largely from water deliveries provided by these projects, including from the California Aqueduct (referred to as San Luis Canal in the joint-use area of the California Aqueduct) and Delta-Mendota Canal, and also from the San Joaquin River (**Figure CC-36**).

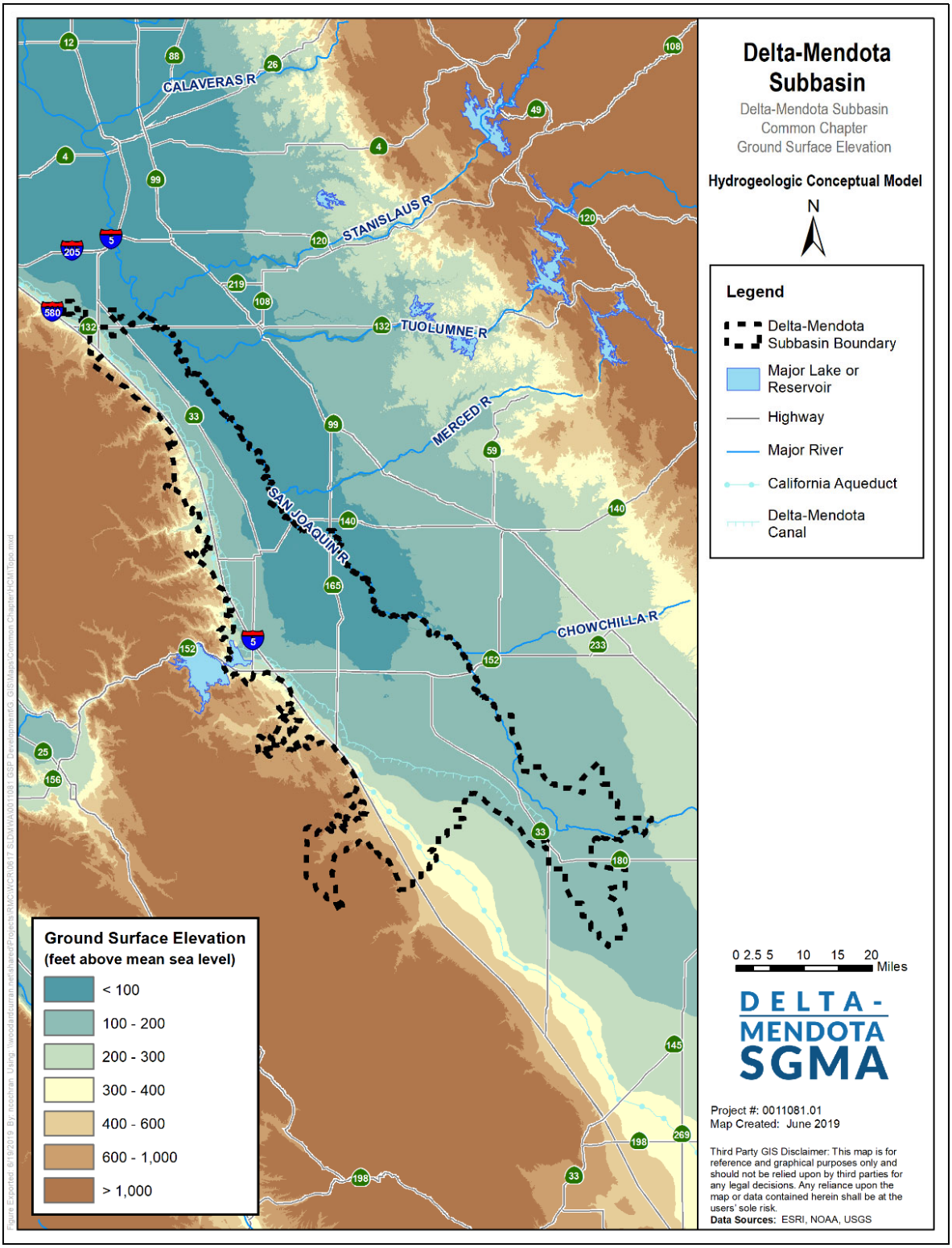


Figure CC-35: Ground Surface Elevation

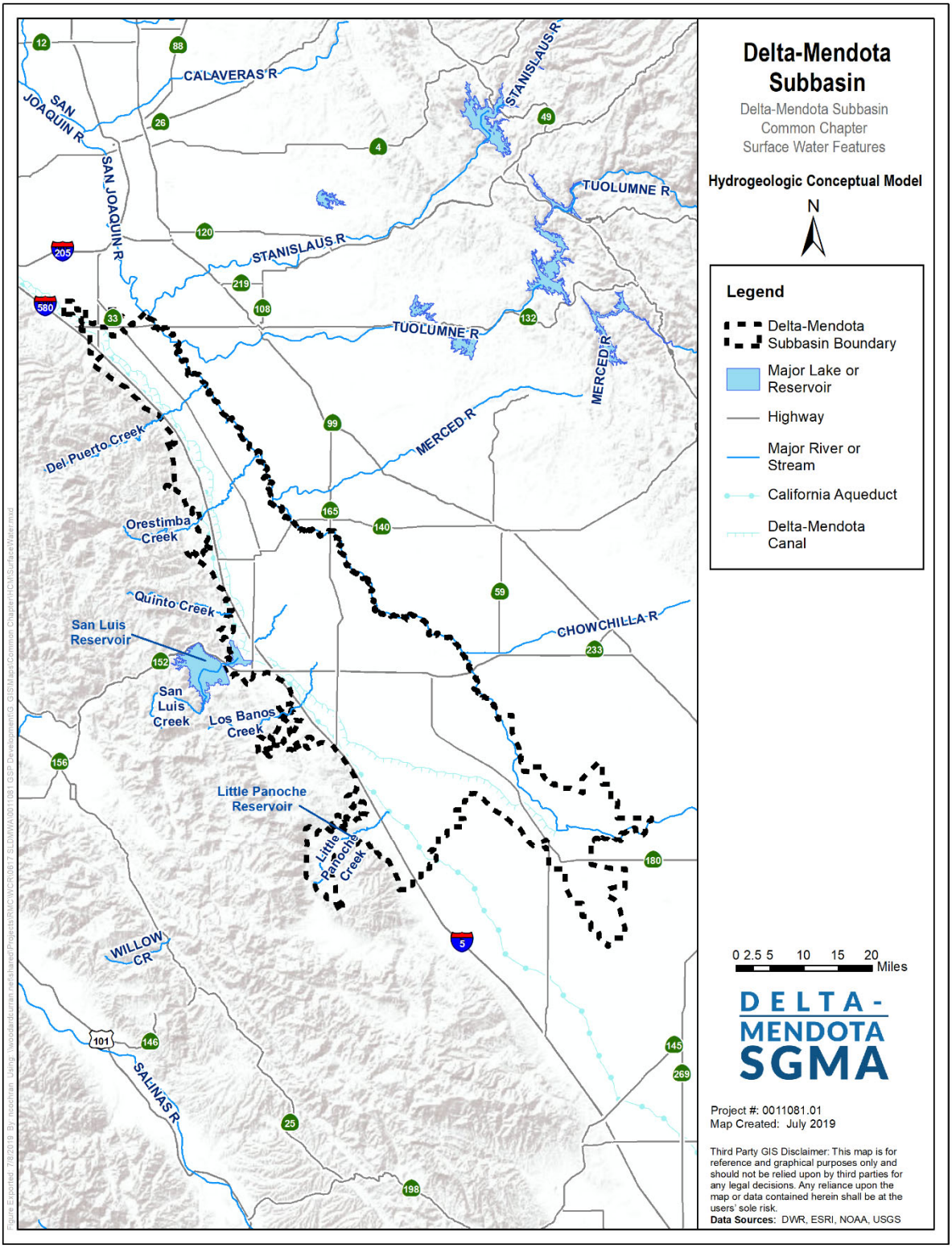


Figure CC-36: Surface Water Features

Soils

The NRCS provides soil mapping in the region. One of the combining soil groupings mapped includes hydrologic groups. The predominant soil hydrologic groups within the Delta-Mendota Subbasin are soil types C and D (**Figure CC-37**). Group C soils have moderately high runoff potential when thoroughly wet (NRCS, 2009) with water transmission through the soil somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Group D soils have a high runoff potential when thoroughly wet and water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential.

Soil hydraulic conductivity groups are closely related to soil drainage characteristics and hydraulic conductivity. The fine-grained floodplain deposits present across much of the southeastern area of the Subbasin are evidenced as soils with lower hydraulic conductivity in **Figure CC-37** and accordingly, these characteristics also make these areas poorly drained. Poorly draining soil conditions are extensive within the southern and eastern areas of the Subbasin, extending from the vicinity of Tranquillity to near Gustine (Fio, 1994; Hotchkiss and Balding, 1971). Soils in the northern and western parts of the Delta-Mendota Subbasin exhibit better drainage characteristics, although areas of poorly drained soils are also present in the north and west in proximity to surface water courses, including most notably directly adjacent to portions of the San Joaquin River and Los Banos Creek channels. Many of the upland soils, which are of generally coarser texture and located proximal to sediment sources derived from the Coast Range hill slopes, are characterized as moderately well drained.

In areas with low hydraulic conductivity, corresponding to areas without adequate natural drainage, tile drains are present to remove shallow groundwater from the rooting zone. Known tile drain locations are shown in **Figure CC-38,** which are primarily located along the eastern boundary of the Delta-Mendota Subbasin as well as the southern portion of the Subbasin in the Grassland Drainage Area. The Grassland Drainage Area contains a tile drainage system connected to the San Joaquin River Improvement Project, which uses tile drainage water for irrigated agriculture with a high salinity tolerance.

Areas of Recharge, Potential Recharge, and Groundwater Discharge Areas

The primary process for groundwater recharge within the Central Valley floor area is from percolation of applied irrigation water and seepage from canals and stream beds, although some groundwater recharge does occur in the Delta-Mendota Subbasin along the western boundary of the Subbasin due to mountain front recharge. In sandier areas, recharge ponds have been constructed within certain districts (CCC, Aliso Water District, CCID and Del Puerto Water District) to promote managed aquifer recharge.

Groundwater recharge potential on agricultural land based on the Soil Agricultural Groundwater Banking Index (SAGBI) is shown in **Figure CC-39**. The SAGBI is based on five major factors: deep percolation, root zone residence time, topography, chemical limitations, and soil surface conditions. Within the Delta-Mendota Subbasin, SAGBI data categorizes 160,248 acres out of 744,237 acres (21%) of agricultural and grazing land within the regions as having Excellent, Good, and Moderately Good (**Figure CC-39**) recharge properties, and 571,573 acres out of 744,237 acres (or 77%) of agricultural and grazing land as having Moderately Poor, Poor, or Very Poor recharge properties. “Modified” SAGBI data shows higher potential for recharge than unmodified SAGBI data because the modified data assumes that soils have been or will be ripped to a depth of six feet, which can break up fine grained materials at the surface to improve percolation. The modified data set was determined to more accurately represent the Delta-Mendota Subbasin due to the heavy presence of agriculture. In almost all cases, recharge from applied water on irrigated lands recharges the Upper Aquifer of the Subbasin. However, the use of percolation

ponds and other managed aquifer recharge techniques must consider existing water quality in addition to soil composition and may be limited in areas where poor water quality currently exists.

The Corcoran Clay is a known barrier restricting vertical flow between the Upper and Lower Aquifers; therefore, natural recharge of the Lower Aquifer from downward percolating water is most likely restricted where the Corcoran Clay is present, including across most of the Central Valley floor. Primary recharge areas to the Lower Aquifer are most likely in western parts of the Central Valley floor where percolating water can enter formations feeding the Lower Aquifer, particularly in the vicinity and west of Los Banos, Orestimba, and Del Puerto Creeks, along the western margin of the Subbasin.

Groundwater discharge areas are identified as springs located within the Delta-Mendota Subbasin and the San Joaquin River. **Figure CC-39** shows the location of historic springs identified by USGS. There are only six springs/seeps identified by USGS in their National Hydrograph Dataset, which are located in the southwestern corner of the Subbasin. The springs shown represent a dataset collected by USGS and are not a comprehensive map of springs in the Subbasin.

Imported Supplies

Both the California Aqueduct and Delta-Mendota Canal run the length of the Delta-Mendota Subbasin, primarily following the Interstate 5 corridor (**Figure CC-40**). The following water purveyors in the Delta-Mendota Subbasin are SLDMWA Member Agencies and thus receive water from the Central Valley Project via the Delta-Mendota Canal: California Department of Fish and Wildlife, Central California Irrigation District, Columbia Canal Company, Del Puerto Water District, Eagle Field Water District, Firebaugh Canal Water District, Fresno Slough Water District, Grassland Water District, Laguna Water District, Mercy Springs Water District, Oro Loma Water District, Pacheco Water District, Panoche Water District, Patterson Irrigation District, San Luis Canal Company, San Luis Water District, Tranquillity Irrigation District, Turner Island Water District, U.S. Fish and Wildlife Service, and West Stanislaus Irrigation District. Oak Flat Water District is the only recipient of State Water Project (SWP) water in the Delta-Mendota Subbasin; Oak Flat Water District initially bought into the SWP in 1968.

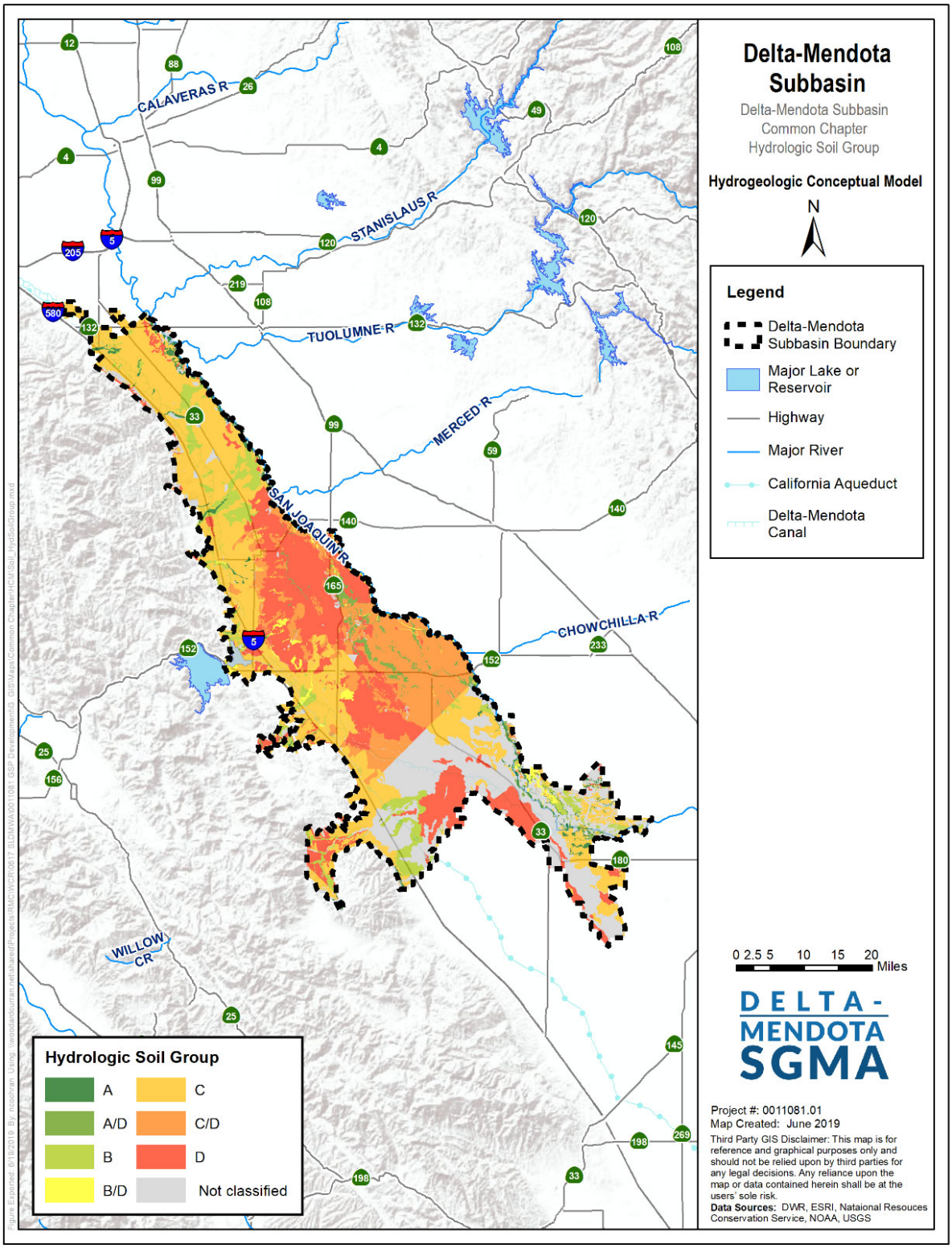


Figure CC-37: SAGBI Soils Map

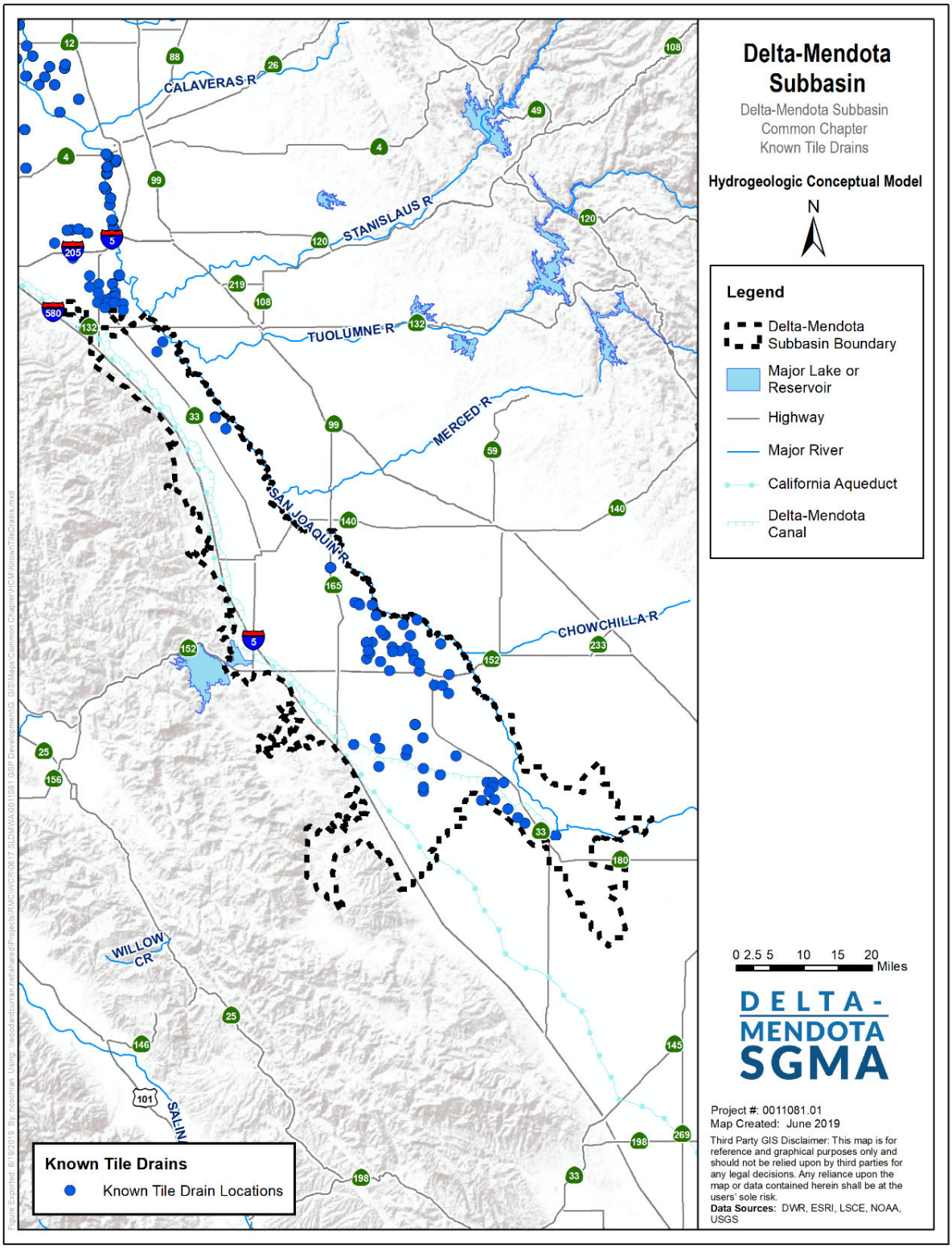


Figure CC-38: Tile Drains

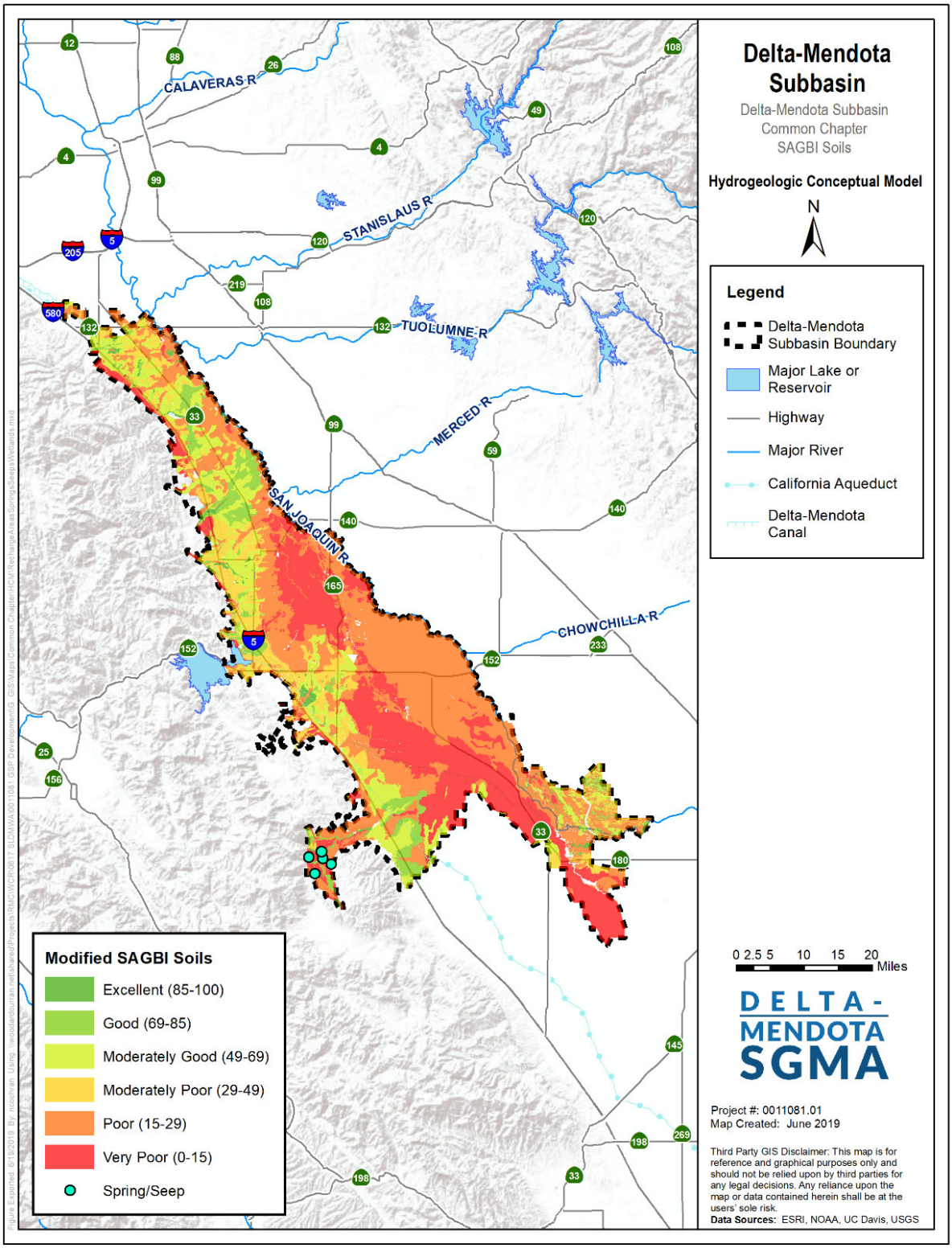


Figure CC-39: Recharge Areas, Seeps and Springs

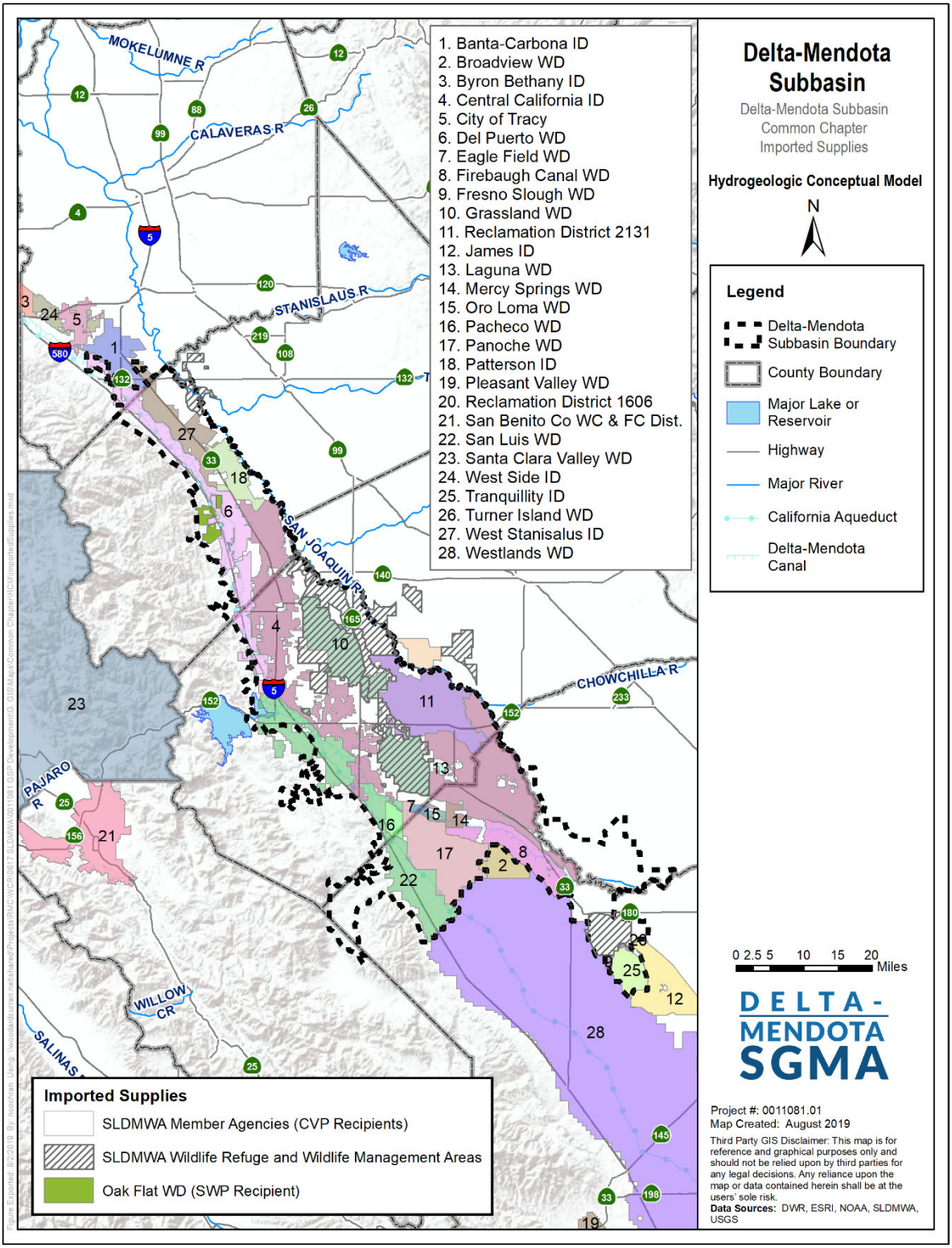


Figure CC-40: Imported Supplies

4.2 Delta-Mendota Subbasin Groundwater Conditions

This section describes the current and historic groundwater conditions in the Delta-Mendota Subbasin, including data from January 1, 2015 to recent conditions for the following parameters: groundwater elevations, groundwater storage, groundwater quality, land subsidence, interconnected surface water systems, and groundwater dependent ecosystems (GDEs) (pursuant to Article 5 Plan Contents, Subarticle 2 Basin Setting, § 354.16 Groundwater Conditions of the GSP Emergency Regulations). Seawater intrusion is not discussed herein as the Delta-Mendota Subbasin is inland and is not impacted by seawater intrusion. For the purposes of this GSP, "current conditions" is represented by Water Year (WY) 2013 conditions, which is consistent with the year representing the Current Conditions Water Budget (see Section 4.3 for more information about Water Budgets). Data post-WY 2013 through present day are presented when available.

The purpose of describing groundwater conditions, as contained in this section and described in the individual GSPs, is to establish baseline conditions that will be used to monitor changes relative to measurable objectives (MOs) and minimum thresholds (MTs). Therefore, these established baseline conditions will help support monitoring to demonstrate measurable efforts in achieving the sustainability goal for the Delta-Mendota Subbasin.

4.2.1 Useful Terminology

This groundwater conditions section includes descriptions of the amounts, quality, and movement of groundwater, among other related components. A list of technical terms and a description of the terms are listed below. The terms and their descriptions are identified here to guide readers through the section and are not a definitive definition of each term:

- **Depth to Groundwater** – The distance from the ground surface to first-detected non-perched groundwater, typically reported at a well.
- **Upper Aquifer** – The alluvial aquifer above the Corcoran Clay (or E-clay) layer.
- **Lower Aquifer** – The alluvial aquifer below the Corcoran Clay (or E-clay) layer.
- **Horizontal gradient** – The slope of the groundwater surface from one location to another when one location is higher or lower than the other. The gradient is shown on maps with an arrow showing the direction of groundwater flow in a horizontal direction.
- **Vertical gradient** – Describes the movement of groundwater perpendicular to the ground surface. Vertical gradient is measured by comparing the elevations of groundwater in wells that are of different depths. A downward gradient is one where groundwater is moving down into the ground towards deeper aquifers and an upward gradient is one where groundwater is upwelling towards the ground surface.
- **Contour Map** – A contour map shows changes in groundwater elevations by interpolating groundwater elevations between monitoring sites. The elevations are shown on the map with the use of a contour line, which represents groundwater being at the indicated elevation along the contour line. Contour maps can be presented in two ways:
    - Elevation of groundwater above mean sea level (msl), which can be used to identify the horizontal gradients of groundwater, and
    - Depth to water (i.e., the distance from the ground surface to groundwater), which can be used to identify areas of shallow or deep groundwater.
- **Hydrograph** – A graph that shows the changes in groundwater elevation or depth to groundwater over time at a specific location. Hydrographs show how groundwater elevations change over the years and indicate whether groundwater is rising or descending over time.

- **Maximum Contaminant Level (MCL)** – MCLs are standards that are set by the State of California and the U.S. Environmental Protection Agency for drinking water quality. MCLs are legal threshold limits on the amount of an identified constituent that is allowed in public drinking water systems. At both the State and Federal levels, there are Primary MCLs, set to be protective of human health, and Secondary MCLs for constituents that do not pose a human health hazard but do pose a nuisance through either smell, odor, taste, and/or color. MCLs are different for different constituents and have not been established for all constituents potentially found in groundwater.
- **Elastic Land Subsidence** – Reversible and temporary fluctuations in the elevation of the earth's surface in response to seasonal periods of groundwater extraction and recharge.
- **Inelastic Land Subsidence** – Irreversible and permanent decline in the elevation of the earth's surface resulting from the collapse or compaction of the pore structure within the fine-grained portions of an aquifer system. This form of subsidence is what is required by SGMA to be monitored and reported.
- **Gaining Stream** – A stream in which groundwater flows into a streambed and contributes to a net increase in surface water flows across an identified reach.
- **Losing Stream** – A stream in which surface water is lost through the streambed to the groundwater, resulting in a net decrease in surface water flows across an identified reach.
- **Conjunctive Use** – The combined use of surface water and groundwater supplies, typically with more surface water use in wet years and more groundwater use in dry years.

4.2.2 Groundwater Elevations

This section describes groundwater elevation data utilized and elevation trends in the Delta-Mendota Subbasin. Groundwater conditions vary widely across the Subbasin. Historic groundwater conditions through present day conditions, the role of imported surface water in the Subbasin, and how conjunctive use has impacted groundwater trends temporally and spatially are discussed. Groundwater elevation contour maps associated with current seasonal high and seasonal low for each principal aquifer, as well as hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients (both horizontal and vertical), are also described.

Available Data

Groundwater elevation data, and accompanying well construction information, within the Delta-Mendota Subbasin from the following sources and associated programs were utilized in the development of the Delta-Mendota Subbasin GSPs:

- California Department of Water Resources (DWR)
    - California Statewide Groundwater Elevation Monitoring Program (CASGEM)
    - Water Data Library (WDL)
- Water level data from local monitoring programs

Data provided by these sources included well information (such as location, well construction, owner, ground surface elevation and other related components), as well as groundwater elevation data (including information such as date measured, depth to water, groundwater surface elevation, questionable measurement code, and comments). At the time that these analyses were performed, groundwater elevation data were available for the time period from 1930 through 2018. There are many wells with monitoring data from some time in the past but no recent data, while a small number of wells have monitoring data recorded for periods of greater than 50 years.

Not all groundwater elevation data received were used in preparing the groundwater elevation contour maps for both principal aquifers (defined in this Common Chapter as the Upper and Lower Aquifers which are divided by the Corcoran Clay or E-clay layer). Some groundwater elevation data were associated with wells with unknown screened depths and/or composite well screens constructed across the Corcoran Clay. Groundwater elevation data associated with wells with composite screens and/or unknown screened depths were removed from the data set in most instances, along with any data point that appears to be an outlier when compared with surrounding data from the same period. Select wells with unknown construction were evaluated for inclusion in contour mapping efforts in areas of limited data. Duplicate well measurements were also removed prior to contouring and only one observation for a given well was used for the identified season, rather than averaging all measurements at a given well during the same season.

Figure CC-41 shows the locations of wells with known screened depths within the Delta-Mendota Subbasin as well as known spatial gaps where no well information is currently available. These wells include those monitored under CASGEM, the Delta-Mendota Canal Well Pump-in Program, and by local owners or agencies. Monitoring data available for these wells varies by local owner and agency. Well locations were provided by local agencies to the best of their knowledge at the time of writing and may include wells that have been destroyed or are no longer in service.

Historic Conditions

Historic groundwater trends changed significantly with the first deliveries of imported water deliveries to the Delta-Mendota Subbasin. Construction of the Delta-Mendota Canal and the California Aqueduct heralded the introduction of significant surface water supplies into the Subbasin and reduced dependence on groundwater as the primary water supply. These conveyance systems have resulted in significant increases in the conjunctive use of surface water and groundwater throughout the Subbasin. Various drought periods and regulations reducing delivery of supplies from the Sacramento-San Joaquin Delta also punctuate critical understandings of groundwater use patterns throughout the Subbasin, as well as what is known regarding response and recovery of groundwater levels following notable droughts.

Prior to Imported Water Deliveries (1850-1950s)

Prior to 1850, the majority of agriculture and development in the San Joaquin Valley consisted of rain-fed grain and cattle production, with irrigated development beginning sporadically during this time via river (primarily San Joaquin River) and perennial stream diversions (SWRCB, 2011). Construction of the railroad through the San Joaquin Valley from 1869 through 1875 increased demand for more extensive agriculture, making markets in larger coastal cities more accessible to valley farmers. Significant irrigation sourced from surface water and resulting production began in the western side of the San Joaquin Valley in 1872 when the San Joaquin River was diverted through the Miller and Lux canal system west of Fresno (DWR, 1965). By the 1890s and early 1900s, sizable areas of the southern San Joaquin Valley were being forced out of production by salt accumulation and shallow water tables. Much of this land lay idle until the 1920s when development of reliable electric pumps and the energy to power them accelerated the expansion of irrigated agriculture with the availability of vast groundwater

resources. The resultant groundwater pumping lowered the water table in many areas (SWRCB, 1977 and Ogden, 1988) and allowed the leaching of salts, particularly near the valley trough and western side of the valley. Groundwater pumping for irrigation from around 1920 to 1950 drew the water table down as much as 200 feet in areas along the westside of the San Joaquin River (Belitz and Heimes, 1990). Declining water tables were causing higher pumping costs and land subsidence, and farmers were finding poorer quality water as water tables continued to decline. These issues created a desire for new surface water supplies, which would be fulfilled by the Central Valley Project.

Post-Imported Water Deliveries (1950s-2012)

Surface water deliveries from the Central Valley Project via the DMC began in the early 1950s, and from the State Water Project via the California Aqueduct in the early 1970s (Sneed et al., 2013). The CVP is the primary source of imported surface water in the Delta-Mendota Subbasin, where only Oak Flat Water District receives deliveries from the SWP. Introduction of imported water supplies to the Delta-Mendota Subbasin resulted in a decrease in groundwater pumping from some parts of the Subbasin and the greater Central Valley, which was accompanied by a steady recovery of water levels. During the droughts of 1976-1977 and 1987-1992, diminished deliveries of imported surface water prompted increased pumping of groundwater to meet irrigation demands, bringing water levels to near-historic lows. Following periods of drought, recovery of pre-drought water levels has been rapid, especially in the Upper Aquifer. This trend has been observed in historic hydrographs for wells across the Subbasin.

Current Conditions

Trends similar to historic drought and subsequent recovery conditions were observed during the 2012 to 2016 drought and the 2016 to present recovery period.

Recent Drought (2012-2016)

During the most recent drought, from 2012 through 2016, similar groundwater trends were observed as during the 1976-1977 and 1987-1992 droughts. With diminished imported surface water deliveries, groundwater pumping increased throughout the Subbasin to meet irrigation needs. This resulted in historic or near-historic low groundwater levels during the height of the drought in 2014 and 2015, when CVP and SWP allocations for agricultural water service contractors were 0%, Exchange Contractors and refuge deliveries were less than 75%, and post-1914 surface water rights in the San Joaquin River watershed were curtailed. In June 2015, senior water rights holders with a priority date of 1903 or later in the San Joaquin and Sacramento watersheds and the Delta were ordered by the State Water Resources Control Board to curtail diversions (State of California, 2015). This marked the first time in recent history that pre-1914 water rights holders were curtailed.

Post-Drought (2016-present)

With wetter conditions following the 2012-2016 drought, groundwater levels began to recover. This was largely a result of increased surface water availability with CVP allocations reaching 100% and full water rights supplies available for diversion from the San Joaquin River in 2017. Additionally, inelastic land subsidence rates also drastically decreased in 2017 as imported water supplies were once again available, resulting in decreased groundwater pumping particularly from the Lower Aquifer. This pattern of increased drought-driven groundwater pumping, accompanied by declining groundwater elevations, followed by recovery is a predominant factor to be considered in the sustainable management of the Delta-Mendota Subbasin. Furthermore, subsidence mitigation projects were developed which drastically reduced the observed subsidence rate on the eastern and southern boundaries of the Subbasin.

Groundwater Trends

Groundwater levels can fluctuate greatly throughout time due to various natural and anthropogenic factors, including long-term climatic conditions, adjacent well pumping, nearby surface water flows, and seasonal groundwater recharge or depletion (LSCE, 2015). As discussed in the Hydrogeologic Conceptual Model section of this Common Chapter (Section 4.1), the Delta-Mendota Subbasin is generally a two-aquifer system consisting of an Upper and Lower Aquifer that are subdivided by the Corcoran Clay layer, a regional aquitard. The Corcoran Clay layer, or E-Clay equivalent, restricts flow between the upper semi-confined aquifer and lower confined aquifer. The presence of a tile drain network along the Grassland Drainage Area and the Subbasin's eastern boundary affects the lateral and vertical water movement in the shallow groundwater zone (LSCE, 2016).

The Delta-Mendota Subbasin has a general flow direction to the east in the Upper Aquifer, where it loses groundwater to the San Joaquin River and its neighboring subbasins. Most recharge throughout the Subbasin is attributed to applied irrigation water, where other sources of recharge include local streams, canal seepage, and infiltration along the western margin of the Subbasin from the Coast Range. The figures that follow were developed for inclusion in the Western San Joaquin River Watershed Groundwater Quality Assessment Report (LSCE, 2015) and the Grassland Drainage Area Groundwater Quality Assessment Report (LSCE, 2016) and are included herein with the intent of demonstrating general trends in groundwater elevations around the Delta-Mendota Subbasin. These figures are not to scale.

Please see the individual GSPs for more specific information relating to similar trends in those respective GSP Plan areas. Additionally, it is important to note that groundwater trends, such as these, are dependent on climatic conditions and are not necessarily representative of the historic and current water budgets for those respective GSP Plan areas.

Upper Aquifer

For the Upper Aquifer, **Figure CC-42** presents select hydrographs illustrating temporal groundwater level trends in the Upper Aquifer wells within the Subbasin. Hydrographs shown on **Figure CC-42** are displayed with different ranges of elevation values on the vertical axes. Wells in the Upper Aquifer exhibit decreasing trends to somewhat stable water levels until the mid-1980s, and increasing or stable water levels thereafter.

Similarly, **Figure CC-43** presents select hydrographs illustrating temporal groundwater level trends in the areas covered by the Central Delta-Mendota, Oro Loma Water District, and Widren Water District GSAs in the Northern & Central Delta-Mendota Region GSP Group at various depths. The three select hydrographs representing wells in the Upper Aquifer each show less than 10 years of available data with two wells showing slight declines of about 10 feet or less from about 2003 through 2013, and one well showing a more drastic elevation change, ranging from 100 feet above mean sea level (ft msl) to -20 ft msl over a 5-year period from 2010 to 2016.

Lower Aquifer

Figure CC-44 presents select hydrographs illustrating temporal groundwater level trends in Lower Aquifer wells within the Subbasin. Note, hydrographs shown on **Figure CC-44** displayed different ranges of elevation on the vertical axes. In the Lower Aquifer, piezometric head typically increased or remained relatively stable during the period from the 1980s through the early 2000s.

Again, similarly, **Figure CC-43** presents select hydrographs illustrating temporal groundwater level trends in the Central Delta-Mendota, Oro Loma Water District, and Widren Water District GSA areas of

the Northern & Central Delta-Mendota Region GSP Group at various depths. The two select hydrographs representing wells in the Lower Aquifer each show similar elevation patterns post-2010 with a total elevation change of 50 ft msl or more. USGS1000489 shows stable and increasing groundwater elevation trends from the late 1950s through the mid-1980s with a data gap from the mid-1980s through 2010, whereafter 2010 groundwater levels have a steep decline through 2016.

Vertical Gradients

Throughout most of the Delta-Mendota Subbasin, the Corcoran Clay layer acts as a regional aquitard, limiting the vertical migration of groundwater. In areas outside the Corcoran Clay layer (along the western margin of the Subbasin), localized interfingered clays minimize the downward migration of groundwater; although in areas where the clay layers are not competent or non-existent, groundwater migrates from shallower to deeper groundwater zones. Similarly, in areas where the Corcoran Clay has been compromised (due to well construction across the clay), groundwater generally flows from the Upper Aquifer to the Lower Aquifer, especially in areas where the Lower Aquifer is actively used as a water supply (lowering the potentiometric head in that zone).

Groundwater Contours

The Subbasin-wide groundwater contours reflected in **Figure CC-45** and **Figure CC-46** evaluate the seasonal high (Spring 2013) and seasonal low (Fall 2013) conditions of the current year (defined as WY2013 for the GSP analyses) for the Upper Aquifer. Spring is defined as groundwater surface elevation measurements collected between January 1 and April 8; where Fall is defined as groundwater surface elevation measurements collected between September 1 and October 31. For wells where multiple Spring 2013 or Fall 2013 measurements were available, the highest elevation for each season was used for contouring. Gaps in data and contours can be attributed to a lack of wells present, level measurements, or requirements to report level readings groundwater level data. Consistent with traditional contouring efforts, the quality of outlier water level data was investigated. In instances of poor quality data, the associated data was eliminated for the groundwater contouring effort. Furthermore, implementation of the CASGEM program in 2014 has reduced temporal and spatial gaps in groundwater level datasets, and implementation of the Delta-Mendota Subbasin GSPs' monitoring programs will add to the improved data quantity and quality.

In the Upper Aquifer, during Spring 2013, the general flow of groundwater in the Delta-Mendota Subbasin was from the Coast Range along the western boundary of the Subbasin toward the San Joaquin River along the eastern boundary. Groundwater elevations tend to increase moving south throughout the Subbasin. Within Stanislaus County, groundwater elevations are the lowest, ranging between 40 and 80 feet above msl, becoming increasingly higher in Madera County, ranging between 80 and 100 feet above msl, and in Merced and Fresno counties, ranging between 80 and 140 feet above msl (**Figure CC-45**). Similar flow directions (west to east and northeast) are observed in the Fall 2013. Within Stanislaus County, groundwater elevations are the lowest ranging between 40 and 80 feet above msl, showing little difference compared to Spring 2013; become increasingly higher in Madera County ranging between 60 and 100 feet above msl; in Merced County ranging between 60 and 140 feet above msl; and in Fresno County ranging from 60 and 120 feet above msl (**Figure CC-46**). Both maps indicate a prevailing southwest to northeast flow gradient above the Corcoran Clay. In general, little variation is apparent in groundwater elevation between seasonal high and low periods in 2013.

Due to insufficient data, groundwater elevation contour maps for the Lower Aquifer for the seasonal high and low (Spring 2013 and Fall 2013, respectively) could not be accurately prepared. **Figure CC-47** and **Figure CC-48** show the available groundwater elevation measurements for Spring 2013 and Fall 2013. Available Spring 2013 measurements range from -127 to 12 feet above msl in Stanislaus County, -65 to

124 feet above msl in Merced County, and -5 to 88 feet above msl in Fresno County (**Figure CC-47**), where no measurements are available for this time period in Madera County. Available Fall 2013 measurements range from -138 to 156 feet above msl in Stanislaus County, -94 to 19 feet above msl in Merced County, and -72 to -4 feet above msl in Fresno County (**Figure CC-48**), where no measurements are available for this time period in Madera County. The Lower Aquifer exhibits less seasonal difference in groundwater elevations than the Upper Aquifer. Throughout most of the Subbasin, the Lower Aquifer shows lower piezometric heads than the Upper Aquifer suggesting that potential exists for downward vertical gradient.

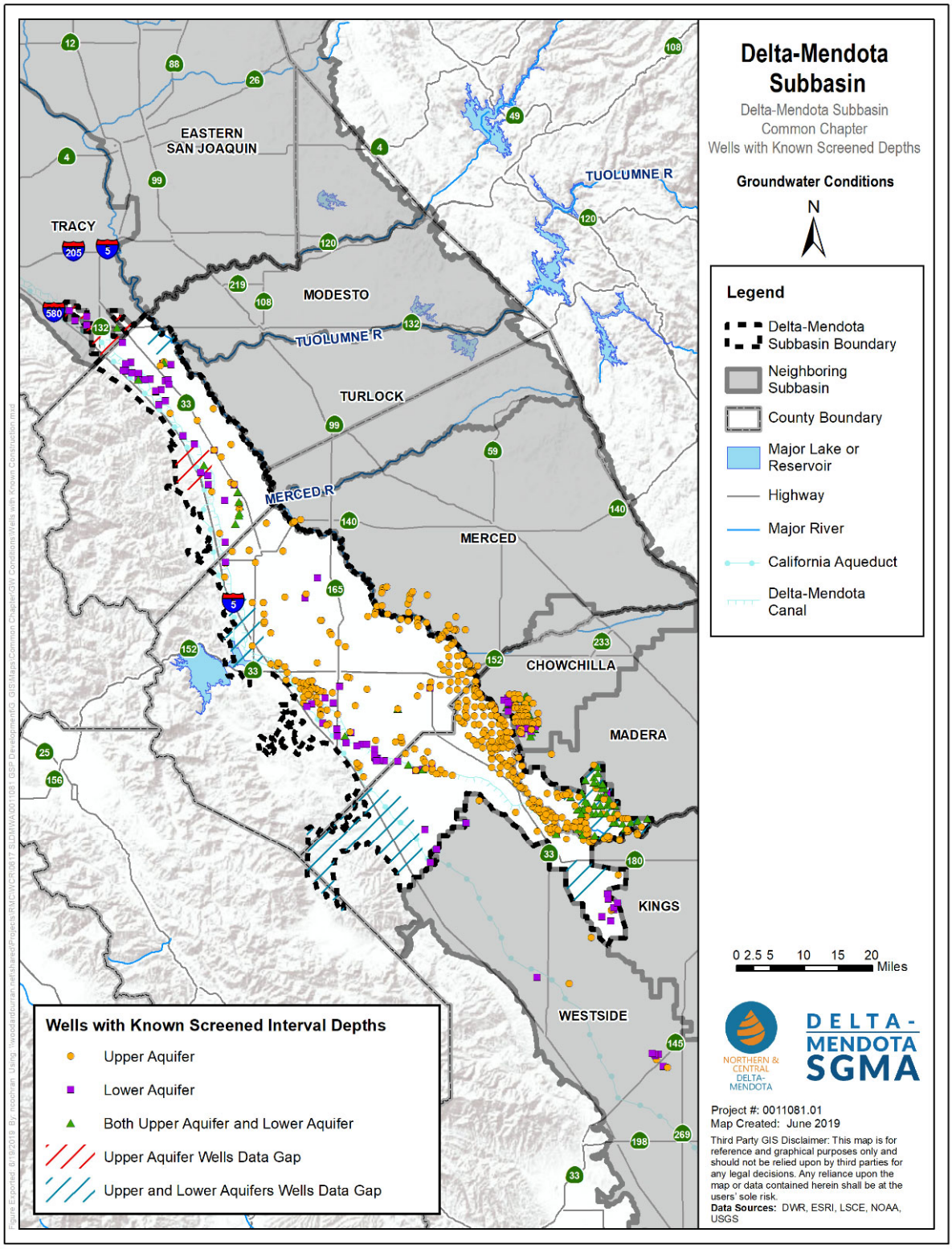
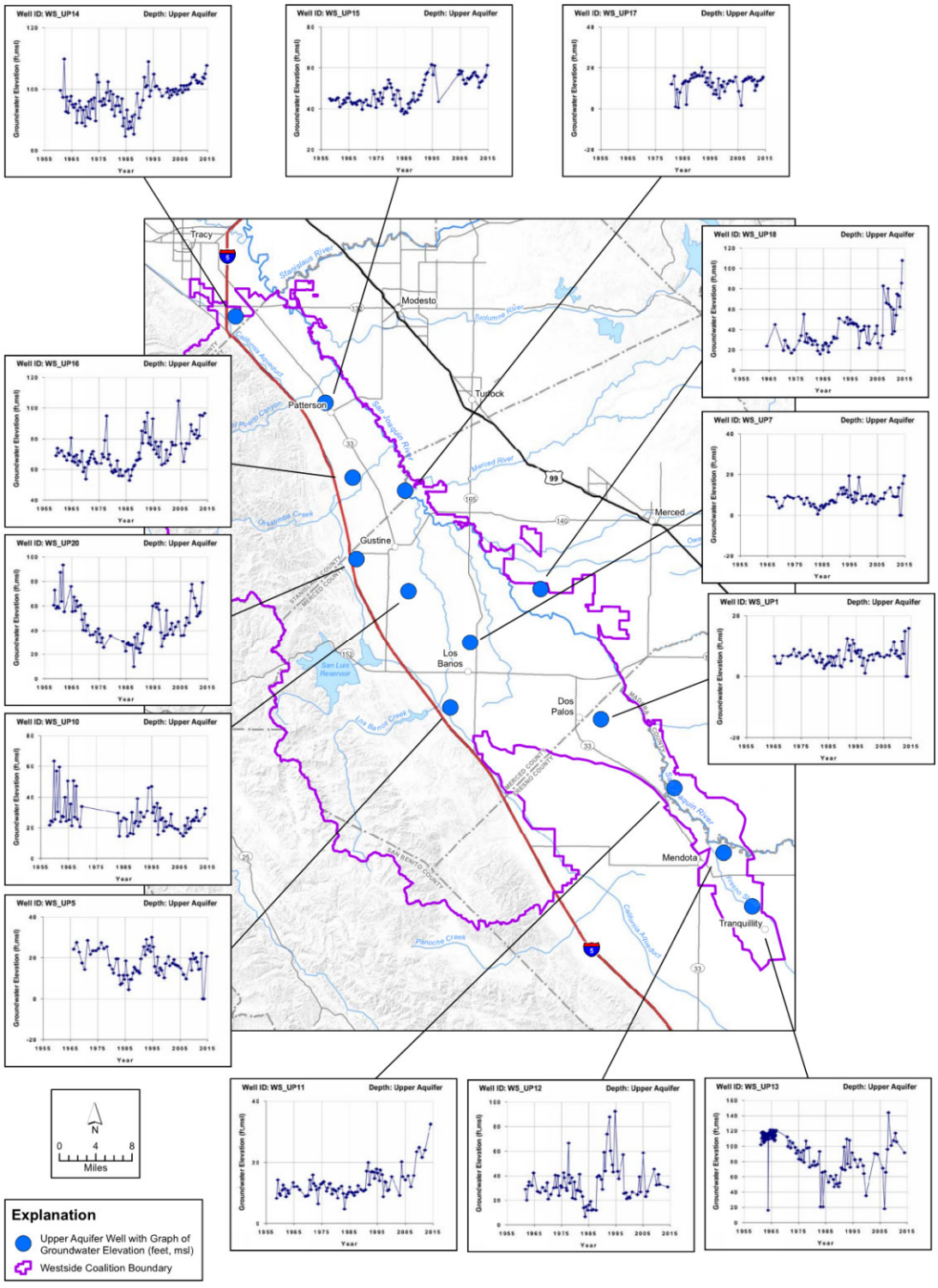
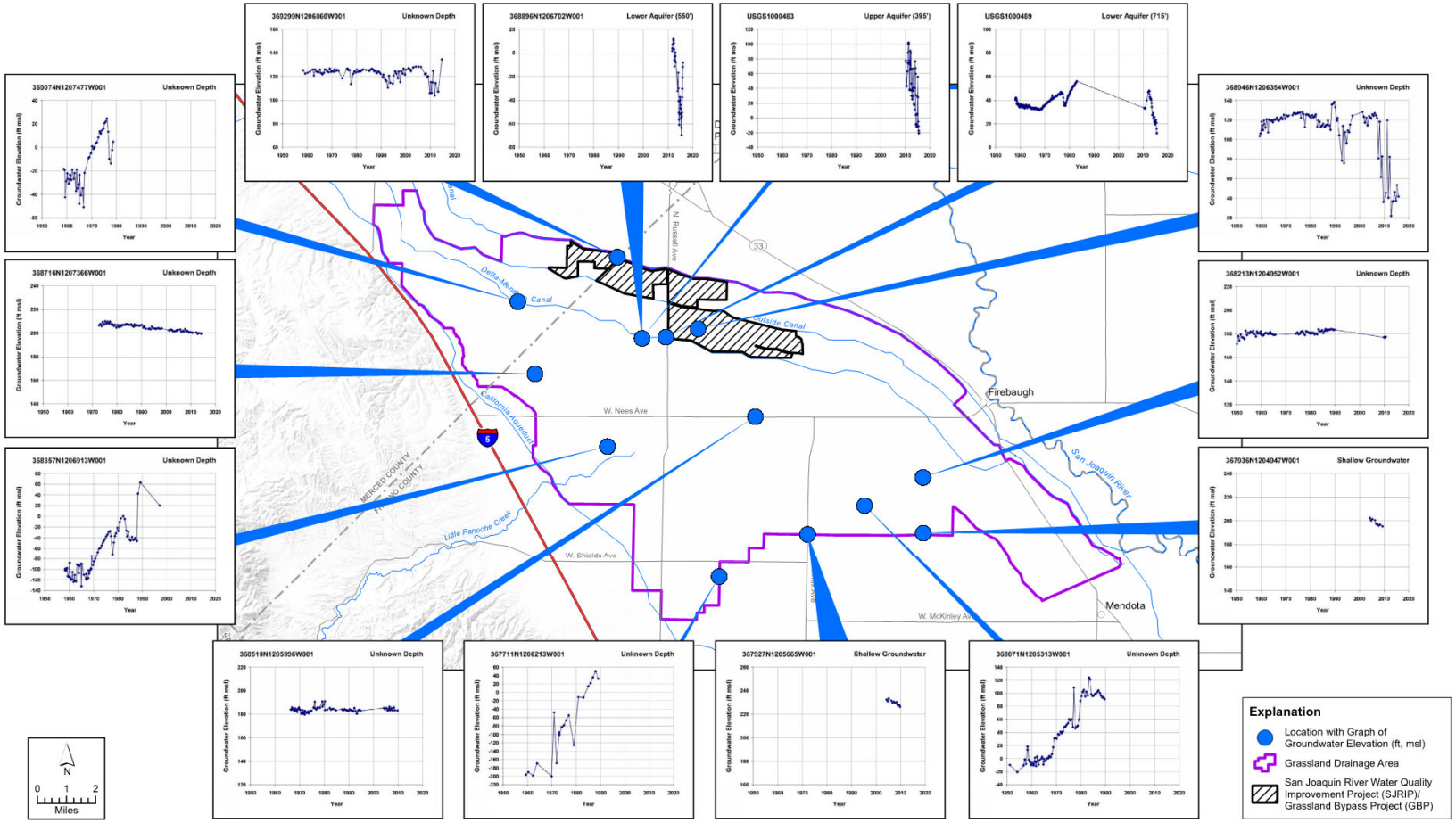


Figure CC-41: Wells with Known Screened Interval Depths



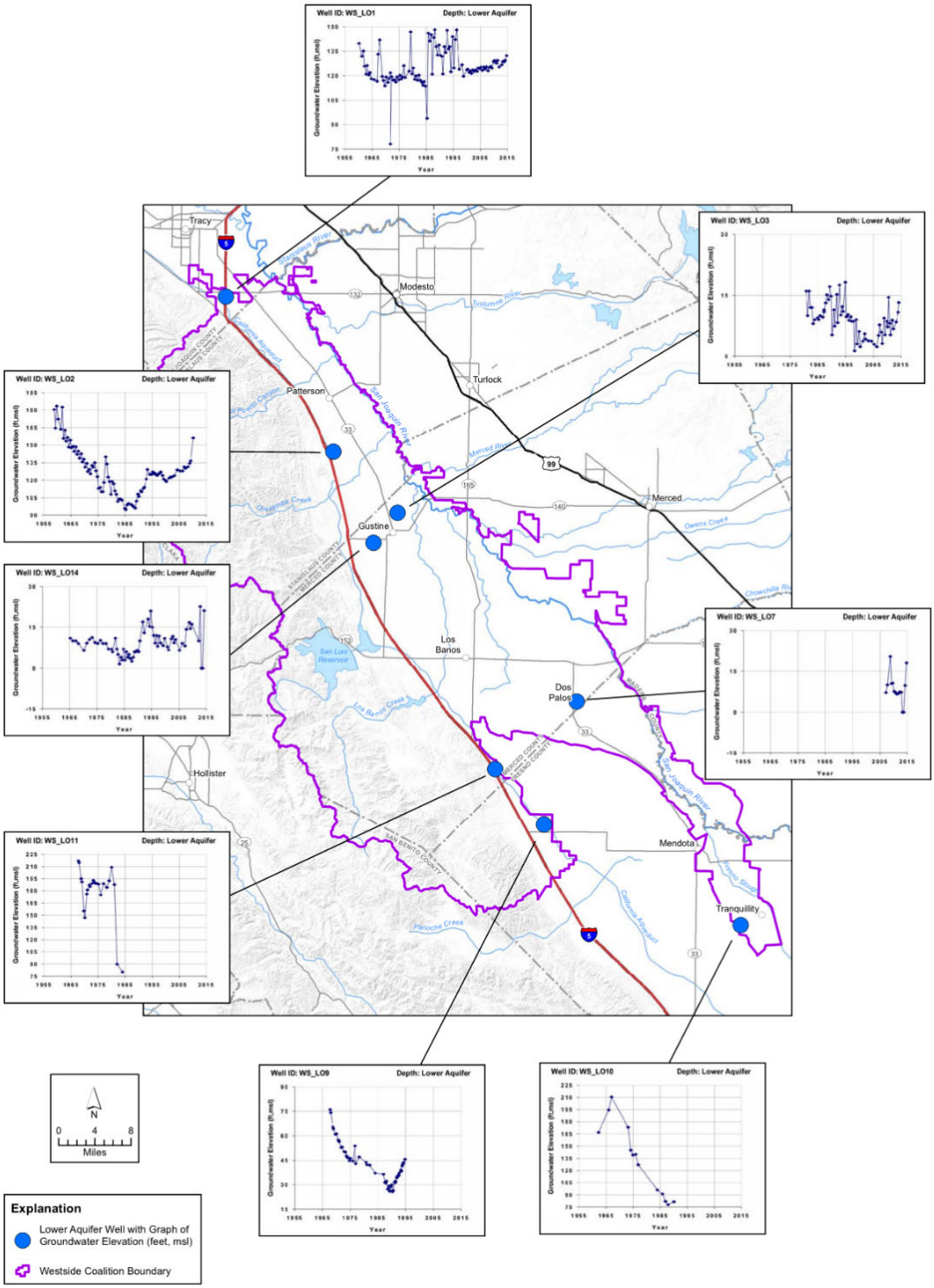
Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016

Figure CC-42: Select Graphs of Groundwater Elevations, Upper Aquifer



Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016.

Figure CC-43: Select Graphs of Groundwater Elevations, Various Depths



Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016.

Figure CC-44: Select Graphs of Groundwater Elevations, Lower Aquifer

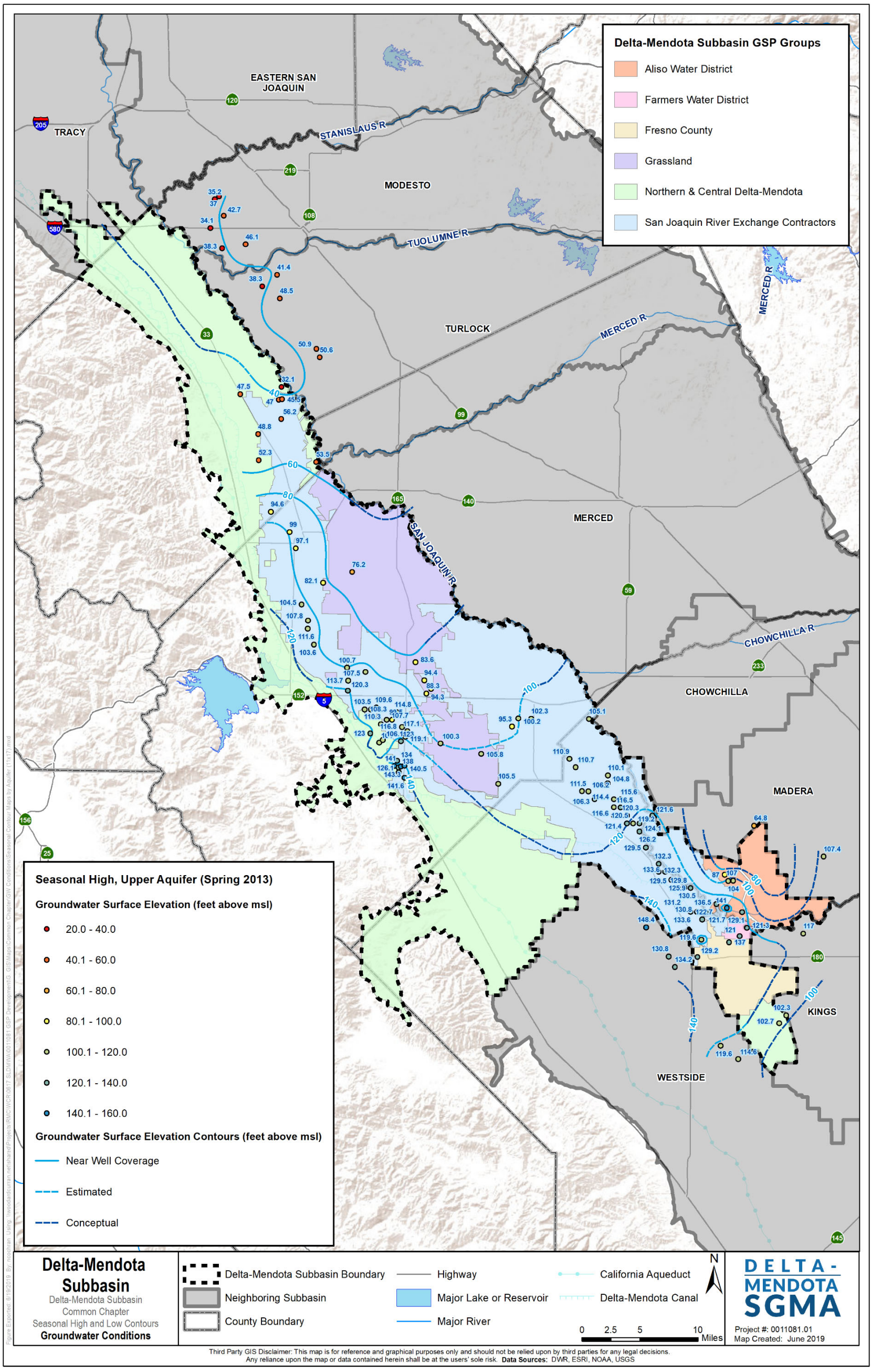


Figure CC-45: Spring 2013 Upper Aquifer Groundwater Contour Map

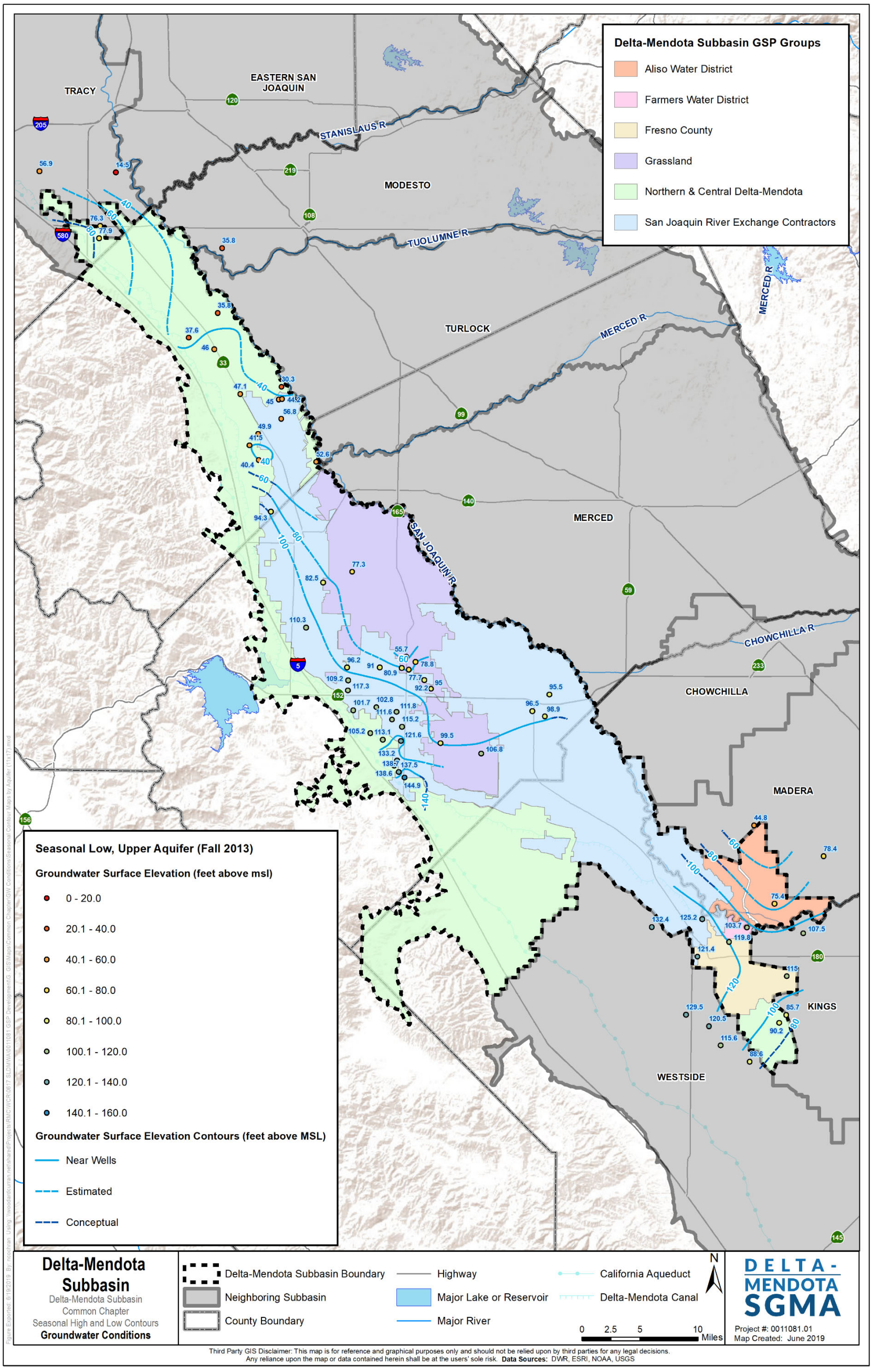


Figure CC-46: Fall 2013 Upper Aquifer Groundwater Contour Map

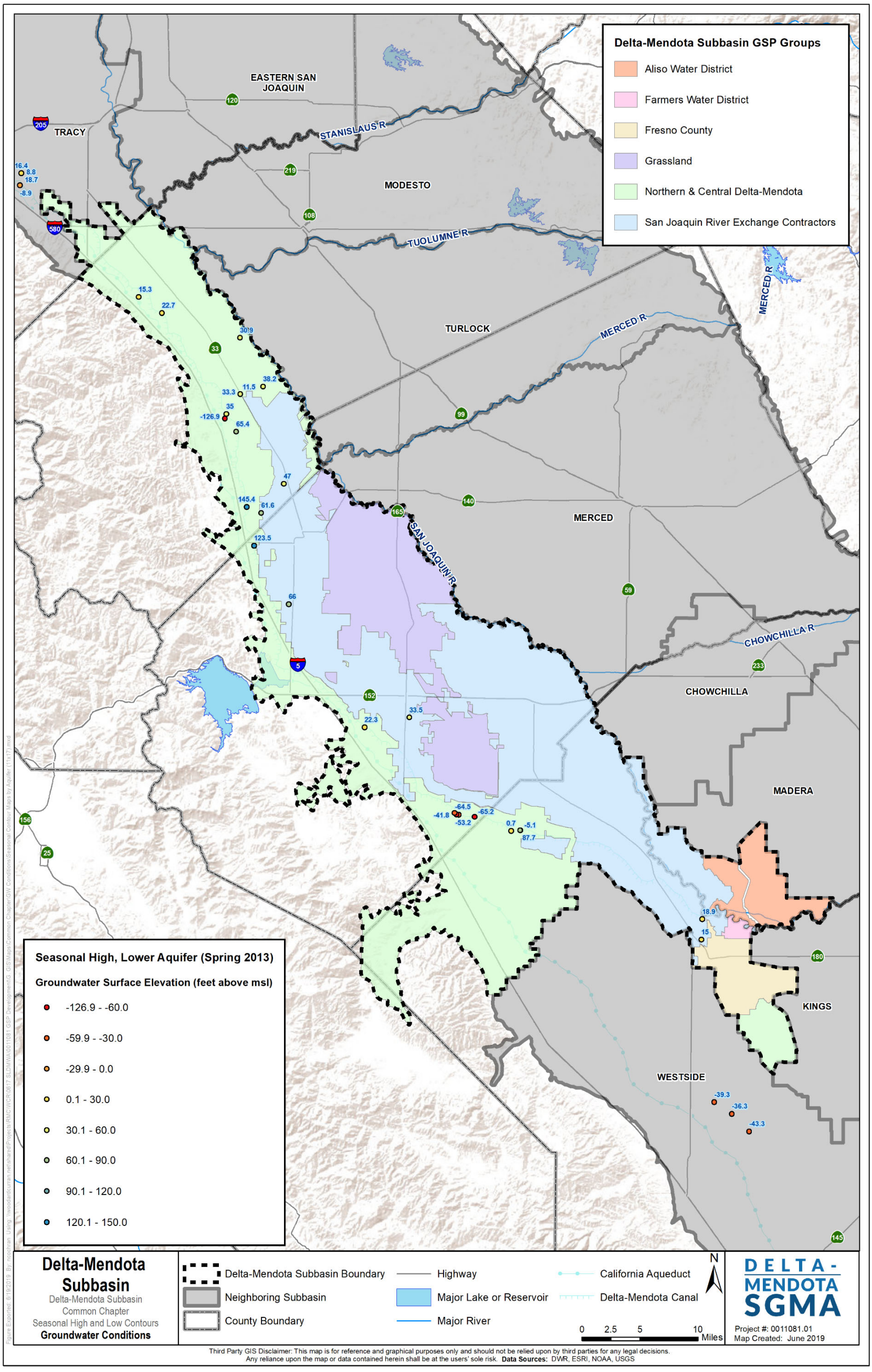


Figure CC-47: Spring 2013 Lower Aquifer Groundwater Elevation Measurements

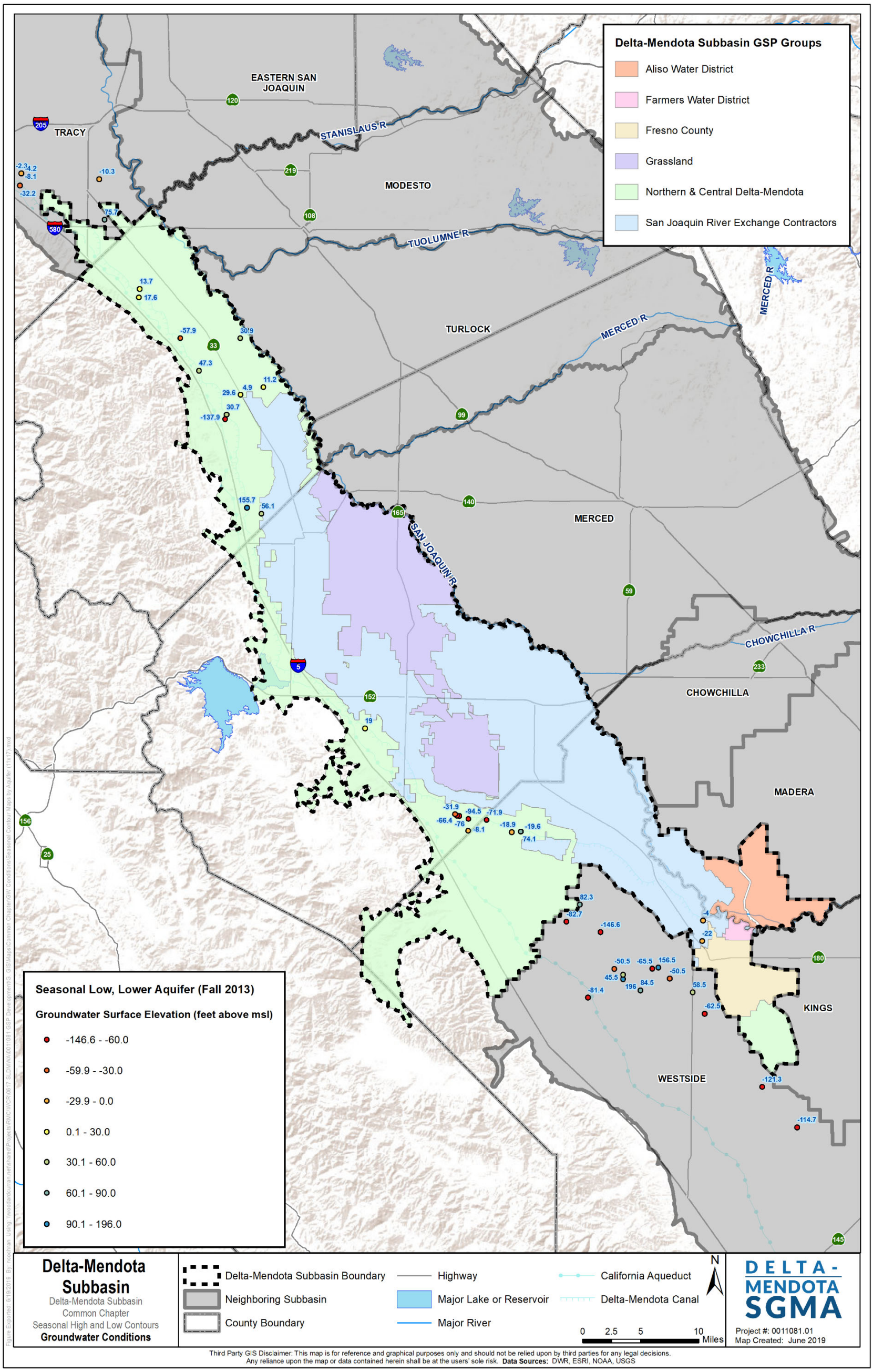


Figure CC-48: Fall 2013 Lower Aquifer Groundwater Elevation Measurements

4.2.3 Groundwater Storage

Annual changes in groundwater storage for both the Upper and Lower Aquifers in the Delta-Mendota Subbasin were estimated as part of the development of the Historic (WY2003-2012), Current (WY2013) and Projected Water Budgets (WY2014-2070). For information on how change in storage was calculated, refer to Section 4.3.2 – Water Budgets of this Common Chapter. **Figure CC-49** and **Figure CC-50** show annual change in storage, cumulative change in storage, and water year type for the Upper Aquifer and Lower Aquifer, respectively, from WY 2003 through 2013 for the Delta-Mendota Subbasin. For the purposes of the water budget four water year types were utilized, wet, average (corresponding to above and below normal water years), dry (corresponding to dry and critical water years) and Shasta critical.

Change in storage is negative for 6 out of the 11-year historic and current water budget period for the Upper Aquifer, and 9 out of 11 years for the Lower Aquifer. Despite periods of wet conditions with recharge outpacing extractions, an overall declining trend in groundwater storage can be observed in both the Upper Aquifer and Lower Aquifer. Cumulative change in storage declined more rapidly in the Upper Aquifer compared to the Lower Aquifer, declining by about 624,0000 AF in the Upper Aquifer and 375,000 AF in the Lower Aquifer between WY2003 to 2013.

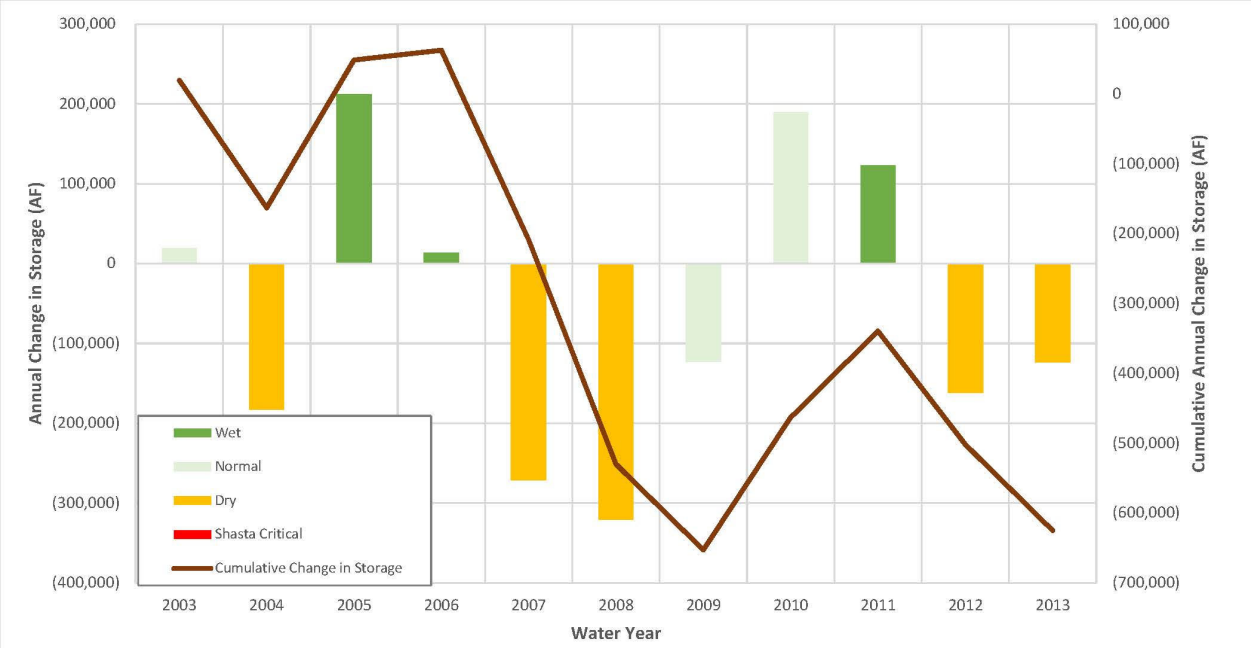


Figure CC-49: Calculated Upper Aquifer Change in Storage, Annual and Cumulative

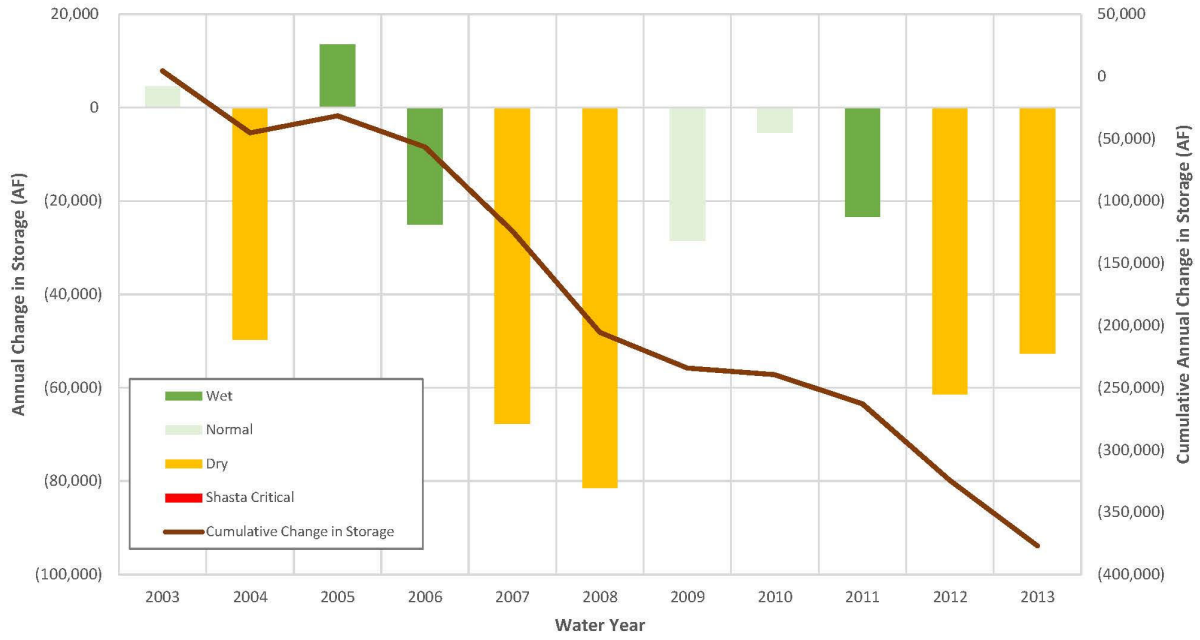


Figure CC-50: Calculated Lower Aquifer Change in Storage, Annual and Cumulative

4.2.4 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator for the Delta-Mendota Subbasin. The Subbasin is located inland from the Pacific Ocean; thus, groundwater conditions related to seawater intrusion are not applicable to the Delta-Mendota Subbasin.

4.2.5 Groundwater Quality

Groundwater quality varies considerably from west to east and north to south throughout the Delta-Mendota Subbasin. In general, Upper Aquifer water quality has historically been impacted by overlying land uses with some areas showing increasing concentrations of nitrate and TDS. Areas of elevated salt concentrations can be found in the Subbasin, generally along the southern portion of the San Joaquin River and in the southern portion of the Subbasin. Lower Aquifer groundwater has, and remains in most cases, to be of generally good quality. For more information about historic and current conditions relative to groundwater quality in each GSP Group area, refer to the individual GSPs.

4.2.6 Land Subsidence

Long-term groundwater level declines can result in a one-time release of "water of compaction" from compacting silt and clay layers (aquitards) resulting in inelastic land subsidence (Galloway et al., 1999). There are several other types of subsidence in the San Joaquin Valley, including subsidence related to hydrocompaction of moisture-deficient deposits above the water table, subsidence related to fluid withdrawal from oil and gas fields, subsidence caused by deep-seated tectonic movements, and subsidence caused by oxidation of peat soils that is a major factor in the Sacramento-San Joaquin Delta (Sneed et al., 2013). However, aquifer-system compaction caused by groundwater pumping causes the largest magnitude and areal extent of land subsidence in the San Joaquin Valley (Poland et al., 1975; Ireland et al., 1984; Farrar and Bertoldi, 1988; Bertoldi et al., 1991; Galloway and Riley, 1999).

Land subsidence is a prevalent issue in the Delta-Mendota Subbasin as it has impacted prominent infrastructure of statewide importance, namely the DMC and the California Aqueduct, as well as local canals, causing serious operational, maintenance, and construction-design issues (Sneed et al., 2013). Reduced freeboard and flow capacity for the DMC and California Aqueduct have rippling effects on imported water availability throughout the State. Even small amounts of subsidence in critical locations, especially where canal gradients are small, can impact canal operations (Sneed and Brandt, 2015). While some subsidence is reversible (referred to as elastic subsidence), inelastic or irreversible subsidence is caused mainly by pumping groundwater from below the Corcoran Clay, thus causing compaction and reducing storage in the fine-grained materials in the lower confined aquifer as well as damaging well infrastructure. As a result, important and extensive damages and repairs have resulted in the loss of conveyance capacity in canals that deliver water or remove floodwaters, the realignment of canals as their constant gradient becomes variable, the raising of infrastructure such as canal check stations, and the releveling of furrowed fields.

Available Data

There are six UNAVCO Continuous GPS (CGPS) locations that monitor subsidence within the Delta-Mendota Subbasin (**Figure CC-51**). Changes in land surface elevation have also been measured at DMC Check Structures. **Figure CC-52** through **Figure CC-57** show the vertical change in land surface elevation from a given time point (specified on charts) for the UNAVCO CGPS stations within the Delta-Mendota Subbasin, along with annual CVP allocations. **Table CC-5** summarizes the greatest monthly land subsidence rate and corresponding year(s) of that change at each UNAVCO CGPS station. Overall, the greatest monthly subsidence rates occurring after January 1, 2015 occurred during the Spring of 2016 to the Spring of 2017. Land subsidence rates (in feet per year), as measured by USBR from December 2011 to December 2014, are shown in **Figure CC-58**. Based on these data, within the majority of the Delta-Mendota Subbasin, annual subsidence rates were between -0.15 and -0.3 feet/year during this period (or between -0.45 and -0.9 feet of total subsidence over this three-year period).

Table CC-5: Subsidence Monitoring Trends
UNAVCO CGPS Stations

Station ID	Greatest Monthly Land Subsidence Rate as of January 1, 2015 (feet)	Year(s) of Greatest Monthly Subsidence Rate
P255	-0.0292	Spring 2016 to 2017
P259	-0.0183	Spring 2016 to 2017
P252	-0.033	Spring 2016 to 2017
P303	-0.2190	Spring 2016 to 2017
P301	-0.0029	Spring 2016 to 2017
P304	-0.0003	Spring 2013 to 2017

Historic Conditions

Along the DMC, in the northern portion of the San Joaquin Valley, extensive groundwater extraction from unconsolidated deposits caused subsidence exceeding 8.5 meters (or about 28 feet) between 1926

and 1970 (Poland et al., 1975), reaching 9 meters (or about 30 feet) in 1980 (Ireland, 1986). Land subsidence from groundwater pumping began in the San Joaquin Valley in the mid-1920s (Poland et al., 1975; Bertoldi et al., 1991; Galloway and Riley, 1999), and by 1970, about half of the San Joaquin Valley had land subsidence of more than 0.3 meters (or about 1 foot) (Poland et al., 1975). When groundwater pumping decreased in the Delta-Mendota Subbasin following imported water deliveries from the CVP via the DMC in the early 1950s, compaction rates were reduced in certain areas and water levels recovered. Notable droughts of 1976-1977 and 1987-1992 saw renewed compaction during these periods, with increased groundwater pumping as imported supplies were reduced or unavailable. However, following these droughts, compaction virtually ceased, and groundwater levels rose to near pre-drought levels quite rapidly (Swanson, 1998; Galloway et al., 1999).

Subsidence contours for 1926-1970 (Poland et al., 1975) show the area of maximum active subsidence was southwest of the community of Mendota. Historical subsidence rates in the Mendota area exceeded 500 millimeters/year (or about 20 inches/year) during the mid-1950s and early 1960s (Ireland et al., 1984). The area southwest of Mendota has experienced some of the highest levels of subsidence in California, where from 1925 to 1977, this area sustained over 29 feet of subsidence (USGS, 2017). Historical subsidence rates along Highway 152 calculated from leveling-survey data from 1972, 1988, and 2004 show that for the two 16-year periods (1972-1988 and 1988-2004), maximum subsidence rates of about 50 millimeters/year (or about 2 inches/year) were found just south of El Nido (Sneed et al., 2013). Geodetic surveys completed along the DMC in 1935, 1953, 1957, 1984, and annually from 1996-2001 indicated that subsidence rates were greatest between 1953 and 1957 surveys, and that the maximum subsidence along the DMC (about 3 meters, or about 10 feet) was just east of DMC Check Structure Number 18.

After 1974, land subsidence was demonstrated to have slowed or largely stopped (DWR, June 2017); however, land subsidence remained poised to resume under certain conditions. Such an example includes the severe droughts that occurred between 1976 and 1977 and between 1987 and 1991. Those droughts, along with other corroborating factors, led to diminished deliveries of imported water which prompted some water agencies and farmers (especially in the western Valley) to refurbish old pumps, drill new water wells, and begin pumping groundwater to make up for cutbacks in the imported water supply. The decisions to renew groundwater pumping were encouraged by the fact that groundwater levels had recovered to near-predevelopment levels. CGPS data collected between 2007 to 2014 show seasonally variable subsidence and compaction rates, including uplift as elastic rebound occurs during the fall and winter (Sneed and Brandt, 2015). Vertical displacement at P303, near Los Banos, indicates subsidence at fairly consistent rates during and between drought periods (Sneed and Brandt, 2015). Vertical displacement at P304, near Mendota, indicates that most subsidence occurred during drought periods with very little occurring between drought periods. Finally, data from extensometers 12S/12E-16H2, located on the DMC west of Los Banos, and 14S/13E-11D6, located between the DMC and California Aqueduct west of Mendota, showed subsidence rate increases during 2014, the third year of the most recent drought (Sneed and Brandt, 2015).

Subsidence impacts to the California Aqueduct, which runs parallel and in close proximity to the Delta-Mendota Canal across the Subbasin, is of statewide importance. During the construction of the California Aqueduct, it was thought that subsidence within the San Joaquin Valley would cease with the delivery of water from the Central Valley Project, though additional freeboard was incorporated into the design and construction of the Aqueduct in an attempt to mitigate for future subsidence (DWR, June 2017). After water deliveries from the Aqueduct began, subsidence rates decreased to an average of less than 0.1 inches/year during normal to wet hydrologic years. During dry to critical hydrologic years, subsidence increased to an average of 1.1 inches per year. The 2012-2015 drought produced subsidence similar to those seen before the Aqueduct began delivering water, with some areas experiencing nearly 1.25 inches of sinking per month (based on NASA UAVSAR flight measurements). Dry and critically dry water years

since Aqueduct deliveries began have resulted in extensive groundwater withdrawals, causing some areas near the Aqueduct to subside nearly 6 feet.

Current Conditions

Based on subsidence rates observed over the last decade, it is anticipated that without mitigation, subsidence will continue to impact operations of the DMC and California Aqueduct. For example, recently, Reach 4A of the San Joaquin River near Dos Palos experienced between 0.38 and 0.42 feet/year in subsidence between 2008 and 2016. As a result of subsidence, freeboard in Reach 4A is projected to be reduced by 0.5 foot by 2026 as compared to 2016, resulting in a 50 percent reduction in designed flow capacity (DWR, May 2018). Reduced flow capacities in the California Aqueduct will impact deliveries and transfers throughout the State and result in the need to pump more groundwater, thus contributing to further subsidence.

More recent subsidence measuring indicates subsidence hot spots within the Subbasin include the area east of Los Banos and the Tranquillity Irrigation District (TRID) area. USGS began periodic measurements of the land surface in parts of the San Joaquin Valley over the last decade. Between December 2011 and December 2014, total subsidence in the area east of Los Banos, located within the Merced Subbasin (also referred to as the El Nido-Red Top area), over the three-year period ranged from 0.15 to 0.75 feet, or 1.8 to 9 inches respectively (KDSA, 2015). The Jet Propulsion Laboratory (JPL) at the California Institute of Technology has also been monitoring subsidence in California using interferometric synthetic aperture radar (or InSAR), and a recent progress report documenting data for the period from May of 2015 to September of 2016 indicates that the two previously-identified primary subsidence areas near the community of Corcoran and centered on El Nido was joined by a third area of significant subsidence near TRID. For the study period (as shown in **Figure CC-59**), maximum total subsidence of 22 inches was measured near Corcoran, while the El Nido area subsided 15 inches and the TRID area subsided around 20 inches. Analyses at two particular stations near El Nido show interesting trends. At Station P303, between 2007 and 2014, 50 mm (or nearly 2 inches) of subsidence occurred at this location. Vertical displacement at P303 (**Figure CC-55**) show subsidence at fairly consistent rates during and between drought periods, indicating that these areas continued to pump groundwater despite climatic variations (possibly due to a lack of surface water availability) (Sneed and Brandt, 2015). Residual compaction may also be a factor. Vertical displacement at Station P304 indicated that most subsidence in this particular area occurred during drought periods and very little occurred between drought periods (**Figure CC-57**). This suggests that this area received other sources of water (most likely surface water available between drought periods) and that residual compaction was not very important in this area. These two areas demonstrate a close link between the availability of surface water, groundwater pumping, and inelastic land subsidence.

Total land subsidence from April 2015 to April 2016 in the San Joaquin Valley is shown in

Figure CC-60: Vertical Displacement, April 2015 to April 2016 . Subsidence monitoring in the Delta-Mendota Subbasin, and in the San Joaquin Valley as a whole, demonstrated significant inelastic land subsidence as a result of the last drought, with effects continuing to the present time (as evidenced by continued subsidence between 2016 and 2018 through surveys of the DMC). While the impacts appeared to have slowed, the temporal and spatial impacts of continued subsidence have not yet been evaluated.

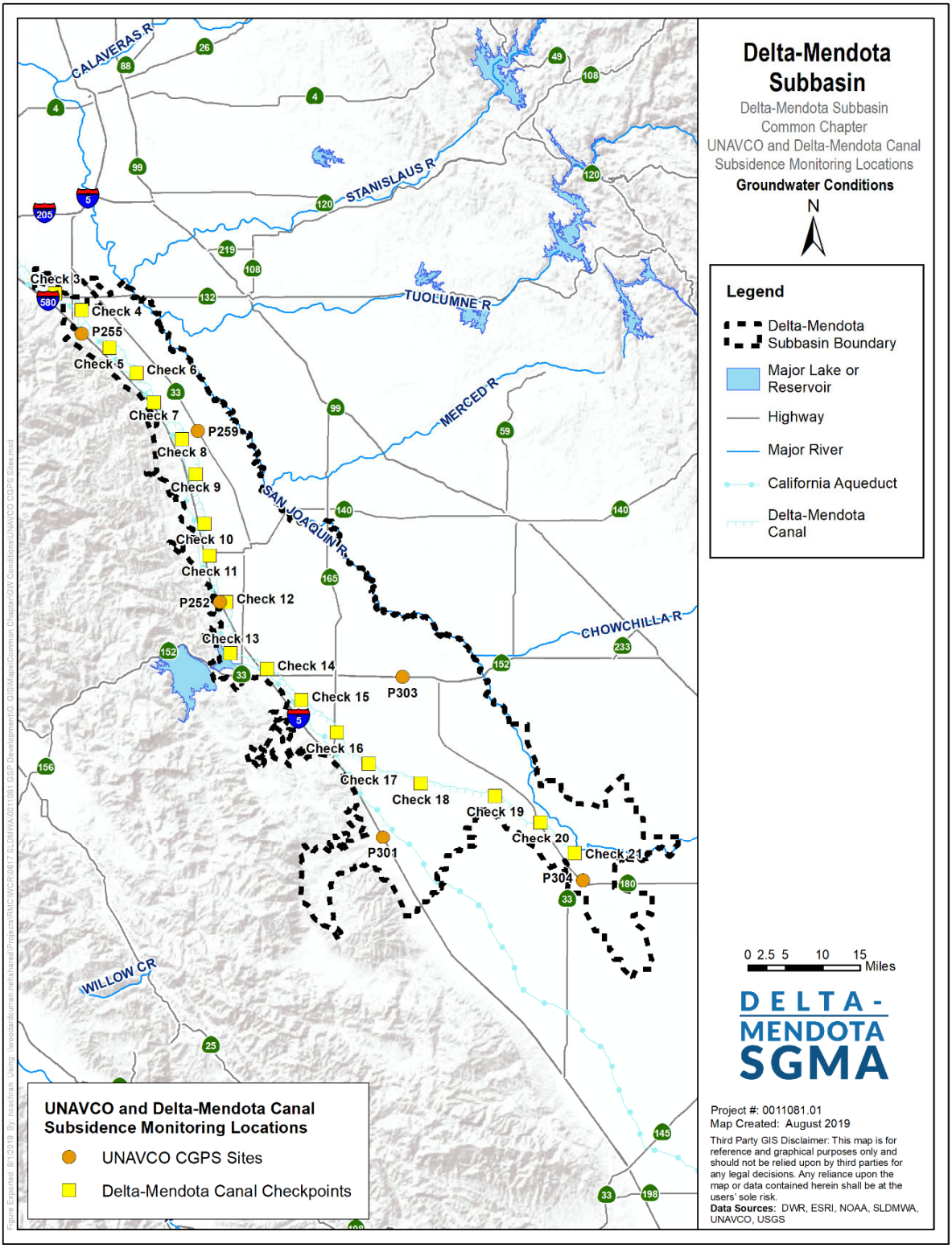


Figure CC-51: UNAVCO and Delta-Mendota Canal Subsidence Monitoring Locations

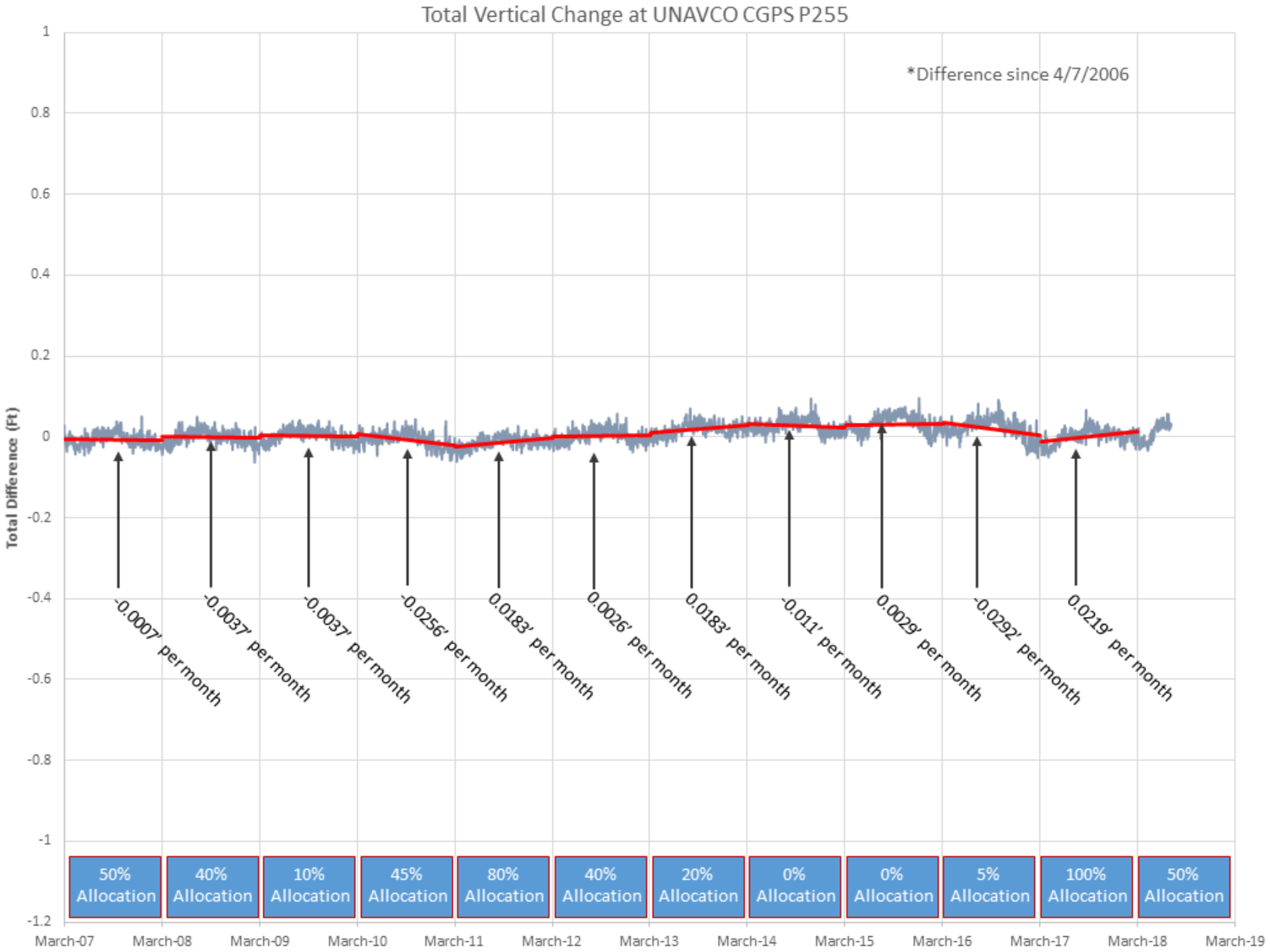


Figure CC-52: Vertical Elevation Change at UNAVCO CGPS P255, Spring 2007 to 2018

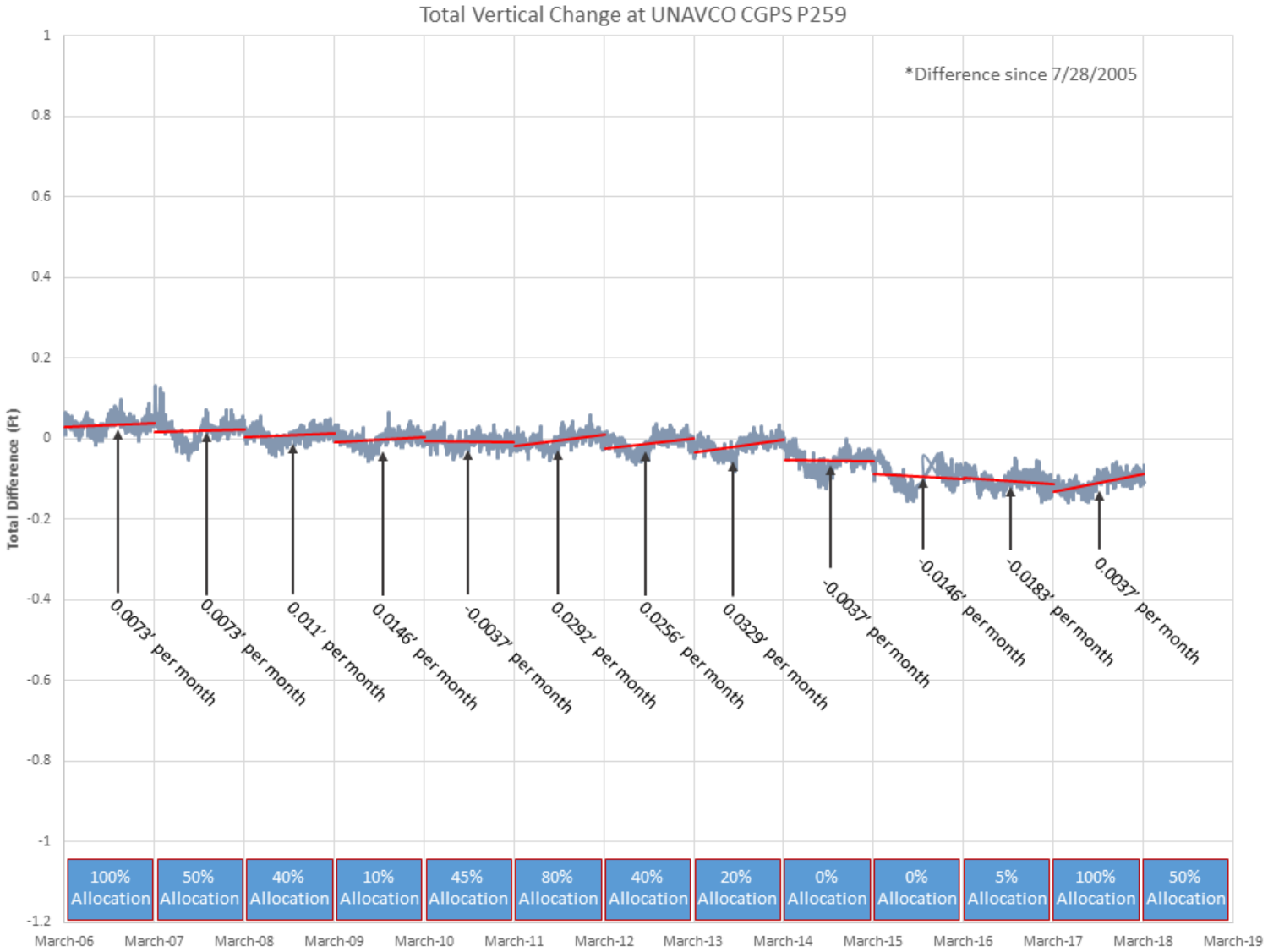


Figure CC-53: Vertical Elevation Change at UNAVCO CGPS P259, Spring 2006 to 2018

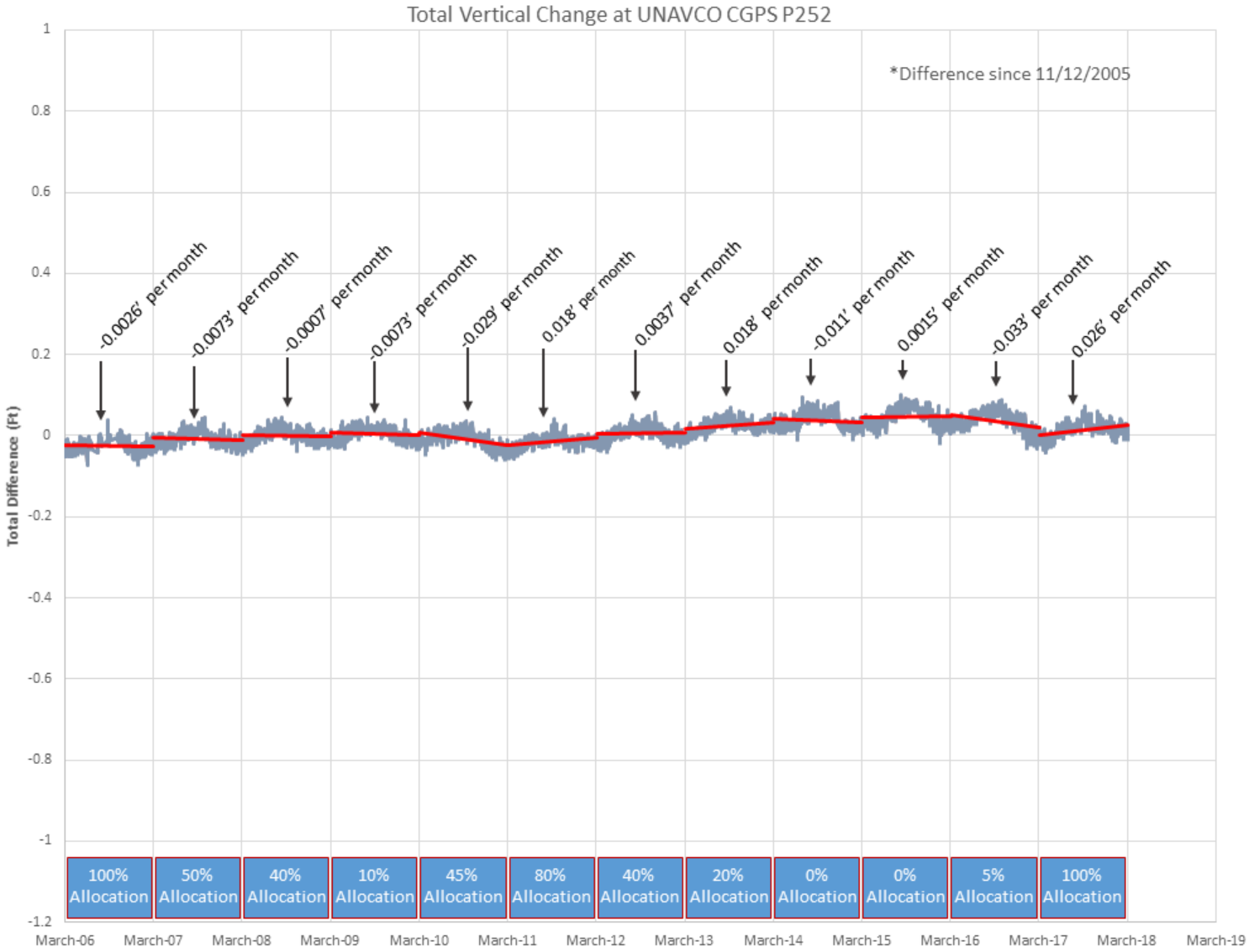


Figure CC-54: Vertical Elevation Change at UNAVCO CGPS P252, Spring 2006 to 2018

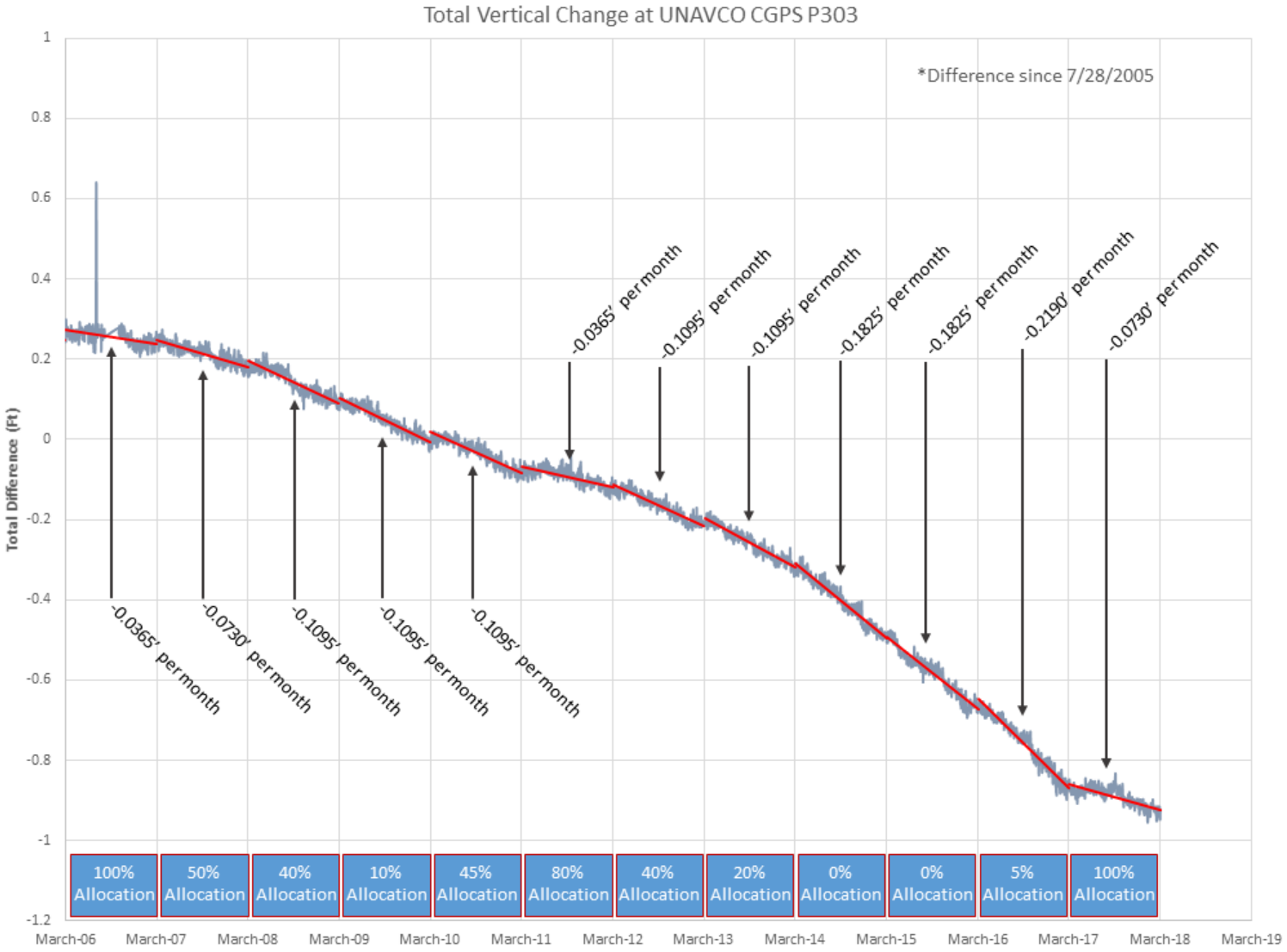


Figure CC-55: Vertical Elevation Change at UNAVCO CGPS P303, Spring 2006 to 2018

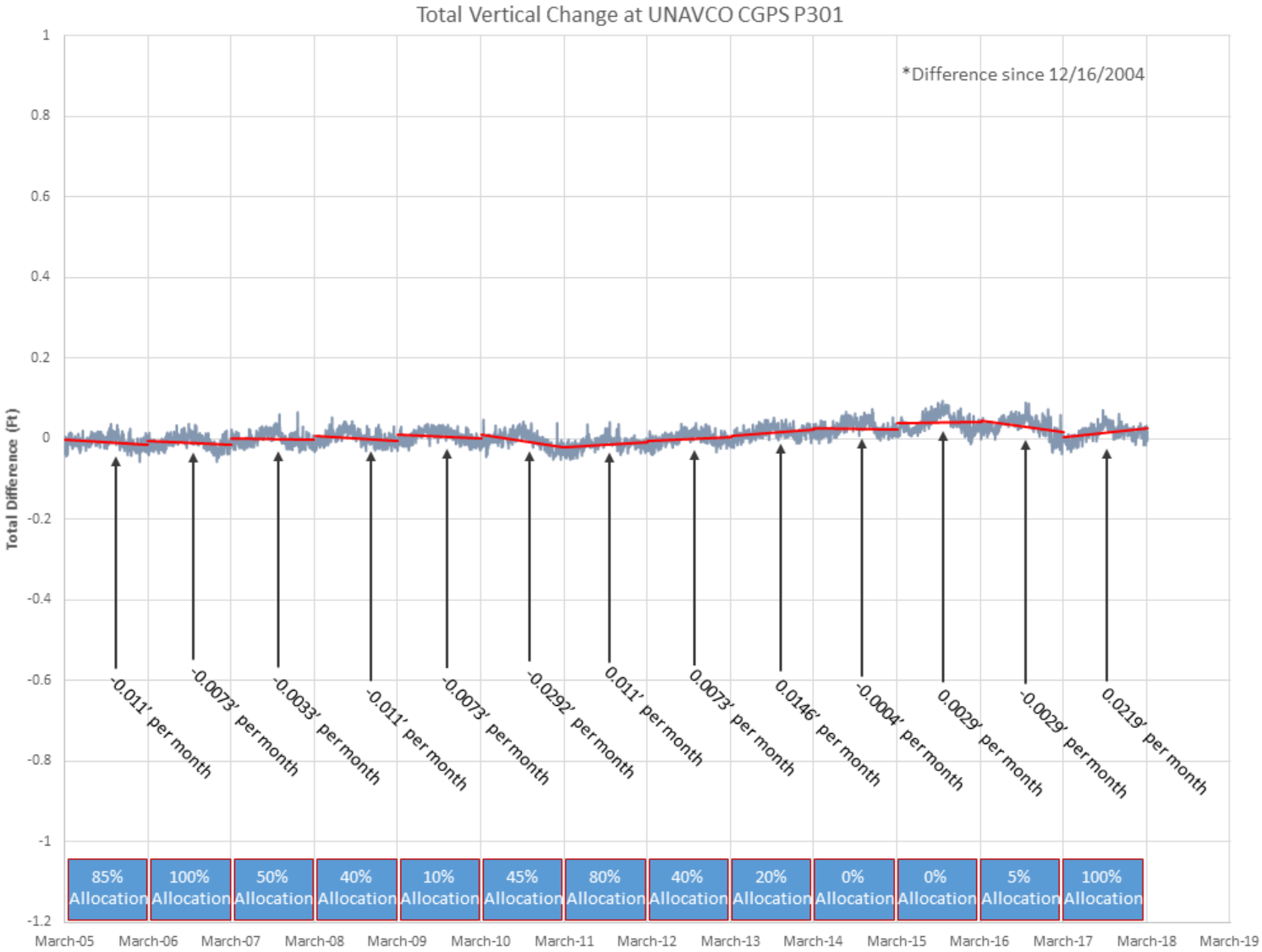


Figure CC-56: Vertical Elevation Change at UNAVCO CGPS P301, Spring 2005 to 2018

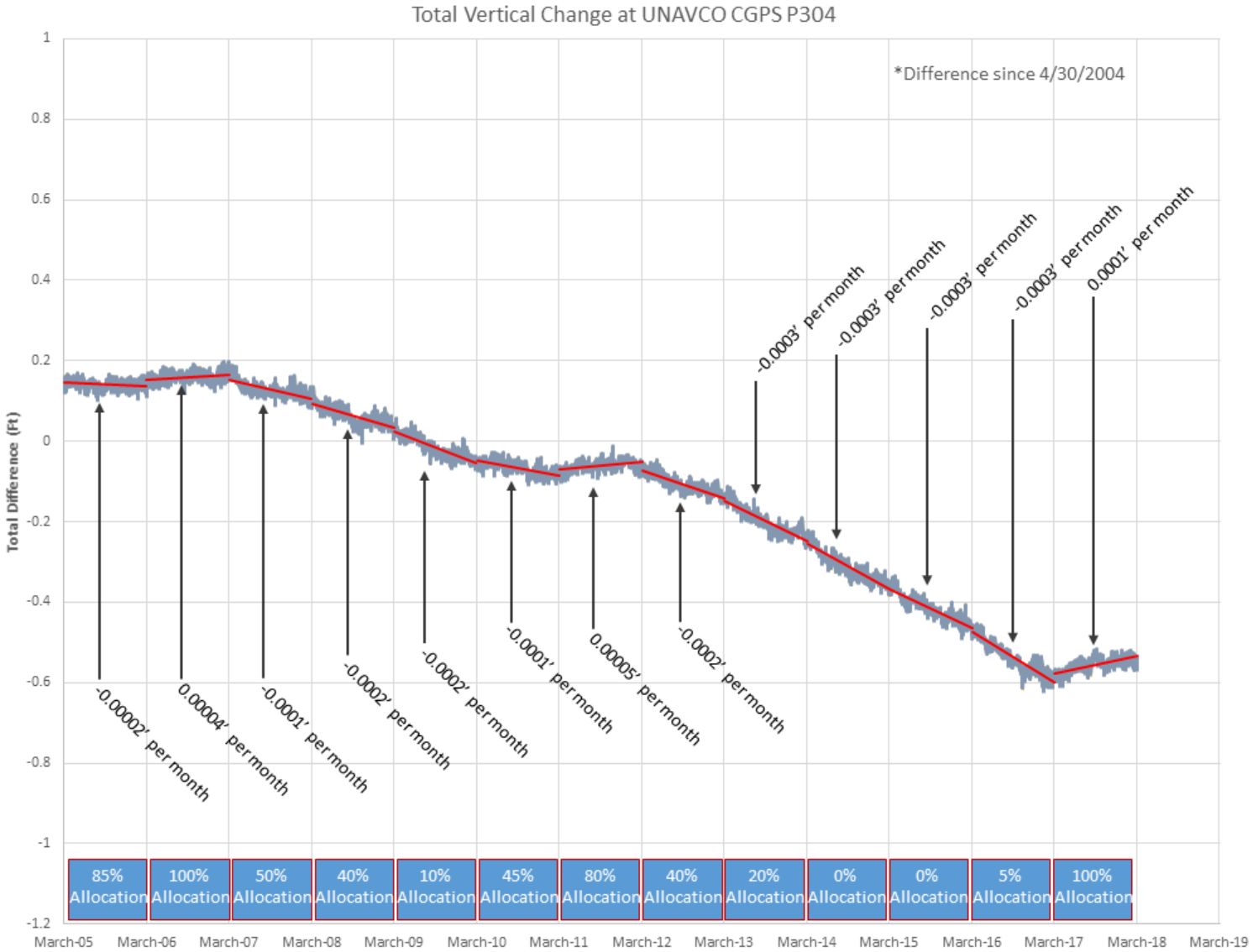


Figure CC-57: Vertical Elevation Change at UNAVCO CGPS P304, Spring 2005 to 2018

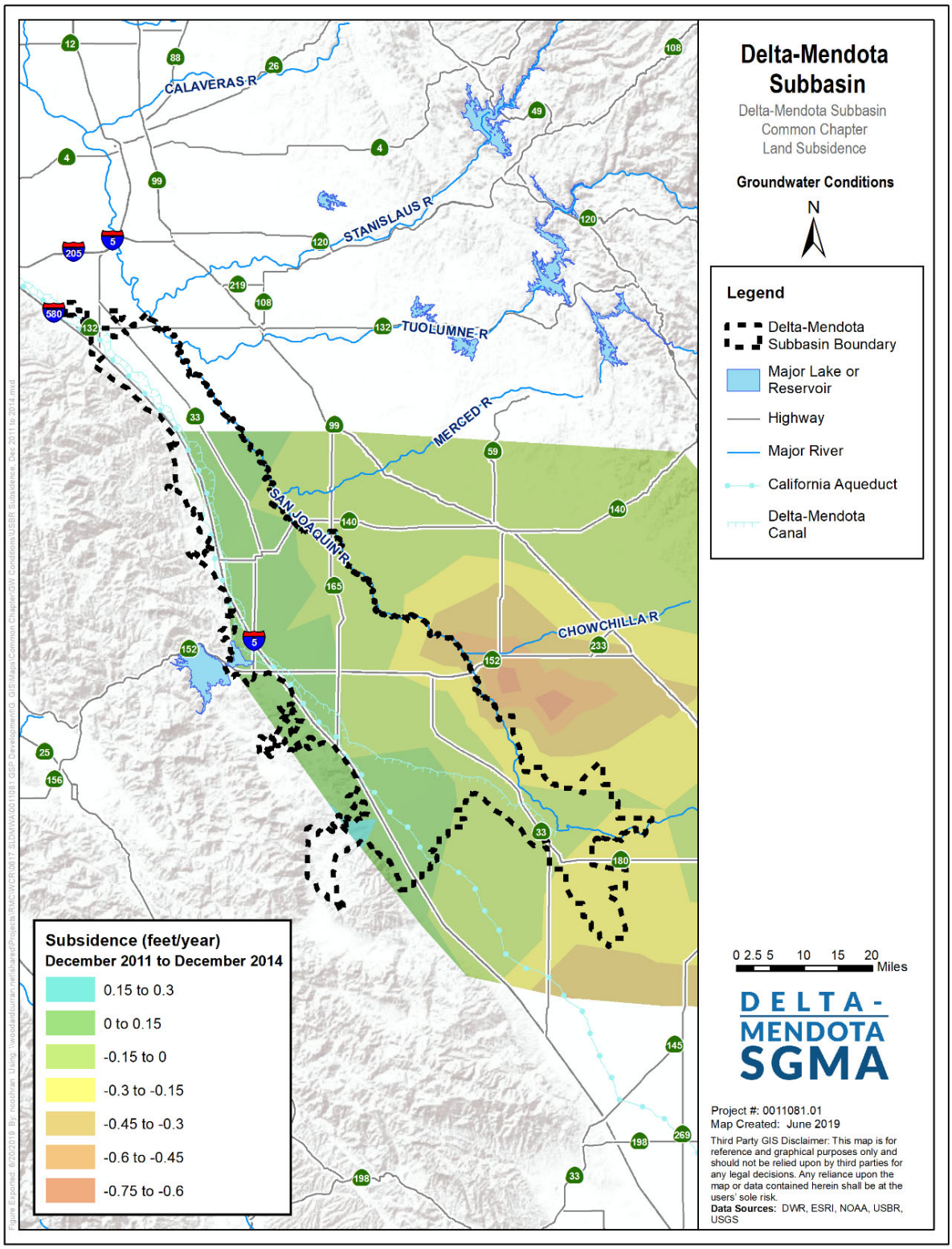


Figure CC-58: Land Subsidence, December 2011 to December 2014



Source: Progress Report: Subsidence in California, March 2015 – September 2016, Farr et. Al. JPL, 2017

Figure CC-59: Recent Land Subsidence at Key San Joaquin Valley Locations

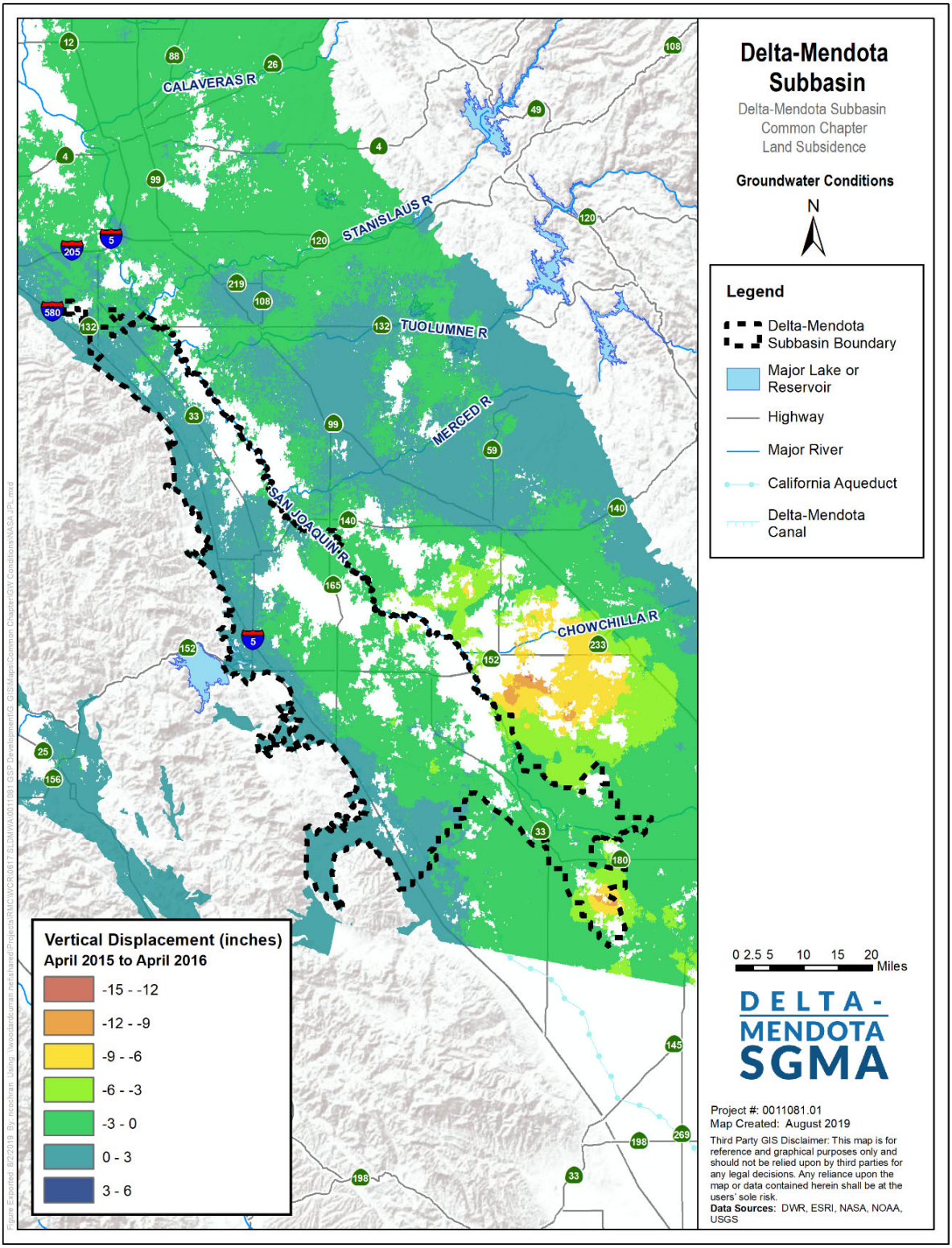


Figure CC-60: Vertical Displacement, April 2015 to April 2016

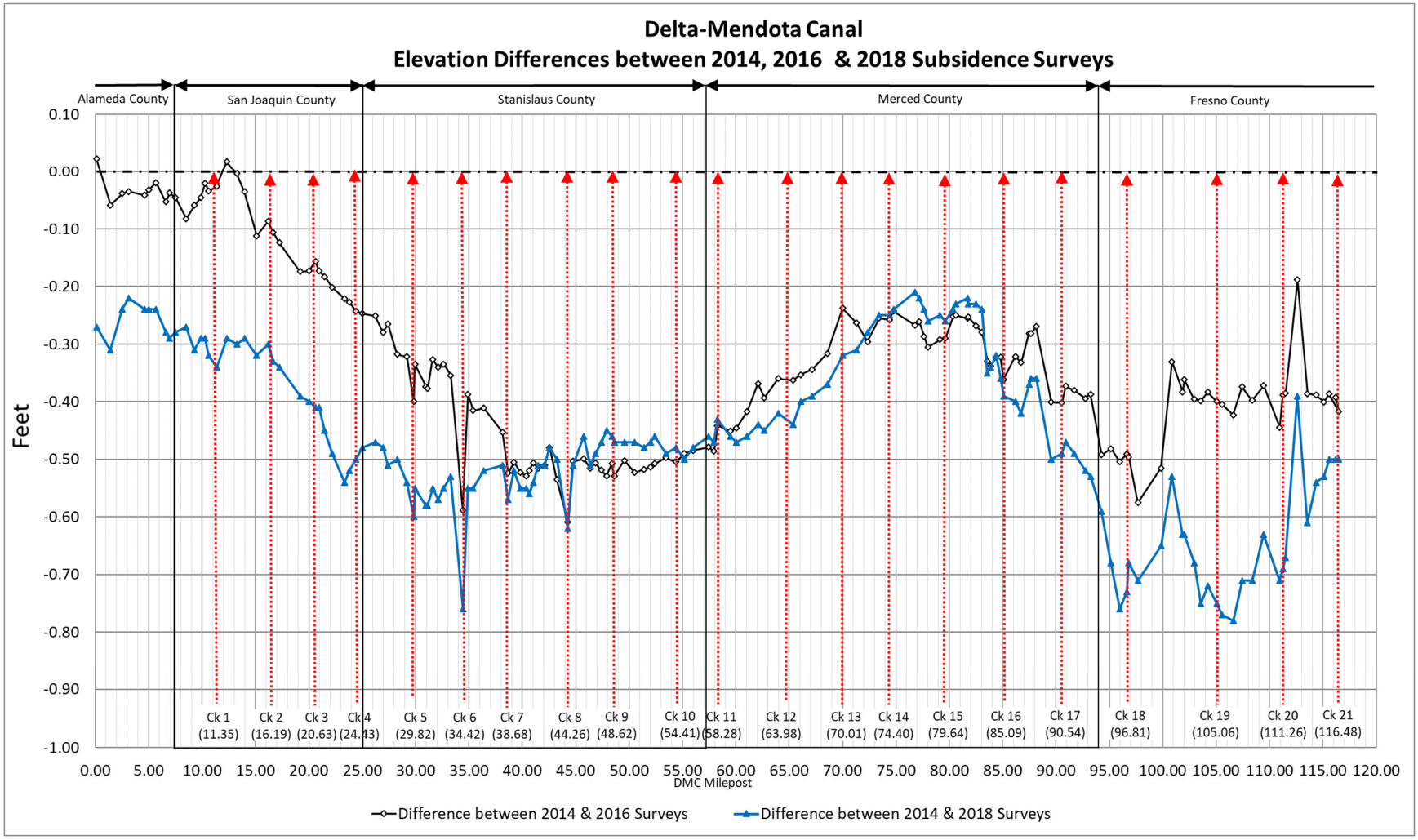


Figure CC-61: Elevation Change along the Delta-Mendota Canal, 2014 through 2018

4.2.7 Interconnected Surface Water Systems

Understanding the location, timing and magnitude of groundwater pumping impacts on interconnected surface water systems is important for the proper management of groundwater resources in order to minimize impacts on interconnected surface waters and the biological communities and permitted surface water diverters that rely on those resources. Historically, throughout the San Joaquin Valley, many interconnected stream reaches have transitioned from net-gaining to net-losing streams (TNC, 2014). Gaining streams occur when streamflows increase as a result of groundwater contribution and losing streams occur when streamflows decrease due to infiltration into the bed of the stream (McBain & Trush, Inc., 2002). Increased groundwater pumping has the ability to contribute to the depletion of interconnected waters with the nature, rate, and location of increased pumping being a function of distance to the river, as well as depth, timing, and rate of groundwater pumping.

Available Data

Two communities in the Delta-Mendota Subbasin are likely most vulnerable to the loss of interconnected surface water as a result of groundwater pumping: San Joaquin River surface water diverters and groundwater dependent ecosystems (GDEs). These communities represent the primary beneficial users of interconnected surface water and groundwater. Streams stemming from the west side of the Delta-Mendota Subbasin are ephemeral in nature, and only two of these creeks reach the San Joaquin River (Del Puerto Creek and Orestimba Creek). These creeks lose their flows to the underlying vadose zone (net-losing streams) and therefore do not represent areas of potential GDEs.

Groundwater dependent ecosystems are defined under Article 2 Definitions, § 351 Definitions of the GSP Emergency Regulations as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (2018) provided by DWR in conjunction with The Nature Conservancy (TNC) was initially used to identify GDEs within the Delta-Mendota Subbasin, following the associated guidance document provided by TNC (Rohde et al., 2018). Local verification efforts were conducted in the Delta-Mendota Subbasin by different GSA representatives to ground-truth GDEs based on local knowledge. Specifically, areas where natural communities have been urbanized or otherwise modified prior to 2015 were eliminated from the data set used to identify GDEs.

Identification of Interconnected Surface Water Systems

The San Joaquin River and Fresno Slough are the primary surface water bodies interconnected with Delta-Mendota Subbasin groundwater. For information about the sources used to determine the interconnected segments of the San Joaquin River and Fresno Slough within the Delta-Mendota Subbasin, refer to the individual GSPs.

Historic Conditions

The San Joaquin River and its tributaries drain approximately 13,500 mi^2 (measured at the USGS gaging station at Vernalis) along the western flank of the Sierra Nevada and eastern flank of the Coast Range, and flows northward into the Sacramento-San Joaquin Delta where it is joined by the Calaveras and Mokelumne Rivers before combining with the Sacramento River. Typical of Mediterranean climate catchments, river flows vary widely seasonally and from year to year. Three major tributaries join the San Joaquin from the east: the Merced, Tuolumne, and Stanislaus Rivers. Smaller tributaries include the Fresno River, Chowchilla River, Bear Creek, and Fresno Slough (from the Kings River). Precipitation is predominantly snow above about 5,500 to 6,000 feet in the Sierra Nevada, with rain in the middle and

lower elevations of the Sierra foothills and in the Coast Range. As a result, the natural hydrology historically reflected a mixed runoff regime dominated by winter-spring rainfall runoff and spring-summer snowmelt runoff. Most flow is derived from snowmelt from the Sierra Nevada, with relatively little runoff contributed from the western side of the drainage basin in the rain shadow of the Coast Range. The unimpaired average annual water yield (WY1906-2002) of the San Joaquin River, as measured immediately above Millerton Reservoir, is 1,801,000 acre-feet (USBR, 2002); the post-Friant Dam average annual water yield (WY 1950-2000) to the lower San Joaquin River is 695,500 acre-feet (USGS, 2000). As average precipitation decreases from north to south, the San Joaquin River basin (including the Stanislaus, Tuolumne, and Merced Rivers) contributes about 22% of the total runoff to the Delta (DWR, 1998).

Current Conditions

Historically, most of the San Joaquin River, which forms the great majority of the Delta-Mendota Subbasin's eastern border, was a gaining reach. Snowmelt runoff during the spring and early summer resulted in these conditions through a good portion of the year. However, significant decreases in groundwater elevations due to a myriad of factors, including pumping, tile drains, the channelizing of flood flows, and upstream diversions on the river, have reversed this condition so most reaches are now losing reaches. Some localized gaining reaches still remain on the lower river, such as between the Stanislaus and Merced Rivers; however, many reaches along these rivers (and along localized streams) may transition from gaining to losing depending on hydrology.

Estimates of Timing and Quantity of Depletions

Using available data and where feasible, each Delta-Mendota Subbasin GSP Group quantified the gains and/or losses from the groundwater at each interconnected reach of the San Joaquin River adjoining the Delta-Mendota Subbasin. **Table CC-6** summarizes these estimates. For more information about the sources or methods used to estimate the timing and quantity of depletions, refer to the individual GSPs.

Table CC-6: Estimated Quantity of Gains/Depletions for Interconnected Stream Reaches, San Joaquin River

	Landmark	River Mile	GSP Group	Interconnected?	Gaining or Losing?	Quantity Gained/Loss (cfs)	Notes
REACH 1		*267.5 to 229.0*	Located outside the Delta-Mendota Subbasin				
A	Friant Dam	267.5					
	North Fork Road Bridge	266.8					
	Cobb Island Bridge	259.0					
	State Route 41 (Lanes Bridge)	255.2					
	Scout Island Bend	250.0					
	ATSF Railroad Bridge	245.0					
B	State Route 99	243.2					
	Southern Pacific Railroad	243.2					
	State Route 145 Bridge (Skaggs Bridge)	234.1					
	Gravelly Ford	229.0					
REACH 2		*229.0 to 204.8*					
A	Gravelly Ford	229.0		Yes	Losing when flowing		
	Upstream Limit of Right Bank Levee	227.0					
	Upstream Limit of Left Bank Levee	225.0					
B	Chowchilla Bypass Control Structure	216.1	Farmers Water District	Yes	Losing when flowing	-4	2003 to 2013 average. High in 2010 (-8 cfs), low in 2004 and 2009 (-1 cfs)
	Mendota Dam	204.8					
	Mendota Pool			Yes	Losing	-40	-29,000 AFY
REACH 3		*204.8 to 182.0*		Yes	Losing	-25	-18.000 AFY
	Mendota Dam	204.8					
	Avenue 7.5 Bridge (Firebaugh)	195.2					
	Sack Dam	182.0					
REACH 4		*182.0 to 135.8*				–-0 - 0	Losses when wet; gaining in some areas (but unquantifiable)
A	Sack Dam	182.0		Y–s - first 2 miles –o - next 1.5 miles Y–s - remaining miles	Losing		
	State Route 152 Bridge	173.9		Yes	Gaining		
B	Sand Slough Control Structure	168.5					
	Mariposa Slough Control Structure	168.4					
	Turner Island Road Bridge	157.2					
	Mariposa Bypass confluence	147.2					

Landmark	River Mile	GSP Group	Interconnected?	Gaining or Losing?	Quantity Gained/Loss (cfs)	Notes
Bear Creek/Eastside Bypass confluence	135.8					
REACH 5	*135.8 to 118.0*		Yes	Gaining	unquantifiable	Likely gaining from ag/refuge draining but unquantifiable
Bear Creek/Eastside Bypass confluence	135.8					
State Route 165 Bridge (Lander Avenue)	132.9					
Salt Slough con fluence	127.7					
State Route 140 Bridge (Fremont Ford)	125.1					
Mud Slough confluence	121.2					
Merced River confluence (Hills Ferry Bridge)	118.0					
Newman to Crows Landing		Northern & Central Delta-Mendota	Yes	Gaining	50	50
Crows Landing to Patterson		Northern & Central Delta-Mendota Region	Yes	Gaining	-50 to 200	-50 to 200
Patterson to Vernalis		Northern & Central Delta-Mendota Region	Yes	Gaining	190	6.1 cfs/mi for 30.8 miles. Based on Cooley, W. 2001. *Groundwater flow net analysis for lower San Joaquin River Basin.* Memo to CRWQCB, August 8, 2001

Groundwater Dependent Ecosystems

A groundwater dependent ecosystem (GDE) is defined under the GSP Emergency Regulations as referring "to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (§351(m)). Under §354.16(g) of the GSP Emergency Regulations, each Plan is required to identify GDEs within the subbasin utilizing data provided by DWR or the best available information. The following section describes the process for verifying GDEs within the Delta-Mendota Subbasin and the location of verified and potential GDEs.

The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (2018c) provided by DWR was used in conjunction with information provided by The Nature Conservancy (TNC) to identify GDEs within the Delta-Mendota Subbasin. To further screen available information regarding GDEs, each GSP Group developed individualized criteria. Additional details regarding the screening process implemented by each GSP can be found in the individual GSPs.

Based on the screening process implemented by each individual GSP Group, GDE polygons determined not to be GDEs were removed from the mapping. **Figure CC-62** and **Figure CC-63** summarize the results of the GDE analysis for the Subbasin. Results are compiled into two habitat classes: wetlands (**Figure CC-62**) and vegetation (**Figure CC-63**). Wetland features are commonly associated with surface expression of groundwater under natural, unmodified conditions. Vegetation feature types are commonly associated with the sub-surface presence of groundwater (phreatophytes – deep rooted plants). Confirmed GDEs have been grouped into larger polygons based on proximity and aquifer connection.

In general, identified Possible GDEs are primarily located along the San Joaquin River corridor, within the northern portion of the Northern & Central Delta-Mendota Region GSP, the SJREC GSP, the Grassland GSP, and the Fresno GSP Plan Areas, where some possible GDEs have been identified along ephemeral streams that originate from the Coast Range. Table CC-7 includes all freshwater species within the Delta-Mendota Subbasin as identified by TNC (2018). Per TNC data, these species (listed in Table CC-7) have either been observed or have the potential to exist within the Delta-Mendota Subbasin; however, the actual presence of these species have not been verified. As a result of the identification of Possible GDEs for the purpose of SGMA, no land use protections for GDEs are conveyed unless otherwise required. Additionally, the Delta Mendota Subbasin recognizes the opportunity to present further-refined GDE delineations in the subsequent GSP Updates.

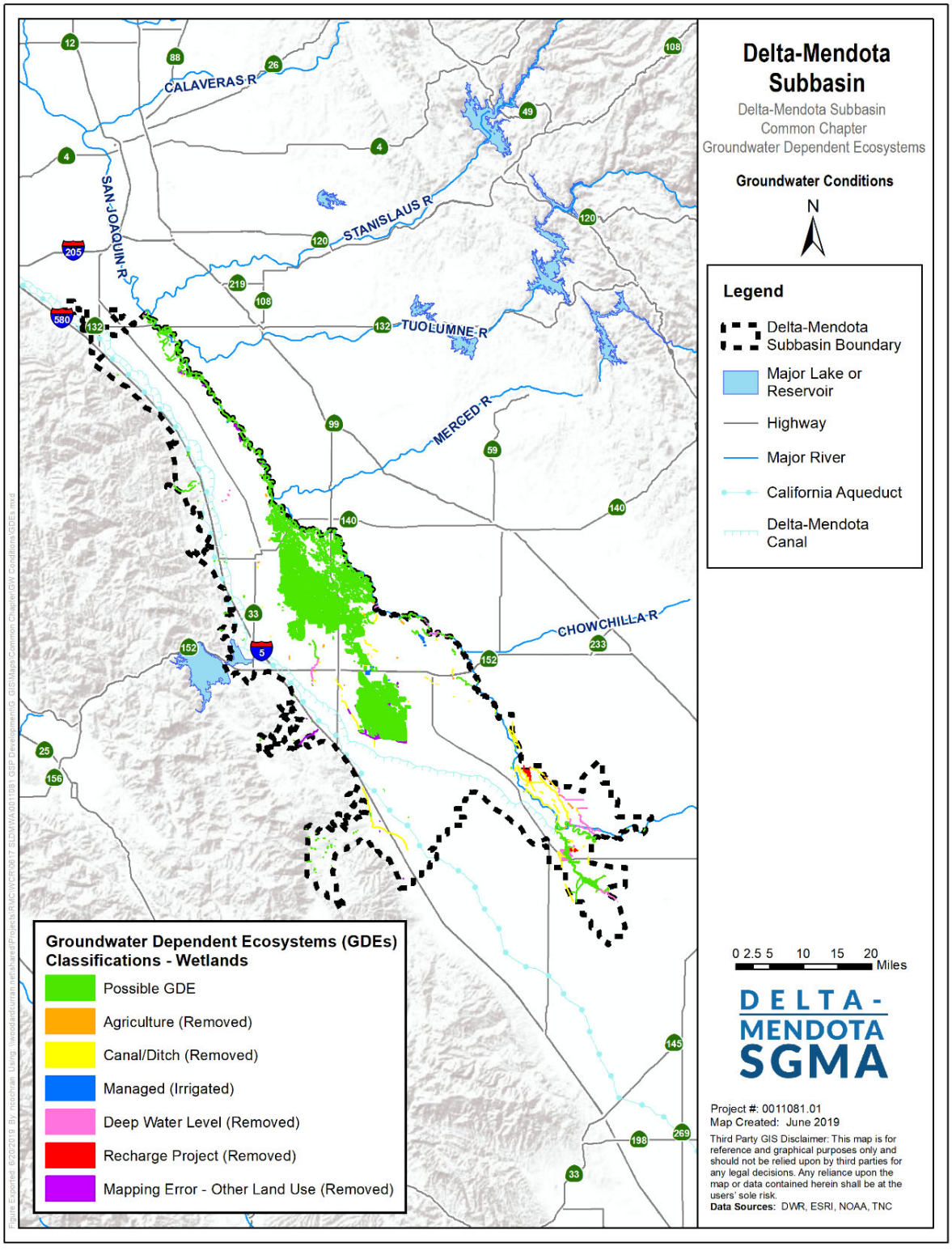


Figure CC-62: Groundwater Dependent Ecosystems, Wetlands

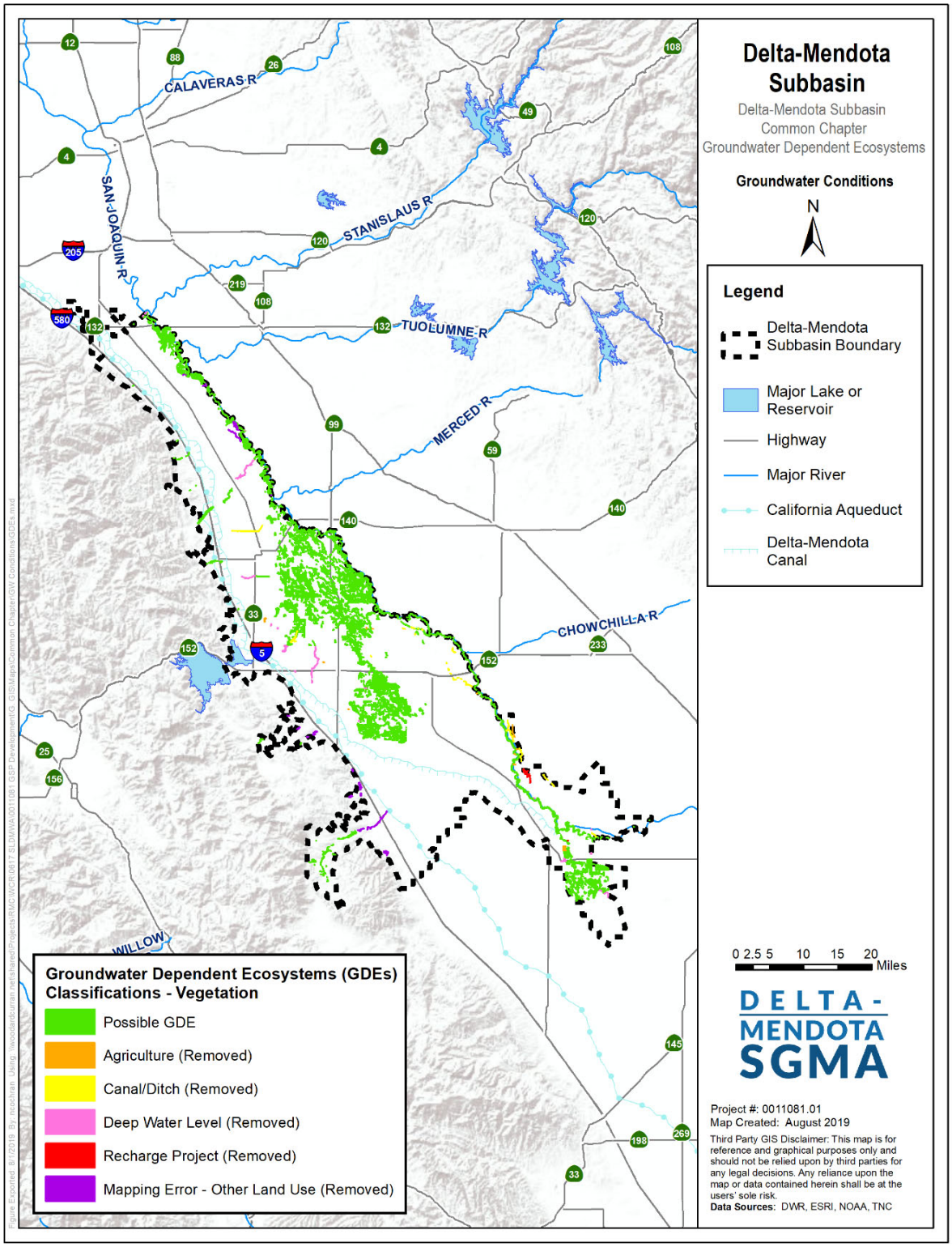


Figure CC-63: Groundwater Dependent Ecosystems, Vegetation

Table CC-7: List of Potential Freshwater Species

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Actitis macularius	Spotted Sandpiper	Birds		
Aechmophorus clarkii	Clark's Grebe	Birds		
Aechmophorus occidentalis	Western Grebe	Birds		
Agelaius tricolor	Tricolored Blackbird	Birds	Bird of Conservation Concern	Special Concern
Aix sponsa	Wood Duck	Birds		
Anas acuta	Northern Pintail	Birds		
Anas americana	American Wigeon	Birds		
Anas clypeata	Northern Shoveler	Birds		
Anas crecca	Green-winged Teal	Birds		
Anas cyanoptera	Cinnamon Teal	Birds		
Anas discors	Blue-winged Teal	Birds		
Anas platyrhynchos	Mallard	Birds		
Ariescriser albifrons	Greater White-fronted Goose	Birds		
Ardea alba	Great Egret	Birds		
Ardea herodias	Great Blue Heron	Birds		
Aythya affinis	Lesser Scaup	Birds		
Aythya americana	Redhead	Birds		Special Concern
Aythya collaris	Ring-necked Duck	Birds		
Aythya marila	Greater Scaup	Birds		
Aythya valisineria	Canvasback	Birds		Special
Botaurus lentiginosus	American Bittern	Birds		
Bucephala albeola	Bufflehead	Birds		
Bucephala clangula	Common Goldeneye	Birds		
Butorides virescens	Green Heron	Birds		
Calidris alpina	Dunlin	Birds		
Calidris mauri	Western Sandpiper	Birds		
Calidris minutilla	Least Sandpiper	Birds		
Chen caerulescens	Snow Goose	Birds		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Chen rossii	Ross's Goose	Birds		
Chlidonias niger	Black Tern	Birds		Special Concern
Chroicocephalus philadelphia	Bonaparte's Gull	Birds		
Cistothorus palustris	Marsh Wren	Birds		
Cygnus columbianus	Tundra Swan	Birds		
Cypseloides niger	Black Swift	Birds	Bird of Conservation Concern	Special Concern
Dendrocygna bicolor	Fulvous Whistling-Duck	Birds		Special Concern
Egretta thula	Snowy Egret	Birds		
Empidonax traillii	Willow Flycatcher	Birds	Bird of Conservation Concern	Endangered
Fulica americana	American Coot	Birds		
Gallinago delicata	Wilson's Snipe	Birds		
Gallinula chloropus	Common Moorhen	Birds		
Geothlypis trichas	Common Yellowthroat	Birds		
Grus canadensis	Sandhill Crane	Birds		
Haliaeetus leucocephalus	Bald Eagle	Birds	Bird of Conservation Concern	Endangered
Himantopus mexicanus	Black-necked Stilt	Birds		
Icteria virens	Yellow-breasted Chat	Birds		Special Concern
Limnodromus scolopaceus	Long-billed Dowitcher	Birds		
Lophodytes cucullatus	Hooded Merganser	Birds		
Megaceryle alcyon	Belted Kingfisher	Birds		
Mergus merganser	Common Merganser	Birds		
Mergus serrator	Red-breasted Merganser	Birds		
Numenius americanus	Long-billed Curlew	Birds		
Numenius phaeopus	Whimbrel	Birds		
Nycticorax	Black-crowned Night-Heron	Birds		
Oxyura jamaicensis	Ruddy Duck	Birds		
Pandion haliaetus	Osprey	Birds		Watch list
Pelecanus erythrorhynchos	American White Pelican	Birds		Special Concern

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Phalacrocorax auritus	Double-crested Cormorant	Birds		
Phalaropus tricolor	Wilson's Phalarope	Birds		
Plegadis chihi	White-faced Ibis	Birds		Watch list
Pluvialis squatarola	Black-bellied Plover	Birds		
Podiceps nigricollis	Eared Grebe	Birds		
Podilymbus podiceps	Pied-billed Grebe	Birds		
Porzana carolina	Sora	Birds		
Rallus limicola	Virginia Rail	Birds		
Recurvirostra americana	American Avocet	Birds		
Riparia	Bank Swallow	Birds		Threatened
Setophaga petechia	Yellow Warbler	Birds		
Tachycineta bicolor	Tree Swallow	Birds		
Tringa melanoleuca	Greater Yellowlegs	Birds		
Tringa semipalmata	Willet	Birds		
Tringa solitaria	Solitary Sandpiper	Birds		
Vireo bellii	Bell's Vireo	Birds		
Vireo bellii pusillus	Least Bell's Vireo	Birds	Endangered	Endangered
Xanthocephalus	Yellow-headed Blackbird	Birds		Special Concern
Artemia franciscana	San Francisco Brine Shrimp	Crustaceans		
Branchinecta conservatio	Conservancy Fairy Shrimp	Crustaceans	Endangered	Special
Branchinecta lindahli	Versatile Fairy Shrimp	Crustaceans		
Branchinecta longiantenna	Longhorn Fairy Shrimp	Crustaceans	Endangered	Special
Branchinecta lynchi	Vernal Pool Fairy Shrimp	Crustaceans	Threatened	Special
Lepidurus packardi	Vernal Pool Tadpole Shrimp	Crustaceans	Endangered	Special
Linderiella occidentalis	California Fairy Shrimp	Crustaceans		Special
Oncorhynchus myki–s - CV	Central Valley steelhead	Fishes	Threatened	Special
Oncorhynchus mykiss irideus	Coastal rainbow trout	Fishes		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Pogonichthys macrolepidotus	Sacramento splittail	Fishes		Special Concern
Actinemys marmorata	Western Pond Turtle	Herps		Special Concern
Ambystoma californiense	California Tiger Salamander	Herps	Threatened	Threatened
Anaxyrus boreas	Boreal Toad	Herps		
Pseudacris regilla	Northern Pacific Chorus Frog	Herps		
Rana boylii	Foothill Yellow-legged Frog	Herps	Under Review in the Candidate or Petition Process	Special Concern
Rana draytonii	California Red-legged Frog	Herps	Threatened	Special Concern
Spea hammondii	Western Spadefoot	Herps	Under Review in the Candidate or Petition Process	Special Concern
Thamnophis atratus	Santa Cruz Gartersnake	Herps		
Thamnophis elegans	Mountain Gartersnake	Herps		
Thamnophis gigas	Giant Gartersnake	Herps	Threatened	Threatened
Thamnophis hammondii	Two-striped Gartersnake	Herps		Special Concern
Thamnophis sirtalis	Common Gartersnake	Herps		
Aeshnidae fam.	Aeshnidae fam.	Insects & other inverts		
Anax junius	Common Green Darner	Insects & other inverts		
Brillia spp.	Brillia spp.	Insects & other inverts		
Callicorixa spp.	Callicorixa spp.	Insects & other inverts		
Capnia hitchcocki	Arroyo Snowfly	Insects & other inverts		
Chironomus spp.	Chironomus spp.	Insects & other inverts		
Coenagrionidae fam.	Coenagrionidae fam.	Insects & other inverts		
Corisella spp.	Corisella spp.	Insects & other inverts		
Cricotopus spp.	Cricotopus spp.	Insects & other inverts		
Ischnura cervula	Pacific Forktail	Insects & other inverts		
Ischnura denticollis	Black-fronted Forktail	Insects & other inverts		
Mesocapnia bulbosa	Bulbous Snowfly	Insects & other inverts		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Paraleptophlebia associata	A Mayfly	Insects & other inverts		
Paratanytarsus spp.	Paratanytarsus spp.	Insects & other inverts		
Phaenopsectra spp.	Phaenopsectra spp.	Insects & other inverts		
Procladius spp.	Procladius spp.	Insects & other inverts		
Psectrocladius spp.	Psectrocladius spp.	Insects & other inverts		
Tanypus spp.	Tanypus spp.	Insects & other inverts		
Tipulidae fam.	Tipulidae fam.	Insects & other inverts		
Trichocorixa spp.	Trichocorixa spp.	Insects & other inverts		
Castor canadensis	American Beaver	Mammals		
Lontra canadensis	North American River Otter	Mammals		
Neovison vison	American Mink	Mammals		
Ondatra zibethicus	Common Muskrat	Mammals		
Anodonta californiensis	California Floater	Mollusks		Special
Margaritifera falcata	Western Pearlshell	Mollusks		Special
Pyrgulopsis diablensis	Diablo Range Pyrg	Mollusks		Special
Alopecurus saccatus	Pacific Foxtail	Plants		
Ammannia coccinea	Scarlet Ammannia	Plants		
Anemopsis californica	Yerba Mansa	Plants		
Arundo donax	NA	Plants		
Azolla filiculoides	NA	Plants		
Azolla microphylla	Mexican mosquito fern	Plants		Special
Baccharis salicina		Plants		
Bacopa eisenii	Gila River Water-hyssop	Plants		
Bidens laevis	Smooth Bur-marigold	Plants		
Bolboschoenus glaucus	NA	Plants		
Bolboschoenus maritimus paludosus	NA	Plants		
Callitriche marginata	Winged Water-starwort	Plants		
Ceratophyllum demersum	Common Hornwort	Plants		
Chloropyronmoesclle hispidum		Plants		Special
Chloropyron palmatum	NA	Plants	Endangered	Special

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Cotula coronopifolia	NA	Plants		
Crassula aquatica	Water Pygmyweed	Plants		
Crypsis vaginiflora	NA	Plants		
Cyperus erythrorhizos	Red-root Flatsedge	Plants		
Cyperus squarrosus	Awned Cyperus	Plants		
Downingia bella	Hoover's Downingia	Plants		
Downingia pulchella	Flat-face Downingia	Plants		
Echinodorus berteroi	Upright Burhead	Plants		
Elatine brachysperma	Shortseed Waterwort	Plants		
Elatine californica	California Waterwort	Plants		
Eleocharis acicularis	Least Spikerush	Plants		
Eleocharis atropurpurea	Purple Spikerush	Plants		
Eleocharis coloradoensis		Plants		
Eleocharis macrostachya	Creeping Spikerush	Plants		
Eleocharis montevidensis	Sand Spikerush	Plants		
Eleocharis quadrangulata	NA	Plants		
Elodea canadensis	Broad Waterweed	Plants		
Epilobium cleistogamum	Cleistogamous Spike-primrose	Plants		
Eragrostis hypnoides	Teal Lovegrass	Plants		
Eryngium castrense	Great Valley Eryngo	Plants		
Eryngium racemosum	Delta Coyote-thistle	Plants		Endangered
Eryngium spinosepalum	Spiny Sepaled Coyote-thistle	Plants		Special
Eryngium vaseyi vallicola		Plants		
Eryngium vaseyi	Vasey's Coyote-thistle	Plants		
Euthamia occidentalis	Western Fragrant Goldenrod	Plants		
Hydrocotyle verticillata	Whorled Marsh-pennywort	Plants		
Juncus acuminatus	Sharp-fruit Rush	Plants		
Juncus xiphioides	Iris-leaf Rush	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Lasthenia ferrisiae	Ferris' Goldfields	Plants		Special
Lasthenia fremontii	Fremont's Goldfields	Plants		
Lemna aequinoctialis	Lesser Duckweed	Plants		
Lemna gibba	Inflated Duckweed	Plants		
Lemna minor	Lesser Duckweed	Plants		
Lepidium jaredii	Jared's Peppergrass	Plants		Special
Lepidium oxycarpum	Sharp-pod Peppergrass	Plants		
Limnanthes douglasii	Douglas' Meadowfoam	Plants		
Limosella acaulis	Southern Mudwort	Plants		
Lipocarpha micrantha	Dwarf Bulrush	Plants		
Ludwigia peploides	NA	Plants		
Ludwigia repens	Creeping Seedbox	Plants		
Lythrum californicum	California Loosestrife	Plants		
Marsilea vestita	NA	Plants		
Mimulus cardinalis	Scarlet Monkeyflower	Plants		
Mimulus guttatus	Common Large Monkeyflower	Plants		
Montia fontana	Fountain Miner's-lettuce	Plants		
Myosurus minimus	NA	Plants		
Myosurus sessilis	Sessile Mousetail	Plants		
Myriophyllum aquaticum	NA	Plants		
Najas guadalupensis	Southern Naiad	Plants		
Navarretia heterandra	Tehama Navarretia	Plants		
Navarretia leucocephala	White-flower Navarretia	Plants		
Navarretia prostrata	Prostrate Navarretia	Plants		Special
Neostapfia colusana	Colusa Grass	Plants	Threatened	Endangered
Panicum dichotomiflorum	NA	Plants		
Paspalum distichum	Joint Paspalum	Plants		
Persicaria hydropiperoides		Plants		
Persicaria lapathifolia		Plants		
Persicaria maculosa	NA	Plants		
Persicaria pensylvanica	NA	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Phacelia distans	NA	Plants		
Phyla lanceolata	Fog-fruit	Plants		
Phyla nodiflora	Common Frog-fruit	Plants		
Pilularia americana	NA	Plants		
Plagiobothrys acanthocarpus	Adobe Popcorn-flower	Plants		
Plagiobothrys greenei	Greene's Popcorn-flower	Plants		
Plagiobothrys humistratus	Dwarf Popcorn-flower	Plants		
Plagiobothrys leptocladus	Alkali Popcorn-flower	Plants		
Plantago elongata	Slender Plantain	Plants		
Pluchea odorata	Scented Conyza	Plants		
Pogogyne douglasii	NA	Plants		
Pogogyne zizyphoroides		Plants		
Potamogeton diversifolius	Water-thread Pondweed	Plants		
Potamogeton foliosus	Leafy Pondweed	Plants		
Potamogeton nodosus	Longleaf Pondweed	Plants		
Potamogeton pusillus	Slender Pondweed	Plants		
Psilocarphus brevissimus	Dwarf Woolly-heads	Plants		
Psilocarphus oregonus	Oregon Woolly-heads	Plants		
Psilocarphus tenellus	NA	Plants		
Puccinellia simplex	Little Alkali Grass	Plants		
Ranunculus sceleratus	NA	Plants		
Rorippa curvisiliqua	Curve-pod Yellowcress	Plants		
Rorippa palustris	Bog Yellowcress	Plants		
Rotala ramosior	Toothcup	Plants		
Ruppia cirrhosa	Widgeon-grass	Plants		
Ruppia maritima	Ditch-grass	Plants		
Sagittaria longiloba	Longbarb Arrowhead	Plants		
Sagittaria montevidensis calycina		Plants		
Salix exigua	Narrowleaf Willow	Plants		
Salix gooddingii	Goodding's Willow	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Schoenoplectus acutus occidentalis	Hardstem Bulrush	Plants		
Schoenoplectus americanus	Three-square Bulrush	Plants		
Sinapis alba	NA	Plants		
Sparganium eurycarpum		Plants		
Stuckenia pectinata		Plants		
Typha domingensis	Southern Cattail	Plants		
Typha latifolia	Broadleaf Cattail	Plants		
Veronica americana	American Speedwell	Plants		
Wolffiella lingulata	Tongue Bogmat	Plants		
Zannichellia palustris	Horned Pondweed	Plants		

Source: The Nature Conservancy (TNC). 2018. Identifying Environmental Surface Water Use–s - Freshwater Species List for Each Groundwater Basin dataset. https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

4.2.8 Data Gaps

The Delta-Mendota Subbasin is an extensive subbasin covering a large area extending along the northwestern end of the San Joaquin Valley. While there is a significant amount of data available regarding various groundwater-related aspects of the Subbasin, much is still not known in multiple locations around the Subbasin. To this end, the following data gaps have been identified and will be addressed as part of the interim period between adoption of this GSP and its first 5-year update.

- Information regarding subsidence varies in extent around the region. While there is a large amount of land elevation survey data available in association with the DMC and the San Joaquin River Restoration Program, other areas in the Delta-Mendota Subbasin require additional data collection to both further establish and monitor future land subsidence rates.

- Only three shallow groundwater wells exist proximate to the northern end of the San Joaquin River (outside of the area being addressed by the San Joaquin River Restoration Program). Additional nested or clustered monitoring wells are required adjacent to the river on the northern end of the Subbasin to evaluate horizontal and vertical groundwater gradients, and in connection with river stage monitoring, to assess the interconnection between the San Joaquin River and the northeastern end of the Delta-Mendota Subbasin.

- There are a large number of wells in the Delta-Mendota Subbasin where no well construction information exists or is readily available. Video surveys and other surveys should be conducted on selected wells that may potentially be added to the Subbasin monitoring network to (1) identify where the wells are screened, and (2) determine if the well(s) are appropriate as additions to the GSP Groups' groundwater monitoring programs.

- Mapping of GDEs in the Delta-Mendota Subbasin, as contained in this Common Chapter, is an initial assessment of their location. This mapping may be refined using most recent groundwater elevation/depth to water contour mapping.

- Monitoring networks contained herein are preliminary and were formulated based on existing well information. As additional wells are installed in the Subbasin and additional well construction information is obtained for existing wells, these networks may need to be refined to improve on the spatial (areal and vertical) distribution of monitoring points and the data collected for evaluation of conditions of the groundwater basin.

- The sustainable yield estimates and water budgets contained in this Common Chapter for both the Upper and Lower Aquifers were developed using limited data. As additional data are collected over the first five years, improved sustainable yield estimates and estimates of water in storage in both principal aquifers should be prepared utilizing the new data.

In addition to these Subbasin-level data gaps, additional data gaps have been identified for each GSP Plan Area. Please see the individual GSPs for additional identified data gaps.

4.3 Delta-Mendota Subbasin Water Budgets

This section describes the common coordinated assumptions agreed upon and utilized by each GSP Group in the Delta-Mendota Subbasin in developing the historical, current, and projected water budgets for their respective GSP Plan Areas. These coordinated historical, current, and projected water budgets were then compiled to prepare the subbasin-level water budgets required under the GSP Regulations §

357.4(b)(3)(B), presented below. The sustainable yield for the Upper Aquifer and Lower Aquifer developed at the Subbasin-level and agreed upon by all GSP Groups in the Delta-Mendota Subbasin is also presented along with a description as to how the sustainable yield for each primary aquifer was calculated.

4.3.1 Coordinated Assumptions

All common coordinated assumptions agreed upon and utilized by each GSP Group in preparing their respective historical, current, and projected water budgets are presented in Technical Memoranda 3 (*Assumptions for the Historical, Current, and Projected Water Budgets of the Delta-Mendota Subbasin*), which is included in **Appendix B** of this Common Chapter.

The data and methodologies used to develop the water budgets in the six individual GSPs (and compiled herein as the Subbasin Water Budgets) were coordinated with the express objective to "rely on the best available information and best available science to quantify the water budget for the basin" (Title 23 of the California Code of Regulations [23 CCR] § 354.18(e)). Given the complex nature of the Subbasin, different data sets and methodologies were appropriate for and/or available in different portions of the Subbasin. As such, a significant effort was made by the Subbasin GSAs to: (1) identify the different sources and accuracy of the available data; (2) consolidate these data and associated methodologies into a general hierarchy for use by the GSAs to honor the local conditions, while maintaining consistency with the intent of 23 CCR § 354.18(e); and (3) standardize the terminology for purposes of the Common Chapter presentation of the Subbasin Water Budget. These standardized water budget components and data sources are presented in Error! Reference source not found. and **Table CC-9** for the historic and current, and projected water budgets, respectively, and are further described below, while acknowledging that significant additional detail is presented in the six underlying GSPs. In some cases, data were not available or applicable, as acknowledged below and in the tables. Additionally, in some cases the specific terminology and/or the details of the calculations included in each underlying GSP remains unique relative to the standardized terminology and descriptions presented below; a full reconciliation of water budget nomenclature will be conducted as part of the 2025 GSP updates, as well as updates to the datasets and methodologies employed. Water use in the Subbasin is largely for agricultural purposes, with local municipal and industrial (M&I) uses. As appropriate, these M&I uses were quantified and incorporated in the individual GSP water budgets.

LAND SURFACE WATER BUDGET

The data sources/methodologies used to estimate the six major components of the Historical and Current Land Surface Water Budgets are summarized in **Table CC-8** and for the Projected Land Surface Water Budgets in **Table CC-9**. A general description of each component and the data hierarchy that was applied by the GSAs is provided below, with further detail provided in the Water Budget sections of the six underlying GSPs. For purposes of the Subbasin GSPs, the Historical and Current Water Budgets represent Water Year (WY) 2003-2013, where the historical period is WY 2003-2012 and the current year is WY 2013. The Projected Water Budgets reflect projected conditions through 2070[1] and consider the impacts

[1] The Subbasin GSAs agreed to use actual data from WYs 2014-2017 and assume a repeat of the historical hydrology for the years WY 2018-2070. The selected period for the projected water budgets meets SGMA requirements by establishing a 50-year period, where the timeframe is continuous between the historic, current, and projected water budgets. The historic hydrologic period for simulating the projected water budget hydrologic

of climate change and projects and management actions (PMAs). To the extent possible the data sources and methodology used were consistent with those identified by the California Department of Water Resources (DWR) in *Table 2 – Potential Data Sources to Support Water Budget Development* and other sections of the Best Management Practices (BMP) –4 - Water Budget.[1] As applicable and available, models and tools (e.g., the Central Valley Hydrologic Model 2 [CVHM2]) were used to support the local sources and assumptions incorporated into the development of the Subbasin Groundwater Water Budget.

(1) **Precipitation (Inflow).** For the Historical and Current Land Surface Water Budgets, total precipitation across the Subbasin was estimated using either: (1) PRISM: the Precipitation-Elevation Regressions on Independent Slopes Model (PRISM); (2) CIMIS: area-weighted data from the California Irrigation Management Information System (CIMIS) stations located in the Subbasin; California Data Exchange Center (CDEC) and/or (3) data from the National Water Service Station located in Los Banos, CA. Total precipitation was further parsed into effective and non-effective precipitation, as applicable to each GSP area, based on assumptions regarding deep percolation percentages and other losses.

For the Projected Land Surface Water Budgets, for WY 2014-2017, actual data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected WY 2018-2070 period, the 2030 Central Tendency and 2070 Central Tendency climate change factors and guidance provided by DWR were applied to the historical precipitation record to project the impact of climate change on precipitation across the Subbasin. For example, either (1) the Gridded Statewide Precipitation and Change Factors developed for the Water Storage Investment Program (WSIP) using the Variable Infiltration Capacity (VIC) Macroscale Hydrology Model (DWR, 2018) were applied to the available precipitation data sets for the Subbasin, or (2) recommendations from the *Perspectives and Guidance for Climate Change Analysis* document prepared by the DWR Climate Change Technical Advisory Group (CCTAG) were incorporated (DWR CCTAG, 2015).

(2) **Applied Water – Groundwater (Inflow).** To estimate the volume of applied groundwater for the Historical and Current Land Surface Water Budgets (including both agricultural and M&I pumping, as applicable to each GSP area), the total pumping within the Subbasin was estimated using the following hierarchy of sources, depending upon existing records: (1) Flow meters: volumetric flow meter records from pumping wells; (2) Power bills: electricity bills from pumping wells (wherein information related to the number of kilowatt-hours used was converted to a pumping volume based on assumptions related to pumping lift and efficiency); and/or (3) Consumptive use: reported crop acreages and consumptive use data based on either Irrigation Training and Research Center (ITRC)[2] Mapping of Evapotranspiration with Internal Calibration (METRIC) procedure or crop coefficient methodologies (e.g., those provided in the Food and Agricultural Organization of the United States (FAO) Irrigation and Drainage Paper No. 56

schema was chosen as WY 1979-2017, then wrapping around to include WY 1965-1978 hydrology. Actual data and hydrology were used for WY 2014- 2017 with the representative water years simulating WY 2018 and beyond (e.g., WY2018 is represented by the hydrology from WY1979; WY2019 is represented by the hydrology from WY1980, and so forth, with the caveat that 1979 would represent the fifth year of the projection and following sequentially the historical water year 1965 would represent the forty-fourth year of the projection).

[1] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

[2] California Polytechnic State University, San Luis Obispo

(FAO-56) (Snyder *et. al*., 2000, Snyder and Bali, 2008) or the ITRC Crop Coefficient data for Zone 14), corrected as applicable, for applied local and imported surface water. This volume of applied groundwater is consistent with the volume estimated under Water Budget Component (9) Extraction of the Groundwater Water Budget (see below).

For the Projected Land Surface Water Budgets, for WY 2014-2017, actual data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of applied groundwater was estimated using various, complementary methods, including: (1) as the difference between projected demand and the assumed volumes of precipitation, surface water deliveries, and tile drainage available to meet the demand, or (2) assuming future groundwater production rates would be equivalent to historical extractions for a given year type (e.g., future dry year production rates would be equivalent to average dry year production rates over the historical record). Climate change impacts and the effects of the planned projects and management actions (PMAs) are implicitly, rather than explicitly, accounted for (i.e., to the extent that climate change and PMAs increase or decrease the amount of water otherwise available to meet applied water demands, the volume of applied groundwater will be adjusted accordingly). Total inflow to Shasta Lake dictates the amount of imported surface water available for use in the Subbasin. The WSIP model was used to analyze the impacts of climate change on the Subbasin and anticipate projected inflow to Shasta Lake, and as to whether or not the water year would be classified as Shasta Critical under the Exchange Contract, the Refuge Contract, and by municipal users.

(3) **Surface Water Inflow (Inflow).** Surface water serves as an inflow to Subbasin water budget as both applied surface water and as seepage from streams and rivers. To estimate the volume of applied surface water for the Historical and Current Land Surface Water Budgets, the total diversions within the Subbasin over the historical and current water budget time periods were reported using the best available data for each source. Deliveries from the Central Valley Project (CVP), State Water Project (SWP), the San Joaquin River, and other local streams and rivers were compiled from records from the following sources, including, but not limited to: State Water Resources Control Board (SWRCB) diversion reports; United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records; CVP refuge water supply delivery data; and GSA member agency records.

To account for seepage of surface water into the Subbasin from streams and rivers for the Historical and Current Water Budgets, California Data Exchange Center (CDEC) data were used (i.e., by comparing the reductions in measured flow at successive gauging stations after accounting for other diversions) and/or from estimates of seepage losses from certain water bodies from prior water infiltration studies or modeling efforts, as described in the individual GSPs. Seepage from streams and rivers is counted either towards the Groundwater Water Budget directly or towards the Land Surface Water Budget and then, because of the lack of storage capacity in the land surface system and by way of mass balance principles, some or all of this water adds to the Groundwater Water Budget through Water Budget Component (6) Deep Percolation (see below).

For the Projected Land Surface Water Budgets, the volume of applied surface water was estimated as (1) the records of actual delivery data as available for the respective service areas for WY 2014-2017; and (2) estimates of anticipated future deliveries by WY type for WY 2018-2070, inclusive of climate change considerations to the extent they could be reasonably estimated (i.e., directly modeled based on data provided by DWR and the USBR), or using water year types as a proxy (i.e., future dry year deliveries would reflect historical average dry year deliveries over

the historical record). The impacts of planned PMAs on the availability of applied surface water volumes were also incorporated, as applicable.

For the Projected Land Surface Water Budgets, the volume of surface water seepage was adjusted, as applicable and available, based on climate change factors provided by DWR. Changes to surface water seepage were directly estimated as a result of PMAs or other program implementation (e.g., the impact on seepage resulting from the San Joaquin River Restoration Program [SJRRP] implemented by the USBR).

(4) **Surface Water Outflow (Outflow).** As described above, total precipitation was parsed into effective and non-effective precipitation (i.e., the latter being that portion of the total precipitation that cannot be used by the plants because it either runs off or percolates beyond the root zone). Similarly, a portion of the applied water can run off or deep percolate (typically termed "irrigation inefficiency"). Other surface water outflows (losses) from the Subbasin Land Surface Water Budget include agency-measured or estimated "spills" (i.e., outflow from tile drained fields, canal spills, field runoff, and precipitation runoff) and stream gauge readings, flow meter readings, and transfer pumping data. These collective data sets, sources, and methodologies were used to estimate the historical and current outflows from this component of the Subbasin Land Surface Water Budget.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of surface water outflows was estimated based on estimates provided by the GSA member agencies (using water year types as a proxy), while those components that may be impacted by climate change (e.g., runoff) were adjusted to reflect changes to precipitation and reference evapotranspiration (ETo). Changes to surface water outflows were directly estimated as a result of PMAs or other program implementation (e.g., water conservation programs to reduce spills) as information was available.

(5) **Evapotranspiration (Outflow).** The largest outflow for the Historical and Current Land Surface Water Budget is evapotranspiration (consumptive use) by crops. As such, a combination of CIMIs ETo data, crop acreage, and crop coefficient data and methodologies (e.g., ITRC data and methodologies) were utilized to estimate the consumptive use, including municipal uses, of water in the Subbasin. In addition, direct evaporation from surface water bodies and phreatophytes (i.e., groundwater dependent ecosystems [GDEs]) was estimated based on the surface area and time period it was wetted.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the actual data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the 2030 Central Tendency and 2070 Central Tendency climate change factors or guidance provided by DWR were applied to the historical ETo record to project the impact of climate change on ETo across the Subbasin. For example, either the Gridded Statewide Precipitation and Change Factors developed for the WSIP using the VIC Macroscale Hydrology Model (DWR, 2018) were applied to the available ETo data sets for the Subbasin, or (2) recommendations from the *Perspectives and Guidance for Climate Change Analysis* document prepared by the DWR CCTAG (2015) were incorporated.

(6) **Deep Percolation (Outflow).** For the Historical, Current, and Projected Land Surface Water Budgets, this water budget component is estimated as the sum of the other Outflow components (Water Budget Components 4 and 5) of the Land Surface Water Budget subtracted from the sum of the Inflow components (Water Budget Components 1 through 3) and represents the total

volume of water that seeps past the root zone and into the Subbasin aquifer(s). This includes applied water seepage, as well as stream seepage (from the San Joaquin River, Delta-Mendota Canal, and California Aqueduct, and other canals), and delivery losses. To the extent that climate change and PMA implementation affects the volumes of Water Budget Components 1 through 5, these impacts are reflected in the resultant Outflow component, Water Budget Component (6) Deep Percolation, which serves as the inflow component, and Water Budget Component (7) Deep Percolation to the Groundwater Water Budget (see below).

GROUNDWATER WATER BUDGET

The data sources/methodologies used to estimate the Historical and Current Groundwater Water Budgets are summarized in **Table CC-8** and for the Projected Groundwater Water Budgets in **Table CC-9**. A general description of each component and the data hierarchy that was applied by the GSAs is provided below, with further detail provided in the Water Budget sections of the six underlying GSPs. The time periods for the Groundwater Water Budgets are consistent with those used for the Land Surface Water Budgets, and likewise, to the extent possible, the data sources and methodology used were consistent with those identified by DWR in *Table 2 – Potential Data Sources to Support Water Budget Development* and other sections of the BMP –4 - Water Budget.[1] As identified in **Table CC-8** and **Table CC-9**, significant data gaps were identified in several of the GSPs on key aspects of the Groundwater Water Budget; additional efforts are on-going to address those data gaps and refine the water budgets as part of the 2025 GSP update. As applicable and available, models and tools (e.g., CVHM2, Westside Subbasin Groundwater Model, and a numerical flow model for the Farmers Water District and Fresno County areas) were used to validate the local sources and support assumptions used to develop the Subbasin Groundwater Water Budget.

(7) **Deep Percolation (Inflow).** In all instances, this component of the Groundwater Water Budget is directly linked to the Water Budget Component (6) Deep Percolation of the Land Surface Water Budget. To the extent that climate change is factored into the Historical, Current, and Projected Land Surface Water Budgets, those impacts are reflected in the varying volumes of deep percolation that are assumed to recharge the aquifer system(s) via infiltration.

(8) **Lateral Subsurface Flow (Inflow).** For the Historical and Current Groundwater Water Budgets, this component is estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

8A. Upper Aquifer. For the Upper Aquifer, lateral inflows were generally estimated using Darcy's equation[2] and estimated aquifer characteristics, or a groundwater flow model, as available. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while observed or simulated water level maps for wet, normal, and dry water year types and hydrographs were prepared to determine the elevation and direction of groundwater flow between GSP areas within the Subbasin and across Subbasin boundaries. Mountain front recharge

[1] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

[2] Darcy's equation in which groundwater flow velocity is identified as a function of the aquifer hydraulic conductivity and hydraulic gradient based upon measured water levels and aquifer properties. Freeze, R.A. and Cherry, J.A. 1979. Groundwater. Prentice Hall, Inc. Englewood Cliffs, NJ. p 16.

from the Coastal Range was also assumed to provide an additional source of inflow to the Upper Aquifer.

8B. Lower Aquifer. To the extent possible, lateral inflows to the Lower Aquifer were estimated, primarily using Darcy's equation and estimated aquifer characteristics, and coarse assumptions regarding contributions of other sources of inflow, or via a groundwater flow model, as available. However, this portion of the Groundwater Budget was acknowledged as a significant data gap, which the GSAs are working to address through the collection of additional data, etc.

In instances where there was significant downward flow between the Upper and Lower Aquifers, vertical flow was estimated using Darcy's equation, estimated aquifer characteristics, and groundwater gradients. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while water level maps for wet, normal, and dry water year types were prepared to determine the elevation and groundwater gradient. Furthermore, flow to the Lower Aquifer from the Upper Aquifer is acknowledged as a data gap.

Projected Groundwater Water Budget. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, this component is generally estimated using historical inflows by water year type as a proxy (i.e., the underflows used in the Historical and Current Water Budgets were averaged by WY type and used throughout the Projected Water Budget period). Impacts of climate change are implicitly incorporated, and expected increases in inflows as a result of PMAs (including projected groundwater banking activities) are directly incorporated to the extent the information was provided by the GSAs. As additional data are obtained during implementation of the GSPs, the inputs will be updated and improved to revise the Projected Groundwater Water Budget.

(9) **Extraction (Outflow).** Consistent with the methodology used to estimate Water Budget Component (2), Applied Groundwater, of the Historical and Current Land Surface Water Budgets, the total pumping from the Subbasin aquifers was estimated using the following hierarchy of sources depending upon available records: (1) Flow meters: Volumetric flow meter records from pumping wells; (2) Power bills: Electricity bills from pumping wells (wherein information related to the number of kilowatt-hours used was converted to a pumping volume based on assumptions related to pumping lift and efficiency and duration of operation); and/or (3) Consumptive use: crop acreages and consumptive use data based on either ITRC-METRIC or crop coefficient methodologies. While the exact distribution of pumping from the Upper and Lower Aquifers is acknowledged as a data gap, total extractions were assumed to be partitioned between the aquifers, with the majority of extractions (80-90%) occurring in the Upper Aquifer. Information regarding well construction obtained and compiled from the local and Subbasin Well Census and Inventory projects completed by the GSAs in 2022 will be used to further improve the estimated allocation of groundwater extraction between the aquifers in the 2025 GSP update.

For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of pumped groundwater was estimated using various, complimentary methods, including (1) as the difference between projected demand and the assumed volumes of precipitation, surface water deliveries, and tile drainage available to meet the demand, or (2) assuming future groundwater production would be equivalent to historical extractions for a given year type (e.g., future dry year production rates would be equivalent to average dry year production rates over the historical record, with the exception of M&I pumping which was projected based on information provided in various source documents such as Urban

Water Management Plans). Climate change impacts and the effect of the planned PMAs are implicitly, rather than explicitly, accounted for.

(10) **Lateral Subsurface Flow (Outflow).** For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin, but similarly to Water Budget Component (8) of the Groundwater Water Budget.

10A. Upper Aquifer. Lateral outflows were generally estimated using Darcy's equation and estimated aquifer characteristics, and validated by a groundwater flow model, as available. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while observed or simulated water level maps for wet, normal, and dry water year types and hydrographs were prepared to determine the elevation and direction of groundwater flow between GSP areas within the Subbasin and across Subbasin boundaries.

10B. Lower Aquifer. To the extent possible, lateral outflows from the Lower Aquifer were estimated, primarily using Darcy's equation and estimated aquifer characteristics, and validated by a groundwater flow model, as available. However, this portion of the Groundwater Water Budget was acknowledged as a significant data gap which the GSAs are working to address through the collection and evaluation of additional data, etc.

Projected Groundwater Water Budget. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, this component is generally estimated using historical outflows by water year type as a proxy (i.e., the underflows used in the Historical and Current Water Budgets were averaged by WY type and used throughout the Projected Water Budget period). Impacts of climate change are implicitly incorporated, and expected increases in outflows as a result of PMAs (including projected groundwater banking activities) are directly incorporated to the extent the information was provided by the GSAs.

(11) **Change in Storage.** For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

11A. Upper Aquifer. A sum of the Outflow components (Water Budget Components 9 through 10) of the Groundwater Water Budget was subtracted from the Inflow components (Water Budget Components 7 and 8) to assess the change in storage. These estimates were also compared in some of the GSPs to the available hydrographs, water level contour maps, and assumed aquifer storativity values from local data sets and models to assess and confirm change in storage, and assumed consumptive use data.

11B. Lower Aquifer. Approaches varied among the GSPs given the limited available data, which the GSAs are working to address through the collection of additional data, etc. Change in storage was estimated using measured subsidence as a proxy (i.e., due to compaction caused by inelastic land subsidence), as the difference between inflows and outflows based on modeled results, or as an assumed proportion of overall groundwater change in storage. These estimates were also compared in some of the GSPs to the available hydrographs, water level contour maps, and assumed aquifer storativity values from local data sets and models to assess and confirm change in storage, and assumed consumptive use data.

Projected Groundwater Water Budgets. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the change in storage volumes used in the Historical and Current Water Budgets were averaged by water year type and used throughout the projected water budget period, or were calculated as the difference between inflows and outflows.

Table CC-8: Historical and Current Water Budgets Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) and California Irrigation Management Information System (CIMIS)	PRISM		PRISM and CIMIS	PRISM and CIMIS	CIMIS and National Weather Service (NWS)
Land Surface	Inflow	Applied Wat–r - Groundwater	Consumptive use	Flow meters	Flow meters, power bills, and consumptive use	Flow meters and consumptive use		Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports; landowner records	San Joaquin River inflows	United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records	Central Valley Project (CVP) refuge water supply delivery data	USBR CVO and SWRCB diversion reports	USBR CVO; California Data Exchange Center (CDEC) where available, water infiltration study used otherwise
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation	Transfer pumping and San Joaquin River outflows	Transfer pumping that exceeds applied groundwater	Non-effective precipitation and agency measured spills	Evapotranspiration and non-effective precipitation)	Non-effective precipitation and flow meter readings
Land Surface	Outflow	Evapotranspiration	Vegetation coefficients and CIMIS					
Land Surface	Outflow	Deep Percolation	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Infiltration	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities)					
Groundwater	Inflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities)			Data G–p - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities)
Groundwater	Outflow	Extraction - Upper Aquifer	Consumptive use and irrigation efficiency	Flow meters	Flow meters, power bills and consumptive use	Flow meters and consumptive use		Flow meters
Groundwater	Outflow	Extraction - Lower Aquifer	Unused - Data Gap	Flow meters	Flow meters, power bills and consumptive use	Flow meters and consumptive use		Assumed 10% of total pumping
Groundwater	Outflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities)					
Groundwater	Outflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities)				
Groundwater	Change in Storage	Upper Aquifer	Inflow - Outflow					
Groundwater	Change in Storage	Lower Aquifer	Land subsidence as proxy	Inflow - Outflow		Land subsidence as proxy		

Table CC-9: Projected Water Budgets Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM), applying climate change factors (CCF)			PRISM and California Irrigation Management Information System (CIMIS), applying CCF		CIMIS and National Weather Service (NWS), applying CCF
Land Surface	Inflow	Applied Wat–r - Groundwater	Consumptive use			Flow meters and consumptive use		Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports, using water year (WY) types as a proxy	San Joaquin River inflows (CDEC and United States Geological Survey [USGS])	Mendota Pool inflows - USBR CVO	USBR CVO and SWRCB diversion reports, using WY types as a proxy		USBR CVO; California Data Exchange Center (CDEC) where available, using WY types as a proxy; Water infiltration study used otherwise
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	San Joaquin River outflows (CDEC and USGS)	Mendota Pool outflows (USBR CVO)	Non-effective precipitation and agency measured spills calculated with CCF and WY types as a proxy for quantity	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	Non-effective precipitation and agency measured spills calculated with CCF and WY types as a proxy for quantity
Land Surface	Outflow	Evapotranspiration	Vegetation coefficients and CIMIS (calculated with CCFs and WY types as a proxy)					
Land Surface	Outflow	Deep Percolation	Land Surface Inflow - Outflow					
Groundwater	Inflow	Infiltration	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy					
Groundwater	Inflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy			Data Gap - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy
Groundwater	Outflow	Extraction - Upper Aquifer	Consumptive use and irrigation efficiency using WY type as a proxy with CCFs and PMAs	Adjusted historic metered data using WY type as a proxy with CCFs and PMAs		Adjusted historic metered data and consumptive use using WY type as a proxy with CCFs and PMAs		
Groundwater	Outflow	Extraction - Lower Aquifer	Unused - Data Gap	Not Applicable		Unused - Data Gap	Adjusted historic metered data and consumptive use using WY type as a proxy with CCFs and PMAs	
Groundwater	Outflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy with CCFs					
Groundwater	Outflow	Lateral subsurface flow - Lower Aquifer	Unused – Data Gap	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy with CCFs			Data Gap - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities) with CCFs
Groundwater	Change in Storage	Upper Aquifer	Inflow - Outflow					
Groundwater	Change in Storage	Lower Aquifer	Unused – Data Gap	Inflow - Outflow		Projected land subsidence and WY types used as a proxy with CCFs and PMAs	Inflow - Outflow	Projected land subsidence and WY types used as proxy with CCFs and PMAs

4.3.2 GSP-Level Water Budgets

Individual historical, current, and projected water budgets were developed by each GSP Group for their respective Plan Area. For more information on the development of those water budgets, as well as tabular and graphical representation of the results, refer to the respective sections of the individual GSPs.

All historical, current, and projected water budgets developed within the Delta-Mendota Subbasin are consistent with GSP Regulations §354.18 Water Budget, and DWR's *Best Management Practices for the Sustainable Management of Groundwater Water Budget BMP* (2016c) document was used when and where applicable at the discretion of each GSP Group.

4.3.3 Coordinated Water Budgets

The land surface budget, groundwater budget, and annual change in storage for the historical water budget, current water budget, and projected water budget with climate change factors (CCFs) and projects and management actions for the Delta-Mendota Subbasin were developed by compiling the water budgets prepared by each of GSP Group. The land surface budget is an accounting of water flows into and out of the land surface above an aquifer within with Delta-Mendota Subbasin, where inflows and outflows include flow between GSP Groups and neighboring subbasins, the atmosphere, and the groundwater aquifer below. The groundwater budget is an accounting of groundwater flows into and out of the two principal groundwater aquifers (Upper Aquifer and Lower Aquifer) within the Delta-Mendota Subbasin, where inflows and outflows include flow between GSP Groups and neighboring subbasins as well as the above land surface.

Subsequent to the submittal of the Delta-Mendota GSP in January 2022, and in response to the Consultation Initiation Letter (CIL) received from DWR on January 21, 2022 in which DWR stated that, while the same data may have been used in developing the water budgets, the terminology used to describe those data sets were not consistent across the basin, the Delta-Mendota Subbasin GSAs acknowledge additional detail was needed to demonstrate that all water budget components across the six Subbasin GSPs utilize the same data and methodologies. As such, subsequent to receipt of the CIL, the Technical Working Group and Coordination Committee met to identify the specific data used and to develop a consistent terminology for the various water budget components. Additionally, the Technical Working Group attempted to simplify the presentation of the Subbasin water budgets through a reduction in the number of water budget components. The mapping of the original GSP water budget components into the revised simplified coordinated water budget component terminology is discussed in the prior section (Section 4.3.1 of this revised Common Chapter).

After agreeing to the set of common simplified definitions for water budget components, the six Delta-Mendota GSP groups mapped their prior water budget components to the new common definitions. The revised land surface budget and groundwater budget are presented respectively for the historical water budget in **Table CC-10** and **Table CC-11,** for the current water budget in **Table CC-12** and **Table CC-13**, and for the projected water budget with climate change factors and projects and management actions in **Table CC-14** and **Table CC-15**. All categories presented in the land surface budget and groundwater budget tables were agreed upon by all Delta-Mendota GSP Groups, with representatives from each GSP group tasked with filling out these budget tables as appropriate to account for the unique hydrology, land use, and water use within their respective GSP regions. The tables below are simply compilations of the individual GSP water budget data as provided by their respective plan preparers, and no water budget data were modified during the mapping process.

Individual GSAs and agencies in the Delta-Mendota Subbasin understand that the historical, current, and projected water budgets were completed using best available science and data, and efforts were made to use the same data sources throughout the Subbasin where available, though due to variability in data availability throughout the Subbasin, the best available data were used and characterized appropriately. Where data gaps exist, the individual GSAs and agencies intend to conduct the work necessary to substantiate or improve the estimates and assumptions developed for determining their water budgets. Nothing in this part, or in any groundwater sustainability plan adopted pursuant to this part, determines, or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights.

Figure CC-64 shows the revised average annual and cumulative change in storage in both principal aquifers under the Subbasin projected water budget (including application of climate change factors and the addition of projects and management actions).

Table CC-10: Delta-Mendota Subbasin Historical Water Budget, Land Surface Budget

Land Surface Budget									
Water Year	Water Year Type	Inflows				Outflows			
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflows	**Total Inflows**	Surface Water Outflows	Evapotranspiration	Deep Percolation	**Total Outflows**
2003	N	450,000	395,000	2,501,000	**3,346,000**	1,306,000	1,772,000	293,000	**3,371,000**
2004	D	412,000	417,000	2,433,000	**3,262,000**	1,206,000	1,760,000	315,000	**3,281,000**
2005	W	739,000	303,000	2,764,000	**3,806,000**	1,614,000	1,810,000	352,000	**3,776,000**
2006	W	571,000	293,000	3,311,000	**4,175,000**	2,111,000	1,804,000	296,000	**4,211,000**
2007	D	258,000	474,000	2,485,000	**3,217,000**	1,230,000	1,701,000	310,000	**3,241,000**
2008	D	328,000	527,000	2,295,000	**3,150,000**	1,140,000	1,769,000	331,000	**3,240,000**
2009	N	304,000	511,000	2,191,000	**3,006,000**	1,017,000	1,813,000	327,000	**3,157,000**
2010	N	539,000	380,000	2,637,000	**3,556,000**	1,515,000	1,655,000	406,000	**3,576,000**
2011	W	626,000	279,000	3,283,000	**4,188,000**	2,013,000	1,799,000	414,000	**4,226,000**
2012	D	275,000	470,000	2,582,000	**3,327,000**	1,301,000	1,679,000	355,000	**3,335,000**

Table CC-11: Delta-Mendota Subbasin Historical Water Budget, Groundwater Budget

Groundwater Budget												
Water Year	Water Year Type	Inflows				Outflows					Change in Storage		
		Infiltration	Lateral Subsurface Flow		**Total Inflows**	Groundwater Extraction		Lateral Subsurface Flow		**Total Outflows**	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Total*
2003	N	324,000	196,000	117,000	**637,000**	357,000	39,000	260,000	106,000	**762,000**	17,000	5,000	22,000
2004	D	345,000	180,000	114,000	**639,000**	376,000	42,000	286,000	132,000	**836,000**	(180,000)	(48,000)	(228,000)
2005	W	424,000	223,000	128,000	**775,000**	268,000	36,000	269,000	78,000	**651,000**	223,000	14,000	237,000
2006	W	394,000	203,000	120,000	**717,000**	260,000	34,000	264,000	75,000	**633,000**	18,000	(23,000)	(5,000)
2007	D	358,000	161,000	99,000	**618,000**	431,000	48,000	280,000	130,000	**889,000**	(282,000)	(67,000)	(349,000)
2008	D	371,000	169,000	106,000	**646,000**	481,000	55,000	293,000	141,000	**970,000**	(341,000)	(80,000)	(421,000)
2009	N	361,000	195,000	112,000	**668,000**	466,000	53,000	273,000	117,000	**909,000**	(134,000)	(28,000)	(162,000)
2010	N	470,000	211,000	124,000	**805,000**	350,000	39,000	264,000	116,000	**769,000**	180,000	(4,000)	176,000
2011	W	515,000	205,000	124,000	**844,000**	248,000	32,000	277,000	83,000	**640,000**	125,000	(23,000)	102,000
2012	D	417,000	168,000	107,000	**692,000**	432,000	45,000	288,000	141,000	**906,000**	(171,000)	(62,000)	(233,000)

Table CC-12: Delta-Mendota Subbasin Current Water Budget, Land Surface Budget

Land Surface Budget									
Water Year	**Water Year Type**	**Inflows**				**Outflows**			
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflows	**Total Inflows**	Surface Water Outflows	Evapotranspiration	Deep Percolation	**Total Outflows**
2013	D	318,000	521,000	2,597,000	**3,436,000**	1,386,000	1,671,000	402,000	**3,459,000**

Table CC-13: Delta-Mendota Subbasin Current Water Budget, Groundwater System

Groundwater Budget												
Water Year	**Water Year Type**	**Inflows**				**Outflows**					**Change in Storage**		
		Infiltration	Lateral Subsurface Flow		**Total Inflows**	Groundwater Extraction		Lateral Subsurface Flow		**Total Outflows**	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Total*
2013	D	467,000	173,000	112,000	**752,000**	477,000	51,000	278,000	136,000	**942,000**	(128,000)	(55,000)	(183,000)

Table CC-14: Delta-Mendota Subbasin Projected Water Budget, Land Surface Budget (containing climate change factors and projects and management actions)

Land Surface Budget																
		Inflows							Outflows							
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflow	Applied Wat–r - Groundwater (Project Effect–) - NCDM Only	Applied Wat–r - Imported Surface Water (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Inflows**	Surface Water Outflow	Evapotranspiration	Crop Evapotranspiration - Aliso Only	Canal/Reservoir Evaporation - Aliso Only	Deep Percolation	Runoff (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Outflows**
2014	SC	283,000	601,000	1,725,000	0	0	1,000	**2,610,000**	852,000	1,616,000	0	0	230,000	0	0	**2,698,000**
2015	SC	363,000	650,000	1,247,000	0	0	0	**2,260,000**	479,000	1,528,000	0	0	287,000	0	0	**2,294,000**
2016	D	712,000	392,000	1,605,000	0	0	0	**2,709,000**	631,000	1,618,000	0	0	403,000	0	0	**2,652,000**
2017	W	686,000	303,000	3,651,000	0	0	6,000	**4,646,000**	2,423,000	1,773,000	0	0	445,000	0	0	**4,641,000**
2018	N	527,000	389,000	2,628,000	(6,000)	0	7,000	**3,545,000**	1,506,000	1,660,000	0	0	403,000	0	0	**3,569,000**
2019	W	712,000	266,000	3,162,000	(7,000)	2,000	6,000	**4,141,000**	1,975,000	1,810,000	0	0	368,000	0	0	**4,153,000**
2020	D	434,000	394,000	2,187,000	(6,000)	9,000	7,000	**3,025,000**	939,000	1,726,000	0	0	343,000	0	0	**3,008,000**
2021	W	808,000	261,000	3,261,000	(7,000)	7,000	6,000	**4,336,000**	2,025,000	1,821,000	0	0	403,000	0	0	**4,249,000**
2022	W	1,021,000	249,000	3,266,000	(7,000)	7,000	6,000	**4,542,000**	2,190,000	1,834,000	0	0	449,000	0	0	**4,473,000**
2023	N	580,000	389,000	2,658,000	(8,000)	6,000	7,000	**3,632,000**	1,470,000	1,711,000	0	0	403,000	0	0	**3,584,000**
2024	D	573,000	387,000	2,176,000	(3,000)	6,000	6,000	**3,145,000**	963,000	1,726,000	0	0	374,000	0	0	**3,063,000**
2025	W	884,000	261,000	3,256,000	(7,000)	7,000	6,000	**4,407,000**	1,993,000	1,847,000	0	0	424,000	0	0	**4,264,000**
2026	D	575,000	483,000	2,098,000	(43,000)	52,000	9,000	**3,174,000**	914,000	1,785,000	0	0	412,000	0	0	**3,111,000**
2027	D	653,000	481,000	2,078,000	(41,000)	49,000	9,000	**3,229,000**	914,000	1,766,000	0	0	419,000	0	0	**3,099,000**
2028	D	534,000	484,000	2,115,000	(42,000)	50,000	9,000	**3,150,000**	934,000	1,789,000	0	0	353,000	0	0	**3,076,000**
2029	D	462,000	484,000	2,099,000	(46,000)	55,000	9,000	**3,063,000**	910,000	1,744,000	0	0	356,000	0	0	**3,010,000**
2030	SC	417,000	575,000	1,800,000	(47,000)	49,000	3,000	**2,797,000**	833,000	1,624,000	0	0	363,000	0	0	**2,820,000**
2031	SC	492,000	573,000	1,780,000	(48,000)	51,000	2,000	**2,850,000**	815,000	1,633,000	0	0	406,000	0	0	**2,854,000**
2032	W	832,000	269,000	3,250,000	(31,000)	46,000	6,000	**4,372,000**	1,963,000	1,830,000	0	0	490,000	1,000	0	**4,284,000**
2033	D	466,000	490,000	2,001,000	(46,000)	60,000	10,000	**2,981,000**	869,000	1,741,000	0	0	364,000	1,000	0	**2,975,000**
2034	W	851,000	252,000	3,258,000	(29,000)	47,000	7,000	**4,386,000**	2,003,000	1,791,000	0	0	465,000	1,000	0	**4,260,000**
2035	W	731,000	280,000	3,163,000	(32,000)	48,000	7,000	**4,197,000**	1,969,000	1,849,000	0	0	422,000	1,000	0	**4,241,000**
2036	W	774,000	316,000	3,268,000	(31,000)	50,000	7,000	**4,384,000**	2,052,000	1,867,000	0	0	494,000	1,000	0	**4,414,000**
2037	W	1,194,000	252,000	3,274,000	(28,000)	49,000	7,000	**4,748,000**	2,254,000	1,780,000	0	0	607,000	1,000	0	**4,642,000**
2038	N	448,000	431,000	2,689,000	(47,000)	53,000	10,000	**3,584,000**	1,529,000	1,660,000	0	0	381,000	0	0	**3,570,000**
2039	N	488,000	446,000	2,655,000	(46,000)	52,000	10,000	**3,605,000**	1,487,000	1,698,000	0	0	411,000	0	0	**3,596,000**
2040	D	534,000	423,000	2,200,000	(46,000)	66,000	9,000	**3,186,000**	1,001,000	1,712,000	0	0	411,000	1,000	0	**3,125,000**
2041	D	384,000	437,000	2,139,000	(52,000)	62,000	9,000	**2,979,000**	879,000	1,704,000	0	0	374,000	1,000	0	**2,958,000**
2042	N	530,000	469,000	2,730,000	(46,000)	51,000	10,000	**3,744,000**	1,532,000	1,795,000	0	0	400,000	0	0	**3,727,000**

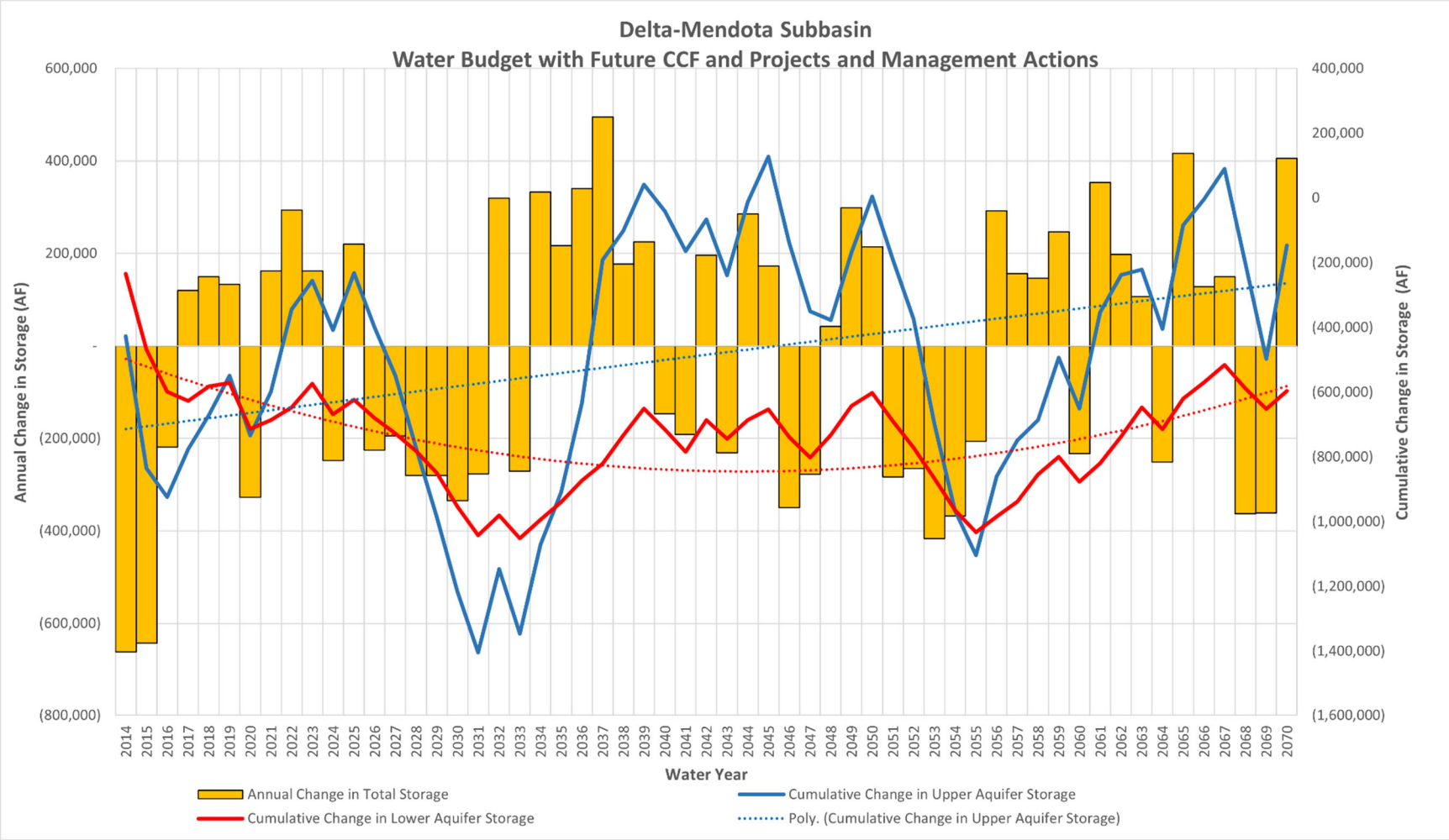
Land Surface Budget																
		Inflows							Outflows							
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflow	Applied Wat–r - Groundwater (Project Effect–) - NCDM Only	Applied Wat–r - Imported Surface Water (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Inflows**	Surface Water Outflow	Evapotranspiration	Crop Evapotranspiration - Aliso Only	Canal/Reservoir Evaporation - Aliso Only	Deep Percolation	Runoff (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Outflows**
2043	D	488,000	437,000	2,101,000	(48,000)	68,000	11,000	**3,057,000**	884,000	1,797,000	0	0	331,000	1,000	0	**3,013,000**
2044	W	875,000	286,000	3,231,000	(37,000)	53,000	11,000	**4,419,000**	2,141,000	1,831,000	0	0	419,000	1,000	0	**4,392,000**
2045	W	622,000	313,000	3,263,000	(45,000)	53,000	12,000	**4,218,000**	1,971,000	1,847,000	0	0	355,000	1,000	0	**4,174,000**
2046	D	268,000	571,000	2,149,000	(57,000)	68,000	12,000	**3,011,000**	893,000	1,794,000	0	0	346,000	1,000	0	**3,034,000**
2047	D	402,000	575,000	2,067,000	(55,000)	64,000	12,000	**3,065,000**	834,000	1,820,000	0	0	383,000	0	0	**3,037,000**
2048	N	331,000	593,000	2,696,000	(49,000)	49,000	12,000	**3,632,000**	1,457,000	1,893,000	0	0	358,000	0	0	**3,708,000**
2049	N	658,000	407,000	2,683,000	(29,000)	62,000	12,000	**3,793,000**	1,525,000	1,706,000	0	0	474,000	2,000	0	**3,707,000**
2050	W	708,000	316,000	3,145,000	(40,000)	54,000	13,000	**4,196,000**	1,974,000	1,878,000	0	0	376,000	1,000	0	**4,229,000**
2051	D	350,000	447,000	2,110,000	(51,000)	69,000	13,000	**2,938,000**	858,000	1,738,000	0	0	302,000	1,000	0	**2,899,000**
2052	D	390,000	553,000	2,103,000	(46,000)	67,000	14,000	**3,081,000**	873,000	1,727,000	0	0	416,000	1,000	0	**3,017,000**
2053	SC	306,000	634,000	1,765,000	(44,000)	47,000	8,000	**2,716,000**	801,000	1,699,000	0	0	304,000	0	0	**2,804,000**
2054	SC	340,000	632,000	1,678,000	(29,000)	34,000	7,000	**2,662,000**	750,000	1,657,000	0	0	354,000	0	0	**2,761,000**
2055	D	630,000	453,000	1,831,000	(39,000)	49,000	14,000	**2,938,000**	855,000	1,742,000	0	0	385,000	1,000	0	**2,983,000**
2056	W	745,000	351,000	3,073,000	(44,000)	46,000	12,000	**4,183,000**	1,935,000	1,894,000	0	0	450,000	0	0	**4,279,000**
2057	W	693,000	313,000	3,150,000	(34,000)	55,000	12,000	**4,189,000**	1,932,000	1,893,000	0	0	401,000	1,000	0	**4,227,000**
2058	N	478,000	547,000	2,688,000	(49,000)	54,000	15,000	**3,733,000**	1,417,000	1,871,000	0	0	446,000	0	0	**3,734,000**
2059	W	739,000	309,000	3,154,000	(33,000)	55,000	13,000	**4,237,000**	1,941,000	1,888,000	0	0	425,000	1,000	0	**4,255,000**
2060	D	405,000	441,000	2,111,000	(52,000)	69,000	15,000	**2,989,000**	847,000	1,786,000	0	0	360,000	1,000	0	**2,994,000**
2061	W	910,000	300,000	3,276,000	(33,000)	55,000	13,000	**4,521,000**	2,106,000	1,896,000	0	0	512,000	1,000	0	**4,515,000**
2062	N	466,000	459,000	2,687,000	(50,000)	58,000	16,000	**3,636,000**	1,482,000	1,757,000	0	0	420,000	0	0	**3,659,000**
2063	N	477,000	544,000	2,674,000	(49,000)	54,000	16,000	**3,716,000**	1,454,000	1,861,000	0	0	397,000	0	0	**3,712,000**
2064	D	338,000	447,000	2,123,000	(49,000)	70,000	16,000	**2,945,000**	818,000	1,780,000	0	0	341,000	1,000	0	**2,940,000**
2065	N	725,000	443,000	2,688,000	(47,000)	58,000	17,000	**3,884,000**	1,502,000	1,739,000	0	0	573,000	1,000	0	**3,815,000**
2066	W	668,000	323,000	3,153,000	(34,000)	55,000	15,000	**4,180,000**	1,929,000	1,897,000	0	0	383,000	1,000	0	**4,210,000**
2067	W	690,000	321,000	3,262,000	(33,000)	55,000	15,000	**4,310,000**	1,942,000	1,898,000	0	0	394,000	1,000	0	**4,235,000**
2068	D	448,000	558,000	1,859,000	(52,000)	69,000	12,000	**2,894,000**	872,000	1,695,000	0	0	327,000	1,000	0	**2,895,000**
2069	D	382,000	561,000	1,824,000	(50,000)	66,000	12,000	**2,795,000**	788,000	1,688,000	0	0	328,000	1,000	0	**2,805,000**
2070	W	962,000	302,000	3,388,000	(34,000)	55,000	16,000	**4,689,000**	2,130,000	1,887,000	0	0	557,000	1,000	0	**4,575,000**

Table CC-15: Delta-Mendota Subbasin Projected Water Budget, Groundwater Budget
(containing climate change factors and projects and management actions)

Groundwater Budget																			
		Inflows							Outflows							Change in Storage		
		Infiltration	Lateral Subsurface Flow		Seepage Through Corcoran Clay - SJREC Only	Applied Water Infiltration (Project Effects) - NCDM Only	Deep Percolation (Project Effects) - NCDM Only	Project Effects	**Total Inflows**	Groundwater Extraction		Lateral Subsurface Flow		Flow to Lower Aquifer - Grassland Only	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow - Grassland Only	**Total Outflows**	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*						*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*				*Upper Aquifer*	*Lower Aquifer*	*Total*
2014	SC	275,000	162,000	115,000	0	0	0	0	**552,000**	513,000	101,000	321,000	191,000	0	0	**1,126,000**	(428,000)	(234,000)	(662,000)
2015	SC	333,000	154,000	113,000	0	0	0	0	**600,000**	558,000	101,000	325,000	202,000	0	0	**1,186,000**	(408,000)	(234,000)	(642,000)
2016	D	487,000	152,000	112,000	0	0	0	0	**751,000**	354,000	60,000	313,000	156,000	0	0	**883,000**	(89,000)	(130,000)	(219,000)
2017	W	525,000	198,000	128,000	0	0	0	10,000	**861,000**	254,000	50,000	307,000	91,000	0	0	**702,000**	148,000	(28,000)	120,000
2018	N	465,000	190,000	115,000	0	0	0	0	**770,000**	347,000	59,000	264,000	101,000	0	0	**771,000**	105,000	44,000	149,000
2019	W	461,000	216,000	124,000	0	0	0	10,000	**811,000**	231,000	38,000	279,000	74,000	0	0	**622,000**	122,000	11,000	133,000
2020	D	385,000	153,000	106,000	0	0	3,000	0	**647,000**	354,000	57,000	298,000	136,000	0	0	**845,000**	(185,000)	(142,000)	(327,000)
2021	W	464,000	218,000	125,000	0	0	10,000	0	**817,000**	224,000	39,000	280,000	72,000	0	0	**615,000**	135,000	27,000	162,000
2022	W	553,000	218,000	125,000	0	0	10,000	10,000	**916,000**	214,000	37,000	276,000	77,000	0	0	**604,000**	254,000	40,000	294,000
2023	N	449,000	186,000	117,000	0	0	3,000	0	**755,000**	348,000	55,000	264,000	111,000	0	0	**778,000**	89,000	74,000	163,000
2024	D	417,000	151,000	108,000	0	0	3,000	0	**679,000**	349,000	58,000	301,000	134,000	0	0	**842,000**	(153,000)	(94,000)	(247,000)
2025	W	493,000	214,000	125,000	0	0	10,000	10,000	**852,000**	227,000	38,000	278,000	73,000	0	0	**616,000**	176,000	44,000	220,000
2026	D	451,000	152,000	107,000	0	0	6,000	0	**716,000**	413,000	51,000	302,000	137,000	0	0	**903,000**	(169,000)	(56,000)	(225,000)
2027	D	470,000	152,000	106,000	0	0	9,000	0	**737,000**	411,000	52,000	303,000	131,000	0	0	**897,000**	(148,000)	(47,000)	(195,000)
2028	D	390,000	153,000	104,000	0	0	9,000	0	**656,000**	414,000	51,000	304,000	130,000	0	0	**899,000**	(225,000)	(55,000)	(280,000)
2029	D	395,000	154,000	103,000	0	0	10,000	0	**662,000**	410,000	51,000	303,000	129,000	0	0	**893,000**	(213,000)	(67,000)	(280,000)
2030	SC	400,000	159,000	97,000	0	0	9,000	0	**665,000**	454,000	84,000	312,000	127,000	0	0	**977,000**	(230,000)	(104,000)	(334,000)
2031	SC	442,000	158,000	97,000	0	0	9,000	0	**706,000**	453,000	82,000	313,000	118,000	0	0	**966,000**	(188,000)	(89,000)	(277,000)
2032	W	545,000	220,000	115,000	0	0	22,000	0	**902,000**	213,000	35,000	279,000	68,000	0	0	**595,000**	258,000	61,000	319,000
2033	D	400,000	157,000	98,000	0	0	10,000	0	**665,000**	402,000	50,000	308,000	133,000	0	0	**893,000**	(201,000)	(70,000)	(271,000)
2034	W	547,000	220,000	118,000	0	0	22,000	10,000	**917,000**	203,000	29,000	273,000	70,000	0	0	**575,000**	275,000	57,000	332,000
2035	W	459,000	220,000	119,000	0	0	22,000	0	**820,000**	225,000	34,000	276,000	76,000	0	0	**611,000**	162,000	55,000	217,000
2036	W	552,000	221,000	119,000	0	0	22,000	10,000	**924,000**	243,000	51,000	275,000	76,000	0	0	**645,000**	275,000	65,000	340,000
2037	W	719,000	217,000	122,000	0	0	23,000	10,000	**1,091,000**	202,000	31,000	269,000	80,000	0	0	**582,000**	442,000	53,000	495,000
2038	N	415,000	185,000	114,000	0	0	15,000	0	**729,000**	350,000	58,000	258,000	111,000	0	0	**777,000**	90,000	87,000	177,000
2039	N	455,000	197,000	117,000	0	0	15,000	0	**784,000**	360,000	63,000	262,000	108,000	0	0	**793,000**	142,000	82,000	224,000
2040	D	457,000	151,000	104,000	0	0	10,000	0	**722,000**	348,000	53,000	299,000	136,000	0	0	**836,000**	(82,000)	(65,000)	(147,000)
2041	D	410,000	150,000	101,000	0	0	10,000	0	**671,000**	352,000	56,000	299,000	130,000	0	0	**837,000**	(123,000)	(68,000)	(191,000)
2042	N	448,000	197,000	111,000	0	0	15,000	0	**771,000**	385,000	62,000	264,000	100,000	0	0	**811,000**	98,000	98,000	196,000
2043	D	368,000	151,000	100,000	0	0	10,000	0	**629,000**	357,000	55,000	298,000	109,000	0	0	**819,000**	(173,000)	(58,000)	(231,000)

Groundwater Budget																			
		Inflows							Outflows							Change in Storage		
		Infiltration	Lateral Subsurface Flow		Seepage Through Corcoran Clay - SJREC Only	Applied Water Infiltration (Project Effects) - NCDM Only	Deep Percolation (Project Effects) - NCDM Only	Project Effects	**Total Inflows**	Groundwater Extraction		Lateral Subsurface Flow		Flow to Lower Aquifer - Grassland Only	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow - Grassland Only	**Total Outflows**	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*						*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*				*Upper Aquifer*	*Lower Aquifer*	*Total*
2044	W	502,000	209,000	119,000	0	0	23,000	28,000	**881,000**	220,000	38,000	282,000	71,000	0	0	**611,000**	227,000	59,000	286,000
2045	W	413,000	215,000	121,000	0	0	22,000	28,000	**799,000**	235,000	43,000	271,000	77,000	0	0	**626,000**	141,000	32,000	173,000
2046	D	382,000	151,000	101,000	0	0	10,000	0	**644,000**	469,000	68,000	296,000	112,000	0	0	**945,000**	(264,000)	(85,000)	(349,000)
2047	D	422,000	150,000	99,000	0	0	10,000	0	**681,000**	471,000	71,000	298,000	105,000	0	0	**945,000**	(214,000)	(64,000)	(278,000)
2048	N	393,000	187,000	109,000	0	0	14,000	0	**703,000**	475,000	92,000	263,000	100,000	0	0	**930,000**	(27,000)	69,000	42,000
2049	N	545,000	188,000	110,000	0	0	16,000	0	**859,000**	345,000	56,000	262,000	103,000	0	0	**766,000**	209,000	90,000	299,000
2050	W	436,000	217,000	120,000	0	0	23,000	28,000	**824,000**	239,000	46,000	274,000	73,000	0	0	**632,000**	173,000	41,000	214,000
2051	D	343,000	152,000	101,000	0	0	10,000	0	**606,000**	361,000	58,000	296,000	136,000	0	0	**851,000**	(195,000)	(88,000)	(283,000)
2052	D	466,000	150,000	98,000	0	0	10,000	0	**724,000**	463,000	66,000	296,000	105,000	0	0	**930,000**	(183,000)	(82,000)	(265,000)
2053	SC	341,000	156,000	97,000	0	0	9,000	0	**603,000**	499,000	99,000	312,000	104,000	0	0	**1,014,000**	(322,000)	(95,000)	(417,000)
2054	SC	392,000	156,000	96,000	0	0	8,000	0	**652,000**	514,000	98,000	312,000	102,000	0	0	**1,026,000**	(270,000)	(98,000)	(368,000)
2055	D	422,000	152,000	96,000	0	0	9,000	0	**679,000**	376,000	62,000	296,000	101,000	0	0	**835,000**	(138,000)	(69,000)	(207,000)
2056	W	511,000	222,000	115,000	0	0	22,000	28,000	**898,000**	258,000	58,000	278,000	67,000	0	0	**661,000**	244,000	48,000	292,000
2057	W	437,000	222,000	116,000	0	0	23,000	0	**798,000**	249,000	41,000	279,000	73,000	0	0	**642,000**	110,000	46,000	156,000
2058	N	479,000	205,000	108,000	0	0	15,000	0	**807,000**	453,000	69,000	266,000	105,000	0	0	**893,000**	63,000	83,000	146,000
2059	W	482,000	221,000	120,000	0	0	23,000	28,000	**874,000**	245,000	40,000	275,000	74,000	0	0	**634,000**	192,000	55,000	247,000
2060	D	395,000	150,000	101,000	0	0	10,000	0	**656,000**	361,000	51,000	293,000	136,000	0	0	**841,000**	(157,000)	(76,000)	(233,000)
2061	W	581,000	218,000	120,000	0	0	23,000	28,000	**970,000**	238,000	40,000	274,000	72,000	0	0	**624,000**	297,000	56,000	353,000
2062	N	454,000	198,000	113,000	0	0	15,000	0	**780,000**	372,000	60,000	262,000	109,000	0	0	**803,000**	115,000	83,000	198,000
2063	N	431,000	200,000	113,000	0	0	15,000	0	**759,000**	448,000	71,000	264,000	107,000	0	0	**890,000**	17,000	90,000	107,000
2064	D	376,000	152,000	101,000	0	0	11,000	0	**640,000**	368,000	52,000	299,000	134,000	0	0	**853,000**	(183,000)	(68,000)	(251,000)
2065	N	657,000	186,000	111,000	0	0	15,000	0	**969,000**	360,000	60,000	263,000	103,000	0	0	**786,000**	321,000	95,000	416,000
2066	W	419,000	218,000	120,000	0	0	23,000	0	**780,000**	258,000	42,000	280,000	74,000	0	0	**654,000**	78,000	50,000	128,000
2067	W	430,000	217,000	121,000	0	0	23,000	0	**791,000**	257,000	42,000	277,000	77,000	0	0	**653,000**	96,000	54,000	150,000
2068	D	362,000	155,000	102,000	0	0	10,000	0	**629,000**	451,000	64,000	311,000	113,000	0	0	**939,000**	(291,000)	(72,000)	(363,000)
2069	D	364,000	154,000	98,000	0	0	10,000	0	**626,000**	457,000	62,000	312,000	105,000	0	0	**936,000**	(297,000)	(64,000)	(361,000)
2070	W	638,000	211,000	118,000	0	0	23,000	28,000	**1,018,000**	237,000	42,000	270,000	70,000	0	0	**619,000**	350,000	55,000	405,000

Figure CC-64: Change in Storage, Delta-Mendota Subbasin Projected Water Budget



4.3.4 Sustainable Yield

Under SGMA, sustainable yield is defined as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result." (CWC 10721(w)). Sustainable yield estimates for the Upper Aquifer and Lower Aquifer have been developed in a coordinated fashion for the Delta-Mendota Subbasin by the Delta-Mendota Technical Working Group and approved by the Delta-Mendota Coordination Committee.

Upper Aquifer Sustainable Yield Estimate

Methodologies for calculating Upper Aquifer sustainable yield were discussed by both the Delta-Mendota Coordination Committee and an ad-hoc Technical Working Group of the Coordination Committee. During a workshop dedicated to this effort, several basic concepts and principles were discussed to calculate the Upper Aquifer sustainable yield estimate. Consideration was given to several potential options with increasing detail, including a combination of the following: total Subbasin Upper Aquifer pumping volumes, total Subbasin Upper Aquifer change in storage, and Subbasin Upper Aquifer subsurface inflows and outflows. Inflow from certain neighboring subbasins, based on groundwater flow direction, as well as subsurface inflow from the Coast Range at existing gradients (as part of the inflow to the Northern & Central Delta-Mendota Region GSP area) was considered. Outflow to neighboring subbasins at existing gradients was also considered in certain applicable areas along the Delta-Mendota Subbasin boundary based on groundwater flow characteristics.

An overarching goal of this Subbasin is to maintain a balanced water budget by managing groundwater extractions (pumping). Therefore, the Upper Aquifer sustainable yield was estimated using the change in storage from the historic water budget (WY2003-2012). Based on these considerations, the following formula was selected for estimating Upper Aquifer sustainable yield utilizing the consolidated historic water budget components:

> Upper Aquifer Sustainable Yield = (Pumping + Change in Storage) + (Subsurface Outflow – Subsurface Inflow)

The formula for determining Upper Aquifer sustainable yield was applied to the following compiled Delta-Mendota Subbasin projected water budgets (WY2014-2070):

- Projected Baseline values with Climate Change Factors
- Projected Baseline values with Climate Change Factors and Projects and Management Actions

This analysis resulted in an Upper Aquifer Sustainable Yield estimate of 403,000 acre-feet.

The Upper Aquifer sustainable yield value, derived from calculations using the best available but limited data, is considered to be a preliminary estimation only and will be updated to an anticipated higher level of accuracy in future GSP updates. The intention of the Delta-Mendota Subbasin GSAs, following GSP submission in 2020, is to increase subbasin-wide data collection efforts. Improved data, modeling results, and understanding of subsurface flows will allow the GSAs and each GSP Group to improve estimated sustainable yield values for future GSP updates. The GSP Groups are in the process of developing GSP implementation guidelines that will address future data collection efforts and other GSP implementation activities.

The Upper Aquifer sustainable yield calculated range reflects the principle that the GSAs within the Delta-Mendota Subbasin reserve the right to claim or retain some portion of subbasin outflow generated by the lowering of groundwater levels from neighboring subbasins and the equitable portion of sources of recharge shared between two subbasins, by physical or non-physical means, in the future if the Delta-Mendota Subbasin GSAs determine that doing so will improve Subbasin sustainability or will prevent undesirable results due to the chronic lowering of groundwater levels. Furthermore, intra-basin coordination during GSP development, followed by continuing inter-basin coordination discussions and data collection after GSP adoption, will allow the GSAs to further refine these determinations.

Lower Aquifer Sustainable Yield Estimate

Currently, within the Delta-Mendota Subbasin, the distribution of known Lower Aquifer water level data and extraction volume data are not sufficient to allow for an accurate calculation of Lower Aquifer sustainable yield utilizing the same methodology as for the Upper Aquifer. Following discussions by both the Coordination Committee and the Technical Working Group of the Coordination Committee, a consensus was reached to establish a Lower Aquifer sustainable yield estimate for the Subbasin based on a projection of existing subsidence rates as measured along the DMC with the minimum threshold established for inelastic land subsidence. In the original 2020 submittal, the calculation for the Lower Aquifer sustainable yield was based on the following. The Westlands Water District GSA recently conducted a study using groundwater modeling, in conjunction with the Westside GSP development, to estimate sustainable yield for the Westside Subbasin. Based on an analysis of available data and an initial assumption of Lower Aquifer sustainable yield equivalent to approximately 0.35 acre-feet per acre within the Westside Subbasin (Westlands Water District GSA, Groundwater Management Strategy Concepts presentation to the WWD Board on October 16, 2018), the GSA estimates a sustainable yield of 230,000 to 250,000 acre-feet, with historic conditions suggesting a range from 250,000 to 300,000 acre-feet (Westlands Water District GSA, Westside Subbasin's Groundwater Model Forecast and Augmentation Strategies presentation to the WWD Board on April 3, 2019). Using Westlands Water District GSA's analysis, the Delta-Mendota Coordination Committee recommended a slightly more conservative sustainable yield value of one-third (0.33) an acre-foot per acre for the Delta-Mendota Subbasin. Using this more conservative value, the estimated Lower Aquifer sustainable yield is approximately 250,000 acre-feet per year over the approximately 750,000-acre subbasin. It should be noted that sustainable management of the Lower Aquifer is governed by significant and unreasonable subsidence rather than sustainable yield. The distribution of sustainable yield is not uniform throughout the Subbasin, and it will be the responsibility of each GSA in the Subbasin to manage Lower Aquifer pumping to prevent significant and unreasonable subsidence.

Acknowledging that land subsidence is occurring at localized areas in the Subbasin, the DMCC refined the Lower Aquifer sustainable yield calculation, adjusting the value from 250,000 AF to 101,000 AF, based on observed extractions from the Lower Aquifer during WY2015. This refinement is consistent with the common definitions established across the Subbasin for all SMCs. It is important to note that subsidence will be the primary factor influencing the allowable volume of groundwater that can be extracted from the Lower Aquifer without incurring significant and unreasonable impacts on beneficial uses and users. As such, this number will be updated as data gaps are filled, particularly using the Proposition (Prop) 68 grant-funded well inventory and subsidence study and the results of the Airborne Electromagnetic (AEM) survey recently completed by DWR. Furthermore, the Subbasin will investigate the feasibility to recharge the Lower Aquifer as a means of reducing subsidence and managing future Lower Aquifer sustainable yield.

The Lower Aquifer sustainable yield estimate will be refined in the future based on data collected and compiled for the Subbasin. This current sustainable yield approximation highlights the importance of an

accepted Subbasin-level subsidence monitoring program concurrent with improved estimates of sub-Corcoran Clay groundwater extractions.

5. SUSTAINABLE MANAGEMENT CRITERIA

As required by Subarticle 3. Sustainable Management Criteria of the GSP regulations, the GSPs must include a sustainability goal and definitions of undesirable results, in addition to defining what is considered to be significant and unreasonable and establishing minimum thresholds, measurable objectives and 5-year interim goals. Given the variability of conditions within the Delta-Mendota Subbasin, a subbasin-wide sustainability goal and definitions of undesirable results were developed at the subbasin-level, while the definitions of significant and unreasonable, minimum thresholds, measurable objectives and 5-year interim goals were established at the GSP Plan area-level.

This section describes the coordinated sustainability goal and definition of undesirable results at a subbasin-level and the sustainable management criteria at a GSP-level. Sustainable management criteria developed by each GSP Group were further compared and coordinated between neighboring GSP Groups to avoid conflicts, particularly in setting numeric minimum thresholds, measurable objectives, and interim milestones at boundary locations. The sustainable management criteria for each GSP Group for each applicable sustainability indicator are presented herein.

5.1 Coordinated Assumptions and Data

All common coordinated assumptions and data agreed upon and implemented by each GSP Group in developing their respective sustainable management criteria for each applicable sustainability indicator are presented in Technical Memoranda 4 (*Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Indicators, and GSP Documentation*), which is included in **Appendix B** of this Common Chapter.

During preparation of the January 2020 GSP, each GSP Group drafted their respective sustainable management criteria for each applicable sustainability indicator and then met with their neighboring GSP Groups to coordinate minimum thresholds and measurable objectives to avoid conflicts and ensure each GSP Group would not negatively impact their neighboring GSP Groups from achieving sustainability. In the CIL received on January 21, 2022, DWR stated that "The GSPs have not established common definitions of undesirable results in the Subbasin." nor did they comply with the Emergency GSP Regulations in establishing common definitions and methodologies for SMC. In response, subsequent to receipt of the CIL, the Technical Working Group and Coordination Committee met to develop, at a subbasin level, singular coordinated definitions and methods for establishing SMC for each applicable sustainability indicator.

5.2 Coordinated Sustainability Goal and Undesirable Results

The sustainability goal for the Delta-Mendota Subbasin was established to succinctly state the objectives and desired conditions of the Subbasin that culminates in the absence of undesirable results by 2040. The sustainability goal for the Delta-Mendota Subbasin is as follows and was approved by the Delta-Mendota Subbasin Coordination Committee during the June 10, 2019 meeting:

> *The Delta-Mendota Subbasin will manage groundwater resources for the benefit of all users of groundwater in a manner that allows for operational flexibility, ensures resource availability under drought conditions, and does not negatively impact surface water diversion and conveyance and delivery capabilities. This goal will be achieved through the implementation of the proposed projects and management actions to reach identified measurable objectives and milestones through the implementation of the GSP(s), and through continued coordination with neighboring subbasins to ensure the absence of undesirable results by 2040.*

The following definitions of "undesirable results" were agreed upon during the 20222 revision of this Common Chapter for the following applicable sustainability indicators:

- **Chronic lowering of groundwater levels** - Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater.

- **Reduction in groundwater storage** - A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater.

- **Degraded water quality** - Degradation of groundwater quality as a result of groundwater management activities that causes significant and unreasonable impacts to beneficial uses and users of groundwater.

- **Land subsidence** - Changes in ground surface elevation that cause damage to critical infrastructure, including significant and unreasonable reductions of conveyance capacity, impacts to natural resource areas, or conditions that threaten public health and safety.

- **Depletions of interconnected surface wat–r** - Depletions of interconnected surface water as a direct result of groundwater pumping that cause significant and unreasonable impacts on natural resources or downstream beneficial uses and users.

5.3 GSP-Level Sustainable Management Criteria

In the original 2020 GSP submittals for the Delta-Mendota Subbasin, each GSP Group defined what was considered significant and unreasonable in their Plan Area for each applicable sustainability indicator, in addition to establishing minimum thresholds, measurable objectives and 5-year interim goals for their Plan Area, consistent with GSP Regulations Article 5. Plan Contents, Subarticle 3. Sustainable Management Criteria (§ 354.2 through 354.30). DWR's *Draft Best Management Practices for the Sustainable Management of Groundwater Sustainable Management Criteria BMP* (2017) document was also used when and where applicable at the discretion of each GSP Group.

Subsequent to this submittal, the Technical Working Group and Coordination Committee met to develop consistent definitions and methodologies for establishing numeric metrics for each applicable sustainability indicator. These revised SMC are discussed in the next section.

5.4 Delta-Mendota Subbasin Sustainable Management Criteria

The sustainable management criteria for each sustainability indicator contains the following components: the subbasin-wide definitions of an undesirable result and of significant and unreasonable, sustainability goals, minimum thresholds (MTs), measurable objectives (MOs), and five-year interim milestones (IMs). Separate tables show the sustainable management criteria for chronic lowering of groundwater levelsError! Reference source not found., reduction in groundwater storageError! Reference source not found., degraded water quality, land subsidence, and depletions of interconnected surface water Error! Reference source not found.with maps showing representative monitoring sites with corresponding numeric MTs and MOs, and a table summarizing the MTs and MOs by representative monitoring location.

5.4.1 Chronic Lowering of Groundwater Levels

Chronic Lowering of Groundwater Levels is arguably the most fundamental Sustainability Indicator, as it directly and indirectly influences several other Sustainability Indicators, such as Reduction of Groundwater Storage, Land Subsidence, and Degraded Water Quality. The Subbasin GSAs are committed to maintaining groundwater levels above historic low conditions in order to avoid undesirable results to beneficial uses and users of groundwater and to prevent further decrease of groundwater levels due to groundwater management actions performed within the Subbasin.

The GSAs developed SMCs for Chronic Lowering of Groundwater Levels using readily available historic records of groundwater level data for 61 of the 75 Representative Monitoring Sites (RMS). The MTs and MOs were developed for each RMS using common data and coordinated assumptions, as detailed in **Table CC-16**, and are consistent with the requirement of Title 23 of the California Code of Regulations (23 CCR) § 354.28(c) to consider trends in historic groundwater levels, water year type, projected water use in the Basin, and relationship with other sustainability indicators. The equivalent process was used in both the Upper Aquifer and Lower Aquifer within the Subbasin.

The MT is currently established as a fixed elevation at each RMS, equivalent to the historic seasonal low prior to the end of WY2016, based on available groundwater level data. The MO is to maintain water levels at or above the Water Year 2015 seasonal high at more than 50% of RMS in a GSP area. The GSAs will conduct a minimum of bi-annual groundwater level monitoring to track progress towards sustainability at the 75 RMS.

Per the definition of Undesirable Results for Chronic Lowering of Groundwater Levels, the exceedance of a MT at a single RMS is not indicative of an Undesirable Result; rather, the exceedance of MTs at 50% or more RMS within a GSP area is considered to cause significant and unreasonable impacts to locally-specific beneficial uses and users of groundwater, namely the increased costs associated with modifying wells to access groundwater, securing alternative sources, or required mitigation of groundwater dependent ecosystems. To account for future year-to-year variations in hydrology, compliance will be assessed by comparing a four-year rolling average of groundwater level measurements to the fixed MT at each RMS within a GSP area.

In addition to the SMCs developed as part of this GSP, the GSAs will continue to coordinate to develop shorter-term ("acute") groundwater level thresholds in the five-year GSP update that will be submitted in 2025. These thresholds will be set at levels that avoid short-term undesirable results, particularly for domestic water users, groundwater dependent ecosystems, and interconnected surface waters and subsidence when present. Each year, both the historic seasonal low MT value and the acute groundwater elevation thresholds will apply, whichever is more protective.

Table CC-16: Delta-Mendota Subbasin SMC for Chronic Lowering of Groundwater Levels

Definition of Undesirable Results	Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater.
Definition of Significant and Unreasonable	Significant and unreasonable impacts to beneficial uses and users of groundwater are substantially increased costs associated with higher total pumping lift, lowering pumps, drilling deeper wells, or otherwise modifying wells to access groundwater, securing alternative water sources, or required mitigation of groundwater dependent ecosystems. Significant

Table CC-16: Delta-Mendota Subbasin SMC for Chronic Lowering of Groundwater Levels	
	and unreasonable is quantitatively defined as exceeding the MT at more than 50% of representative monitoring sites by aquifer in a GSP area.
Sustainability Goal	Maintain groundwater levels that are comparable to existing conditions (historic low conditions as of Water Year 2016) in order to continue meeting the demand of beneficial uses and users of groundwater and prevent a trend of decreasing groundwater levels. The Delta-Mendota Subbasin will continue successful and ongoing coordination with neighboring Subbasins to address chronic lowering of groundwater levels caused by pumping outside of the Subbasin.
Minimum Threshold	The groundwater elevation indicating a chronic lowering of groundwater levels that may lead to undesirable results is an elevation that is lower than the historical seasonal low. The historic seasonal low is a fixed elevation at each site, based on available groundwater level data prior to the end of Water Year 2016. To account for future year-to-year variations in hydrology, compliance with the fixed historic seasonal low threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Shorter-term ("acute") groundwater elevation thresholds will also be established at each representative monitoring site by 2025 using a coordinated methodology. Acute thresholds will be established at levels that are intended to avoid short-term undesirable results, particularly for domestic water wells, groundwater dependent ecosystems, and interconnected surface waters where present in the Upper Aquifer, and for subsidence in the Lower Aquifer. Each year, both the historic seasonal low and the acute groundwater elevation thresholds will apply, whichever is more protective. Groundwater levels are measured as water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the minimum threshold applies. See **Table CC-17**for numeric MTs. For any RMS without data prior to Water Year 2016, MTs and acute thresholds will be established using the aforementioned methodologies and the data resulting from the first five years of monitoring following Water Year 2016 or following construction of the well.
Measurable Objective	Maintain seasonal high groundwater levels at an elevation that is at or above the Water Year 2015 seasonal high at more than 50% of representative monitoring sites in a GSP area. The Water Year 2015 seasonal high is a fixed elevation at each site, based on available groundwater level data. If data are unavailable for Water Year 2015 at a representative monitoring site, either a Water Year 2014 or Water Year 2016 Seasonal High will be used. To account for future year-to-year variations in hydrology, compliance with the fixed seasonal high threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Groundwater levels are measured as water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the measurable objective applies. See **Table CC-17** for numeric MOs. For any RMS without data prior to Water Year 2016, Measurable Objectives will be established using the aforementioned methodology and

Table CC-16: Delta-Mendota Subbasin SMC for Chronic Lowering of Groundwater Levels	
	the data resulting from the first five years of monitoring following Water Year 2016 or following the construction of the well.
5-Year Interim Milestones	**Year 5:** Gather data and complete the establishment of seasonal low and seasonal high elevations at representative monitoring sites in the Lower Aquifer for the Grassland GSP area. Develop a coordinated methodology and complete the establishment of acute groundwater elevation thresholds. Identify chronic lowering of groundwater levels caused by pumping outside the Subbasin. **Year 10:** Maintain groundwater levels at MOs. Where chronic lowering of groundwater levels is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 15:** Maintain groundwater levels at MOs. Where chronic lowering of groundwater levels is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

The numeric MTs and MOs by RMS are shown below in **Figure CC-65** for the Upper Aquifer and **Figure CC-66** for the Lower Aquifer, with the numeric SMC tabulated in **Table CC-17**.

Table CC-17: Numeric SMC for the Chronic Lowering of Groundwater Levels

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (ft above MSL, NAVD88)	Measurable Objective (ft above MSL, NAVD88)
09-001	Aliso Water District	Upper	40.5	114.3
09-002	Aliso Water District	Upper (Composite)	-4.0	17.1
09-003	Aliso Water District	Upper	37.4	52.9
09-004	Aliso Water District	Upper	37.7	51.9
10-001	Farmers Water District	Upper	34.0	102.7
12-001	Fresno County	Upper	98.2	103.2
13-001	Fresno County	Upper	109.4	120.5
13-003	Fresno County	Upper	48.6	116.1
13-004	Fresno County	Lower	-59.0	-27.0
11-001	Grassland	Lower	TBD	TBD
11-002	Grassland	Lower	TBD	TBD
11-003	Grassland	Lower	TBD	TBD
11-004	Grassland	Lower	TBD	TBD

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (ft above MSL, NAVD88)	Measurable Objective (ft above MSL, NAVD88)
11-005	Grassland	Lower	TBD	TBD
11-006	Grassland	Lower	TBD	TBD
11-007	Grassland	Upper	79.9	91.1
11-008	Grassland	Upper	82.3	93.2
11-009	Grassland	Upper	63.4	77.3
11-013	Grassland	Upper	76.8	80.4
11-014	Grassland	Upper	68.1	80.7
11-015	Grassland	Upper	72.8	75.7
11-016	Grassland	Upper	83.1	92.8
11-017	Grassland	Upper	90.2	116.6
11-019	Grassland	Upper	27.0	27.0
19-003	Grassland	Upper	90.5	91.8
01-001	NCDM	Lower	-44.9	-13.4
01-002	NCDM	Lower	-36.1	-18.9
01-003	NCDM	Lower	-21.8	62.3
01-004	NCDM	Upper	158.9	161.8
01-005	NCDM	Upper	110.6	179.6
01-006	NCDM	Lower	77.1	94.0
01-007	NCDM	Lower	12.3	56.7
01-008	NCDM	Lower	-44.9	2.4
02-002	NCDM	Lower	-18.3	33.7
02-009	NCDM	Upper	-6.2	29.8
03-001	NCDM	Upper	30.7	46.7
03-002	NCDM	Upper	7.7	67.2
03-003	NCDM	Upper	TBD	TBD
04-001	NCDM	Lower	-17.6	-3.6
06-001	NCDM	Lower	-52.3	16.1
06-002	NCDM	Upper	31.5	44.6
06-003	NCDM	Lower	-9.1	18.5
06-004	NCDM	Upper	14.8	30.5
07-002	NCDM	Lower	1.6	10.8
07-003	NCDM	Upper	62.5	89.9
07-005	NCDM	Lower	-84.7	-41.8
07-007	NCDM	Lower	-53.4	-26.6
07-008	NCDM	Lower	-63.0	-47.0
07-009	NCDM	Upper	49.3	73.9
07-010	NCDM	Upper	64.0	96.2
07-012	NCDM	Upper	TBD	TBD
07-014	NCDM	Lower	-133.5	-47.2

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (ft above MSL, NAVD88)	Measurable Objective (ft above MSL, NAVD88)
07-015	NCDM	Lower	-147.0	-65.0
07-016	NCDM	Lower	-2.4	74.6
07-017	NCDM	Upper	TBD	TBD
07-018	NCDM	Upper	TBD	TBD
07-028	NCDM	Lower	-88.2	-64.8
07-029	NCDM	Upper	TBD	TBD
07-030	NCDM	Lower	TBD	TBD
07-031	NCDM	Lower	TBD	TBD
07-032	NCDM	Lower	TBD	TBD
07-035	NCDM	Upper	-99.8	95.2
08-002	NCDM	Upper	50.7	83.7
14-001	SJREC	Upper	24.0	48.5
14-002	SJREC	Upper	96.5	125.7
14-003	SJREC	Upper	81.3	92.2
14-004	SJREC	Upper	78.7	92.6
14-005	SJREC	Upper	92.2	106.2
14-006	SJREC	Upper	76.7	98.2
14-007	SJREC	Upper	73.5	98.5
14-008	SJREC	Upper	70.5	98.5
14-019	SJREC	Lower	-48.8	35.0
14-020	SJREC	Lower	38.1	57.4
14-021	SJREC	Lower	-33.0	14.8
23-001	SJREC	Upper	102.3	120.2

T–D - Numeric SMC to be determined after five years of data have been collected for this representative monitoring site.

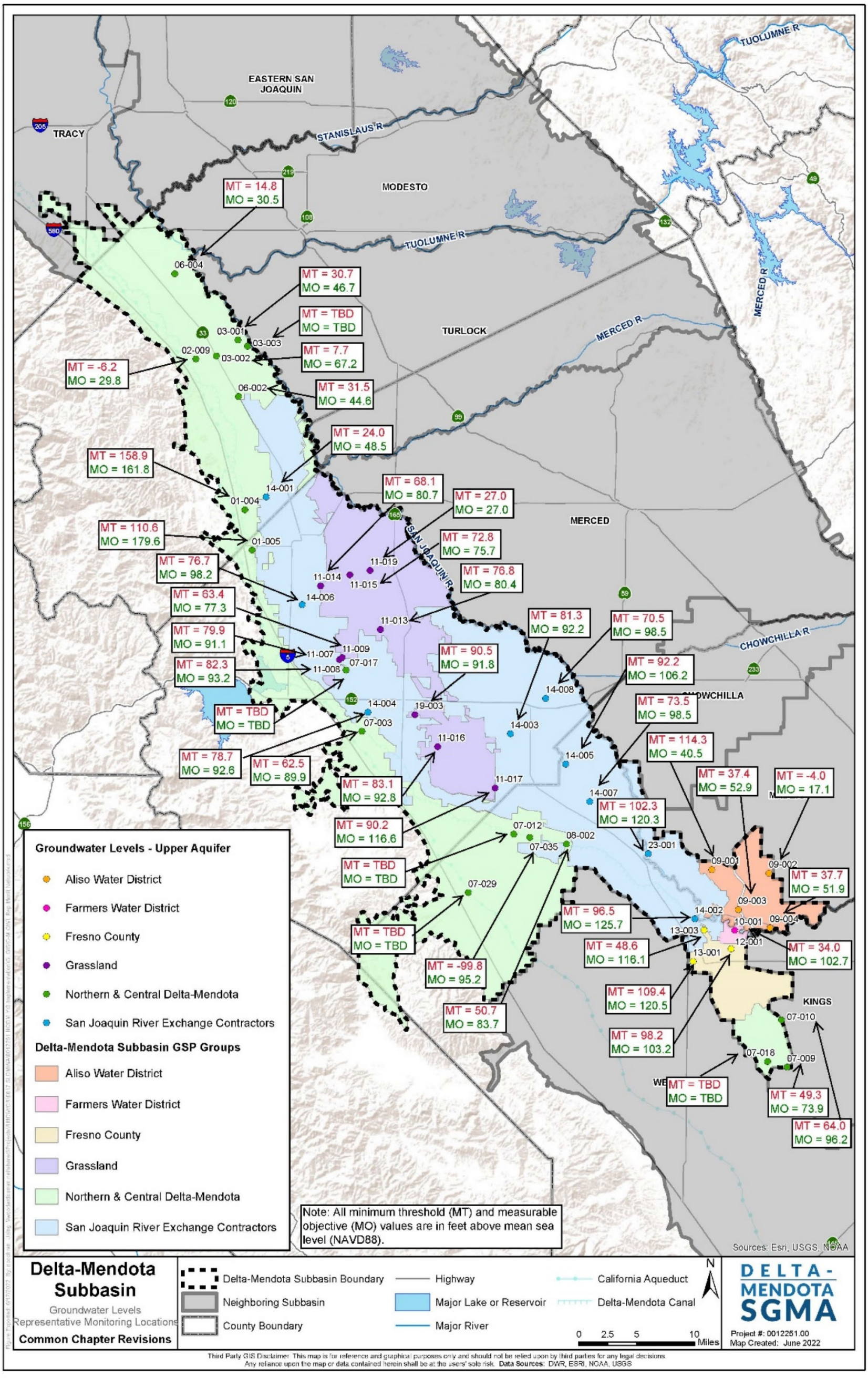


Figure CC-65: Groundwater Level Representative Monitoring Locations with SMC – Upper Aquifer

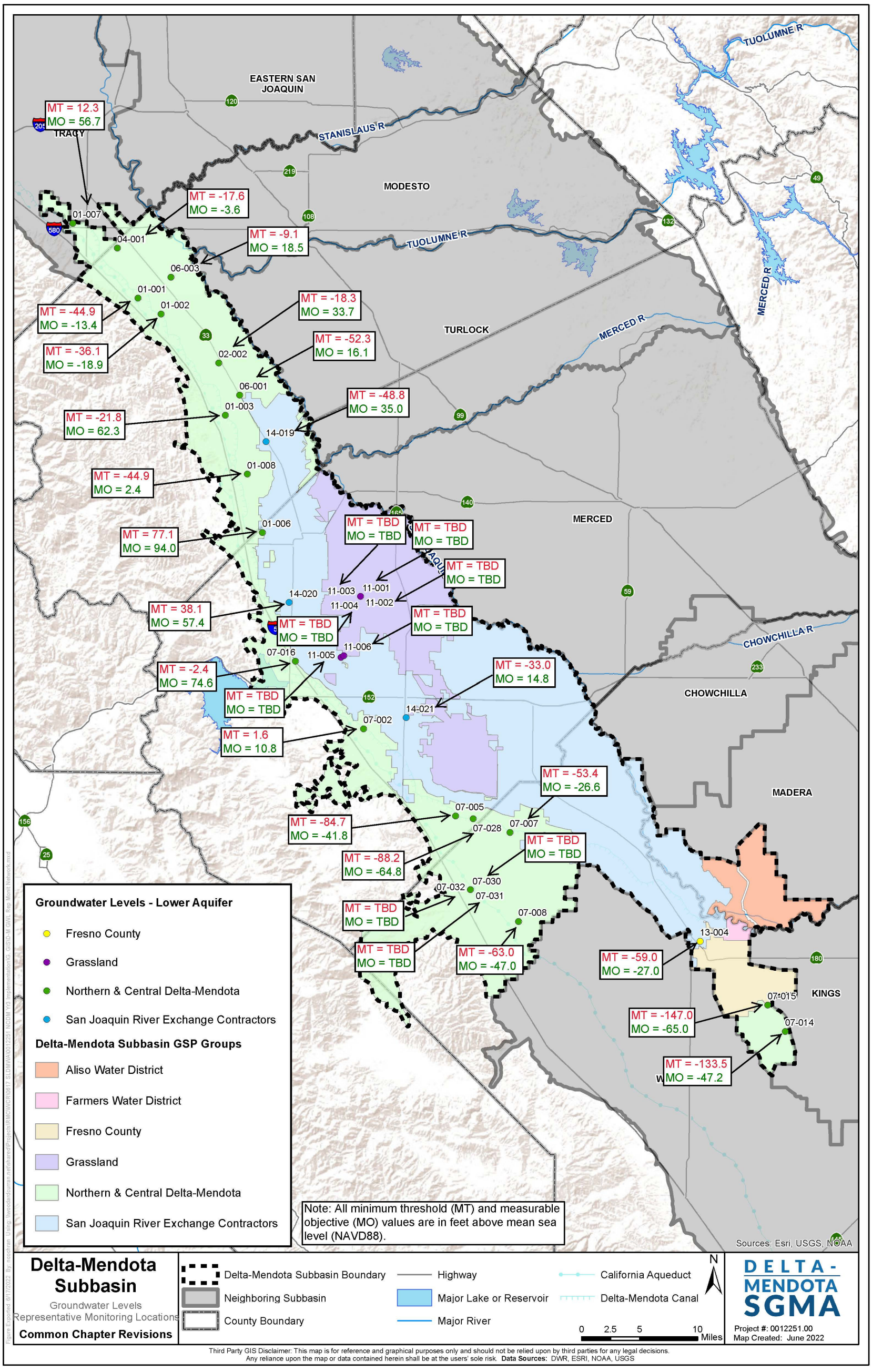


Figure CC-66: Groundwater Level Representative Monitoring Locations with SMC – Lower Aquifer

5.4.2 Reduction in Groundwater Storage

The GSAs intend to maintain groundwater storage at volumes that will continue to meet the demands of beneficial uses and users of groundwater, provide a three-year drought buffer, and minimize reductions in groundwater storage during extended dry periods. Further, the GSAs will coordinate with neighboring subbasins to address reductions in groundwater storage caused by pumping outside of the Subbasin. The SMCs were developed using common data and coordinated assumptions, as detailed in **Table CC-18** and will be monitored a minimum of bi-annually as detailed for Chronic Lowering of Groundwater Levels in Section 5.4.1 (**Table CC-16**) and consistent Land Subsidence monitoring as detailed in Section 5.4.4 (**Table CC-21**).

Pursuant to 23 CCR § 354.28(d), the MTs for Reduction of Groundwater Storage may be set by using groundwater levels as a proxy if it is demonstrated that a correlation exists between the two metrics. It is logical to link these two Sustainability Indicators for the Upper Aquifer, as the amount of groundwater in storage is directly, if not linearly, related to groundwater levels. As such, in the Upper Aquifer, it is not necessary to set a unique MT for Reduction of Groundwater Storage, and the MTs for Chronic Lowering of Groundwater Levels are used as a proxy for the Reduction of Groundwater Storage Sustainability Indicator. Similarly, the MOs for Chronic Lowering of Groundwater Levels serves as a proxy for Reduction of Groundwater Storage. Because the SMCs established for Chronic Lowering of Groundwater Levels are designed to maintain groundwater levels above historic low conditions, they are protective of the Reduction of Groundwater Storage Sustainability indicator and local beneficial uses and users of the Upper Aquifer, as the SMCs maintain sufficient water storage to maintain beneficial uses, including the conjunctive use of groundwater.

In the Lower Aquifer, the physical reduction in groundwater storage is caused by inelastic land subsidence, as detailed in Section 5.4.4 (**Table CC-21**). As such, the SMCs set for Land Subsidence (which are designed to reduce subsidence caused by groundwater extraction in the Subbasin, with no additional subsidence after 2040) are reasonably protective and used as a tool to calculate the Reduction of Groundwater Storage Sustainability Indicator SMCs in the Lower Aquifer[1].

[1] The most significant subsidence in the Subbasin observed between from 2014-2018 was a 0.6-foot decline at Check 18 of the Delta-Mendota Canal. During those same years, the water budget calculation estimated what the change in storage was in the Lower Aquifer. Given the apparent relationship between the loss in groundwater storage and the observed subsidence, the projected allowable additional subsidence (i.e., two feet by 2040) was converted to a groundwater storage volume in the Lower Aquifer and used as the SMC.

Table CC-18: Delta-Mendota Subbasin SMC for Reduction in Groundwater Storage	
Definition of Undesirable Results	A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater.
Definition of Significant and Unreasonable	A significant and unreasonable impact to beneficial uses and users of groundwater is insufficient water storage to maintain beneficial uses and natural resource areas in the Subbasin, including the conjunctive use of groundwater.
Sustainability Goal	Maintain historic groundwater storage volumes in order to continue meeting the demand of beneficial uses and users of groundwater and to provide a 3-year drought buffer. Minimize reductions in groundwater storage during extended dry periods. Work with neighboring Subbasins to address reduction in groundwater storage caused by pumping outside of the Subbasin.
Minimum Threshold	For the Upper Aquifer, as a reasonable proxy for an individual groundwater storage threshold, maintain groundwater levels in accordance with the minimum threshold set for Chronic Lowering of Groundwater Levels. For the Lower Aquifer, correlate the SMCs for inelastic land subsidence with the reduction in groundwater storage that would cause undesirable results, estimated to be 1.1 million acre-feet of storage loss by 2040 attributable to groundwater extraction in the Subbasin.
Measurable Objective	For the Upper Aquifer, maintain groundwater levels in accordance with the measurable objectives set for Chronic Lowering of Groundwater Levels. For the Lower Aquifer, minimize loss of groundwater storage caused by inelastic land subsidence.
5-Year Interim Milestones	**Year 5:** Maintain groundwater levels in accordance with the measurable objectives. Identify reduction in groundwater storage caused by pumping outside the Subbasin. **Year 10:** Maintain groundwater levels in accordance with the measurable objectives. Where reduction in groundwater storage is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 15:** Maintain groundwater levels in accordance with the measurable objectives. Where reduction in groundwater storage is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

5.4.3 Degraded Groundwater Quality

The GSP groups within the Delta-Mendota Subbasin are committed to preventing the migration or elevated concentrations of constituents of concern due to groundwater management activities. The primary constituent of concern in the Subbasin is salinity, frequently reported as total dissolved solids (TDS).

For drinking water, California has three secondary maximum contaminant level (SMCL) standards for TDS, all based on aesthetic considerations such as taste and odor, not public health concerns. These are 500 mg/L (recommended limit), 1,000 mg/L (upper limit), and 1,500 mg/L (short-term limit). To reflect the Subbasin's designation as a Municipal (MUN) beneficial use, as established in the Central Valley Water Control Plans (often referred to as Basin Plans), the Subbasin has selected the upper limit of 1,000 mg/L as the Minimum Threshold.

The Delta-Mendota GSAs also recognize that a Salt Control Program for the San Joaquin Valley was recently developed through the collaborative CV-SALTS Program and was adopted into the Central Valley Basin Plans to address the long-term problem of salt accumulation in the Valley. The program recognizes that salt accumulation and water uses vary widely across the Valley. The program approach is intended to protect beneficial uses by maintaining water quality that meets applicable objectives, allow some salt accumulation in areas where salt can be stored without impairing beneficial uses of water, and, through long-term management, restore water quality where reasonable, feasible, and practicable.

A Prioritization and Optimization (P&O) Study planning process is now underway to identify potential requirements that will protect beneficial uses, improve salt management, and restore water quality where possible. During the next ten years (Phase 1), the P&O Study will: characterize the salt conditions and trends in the Valley; identify salt management needs and mechanisms; evaluate the feasibility of potential solutions; prepare an implementation plan; and review and recommend revising salinity regulations as necessary. [1]

The minimum thresholds and measurable objectives for groundwater quality incorporate these standards and objectives for salinity. The minimum threshold is therefore set as 1,000 mg/L TDS, and the measurable objective is a concentration less than 1,000 mg/L TDS with acknowledgement that salinity standards are still being developed by water quality experts and regulatory agencies in the Central Valley, and thus may need to be revised in the future. Additionally, groundwater is frequently blended with other water supplies to reduce TDS concentrations to meet the salinity sensitivity of a particular beneficial use.

For any representative monitoring site that currently exceeds the TDS thresholds set forth above, the existing regulatory water quality compliance and remediation programs will apply. These include, but are not limited to, the CV-SALTS Salt Control Program, the County Drought Plan requirements for State Small Water Systems and Domestic Wells (SB 552), the Safe and Affordable Funding for Equity and Resilience (SAFER) program, and the Bureau of Reclamation's Refuge Water Supply Program. For any future exceedance of the TDS thresholds at representative monitoring sites that do not currently exceed the objectives, the applicable GSP group is required to coordinate and publish an assessment of the effect of groundwater management activities on the documented exceedance, and propose timely actions to manage groundwater differently in order to avoid exacerbating the exceedance.

The sustainable management criteria also incorporate by reference the specific requirements for preventing the migration of contaminants adopted by the Central Valley Regional Water Quality Control Board in Cleanup and Abatement Orders for individual contaminated sites.[2]

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[1] *See* https://www.cvsalinity.org/salt-program/; https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf

[2] *E.g.,* the Cleanup and Abatement Order R5-2018-0033 for the Spreckels facility: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/fresno/r5-2018-0033.pdf

Table CC-19: Delta-Mendota Subbasin SMC for Degraded Groundwater Quality	
Definition of Undesirable Results	Degradation of groundwater quality as a result of groundwater management activities that causes significant and unreasonable impacts to beneficial uses and users of groundwater.
Definition of Significant and Unreasonable	Significant and unreasonable impacts to beneficial uses and users of groundwater as a result of groundwater management activities are the migration of contaminant plumes or elevated concentrations of constituents of concern that reduce groundwater availability, and the degradation of surface water quality as a result of groundwater migration that substantially impair an existing beneficial use. Significant and unreasonable is quantitatively defined as exceeding the MT at more than 50% of representative monitoring sites by aquifer in a GSP area where current groundwater quality (as established in the Subbasins GSPs) does not exceed 1,000 mg/L TDS.
Sustainability Goal	Minimize further impairment of water supplies resulting from groundwater management activities that cause the migration or concentration of contaminant plumes or the increased rate of movement or concentrations of constituents of concern. Coordinate with and support compliance with existing regulatory groundwater quality orders and objectives for drinking water, agricultural irrigation, and managed wetlands. Work with neighboring Subbasins to address existing or potential impairments of groundwater quality in the Subbasin caused by groundwater management activities outside the Subbasin.
Minimum Threshold	The minimum threshold for salinity is 1,000 mg/L TDS. For representative monitoring sites that currently exceed the minimum threshold, existing regulatory water quality compliance and remediation programs will apply, including but not limited to, the CV-SALTS Salt Control Program, the Irrigated Lands Regulatory Program, the County Drought Plan requirements for State Small Water Systems and Domestic Wells (SB 552), and the Safe and Affordable Funding for Equity and Resilience (SAFER) program. For any RMS without data prior to the end of Water Year 2016, current (ambient) groundwater quality will be established using data collected during the first five years of monitoring following Water Year 2016 or following construction of the well. For representative monitoring sites that do not currently exceed the minimum threshold, but are found to exceed minimum thresholds in the future, the applicable GSP group will conduct and publish an assessment of the effect of groundwater management activities on the documented exceedance, and propose timely actions to manage groundwater differently, if needed, to avoid exacerbating the exceedance. The applicable GSP group will also coordinate with the appropriate regulatory program to address the impact.
Measurable Objective	The measurable objective for salinity will be concentrations less than 1,000 mg/L TDS. Each GSP group will participate in, provide data for, and track and report on compliance with orders and objectives adopted by the State and Central Valley Regional Water Quality Control Boards and similar regulatory agencies, in coordination with the Central Valley Groundwater Monitoring Collaborative.

Table CC-19: Delta-Mendota Subbasin SMC for Degraded Groundwater Quality	
5-Year Interim Milestones	**Year 5:** Maintain salinity consistent with measurable objectives. Participate in, provide data for, and track and report on compliance with orders and objectives adopted by the State Water Resources and Central Valley Regional Water Quality Control Boards and similar regulatory agencies, in coordination with the Central Valley Groundwater Monitoring Collaborative. Develop correlation between groundwater quality and groundwater levels in order to establish methodology for the use of groundwater levels as a proxy for groundwater quality. **Year 10:** Maintain water quality consistent with measurable objectives. Continue monitoring and publishing groundwater quality data, and tracking and reporting on compliance with regulatory orders and objectives. Where water quality impairments are caused by activities outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Utilizing the methodology developed by the Year 5 Interim Milestone, develop minimum thresholds and measurable objectives for groundwater quality that utilize groundwater elevations as a proxy for monitoring. **Year 15:** Maintain water quality consistent with measurable objectives. Continue monitoring and publishing groundwater quality data, and tracking and reporting on compliance with regulatory orders and objectives. Where water quality impairments are caused by activities outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

The numeric MTs and MOs by RMS are shown below in **Figure CC-67** for the Upper Aquifer and **Figure CC-68** for the Lower Aquifer, with the numeric SMC tabulated in **Table CC-20**.

Table CC-20: Numeric SMC for Degraded Groundwater Quality

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (TDS in mg/L)	Measurable Objective (TDS in mg/L)
09-002	Aliso Water District	Upper	1,000	< 1,000
09-003	Aliso Water District	Upper	1,000	< 1,000
09-005	Aliso Water District	Upper	1,000	< 1,000
09-196	Aliso Water District	Upper	1,000	< 1,000
10-001	Farmers Water District	Upper	1,000	< 1,000
10-005	Farmers Water District	Upper	1,000	< 1,000
12-002	Fresno County	Upper	N/A	N/A
12-003	Fresno County	Upper	N/A	N/A
12-004	Fresno County	Upper	N/A	N/A
12-005	Fresno County	Upper	N/A	N/A
12-006	Fresno County	Upper	1,000	< 1,000
12-007	Fresno County	Upper	N/A	N/A
13-006	Fresno County	Upper	N/A	N/A
13-007	Fresno County	Upper	N/A	N/A

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (TDS in mg/L)	Measurable Objective (TDS in mg/L)
13-008	Fresno County	Upper	N/A	N/A
11-010	Grassland	Lower	TBD	TBD
11-011	Grassland	Lower	1,000	< 1,000
11-012	Grassland	Lower	1,000	< 1,000
11-021	Grassland	Upper	N/A	N/A
19-002	Grassland	Upper	1,000	< 1,000
19-004	Grassland	Upper	N/A	N/A
01-001	NCDM	Lower	1,000	< 1,000
01-002	NCDM	Lower	1,000	< 1,000
01-003	NCDM	Lower	N/A	N/A
01-004	NCDM	Upper	1,000	< 1,000
01-006	NCDM	Lower	1,000	< 1,000
01-007	NCDM	Lower	1,000	< 1,000
01-008	NCDM	Lower	1,000	< 1,000
01-018	NCDM	Upper (assumed)	1,000	< 1,000
02-002	NCDM	Lower	1,000	< 1,000
02-009	NCDM	Upper	1,000	< 1,000
03-001	NCDM	Upper	N/A	N/A
03-003	NCDM	Upper	N/A	N/A
03-007	NCDM	Upper	1,000	< 1,000
04-001	NCDM	Lower	1,000	< 1,000
06-001	NCDM	Lower	1,000	< 1,000
06-002	NCDM	Upper	1,000	< 1,000
06-003	NCDM	Lower	1,000	< 1,000
06-004	NCDM	Upper	N/A	N/A
07-002	NCDM	Lower	1,000	< 1,000
07-003	NCDM	Upper	1,000	< 1,000
07-007	NCDM	Lower	1,000	< 1,000
07-008	NCDM	Lower	N/A	N/A
07-012	NCDM	Upper	N/A	N/A
07-014	NCDM	Lower	1,000	< 1,000
07-015	NCDM	Lower	1,000	< 1,000
07-016	NCDM	Lower	1,000	< 1,000
07-017	NCDM	Upper	1,000	< 1,000
07-018	NCDM	Upper	N/A	N/A
07-028	NCDM	Lower	N/A	N/A
07-029	NCDM	Upper	N/A	N/A
07-030	NCDM	Lower	N/A	N/A
07-031	NCDM	Lower	N/A	N/A
07-032	NCDM	Lower	N/A	N/A

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (TDS in mg/L)	Measurable Objective (TDS in mg/L)
07-033	NCDM	Upper	1,000	< 1,000
07-034	NCDM	Lower (assumed)	N/A	N/A
07-035	NCDM	Upper	N/A	N/A
08-002	NCDM	Upper	N/A	N/A
14-001	SJREC	Upper	1,000	< 1,000
14-002	SJREC	Upper	1,000	< 1,000
14-003	SJREC	Upper	N/A	N/A
14-004	SJREC	Upper	1,000	< 1,000
14-005	SJREC	Upper	N/A	N/A
14-006	SJREC	Upper	1,000	< 1,000
14-007	SJREC	Upper	N/A	N/A
14-008	SJREC	Upper	1,000	< 1,000
14-019	SJREC	Lower	1,000	< 1,000
14-020	SJREC	Lower	1,000	< 1,000
14-021	SJREC	Lower	N/A	N/A
23-001	SJREC	Upper	1,000	< 1,000

Notes:

1. Current TDS concentration is defined as prior to the end of WY 2016.
2. N/A - Current groundwater quality exceeds 1,000 mg/L TDS.
3. TBD - Numeric SMC to be determined after five years of data have been collected for this representative monitoring site.

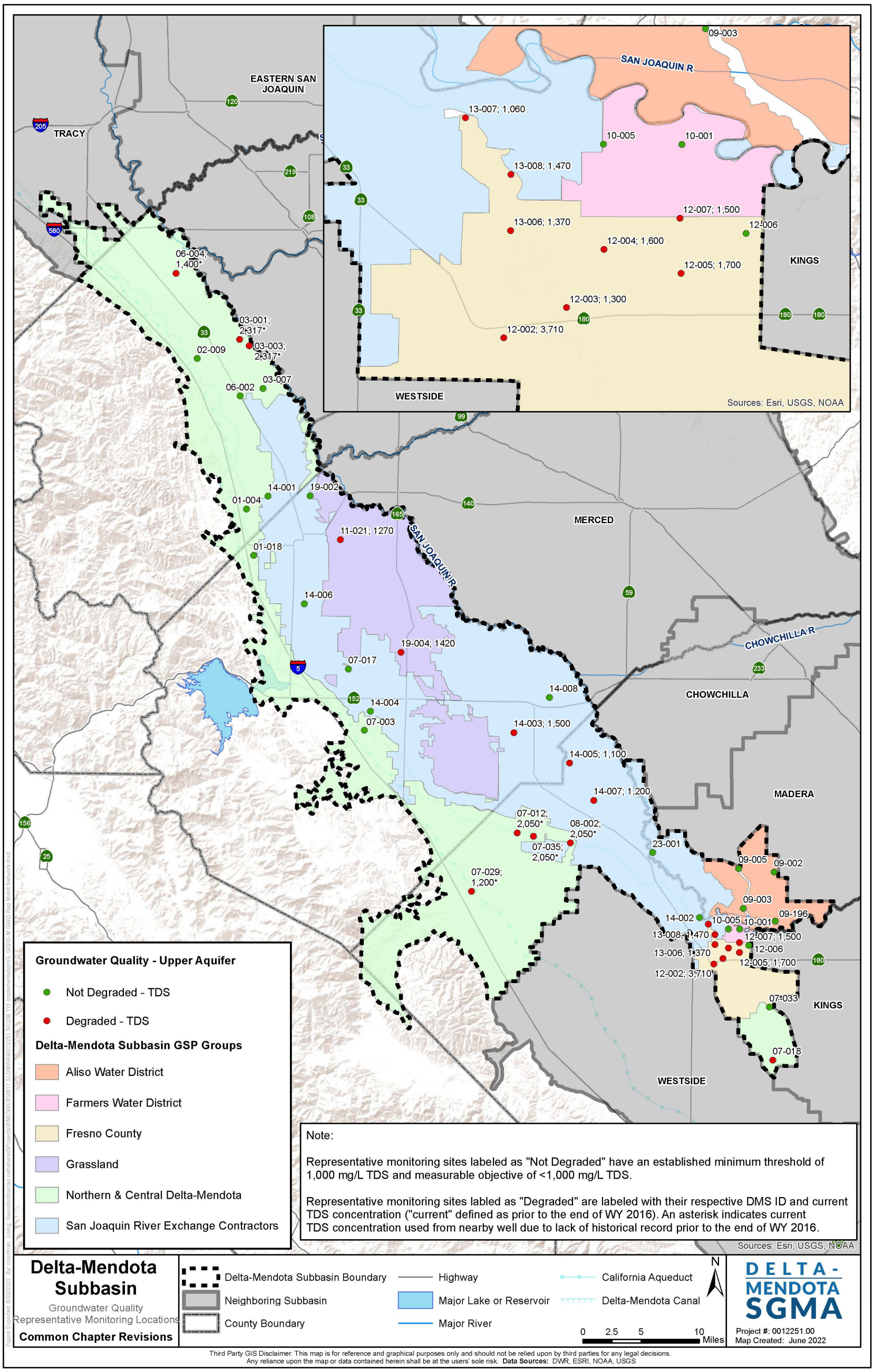

Figure CC-67: Groundwater Quality Representative Monitoring Locations with SMC – Upper Aquifer

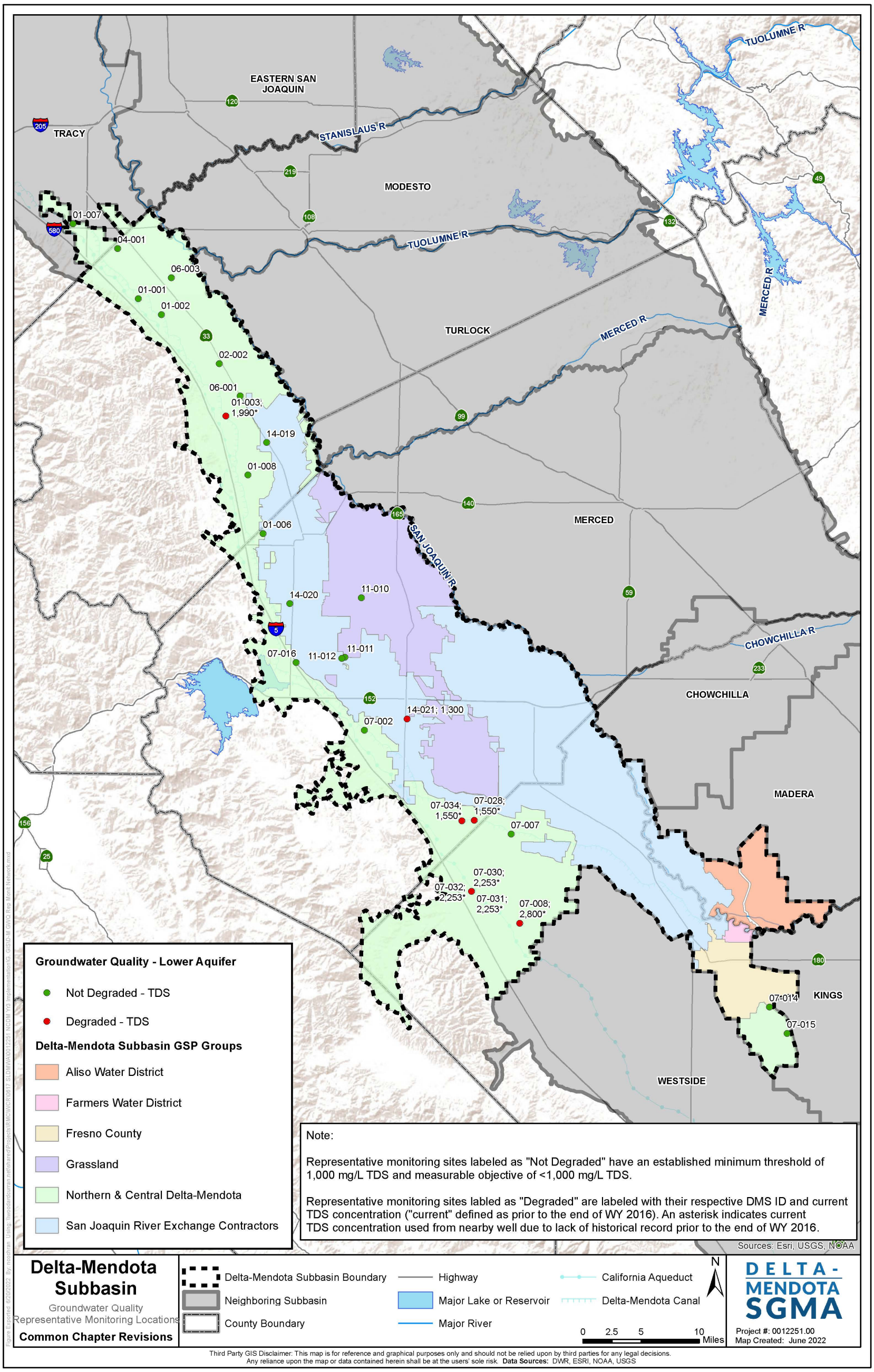

Figure CC-68: Groundwater Quality Representative Monitoring Locations with SMC – Lower Aquifer

5.4.4 Inelastic Land Subsidence

The Subbasin GSAs are committed to ramping down the amount of allowable subsidence caused by groundwater extraction in the Subbasin and eliminating additional subsidence within the Subbasin by 2040. Further, the GSAs will coordinate with neighboring subbasins to address inelastic land subsidence caused by groundwater management activities that occur outside of the Subbasin.

The SMCs for Land Subsidence were coordinated at the Subbasin level and are designed to be protective of critical infrastructure, including significant and unreasonable reductions of conveyance capacity (i.e., structural damage that creates an unmanageable reduction of design capacity), impacts to natural resource areas (i.e., unmitigated decreases in the ability to irrigate or drain these areas by gravity), or conditions that threaten public health and safety (i.e., unmitigated reduction of freeboard that allows for flooding, or unmitigated damage to roads and bridges). The Subbasin-wide MT is set to prevent subsidence that exceeds the corrective design standards or established triggers for critical infrastructure, including the Delta-Mendota Canal and California Aqueduct. At the RMS, the MT is defined as two feet of additional inelastic subsidence by 2040 attributable to groundwater extraction within the Subbasin. The MO is set at no additional subsidence after 2040 based on groundwater extractions within the Delta-Mendota Subbasin.

The GSAs further developed Interim Milestones (IMs) to periodically reduce the amount of allowable subsidence and meet the MO by 2040. The IMs allow for no more than 1.0 foot of additional subsidence by 2025, 0.5 feet of additional subsidence by 2030 (1.5 feet of cumulative subsidence), 0.25 feet of additional subsidence by 2035 (1.75 feet of cumulative subsidence), and 0.25 feet of additional subsidence by 2040 (2.0 feet of cumulative subsidence). The SMCs were defined at 45 RMS in the Subbasin, and the GSAs will conduct monitoring to track progress towards sustainability. Additionally, as part of the 5-year update to the GSPs, the Subbasin Hydrogeologic Conceptual Model (HCM) will be reviewed and revised to incorporate new data, including Airborne Electromagnetic (AEM) survey data provided by DWR and data/results from the Subsidence Study prepared using Prop 68 grant funding. Additionally, the GSAs will continue work with USBR on revisions to the CVHM2 model for simulating groundwater extraction-subsidence interactions, to re-evaluate inelastic land subsidence SMC to consider new data and studies, and to assess allowable land subsidence on a Subbasin and localized (subbasin subarea) basis.

Table CC-21: Delta-Mendota Subbasin SMC for Inelastic Land Subsidence

Definition of Undesirable Results	Changes in ground surface elevation that cause damage to critical infrastructure, including significant and unreasonable reductions of conveyance capacity, impacts to natural resource areas, or conditions that threaten public health and safety.
Definition of Significant and Unreasonable	Significant and unreasonable damage to conveyance capacity from inelastic land subsidence is structural damage that creates an unmitigated and unmanageable reduction of design capacity or freeboard. Significant and unreasonable impacts to natural resource areas from inelastic land subsidence are unmitigated decreases in the ability to flood or drain such areas by gravity. Significant and unreasonable threats to public health and safety from inelastic land subsidence are those that cause an unmitigated reduction of freeboard that allows for flooding, or unmitigated damage to roads and bridges.

Table CC-21: Delta-Mendota Subbasin SMC for Inelastic Land Subsidence	
Sustainability Goal	Minimize inelastic land subsidence by ramping down allowable subsidence caused by groundwater extraction in the Subbasin, with no additional subsidence after 2040. Work with neighboring Subbasins to address inelastic land subsidence caused by groundwater extraction outside of the Subbasin.
Minimum Threshold	At representative monitoring sites, the change in ground surface elevation that would cause undesirable results is up to 2 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin. Prevent subsidence caused by groundwater extractions in the Delta-Mendota Subbasin that exceeds corrective design standards or established triggers for critical infrastructure including the Delta-Mendota Canal, California Aqueduct, and roads and bridges.
Measurable Objective	Minimize inelastic land subsidence attributable to groundwater extraction within the Subbasin, with no additional subsidence after 2040.
5-Year Interim Milestones	**Year 5:** Interim goal of no more than 1 foot of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the first 5-year period of SGMA implementation. Review and revise Hydrogeologic Conceptual Model (HCM) to incorporate new data. Re-evaluate inelastic land subsidence SMC to consider new data and studies and to assess allowable land subsidence on a Subbasin and localized (subbasin subarea) basis. Gather data and complete the selection or establishment of representative monitoring sites (RMS) for land subsidence, with particular attention to the locations of critical infrastructure in the Subbasin, and in coordination with the Bureau of Reclamation and Department of Water Resources. Determine the relative proportion of subsidence caused by groundwater extraction within and outside the Subbasin for each RMS. Where subsidence is caused by pumping outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 10:** Interim goal of no more than 0.5 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the second 5-year period of SGMA implementation, for a cumulative total of 1.5 feet in the first 10 years. Where subsidence is caused by groundwater extraction outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Continue work to improve understanding of interconnection between groundwater extractions and land subsidence, utilizing model simulations and/or data collection and analysis. **Year 15:** Interim goal of no more than 0.25 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the third 5-year period of SGMA implementation, for a cumulative total of 1.75 feet in the first 15 years. Where subsidence is caused by groundwater extraction outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Continue work to improve understanding of interconnection between groundwater extractions and land subsidence, utilizing model simulations and/or data collection and analysis.

The numeric MTs and MOs by RMS are shown below in **Figure CC-69**, with the numeric SMC tabulated in **Table CC-22**.

Table CC-22: Numeric SMC for Inelastic Land Subsidence

DMS ID	GSP Region	Minimum Threshold (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)	Measurable Objective (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)
09-006	Aliso Water District	2	0
09-007	Aliso Water District	2	0
09-008	Aliso Water District	2	0
10-008	Farmers Water District	2	0
12-010	Fresno County	2	0
13-010	Fresno County	2	0
11-018	Grassland	2	0
11-019	Grassland	2	0
11-020	Grassland	2	0
01-009	NCDM	2	0
01-010	NCDM	2	0
01-011	NCDM	2	0
01-012	NCDM	2	0
01-013	NCDM	2	0
01-014	NCDM	2	0
01-015	NCDM	2	0
01-016	NCDM	2	0
01-017	NCDM	2	0
02-003	NCDM	2	0
02-004	NCDM	2	0
02-005	NCDM	2	0
02-006	NCDM	2	0
02-007	NCDM	2	0
02-008	NCDM	2	0
03-004	NCDM	2	0
03-005	NCDM	2	0
03-006	NCDM	2	0
04-003	NCDM	2	0
04-004	NCDM	2	0
04-005	NCDM	2	0
06-006	NCDM	2	0
07-019	NCDM	2	0
07-020	NCDM	2	0
07-021	NCDM	2	0
07-022	NCDM	2	0

DMS ID	GSP Region	Minimum Threshold (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)	Measurable Objective (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)
07-023	NCDM	2	0
07-024	NCDM	2	0
07-025	NCDM	2	0
07-026	NCDM	2	0
07-027	NCDM	2	0
14-014	SJREC	2	0
14-015	SJREC	2	0
14-016	SJREC	2	0
14-017	SJREC	2	0
14-018	SJREC	2	0

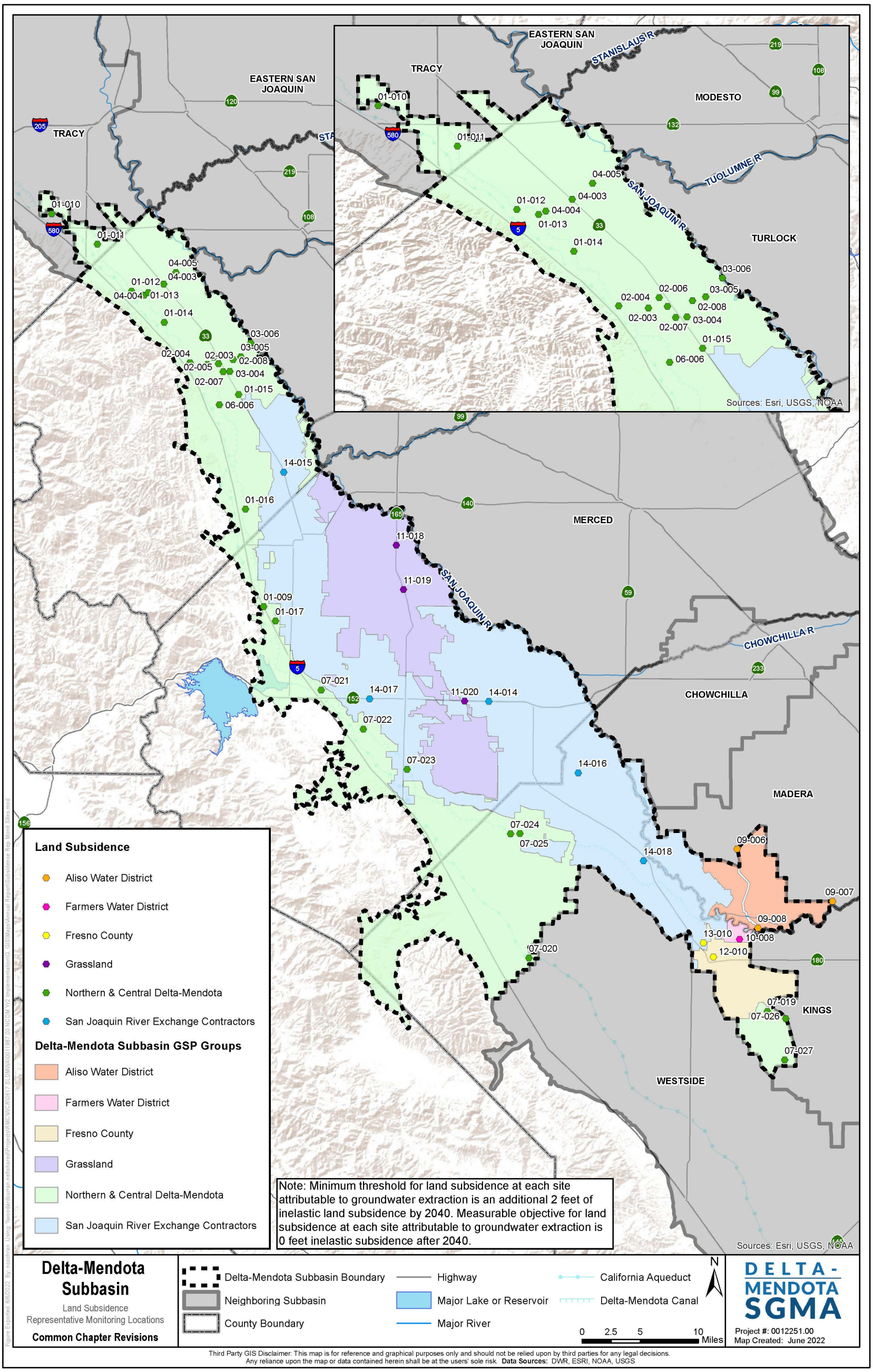

Figure CC-69: Land Subsidence Representative Monitoring Locations with SMC

5.4.5 Depletion of Interconnected Surface Water

The GSAs are committed to managing groundwater within the Subbasin to maintain interconnected surface waters comparable to existing conditions and prevent a trend of increasing interconnected surface water losses from the San Joaquin River. The GSAs will coordinate with neighboring subbasins to address interconnected surface water losses caused by groundwater management activities that occur outside of the Subbasin.

Presently, the Depletion of Interconnected Surface Water Sustainability Indicator is identified as a data gap within the Subbasin. Until the GSAs are able to collect the additional data necessary to set quantitative SMCs for this Sustainability Indicator, the SMCs for Chronic Lowering of Groundwater Levels serve as a proxy in the Upper Aquifer, pursuant to 23 CCR §354.28(d). Because the SMCs established for Chronic Lowering of Groundwater Levels are designed to maintain groundwater levels above historic low conditions, they are understood to be protective of the Depletion of Interconnected Surface Water Sustainability indicator and local natural resources and downstream beneficial uses and users. The RMS locations and frequency are consistent with that detailed in Section 6.

The GSAs plan to establish an Interconnected Surface Water monitoring network and develop SMCs as detailed in Table CC-18. By 2025, the GSAs anticipate completing an Interconnected Surface Water monitoring network that includes nine existing sites in the San Joaquin River Restoration Program and additional sites funded by the SGMA Implementation Grant award. The additional RMS will focus on the Northern & Central Delta-Mendota and Grassland GSP areas along the San Joaquin River. By 2030, the GSAs anticipate being able to gather and analyze data from these new RMS to estimate the influence of groundwater levels on gains and losses observed on the San Joaquin River. At this point, the Subbasin GSAs will establish Interconnected Surface Water SMCs as a rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and may lead to undesirable results.

Table CC-23: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water

Definition of Undesirable Results	Depletions of interconnected surface water as a direct result of groundwater pumping that cause significant and unreasonable impacts on natural resources or downstream beneficial uses and users.
Definition of Significant and Unreasonable	Significant and unreasonable impacts on natural resources or downstream beneficial uses and users of groundwater are a reduction in available surface water supplies for natural resource areas, and reductions in downstream water availability as a result of increased streamflow depletions along the San Joaquin River when compared to similar historic water year types.
Sustainability Goal	Maintain interconnected surface waters comparable to existing conditions (historic low conditions as of Water Year 2016) in order to prevent a trend of increasing interconnected surface water losses from the San Joaquin River. Work with neighboring Subbasins to address increased interconnected surface water losses caused by pumping outside of the Subbasin.
Minimum Threshold	Interconnected Surface Water is an identified data gap in the Delta-Mendota Subbasin. As an interim minimum threshold, use the Chronic Lowering of Groundwater Level Minimum Threshold as a proxy for impacts to interconnected surface waters (see below). The groundwater elevation indicating a chronic lowering of groundwater levels that may lead to undesirable results is an elevation that is lower than the historical seasonal low. The historic seasonal low is a fixed elevation at each

Table CC-23: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water	
	site, based on available groundwater level data prior to the end of Water Year 2016. To account for future year-to-year variations in hydrology, compliance with the fixed historic seasonal low threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Groundwater levels are measured as water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the minimum threshold applies. For any RMS without data prior to Water Year 2016, Minimum Thresholds and acute thresholds will be established using the aforementioned methodologies and the data resulting from the first five years of monitoring following Water Year 2016 or following construction of the well.
Measurable Objective	Interconnected Surface Water is an identified data gap in the Subbasin. As an interim measurable objective, use the Chronic Lowering of Groundwater Level Measurable Objective as a proxy for interconnected surface waters (see below). Maintain seasonal high groundwater levels at an elevation that is at or above the Water Year 2015 seasonal high at representative monitoring sites in a GSP area. The Water Year 2015 seasonal high is a fixed elevation at each site, based on available groundwater level data. If data are unavailable for Water Year 2015 at a representative monitoring site, either a Water Year 2014 or Water Year 2016 Seasonal High will be used. To account for future year-to-year variations in hydrology, compliance with the fixed seasonal high threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Groundwater levels are measured as water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the measurable objective applies. For any RMS without data prior to Water Year 2016, Measurable Objectives will be established using the aforementioned methodology and the data resulting from the first five years of monitoring following Water Year 2016 or following the construction of the well.
5-Year Interim Milestones	**Year 5:** Fill data gaps, establish, and manage groundwater use to avoid the rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and may lead to undesirable results. The Subbasin will complete a monitoring network of Interconnected Surface Water sites that will include six existing sites and datasets. GSP groups will complete the monitoring network with additional sites installed with SGMA Implementation Grant funding awarded to the Subbasin. The existing nine sites are part of the San Joaquin River Restoration Program and are located along the San Joaquin River at the southern end of the Subbasin. These nine sites, and the associated datasets, will continue to be utilized by the Subbasin as part of its monitoring network. Additional representative monitoring network sites for Interconnected Surface Water will focus on the Northern & Central Delta-Mendota and Grassland GSP areas along the San Joaquin River. **Year 10:** Gather and analyze data from Subbasin's established representative monitoring network sites. Also gather and analyze available data in cooperation with neighboring subbasins, the U.S. Bureau of Reclamation's San Joaquin River Restoration Program, the U.S. Geological Survey, and DWR's California Data Exchange Center (CDEC), to estimate the influence of groundwater on gains and losses in the San Joaquin River. Establish minimum thresholds and

Table CC-23: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water	
	measurable objectives as a rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and may lead to undesirable results. **Year 15:** Monitor and maintain interconnected surface waters in accordance with revised minimum thresholds and measurable objectives. Where increased interconnected surface water losses are caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

The RMN for this sustainability indicator is shown below in **Figure CC-70**. Please see **Table CC-17** for the numeric SMC associated with the Chronic Lowering of Groundwater Levels.

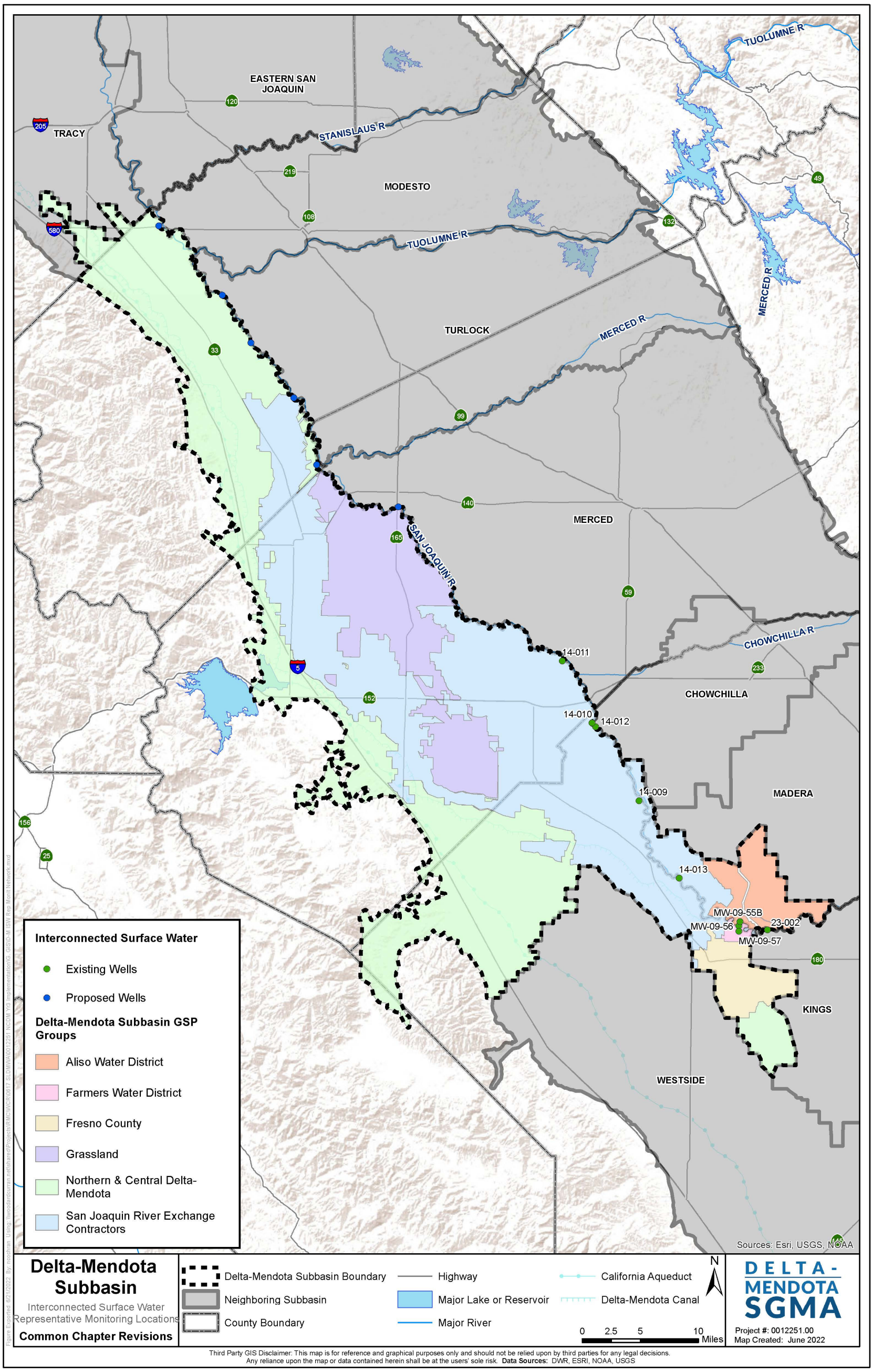

Figure CC-70: Interconnected Surface Water Representative Monitoring Locations with SMC

6. SUBBASIN MONITORING PROGRAM

As required by Subarticle 4. Monitoring Networks of the GSP regulations, the GSPs must include a monitoring network for each sustainability indicator, in addition to describing the monitoring protocols and data management to be followed in implementing the GSP monitoring program. Given the variability of conditions within the Delta-Mendota Subbasin, each GSP Group initially developed their individual monitoring networks, in coordination with their neighboring GSP Groups, such that the subbasin-wide monitoring program is simply a compilation of those coordinated individual monitoring networks. These representative monitoring networks were then re-evaluated as part of the update to the Subbasin GSP in 2022. Please see the individual GSPs for further discussion as to how the monitoring networks were developed.

The subbasin-wide monitoring networks presented herein are the representative monitoring networks for each of the applicable sustainability indicators, as defined according to the GSP Regulations § 354.36, *Representative Monitoring*. It is at the representative monitoring sites where each GSP Group has defined minimum thresholds, measurable objectives, and interim milestones to evaluate progress in achieving the Subbasin's sustainability goal by 2040. Data collected at the representative monitoring locations may be augmented with additional data, as available and appropriate, from other locations and/or publicly available datasets, in evaluating Subbasin conditions on an annual basis.

6.1.1 Coordinated Assumptions and Data

As previously noted, the required monitoring networks were initially developed at the GSP-level in order to appropriately capture the variability of hydrogeologic and water quality conditions in the Delta-Mendota Subbasin, and then re-evaluated at the Subbasin level to confirm that the monitoring networks meet the necessary requirements. All common coordinated assumptions agreed upon and implemented by each GSP Group in developing their respective monitoring networks are presented in Technical Memorandum 5 (*Assumptions for Delta-Mendota Subbasin Monitoring Network*) which is included in **Appendix B** of this Common Chapter.

6.1.2 Coordinated Monitoring Activities

All Delta-Mendota Subbasin GSP Groups have agreed to utilize the following monitoring protocols, data management, and roles and responsibilities for implementing and reporting from their respective monitoring plans under SGMA to ensure consistency in data collection, analysis and management allowing for subbasin-wide evaluation of groundwater conditions relative to the Subbasin sustainability goal, as defined and agreed upon by all GSP Groups.

Monitoring Protocols

Each GSP Group will utilize agreed-upon protocols, which may be the same as, or equal to, data collection protocols (i.e., industry standards and best management practices) to ensure the collection of comparable data using comparable methods. Additionally, the following minimum monitoring frequency for each applicable sustainability indicator was agreed upon by each GSP Group during the joint Delta-Mendota Subbasin Coordination Committee and Technical Working Group meeting on June 18, 2019:

- **Chronic lowering of groundwater levels/reduction in groundwater storage** - Twice per year, with seasonal high groundwater elevation data collected between February and April, and seasonal low groundwater elevation data collected between September and October. All measurements will be collected to a tenth of a foot.

- **Degraded water quality** – Once per year during irrigation season, typically between May and July.
- **Depletions of interconnected surface water** – Twice per year in conjunction with groundwater level monitoring.
- **Subsidence** – Publicly available subsidence data will be used along with locally-collected data. At a minimum, three data points will be collected within the first five years of GSP implementation, with a baseline value from 2019 or a date prior to that.

For non-monitored data to be reported as part of the annual reports (e.g., groundwater extractions, surface water deliveries), actual metered data will be used where such data exists, and when direct data do not exist, estimated quantities will be calculated based on existing indirect data (e.g., electrical usage, crop demand, ET) and/or other industry best practices. Additionally, where available and applicable, public datasets will be used to augment monitoring data collected by the Subbasin and analyzed on an annual basis.

Data Management

Each GSP Group will be responsible for conducting quality control reviews of data collected from the monitoring networks. As described in the Coordination Agreement, each GSP Group will exchange and share collected data in order to facilitate analysis and reporting at the Subbasin level. The Coordinated Data Management System (DMS) will be the primary vehicle by which data are shared amongst the GSP Groups, and it will be the responsibility of each GSP Group to conduct a quality control review of data entered into the DMS.

Roles and Responsibilities

It will be the responsibility of each GSP Group, and the GSAs included in that group, to conduct the monitoring program as agreed upon at the Subbasin level, for reviewing the data collected, and for ensuring that these data are available at the Subbasin level. **Figure CC-71** shows the general flow of data collected from the Delta-Mendota monitoring programs.

Figure CC-72 shows the roles and responsibilities of each GSA and GSP Group in the collecting, processing and reporting of data from the GSP monitoring networks. Additionally, it is the responsibility of each GSP Group, including their respective GSAs, to maintain the monitoring network and, as appropriate, revise and/or expand the monitoring networks to fill identified data gaps. Please see the individual GSPs for further information regarding data gaps and the GSAs plans for addressing those gaps.

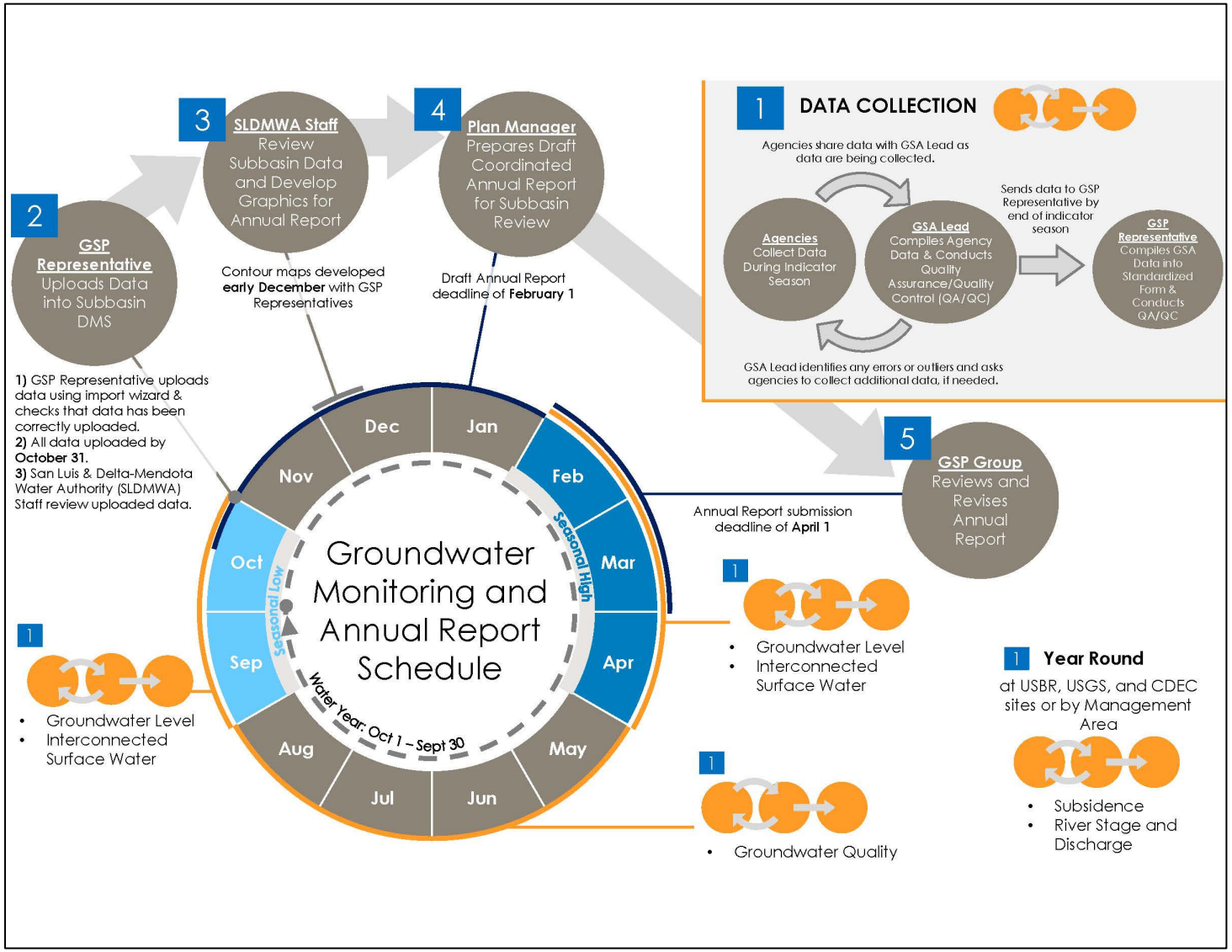

Figure CC-71: Data Flow in Delta-Mendota Subbasin

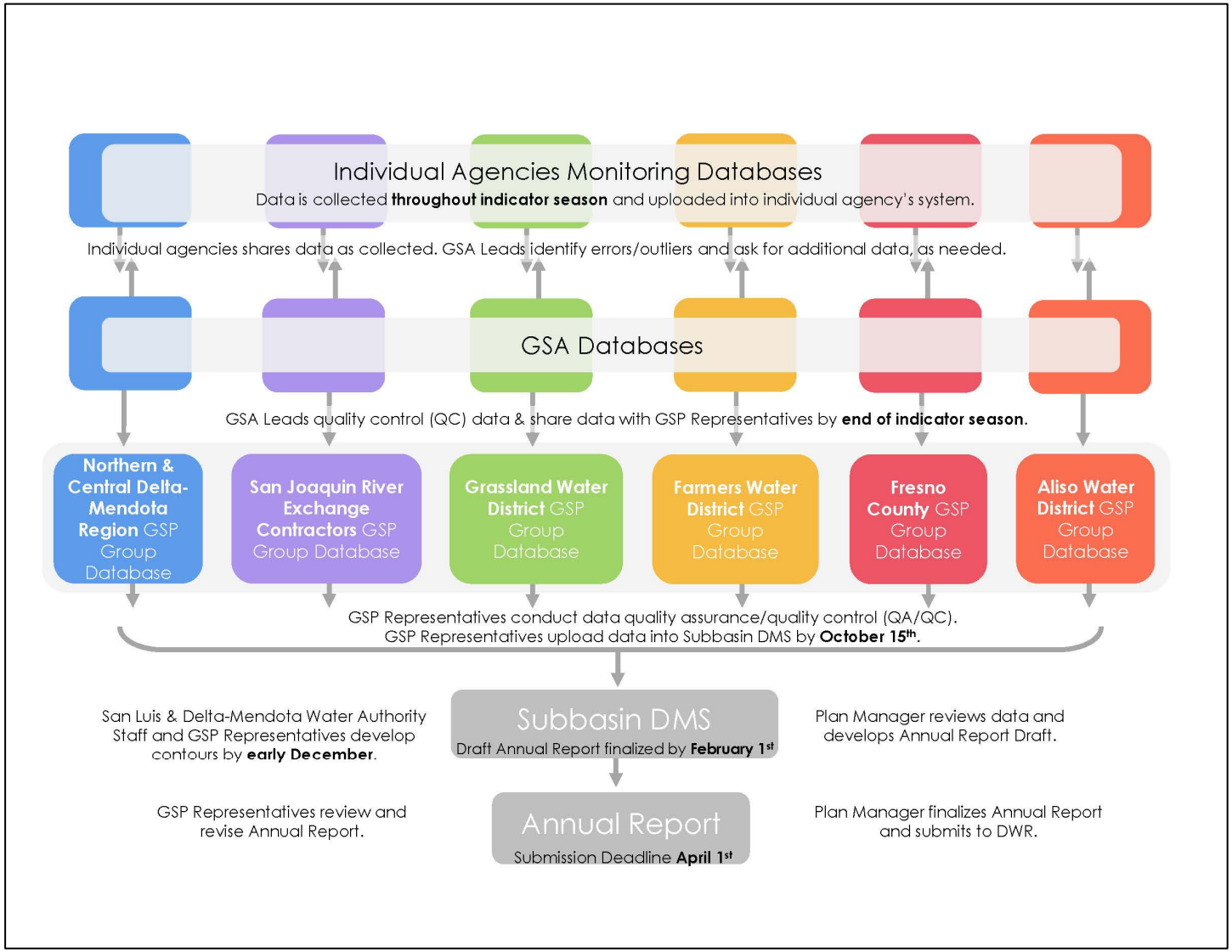

Figure CC-72: Delta-Mendota Monitoring and Data Management Roles and Responsibilities

6.1.3 GSP-Level Monitoring Networks

For more information on the individual GSP monitoring networks for each applicable sustainability indicator, including how the networks were developed, please refer to the individual GSPs. The monitoring networks for each applicable sustainability indicator for each GSP Group were developed in accordance with the GSP Regulations Article 5. Plan Contents, Subarticle 4. Monitoring Networks (§ 354.21 – 354.40). DWR's Best Management Practices for the *Sustainable Management of Groundwater Monitoring Protocols, Standards, and Sites BMP* (2016b) and *Monitoring Networks and Identification of Data Gaps BMP* (2016a) documents were used when and where applicable at the discretion of each GSP group in developing monitoring networks and monitoring protocols.

6.1.4 Delta-Mendota Subbasin Monitoring Networks

The subbasin-level monitoring networks are a compilation of the representative monitoring networks developed by each individual GSP Group and reviewed and modified at the Subbasin level for consistency and appropriate coverage. The monitoring network for the chronic lowering of groundwater sustainability indicator is comprised of two parts, the Upper Aquifer (**Figure CC-73**) and Lower Aquifer (**Figure CC-74**). The monitoring networks for the reduction in groundwater storage for the Upper Aquifer and Lower Aquifer are the same as those utilized for the chronic lowering of groundwater levels. The monitoring network for the degraded water quality sustainability indicator is also comprised of two parts, the Upper Aquifer (**Figure CC-75**) and Lower Aquifer (**Figure CC-76**). Data gaps (areas without wells of known construction) are shown for the Upper Aquifer and Lower Aquifer for the chronic lowering of groundwater and degraded water quality sustainability indicator. The interconnected surface water monitoring network for the Delta-Mendota Subbasin is shown in **Figure CC-77**, and the monitoring network for land subsidence for the Delta-Mendota Subbasin is shown in **Figure CC-78**.

The Delta-Mendota Subbasin representative monitoring networks will be periodically reviewed and revised, as appropriate, by the GSP Groups responsible for maintaining them and coordinated at the Subbasin level. Revised monitoring networks will be included in the five-year updates to the GSPs.

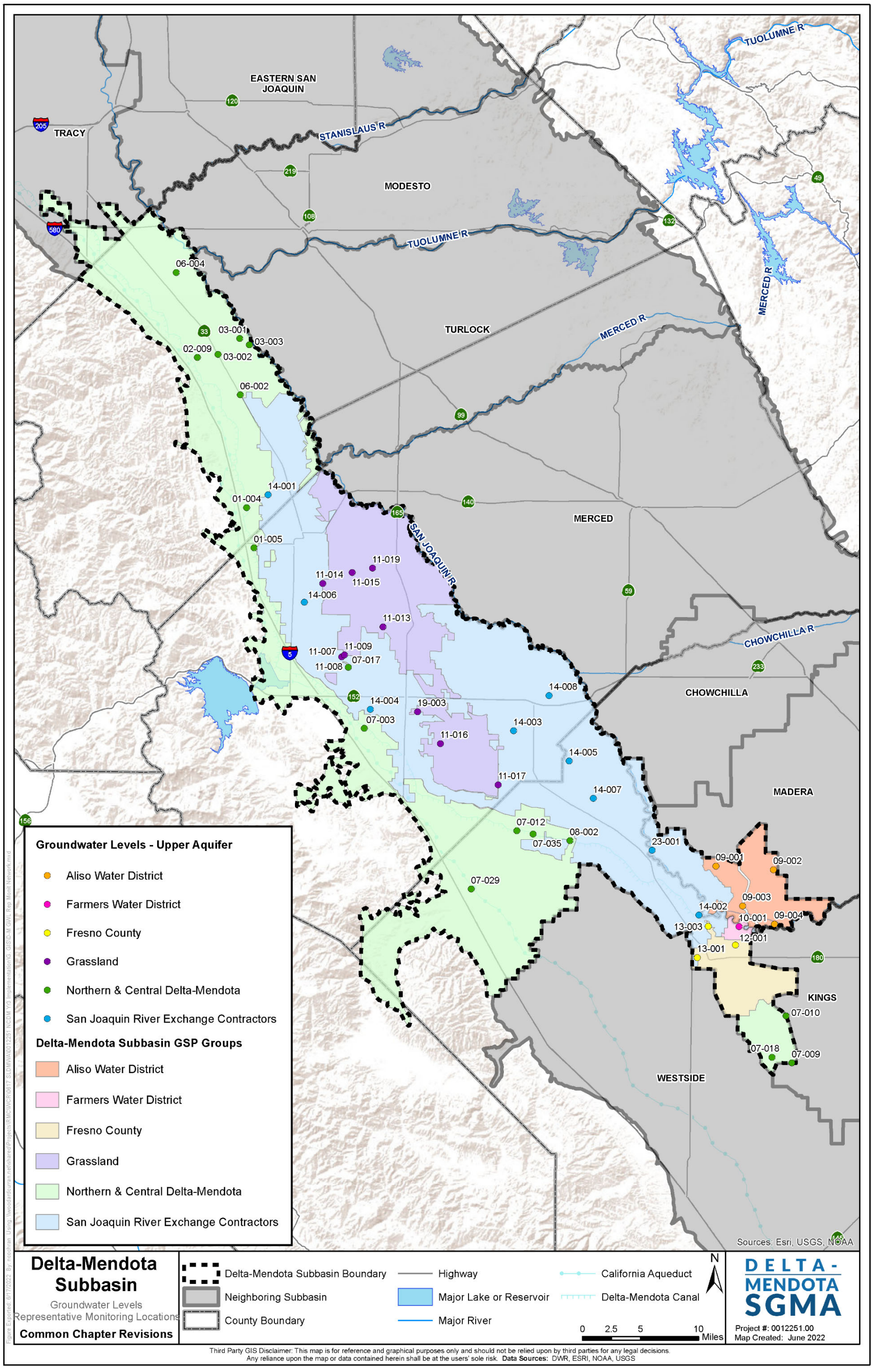

Figure CC-73: Upper Aquifer Groundwater Level Monitoring Network

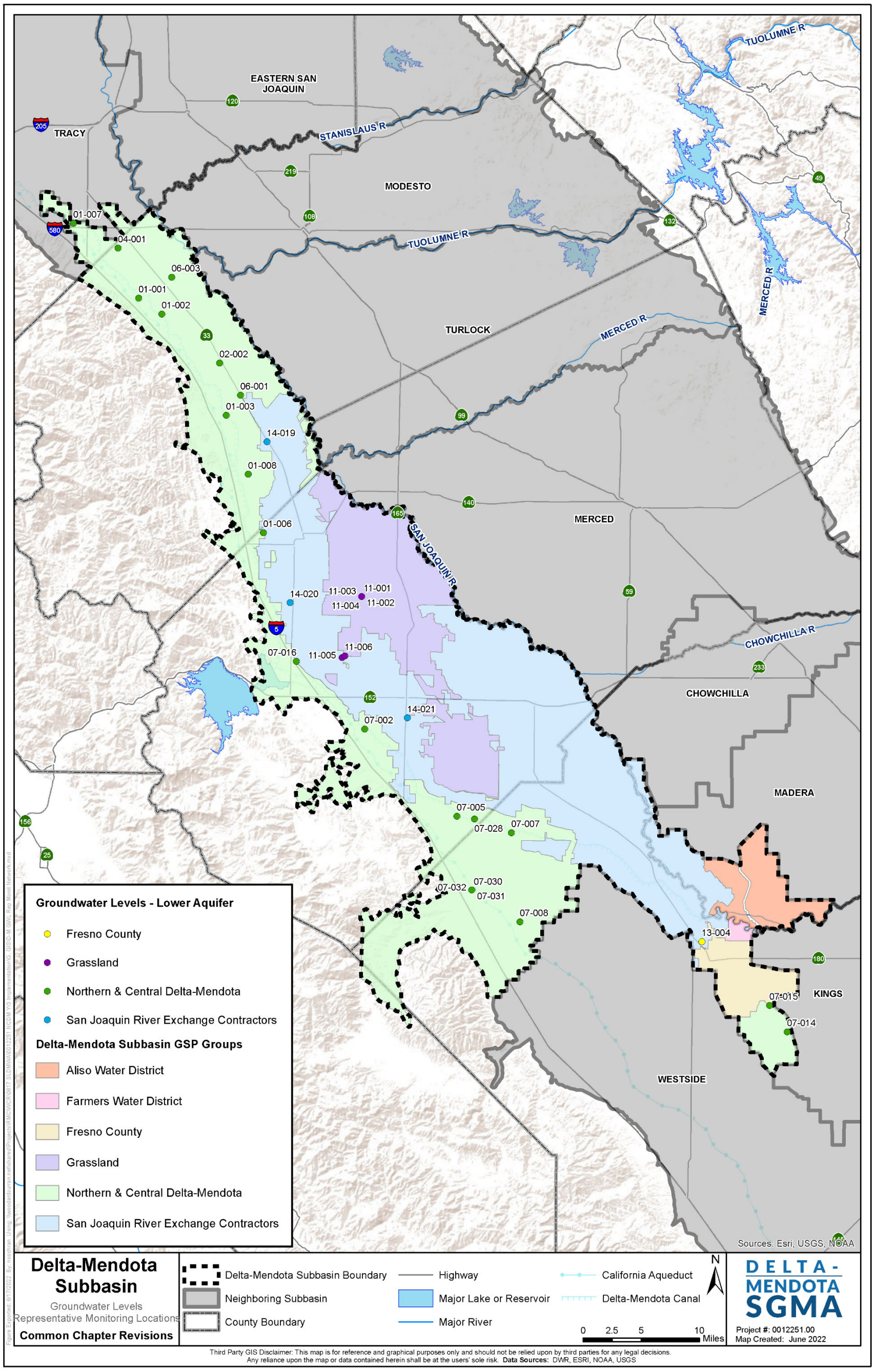

Figure CC-74: Lower Aquifer Groundwater Level Monitoring Network

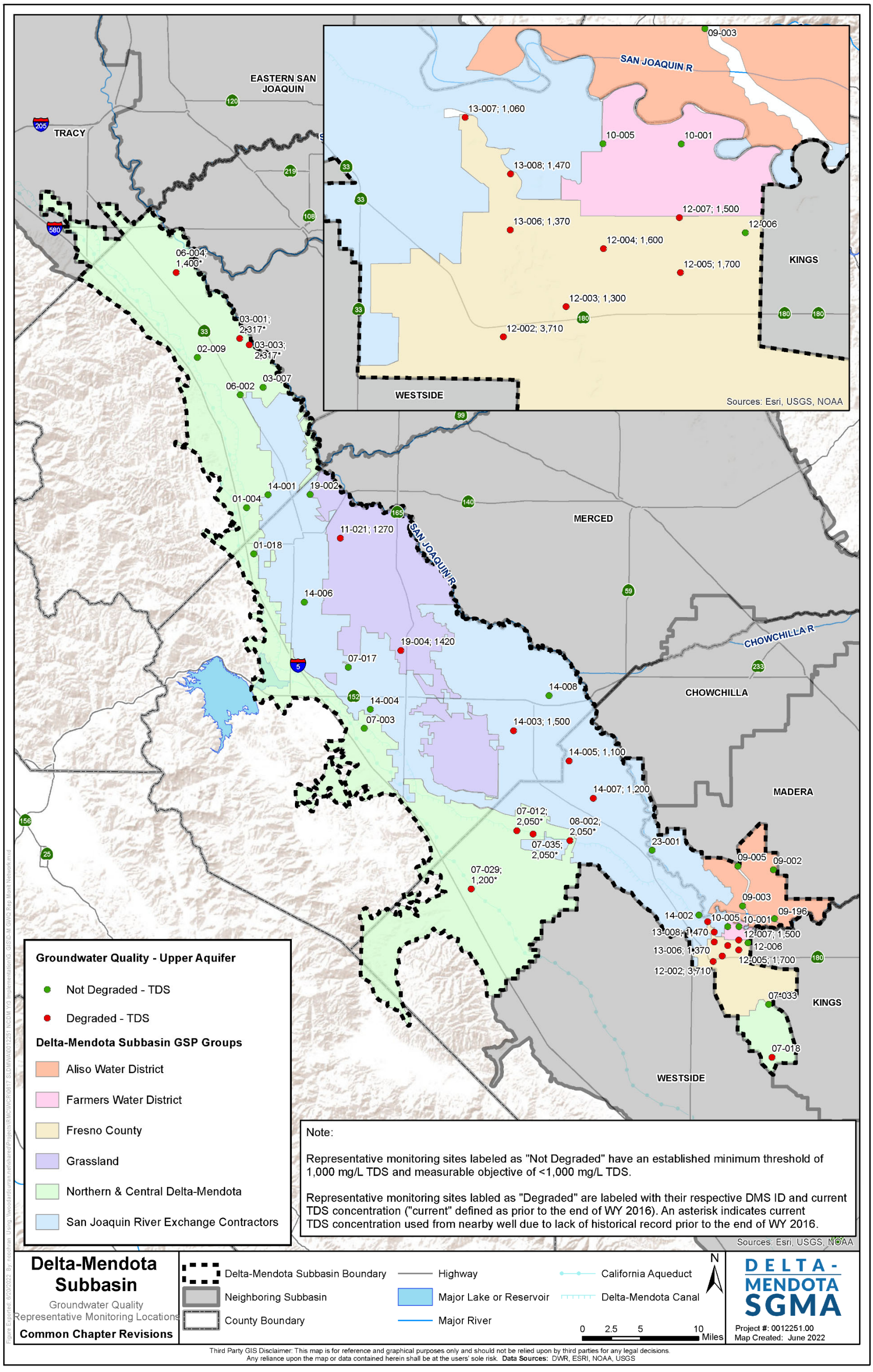

Figure CC-75: Upper Aquifer Groundwater Quality Monitoring Network

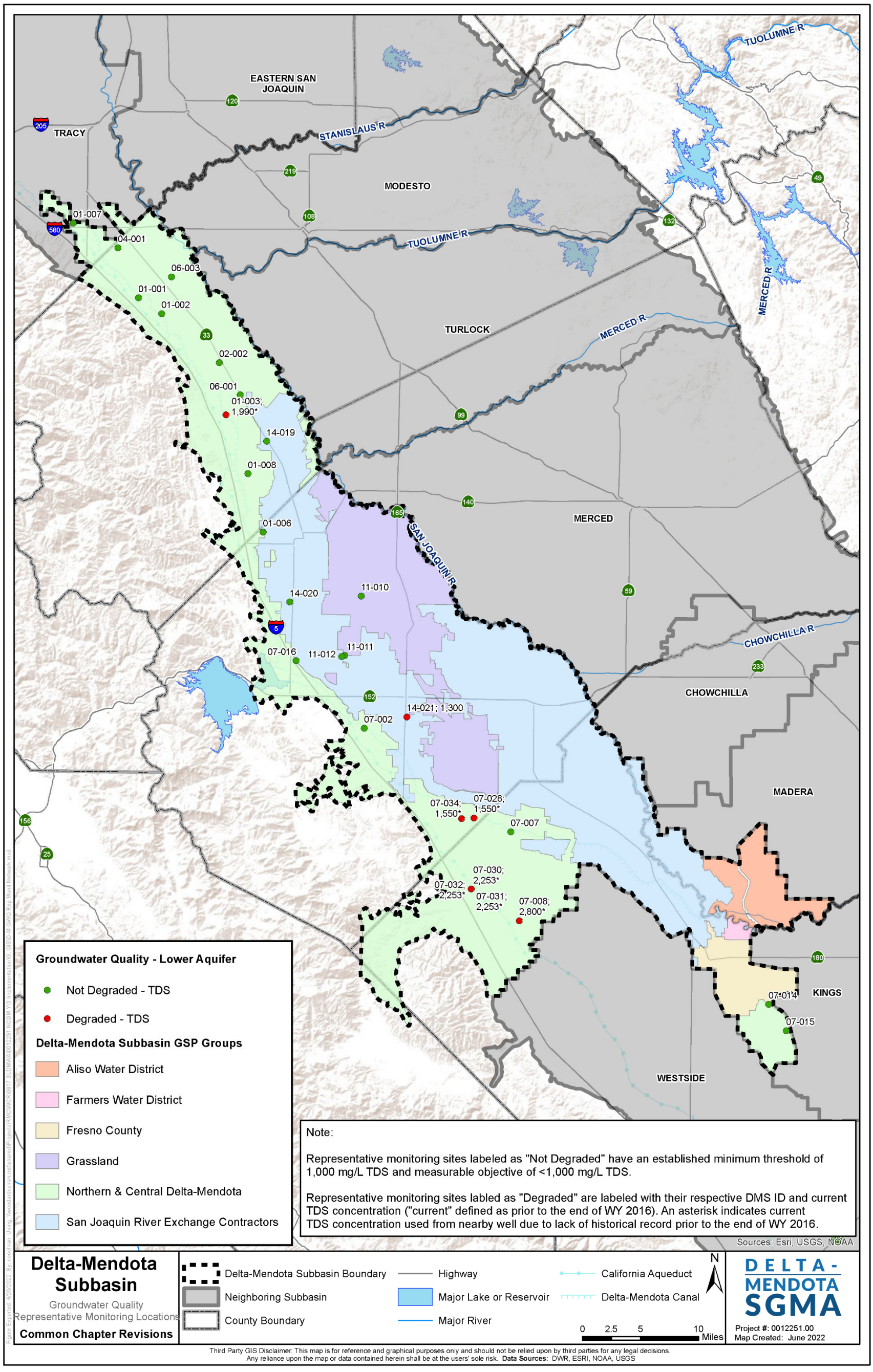

Figure CC-76: Lower Aquifer Groundwater Quality Monitoring Network

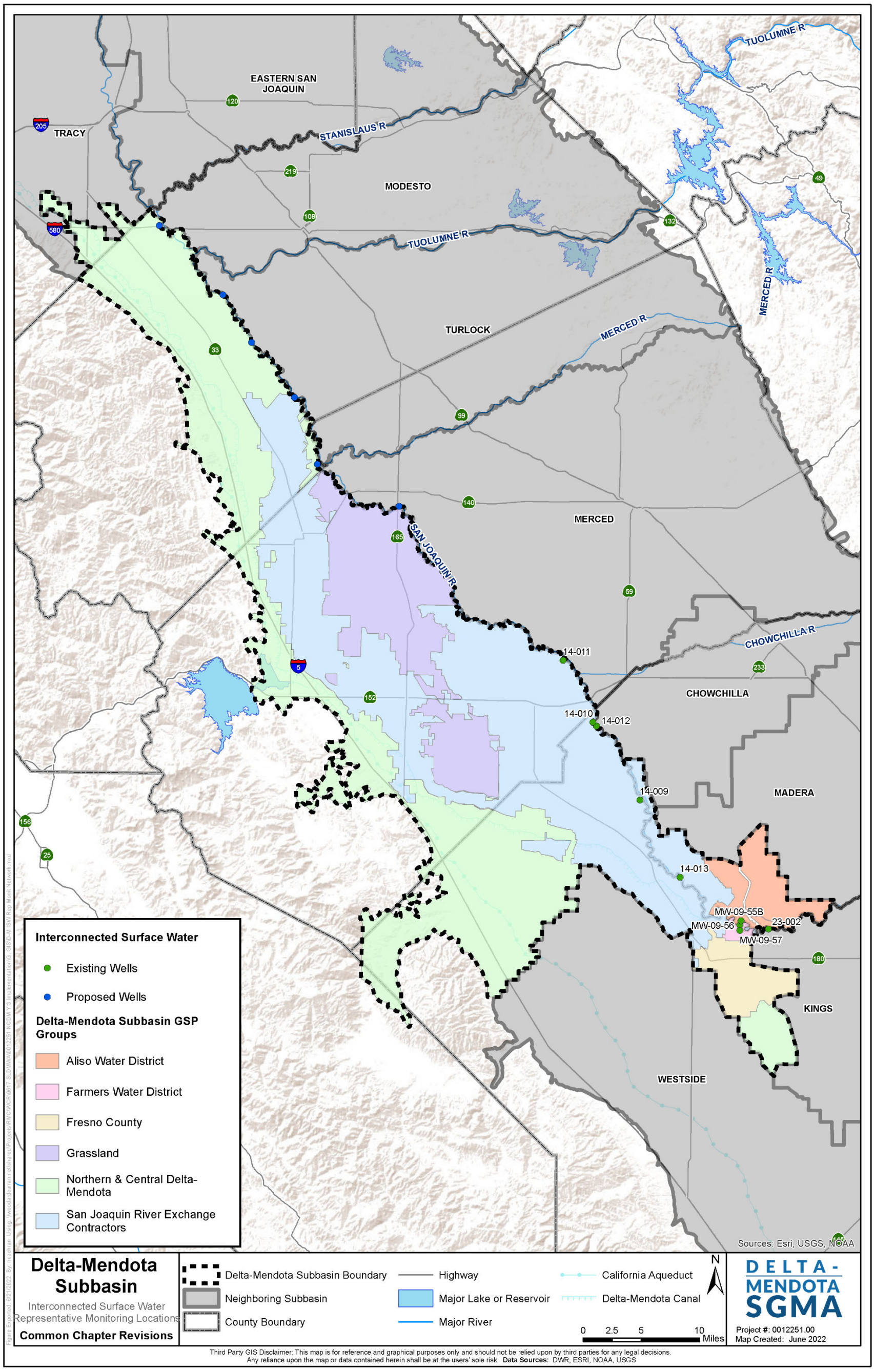

Figure CC-77: Interconnected Surface Water Monitoring Network

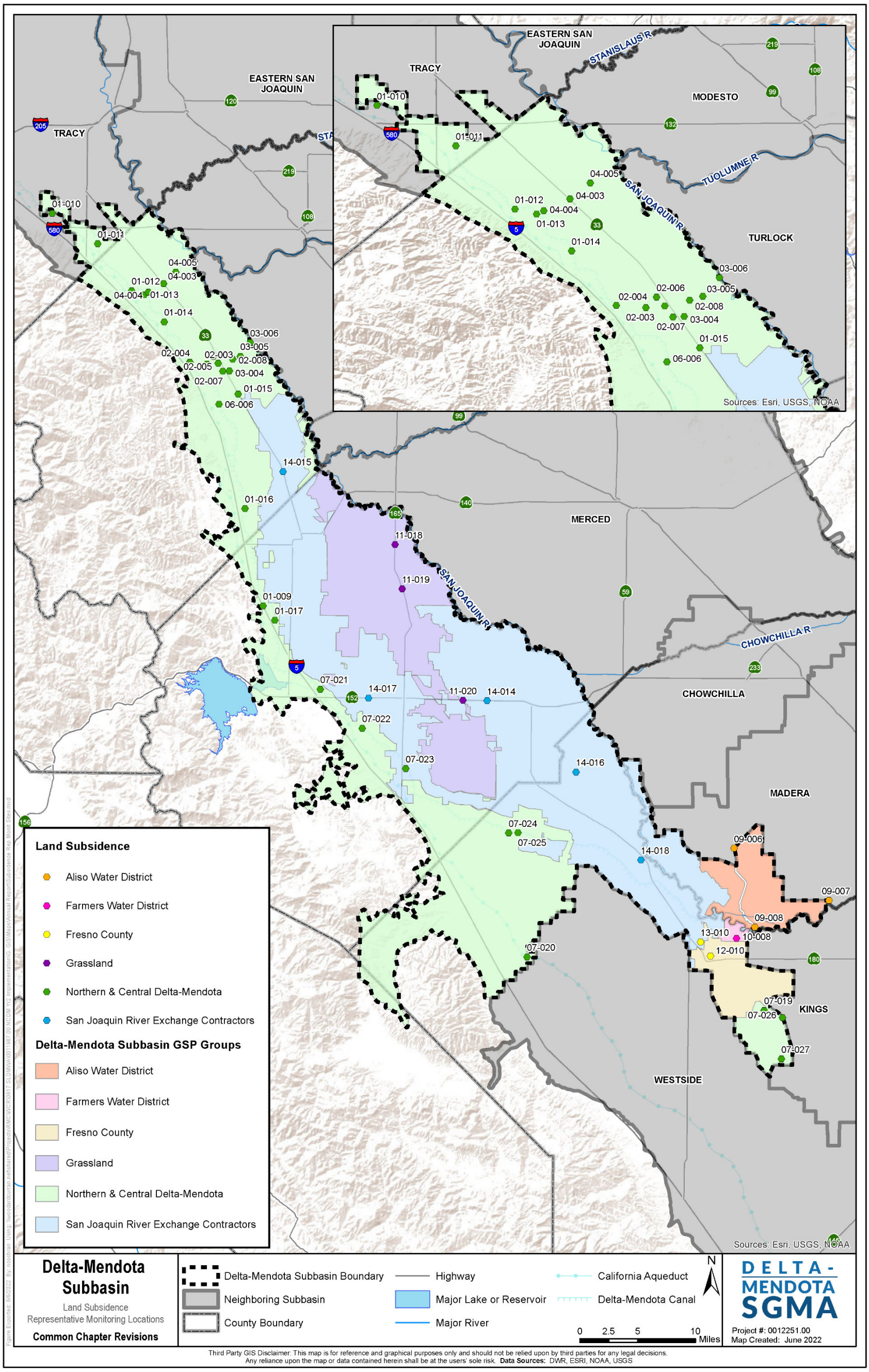

Figure CC-78: Land Surface Elevation Monitoring Network

7. SUBBASIN DATA COLLECTION AND MANAGEMENT

As required in §352.6, Data Management System of the GSP regulations, each GSA is required to develop and maintain a data management system (DMS) that is capable of storing and reporting information relevant to the development or implementation of the GSP(s). Additionally, per §354.4, Reporting Monitoring Data to the Department, all monitoring data is to be stored in a DMS with copies of the monitoring data included in the annual report and submitted electronically on forms provided by DWR. Recognizing that GSP implementation, including annual reporting, will require some efforts at the subbasin level, the 23 GSAs overlying the Delta-Mendota Subbasin have chosen to develop a coordinated DMS that can be utilized by each GSP Group for management of their data, but which will allow for the required compendium of data sets for preparation of Subbasin annual reports. The coordinated DMS will also provide a generic framework that can be used by any GSP Group or GSA in the Subbasin for individual data management while allowing for consistent formatting and the simplified uploading of compiled datasets into the Subbasin-wide coordinated DMS.

The individual GSP Groups have also developed and will maintain separate data storage processes or DMSs. Each separate DMS developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the respective GSA and/or GSP Group, and ultimately to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Subbasin Plan Manager and Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

The DMS constructed for the Delta-Mendota Subbasin is a secured web-based application hosted on Amazon Web Services (AWS). The DMS focuses on five core business requirements including: centralized data warehouse, security of data, permissioned based access, data visualization and reporting. Other goals of the DMS focus around improving data collection/aggregation processes, creating data standards, gaining efficiencies in reporting and improving data sharing with stakeholders. The DMS is designed to aggregate data through import processes by GSP to support data visualization and annual report generation.

Underlying the web application is a relationship database used to store the information aggregated from GSPs across primary data types identified to support monitoring and Annual Report development. Those data types include groundwater extractions, surface water deliveries, groundwater storage, groundwater elevations, groundwater quality, interconnected surface water and land subsidence. The web application functionality includes an embedded GIS viewer, screens to view tables of time series data, and charting capabilities for hydrographs. The embedded GIS viewer contains functionality to store map layers such as reference data, GSA/GSP boundaries and derived information such as water level contours.

Section 6.1.2 describes the process by which monitoring data are collected by each GSP Group and processed for inclusion in the Coordinated DMS. In order to be able to track data by location in the Subbasin, each monitoring locations in the Delta-Mendota Subbasin is assigned a unique identifier in the DMS. The number system is in a format of ##-####, where the first two digits indicates which GSA the monitoring location is associated with, the subsequent four digits indicate which specific monitoring

location in that GSA area. As shown in **Figure CC-72**, the general methodology agreed upon for data import and management is as follows:

- Each GSA collects their respective data per agreed-upon monitoring protocols and transmits it to the GSA Representative.
- Each GSA Representative then compiles the data and conducts a quality control check.
- The GSA Representative then transmits the compiled data set to the GSP Lead or Representative, who then aggregates the data from all GSAs and conducts a second quality control check.
- The GSP Lead or Representative then uploads the data set into the DMS using import wizards designed specifically for this process.
- The Subbasin Plan Manager then uses the data in the DMS to compile information as required for the annual report.

Compiled data sets from the DMS are then augmented with required maps generated externally to produce the required annual report. Mapping prepared outside the DMS are subsequently imported into the DMS as GIS files to ensure all data are kept in one place and to allow for access by GSAs and other Subbasin stakeholders.

The DMS will be maintained by the San Luis & Delta-Mendota Water Authority, while acting as the Plan Manager, with a contract with the software vendor for hosting, maintenance and future maintenance. Each GSP will pay a maintenance fee for the continued hosting and support of the Subbasin coordinated DMS.

The Coordinated DMS as described herein may be supplemented by additional DMS developed and maintained by each GSP Group in the Subbasin. The reader is referred to each of the six Subbasin GSPs for specific information relative to data collection and management in each GSP Plan area.

8. STAKEHOLDER OUTREACH

California Code of Regulations, Title 23, §354.10 identifies the requirements for notice and communication information presented in a GSP, which includes:

- A summary of information relating to notification and communication by the GSAs with other agencies and interested parties;
- A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties;
- A list of public meetings at which the GSP was discussed or considered by the GSAs;
- Comments regarding the GSP received by the GSAs and a summary of any responses by the GSAs;
- A communication section of the GSP that includes an explanation of the GSAs' decision-making process, identification of opportunities for public engagement, a discussion of how public input and response was used, a description of how the GSAs encouraged the active involvement of diverse social, cultural and economic elements of the population within the basin, and the methods used by the GSAs to inform the public about progress implementing the GSP, including the status of projects and actions.

In meeting these requirements, outreach and educational activities were conducted at the Subbasin, GSP and GSA level throughout the GSP development process. This section describes the noticing and outreach conducted at the Delta-Mendota Subbasin level for GSP development. Please refer to each individual Subbasin GSP for specific details regarding noticing and communication, and descriptions of the beneficial uses and users of groundwater at the GSP and GSA level. Information regarding Subbasin coordination and committees can be found in Section 2, Delta-Mendota Subbasin Governance, of this document.

8.1 Situation Assessment and Communications Plan

To assist in GSA formation and GSP development, agencies in the Delta-Mendota Subbasin sought and received Facilitation Support Services funding from DWR in August 2016. Under this funding, a neutral, third-party facilitation team conducted a situation assessment on behalf of the Subbasin GSAs. The purpose of the assessment was to understand how stakeholders perceived the status of the Subbasin's groundwater resources and identify potential barriers to the successful development of the GSPs. The facilitation team, with input from local agencies, identified 30 stakeholders representing diverse interests and beneficial users in the Subbasin, together with disadvantaged communities, agricultural well owners, government and land use agencies, and environmental and ecosystem interests. From February 2017 to May 2017, the facilitators conducted over 30 phone and in-person interviews with stakeholders. The facilitators recorded the interview responses and summarized the results in a presentation made to the GSA representatives.

The assessment results were used to inform the development of the Delta-Mendota Subbasin Sustainable Groundwater Management Act Communications Plan (Communications Plan), which is provided with this document as **Appendix E**. The Communications Plan identifies near- and long-term outreach and engagement strategies, tactics, and tools for stakeholder engagement in GSP development and

implementation. The Subbasin GSAs used the Communications Plan as a framework for conducting the stakeholder outreach and engagement activities described in this document.

The Delta-Mendota Subbasin is home to a large Hispanic or Latino population with many using Spanish as their primary language. As such, public noticing, educational materials and other outreach efforts were developed and presented in both English and Spanish throughout the GSP development process.

8.2 Public Noticing and Information

The Delta-Mendota Subbasin GSAs developed and used several coordinated tools, in addition to their own resources to inform members of the public about GSP development activities and promote opportunities for public engagement. These tools are described below.

- **Website:** The Subbasin website – www.deltamendota.org – is the primary location for information related to SGMA implementation in the Subbasin. Information provided on the website includes: an overview of SGMA, a description of each of the GSP groups, contact information for each of the GSAs, and upcoming workshops and public meetings. The website also serves as a repository for outreach collateral, workshop materials, and meeting packets and minutes for the Delta-Mendota Subbasin Coordination Committee, Technical Working Group, and Communications Working Group (described below), and provides links to the individual GSP websites maintained by each GSP Group.

- **Delta-Mendota Subbasin Newsletter:** The Delta-Mendota Subbasin Newsletter is distributed on a monthly basis and serves as an informational tool to keep interested parties, beneficial users, and members of the general public informed about the development and status of the GSPs. Newsletter topics include Subbasin-wide activities, general announcements, upcoming meetings and workshops, and past and upcoming GSP development activities. Copies of the newsletters are archived on the Subbasin website.

- **Informational Materials**: GSAs in the Subbasin developed a suite of materials in English and Spanish to educate and inform members of the public about SGMA and topics covered in the GSP. These materials include bilingual presentations, fact sheets, handouts, frequently asked questions, and videos. Copies of the materials are available on the Subbasin website. GSA representatives distributed these materials before and during meetings, workshops, and other outreach activities.

8.3 List of Public Meetings Where the GSPs were Discussed

Each GSP Group for the Delta-Mendota Subbasin has conducted individual outreach efforts relative to their own GSP Plan area in addition to those same efforts at the subbasin-level. Please refer to each of the individual GSPs for this information. Below is a list of the coordinated public workshops and meetings where the GSPs were discussed. These include meetings of the Delta-Mendota Subbasin Coordination Committee, the two Subbasin Working Groups and coordinated public workshops. All meetings were publicly noticed and held from June 2017 through July 2019. Meeting agenda, minutes and handouts are available on the Delta-Mendota Subbasin website at www.deltamendota.org.

Delta-Mendota Coordination Committee Meetings

The Delta-Mendota Subbasin Coordination Committee meets on the second Monday of each month at 9:30 am at the SLDMWA Administration Offices located at 842 6th Street, Los Banos, California. These meetings are noticed as required under the Brown Act and are open to the public.

In addition to the monthly meetings, a special meeting of the Coordination Committee was held on March 8, 2019 to discuss sustainable yield estimation methodologies.

Delta-Mendota Technical Working Group Meetings

The Delta-Mendota Technical Working Group meets on the third Tuesday of each month at 10:00 am at the SLDMWA Administration Offices located at 842 6th Street, Los Banos, California. These meetings are noticed as required under the Brown Act and are open to the public.

In addition to the monthly meetings, several special meetings of the Technical Working Group were held to discuss specific topics. These additional meetings were as follows:

- August 24, 2018 and September 19, 2018 meetings to discuss Groundwater Dependent Ecosystems
- August 8, 2018, October 30, 2018 and December 19, 2018 meetings to discuss water budgets

Delta-Mendota Communication Working Group Meetings

The Delta-Mendota Communications Working Group meets on the fourth Tuesday of each month at 1:00 pm. These meetings typically conducted via conference call. Meeting information for this working group is available on the Delta-Mendota Subbasin website.

Coordinated Public Workshops

Coordinated public workshops were held for the Delta-Mendota Subbasin shown in the table below. All workshops were advertised and conducted in both English and Spanish.

Table CC-24: Coordinated Public Workshops

Date	Location, Venue	Topic
Spring 2018 Workshops		
May 14, 2018	Los Banos, San Luis & Delta Mendota Water Authority	• Sustainable Groundwater Management Act overview • Delta-Mendota Subbasin overview • Opportunities for engagement
May 16, 2018	Patterson, Hammon Senior Center	
May 17, 2018	Mendota, Mendota Library	
Fall 2018 Workshops		
October 22, 2018	Firebaugh, Firebaugh Middle School	• GSP development and implementation process • Data collection • Hydrogeologic Conceptual Model • Numerical and analytical models • Water budgets
October 24, 2018	Los Banos, College Greens Building	
October 25, 2018	Patterson, Hammon Senior Center	
Winter 2019 Workshops		
February 19, 2019	Los Banos, College Greens Building	• Historic and current water budgets
February 20, 2019	Patterson, Patterson City Hall	

Date	Location, Venue	Topic
March 4, 2019	Santa Nella, Romero Elementary School	• Sustainability criteria • Undesirable results • Projects and management actions
Spring 2019 Workshops		
May 20, 2019	Patterson, Patterson City Hall	• Projected water budgets • Sustainable yield • Groundwater monitoring networks • Projects and management actions
May 21, 2019	Los Banos, College Greens Building	
May 22, 2019	Santa Nella, Romero Elementary School	
May 23, 2019	Mendota, Mendota Library	

Please see **Appendix F** for summaries of the coordinated public workshops, and **Appendix G** for example promotional materials for the public workshops.

8.4 Comments Regarding the GSPs

Key components of the six Subbasin GSPs were presented at the public workshops conducted throughout the GSP development process. **Appendix F** contains summaries of the coordinated public workshops, including comments received from and feedback provided to workshop participants. Additionally, each of the GSP Groups in the Delta-Mendota Subbasin are individually responsible for the public review of their plans and for addressing any public comments received. Please see the individual GSPs for additional information regarding plan review.

8.5 Subbasin Decision Making Process

The Delta-Mendota Subbasin Coordination Agreement outlines the responsibilities of all Subbasin parties, including decision making protocols and voting structure. These are further discussed in Chapter 2 of this document.

During the GSP development process, the Technical Working Group was charged with coordinating implementation of the required technical elements of the GSP (e.g., water budgets, monitoring networks), and to provide recommendations to the Delta-Mendota Subbasin Coordination Committee. Similarly, the Communications Working Group was charged with implementing the Subbasin Communications Plan and with providing recommendations for workshops and other outreach activities to the Coordination Committee. The Coordination Committee took actions and approved recommendations and work products and provided direction to both working groups and other ad hoc committees.

In general, the coordinated decision-making process included developing agendas for each meeting of the Delta-Mendota Subbasin Coordination Committee and for each Working Group meeting. The agendas were developed in concert with the Technical and Communications Working Groups, and the respective representatives of each GSP Group. Agenda items were either educational, informational, or required direction or decision. Meeting agendas, meetings minutes and handouts have been posted on the Delta-Mendota Subbasin website for public access.

8.6 Opportunities for Public Engagement and How Public Input was Used

Community input was encouraged and received at all meetings of the Coordination Committee, Technical Working Group, Communications Working Group meetings and at the public workshops. The Subbasin GSPs (and therefore, this Common Chapter) was shaped by community input, Working Group input, and Coordination Committee direction and decisions.

8.6.1 Opportunities for Public Engagement

Regular opportunities for public engagement were available throughout GSP development. The Coordination Committee, Technical and Communications Working Groups, and individual GSA staff encouraged public input throughout the development of the GSPs as described below. A list of stakeholder and community organizations contacted as part of the Subbasin coordinated outreach efforts is included in **Appendix H**.

Meetings and Direct Engagement

Open meetings and public workshops were held as described in Section 8.1. In addition, GSA staff made direct contact with community representatives to encourage their participation in the GSP development process. GSA representatives provided their contact information by phone, email, or mail both online (on the Subbasin website) and at workshops for stakeholder questions and comments.

Targeted Stakeholder Engagement

The Subbasin GSAs also conducted targeted outreach and engagement to hard-to-reach communities, interested parties, and stakeholders that were previously underrepresented in other engagement activities. This included outreach to the following stakeholder types:

- **Agricultural Interests:** Agricultural stakeholders in the Subbasin include agricultural well operators, growers, ranchers, farmworkers, and agricultural landowners. Strong agricultural representation exists within the leadership of the GSAs. To augment direct outreach being conducted by individuals GSAs, Subbasin representatives also coordinated closely with local county farm bureaus to disseminate information related to GSP development and public workshops.
- **School Districts:** Schools districts are considered for both beneficial users of groundwater (for drinking water), as well communication channels to disseminate information about SGMA and GSP development. GSA representatives directly contacted local school districts to notify them of the public workshops. Some schools also help distributed informational materials and workshop flyers to their students and parents.
- **Industrial Interests:** There are many industrial interested in the Subbasin, including packaging and processing plants, mining industries, and other similar facilities that use groundwater in some fashion. The GSP Groups have identified these interests within their respective Plan areas and have disseminated information related to GSP development during individual outreach efforts.
- **Environmental/Conservation Interests:** Environmental and conservation interests in the Subbasin have been contacted and communicated with during GSP development. Specific related interest groups contacted during GSP development include The Nature Conservancy, the California Department of Fish and Wildlife, Audubon, and various sportsman clubs and wetland managers.

- **Disadvantaged Communities:** The GSAs followed best practices identified in Collaborating for Success: Stakeholder Engagement for Sustainable Groundwater Management Act Implementation (Community Water Center, 2015) and other guidance documents to engage disadvantaged and severely disadvantaged communities. This included holding meetings in disadvantaged communities; holding meetings in the evening at known local venues, such as schools, civic centers, and community centers; translating fact sheets, meeting materials, and presentations into other languages; and providing interpreting services at all public workshops.
- **Other Interests:** Other potential groundwater users in the Subbasin (or those with groundwater-related interests) contacted during GSP development included the various counties in which the Delta-Mendota Subbasin lie and/or are adjoining (including San Joaquin County and San Benito County), Caltrans, the DWR State Water Project Division of Operations and Maintenance, the U.S. Bureau of Reclamation, the U.S. Geological Survey and the San Joaquin River Restoration Program.

The Reader should refer to each individual GSP for a more complete description of GSP-specific meetings and direct engagement.

GSP Section Review and Comment Periods

Each GSP Group was responsible for coordinating the individual review of their GSP. Please see each GSP for additional information as to their specific public review process. This Common Chapter to the six Delta-Mendota Subbasin GSPs was posted on the Subbasin's website (www.deltamendota.org) following submittal of the Subbasin GSPs.

8.6.2 How Public Input and Response was Used in the Development of the GSP

Each GSP Group was responsible for coordinating the individual review of their GSP and for determining how to incorporate public input and responses into their respective plans. Public input to the GSPs was solicited through the GSP development process through a number of means, including coordinated public workshops, Board of Directors presentations, City Council presentations, and growers' meetings. Please see the individual GSPs for more information regarding GSP-specific outreach efforts and how stakeholder and public input was received and factored into the GSPs.

8.7 Revisions to Common Chapter and Subbasin GSPs

As previously noted in this document, the Delta-Mendota Subbasin received a Consultation Initiation Letter on January 21, 2022 from DWR. The CIL identified four potential deficiencies across the six Subbasin GSPs which may preclude DWR's approval, as well as potential corrective actions to address each potential deficiency. The CIL thus initiated consultation between DWR, the Basin Manager, Plan Managers, and the Subbasin's 23 Groundwater Sustainability Agencies (GSAs) on February 18, 2022 regarding the amount of time needed to address the potential deficiencies and corrective actions. Subsequent meetings were held on March 7, March 30, April 19, May 24, and June 20 2022 to discuss the Subbasin's proposed approach to addressing the identified deficiencies.

The four deficiencies identified in DWR's CIL are summarized as follows:

Potential Deficiency 1: The GSPs do not use the same data and methodologies.

Potential Deficiency 2: The GSPs have not established common definitions of undesirable results in the Subbasin.

Potential Deficiency 3: The GSPs in the Subbasin have not set sustainable management criteria in accordance with GSP regulations.

Potential Deficiency 4: The management areas established in the Plan have not sufficiently addressed the requirements specified in 23 CCR §354.20.

This revised Common Chapter, and associated revisions to the six Subbasin GSPs, have been prepared in response to the deficiencies identified in the CIL based on direction provided by the Delta-Mendota Subbasin Coordination Committee, the Delta-Mendota Technical Working Group, the Subbasin GSAs and DWR. It is intended to document how the deficiencies identified in the CIL were addressed in the revised GSPs and associated Common Chapter, and where those revisions are addressed in the Common Chapter.

A Notice of Intent to Adopt the revised Common Chapter and six Subbasin GSPs (known as the Amended Groundwater Sustainability Plan) was distributed on March 15, 2022. Public meetings for the adoption of the Common Chapter and Subbasin GSPs were held in June and July of 2022; please see the Subbasin's website (www.deltamendota.org) for the respective dates for each GSAs meeting and adoption.

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Delta-Mendota Groundwater Subbasin

Groundwater Sustainability Plan: Revised Common Chapter

Prepared by:

August 2019; Revised June 2022

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Appendix H – List of Stakeholders and Community Organizations Contacted

Acronyms

AB 3030	1992 California Assembly Bill 3030
AWMP	Agricultural~~e~~ Water Management Plan
BMP	Best Management Practice
CASGEM	California Statewide Groundwater Elevation Monitoring
CCC	Columbia Canal Company
CCF	Climate Change Factors
CCID	Central California Irrigation District
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
CVO	Central Valley Operations
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
DAC	Disadvantaged Community
DMC	Delta-Mendota Canal
DPWD	Del Puerto Water District
DWR	California Department of Water Resources
ET	Evapotranspiration
ET_c	Total Crop Evapotranspiration
ET_{iw}	Crop Evapotranspiration of Irrigation Water
ET_{misc}	Miscellaneous Evapotranspiration including; canal evaporation, consumptive use of phreatophytes, etc.
FCWD	Firebaugh Canal Water District
FNF	Full Natural Flow
GAMA	Groundwater Ambient Monitoring and Assessment
gpm	gallons per minute
GRCD	Grassland Resource Conservation District
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan

Acronyms

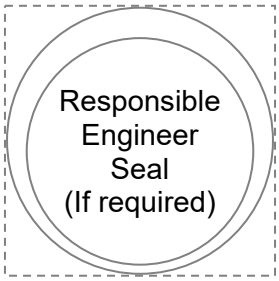
GWD	Grassland Water District
HCM	Hydrogeologic Conceptual Model
HMRD	Henry Miller Reclamation District
IM	interim milestone
IRWM	Integrated Regional Water Management
JPA	Joint Powers Authority
KDSA	Kenneth D. Schmidt and Associates
MAF	million acre-feet
MO	measurable objective
MSL	Mean Sea Level
MT	minimum threshold
NASA JPL	National Aeronautics and Space Administration Jet Propulsions Laboratory
P&P	Provost and Pritchard Consulting Group
RCD	Resource Conservation District
RWQCB	Regional Water Quality Control Board
SB 372	2017 California Senate Bill 372
SGMA	Sustainable Groundwater Management Act
SGWP	Sustainable Groundwater Planning
SJREC	San Joaquin River Exchange Contractors
SJRECWA	San Joaquin River Exchange Contractors Water Authority
SJRIP	San Joaquin River Improvement Program
SJRRP	San Joaquin River Restoration Program
SLDMWA	San Luis & Delta-Mendota Water Authority
SMC	Sustainable Management Criteria
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TDS	Total Dissolved Solids
TIWD	Turner Island Water District

Acronyms

TNC	The Nature Conservancy
UNAVCO	University NAVSTAR Consortium
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USF&WS	U.S. Fish & Wildlife Service
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
WDL	Water Data Library
WMP	Water Management Plan
WSIP	Water Storage Investment Program
WWD	Westlands Water District
WY	Water Year

DISCLAIMER

The work products presented in this Common Chapter and associated Technical Memoranda (Appendix B) are a compilation of work completed by the six (6) individual Groundwater Sustainability Plan (GSP) regions under the direction of a Professional Geologist (PG) or Professional Engineer (PE) as indicated by the stamps on the respective GSP Executive Summaries. The signature here represents work completed in compiling the Common Chapter from these individual GSPs, and the signing Professional Engineer assumes no responsibility for any errors or misleading statements presented therein. Compilation of the Common Chapter, exclusive of work conducted for the individual GSPs, and revisions to this Common Chapter haves been prepared under the oversight of Leslie Dumas, P.E. and the signature below is specifically for that compilation.



1. INTRODUCTION

1.1 Purpose of Common Chapter

The 23 Groundwater Sustainability Agencies (GSAs) overlying the Delta-Mendota Subbasin (Subbasin) have prepared six Groundwater Sustainability Plans (GSPs) that, together, encompass the entire Subbasin area (**Figure CC-1**~~**Figure CC-1**~~). ~~-~~These GSPs have been prepared in a coordinated manner under the oversight of the Delta-Mendota Subbasin Coordination Committee (Coordination Committee) and in accordance with the Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement) for the Subbasin. ~~-~~This Common Chapter has been prepared as means of integrating key parts of the six GSPs to meet subbasin-level requirements per the Sustainable Groundwater Management Act (SGMA) and the Emergency GSP regulations (DWR, 2016).

On January 21, 2022, the Subbasin received a Consultation Initiation Letter (CIL) from the California Department of Water Resources (DWR). The CIL identified four potential deficiencies across the six Subbasin GSPs which may preclude DWR's approval, as well as potential corrective actions to address each potential deficiency. The CIL thus initiated consultation between DWR, the Subbasin Point of Contact, Plan Managers, and the Subbasin's GSAs. This Common Chapter has been revised to incorporate changes required to reflect the Subbasin's response to the deficiencies identified in the CIL, based on direction provided by the Coordination Committee, the Delta-Mendota Technical Working Group (Technical Working Group), the Subbasin GSAs and DWR. This revised Common Chapter, along with the attached cover letter, are intended to document how the deficiencies identified in the CIL were addressed in the revised Subbasin GSPs and this revised Common Chapter.

This revised Common Chapter, along with the six Subbasin GSPs, Coordination Agreement (**Appendix A**) and Common Technical Memoranda (**Appendix B**), meets regulatory requirements established by ~~the California Department of Water Resources (~~DWR~~)~~ as shown in the completed *Preparation Checklist for GSP Submittal* (**Appendix C**). The Common Technical Memoranda summarize the common data sets, assumptions and methodologies used during preparation of the six Subbasin GSPs.~~-~~ The reader is referred to the individual GSP (and their associated Executive Summaries) for information, data, and GSP requirements specific to each GSP Plan Area.

1.2 Delta-Mendota Subbasin

The Delta-Mendota Subbasin (DWR Basin 5-022.07) is located in the San Joaquin Valley Groundwater Basin and adjoins nine (9) subbasins of the San Joaquin Valley Groundwater Basin. The Delta-Mendota Subbasin boundaries generally correspond~~s~~ to DWR's California's Groundwater Bulletin 118 – Update 2003 (Bulletin 118) groundwater basin boundaries. Changes made to the Subbasin boundaries as part of the SGMA planning process include the following:

- A jurisdictional internal boundary modification made in 2016 to extend the boundary of the Delta-Mendota Subbasin eastward to include all of Aliso Water District.
- A jurisdictional internal boundary modification made in 2016 to bring areas that straddle the Delta-Mendota Subbasin and adjacent subbasins fully within the Delta-Mendota Subbasin. This

modification adjusted areas from the southern boundary of the Delta-Mendota Subbasin and the Westside Subbasin in coordination with Westlands Water District, and moved the eastern boundary of the Delta-Mendota Subbasin from the Madera Subbasin into the Delta-Mendota Subbasin in coordination with Aliso Water District. The modification also moved areas from the Tracy Subbasin into the Delta-Mendota Subbasin so that Del Puerto Water District and West Stanislaus Irrigation District were fully within the Delta-Mendota Subbasin, and cleaned up boundaries between the Delta-Mendota Subbasin and the Kings Subbasin to conform with the boundaries of Tranquillity Irrigation District and the Traction Ranch property (bounded on the east by Mid-Valley Water District).

- A jurisdictional internal boundary modification made in 2018 to modify the boundary between the Delta-Mendota and the Chowchilla Subbasins to follow the western boundary of Triangle T Water District and the southern boundary of Clayton Water District. This modification moved approximately 700 acres of land from the Chowchilla Subbasin into the Delta-Mendota Subbasin.

The western San Joaquin Valley is a highly agricultural region with an economy dependent on that industry. There are no large cities or industries in the Delta-Mendota Subbasin to provide an alternative economic base; hence the availability of Central Valley Project (CVP) imported supplies and surface water supplies (primarily from the San Joaquin and Kings River) are essential elements to the economic health of the region. Other uses of CVP and surface water in the Subbasin are for municipal and industrial (M&I) purposes and wildlife refuge water supply.

Groundwater is a key component of overall water supplies in the Delta-Mendota Subbasin. Agricultural and wildlife refuge needs may be supplemented by groundwater for areas with access to CVP water. Other landowners within the Subbasin may rely wholly on groundwater for irrigation and/or potable purposes. Municipal and industrial (M&I) water use, which is a small share of total water use in the Subbasin, occurs primarily within the cities, and predominantly uses groundwater to meet those demands. The largest M&I use areas in the Delta-Mendota Subbasin, based on 2015 population estimates from the U.S. Census Bureau, are the cities of Patterson (population 21,498) and Los Banos (population 37,457) (U.S. Census Bureau, 2015).

As previously noted, most communities within the Delta-Mendota Subbasin have economies greatly dependent on agricultural production. These communities include Patterson, Grayson, Tranquillity, Mendota, Firebaugh, Dos Palos, Los Banos, Santa Nella, Newman, Gustine, Crows Landing, Westley, Volta, and Vernalis.

1.3 Disadvantaged Communities within the Delta-Mendota Subbasin

A disadvantaged community (DAC) is defined as a community with a Median Household Income (MHI) less than 80% of the California statewide MHI. The California Department of Water Resources (DWR) compiled U.S. Census Bureau's American Community Survey (ACS) data from 2012 to 2016; these data were used in GIS to identify DACs within the Delta-Mendota Subbasin. California's average statewide MHI from 2012 to 2016 is $63,783; thus, a community with an MHI less than or equal to $51,026 is considered a DAC. Based on these criteria, 93% of the geographic area of the Subbasin is considered disadvantaged. Furthermore, a community with an MHI of less than 60% of the California statewide

MHI, meaning an MHI of less than or equal to $38,270, is considered a severely disadvantaged community (SDAC). According to the U.S. Census ACS 2012-2016 data, there are a number of SDACs throughout the Subbasin. See Figure CC-2~~Figure CC-2~~ for a map of the DACs and SDACs throughout the Delta-Mendota Subbasin.

As noted above, a significant portion of the Subbasin contains DACs. Of the total population of 117,120 within the Subbasin, 80% of the population lives within a DAC, with 93% of the Subbasin's total geographic area consisting of DACs. Table CC-1~~Table CC-1~~ includes the proportion of DACs in the Subbasin based on population and geographic area.

Table CC-1: DACs as a Percentage of the Delta-Mendota Subbasin

Area	Geographic Area (Square Miles)	% Based on Geographic Area	Population	% Based on Population
DAC (including SDAC)	1,109	93%	93,786	80%
Delta-Mendota Subbasin	1,194		117,120	

Table CC-2~~Table CC-2~~ includes Census Designated Places that are DACs in the Delta-Mendota Subbasin, with their associated MHIs and percentage of the California MHI from the ACS 5-Year 2012-2016 average. Several DACs in the Subbasin have considerably lower MHI than 80% of the California Statewide MHI and are further designated as Severely Disadvantaged Communities (SDACs). In Table CC-2~~Table CC-2~~, SDACs are indicated in bold text. Note that according to the U.S. Department of the Interior Indian Affairs, as of January 2017, there are no listed federally recognized tribes within the Region (Mosley, 2017).

Table CC-2: DAC and SDAC Census Designated Places in Delta-Mendota Subbasin

Census Designated Place (CDP)	Median Household Income (MHI)	% of CA MHI
City of Dos Palos	**$36,509**	**57%**
City of Firebaugh	**$36,181**	**57%**
City of Gustine	**$37,770**	**59%**
City of Los Banos	$45,751	72%
City of Mendota	**$26,094**	**41%**
City of Newman	$52,783	83%
Crows Landing	**$26,786**	**42%**
Dos Palos Y (CDP)	**$16,656**	**26%**
Grayson	**$29,787**	**47%**
Madera County	$45,490	74%
Merced County	$43,066	70%
Fresno County	$45,963	72%
Santa Nella	**$27,778**	**44%**

Census Designated Place (CDP)	Median Household Income (MHI)	% of CA MHI
South Dos Palos	$41,992	66%
Tranquillity	**$30,441**	**48%**
Volta	$48,250	76%
Westley	**$23,375**	**37%**

Data Sources:
1. U.S. Census ACS data from 2012 to 2016 provided by DWR Mapping Tool.
2. MHI data are from the 2016 Census, and percent of CA MHI is calculated based on the 2012-2016 Statewide MHI. Bold rows indicate severely disadvantaged communities (less than 60% of CA Statewide MHI).

1.4 Economically Disadvantaged Areas within the Delta-Mendota Subbasin

An economically distressed area (EDA) is defined by the State of California as a "municipality with a population of 20,000 persons or less, a rural county, or a reasonably isolated and divisible segment of a larger municipality where the segment of the population is 10,000 persons or less, with an annual median household income that is less than 85% of the statewide median household income, and with one or more of the following conditions as determined by the (sic) Department of Water Resources:

1. Financial hardship
2. Unemployment rate at least two percent higher than the statewide average
3. Low population density (CA Assembly, 2014)."

U.S. Census GIS data provided by DWR were used to identify EDAs in the Delta-Mendota Subbasin. Figure CC-3~~Figure CC-3~~ shows the location of EDAs within the Delta-Mendota Subbasin

A significant portion of the Subbasin contains EDAs. Of the total population of 117,120 within the Subbasin, 87% live in areas that meet EDA Criterion 2, 20% live in areas that meet EDA Criterion 3, and 87% live in areas that meet Criteria 2 or 3. In all, 93% of the geographic area within the Subbasin consists of areas considered to meet either EDA Criteria 2 or 3. Table CC-3~~Table CC-3~~ includes the proportion of EDAs in Subbasin based on population and geographic area.

Table CC-3: EDAs as a Percentage of the Delta-Mendota Subbasin

Area	Geographic Area (Square Miles)	% Based on Geographic Area	Population	% Based on Population
EDA Criterion 2	1,112	93%	102,407	87%
EDA Criterion 3	1,004	84%	23,688	20%
EDA Criteria 2 or 3	1,112	93%	102,407	87%
Delta-Mendota Subbasin	1,194		117,120	

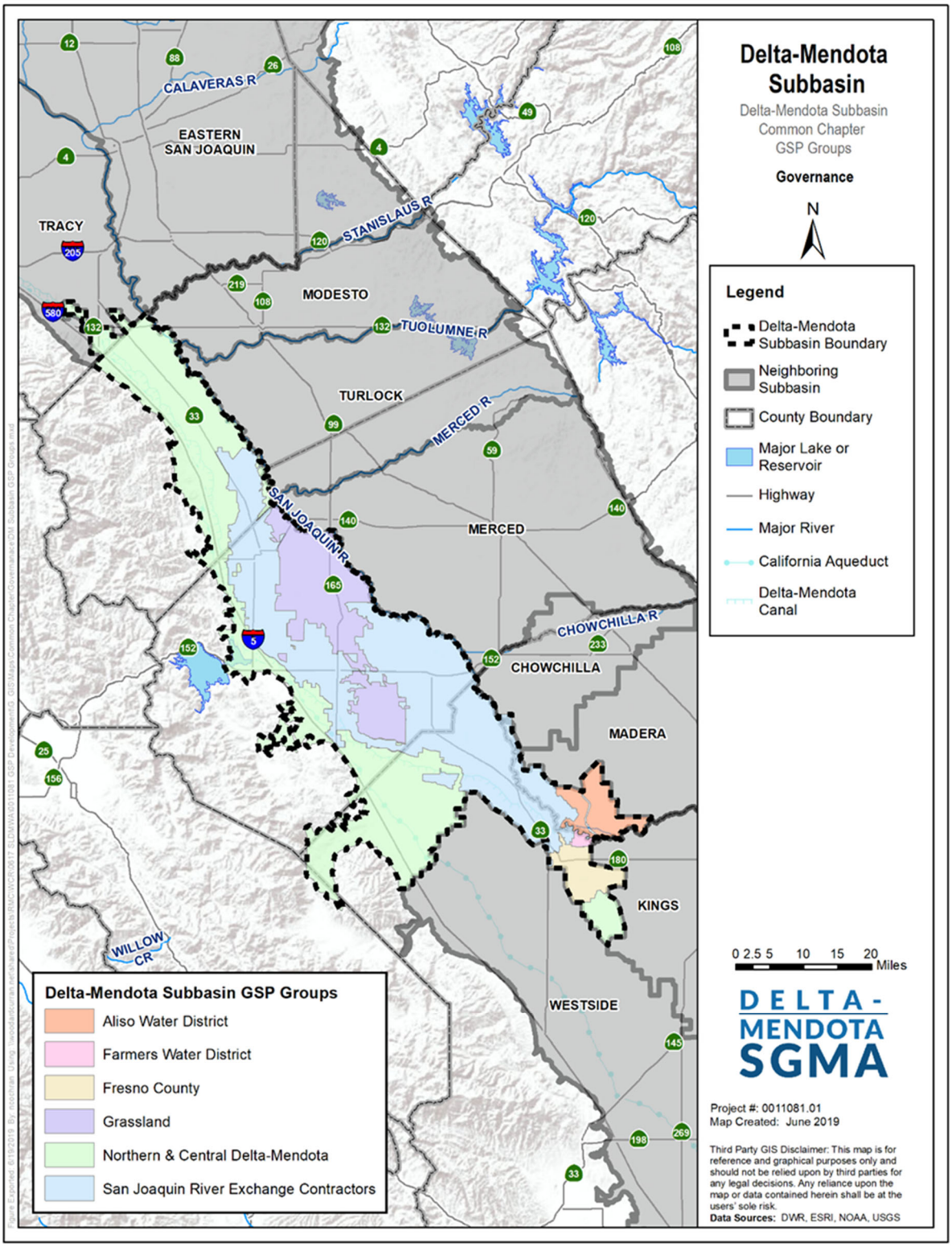

Delta-Mendota Subbasin
Delta-Mendota Subbasin
Common Chapter
GSP Groups
Governance
N
Legend
Delta-Mendota Subbasin Boundary
Neighboring Subbasin
County Boundary
Major Lake or Reservoir
Highway
Major River
California Aqueduct
Delta-Mendota Canal
CALAVERAS R
EASTERN SAN JOAQUIN
TRACY
STANISLAUS R
MODESTO
TUOLUMNE R
TURLOCK
MERCED R
SAN JOAQUIN R
MERCED
CHOWCHILLA R
CHOWCHILLA
MADERA
KINGS
WILLOW CR
WESTSIDE
Delta-Mendota Subbasin GSP Groups
Aliso Water District
Farmers Water District
Fresno County
Grassland
Northern & Central Delta-Mendota
San Joaquin River Exchange Contractors
0 2.5 5 10 15 20 Miles
DELTA-MENDOTA SGMA
Project #: 0011081.01
Map Created: June 2019
Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk.
Data Sources: DWR, ESRI, NOAA, USGS

Figure CC-1: Delta-Mendota Subbasin and GSP Regions

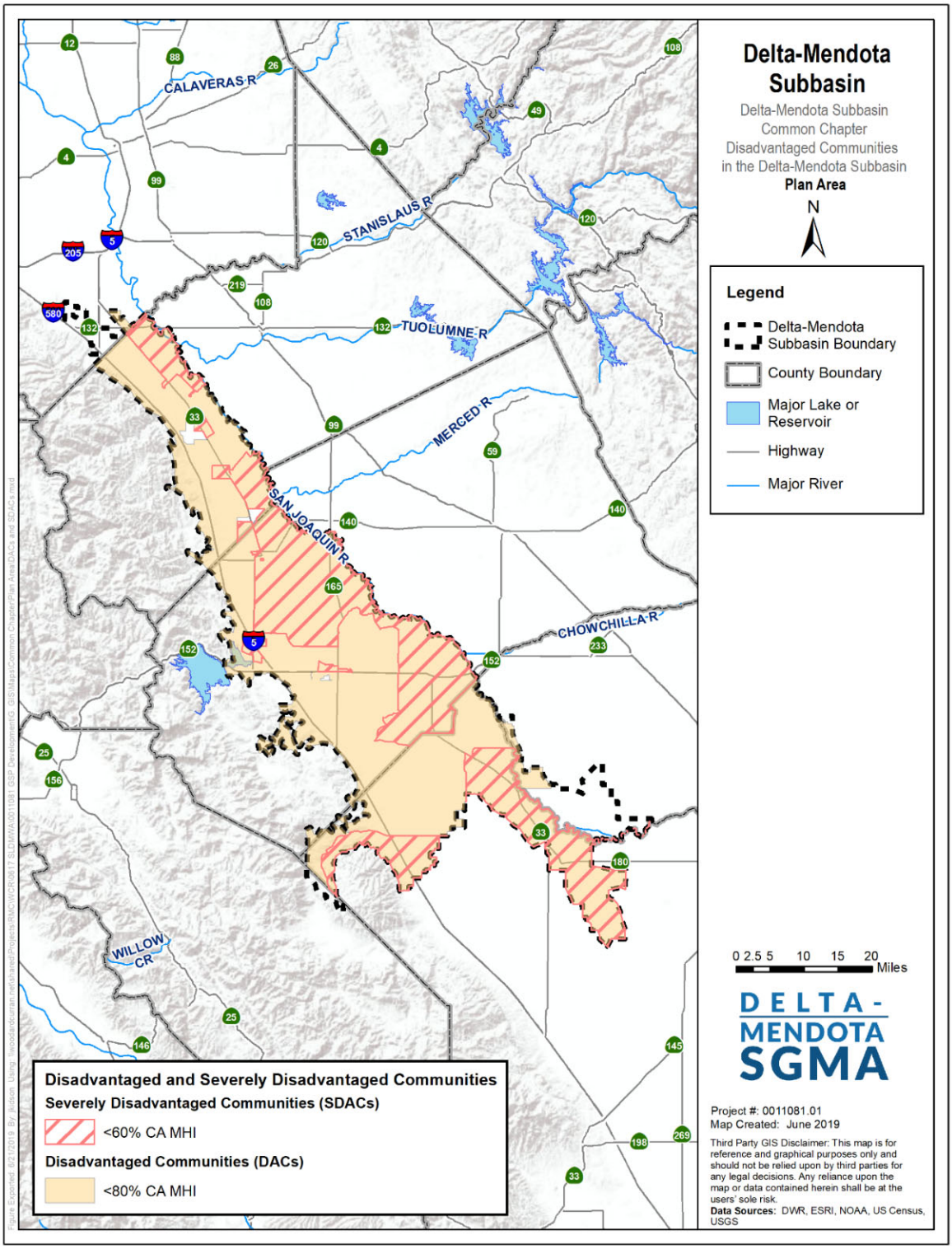

Delta-Mendota Subbasin
Delta-Mendota Subbasin
Common Chapter
Disadvantaged Communities
in the Delta-Mendota Subbasin
Plan Area
N
Legend
Delta-Mendota Subbasin Boundary
County Boundary
Major Lake or Reservoir
Highway
Major River
CALAVERAS R
STANISLAUS R
TUOLUMNE R
MERCED R
SAN JOAQUIN R
CHOWCHILLA R
WILLOW CR
0 2.5 5 10 15 20 Miles
DELTA-MENDOTA SGMA
Project #: 0011081.01
Map Created: June 2019
Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk.
Data Sources: DWR, ESRI, NOAA, US Census, USGS
Disadvantaged and Severely Disadvantaged Communities
Severely Disadvantaged Communities (SDACs)
<60% CA MHI
Disadvantaged Communities (DACs)
<80% CA MHI

Figure CC-2: Disadvantaged and Severely Disadvantaged Communities in the Delta-Mendota Subbasin

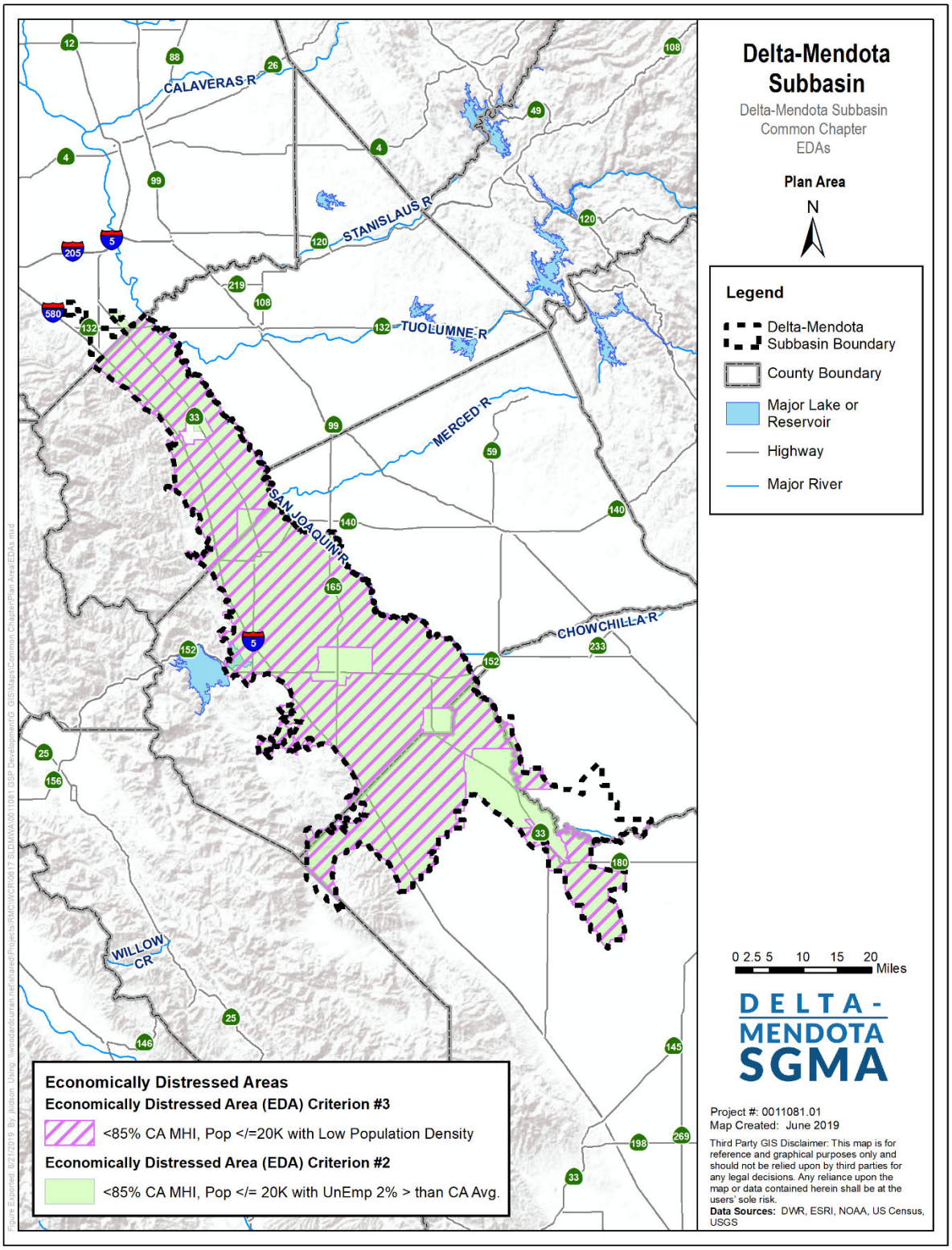

Delta-Mendota Subbasin
Delta-Mendota Subbasin Common Chapter EDAs
Plan Area
N
Legend
Delta-Mendota Subbasin Boundary
County Boundary
Major Lake or Reservoir
Highway
Major River
CALAVERAS R
STANISLAUS R
TUOLUMNE R
MERCED R
SAN JOAQUIN R
CHOWCHILLA R
WILLOW CR
0 2.5 5 10 15 20 Miles
DELTA-MENDOTA SGMA
Economically Distressed Areas
Economically Distressed Area (EDA) Criterion #3
<85% CA MHI, Pop </=20K with Low Population Density
Economically Distressed Area (EDA) Criterion #2
<85% CA MHI, Pop </= 20K with UnEmp 2% > than CA Avg.
Project #: 0011081.01
Map Created: June 2019
Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk.
Data Sources: DWR, ESRI, NOAA, US Census, USGS

Figure CC-3: Economically Distressed Areas in the Delta-Mendota Subbasin

2. DELTA-MENDOTA SUBBASIN GOVERNANCE

This section includes information pursuant to Article 5. Plan Contents, Subarticle 1. Administrative Information, § 354.6 (Agency Information) as well as Subarticle 8. Interagency Agreements (§ 357.2 Interbasin Agreements and § 357.4 Coordination Agreements), as required by the Groundwater Sustainability Plan (GSP) Regulations. Agency Contact information for the Delta-Mendota Subbasin and the plan manager is included in this section. The organization and management structure, as well as the legal authority of each Groundwater Sustainability Agency (GSA) in the Delta-Mendota Subbasin, is detailed and accompanied by GSA boundary maps and a description of intra-basin and inter-basin coordination agreements in place for the development and implementation of the GSPs overlying the Delta-Mendota Subbasin.

Agency Contact Information

This Common Chapter to the six GSPs for the Delta-Mendota Subbasin has been prepared in a cooperative manner by the following GSAs in the Delta-Mendota Subbasin:

Northern & Central Delta-Mendota Region GSP

- Patterson Irrigation District GSA
- West Stanislaus Irrigation District GSA
- DM-II GSA
- City of Patterson GSA
- Northwestern Delta-Mendota GSA
- Central Delta-Mendota GSA
- Widren Water District GSA
- Oro Loma Water District GSA

San Joaquin River Exchange Contractors (SJREC) GSP

- San Joaquin River Exchange Contractors Water Authority GSA
- Turner Island Water District-2 GSA
- City of Mendota GSA
- City of Firebaugh GSA
- City of Los Banos GSA
- City of Dos Palos GSA
- City of Gustine GSA
- City of Newman GSA
- Madera County ~~–~~ 3 GSA
- Portion of Merced County – Delta-Mendota GSA
- Portion of Fresno County Management Area B GSA

Grassland GSP

- Grassland GSA
- Portion of Merced County – Delta-Mendota GSA

Aliso Water District GSP

- Aliso Water District GSA

Farmers Water District GSP

- Farmers Water District GSA

Fresno County GSP

- Fresno County Management Area A GSA
- Portion of Fresno County Management Area B GSA

The plan areas covered by each of the six Subbasin GSPs is show in **Figure CC-1**~~**Figure CC-1**~~. **Figure CC-4**~~**Figure CC-4**~~ through **Figure CC-6**~~**Figure CC-6**~~ show the location of the GSAs comprising the six GSP regions. These GSAs are coordinating development and implementation of the six GSPs under the Coordination Agreement, as described below in Section 2.1.

The ~~initial~~ current Plan Manager for the coordinated Delta-Mendota Subbasin GSPs is ~~Andrew Garcia~~John Brodie, Water Resources Program Manager ~~Senior Civil Engineer~~ for San Luis & Delta-Mendota Water Authority (SLDMWA). Mr. ~~Garcia~~ Brodie can be contacted as follows:

Mr. ~~Andrew Garcia~~John Brodie, Plan Manager
Delta-Mendota Subbasin
842 6th Street
Los Banos, CA 93635
Phone: (209) ~~-~~826-1872~~832-6200~~ / Fax (209) ~~-~~833-1034
Error! Hyperlink reference not valid.john.brodie@sldmwa.org

Contact information for each GSP plan administrator can be found in the respective GSPs. The DWR Point of Contact is shown below.

Department of Water Resources ~~(DWR)~~ Point of Contact

The point of contact for the Delta-Mendota Subbasin is:

Christopher Olvera
Department of Water Resources
Christopher.Olvera@water.ca.gov
(559) 230-3373

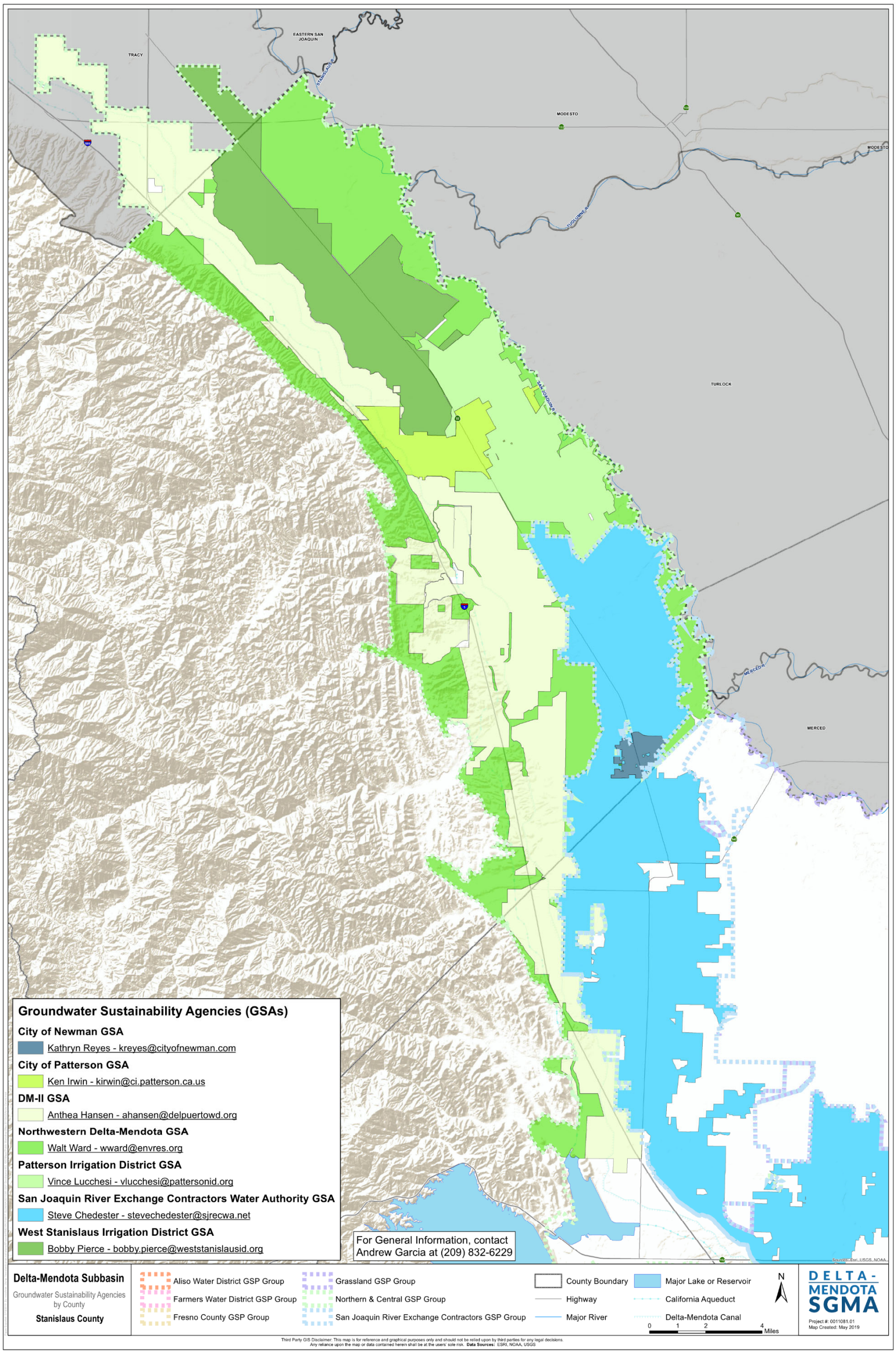


Figure CC-4: GSAs in the Delta-Mendota Subbasin – Stanislaus County

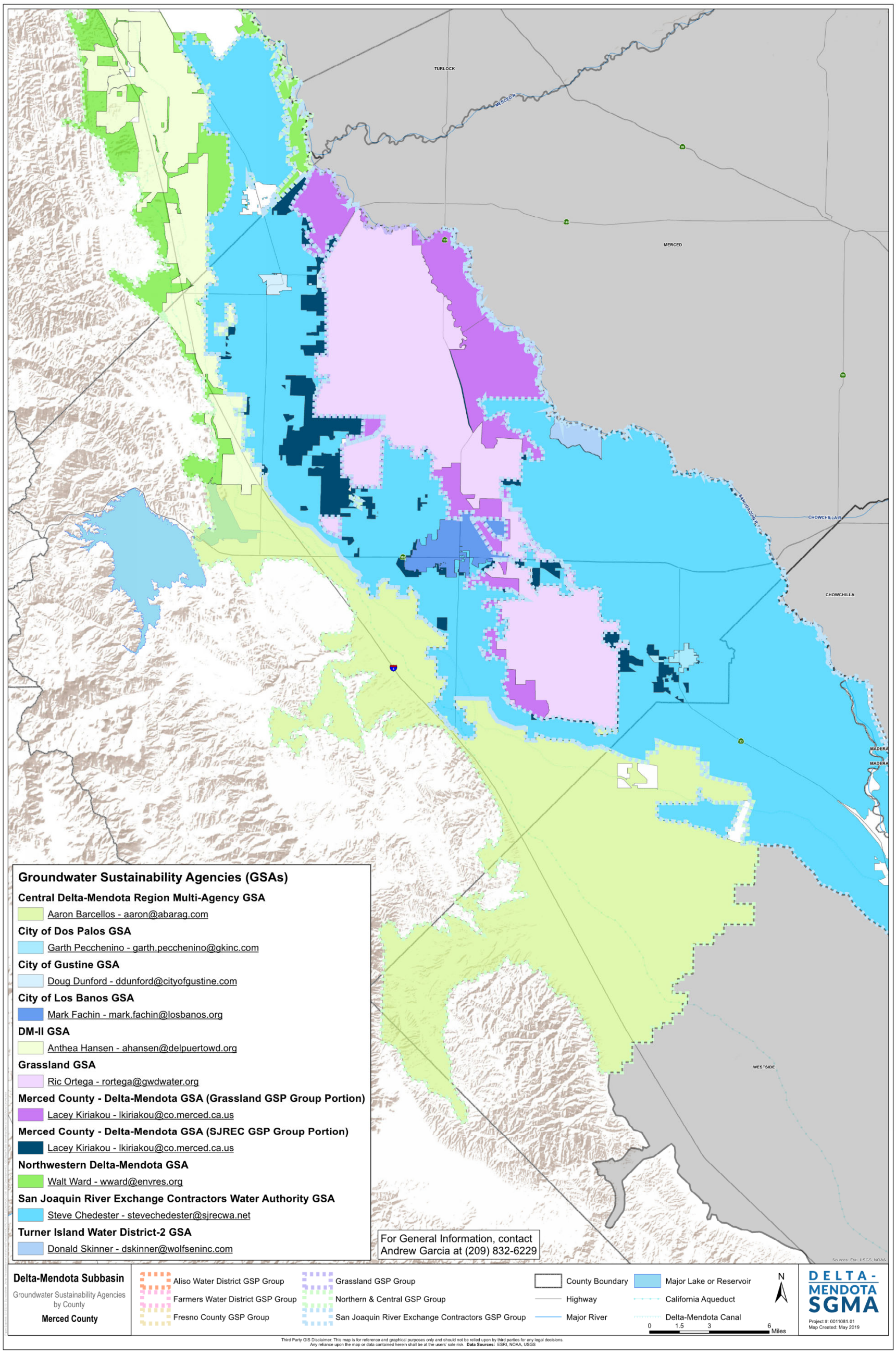


Figure CC-5: GSAs in the Delta-Mendota Subbasin – Merced County

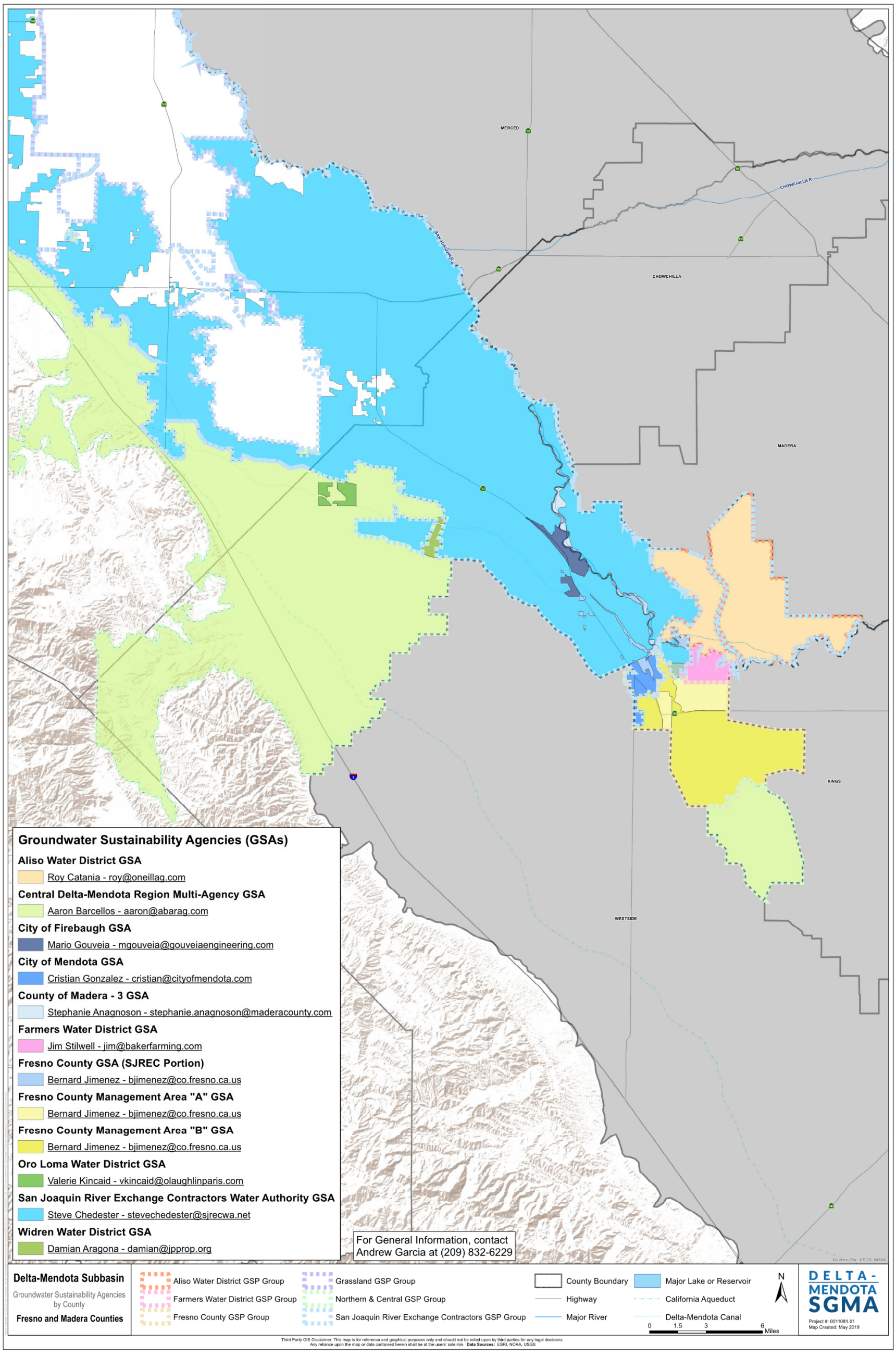


Figure CC-6: GSAs in the Delta-Mendota Subbasin – Fresno and Madera Counties

2.1 GSA and GSP Coordination and Governance

This section includes a description of intra-basin coordination agreements, which are required where there is more than one GSP prepared for a groundwater basin, and inter-basin coordination agreements, which are optional agreements between neighboring groundwater subbasins, pursuant to Article 8. Interagency Agreements, § 357.4. Coordination Agreements and § 357.2 Interbasin Agreements.

2.1.1 Delta-Mendota Subbasin SGMA Governance Structure

The GSAs within the Delta-Mendota Subbasin adopted and executed a Coordination Agreement on December 12, 2018 to comply with the SGMA requirement that multiple GSAs within a given subbasin must coordinate when developing and implementing their GSPs (see Intra-Agency Coordination subsection above for more information). Additionally, a Cost Sharing Agreement was signed and executed by the same parties on December 12, 2018. **Figure CC-5** shows the SGMA governance structure within the Delta-Mendota Subbasin. In addition to the two members appointed to represent each of the Northern & Central Delta-Mendota GSP Region and the San Joaquin River Exchange Contractors (SJREC) GSP Region on the Delta-Mendota Subbasin Coordination Committee as voting members, the Grassland GSP Region, Farmers Water District GSP Region, Fresno County Management Areas A & B GSP Region, and Aliso Water District GSP Region all have appointed one voting member each for a total of eight voting members.

Three working groups were formed under the auspices of the Delta-Mendota Subbasin Coordination Committee: ~~-~~the Technical Working Group, the Communications Working Group and the DMS Working Group. Representatives of each GSP region participate i~~o~~n each working group.

Table CC-4: Delta-Mendota Subbasin Coordination Committee Members

GSP		GSA	Agency	Coordination Committee Members	
				Primary	Alternate
Northern & Central Delta-Mendota Region GSP	Northern Delta Mendota Region Management Committee	Patterson Irrigation District GSA	Patterson Irrigation District	Vince Lucchesi	Walt Ward
			Twin Oaks Irrigation District		
		West Stanislaus Irrigation District GSA	West Stanislaus Irrigation District		
		DM-II GSA	Del Puerto Water District		
			Oak Flat Water District		
		City of Patterson GSA	City of Patterson		
		Northwestern Delta-Mendota GSA	Merced County		
			Fresno County		
	Central Delta-Mendota Region Management Committee	Central Delta-Mendota GSA	San Luis Water District	Ben Fenters	Lacey Kiriakou
			Panoche Water District		
			Tranquillity Irrigation District		
			Fresno Slough Water District		
			Eagle Field Water District		
			Pacheco Water District		
			Santa Nella County Water District		
			Mercy Springs Water District		
			Merced County		
			Fresno County		
		Widren Water District GSA	Widren Water District		

GSP	GSA	Agency	Coordination Committee Members	
			Primary	Alternate
	Oro Loma Water District GSA	Oro Loma Water District		
San Joaquin River Exchange Contractors GSP	San Joaquin River Exchange Contractors Water Authority GSA	Central California Irrigation District	Jarrett Martin, Alejandro Paolini	Chris White, John Wiersma
		Columbia Canal Company		
		Firebaugh Canal Water District		
		San Luis Canal Company		
	Turner Island Water District-2 GSA	Turner Island Water District		
	City of Mendota GSA	City of Mendota		
	City of Firebaugh GSA	City of Firebaugh		
	City of Los Banos GSA	City of Los Banos		
	City of Dos Palos GSA	City of Dos Palos		
	City of Gustine GSA	City of Gustine		
	City of Newman GSA	City of Newman		
	County of Madera ~~–~~ 3 GSA	County of Madera		
	Portion of Merced County – Delta-Mendota GSA	County of Merced		
	Portion of Fresno County Management Area B GSA	County of Fresno		
Grassland GSP	Grassland GSA	Grassland Water District	Ric Ortega	Ken Swanson
		Grassland Resource Conservation District		
	Portion of Merced County Delta-Mendota GSA	County of Merced		

GSP	GSA	Agency	Coordination Committee Members	
			Primary	Alternate
Farmers Water District GSP	Farmers Water District GSA	Farmers Water District	Jim Stilwell	Don Peracchi
Fresno County GSP	Fresno County – Management Area A	County of Fresno	Buddy Mendes	Glenn Allen or Augustine Ramirez
	Fresno County – Management Area B	County of Fresno		
Aliso Water District GSP	Aliso Water District GSA	Aliso Water District	Joe Hopkins	Board Secretary (Ross Franson)

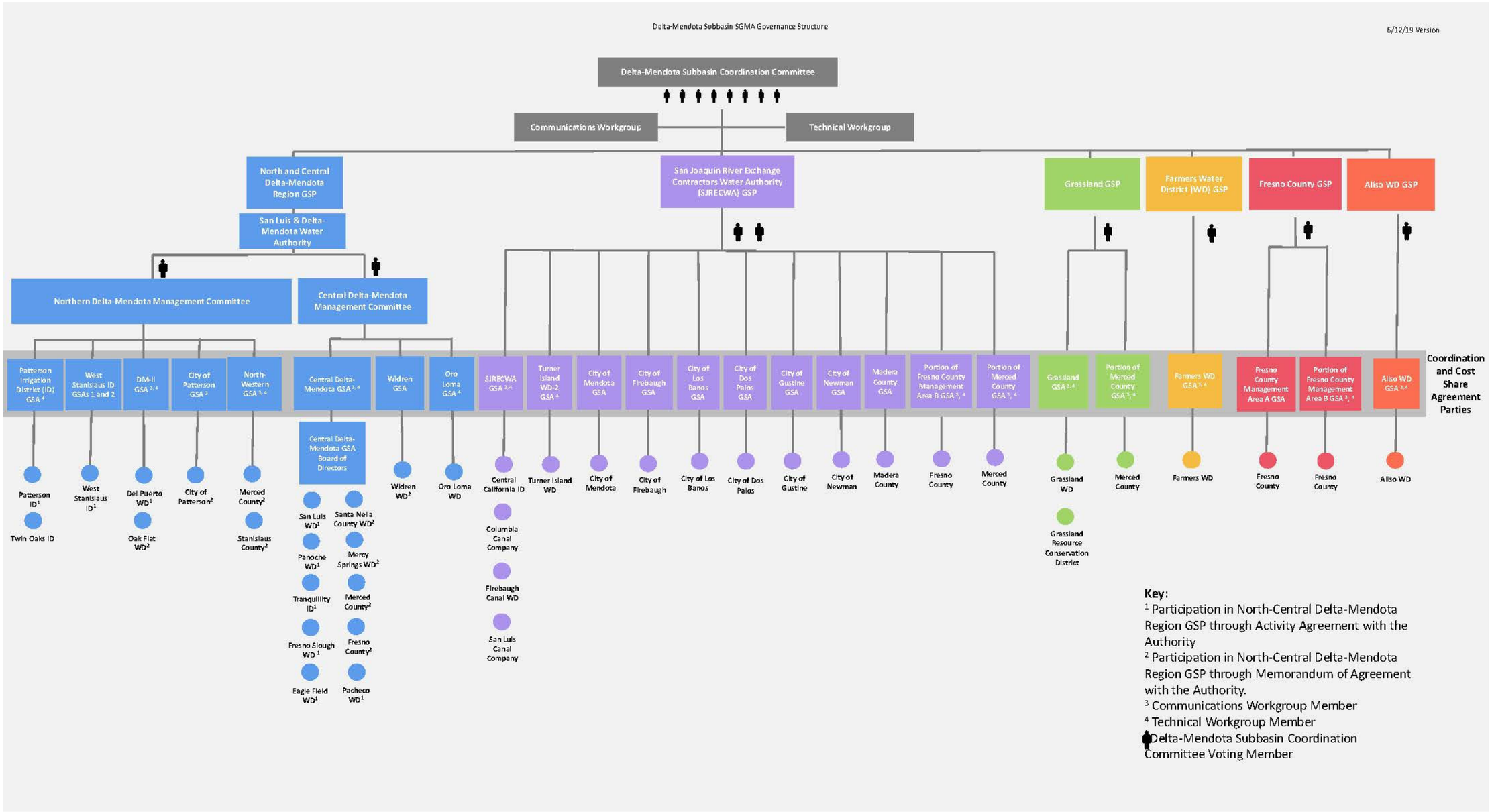


Figure CC-7: Governance Structure of the Delta-Mendota Subbasin

2.1.2 Intra-Basin Coordination

The Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement), effective as of December 12, 2018, has been signed by all participating agencies in the Delta-Mendota Subbasin; a copy of this agreement is included in **Appendix A**. The purpose of the Agreement, including technical reports to be developed after the initial execution of this Agreement, is to comply with SGMA requirements and to ensure that the multiple GSPs within the Subbasin are developed and implemented utilizing the same datasets, methodologies and assumptions, that the elements of the GSPs are appropriately coordinated to support sustainable subbasin management of groundwater resources, and to ultimately set forth the information necessary to show how the multiple GSPs in the Subbasin will achieve the sustainability goal as determined for the Subbasin in compliance with SGMA and its associated regulations.

A key goal of basin-wide coordination is to ensure that the Subbasin GSPs utilize the same data and methodologies during their plan development and that elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting, as required by SGMA and associated regulations. The Coordination Agreement defines how the coordinated efforts will be achieved and documented, and also sets out the process for identifying the Plan Manager. The Coordination Agreement is part of each individual GSP within the Delta-Mendota Subbasin.

The Coordination Agreement for the Delta-Mendota Subbasin covers the following topics:

1. Purpose of the Agreement, including:
    a. Compliance with SGMA and
    b. Description of Criteria and Function;
2. General Guidelines, including:
    a. Responsibilities of the Parties and
    b. Adjudicated or Alternative Plans in the Subbasin;
3. Role of San Luis & Delta-Mendota Water Authority (SLDMWA), including:
    a. Agreement to Serve,
    b. Reimbursement of SLDMWA, and
    c. Termination of SLDMWA's Services;
4. Responsibilities for Key Functions, including:
    a. Coordination Committee,
    b. Coordination Committee Officers,
    c. Coordination Committee Authorized Action and Limitations,
    d. Subcommittees and Workgroups,
    e. Coordination Committee Meetings, and
    f. Voting by Coordination Committee;
5. Approval by Individual Parties;
6. Exchange of Data and Information, including:
    a. Exchange of Information and
    b. Procedure for Exchange of Information;
7. Methodologies and Assumptions, including:
    a. SGMA Coordination Agreements,

   b. Pre-GSP Coordination, and
   c. Technical Memoranda Required;
8. Monitoring Network
9. Coordinated Water Budget
10. Coordinated Data Management System
11. Adoption and Use of the Coordination Agreement, including:
   a. Coordination of GSPs and
   b. GSP and Coordination Agreement Submission;
12. Modification and Termination of the Coordination Agreement, including:
   a. Modification or Amendment of Exhibit "A" (Groundwater Sustainability Plan Groups including Participation Percentages),
   b. Modification or Amendment of Coordination Agreement, and
   c. Amendment for Compliance with Law;
13. Withdrawal, Term, and Termination;
14. Procedures for Resolving Conflicts;
15. General Provisions, including:
   a. Authority of Signers,
   b. Governing Law,
   c. Severability,
   d. Counterparts, and
   e. Good Faith; and
16. Signatories of all Parties

Coordination During GSP Implementation

The Coordination Agreement ensures that the multiple GSAs are working cooperatively and collaboratively to ensure GSPs within the Subbasin are developed and implemented utilizing the same methodologies and assumptions and to ultimately establish the processes necessary to show how the multiple GSPs in the Subbasin will be sustainably managed to achieve the Delta-Mendota Subbasin's sustainability goal. The Coordination Committee intends to continue to meet and confer following the submittal of the Subbasin's GSPs and will develop guidelines for GSP implementation between the GSP Groups and update the Coordination Agreement as the Parties to the Agreement deem necessary.

The Coordination Committee will continue meeting regularly following submittal of the Subbasin GSPs in order to develop the guidelines for coordinated implementation of GSPs. The intent of the guidelines will be to outline processes that will ensure the GSAs are progressing toward the Subbasin sustainability goal, while meeting the Annual Reporting requirements or any other requirements agreed upon for purposes of coordination.

Agency Responsibilities

In meeting the terms of the Coordination Agreement, all Parties (meaning the Delta-Mendota Subbasin GSAs) agree to work collaboratively to meet the objectives of SGMA and the Coordination Agreement. Each Party to the Agreement is a GSA and acknowledges that it is bound by the terms of the Coordination Agreement as an individual party.

The Parties have established a Coordination Committee to provide a forum to accomplish the coordination obligations of SGMA. The Coordination Committee operates in full compliance with the Brown Act and is composed of a Chairperson and Vice Chairperson, Secretary, Plan Manager, and a GSP Group Representative and Alternate Representative for each of the six GSP groups. The Chairperson and Vice Chairperson are rotated annually among GSP Groups in alphabetical order. The Secretary assumes primary responsibility for Brown Act compliance. The GSP Group Representatives, who are identified in Table CC-4~~Table CC-4~~, are selected by each respective GSP Group at the discretion of the respective GSP Group, and such appointments are effective upon providing written notice to the Secretary and to each Group Contact. The Coordination Committee recognizes each GSP Group Representative and GSP Group Alternate Representative until the Group Contact provides written notice of removal and replacement to the Secretary and to every other Group Contact. Each GSP Group is required to promptly fill any vacancy created by the removal of its Representative or Alternate Representative so that each GSP Group has the number of validly designated representatives.

Each GSP Group Representative is entitled to one vote at the Coordination Committee, where the Alternate Representative is authorized to vote in the absence of the GSP Group Representative. The unanimous vote of the GSP Representatives from all GSP Groups is required on most items upon which the Coordination Committee is authorized to act, with the exception of certain ministerial and administrative items. Voting procedures to address a lack of unanimity take place upon a majority vote of a quorum of the Coordination Committee and include: straw polls, provisional voting, and delay of voting (see Section 5.6.3 – *Voting Procedures to Address Lack of Unanimity* of the Coordination Agreement). Where the law or the Coordination Agreement require separate written approval by each of the Parties, such approval is evidenced in writing by providing the resolution, Motion, or Minutes of their respective Board of Directors to the Secretary of the Coordination Committee. Minutes of the Coordinate Committee are kept and prepared by the Secretary's appointee and maintained by the Secretary as Coordination Agreement records and are available to the Parties and the public upon request. Meeting agenda and minutes are posted on the Delta-Mendota website (www.deltamendota.org).

The Coordination Committee may appoint subcommittees, working groups, and otherwise direct staff made available by the Parties. Subcommittees or working groups may include qualified individuals possessing the knowledge and expertise to advance the goals of the Coordination Agreement on the topics being addressed by the subcommittee or working group, whether or not such individuals are GSP Group Representatives or Alternate Representatives. Tasks assigned to subcommittees, working groups, or staff made available by the Parties may include developing technical data, supporting information, and/or recommendations on specialized matters to the Coordination Committee. One GSP Group Representative or Alternate Representative is required to vote on behalf of the GSP Group at the subcommittee level. If no GSP Group Representative or Alternate Representative is present, one individual working on a subcommittee on behalf of the Parties in a GSP Group votes on behalf of the GSP Group. Subcommittees report voting results and provide information to the Coordination Committee but are not entitled to make determinations or decisions that are binding on the Parties.

The Coordination Committee is authorized to act upon the following items:

1. The Coordination Committee reviews, and consistent with the requirements of SGMA, approves the Technical Memoranda that compose the Common Chapter (see *Coordinated Data and Methodology*);
2. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda as needed; assuring submittal of annual reports; providing five-year assessments and recommending any needed revisions to the Coordination Agreement; and providing review and assistance with coordinated projects and programs, once the GSPs have been submitted to and approved by DWR;
3. The Coordination Committee reviews and approves work plans, and in accordance with the budgetary requirements of the respective Parties, approves annual budget estimates of Coordinated Plan Expenses presented by the Secretary and any updates to such estimates provided that such estimates or updates with supporting documentation are circulated to all Parties for comment at least thirty (30) days in advance of the meeting at which the Coordination Committee will consider approval of the annual estimate;
4. The Coordination Committee is authorized to approve changes to Exhibit "A" (Groundwater Sustainability Plan Groups including Participation Percentages) to the Agreement and to recommend amendments to terms of the Agreement;
5. The Coordination Committee may assign work to subcommittees and workgroups as needed, provide guidance and feedback and ensure that subcommittees and workgroups prepare work products in a timely manner;
6. The Coordination Committee directs the Plan Manager in the performance of its duties under SGMA; and
7. The Coordination Committee provides direction to its Officers concerning other administrative and ministerial issues necessary for the fulfillment of the above-enumerated tasks.

Additional information regarding the roles, responsibilities, and duties of the Coordination Committee can be found in Section 5 – *Responsibilities for Key Functions* of the Coordination Agreement.

Exchange of Information

Timely exchange of information is a critical aspect of GSP coordination. All parties to the Coordination Agreement have agreed to exchange public and non-privileged information through collaboration and/or informal requests made at the Coordination Committee level or through subcommittees designated by the Coordination Committee. To the extent it is necessary to make a written request for information to another Party, each Party designates a representative to respond to information requests and provides the name and contact information of the designee to the Coordination Committee. Requests may be communicated in writing and transmitted in person or by mail, facsimile machine, or other electronic means to the appropriate representative as named in the Coordination Agreement. The designated representative is required to respond in a reasonably timely manner. Nothing in the Agreement shall be construed to prohibit any Party from voluntarily exchanging information with any other Party by any other mechanism separate from the Coordination Committee.

The Parties agree that each GSP Group shall provide the data required to develop the Subbasin-wide coordinated water budget but, unless required by law, will not be required to provide individual well or parcel-level information in order to preserve confidentiality of individuals to the extent authorized by law,

including but not limited to Water Code Section 10730.8, subdivision (b). To the extent that a court order, subpoena, or the California Public Records Act is applicable to a party, the Party in responding to a request made pursuant to that Act for release of information exchanged from another Party shall notify each other Party in writing of its proposed release of information in order to provide the other Parties with the opportunity to seek a court order preventing such release of information.

Dispute Resolution

Procedures for conflict resolution have been established within the Coordination Agreement. In the event that a dispute arises among Parties as it relates to the Coordination Agreement, the disputing Party or Parties are to provide written notice of the basis of the dispute to the other Parties within thirty (30) calendar days of the discovery of the events giving rise to the dispute. Within thirty (30) days after such written notice, all interested Parties are to meet and confer in good faith to informally resolve the dispute. All disputes that are not resolved informally shall be settled by arbitration. In such an event, within ten (10) days following the failed informal proceedings, each interested Party is to nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties are to rank their top three among all nominated arbitrators, awarding three points to the top choice, two points to the second choice, and one point to the third choice and zero points to all others. Each interested Party will then forward its tally to the Secretary, who tabulates the points and notifies the interested Parties of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The Secretary may also develop procedures for approval by the Parties for selection of an arbitrator in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines to act. The arbitration is to be administered in accordance with the procedures set forth in the California Code of Civil Procedure, Section 1280, *et seq.*, and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring legal action relating to the controversy.

Coordinated Data and Methodology

Pursuant to SGMA, the Coordination Agreement ensures that the individual GSPs utilize the same data and methodologies for developing assumptions used to determine: 1) groundwater elevation; 2) groundwater extraction data; 3) surface water supply; 4) total water use; 5) changes in groundwater storage; 6) water budgets; and 7) sustainable yield. The Parties have agreed to develop agreed-upon methodologies and assumptions for the aforementioned items prior to or concurrent with the individual development of GSPs. This development is facilitated through the Coordination Committee's delegation to a subcommittee or working group of the technical staff provided by some or all of the Parties. The basis upon which the methodologies and assumptions have been developed includes existing data/information, best management practices, and/or best modeled or projected data available and may include consultation with DWR as appropriate.

The data and methodologies for assumptions ~~described~~described in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans are set forth in Technical Memoranda prepared by the Coordination Committee for each of the following elements: Data and Assumptions; Hydrogeologic Conceptual Model; Coordinated Water Budgets; Sustainable Management Criteria (SMC); Coordinated Monitoring Network; Coordinated Data Management System, and Adoption and Use of the Coordination Agreement. The Technical Memoranda have been subject to the unanimous approval of the Coordination Committee and once approved, have been attached to and incorporated by reference into the Coordination Agreement without formal amendment of the Coordination Agreement being required. The Parties have agreed that they will not submit this Coordination Agreement to DWR until the Technical Memoranda described herein have been added to the Coordination Agreement. The Technical Memoranda created pursuant to the Coordination Agreement are to be utilized by the Parties

during the development and implementation of their individual GSPs in order to assure coordination of the GSPs is in compliance with SGMA. The Technical Memoranda have been included as an appendix to this GSP as a part of the Common Chapter.

Plan Implementation and Submittal

Under the Coordination Agreement, the Parties have agreed to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. Subject to the subsequent attachment of the Technical Memoranda as appendices to the Common Chapter, the Parties intend that the described Coordination Agreement fulfill the requirements of providing an explanation of how the GSPs implemented together satisfy the requirements of SGMA for the entire Subbasin. The Coordination Agreement does not otherwise affect each Party's responsibility to implement the terms of its respective GSP in accordance with SGMA. Rather, this Coordination Agreement is the mechanism through which the Parties will coordinate their respective GSPs to the extent necessary to ensure that such GSP coordination complies with SGMA.

Each Party is responsible for ensuring that its own GSP complies with the statutory requirements of SGMA, including but not limited to the filing deadline. The Parties to this Coordination Agreement intend that their individual GSPs be coordinated together in order to satisfy the requirements of SGMA and to be in substantial compliance with the California Code of Regulations. The collective GSPs will satisfy the requirements of Water Code Sections 10727.2 and 10727.4 by providing a description of the physical setting and characteristics of the separate aquifer systems within the Subbasin, the measurable objectives for each such GSP, interim milestones (IMs), and monitoring protocols that together provide a detailed description of how the Subbasin as a whole will be sustainably managed.

The Parties agree to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. The Coordination Committee is responsible for assuring submittal of annual reports, five-year updates, and for providing assessments recommending any needed revisions to the Coordination Agreement.

Coordinated Data Management System

The Delta-Mendota Subbasin GSAs have developed and will maintain a coordinated Data Management System that is capable of storing and reporting information relevant to the reporting requirements and/or implementation of the GSPs and monitoring network of the Subbasin.

The Parties may also develop and maintain separate Data Management Systems. Each separate Data Management System developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

Adjudicated Areas and Alternative Plans

There are no adjudicated areas within the Delta-Mendota Subbasin, and no Alternative Plans have been submitted by the local agencies within the Subbasin.

Legal Bindings of the Delta-Mendota Subbasin Coordination Agreement

The Coordination Agreement, as contained herein, is reflected in the same manner and form as in the six Subbasin GSPs. All parties understand that the Delta-Mendota Subbasin Coordination Agreement is part

of the GSPs for participating Subbasin GSAs and will be a primary mechanism by which the six Subbasin GSPs will be implemented in a coordinated fashion. Further, all parties to the Coordination Agreement understand that DWR will evaluate the agreement for compliance with the procedural and technical requirements of GSP Regulations §-357.4 (Coordination Agreement) to ensure that the agreement is binding on all parties and that provisions of the agreement are sufficient to address any disputes between or among parties to the agreement.

The Coordination Agreement will continue to be the framework under which the six Delta-Mendota Subbasin GSPs will be implemented and will be reviewed as part of the five-year assessment and revised as necessary, dated, and signed by all parties.

2.1.3 Inter-basin Agreements

SLDMWA, on behalf of the Northern and Central Delta-Mendota Regions, and the SJREC GSA executed inter-basin data sharing agreements with Westlands Water District (the lead entity encompassing the adjoining Westside Subbasin).- The purpose of the agreement is to establish a set of common assumptions on groundwater conditions on either side of the boundary between the Westside Subbasin and the Delta-Mendota Subbasin to be used for the development of GSPs in support of implementation of SGMA. In this agreement, the parties agree to provide each other with recorded, measured, estimated, and/or simulated modeling data located within five (5) miles of the boundary between the Westside Subbasin and the Delta-Mendota Subbasin. A list of data types to be shared between the parties to the agreement can be found in **Appendix D**.

Data provided under this agreement are understood to be shared with consultants and other stakeholders in the respective basins (Delta-Mendota Subbasin and Westside Subbasin), and that the information will be made public through the development of the respective Parties' (meaning SLDMWA/SJREC and Westlands Water District) GSPs and the supporting documentation of the GSPs. Other than publishing information for those purposes, neither Party will disclose the other Party's information to any third party, except if the other Party determines, at its sole discretion, the disclosure is required by law. Each Party may review preliminary results before publishing the information.

It is recognized that many of the sustainability indicators, notably groundwater quality, inelastic land subsidence and change in storage, are regional issues that may require future inter-basin discussions and coordination. Memorandum of Intent (MOI) are being discussed with the surrounding subbasins to demonstrate/confirm the subbasins' desires to coordinate during GSP implementation. These agreements, to be discussed further following submittal of GSPs, will allow for thoughtful consideration of the intent, structure, and need for future coordination with respect to data collection, reporting, regular meetings, and updates prior to annual reporting.

3. DELTA-MENDOTA SUBBASIN PLAN AREA

This section describes the Delta-Mendota Subbasin, including major streams and creeks, institutional entities, agricultural and urban land uses, locations of state lands (including wetlands), and geographic boundaries of surface water runoff areas. The reader is referred to the individual Subbasin GSPs for descriptions of existing surface water and groundwater monitoring programs, existing water management programs, and general plans in the individual GSP Plan Areas. The information contained in this section reflects information from publicly available sources and may not reflect all information that will be used for GSP technical analysis.

This section of the GSP satisfies Section 354.8 of the SGMA regulations.

3.1 Plan Area Definition

The Plan Area for the six coordinated GSPs is the Delta-Mendota Subbasin (DWR Basin 5-022.07). As previously noted, the Delta-Mendota Subbasin is one of nine subbasins that lie completely within the San Joaquin Valley Hydrologic Region and adjoins the following subbasins (**Figure CC-8**~~**Figure CC-8**~~):

- Tracy
- Eastern San Joaquin
- Modesto
- Turlock
- Merced
- Chowchilla
- Madera
- Kings
- Westside

As described in *California's Groundwater*, DWR Bulletin 1188 (2016), the Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley and includes portions of San Joaquin, Stanislaus, Merced, Fresno, San Benito, and Madera Counties. The northern boundary begins just south of Tracy in San Joaquin County, and the eastern boundary generally follows the San Joaquin River and Fresno Slough. The southern boundary is near the small town of San Joaquin, and the Subbasin is bounded on the west by the Coast Range. The Subbasin boundaries are further described in Section 4.1.5, Basin Boundaries, and is shown in relation to each of the six counties in **Figure CC-9**~~**Figure CC-9**~~.

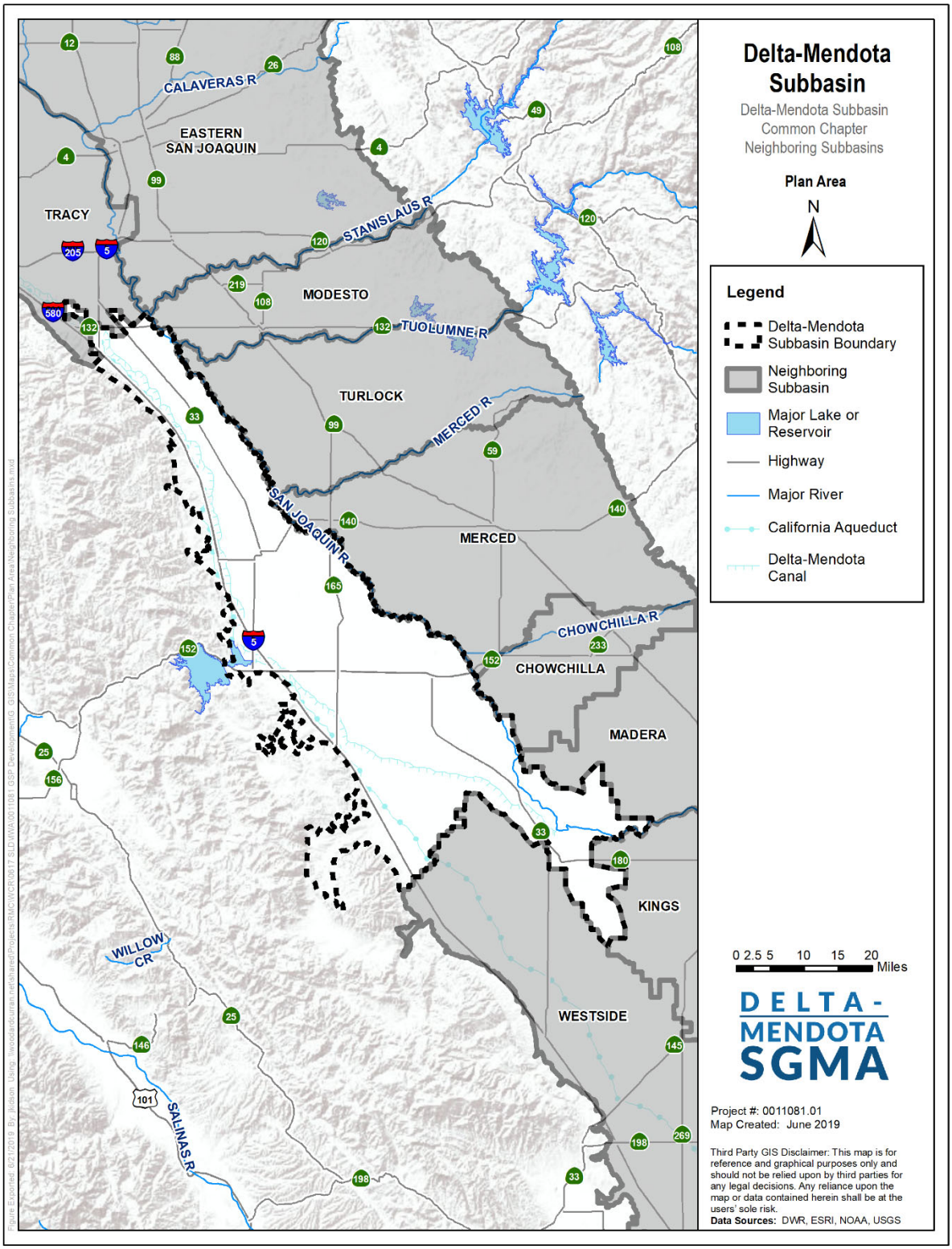


Figure CC-8: Neighboring Subbasins of the Delta-Mendota Subbasin

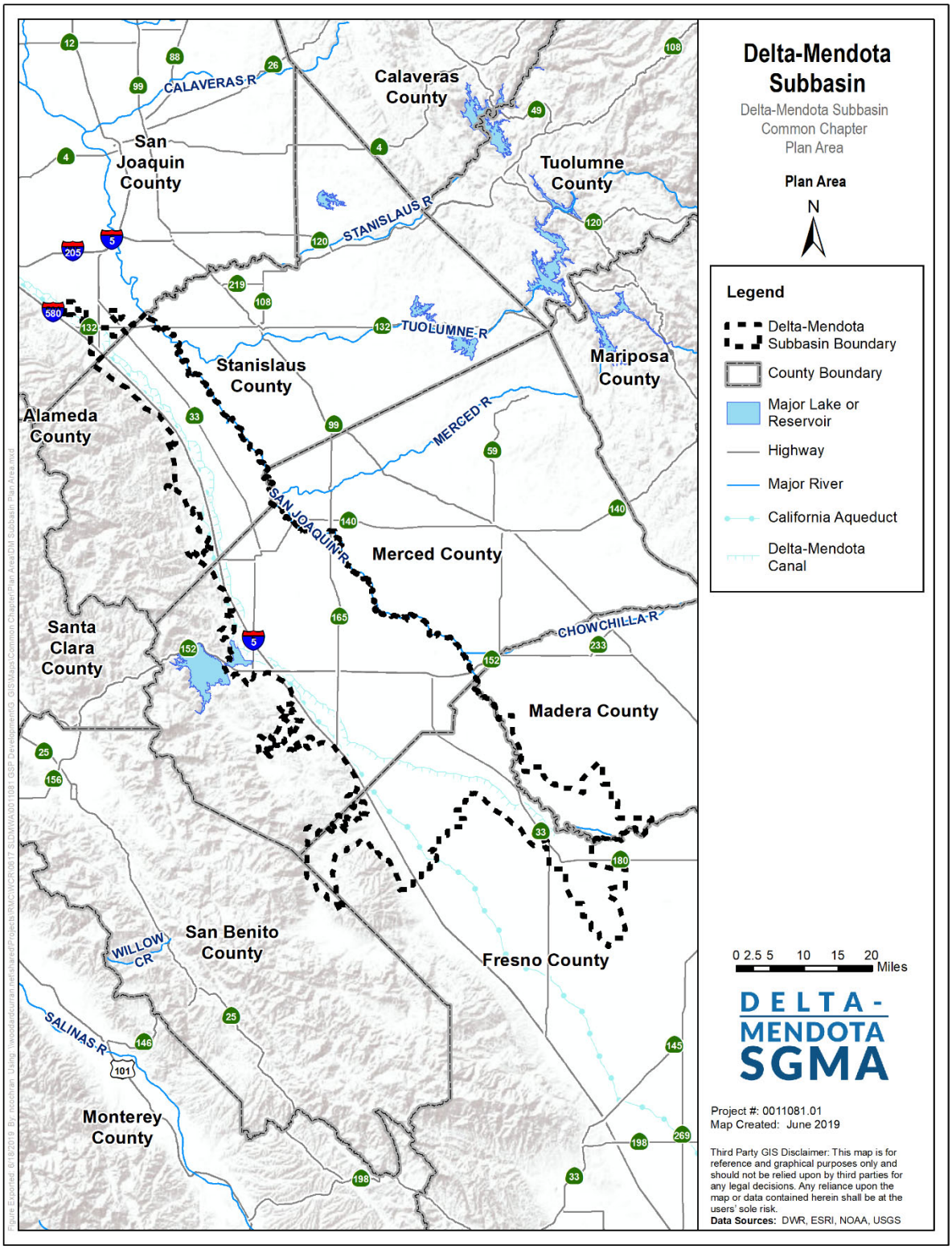


Figure CC-9: Delta-Mendota Groundwater Subbasin Plan Area

3.2 Plan Area Setting

As previously noted, the Delta-Mendota Subbasin lies along the western margin of the San Joaquin Valley. This valley is part of the large, northwest-to-southeast-trending asymmetric trough of the Central Valley, which has been filled with up to six vertical miles of sediment. This sediment includes both marine and continental deposits ranging in age from Jurassic to Holocene. The San Joaquin Valley lies between the Coast Range Mountains on the west and the Sierra Nevada on the east and extends northwestward from the San Emigdo and Tehachapi Mountains to the Sacramento-San Joaquin Delta (Delta) near the City of Stockton. The San Joaquin Valley is 250 miles long and 50 to 60 miles wide. The relatively flat alluvial floor is interrupted occasionally by low hills. Foothills adjacent on the west are composed of folded and faulted beds of mainly marine shale in the north and sandstone and shale in the south.

The San Joaquin Valley floor is divided into several geomorphic land types, including dissected uplands, low alluvial fans and plains, river floodplains and channels, and overflow lands and lake bottoms. Alluvial plains cover most of the valley floor and comprise some of the most intensely developed agricultural lands in the San Joaquin Valley. In general, alluvial sediments of the western and southern parts of the San Joaquin Valley tend to have lower permeability than east side deposits.

This section provides additional information relating to water resources in and around the Delta-Mendota Subbasin.

Watersheds

The Delta-Mendota Subbasin lies in the Middle San Joaquin-Lower Merced-Lower Stanislaus watershed and the Middle San Joaquin-Lower Chowchilla watershed (**Figure CC-10**~~**Figure CC-10**~~). Historically, the San Joaquin Valley Basin was a large floodplain of the San Joaquin River that supported vast expanses of permanent and seasonal marshes, lakes, and riparian areas. Approximately 90 percent of the basin's wetlands have been lost, with approximately 58,000 flooded acres remaining on State, federal and private wildlife refuges. Approximately 100,000 acres of managed wetland, upland and riparian habitat is found within the Grassland Plan area, and together with the 12,000-acre Mendota Wildlife Area (found in the Fresno County Plan area), encompasses the vast majority of the remaining wetlands found in the basin (**Figure CC-11**~~**Figure CC-11**~~).

The San Joaquin River Basin (Basin) includes the entire area drained by the San Joaquin River. The San Joaquin River Basin drains 13,513 square miles (mi^2) before it flows into the Sacramento-San Joaquin Delta near the town of Vernalis. The Merced, Tuolumne and Stanislaus Rivers are the three major tributaries that join the mainstream San Joaquin River from the east before it flows into the Delta.

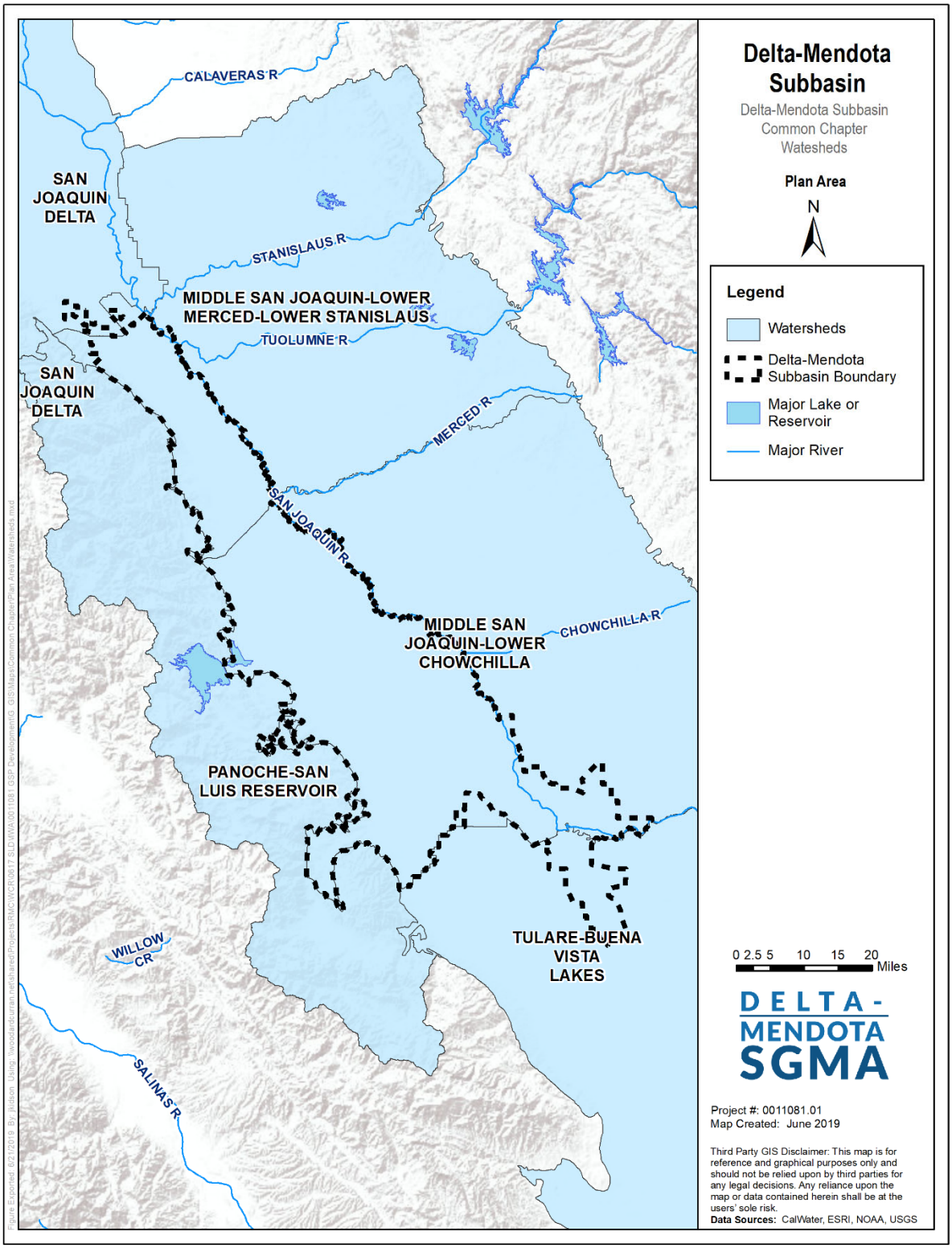


Figure CC-10: Local Watersheds

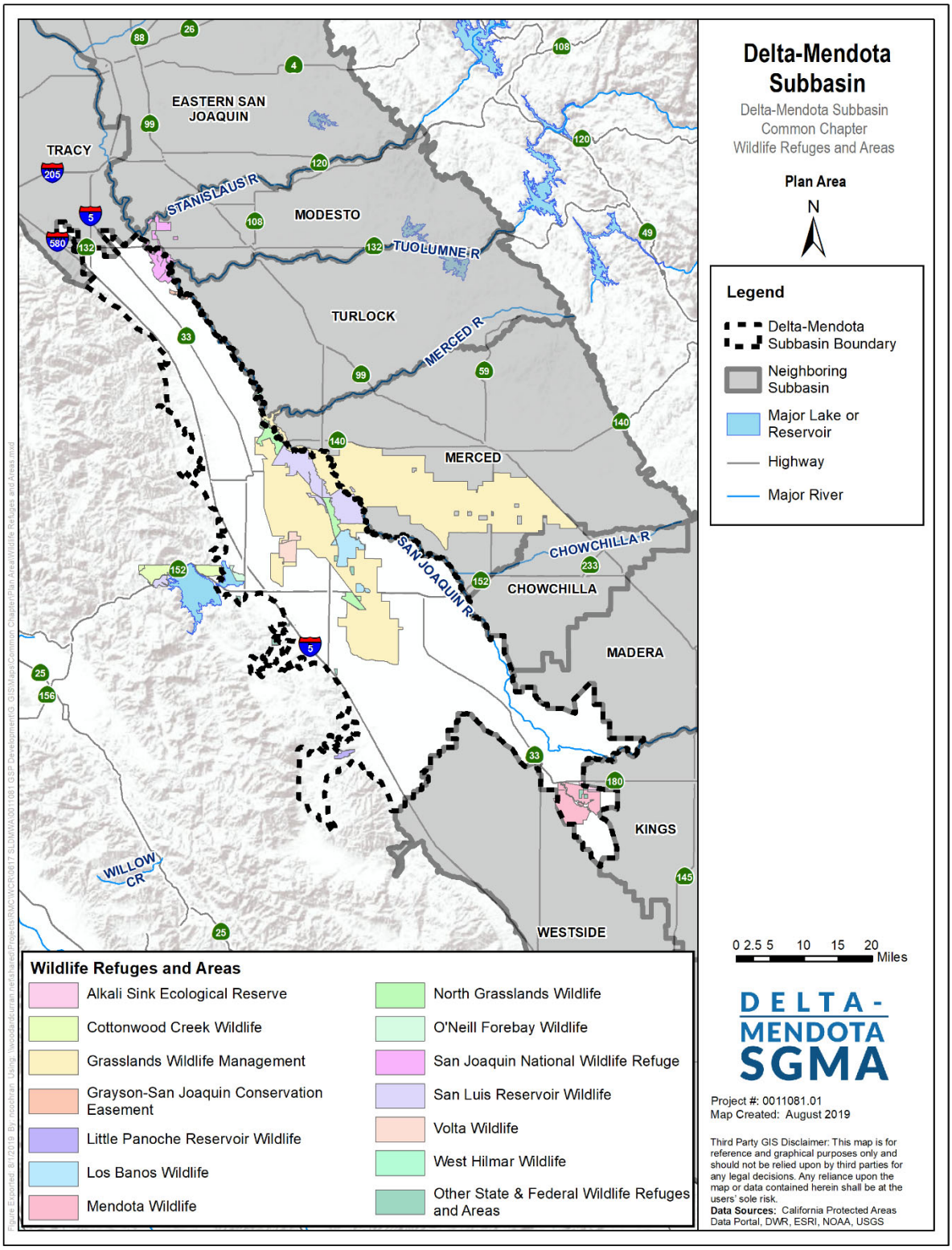


Figure CC-11: Wildlife Refuges and Wetland Habitat Areas in the Delta-Mendota Subbasin

Surface Water Use

Surface water is a primary water supply for agriculture within the Delta-Mendota Subbasin. Surface water supplies are brought into the Subbasin using an extensive series of water systems relied upon by multiple water agencies, cities, and private water users. Major water-related infrastructure in the Subbasin includes the facilities required to deliver Central Valley Project (CVP) supplies to CVP water supply contractors, in addition to key infrastructure of the State Water Project (SWP) utilized to deliver water to SWP water supply contractors and surface water diversions (e.g. intakes) to divert and distribute water from the San Joaquin and Kings Rivers.

The San Luis & Delta-Mendota Water Authority (SLDMWA) is a joint powers authority consisting of 28 member agencies that provide water to approximately 1.2 million acres of highly productive farmland, 2 million California residents, and millions of waterfowl dependent upon the nearly 200,000 acres of managed wetlands within this area of the Pacific Flyway. The SLDMWA operates and maintains portions of the CVP, including the Delta Cross Channel, the C.W. "Bill" Jones Pumping Plant, the Delta-Mendota Canal (DMC), O'Neill Pumping-Generating Plant, and the San Luis Drain, and provides emergency assistance when requested on the Delta Cross Channel and the Tracy Fish Collection Facility. The California Department of Water Resources (DWR) operates and maintains the SWP facilities, designed to deliver nearly 4.2 million acre-feet of water per year to 29 long-term SWP water supply contractors. Joint federal-state facilities include the California Aqueduct, Banks Pumping Plant, O'Neill Dam and Forebay, Sisk Dam and San Luis Reservoir, and Dos Amigos Pumping Plant. Surface water diversion facilities are owned and operated by individual water and irrigation districts and typically include some form of intake (e.g. fish screen, open water intake, flumes) plus facilities to convey the diverted surface water to a distribution system.

Groundwater Use

Groundwater is a key component of water supplies in the Delta-Mendota Subbasin. To protect the long-term sustainability of groundwater resources, pumping has significantly reduced in past years (2017-2019), allowing the groundwater levels in the Subbasin to recover to some extent. During the most recent drought period, groundwater was heavily relied upon throughout the Subbasin for irrigation as surface water deliveries were significantly severely reduced for many water users (especially those with junior surface water rights), resulting in increased groundwater pumping.

There are many communities within the Subbasin that are partially or completely reliant on groundwater for municipal and domestic water supplies, including the cities of Patterson, Newman, Gustine, Los Banos, Firebaugh, and Mendota and the communities of Grayson, Westley, Crows Landing, Santa Nella, Volta, Dos Palos Y, and Tranquillity (Figure CC-12~~Figure CC-12~~). Other unincorporated areas of the Subbasin also rely on groundwater as the sole water supply source. There are several areas of *de minimis* groundwater extractors in the Subbasin, which are defined as well owners who extracts two acre-feet or less per year from a parcel for domestic purposes (SWRCB, n.d. (a)).

Figure CC-13~~Figure CC-13~~, Figure CC-14~~Figure CC-14~~, and Figure CC-15~~Figure CC-15~~ show the density per square mile (PLSS Section) of domestic, production, and public wells in the Delta-Mendota Subbasin as identified by DWR's Well Completion Report Map Application. Domestic wells are defined as individual domestic wells which supply water for the domestic needs of an individual residence or systems of four or less service connections (DWR, 1981). Within the Delta-Mendota Subbasin, the majority of PLSS Sections contain five or fewer domestic wells (Figure CC-13~~Figure CC-13~~). Production well statistics include wells that are designated as irrigation, municipal, public, and industrial on well completion reports, generally indicating wells designed to obtain water from productive zones

containing good-quality water (DWR, 1991). The majority of PLSS Sections in the Subbasin contain only zero, one, or two production wells (**Figure CC-14**~~**Figure CC-14**~~). The highest concentration of production wells can be found in the south of the Subbasin, near Mendota. Public wells are defined as wells that provide water for human consumption to 15 or more connections or regularly serves 25 or more people daily for at least 60 days out of the year (SWRCB, n.d. (b)). Compared to domestic and production wells, public wells are less common in the Subbasin. The status of the wells (e.g. active, abandoned, destroyed) contained in the DWR Well Completion Report Map Application has not been independently confirmed. Additionally, the reader is referred to each of the six Subbasin GSPs for more information regarding wells in the Delta-Mendota Subbasin.

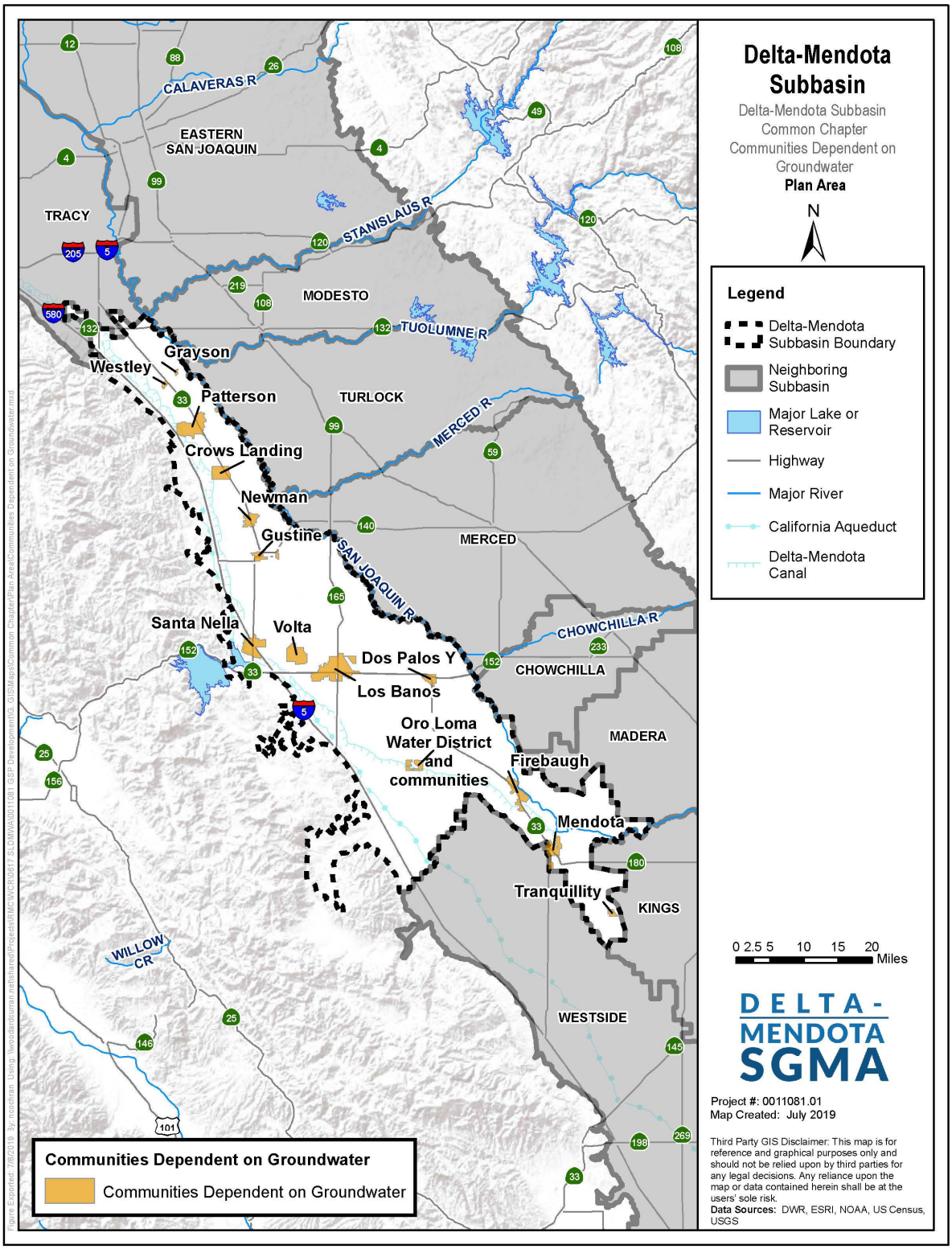


Figure CC-12: Communities Dependent on Groundwater

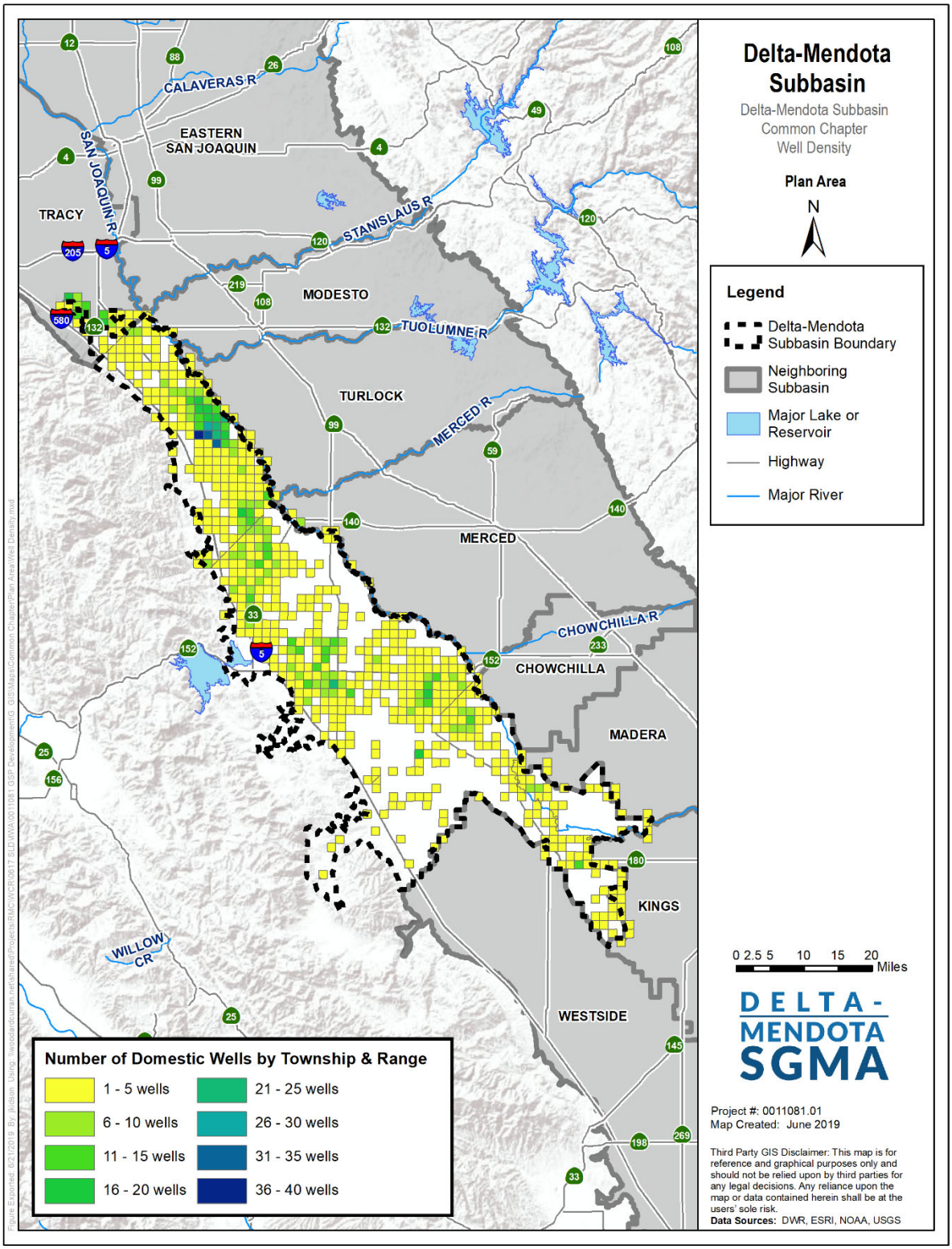


Figure CC-13: Domestic Well Density in the Delta-Mendota Subbasin

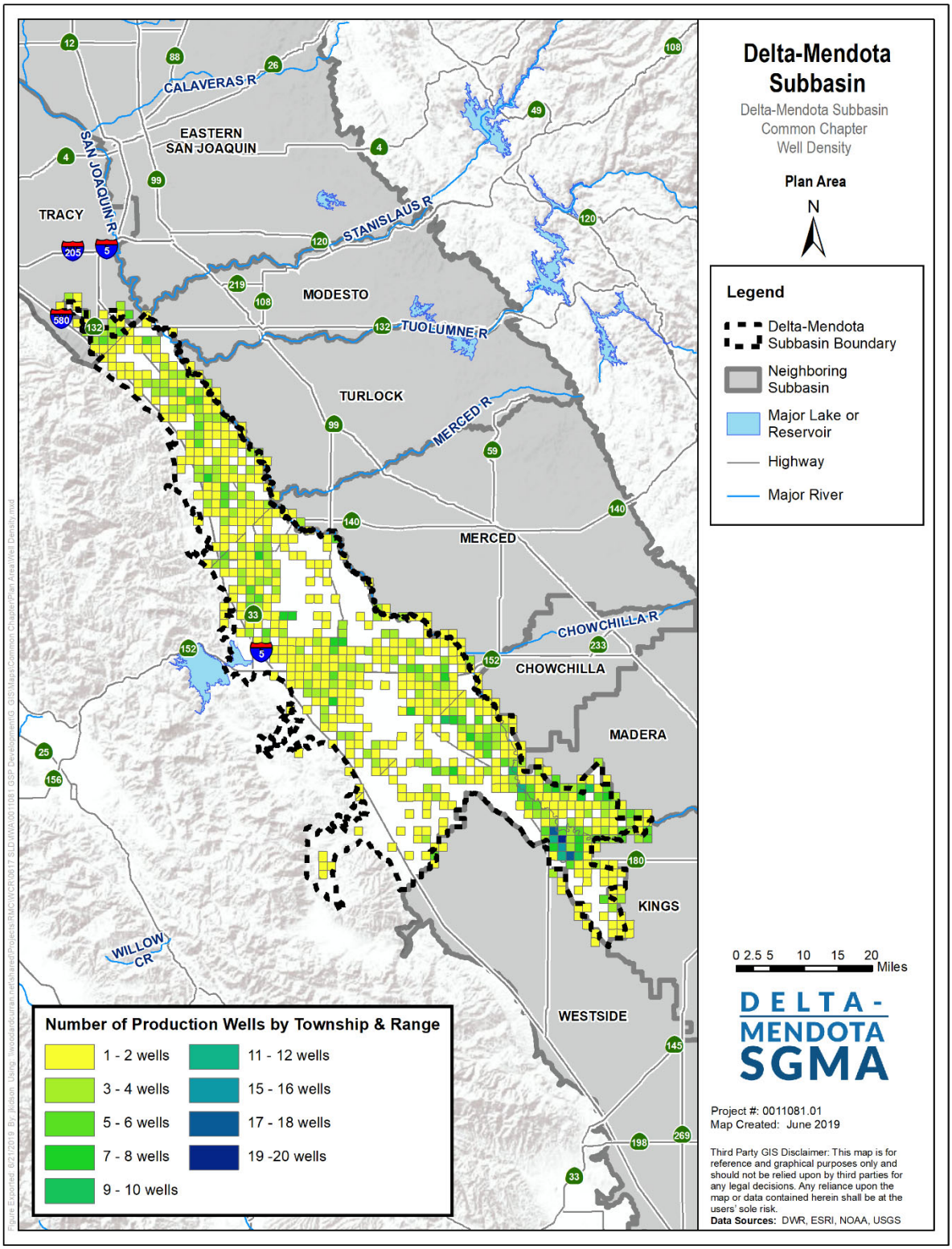


Figure CC-14: Production Well Density in the Delta-Mendota Subbasin

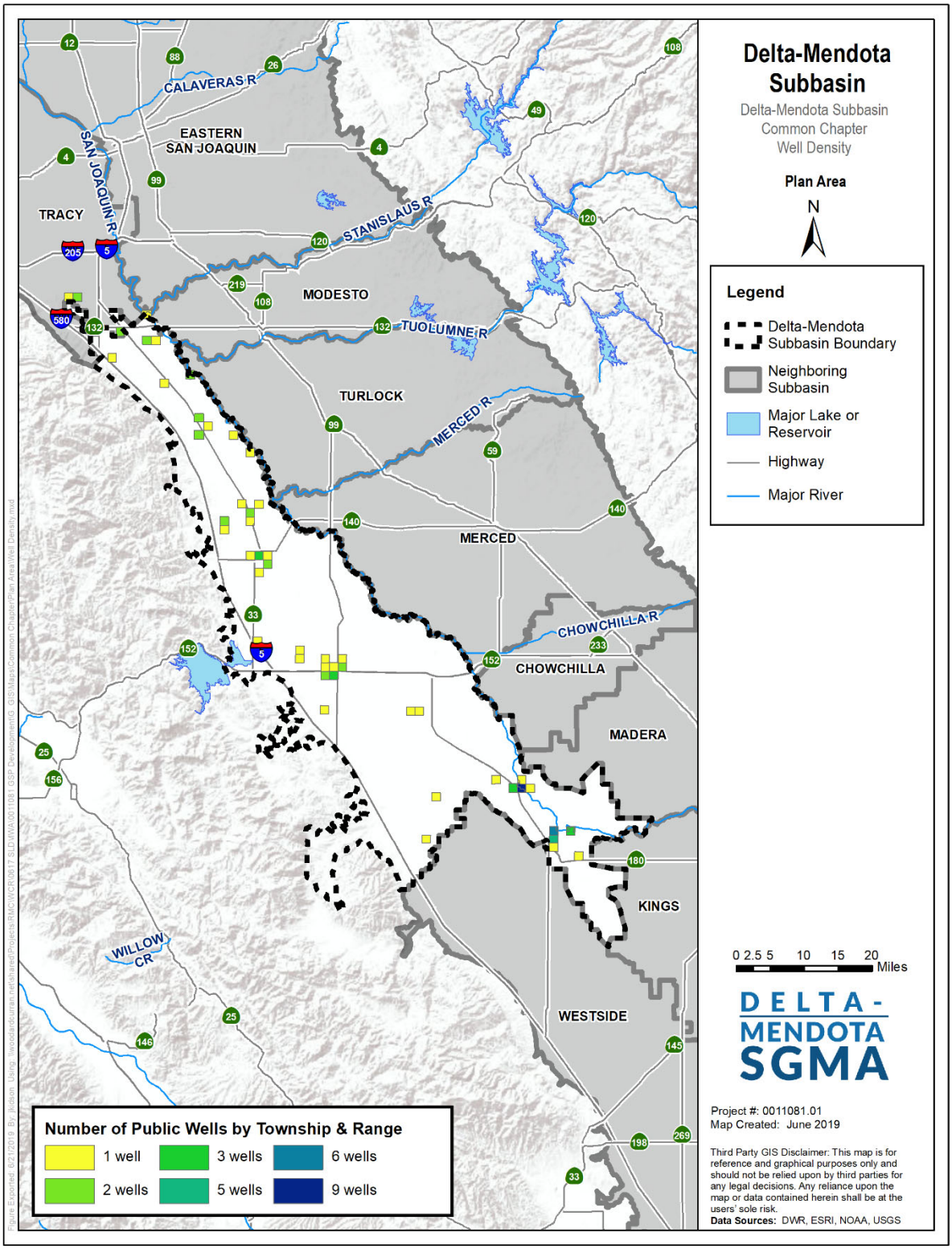


Figure CC-15: Public Well Density in the Delta-Mendota Subbasin

Flood Management

In general, the Delta-Mendota Subbasin slopes toward the San Joaquin River with steeper slopes along the western boundary (near the Coast Range), tapering off closer to the San Joaquin River. The flood management system in the San Joaquin Valley includes reservoirs to regulate snowmelt from elevations greater than 5,000 feet, bypasses at lower elevations, and levees that line major rivers.

Severe rain events in 1997/98, 2005/2006, 2011 and 2017 flooded communities, agricultural lands and refuges adjacent to the San Joaquin River in the Delta-Mendota Subbasin (specifically the communities of Firebaugh, Newman, Gustine and Mendota) and produced some localized flooding of farmland and refuges caused by runoff impoundment by elevated canal banks. Based on the recent historical events, the primary threat of flooding to urban areas will be for those along (and immediately adjacent to) the San Joaquin River. Areas within the 100-year floodplain within the Subbasin are shown in **Figure CC-16**~~**Figure CC-16**~~.

Major Land Use Divisions

The Delta-Mendota Subbasin consists mostly of agricultural land use types (**Figure CC-17**~~**Figure CC-17**~~). Typical land uses are described in the following sections and consist predominantly of the following:

- Pasture/Rangeland
- Agricultural Land (including rice, field crops and grains)
- Deciduous Forest
- Idle and Retired Farmland/Rangeland
- Riparian/Wetland
- Urban

The primary land use planning entities in the Delta-Mendota Subbasin include San Joaquin, Stanislaus, Merced, Fresno, and Madera Counties, as well as the cities of Patterson, Newman, Gustine, Los Banos, Dos Palos, Firebaugh, and Mendota, and Community of Santa Nella, as shown in **Figure CC-18**~~**Figure CC-18**~~.

Pasture/Rangeland

Grasslands in the Central Valley were originally dominated by native perennial grasses such as needlegrass and alkali sacaton. Currently, grassland vegetation is characterized by a predominance of annual or perennial grasses in an area with few or no trees and shrubs. Annual grasses found in grassland vegetation include wild oats, soft chess, ripgut grass, medusa head, wild barley, red brome, and slender fescue. Perennial grasses found in grassland vegetation are purple needlegrass, Idaho fescue, and California oatgrass. Forbs commonly encountered in grassland vegetation include long-beaked filaree, redstem filaree, dove weed, clovers, Mariposa lilies, popcornflower, and California poppy. Vernal pools found in small depressions with an underlying impermeable layer are isolated wetlands within grassland vegetation. Pastures can consist of both irrigated and unirrigated lands dominated by perennial grasses used predominantly for grazing.

Rangeland communities are composed of similar grasses, grass-like plants, forbs, or shrubs which are grazed by livestock. Rangelands are classified into three basic types: shrub and brush rangeland, mixed rangeland, and herbaceous rangeland. The shrub and brush rangeland is dominated by woody vegetation and is typically found in arid and semiarid regions. Mixed rangelands are ecosystems where more than one-third of the land supports a mixture of herbaceous species and shrub or brush rangeland species.

Herbaceous rangelands are dominated by naturally occurring grasses and forbs as well as some areas that have been modified to include grasses and forbs as their principal cover. Rangelands are, by definition, areas where a variety of commercial livestock are actively maintained.

Agricultural Land

General agricultural types occurring in the Delta-Mendota Subbasin include row crops, grains, orchards, and vineyards. Management of agricultural lands often includes intensive management, including soil preparation activities, crop rotation, grazing, and the use of chemicals.

Row Crops

Most row crops grown in the San Joaquin Valley and harvested for food are annual species and are managed with a crop rotation system. During the year, several different crops may be produced on a given parcel of land either concurrently or in succession. Typical crops grown in the Delta-Mendota Subbasin include tomatoes, melons, grain crops (such as barley, wheat, corn, and oats), rice, cotton, and beans.

Orchards and Vineyards

Orchard and vineyards consist of cultivated fruit or nut-bearing trees or grapevines. Orchards are typically open, single-species, tree-dominated habitats and are planted in a uniform pattern and intensively managed. Understory vegetation is usually sparse. Vineyards are typically managed in a similar manner for producing grapes for wine and/or direct consumption.

Deciduous Forest

Deciduous forests are composed of trees that lose their leaves in the winter. These include species such as the various California oaks, California buckeye, Fremont Cottonwoods, Goodding Willows, and California Sycamores. The interior live oak, which is not deciduous, is also found in deciduous forests. Valley oak woodlands are found in the Sacramento and San Joaquin Valleys and usually occur below elevations of 2,000 feet.

Idle or Retired Farmland/Rangeland

Lands of this category are similar to abandoned farmlands in ruderal (disturbed) areas. Plants on these parcels may consist of either native and/or non-native species.

Riparian/Wetland

Riparian and wetland communities are both natural and man-made. Managed wetlands are classified as riparian and are flooded for overwintering migratory bird habitat. In the spring the wetlands are drained to promote grasses such as swamp timothy and watergrass which are an important waterfowl food supply. Although some grazing continues on managed wetlands, historically, many of these lands were irrigated and used as rangeland throughout the summer months. Today, managed wetlands are irrigated in the spring to maximize wetland productivity and provide nesting and sensitive species habitat. Managed wetlands also contain emergent vegetation such as cattail and tule and are often adjacent to riparian corridors.

Urban

Urban land uses include cities and smaller communities, in addition to other lands used for industrial and/or commercial practices.

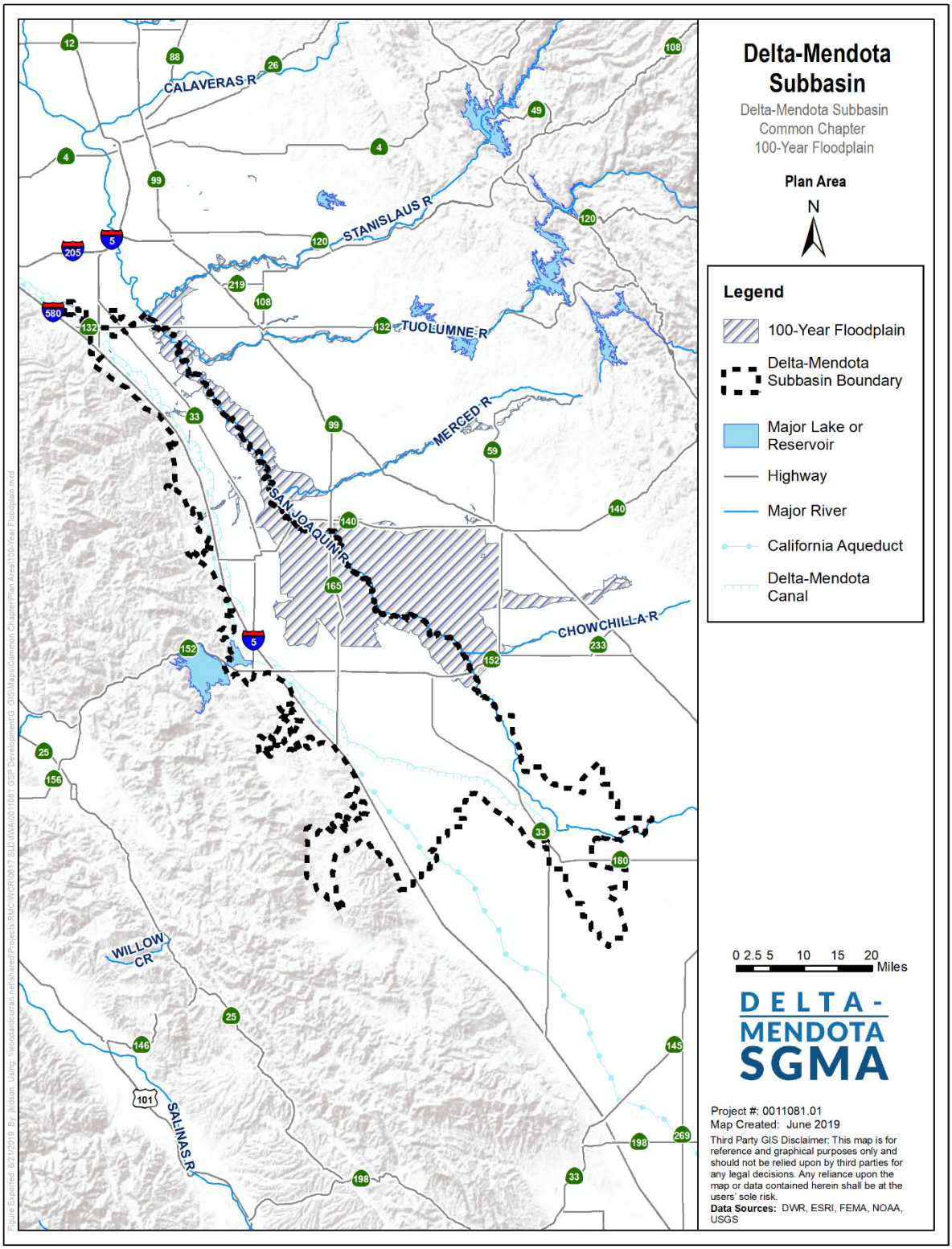


Figure CC-16: 100-Year Floodplain, Delta-Mendota Subbasin

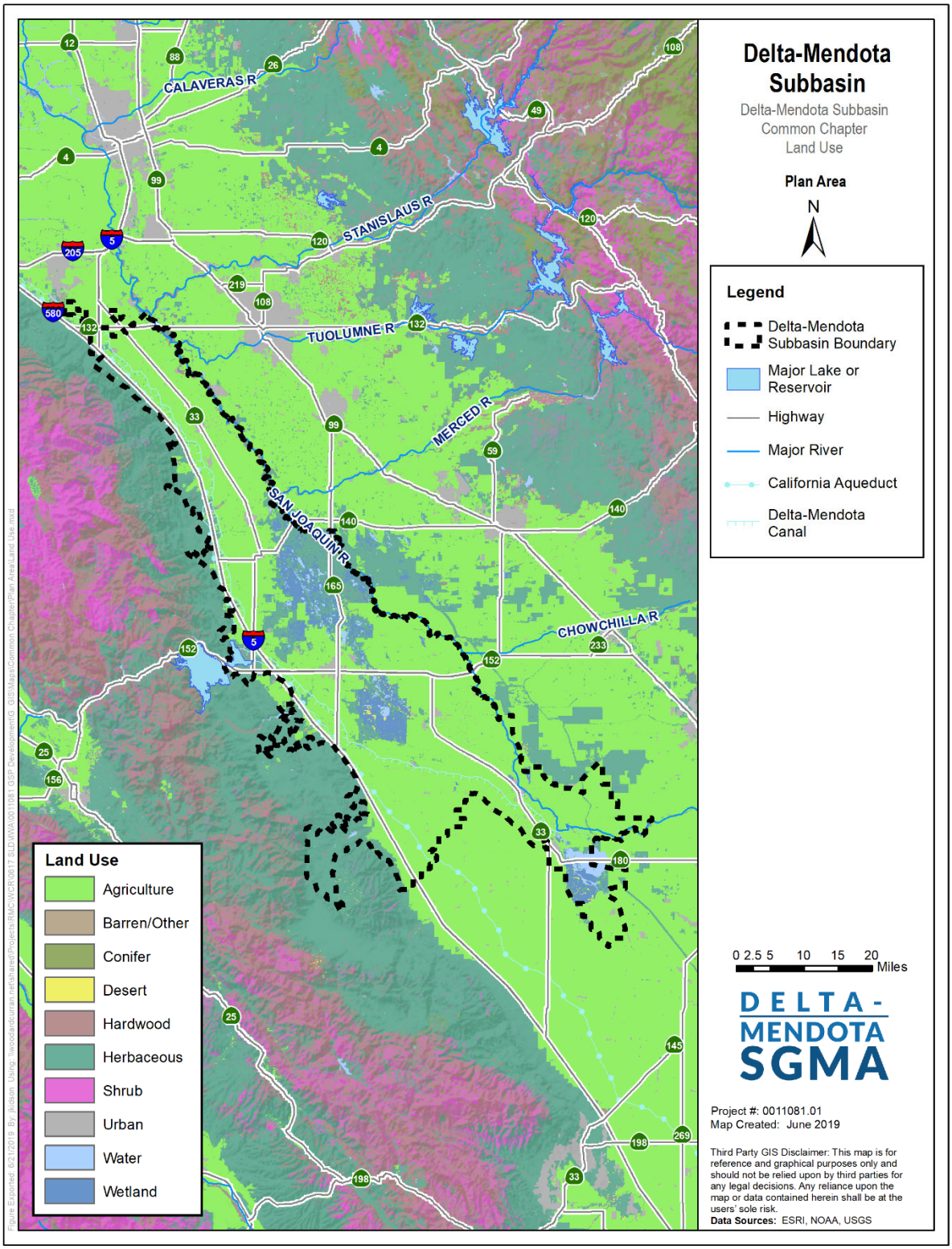


Figure CC-17: Typical Land Use

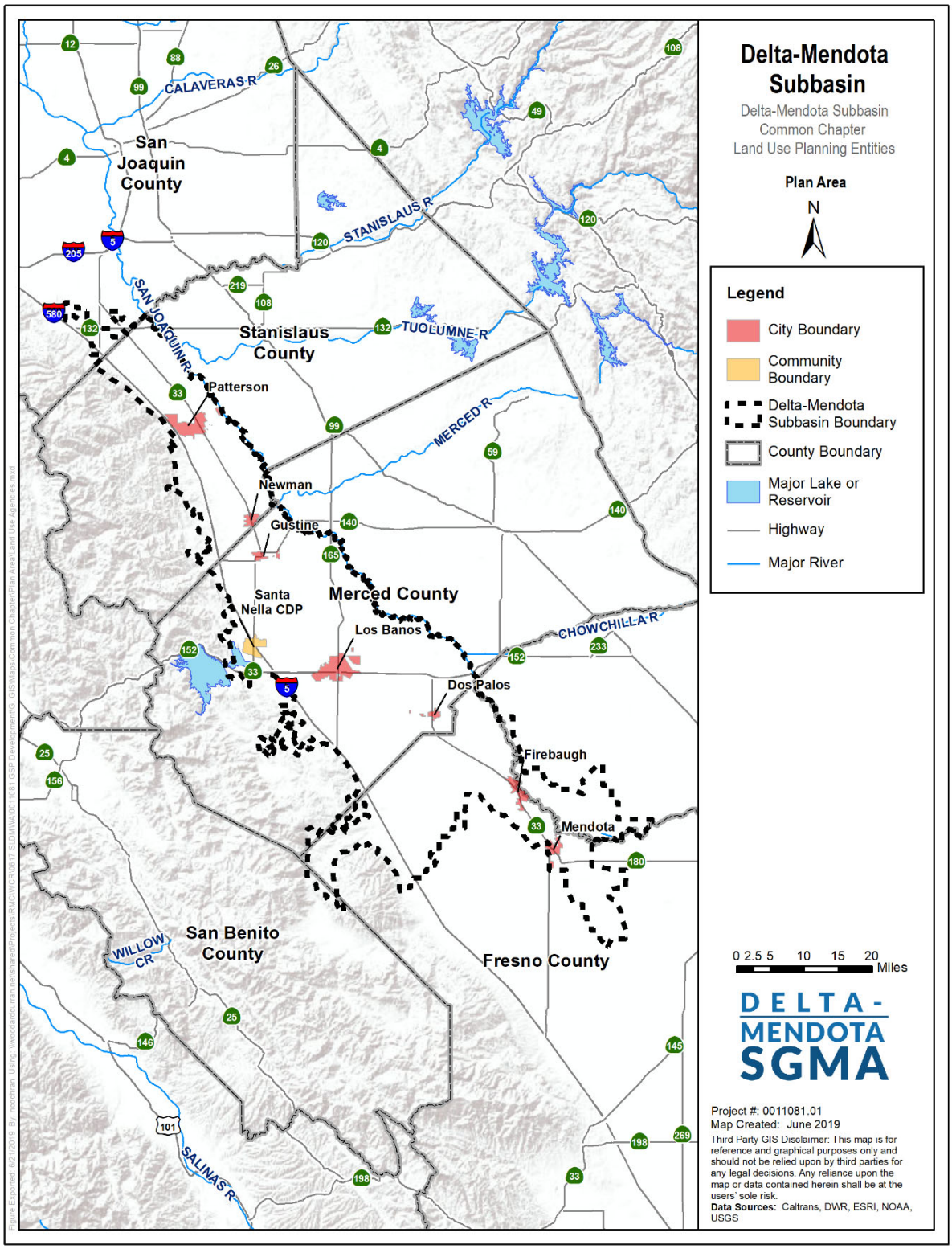


Figure CC-18: Land Use Planning Entities

Regional Economic Issues and Trends

The western San Joaquin Valley is a highly agricultural region. There are no large cities or industries in the Subbasin to provide an alternative economic base. The economy of this region is predominately driven by agricultural production and therefore, the availability of surface water supplies (predominantly in the form of CVP agricultural water and diversions from the San Joaquin and Kings Rivers) is an essential element to the economic health of the region. Other uses of surface water in the Subbasin are used for M&I purposes and wildlife refuge water supply.

Depending on water supply conditions, about 800,000 acres in the Delta-Mendota Subbasin are partially or solely irrigated with surface water. Other economic base industries include travel on the Interstate 5 (I-5) corridor, some petroleum extraction, and tourism. State, federal, and private wildlife refuges benefit local economies by attracting hunters, anglers, outdoor recreationists to the region. Managed wetland water conveyance infrastructure is maintained and improved by many contractors and local agency staff. Large scale conveyance improvements and habitat restoration projects, including mitigation banks, are also common throughout the Subbasin. M&I water use, which is a small share of total water use in the Subbasin, occurs primarily within the cities and smaller communities. The largest M&I use areas in the Delta-Mendota Subbasin, based on 2018 population estimates from the U.S. Census Bureau, are the cities of Patterson (population 22,352) and Los Banos (population 30,074) (U.S. Census Bureau, 2017).

All communities within the Delta-Mendota Subbasin have economies greatly dependent on agricultural production. These communities include Patterson, Tranquillity, Grayson, Mendota, Firebaugh, Dos Palos, Los Banos, Santa Nella, Newman, Gustine, Crows Landing, and Westley. All of these communities are strongly affected by the reliability of agricultural water supplies. Some of them are dependent upon groundwater for M&I use.

Plan Area Jurisdictional Boundaries

Jurisdictional areas within the Delta-Mendota Subbasin include counties, cities, water districts, irrigation districts, mutual water companies, and federal and state agencies. There are no federal- or state-recognized tribal communities in the Subbasin. Federal and State Lands are shown in **Figure CC-19**~~**Figure CC-19**~~. More detail on specific jurisdictional areas within each GSP area can be found in the respective GSP.

In general, all municipal, water/irrigation districts and counties within the Delta-Mendota Subbasin are participating in GSP development either as a separate GSA or as members of a GSA. The California Department of Fish and Wildlife boundaries and the U.S. Fish and Wildlife Service boundaries overlay the wildlife refuges and areas and state parks within the Subbasin. DWR manages the SWP and the California Aqueduct, and the U.S. Bureau of Reclamation (USBR), through the SLDMWA, manages the CVP and the Delta-Mendota Canal. The California Department of Transportation (Caltrans) is responsible for managing the State and Interstate highways in the Subbasin, including Interstate- (I-) 5, and State Highways 132, 33, 140, 152, and 165.

Figure CC-9~~**Figure CC-9**~~ depicts the Subbasin's extent relative to the boundaries of the various counties that overlie the Subbasin. Merced County has jurisdiction over the largest portion of the Subbasin (525 square miles), in the central portion of the Subbasin. Stanislaus County has jurisdiction over most of the area on the northern end of the Subbasin (covering 223 square miles). Fresno and Madera Counties have jurisdiction over the southern extent of the Delta-Mendota Subbasin (400 square miles). Finally, San Benito County covers the smallest portion of the Subbasin (5 square miles) in the southwestern portion of the Subbasin near San Luis Reservoir.

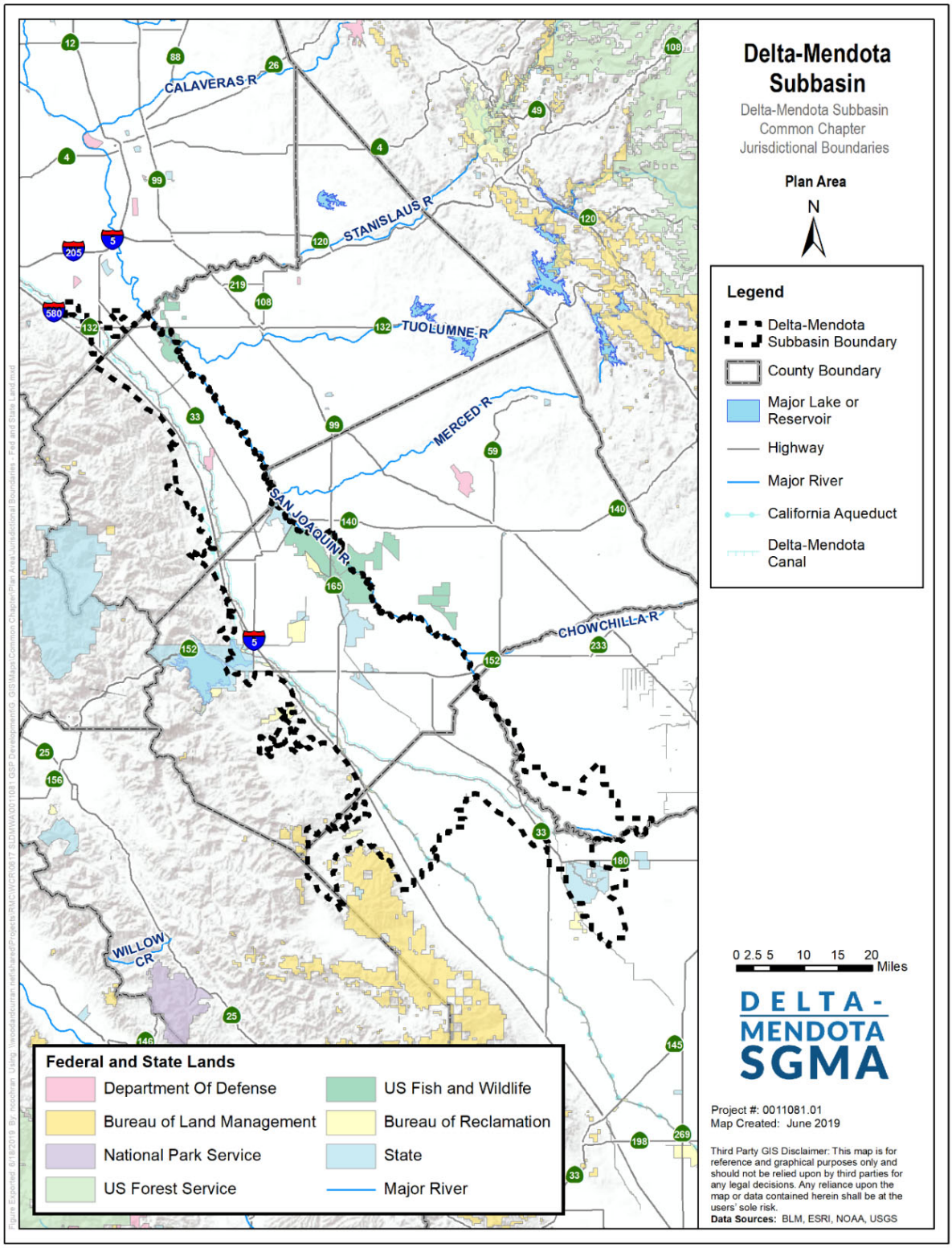


Figure CC-19: Federal and State Lands

Land Use Elements

Land use in the Delta-Mendota Subbasin is predominantly agricultural with wildlife habitat areas and areas of municipal, industrial, and commercial use. Predominant crops grown in the region include grain and hay crops, nut and fruit trees, and row crops. Figure CC-20~~Figure CC-20~~ shows the distribution of different land use types across the Delta-Mendota Subbasin.

Conjunctive use of surface water and groundwater is practiced throughout much of the Delta-Mendota Subbasin. Urban centers, such as the City of Patterson, and most unincorporated county areas rely solely on groundwater for their water supplies. Several water and irrigation districts hold water rights to divert from the San Joaquin River and/or the Kings Rivers. Other water purveyors receive water from the CVP and use groundwater and non-CVP-acquired surface waters to supplement demand, while some water districts rely solely on groundwater for their supplies. Refer to each GSP for detailed discussions of the water sources used by each agricultural, wetland, and urban water supplier.

Agriculture is the predominant water use sector throughout the Delta-Mendota Subbasin (Figure CC-20~~Figure CC-20~~). Urban water uses are mostly concentrated within and surrounding cities (such as Patterson and Los Banos). Non-irrigated land includes any idle or native riparian land classifications, which are scattered throughout the Regions.

3.3 General Plans in Plan Area

Within each GSP, General Plans and/or Community Specific Plans overlie the area. These include County general plans for Fresno, Merced, San Benito, San Joaquin, Stanislaus, and Madera Counties, and specific plans for cities and communities. Each GSP contains a detailed list of General Plan policies and objectives relevant to water resources management in the applicable GSP area. Refer to discussions in the individual GSPs which satisfy §354.8(f) of the GSP Emergency Regulations under SGMA.

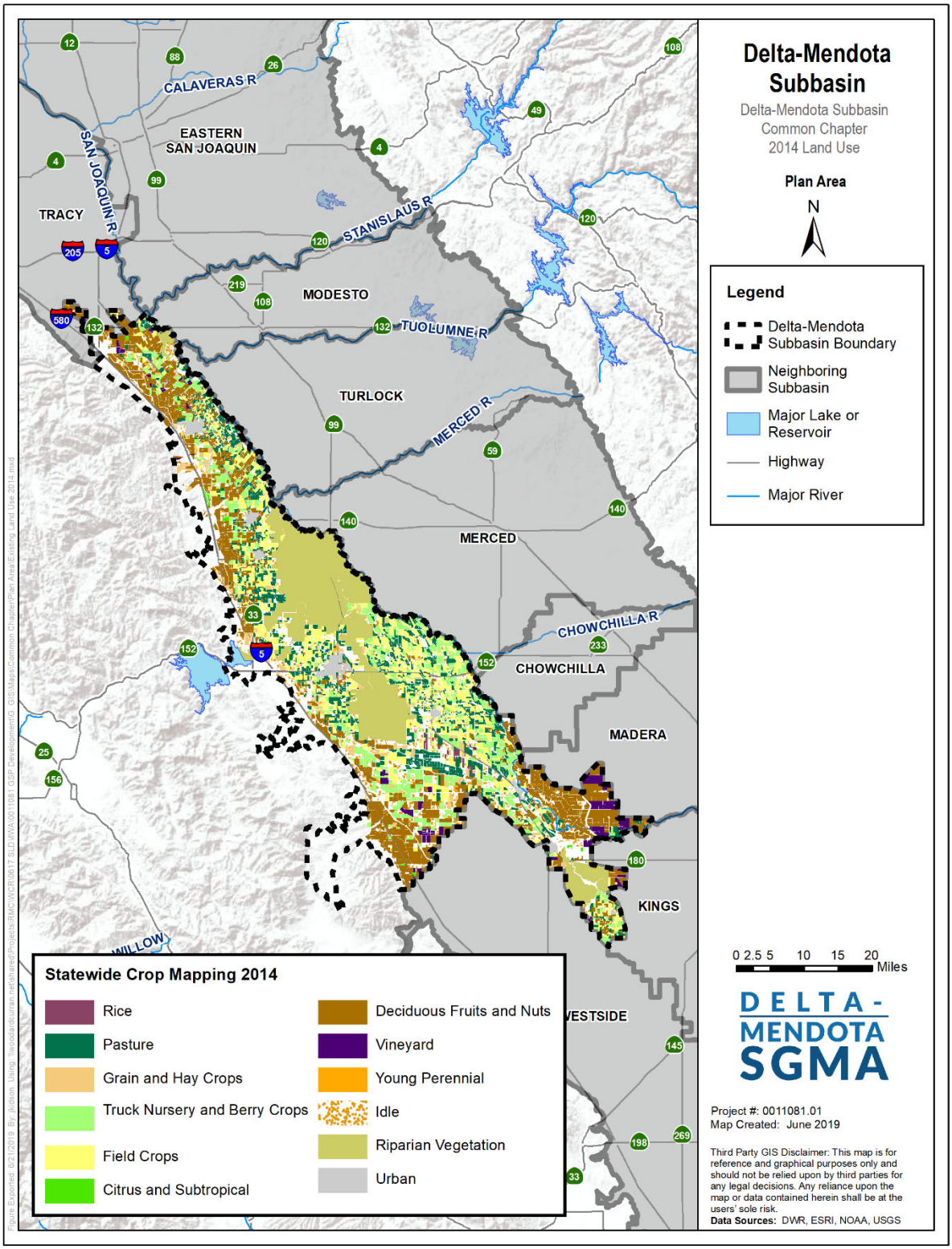


Figure CC-20: 2014 Land Use in the Delta-Mendota Subbasin

3.4 Existing Land Use Plans and Impacts to Sustainable Groundwater Management

Numerous policies in each County's and Community's General Plan compliment the GSPs' plans to conserve and sustainably manage groundwater resources. In general, the County and City General Plans guide future growth and development (and associated demands) within their respective jurisdictional areas. This additional growth may impact groundwater sustainability by placing additional demands on groundwater resources in an area where surface water resources are scarce or are otherwise unavailable. The General Plans also promote water conservation (in both the urban and agricultural sectors), which could potentially offset the additional demands associated with future urban development. In addition to conservation, some (though not all) General Plans promote groundwater recharge, the protection of recharge areas and wetlands, and the use of water transfers to further benefit groundwater sustainability.

Most General Plans within the Delta-Mendota Subbasin include goals focused on preserving agriculture, efficient use of existing and future water sources in both the urban and agricultural sectors, connecting smaller rural communities to larger water systems, and water quality protection. With respect to the protection of water quality and groundwater dependent ecosystems, the General Plans generally protect riparian and wetland habitats, encourage the protection of water quality (including through the remediation of contamination that may impact groundwater quality, requiring the use of septic systems in rural areas that are designed to be protective of groundwater quality and/or the use of community wastewater systems in urban areas), and promote flood control and management (including the associated impacts of erosion and sedimentation of surface water-courses).

The Fresno County General Plan, in particular, promotes sustainability by managing new wells in urban areas, supporting monitoring of water resources and associated habitats, and through the formation of a water resources document repository.

While the magnitude of impacts of these policies over the planning and implementation horizon are not known, such policies have been considered in this GSP, primarily through the use of the General Plans and associated zoning maps to identify future land use types and projected growth areas. These General Plans and mapping were used along with available water master plans, urban water management plans, agricultural water management plans, and other relevant planning documents to determine projected future land use and estimate future water demands by land use sector for use in the projected future water budgets.

Just as the General Plans complement the GSPs, the GSPs in the Delta-Mendota Subbasin may influence the General Plans' goals and policies. Sustainable management of groundwater resources through a GSP may change the pace, location, and type of development and/or land use that will occur in the Subbasin. GSP implementation is anticipated to be consistent with the General Plans' goals to sustainably manage land development and water resources in the Subbasin.

3.5 Existing Water Resources Monitoring and Management Programs

As required by §354.8~~(c)~~I and (d) of the GSP Emergency Regulations, the following section describes key existing water resources-related management and monitoring programs, and a discussion of how these programs will either impact GSP implementation and/or will be incorporated into the GSPs. The information shown below is a high-level summary of key existing programs; please see the individual GSPs for additional relevant management and monitoring programs.

Irrigated Lands Regulatory Program (ILRP)

In 1999, the California Legislature passed Senate Bill 390, which eliminated a blanket waiver of water quality regulations for agricultural waste discharges. The Bill required the Regional Water Quality Control Boards to develop a program to regulate agricultural lands under the Porter-Cologne Water Quality Control Act. In 2003, the Central Valley Regional Water Quality Control Board (CV-RWQCB) issued an order that sets Waste Discharge Requirements (WDRs) for irrigated lands to protect both surface and groundwater throughout the Central Valley, primarily to address nitrates, pesticides, and sediment discharge. The resulting Irrigated Lands Regulatory Program (ILRP) regulates wastes from commercial irrigated lands that discharge into surface and groundwater. The program is administered by the CV-RWQCB working directly with a regional or crop-based coalition as well as directly with irrigators. The goal of the ILRP is to protect surface water and groundwater and to reduce impacts of irrigated agricultural discharges to waters of the State. As a result of the ILRP, monitoring reports, assessment reports, management plans, surface water quality data, and groundwater quality data are made available to the public.

Implementation of the IRLP in the Delta-Mendota Subbasin is managed primarily by the Westside San Joaquin River Watershed Coalition and the Grassland Drainage Area Coalition under the San Joaquin Valley Drainage Authority, a California Joint Powers Authority (JPA). This region specifically emphasizes nitrogen, sediment, and erosion control.

CV-SALTS

The Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) is an initiative to reduce salt and nitrate impacts, restore groundwater quality, and provide safe drinking water supplies. Developed by a group of stakeholders (federal, state, and local agencies, dischargers and growers, and environmental groups) called the Central Valley Salinity Coalition, the Central Valley Salt and Nitrate Management Plan (SNMP) was released in 2017.

The Central Valley SNMP recommends revised and flexible regulations for existing Basin Plans and includes recommended interim solutions for salt and nutrient management in high priority basins in addition to long-term salt management strategies. Under the Central Valley SNMP, dischargers are provided two compliance pathways: (1) traditional permitting as an individual discharger or as a coalition (i.e. irrigated lands coalition), or (2) groundwater management zone permitting. Zone permitting allows dischargers to work as a collective in collaboration with the CV-RWQCB to provide safe drinking water with the option to extend time to achieve nitrogen balance. At this time, the Central Valley SNMP is not currently enforced.

Integrated Regional Water Management Program

Three Integrated Regional Water Management Plans (IRWMPs) overlie the Delta-Mendota Subbasin. The Westside-San Joaquin IRWMP covers most of the Subbasin, while smaller portions of the Subbasin are covered by the East Stanislaus and Madera IRWM Plans.

Integrated Regional Water Management (IRWM) is a collaborative effort to identify and implement water management solutions on a regional scale that increase regional self-reliance, reduce conflict, and manage water to concurrently achieve social, environmental, and economic objectives. Developed by Regional Water Management Groups, the IRWMPs seek to deliver higher value for investments in water resources and management by considering all interests, providing multiple benefits, and working across jurisdictional boundaries. Examples of multiple benefits include improved water quality, better flood

management, restored and enhanced ecosystems, and more reliable surface and groundwater supplies. Please see the individual GSPs for additional details regarding the IRWM program in their GSP Plan areas.

California State Groundwater Elevation Monitoring Program (CASGEM)

Since 2009, the California Statewide Groundwater Elevation Monitoring (CASGEM) Program has tracked seasonal and long-term groundwater elevation trends in groundwater basins statewide. The program's mission is to establish a permanent, locally-managed program of regular and systematic monitoring in all of ~~California's~~California's alluvial groundwater basins. This early attempt to monitor groundwater continues to exist as a tool to help achieve the goals set out under the Sustainable Groundwater Management Act (SGMA) with mandatory annual water elevation monitoring and reporting.

San Joaquin River Restoration Program (SJRR)

The San Joaquin River Restoration Program (SJRRP) is a comprehensive, long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River and restore a self-sustaining Chinook salmon fishery in the river while reducing or avoiding adverse water supply impacts from Restoration Flows. The program has two general goals resulting from the San Joaquin River Restoration Settlement reached in 2006:

- **Restoration:** To restore and maintain fish populations in "good condition" in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.
- **Water Management:** To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

The program includes the implementation of projects, reintroduction activities and associated monitoring to assess progress towards achieving the Settlement goals.

USGS Land Subsidence Monitoring

The USGS maintains and monitors a large system of monitoring locations nationwide using interferometric synthetic aperture radar (InSAR), continuous GPS (CGPS) measurements, campaign global positioning system (GPS) surveying, and spirit-leveling surveying. Aquifer-system compaction is measured by using extensometers to aid in the understanding of the depths at which compaction is occurring. The USGS shares these results to support decision making relative to groundwater basin management with the goal of minimizing future inelastic land subsidence.

3.6 County Well Construction/Destruction Standards and Permitting

DWR has developed well standards for the state per California Water Code Sections 13700 to 13806. These standards have been adopted by the State Water Resources Control Board (SWRCB) into a statewide model well ordinance (Resolution No. 89-98) for use by the Regional Boards for enforcing well construction standards where no local well design ordinance exists that meets or exceeds the DWR standards. DWR's Well Standards are presented in Bulletin 74-81 and Bulletin 74-90.

Each GSP lists the counties within their GSP Plan areas and the respective permitting agencies and local ordinances for well construction and destruction standards. Discussion of these standards and the respective permitting process as well as well abandonment and destruction procedures can be found in the individual GSPs.

3.7 Existing and Planned Conjunctive Use Programs

Conjunctive use programs in the Subbasin are currently implemented and planned by single agencies as well as through multi-agency partnerships. Maximizing the beneficial use of surface water, groundwater, and recycled water resources is of critical concern to water managers throughout the Delta-Mendota Subbasin with the ultimate goal of using all of these water sources more efficiently to avoid overdraft and to sustainably manage groundwater resources. Each GSP describes efforts to utilize existing water resources conjunctively and demonstrate feasibility to continue to implement conjunctive use projects in the future. These may include projects such as groundwater recharge and conveyance facilities, new wells, improved monitoring systems, improved delivery efficiency, water recycling, and water quality improvements and treatment.

Underground recharge and storage occurs throughout the Delta-Mendota Subbasin through stormwater applied water and managed wetland recharge. Stormwater collects both naturally and artificially and eventually percolates through the ground and into aquifers for beneficial use for both urban and agriculture. Recharge from agricultural and wetland water conveyance and irrigation percolates into the ground and eventually into aquifers where it can be pumped again for use. This natural and unmanaged recharge creates future opportunities for conjunctive use programs; however, this recharge may decline as farmers move toward more precise and water efficient irrigation methods.

3.8 Plan Elements from California Water Code Section 10727.4

Each GSP may contain, as deemed appropriate, a detailed discussion of the additional plan elements as identified in California Water Code (CWC) Section 10727.4. These elements are:

- Control of saline water intrusion
- Wellhead protection areas and recharge areas
- Migration of contaminated groundwater
- Well abandonment and well destruction programs
- Activities implementing, opportunities for, and removing impediments to conjunctive use or underground storage
- Measures addressing groundwater contamination cleanup, groundwater recharge, in-lieu use, diversions to storage, conservation, water recycling, conveyance, and extraction projects
- Efficient Water Management Practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use
- Efforts to develop relationships with state and federal regulatory agencies
- Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risk to groundwater quality or quantity
- Impacts on Groundwater Dependent Ecosystems

4. SUBBASIN SETTING

This Delta-Mendota Subbasin Settings section contains three main subsections as follows:

- **Hydrogeologic Conceptual Model (HCM)** – The HCM section (Section 4.1) provides the geologic information needed to understand the framework that water moves through in the Subbasin. It focuses on geologic formations, aquifers, structural features, and topography.
- **Groundwater Conditions** – The Groundwater Conditions section (Section 4.2) describes and presents groundwater trends, levels, hydrographs and level contour maps, estimates changes in groundwater storage, identifies groundwater quality issues, addresses subsidence, and addresses surface water interconnection.
- **Water Budget** – The Water Budget section (Section 4.3) describes the data used to develop the water budget. Additionally, this section discusses how the budget was calculated, provides water budget estimates for historical conditions, and current conditions and projected conditions

4.1 Hydrogeologic Conceptual Model

This section describes the hydrogeologic conceptual model (HCM) for the Delta-Mendota Subbasin based on technical studies and qualified maps that characterize the physical components and interaction of the surface water and groundwater systems, pursuant to Article 5, Plan Contents, Subarticle 2, Basin Setting, § 354.14 Hydrogeologic Conceptual Model of the GSP Emergency Regulations. The physical description of the Delta-Mendota Subbasin is based on information originally published in the *Western San Joaquin River Watershed Groundwater Quality Assessment Report* (GAR) (LSCE, 2015), *Grassland Drainage Area Groundwater Quality Assessment Report* (LSCE, 2016), and *Groundwater Overdraft in the Delta-Mendota Subbasin* (KDSA, 2015).

4.1.1 Regional Geologic and Structural Setting

The Delta-Mendota Subbasin is located in the northwestern portion of the San Joaquin Valley Groundwater Basin within the southern portion of the Central Valley (**Figure CC-21**~~**Figure CC-21**~~). The San Joaquin Valley is a structural trough up to 200 miles long and 70 miles wide filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and by erosion of the surrounding Sierra Nevada and Coast Range mountains, respectively (DWR, 2006). Continental deposits shed from the surrounding mountains form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough. This depositional axis is slightly west of the series of rivers, lakes, sloughs, and marshes which mark the current and historic axis of surface drainage in the San Joaquin Valley.

The Delta-Mendota Subbasin (DWR Basin No. 5-22.07) is bounded on the west by the tertiary and older marine sediments of the Coast Ranges, on the north generally by the San Joaquin-Stanislaus County line, on the east generally by the San Joaquin River and Fresno Slough, and on the south by the Tranquillity Irrigation District boundary near the community of San Joaquin. Surface waters converge from the Fresno, Merced, Tuolumne, and Stanislaus Rivers into the San Joaquin River, which drains to the north toward the Sacramento-San Joaquin Delta.

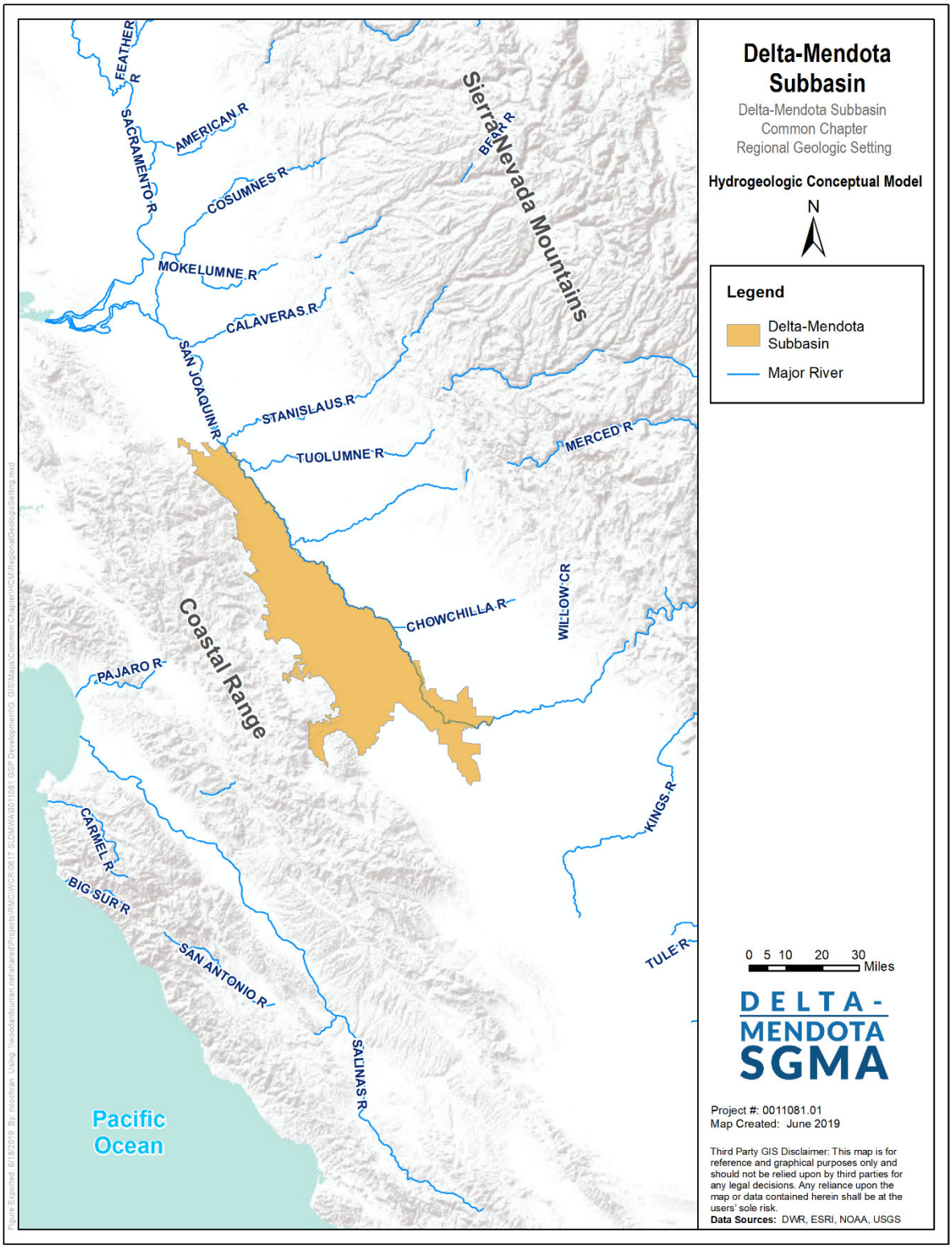


Figure CC-21: Regional Geologic Setting

4.1.2 Geologic History

Approximately three million years ago, tectonic movement of the Oceanic and Continental plates associated with the San Andreas Fault system resulted in the formation of the Coast Range which sealed off the Central Valley from the Pacific Ocean (LSCE, 2015). As this occurred, the floor of the San Joaquin Valley began to transition from a marine depositional environment to a freshwater system with ancestral rivers bringing alluvium to saltwater bodies (Mendenhall et al., 1916). The Coast Ranges on the western side of the San Joaquin Valley consist mostly of complexly folded and faulted consolidated marine and non-marine sedimentary and crystalline rocks ranging from Jurassic to Tertiary age, dipping eastward and overlying the basement complex in the region (Croft, 1972; Hotchkiss and Balding, 1971). The Central Valley Floor, in which the Delta-Mendota Subbasin lies, consists of Tertiary and Quaternary-aged alluvial and basin fill deposits (**Figure CC-22**~~**Figure CC-22**~~). The fill deposits mapped throughout much of the valley extend vertically for thousands of feet, and the texture of sediments varies in the east-west direction across the valley. Coalescing alluvial fans have formed along the sides of the valley created by the continuous shifting of distributary stream channels over time. This process has led to the development of thick fans of generally coarse texture along the margins of the valley and a generally fining texture towards the axis of the valley (Faunt et al., 2009 and 2010).

Deposits of Coast Range and Sierra Nevada sources interfinger within the Delta-Mendota Subbasin. Steeper fan surfaces, with slopes as high as 80 feet per mile, exist proximal to the Coast Range, whereas more distal fan surfaces consist of more gentle slopes of 20 feet per mile (Hotchkiss and Balding, 1971). In contrast to the east side of the valley, the more irregular and ephemeral streams on the western side of the valley floor have less energy and transport smaller volumes of sediment resulting in less developed alluvial features, including alluvial fans which are less extensive, although steeper, than alluvial fan features on the east side of the valley (Bertoldi et al., 1991). Lacustrine and floodplain deposits also exist closer to the valley axis as thick silt and clay layers. Lakes present during the Pleistocene epoch in parts of the San Joaquin Valley deposited great thicknesses of clay sediments.

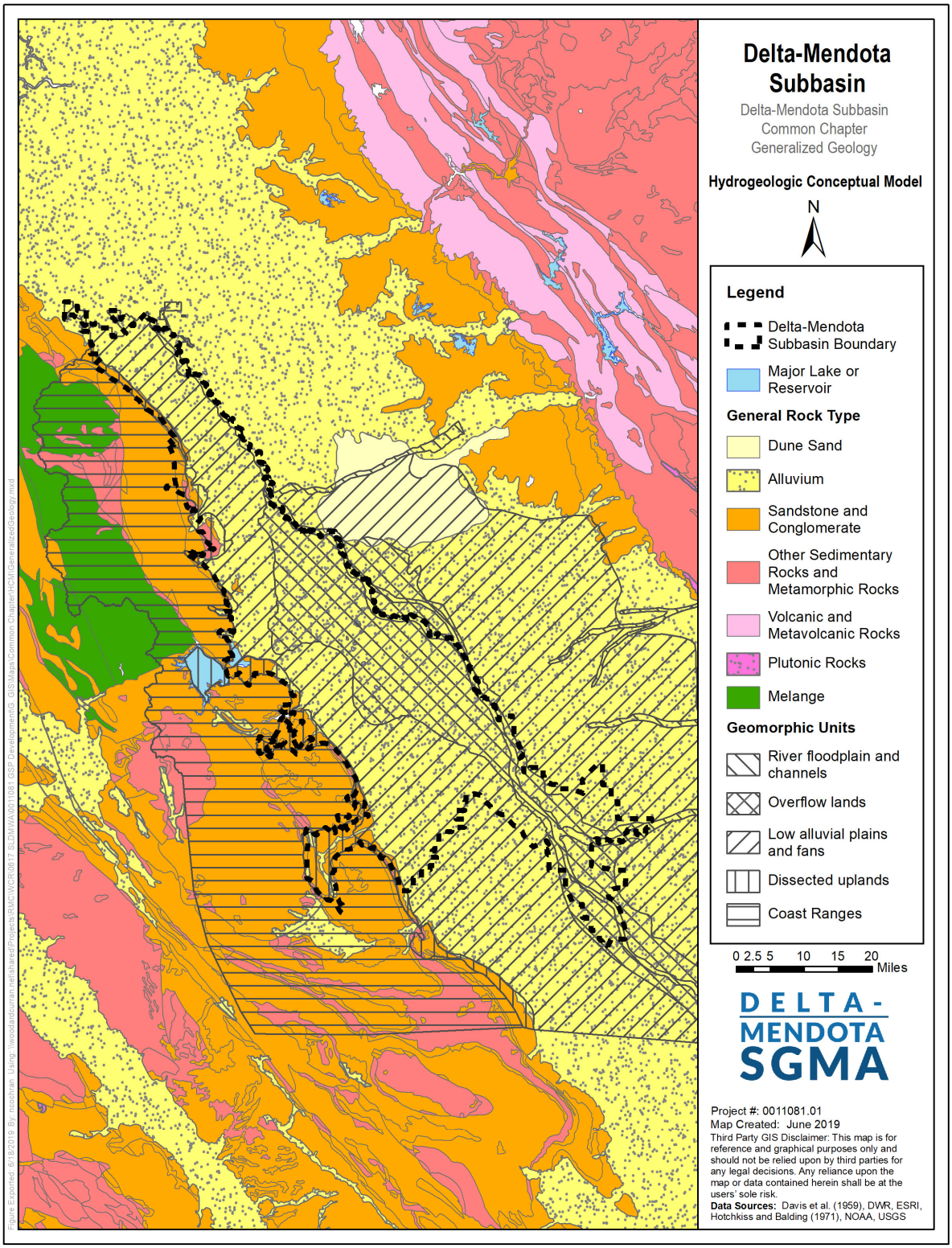


Figure CC-22: Generalized Geology

4.1.3 Geologic Formations and Stratigraphy

Distinct geomorphic units exist within the Delta-Mendota Subbasin defining areas of unique hydrogeologic environments. The geomorphic units are mapped and described by Hotchkiss and Balding (1971) and Davis et al. (1959) and are shown in Figure CC-22~~Figure CC-22~~. The two primary geomorphic units within the Central Valley Floor area of the Delta-Mendota Subbasin include the overflow lands geomorphic unit and the alluvial fans and plains geomorphic unit. Overflow lands are defined as areas of relatively poorly draining soils with a shallow water table. The overflow lands geomorphic unit is located in the southeastern portion of the Subbasin and is dominated by finer-grained floodplain deposits that are the result of historical episodic flooding of this low-land area. This has formed poorly-draining soils with generally low hydraulic conductivity characteristics. In contrast, the alluvial fans and plains geomorphic unit is characterized by relatively better drainage conditions, with sediments comprised of coalescing and somewhat coarser-grained alluvial fan materials deposited by higher-energy streams flowing out of the Coast Range (Hotchkiss and Balding, 1971). The alluvial fans and plains geomorphic unit covers much of the Delta-Mendota Subbasin along the western margins of the Central Valley Floor at the base of the Coast Range.

The primary groundwater bearing units within the Delta-Mendota Subbasin consist of Tertiary and Quaternary-aged unconsolidated continental deposits and older alluvium of the Tulare Formation. Subsurface hydrogeologic materials covering the Central Valley Floor consist of lenticular and generally poorly sorted clay, silt, sand, and gravel that make up the alluvium and Tulare Formation. These deposits are thickest along the axis of the valley with thinning along the margins towards the Coast Range mountains (DWR, 2003; Hotchkiss and Balding, 1971). A zone of very shallow groundwater, generally within 25 feet of the ground surface, exists throughout large areas of the Subbasin, with considerable amounts (greater than 50 percent) of farmland in the area estimated to have very shallow depths to groundwater of less than 10 feet (Hotchkiss and Balding, 1971). Many of these areas are naturally swampy lands adjacent to the San Joaquin River.

The Tulare Formation extends to several thousand feet in depth and to the base of freshwater throughout most of the area and consists of interfingered sediments ranging in texture from clay to gravel of both Sierra Nevadan and Coast Range origin. The formation is composed of beds, lenses, and tongues of clay, sand, and gravel that have been alternatively deposited in oxidizing and reducing environments (Hotchkiss and Balding, 1971).

Terrace deposits of Pleistocene age lie up to several feet higher than present streambeds and are comprised of yellow, tan, and light-to-dark brown silt, sand, and gravel with a matrix that varies from sand to clay (Hotchkiss and Balding, 1971). The water table generally lies below the bottom of the terrace deposits; however, the relatively large grain size of the terrace deposits suggests their value as possible recharge sites. Alluvium is composed of interbedded, poorly to well-sorted clay, silt, sand, and gravel and is divided based on its degree of dissection and soil formation. The flood-basin deposits are generally composed of light-to-dark brown and gray clay, silt, sand, and organic material with locally high concentrations of salt and alkali. Stream channel deposits of coarse sand and gravel are also included.

The Tulare Formation also includes the Corcoran Clay (E-Clay) member, a diatomaceous clay or silty clay of lake bed origin which is a prominent aquitard in the San Joaquin Valley, separating the upper zone from the lower zone and distinguishing the semi-confined Upper Aquifer from the confined Lower Aquifer (Hotchkiss and Balding, 1971). The depth and thickness of the Corcoran Clay are variable within the Central Valley Floor, and it is not present in peripheral areas (outside the Central Valley Floor) of the Subbasin. Within the Upper Aquifer, additional clay layers exist and also provide varying degrees of confinement, including other clay members of the Tulare Formation and layers of white clay identified by

Hotchkiss and Balding (1971). These clays are variable in extent and thickness, but the white clay is noted to be as much as 60 feet thick in areas providing very effective confinement of underlying zones (Croft, 1972; Hotchkiss and Balding, 1971). The Tulare Formation is hydrologically the most important geologic formation in the Delta-Mendota Subbasin because it contains most of the fresh water-bearing deposits. Most of the natural recharge that occurs in the Subbasin is in the alluvial fan apex areas along Coast Range stream channels (Hotchkiss and Balding, 1971).

4.1.4 Faults and Structural Features

The valley floor portion of the Delta-Mendota Subbasin contains no known major faults and is fairly geologically inactive. There are few faults along the western boundary of the Subbasin within the Coast Range mountains, but they are not known to inhibit groundwater flow or impact water conveyance infrastructure (**Figure CC-23**~~**Figure CC-23**~~).

4.1.5 Basin Boundaries

The Delta-Mendota Subbasin is defined by both geological and jurisdictional boundaries. The Delta-Mendota Subbasin borders all subbasins within the San Joaquin Valley Hydrologic Region with the exception of the Cosumnes Subbasin. The following subsections describe the lateral boundaries of the Subbasin, boundaries with neighboring subbasins, and the definable bottom of the Delta-Mendota Subbasin.

Lateral Boundaries

The Delta-Mendota Subbasin is geologically and topographically bounded to the west by the Tertiary and older marine sediments of the Coast Ranges, and to the east generally by the San Joaquin River. The northern, central, and southern portion of the eastern boundary are dictated by jurisdictional boundaries of water purveyors within the Delta-Mendota Subbasin.

As described in *California's Groundwater*, DWR Bulletin 118 (2016), the Delta-Mendota Subbasin is in the San Joaquin Valley Groundwater Basin, located along the western edge of the San Joaquin Valley. The northern boundary begins just south of Tracy in San Joaquin County. The eastern boundary generally follows the San Joaquin River and Fresno Slough. The southern boundary is near the small town of San Joaquin. The subbasin is bounded on the west by the coast range. The Subbasin boundary is defined by 20 segments detailed in the descriptions below. The Delta-Mendota Subbasin extends into six (6) counties: San Joaquin, Stanislaus, Merced, Fresno, San Benito, and Madera and is shown in relation to each of the six counties in **Figure CC-9**~~**Figure CC-9**~~.

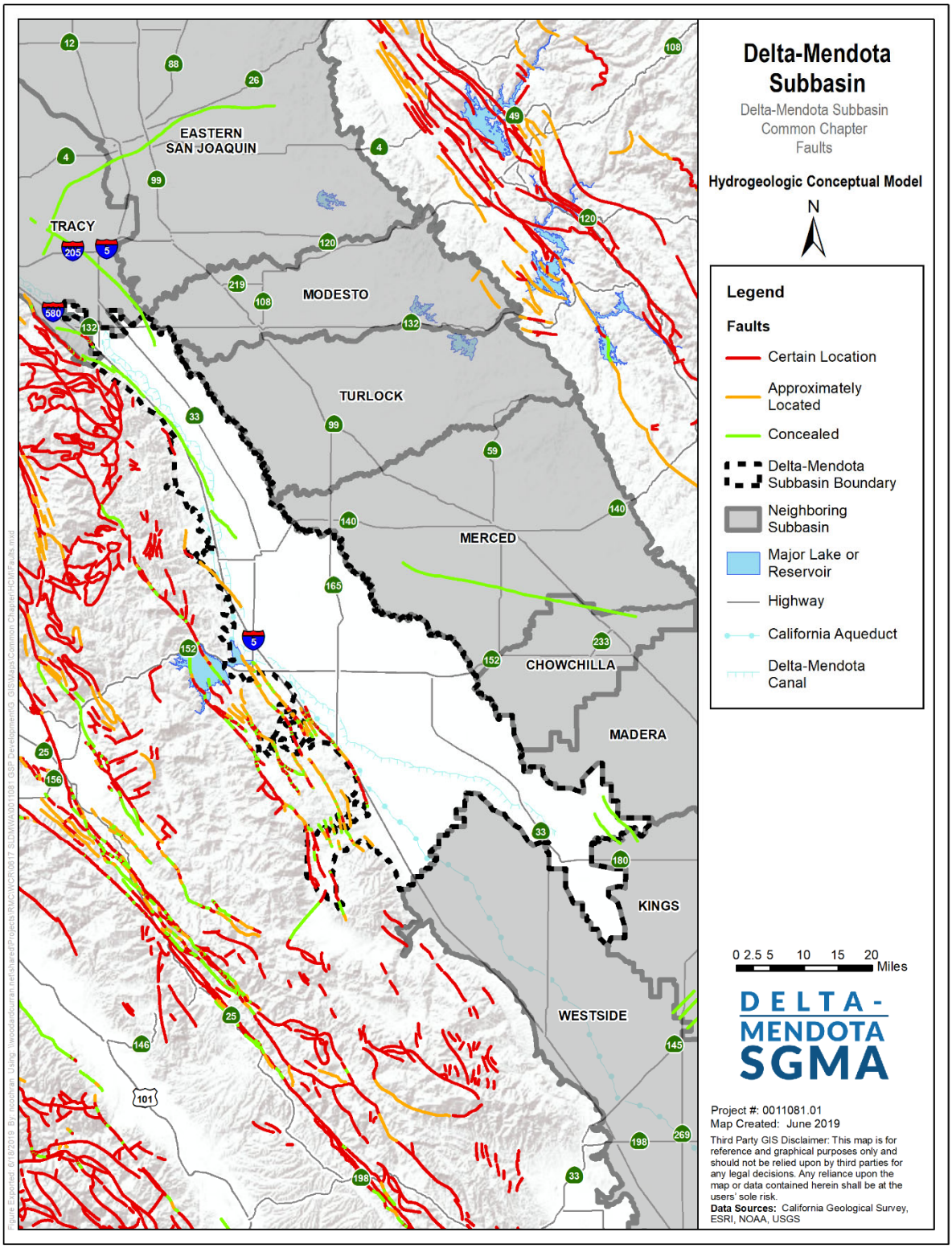


Figure CC-23: Subbasin Faults

4.1.6 Definable Bottom of Basin

In the San Joaquin Valley, the bottom of the Delta-Mendota Subbasin is defined as the interface of saline water of marine origin (base of fresh water) within the uppermost beds of the Tulare Formation. The Tulare Formation is characterized by blue and green fine-grained rocks and principally composed of fine-grained silty sands, silt, and clay (Foss and Blaisdell 1968). The Tulare Formation is predominantly marine in origin and is considered late Pliocene and possibly early Pleistocene in age. This formation is the upper shaley part of the Pliocene sequence. The top of the Tulare Formation is generally encountered around -2,000 feet mean sea level throughout the Delta-Mendota Subbasin. As agreed upon by the Delta-Mendota Subbasin GSP Groups, the base of freshwater is specifically defined by an electrical conductivity of 3,000 micromhos per centimeter at 25 °C, as presented by Page (1973). If and when significant use of water beyond the defined bottom takes place, the definition of the bottom will be revised appropriately.

4.1.7 Principal Aquifers and Aquitards

DWR's Groundwater Glossary defines an aquifer as "a body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells, and springs". There are two primary aquifers within the Delta-Mendota Subbasin: a semi-confined aquifer above the Corcoran Clay and a confined aquifer below the Corcoran Clay, with the Corcoran Clay acting as the principal aquitard within the Delta-Mendota Subbasin. Figure CC-24~~Figure CC-24~~ shows the locations of the representative cross-sections for the Delta-Mendota Subbasin, where Figure CC-25~~Figure CC-25~~ through Figure CC-30~~Figure CC-30~~ show the hydrostratigraphy of the representative cross-sections.

While the two-aquifer system described above is generally true across the Delta-Mendota Subbasin, there are portions of the Subbasin where the Corcoran Clay does not exist (predominantly along the western margin of the Subbasin) and hydrogeology is generally controlled by localized interfingering clays, and/or where local hydrostratigraphy results in shallow groundwater conditions that differ, to some extent, from that seen in the Subbasin as a whole. Additionally, in the southern portion of the Subbasin in the Mendota, Aliso and Tranquillity areas, there are A and C Clay layers in addition to the Corcoran Clay that inhibit vertical groundwater flow. However, while there are localized complexities throughout the Subbasin, the Corcoran Clay (or E Clay) extends through much of the Delta-Mendota Subbasin, generally creating a two-aquifer system.

Principal Aquifers

In the Delta-Mendota Subbasin, there are two primary aquifers composed of alluvial deposits separated by the Corcoran Clay (KDSA, 2015): a semi-confined Upper Aquifer (generally the ground surface to the top of the Corcoran Clay), and a confined Lower Aquifer starting at the bottom of the Corcoran Clay to the base of fresh water. However, as previously described, the localized presence of the A and C Clay layers in the southern portion of the Subbasin, the absence of the Corcoran Clay at the western margin of the Subbasin, and/or local hydrostratigraphy result in differing shallow groundwater conditions and/or perched groundwater conditions in some portions of the Subbasin. See the individual GSPs for more detailed descriptions of hydrostratigraphy in the respective Plan areas.

Upper Aquifer

The Upper Aquifer is represented by materials extending from the upper groundwater table to the top of the Corcoran Clay. The Upper Aquifer includes shallow geologic units of younger and older alluvium and upper parts of the Tulare Formation. Sediments within the upper Tulare Formation have variable sources, and subdivision of units can be distinguished between eastern and western sourced materials. Alluvial fan materials above the Corcoran Clay in the Delta-Mendota Subbasin are generally more extensive than older alluvial fan deposits within the Tulare Formation below the Corcoran Clay. As shown in Figure CC-31~~Figure CC-31~~ by the depth to the top of the Corcoran Clay, the Upper Aquifer extends to depths ranging between approximately 150 feet and greater than 350 feet. Other notable mapped clay units also exist within the upper part of the Tulare Formation in the Delta-Mendota Subbasin, including the A and C Clay members of the Tulare Formation and a white clay mapped by Hotchkiss and Balding (1971).

Lower Aquifer

The Lower Aquifer is the portion of the Tulare Formation that is confined beneath the Corcoran Clay, extending downward to the underlying San Joaquin Formation and the interface of saline water of marine origin within its uppermost beds. The Lower Aquifer is generally characterized by groundwater that tends to be dominantly sodium-sulfate type, which is often of better quality than the Upper Aquifer (Davis et al., 1957; Hotchkiss and Balding, 1971). Exceptions to this quality do exist in the Subbasin, particularly in the southwestern portion of the Subbasin. Because of its relatively shallow depth within the Delta-Mendota Subbasin and lower salinity in areas when compared to other groundwater resources, the Lower Aquifer is heavily utilized as a source of groundwater for agricultural and drinking water uses within the Subbasin.

The base of the Lower Aquifer generally decreases from south to north, changing in depth from about 1,100 to 1,200 feet deep in the south to about 600 feet to the north. Depth to the top of the Corcoran Clay ranges from less than 100 feet on the west near Interstate 5 (I-5) to more than 500 feet in the area near Tranquillity. The Corcoran Clay pinches out or is above the water level near the California Aqueduct in the western part of the Subbasin, where the Upper and Lower Aquifers merge into interfingered layers of sand, gravel, and clay.

Corcoran Clay

The Corcoran Clay, as a regional aquitard, is a notable hydrogeologic feature throughout most of the Delta-Mendota Subbasin, impeding vertical flow between the Upper and Lower Aquifers. The Corcoran Clay is present at varying depths across most of the Central Valley floor (**Figure CC-31**~~**Figure CC-31**~~ and **Figure CC-33**~~**Figure CC-33**~~). The depths to the top of the Corcoran Clay ranges between approximately 100 and 500 feet below the ground surface throughout most of the Subbasin, with a general spatial pattern of deepening to the south and east. In the far southeastern area of the Subbasin, in the vicinity of Mendota and Tranquillity, the top of the Corcoran Clay is at depths of greater than 350 feet (**Figure CC-31**~~**Figure CC-31**~~). The thickness of the Corcoran Clay, which likely influences the degree of hydraulic separation between the Upper and Lower Aquifers, is greater than 50 feet across most of the Delta-Mendota Subbasin with thicknesses of more than 75 feet in central Subbasin areas in the vicinity of Los Banos and Dos Palos, and 140 feet in the eastern portions of the Subbasin. The Corcoran Clay appears thinner in areas north of Patterson, between Patterson and Gustine, and also in the vicinity of Tranquillity to the south (**Figure CC-33**~~**Figure CC-33**~~). Along the westernmost portions of the Delta-Mendota Subbasin, the Corcoran Clay layer is generally non-existent or it exists as Corcoran-equivalent clays (clays existing at the same approximate depth but not part of the mapped aquitard).

Aquifer Properties

The following subsections include discussion of generalized aquifer properties within the Delta-Mendota Subbasin. These include hydraulic conductivity, transmissivity, specific yield and specific storage.

DWR defines hydraulic conductivity as the "measure of a rock or sediment's ability to transmit water" and transmissivity as the "aquifer's ability to transmit groundwater through its entire saturated thickness" (DWR, 2003). High hydraulic conductivity values correlate with areas of transmissive groundwater conditions with transmissivity generally equaling hydraulic conductivity times the saturated thickness of the formation. Storage of water within the aquifer system can be quantified in terms of the specific yield for unconfined groundwater flow and the storage coefficient for confined flow, respectively (Faunt et al., 2009). Specific yield represents gravity-driven dewatering of shallow, unconfined sediments at a declining water table, but also accommodates a rising water table. The specific yield is dimensionless and represents the volume of water released from or taken into storage per unit head change per unit area of the water table. Specific yield is a function of porosity and specific retention of the sediments in the zone of water-table fluctuation.

Where the aquifer system is confined, storage change is governed by the storage coefficient, which is the product of the thickness of the confined-flow system and its specific storage. The specific storage is the sum of two component specific storages – the fluid (water) specific storage and the matrix (skeletal) specific storage, which are governed by the compressibility of the water and skeleton, respectively (Jacob, 1940). Specific storage has units of 1 over length and represents the volume of water released from or taken into storage in a confined flow system per unit change in head per unit volume of the confined flow system (Faunt et al., 2009). Therefore, the storage coefficient of a confined flow system is dimensionless and, similar to specific yield, represents the volume of water released from or taken into storage per unit head change.

Hydraulic Conductivity

Figure CC-34~~Figure CC-34~~ shows the saturated C-horizon hydraulic conductivity of surficial soils within the Delta-Mendota Subbasin based on the National Resource Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO). Soil survey data for counties within the Subbasin were combined using the weighted harmonic mean of these representative layers to depict the saturated hydraulic conductivity of the C-horizon for each soil map unit. The soil profile represented by these data is variable but commonly extends to a depth of six or more feet.

Floodplain deposits are evident as soils with relatively low hydraulic conductivity (less than 0.5 feet per day [ft/day]) blanket much of the Central Valley Floor, although localized areas of soils with higher hydraulic conductivity are present in association with modern and ancient surface waterways and alluvial fan features (Figure CC-34~~Figure CC-34~~). Coarse soils of distributary alluvial fan sediments deposited by Del Puerto Creek, Orestimba Creek, Los Banos Creek, Ortigalita Creek, and Little Panoche Creek, in addition to other ephemeral northeasterly creek flows off the Coast Ranges, are notably apparent as areas of soils of high hydraulic conductivity located along active and inactive stream channels extending eastward from the fan apex areas along the Valley Floor margins to the current alignment of the San Joaquin River in the valley axis. Additionally, soils in areas adjacent to the active channel of the San Joaquin River also exhibit high hydraulic conductivities, including values of greater than 4 ft/day which are particularly apparent in an area north of Mendota. Soils of similarly high hydraulic conductivity trending as linear features in a general northwest-southeast alignment to the north of Dos Palos and Los Banos are likely the result of historical depositional processes and paleochannels associated with the San Joaquin River (Figure CC-34~~Figure CC-34~~). In areas peripheral to the Central Valley floor, soils tend to

be characterized by relatively low hydraulic conductivity, although soils of somewhat higher hydraulic conductivity associated with distinct geologic units are mapped across much of the peripheral area to the west of Patterson and Gustine and also in localized bands associated with surface water courses.

Transmissivity

Transmissivity varies greatly above the Corcoran Clay, within the Corcoran Clay, and below the Corcoran Clay within the Delta-Mendota Subbasin, with transmissivities in the confined Lower Aquifer generally being larger than those in the semi-confined Upper Aquifer. Based on testing conducted at multiple locations within both the Upper and Lower Aquifers of the Delta-Mendota Subbasin, average transmissivities in the Subbasin are approximately 109,000 gallons per day per square foot (gpd/ft^2) (KDSA, 1997b).

Specific Yield

DWR defines specific yield as the "amount of water that would drain freely from rocks or sediments due to gravity and describes the proportion of groundwater that could actually be available for extraction" (DWR, 2003). Specific yield is a measurement specific to unconfined aquifers.

The estimated specific yield of the Delta-Mendota Subbasin is 0.118 (DWR, 2006). Within the southern portion of the Delta-Mendota Subbasin, specific yield ranges from 0.2 to 0.3 (Belitz et al., 1993). Specific yield estimates for the Delta-Mendota Subbasin are fairly limited in literature since the Upper Aquifer above the Corcoran Clay is semi-confined and the Lower Aquifer below the Corcoran Clay is confined. Therefore, specific yield values only characterize the shallow, unconfined groundwater within the Subbasin.

Specific Storage

Values for specific storage were extracted from the Central Valley Hydrologic Model 2 (CVHM2), which is currently under development by the United States Geological Survey (USGS) and includes refinements for the Delta-Mendota Subbasin. Specific storage varies above, within, and below the Corcoran Clay with CVMH2. Above the Corcoran Clay, specific storage ranges from 1.34×10^{-6} to 6.46×10^{-2} $meters^{-1}$ (m^{-1}) with average values ranging from 6.16×10^{-3} to 1.97×10^{-2} m^{-1}. Specific storage within the Corcoran Clay is considerably smaller than above the Corcoran Clay, ranging between 1.41×10^{-6} and 2.35×10^{-6} m^{-1} and average values between 1.96×10^{-6} and 2.02×10^{-6} m^{-1}. Below the Corcoran Clay, specific storage is comparable to within the Corcoran Clay with overall ranges the same as within the Corcoran Clay and average values ranging from 1.86×10^{-6} to 2.01×10^{-6} m^{-1}. Therefore, specific storage is greatest within the semi-confined aquifer overlying the Corcoran Clay layer, with considerably smaller specific storage values within the low permeability Corcoran Clay and confined aquifer underlying the Corcoran Clay layer.

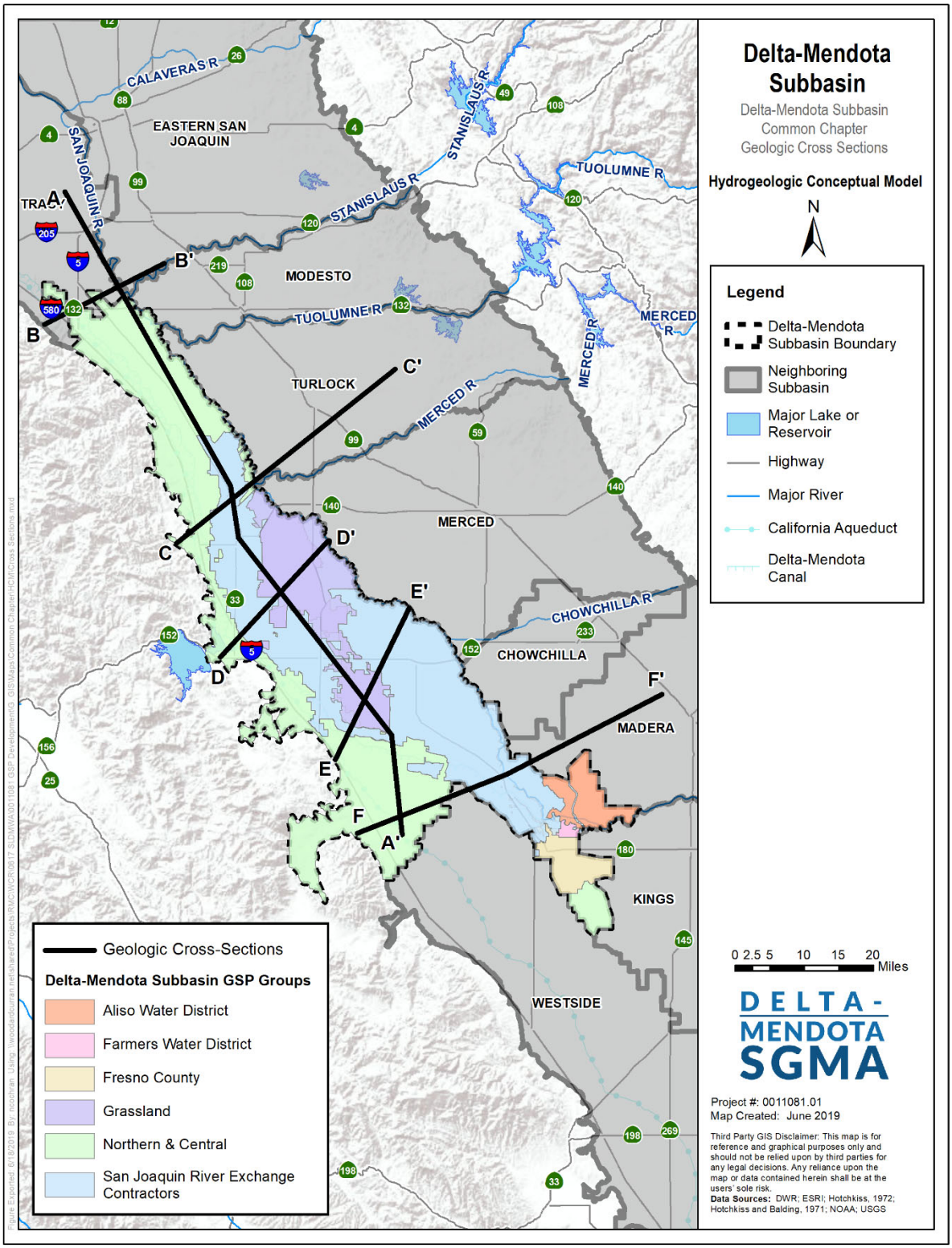


Figure CC-24: Representative Cross-Sections

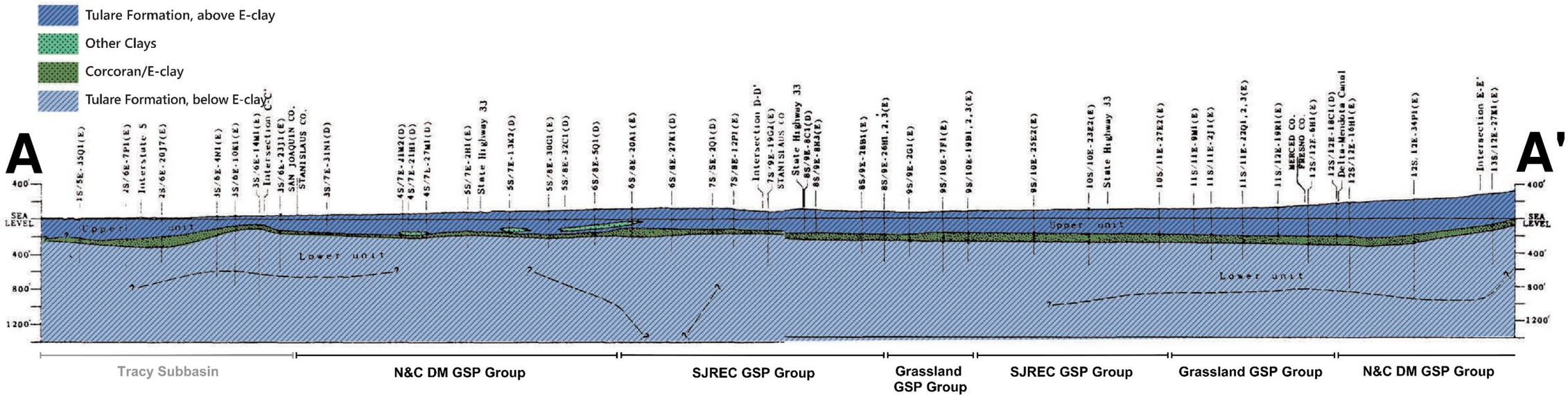


Figure CC-25: Cross-Section A-A' (Hotchkiss, 1972)

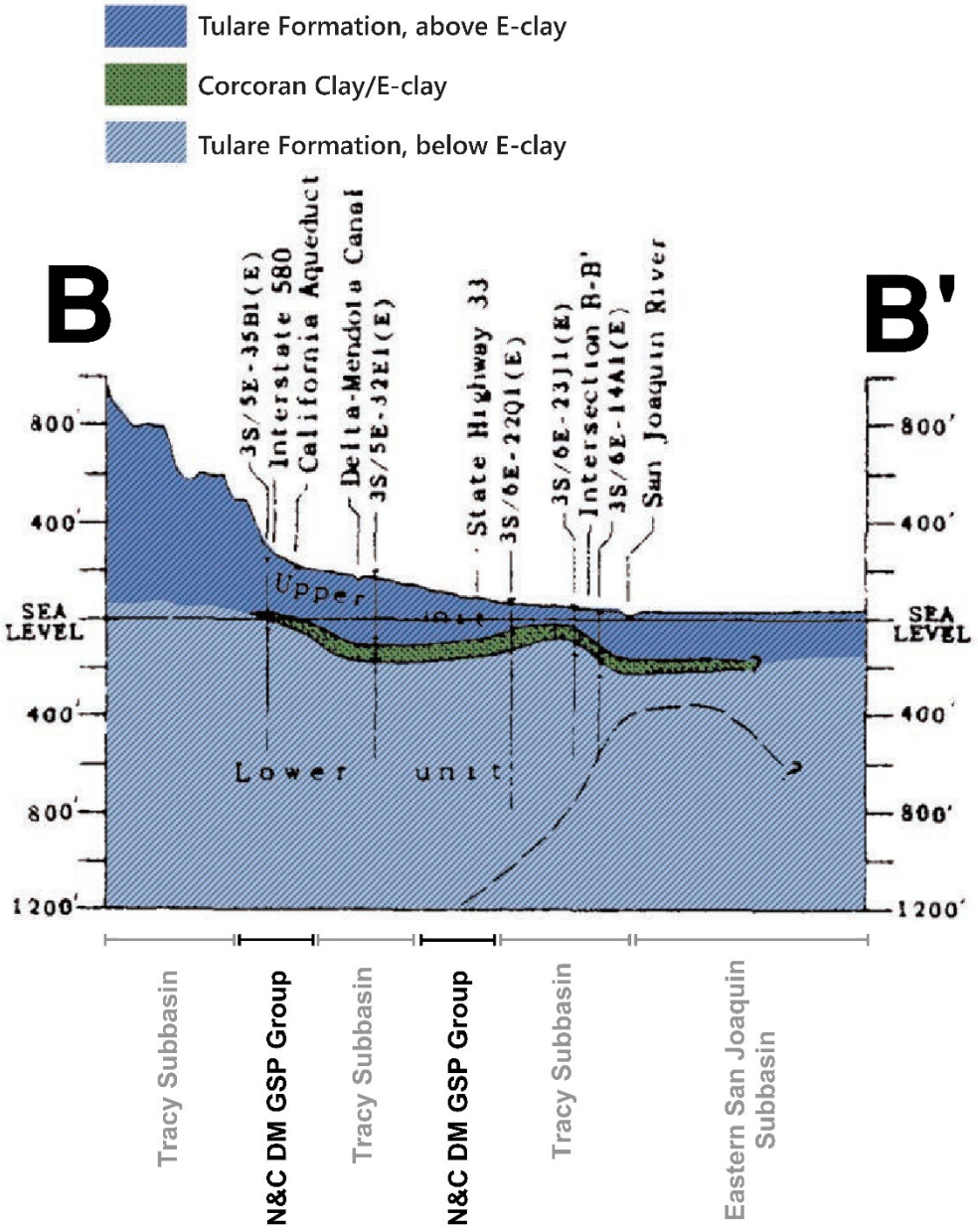


Figure CC-26: Cross-Section B-B' (Hotchkiss, 1972)

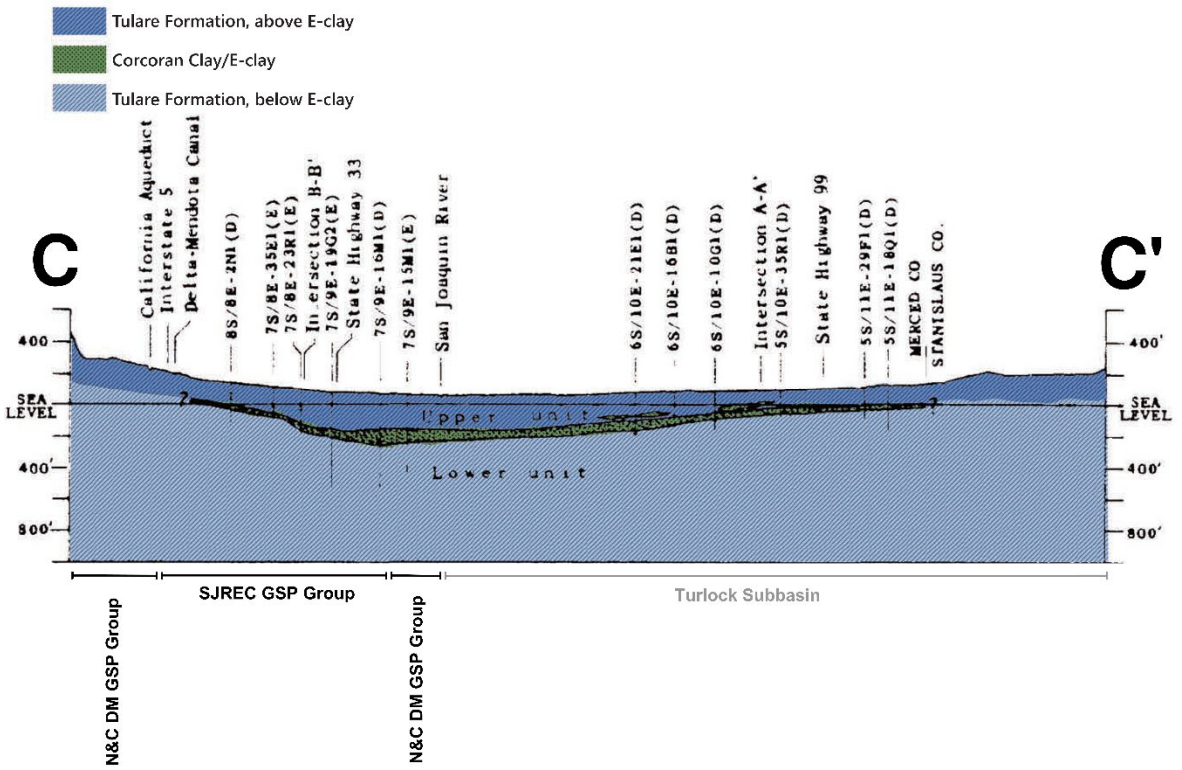


Figure CC-27: Cross-Section C-C' (Hotchkiss, 1972)

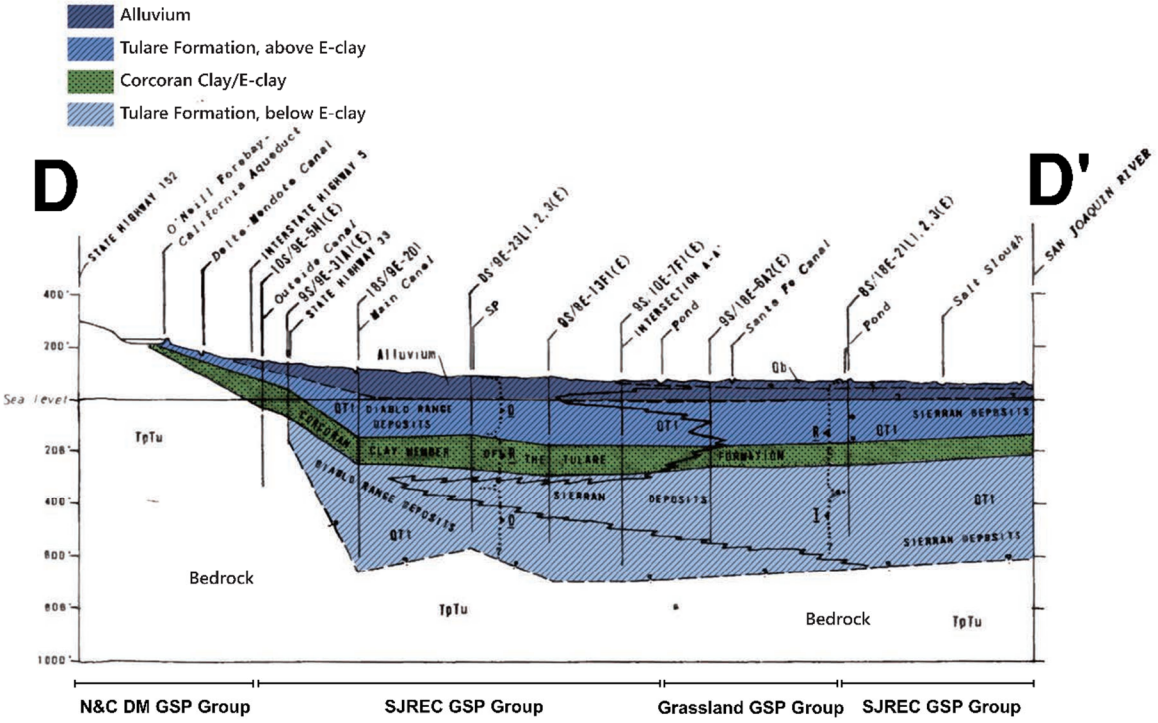


Figure CC-28: Cross-Section D-D' (Hotchkiss & Balding, 1971)

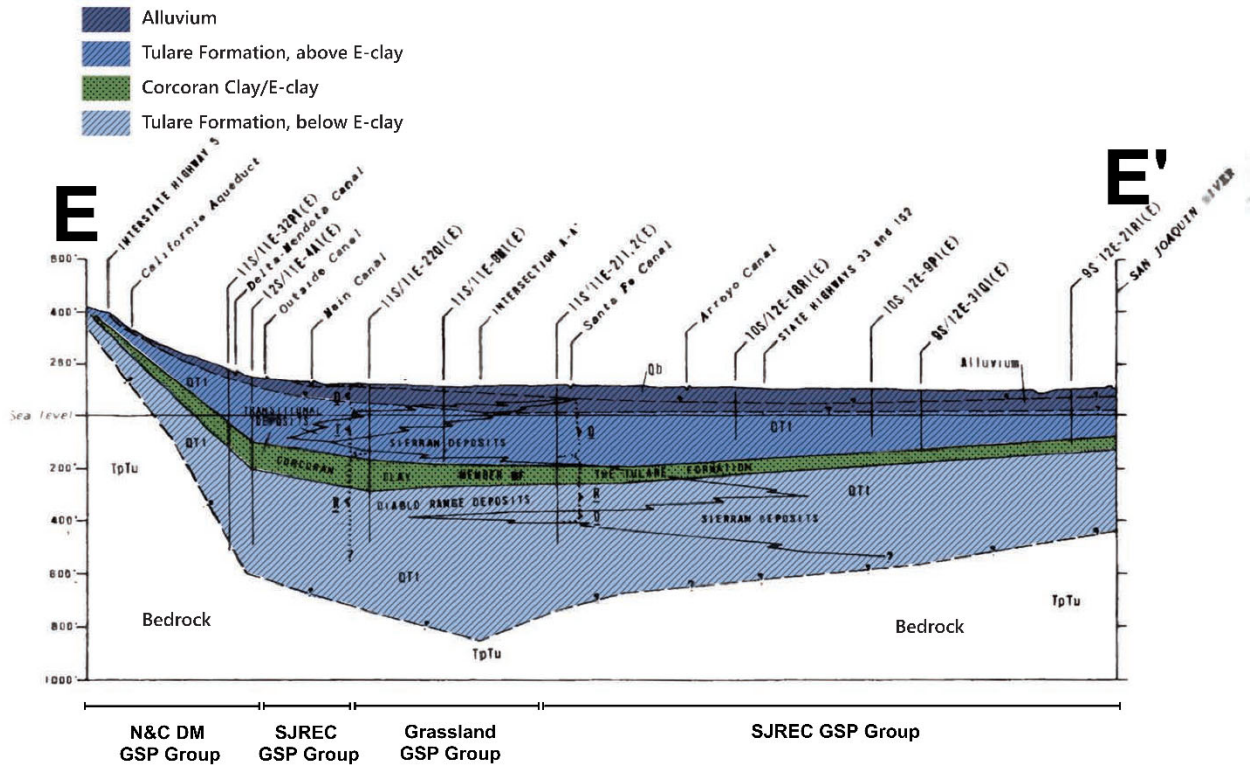


Figure CC-29: Cross-Section E-E' (Hotchkiss & Balding, 1971)

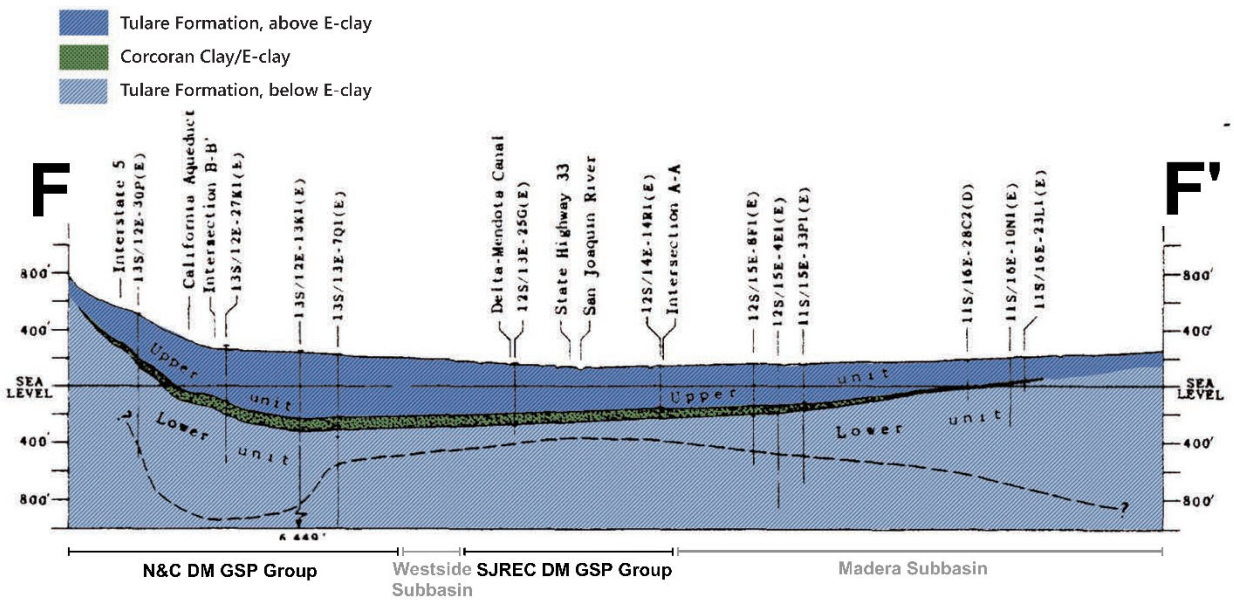


Figure CC-30: Cross-Section F-F' (Hotchkiss, 1972)

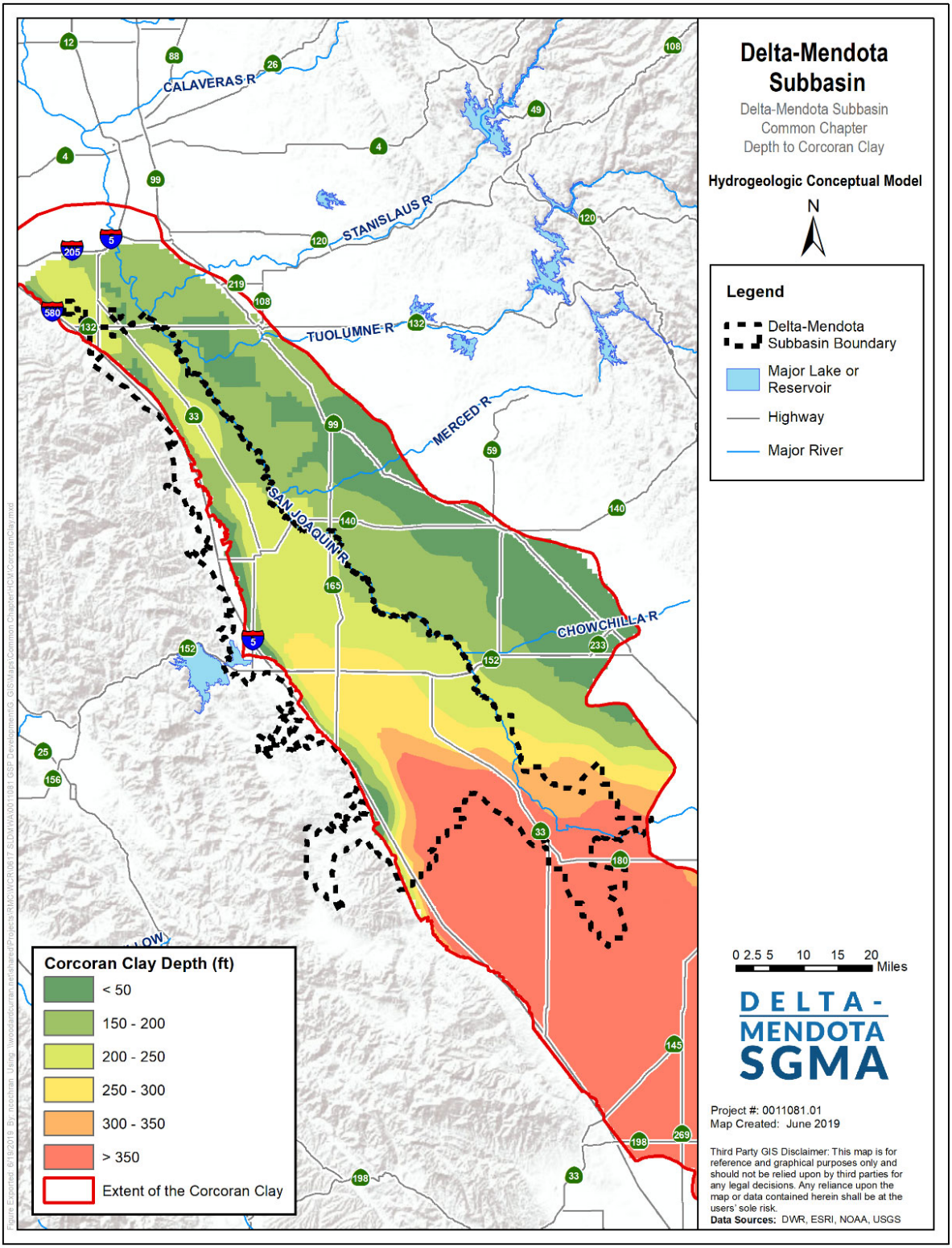


Figure CC-31: Depth to Corcoran Clay

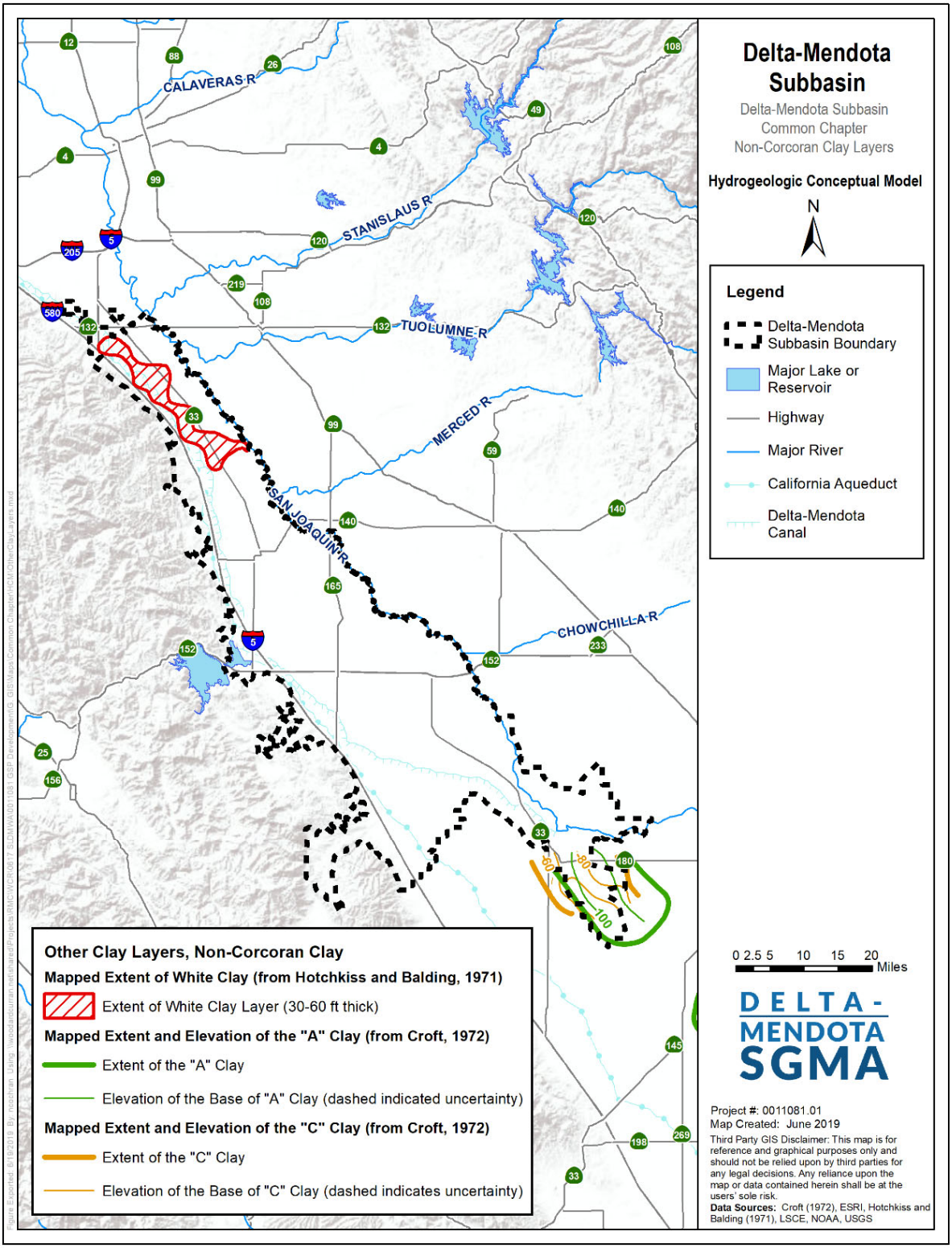


Figure CC-32: Non-Corcoran Clay Layers

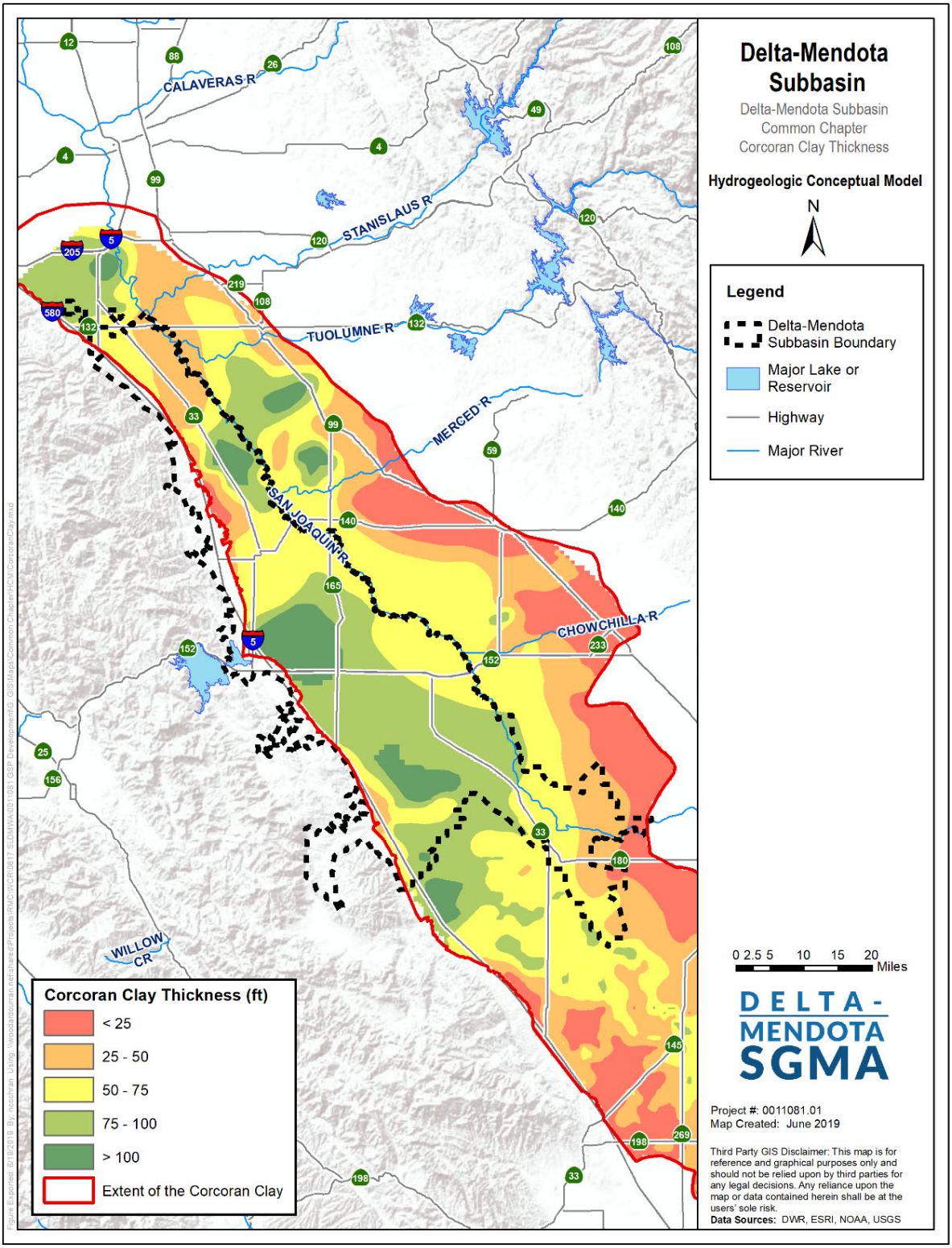


Figure CC-33: Thickness of Corcoran Clay

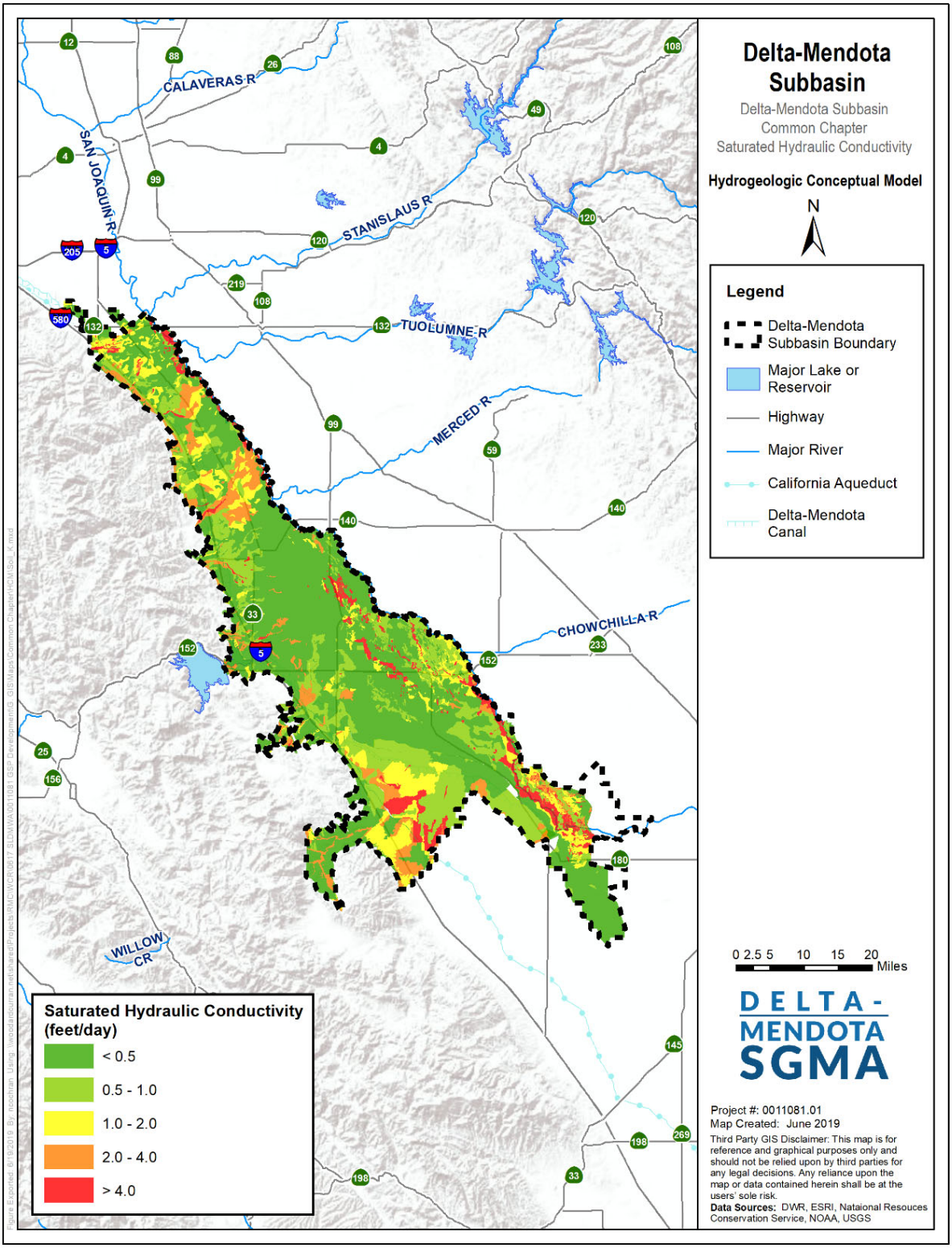


Figure CC-34: Soil Hydraulic Conductivity

4.1.8 Structural Properties and Restricted Groundwater Flow

Under natural (pre-development) conditions, the prevailing groundwater flow within the Upper and Lower Aquifer systems of the western San Joaquin Valley was predominantly in a generally northeasterly direction from the Coast Range towards and parallel to the San Joaquin River and the Sacramento-San Joaquin Delta (LSCE, 2015; Hotchkiss and Balding, 1971; KDSA, 2015). Historically, numerous flowing artesian wells within the Lower Aquifer existed throughout the Delta-Mendota Subbasin (Mendenhall et al., 1916) and the pressure gradient for groundwater flow was upward from the Lower Aquifer to the Upper Aquifer. These flowing artesian conditions have disappeared in many areas as a result of increased development of groundwater resources within the Tulare Formation (Hotchkiss and Balding, 1971). Additionally, the Delta-Mendota Subbasin has experienced periods of considerable decline in groundwater levels during which hydraulic heads in the Lower Aquifer decreased considerably in some areas due to heavy pumping (Bertoldi et al., 1991).

Despite the presence of local pumping depressions within parts of the Subbasin, the prevailing northeastward flow direction for groundwater in the Upper Aquifer within the region has remained (AECOM, 2011; DWR, 2010; Hotchkiss and Balding, 1971). Groundwater generally flows outward from the Delta-Mendota Subbasin, except along the southern and western margins where there is some recharge from local streams and canal seepage (KDSA, 2015), in addition to northward subbasin boundary flows. Within the Upper Aquifer, there are similar groundwater flow directions in most of the Subbasin with groundwater outflow to the northeast or towards the San Joaquin River in much of the Subbasin during wet and normal periods. One exception is in the Orestimba Creek area west of Newman where groundwater flows to the west during drought conditions and east during wet periods. Calculations based on aquifer transmissivity indicate the net groundwater outflow in the Upper Aquifer has been about three times greater during drought periods than during normal periods (KDSA, 1997a and 1997b).

Within the Lower Aquifer, there is a groundwater divide generally in the area between Mendota and the point near the San Joaquin River in the Turner Island area, northeast of Los Banos. Groundwater southwest of this divide generally flows southwest toward Panoche Water District and Westlands Water District. Groundwater northeast of this divide flows to the northeast into Madera and Merced Counties. Net groundwater outflow in the Lower Aquifer under drought conditions has been about two and a half times greater than for normal conditions (KDSA, 1997a and 1997b). Based on current and historical groundwater elevation maps, groundwater barriers do not appear to exist in the Delta-Mendota Subbasin (DWR, 2006).

The combined effect of pumping below the Corcoran Clay and increased leakage from the Upper Aquifer to the Lower Aquifer where the Corcoran Clay does not exist or has been perforated has developed a generally downward flow gradient in the Tulare Formation which changes with variable pumping and irrigation over time (Bertoldi et al., 1991). Periods of great groundwater level declines have also resulted in inelastic compaction of fine-grained materials in some locations, particularly between Los Banos and Mendota, potentially resulting in considerable decreases (between 1.5 and 6 times) in permeability of clay members within the Tulare Formation, including the Corcoran Clay (Bertoldi et al., 1991). However, the number of wells penetrating the Corcoran Clay may be enabling vertical hydraulic communication across the Corcoran Clay aquitard and other clay layers (Davis et al., 1959; Davis et al., 1964).

4.1.9 Water Quality

Groundwater in the Delta-Mendota Subbasin is characterized by mixed sulfate to bicarbonate water types in the northern and central portion of the Subbasin, with areas of sodium chloride and sodium sulfate waters in the central and southern portions (DWR, 2003). Total Dissolved Solids (TDS) values range

from 400 to 1,600 mg/L in the northern portion, and 730 to 6,000 mg/L in the southern portion of the Delta-Mendota Subbasin (Hotchkiss and Balding, 1971). The Department of Health Services (currently the Division of Drinking Water), which monitors Title 22 water quality standards, reports TDS values in 44 public supply wells in the Subbasin ranging in value from 210 to 1,750 mg/L, with an average value of 770 mg/L. Shallow, saline groundwater also occurs within about 10 feet of the ground surface over a large portion of the Delta-Mendota Subbasin. There are also localized areas of high iron, fluoride, nitrate, selenium, and boron in the Delta-Mendota Subbasin (Hotchkiss and Balding, 1971).

Alluvial sediments derived from west-side streams are composed of material from serpentine, shale, and sandstone parent rock, which results in soil and groundwater types entirely different from those on the east side of the San Joaquin Valley (LSCE, 2015). In contrast with the siliceous mineralogy of the alluvial sands and gravels on the eastern side of the Central Valley that are derived from the Sierra granitic rocks (which are coarser and more resistant to chemical dissolution), the sulfate and carbonate shales and sandstones of Coast Range sediments on the western side are more susceptible to dissolution processes. Some soils and sediments within the western San Joaquin Valley that are derived from marine rocks of the Coast Range have notably high concentrations of naturally-occurring nitrogen, with particularly higher nitrate concentrations in younger alluvial sediments (Strathouse and Sposito, 1980; Sullivan et al., 1979). These naturally-occurring nitrogen sources may contribute to nitrate concentrations in groundwater within the Delta-Mendota Subbasin, although it is not well known where this may occur and to what degree. Naturally-high concentrations of TDS in groundwater are known to have existed historically within parts of the Subbasin due to the geochemistry of the Coast Range rocks and the marine depositional environment, the resulting naturally-high TDS of recharge derived from Coast Range streams, the dissolvable materials within the alluvial fan complexes, and the naturally-poor draining conditions which tend to concentrate salts in the system. The chemical quality of waters in the Coast Range streams can be closely correlated with the geologic units within their respective catchments. Groundwater flows discharging from these marine and non-marine rocks into streams introduce a variety of dissolved constituents resulting in variable groundwater types. The water quality and chemical makeup in westside streams can be highly saline, especially in more northern streams, including Corral Hollow, Panoche and Del Puerto Creeks, where historical baseflow TDS concentrations have typically exceeded 1,000 mg/L with measured concentrations as high as 1,790 mg/L (Hotchkiss and Balding, 1971). This is in contrast with TDS concentrations typically below 175 mg/L in streams draining from the Sierras. The contribution of water associated with these Coast Range sediments has resulted in naturally-high salinity in groundwater within and around the Delta-Mendota Subbasin, which has been recognized as early as the 1900s (Mendenhall et al., 1916). Groundwater in some areas within the immediate vicinity of the San Joaquin River is influenced by lower-salinity surface water discharging from the east side of the San Joaquin Valley Groundwater Basin (Davis et al., 1957).

Areas of historical high saline groundwater documented by Mendenhall *et al*. (1916) indicate somewhat high TDS concentrations approaching or greater than 1,000 mg/L in wells sampled throughout many parts of the Delta-Mendota Subbasin. Areas of locally higher TDS concentrations (1,500-2,400 mg/L) have existed between Mendota and Los Banos; whereas the trend in deeper groundwater (average well depth of 450 feet) south of Mendota near Tranquillity indicates slightly lower historical salinity conditions, but still somewhat high with an average TDS concentration of greater than 1,000 mg/L. In the northern part of the Subbasin, north of Gustine, the average historical TDS concentration of wells was also relatively high (930 mg/L). Historically low TDS concentrations (<500 mg/L) existed in groundwater from wells with an average depth of 209 feet in the central Subbasin area between Los Banos and Gustine.

The general chemical composition of groundwater in the Subbasin is variable based on location and depth. Groundwater within the Upper Aquifer is largely characterized as transitional type with less area characterized as predominantly of chloride, bicarbonate, and sulfate water types. Transitional water types,

in which no single anion represents more than 50 percent of the reactive anions, occurs in many different combinations with greatly ranging TDS concentrations. Chloride-type waters occur generally in grassland areas east of Gustine and around Dos Palos, with sodium chloride water present in northern areas near Tracy and also extending south from Dos Palos. These waters also exhibit greatly varying salinity with typical TDS concentrations, ranging from less than 500 mg/L to greater than 10,000 mg/L and of high sodium makeup (50-75 percent of cations present) (Hotchkiss and Balding, 1971). Areas of bicarbonate groundwater within the Upper Aquifer of relatively lower TDS concentrations are directly associated with intermittent streams of the Coast Range near Del Puerto, Orestimba, San Luis, and Los Banos Creeks. Sulfate water in the central and southern Subbasin areas has TDS concentrations decreasing from west (1,200 mg/L) to east (700 mg/L) towards the San Joaquin River, similar to the bicarbonate water areas, although areas of sulfate water south of Dos Palos have much higher TDS concentrations (1,900 to 86,500 mg/L) (Hotchkiss and Balding, 1971).

Groundwater in the Lower Aquifer below the Corcoran Clay is also spatially variable, consisting of mostly transitional sulfate waters in the northern part of the Delta-Mendota Subbasin to more sodium-rich water further south in the grassland areas. In the northern part of the Delta-Mendota Subbasin, the Lower Aquifer exhibits relatively lower TDS concentrations, ranging from 400 to 1,600 mg/L, with a sulfate-chloride type makeup near the valley margin trending to sulfate-bicarbonate type near the valley axis. Farther south, TDS concentrations in the Lower Aquifer increase (Hotchkiss and Balding, 1971).

Natural conditions of groundwater salinity exist throughout the Upper and Lower Aquifers as a result of the contribution of salts from recharge off the Coast Range mountains. Surface water and groundwater flowing over and through Coast Range sediments of marine origin have dissolved naturally-occurring salts, contributing to the historical and current presence of salinity in groundwater within the Delta-Mendota Subbasin. In addition to natural salinity contributed from the Coast Range sediments, a number of other mechanisms are believed to further contribute to increased salinity in the groundwater in the region. Poorly draining soil conditions are extensive within some of the southern and eastern areas of the Subbasin, extending from the vicinity of Tranquillity to near Gustine, and these types of soil, combined with a shallow water table, contribute to a build-up of soil salinity.

4.1.10 Topography, Surface Water, Recharge, and Imported Supplies

This section describes the topography, surface water, soils, and groundwater recharge potential in the Delta-Mendota Subbasin.

Topography

As previously described, the Delta-Mendota Subbasin lies on the western side of the Central Valley and extends from the San Joaquin River on the east, along the axis of the Valley, to the Coast Range on the west side (LSCE, 2015). The Subbasin has ground surface elevations ranging from less than 100 feet above mean sea level (msl) along parts of the eastern edge to greater than 1,600 feet msl in the Coast Range mountains (**Figure CC-35**~~**Figure CC-35**~~). Most of the lower elevation areas occur east of Interstate 5, in the eastern parts of the Delta-Mendota Subbasin; although some lower elevation areas also extend westward into the Coast Range, such as in Los Banos Creek Valley. Low elevation areas generally coincide with the extent of the Central Valley floor. Topography within the Delta-Mendota Subbasin consists largely of flat areas across the Central Valley floor, where slopes are generally less than 2 percent, with steepening slopes to the west. The topography outside of the Central Valley floor in the Coast Range mountains is characterized by steeper slopes, generally greater than 6 percent.

Surface Water Bodies

The San Joaquin River and its tributaries is the primary natural surface water feature within the Delta-Mendota Subbasin, flowing from south to north along the eastern edge of the Subbasin (LSCE, 2015). During the 1960s, the San Joaquin River exhibited gaining flow conditions through much of the Subbasin (Hotchkiss and Balding, 1971). Numerous intermittent streams from the Coast Range enter the Delta-Mendota Subbasin from the west; however, none of these maintain perennial flow and only Orestimba Creek, Los Banos Creek and Del Puerto Creek have channels that extend eastward to a junction with the San Joaquin River. Most of the flow in other notable west-side creeks, including Quinto Creek, San Luis Creek, Little Panoche Creek, and Ortigalita Creek, is lost to infiltration (Hotchkiss and Balding, 1971). Flow from Los Banos and San Luis Creeks are impounded by dams on their respective systems. When flood releases are made from Los Banos Creek Reservoir, the vast majority of flows pass through Grassland Water District to the San Joaquin River as they tend to occur during times when agricultural and wetland demand is low. San Luis Reservoir on San Luis Creek, which is located along the western boundary of the Delta-Mendota Subbasin, is an artificial water storage facility for the Central Valley Project and California State Water Project and has no notable natural surface water inflows. Outflows from the reservoir go into the system of federal- and state-operated canals and aqueducts comprising the Central Valley and State Water Projects. Surface water use within the Delta-Mendota Subbasin is derived largely from water deliveries provided by these projects, including from the California Aqueduct (referred to as San Luis Canal in the joint-use area of the California Aqueduct) and Delta-Mendota Canal, and also from the San Joaquin River (**Figure CC-36**~~**Figure CC-36**~~).

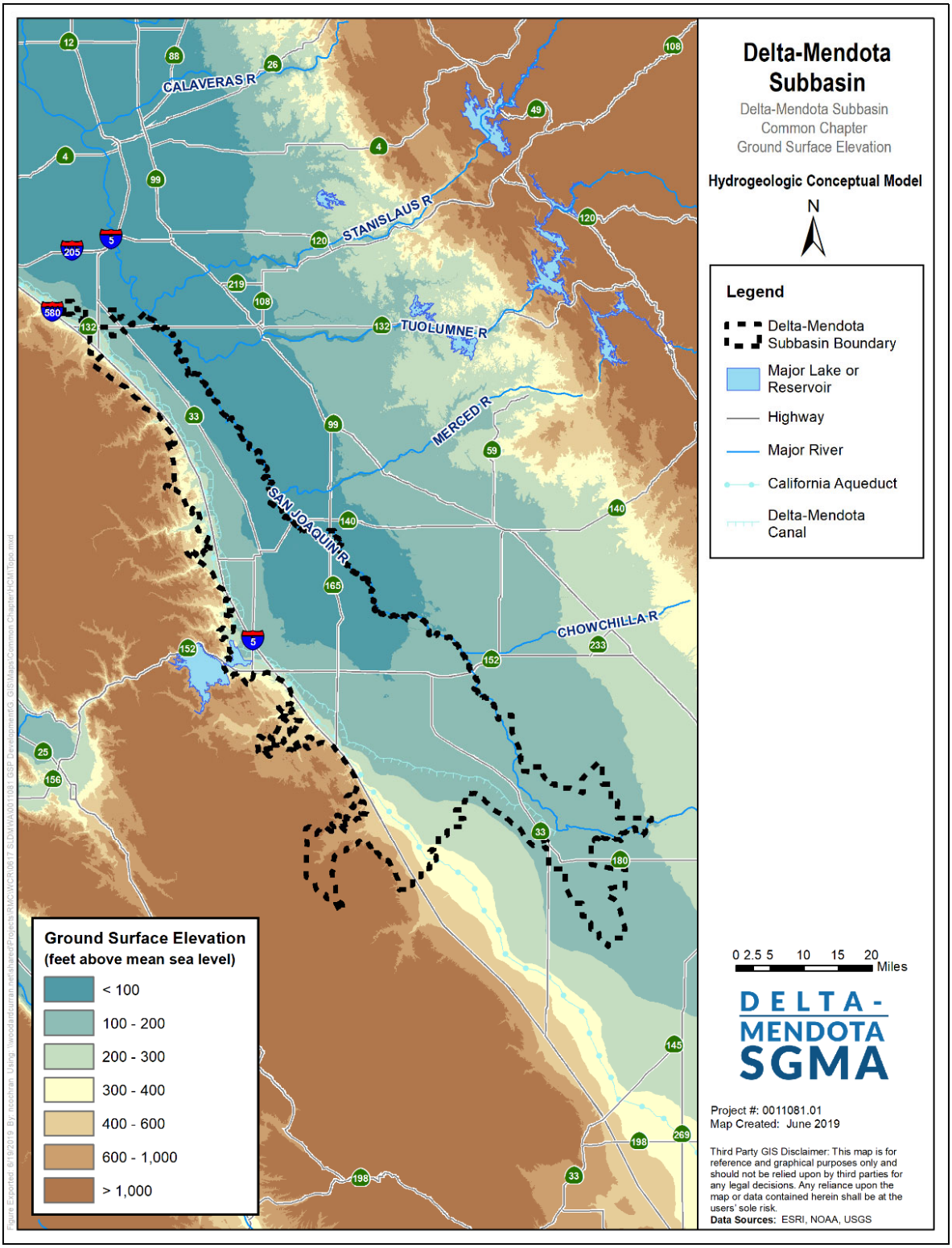


Figure CC-35: Ground Surface Elevation

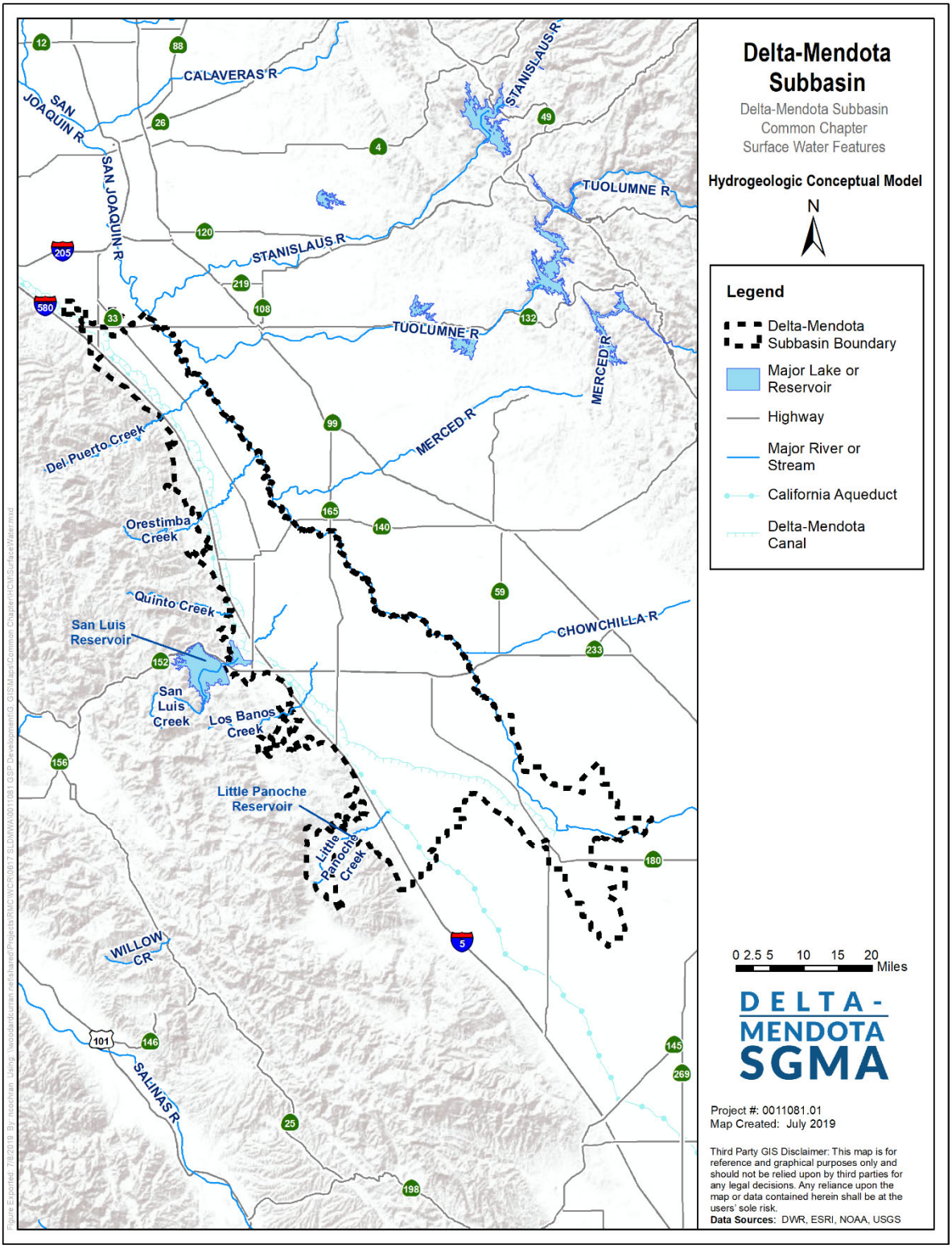


Figure CC-36: Surface Water Features

Soils

The NRCS provides soil mapping in the region. One of the combining soil groupings mapped includes hydrologic groups. The predominant soil hydrologic groups within the Delta-Mendota Subbasin are soil types C and D (Figure CC-37~~Figure CC-37~~). Group C soils have moderately high runoff potential when thoroughly wet (NRCS, 2009) with water transmission through the soil somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Group D soils have a high runoff potential when thoroughly wet and water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential.

Soil hydraulic conductivity groups are closely related to soil drainage characteristics and hydraulic conductivity. The fine-grained floodplain deposits present across much of the southeastern area of the Subbasin are evidenced as soils with lower hydraulic conductivity in Figure CC-37~~Figure CC-37~~ and accordingly, these characteristics also make these areas poorly drained. Poorly draining soil conditions are extensive within the southern and eastern areas of the Subbasin, extending from the vicinity of Tranquillity to near Gustine (Fio, 1994; Hotchkiss and Balding, 1971). Soils in the northern and western parts of the Delta-Mendota Subbasin exhibit better drainage characteristics, although areas of poorly drained soils are also present in the north and west in proximity to surface water courses, including most notably directly adjacent to portions of the San Joaquin River and Los Banos Creek channels. Many of the upland soils, which are of generally coarser texture and located proximal to sediment sources derived from the Coast Range hill slopes, are characterized as moderately well drained.

In areas with low hydraulic conductivity, corresponding to areas without adequate natural drainage, tile drains are present to remove shallow groundwater from the rooting zone. Known tile drain locations are shown in Figure CC-38~~Figure CC-38~~**,** which are primarily located along the eastern boundary of the Delta-Mendota Subbasin as well as the southern portion of the Subbasin in the Grassland Drainage Area. The Grassland Drainage Area contains a tile drainage system connected to the San Joaquin River Improvement Project, which uses tile drainage water for irrigated agriculture with a high salinity tolerance.

Areas of Recharge, Potential Recharge, and Groundwater Discharge Areas

The primary process for groundwater recharge within the Central Valley floor area is from percolation of applied irrigation water and seepage from canals and stream beds, although some groundwater recharge does occur in the Delta-Mendota Subbasin along the western boundary of the Subbasin due to mountain front recharge. In sandier areas, recharge ponds have been constructed within certain districts (CCC, Aliso Water District, CCID and Del Puerto Water District) to promote managed aquifer recharge.

Groundwater recharge potential on agricultural land based on the Soil Agricultural Groundwater Banking Index (SAGBI) is shown in Figure CC-39~~Figure CC-39~~. The SAGBI is based on five major factors: deep percolation, root zone residence time, topography, chemical limitations, and soil surface conditions. Within the Delta-Mendota Subbasin, SAGBI data categorizes 160,248 acres out of 744,237 acres (21%) of agricultural and grazing land within the regions as having Excellent, Good, and Moderately Good (Figure CC-39~~Figure CC-39~~) recharge properties, and 571,573 acres out of 744,237 acres (or 77%) of agricultural and grazing land as having Moderately Poor, Poor, or Very Poor recharge properties. "Modified" SAGBI data shows higher potential for recharge than unmodified SAGBI data because the modified data assumes that soils have been or will be ripped to a depth of six feet, which can break up fine grained materials at the surface to improve percolation. The modified data set was determined to

more accurately represent the Delta-Mendota Subbasin due to the heavy presence of agriculture. In almost all cases, recharge from applied water on irrigated lands recharges the Upper Aquifer of the Subbasin. However, the use of percolation ponds and other managed aquifer recharge techniques must consider existing water quality in addition to soil composition and may be limited in areas where poor water quality currently exists.

The Corcoran Clay is a known barrier restricting vertical flow between the Upper and Lower Aquifers; therefore, natural recharge of the Lower Aquifer from downward percolating water is most likely restricted where the Corcoran Clay is present, including across most of the Central Valley floor. Primary recharge areas to the Lower Aquifer are most likely in western parts of the Central Valley floor where percolating water can enter formations feeding the Lower Aquifer, particularly in the vicinity and west of Los Banos, Orestimba, and Del Puerto Creeks, along the western margin of the Subbasin.

Groundwater discharge areas are identified as springs located within the Delta-Mendota Subbasin and the San Joaquin River. **Figure CC-39**~~**Figure CC-39**~~ shows the location of historic springs identified by USGS. There are only six springs/seeps identified by USGS in their National Hydrograph Dataset, which are located in the southwestern corner of the Subbasin. The springs shown represent a dataset collected by USGS and are not a comprehensive map of springs in the Subbasin.

Imported Supplies

Both the California Aqueduct and Delta-Mendota Canal run the length of the Delta-Mendota Subbasin, primarily following the Interstate 5 corridor (**Figure CC-40**~~**Figure CC-40**~~). The following water purveyors in the Delta-Mendota Subbasin are SLDMWA Member Agencies and thus receive water from the Central Valley Project via the Delta-Mendota Canal: California Department of Fish and Wildlife, Central California Irrigation District, Columbia Canal Company, Del Puerto Water District, Eagle Field Water District, Firebaugh Canal Water District, Fresno Slough Water District, Grassland Water District, Laguna Water District, Mercy Springs Water District, Oro Loma Water District, Pacheco Water District, Panoche Water District, Patterson Irrigation District, San Luis Canal Company, San Luis Water District, Tranquillity Irrigation District, Turner Island Water District, U.S. Fish and Wildlife Service, and West Stanislaus Irrigation District. Oak Flat Water District is the only recipient of State Water Project (SWP) water in the Delta-Mendota Subbasin; Oak Flat Water District initially bought into the SWP in 1968.

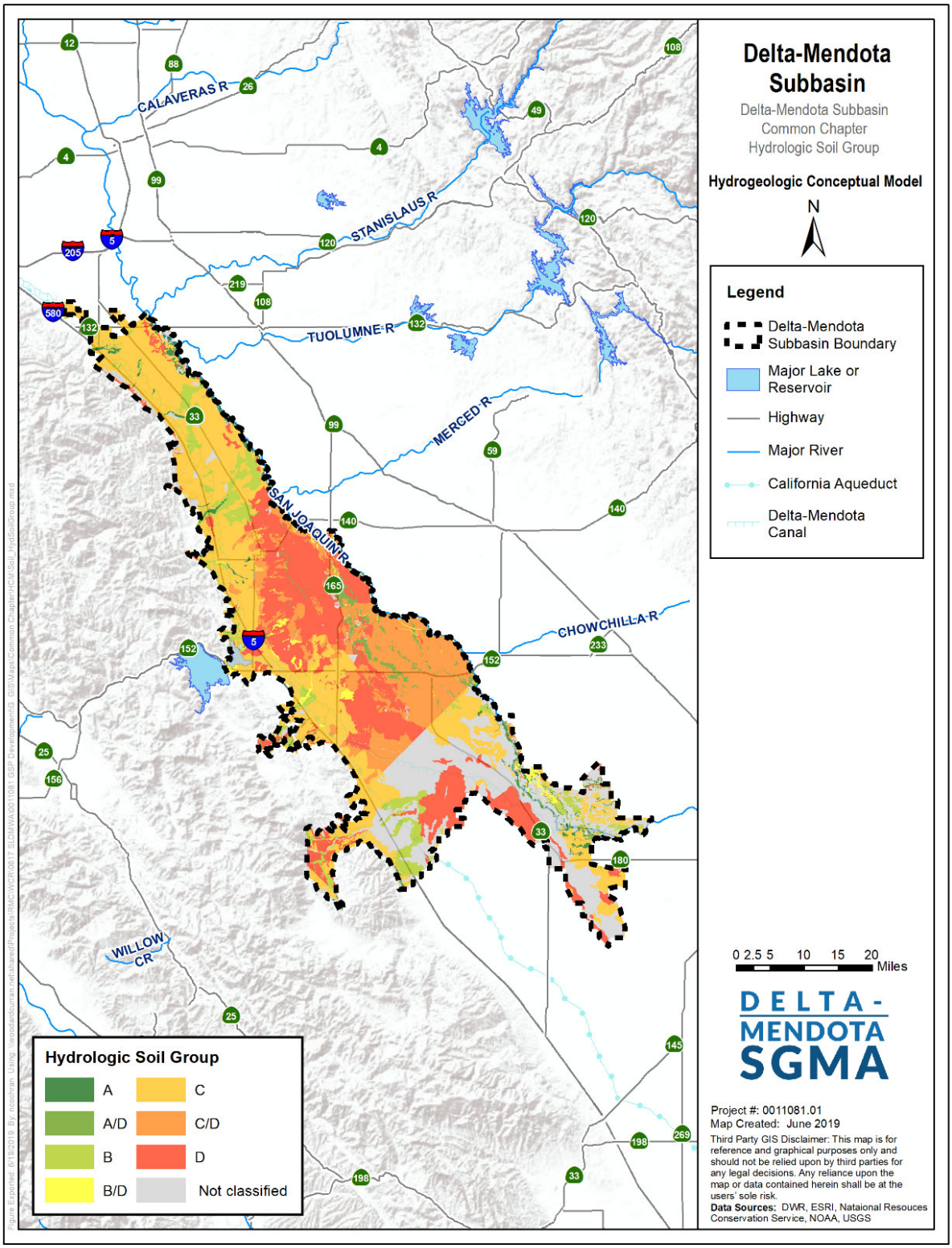


Figure CC-37: SAGBI Soils Map

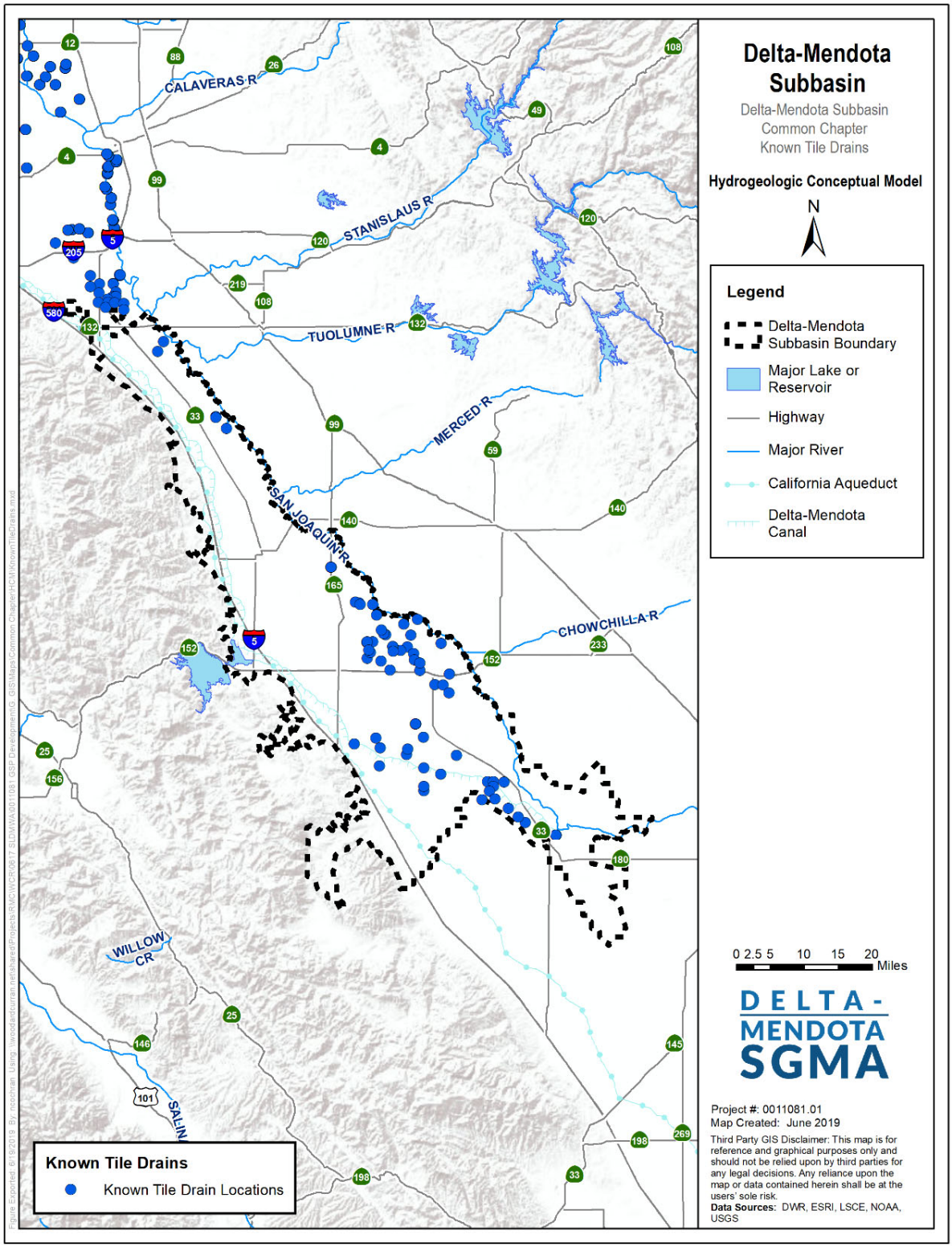


Figure CC-38: Tile Drains

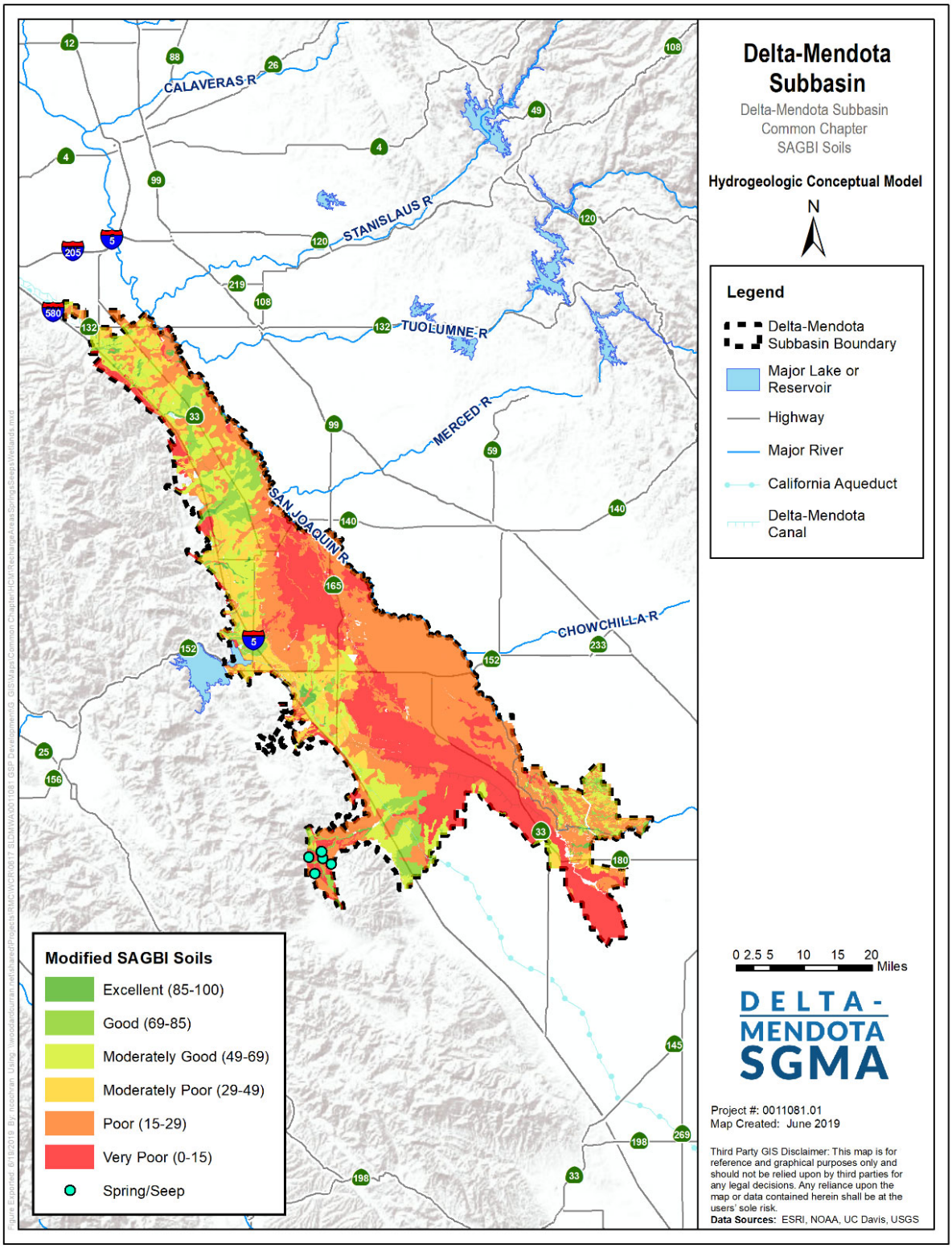


Figure CC-39: Recharge Areas, Seeps and Springs

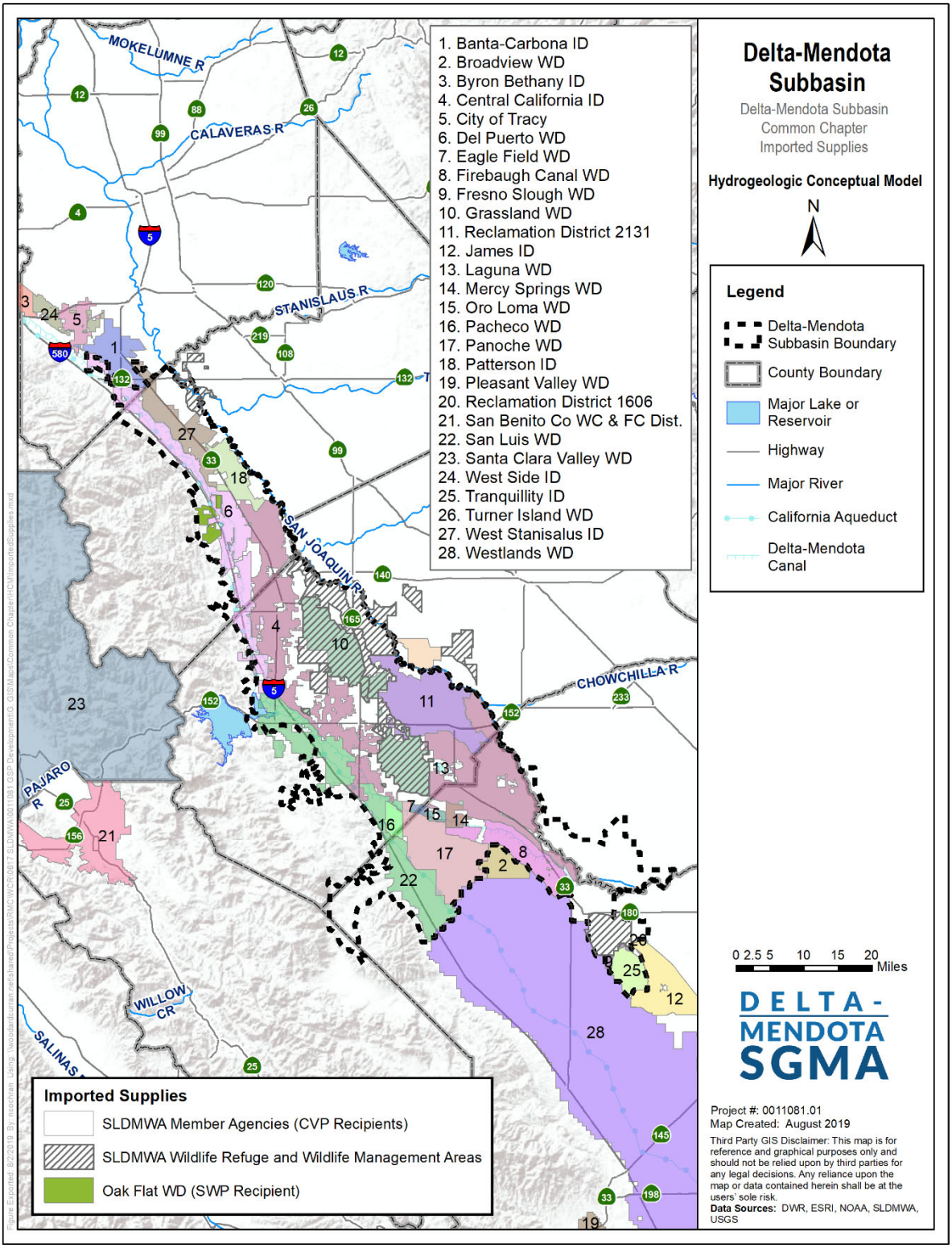


Figure CC-40: Imported Supplies

4.2 Delta-Mendota Subbasin Groundwater Conditions

This section describes the current and historic groundwater conditions in the Delta-Mendota Subbasin, including data from January 1, 2015 to recent conditions for the following parameters: groundwater elevations, groundwater storage, groundwater quality, land subsidence, interconnected surface water systems, and groundwater dependent ecosystems (GDEs) (pursuant to Article 5 Plan Contents, Subarticle 2 Basin Setting, § 354.16 Groundwater Conditions of the GSP Emergency Regulations). Seawater intrusion is not discussed herein as the Delta-Mendota Subbasin is inland and is not impacted by seawater intrusion. For the purposes of this GSP, "current conditions" is represented by Water Year (WY) 2013 conditions, which is consistent with the year representing the Current Conditions Water Budget (see Section 4.3 for more information about Water Budgets). Data post-WY 2013 through present day are presented when available.

The purpose of describing groundwater conditions, as contained in this section and described in the individual GSPs, is to establish baseline conditions that will be used to monitor changes relative to measurable objectives (MOs) and minimum thresholds (MTs). Therefore, these established baseline conditions will help support monitoring to demonstrate measurable efforts in achieving the sustainability goal for the Delta-Mendota Subbasin.

4.2.1 Useful Terminology

This groundwater conditions section includes descriptions of the amounts, quality, and movement of groundwater, among other related components. A list of technical terms and a description of the terms are listed below. The terms and their descriptions are identified here to guide readers through the section and are not a definitive definition of each term:

- **Depth to Groundwater** – The distance from the ground surface to first-detected non-perched groundwater, typically reported at a well.
- **Upper Aquifer** – The alluvial aquifer above the Corcoran Clay (or E-clay) layer.
- **Lower Aquifer** – The alluvial aquifer below the Corcoran Clay (or E-clay) layer.
- **Horizontal gradient** – The slope of the groundwater surface from one location to another when one location is higher or lower than the other. The gradient is shown on maps with an arrow showing the direction of groundwater flow in a horizontal direction.
- **Vertical gradient** – Describes the movement of groundwater perpendicular to the ground surface. Vertical gradient is measured by comparing the elevations of groundwater in wells that are of different depths. A downward gradient is one where groundwater is moving down into the ground towards deeper aquifers and an upward gradient is one where groundwater is upwelling towards the ground surface.
- **Contour Map** – A contour map shows changes in groundwater elevations by interpolating groundwater elevations between monitoring sites. The elevations are shown on the map with the use of a contour line, which represents groundwater being at the indicated elevation along the contour line. Contour maps can be presented in two ways:
    - Elevation of groundwater above mean sea level (msl), which can be used to identify the horizontal gradients of groundwater, and
    - Depth to water (i.e. the distance from the ground surface to groundwater), which can be used to identify areas of shallow or deep groundwater.

- **Hydrograph** – A graph that shows the changes in groundwater elevation or depth to groundwater over time at a specific location. Hydrographs show how groundwater elevations change over the years and indicate whether groundwater is rising or descending over time.
- **Maximum Contaminant Level (MCL)** – MCLs are standards that are set by the State of California and the U.S. Environmental Protection Agency for drinking water quality. MCLs are legal threshold limits on the amount of an identified constituent that is allowed in public drinking water systems. At both the State and Federal levels, there are Primary MCLs, set to be protective of human health, and Secondary MCLs for constituents that do not pose a human health hazard but do pose a nuisance through either smell, odor, taste, and/or color. MCLs are different for different constituents and have not been established for all constituents potentially found in groundwater.
- **Elastic Land Subsidence** – Reversible and temporary fluctuations in the elevation of the earth's surface in response to seasonal periods of groundwater extraction and recharge.
- **Inelastic Land Subsidence** – Irreversible and permanent decline in the elevation of the earth's surface resulting from the collapse or compaction of the pore structure within the fine-grained portions of an aquifer system. This form of subsidence is what is required by SGMA to be monitored and reported.
- **Gaining Stream** – A stream in which groundwater flows into a streambed and contributes to a net increase in surface water flows across an identified reach.
- **Losing Stream** – A stream in which surface water is lost through the streambed to the groundwater, resulting in a net decrease in surface water flows across an identified reach.
- **Conjunctive Use** – The combined use of surface water and groundwater supplies, typically with more surface water use in wet years and more groundwater use in dry years.

4.2.2 Groundwater Elevations

This section describes groundwater elevation data utilized and elevation trends in the Delta-Mendota Subbasin. Groundwater conditions vary widely across the Subbasin. Historic groundwater conditions through present day conditions, the role of imported surface water in the Subbasin, and how conjunctive use has impacted groundwater trends temporally and spatially are discussed. Groundwater elevation contour maps associated with current seasonal high and seasonal low for each principal aquifer, as well as hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients (both horizontal and vertical), are also described.

Available Data

Groundwater elevation data, and accompanying well construction information, within the Delta-Mendota Subbasin from the following sources and associated programs were utilized in the development of the Delta-Mendota Subbasin GSPs:

- California Department of Water Resources (DWR)
    - California Statewide Groundwater Elevation Monitoring Program (CASGEM)
    - Water Data Library (WDL)
- Water level data from local monitoring programs

Data provided by these sources included well information (such as location, well construction, owner, ground surface elevation and other related components), as well as groundwater elevation data (including information such as date measured, depth to water, groundwater surface elevation, questionable measurement code, and comments). At the time that these analyses were performed, groundwater elevation data were available for the time period from 1930 through 2018. There are many wells with monitoring data from some time in the past but no recent data, while a small number of wells have monitoring data recorded for periods of greater than 50 years.

Not all groundwater elevation data received were used in preparing the groundwater elevation contour maps for both principal aquifers (defined in this Common Chapter as the Upper and Lower Aquifers which are divided by the Corcoran Clay or E-clay layer). Some groundwater elevation data were associated with wells with unknown screened depths and/or composite well screens constructed across the Corcoran Clay. Groundwater elevation data associated with wells with composite screens and/or unknown screened depths were removed from the data set in most instances, along with any data point that appears to be an outlier when compared with surrounding data from the same period. Select wells with unknown construction were evaluated for inclusion in contour mapping efforts in areas of limited data. Duplicate well measurements were also removed prior to contouring and only one observation for a given well was used for the identified season, rather than averaging all measurements at a given well during the same season.

Figure CC-41~~Figure CC-41~~ shows the locations of wells with known screened depths within the Delta-Mendota Subbasin as well as known spatial gaps where no well information is currently available. These wells include those monitored under CASGEM, the Delta-Mendota Canal Well Pump-in Program, and by local owners or agencies. Monitoring data available for these wells varies by local owner and agency. Well locations were provided by local agencies to the best of their knowledge at the time of writing and may include wells that have been destroyed or are no longer in service.

Historic Conditions

Historic groundwater trends changed significantly with the first deliveries of imported water deliveries to the Delta-Mendota Subbasin. Construction of the Delta-Mendota Canal and the California Aqueduct heralded the introduction of significant surface water supplies into the Subbasin and reduced dependence on groundwater as the primary water supply. These conveyance systems have resulted in significant increases in the conjunctive use of surface water and groundwater throughout the Subbasin. Various drought periods and regulations reducing delivery of supplies from the Sacramento-San Joaquin Delta also punctuate critical understandings of groundwater use patterns throughout the Subbasin, as well as what is known regarding response and recovery of groundwater levels following notable droughts.

Prior to Imported Water Deliveries (1850-1950s)

Prior to 1850, the majority of agriculture and development in the San Joaquin Valley consisted of rain-fed grain and cattle production, with irrigated development beginning sporadically during this time via river (primarily San Joaquin River) and perennial stream diversions (SWRCB, 2011). Construction of the railroad through the San Joaquin Valley from 1869 through 1875 increased demand for more extensive agriculture, making markets in larger coastal cities more accessible to valley farmers. Significant irrigation sourced from surface water and resulting production began in the western side of the San Joaquin Valley in 1872 when the San Joaquin River was diverted through the Miller and Lux canal system west of Fresno (DWR, 1965). By the 1890s and early 1900s, sizable areas of the southern San Joaquin Valley were being forced out of production by salt accumulation and shallow water tables. Much of this land lay idle until the 1920s when development of reliable electric pumps and the energy to power

them accelerated the expansion of irrigated agriculture with the availability of vast groundwater resources. The resultant groundwater pumping lowered the water table in many areas (SWRCB, 1977 and Ogden, 1988) and allowed the leaching of salts, particularly near the valley trough and western side of the valley. Groundwater pumping for irrigation from around 1920 to 1950 drew the water table down as much as 200 feet in areas along the westside of the San Joaquin River (Belitz and Heimes, 1990). Declining water tables were causing higher pumping costs and land subsidence, and farmers were finding poorer quality water as water tables continued to decline. These issues created a desire for new surface water supplies, which would be fulfilled by the Central Valley Project.

Post-Imported Water Deliveries (1950s-2012)

Surface water deliveries from the Central Valley Project via the DMC began in the early 1950s, and from the State Water Project via the California Aqueduct in the early 1970s (Sneed et al., 2013). The CVP is the primary source of imported surface water in the Delta-Mendota Subbasin, where only Oak Flat Water District receives deliveries from the SWP. Introduction of imported water supplies to the Delta-Mendota Subbasin resulted in a decrease in groundwater pumping from some parts of the Subbasin and the greater Central Valley, which was accompanied by a steady recovery of water levels. During the droughts of 1976-1977 and 1987-1992, diminished deliveries of imported surface water prompted increased pumping of groundwater to meet irrigation demands, bringing water levels to near-historic lows. Following periods of drought, recovery of pre-drought water levels has been rapid, especially in the Upper Aquifer. This trend has been observed in historic hydrographs for wells across the Subbasin.

Current Conditions

Trends similar to historic drought and subsequent recovery conditions were observed during the 2012 to 2016 drought and the 2016 to present recovery period.

Recent Drought (2012-2016)

During the most recent drought, from 2012 through 2016, similar groundwater trends were observed as during the 1976-1977 and 1987-1992 droughts. With diminished imported surface water deliveries, groundwater pumping increased throughout the Subbasin to meet irrigation needs. This resulted in historic or near-historic low groundwater levels during the height of the drought in 2014 and 2015, when CVP and SWP allocations for agricultural water service contractors were 0%, Exchange Contractors and refuge deliveries were less than 75%, and post-1914 surface water rights in the San Joaquin River watershed were curtailed. In June 2015, senior water rights holders with a priority date of 1903 or later in the San Joaquin and Sacramento watersheds and the Delta were ordered by the State Water Resources Control Board to curtail diversions (State of California, 2015). This marked the first time in recent history that pre-1914 water rights holders were curtailed.

Post-Drought (2016-present)

With wetter conditions following the 2012-2016 drought, groundwater levels began to recover. This was largely a result of increased surface water availability with CVP allocations reaching 100% and full water rights supplies available for diversion from the San Joaquin River in 2017. Additionally, inelastic land subsidence rates also drastically decreased in 2017 as imported water supplies were once again available, resulting in decreased groundwater pumping particularly from the Lower Aquifer. This pattern of increased drought-driven groundwater pumping, accompanied by declining groundwater elevations, followed by recovery is a predominant factor to be considered in the sustainable management of the Delta-Mendota Subbasin. Furthermore, subsidence mitigation projects were developed which drastically reduced the observed subsidence rate on the eastern and southern boundaries of the Subbasin.

Groundwater Trends

Groundwater levels can fluctuate greatly throughout time due to various natural and anthropogenic factors, including long-term climatic conditions, adjacent well pumping, nearby surface water flows, and seasonal groundwater recharge or depletion (LSCE, 2015). As discussed in the Hydrogeologic Conceptual Model section of this Common Chapter (Section 4.1), the Delta-Mendota Subbasin is generally a two-aquifer system consisting of an Upper and Lower Aquifer that are subdivided by the Corcoran Clay layer, a regional aquitard. The Corcoran Clay layer, or E-Clay equivalent, restricts flow between the upper semi-confined aquifer and lower confined aquifer. The presence of a tile drain network along the Grassland Drainage Area and the Subbasin's eastern boundary affects the lateral and vertical water movement in the shallow groundwater zone (LSCE, 2016).

The Delta-Mendota Subbasin has a general flow direction to the east in the Upper Aquifer, where it loses groundwater to the San Joaquin River and its neighboring subbasins. Most recharge throughout the Subbasin is attributed to applied irrigation water, where other sources of recharge include local streams, canal seepage, and infiltration along the western margin of the Subbasin from the Coast Range. The figures that follow were developed for inclusion in the Western San Joaquin River Watershed Groundwater Quality Assessment Report (LSCE, 2015) and the Grassland Drainage Area Groundwater Quality Assessment Report (LSCE, 2016) and are included herein with the intent of demonstrating general trends in groundwater elevations around the Delta-Mendota Subbasin. These figures are not to scale.

Please see the individual GSPs for more specific information relating to similar trends in those respective GSP Plan areas. Additionally, it is important to note that groundwater trends, such as these, are dependent on climatic conditions and are not necessarily representative of the historic and current water budgets for those respective GSP Plan areas.

Upper Aquifer

For the Upper Aquifer, Figure CC-42~~Figure CC-42~~ presents select hydrographs illustrating temporal groundwater level trends in the Upper Aquifer wells within the Subbasin. Hydrographs shown on Figure CC-42~~Figure CC-42~~ are displayed with different ranges of elevation values on the vertical axes. Wells in the Upper Aquifer exhibit decreasing trends to somewhat stable water levels until the mid-1980s, and increasing or stable water levels thereafter.

Similarly, Figure CC-43~~Figure CC-43~~ presents select hydrographs illustrating temporal groundwater level trends in the areas covered by the Central Delta-Mendota, Oro Loma Water District, and Widren Water District GSAs in the Northern & Central Delta-Mendota Region GSP Group at various depths. The three select hydrographs representing wells in the Upper Aquifer each show less than 10 years of available data with two wells showing slight declines of about 10 feet or less from about 2003 through 2013, and one well showing a more drastic elevation change, ranging from 100 feet above mean sea level (ft msl) to -20 ft msl over a 5-year period from 2010 to 2016.

Lower Aquifer

Figure CC-44~~Figure CC-44~~ presents select hydrographs illustrating temporal groundwater level trends in Lower Aquifer wells within the Subbasin. Note, hydrographs shown on Figure CC-44~~Figure CC-44~~ displayed different ranges of elevation on the vertical axes. In the Lower Aquifer, piezometric head typically increased or remained relatively stable during the period from the 1980s through the early 2000s.

Again, similarly, Figure CC-43~~Figure CC-43~~ presents select hydrographs illustrating temporal groundwater level trends in the Central Delta-Mendota, Oro Loma Water District, and Widren Water District GSA areas of the Northern & Central Delta-Mendota Region GSP Group at various depths. The two select hydrographs representing wells in the Lower Aquifer each show similar elevation patterns post-2010 with a total elevation change of 50 ft msl or more. USGS1000489 shows stable and increasing groundwater elevation trends from the late 1950s through the mid-1980s with a data gap from the mid-1980s through 2010, whereafter 2010 groundwater levels have a steep decline through 2016.

Vertical Gradients

Throughout most of the Delta-Mendota Subbasin, the Corcoran Clay layer acts as a regional aquitard, limiting the vertical migration of groundwater. ~~-~~In areas outside the Corcoran Clay layer (along the western margin of the Subbasin), localized interfingered clays minimize the downward migration of groundwater; although in areas where the clay layers are not competent or non-existent, groundwater migrates from shallower to deeper groundwater zones. Similarly, in areas where the Corcoran Clay has been compromised (due to well construction across the clay), groundwater generally flows from the Upper Aquifer to the Lower Aquifer, especially in areas where the Lower Aquifer is actively used as a water supply (lowering the potentiometric head in that zone).

Groundwater Contours

The Subbasin-wide groundwater contours reflected in Figure CC-45~~Figure CC-45~~ and Figure CC-46~~Figure CC-46~~ evaluate the seasonal high (Spring 2013) and seasonal low (Fall 2013) conditions of the current year (defined as WY2013 for the GSP analyses) for the Upper Aquifer. Spring is defined as groundwater surface elevation measurements collected between January 1 and April 8; where Fall is defined as groundwater surface elevation measurements collected between September 1 and October 31. For wells where multiple Spring 2013 or Fall 2013 measurements were available, the highest elevation for each season was used for contouring. Gaps in data and contours can be attributed to a lack of wells present, level measurements, or requirements to report level readings groundwater level data. Consistent with traditional contouring efforts, the quality of outlier water level data was investigated. In instances of poor quality data, the associated data was eliminated for the groundwater contouring effort. Furthermore, implementation of the CASGEM program in 2014 has reduced temporal and spatial gaps in groundwater level datasets, and implementation of the Delta-Mendota Subbasin GSPs' monitoring programs will add to the improved data quantity and quality.

In the Upper Aquifer, during Spring 2013, the general flow of groundwater in the Delta-Mendota Subbasin was from the Coast Range along the western boundary of the Subbasin toward the San Joaquin River along the eastern boundary. Groundwater elevations tend to increase moving south throughout the Subbasin. Within Stanislaus County, groundwater elevations are the lowest, ranging between 40 and 80 feet above msl, becoming increasingly higher in Madera County, ranging between 80 and 100 feet above msl, and in Merced and Fresno counties, ranging between 80 and 140 feet above msl (Figure CC-45~~Figure CC-45~~). Similar flow directions (west to east and northeast) are observed in the Fall 2013. Within Stanislaus County, groundwater elevations are the lowest ranging between 40 and 80 feet above msl, showing little difference compared to Spring 2013; become increasingly higher in Madera County ranging between 60 and 100 feet above msl; in Merced County ranging between 60 and 140 feet above msl; and in Fresno County ranging from 60 and 120 feet above msl (Figure CC-46~~Figure CC-46~~). Both maps indicate a prevailing southwest to northeast flow gradient above the Corcoran Clay. In general, little variation is apparent in groundwater elevation between seasonal high and low periods in 2013.

Due to insufficient data, groundwater elevation contour maps for the Lower Aquifer for the seasonal high and low (Spring 2013 and Fall 2013, respectively) could not be accurately prepared. Figure CC-

47~~Figure CC-47~~ and Figure CC-48~~Figure CC-48~~ show the available groundwater elevation measurements for Spring 2013 and Fall 2013. Available Spring 2013 measurements range from -127 to 12 feet above msl in Stanislaus County, -65 to 124 feet above msl in Merced County, and -5 to 88 feet above msl in Fresno County (Figure CC-47~~Figure CC-47~~), where no measurements are available for this time period in Madera County. Available Fall 2013 measurements range from -138 to 156 feet above msl in Stanislaus County, -94 to 19 feet above msl in Merced County, and -72 to -4 feet above msl in Fresno County (Figure CC-48~~Figure CC-48~~), where no measurements are available for this time period in Madera County. The Lower Aquifer exhibits less seasonal difference in groundwater elevations than the Upper Aquifer. Throughout most of the Subbasin, the Lower Aquifer shows lower piezometric heads than the Upper Aquifer suggesting that potential exists for downward vertical gradient.

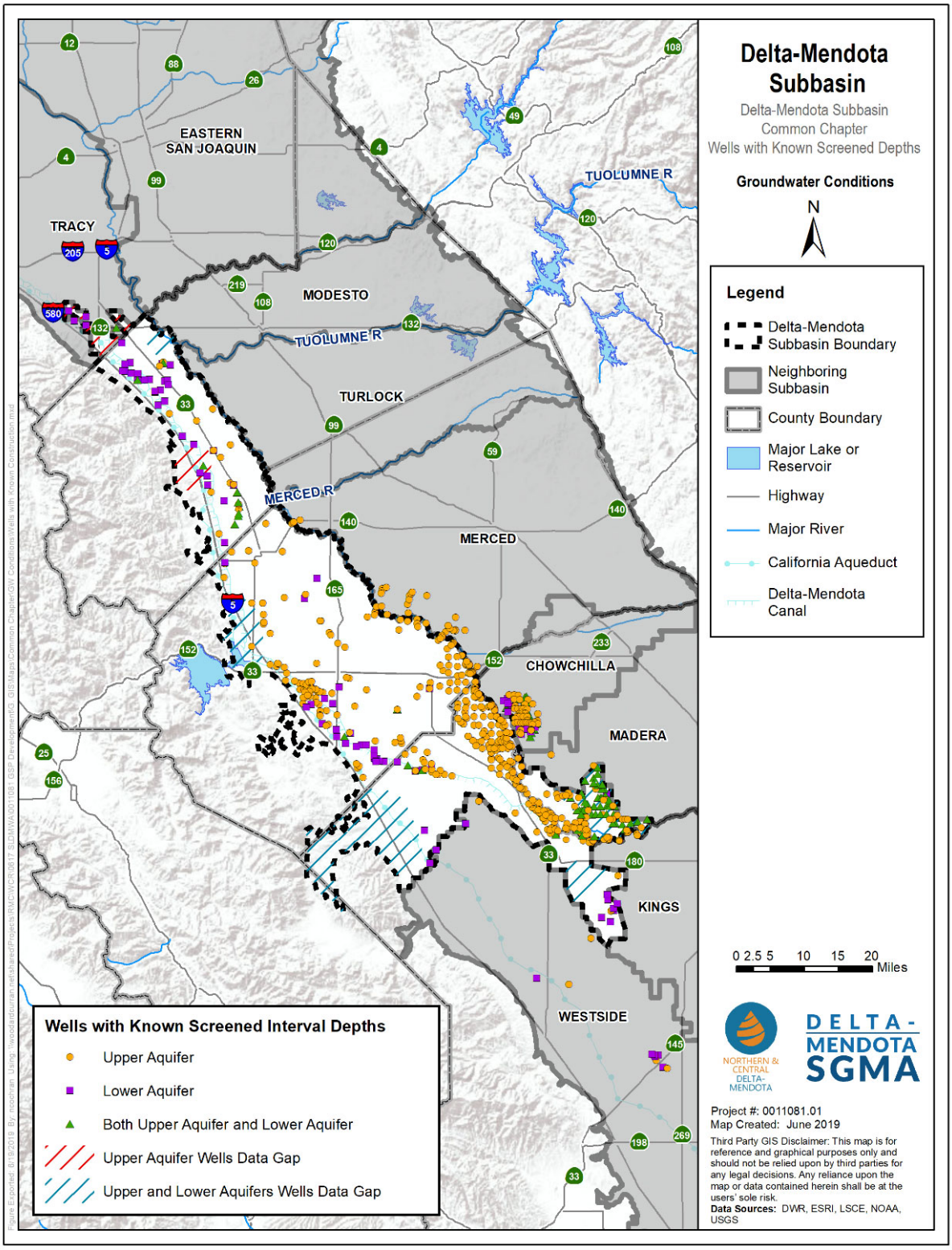
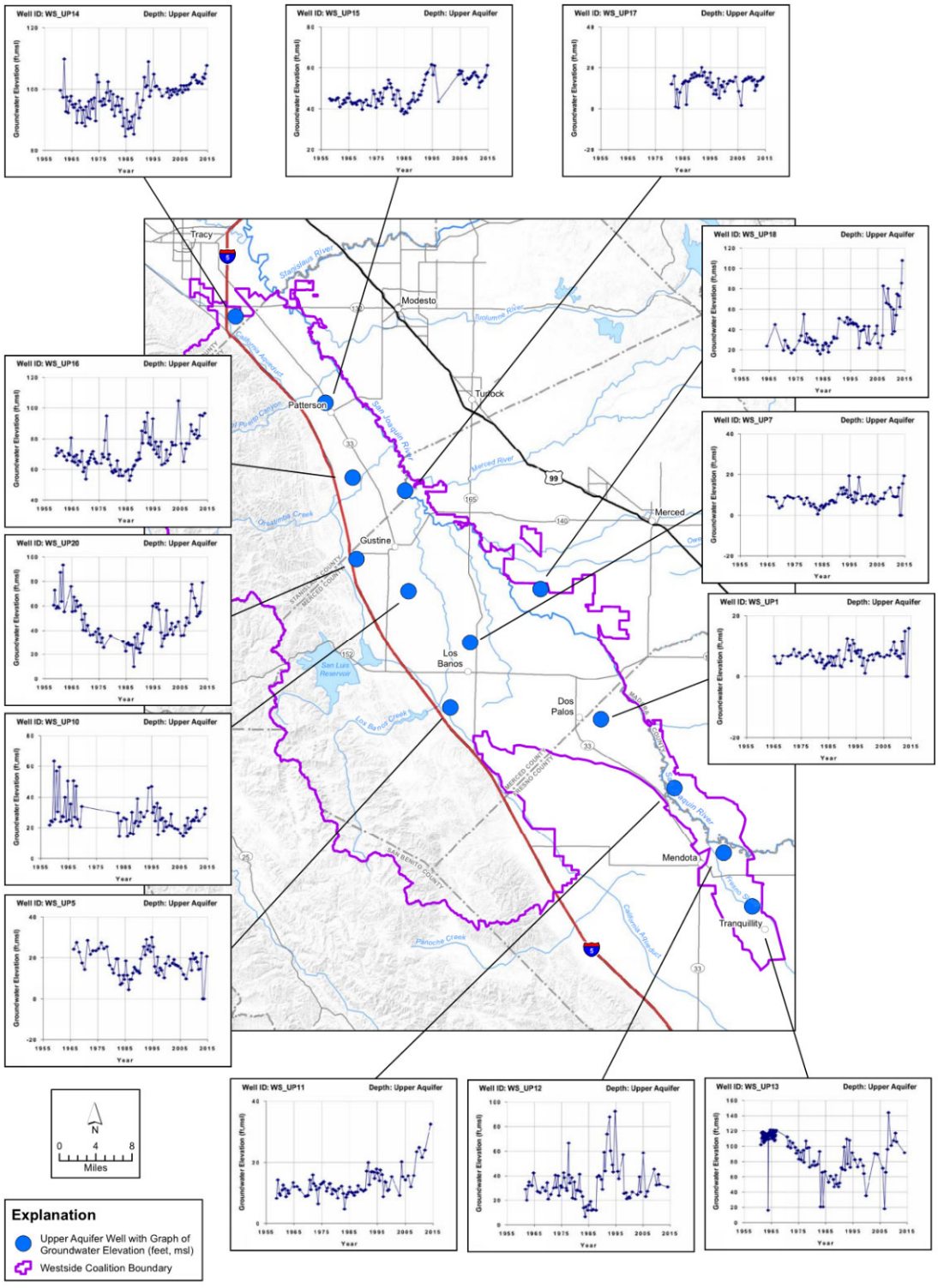
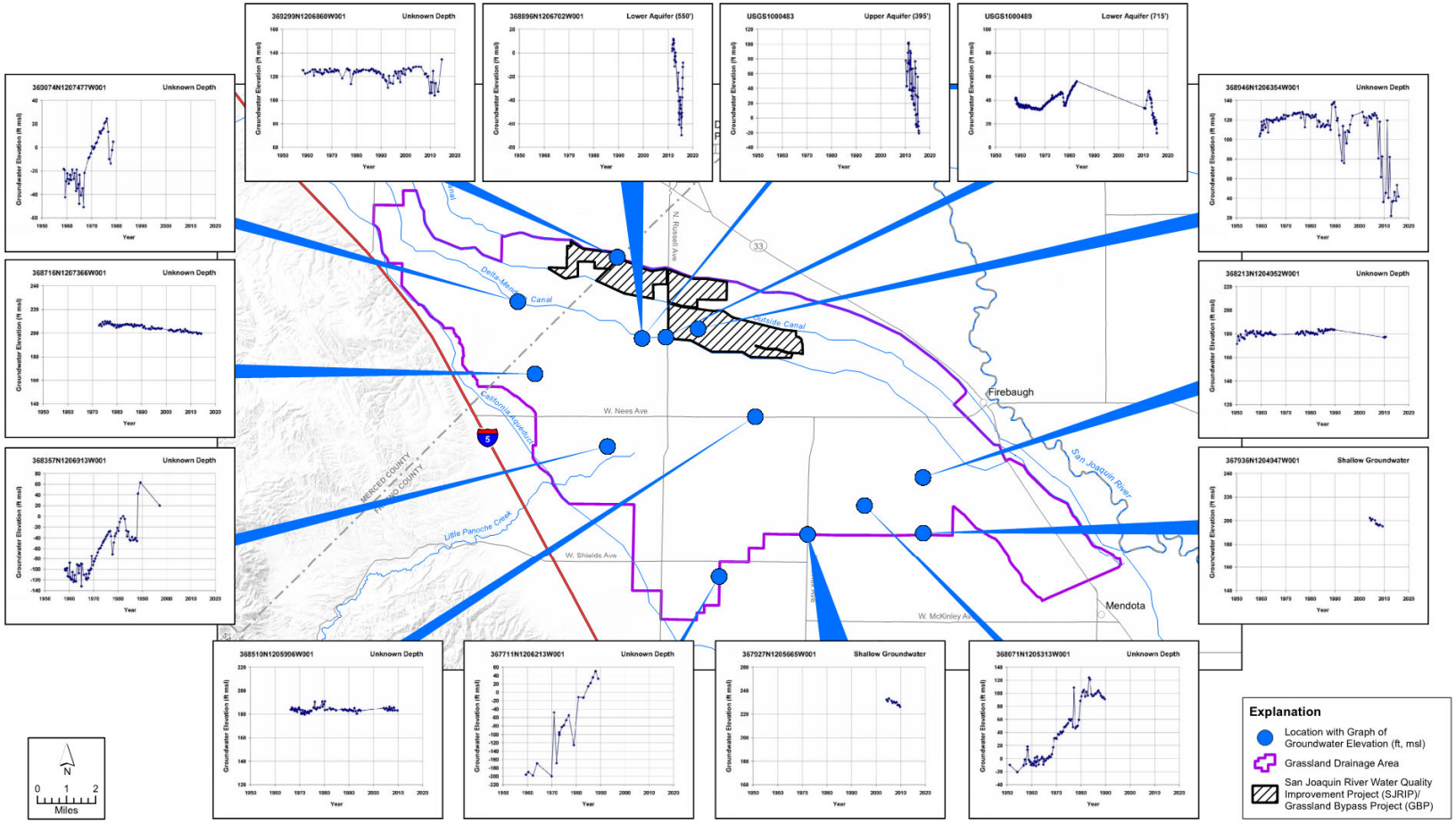


Figure CC-41: Wells with Known Screened Interval Depths



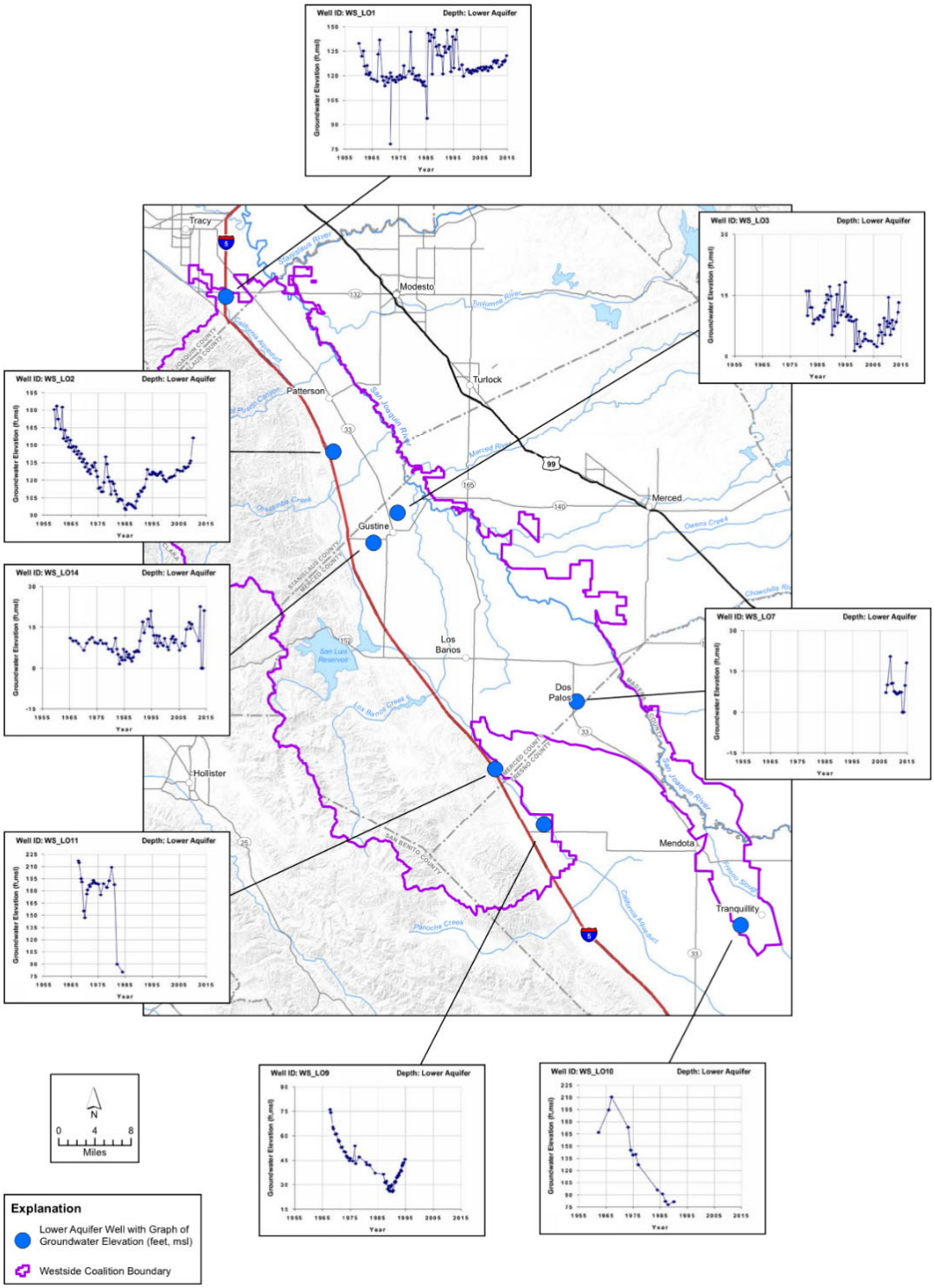
Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016

Figure CC-42: Select Graphs of Groundwater Elevations, Upper Aquifer



Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016.

Figure CC-43: Select Graphs of Groundwater Elevations, Various Depths



Note: Figure not to scale.
Source: *Western San Joaquin River Watershed Groundwater Quality Assessment Report*, 2016.

Figure CC-44: Select Graphs of Groundwater Elevations, Lower Aquifer

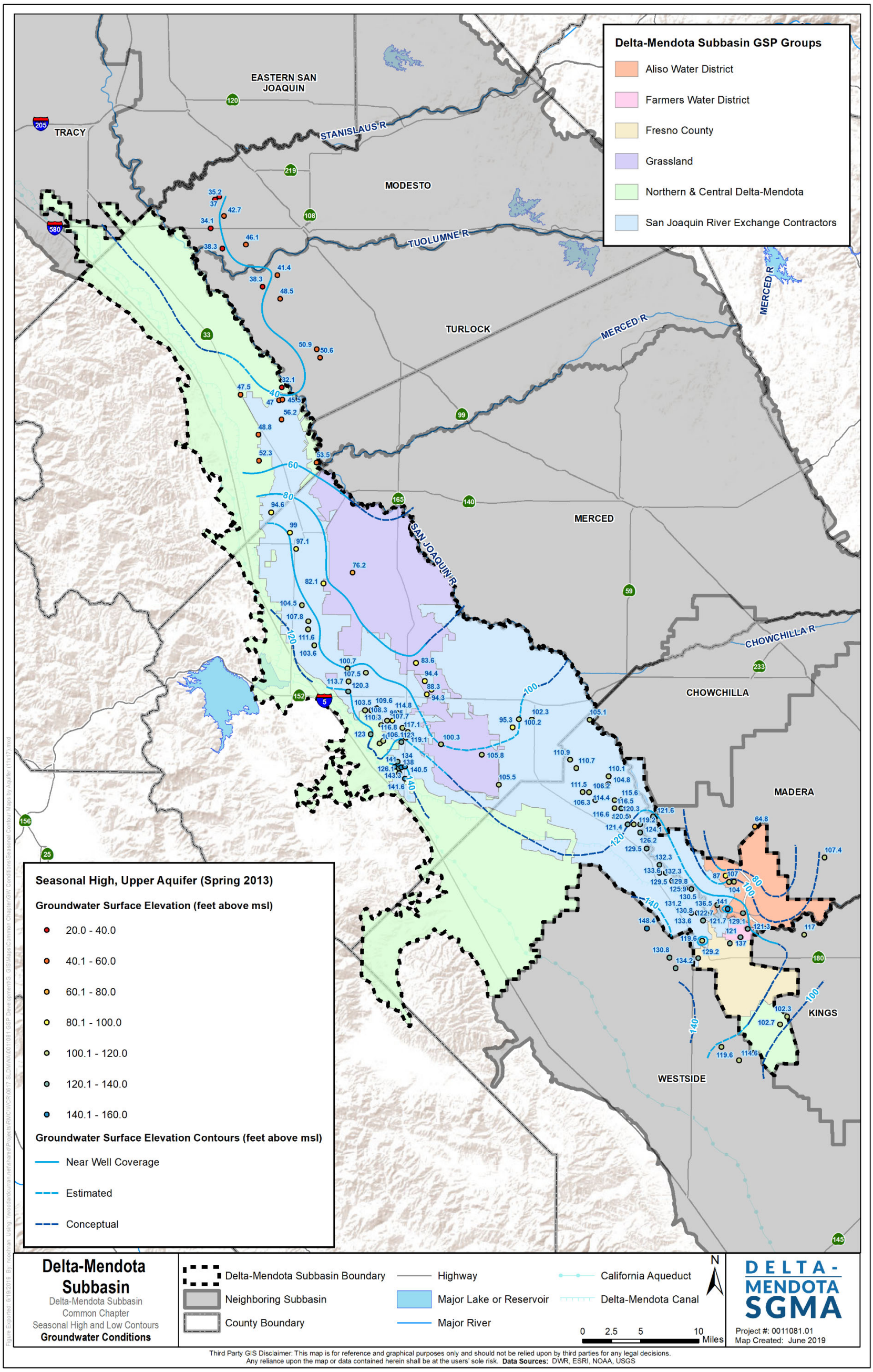


Figure CC-45: Spring 2013 Upper Aquifer Groundwater Contour Map

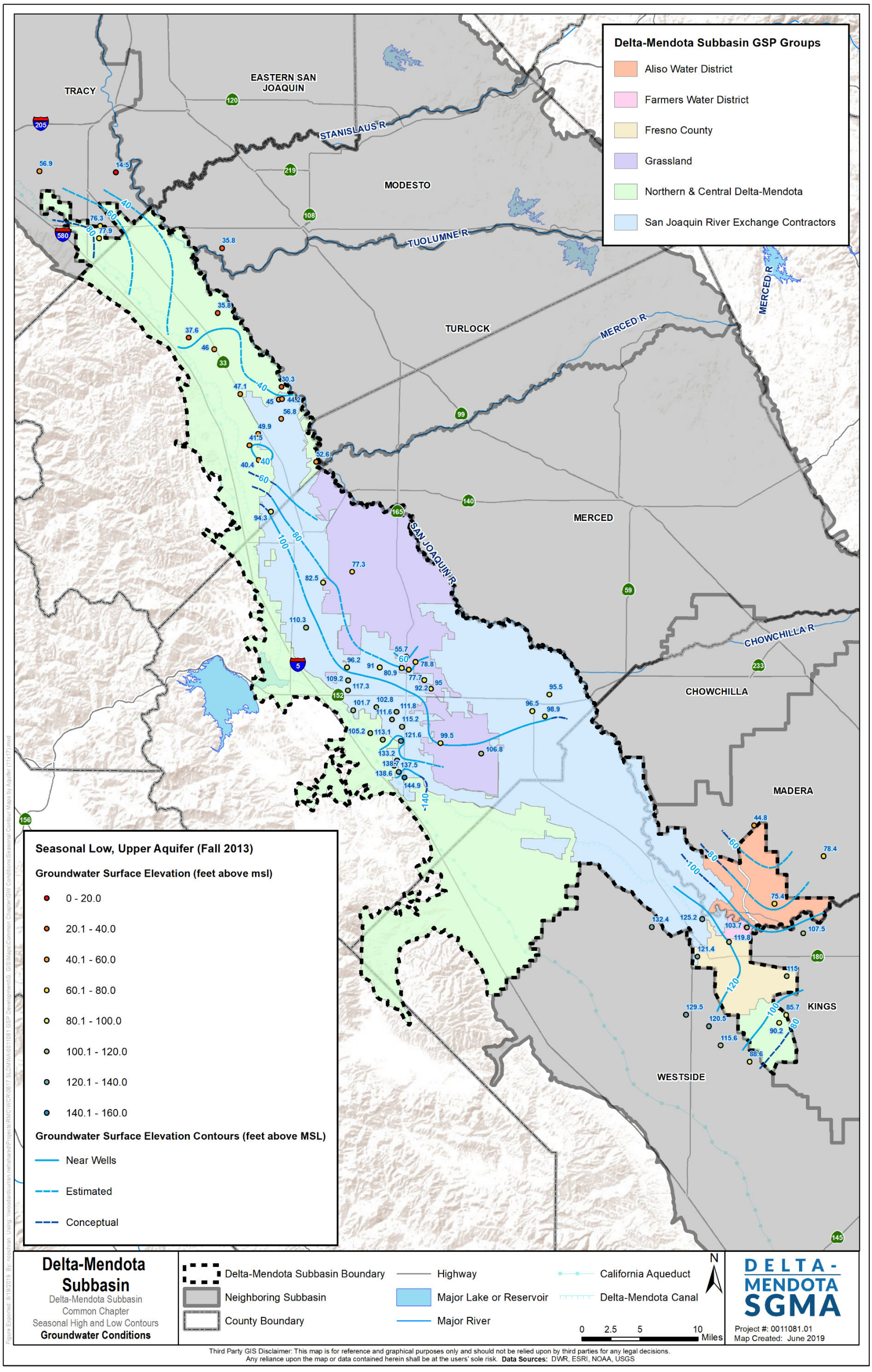


Figure CC-46: Fall 2013 Upper Aquifer Groundwater Contour Map

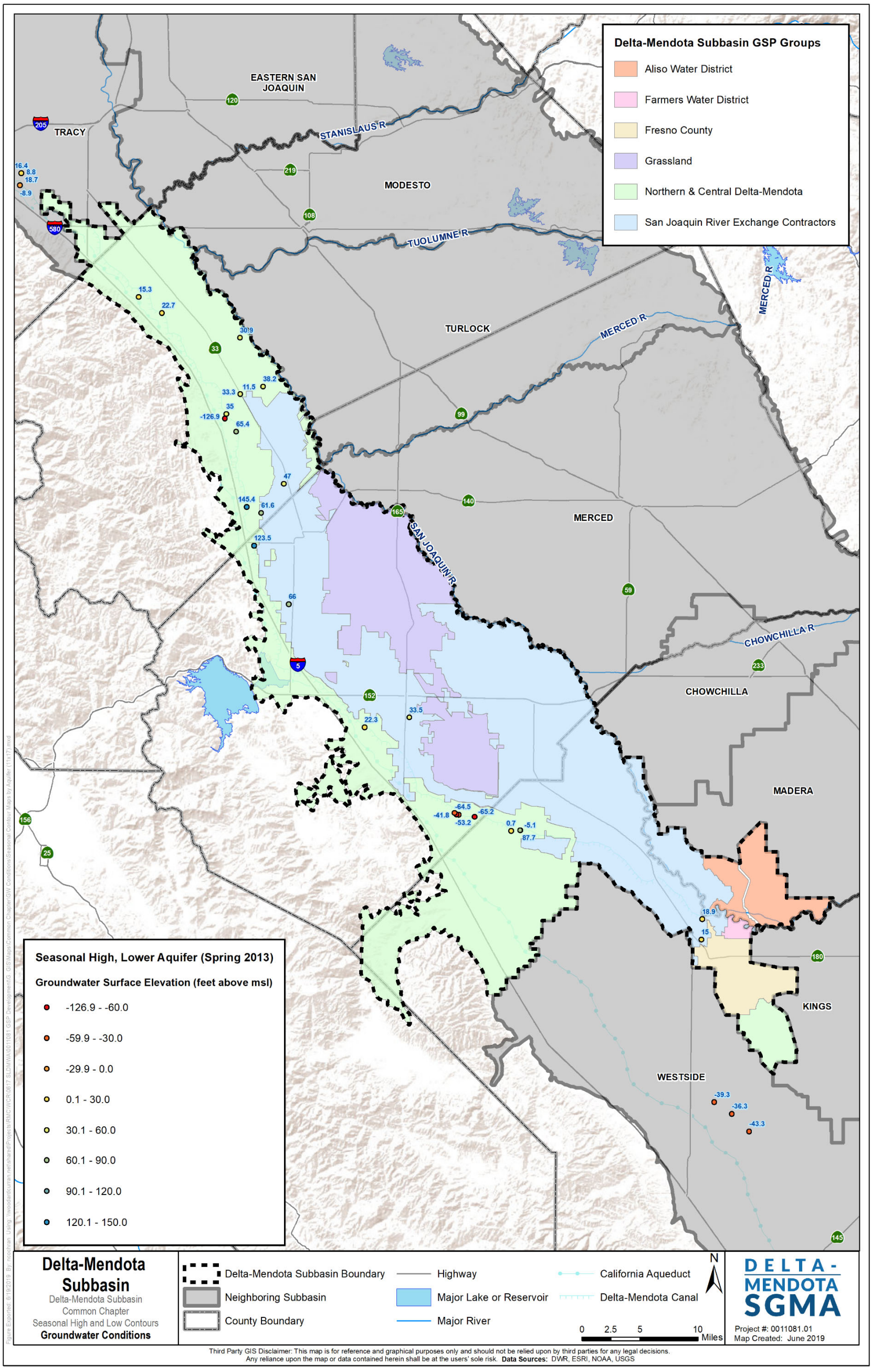


Figure CC-47: Spring 2013 Lower Aquifer Groundwater Elevation Measurements

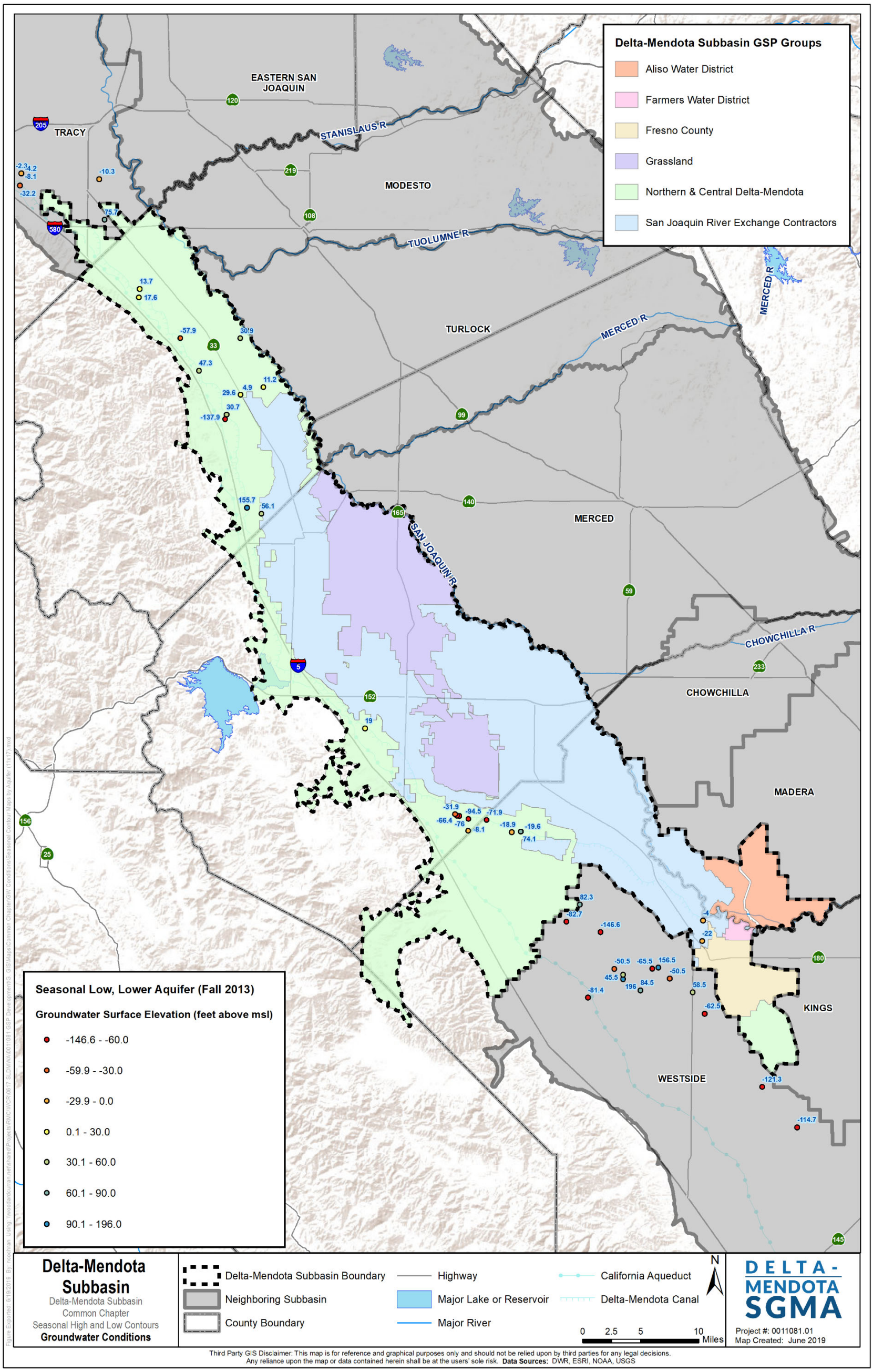


Figure CC-48: Fall 2013 Lower Aquifer Groundwater Elevation Measurements

4.2.3 Groundwater Storage

Annual changes in groundwater storage for both the Upper and Lower Aquifers in the Delta-Mendota Subbasin were estimated as part of the development of the Historic (WY2003-2012), Current (WY2013) and Projected Water Budgets (WY2014-2070). For information on how change in storage was calculated, refer to Section 4.3.2 – Water Budgets of this Common Chapter. Figure CC-49~~Figure CC-49~~ and Figure CC-50~~Figure CC-50~~ show annual change in storage, cumulative change in storage, and water year type for the Upper Aquifer and Lower Aquifer, respectively, from WY 2003 through 2013 for the Delta-Mendota Subbasin. For the purposes of the water budget four water year types were utilized, wet, average (corresponding to above and below normal water years), dry (corresponding to dry and critical water years) and Shasta critical.

Change in storage is negative for 6 out of the 11-year historic and current water budget period for the Upper Aquifer, and 9 out of 11 years for the Lower Aquifer. Despite periods of wet conditions with recharge outpacing extractions, an overall declining trend in groundwater storage can be observed in both the Upper Aquifer and Lower Aquifer. Cumulative change in storage declined more rapidly in the Upper Aquifer compared to the Lower Aquifer, declining by about ~~1,300~~624,0000 AF in the Upper Aquifer and ~~678~~375,000 AF in the Lower Aquifer between WY2003 to 2013.

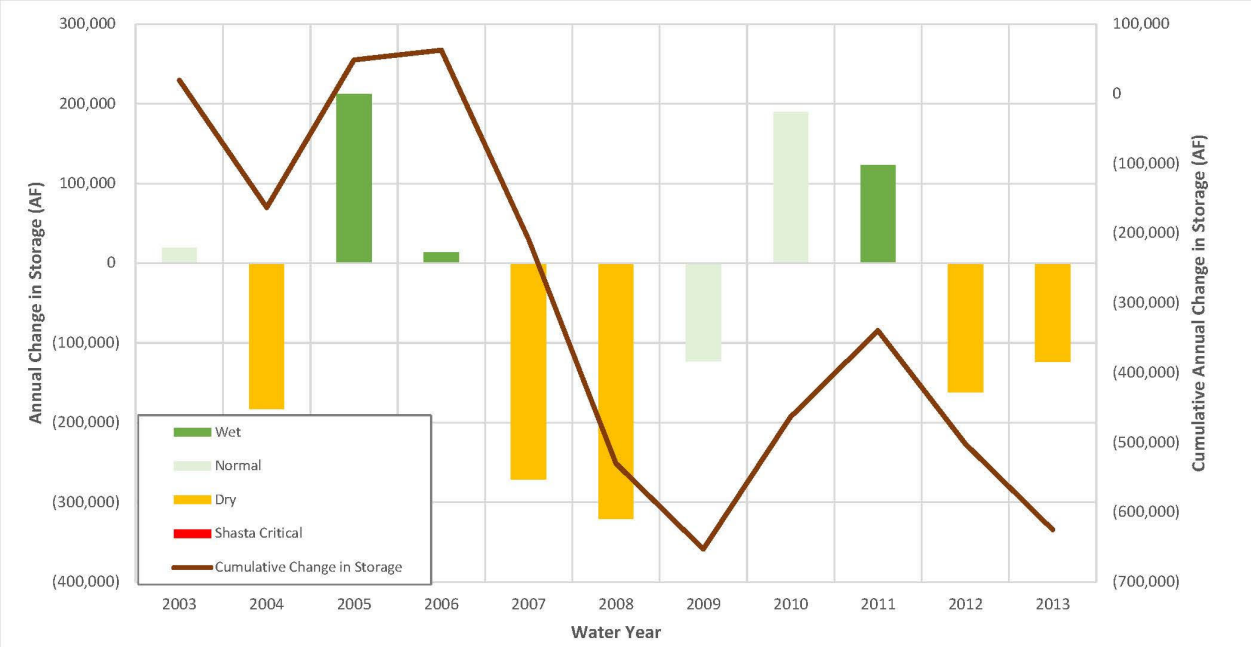


Figure CC-49: Calculated Upper Aquifer Change in Storage, Annual and Cumulative

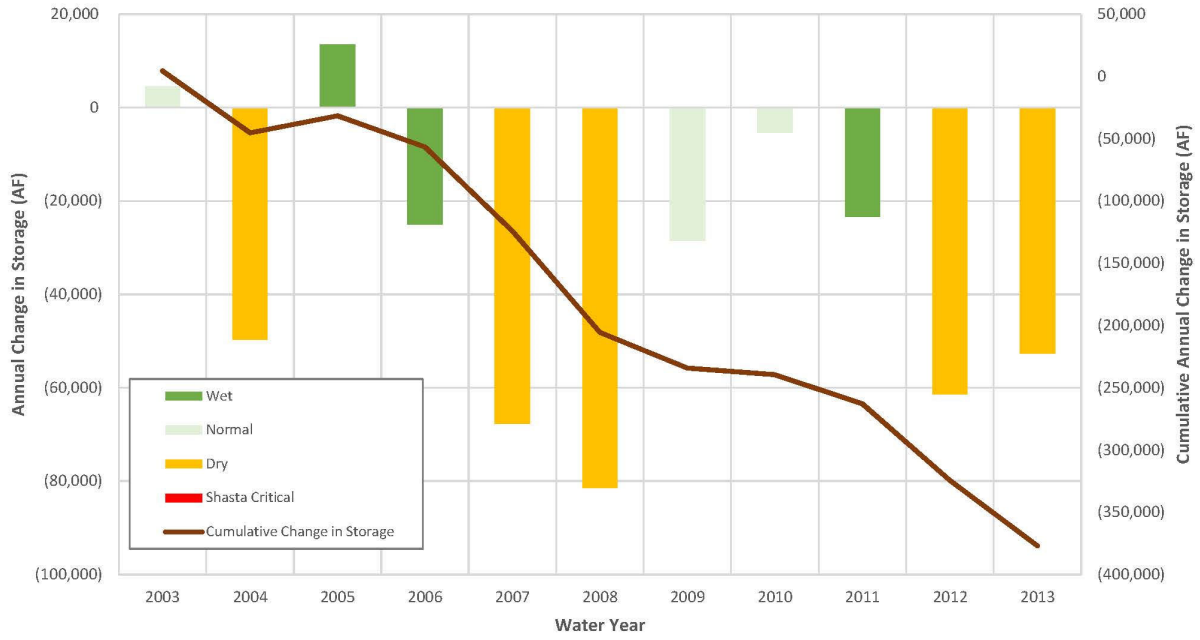


Figure CC-50: Calculated Lower Aquifer Change in Storage, Annual and Cumulative

4.2.4 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator for the Delta-Mendota Subbasin. The Subbasin is located inland from the Pacific Ocean; thus, groundwater conditions related to seawater intrusion are not applicable to the Delta-Mendota Subbasin.

4.2.5 Groundwater Quality

Groundwater quality varies considerably from west to east and north to south throughout the Delta-Mendota Subbasin. In general, Upper Aquifer water quality has historically been impacted by overlying land uses with some areas showing increasing concentrations of nitrate and TDS. Areas of elevated salt concentrations can be found in the Subbasin, generally along the southern portion of the San Joaquin River and in the southern portion of the Subbasin. Lower Aquifer groundwater has, and remains in most cases, to be of generally good quality. For more information about historic and current conditions relative to groundwater quality in each GSP Group area, refer to the individual GSPs.

4.2.6 Land Subsidence

Long-term groundwater level declines can result in a one-time release of "water of compaction" from compacting silt and clay layers (aquitards) resulting in inelastic land subsidence (Galloway et al., 1999). There are several other types of subsidence in the San Joaquin Valley, including subsidence related to hydrocompaction of moisture-deficient deposits above the water table, subsidence related to fluid withdrawal from oil and gas fields, subsidence caused by deep-seated tectonic movements, and subsidence caused by oxidation of peat soils that is a major factor in the Sacramento-San Joaquin Delta (Sneed et al., 2013). However, aquifer-system compaction caused by groundwater pumping causes the largest magnitude and areal extent of land subsidence in the San Joaquin Valley (Poland et al., 1975; Ireland et al., 1984; Farrar and Bertoldi, 1988; Bertoldi et al., 1991; Galloway and Riley, 1999).

Land subsidence is a prevalent issue in the Delta-Mendota Subbasin as it has impacted prominent infrastructure of statewide importance, namely the DMC and the California Aqueduct, as well as local canals, causing serious operational, maintenance, and construction-design issues (Sneed et al., 2013). Reduced freeboard and flow capacity for the DMC and California Aqueduct have rippling effects on imported water availability throughout the State. Even small amounts of subsidence in critical locations, especially where canal gradients are small, can impact canal operations (Sneed and Brandt, 2015). While some subsidence is reversible (referred to as elastic subsidence), inelastic or irreversible subsidence is caused mainly by pumping groundwater from below the Corcoran Clay, thus causing compaction and reducing storage in the fine-grained materials in the lower confined aquifer as well as damaging well infrastructure. As a result, important and extensive damages and repairs have resulted in the loss of conveyance capacity in canals that deliver water or remove floodwaters, the realignment of canals as their constant gradient becomes variable, the raising of infrastructure such as canal check stations, and the releveling of furrowed fields.

Available Data

There are six UNAVCO Continuous GPS (CGPS) locations that monitor subsidence within the Delta-Mendota Subbasin (Figure CC-51~~Figure CC-51~~). Changes in land surface elevation have also been measured at DMC Check Structures. Figure CC-52~~Figure CC-52~~ through Figure CC-57~~Figure CC-57~~ show the vertical change in land surface elevation from a given time point (specified on charts) for the UNAVCO CGPS stations within the Delta-Mendota Subbasin, along with annual CVP allocations. Table CC-5~~Table CC-5~~ summarizes the greatest monthly land subsidence rate and corresponding year(s) of that change at each UNAVCO CGPS station. Overall, the greatest monthly subsidence rates occurring after January 1, 2015 occurred during the Spring of 2016 to the Spring of 2017. Land subsidence rates (in feet per year), as measured by USBR from December 2011 to December 2014, are shown in Figure CC-58~~Figure CC-58~~. Based on these data, within the majority of the Delta-Mendota Subbasin, annual subsidence rates were between -0.15 and -0.3 feet/year during this period (or between -0.45 and -0.9 feet of total subsidence over this three-year period).

Table CC-5: Subsidence Monitoring Trends
UNAVCO CGPS Stations

Station ID	Greatest Monthly Land Subsidence Rate as of January 1, 2015 (feet)	Year(s) of Greatest Monthly Subsidence Rate
P255	-0.0292	Spring 2016 to 2017
P259	-0.0183	Spring 2016 to 2017
P252	-0.033	Spring 2016 to 2017
P303	-0.2190	Spring 2016 to 2017
P301	-0.0029	Spring 2016 to 2017
P304	-0.0003	Spring 2013 to 2017

Historic Conditions

Along the DMC, in the northern portion of the San Joaquin Valley, extensive groundwater extraction from unconsolidated deposits caused subsidence exceeding 8.5 meters (or about 28 feet) between 1926 and 1970 (Poland et al., 1975), reaching 9 meters (or about 30 feet) in 1980 (Ireland, 1986). Land subsidence from groundwater pumping began in the San Joaquin Valley in the mid-1920s (Poland et al., 1975; Bertoldi et al., 1991; Galloway and Riley, 1999), and by 1970, about half of the San Joaquin Valley had land subsidence of more than 0.3 meters (or about 1 foot) (Poland et al., 1975). When groundwater pumping decreased in the Delta-Mendota Subbasin following imported water deliveries from the CVP via the ~~dMC~~ DMC in the early 1950s, compaction rates were reduced in certain areas and water levels recovered. Notable droughts of 1976-1977 and 1987-1992 saw renewed compaction during these periods, with increased groundwater pumping as imported supplies were reduced or unavailable. However, following these droughts, compaction virtually ceased and groundwater levels rose to near pre-drought levels quite rapidly (Swanson, 1998; Galloway et al., 1999).

Subsidence contours for 1926-1970 (Poland et al., 1975) show the area of maximum active subsidence was southwest of the community of Mendota. Historical subsidence rates in the Mendota area exceeded 500 millimeters/year (or about 20 inches/year) during the mid-1950s and early 1960s (Ireland et al., 1984). The area southwest of Mendota has experienced some of the highest levels of subsidence in California, where from 1925 to 1977, this area sustained over 29 feet of subsidence (USGS, 2017). Historical subsidence rates along Highway 152 calculated from leveling-survey data from 1972, 1988, and 2004 show that for the two 16-year periods (1972-1988 and 1988-2004), maximum subsidence rates of about 50 millimeters/year (or about 2 inches/year) were found just south of El Nido (Sneed et al., 2013). Geodetic surveys completed along the DMC in 1935, 1953, 1957, 1984, and annually from 1996-2001 indicated that subsidence rates were greatest between 1953 and 1957 surveys, and that the maximum subsidence along the DMC (about 3 meters, or about 10 feet) was just east of DMC Check Structure Number 18.

After 1974, land subsidence was demonstrated to have slowed or largely stopped (DWR, June 2017); however, land subsidence remained poised to resume under certain conditions. Such an example includes the severe droughts that occurred between 1976 and 1977 and between 1987 and 1991. Those droughts, along with other corroborating factors, led to diminished deliveries of imported water which prompted some water agencies and farmers (especially in the western Valley) to refurbish old pumps, drill new water wells, and begin pumping groundwater to make up for cutbacks in the imported water supply. The decisions to renew groundwater pumping were encouraged by the fact that groundwater levels had recovered to near-predevelopment levels. CGPS data collected between 2007 to 2014 show seasonally variable subsidence and compaction rates, including uplift as elastic rebound occurs during the fall and winter (Sneed and Brandt, 2015). Vertical displacement at P303, near Los Banos, indicates subsidence at fairly consistent rates during and between drought periods (Sneed and Brandt, 2015). Vertical displacement at P304, near Mendota, indicates that most subsidence occurred during drought periods with very little occurring between drought periods. Finally, data from extensometers 12S/12E-16H2, located on the DMC west of Los Banos, and 14S/13E-11D6, located between the DMC and California Aqueduct west of Mendota, showed subsidence rate increases during 2014, the third year of the most recent drought (Sneed and Brandt, 2015).

Subsidence impacts to the California Aqueduct, which runs parallel and in close proximity to the Delta-Mendota Canal across the Subbasin, is of statewide importance. During the construction of the California Aqueduct, it was thought that subsidence within the San Joaquin Valley would cease with the delivery of water from the Central Valley Project, though additional freeboard was incorporated into the design and construction of the Aqueduct in an attempt to mitigate for future subsidence (DWR, June 2017). After

water deliveries from the Aqueduct began, subsidence rates decreased to an average of less than 0.1 inches/year during normal to wet hydrologic years. During dry to critical hydrologic years, subsidence increased to an average of 1.1 inches per year. The 2012-2015 drought produced subsidence similar to those seen before the Aqueduct began delivering water, with some areas experiencing nearly 1.25 inches of sinking per month (based on NASA UAVSAR flight measurements). Dry and critically dry water years since Aqueduct deliveries began have resulted in extensive groundwater withdrawals, causing some areas near the Aqueduct to subside nearly 6 feet.

Current Conditions

Based on subsidence rates observed over the last decade, it is anticipated that without mitigation, subsidence will continue to impact operations of the DMC and California Aqueduct. For example, recently, Reach 4A of the San Joaquin River near Dos Palos experienced between 0.38 and 0.42 feet/year in subsidence between 2008 and 2016. As a result of subsidence, freeboard in Reach 4A is projected to be reduced by 0.5 foot by 2026 as compared to 2016, resulting in a 50 percent reduction in designed flow capacity (DWR, May 2018). Reduced flow capacities in the California Aqueduct will impact deliveries and transfers throughout the State and result in the need to pump more groundwater, thus contributing to further subsidence.

More recent subsidence measuring indicates subsidence hot spots within the Subbasin include the area east of Los Banos and the Tranquillity Irrigation District (TRID) area. USGS began periodic measurements of the land surface in parts of the San Joaquin Valley over the last decade. Between December 2011 and December 2014, total subsidence in the area east of Los Banos, located within the Merced Subbasin (also referred to as the El Nido-Red Top area), over the three-year period ranged from 0.15 to 0.75 feet, or 1.8 to 9 inches respectively (KDSA, 2015). The Jet Propulsion Laboratory (JPL) at the California Institute of Technology has also been monitoring subsidence in California using interferometric synthetic aperture radar (or InSAR), and a recent progress report documenting data for the period from May of 2015 to September of 2016 indicates that the two previously-identified primary subsidence areas near the community of Corcoran and centered on El Nido was joined by a third area of significant subsidence near TRID. For the study period (as shown in **Figure CC-59**~~**Figure CC-59**~~), maximum total subsidence of 22 inches was measured near Corcoran, while the El Nido area subsided 15 inches and the TRID area subsided around 20 inches. Analyses at two particular stations near El Nido show interesting trends. At Station P303, between 2007 and 2014, 50 mm (or nearly 2 inches) of subsidence occurred at this location. Vertical displacement at P303 (**Figure CC-55**~~**Figure CC-55**~~) show subsidence at fairly consistent rates during and between drought periods, indicating that these areas continued to pump groundwater despite climatic variations (possibly due to a lack of surface water availability) (Sneed and Brandt, 2015). Residual compaction may also be a factor. Vertical displacement at Station P304 indicated that most subsidence in this particular area occurred during drought periods and very little occurred between drought periods (**Figure CC-57**~~**Figure CC-57**~~). This suggests that this area received other sources of water (most likely surface water available between drought periods) and that residual compaction was not very important in this area. These two areas demonstrate a close link between the availability of surface water, groundwater pumping, and inelastic land subsidence.

Total land subsidence from April 2015 to April 2016 in the San Joaquin Valley is shown in

Figure CC-60: Vertical Displacement, April 2015 to April 2016

~~**Figure CC-60: Vertical Displacement, April 2015 to April 2016**~~. Subsidence monitoring in the Delta-Mendota Subbasin, and in the San Joaquin Valley as a whole, demonstrated significant inelastic land subsidence as a result of the last drought, with effects continuing to the present time (as evidenced by

continued subsidence between 2016 and 2018 through surveys of the DMC). While the impacts appeared to have slowed, the temporal and spatial impacts of continued subsidence have not yet been evaluated.

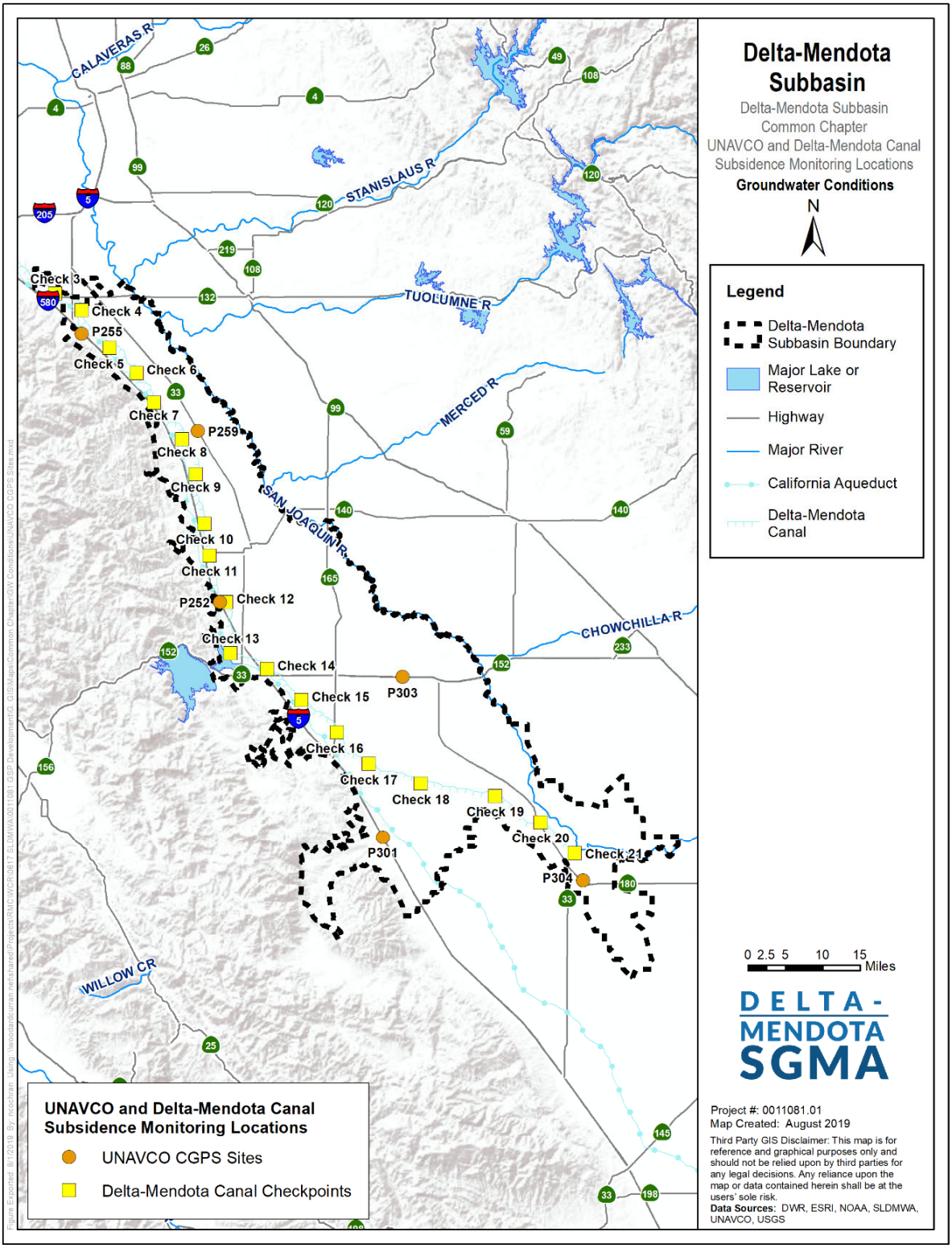


Figure CC-51: UNAVCO and Delta-Mendota Canal Subsidence Monitoring Locations

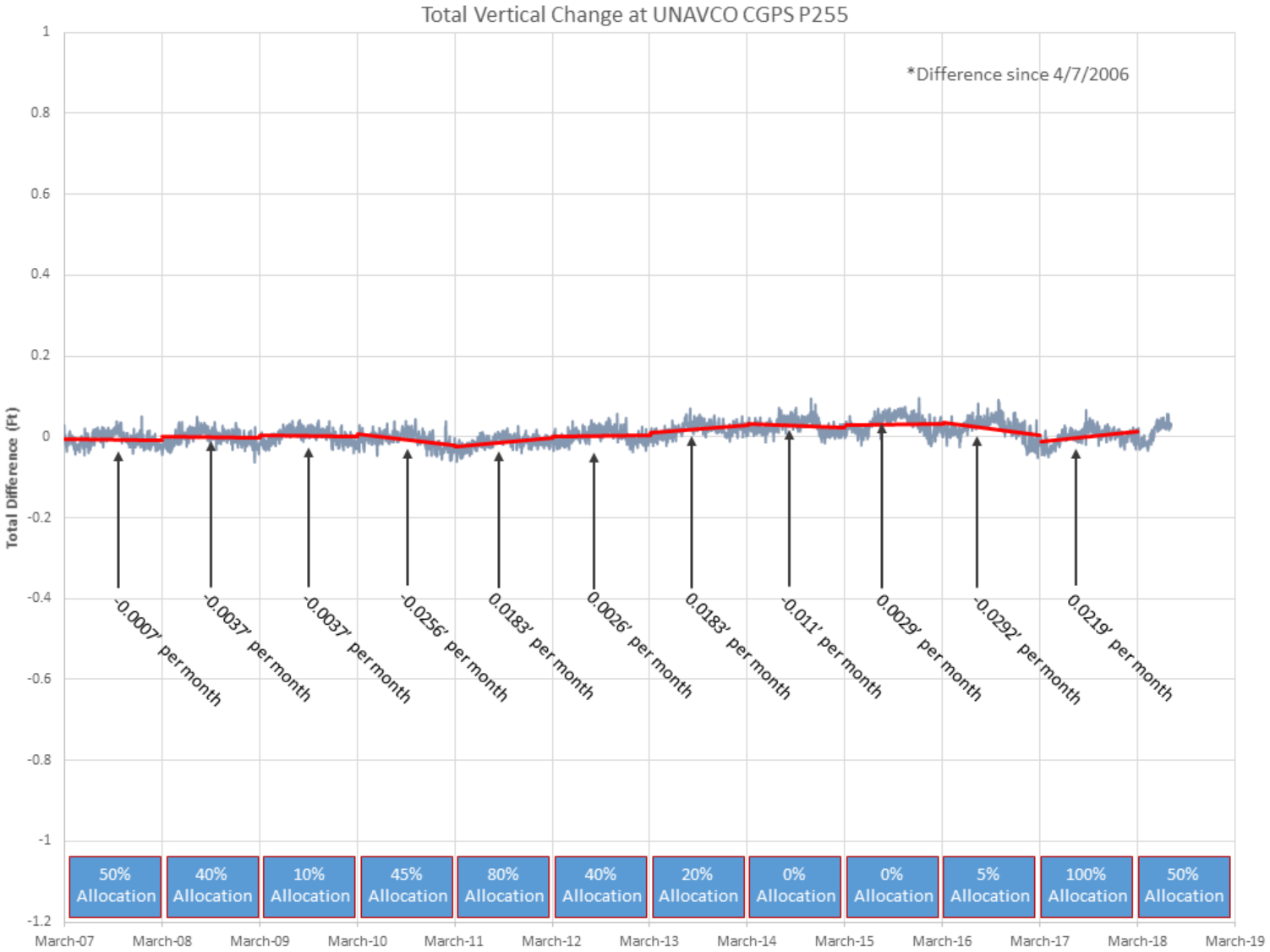


Figure CC-52: Vertical Elevation Change at UNAVCO CGPS P255, Spring 2007 to 2018

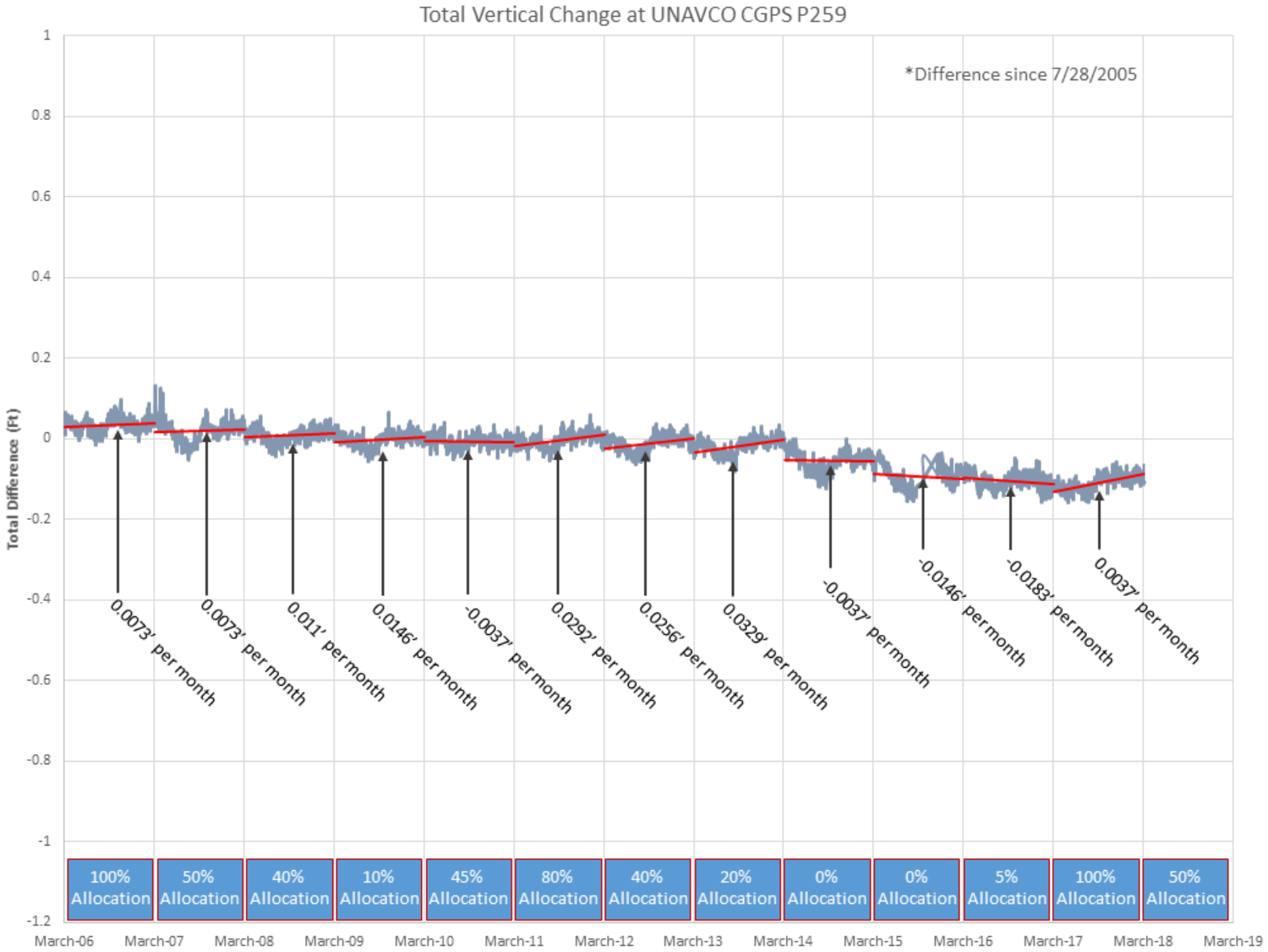


Figure CC-53: Vertical Elevation Change at UNAVCO CGPS P259, Spring 2006 to 2018

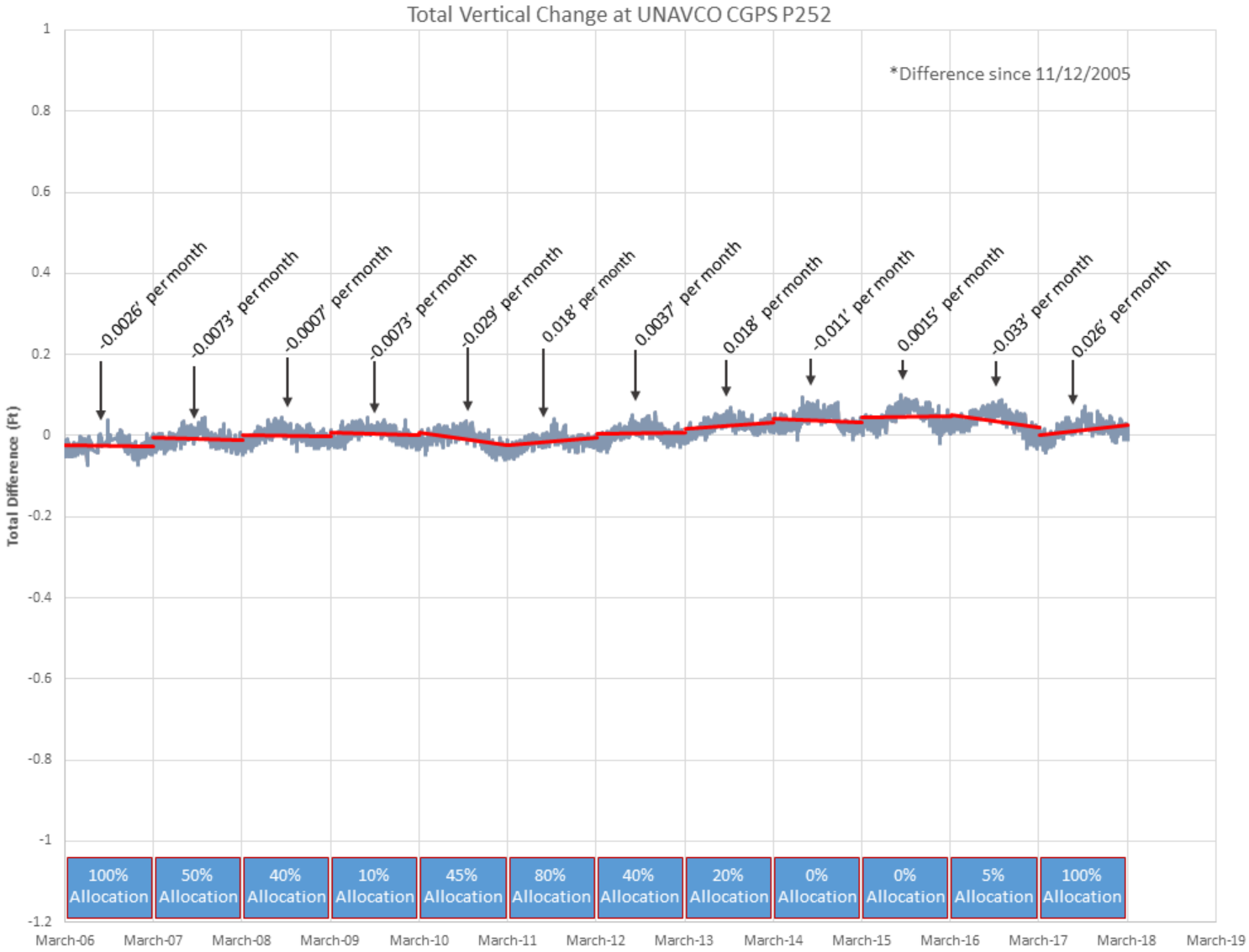


Figure CC-54: Vertical Elevation Change at UNAVCO CGPS P252, Spring 2006 to 2018

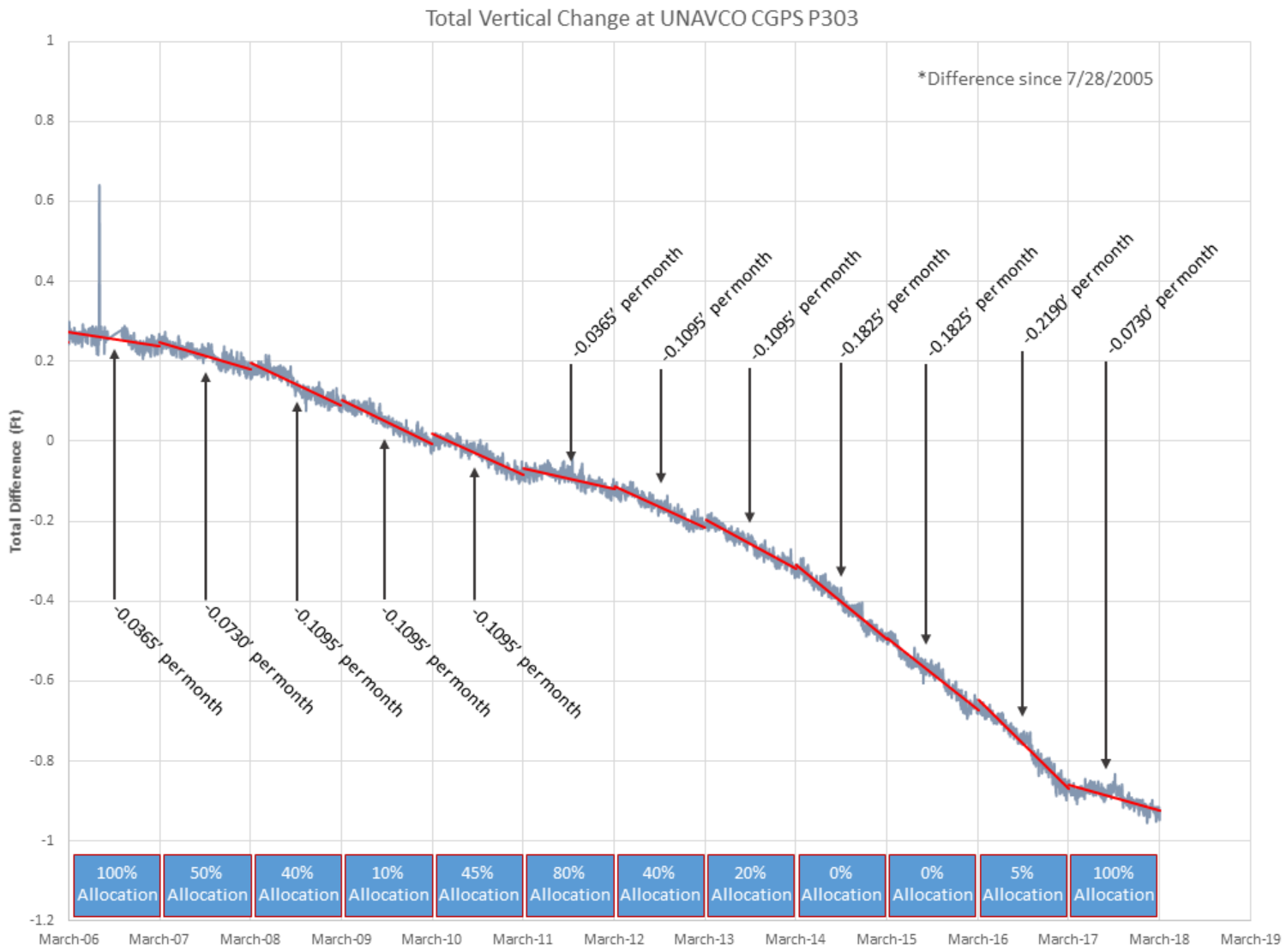


Figure CC-55: Vertical Elevation Change at UNAVCO CGPS P303, Spring 2006 to 2018

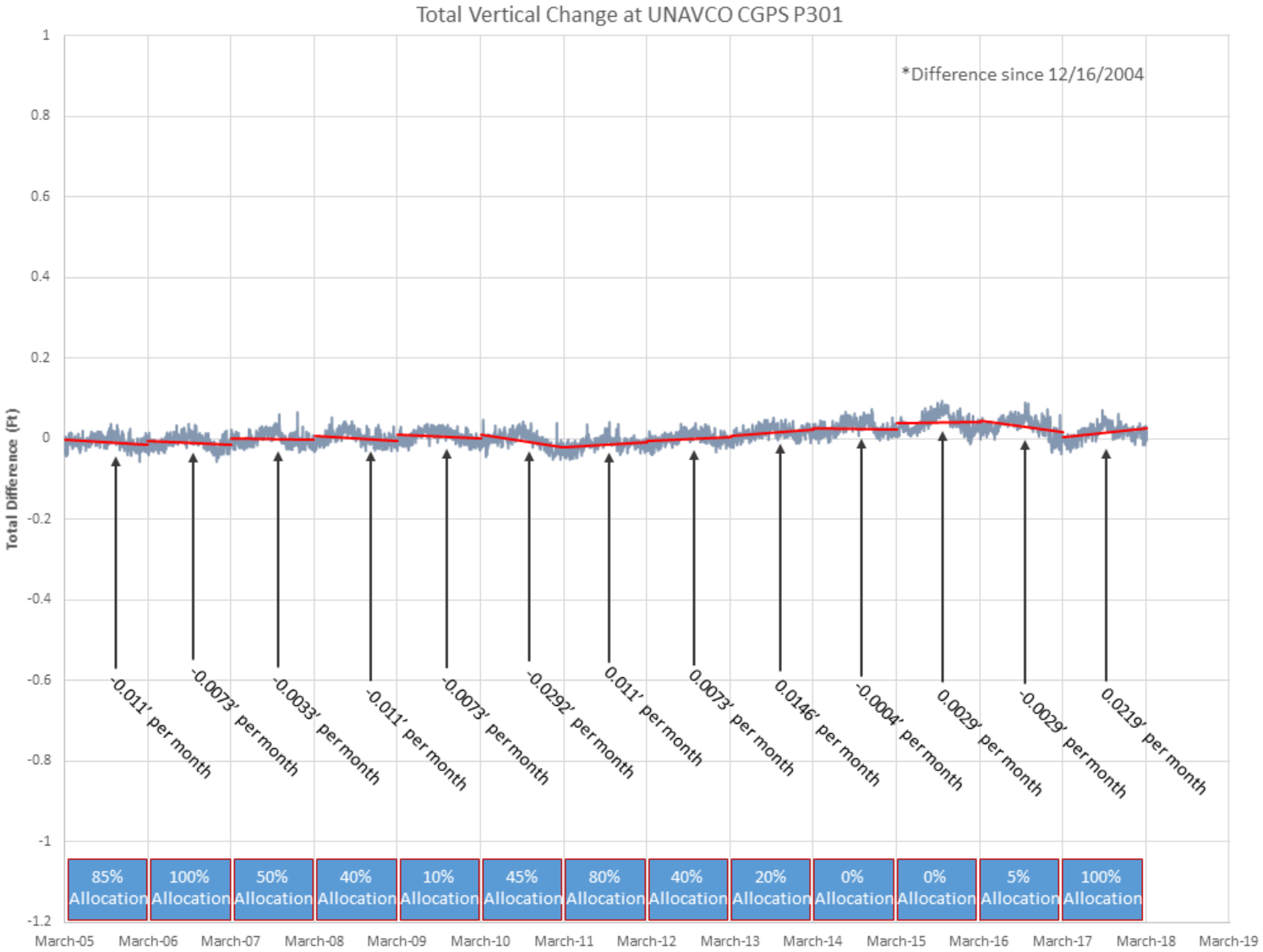


Figure CC-56: Vertical Elevation Change at UNAVCO CGPS P301, Spring 2005 to 2018

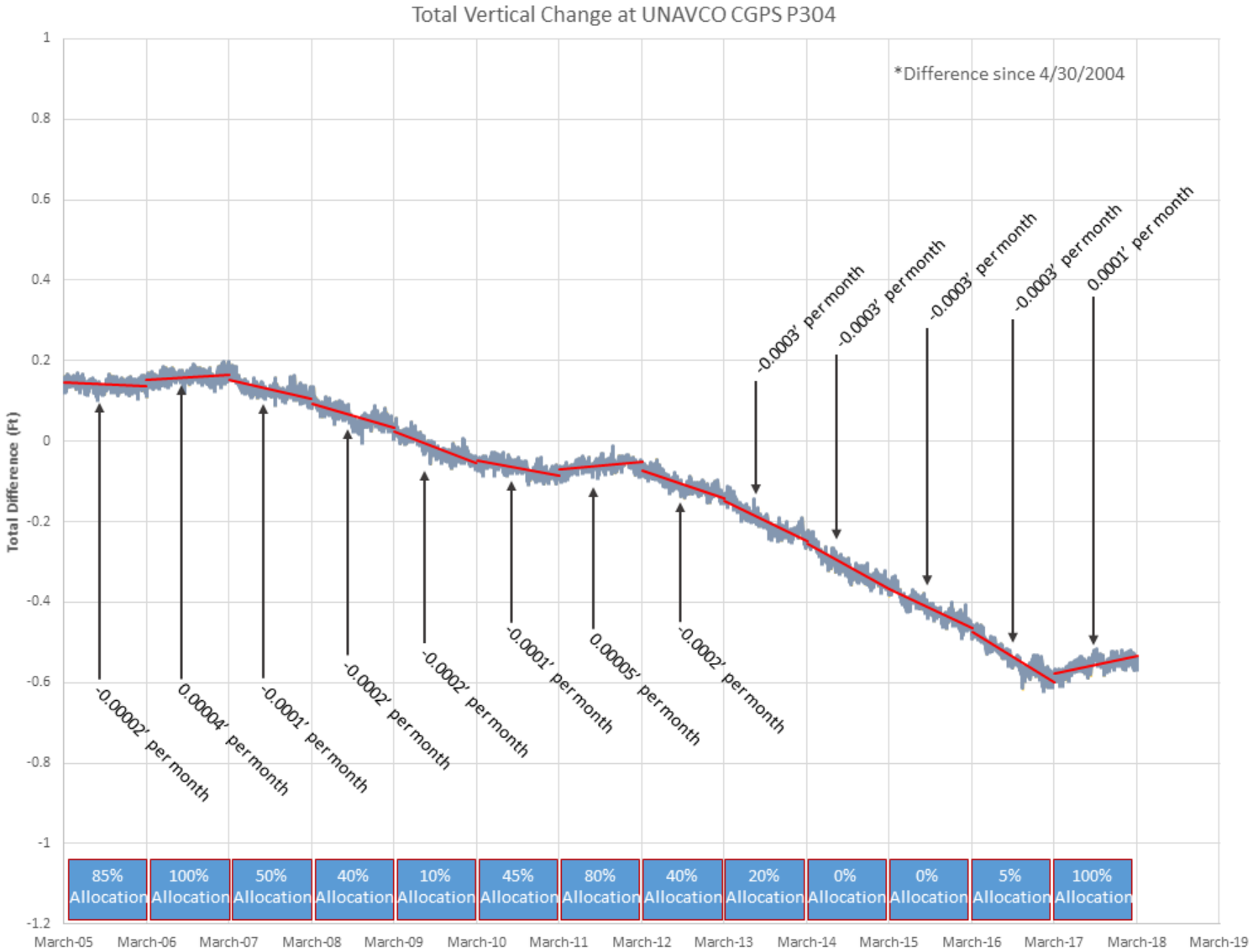


Figure CC-57: Vertical Elevation Change at UNAVCO CGPS P304, Spring 2005 to 2018

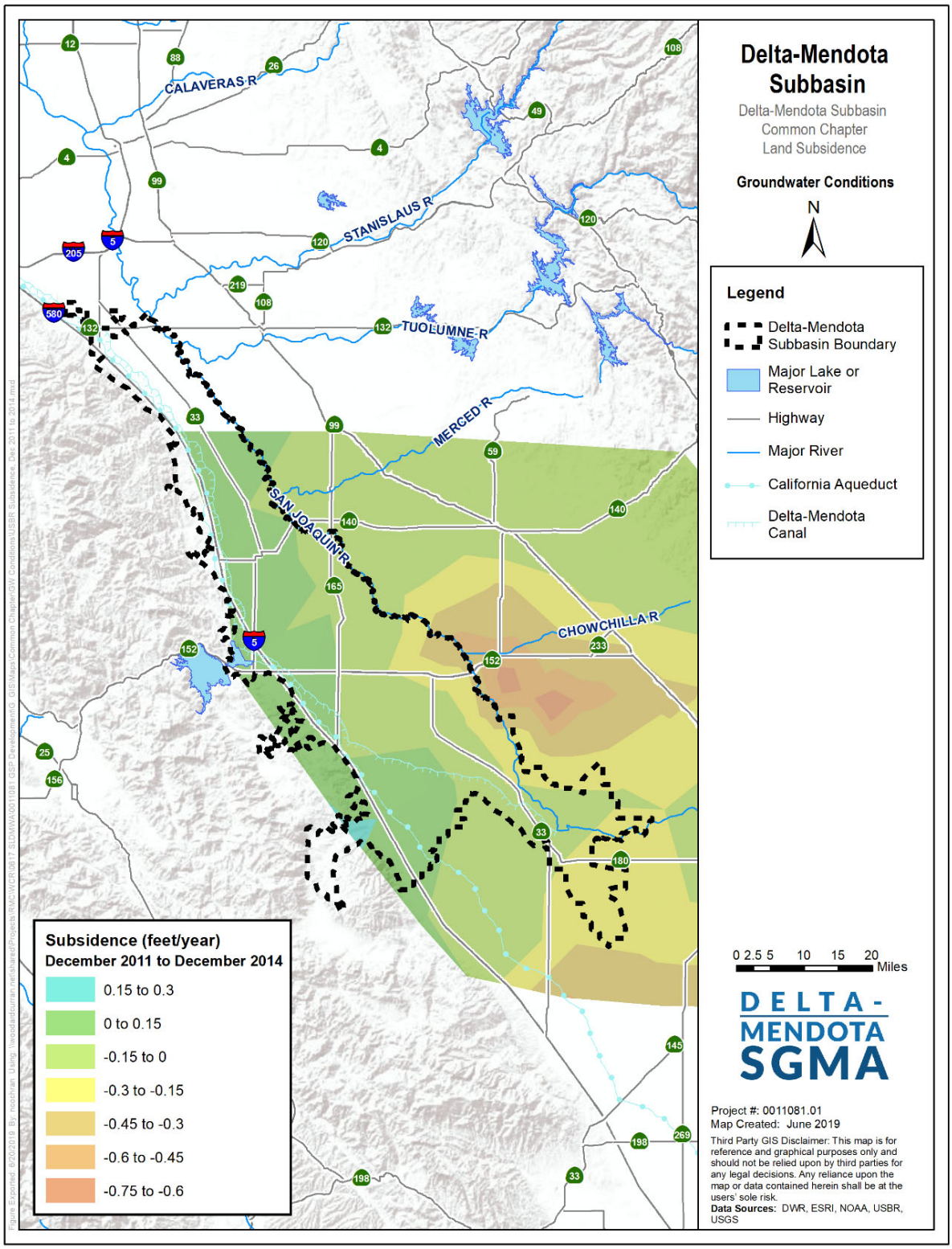


Figure CC-58: Land Subsidence, December 2011 to December 2014



Source: Progress Report: Subsidence in California, March 2015 – September 2016, Farr et. Al. JPL, 2017

Figure CC-59: Recent Land Subsidence at Key San Joaquin Valley Locations

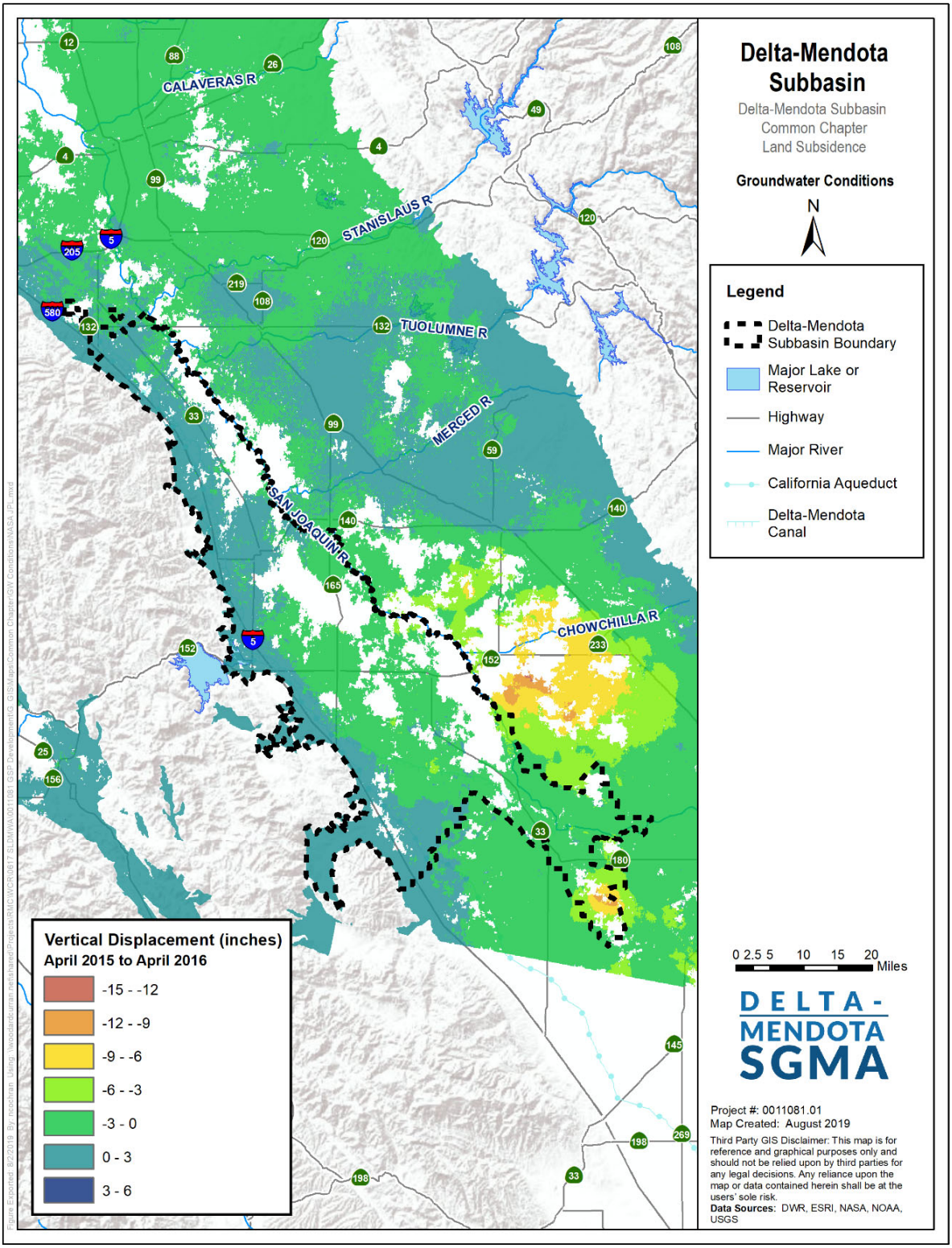


Figure CC-60: Vertical Displacement, April 2015 to April 2016

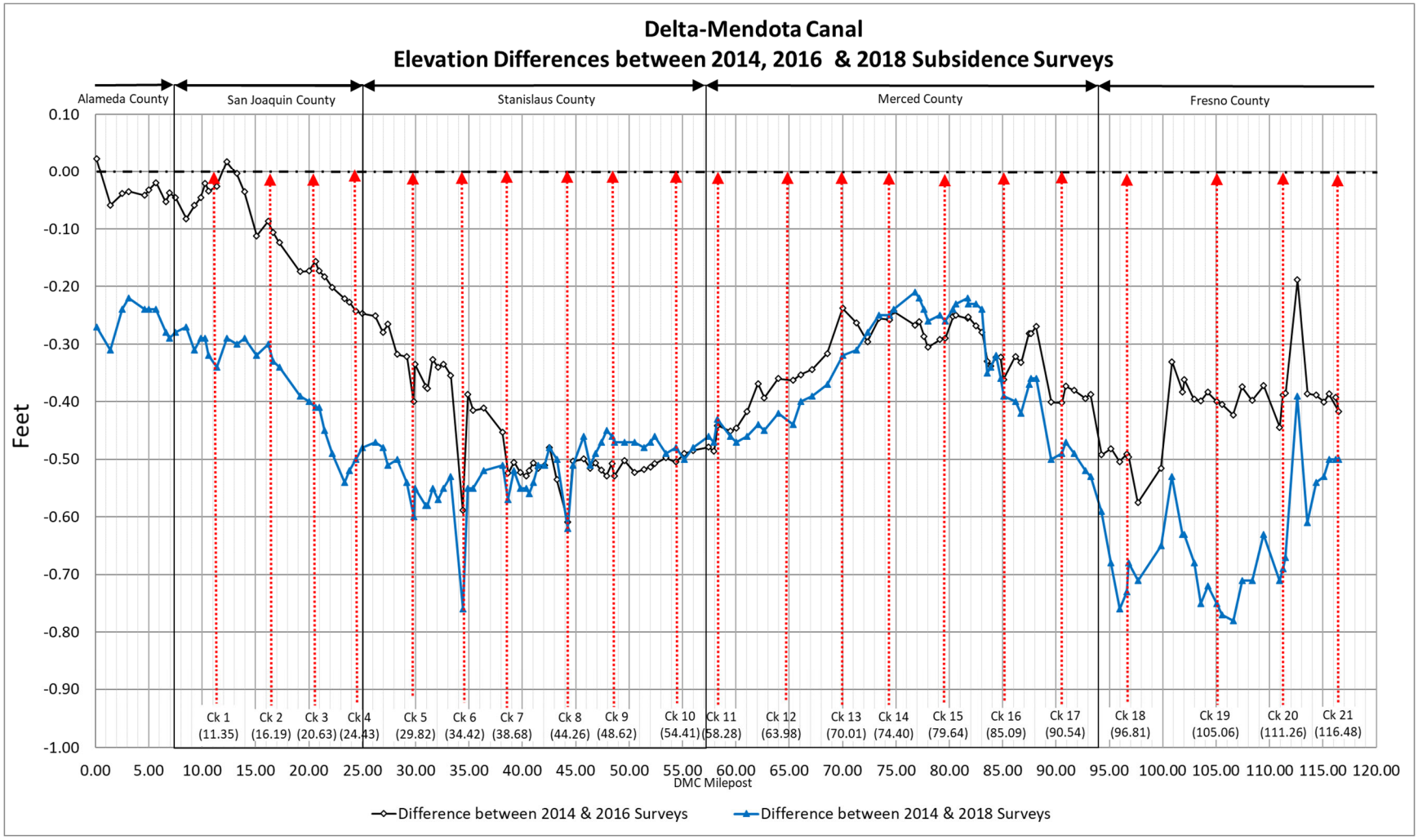


Figure CC-61: Elevation Change along the Delta-Mendota Canal, 2014 through 2018

4.2.7 Interconnected Surface Water Systems

Understanding the location, timing and magnitude of groundwater pumping impacts on interconnected surface water systems is important for the proper management of groundwater resources in order to minimize impacts on interconnected surface waters and the biological communities and permitted surface water diverters that rely on those resources. Historically, throughout the San Joaquin Valley, many interconnected stream reaches have transitioned from net-gaining to net-losing streams (TNC, 2014). Gaining streams occur when streamflows increase as a result of groundwater contribution and losing streams occur when streamflows decrease due to infiltration into the bed of the stream (McBain & Trush, Inc., 2002). Increased groundwater pumping has the ability to contribute to the depletion of interconnected waters with the nature, rate, and location of increased pumping being a function of distance to the river, as well as depth, timing, and rate of groundwater pumping.

Available Data

Two communities in the Delta-Mendota Subbasin are likely most vulnerable to the loss of interconnected surface water as a result of groundwater pumping: San Joaquin River surface water diverters and groundwater dependent ecosystems (GDEs). These communities represent the primary beneficial users of interconnected surface water and groundwater. Streams stemming from the west side of the Delta-Mendota Subbasin are ephemeral in nature, and only two of these creeks reach the San Joaquin River (Del Puerto Creek and Orestimba Creek). These creeks lose their flows to the underlying vadose zone (net-losing streams) and therefore do not represent areas of potential GDEs.

Groundwater dependent ecosystems are defined under Article 2 Definitions, § 351 Definitions of the GSP Emergency Regulations as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (2018) provided by DWR in conjunction with The Nature Conservancy (TNC) was initially used to identify GDEs within the Delta-Mendota Subbasin, following the associated guidance document provided by TNC (Rohde et al., 2018). Local verification efforts were conducted in the Delta-Mendota Subbasin by different GSA representatives to ground-truth GDEs based on local knowledge. Specifically, areas where natural communities have been urbanized or otherwise modified prior to 2015 were eliminated from the data set used to identify GDEs.

Identification of Interconnected Surface Water Systems

The San Joaquin River and Fresno Slough are the primary surface water bodies interconnected with Delta-Mendota Subbasin groundwater. For information about the sources used to determine the interconnected segments of the San Joaquin River and Fresno Slough within the Delta-Mendota Subbasin, refer to the individual GSPs.

Historic Conditions

The San Joaquin River and its tributaries drain approximately 13,500 mi^2 (measured at the USGS gaging station at Vernalis) along the western flank of the Sierra Nevada and eastern flank of the Coast Range, and flows northward into the Sacramento-San Joaquin Delta where it is joined by the Calaveras and Mokelumne Rivers before combining with the Sacramento River. Typical of Mediterranean climate catchments, river flows vary widely seasonally and from year to year. Three major tributaries join the San Joaquin from the east: the Merced, Tuolumne, and Stanislaus Rivers. Smaller tributaries include the Fresno River, Chowchilla River, Bear Creek, and Fresno Slough (from the Kings River). Precipitation is

predominantly snow above about 5,500 to 6,000 feet in the Sierra Nevada, with rain in the middle and lower elevations of the Sierra foothills and in the Coast Range. As a result, the natural hydrology historically reflected a mixed runoff regime dominated by winter-spring rainfall runoff and spring-summer snowmelt runoff. Most flow is derived from snowmelt from the Sierra Nevada, with relatively little runoff contributed from the western side of the drainage basin in the rain shadow of the Coast Range. The unimpaired average annual water yield (WY1906-2002) of the San Joaquin River, as measured immediately above Millerton Reservoir, is 1,801,000 acre-feet (USBR, 2002); the post-Friant Dam average annual water yield (WY 1950-2000) to the lower San Joaquin River is 695,500 acre-feet (USGS, 2000). As average precipitation decreases from north to south, the San Joaquin River basin (including the Stanislaus, Tuolumne, and Merced Rivers) contributes about 22% of the total runoff to the Delta (DWR, 1998).

Current Conditions

Historically, most of the San Joaquin River, which forms the great majority of the Delta-Mendota Subbasin's eastern border, was a gaining reach. Snowmelt runoff during the spring and early summer resulted in these conditions through a good portion of the year. However, significant decreases in groundwater elevations due to a myriad of factors, including pumping, tile drains, the channelizing of flood flows, and upstream diversions on the river, have reversed this condition so most reaches are now losing reaches. Some localized gaining reaches still remain on the lower river, such as between the Stanislaus and Merced Rivers; however, many reaches along these rivers (and along localized streams) may transition from gaining to losing depending on hydrology.

Estimates of Timing and Quantity of Depletions

Using available data and where feasible, each Delta-Mendota Subbasin GSP Group quantified the gains and/or losses from the groundwater at each interconnected reach of the San Joaquin River adjoining the Delta-Mendota Subbasin. **Table CC-6~~Table CC-6~~** summarizes these estimates. For more information about the sources or methods used to estimate the timing and quantity of depletions, refer to the individual GSPs.

Table CC-6: Estimated Quantity of Gains/Depletions for Interconnected Stream Reaches, San Joaquin River

Landmark		River Mile	GSP Group	Interconnected?	Gaining or Losing?	Quantity Gained/Loss (cfs)	Notes
REACH 1		*267.5 to 229.0*	Located outside the Delta-Mendota Subbasin				
A	Friant Dam	267.5					
	North Fork Road Bridge	266.8					
	Cobb Island Bridge	259.0					
	State Route 41 (Lanes Bridge)	255.2					
	Scout Island Bend	250.0					
	ATSF Railroad Bridge	245.0					
B	State Route 99	243.2					
	Southern Pacific Railroad	243.2					
	State Route 145 Bridge (Skaggs Bridge)	234.1					
	Gravelly Ford	229.0					
REACH 2		*229.0 to 204.8*					
A	Gravelly Ford	229.0		Yes	Losing when flowing		
	Upstream Limit of Right Bank Levee	227.0					
	Upstream Limit of Left Bank Levee	225.0					
B	Chowchilla Bypass Control Structure	216.1	Farmers Water District	Yes	Losing when flowing	-4	2003 to 2013 average. High in 2010 (-8 cfs), low in 2004 and 2009 (-1 cfs)
	Mendota Dam	204.8					
	Mendota Pool			Yes	Losing	-40	-29,000 AFY
REACH 3		*204.8 to 182.0*		Yes	Losing	-25	-18.000 AFY
	Mendota Dam	204.8					
	Avenue 7.5 Bridge (Firebaugh)	195.2					
	Sack Dam	182.0					
REACH 4		*182.0 to 135.8*				-~~5~~0 - 0	Losses when wet; gaining in some areas (but unquantifiable)
A	Sack Dam	182.0		Y~~e~~s - first 2 miles ~~N~~o - next 1.5 miles Y~~e~~s - remaining miles	Losing		
	State Route 152 Bridge	173.9		Yes	Gaining		
B	Sand Slough Control Structure	168.5					
	Mariposa Slough Control Structure	168.4					
	Turner Island Road Bridge	157.2					

Landmark	River Mile	GSP Group	Interconnected?	Gaining or Losing?	Quantity Gained/Loss (cfs)	Notes
Mariposa Bypass confluence	147.2					
Bear Creek/Eastside Bypass confluence	135.8					
REACH 5	*135.8 to 118.0*		Yes	Gaining	unquantifiable	Likely gaining from ag/refuge draining but unquantifiable
Bear Creek/Eastside Bypass confluence	135.8					
State Route 165 Bridge (Lander Avenue)	132.9					
Salt Slough con fluence	127.7					
State Route 140 Bridge (Fremont Ford)	125.1					
Mud Slough confluence	121.2					
Merced River confluence (Hills Ferry Bridge)	118.0					
Newman to Crows Landing		Northern & Central Delta-Mendota	Yes	Gaining	50	50
Crows Landing to Patterson		Northern & Central Delta-Mendota Region	Yes	Gaining	-50 to 200	-50 to 200
Patterson to Vernalis		Northern & Central Delta-Mendota Region	Yes	Gaining	190	6.1 cfs/mi for 30.8 miles. Based on Cooley, W. 2001. *Groundwater flow net analysis for lower San Joaquin River Basin.* Memo to CRWQCB, August 8, 2001

Groundwater Dependent Ecosystems

A groundwater dependent ecosystem (GDE) is defined under the GSP Emergency Regulations as referring "to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (§351(m)). Under §354.16(g) of the GSP Emergency Regulations, each Plan is required to identify GDEs within the subbasin utilizing data provided by DWR or the best available information. The following section describes the process for verifying GDEs within the Delta-Mendota Subbasin and the location of verified and potential GDEs.

The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (2018c) provided by DWR was used in conjunction with information provided by The Nature Conservancy (TNC) to identify GDEs within the Delta-Mendota Subbasin. To further screen available information regarding GDEs, each GSP Group developed individualized criteria. Additional details regarding the screening process implemented by each GSP can be found in the individual GSPs.

Based on the screening process implemented by each individual GSP Group, GDE polygons determined not to be GDEs were removed from the mapping. **Figure CC-62~~Figure CC-62~~** and **Figure CC-63~~Figure CC-63~~** summarize the results of the GDE analysis for the Subbasin. Results are compiled into two habitat classes: wetlands (**Figure CC-62~~Figure CC-62~~**) and vegetation (**Figure CC-63~~Figure CC-63~~**). Wetland features are commonly associated with surface expression of groundwater under natural, unmodified conditions. Vegetation feature types are commonly associated with the sub-surface presence of groundwater (phreatophytes – deep rooted plants). Confirmed GDEs have been grouped into larger polygons based on proximity and aquifer connection.

In general, identified Possible GDEs are primarily located along the San Joaquin River corridor, within the northern portion of the Northern & Central Delta-Mendota Region GSP, the SJREC GSP, the Grassland GSP, and the Fresno GSP Plan Areas, where some possible GDEs have been identified along ephemeral streams that originate from the Coast Range. Table CC-7~~Table CC-7~~ includes all freshwater species within the Delta-Mendota Subbasin as identified by TNC (2018). Per TNC data, these species (listed in Table CC-7~~Table CC-7~~) have either been observed or have the potential to exist within the Delta-Mendota Subbasin; however, the actual presence of these species have not been verified. As a result of the identification of Possible GDEs for the purpose of SGMA, no land use protections for GDEs are conveyed unless otherwise required. Additionally, the Delta Mendota Subbasin recognizes the opportunity to present further-refined GDE delineations in the subsequent GSP Updates.

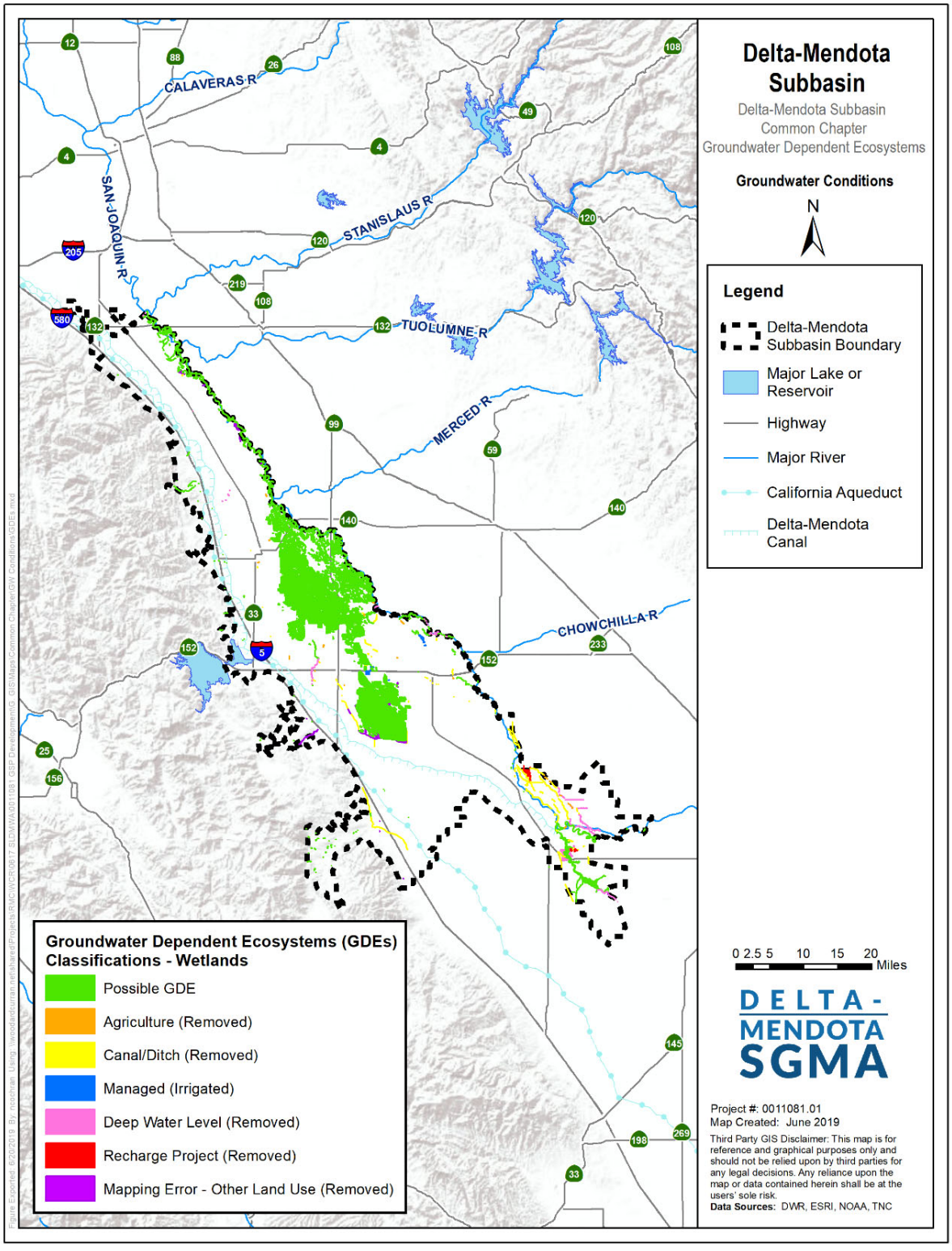


Figure CC-62: Groundwater Dependent Ecosystems, Wetlands

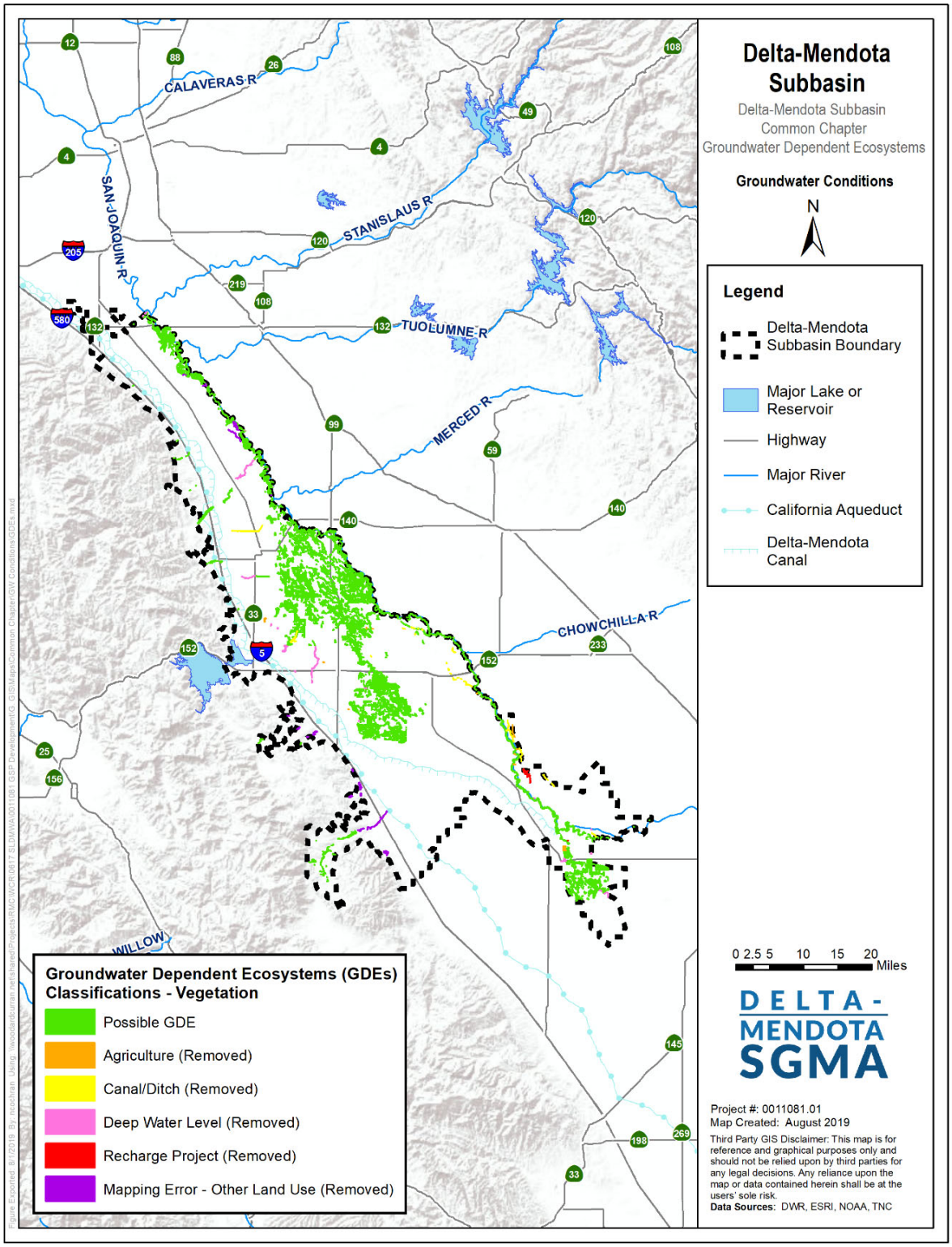


Figure CC-63: Groundwater Dependent Ecosystems, Vegetation

Table CC-7: List of Potential Freshwater Species

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Actitis macularius	Spotted Sandpiper	Birds		
Aechmophorus clarkii	~~Clark's~~Clark's Grebe	Birds		
Aechmophorus occidentalis	Western Grebe	Birds		
Agelaius tricolor	Tricolored Blackbird	Birds	Bird of Conservation Concern	Special Concern
Aix sponsa	Wood Duck	Birds		
Anas acuta	Northern Pintail	Birds		
Anas americana	American Wigeon	Birds		
Anas clypeata	Northern Shoveler	Birds		
Anas crecca	Green-winged Teal	Birds		
Anas cyanoptera	Cinnamon Teal	Birds		
Anas discors	Blue-winged Teal	Birds		
Anas platyrhynchos	Mallard	Birds		
Anas strepera	Gadwall	Birds		-
Anser albifrons	Greater White-fronted Goose	Birds		
Ardea alba	Great Egret	Birds		
Ardea herodias	Great Blue Heron	Birds		
Aythya affinis	Lesser Scaup	Birds		
Aythya americana	Redhead	Birds		Special Concern
Aythya collaris	Ring-necked Duck	Birds		
Aythya marila	Greater Scaup	Birds		
Aythya valisineria	Canvasback	Birds		Special
Botaurus lentiginosus	American Bittern	Birds		
Bucephala albeola	Bufflehead	Birds		
Bucephala clangula	Common Goldeneye	Birds		
Butorides virescens	Green Heron	Birds		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Calidris alpina	Dunlin	Birds		
Calidris mauri	Western Sandpiper	Birds		
Calidris minutilla	Least Sandpiper	Birds		
Chen caerulescens	Snow Goose	Birds		
Chen rossii	Ross's Goose	Birds		
Chlidonias niger	Black Tern	Birds		Special Concern
Chroicocephalus philadelphia	Bonaparte's Gull	Birds		
Cistothorus palustris	Marsh Wren	Birds		
Cygnus columbianus	Tundra Swan	Birds		
Cypseloides niger	Black Swift	Birds	Bird of Conservation Concern	Special Concern
Dendrocygna bicolor	Fulvous Whistling-Duck	Birds		Special Concern
Egretta thula	Snowy Egret	Birds		
Empidonax traillii	Willow Flycatcher	Birds	Bird of Conservation Concern	Endangered
Fulica americana	American Coot	Birds		
Gallinago delicata	Wilson's Snipe	Birds		
Gallinula chloropus	Common Moorhen	Birds		
Geothlypis trichas	Common Yellowthroat	Birds		
Grus canadensis	Sandhill Crane	Birds		
Haliaeetus leucocephalus	Bald Eagle	Birds	Bird of Conservation Concern	Endangered
Himantopus mexicanus	Black-necked Stilt	Birds		
Icteria virens	Yellow-breasted Chat	Birds		Special Concern
Limnodromus scolopaceus	Long-billed Dowitcher	Birds		
Lophodytes cucullatus	Hooded Merganser	Birds		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Megaceryle alcyon	Belted Kingfisher	Birds		
Mergus merganser	Common Merganser	Birds		
Mergus serrator	Red-breasted Merganser	Birds		
Numenius americanus	Long-billed Curlew	Birds		
Numenius phaeopus	Whimbrel	Birds		
Nycticorax ~~nycticorax~~	Black-crowned Night-Heron	Birds		
Oxyura jamaicensis	Ruddy Duck	Birds		
Pandion haliaetus	Osprey	Birds		Watch list
Pelecanus erythrorhynchos	American White Pelican	Birds		Special Concern
Phalacrocorax auritus	Double-crested Cormorant	Birds		
Phalaropus tricolor	Wilson's Phalarope	Birds		
Plegadis chihi	White-faced Ibis	Birds		Watch list
Pluvialis squatarola	Black-bellied Plover	Birds		
Podiceps nigricollis	Eared Grebe	Birds		
Podilymbus podiceps	Pied-billed Grebe	Birds		
Porzana carolina	Sora	Birds		
Rallus limicola	Virginia Rail	Birds		
Recurvirostra americana	American Avocet	Birds		
Riparia ~~riparia~~	Bank Swallow	Birds		Threatened
Setophaga petechia	Yellow Warbler	Birds		
Tachycineta bicolor	Tree Swallow	Birds		
Tringa melanoleuca	Greater Yellowlegs	Birds		
Tringa semipalmata	Willet	Birds		
Tringa solitaria	Solitary Sandpiper	Birds		
Vireo bellii	Bell's Vireo	Birds		
Vireo bellii pusillus	Least Bell's Vireo	Birds	Endangered	Endangered

	Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
	Xanthocephalus ~~xanthocephalus~~	Yellow-headed Blackbird	Birds		Special Concern
	Artemia franciscana	San Francisco Brine Shrimp	Crustaceans		
	Branchinecta conservatio	Conservancy Fairy Shrimp	Crustaceans	Endangered	Special
	Branchinecta lindahli	Versatile Fairy Shrimp	Crustaceans		
	Branchinecta longiantenna	Longhorn Fairy Shrimp	Crustaceans	Endangered	Special
	Branchinecta lynchi	Vernal Pool Fairy Shrimp	Crustaceans	Threatened	Special
	Lepidurus packardi	Vernal Pool Tadpole Shrimp	Crustaceans	Endangered	Special
	Linderiella occidentalis	California Fairy Shrimp	Crustaceans		Special
Oncorhynchus mykis~~s~~ - CV	Central Valley steelhead	Fishes	Threatened	Special	
	Oncorhynchus mykiss irideus	Coastal rainbow trout	Fishes		
	Pogonichthys macrolepidotus	Sacramento splittail	Fishes		Special Concern
	Actinemys marmorata	Western Pond Turtle	Herps		Special Concern
	Ambystoma californiense	California Tiger Salamander	Herps	Threatened	Threatened
	Anaxyrus boreas	Boreal Toad	Herps		
	Pseudacris regilla	Northern Pacific Chorus Frog	Herps		
	Rana boylii	Foothill Yellow-legged Frog	Herps	Under Review in the Candidate or Petition Process	Special Concern
	Rana draytonii	California Red-legged Frog	Herps	Threatened	Special Concern

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Spea hammondii	Western Spadefoot	Herps	Under Review in the Candidate or Petition Process	Special Concern
Thamnophis atratus	Santa Cruz Gartersnake	Herps		
Thamnophis elegans	Mountain Gartersnake	Herps		
Thamnophis gigas	Giant Gartersnake	Herps	Threatened	Threatened
Thamnophis hammondii	Two-striped Gartersnake	Herps		Special Concern
Thamnophis sirtalis	Common Gartersnake	Herps		
Aeshnidae fam.	Aeshnidae fam.	Insects & other inverts		
Anax junius	Common Green Darner	Insects & other inverts		
Brillia spp.	Brillia spp.	Insects & other inverts		
Callicorixa spp.	Callicorixa spp.	Insects & other inverts		
Capnia hitchcocki	Arroyo Snowfly	Insects & other inverts		
Chironomus spp.	Chironomus spp.	Insects & other inverts		
Coenagrionidae fam.	Coenagrionidae fam.	Insects & other inverts		
Corisella spp.	Corisella spp.	Insects & other inverts		
Cricotopus spp.	Cricotopus spp.	Insects & other inverts		
Ischnura cervula	Pacific Forktail	Insects & other inverts		
Ischnura denticollis	Black-fronted Forktail	Insects & other inverts		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Mesocapnia bulbosa	Bulbous Snowfly	Insects & other inverts		
Paraleptophlebia associata	A Mayfly	Insects & other inverts		
Paratanytarsus spp.	Paratanytarsus spp.	Insects & other inverts		
Phaenopsectra spp.	Phaenopsectra spp.	Insects & other inverts		
Procladius spp.	Procladius spp.	Insects & other inverts		
Psectrocladius spp.	Psectrocladius spp.	Insects & other inverts		
Tanypus spp.	Tanypus spp.	Insects & other inverts		
Tipulidae fam.	Tipulidae fam.	Insects & other inverts		
Trichocorixa spp.	Trichocorixa spp.	Insects & other inverts		
Castor canadensis	American Beaver	Mammals		
Lontra canadensis	North American River Otter	Mammals		
Neovison vison	American Mink	Mammals		
Ondatra zibethicus	Common Muskrat	Mammals		
Anodonta californiensis	California Floater	Mollusks		Special
Margaritifera falcata	Western Pearlshell	Mollusks		Special
Pyrgulopsis diablensis	Diablo Range Pyrg	Mollusks		Special
Alopecurus saccatus	Pacific Foxtail	Plants		
Ammannia coccinea	Scarlet Ammannia	Plants		
Anemopsis californica	Yerba Mansa	Plants		
Arundo donax	NA	Plants		
Azolla filiculoides	NA	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Azolla microphylla	Mexican mosquito fern	Plants		Special
Baccharis salicina		Plants		
Bacopa eisenii	Gila River Water-hyssop	Plants		
Bidens laevis	Smooth Bur-marigold	Plants		
Bolboschoenus glaucus	NA	Plants		
Bolboschoenus maritimus paludosus	NA	Plants		
Callitriche marginata	Winged Water-starwort	Plants		
Ceratophyllum demersum	Common Hornwort	Plants		
Chloropyresclle hispidum		Plants		Special
Chloropyron palmatum	NA	Plants	Endangered	Special
Cotula coronopifolia	NA	Plants		
Crassula aquatica	Water Pygmyweed	Plants		
Crypsis vaginiflora	NA	Plants		
Cyperus erythrorhizos	Red-root Flatsedge	Plants		
Cyperus squarrosus	Awned Cyperus	Plants		
Downingia bella	Hoover's Downingia	Plants		
Downingia pulchella	Flat-face Downingia	Plants		
Echinodorus berteroi	Upright Burhead	Plants		
Elatine brachysperma	Shortseed Waterwort	Plants		
Elatine californica	California Waterwort	Plants		
Eleocharis acicularis	Least Spikerush	Plants		
Eleocharis atropurpurea	Purple Spikerush	Plants		
Eleocharis coloradoensis		Plants		
Eleocharis macrostachya	Creeping Spikerush	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Eleocharis montevidensis	Sand Spikerush	Plants		
Eleocharis quadrangulata	NA	Plants		
Elodea canadensis	Broad Waterweed	Plants		
Epilobium cleistogamum	Cleistogamous Spike-primrose	Plants		
Eragrostis hypnoides	Teal Lovegrass	Plants		
Eryngium castrense	Great Valley Eryngo	Plants		
Eryngium racemosum	Delta Coyote-thistle	Plants		Endangered
Eryngium spinosepalum	Spiny Sepaled Coyote-thistle	Plants		Special
Eryngium vaseyi vallicola		Plants		
Eryngium vaseyi	Vasey's Coyote-thistle	Plants		
Euthamia occidentalis	Western Fragrant Goldenrod	Plants		
Hydrocotyle verticillata	Whorled Marsh-pennywort	Plants		
Juncus acuminatus	Sharp-fruit Rush	Plants		
Juncus xiphioides	Iris-leaf Rush	Plants		
Lasthenia ferrisiae	Ferris'' Goldfields	Plants		Special
Lasthenia fremontii	Fremont's Goldfields	Plants		
Lemna aequinoctialis	Lesser Duckweed	Plants		
Lemna gibba	Inflated Duckweed	Plants		
Lemna minor	Lesser Duckweed	Plants		
Lepidium jaredii	Jared's Pepper-grass	Plants		Special
Lepidium oxycarpum	Sharp-pod Pepper-grass	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Limnanthes douglasii	Douglas'' Meadowfoam	Plants		
Limosella acaulis	Southern Mudwort	Plants		
Lipocarpha micrantha	Dwarf Bulrush	Plants		
Ludwigia peploides	NA	Plants		
Ludwigia repens	Creeping Seedbox	Plants		
Lythrum californicum	California Loosestrife	Plants		
Marsilea vestita	NA	Plants		
Mimulus cardinalis	Scarlet Monkeyflower	Plants		
Mimulus guttatus	Common Large Monkeyflower	Plants		
Montia fontana	Fountain Miner's-lettuce	Plants		
Myosurus minimus	NA	Plants		
Myosurus sessilis	Sessile Mousetail	Plants		
Myriophyllum aquaticum	NA	Plants		
Najas guadalupensis	Southern Naiad	Plants		
Navarretia heterandra	Tehama Navarretia	Plants		
Navarretia leucocephala	White-flower Navarretia	Plants		
Navarretia prostrata	Prostrate Navarretia	Plants		Special
Neostapfia colusana	Colusa Grass	Plants	Threatened	Endangered
Panicum dichotomiflorum	NA	Plants		
Paspalum distichum	Joint Paspalum	Plants		
Persicaria hydropiperoides		Plants		
Persicaria lapathifolia		Plants		
Persicaria maculosa	NA	Plants		
Persicaria pensylvanica	NA	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Phacelia distans	NA	Plants		
Phyla lanceolata	Fog-fruit	Plants		
Phyla nodiflora	Common Frog-fruit	Plants		
Pilularia americana	NA	Plants		
Plagiobothrys acanthocarpus	Adobe Popcorn-flower	Plants		
Plagiobothrys greenei	Greene's Popcorn-flower	Plants		
Plagiobothrys humistratus	Dwarf Popcorn-flower	Plants		
Plagiobothrys leptocladus	Alkali Popcorn-flower	Plants		
Plantago elongata	Slender Plantain	Plants		
Pluchea odorata	Scented Conyza	Plants		
Pogogyne douglasii	NA	Plants		
Pogogyne zizyphoroides		Plants		
Potamogeton diversifolius	Water-thread Pondweed	Plants		
Potamogeton foliosus	Leafy Pondweed	Plants		
Potamogeton nodosus	Longleaf Pondweed	Plants		
Potamogeton pusillus	Slender Pondweed	Plants		
Psilocarphus brevissimus	Dwarf Woolly-heads	Plants		
Psilocarphus oregonus	Oregon Woolly-heads	Plants		
Psilocarphus tenellus	NA	Plants		
Puccinellia simplex	Little Alkali Grass	Plants		
Ranunculus sceleratus	NA	Plants		
Rorippa curvisiliqua	Curve-pod Yellowcress	Plants		
Rorippa palustris	Bog Yellowcress	Plants		

Scientific Name	Common Name	Group	Federal Protection Status	State Protection Status
Rotala ramosior	Toothcup	Plants		
Ruppia cirrhosa	Widgeon-grass	Plants		
Ruppia maritima	Ditch-grass	Plants		
Sagittaria longiloba	Longbarb Arrowhead	Plants		
Sagittaria montevidensis calycina		Plants		
Salix exigua	Narrowleaf Willow	Plants		
Salix gooddingii	Goodding's Willow	Plants		
Schoenoplectus acutus occidentalis	Hardstem Bulrush	Plants		
Schoenoplectus americanus	Three-square Bulrush	Plants		
Sinapis alba	NA	Plants		
Sparganium eurycarpum		Plants		
Stuckenia pectinata		Plants		
Typha domingensis	Southern Cattail	Plants		
Typha latifolia	Broadleaf Cattail	Plants		
Veronica americana	American Speedwell	Plants		
Wolffiella lingulata	Tongue Bogmat	Plants		
Zannichellia palustris	Horned Pondweed	Plants		

Source: The Nature Conservancy (TNC). 2018. Identifying Environmental Surface Water Use~~r~~s - Freshwater Species List for Each Groundwater Basin dataset. https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

4.2.8 Data Gaps

The Delta-Mendota Subbasin is an extensive subbasin covering a large area extending along the northwestern end of the San Joaquin Valley. While there is a significant amount of data available regarding various groundwater-related aspects of the Subbasin, much is still not known in multiple locations around the Subbasin. To this end, the following data gaps have been identified and will be addressed as part of the interim period between adoption of this GSP and its first 5-year update.

- Information regarding subsidence varies in extent around the region. While there is a large amount of land elevation survey data available in association with the DMC and the San Joaquin River Restoration Program, other areas in the Delta-Mendota Subbasin require additional data collection to both further establish and monitor future land subsidence rates.

- Only three shallow groundwater wells exist proximate to the northern end of the San Joaquin River (outside of the area being addressed by the San Joaquin River Restoration Program). Additional nested or clustered monitoring wells are required adjacent to the river on the northern end of the Subbasin to evaluate horizontal and vertical groundwater gradients, and in connection with river stage monitoring, to assess the interconnection between the San Joaquin River and the northeastern end of the Delta-Mendota Subbasin.

- There are a large number of wells in the Delta-Mendota Subbasin where no well construction information exists or is readily available. Video surveys and other surveys should be conducted on selected wells that may potentially be added to the Subbasin monitoring network to (1) identify where the wells are screened, and (2) determine if the well(s) are appropriate as additions to the GSP Groups' groundwater monitoring programs.

- Mapping of GDEs in the Delta-Mendota Subbasin, as contained in this Common Chapter, is an initial assessment of their location. This mapping may be refined using most recent groundwater elevation/depth to water contour mapping.

- Monitoring networks contained herein are preliminary and were formulated based on existing well information. As additional wells are installed in the Subbasin and additional well construction information is obtained for existing wells, these networks may need to be refined to improve on the spatial (areal and vertical) distribution of monitoring points and the data collected for evaluation of conditions of the groundwater basin.

- The sustainable yield estimates and water budgets contained in this Common Chapter for both the Upper and Lower Aquifers were developed using limited data. As additional data are collected over the first five years, improved sustainable yield estimates and estimates of water in storage in both principle aquifers should be prepared utilizing the new data.

In addition to these Subbasin-level data gaps, additional data gaps have been identified for each GSP Plan Area. Please see the individual GSPs for additional identified data gaps.

4.3 Delta-Mendota Subbasin Water Budgets

This section describes the common coordinated assumptions agreed upon and utilized by each GSP Group in the Delta-Mendota Subbasin in developing the historical, current, and projected water budgets for their respective GSP Plan Areas. These coordinated historical, current, and projected water budgets

were then compiled to prepare the subbasin-level water budgets required under the GSP Regulations § 357.4(b)(3)(B), presented below. The sustainable yield for the Upper Aquifer and Lower Aquifer developed at the Subbasin-level and agreed upon by all GSP Groups in the Delta-Mendota Subbasin is also presented along with a description as to how the sustainable yield for each primary aquifer was calculated.

4.3.1 Coordinated Assumptions

All common coordinated assumptions agreed upon and utilized by each GSP Group in preparing their respective historical, current, and projected water budgets are presented in Technical Memoranda 3 (*Assumptions for the Historical, Current, and Projected Water Budgets of the Delta-Mendota Subbasin*), which is included in **Appendix B** of this Common Chapter.

The data and methodologies used to develop the water budgets in the six individual GSPs (and compiled herein as the Subbasin Water Budgets) were coordinated with the express objective to "rely on the best available information and best available science to quantify the water budget for the basin" (Title 23 of the California Code of Regulations [23 CCR] § 354.18(e)). Given the complex nature of the Subbasin, different data sets and methodologies were appropriate for and/or available in different portions of the Subbasin. As such, a significant effort was made by the Subbasin GSAs to: (1) identify the different sources and accuracy of the available data; (2) consolidate these data and associated methodologies into a general hierarchy for use by the GSAs to honor the local conditions, while maintaining consistency with the intent of 23 CCR § 354.18(e); and (3) standardize the terminology for purposes of the Common Chapter presentation of the Subbasin Water Budget. These standardized water budget components and data sources are presented in **Table CC-8** and **Table CC-9** for the historic and current, and projected water budgets, respectively, and are further described below, while acknowledging that significant additional detail is presented in the six underlying GSPs. In some cases, data were not available or applicable, as acknowledged below and in the tables. Additionally, in some cases the specific terminology and/or the details of the calculations included in each underlying GSP remains unique relative to the standardized terminology and descriptions presented below; a full reconciliation of water budget nomenclature will be conducted as part of the 2025 GSP updates, as well as updates to the datasets and methodologies employed. Water use in the Subbasin is largely for agricultural purposes, with local municipal and industrial (M&I) uses. As appropriate, these M&I uses were quantified and incorporated in the individual GSP water budgets.

LAND SURFACE WATER BUDGET

The data sources/methodologies used to estimate the six major components of the Historical and Current Land Surface Water Budgets are summarized in **Table CC-8** and for the Projected Land Surface Water Budgets in **Table CC-9**. A general description of each component and the data hierarchy that was applied by the GSAs is provided below, with further detail provided in the Water Budget sections of the six underlying GSPs. For purposes of the Subbasin GSPs, the Historical and Current Water Budgets represent Water Year (WY) 2003-2013, where the historical period is WY 2003-2012 and the current year is WY 2013. The Projected Water Budgets reflect projected conditions through 2070[1] and consider the impacts

[1] The Subbasin GSAs agreed to use actual data from WYs 2014-2017 and assume a repeat of the historical hydrology for the years WY 2018-2070. The selected period for the projected water budgets meets SGMA

of climate change and projects and management actions (PMAs). To the extent possible the data sources and methodology used were consistent with those identified by the California Department of Water Resources (DWR) in *Table 2 – Potential Data Sources to Support Water Budget Development* and other sections of the Best Management Practices (BMP) –4 - Water Budget.[1] As applicable and available, models and tools (e.g., the Central Valley Hydrologic Model 2 [CVHM2]) were used to support the local sources and assumptions incorporated into the development of the Subbasin Groundwater Water Budget.

(1) **Precipitation (Inflow).** For the Historical and Current Land Surface Water Budgets, total precipitation across the Subbasin was estimated using either: (1) PRISM: the Precipitation-Elevation Regressions on Independent Slopes Model (PRISM); (2) CIMIS: area-weighted data from the California Irrigation Management Information System (CIMIS) stations located in the Subbasin; California Data Exchange Center (CDEC) and/or (3) data from the National Water Service Station located in Los Banos, CA. Total precipitation was further parsed into effective and non-effective precipitation, as applicable to each GSP area, based on assumptions regarding deep percolation percentages and other losses.

For the Projected Land Surface Water Budgets, for WY 2014-2017, actual data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected WY 2018-2070 period, the 2030 Central Tendency and 2070 Central Tendency climate change factors and guidance provided by DWR were applied to the historical precipitation record to project the impact of climate change on precipitation across the Subbasin. For example, either (1) the Gridded Statewide Precipitation and Change Factors developed for the Water Storage Investment Program (WSIP) using the Variable Infiltration Capacity (VIC) Macroscale Hydrology Model (DWR, 2018) were applied to the available precipitation data sets for the Subbasin, or (2) recommendations from the *Perspectives and Guidance for Climate Change Analysis* document prepared by the DWR Climate Change Technical Advisory Group (CCTAG) were incorporated (DWR CCTAG, 2015).

(2) **Applied Water – Groundwater (Inflow).** To estimate the volume of applied groundwater for the Historical and Current Land Surface Water Budgets (including both agricultural and M&I pumping, as applicable to each GSP area), the total pumping within the Subbasin was estimated using the following hierarchy of sources, depending upon existing records: (1) Flow meters: volumetric flow meter records from pumping wells; (2) Power bills: electricity bills from pumping wells (wherein information related to the number of kilowatt-hours used was converted to a pumping volume based on assumptions related to pumping lift and efficiency); and/or (3) Consumptive use: reported crop acreages and consumptive use data based on either Irrigation

requirements by establishing a 50-year period, where the timeframe is continuous between the historic, current, and projected water budgets. The historic hydrologic period for simulating the projected water budget hydrologic schema was chosen as WY 1979-2017, then wrapping around to include WY 1965-1978 hydrology. Actual data and hydrology were used for WY 2014- 2017 with the representative water years simulating WY 2018 and beyond (e.g., WY2018 is represented by the hydrology from WY1979; WY2019 is represented by the hydrology from WY1980, and so forth, with the caveat that 1979 would represent the fifth year of the projection and following sequentially the historical water year 1965 would represent the forty-fourth year of the projection).

[1] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

Training and Research Center (ITRC)[1] Mapping of Evapotranspiration with Internal Calibration (METRIC) procedure or crop coefficient methodologies (e.g., those provided in the Food and Agricultural Organization of the United States (FAO) Irrigation and Drainage Paper No. 56 (FAO-56) (Snyder *et. al*., 2000, Snyder and Bali, 2008) or the ITRC Crop Coefficient data for Zone 14), corrected as applicable, for applied local and imported surface water. This volume of applied groundwater is consistent with the volume estimated under Water Budget Component (9) Extraction of the Groundwater Water Budget (see below).

For the Projected Land Surface Water Budgets, for WY 2014-2017, actual data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of applied groundwater was estimated using various, complementary methods, including: (1) as the difference between projected demand and the assumed volumes of precipitation, surface water deliveries, and tile drainage available to meet the demand, or (2) assuming future groundwater production rates would be equivalent to historical extractions for a given year type (e.g., future dry year production rates would be equivalent to average dry year production rates over the historical record). Climate change impacts and the effects of the planned projects and management actions (PMAs) are implicitly, rather than explicitly, accounted for (i.e., to the extent that climate change and PMAs increase or decrease the amount of water otherwise available to meet applied water demands, the volume of applied groundwater will be adjusted accordingly). Total inflow to Shasta Lake dictates the amount of imported surface water available for use in the Subbasin. The WSIP model was used to analyze the impacts of climate change on the Subbasin and anticipate projected inflow to Shasta Lake, and as to whether or not the water year would be classified as Shasta Critical under the Exchange Contract, the Refuge Contract, and by municipal users.

(3) **Surface Water Inflow (Inflow).** Surface water serves as an inflow to Subbasin water budget as both applied surface water and as seepage from streams and rivers. To estimate the volume of applied surface water for the Historical and Current Land Surface Water Budgets, the total diversions within the Subbasin over the historical and current water budget time periods were reported using the best available data for each source. Deliveries from the Central Valley Project (CVP), State Water Project (SWP), the San Joaquin River, and other local streams and rivers were compiled from records from the following sources, including, but not limited to: State Water Resources Control Board (SWRCB) diversion reports; United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records; CVP refuge water supply delivery data; and GSA member agency records.

To account for seepage of surface water into the Subbasin from streams and rivers for the Historical and Current Water Budgets, California Data Exchange Center (CDEC) data were used (i.e., by comparing the reductions in measured flow at successive gauging stations after accounting for other diversions) and/or from estimates of seepage losses from certain water bodies from prior water infiltration studies or modeling efforts, as described in the individual GSPs. Seepage from streams and rivers is counted either towards the Groundwater Water Budget directly or towards the Land Surface Water Budget and then, because of the lack of storage capacity in the land surface system and by way of mass balance principles, some or all of this

[1] California Polytechnic State University, San Luis Obispo

water adds to the Groundwater Water Budget through Water Budget Component (6) Deep Percolation (see below).

For the Projected Land Surface Water Budgets, the volume of applied surface water was estimated as (1) the records of actual delivery data as available for the respective service areas for WY 2014-2017; and (2) estimates of anticipated future deliveries by WY type for WY 2018-2070, inclusive of climate change considerations to the extent they could be reasonably estimated (i.e., directly modeled based on data provided by DWR and the USBR), or using water year types as a proxy (i.e., future dry year deliveries would reflect historical average dry year deliveries over the historical record). The impacts of planned PMAs on the availability of applied surface water volumes were also incorporated, as applicable.

For the Projected Land Surface Water Budgets, the volume of surface water seepage was adjusted, as applicable and available, based on climate change factors provided by DWR. Changes to surface water seepage were directly estimated as a result of PMAs or other program implementation (e.g., the impact on seepage resulting from the San Joaquin River Restoration Program [SJRRP] implemented by the USBR).

(4) **Surface Water Outflow (Outflow).** As described above, total precipitation was parsed into effective and non-effective precipitation (i.e., the latter being that portion of the total precipitation that cannot be used by the plants because it either runs off or percolates beyond the root zone). Similarly, a portion of the applied water can run off or deep percolate (typically termed "irrigation inefficiency"). Other surface water outflows (losses) from the Subbasin Land Surface Water Budget include agency-measured or estimated "spills" (i.e., outflow from tile drained fields, canal spills, field runoff, and precipitation runoff) and stream gauge readings, flow meter readings, and transfer pumping data. These collective data sets, sources, and methodologies were used to estimate the historical and current outflows from this component of the Subbasin Land Surface Water Budget.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of surface water outflows were estimated based on estimates provided by the GSA member agencies (using water year types as a proxy), while those components that may be impacted by climate change (e.g., runoff) were adjusted to reflect changes to precipitation and reference evapotranspiration (ETo). Changes to surface water outflows were directly estimated as a result of PMAs or other program implementation (e.g., water conservation programs to reduce spills) as information was available.

(5) **Evapotranspiration (Outflow).** The largest outflow for the Historical and Current Land Surface Water Budget is evapotranspiration (consumptive use) by crops. As such, a combination of CIMIs ETo data, crop acreage, and crop coefficient data and methodologies (e.g., ITRC data and methodologies) were utilized to estimate the consumptive use, including municipal uses, of water in the Subbasin. In addition, direct evaporation from surface water bodies and phreatophytes (i.e., groundwater dependent ecosystems [GDEs]) was estimated based on the surface area and time period it was wetted.

For the Projected Land Surface Water Budgets, for WY 2014-2017, the actual data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the 2030 Central Tendency and 2070 Central Tendency climate change factors or guidance provided by DWR were applied to the historical ETo record to

project the impact of climate change on ETo across the Subbasin. For example, either the Gridded Statewide Precipitation and Change Factors developed for the WSIP using the VIC Macroscale Hydrology Model (DWR, 2018) were applied to the available ETo data sets for the Subbasin, or (2) recommendations from the *Perspectives and Guidance for Climate Change Analysis* document prepared by the DWR CCTAG (2015) were incorporated.

(6) **Deep Percolation (Outflow).** For the Historical, Current, and Projected Land Surface Water Budgets, this water budget component is estimated as the sum of the other Outflow components (Water Budget Components 4 and 5) of the Land Surface Water Budget subtracted from the sum of the Inflow components (Water Budget Components 1 through 3) and represents the total volume of water that seeps past the root zone and into the Subbasin aquifer(s). This includes applied water seepage, as well as stream seepage (from the San Joaquin River, Delta-Mendota Canal, and California Aqueduct, and other canals), and delivery losses. To the extent that climate change and PMA implementation affects the volumes of Water Budget Components 1 through 5, these impacts are reflected in the resultant Outflow component, Water Budget Component (6) Deep Percolation, which serves as the inflow component, and Water Budget Component (7) Deep Percolation to the Groundwater Water Budget (see below).

GROUNDWATER WATER BUDGET

The data sources/methodologies used to estimate the Historical and Current Groundwater Water Budgets are summarized in **Table CC-8** and for the Projected Groundwater Water Budgets in **Table CC-9**. A general description of each component and the data hierarchy that was applied by the GSAs is provided below, with further detail provided in the Water Budget sections of the six underlying GSPs. The time periods for the Groundwater Water Budgets are consistent with those used for the Land Surface Water Budgets, and likewise, to the extent possible, the data sources and methodology used were consistent with those identified by DWR in *Table 2 – Potential Data Sources to Support Water Budget Development* and other sections of the BMP –4 - Water Budget.[1] As identified in **Table CC-8** and **Table CC-9**, significant data gaps were identified in several of the GSPs on key aspects of the Groundwater Water Budget; additional efforts are on-going to address those data gaps and refine the water budgets as part of the 2025 GSP update. As applicable and available, models and tools (e.g., CVHM2, Westside Subbasin Groundwater Model, and a numerical flow model for the Farmers Water District and Fresno County areas) were used to validate the local sources and support assumptions used to develop the Subbasin Groundwater Water Budget.

(7) **Deep Percolation (Inflow).** In all instances, this component of the Groundwater Water Budget is directly linked to the Water Budget Component (6) Deep Percolation of the Land Surface Water Budget. To the extent that climate change is factored into the Historical, Current, and Projected Land Surface Water Budgets, those impacts are reflected in the varying volumes of deep percolation that are assumed to recharge the aquifer system(s) via infiltration.

[1] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-4-Water-Budget_ay_19.pdf

(8) **Lateral Subsurface Flow (Inflow).** For the Historical and Current Groundwater Water Budgets, this component is estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

8A. Upper Aquifer. For the Upper Aquifer, lateral inflows were generally estimated using Darcy's equation[1] and estimated aquifer characteristics, or a groundwater flow model, as available. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while observed or simulated water level maps for wet, normal, and dry water year types and hydrographs were prepared to determine the elevation and direction of groundwater flow between GSP areas within the Subbasin and across Subbasin boundaries. Mountain front recharge from the Coastal Range was also assumed to provide an additional source of inflow to the Upper Aquifer.

8B. Lower Aquifer. To the extent possible, lateral inflows to the Lower Aquifer were estimated, primarily using Darcy's equation and estimated aquifer characteristics, and coarse assumptions regarding contributions of other sources of inflow, or via a groundwater flow model, as available. However, this portion of the Groundwater Budget was acknowledged as a significant data gap, which the GSAs are working to address through the collection of additional data, etc.

In instances where there was significant downward flow between the Upper and Lower Aquifers, vertical flow was estimated using Darcy's equation, estimated aquifer characteristics, and groundwater gradients. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while water level maps for wet, normal, and dry water year types were prepared to determine the elevation and groundwater gradient. Furthermore, flow to the Lower Aquifer from the Upper Aquifer is acknowledged as a data gap.

Projected Groundwater Water Budget. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, this component is generally estimated using historical inflows by water year type as a proxy (i.e., the underflows used in the Historical and Current Water Budgets were averaged by WY type and used throughout the Projected Water Budget period). Impacts of climate change are implicitly incorporated, and expected increases in inflows as a result of PMAs (including projected groundwater banking activities) are directly incorporated to the extent the information was provided by the GSAs. As additional data are obtained during implementation of the GSPs, the inputs will be updated and improved to revise the Projected Groundwater Water Budget.

(9) **Extraction (Outflow).** Consistent with the methodology used to estimate Water Budget Component (2), Applied Groundwater, of the Historical and Current Land Surface Water Budgets, the total pumping from the Subbasin aquifers was estimated using the following hierarchy of sources depending upon available records: (1) Flow meters: Volumetric flow meter records from pumping wells; (2) Power bills: Electricity bills from pumping wells (wherein information related to the number of kilowatt-hours used was converted to a pumping volume based on assumptions related to pumping lift and efficiency and duration of operation); and/or (3)

[1] Darcy's equation in which groundwater flow velocity is identified as a function of the aquifer hydraulic conductivity and hydraulic gradient based upon measured water levels and aquifer properties. Freeze, R.A. and Cherry, J.A. 1979. Groundwater. Prentice Hall, Inc. Englewood Cliffs, NJ. p 16.

Consumptive use: crop acreages and consumptive use data based on either ITRC-METRIC or crop coefficient methodologies. While the exact distribution of pumping from the Upper and Lower Aquifers is acknowledged as a data gap, total extractions were assumed to be partitioned between the aquifers, with the majority of extractions (80-90%) occurring in the Upper Aquifer. Information regarding well construction obtained and compiled from the local and Subbasin Well Census and Inventory projects completed by the GSAs in 2022 will be used to further improve the estimated allocation of groundwater extraction between the aquifers in the 2025 GSP update.

For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the volume of pumped groundwater was estimated using various, complimentary methods, including (1) as the difference between projected demand and the assumed volumes of precipitation, surface water deliveries, and tile drainage available to meet the demand, or (2) assuming future groundwater production would be equivalent to historical extractions for a given year type (e.g., future dry year production rates would be equivalent to average dry year production rates over the historical record, with the exception of M&I pumping which was projected based on information provided in various source documents such as Urban Water Management Plans). Climate change impacts and the effect of the planned PMAs are implicitly, rather than explicitly, accounted for.

(10) **Lateral Subsurface Flow (Outflow).** For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin, but similarly to Water Budget Component (8) of the Groundwater Water Budget.

10A. Upper Aquifer. Lateral outflows were generally estimated using Darcy's equation and estimated aquifer characteristics, and validated by a groundwater flow model, as available. Aquifer transmissivity values were compiled from aquifer tests, model parameters and other sources, while observed or simulated water level maps for wet, normal, and dry water year types and hydrographs were prepared to determine the elevation and direction of groundwater flow between GSP areas within the Subbasin and across Subbasin boundaries.

10B. Lower Aquifer. To the extent possible, lateral outflows from the Lower Aquifer were estimated, primarily using Darcy's equation and estimated aquifer characteristics, and validated by a groundwater flow model, as available. However, this portion of the Groundwater Water Budget was acknowledged as a significant data gap which the GSAs are working to address through the collection and evaluation of additional data, etc.

Projected Groundwater Water Budget. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, this component is generally estimated using historical outflows by water year type as a proxy (i.e., the underflows used in the Historical and Current Water Budgets were averaged by WY type and used throughout the Projected Water Budget period). Impacts of climate change are implicitly incorporated, and expected increases in outflows as a result of PMAs (including projected groundwater banking activities) are directly incorporated to the extent the information was provided by the GSAs.

(11) **Change in Storage.** For the Historical and Current Groundwater Water Budgets, this component was estimated somewhat differently for the Upper and Lower Aquifer portions of the Subbasin.

11A. Upper Aquifer. A sum of the Outflow components (Water Budget Components 9 through 10) of the Groundwater Water Budget was subtracted from the Inflow components (Water Budget Components 7 and 8) to assess the change in storage. These estimates were also compared in some of the GSPs to the available hydrographs, water level contour maps, and assumed aquifer storativity values from local data sets and models to assess and confirm change in storage, and assumed consumptive use data.

11B. Lower Aquifer. Approaches varied among the GSPs given the limited available data, which the GSAs are working to address through the collection of additional data, etc. Change in storage was estimated using measured subsidence as a proxy (i.e., due to compaction caused by inelastic land subsidence), as the difference between inflows and outflows based on modeled results, or as an assumed proportion of overall groundwater change in storage. These estimates were also compared in some of the GSPs to the available hydrographs, water level contour maps, and assumed aquifer storativity values from local data sets and models to assess and confirm change in storage, and assumed consumptive use data.

Projected Groundwater Water Budgets. For the Projected Groundwater Water Budgets, for WY 2014-2017, the data were provided, consistent with the process described above for the Historical and Current Water Budgets. For the projected (WY 2018-2070) period, the change in storage volumes used in the Historical and Current Water Budgets were averaged by water year type and used throughout the projected water budget period, or were calculated as the difference between inflows and outflows.

Table CC-8: Historical and Current Water Budgets Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) and California Irrigation Management Information System (CIMIS)	PRISM		PRISM and CIMIS	PRISM and CIMIS	CIMIS and National Weather Service (NWS)
Land Surface	Inflow	Applied Water - Groundwater	Consumptive use	Flow meters	Flow meters, power bills, and consumptive use	Flow meters and consumptive use		Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports; landowner records	San Joaquin River inflows	United States Bureau of Reclamation (USBR) Central Valley Operations (CVO); Meyers Water Bank Records	Central Valley Project (CVP) refuge water supply delivery data	USBR CVO and SWRCB diversion reports	USBR CVO; California Data Exchange Center (CDEC) where available, water infiltration study used otherwise
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation	Transfer pumping and San Joaquin River outflows	Transfer pumping that exceeds applied groundwater	Non-effective precipitation and agency measured spills	Evapotranspiration and non-effective precipitation)	Non-effective precipitation and flow meter readings
Land Surface	Outflow	Evapotranspiration	Vegetation coefficients and CIMIS					
Land Surface	Outflow	Deep Percolation	Land Surface Budget Inflow- Outflow					
Groundwater	Inflow	Infiltration	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities)					
Groundwater	Inflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities)			Data G–p - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities)
Groundwater	Outflow	Extraction - Upper Aquifer	Consumptive use and irrigation efficiency	Flow meters	Flow meters, power bills and consumptive use	Flow meters and consumptive use		Flow meters
Groundwater	Outflow	Extraction - Lower Aquifer	Unused - Data Gap	Flow meters	Flow meters, power bills and consumptive use	Flow meters and consumptive use		Assumed 10% of total pumping
Groundwater	Outflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities)					
Groundwater	Outflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities)				
Groundwater	Change in Storage	Upper Aquifer	Inflow - Outflow					
Groundwater	Change in Storage	Lower Aquifer	Land subsidence as proxy	Inflow - Outflow		Land subsidence as proxy		

Table CC-9: Projected Water Budgets Data Sources

Water Budget	Flow Direction	Flow Budget Category	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Land Surface	Inflow	Precipitation	Precipitation-Elevation Regressions on Independent Slopes Model (PRISM), applying climate change factors (CCF)			PRISM and California Irrigation Management Information System (CIMIS), applying CCF		CIMIS and National Weather Service (NWS), applying CCF
Land Surface	Inflow	Applied Water - Groundwater	Consumptive use			Flow meters and consumptive use		Flow meters
Land Surface	Inflow	Surface Water Inflow	State Water Resources Control Board (SWRCB) diversion reports, using water year (WY) types as a proxy	San Joaquin River inflows (CDEC and United States Geological Survey [USGS])	Mendota Pool Inflow~~w~~ - USBR CVO	USBR CVO and SWRCB diversion reports, using WY types as a proxy		USBR CVO; California Data Exchange Center (CDEC) where available, using WY types as a proxy; Water infiltration study used otherwise
Land Surface	Outflow	Surface Water Outflow	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	San Joaquin River outflows (CDEC and USGS)	Mendota Pool outflows (USBR CVO)	Non-effective precipitation and agency measured spills calculated with CCF and WY types as a proxy for quantity	Non-effective precipitation calculated with CCF and WY types as a proxy for quantity	Non-effective precipitation and agency measured spills calculated with CCF and WY types as a proxy for quantity
Land Surface	Outflow	Evapotranspiration	Vegetation coefficients and CIMIS (calculated with CCFs and WY types as a proxy)					
Land Surface	Outflow	Deep Percolation	Land Surface Inflow - Outflow					
Groundwater	Inflow	Infiltration	Land Surface Budget Inflow - Outflow					
Groundwater	Inflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy					
Groundwater	Inflow	Lateral subsurface flow - Lower Aquifer	Unused - Data Gap	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy			Data Gap - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy
Groundwater	Outflow	Extraction~~e~~ - Upper Aquifer	Consumptive use and irrigation efficiency using WY type as a proxy with CCFs and PMAs	Adjusted historic metered data using WY type as a proxy with CCFs and PMAs		Adjusted historic metered data and consumptive use using WY type as a proxy with CCFs and PMAs		
Groundwater	Outflow	Extraction~~e~~ - Lower Aquifer	Unused - Data Gap	Not Applicable		Unused - Data Gap	Adjusted historic metered data and consumptive use using WY type as a proxy with CCFs and PMAs	
Groundwater	Outflow	Lateral subsurface flow - Upper Aquifer	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy with CCFs					
Groundwater	Outflow	Lateral subsurface flow - Lower Aquifer	Unused – Data Gap	Darcy's equation (groundwater levels and transmissivities) using WY types as a proxy with CCFs			Data Gap - Assumed 20% of total inflows.	Darcy's equation (groundwater levels and transmissivities) with CCFs
Groundwater	Change in Storage	Upper Aquifer	Inflow - Outflow					
Groundwater	Change in Storage	Lower Aquifer	Unused – Data Gap	Inflow - Outflow		Projected land subsidence and WY types used as a proxy with CCFs and PMAs	Inflow - Outflow	Projected land subsidence and WY types used as proxy with CCFs and PMAs

4.3.2 GSP-Level Water Budgets

Individual historical, current, and projected water budgets were developed by each GSP Group for their respective Plan Area. For more information on the development of those water budgets, as well as tabular and graphical representation of the results, refer to the respective sections of the individual GSPs.

All historical, current, and projected water budgets developed within the Delta-Mendota Subbasin are consistent with GSP Regulations §-354.18 Water Budget, and DWR's *Best Management Practices for the Sustainable Management of Groundwater Water Budget BMP* (2016c) document was used when and where applicable at the discretion of each GSP Group.

4.3.3 Coordinated Water Budgets

The land surface budget, groundwater budget, and annual change in storage for the historical water budget, current water budget, and projected water budget with climate change factors (CCFs) and projects and management actions for the Delta-Mendota Subbasin were developed by compiling the water budgets prepared by each of GSP Group. The land surface budget is an accounting of water flows into and out of the land surface above an aquifer within with Delta-Mendota Subbasin, where inflows and outflows include flow between GSP Groups and neighboring subbasins, the atmosphere, and the groundwater aquifer below. The groundwater budget is an accounting of groundwater flows into and out of the two principal groundwater aquifers (Upper Aquifer and Lower Aquifer) within the Delta-Mendota Subbasin, where inflows and outflows include flow between GSP Groups and neighboring subbasins as well as the above land surface.

Subsequent to the submittal of the Delta-Mendota GSP in January 2022, and in response to the Consultation Initiation Letter (CIL) received from DWR on January 21, 2022 in which DWR stated that, while the same data may have been used in developing the water budgets, the terminology used to describe those data sets were not consistent across the basin, the Delta-Mendota Subbasin GSAs acknowledge additional detail was needed to demonstrate that all water budget components across the six Subbasin GSPs utilize the same data and methodologies. As such, subsequent to receipt of the CIL, the Technical Working Group and Coordination Committee met to identify the specific data used and to develop a consistent terminology for the various water budget components. Additionally, the Technical Working Group attempted to simplify the presentation of the Subbasin water budgets through a reduction in the number of water budget components. The mapping of the original GSP water budget components into the revised simplified coordinated water budget component terminology is discussed in the prior section (Section 4.3.1 of this revised Common Chapter).

After agreeing to the set of common simplified definitions for water budget components, the six Delta-Mendota GSP groups mapped their prior water budget components to the new common definitions.

The revised land surface budget and groundwater budget are presented respectively for the historical water budget in **Table CC-10~~Table CC-8~~** and **Table CC-11~~Table CC-9~~,** for the current water budget in **Table CC-12~~Table CC-10~~** and **Table CC-13~~Table CC-11~~**, and for the projected water budget with climate change factors and projects and management actions in **Table CC-14~~Table CC-12~~** and **Table CC-15~~Table CC-13~~**. All categories presented in the land surface budget and groundwater budget tables were agreed upon by all Delta-Mendota GSP Groups, with representatives from each GSP group tasked with filling out these budget tables as appropriate to account for the unique hydrology, land use, and water use within their respective GSP regions. The tables below are simply compilations of the individual

GSP water budget data as provided by their respective plan preparers, and no water budget data were modified during the mapping process.

Individual GSAs and agencies in the Delta-Mendota Subbasin understand that the historical, current, and projected water budgets were completed using best available science and data, and efforts were made to use the same data sources throughout the Subbasin where available, though due to variability in data availability throughout the Subbasin, the best available data were used and characterized appropriately. Where data gaps exist, the individual GSAs and agencies intend to conduct the work necessary to substantiate or improve the estimates and assumptions developed for determining their water budgets. Nothing in this part, or in any groundwater sustainability plan adopted pursuant to this part, determines, or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights.

~~.~~ **Figure CC-64**~~**Figure CC-64**~~ shows the revised average annual and cumulative change in storage in both principal aquifers under the Subbasin projected water budget (including application of climate change factors and the addition of projects and management actions).

~~Individual GSAs and agencies in the Delta-Mendota Subbasin understand that the historical, current and projected water budgets were completed using best available science and data. Where data gaps exist, the individual GSAs and agencies intend to conduct the work necessary to substantiate or improve the estimates and assumptions developed for determining their water budgets. Nothing in this part, or in any groundwater sustainability plan adopted pursuant to this part, determines or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights.~~

Table CC-108: Delta-Mendota Subbasin Historical Water Budget, Land Surface Budget

Land Surface Budget									
Water Year	Water Year Type	Inflows				Outflows			
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflows	Total Inflows	Surface Water Outflows	Evapotranspiration	Deep Percolation	Total Outflows
2003	N	450,000	395,000	2,501,000	**3,346,000**	1,306,000	1,772,000	293,000	**3,371,000**
2004	D	412,000	417,000	2,433,000	**3,262,000**	1,206,000	1,760,000	315,000	**3,281,000**
2005	W	739,000	303,000	2,764,000	**3,806,000**	1,614,000	1,810,000	352,000	**3,776,000**
2006	W	571,000	293,000	3,311,000	**4,175,000**	2,111,000	1,804,000	296,000	**4,211,000**
2007	D	258,000	474,000	2,485,000	**3,217,000**	1,230,000	1,701,000	310,000	**3,241,000**
2008	D	328,000	527,000	2,295,000	**3,150,000**	1,140,000	1,769,000	331,000	**3,240,000**
2009	N	304,000	511,000	2,191,000	**3,006,000**	1,017,000	1,813,000	327,000	**3,157,000**
2010	N	539,000	380,000	2,637,000	**3,556,000**	1,515,000	1,655,000	406,000	**3,576,000**
2011	W	626,000	279,000	3,283,000	**4,188,000**	2,013,000	1,799,000	414,000	**4,226,000**
2012	D	275,000	470,000	2,582,000	**3,327,000**	1,301,000	1,679,000	355,000	**3,335,000**

~~Water Year~~	~~Water Year Type~~	~~Precipitation~~	~~Applied Wate_r Groundwater~~	~~Applied Wate_r Imported Surface Water~~	~~Total Inflows~~	~~Runoff~~	~~Evapotranspiration~~	~~Surface Water Outflows~~	~~Deep Percolation~~	~~Total Outflows~~
~~2003~~	~~Normal~~	~~451,000~~	~~382,000~~	~~1,485,000~~	~~2,364,000~~	~~310,000~~	~~1,771,000~~	~~31,000~~	~~291,000~~	~~2,403,000~~
~~2004~~	~~Dry~~	~~412,000~~	~~398,000~~	~~1,486,000~~	~~2,341,000~~	~~263,000~~	~~1,764,000~~	~~31,000~~	~~304,000~~	~~2,362,000~~
~~2005~~	~~Wet~~	~~739,000~~	~~285,000~~	~~1,483,000~~	~~2,567,000~~	~~357,000~~	~~1,811,000~~	~~35,000~~	~~338,000~~	~~2,541,000~~
~~2006~~	~~Wet~~	~~572,000~~	~~270,000~~	~~1,499,000~~	~~2,399,000~~	~~318,000~~	~~1,795,000~~	~~34,000~~	~~289,000~~	~~2,436,000~~
~~2007~~	~~Dry~~	~~259,000~~	~~471,000~~	~~1,499,000~~	~~2,275,000~~	~~240,000~~	~~1,724,000~~	~~31,000~~	~~307,000~~	~~2,302,000~~
~~2008~~	~~Dry~~	~~329,000~~	~~529,000~~	~~1,382,000~~	~~2,288,000~~	~~224,000~~	~~1,797,000~~	~~30,000~~	~~327,000~~	~~2,378,000~~
~~2009~~	~~Normal~~	~~304,000~~	~~517,000~~	~~1,360,000~~	~~2,227,000~~	~~191,000~~	~~1,843,000~~	~~30,000~~	~~321,000~~	~~2,385,000~~
~~2010~~	~~Normal~~	~~538,000~~	~~371,000~~	~~1,392,000~~	~~2,354,000~~	~~283,000~~	~~1,669,000~~	~~30,000~~	~~394,000~~	~~2,376,000~~
~~2011~~	~~Wet~~	~~626,000~~	~~259,000~~	~~1,556,000~~	~~2,518,000~~	~~321,000~~	~~1,794,000~~	~~34,000~~	~~402,000~~	~~2,551,000~~
~~2012~~	~~Dry~~	~~276,000~~	~~471,000~~	~~1,505,000~~	~~2,303,000~~	~~223,000~~	~~1,709,000~~	~~30,000~~	~~353,000~~	~~2,315,000~~

Table CC-119: Delta-Mendota Subbasin Historical Water Budget, Groundwater Budget

Groundwater Budget												
Water Year	Water Year Type	Inflows				Outflows					Change in Storage		
		Infiltration	Lateral Subsurface Flow		Total Inflows	Groundwater Extraction		Lateral Subsurface Flow		Total Outflows	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Total*
2003	N	324,000	196,000	117,000	**637,000**	357,000	39,000	260,000	106,000	**762,000**	17,000	5,000	22,000
2004	D	345,000	180,000	114,000	**639,000**	376,000	42,000	286,000	132,000	**836,000**	(180,000)	(48,000)	(228,000)

2005	W	424,000	223,000	128,000	**775,000**	268,000	36,000	269,000	78,000	**651,000**	223,000	14,000	237,000
2006	W	394,000	203,000	120,000	**717,000**	260,000	34,000	264,000	75,000	**633,000**	18,000	(23,000)	(5,000)
2007	D	358,000	161,000	99,000	**618,000**	431,000	48,000	280,000	130,000	**889,000**	(282,000)	(67,000)	(349,000)
2008	D	371,000	169,000	106,000	**646,000**	481,000	55,000	293,000	141,000	**970,000**	(341,000)	(80,000)	(421,000)
2009	N	361,000	195,000	112,000	**668,000**	466,000	53,000	273,000	117,000	**909,000**	(134,000)	(28,000)	(162,000)
2010	N	470,000	211,000	124,000	**805,000**	350,000	39,000	264,000	116,000	**769,000**	180,000	(4,000)	176,000
2011	W	515,000	205,000	124,000	**844,000**	248,000	32,000	277,000	83,000	**640,000**	125,000	(23,000)	102,000
2012	D	417,000	168,000	107,000	**692,000**	432,000	45,000	288,000	141,000	**906,000**	(171,000)	(62,000)	(233,000)

~~**Groundwater Budget**~~

~~Water Year~~	~~Water Year Type~~	~~Inflows~~								~~Outflows~~					~~Change in Storage~~				
		~~Deep Percolation~~			~~Subsurface Groundwater Inflows~~		~~Seepage through Corcoran Clay~~	~~Other Direct Recharge~~	~~Total Inflows~~	~~Groundwater Extraction from Upper Aquifer~~	~~Groundwater Extraction from Lower Aquifer~~	~~Subsurface Groundwater Outflows~~		~~Total Outflows~~	~~Estimated Annual Change in Groundwater Storage~~				
		~~*Precipitation Infiltration*~~	~~*Surface Water Infiltration*~~	~~*Applied Water Infiltration*~~	~~*Upper Aquifer*~~	~~*Lower Aquifer*~~						~~*Upper Aquifer*~~	~~*Lower Aquifer*~~		~~Inflows~~	~~Outflows~~	~~Change in Storag_e — Upper Aquifer~~	~~Change in Storag_e — Lower Aquifer~~	~~Change in Storag_e - Total~~
~~2003~~	~~Normal~~	~~51,000~~	~~66,000~~	~~174,000~~	~~206,000~~	~~68,000~~	~~45,000~~	~~32,000~~	~~**642,000**~~	~~350,000~~	~~49,000~~	~~210,000~~	~~105,000~~	~~**759,000**~~	~~641,000~~	~~759,000~~	~~20,000~~	~~5,000~~	~~24,000~~
~~2004~~	~~Dry~~	~~36,000~~	~~65,000~~	~~204,000~~	~~184,000~~	~~64,000~~	~~45,000~~	~~30,000~~	~~**628,000**~~	~~365,000~~	~~49,000~~	~~233,000~~	~~131,000~~	~~**823,000**~~	~~628,000~~	~~822,000~~	~~(183,000)~~	~~(50,000)~~	~~(232,000)~~
~~2005~~	~~Wet~~	~~78,000~~	~~79,000~~	~~181,000~~	~~229,000~~	~~78,000~~	~~45,000~~	~~72,000~~	~~**762,000**~~	~~252,000~~	~~47,000~~	~~223,000~~	~~78,000~~	~~**645,000**~~	~~762,000~~	~~645,000~~	~~212,000~~	~~14,000~~	~~225,000~~
~~2006~~	~~Wet~~	~~59,000~~	~~78,000~~	~~152,000~~	~~208,000~~	~~70,000~~	~~45,000~~	~~98,000~~	~~**710,000**~~	~~238,000~~	~~46,000~~	~~221,000~~	~~78,000~~	~~**628,000**~~	~~710,000~~	~~628,000~~	~~14,000~~	~~(25,000)~~	~~(11,000)~~
~~2007~~	~~Dry~~	~~23,000~~	~~66,000~~	~~218,000~~	~~171,000~~	~~50,000~~	~~45,000~~	~~48,000~~	~~**621,000**~~	~~431,000~~	~~57,000~~	~~217,000~~	~~127,000~~	~~**877,000**~~	~~621,000~~	~~876,000~~	~~(272,000)~~	~~(68,000)~~	~~(339,000)~~
~~2008~~	~~Dry~~	~~26,000~~	~~69,000~~	~~233,000~~	~~186,000~~	~~57,000~~	~~45,000~~	~~40,000~~	~~**656,000**~~	~~475,000~~	~~70,000~~	~~234,000~~	~~131,000~~	~~**955,000**~~	~~655,000~~	~~954,000~~	~~(321,000)~~	~~(81,000)~~	~~(403,000)~~
~~2009~~	~~Normal~~	~~21,000~~	~~66,000~~	~~235,000~~	~~207,000~~	~~62,000~~	~~45,000~~	~~33,000~~	~~**669,000**~~	~~469,000~~	~~66,000~~	~~210,000~~	~~104,000~~	~~**894,000**~~	~~669,000~~	~~893,000~~	~~(123,000)~~	~~(28,000)~~	~~(151,000)~~
~~2010~~	~~Normal~~	~~53,000~~	~~73,000~~	~~267,000~~	~~230,000~~	~~74,000~~	~~45,000~~	~~65,000~~	~~**807,000**~~	~~335,000~~	~~52,000~~	~~215,000~~	~~112,000~~	~~**759,000**~~	~~808,000~~	~~759,000~~	~~190,000~~	~~(5,000)~~	~~184,000~~
~~2011~~	~~Wet~~	~~67,000~~	~~96,000~~	~~239,000~~	~~217,000~~	~~74,000~~	~~45,000~~	~~101,000~~	~~**839,000**~~	~~234,000~~	~~40,000~~	~~229,000~~	~~86,000~~	~~**634,000**~~	~~840,000~~	~~633,000~~	~~124,000~~	~~(23,000)~~	~~100,000~~
~~2012~~	~~Dry~~	~~26,000~~	~~71,000~~	~~257,000~~	~~180,000~~	~~57,000~~	~~45,000~~	~~62,000~~	~~**698,000**~~	~~432,000~~	~~56,000~~	~~230,000~~	~~136,000~~	~~**899,000**~~	~~698,000~~	~~898,000~~	~~(162,000)~~	~~(61,000)~~	~~(224,000)~~

Table CC-12~~10~~: Delta-Mendota Subbasin Current Water Budget, Land Surface Budget

Land Surface Budget									
Water Year	Water Year Type	Inflows				Outflows			
		Precipitation	Applied Wat–r - Groundwater	Surface Water Inflows	Total Inflows	Surface Water Outflows	Evapotranspiration	Deep Percolation	Total Outflows
2013	D	318,000	521,000	2,597,000	3,436,000	1,386,000	1,671,000	402,000	3,459,000

~~Land Surface Budget~~											
~~Water Year~~	~~Water Year Type~~	~~Inflows~~						~~Outflows~~				
		~~Precipitation~~	~~Surface Water Inflows~~	~~Applied Wate_r - Groundwater~~	~~Applied Wate_r - Imported Surface Water~~	~~Other Direct Recharge~~	~~Total Inflows~~	~~Runoff~~	~~Evapotranspiration~~	~~Surface Water Outflows~~	~~Deep Percolation~~	~~Total Outflows~~
~~2013~~	~~Dry~~	~~318,000~~	~~31,000~~	~~514,000~~	~~1,428,000~~	~~17,000~~	~~2,308,000~~	~~228,000~~	~~1,685,000~~	~~30,000~~	~~385,000~~	~~2,328,000~~

Table CC-13~~11~~: Delta-Mendota Subbasin Current Water Budget, Groundwater System

Groundwater Budget												
Water Year	Water Year Type	Inflows				Outflows					Change in Storage		
		Infiltration	Lateral Subsurface Flow		Total Inflows	Groundwater Extraction		Lateral Subsurface Flow		Total Outflows	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*		*Upper Aquifer*	*Lower Aquifer*	*Total*
2013	D	467,000	173,000	112,000	752,000	477,000	51,000	278,000	136,000	942,000	(128,000)	(55,000)	(183,000)

~~Groundwater Budget~~																
~~Water Year~~	~~Water Year Type~~	~~Inflows~~							~~Outflows~~					~~Change in Storage~~				
		~~Deep Percolation~~			~~Subsurface Groundwater Inflows~~		~~Seepage through Corcoran Clay~~	~~Other Direct Recharge~~	~~Total Inflows~~	~~Groundwater Extraction from Upper Aquifer~~	~~Groundwater Extraction from Lower Aquifer~~	~~Subsurface Groundwater Outflows~~		~~Total Outflows~~	~~Estimated Annual Change in Groundwater Storage~~				
		~~*Precipitation Infiltration*~~	~~*Surface Water Infiltration*~~	~~*Applied Water Infiltration*~~	~~*Upper Aquifer*~~	~~*Lower Aquifer*~~						~~*Upper Aquifer*~~	~~*Lower Aquifer*~~		~~Inflows~~	~~Outflows~~	~~Change in Storag_e – Upper Aquifer~~	~~Change in Storag_e – Lower Aquifer~~	~~Change in Storag_e – Total~~
~~2013~~	~~Dry~~	~~28,000~~	~~68,000~~	~~289,000~~	~~177,000~~	~~67,000~~	~~45,000~~	~~65,000~~	~~739,000~~	~~447,000~~	~~65,000~~	~~220,000~~	~~140,000~~	~~917,000~~	~~738,000~~	~~917,000~~	~~(123,000)~~	~~(53,000)~~	~~(176,000)~~

Table CC-1412: Delta-Mendota Subbasin Projected Water Budget, Land Surface Budget (containing climate change factors and projects and management actions)

		Land Surface Budget														
		Inflows							Outflows							
		Precipitation	Applied Water - Groundwater	Surface Water Inflow	Applied Waer - Groundwater (Project Effect–) - NCDM Only	Applied Water - Imported Surface Water (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	Total Inflows	Surface Water Outflow	Evapotranspiration	Crop Evapotranspiration - Aliso Only	Canal/Reservoir Evaporation - Aliso Only	Deep Percolation	Runoff (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	Total Outflows
2014	SC	283,000	601,000	1,725,000	0	0	1,000	**2,610,000**	852,000	1,616,000	0	0	230,000	0	0	**2,698,000**
2015	SC	363,000	650,000	1,247,000	0	0	0	**2,260,000**	479,000	1,528,000	0	0	287,000	0	0	**2,294,000**
2016	D	712,000	392,000	1,605,000	0	0	0	**2,709,000**	631,000	1,618,000	0	0	403,000	0	0	**2,652,000**
2017	W	686,000	303,000	3,651,000	0	0	6,000	**4,646,000**	2,423,000	1,773,000	0	0	445,000	0	0	**4,641,000**
2018	N	527,000	389,000	2,628,000	(6,000)	0	7,000	**3,545,000**	1,506,000	1,660,000	0	0	403,000	0	0	**3,569,000**
2019	W	712,000	266,000	3,162,000	(7,000)	2,000	6,000	**4,141,000**	1,975,000	1,810,000	0	0	368,000	0	0	**4,153,000**
2020	D	434,000	394,000	2,187,000	(6,000)	9,000	7,000	**3,025,000**	939,000	1,726,000	0	0	343,000	0	0	**3,008,000**
2021	W	808,000	261,000	3,261,000	(7,000)	7,000	6,000	**4,336,000**	2,025,000	1,821,000	0	0	403,000	0	0	**4,249,000**
2022	W	1,021,000	249,000	3,266,000	(7,000)	7,000	6,000	**4,542,000**	2,190,000	1,834,000	0	0	449,000	0	0	**4,473,000**
2023	N	580,000	389,000	2,658,000	(8,000)	6,000	7,000	**3,632,000**	1,470,000	1,711,000	0	0	403,000	0	0	**3,584,000**
2024	D	573,000	387,000	2,176,000	(3,000)	6,000	6,000	**3,145,000**	963,000	1,726,000	0	0	374,000	0	0	**3,063,000**
2025	W	884,000	261,000	3,256,000	(7,000)	7,000	6,000	**4,407,000**	1,993,000	1,847,000	0	0	424,000	0	0	**4,264,000**
2026	D	575,000	483,000	2,098,000	(43,000)	52,000	9,000	**3,174,000**	914,000	1,785,000	0	0	412,000	0	0	**3,111,000**
2027	D	653,000	481,000	2,078,000	(41,000)	49,000	9,000	**3,229,000**	914,000	1,766,000	0	0	419,000	0	0	**3,099,000**
2028	D	534,000	484,000	2,115,000	(42,000)	50,000	9,000	**3,150,000**	934,000	1,789,000	0	0	353,000	0	0	**3,076,000**
2029	D	462,000	484,000	2,099,000	(46,000)	55,000	9,000	**3,063,000**	910,000	1,744,000	0	0	356,000	0	0	**3,010,000**
2030	SC	417,000	575,000	1,800,000	(47,000)	49,000	3,000	**2,797,000**	833,000	1,624,000	0	0	363,000	0	0	**2,820,000**
2031	SC	492,000	573,000	1,780,000	(48,000)	51,000	2,000	**2,850,000**	815,000	1,633,000	0	0	406,000	0	0	**2,854,000**
2032	W	832,000	269,000	3,250,000	(31,000)	46,000	6,000	**4,372,000**	1,963,000	1,830,000	0	0	490,000	1,000	0	**4,284,000**
2033	D	466,000	490,000	2,001,000	(46,000)	60,000	10,000	**2,981,000**	869,000	1,741,000	0	0	364,000	1,000	0	**2,975,000**
2034	W	851,000	252,000	3,258,000	(29,000)	47,000	7,000	**4,386,000**	2,003,000	1,791,000	0	0	465,000	1,000	0	**4,260,000**
2035	W	731,000	280,000	3,163,000	(32,000)	48,000	7,000	**4,197,000**	1,969,000	1,849,000	0	0	422,000	1,000	0	**4,241,000**
2036	W	774,000	316,000	3,268,000	(31,000)	50,000	7,000	**4,384,000**	2,052,000	1,867,000	0	0	494,000	1,000	0	**4,414,000**
2037	W	1,194,000	252,000	3,274,000	(28,000)	49,000	7,000	**4,748,000**	2,254,000	1,780,000	0	0	607,000	1,000	0	**4,642,000**
2038	N	448,000	431,000	2,689,000	(47,000)	53,000	10,000	**3,584,000**	1,529,000	1,660,000	0	0	381,000	0	0	**3,570,000**
2039	N	488,000	446,000	2,655,000	(46,000)	52,000	10,000	**3,605,000**	1,487,000	1,698,000	0	0	411,000	0	0	**3,596,000**
2040	D	534,000	423,000	2,200,000	(46,000)	66,000	9,000	**3,186,000**	1,001,000	1,712,000	0	0	411,000	1,000	0	**3,125,000**
2041	D	384,000	437,000	2,139,000	(52,000)	62,000	9,000	**2,979,000**	879,000	1,704,000	0	0	374,000	1,000	0	**2,958,000**

Land Surface Budget																
		Inflows							Outflows							
		Precipitation	Applied Water - Groundwater	Surface Water Inflow	Applied Waer - Groundwater (Project Effect–) - NCDM Only	Applied Water - Imported Surface Water (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Inflows**	Surface Water Outflow	Evapotranspiration	Crop Evapotranspiration - Aliso Only	Canal/Reservoir Evaporation - Aliso Only	Deep Percolation	Runoff (Project Effect–) - NCDM Only	Project Effects - All GSP Groups	**Total Outflows**
2042	N	530,000	469,000	2,730,000	(46,000)	51,000	10,000	**3,744,000**	1,532,000	1,795,000	0	0	400,000	0	0	**3,727,000**
2043	D	488,000	437,000	2,101,000	(48,000)	68,000	11,000	**3,057,000**	884,000	1,797,000	0	0	331,000	1,000	0	**3,013,000**
2044	W	875,000	286,000	3,231,000	(37,000)	53,000	11,000	**4,419,000**	2,141,000	1,831,000	0	0	419,000	1,000	0	**4,392,000**
2045	W	622,000	313,000	3,263,000	(45,000)	53,000	12,000	**4,218,000**	1,971,000	1,847,000	0	0	355,000	1,000	0	**4,174,000**
2046	D	268,000	571,000	2,149,000	(57,000)	68,000	12,000	**3,011,000**	893,000	1,794,000	0	0	346,000	1,000	0	**3,034,000**
2047	D	402,000	575,000	2,067,000	(55,000)	64,000	12,000	**3,065,000**	834,000	1,820,000	0	0	383,000	0	0	**3,037,000**
2048	N	331,000	593,000	2,696,000	(49,000)	49,000	12,000	**3,632,000**	1,457,000	1,893,000	0	0	358,000	0	0	**3,708,000**
2049	N	658,000	407,000	2,683,000	(29,000)	62,000	12,000	**3,793,000**	1,525,000	1,706,000	0	0	474,000	2,000	0	**3,707,000**
2050	W	708,000	316,000	3,145,000	(40,000)	54,000	13,000	**4,196,000**	1,974,000	1,878,000	0	0	376,000	1,000	0	**4,229,000**
2051	D	350,000	447,000	2,110,000	(51,000)	69,000	13,000	**2,938,000**	858,000	1,738,000	0	0	302,000	1,000	0	**2,899,000**
2052	D	390,000	553,000	2,103,000	(46,000)	67,000	14,000	**3,081,000**	873,000	1,727,000	0	0	416,000	1,000	0	**3,017,000**
2053	SC	306,000	634,000	1,765,000	(44,000)	47,000	8,000	**2,716,000**	801,000	1,699,000	0	0	304,000	0	0	**2,804,000**
2054	SC	340,000	632,000	1,678,000	(29,000)	34,000	7,000	**2,662,000**	750,000	1,657,000	0	0	354,000	0	0	**2,761,000**
2055	D	630,000	453,000	1,831,000	(39,000)	49,000	14,000	**2,938,000**	855,000	1,742,000	0	0	385,000	1,000	0	**2,983,000**
2056	W	745,000	351,000	3,073,000	(44,000)	46,000	12,000	**4,183,000**	1,935,000	1,894,000	0	0	450,000	0	0	**4,279,000**
2057	W	693,000	313,000	3,150,000	(34,000)	55,000	12,000	**4,189,000**	1,932,000	1,893,000	0	0	401,000	1,000	0	**4,227,000**
2058	N	478,000	547,000	2,688,000	(49,000)	54,000	15,000	**3,733,000**	1,417,000	1,871,000	0	0	446,000	0	0	**3,734,000**
2059	W	739,000	309,000	3,154,000	(33,000)	55,000	13,000	**4,237,000**	1,941,000	1,888,000	0	0	425,000	1,000	0	**4,255,000**
2060	D	405,000	441,000	2,111,000	(52,000)	69,000	15,000	**2,989,000**	847,000	1,786,000	0	0	360,000	1,000	0	**2,994,000**
2061	W	910,000	300,000	3,276,000	(33,000)	55,000	13,000	**4,521,000**	2,106,000	1,896,000	0	0	512,000	1,000	0	**4,515,000**
2062	N	466,000	459,000	2,687,000	(50,000)	58,000	16,000	**3,636,000**	1,482,000	1,757,000	0	0	420,000	0	0	**3,659,000**
2063	N	477,000	544,000	2,674,000	(49,000)	54,000	16,000	**3,716,000**	1,454,000	1,861,000	0	0	397,000	0	0	**3,712,000**
2064	D	338,000	447,000	2,123,000	(49,000)	70,000	16,000	**2,945,000**	818,000	1,780,000	0	0	341,000	1,000	0	**2,940,000**
2065	N	725,000	443,000	2,688,000	(47,000)	58,000	17,000	**3,884,000**	1,502,000	1,739,000	0	0	573,000	1,000	0	**3,815,000**
2066	W	668,000	323,000	3,153,000	(34,000)	55,000	15,000	**4,180,000**	1,929,000	1,897,000	0	0	383,000	1,000	0	**4,210,000**
2067	W	690,000	321,000	3,262,000	(33,000)	55,000	15,000	**4,310,000**	1,942,000	1,898,000	0	0	394,000	1,000	0	**4,235,000**
2068	D	448,000	558,000	1,859,000	(52,000)	69,000	12,000	**2,894,000**	872,000	1,695,000	0	0	327,000	1,000	0	**2,895,000**
2069	D	382,000	561,000	1,824,000	(50,000)	66,000	12,000	**2,795,000**	788,000	1,688,000	0	0	328,000	1,000	0	**2,805,000**
2070	W	962,000	302,000	3,388,000	(34,000)	55,000	16,000	**4,689,000**	2,130,000	1,887,000	0	0	557,000	1,000	0	**4,575,000**

Land Surface Budget														
Water Year	Water Year Type	Inflows							Outflows					
		Precipitation	Surface Water Inflows	Applied Water – Groundwater	Applied Water – Imported Surface Water	Project Effects	Other Direct Recharge	Total Inflows	Runoff	Evapotranspiration	Surface Water Outflows	Deep Percolation	Project Effects	Total Outflows
2014	Shasta Critical	283,000	26,000	556,000	1,025,000	0	7,000	**1,897,000**	189,000	1,605,000	5,000	200,000	0	**1,999,000**
2015	Shasta Critical	363,000	26,000	607,000	907,000	0	8,000	**1,911,000**	169,000	1,519,000	4,000	261,000	0	**1,953,000**
2016	Dry	712,000	39,000	355,000	1,219,000	0	9,000	**2,334,000**	280,000	1,598,000	32,000	367,000	0	**2,277,000**
2017	Wet	686,000	53,000	282,000	1,442,000	16,000	8,000	**2,487,000**	330,000	1,755,000	39,000	405,000	0	**2,529,000**
2018	Normal	527,000	39,000	356,000	1,376,000	0	6,000	**2,304,000**	279,000	1,625,000	33,000	363,000	(1,000)	**2,300,000**
2019	Wet	712,000	53,000	234,000	1,501,000	11,000	8,000	**2,519,000**	331,000	1,780,000	39,000	338,000	(1,000)	**2,488,000**
2020	Dry	434,000	39,000	353,000	1,463,000	9,000	7,000	**2,305,000**	236,000	1,693,000	32,000	314,000	3,000	**2,275,000**
2021	Wet	808,000	53,000	227,000	1,499,000	6,000	8,000	**2,601,000**	383,000	1,787,000	39,000	352,000	10,000	**2,561,000**
2022	Wet	1,021,000	53,000	216,000	1,502,000	16,000	8,000	**2,816,000**	440,000	1,803,000	39,000	412,000	10,000	**2,694,000**
2023	Normal	580,000	39,000	355,000	1,443,000	4,000	6,000	**2,427,000**	257,000	1,683,000	33,000	371,000	2,000	**2,344,000**
2024	Dry	573,000	39,000	344,000	1,466,000	8,000	7,000	**2,437,000**	260,000	1,695,000	32,000	347,000	3,000	**2,334,000**
2025	Wet	884,000	53,000	227,000	1,501,000	16,000	8,000	**2,689,000**	355,000	1,815,000	39,000	384,000	10,000	**2,593,000**
2026	Dry	575,000	39,000	440,000	1,423,000	15,000	8,000	**2,500,000**	248,000	1,751,000	32,000	377,000	7,000	**2,408,000**
2027	Dry	653,000	39,000	438,000	1,423,000	14,000	8,000	**2,575,000**	280,000	1,732,000	32,000	380,000	9,000	**2,424,000**
2028	Dry	534,000	39,000	442,000	1,424,000	14,000	8,000	**2,461,000**	275,000	1,758,000	32,000	312,000	9,000	**2,377,000**
2029	Dry	462,000	39,000	441,000	1,422,000	15,000	8,000	**2,387,000**	257,000	1,709,000	32,000	312,000	10,000	**2,310,000**
2030	Shasta Critical	417,000	26,000	531,000	1,136,000	3,000	8,000	**2,121,000**	209,000	1,591,000	5,000	318,000	9,000	**2,123,000**
2031	Shasta Critical	492,000	26,000	531,000	1,136,000	3,000	8,000	**2,196,000**	211,000	1,606,000	5,000	360,000	9,000	**2,182,000**
2032	Wet	832,000	53,000	234,000	1,503,000	21,000	8,000	**2,651,000**	335,000	1,802,000	39,000	420,000	23,000	**2,596,000**
2033	Dry	466,000	26,000	445,000	1,350,000	20,000	8,000	**2,315,000**	245,000	1,706,000	5,000	316,000	11,000	**2,272,000**
2034	Wet	851,000	53,000	215,000	1,500,000	34,000	8,000	**2,661,000**	365,000	1,756,000	39,000	405,000	23,000	**2,565,000**
2035	Wet	731,000	53,000	243,000	1,502,000	22,000	8,000	**2,559,000**	324,000	1,815,000	39,000	356,000	23,000	**2,534,000**
2036	Wet	774,000	53,000	278,000	1,508,000	35,000	8,000	**2,656,000**	301,000	1,842,000	39,000	441,000	23,000	**2,623,000**
2037	Wet	1,194,000	53,000	211,000	1,497,000	37,000	8,000	**3,000,000**	494,000	1,741,000	39,000	554,000	24,000	**2,828,000**
2038	Normal	448,000	39,000	390,000	1,440,000	12,000	6,000	**2,335,000**	273,000	1,626,000	33,000	335,000	15,000	**2,267,000**
2039	Normal	488,000	39,000	404,000	1,439,000	11,000	6,000	**2,387,000**	265,000	1,664,000	33,000	362,000	15,000	**2,324,000**
2040	Dry	534,000	39,000	373,000	1,466,000	26,000	7,000	**2,445,000**	263,000	1,675,000	32,000	376,000	11,000	**2,346,000**
2041	Dry	384,000	39,000	388,000	1,468,000	16,000	7,000	**2,302,000**	214,000	1,671,000	32,000	335,000	10,000	**2,252,000**
2042	Normal	530,000	39,000	427,000	1,484,000	12,000	6,000	**2,498,000**	282,000	1,759,000	34,000	344,000	15,000	**2,419,000**
2043	Dry	488,000	39,000	386,000	1,449,000	26,000	7,000	**2,395,000**	238,000	1,766,000	33,000	285,000	11,000	**2,322,000**
2044	Wet	875,000	53,000	244,000	1,483,000	50,000	7,000	**2,712,000**	400,000	1,799,000	40,000	380,000	24,000	**2,619,000**
2045	Wet	622,000	53,000	270,000	1,512,000	42,000	6,000	**2,505,000**	328,000	1,809,000	39,000	318,000	23,000	**2,494,000**
2046	Dry	268,000	39,000	516,000	1,477,000	17,000	7,000	**2,324,000**	225,000	1,765,000	33,000	301,000	11,000	**2,324,000**
2047	Dry	402,000	39,000	522,000	1,427,000	15,000	8,000	**2,413,000**	202,000	1,795,000	32,000	333,000	10,000	**2,362,000**

Land Surface Budget														
Water Year	Water Year Type	Inflows							Outflows					
		Precipitation	Surface Water Inflows	Applied Water - Groundwater	Applied Water - Imported Surface Water	Project Effects	Other Direct Recharge	Total Inflows	Runoff	Evapotranspiration	Surface Water Outflows	Deep Percolation	Project Effects	Total Outflows
2048	Normal	331,000	39,000	548,000	1,455,000	6,000	5,000	**2,384,000**	212,000	1,858,000	33,000	298,000	14,000	**2,401,000**
2049	Normal	658,000	39,000	359,000	1,438,000	39,000	6,000	**2,539,000**	280,000	1,667,000	33,000	409,000	18,000	**2,389,000**
2050	Wet	708,000	53,000	267,000	1,505,000	48,000	7,000	**2,588,000**	343,000	1,840,000	39,000	336,000	23,000	**2,558,000**
2051	Dry	350,000	39,000	390,000	1,465,000	24,000	7,000	**2,275,000**	222,000	1,704,000	32,000	254,000	11,000	**2,212,000**
2052	Dry	390,000	39,000	496,000	1,421,000	28,000	8,000	**2,382,000**	210,000	1,693,000	32,000	363,000	11,000	**2,298,000**
2053	Shasta Critical	306,000	26,000	576,000	1,109,000	3,000	7,000	**2,027,000**	180,000	1,661,000	5,000	250,000	9,000	**2,096,000**
2054	Shasta Critical	340,000	26,000	575,000	1,045,000	5,000	8,000	**1,999,000**	154,000	1,627,000	4,000	300,000	8,000	**2,085,000**
2055	Dry	630,000	39,000	394,000	1,205,000	16,000	9,000	**2,293,000**	253,000	1,701,000	32,000	317,000	10,000	**2,303,000**
2056	Wet	745,000	53,000	300,000	1,432,000	35,000	8,000	**2,573,000**	311,000	1,857,000	39,000	395,000	22,000	**2,602,000**
2057	Wet	693,000	53,000	261,000	1,505,000	28,000	8,000	**2,548,000**	302,000	1,855,000	39,000	322,000	24,000	**2,518,000**
2058	Normal	478,000	39,000	494,000	1,459,000	11,000	5,000	**2,486,000**	208,000	1,836,000	33,000	380,000	15,000	**2,457,000**
2059	Wet	739,000	53,000	252,000	1,501,000	55,000	8,000	**2,608,000**	306,000	1,844,000	39,000	372,000	24,000	**2,561,000**
2060	Dry	405,000	39,000	377,000	1,466,000	23,000	7,000	**2,317,000**	200,000	1,743,000	32,000	305,000	11,000	**2,280,000**
2061	Wet	910,000	53,000	244,000	1,502,000	56,000	8,000	**2,773,000**	348,000	1,851,000	39,000	459,000	24,000	**2,697,000**
2062	Normal	466,000	39,000	400,000	1,441,000	14,000	6,000	**2,366,000**	230,000	1,716,000	33,000	352,000	15,000	**2,331,000**
2063	Normal	477,000	39,000	483,000	1,453,000	11,000	5,000	**2,468,000**	236,000	1,816,000	33,000	332,000	15,000	**2,417,000**
2064	Dry	338,000	39,000	379,000	1,469,000	26,000	7,000	**2,258,000**	168,000	1,739,000	32,000	287,000	11,000	**2,226,000**
2065	Normal	725,000	39,000	382,000	1,438,000	17,000	6,000	**2,607,000**	249,000	1,693,000	33,000	499,000	16,000	**2,474,000**
2066	Wet	668,000	53,000	261,000	1,503,000	28,000	8,000	**2,521,000**	293,000	1,853,000	39,000	300,000	24,000	**2,485,000**
2067	Wet	690,000	53,000	257,000	1,502,000	28,000	8,000	**2,538,000**	296,000	1,851,000	39,000	313,000	24,000	**2,499,000**
2068	Dry	448,000	26,000	484,000	1,188,000	17,000	8,000	**2,171,000**	222,000	1,650,000	5,000	267,000	11,000	**2,144,000**
2069	Dry	382,000	26,000	490,000	1,191,000	15,000	8,000	**2,112,000**	186,000	1,652,000	5,000	262,000	11,000	**2,105,000**
2070	Wet	962,000	53,000	236,000	1,498,000	55,000	8,000	**2,812,000**	360,000	1,838,000	39,000	490,000	24,000	**2,727,000**

Table CC-15~~13~~: Delta-Mendota Subbasin Projected Water Budget, Groundwater Budget
(containing climate change factors and projects and management actions)

Groundwater Budget																		
		Inflows							Outflows							Change in Storage		
		Infiltration	Lateral Subsurface Flow		Seepage Through Corcoran Clay - SJREC Only	Applied Water Infiltration (Project Effect–) - NCDM Only	Deep Percolation (Project Effect–) - NCDM Only	Project Effects	Total Inflows	Groundwater Extraction		Lateral Subsurface Flow		Flow to Lower Aquifer- Grassland Only	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow - Grassland Only	Total Outflows	Estimated Annual Change in Groundwater Storage		
			Upper Aquifer	*Lower Aquifer*						*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*				*Upper Aquifer*	*Lower Aquifer*	*Total*
2014	SC	275,000	162,000	115,000	0	0	0	0	**552,000**	513,000	101,000	321,000	191,000	0	0	**1,126,000**	(428,000)	(234,000)	(662,000)
2015	SC	333,000	154,000	113,000	0	0	0	0	**600,000**	558,000	101,000	325,000	202,000	0	0	**1,186,000**	(408,000)	(234,000)	(642,000)
2016	D	487,000	152,000	112,000	0	0	0	0	**751,000**	354,000	60,000	313,000	156,000	0	0	**883,000**	(89,000)	(130,000)	(219,000)
2017	W	525,000	198,000	128,000	0	0	0	10,000	**861,000**	254,000	50,000	307,000	91,000	0	0	**702,000**	148,000	(28,000)	120,000
2018	N	465,000	190,000	115,000	0	0	0	0	**770,000**	347,000	59,000	264,000	101,000	0	0	**771,000**	105,000	44,000	149,000
2019	W	461,000	216,000	124,000	0	0	0	10,000	**811,000**	231,000	38,000	279,000	74,000	0	0	**622,000**	122,000	11,000	133,000
2020	D	385,000	153,000	106,000	0	0	3,000	0	**647,000**	354,000	57,000	298,000	136,000	0	0	**845,000**	(185,000)	(142,000)	(327,000)
2021	W	464,000	218,000	125,000	0	0	10,000	0	**817,000**	224,000	39,000	280,000	72,000	0	0	**615,000**	135,000	27,000	162,000
2022	W	553,000	218,000	125,000	0	0	10,000	10,000	**916,000**	214,000	37,000	276,000	77,000	0	0	**604,000**	254,000	40,000	294,000
2023	N	449,000	186,000	117,000	0	0	3,000	0	**755,000**	348,000	55,000	264,000	111,000	0	0	**778,000**	89,000	74,000	163,000
2024	D	417,000	151,000	108,000	0	0	3,000	0	**679,000**	349,000	58,000	301,000	134,000	0	0	**842,000**	(153,000)	(94,000)	(247,000)
2025	W	493,000	214,000	125,000	0	0	10,000	10,000	**852,000**	227,000	38,000	278,000	73,000	0	0	**616,000**	176,000	44,000	220,000
2026	D	451,000	152,000	107,000	0	0	6,000	0	**716,000**	413,000	51,000	302,000	137,000	0	0	**903,000**	(169,000)	(56,000)	(225,000)
2027	D	470,000	152,000	106,000	0	0	9,000	0	**737,000**	411,000	52,000	303,000	131,000	0	0	**897,000**	(148,000)	(47,000)	(195,000)
2028	D	390,000	153,000	104,000	0	0	9,000	0	**656,000**	414,000	51,000	304,000	130,000	0	0	**899,000**	(225,000)	(55,000)	(280,000)
2029	D	395,000	154,000	103,000	0	0	10,000	0	**662,000**	410,000	51,000	303,000	129,000	0	0	**893,000**	(213,000)	(67,000)	(280,000)
2030	SC	400,000	159,000	97,000	0	0	9,000	0	**665,000**	454,000	84,000	312,000	127,000	0	0	**977,000**	(230,000)	(104,000)	(334,000)
2031	SC	442,000	158,000	97,000	0	0	9,000	0	**706,000**	453,000	82,000	313,000	118,000	0	0	**966,000**	(188,000)	(89,000)	(277,000)
2032	W	545,000	220,000	115,000	0	0	22,000	0	**902,000**	213,000	35,000	279,000	68,000	0	0	**595,000**	258,000	61,000	319,000
2033	D	400,000	157,000	98,000	0	0	10,000	0	**665,000**	402,000	50,000	308,000	133,000	0	0	**893,000**	(201,000)	(70,000)	(271,000)
2034	W	547,000	220,000	118,000	0	0	22,000	10,000	**917,000**	203,000	29,000	273,000	70,000	0	0	**575,000**	275,000	57,000	332,000
2035	W	459,000	220,000	119,000	0	0	22,000	0	**820,000**	225,000	34,000	276,000	76,000	0	0	**611,000**	162,000	55,000	217,000
2036	W	552,000	221,000	119,000	0	0	22,000	10,000	**924,000**	243,000	51,000	275,000	76,000	0	0	**645,000**	275,000	65,000	340,000
2037	W	719,000	217,000	122,000	0	0	23,000	10,000	**1,091,000**	202,000	31,000	269,000	80,000	0	0	**582,000**	442,000	53,000	495,000
2038	N	415,000	185,000	114,000	0	0	15,000	0	**729,000**	350,000	58,000	258,000	111,000	0	0	**777,000**	90,000	87,000	177,000
2039	N	455,000	197,000	117,000	0	0	15,000	0	**784,000**	360,000	63,000	262,000	108,000	0	0	**793,000**	142,000	82,000	224,000
2040	D	457,000	151,000	104,000	0	0	10,000	0	**722,000**	348,000	53,000	299,000	136,000	0	0	**836,000**	(82,000)	(65,000)	(147,000)
2041	D	410,000	150,000	101,000	0	0	10,000	0	**671,000**	352,000	56,000	299,000	130,000	0	0	**837,000**	(123,000)	(68,000)	(191,000)
2042	N	448,000	197,000	111,000	0	0	15,000	0	**771,000**	385,000	62,000	264,000	100,000	0	0	**811,000**	98,000	98,000	196,000

Groundwater Budget																		
-	-	Inflows							Outflows							Change in Storage		
-	-	Infiltration	Lateral Subsurface Flow		Seepage Through Corcoran Clay - SJREC Only	Applied Water Infiltration (Project Effect–) - NCDM Only	Deep Percolation (Project Effect–) - NCDM Only	Project Effects	Total Inflows	Groundwater Extraction		Lateral Subsurface Flow		Flow to Lower Aquifer- Grassland Only	Discharge to Surface Water/Consumptive Use by GDEs/Lateral Flow - Grassland Only	Total Outflows	Estimated Annual Change in Groundwater Storage		
-	-		*Upper Aquifer*	*Lower Aquifer*						*Upper Aquifer*	*Lower Aquifer*	*Upper Aquifer*	*Lower Aquifer*				*Upper Aquifer*	*Lower Aquifer*	*Total*
2043	D	368,000	151,000	100,000	0	0	10,000	0	**629,000**	357,000	55,000	298,000	109,000	0	0	**819,000**	(173,000)	(58,000)	(231,000)
2044	W	502,000	209,000	119,000	0	0	23,000	28,000	**881,000**	220,000	38,000	282,000	71,000	0	0	**611,000**	227,000	59,000	286,000
2045	W	413,000	215,000	121,000	0	0	22,000	28,000	**799,000**	235,000	43,000	271,000	77,000	0	0	**626,000**	141,000	32,000	173,000
2046	D	382,000	151,000	101,000	0	0	10,000	0	**644,000**	469,000	68,000	296,000	112,000	0	0	**945,000**	(264,000)	(85,000)	(349,000)
2047	D	422,000	150,000	99,000	0	0	10,000	0	**681,000**	471,000	71,000	298,000	105,000	0	0	**945,000**	(214,000)	(64,000)	(278,000)
2048	N	393,000	187,000	109,000	0	0	14,000	0	**703,000**	475,000	92,000	263,000	100,000	0	0	**930,000**	(27,000)	69,000	42,000
2049	N	545,000	188,000	110,000	0	0	16,000	0	**859,000**	345,000	56,000	262,000	103,000	0	0	**766,000**	209,000	90,000	299,000
2050	W	436,000	217,000	120,000	0	0	23,000	28,000	**824,000**	239,000	46,000	274,000	73,000	0	0	**632,000**	173,000	41,000	214,000
2051	D	343,000	152,000	101,000	0	0	10,000	0	**606,000**	361,000	58,000	296,000	136,000	0	0	**851,000**	(195,000)	(88,000)	(283,000)
2052	D	466,000	150,000	98,000	0	0	10,000	0	**724,000**	463,000	66,000	296,000	105,000	0	0	**930,000**	(183,000)	(82,000)	(265,000)
2053	SC	341,000	156,000	97,000	0	0	9,000	0	**603,000**	499,000	99,000	312,000	104,000	0	0	**1,014,000**	(322,000)	(95,000)	(417,000)
2054	SC	392,000	156,000	96,000	0	0	8,000	0	**652,000**	514,000	98,000	312,000	102,000	0	0	**1,026,000**	(270,000)	(98,000)	(368,000)
2055	D	422,000	152,000	96,000	0	0	9,000	0	**679,000**	376,000	62,000	296,000	101,000	0	0	**835,000**	(138,000)	(69,000)	(207,000)
2056	W	511,000	222,000	115,000	0	0	22,000	28,000	**898,000**	258,000	58,000	278,000	67,000	0	0	**661,000**	244,000	48,000	292,000
2057	W	437,000	222,000	116,000	0	0	23,000	0	**798,000**	249,000	41,000	279,000	73,000	0	0	**642,000**	110,000	46,000	156,000
2058	N	479,000	205,000	108,000	0	0	15,000	0	**807,000**	453,000	69,000	266,000	105,000	0	0	**893,000**	63,000	83,000	146,000
2059	W	482,000	221,000	120,000	0	0	23,000	28,000	**874,000**	245,000	40,000	275,000	74,000	0	0	**634,000**	192,000	55,000	247,000
2060	D	395,000	150,000	101,000	0	0	10,000	0	**656,000**	361,000	51,000	293,000	136,000	0	0	**841,000**	(157,000)	(76,000)	(233,000)
2061	W	581,000	218,000	120,000	0	0	23,000	28,000	**970,000**	238,000	40,000	274,000	72,000	0	0	**624,000**	297,000	56,000	353,000
2062	N	454,000	198,000	113,000	0	0	15,000	0	**780,000**	372,000	60,000	262,000	109,000	0	0	**803,000**	115,000	83,000	198,000
2063	N	431,000	200,000	113,000	0	0	15,000	0	**759,000**	448,000	71,000	264,000	107,000	0	0	**890,000**	17,000	90,000	107,000
2064	D	376,000	152,000	101,000	0	0	11,000	0	**640,000**	368,000	52,000	299,000	134,000	0	0	**853,000**	(183,000)	(68,000)	(251,000)
2065	N	657,000	186,000	111,000	0	0	15,000	0	**969,000**	360,000	60,000	263,000	103,000	0	0	**786,000**	321,000	95,000	416,000
2066	W	419,000	218,000	120,000	0	0	23,000	0	**780,000**	258,000	42,000	280,000	74,000	0	0	**654,000**	78,000	50,000	128,000
2067	W	430,000	217,000	121,000	0	0	23,000	0	**791,000**	257,000	42,000	277,000	77,000	0	0	**653,000**	96,000	54,000	150,000
2068	D	362,000	155,000	102,000	0	0	10,000	0	**629,000**	451,000	64,000	311,000	113,000	0	0	**939,000**	(291,000)	(72,000)	(363,000)
2069	D	364,000	154,000	98,000	0	0	10,000	0	**626,000**	457,000	62,000	312,000	105,000	0	0	**936,000**	(297,000)	(64,000)	(361,000)
2070	W	638,000	211,000	118,000	0	0	23,000	28,000	**1,018,000**	237,000	42,000	270,000	70,000	0	0	**619,000**	350,000	55,000	405,000

Groundwater Budget																					
Water Year	Water Year Type	Inflows								Outflows					Change in Storage				
		Deep Percolation			Subsurface Groundwater Inflows		Seepage through Corcoran Clay	Other Direct Recharge	Project Effects	Total Inflows	Groundwater Extraction from Upper Aquifer	Groundwater Extraction from Lower Aquifer	Subsurface Groundwater Outflows		Total Outflows	Estimated Annual Change in Groundwater Storage				
		Precipitation Infiltration	Surface Water Infiltration	Applied Water Infiltration	Upper Aquifer	Lower Aquifer							Upper Aquifer	Lower Aquifer		Inflows	Outflows	Change in Storag_e – Upper Aquifer	Change in Storag_e – Lower Aquifer	Change in Storag_e – Total
2014	Shasta Critical	51,000	58,000	96,000	162,000	70,000	45,000	58,000	0	**540,000**	500,000	97,000	281,000	186,000	**1,109,000**	540,000	1,110,000	(433,000)	(123,000)	(556,000)
2015	Shasta Critical	39,000	57,000	167,000	157,000	68,000	45,000	60,000	0	**593,000**	546,000	98,000	282,000	197,000	**1,168,000**	593,000	1,168,000	(405,000)	(132,000)	(537,000)
2016	Dry	98,000	75,000	235,000	154,000	67,000	45,000	70,000	0	**744,000**	338,000	57,000	280,000	151,000	**871,000**	743,000	871,000	(92,000)	(49,000)	(141,000)
2017	Wet	93,000	93,000	212,000	198,000	82,000	45,000	109,000	16,000	**848,000**	245,000	50,000	260,000	87,000	**687,000**	843,000	688,000	142,000	(14,000)	128,000
2018	Normal	70,000	84,000	228,000	190,000	70,000	45,000	77,000	5,000	**769,000**	328,000	57,000	233,000	100,000	**763,000**	763,000	762,000	105,000	18,000	122,000
2019	Wet	106,000	92,000	145,000	215,000	79,000	45,000	105,000	15,000	**802,000**	226,000	37,000	233,000	73,000	**614,000**	798,000	614,000	116,000	13,000	128,000
2020	Dry	58,000	78,000	179,000	152,000	62,000	45,000	68,000	9,000	**651,000**	336,000	52,000	266,000	134,000	**833,000**	645,000	833,000	(184,000)	(43,000)	(227,000)
2021	Wet	108,000	93,000	166,000	218,000	80,000	45,000	85,000	16,000	**811,000**	219,000	37,000	235,000	71,000	**607,000**	805,000	608,000	128,000	15,000	144,000
2022	Wet	126,000	88,000	221,000	216,000	80,000	45,000	107,000	26,000	**909,000**	209,000	35,000	231,000	75,000	**595,000**	904,000	596,000	246,000	21,000	267,000
2023	Normal	81,000	78,000	212,000	188,000	72,000	45,000	75,000	9,000	**760,000**	329,000	52,000	234,000	108,000	**768,000**	753,000	768,000	91,000	28,000	119,000
2024	Dry	75,000	74,000	194,000	153,000	62,000	45,000	70,000	9,000	**682,000**	331,000	51,000	270,000	132,000	**829,000**	676,000	829,000	(152,000)	(13,000)	(164,000)
2025	Wet	111,000	91,000	173,000	214,000	81,000	45,000	107,000	26,000	**848,000**	220,000	36,000	234,000	71,000	**606,000**	841,000	606,000	170,000	27,000	197,000
2026	Dry	75,000	76,000	223,000	153,000	62,000	45,000	70,000	13,000	**717,000**	391,000	46,000	269,000	135,000	**886,000**	711,000	885,000	(165,000)	(7,000)	(172,000)
2027	Dry	82,000	80,000	233,000	153,000	60,000	45,000	68,000	15,000	**736,000**	390,000	47,000	270,000	128,000	**880,000**	731,000	879,000	(144,000)	0	(144,000)
2028	Dry	72,000	81,000	161,000	156,000	59,000	45,000	68,000	15,000	**657,000**	391,000	47,000	269,000	127,000	**879,000**	651,000	879,000	(216,000)	(5,000)	(222,000)
2029	Dry	60,000	84,000	175,000	155,000	58,000	45,000	68,000	16,000	**661,000**	387,000	46,000	269,000	127,000	**874,000**	654,000	875,000	(208,000)	(13,000)	(221,000)
2030	Shasta Critical	59,000	65,000	204,000	162,000	57,000	40,000	65,000	9,000	**661,000**	440,000	78,000	277,000	125,000	**960,000**	660,000	960,000	(225,000)	(33,000)	(257,000)
2031	Shasta Critical	66,000	66,000	240,000	162,000	57,000	40,000	65,000	9,000	**705,000**	439,000	77,000	276,000	116,000	**948,000**	703,000	947,000	(180,000)	(22,000)	(201,000)
2032	Wet	112,000	97,000	236,000	222,000	75,000	40,000	86,000	29,000	**897,000**	205,000	32,000	240,000	68,000	**585,000**	891,000	584,000	253,000	17,000	271,000
2033	Dry	61,000	69,000	195,000	161,000	57,000	40,000	65,000	17,000	**665,000**	386,000	45,000	273,000	130,000	**874,000**	659,000	874,000	(195,000)	(18,000)	(213,000)
2034	Wet	114,000	96,000	214,000	219,000	77,000	40,000	107,000	39,000	**906,000**	194,000	26,000	233,000	69,000	**562,000**	901,000	562,000	269,000	15,000	285,000
2035	Wet	100,000	93,000	165,000	220,000	78,000	40,000	86,000	29,000	**811,000**	215,000	30,000	237,000	74,000	**596,000**	806,000	596,000	157,000	14,000	171,000
2036	Wet	105,000	89,000	236,000	219,000	78,000	40,000	105,000	39,000	**911,000**	234,000	48,000	236,000	74,000	**632,000**	905,000	633,000	266,000	19,000	285,000
2037	Wet	149,000	86,000	359,000	214,000	83,000	40,000	107,000	40,000	**1,078,000**	192,000	27,000	230,000	77,000	**566,000**	1,072,000	566,000	431,000	14,000	445,000
2038	Normal	80,000	75,000	175,000	187,000	74,000	40,000	75,000	21,000	**727,000**	323,000	54,000	232,000	107,000	**756,000**	722,000	756,000	95,000	20,000	115,000
2039	Normal	72,000	75,000	219,000	195,000	76,000	40,000	77,000	21,000	**775,000**	332,000	60,000	236,000	105,000	**773,000**	769,000	773,000	143,000	20,000	163,000
2040	Dry	76,000	70,000	232,000	154,000	63,000	40,000	70,000	18,000	**723,000**	324,000	46,000	271,000	133,000	**814,000**	717,000	814,000	(75,000)	(11,000)	(87,000)
2041	Dry	61,000	75,000	197,000	153,000	60,000	40,000	68,000	16,000	**670,000**	328,000	49,000	269,000	128,000	**814,000**	665,000	814,000	(115,000)	(12,000)	(127,000)
2042	Normal	80,000	82,000	198,000	197,000	72,000	40,000	75,000	21,000	**765,000**	357,000	58,000	238,000	99,000	**792,000**	758,000	791,000	98,000	27,000	125,000
2043	Dry	72,000	77,000	136,000	152,000	60,000	40,000	70,000	18,000	**625,000**	329,000	49,000	271,000	106,000	**795,000**	617,000	796,000	(171,000)	(10,000)	(180,000)
2044	Wet	117,000	91,000	172,000	209,000	80,000	40,000	107,000	57,000	**873,000**	203,000	35,000	242,000	70,000	**590,000**	867,000	590,000	230,000	17,000	247,000

Groundwater Budget																					
Water Year	Water Year Type	Inflows								Outflows					Change in Storage				
		Deep Percolation			Subsurface Groundwater Inflows		Seepage through Corcoran Clay	Other Direct Recharge	Project Effects	Total Inflows	Groundwater Extraction from Upper Aquifer	Groundwater Extraction from Lower Aquifer	Subsurface Groundwater Outflows		Total Outflows	Estimated Annual Change in Groundwater Storage				
		Precipitation Infiltration	Surface Water Infiltration	Applied Water Infiltration	Upper Aquifer	Lower Aquifer							Upper Aquifer	Lower Aquifer		Inflows	Outflows	Change in Storag_e – Upper Aquifer	Change in Storag_e – Lower Aquifer	Change in Storag_e – Total
2045	Wet	89,000	87,000	113,000	215,000	81,000	40,000	107,000	56,000	**788,000**	217,000	40,000	230,000	75,000	**602,000**	782,000	603,000	143,000	9,000	151,000
2046	Dry	44,000	75,000	179,000	154,000	61,000	40,000	68,000	17,000	**638,000**	439,000	62,000	268,000	109,000	**918,000**	632,000	919,000	(259,000)	(19,000)	(278,000)
2047	Dry	52,000	80,000	206,000	152,000	59,000	40,000	68,000	16,000	**673,000**	440,000	65,000	270,000	103,000	**918,000**	667,000	919,000	(210,000)	(10,000)	(220,000)
2048	Normal	52,000	84,000	168,000	188,000	68,000	40,000	75,000	20,000	**695,000**	446,000	85,000	237,000	98,000	**906,000**	690,000	907,000	(26,000)	19,000	(7,000)
2049	Normal	94,000	84,000	271,000	188,000	70,000	40,000	77,000	24,000	**848,000**	312,000	51,000	238,000	101,000	**742,000**	842,000	742,000	210,000	24,000	234,000
2050	Wet	87,000	90,000	133,000	216,000	80,000	40,000	107,000	57,000	**810,000**	219,000	41,000	235,000	72,000	**607,000**	803,000	608,000	172,000	11,000	183,000
2051	Dry	48,000	76,000	134,000	152,000	61,000	40,000	68,000	17,000	**596,000**	329,000	51,000	269,000	133,000	**822,000**	591,000	822,000	(192,000)	(20,000)	(212,000)
2052	Dry	49,000	81,000	249,000	154,000	58,000	40,000	68,000	17,000	**716,000**	430,000	60,000	268,000	103,000	**901,000**	711,000	901,000	(175,000)	(14,000)	(189,000)
2053	Shasta Critical	49,000	63,000	148,000	160,000	57,000	40,000	63,000	9,000	**589,000**	474,000	91,000	276,000	101,000	**982,000**	588,000	982,000	(316,000)	(14,000)	(330,000)
2054	Shasta Critical	37,000	65,000	208,000	161,000	55,000	40,000	63,000	8,000	**637,000**	488,000	91,000	277,000	101,000	**997,000**	638,000	996,000	(262,000)	(18,000)	(280,000)
2055	Dry	85,000	86,000	152,000	156,000	55,000	40,000	70,000	16,000	**660,000**	340,000	54,000	268,000	100,000	**802,000**	654,000	801,000	(139,000)	(6,000)	(145,000)
2056	Wet	95,000	97,000	185,000	220,000	75,000	40,000	107,000	55,000	**874,000**	237,000	52,000	238,000	66,000	**633,000**	869,000	633,000	236,000	17,000	253,000
2057	Wet	97,000	95,000	133,000	223,000	76,000	40,000	85,000	30,000	**779,000**	228,000	34,000	240,000	72,000	**614,000**	772,000	613,000	105,000	14,000	119,000
2058	Normal	66,000	82,000	236,000	205,000	68,000	40,000	75,000	21,000	**793,000**	416,000	61,000	239,000	103,000	**859,000**	786,000	860,000	65,000	20,000	85,000
2059	Wet	101,000	92,000	152,000	222,000	79,000	40,000	107,000	58,000	**851,000**	222,000	33,000	235,000	72,000	**602,000**	845,000	602,000	187,000	18,000	205,000
2060	Dry	59,000	76,000	168,000	151,000	61,000	40,000	70,000	17,000	**642,000**	325,000	42,000	265,000	133,000	**805,000**	635,000	805,000	(155,000)	(13,000)	(167,000)
2061	Wet	108,000	91,000	243,000	217,000	80,000	40,000	107,000	58,000	**944,000**	214,000	33,000	235,000	70,000	**592,000**	938,000	592,000	289,000	20,000	309,000
2062	Normal	73,000	79,000	199,000	199,000	73,000	40,000	77,000	22,000	**762,000**	330,000	53,000	236,000	106,000	**765,000**	756,000	765,000	119,000	21,000	140,000
2063	Normal	71,000	77,000	183,000	201,000	73,000	40,000	75,000	21,000	**741,000**	408,000	61,000	237,000	104,000	**850,000**	735,000	850,000	20,000	25,000	45,000
2064	Dry	50,000	74,000	159,000	153,000	61,000	40,000	68,000	18,000	**623,000**	328,000	42,000	271,000	131,000	**812,000**	616,000	813,000	(180,000)	(9,000)	(190,000)
2065	Normal	81,000	82,000	388,000	187,000	71,000	40,000	77,000	22,000	**948,000**	315,000	53,000	238,000	100,000	**746,000**	941,000	745,000	323,000	26,000	349,000
2066	Wet	94,000	90,000	114,000	219,000	80,000	40,000	85,000	30,000	**752,000**	229,000	34,000	240,000	72,000	**615,000**	745,000	615,000	74,000	17,000	91,000
2067	Wet	97,000	89,000	126,000	216,000	80,000	40,000	85,000	30,000	**763,000**	227,000	33,000	236,000	75,000	**611,000**	756,000	611,000	92,000	16,000	108,000
2068	Dry	65,000	58,000	146,000	157,000	62,000	40,000	63,000	11,000	**602,000**	415,000	53,000	274,000	110,000	**892,000**	603,000	892,000	(284,000)	(12,000)	(296,000)
2069	Dry	57,000	64,000	150,000	156,000	58,000	40,000	63,000	11,000	**599,000**	421,000	53,000	274,000	103,000	**891,000**	598,000	890,000	(290,000)	(8,000)	(298,000)
2070	Wet	119,000	100,000	274,000	211,000	77,000	40,000	107,000	57,000	**985,000**	204,000	33,000	227,000	69,000	**573,000**	980,000	573,000	350,000	19,000	369,000

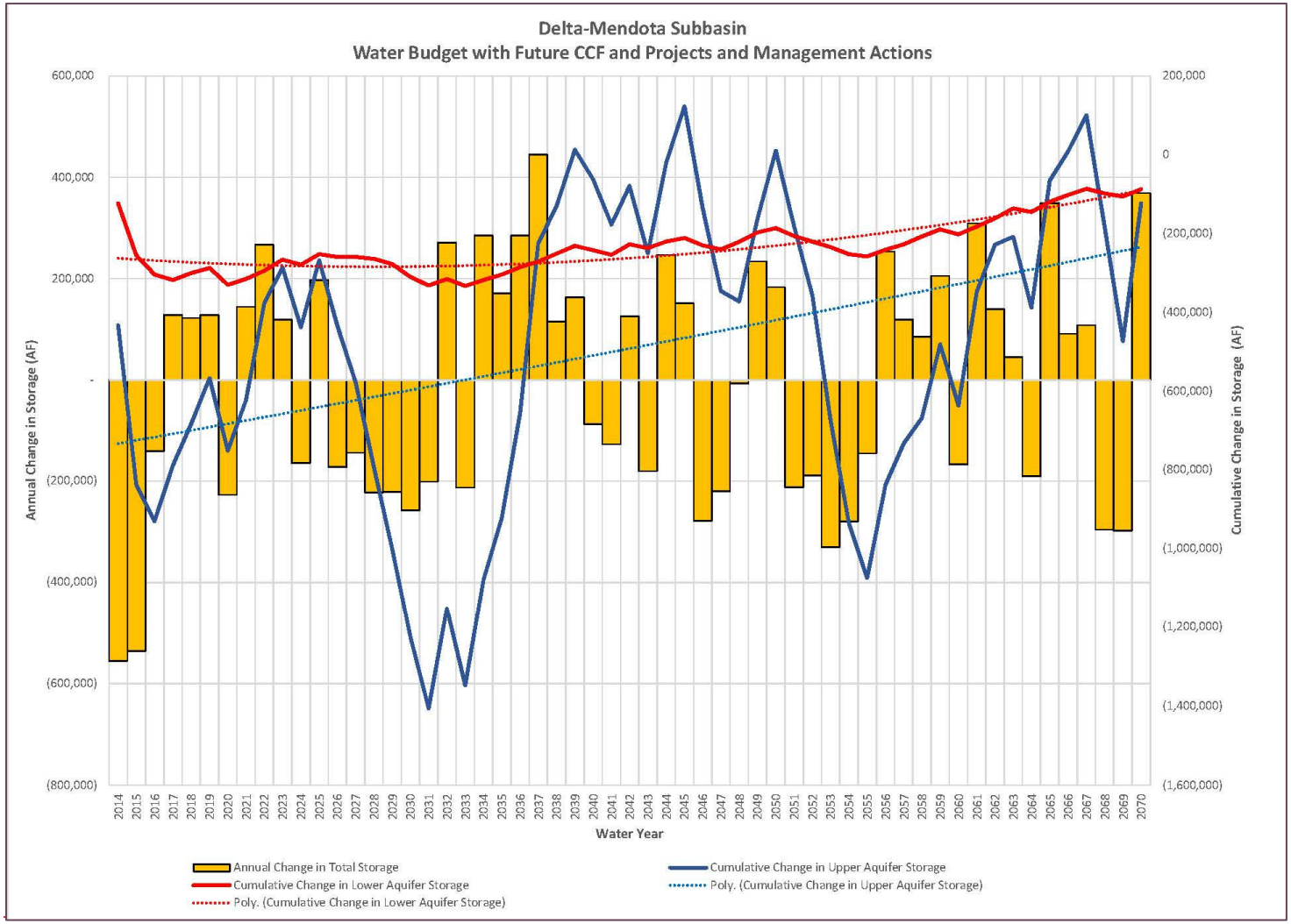
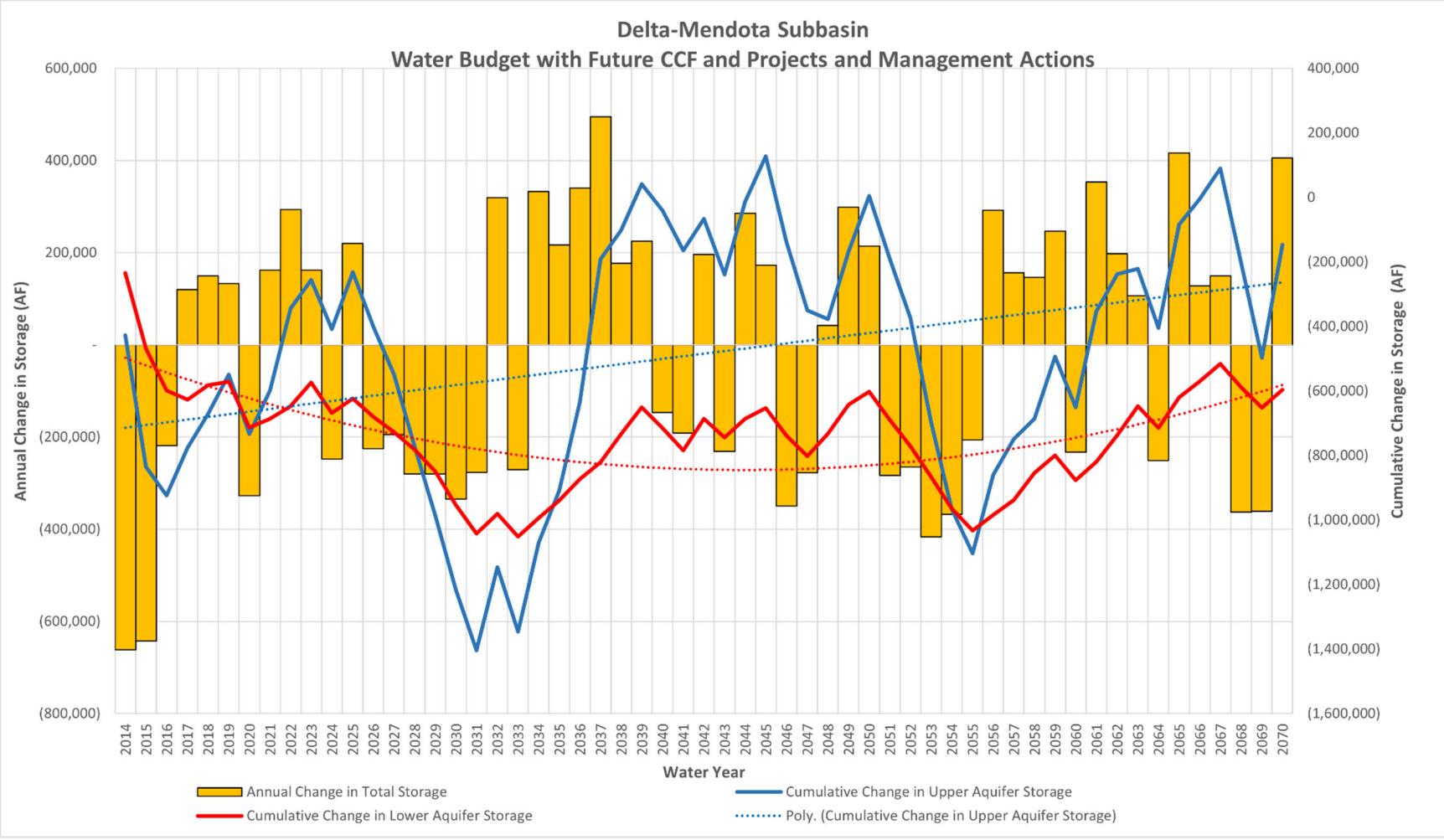

Delta-Mendota Subbasin
Water Budget with Future CCF and Projects and Management Actions
Annual Change in Storage (AF)
Cumulative Change in Storage (AF)
Water Year
600,000
400,000
200,000
-
(200,000)
(400,000)
(600,000)
(800,000)
200,000
0
(200,000)
(400,000)
(600,000)
(800,000)
(1,000,000)
(1,200,000)
(1,400,000)
(1,600,000)
2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070
Annual Change in Total Storage
Cumulative Change in Upper Aquifer Storage
Cumulative Change in Lower Aquifer Storage
Poly. (Cumulative Change in Upper Aquifer Storage)
Poly. (Cumulative Change in Lower Aquifer Storage)

Figure CC-64: Change in Storage, Delta-Mendota Subbasin Projected Water Budget



4.3.4 Sustainable Yield

Under SGMA, sustainable yield is defined as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result." (CWC 10721(w)). Sustainable yield estimates for the Upper Aquifer and Lower Aquifer have been developed in a coordinated fashion for the Delta-Mendota Subbasin by the Delta-Mendota Technical Working Group and approved by the Delta-Mendota Coordination Committee.

Upper Aquifer Sustainable Yield Estimate

Methodologies for calculating Upper Aquifer sustainable yield were discussed by both the Delta-Mendota Coordination Committee and an ad-hoc Technical Working Group of the Coordination Committee. During a workshop dedicated to this effort, several basic concepts and principles were discussed to calculate the Upper Aquifer sustainable yield estimate. Consideration was given to several potential options with increasing detail, including a combination of the following: total Subbasin Upper Aquifer pumping volumes, total Subbasin Upper Aquifer change in storage, and Subbasin Upper Aquifer subsurface inflows and outflows. Inflow from certain neighboring subbasins, based on groundwater flow direction, as well as subsurface inflow from the Coast Range at existing gradients (as part of the inflow to the Northern & Central Delta-Mendota Region GSP area) was considered. Outflow to neighboring subbasins at existing gradients was also considered in certain applicable areas along the Delta-Mendota Subbasin boundary based on groundwater flow characteristics.

An overarching goal of this Subbasin is to maintain a balanced water budget by managing groundwater extractions (pumping). Therefore, the Upper Aquifer sustainable yield was estimated using the change in storage from the historic water budget (WY2003-2012). Based on these considerations, the following formula was selected for estimating Upper Aquifer sustainable yield utilizing the consolidated historic water budget components:

> Upper Aquifer Sustainable Yield = (Pumping + Change in Storage) + (Subsurface Outflow – Subsurface Inflow)

~~Given existing Subbasin data gaps and uncertainties associated with the data used to develop the water budgets and this estimate, it was also decided that a +/- 10% factor should be applied to determine a range for the Upper Aquifer sustainable yield value. The +/- 10% factor is applied based on the percentage difference between the values from change in storage Subbasin contour mapping for the historic water budget period and the reported changes in storage from the Subbasin consolidated historic water budgets (WY2003-2012) for the Upper Aquifer.~~

The formula for determining Upper Aquifer sustainable yield was applied to the following compiled Delta-Mendota Subbasin projected water budgets (WY2014-2070):

- ~~—~~Projected Baseline values with Climate Change Factors
- ~~—~~Projected Baseline values with Climate Change Factors and Projects and Management Actions

This analysis resulted in an Upper Aquifer Sustainable Yield estimate ~~ranging from 325,000 acre-feet to of~~ 480,000403,000 acre-feet~~, demonstrating the Subbasin's Upper Aquifer sustainable yield estimated without implementing any projects and management actions (low end of range) and how the Subbasin's~~

~~Upper Aquifer sustainable yield will be impacted by implementing planned projects and management actions (high end of range)~~.

The Upper Aquifer sustainable yield values, derived from calculations using the best available but limited data, are is considered to be a preliminary estimations only and will be updated to an anticipated higher level of accuracy in future GSP updates. The intention of the Delta-Mendota Subbasin GSAs, following GSP submission in 2020, is to increase subbasin-wide data collection efforts. Improved data, modeling results, and understanding of subsurface flows will allow the GSAs and each GSP Group to improve estimated sustainable yield values for future GSP updates. The GSP Groups are in the process of developing GSP implementation guidelines that will address future data collection efforts and other GSP implementation activities.

The Upper Aquifer sustainable yield calculated range reflects the principle that the GSAs within the Delta-Mendota Subbasin reserve the right to claim or retain some portion of subbasin outflow generated by the lowering of groundwater levels from neighboring subbasins and the equitable portion of sources of recharge shared between two subbasins, by physical or non-physical means, in the future if the Delta-Mendota Subbasin GSAs determine that doing so will improve Subbasin sustainability or will prevent undesirable results due to the chronic lowering of groundwater levels. Furthermore, intra-basin coordination during GSP development, followed by continuing inter-basin coordination discussions and data collection after GSP adoption, will allow the GSAs to further refine these determinations.

Lower Aquifer Sustainable Yield Estimate

Currently, within the Delta-Mendota Subbasin, the distribution of known Lower Aquifer water level data and extraction volume data are not sufficient to allow for an accurate calculation of Lower Aquifer sustainable yield utilizing the same methodology as for the Upper Aquifer. Following discussions by both the Coordination Committee and the ad hoc Technical Working Group of the Coordination Committee, a consensus was reached to establish a Lower Aquifer sustainable yield estimate for the Subbasin by evaluating studies previously conducted in adjoining subbasinsbased on a projection of existing subsidence rates as measured along the DMC with the minimum threshold established for inelastic land subsidence.

In the original 2020 submittal, the calculation for the Lower Aquifer sustainable yield was based on the following. The Westlands Water District GSA recently conducted a study using groundwater modeling, in conjunction with the Westside GSP development, to estimate sustainable yield for the Westside Subbasin. Based on an analysis of available data and an initial assumption of Lower Aquifer sustainable yield equivalent to approximately 0.35 acre-feet per acre within the Westside Subbasin (Westlands Water District GSA, Groundwater Management Strategy Concepts presentation to the WWD Board on October 16, 2018), the GSA estimates a sustainable yield of 230,000 to 250,000 acre-feet, with historic conditions suggesting a range from 250,000 to 300,000 acre-feet (Westlands Water District GSA, Westside Subbasin's Groundwater Model Forecast and Augmentation Strategies presentation to the WWD Board on April 3, 2019). Using Westlands Water District GSA's analysis, the Delta-Mendota Coordination Committee recommended a slightly more conservative sustainable yield value of one-third (0.33) an acre-foot per acre for the Delta-Mendota Subbasin. -Using this more conservative value, the estimated Lower Aquifer sustainable yield is approximately 250,000 acre-feet per year over the approximately 750,000-acre subbasin. It should be noted that sustainable management of the Lower Aquifer is governed by significant and unreasonable subsidence rather than sustainable yield. The distribution of sustainable yield is not uniform throughout the Subbasin, and it will be the responsibility of each GSA in the Subbasin to manage Lower Aquifer pumping to prevent significant and unreasonable subsidence.

Acknowledging that land subsidence is occurring at localized areas in the Subbasin, the DMCC refined the Lower Aquifer sustainable yield calculation, adjusting the value from 250,000 AF to 101,000 AF, based on observed extractions from the Lower Aquifer during WY2015. This refinement is consistent

with the common definitions established across the Subbasin for all SMCs. It is important to note that subsidence will be the primary factor influencing the allowable volume of groundwater that can be extracted from the Lower Aquifer without incurring significant and unreasonable impacts on beneficial uses and users. As such, this number will be updated as data gaps are filled, particularly using the Proposition (Prop) 68 grant-funded well inventory and subsidence study and the results of the Airborne Electromagnetic (AEM) survey recently completed by DWR. Furthermore, the Subbasin will investigate the feasibility to recharge the Lower Aquifer as a means of reducing subsidence and managing future Lower Aquifer sustainable yield.

~~Since DWR classified the Delta-Mendota Subbasin as a critically overdraft subbasin due to subsidence issues, the more conservative acre-foot per acre value for a Lower Aquifer sustainable yield estimation is considered valid as a starting point for the Subbasin. Lower Aquifer groundwater extractions may be managed to a stricter criterion in some areas in order to reduce or eliminate the potential for future inelastic land subsidence on critical infrastructure.~~

The Lower Aquifer sustainable yield estimate will be refined in the future based on data collected and compiled for the Subbasin. This current sustainable yield approximation highlights the importance of an accepted Subbasin-level subsidence monitoring program concurrent with improved estimates of sub-Corcoran Clay groundwater extractions.

5. SUSTAINABLE MANAGEMENT CRITERIA

As required by Subarticle 3. Sustainable Management Criteria of the GSP regulations, the GSPs must include a sustainability goal and definitions of undesirable results, in addition to defining what is considered to be significant and unreasonable and establishing minimum thresholds, measurable objectives and 5-year interim goals. Given the variability of conditions within the Delta-Mendota Subbasin, a subbasin-wide sustainability goal and definitions of undesirable results were developed at the subbasin-level, while the definitions of significant and unreasonable, minimum thresholds, measurable objectives and 5-year interim goals were established at the GSP Plan area-level.

This section describes the coordinated sustainability goal and definition of undesirable results at a subbasin-level and the sustainable management criteria at a GSP-level. Sustainable management criteria developed by each GSP Group were further compared and coordinated between neighboring GSP Groups to avoid conflicts, particularly in setting numeric minimum thresholds, measurable objectives, and interim milestones at boundary locations. The sustainable management criteria for each GSP Group for each applicable sustainability indicator are presented herein.

5.1 Coordinated Assumptions and Data

All common coordinated assumptions and data agreed upon and implemented by each GSP Group in developing their respective sustainable management criteria for each applicable sustainability indicator are presented in Technical Memoranda 4 (*Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Indicators, and GSP Documentation*), which is included in **Appendix B** of this Common Chapter.

During preparation of the January 2020 GSP, ~~Once~~ each GSP Group drafted their respective sustainable management criteria for each applicable sustainability indicator and then met ~~, the Delta-Mendota Subbasin Technical Working Group requested that all GSP Groups meet~~ with their neighboring GSP Groups to coordinate minimum thresholds and measurable objectives to avoid conflicts and ensure each GSP Group would not negatively impact their neighboring GSP Groups from achieving sustainability. ~~These coordination meetings took place between April and August of 2019.~~In the CIL received on January 21, 2022, DWR stated that "The GSPs have not established common definitions of undesirable results in the Subbasin." nor did they comply with the Emergency GSP Regulations in establishing common definitions and methodologies for SMC. In response, subsequent to receipt of the CIL, the Technical Working Group and Coordination Committee met to develop, at a subbasin level, singular coordinated definitions and methods for establishing SMC for each applicable sustainability indicator.

5.2 Coordinated Sustainability Goal and Undesirable Results

The sustainability goal for the Delta-Mendota Subbasin was established to succinctly state the objectives and desired conditions of the Subbasin that culminates in the absence of undesirable results by 2040. The sustainability goal for the Delta-Mendota Subbasin is as follows and was approved by the Delta-Mendota Subbasin Coordination Committee during the June 10, 2019 meeting:

> *The Delta-Mendota Subbasin will manage groundwater resources for the benefit of all users of groundwater in a manner that allows for operational flexibility, ensures resource availability under drought conditions, and does not negatively impact surface water diversion and conveyance and delivery capabilities. This goal will be achieved through the implementation of the proposed projects and management actions to reach identified measurable objectives and milestones through the*

implementation of the GSP(s), and through continued coordination with neighboring subbasins to ensure the absence of undesirable results by 2040.

The following definitions of "undesirable results" were agreed upon during the 20222 revision of this Common Chapter for the following applicable sustainability indicators:

- **Chronic lowering of groundwater ~~levels~~levels** - Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater~~Significant and unreasonable chronic change in in water levels, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions~~.

- **Reduction in groundwater ~~storage~~storage** - A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater~~Significant and unreasonable chronic decrease in groundwater storage, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions~~.

- **Degraded water ~~quality~~quality** - Degradation of groundwater quality as a result of groundwater management activities that causes significant and unreasonable impacts to beneficial uses and users of groundwater~~Significant and unreasonable degradation of groundwater quality, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions and/or activities~~.

- **Land ~~subsidence~~subsidence** - Changes in ground surface elevation that cause damage to critical infrastructure, including significant and unreasonable reductions of conveyance capacity, impacts to natural resource areas, or conditions that threaten public health and safety~~Changes in ground surface elevation that cause damage to critical infrastructure that would cause significant and unreasonable reductions of conveyance capacity, damage to personal property, impacts to natural resources or create conditions that threaten public health and safety~~.

- **Depletions of interconnected surface ~~water~~water** - Depletions of interconnected surface water as a direct result of groundwater pumping that cause significant and unreasonable impacts on natural resources or downstream beneficial uses and users~~Depletions of interconnected surface water, as defined by each GSP Group, that have significant and unreasonable adverse impacts on the beneficial uses of surface water~~.

5.3 GSP-Level Sustainable Management Criteria

In the original 2020 GSP submittals for the Delta-Mendota Subbasin, each ~~For more information on the development of the sustainable management criteria and information used to support the established sustainable management criteria for the individual GSP Groups, refer to the individual GSPs. Each~~ GSP Group defined what ~~is~~ was considered significant and unreasonable in their Plan Area for each applicable sustainability indicator~~s~~, in addition to establishing minimum thresholds, measurable objectives and 5-year interim goals for their Plan Area, ~~.~~

~~Each GSP Group developed their sustainable management criteria~~ consistent with GSP Regulations Article 5. Plan Contents, Subarticle 3. Sustainable Management Criteria (§ 354.2 through 354.30). DWR's *Draft Best Management Practices for the Sustainable Management of Groundwater Sustainable Management Criteria BMP* (2017) document was also used when and where applicable at the discretion of each GSP Group.

Subsequent to this submittal, the Technical Working Group and Coordination Committee met to develop consistent definitions and methodologies for establishing numeric metrics for each applicable sustainability indicator. These revised SMC are discussed in the next section.

5.4 Delta-Mendota Subbasin Sustainable Management Criteria

The sustainable management criteria for each sustainability indicator contains the following components: the subbasin-wide definitions of an undesirable result~~, GSP level definition~~ and of significant and unreasonable, sustainability goals, ~~5-year interim goals,~~ minimum thresholds (MTs), ~~and~~ measurable objectives (MOs), and five-year interim milestones (IMs). Separate tables show the sustainable management criteria for chronic lowering of groundwater levels ~~(**Table CC-14**)~~, reduction in groundwater storage ~~(**Table CC-15**)~~, degraded water quality, ~~(**Table CC-16**),~~ land subsidence, ~~(**Table CC-17**),~~ and depletions of interconnected surface water ~~(**Table CC-18**)~~ with ~~details corresponding to the individual GSP Groups~~maps showing representative monitoring sites with corresponding numeric MTs and MOs, and a table summarizing the MTs and MOs by representative monitoring location. ~~The established sustainable management criteria were developed through detailed analysis and consideration of conditions unique to each GSP Group, where more detail may be necessary to support the decisions made by each GSP Group. For greater detail regarding the development of the sustainable management criteria for each GSP Group, refer to the sustainable management criteria section or chapter contained in each individual GSP.~~

5.4.1 Chronic Lowering of Groundwater Levels

Chronic Lowering of Groundwater Levels is arguably the most fundamental Sustainability Indicator, as it directly and indirectly influences several other Sustainability Indicators, such as Reduction of Groundwater Storage, Land Subsidence, and Degraded Water Quality. The Subbasin GSAs are committed to maintaining groundwater levels above historic low conditions in order to avoid undesirable results to beneficial uses and users of groundwater and to prevent further decrease of groundwater levels due to groundwater management actions performed within the Subbasin.

The GSAs developed SMCs for Chronic Lowering of Groundwater Levels using readily available historic records of groundwater level data for 61 of the 75 Representative Monitoring Sites (RMS). The MTs and MOs were developed for each RMS using common data and coordinated assumptions, as detailed in **Table CC-16**, and are consistent with the requirement of Title 23 of the California Code of Regulations (23 CCR) § 354.28(c) to consider trends in historic groundwater levels, water year type, projected water use in the Basin, and relationship with other sustainability indicators. The equivalent process was used in both the Upper Aquifer and Lower Aquifer within the Subbasin.

The MT is currently established as a fixed elevation at each RMS, equivalent to the historic seasonal low prior to the end of WY2016, based on available groundwater level data. The MO is to maintain water levels at or above the Water Year 2015 seasonal high at more than 50% of RMS in a GSP area. The GSAs will conduct a minimum of bi-annual groundwater level monitoring to track progress towards sustainability at the 75 RMS.

Per the definition of Undesirable Results for Chronic Lowering of Groundwater Levels, the exceedance of a MT at a single RMS is not indicative of an Undesirable Result; rather, the exceedance of MTs at 50% or more RMS within a GSP area is considered to cause significant and unreasonable impacts to locally-specific beneficial uses and users of groundwater, namely the increased costs associated with modifying wells to access groundwater, securing alternative sources, or required mitigation of groundwater dependent ecosystems. To account for future year-to-year variations in hydrology, compliance will be assessed by comparing a four-year rolling average of groundwater level measurements to the fixed MT at each RMS within a GSP area.

In addition to the SMCs developed as part of this GSP, the GSAs will continue to coordinate to develop shorter-term ("acute") groundwater level thresholds in the five-year GSP update that will be submitted in 2025. These thresholds will be set at levels that avoid short-term undesirable results, particularly for domestic water users, groundwater dependent ecosystems, and interconnected surface waters and subsidence when present. Each year, both the historic seasonal low MT value and the acute groundwater elevation thresholds will apply, whichever is more protective.

~~Table CC-14: Delta-Mendota Subbasin SMC for Chronic Lowering of Groundwater Levels~~

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Significant and unreasonable chronic change in in water levels, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions					

Definition of Significant and Unreasonable	Aliso is not currently experiencing significant and unreasonable effects of reduction in water levels or aquifer storage in the Upper Aquifer. Significant and unreasonable effects would be accelerated rates of subsidence as productive layers in the Upper Aquifer above the Corcoran Clay are depleted, especially in areas with deep or composite wells. Accelerated rates of subsidence may occur If 30% of the wells in the Mmonitoring Zzone exceed the min174escripimum threshold value on a 4-year consecutive average under normal or average year conditions.	Groundwater elevations dropping below historic lows (2015-2016)	Groundwater elevations dropping below historic lows (2015-2016)	Lowering of groundwater levels would lead to increased costs associated with higher total lift, lowering pumps, need to drill deeper wells or costs securing alternative water sources. Impacts to habitat would require mitigation, including alternative water supplies and habitat restoration.	Groundwater elevations dropping below the Minimum Threshold criteria at 40% of representative monitoring locations concurren	The San Joaquin River Exchange Contractors (SJREC) GSP Groupha

					tly over a given water year resulting in shallow domestic wells going dry in the same subregion zone as the representative	sapositive impact to the aquifer and is unlikely to cause Significant

					monitoring points in violation, higher pumping costs, and/or the need to modify wells to obtain groundwater.	ieant and/or Unreasonable lowering of groundwater levels. Tri

[redacted]						~~ggershavebeenestablishedtorecoveraquiferwaterlevelsbef~~

[redacted]						~~orenearingan~~ ~~Undesirable~~ ~~Result.~~ ~~Currently,~~ ~~anapproximatio~~

						~~n o f 2 5 % b e l o w h i s t o r i c l o w f o r e a e l h m a n a g e m e n t a r e a i s u s e d t o i n d~~

[redacted]						~~i~~ ~~e~~ ~~a~~ ~~t~~ ~~e~~ ~~a~~ ~~n~~ ~~U~~ ~~n~~ ~~d~~ ~~e~~ ~~s~~ ~~i~~ ~~r~~ ~~a~~ ~~b~~ ~~l~~ ~~e~~ ~~R~~ ~~e~~ ~~s~~ ~~u~~ ~~l~~ ~~t~~ ~~w~~ ~~h~~ ~~i~~ ~~c~~ ~~h~~ ~~w~~ ~~i~~ ~~l~~ ~~l~~ ~~b~~ ~~e~~ ~~r~~ ~~e~~ ~~f~~ ~~i~~ ~~n~~ ~~e~~ ~~d~~ ~~b~~ ~~a~~ ~~s~~ ~~e~~ ~~d~~ ~~o~~ ~~n~~ ~~a~~ ~~n~~ ~~n~~ ~~u~~ ~~a~~

						~~Update and integration with other GSP Groups.~~

Sustainability Goal for Sustainability Criterion	To maintain the historic hydrological cycle and expand access to surface water during flood years for replenishment of the Upper Aquifer.	Maintain seasonal highs and lows. Prevent trend of decreasing groundwater levels.	Maintain seasonal highs and lows. Prevent trend of decreasing groundwater levels.	Maintain water levels and storage sufficient to meet operational storage in each the Upper Aquifer and Lower Aquifer.	Maintain water levels sufficient to meet operational storage as well as 3-year drought buffer storage.	Maintain historic water levels to meet demand of the beneficial

						~~Uses~~

5-Year Interim Goals	Year 5: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 10: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 15: Maintain groundwater elevations comparable to historic hydrologic highs and lows	Year 5: < Minimum Threshold Year 10: < Minimum Threshold Year 15: < Minimum Threshold	Year 5: < Minimum Threshold Year 10: < Minimum Threshold Year 15: < Minimum Threshold	Year 5: WSE > Measurable Objective Year 10: WSE > Measurable Objective Year 15: WSE > Measurable Objective	Year 5: Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows Year 10: Maintain groundwater	Year 5: Maintain groundwater level; SJREC GSP Group is sustai

					~~nd water elevations compared to 2012 through 2017 hydrologic highs and lows~~ ~~**Year 15: Maintain groundwater elevations, SJREC GSP Group i**~~	~~nable: **Year 10: Maintain current water levels,**~~ ~~**SJREC GSP Group i**~~

					~~rable to 2012 through 2017 hydrologic highs and lows~~	~~sustainable. Year 15: Maintain neutral water level s; SJREGGS~~



Minimum Threshold	The minimum threshold is to provide a 100-foot of buffer from the top of the Corcoran Clay to the top of the water table	**Upper Aquifer** Season Low >- 126 feet below ground surface (ft bgs) Season High >- 57 ft bgs **Lower Aquifer** Season Low >213 ft bgs Season High >- 185 ft bgs	**Upper Aquifer** Season Low >- 63 feet below ground surface (ft bgs) Season High >- 55 ft bgs **Lower Aquifer** Season Low >213 ft bgs Season High >- 185 ft bgs	**Upper Aquifer:** 20% lowered water elevation from recent historic low (set at each monitoring site). **Lower Aquifer:** Lower aquifer representative monitoring wells have been identified for the monitoring network. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds	**Upper Aquifer:** Hydrologic low **Lower Aquifer:** 95% of historic low	The SJREC GSP Group is sustainable. The SJREC GSP Group is unlike

				~~in future GSP Updates.~~		~~lytocausegroundwaterover draft. As a result of this and his tor~~

						~~ideal groundwater management; trigger levels have been established~~

						~~shedforarepresentativesiteineachmanagementarea. Ifwater~~

						~~levels drop below the established trigger level, not transfers o~~

						~~f~~ ~~g~~ ~~r~~ ~~o~~ ~~u~~ ~~n~~ ~~d~~ ~~w~~ ~~a~~ ~~t~~ ~~e~~ ~~r~~ ~~o~~ ~~u~~ ~~t~~ ~~s~~ ~~i~~ ~~d~~ ~~e~~ ~~t~~ ~~h~~ ~~e~~ ~~a~~ ~~r~~ ~~e~~ ~~a~~ ~~a~~ ~~r~~ ~~e~~ ~~a~~ ~~l~~ ~~l~~ ~~o~~ ~~w~~ ~~e~~ ~~d~~ ~~.~~ ~~T~~ ~~h~~ ~~i~~ ~~s~~ ~~m~~ ~~a~~ ~~n~~ ~~a~~ ~~g~~ ~~e~~ ~~m~~ ~~e~~ ~~n~~ ~~t~~ ~~h~~ ~~a~~ ~~s~~

						~~been in place for parts of the Subbasin for years and has proven ef~~

						~~feet above healthy aquifer.~~

~~**Measurable Objective**~~	~~The measurable objective is site specific and tied to water levels in long term hydrographs. The average rate in decline in each well was projected out until 2040 when water levels should begin to stabilize over the long term.~~	~~Maintain seasonal highs and lows above minimum thresho~~ 196escript196~~lds.~~	~~Maintain seasonal highs and lows above minimum thresho~~ 196escript196~~lds.~~	~~**Upper Aquifer:** Recent historic low (set at each monitoring site~~ ~~**Lower Aquifer:** Lower aquifer representative monitoring wells have been identified for the monitoring network. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds in future GSP Updates.~~	~~**Both Aquifers:** Seasonal historic high average, Spring 2012 or Spring 2017, whichever elevation is lowest or where data exists.~~	~~Operate groundwater levels between the effective root zone and~~

						~~the Minimum Threshold.~~

Table CC-16: Delta-Mendota Subbasin SMC for Chronic Lowering of Groundwater Levels

Definition of Undesirable Results	Chronic changes in groundwater levels that diminish access to groundwater, causing significant and unreasonable impacts to beneficial uses and users of groundwater.
Definition of Significant and Unreasonable	Significant and unreasonable impacts to beneficial uses and users of groundwater are substantially increased costs associated with higher total pumping lift, lowering pumps, drilling deeper wells, or otherwise modifying wells to access groundwater, securing alternative water sources, or required mitigation of groundwater dependent ecosystems. Significant and unreasonable is quantitatively defined as exceeding the MT at more than 50% of representative monitoring sites by aquifer in a GSP area.
Sustainability Goal	Maintain groundwater levels that are comparable to existing conditions (historic low conditions as of Water Year 2016) in order to continue meeting the demand of beneficial uses and users of groundwater and prevent a trend of decreasing groundwater levels. The Delta-Mendota Subbasin will continue successful and ongoing coordination with neighboring Subbasins to address chronic lowering of groundwater levels caused by pumping outside of the Subbasin.
Minimum Threshold	The groundwater elevation indicating a chronic lowering of groundwater levels that may lead to undesirable results is an elevation that is lower than the historical seasonal low. The historic seasonal low is a fixed elevation at each site, based on available groundwater level data prior to the end of Water Year 2016. To account for future year-to-year variations in hydrology, compliance with the fixed historic seasonal low threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Shorter-term ("acute") groundwater elevation thresholds will also be established at each representative monitoring site by 2025 using a

	coordinated methodology. Acute thresholds will be established at levels that are intended to avoid short-term undesirable results, particularly for domestic water wells, groundwater dependent ecosystems, and interconnected surface waters where present in the Upper Aquifer, and for subsidence in the Lower Aquifer. Each year, both the historic seasonal low and the acute groundwater elevation thresholds will apply, whichever is more protective. Groundwater levels are measured as water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the minimum threshold applies. See **Table CC-17** for numeric MTs. For any RMS without data prior to Water Year 2016, MTs and acute thresholds will be established using the aforementioned methodologies and the data resulting from the first five years of monitoring following Water Year 2016 or following construction of the well.
Measurable Objective	Maintain seasonal high groundwater levels at an elevation that is at or above the Water Year 2015 seasonal high at more than 50% of representative monitoring sites in a GSP area. The Water Year 2015 seasonal high is a fixed elevation at each site, based on available groundwater level data. If data are unavailable for Water Year 2015 at a representative monitoring site, either a Water Year 2014 or Water Year 2016 Seasonal High will be used. To account for future year-to-year variations in hydrology, compliance with the fixed seasonal high threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Groundwater levels are measured as water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the measurable objective applies. See **Table CC-17** for numeric MOs. For any RMS without data prior to Water Year 2016, Measurable Objectives will be established using the aforementioned methodology and the data resulting from the first five years of monitoring following Water Year 2016 or following the construction of the well.
5-Year Interim Milestones	**Year 5:** Gather data and complete the establishment of seasonal low and seasonal high elevations at representative monitoring sites in the Lower Aquifer for the Grassland GSP area. Develop a coordinated methodology and complete the establishment of acute groundwater elevation thresholds. Identify chronic lowering of groundwater levels caused by pumping outside the Subbasin. **Year 10:** Maintain groundwater levels at MOs. Where chronic lowering of groundwater levels is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 15:** Maintain groundwater levels at MOs. Where chronic lowering of groundwater levels is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

The numeric MTs and MOs by RMS are shown below in **Figure CC-65** for the Upper Aquifer and **Figure CC-66** for the Lower Aquifer, with the numeric SMC tabulated in **Table CC-17**.

Table CC-17: Numeric SMC for the Chronic Lowering of Groundwater Levels

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (ft above MSL, NAVD88)	Measurable Objective (ft above MSL, NAVD88)
09-001	Aliso Water District	Upper	40.5	114.3
09-002	Aliso Water District	Upper (Composite)	-4.0	17.1
09-003	Aliso Water District	Upper	37.4	52.9
09-004	Aliso Water District	Upper	37.7	51.9
10-001	Farmers Water District	Upper	34.0	102.7
12-001	Fresno County	Upper	98.2	103.2
13-001	Fresno County	Upper	109.4	120.5
13-003	Fresno County	Upper	48.6	116.1
13-004	Fresno County	Lower	-59.0	-27.0
11-001	Grassland	Lower	TBD	TBD
11-002	Grassland	Lower	TBD	TBD
11-003	Grassland	Lower	TBD	TBD
11-004	Grassland	Lower	TBD	TBD
11-005	Grassland	Lower	TBD	TBD
11-006	Grassland	Lower	TBD	TBD
11-007	Grassland	Upper	79.9	91.1
11-008	Grassland	Upper	82.3	93.2
11-009	Grassland	Upper	63.4	77.3
11-013	Grassland	Upper	76.8	80.4
11-014	Grassland	Upper	68.1	80.7
11-015	Grassland	Upper	72.8	75.7
11-016	Grassland	Upper	83.1	92.8
11-017	Grassland	Upper	90.2	116.6
11-019	Grassland	Upper	27.0	27.0
19-003	Grassland	Upper	90.5	91.8
01-001	NCDM	Lower	-44.9	-13.4
01-002	NCDM	Lower	-36.1	-18.9
01-003	NCDM	Lower	-21.8	62.3
01-004	NCDM	Upper	158.9	161.8
01-005	NCDM	Upper	110.6	179.6
01-006	NCDM	Lower	77.1	94.0
01-007	NCDM	Lower	12.3	56.7
01-008	NCDM	Lower	-44.9	2.4

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (ft above MSL, NAVD88)	Measurable Objective (ft above MSL, NAVD88)
02-002	NCDM	Lower	-18.3	33.7
02-009	NCDM	Upper	-6.2	29.8
03-001	NCDM	Upper	30.7	46.7
03-002	NCDM	Upper	7.7	67.2
03-003	NCDM	Upper	TBD	TBD
04-001	NCDM	Lower	-17.6	-3.6
06-001	NCDM	Lower	-52.3	16.1
06-002	NCDM	Upper	31.5	44.6
06-003	NCDM	Lower	-9.1	18.5
06-004	NCDM	Upper	14.8	30.5
07-002	NCDM	Lower	1.6	10.8
07-003	NCDM	Upper	62.5	89.9
07-005	NCDM	Lower	-84.7	-41.8
07-007	NCDM	Lower	-53.4	-26.6
07-008	NCDM	Lower	-63.0	-47.0
07-009	NCDM	Upper	49.3	73.9
07-010	NCDM	Upper	64.0	96.2
07-012	NCDM	Upper	TBD	TBD
07-014	NCDM	Lower	-133.5	-47.2
07-015	NCDM	Lower	-147.0	-65.0
07-016	NCDM	Lower	-2.4	74.6
07-017	NCDM	Upper	TBD	TBD
07-018	NCDM	Upper	TBD	TBD
07-028	NCDM	Lower	-88.2	-64.8
07-029	NCDM	Upper	TBD	TBD
07-030	NCDM	Lower	TBD	TBD
07-031	NCDM	Lower	TBD	TBD
07-032	NCDM	Lower	TBD	TBD
07-035	NCDM	Upper	-99.8	95.2
08-002	NCDM	Upper	50.7	83.7
14-001	SJREC	Upper	24.0	48.5
14-002	SJREC	Upper	96.5	125.7
14-003	SJREC	Upper	81.3	92.2
14-004	SJREC	Upper	78.7	92.6
14-005	SJREC	Upper	92.2	106.2
14-006	SJREC	Upper	76.7	98.2
14-007	SJREC	Upper	73.5	98.5
14-008	SJREC	Upper	70.5	98.5

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (ft above MSL, NAVD88)	Measurable Objective (ft above MSL, NAVD88)
14-019	SJREC	Lower	-48.8	35.0
14-020	SJREC	Lower	38.1	57.4
14-021	SJREC	Lower	-33.0	14.8
23-001	SJREC	Upper	102.3	120.2

T–D - Numeric SMC to be determined after five years of data have been collected for this representative monitoring site.

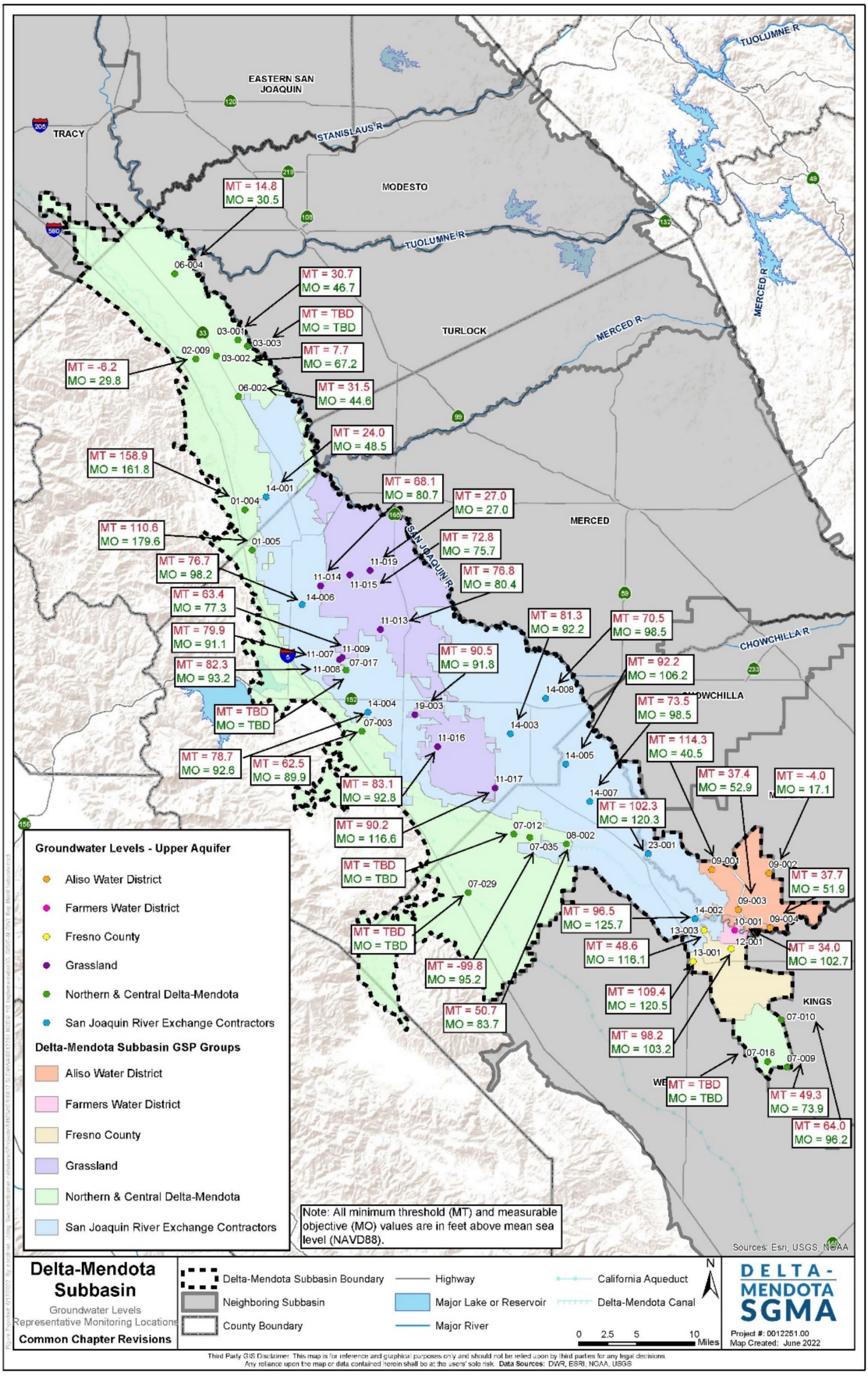


Figure CC-65: Groundwater Level Representative Monitoring Locations with SMC – Upper Aquifer

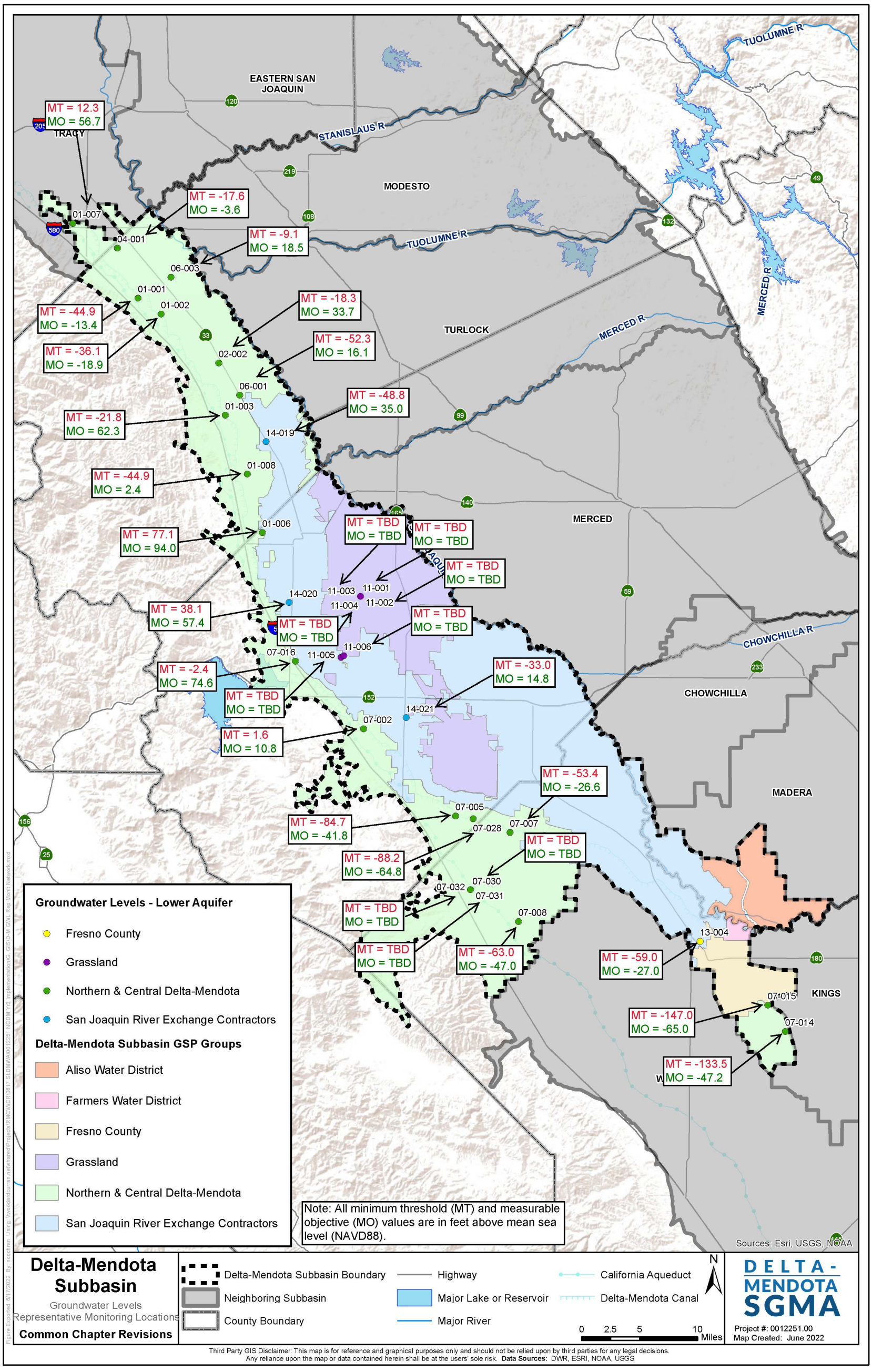


Figure CC-66: Groundwater Level Representative Monitoring Locations with SMC – Lower Aquifer

5.4.2 Reduction in Groundwater Storage

The GSAs intend to maintain groundwater storage at volumes that will continue to meet the demands of beneficial uses and users of groundwater, provide a three-year drought buffer, and minimize reductions in groundwater storage during extended dry periods. Further, the GSAs will coordinate with neighboring subbasins to address reductions in groundwater storage caused by pumping outside of the Subbasin. The SMCs were developed using common data and coordinated assumptions, as detailed in **Table CC-18** and will be monitored a minimum of bi-annually as detailed for Chronic Lowering of Groundwater Levels in Section 5.4.1 (**Table CC-16**) and consistent Land Subsidence monitoring as detailed in Section 5.4.4 (**Table CC-21**).

Pursuant to 23 CCR § 354.28(d), the MTs for Reduction of Groundwater Storage may be set by using groundwater levels as a proxy if it is demonstrated that a correlation exists between the two metrics. It is logical to link these two Sustainability Indicators for the Upper Aquifer, as the amount of groundwater in storage is directly, if not linearly, related to groundwater levels. As such, in the Upper Aquifer, it is not necessary to set a unique MT for Reduction of Groundwater Storage, and the MTs for Chronic Lowering of Groundwater Levels are used as a proxy for the Reduction of Groundwater Storage Sustainability Indicator. Similarly, the MOs for Chronic Lowering of Groundwater Levels serves as a proxy for Reduction of Groundwater Storage. Because the SMCs established for Chronic Lowering of Groundwater Levels are designed to maintain groundwater levels above historic low conditions, they are protective of the Reduction of Groundwater Storage Sustainability indicator and local beneficial uses and users of the Upper Aquifer, as the SMCs maintain sufficient water storage to maintain beneficial uses, including the conjunctive use of groundwater.

In the Lower Aquifer, the physical reduction in groundwater storage is caused by inelastic land subsidence, as detailed in Section 5.4.4 (**Table CC-21**). As such, the SMCs set for Land Subsidence (which are designed to reduce subsidence caused by groundwater extraction in the Subbasin, with no additional subsidence after 2040) are reasonably protective and used as a tool to calculate the Reduction of Groundwater Storage Sustainability Indicator SMCs in the Lower Aquifer[1].

[1] The most significant subsidence in the Subbasin observed between from 2014-2018 was a 0.6 foot decline at Check 18 of the Delta-Mendota Canal. During those same years, the water budget calculation estimated what the change in storage was in the Lower Aquifer. Given the apparent relationship between the loss in groundwater storage and the observed subsidence, the projected allowable additional subsidence (i.e., two feet by 2040) was converted to a groundwater storage volume in the Lower Aquifer and used as the SMC.

Table CC-18: Delta-Mendota Subbasin SMC for Reduction in Groundwater Storage	
Definition of Undesirable Results	A chronic decrease in groundwater storage that causes a significant and unreasonable impact to the beneficial uses and users of groundwater.
Definition of Significant and Unreasonable	A significant and unreasonable impact to beneficial uses and users of groundwater is insufficient water storage to maintain beneficial uses and natural resource areas in the Subbasin, including the conjunctive use of groundwater.
Sustainability Goal	Maintain historic groundwater storage volumes in order to continue meeting the demand of beneficial uses and users of groundwater and to provide a 3-year drought buffer. Minimize reductions in groundwater storage during extended dry periods. Work with neighboring Subbasins to address reduction in groundwater storage caused by pumping outside of the Subbasin.
Minimum Threshold	For the Upper Aquifer, as a reasonable proxy for an individual groundwater storage threshold, maintain groundwater levels in accordance with the minimum threshold set for Chronic Lowering of Groundwater Levels. For the Lower Aquifer, correlate the SMCs for inelastic land subsidence with the reduction in groundwater storage that would cause undesirable results, estimated to be 1.1 million acre-feet of storage loss by 2040 attributable to groundwater extraction in the Subbasin.
Measurable Objective	For the Upper Aquifer, maintain groundwater levels in accordance with the measurable objectives set for Chronic Lowering of Groundwater Levels. For the Lower Aquifer, minimize loss of groundwater storage caused by inelastic land subsidence.
5-Year Interim Milestones	**Year 5:** Maintain groundwater levels in accordance with the measurable objectives. Identify reduction in groundwater storage caused by pumping outside the Subbasin. **Year 10:** Maintain groundwater levels in accordance with the measurable objectives. Where reduction in groundwater storage is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 15:** Maintain groundwater levels in accordance with the measurable objectives. Where reduction in groundwater storage is caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

5.4.3 Degraded Groundwater Quality

The GSP groups within the Delta-Mendota Subbasin are committed to preventing the migration or elevated concentrations of constituents of concern due to groundwater management activities. The primary constituent of concern in the Subbasin is salinity, frequently reported as total dissolved solids (TDS).

For drinking water, California has three secondary maximum contaminant level (SMCL) standards for TDS, all based on aesthetic considerations such as taste and odor, not public health concerns. These are 500 mg/L (recommended limit), 1,000 mg/L (upper limit), and 1,500 mg/L (short-term limit). To reflect the Subbasin's designation as a Municipal (MUN) beneficial use, as established in the Central Valley Water Control Plans (often referred to as Basin Plans), the Subbasin has selected the upper limit of 1,000 mg/L as the Minimum Threshold.

The Delta-Mendota GSAs also recognize that a Salt Control Program for the San Joaquin Valley was recently developed through the collaborative CV-SALTS Program and was adopted into the Central Valley Basin Plans to address the long-term problem of salt accumulation in the Valley. The program recognizes that salt accumulation and water uses vary widely across the Valley. The program approach is intended to protect beneficial uses by maintaining water quality that meets applicable objectives, allow some salt accumulation in areas where salt can be stored without impairing beneficial uses of water, and, through long-term management, restore water quality where reasonable, feasible, and practicable.

A Prioritization and Optimization (P&O) Study planning process is now underway to identify potential requirements that will protect beneficial uses, improve salt management, and restore water quality where possible. During the next ten years (Phase 1), the P&O Study will: characterize the salt conditions and trends in the Valley; identify salt management needs and mechanisms; evaluate the feasibility of potential solutions; prepare an implementation plan; and review and recommend revising salinity regulations as necessary. [1]

The minimum thresholds and measurable objectives for groundwater quality incorporate these standards and objectives for salinity. The minimum threshold is therefore set as 1,000 mg/L TDS, and the measurable objective is a concentration less than 1,000 mg/L TDS with acknowledgement that salinity standards are still being developed by water quality experts and regulatory agencies in the Central Valley, and thus may need to be revised in the future. Additionally, groundwater is frequently blended with other water supplies to reduce TDS concentrations to meet the salinity sensitivity of a particular beneficial use.

For any representative monitoring site that currently exceeds the TDS thresholds set forth above, the existing regulatory water quality compliance and remediation programs will apply. These include, but are not limited to, the CV-SALTS Salt Control Program, the County Drought Plan requirements for State Small Water Systems and Domestic Wells (SB 552), the Safe and Affordable Funding for Equity and Resilience (SAFER) program, and the Bureau of Reclamation's Refuge Water Supply Program. For any future exceedance of the TDS thresholds at representative monitoring sites that do not currently exceed the objectives, the applicable GSP group is required to coordinate and publish an assessment of the effect of groundwater management activities on the documented exceedance, and propose timely actions to manage groundwater differently in order to avoid exacerbating the exceedance.

The sustainable management criteria also incorporate by reference the specific requirements for preventing the migration of contaminants adopted by the Central Valley Regional Water Quality Control Board in Cleanup and Abatement Orders for individual contaminated sites.[2]

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[1] *See* https://www.cvsalinity.org/salt-program/; https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf

[2] *E.g.* the Cleanup and Abatement Order R5-2018-0033 for the Spreckels facility: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/fresno/r5-2018-0033.pdf

Table CC-19: Delta-Mendota Subbasin SMC for Degraded Groundwater Quality	
Definition of Undesirable Results	Degradation of groundwater quality as a result of groundwater management activities that causes significant and unreasonable impacts to beneficial uses and users of groundwater.
Definition of Significant and Unreasonable	Significant and unreasonable impacts to beneficial uses and users of groundwater as a result of groundwater management activities are the migration of contaminant plumes or elevated concentrations of constituents of concern that reduce groundwater availability, and the degradation of surface water quality as a result of groundwater migration that substantially impair an existing beneficial use. Significant and unreasonable is quantitatively defined as exceeding the MT at more than 50% of representative monitoring sites by aquifer in a GSP area where current groundwater quality (as established in the Subbasins GSPs) does not exceed 1,000 mg/L TDS.
Sustainability Goal	Minimize further impairment of water supplies resulting from groundwater management activities that cause the migration or concentration of contaminant plumes or the increased rate of movement or concentrations of constituents of concern. Coordinate with and support compliance with existing regulatory groundwater quality orders and objectives for drinking water, agricultural irrigation, and managed wetlands. Work with neighboring Subbasins to address existing or potential impairments of groundwater quality in the Subbasin caused by groundwater management activities outside the Subbasin.
Minimum Threshold	The minimum threshold for salinity is 1,000 mg/L TDS. For representative monitoring sites that currently exceed the minimum threshold, existing regulatory water quality compliance and remediation programs will apply, including but not limited to, the CV-SALTS Salt Control Program, the Irrigated Lands Regulatory Program, the County Drought Plan requirements for State Small Water Systems and Domestic Wells (SB 552), and the Safe and Affordable Funding for Equity and Resilience (SAFER) program. For any RMS without data prior to the end of Water Year 2016, current (ambient) groundwater quality will be established using data collected during the first five years of monitoring following Water Year 2016 or following construction of the well. For representative monitoring sites that do not currently exceed the minimum threshold, but are found to exceed minimum thresholds in the future, the applicable GSP group will conduct and publish an assessment of the effect of groundwater management activities on the documented exceedance, and propose timely actions to manage groundwater differently, if needed, to avoid exacerbating the exceedance. The applicable GSP group will also coordinate with the appropriate regulatory program to address the impact.

Table CC-19: Delta-Mendota Subbasin SMC for Degraded Groundwater Quality	
Measurable Objective	The measurable objective for salinity will be concentrations less than 1,000 mg/L TDS. Each GSP group will participate in, provide data for, and track and report on compliance with orders and objectives adopted by the State and Central Valley Regional Water Quality Control Boards and similar regulatory agencies, in coordination with the Central Valley Groundwater Monitoring Collaborative.
5-Year Interim Milestones	**Year 5:** Maintain salinity consistent with measurable objectives. Participate in, provide data for, and track and report on compliance with orders and objectives adopted by the State Water Resources and Central Valley Regional Water Quality Control Boards and similar regulatory agencies, in coordination with the Central Valley Groundwater Monitoring Collaborative. Develop correlation between groundwater quality and groundwater levels in order to establish methodology for the use of groundwater levels as a proxy for groundwater quality. **Year 10:** Maintain water quality consistent with measurable objectives. Continue monitoring and publishing groundwater quality data, and tracking and reporting on compliance with regulatory orders and objectives. Where water quality impairments are caused by activities outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Utilizing the methodology developed by the Year 5 Interim Milestone, develop minimum thresholds and measurable objectives for groundwater quality that utilize groundwater elevations as a proxy for monitoring. **Year 15:** Maintain water quality consistent with measurable objectives. Continue monitoring and publishing groundwater quality data, and tracking and reporting on compliance with regulatory orders and objectives. Where water quality impairments are caused by activities outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

The numeric MTs and MOs by RMS are shown below in **Figure CC-67** for the Upper Aquifer and **Figure CC-68** for the Lower Aquifer, with the numeric SMC tabulated in **Table CC-20**.

Table CC-20: Numeric SMC for Degraded Groundwater Quality

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (TDS in mg/L)	Measurable Objective (TDS in mg/L)
09-002	Aliso Water District	Upper	1,000	< 1,000
09-003	Aliso Water District	Upper	1,000	< 1,000
09-005	Aliso Water District	Upper	1,000	< 1,000
09-196	Aliso Water District	Upper	1,000	< 1,000
10-001	Farmers Water District	Upper	1,000	< 1,000
10-005	Farmers Water District	Upper	1,000	< 1,000
12-002	Fresno County	Upper	N/A	N/A
12-003	Fresno County	Upper	N/A	N/A

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (TDS in mg/L)	Measurable Objective (TDS in mg/L)
12-004	Fresno County	Upper	N/A	N/A
12-005	Fresno County	Upper	N/A	N/A
12-006	Fresno County	Upper	1,000	< 1,000
12-007	Fresno County	Upper	N/A	N/A
13-006	Fresno County	Upper	N/A	N/A
13-007	Fresno County	Upper	N/A	N/A
13-008	Fresno County	Upper	N/A	N/A
11-010	Grassland	Lower	TBD	TBD
11-011	Grassland	Lower	1,000	< 1,000
11-012	Grassland	Lower	1,000	< 1,000
11-021	Grassland	Upper	N/A	N/A
19-002	Grassland	Upper	1,000	< 1,000
19-004	Grassland	Upper	N/A	N/A
01-001	NCDM	Lower	1,000	< 1,000
01-002	NCDM	Lower	1,000	< 1,000
01-003	NCDM	Lower	N/A	N/A
01-004	NCDM	Upper	1,000	< 1,000
01-006	NCDM	Lower	1,000	< 1,000
01-007	NCDM	Lower	1,000	< 1,000
01-008	NCDM	Lower	1,000	< 1,000
01-018	NCDM	Upper (assumed)	1,000	< 1,000
02-002	NCDM	Lower	1,000	< 1,000
02-009	NCDM	Upper	1,000	< 1,000
03-001	NCDM	Upper	N/A	N/A
03-003	NCDM	Upper	N/A	N/A
03-007	NCDM	Upper	1,000	< 1,000
04-001	NCDM	Lower	1,000	< 1,000
06-001	NCDM	Lower	1,000	< 1,000
06-002	NCDM	Upper	1,000	< 1,000
06-003	NCDM	Lower	1,000	< 1,000
06-004	NCDM	Upper	N/A	N/A
07-002	NCDM	Lower	1,000	< 1,000
07-003	NCDM	Upper	1,000	< 1,000
07-007	NCDM	Lower	1,000	< 1,000
07-008	NCDM	Lower	N/A	N/A
07-012	NCDM	Upper	N/A	N/A
07-014	NCDM	Lower	1,000	< 1,000
07-015	NCDM	Lower	1,000	< 1,000
07-016	NCDM	Lower	1,000	< 1,000

DMS ID	GSP Region	Principal Aquifer	Minimum Threshold (TDS in mg/L)	Measurable Objective (TDS in mg/L)
07-017	NCDM	Upper	1,000	< 1,000
07-018	NCDM	Upper	N/A	N/A
07-028	NCDM	Lower	N/A	N/A
07-029	NCDM	Upper	N/A	N/A
07-030	NCDM	Lower	N/A	N/A
07-031	NCDM	Lower	N/A	N/A
07-032	NCDM	Lower	N/A	N/A
07-033	NCDM	Upper	1,000	< 1,000
07-034	NCDM	Lower (assumed)	N/A	N/A
07-035	NCDM	Upper	N/A	N/A
08-002	NCDM	Upper	N/A	N/A
14-001	SJREC	Upper	1,000	< 1,000
14-002	SJREC	Upper	1,000	< 1,000
14-003	SJREC	Upper	N/A	N/A
14-004	SJREC	Upper	1,000	< 1,000
14-005	SJREC	Upper	N/A	N/A
14-006	SJREC	Upper	1,000	< 1,000
14-007	SJREC	Upper	N/A	N/A
14-008	SJREC	Upper	1,000	< 1,000
14-019	SJREC	Lower	1,000	< 1,000
14-020	SJREC	Lower	1,000	< 1,000
14-021	SJREC	Lower	N/A	N/A
23-001	SJREC	Upper	1,000	< 1,000

Notes:

1. Current TDS concentration is defined as prior to the end of WY 2016.
2. N/A - Current groundwater quality exceeds 1,000 mg/L TDS.
3. TBD - Numeric SMC to be determined after five years of data have been collected for this representative monitoring site.

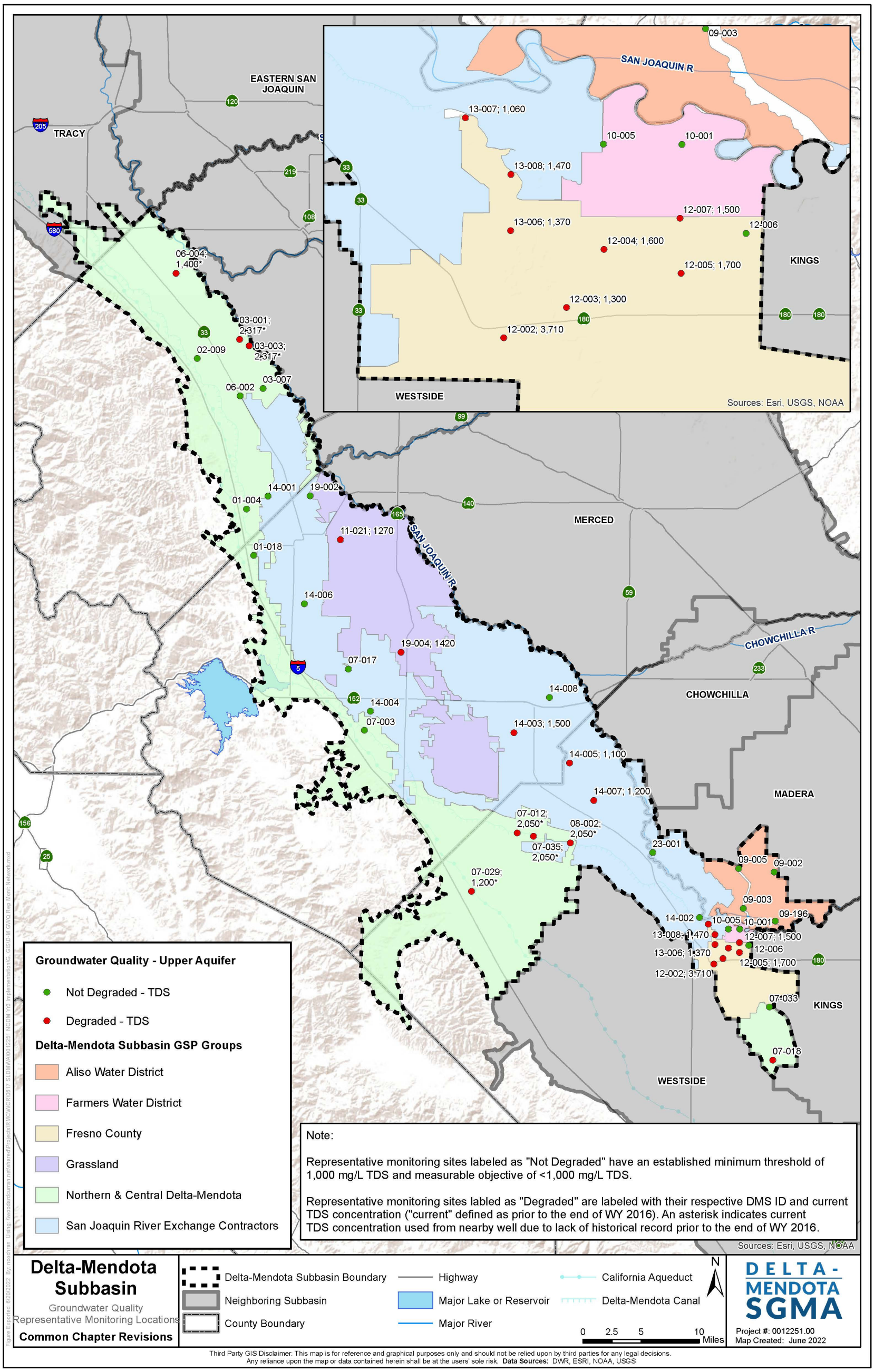

Figure CC-67: Groundwater Quality Representative Monitoring Locations with SMC – Upper Aquifer

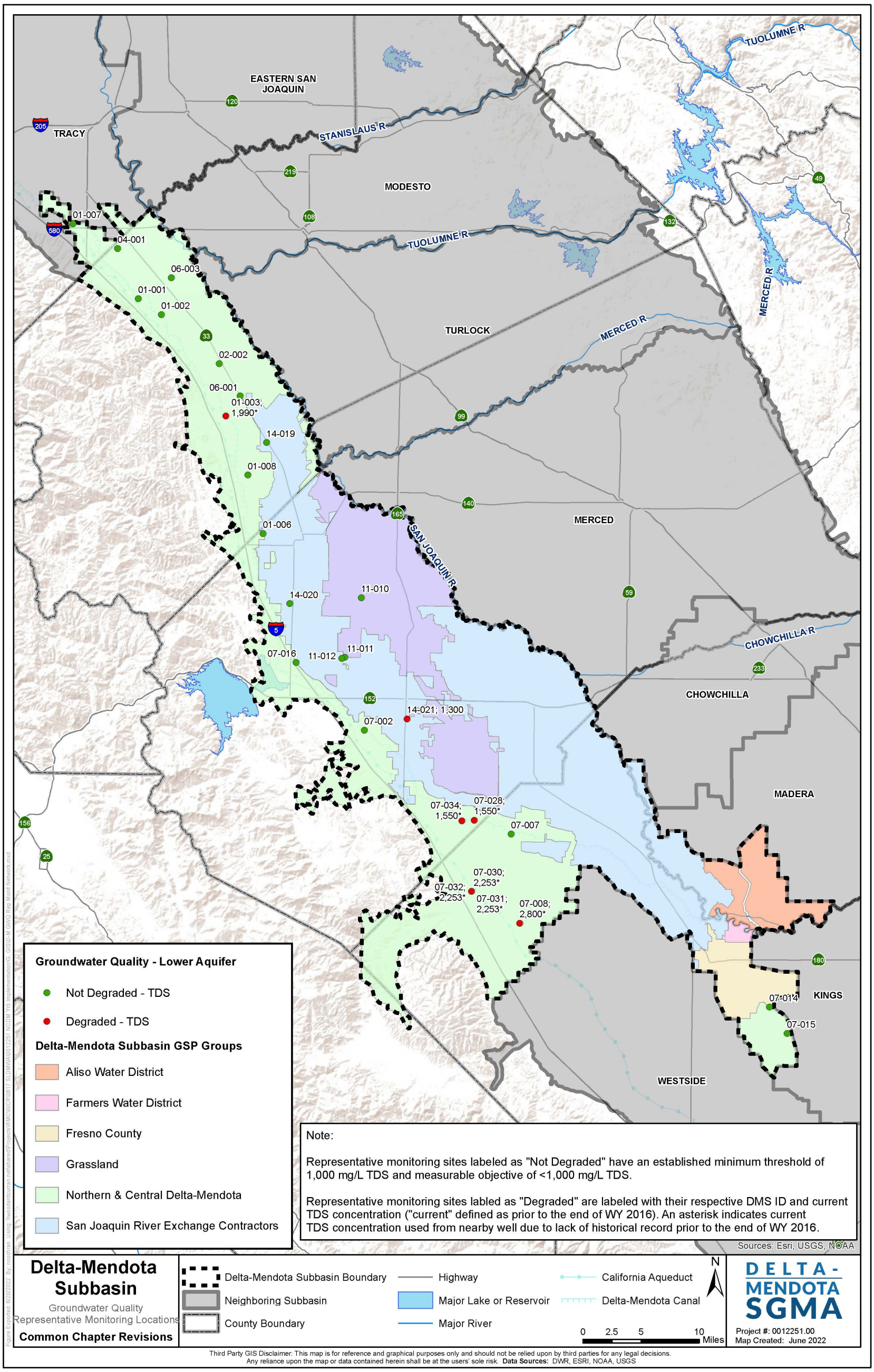

Figure CC-68: Groundwater Quality Representative Monitoring Locations with SMC – Lower Aquifer

5.4.4 Inelastic Land Subsidence

The Subbasin GSAs are committed to ramping down the amount of allowable subsidence caused by groundwater extraction in the Subbasin and eliminating additional subsidence within the Subbasin by 2040. Further, the GSAs will coordinate with neighboring subbasins to address inelastic land subsidence caused by groundwater management activities that occur outside of the Subbasin.

The SMCs for Land Subsidence were coordinated at the Subbasin level and are designed to be protective of critical infrastructure, including significant and unreasonable reductions of conveyance capacity (i.e., structural damage that creates an unmanageable reduction of design capacity), impacts to natural resource areas (i.e., unmitigated decreases in the ability to irrigate or drain these areas by gravity), or conditions that threaten public health and safety (i.e., unmitigated reduction of freeboard that allows for flooding, or unmitigated damage to roads and bridges). The Subbasin-wide MT is set to prevent subsidence that exceeds the corrective design standards or established triggers for critical infrastructure, including the Delta-Mendota Canal and California Aqueduct. At the RMS, the MT is defined as two feet of additional inelastic subsidence by 2040 attributable to groundwater extraction within the Subbasin. The MO is set at no additional subsidence after 2040 based on groundwater extractions within the Delta-Mendota Subbasin.

The GSAs further developed Interim Milestones (IMs) to periodically reduce the amount of allowable subsidence and meet the MO by 2040. The IMs allow for no more than 1.0 foot of additional subsidence by 2025, 0.5 feet of additional subsidence by 2030 (1.5 feet of cumulative subsidence), 0.25 feet of additional subsidence by 2035 (1.75 feet of cumulative subsidence), and 0.25 feet of additional subsidence by 2040 (2.0 feet of cumulative subsidence). The SMCs were defined at 45 RMS in the Subbasin, and the GSAs will conduct monitoring to track progress towards sustainability. Additionally, as part of the 5-year update to the GSPs, the Subbasin Hydrogeologic Conceptual Model (HCM) will be reviewed and revised to incorporate new data, including Airborne Electromagnetic (AEM) survey data provided by DWR and data/results from the Subsidence Study prepared using Prop 68 grant funding. Additionally, the GSAs will continue work with USBR on revisions to the CVHM2 model for simulating groundwater extraction-subsidence interactions, to re-evaluate inelastic land subsidence SMC to consider new data and studies, and to assess allowable land subsidence on a Subbasin and localized (subbasin subarea) basis.

Table CC-21: Delta-Mendota Subbasin SMC for Inelastic Land Subsidence

Definition of Undesirable Results	Changes in ground surface elevation that cause damage to critical infrastructure, including significant and unreasonable reductions of conveyance capacity, impacts to natural resource areas, or conditions that threaten public health and safety.
Definition of Significant and Unreasonable	Significant and unreasonable damage to conveyance capacity from inelastic land subsidence is structural damage that creates an unmitigated and unmanageable reduction of design capacity or freeboard. Significant and unreasonable impacts to natural resource areas from inelastic land subsidence are unmitigated decreases in the ability to flood or drain such areas by gravity. Significant and unreasonable threats to public health and safety from inelastic

Table CC-21: Delta-Mendota Subbasin SMC for Inelastic Land Subsidence	
	land subsidence are those that cause an unmitigated reduction of freeboard that allows for flooding, or unmitigated damage to roads and bridges.
Sustainability Goal	Minimize inelastic land subsidence by ramping down allowable subsidence caused by groundwater extraction in the Subbasin, with no additional subsidence after 2040. Work with neighboring Subbasins to address inelastic land subsidence caused by groundwater extraction outside of the Subbasin.
Minimum Threshold	At representative monitoring sites, the change in ground surface elevation that would cause undesirable results is up to 2 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin. Prevent subsidence caused by groundwater extractions in the Delta-Mendota Subbasin that exceeds corrective design standards or established triggers for critical infrastructure including the Delta-Mendota Canal, California Aqueduct, and roads and bridges.
Measurable Objective	Minimize inelastic land subsidence attributable to groundwater extraction within the Subbasin, with no additional subsidence after 2040.
5-Year Interim Milestones	**Year 5:** Interim goal of no more than 1 foot of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the first 5-year period of SGMA implementation. Review and revise Hydrogeologic Conceptual Model (HCM) to incorporate new data. Re-evaluate inelastic land subsidence SMC to consider new data and studies and to assess allowable land subsidence on a Subbasin and localized (subbasin subarea) basis. Gather data and complete the selection or establishment of representative monitoring sites (RMS) for land subsidence, with particular attention to the locations of critical infrastructure in the Subbasin, and in coordination with the Bureau of Reclamation and Department of Water Resources. Determine the relative proportion of subsidence caused by groundwater extraction within and outside the Subbasin for each RMS. Where subsidence is caused by pumping outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. **Year 10:** Interim goal of no more than 0.5 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the second 5-year period of SGMA implementation, for a cumulative total of 1.5 feet in the first 10 years. Where subsidence is caused by groundwater extraction outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Continue work to improve understanding of interconnection between groundwater extractions and land subsidence, utilizing model simulations and/or data collection and analysis. **Year 15:** Interim goal of no more than 0.25 feet of additional inelastic land subsidence attributable to groundwater extraction in the Subbasin during the third 5-year period of SGMA implementation, for a cumulative total of 1.75 feet in the first 15 years. Where subsidence is caused by groundwater extraction outside the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs. Continue work to improve understanding of interconnection between groundwater extractions and land subsidence, utilizing model simulations and/or data collection and analysis.

The numeric MTs and MOs by RMS are shown below in **Figure CC-69**, with the numeric SMC tabulated in **Table CC-22**.

Table CC-22: Numeric SMC for Inelastic Land Subsidence

DMS ID	GSP Region	Minimum Threshold (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)	Measurable Objective (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)
09-006	Aliso Water District	2	0
09-007	Aliso Water District	2	0
09-008	Aliso Water District	2	0
10-008	Farmers Water District	2	0
12-010	Fresno County	2	0
13-010	Fresno County	2	0
11-018	Grassland	2	0
11-019	Grassland	2	0
11-020	Grassland	2	0
01-009	NCDM	2	0
01-010	NCDM	2	0
01-011	NCDM	2	0
01-012	NCDM	2	0
01-013	NCDM	2	0
01-014	NCDM	2	0
01-015	NCDM	2	0
01-016	NCDM	2	0
01-017	NCDM	2	0
02-003	NCDM	2	0
02-004	NCDM	2	0
02-005	NCDM	2	0
02-006	NCDM	2	0
02-007	NCDM	2	0
02-008	NCDM	2	0
03-004	NCDM	2	0
03-005	NCDM	2	0
03-006	NCDM	2	0
04-003	NCDM	2	0
04-004	NCDM	2	0
04-005	NCDM	2	0
06-006	NCDM	2	0
07-019	NCDM	2	0
07-020	NCDM	2	0

DMS ID	GSP Region	Minimum Threshold (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)	Measurable Objective (Inelastic Land Subsidence in ft Attributable to Groundwater Extraction)
07-021	NCDM	2	0
07-022	NCDM	2	0
07-023	NCDM	2	0
07-024	NCDM	2	0
07-025	NCDM	2	0
07-026	NCDM	2	0
07-027	NCDM	2	0
14-014	SJREC	2	0
14-015	SJREC	2	0
14-016	SJREC	2	0
14-017	SJREC	2	0
14-018	SJREC	2	0

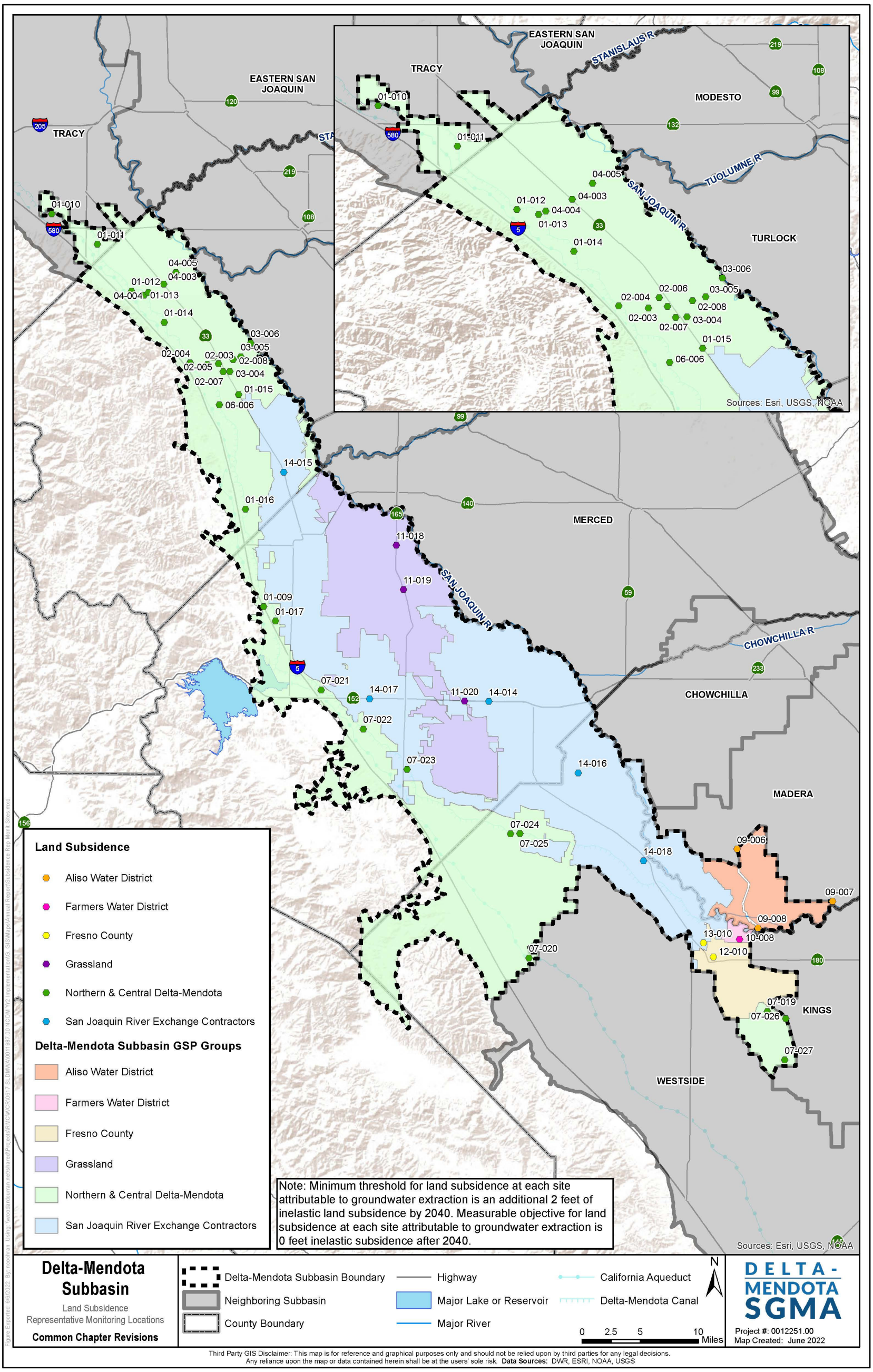

Figure CC-69: Land Subsidence Representative Monitoring Locations with SMC

5.4.5 Depletion of Interconnected Surface Water

The GSAs are committed to managing groundwater within the Subbasin to maintain interconnected surface waters comparable to existing conditions and prevent a trend of increasing interconnected surface water losses from the San Joaquin River. The GSAs will coordinate with neighboring subbasins to address interconnected surface water losses caused by groundwater management activities that occur outside of the Subbasin.

Presently, the Depletion of Interconnected Surface Water Sustainability Indicator is identified as a data gap within the Subbasin. Until the GSAs are able to collect the additional data necessary to set quantitative SMCs for this Sustainability Indicator, the SMCs for Chronic Lowering of Groundwater Levels serve as a proxy in the Upper Aquifer, pursuant to 23 CCR §354.28(d). Because the SMCs established for Chronic Lowering of Groundwater Levels are designed to maintain groundwater levels above historic low conditions, they are understood to be protective of the Depletion of Interconnected Surface Water Sustainability indicator and local natural resources and downstream beneficial uses and users. The RMS locations and frequency are consistent with that detailed in Section 6.

The GSAs plan to establish an Interconnected Surface Water monitoring network and develop SMCs as detailed in Table CC-18. By 2025, the GSAs anticipate completing an Interconnected Surface Water monitoring network that includes nine existing sites in the San Joaquin River Restoration Program and additional sites funded by the SGMA Implementation Grant award. The additional RMS will focus on the Northern & Central Delta-Mendota and Grassland GSP areas along the San Joaquin River. By 2030, the GSAs anticipate being able to gather and analyze data from these new RMS to estimate the influence of groundwater levels on gains and losses observed on the San Joaquin River. At this point, the Subbasin GSAs will establish Interconnected Surface Water SMCs as a rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and may lead to undesirable results.

Table CC-23: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water

Definition of Undesirable Results	Depletions of interconnected surface water as a direct result of groundwater pumping that cause significant and unreasonable impacts on natural resources or downstream beneficial uses and users.
Definition of Significant and Unreasonable	Significant and unreasonable impacts on natural resources or downstream beneficial uses and users of groundwater are a reduction in available surface water supplies for natural resource areas, and reductions in downstream water availability as a result of increased streamflow depletions along the San Joaquin River when compared to similar historic water year types.
Sustainability Goal	Maintain interconnected surface waters comparable to existing conditions (historic low conditions as of Water Year 2016) in order to prevent a trend of increasing interconnected surface water losses from the San Joaquin River. Work with neighboring Subbasins to address increased interconnected surface water losses caused by pumping outside of the Subbasin.
Minimum Threshold	Interconnected Surface Water is an identified data gap in the Delta-Mendota Subbasin. As an interim minimum threshold, use the Chronic Lowering of Groundwater Level Minimum Threshold as a proxy for impacts to interconnected surface waters (see below). The groundwater elevation indicating a chronic lowering of groundwater levels that may lead to undesirable results is an elevation that is lower than the

Table CC-23: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water	
	historical seasonal low. The historic seasonal low is a fixed elevation at each site, based on available groundwater level data prior to the end of Water Year 2016. To account for future year-to-year variations in hydrology, compliance with the fixed historic seasonal low threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Groundwater levels are measured as water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the minimum threshold applies. For any RMS without data prior to Water Year 2016, Minimum Thresholds and acute thresholds will be established using the aforementioned methodologies and the data resulting from the first five years of monitoring following Water Year 2016 or following construction of the well.
Measurable Objective	Interconnected Surface Water is an identified data gap in the Subbasin. As an interim measurable objective, use the Chronic Lowering of Groundwater Level Measurable Objective as a proxy for interconnected surface waters (see below). Maintain seasonal high groundwater levels at an elevation that is at or above the Water Year 2015 seasonal high at representative monitoring sites in a GSP area. The Water Year 2015 seasonal high is a fixed elevation at each site, based on available groundwater level data. If data are unavailable for Water Year 2015 at a representative monitoring site, either a Water Year 2014 or Water Year 2016 Seasonal High will be used. To account for future year-to-year variations in hydrology, compliance with the fixed seasonal high threshold will be compared with a 4-year rolling average of annual groundwater level measurements. Groundwater levels are measured as water surface elevation (WSE). Each GSP area includes multiple representative monitoring sites (RMS) to which the measurable objective applies. For any RMS without data prior to Water Year 2016, Measurable Objectives will be established using the aforementioned methodology and the data resulting from the first five years of monitoring following Water Year 2016 or following the construction of the well.
5-Year Interim Milestones	**Year 5:** Fill data gaps, establish, and manage groundwater use to avoid the rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and may lead to undesirable results. The Subbasin will complete a monitoring network of Interconnected Surface Water sites that will include six existing sites and datasets. GSP groups will complete the monitoring network with additional sites installed with SGMA Implementation Grant funding awarded to the Subbasin. The existing nine sites are part of the San Joaquin River Restoration Program and are located along the San Joaquin River at the southern end of the Subbasin. These nine sites, and the associated datasets, will continue to be utilized by the Subbasin as part of its monitoring network. Additional representative monitoring network sites for Interconnected Surface Water will focus on the Northern & Central Delta-Mendota and Grassland GSP areas along the San Joaquin River. **Year 10:** Gather and analyze data from Subbasin's established representative monitoring network sites. Also gather and analyze available data in cooperation with neighboring subbasins, the U.S. Bureau of Reclamation's San Joaquin River Restoration Program, the U.S. Geological Survey, and DWR's California

Table CC-23: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water	
	Data Exchange Center (CDEC), to estimate the influence of groundwater on gains and losses in the San Joaquin River. Establish minimum thresholds and measurable objectives as a rate or volume of surface water depletions that have adverse impacts on beneficial uses and users and may lead to undesirable results. **Year 15:** Monitor and maintain interconnected surface waters in accordance with revised minimum thresholds and measurable objectives. Where increased interconnected surface water losses are caused by pumping outside of the Subbasin, seek remedies in coordination with the Department of Water Resources and neighboring GSAs.

The RMN for this sustainability indicator is shown below in **Figure CC-70**. Please see **Table CC-17** for the numeric SMC associated with the Chronic Lowering of Groundwater Levels.

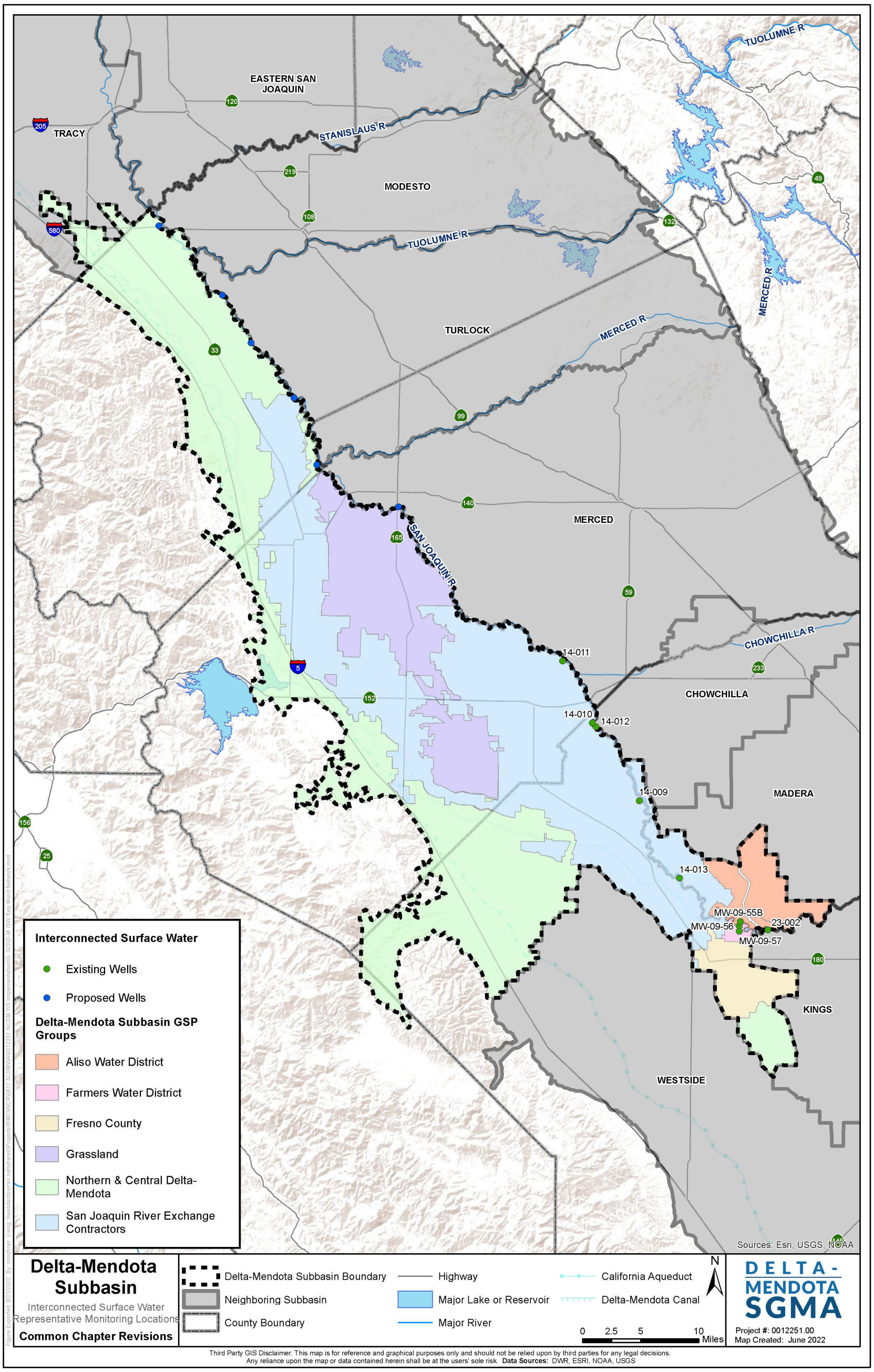

Figure CC-70: Interconnected Surface Water Representative Monitoring Locations with SMC

~~Table CC-15: Delta-Mendota Subbasin SMC for Reduction in Groundwater Storage~~

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Significant and unreasonable chronic decrease in groundwater storage, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions					
Definition of Significant and Unreasonable	Aliso is not currently experiencing significant and unreasonable effects of reduction in water levels or aquifer storage in the Upper Aquifer. Significant and unreasonable effects would be accelerated rates of subsidence as productive layers in the Upper Aquifer above the Corcoran Clay are depleted, especially in areas with deep or composite wells. Accelerated rates of subsidence may occur if 30% of the wells in the Mmonitoring Zzone exceed the min225escripimum threshold value on a 4-year consecutive average under normal or average year conditions.	Depletion of storage greater than the 2012-2016 period.	Depletion of storage greater than the 2012-2016.	Insufficient water storage to develop necessary water to maintain critical habitat. Reduction in storage would lead to increased costs associated with higher total lift, lowering pumps, need to drill deeper wells or costs securing alternative water sources. Impacts to habitat would require mitigation, including alternative water supplies and habitat restoration.	If water levels are managed to meet the Minimum Thresholds, the Northern & Central Delta-Mendota Region GSP Group does not anticipate long-term reductions in storage. And, through coordination with other GSP Groups in the Subbasin, additional projects and/or management actions will be implemented to prevent the long-term decline in storage.	The San Joaquin River Exchange Contractors (SJREC) GSP Group has a positive impact on the aquifer and is unlikely to cause Significant and/or Unreasonable reduction of groundwater storage. Triggers have been established to recover aquifer water levels before nearing an Undesirable Result. Currently, an approximation of 25% below historic low water levels for each management area coupled with a determined storage coefficient, is used to indicate an Undesirable Result which will be refined based on annual updates and integration with other GSP Groups.
Sustainability Goal for Sustainability Criterion	To expand access to surface water during flood years for replenishment of the Upper Aquifer by working with neighbors in both Delta-Mendota and Madera subbasins where overdraft is occurring.	Minimize storage change during extended dry periods.	Minimize storage change during extended dry periods.	Maintain water levels and storage sufficient to meet operational demand.	Maintain water levels sufficient to meet operational storage as well as 3-year drought buffer storage.	Maintain historic water storage to meet demand of the beneficial users.
5-Year Interim Goals	Year 5: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 10: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 15: Maintain groundwater elevations comparable to historic hydrologic highs and lows	Year 5: < Minimum Threshold Year 10: < Minimum Threshold Year 15: < Minimum Threshold	Year 5: < Minimum Threshold Year 10: < Minimum Threshold Year 15: < Minimum Threshold	Year 5: WSE > Measurable Objective Year 10: WSE > Measurable Objective Year 15: WSE > Measurable Objective	Year 5: Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows Year 10: Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows Year 15: Maintain groundwater elevations comparable to 2012 through 2017 hydrologic highs and lows	Year 5: Maintain current water levels, SJREC GSP Group is sustainable Year 10: Maintain current water levels, SJREC GSP Group is sustainable Year 15: Maintain current water levels, SJREC GSP Group is sustainable

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Minimum Threshold	The minimum threshold is to provide a 100-foot of buffer from the top of the Corcoran Clay to the top of the water table.	Upper Aquifer – Storage Loss of >12,000 acre-feet (AF) from over extended dry period Lower Aquifer – Storage Loss of >4600 AF over extended dry period	Upper Aquifer – Storage Loss of >90,000 acre-feet (AF) over extended dry period – Lower Aquifer – Storage Loss of >55,000 AF over extended dry period	Upper Aquifer: 20% lowered water elevation from recent historic low (set at each monitoring site). Lower Aquifer: Lower aquifer representative monitoring wells have been identified for the monitoring network. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds in future GSP Updates.	Upper Aquifer: Hydrologic low Lower Aquifer: 95% of historic low	The SJREC GSP Group is sustainable. The SJREC GSP Group is unlikely to cause groundwater overdraft. As a result of this and historical groundwater management, trigger levels have been established for a representative site in each management area. If water levels drop below the established trigger level, no transfers of groundwater outside the area are allowed. This management has been in place for parts of the Subbasin for years and has proven effective to preserve a healthy aquifer.
Measurable Objective	The measurable objective is site specific and tied to water levels in long term hydrographs. The average rate in decline in each well was projected out until 2040 when water levels should begin to stabilize over the long term.	Long term average change of 0 AF/year	Long term average change of 0 AF/year	Upper Aquifer: Recent historic low (set at each monitoring site). Lower Aquifer: Four lower aquifer representative monitoring sites have been identified at a multi-completion well. However, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals, measurable objectives, and minimum thresholds in future GSP Updates.	Both Aquifers: Seasonal historic high average, Spring 2012 or Spring 2017, whichever elevation is lowest or where data exists.	Operate groundwater levels between the effective root zone and the Minimum Threshold which will maintain groundwater storage.

~~Table CC-16: Delta-Mendota Subbasin SMC for Degraded Water Quality~~

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Significant and unreasonable degradation of groundwater quality, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions and/or activities					
Definition of Significant and Unreasonable	Aliso is not experiencing any significant and unreasonable impacts of water quality. Significant and unreasonable is defined as a reduction in crop production due to water quality issues and if 30% of the wells exceed the minimum threshold value on a 4-year consecutive average without treatment.	(1) Continued migration of the Steffens plume (elevated Total dissolved solids [TDS]) in Upper Aquifer both within Management Area A and towards Farmers Water District. (2) Unreasonable rates of migration of groundwater in the Upper Aquifer with naturally-occurring elevated concentrations of total dissolved solids in Management Area B. (3) Potential effects on the beneficial uses of groundwater include agricultural and domestic uses. (4) Degraded water quality in the Fresno Slough effect beneficial users of surface water	(1) Impairment of groundwater quality from the migration of the Steffens Plume from Fresno Coun'ty's Management Area A. Impacts from the Steffens plume impacts Farmers Water District's ability to utilize groundwater for adjacent use and discharge into the Mendota Pool. (2) Potential effects on the beneficial users of groundwater include water quality levels that impact crops and drinking water standards for domestic uses. (3) Degraded water quality in the Fresno Slough effecting beneficial users of surface water.	Degradation of groundwater quality resulting in reduced ability to develop and manage groundwater for habitat productivity.	(1) Exceedance of maximum contaminant levels (MCLs) or water quality objectives (WQOs) for irrigation in public water systems for three (3) consecutive sampling events in non-drought years or the additional degradation of current groundwater quality where current groundwater quality exceeds the MCLs or WQOs for irrigation. (2) Water quality degradation due to recharge projects that exceeds 20% of the aquifer's assimilative capacity for one or more constituents without justification of a greater public benefit achieved	Migration of contamination plume that makes the water unusable for beneficial use
Sustainability Goal for Sustainability Criterion	Maintain Current Water Quality	Contain the Spreckels Plume and maintain historical rates of saline front migration	Prevent further degradation of groundwater quality from the Steffens Plume migrating from Fresno County Management Area A	Maintain groundwater quality suitable for habitat	Maintain existing water quality in all aquifers	Monitor existing groundwater contamination sites and engage to ensure cleanup and abatement orders are consistent with the San Joaquin River Exchange Contractors (SJREC) GSP Group. Work with upslope drainage area to reduce the migration of saline water into the SJREC GSP Group
5-Year Interim Goals	Year 5: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 10: Maintain groundwater elevations comparable to historic hydrologic highs and lows Year 15: Maintain groundwater elevations comparable to historic hydrologic highs and lows	Year 5: Average annual rate of degradation of 30 milligrams per liter (mg/L) TDS for saline front Year 10: Average annual rate of degradation of 30 mg/L TDS for saline front Year 15: Average annual rate of degradation of 30 mg/L TDS for saline front Spreckels Steffens plume dependent on Central Valley Regional Water Quality Control Board (CV-RWQCB) Cleanup and Abatement Order (CAO) actions.	Year 5: 1000 milligrams per liter (mg/L) total dissolved solids (TDS) Year 10: 800 mg/L TDS Year 15: 700 mg/L TDS	Year 5: < Measurable Objective Year 10: < Measurable Objective Year 15: < Measurable Objective	Year 5: Maintain 2003-2017 groundwater quality range Year 10: Maintain 2003-2017 groundwater quality range Year 15: Maintain 2003-2017 groundwater quality range	Continue mitigation efforts on the migration of saline water from upslope drainage.

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Minimum Threshold	Electrical Conductivity (EC_) - 4.5 deciSiemens per meter (dS/m)* Chlorine (Cl_) - 13.3 milliequivalents per liter (meq/L)* NO_3-N - 30 milligrams per liter (mg/L)**	Average annual rate of degradation of 60 mg/L TDS for saline front. Threshold for Steffens plume determined by CV-RWQCB.	TDS concentration of 1100 mg/L	Production Wellhead thresholds: Total dissolved solids (TDS) 2,500 milligrams per liter (mg/L) in both aquifers	NO3 – 10 mg/L as N (Primary MCL) TDS – 1,000 mg/L (Secondary MCL) Boron – 0.7 mg/L (WQO for irrigation) or current groundwater quality where it exceeds MCLs or WQOs for irrigation as of December 2018	The minimum threshold is defined as the amount of poor-quality groundwater that is greater than what can be successfully managed through the management actions
Measurable Objective	E_C - 0.75-1.0 dS/m, based on JM Lord and FAO 100% yield for grapes and almonds. C_l - 3.0 meq/L, based on JM Lord minimum recommendations NO_3-N - >5 mg/L, based on FAO Section 5.1, sensitive crop tolerance	Average annual rate of degradation of 20 mg/L TDS for saline front. Measurable objective for Steffens plume will be determined by CV-RWQCB as part of a CAO.	TDS concentration equivalent to background concentrations (approximately 500 mg/L, depending on Cleanup and Abatement Order [CAO] from Central Valley Regional Water Quality Control Board [CV-RWQCB] for Steffens Plume).	Upper Aquifer: Production Wellhead thresholds: 20% increase from max historic electrical conductivity (EC) concentration Lower Aquifer: Lower aquifer representative water quality monitoring sites have been identified; however, no historic data exists. The Grassland Plan Area participants will monitor the site and with the gathered data, intend to establish meaningful interim goals and measurable objectives in future GSP Updates.	2003-2017 groundwater quality range conditions by GSP sub-region	Mitigate impacts of the migration of saline groundwater from lands upslope of the SJREC GSP

* Based on Food and Agriculture Organization (FAO) 50% yield for grapes

** Based on FAO Section 5.1 typical crop tolerance

Table CC-17: Delta-Mendota Subbasin SMC for Land Subsidence

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland
Definition of Undesirable Results	Changes in ground surface elevation that cause damage to critical infrastructure that would cause significant and unreasonable reductions of conve conditions that threaten public health and safety			
Definition of Significant and Unreasonable	Aliso is not currently experiencing any significant and unreasonable effects of subsidence. Significant and unreasonable impacts are assumed to occur when the levees within the District have subsided to an elevation causing impacts to the water carrying capacity of the San Joaquin River and Chowchilla Bypass beyond their design flow rates, causing significant and unreasonable flooding or crop damage.	Damage to infrastructure and loss of conveyance capacity in neighboring Groundwater Sustainability Agencies (GSAs).	Damage to infrastructure, loss of conveyance capacity, and potential inability to flood or drain by gravity and associated habitat impacts.	Damage to infrastruct permanent loss of conveyance capacity be mitigation, and poten inability to flood or dra gravity and associat habitat impacts.
Sustainability Goal for Sustainability Criterion	Expand access to surface water during flood years for replenishment of the Upper Aquifer by working with neighbors in both the Delta-Mendota and Madera subbasins where subsidence is occurring.	No contribution to lower aquifer compaction.	No contribution to lower aquifer compaction.	No permanent reducti conveyance and abili manage habitat.
5-Year Interim Goals	Interim goals established at 0.5-feet of additional subsidence per 5-year interim goal period.	Year 5: -0.0088 ft Year 10: -0.0065 ft Year 15: -0.0043 ft	Year 5: at Fordel-Ext: -0.015 ft P304-PBO: -0.084 ft Year 10: at Fordel-Ext: -0.013 ft P304-PBO: -0.068 ft Year 15: at Fordel-Ext: -0.011 ft P304-PBO: -0.0065 ft	The Grassland Plan ar not causing subsidenc will work with neighbo achieve Subbasin-wi sustainability. Year 5: > Measurab Objective Year 10: > Measurab Objective Year 15: > Measurab Objective
Minimum Threshold	The minimum threshold is set to not exceed the current rate of subsidence of 0.2 feet/year or 4.0 feet total by 2040	-0.011 ft	Target additional subsidence at two subsidence monitoring points: - Fordel-Ext: -0.017 ft - P304-PBO: -0.1 ft	The minimum thresho not to exceed, on aver the historic annual ave rate of subsidence fr December 2011 to Dece 2015 as defined at ea representative subsid monitoring site: Point 108: -0.1 Point 152: -0.1 Point 137: -0.1
Measurable Objective	The Measurable Objective is set to be the more restrictive of the two Significant and Unreasonable scenarios. It is assumed that significant impacts will cause flooding and crop damage will be ½1/2 of the current design minimum freeboard of 4 feet (therefore 2 feet).	-0.002 ft	Target additional subsidence at two subsidence monitoring points: - Fordel-Ext: -0.0086 ft - P304-PBO: -0.036 ft	The measurable object not to exceed, on aver the historic annual ave rate of subsidence fr December 2011 to Dece 2018, defined at eac respective site: - Point 108: -0.08 ft/ - Point 152: -0.1 ft/y - Point 137: -0.11 ft/

~~Table CC-18: Delta-Mendota Subbasin SMC for Depletions of Interconnected Surface Water~~

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Definition of Undesirable Results	Depletions of interconnected surface water, as defined by each GSP Group, that have significant and unreasonable adverse impacts on the beneficial uses of surface water					
Definition of Significant and Unreasonable	Aliso Water District groundwater pumping does not influence surface water depletion. Landowners within the District are limited by the Herminghaus Agreement and similar pumping restrictions along the San Joaquin River that prevent pumping from above the A-Clay. Additionally, the primary aquifer, where groundwater pumping occurs, is disconnected from surface water source. A significant and unreasonable result would be a reduction in water availability to downstream beneficial users beyond what was experienced in similar water years in recent history as a result of groundwater extractions.	(1) San Joaquin River Restoration Project (SJRRP) operations and groundwater extractions from the Upper Aquifer that will influence stream depletion along San Joaquin River (2) Water level measurements along the San Joaquin River in the shallow zone of the Upper Aquifer to determine degree of vertical gradient (3) Potential degradation to groundwater dependent ecosystems (GDEs) along San Joaquin River primarily dependent on SJRRP operations of San Joaquin River flows since groundwater pumping expected to remain stable and consistent with historical (pre-SJRRP) levels	Decrease in surface water stage in Mendota Pool from Bureau of Reclamation and Central California Irrigation District (CCID) operations that impact groundwater dependent ecosystems (GDEs) and operations in Mendota Wildlife Area.	The Grassland Plan Area groundwater pumping does not influence surface water depletion. Reduction of interconnected surface water bodies and associated groundwater dependent ecosystems (GDEs), requiring reduction in groundwater pumping (no management activities have depleted interconnected surface water in the Grassland Plan Area within the Historic Period). A significant and unreasonable undesirable result would regard impaired habitat directly associated with interconnected surface waters.	Where interconnected stretches of surface water are identified, an X%* increase in depletions of surface water as a result of groundwater pumping. *The percent increase in depletions is to be determined from monitoring data collected between 2020 and 2025 and associated analyses of these data.	When groundwater extraction directly decreases streamflow in losing stretch of the San Joaquin River.
Sustainability Goal for Sustainability Criterion	Similar reductions in water availability to downstream beneficial users as was experienced in similar water years in recent history as a result of groundwater extractions.	Minimize downward gradient in the San Joaquin River	Maintain stage in Mendota Pool between 12.75 and 13 feet.	No reduction in interconnected surface water bodies or associated GDEs due to GGSA pumping.	No loss of productive agriculture due to an inability to pump groundwater.	Mitigate observed reductions of interconnected surface and groundwater due to pumping in the San Joaquin River Exchange Contractors (SJREC) GSP Group area.
5-Year Interim Goals	Not Applicable	Year 5: gradient of -1.1 Year 10: gradient of -0.99 Year 15: gradient of -0.83 All gradients measured at monitoring site SJRRP-09-55, 55b	Year 5: Mendota Pool staff gage reading of 7.4 ft Year 10: Mendota Pool staff gage reading of 9.1 ft Year 15: Mendota Pool staff gage reading of 11.3 ft	Year 5: WSE > Measurable Objective (Upper Aquifer) Year 10: WSE > Measurable Objective (Upper Aquifer) Year 15: WSE > Measurable Objective (Upper Aquifer)	Year 5: Establish Minimum Threshold and Measurable Objective for this parameter Year 10: To be determined (TBD) in 2025 GSP update based on additional data analysis Year 15: TBD in 2025 GSP update based on additional data analysis	Year 5: Mitigate depleted interconnected surface water in the San Joaquin River Year 10: Mitigate depleted interconnected surface water in the San Joaquin River Year 15: Mitigate depleted interconnected surface water in the San Joaquin River

GSP Group	Aliso Water District	Farmers Water District	Fresno County	Grassland	Northern & Central Delta-Mendota	San Joaquin River Exchange Contractors
Minimum Threshold	Not Applicable Similar reductions in water availability to downstream beneficial users as was experienced in similar water years in recent history as a result of groundwater extractions.	Gradient of -1.3 at monitoring site SJRRP-09-55, 55b	Mendota Pool staff gage reading of 5.4 ft	20% lowered water elevation from recent historic low (set at each monitoring site).	An X%* increasle in surface water depletions along interconnected stretches of surface water as a result of groundwater pumping. *The percent increase in depletions is to be determined from monitoring data collected between 2020 and 2025 and associated analyses of these data.	Observed increase in seepage from the San Joaquin River due to groundwater extractions in the SJREC GSP Group area. The SJREC plan to work with the counties to restrict perforating wells above the first encountered restrictive clay layer (near the San Joaquin River) to prevent induced seepage similar to the established operations defined in the Herminghaus Agreement on Reach 2 of the San Joaquin River.
Measurable Objective	Not Applicable. Similar reductions in water availability to downstream beneficial users as was experienced in similar water years in recent history as a result of groundwater extractions.	Gradient of -0.67 at monitoring site SJRRP-09-55, 55b	Mendota Pool staff gage reading of 13.5 ft	Recent historic low (set at each monitoring site).	No increased depletions of surface water as a result of groundwater pumping.	Same as Minimum Threshold

6. SUBBASIN MONITORING PROGRAM

As required by Subarticle 4. Monitoring Networks of the GSP regulations, the GSPs must include a monitoring network for each sustainability indicator, in addition to describing the monitoring protocols and data management to be followed in implementing the GSP monitoring program. Given the variability of conditions within the Delta-Mendota Subbasin, each GSP Group initially developed their individual monitoring networks, in coordination with their neighboring GSP Groups, such that the subbasin-wide monitoring program is simply a compilation of those coordinated individual monitoring networks. These representative monitoring networks were then re-evaluated as part of the update to the Subbasin GSP in 2022. Please see the individual GSPs for further discussion as to how the monitoring networks were developed.

The subbasin-wide monitoring networks presented herein are the representative monitoring networks for each of the applicable sustainability indicators, as defined according to the GSP Regulations § 354.36, *Representative Monitoring*. It is at the representative monitoring sites where each GSP Group has defined minimum thresholds, measurable objectives, and interim milestones to evaluate progress in achieving the Subbasin's sustainability goal by 2040. Data collected at the representative monitoring locations may be augmented with additional data, as available and appropriate, from other locations and/or publicly-available datasets, in evaluating Subbasin conditions on an annual basis.

6.1.1 Coordinated Assumptions and Data

As previously noted, the required monitoring networks were initially developed at the GSP-level in order to appropriately capture the variability of hydrogeologic and water quality conditions in the Delta-Mendota Subbasin, and then re-evaluated at the Subbasin level to confirm that the monitoring networks meet the necessary requirements. All common coordinated assumptions agreed upon and implemented by each GSP Group in developing their respective monitoring networks are presented in Technical Memorandum 5 (*Assumptions for Delta-Mendota Subbasin Monitoring Network*) which is included in **Appendix B** of this Common Chapter.

6.1.2 Coordinated Monitoring Activities

All Delta-Mendota Subbasin GSP Groups have agreed to utilize the following monitoring protocols, data management, and roles and responsibilities for implementing and reporting from their respective monitoring plans under SGMA to ensure consistency in data collection, analysis and management allowing for subbasin-wide evaluation of groundwater conditions relative to the Subbasin sustainability goal, as defined and agreed upon by all GSP Groups.

Monitoring Protocols

Each GSP Group will utilize agreed-upon protocols, which may be the same as, or equal to, data collection protocols (i.e., industry standards and best management practices) to ensure the collection of comparable data using comparable methods. Additionally, the following minimum monitoring frequency for each applicable sustainability indicator was agreed upon by each GSP Group during the joint Delta-Mendota Subbasin Coordination Committee and Technical Working Group meeting on June 18, 2019:

- **Chronic lowering of groundwater levels/reduction in groundwater ~~storage~~storage** - Twice per year, with seasonal high groundwater elevation data collected between February and April, and seasonal low groundwater elevation data collected between September and October. All measurements will be collected to a tenth of a foot.

- **Degraded water quality** – Once per year during irrigation season, typically between May and July.
- **Depletions of interconnected surface water** – Twice per year in conjunction with groundwater level monitoring.
- **Subsidence** – Publicly available subsidence data will be used along with locally-collected data. At a minimum, three data points will be collected within the first five years of GSP implementation, with a baseline value from 2019 or a date prior to that.

For non-monitored data to be reported as part of the annual reports (e.g., groundwater extractions, surface water deliveries), actual metered data will be used where such data exists, and when direct data do not exist, estimated quantities will be calculated based on existing indirect data (e.g., electrical usage, crop demand, ET) and/or other industry best practices. Additionally, where available and applicable, public datasets will be used to augment monitoring data collected by the Subbasin and analyzed on an annual basis.

Data Management

Each GSP Group will be responsible for conducting quality control reviews of data collected from the monitoring networks. As described in the Coordination Agreement, each GSP Group will exchange and share collected data in order to facilitate analysis and reporting at the Subbasin level. The Coordinated Data Management System (DMS) will be the primary vehicle by which data are shared amongst the GSP Groups, and it will be the responsibility of each GSP Group to conduct a quality control review of data entered into the DMS.

Roles and Responsibilities

It will be the responsibility of each GSP Group, and the GSAs included in that group, to conduct the monitoring program as agreed upon at the Subbasin level, for reviewing the data collected, and for ensuring that these data are available at the Subbasin level. **Figure CC-71**~~**Figure CC-65**~~ shows the general flow of data collected from the Delta-Mendota monitoring programs.

Figure CC-72~~**Figure CC-66**~~ shows the roles and responsibilities of each GSA and GSP Group in the collecting, processing and reporting of data from the GSP monitoring networks. Additionally, it is the responsibility of each GSP Group, including their respective GSAs, to maintain the monitoring network and, as appropriate, revise and/or expand the monitoring networks to fill identified data gaps. Please see the individual GSPs for further information regarding data gaps and the GSAs plans for addressing those gaps.

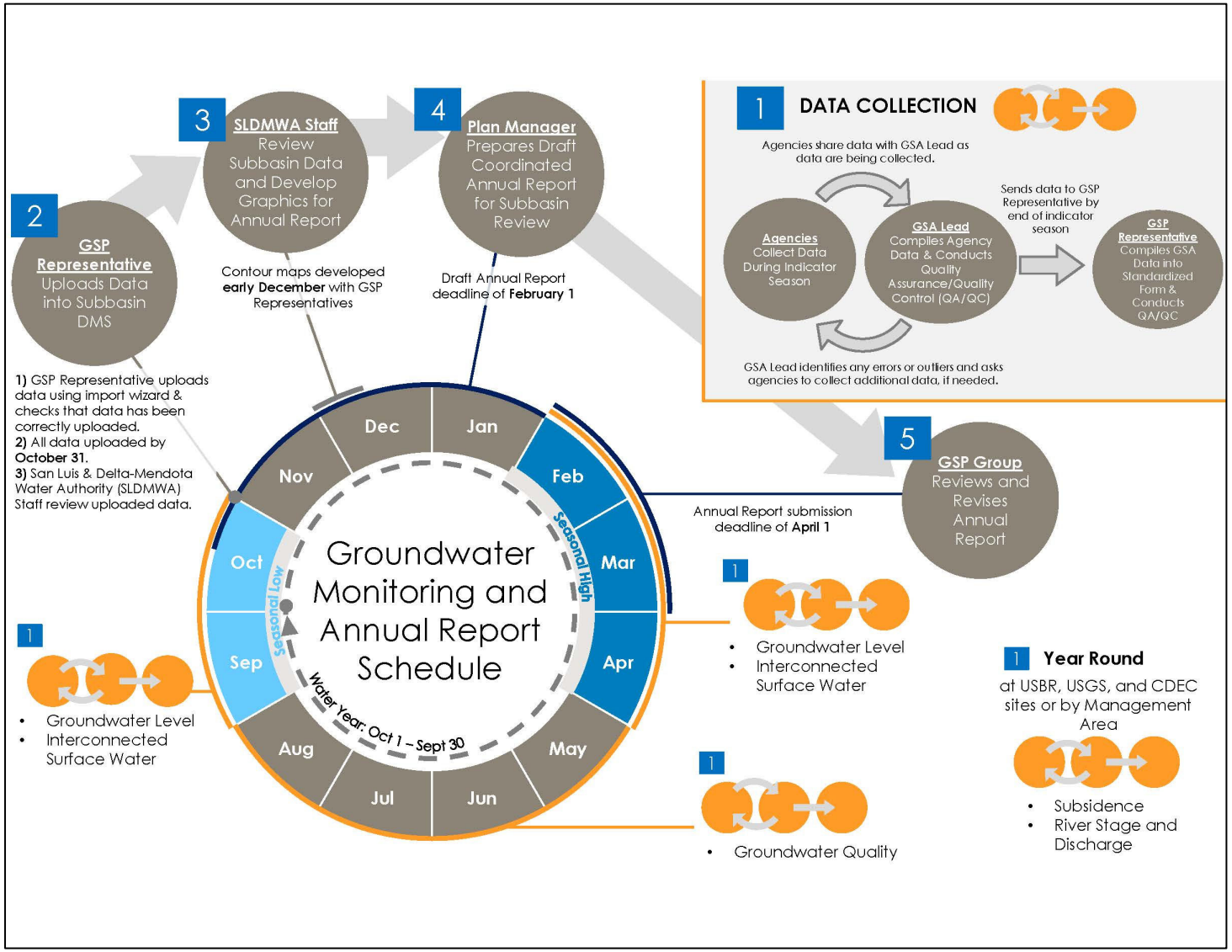

Figure CC-~~71~~65: Data Flow in Delta-Mendota Subbasin

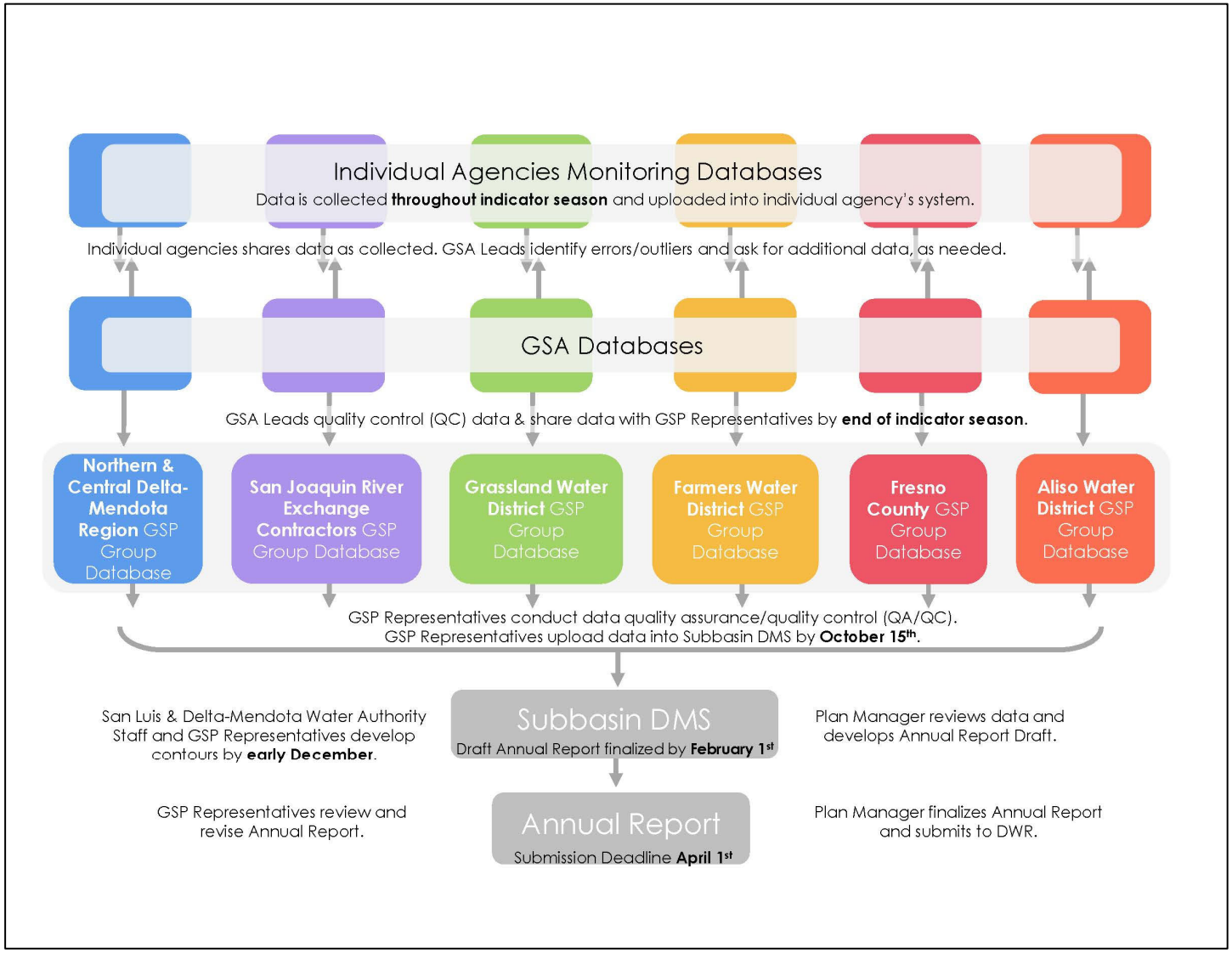

Figure CC-~~72~~66: Delta-Mendota Monitoring and Data Management Roles and Responsibilities

6.1.3 GSP-Level Monitoring Networks

For more information on the individual GSP monitoring networks for each applicable sustainability indicator, including how the networks were developed, please refer to the individual GSPs. The monitoring networks for each applicable sustainability indicator for each GSP Group were developed in accordance with the GSP Regulations Article 5. Plan Contents, Subarticle 4. Monitoring Networks (§ 354.21 – 354.40). DWR's Best Management Practices for the *Sustainable Management of Groundwater Monitoring Protocols, Standards, and Sites BMP* (2016b) and *Monitoring Networks and Identification of Data Gaps BMP* (2016a) documents were used when and where applicable at the discretion of each GSP group in developing monitoring networks and monitoring protocols.

6.1.4 Delta-Mendota Subbasin Monitoring Networks

The subbasin-level monitoring networks are a compilation of the representative monitoring networks developed by each individual GSP Group and reviewed and modified at the Subbasin level for consistency and appropriate coverage. The monitoring network for the chronic lowering of groundwater sustainability indicator is comprised of two parts, the Upper Aquifer (**Figure CC-73**~~**Figure CC-67**~~) and Lower Aquifer (**Figure CC-74**~~**Figure CC-68**~~). The monitoring networks for the reduction in groundwater storage for the Upper Aquifer and Lower Aquifer are the same as those utilized for the chronic lowering of groundwater levels. The monitoring network for the degraded water quality sustainability indicator is also comprised of two parts, the Upper Aquifer (**Figure CC-75**~~**Figure CC-69**~~) and Lower Aquifer (**Figure CC-76**~~**Figure CC-70**~~). Data gaps (areas without wells of known construction) are shown for the Upper Aquifer and Lower Aquifer for the chronic lowering of groundwater and degraded water quality sustainability indicator. The interconnected surface water monitoring network for the Delta-Mendota Subbasin is shown in **Figure CC-77**~~**Figure CC-71**~~, and the monitoring network for land subsidence for the Delta-Mendota Subbasin is shown in **Figure CC-78**~~**Figure CC-72**~~.

The Delta-Mendota Subbasin representative monitoring networks will be periodically reviewed and revised, as appropriate, by the GSP Groups responsible for maintaining them and coordinated at the Subbasin level. Revised monitoring networks will be included in the five-year updates to the GSPs.

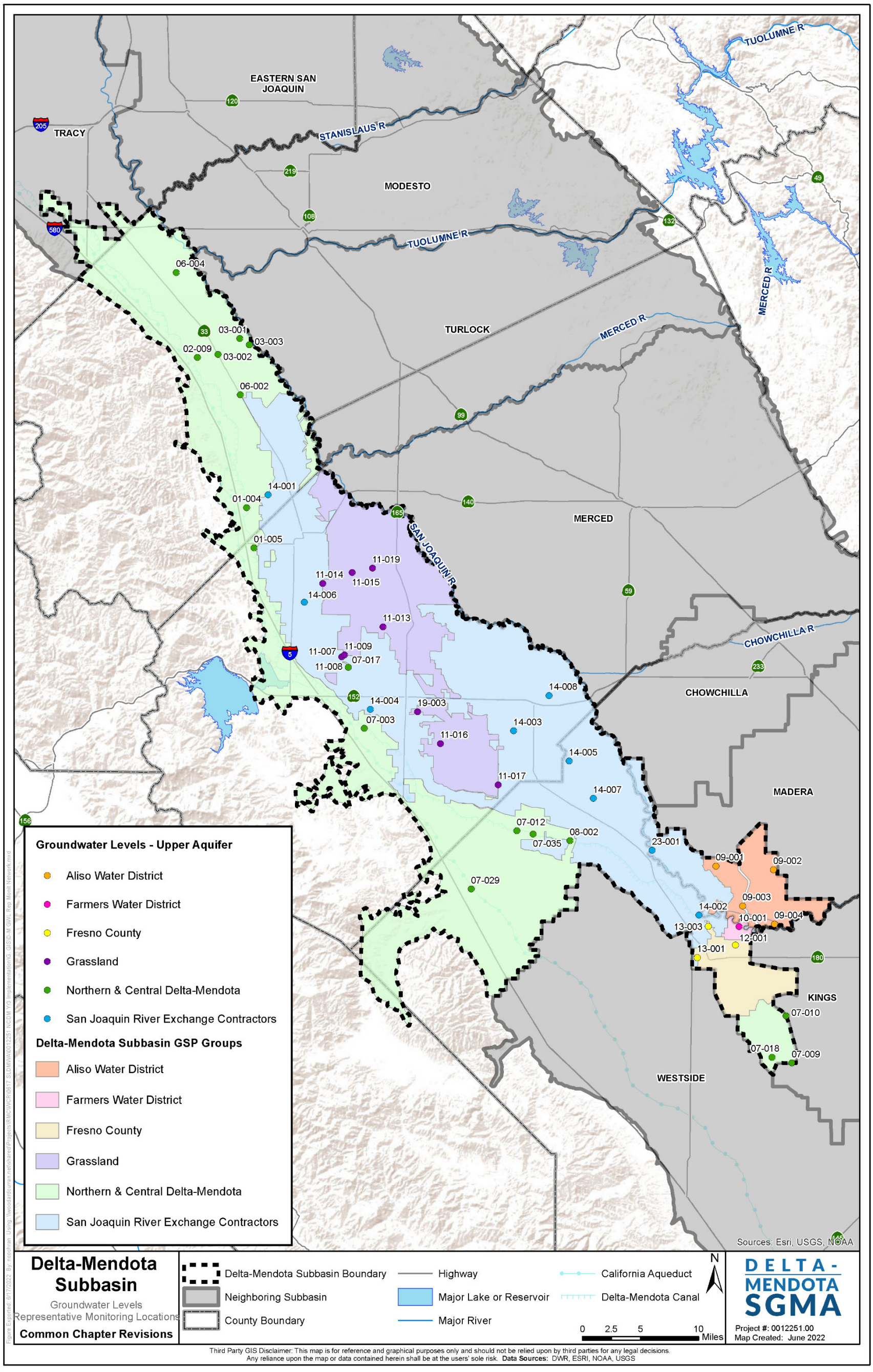

Figure CC-~~73~~67: Upper Aquifer Groundwater Level Monitoring Network

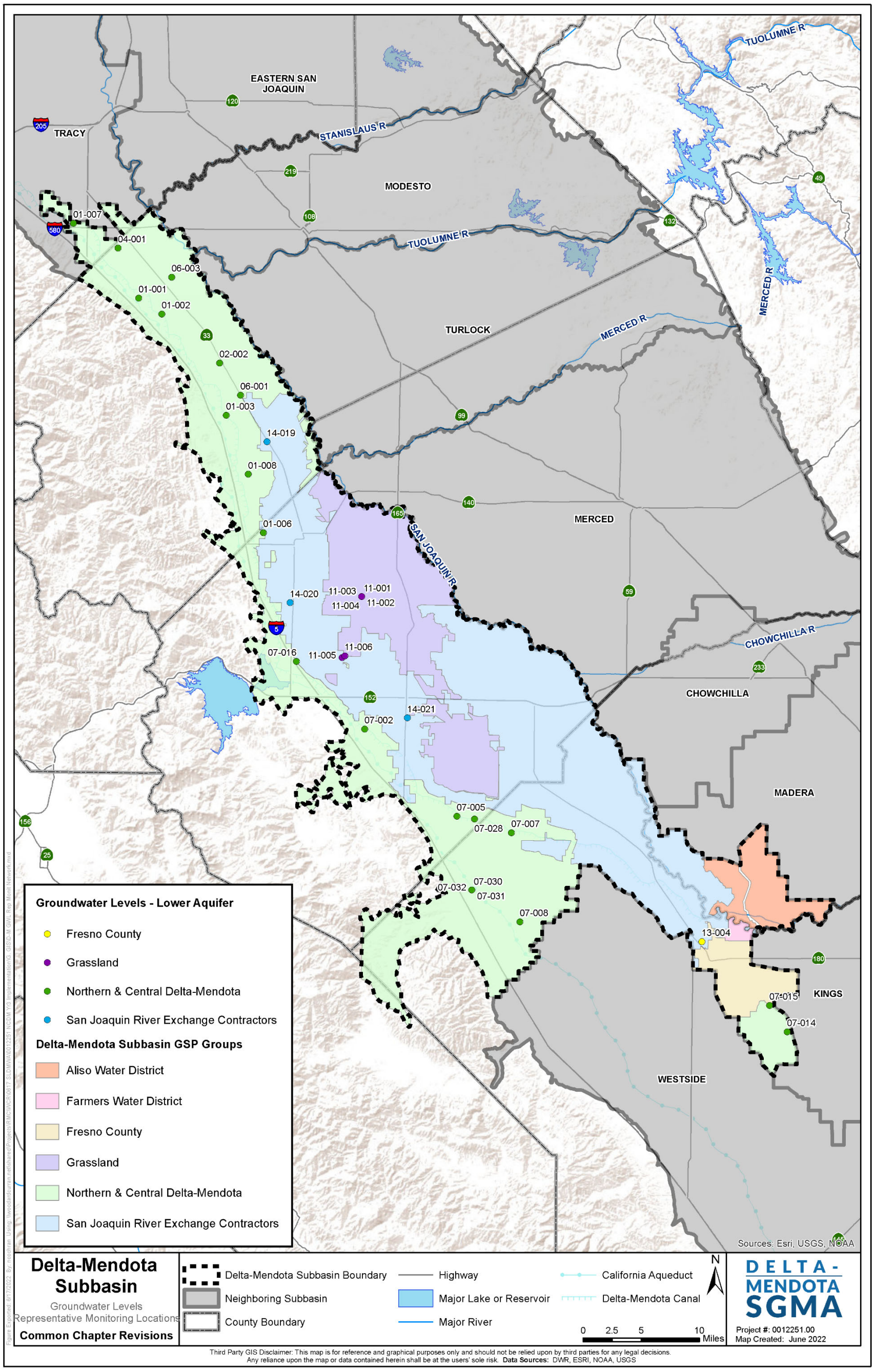

Figure CC-~~74~~68: Lower Aquifer Groundwater Level Monitoring Network

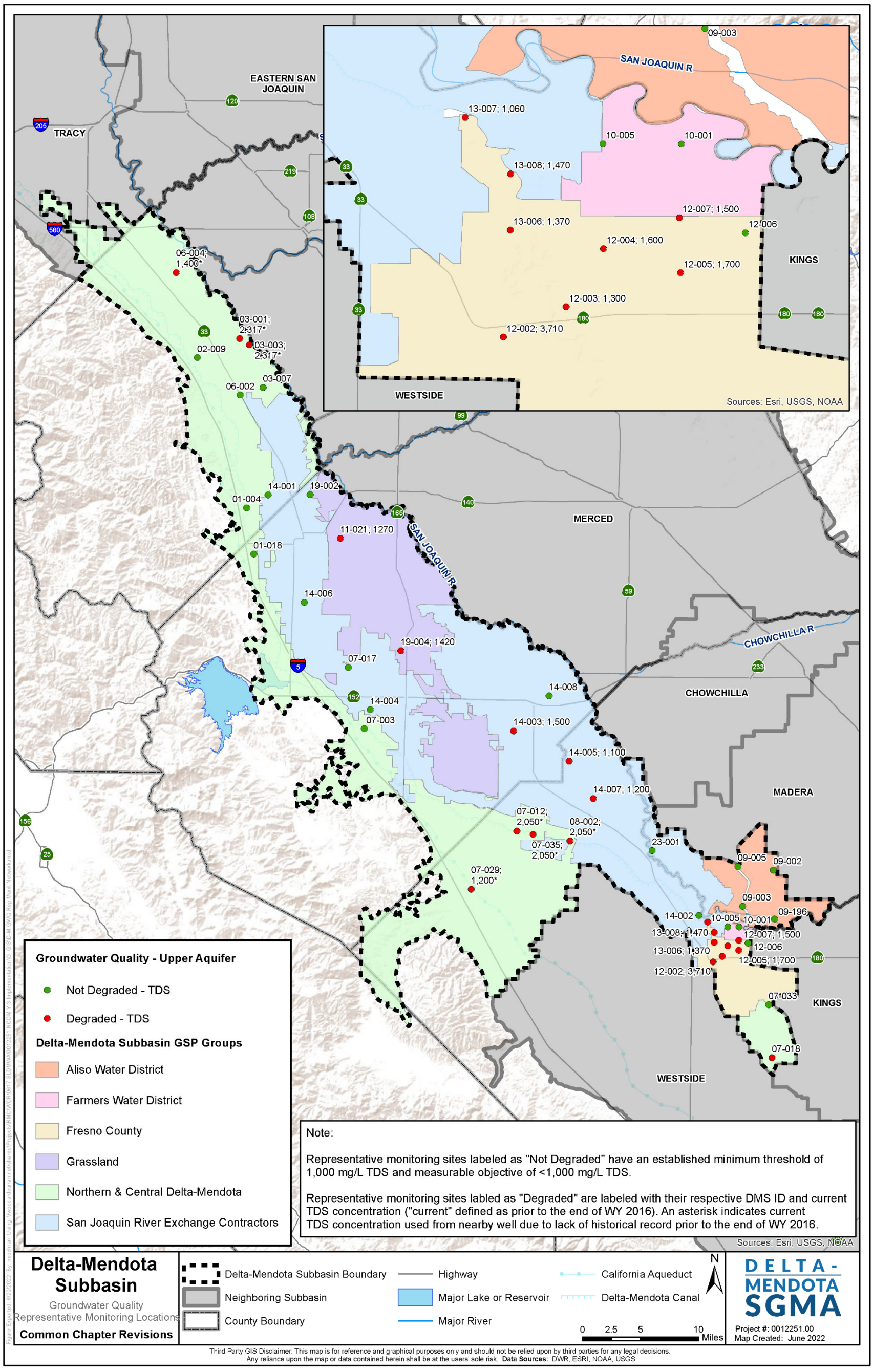

Figure CC-~~75~~69: Upper Aquifer Groundwater Quality Monitoring Network

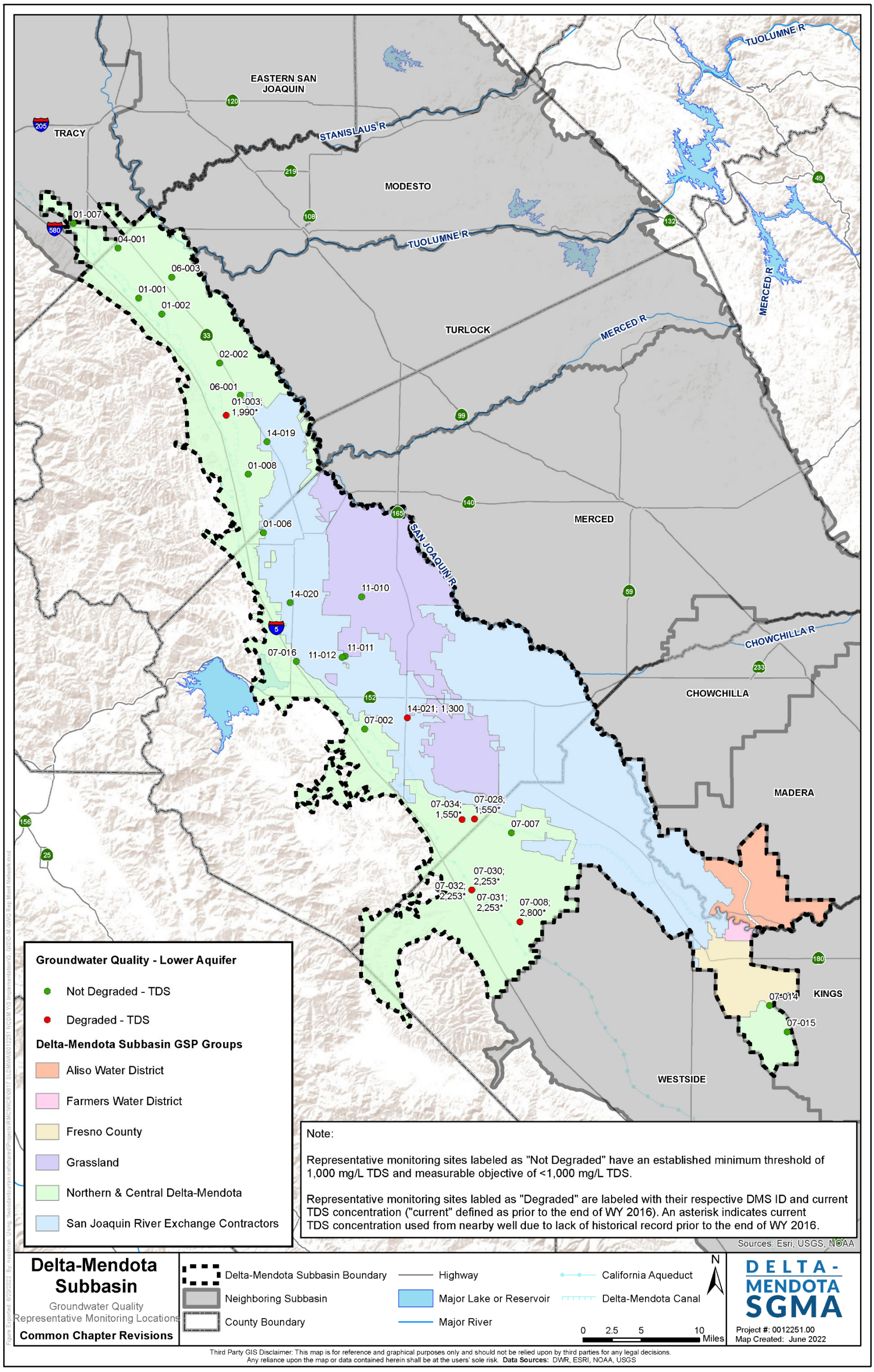

Figure CC-~~76~~70: Lower Aquifer Groundwater Quality Monitoring Network

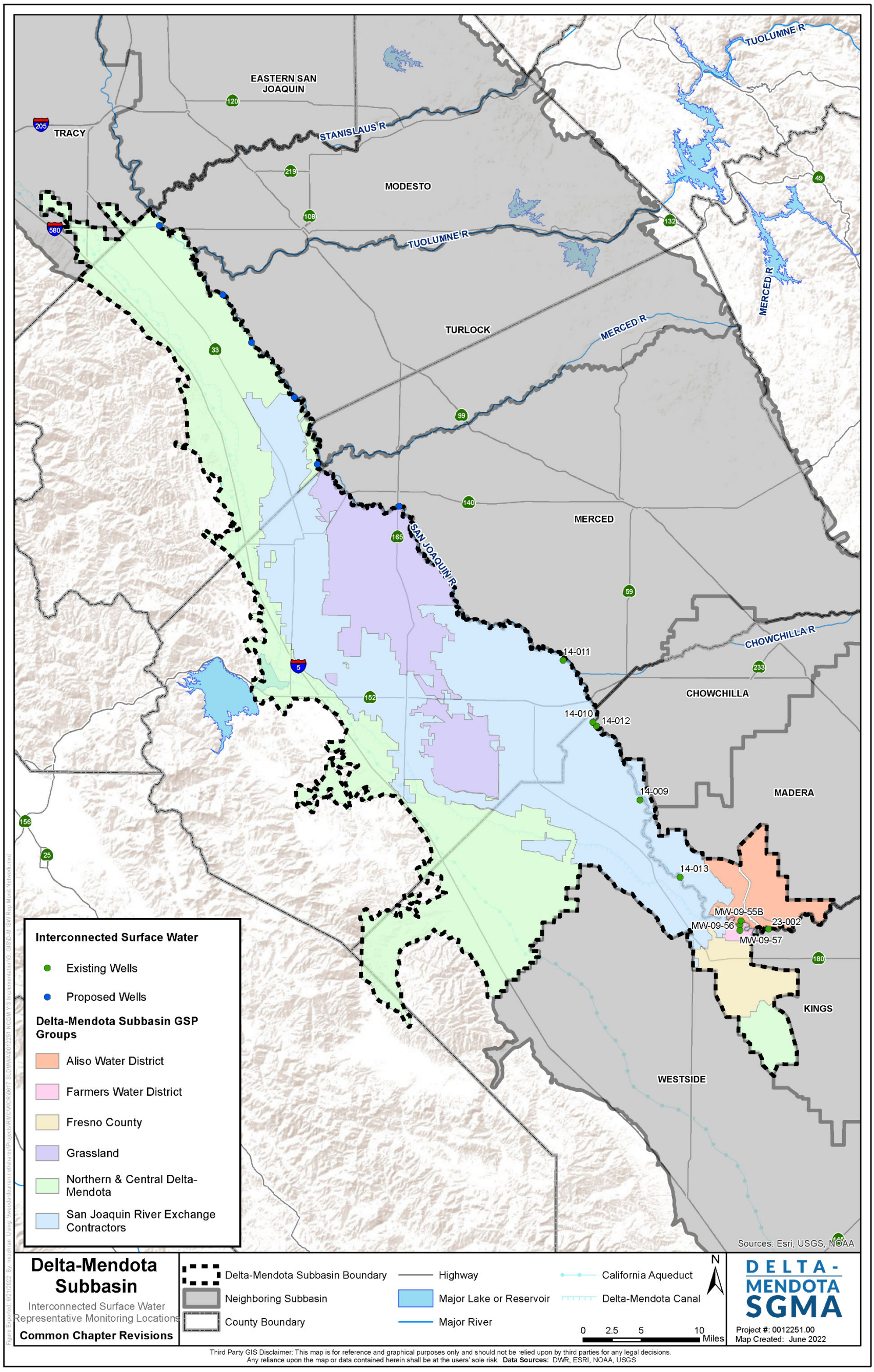

Figure CC-~~77~~71: Interconnected Surface Water Monitoring Network

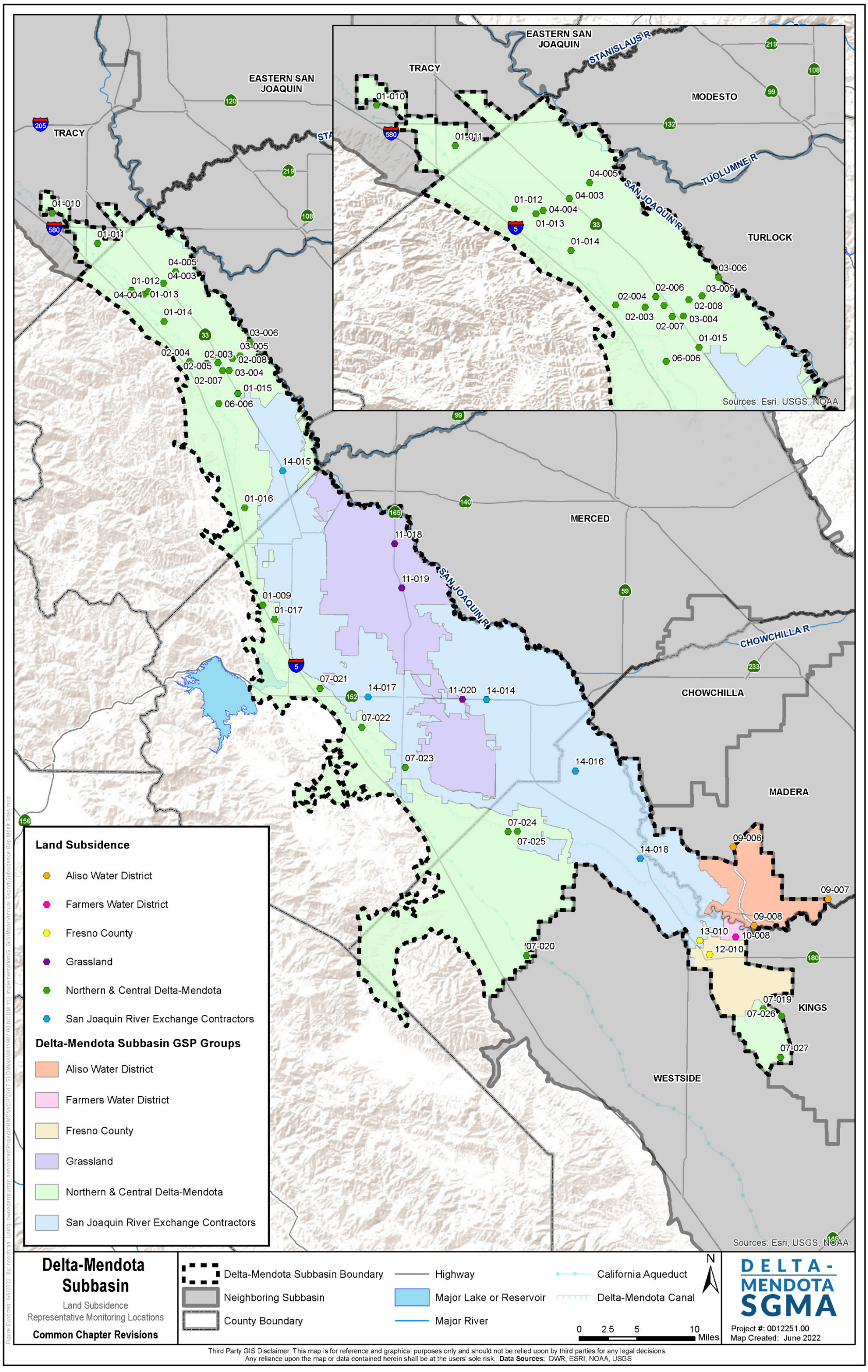

Figure CC-~~78~~72: Land Surface Elevation Monitoring Network

7. SUBBASIN DATA COLLECTION AND MANAGEMENT

As required in §352.6, Data Management System of the GSP regulations, each GSA is required to develop and maintain a data management system (DMS) that is capable of storing and reporting information relevant to the development or implementation of the GSP(s). Additionally, per §354.4, Reporting Monitoring Data to the Department, all monitoring data is to be stored in a DMS with copies of the monitoring data included in the annual report and submitted electronically on forms provided by DWR. Recognizing that GSP implementation, including annual reporting, will require some efforts at the subbasin level, the 23 GSAs overlying the Delta-Mendota Subbasin have chosen to develop a coordinated DMS that can be utilized by each GSP Group for management of their data but which will allow for the required compendium of data sets for preparation of Subbasin annual reports. The coordinated DMS will also provide a generic framework that can be used by any GSP Group or GSA in the Subbasin for individual data management while allowing for consistent formatting and the simplified uploading of compiled datasets into the Subbasin-wide coordinated DMS.

The individual GSP Groups have also developed and will maintain separate data storage processes or DMSs. Each separate DMS developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the respective GSA and/or GSP Group, and ultimately to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Subbasin Plan Manager and Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

The DMS constructed for the Delta-Mendota Subbasin is a secured web-based application hosted on Amazon Web Services (AWS). The DMS focuses on five core business requirements including: centralized data warehouse, security of data, permissioned based access, data visualization and reporting. Other goals of the DMS focus around improving data collection/aggregation processes, creating data standards, gaining efficiencies in reporting and improving data sharing with stakeholders. The DMS is designed to aggregate data through import processes by GSP to support data visualization and annual report generation.

Underlying the web application is a relationship database used to store the information aggregated from GSPs across primary data types identified to support monitoring and Annual Report development. Those data types include groundwater extractions, surface water deliveries, groundwater storage, groundwater elevations, groundwater quality, interconnected surface water and land subsidence. The web application functionality includes an embedded GIS viewer, screens to view tables of time series data, and charting capabilities for hydrographs. The embedded GIS viewer contains functionality to store map layers such as reference data, GSA/GSP boundaries and derived information such as water level contours.

Section 6.1.2 describes the process by which monitoring data are collected by each GSP Group and processed for inclusion in the Coordinated DMS. In order to be able to track data by location in the Subbasin, each monitoring locations in the Delta-Mendota Subbasin is assigned a unique identifier in the DMS. The number system is in a format of ##-####, where the first two digits indicates which GSA the monitoring location is associated with, the subsequent four digits indicate which specific monitoring

location in that GSA area. As shown in Figure CC-72~~Figure CC-66~~, the general methodology agreed upon for data import and management is as follows:

- Each GSA collects their respective data per agreed-upon monitoring protocols and transmits it to the GSA Representative.
- Each GSA Representative then compiles the data and conducts a quality control check.
- The GSA Representative then transmits the compiled data set to the GSP Lead or Representative, who then aggregates the data from all GSAs and conducts a second quality control check.
- The GSP Lead or Representative then uploads the data set into the DMS using import wizards designed specifically for this process.
- The Subbasin Plan Manager then uses the data in the DMS to compile information as required for the annual report.

Compiled data sets from the DMS are then augmented with required maps generated externally to produce the required annual report. Mapping prepared outside the DMS are subsequently imported into the DMS as GIS files to ensure all data are kept in one place and to allow for access by GSAs and other Subbasin stakeholders.

The DMS will be maintained by the San Luis & Delta-Mendota Water Authority, while acting as the Plan Manager, with a contract with the software vendor for hosting, maintenance and future maintenance. Each GSP will pay a maintenance fee for the continued hosting and support of the Subbasin coordinated DMS.

The Coordinated DMS as described herein may be supplemented by additional DMS developed and maintained by each GSP Group in the Subbasin. The reader is referred to each of the six Subbasin GSPs for specific information relative to data collection and management in each GSP Plan area.

8. STAKEHOLDER OUTREACH

California Code of Regulations, Title 23, §354.10 identifies the requirements for notice and communication information presented in a GSP, which includes:

- A summary of information relating to notification and communication by the GSAs with other agencies and interested parties;
- A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties;
- A list of public meetings at which the GSP was discussed or considered by the GSAs;
- Comments regarding the GSP received by the GSAs and a summary of any responses by the GSAs;
- A communication section of the GSP that includes an explanation of the GSAs' decision-making process, identification of opportunities for public engagement, a discussion of how public input and response was used, a description of how the GSAs encouraged the active involvement of diverse social, cultural and economic elements of the population within the basin, and the methods used by the GSAs to inform the public about progress implementing the GSP, including the status of projects and actions.

In meeting these requirements, outreach and educational activities were conducted at the Subbasin, GSP and GSA level throughout the GSP development process. This section describes the noticing and outreach conducted at the Delta-Mendota Subbasin level for GSP development. Please refer to each individual Subbasin GSP for specific details regarding noticing and communication, and descriptions of the beneficial uses and users of groundwater at the GSP and GSA level. Information regarding Subbasin coordination and committees can be found in Section 2, Delta-Mendota Subbasin Governance, of this document.

8.1 Situation Assessment and Communications Plan

To assist in GSA formation and GSP development, agencies in the Delta-Mendota Subbasin sought and received Facilitation Support Services funding from DWR in August 2016. Under this funding, a neutral, third-party facilitation team conducted a situation assessment on behalf of the Subbasin GSAs. The purpose of the assessment was to understand how stakeholders perceived the status of the Subbasin's groundwater resources and identify potential barriers to the successful development of the GSPs.

~~The facilitation~~The facilitation team, with input from local agencies, identified 30 stakeholders representing diverse interests and beneficial users in the Subbasin, together with disadvantaged communities, agricultural well owners, government and land use agencies, and environmental and ecosystem interests. From February 2017 to May 2017, the facilitators conducted over 30 phone and in-person interviews with stakeholders. The facilitators recorded the interview responses and summarized the results in a presentation made to the GSA representatives.

The assessment results were used to inform the development of the Delta-Mendota Subbasin Sustainable Groundwater Management Act Communications Plan (Communications Plan), which is provided with this document as **Appendix E**. The Communications Plan identifies near- and long-term outreach and

engagement strategies, tactics, and tools for stakeholder engagement in GSP development and implementation. The Subbasin GSAs used the Communications Plan as a framework for conducting the stakeholder outreach and engagement activities described in this document.

The Delta-Mendota Subbasin is home to a large Hispanic or Latino population with many using Spanish as their primary language. As such, public noticing, educational materials and other outreach efforts were developed and presented in both English and Spanish throughout the GSP development process.

8.2 Public Noticing and Information

The Delta-Mendota Subbasin GSAs developed and used several coordinated tools, in addition to their own resources to inform members of the public about GSP development activities and promote opportunities for public engagement. These tools are described below.

- **Website:** The Subbasin website – www.deltamendota.org – is the primary location for information related to SGMA implementation in the Subbasin. Information provided on the website includes: an overview of SGMA, a description of each of the GSP groups, contact information for each of the GSAs, and upcoming workshops and public meetings. The website also serves as a repository for outreach collateral, workshop materials, and meeting packets and minutes for the Delta-Mendota Subbasin Coordination Committee, Technical Working Group, and Communications Working Group (described below), and provides links to the individual GSP websites maintained by each GSP Group.

- **Delta-Mendota Subbasin Newsletter:** The Delta-Mendota Subbasin Newsletter is distributed on a monthly basis and serves as an informational tool to keep interested parties, beneficial users, and members of the general public informed about the development and status of the GSPs. Newsletter topics include Subbasin-wide activities, general announcements, upcoming meetings and workshops, and past and upcoming GSP development activities. Copies of the newsletters are archived on the Subbasin website.

- **Informational Materials**: GSAs in the Subbasin developed a suite of materials in English and Spanish to educate and inform members of the public about SGMA and topics covered in the GSP. These materials include bilingual presentations, fact sheets, handouts, frequently asked questions, and videos. Copies of the materials are available on the Subbasin website. GSA representatives distributed these materials before and during meetings, workshops, and other outreach activities.

8.3 List of Public Meetings Where the GSPs were Discussed

Each GSP Group for the Delta-Mendota Subbasin has conducted individual outreach efforts relative to their own GSP Plan area in addition to those same efforts at the subbasin-level. Please refer to each of the individual GSPs for this information. Below is a list of the coordinated public workshops and meetings where the GSPs were discussed. These include meetings of the Delta-Mendota Subbasin Coordination Committee, the two Subbasin Working Groups and coordinated public workshops. All meetings were publicly noticed and held from June 2017 through July 2019. Meeting agenda, minutes and handouts are available on the Delta-Mendota Subbasin website at www.deltamendota.org.

Delta-Mendota Coordination Committee Meetings

The Delta-Mendota Subbasin Coordination Committee meets on the second Monday of each month at 9:30 am at the SLDMWA Administration Offices located at 842 6th Street, Los Banos, California. These meetings are noticed as required under the Brown Act and are open to the public.

In addition to the monthly meetings, a special meeting of the Coordination Committee was held on March 8, 2019 to discuss sustainable yield estimation methodologies.

Delta-Mendota Technical Working Group Meetings

The Delta-Mendota Technical Working Group meets on the third Tuesday of each month at 10:00 am at the SLDMWA Administration Offices located at 842 6th Street, Los Banos, California. These meetings are noticed as required under the Brown Act and are open to the public.

In addition to the monthly meetings, several special meetings of the Technical Working Group were held to discuss specific topics. These additional meetings were as follows:

- August 24, 2018 and September 19, 2018 meetings to discuss Groundwater Dependent Ecosystems
- August 8, 2018, October 30, 2018 and December 19, 2018 meetings to discuss water budgets

Delta-Mendota Communication Working Group Meetings

The Delta-Mendota Communications Working Group meets on the fourth Tuesday of each month at 1:00 pm. These meetings typically conducted via conference call. Meeting information for this working group is available on the Delta-Mendota Subbasin website.

Coordinated Public Workshops

Coordinated public workshops were held for the Delta-Mendota Subbasin shown in the table below. All workshops were advertised and conducted in both English and Spanish.

Table CC-2419: Coordinated Public Workshops

Date	Location, Venue	Topic
Spring 2018 Workshops		
May 14, 2018	Los Banos, San Luis & Delta Mendota Water Authority	• Sustainable Groundwater Management Act overview • Delta-Mendota Subbasin overview • Opportunities for engagement
May 16, 2018	Patterson, Hammon Senior Center	
May 17, 2018	Mendota, Mendota Library	
Fall 2018 Workshops		
October 22, 2018	Firebaugh, Firebaugh Middle School	• GSP development and implementation process • Data collection • Hydrogeologic Conceptual Model • Numerical and analytical models • Water budgets
October 24, 2018	Los Banos, College Greens Building	
October 25, 2018	Patterson, Hammon Senior Center	
Winter 2019 Workshops		
February 19, 2019	Los Banos, College Greens Building	

Date	Location, Venue	Topic
February 20, 2019	Patterson, Patterson City Hall	• Historic and current water budgets • Sustainability criteria • Undesirable results • Projects and management actions
March 4, 2019	Santa Nella, Romero Elementary School	
Spring 2019 Workshops		
May 20, 2019	Patterson, Patterson City Hall	• Projected water budgets • Sustainable yield • Groundwater monitoring networks • Projects and management actions
May 21, 2019	Los Banos, College Greens Building	
May 22, 2019	Santa Nella, Romero Elementary School	
May 23, 2019	Mendota, Mendota Library	

Please see **Appendix F** for summaries of the coordinated public workshops, and **Appendix G** for example promotional materials for the public workshops.

8.4 Comments Regarding the GSPs

Key components of the six Subbasin GSPs were presented at the public workshops conducted throughout the GSP development process. **Appendix F** contains summaries of the coordinated public workshops, including comments received from and feedback provided to workshop participants. Additionally, each of the GSP Groups in the Delta-Mendota Subbasin are individually responsible for the public review of their plans and for addressing any public comments received. Please see the individual GSPs for additional information regarding plan review.

8.5 Subbasin Decision Making Process

The Delta-Mendota Subbasin Coordination Agreement outlines the responsibilities of all Subbasin parties, including decision making protocols and voting structure. These are further discussed in Chapter 2 of this document.

During the GSP development process, the Technical Working Group was charged with coordinating implementation of the required technical elements of the GSP (e.g., water budgets, monitoring networks), and to provide recommendations to the Delta-Mendota Subbasin Coordination Committee. Similarly, the Communications Working Group was charged with implementing the Subbasin Communications Plan and with providing recommendations for workshops and other outreach activities to the Coordination Committee. The Coordination Committee took actions and approved recommendations and work products and provided direction to both working groups and other ad hoc committees.

In general, the coordinated decision-making process included developing agendas for each meeting of the Delta-Mendota Subbasin Coordination Committee and for each Working Group meeting. The agendas were developed in concert with the Technical and Communications Working Groups, and the respective representatives of each GSP Group. Agenda items were either educational, informational, or required direction or decision. Meeting agendas, meetings minutes and handouts have been posted on the Delta-Mendota Subbasin website for public access.

8.6 Opportunities for Public Engagement and How Public Input was Used

Community input was encouraged and received at all meetings of the Coordination Committee, Technical Working Group, Communications Working Group meetings and at the public workshops. The Subbasin

GSPs (and therefore, this Common Chapter) was shaped by community input, Working Group input, and Coordination Committee direction and decisions.

8.6.1 Opportunities for Public Engagement

Regular opportunities for public engagement were available throughout GSP development. The Coordination Committee, Technical and Communications Working Groups, and individual GSA staff encouraged public input throughout the development of the GSPs as described below. A list of stakeholder and community organizations contacted as part of the Subbasin coordinated outreach efforts is included in **Appendix H**.

Meetings and Direct Engagement

Open meetings and public workshops were held as described in Section 8.1. In addition, GSA staff made direct contact with community representatives to encourage their participation in the GSP development process. GSA representatives provided their contact information by phone, email, or mail both online (on the Subbasin website) and at workshops for stakeholder questions and comments.

Targeted Stakeholder Engagement

The Subbasin GSAs also conducted targeted outreach and engagement to hard-to-reach communities, interested parties, and stakeholders that were previously underrepresented in other engagement activities. This included outreach to the following stakeholder types:

- **Agricultural Interests:** Agricultural stakeholders in the Subbasin include agricultural well operators, growers, ranchers, farmworkers, and agricultural landowners. Strong agricultural representation exists within the leadership of the GSAs. To augment direct outreach being conducted by individuals GSAs, Subbasin representatives also coordinated closely with local county farm bureaus to disseminate information related to GSP development and public workshops.
- **School Districts:** Schools districts are considered for both beneficial users of groundwater (for drinking water), as well communication channels to disseminate information about SGMA and GSP development. GSA representatives directly contacted local school districts to notify them of the public workshops. Some schools also help distributed informational materials and workshop flyers to their students and parents.
- **Industrial Interests:** There are many industrial interested in the Subbasin, including packaging and processing plants, mining industries, and other similar facilities that use groundwater in some fashion. The GSP Groups have identified these interests within their respective Plan areas and have disseminated information related to GSP development during individual outreach efforts.
- **Environmental/Conservation Interests:** Environmental and conservation interests in the Subbasin have been contacted and communicated with during GSP development. Specific related interest groups contacted during GSP development include The Nature Conservancy, the California Department of Fish and Wildlife, Audubon, and various sportsman clubs and wetland managers.

- **Disadvantaged Communities:** The GSAs followed best practices identified in Collaborating for Success: Stakeholder Engagement for Sustainable Groundwater Management Act Implementation (Community Water Center, 2015) and other guidance documents to engage disadvantaged and severely disadvantaged communities. This included holding meetings in disadvantaged communities; holding meetings in the evening at known local venues, such as schools, civic centers, and community centers; translating fact sheets, meeting materials, and presentations into other languages; and providing interpreting services at all public workshops.
- **Other Interests:** Other potential groundwater users in the Subbasin (or those with groundwater-related interests) contacted during GSP development included the various counties in which the Delta-Mendota Subbasin lie and/or are adjoining (including San Joaquin County and San Benito County), Caltrans, the DWR State Water Project Division of Operations and Maintenance, the U.S. Bureau of Reclamation, the U.S. Geological Survey and the San Joaquin River Restoration Program.

The Reader should refer to each individual GSP for a more ~~complete description~~complete description of GSP-specific meetings and direct engagement.

GSP Section Review and Comment Periods

Each GSP Group was responsible for coordinating the individual review of their GSP. Please see each GSP for additional information as to their specific public review process. This Common Chapter to the six Delta-Mendota Subbasin GSPs was posted on the Subbasin's website (www.deltamendota.org) following submittal of the Subbasin GSPs.

8.6.2 How Public Input and Response was Used in the Development of the GSP

Each GSP Group was responsible for coordinating the individual review of their GSP and for determining how to incorporate public input and responses into their respective plans. Public input to the GSPs was solicited through the GSP development process through a number of means, including coordinated public workshops, Board of Directors presentations, City Council presentations, and growers' meetings. Please see the individual GSPs for more information regarding GSP-specific outreach efforts and how stakeholder and public input was received and factored into the GSPs.

8.7 Revisions to Common Chapter and Subbasin GSPs

As previously noted in this document, the Delta-Mendota Subbasin received a Consultation Initiation Letter on January 21, 2022 from DWR. The CIL identified four potential deficiencies across the six Subbasin GSPs which may preclude DWR's approval, as well as potential corrective actions to address each potential deficiency. The CIL thus initiated consultation between DWR, the Basin Manager, Plan Managers, and the Subbasin's 23 Groundwater Sustainability Agencies (GSAs) on February 18, 2022 regarding the amount of time needed to address the potential deficiencies and corrective actions. Subsequent meetings were held on March 7, March 30, April 19, May 24, and June 20 2022 to discuss the Subbasin's proposed approach to addressing the identified deficiencies.

The four deficiencies identified in DWR's CIL are summarized as follows:

Potential Deficiency 1: The GSPs do not use the same data and methodologies.

Potential Deficiency 2: The GSPs have not established common definitions of undesirable results in the Subbasin.

Potential Deficiency 3: The GSPs in the Subbasin have not set sustainable management criteria in accordance with GSP regulations.

Potential Deficiency 4: The management areas established in the Plan have not sufficiently addressed the requirements specified in 23 CCR §354.20.

This revised Common Chapter, and associated revisions to the six Subbasin GSPs, have been prepared in response to the deficiencies identified in the CIL based on direction provided by the Delta-Mendota Subbasin Coordination Committee, the Delta-Mendota Technical Working Group, the Subbasin GSAs and DWR. It is intended to document how the deficiencies identified in the CIL were addressed in the revised GSPs and associated Common Chapter, and where those revisions are addressed in the Common Chapter.

A Notice of Intent to Adopt the revised Common Chapter and six Subbasin GSPs (known as the Amended Groundwater Sustainability Plan) was distributed on March 15, 2022. Public meetings for the adoption of the Common Chapter and Subbasin GSPs were held in June and July of 2022; please see the Subbasin's website (www.deltamendota.org) for the respective dates for each GSAs meeting and adoption.

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Appendix B
Coordination Agreement

DELTA-MENDOTA SUBBASIN COORDINATION AGREEMENT

THIS DELTA-MENDOTA SUBBASIN COORDINATION AGREEMENT is made effective as of December 12, 2018 by and among the groundwater sustainability agencies within the Delta-Mendota Subbasin (each a "**Party**" and collectively the "**Parties**") and is made with reference to the following facts:

WHEREAS, On September 16, 2014, Governor Jerry Brown signed into law Senate Bills 1168 and 1319 and Assembly Bill 1739, known collectively as the Sustainable Groundwater Management Act ("**SGMA**");

WHEREAS, SGMA requires all groundwater subbasins designated as high or medium priority by the California Department of Water Resources ("**DWR**") to manage groundwater in a sustainable manner;

WHEREAS, the Delta-Mendota Subbasin (Basin Number 5-22.07, DWR Bulletin 118) within the San Joaquin Valley Groundwater Basin ("**Subbasin**"), has been designated as a high-priority basin by DWR;

WHEREAS, the Delta-Mendota Subbasin includes multiple groundwater sustainability agencies that intend to manage the Subbasin through the development and implementation of multiple different groundwater sustainability plans ("**GSP**");

WHEREAS, SGMA allows local agencies to engage in the sustainable management of groundwater, but requires groundwater sustainability agencies in all basins that are managed by more than one groundwater sustainability plan to enter into a coordination agreement to coordinate the multiple groundwater sustainability plans to sustainably manage the Subbasin pursuant to SGMA;

WHEREAS, pursuant to the requirements of SGMA, and the California Code of Regulations, and in recognition of the need to sustainably manage the groundwater within the Delta-Mendota Subbasin, the Parties desire to enter into this Agreement between their individual groundwater sustainability agencies;

WHEREAS, in order to efficiently coordinate among the large number of groundwater sustainability agencies ("**GSA**") in the Subbasin, the Parties intend to organize themselves into "**GSP Groups**" and to be represented by the "**GSP Group Representatives**," on terms

to be developed and implemented by separate Agreements between each GSP Group and the Parties within such GSP Group; and

WHEREAS, this Coordination Agreement is being executed before the respective GSPs have been prepared, and the Parties anticipate attaching and incorporating technical reports covering such additional required information before submittal of this Agreement to DWR with the Parties' respective GSPs without separate amendment being required.

THEREFORE, in consideration of the facts recited above and of the covenants, terms and conditions set forth herein, the Parties agree as follows:

SECTION 1 – PURPOSE

1.1 Compliance with SGMA

In subbasins with multiple GSPs, SGMA requires the GSPs to be coordinated through a coordination agreement. The purpose of this Coordination Agreement including the anticipated attachment and incorporation of technical reports to be developed after the initial execution of this Agreement, is to comply with that SGMA requirement and ensure that the multiple GSPs within the Subbasin are developed and implemented utilizing the same methodologies and assumptions, that the elements of the GSPs are appropriately coordinated to support sustainable management, and to ultimately set forth the information necessary to show how the multiple GSPs in the Subbasin will achieve the sustainability goal, as determined for the Subbasin in compliance with SGMA and its associated regulations.

1.2 Description of Criteria & Function

An additional purpose of this Coordination Agreement is to describe the criteria for establishing the responsibilities of each Party for meeting the terms of this Coordination Agreement, the procedure for the exchange of information between the Parties, and procedures for resolving conflicts between the Parties. The goal of the coordination is to ensure that the Subbasin GSPs utilize the same data and methodologies, including but not limited to, groundwater elevation data, groundwater extraction data, surface water supply, total water use, changes in groundwater storage, water budgets, and sustainable yield during their development as required by SGMA and associated regulations. Additionally, this Coordination Agreement sets out the process for identifying a Plan Manager.

SECTION 2 – DEFINITIONS

2.1 **"Coordinated Plan Expenses"** shall mean any expenses incurred by the Secretary and the Plan Manager for purposes of developing and implementing the Coordination Agreement.

2.2 "**Coordination Agreement**" shall mean this Coordination Agreement.

2.3 "**Coordination Committee**" shall mean the committee of GSP Group Representatives established pursuant to this Coordination Agreement.

2.4 "**Group Contact"** shall mean one Party designated on Exhibit "A" attached hereto and by reference incorporated herein as responsible to supply notices and to circulate information and invoices for its respective Exhibit "A" GSP Group, as said Exhibit may be updated from time to time.

2.5 "**GSA**" shall mean a groundwater sustainability agency established in accordance with SGMA and its associated regulations, and "GSAs" shall mean more than one such groundwater sustainability agency. Each Party is a GSA.

2.6 "**GSP"** shall mean a groundwater sustainability plan as defined by SGMA and its regulations, and "GSPs" shall mean more than one such plan.

2.7 "**GSP Group**" shall mean a grouping of Parties, stakeholders, and interested parties developing an individual GSP within the Subbasin, as shown in Exhibit "A," who are combined for purposes of representation and voting on the Coordination Committee and for purposes of sharing Coordinated Plan Expenses as set forth in this Coordination Agreement.

2.8 "**GSP Group Alternate Representative," "Alternate Representative,"** or **"Alternate"** and their plural forms shall mean an alternate member of the Coordination Committee selected to represent the GSP Groups in accordance with Exhibit "A" and Section 5.1.2-5.1.4 of this Coordination Agreement who shall serve in the absence of the respective GSP Group Representative and shall be entitled to cast the vote for the absent GSP Representative.

2.9 "**GSP Group Representative"** or **"Representative"** and their plural forms as appropriate shall mean a member or members of the Coordination Committee selected to represent the GSP Groups in accordance with Exhibit "A" and Section 5.1.2 – 5.1.4 this Coordination Agreement.

2.10 "**Participation Percentages"** shall mean that percentage of Coordinated Plan Expenses allocated to each GSP Group as described on Exhibit "A" to this Coordination Agreement, which is attached and incorporated by reference herein, as updated from time to time.

2.11 "**Party**" or "**Parties**" shall mean a Groundwater Sustainability Agency or in the plural, two or more Groundwater Sustainability Agencies within the Delta-Mendota Subbasin.

2.12 "**Plan Manager**" shall mean an entity or individual, appointed at the pleasure of the Coordination Committee, or as provided in section 4.1.2 of this Coordination Agreement, to perform the role of the Plan Manager to serve as the point of contact to DWR as set forth in Section 5.2.3 of this Coordination Agreement.

2.13 "**Seasonal High**" shall mean the highest annual static groundwater elevation associated with stable aquifer conditions following a period of lowest annual groundwater demand.

2.14 "**Seasonal Low**" shall mean the lowest annual static groundwater elevation associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.

2.15 "**San Luis & Delta-Mendota Water Authority"** or "**SLDMWA"** shall mean the San Luis & Delta-Mendota Water Authority, a California joint powers agency.

2.16 "**SGMA**" shall mean the Sustainable Groundwater Management Act, as amended from time to time, commencing at Water Code section 10720, together with its implementing regulations applicable to Groundwater Sustainability Plans, set forth at California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2.

2.17 "**SGMA Definitions**" shall mean those SGMA-specific definitions provided by statute or regulation and attached in the Appendix to this Coordination Agreement; in the event of any inconsistency between a term defined in this Section and a SGMA-specific definition, the definition contained in this Coordination Agreement shall prevail.

2.18 "**Subbasin**" shall mean the Delta-Mendota Subbasin (Basin Number 5-22.07, DWR Bulletin 118) within the San Joaquin Valley Groundwater Basin.

2.19 "**Technical Memoranda**" shall mean the memoranda prepared by the Coordination Committee that include the data and methodologies for assumptions described in Water Code section 10727.6 to prepare coordinated plans. Individually, the memoranda shall be referred to as a "**Technical Memorandum**."

2.20 "**Water Year**" shall mean the period from October 1 through the following September 30 as defined by SGMA.

2.21 "**Water Year Type**" shall mean the classification provided by DWR to assess the amount of annual precipitation in a basin and as defined by SGMA.

SECTION 3 – GENERAL GUIDELINES

3.1 Responsibilities of the Parties

3.1.1 Obligation to Coordinate

The Parties to this Coordination Agreement agree to work collaboratively to meet the objectives of SGMA and this Coordination Agreement. Each Party to this Coordination Agreement is a GSA and acknowledges that it is bound by the terms of this Coordination Agreement as an individual Party.

3.1.2 Obligations Outside of Coordination Agreement Regarding GSP Groups

a) Representation and Voting. Each Party understands its participation, as more fully set forth in Section 5 of this Coordination Agreement, is based on representation through and by its GSP Group Representative(s). It is the responsibility and obligation of each Party under this Coordination Agreement to develop its own arrangements for how its respective GSP Group Representative and Alternate Representative are selected and how required actions of GSAs within the GSP Group under its respective GSP are identified and implemented.

b) The Coordination Committee and its members shall have no requirement to recognize a voting status or other decisional authority of any Party to this Coordination Agreement other than through the designated GSP Group Representative(s). For purposes of this Coordination Agreement, it is assumed that GSP Group Representatives have been authorized by the Parties in their GSP Groups to participate as described herein.

c) By signing this Coordination Agreement, each Party commits to provide documentation to the Secretary and the Coordination Committee of the authorization of its GSP Group Representative(s). Provided, that the Secretary shall not be obligated to evaluate or provide an opinion on the legal sufficiency of the documentation.

d) It is the responsibility and obligation of each Party under this Coordination Agreement that is included on Exhibit "A" as part of a multi-party GSP Group to provide documentation to the Secretary and to the Coordination Committee establishing that such GSP Group has a binding agreement or mechanism assuring that the GSP Group will pay its Participation Percentage set forth on Exhibit "A," as said Exhibit "A" may be modified from time to time. Provided, that the Secretary shall not be obligated to evaluate or provide an opinion on the legal sufficiency of the documentation.

3.1.3 Non-Entity Status

The Parties acknowledge and agree that this Coordination Agreement does not create a legal entity with power to sue or be sued, to enter into contract, or to enjoy the benefits or accept the obligations of a legal entity.

3.1.4 Implementation of Individual GSPs

This Coordination Agreement does not otherwise affect each Party's responsibility to implement the terms of its respective GSP in accordance with SGMA. Rather, this Coordination Agreement is the mechanism through which the Parties will coordinate their respective GSPs to the extent necessary to ensure that such GSP coordination complies with SGMA.

3.2 Adjudicated or Alternate Plans in the Subbasin

As of the date of this Coordination Agreement, there are no portions of the Subbasin that have been adjudicated or approved to submit an alternative plan as defined by SGMA.

SECTION 4 – ROLE OF SAN LUIS & DELTA-MENDOTA WATER AUTHORITY

4.1 Agreement to Serve

By executing this Agreement, and not as a Party, the San Luis & Delta-Mendota Water Authority agrees to carry out the functions described in this Section 4 and its subparts consistent with the terms of this Section and under the direction and supervision of the Coordination Committee, subject to the reimbursement and the termination provisions contained in this Section.

4.1.1 Secretary

The SLDMWA agrees to perform the obligations of the Secretary described in this Coordination Agreement, by delegation to one or more of its employees or to a consultant under contract to the SLDMWA.

4.1.2 Plan Manager

The SLDMWA agrees to perform the obligations of the Plan Manager described in this Coordination Agreement, by delegation to one or more of its employees or to a consultant under contract to the SLDMWA.

4.2 Reimbursement of SLDMWA

The commitment of the SLDMWA to perform the designated functions under this Section is contingent upon the execution and performance of a separate cost sharing agreement between the SLDMWA and the Parties.

4.3 Termination of SLDMWA's Services

Either the Parties acting through the Coordination Committee or the SLDMWA at any time may terminate the services being provided by the SLDMWA under this Coordination Agreement upon thirty (30) days' written notice, if from the SLDMWA, to the Coordination Committee and each GSP Group Representative; and if from the Coordination Committee, to the SLDMWA and each GSP Group Representative.

SECTION 5 – RESPONSIBILITIES FOR KEY FUNCTIONS

5.1 Coordination Committee

5.1.1 The Parties agree to establish a Coordination Committee to provide the forum for the Parties to accomplish the coordination obligation of SGMA pursuant to this Coordination Agreement.

5.1.2 The Coordination Committee will consist of the GSP Group Representatives identified on Exhibit "A" attached hereto and incorporated herein by this reference, as said Exhibit "A" may be modified from time to time pursuant to Section 13 of this Agreement. Each GSP Group Representative shall have one Alternate Representative authorized to vote in the absence of the GSP Group Representative.

5.1.3 Individuals serving as GSP Group Representatives and Alternate Representatives shall be selected by each respective GSP Group in the discretion of the respective GSP Group, and such appointments shall be effective upon providing written notice to the Secretary and to each Group Contact listed on Exhibit "A".

5.1.4 The Coordination Committee will recognize each GSP Group Representative and GSP Group Alternate Representative until such time as the Group Contact provides written notice of removal and replacement to the Secretary and to every other Group Contact designated on Exhibit "A." Each GSP Group or GSP Subgroup shall promptly fill any vacancy created by the removal of such Representative or Alternate Representative so that each GSP

Group shall have the number of validly designated Representatives and Alternate Representatives specified on Exhibit "A".

5.1.5. Minutes of the Coordination Committee will be prepared and maintained as set forth in Section 5.5.4.

5.2 Coordination Committee Officers

The Officers of the Coordination Committee will include a Chairperson, Vice Chairperson, Secretary, and Plan Manager. Except where the Parties have named such Officers pursuant to Section 4 of this Coordination Agreement, Officers shall be selected at the initial meeting of the Committee or as soon thereafter as reasonably can be accomplished.

5.2.1 Chairperson and Vice Chairperson

a) A GSP Group Representative shall serve as Chairperson. The Vice Chairperson, who shall also be a GSP Group Representative, shall serve in the absence of the Chairperson. In the absence of both the Chairperson and Vice Chairperson, a meeting may be led by an Acting Chairperson selected on an ad hoc basis.

b) The positions of Chairperson and Vice Chairperson shall rotate among the GSP Groups on an annual basis according to alphabetical order, with the first rotation beginning on the date the first Chairperson is selected. The schedule for rotation among the GSP Groups will be set at the first meeting after the Chairperson is appointed and reviewed and adjusted annually. A GSP Group Representative may waive designation as Chairperson. In such a case the Chairperson office would rotate to the next designated entity.

5.2.2 Secretary

The Coordination Committee shall select a Secretary to carry out the functions described in this subsection, to serve at the pleasure of the Coordination Committee. The Secretary shall be a public agency who may be, but need not be a Party to this Coordination Agreement. The San Luis & Delta-Mendota Water Authority is hereby designated as the initial Secretary, to serve at the pleasure of the Coordination Committee.

a) The Secretary shall select an appointee to implement the Secretary's responsibilities under this Coordination Agreement, for example, to coordinate meetings; prepare agendas; circulate notices and agendas; provide written notice to all Parties that the Coordination Committee has made a recommendation requiring approval by the Parties; prepare and maintain minutes of meetings of the Coordination Committee; receive notices on

behalf of the Coordination Committee and call to the Coordination Committee's attention the need for responding; and provide such other assistance in coordination as may be appropriate.

b) The Secretary shall assume primary responsibility for Brown Act compliance, including without limitation, the responsibility to: prepare an agenda and notice, publicly post, and distribute agendas to all GSP Group or Subgroup Representatives, the Parties, and any other interested persons who requests, in writing, such notices. The Agenda shall be of adequate detail to inform the public and the parties of the meeting and the matters to be transacted or discussed, and shall be posted in a public location and distributed to each of the parties to this Coordination Agreement at least seventy-two (72) hours prior to every regular meeting and at least twenty-four (24) hours prior to every special meeting.

5.2.3 Plan Manager

If the SLDMWA ceases to serve as Plan Manager as agreed under Section 4.1.2 of this coordination Agreement, then the Coordination Committee shall name a successor Plan Manager, who may be a consultant hired by the Secretary pursuant to the Coordination Agreement, the representative of an entity that has been selected as Secretary, or a public agency serving as or participating in a GSA that is a Party to this Coordination Agreement, and who shall serve as the point of contact for DWR as specified by SGMA. The San Luis & Delta-Mendota Water Authority is hereby designated as the initial Plan Manager, to serve at the pleasure of the Coordination Committee.

a) The Plan Manager shall carry out the duties of a "plan manager" as provided in Title 23, division 2, Chapter 1.5, Subchapter 2, California Code of Regulations.

b) The Plan Manager has no authority to make policy decisions or represent the Coordination Committee without the specific direction of the Coordination Committee. The Plan Manager is obligated to disclose all substantive communications he/she transmits and receives in his/her capacity as Plan Manager to the Coordination Committee.

5.3 Coordination Committee Authorized Actions and Limitations

5.3.1 Authorized Actions

The Coordination Committee is authorized to act upon the following enumerated items:

a) The Coordination Committee shall review, and consistent with the requirements of SGMA, approve the Technical Memoranda described in Sections 8-12 of this Coordination Agreement.

b) Once GSP Plans have been submitted to and approved by DWR, the Coordination Committee shall be responsible for ongoing review and updating of the Technical Memoranda as needed; assuring submittal of annual reports; providing five-year assessments and recommending any needed revisions to the Coordination Agreement; and providing review and assistance with coordinated projects and programs.

c) The Coordination Committee shall review and approve work plans, and in accordance with the budgetary requirements of the respective Parties, approve annual estimates of Coordinated Plan Expenses presented by the Secretary and any updates to such estimates; provided, that such estimates or updates with supporting documentation shall be circulated to all Parties for comment at least thirty (30) days in advance of the meeting at which the Coordination Committee will consider approval of the annual estimate.

d) Pursuant to Section 13, the Coordination Committee is authorized to approve changes to Exhibit "A" to this Coordination Agreement and to recommend amendments to terms of this Coordination Agreement.

e) The Coordination Committee shall assign work to subcommittees and workgroups as needed, provide guidance and feedback and ensure that subcommittees and workgroups prepare work products in a timely manner.

f) The Coordination Committee shall direct the Plan Manager in the performance of its duties under SGMA.

g) The Coordination Committee shall provide direction to its Officers concerning other administrative and ministerial issues necessary for the fulfillment of the above-enumerated tasks.

5.3.2 Limitations

When the terms of this Coordination Agreement or applicable law require the approval of a Party, that approval shall be required and evidenced as indicated in Section 6 of this Agreement.

5.4 Subcommittees and Workgroups

The Coordination Committee may appoint subcommittees, workgroups, or otherwise direct staff made available by the Parties. Such subcommittees or workgroups may include qualified individuals possessing the knowledge and expertise to advance the goals of the Coordination

Agreement on the topics being addressed by the subcommittee, whether or not such individuals are GSP Group Representatives or Alternate Representatives.

5.4.1 Work of Subcommittees and Workgroups

Tasks assigned to subcommittees, workgroups, or staff made available by the Parties may include developing technical data, supporting information, and/or recommendations on matters including, but not limited to:

a) Developing a process to update the Coordination Committee on the activities of the respective Parties, including the development, planning, financing, environmental review, permitting, implementation, and long-term monitoring of the multiple GSPs in the Subbasin;

b) Subject to the oversight of the Coordination Committee, scheduling meetings of the subcommittee or workgroup as necessary to coordinate development and implementation of the Technical Memoranda and Coordination Agreement. Attendance at these meetings may be augmented to include staff or consultants of all Parties to ensure that the appropriate expertise is available;

c) Determining common methodologies for GSP development;

d) Developing a Subbasin-wide monitoring network;

e) Preparing a coordinated water budget;

f) Developing a coordinated data management system;

g) Providing an explanation of how the respective GSPs implemented together satisfy the requirements of SGMA and are in substantial compliance with SGMA; and

h) Such other tasks as may be referred by the Coordination Committee from time to time.

5.4.2 Subcommittee Voting

One GSP Group Representative or Alternate Representative shall vote on behalf of the GSP Group at the subcommittee level; if no GSP Group Representative or Alternate Representative is present, one individual working on a subcommittee on behalf of the Parties in a GSP Group shall vote on behalf of the GSP Group. Subcommittees shall report voting results and provide

information to the Coordination Committee but shall not be entitled to make determinations or determinations that are binding on the Parties.

5.5 Coordination Committee Meetings

5.5.1 Timing and Notice

The Chairperson of the Coordination Committee, any two GSP Group Representatives, or the Secretary may call meetings of the Coordination Committee as needed to carry out the activities described in this Coordination Agreement. The Coordination Committee may, but is not required to, set a date for regular meetings for the purposes described in this Coordination Agreement. All Coordination Committee Meetings shall be held in compliance with the Ralph M. Brown Act (Government Code Section 54950 *et seq*.).

5.5.2 Quorum

A majority of the GSP Group Representative(s) from every GSP Group listed on Exhibit "A" shall constitute a quorum of the Coordination Committee for purposes of holding a Coordination Committee meeting; provided, that the GSP Group Representative(s) from every GSP Group listed on Exhibit "A" must be present at a meeting for any Coordination Committee vote on a matter described in section 5.3.1 a) through 5.3 d) and 5.3.1 f) to take place. The GSP Group Alternate Representative(s) of each GSP Group shall be counted towards a quorum and as the voting representative(s) in the absence of the GSP Group Representative for which the GSP Group Alternate has been appointed. If less than a quorum is present, the GSP Group Representatives and Alternate Representatives may hear reports and discuss items on the agenda, but no action may be taken.

5.5.3 Open Attendance

Members of the public, stakeholders, and representatives of the Parties who are not appointed as GSP Group Representatives may attend all meetings and shall be provided with an opportunity to comment on matters on the meeting agenda, but shall have no vote.

5.5.4 Minutes

The Secretary's appointee shall keep and prepare minutes of all Coordination Committee meetings. Notes of subcommittee and workgroup meetings shall be kept by the Secretary's appointee or an assistant to the appointee. All minutes and subcommittee and workgroup meeting notes shall be maintained by the Secretary as Coordination Agreement records and shall be available to the Parties and the public upon request.

5.6 Voting by Coordination Committee

5.6.1. Each GSP Group Representative shall be entitled to one vote at the Coordination Committee. It shall be up to the Parties in each GSP Group to determine how the GSP Group vote(s) will be cast.

5.6.2 Except as set forth in Section 5.6.3, the unanimous vote of the GSP Representatives from all GSP Groups is required on all items upon which the Coordination Committee is authorized to act as identified in Section 5.3.1 a) through 5.3.1 d) and 5.3.1 f); the vote of a majority of a quorum shall be required for all other matters on which the Coordination Committee is authorized to act.

5.6.3 Voting Procedures to Address Lack of Unanimity

When it appears likely that the Coordination Committee will not be able to come to unanimous decision on any matter upon for which a unanimous decision is required, upon a majority vote of a quorum of the Coordination Committee, the matter may be subjected to the following additional procedures.

a) Straw Polls

Straw poll votes may be taken for the purpose of refining ideas and providing guidance to the Coordination Committee, subcommittees, or both.

b) Provisional Voting

Provisional votes may occur prior to final votes. This will be done when an initial vote is needed to refine a proposal but the GSP Group Representatives wish to consult with their respective GSP Group(s) before making a final vote.

c) A vote shall be delayed if any GSP Group Representative declares its intention to propose an alternative or modified recommended action, to be proposed at the next meeting, or as soon thereafter as the GSP Group Representative can obtain any further information or clarifying direction from its GSP Group or governing body, or both, as needed to proposed its alternative or modified recommended action.

d) If the process outlined in subsection 5.6.3(c) fails to result in a unanimous vote, any GSP Group Representative not voting in favor of the recommended action may request that the vote be delayed so that the Coordination Committee can obtain further information on the recommended action (for example, by directing a subcommittee established under this

Coordination Agreement), so the GSP Group Representative can obtain clarifying direction from its GSP Group or governing body, or both, as needed.

e) Each of the Parties acknowledges the limited time provided by SGMA to complete the GSP preparation process, and agrees to make its best efforts to cooperate through the Coordinating Committee in coming to require a unanimous vote.

SECTION 6 – APPROVAL BY INDIVIDUAL PARTIES

6.1 Where law or this Coordination Agreement require separate written approval by each of the Parties, such approval shall be evidenced in writing by providing the resolution, Motion, or Minutes of their respective Boards of Directors to the Secretary of the Coordination Committee.

SECTION 7 – EXCHANGE OF DATA AND INFORMATION

7.1 Exchange of Information

The Parties acknowledge and recognize pursuant to this Coordination Agreement that the Parties may need to exchange information amongst and between the Parties.

7.2 Procedure for Exchange of Information

7.2.1 The Parties shall exchange public and non-privileged information through collaboration and/or informal requests made at the Coordination Committee level or through subcommittees designated by the Coordination Committee. However, to the extent it is necessary to make a written request for information to another Party, each Party shall designate a representative to respond to information requests and provide the name and contact information of the designee to the Coordination Committee. Requests may be communicated in writing and transmitted in person or by mail, facsimile machine, or other electronic means to the appropriate representative as named in this Coordination Agreement. The designated representative shall respond in a reasonably timely manner.

7.2.2 Nothing in this Coordination Agreement shall be construed to prohibit any Party from voluntarily exchanging information with any other Party by any other mechanism separate from the Coordination Committee.

7.2.3 The Parties agree that each GSP Group shall provide the data required to develop the Subbasin-wide coordinated water budget but unless required by law, will not be required to provide individual well or parcel-level information in order to preserve

confidentiality of individuals to the extent authorized by law, including but not limited to Water Code Section 10730.8, subdivision (b).

7.2.4 To the extent that a court order, subpoena, or the California Public Records Act is applicable to a Party, such Party in responding to a request made pursuant to that Act for release of information exchanged from another Party shall notify each other Party in writing of its proposed release of information in order to provide the other Parties with the opportunity to seek a court order preventing such release of information.

SECTION 8 – METHODOLOGIES AND ASSUMPTIONS

8.1 SGMA Coordination Requirements

Pursuant to SGMA, this Coordination Agreement must ensure that the individual GSPs utilize the same data and methodologies for developing assumptions used to determine: 1) groundwater elevation; 2) groundwater extraction data; 3) surface water supply; 4) total water use; 5) changes in groundwater storage; 6) water budgets; and 7) sustainable yield.

8.2 Pre-GSP Coordination

Prior to the individual development of GSPs, the Parties agree to develop agreed-upon methodologies and assumptions for 1) groundwater elevation; 2) groundwater extraction data; 3) surface water supply; 4) total water use; 5) changes in groundwater storage; 6) water budgets; and 7) sustainable yield. This development may be facilitated through the Coordination Committee's delegation to a sub-committee or workgroup of the technical staff provided by some or all of the Parties. The basis upon which the methodologies and assumptions will be developed includes existing data/information, best management practices, and/or best modeled or projected data available and may include consultation with the DWR as appropriate.

8.3 Technical Memoranda Required

The data and methodologies for assumptions described in Water Code section 10727.6 and title 23, California Code of Regulations, section 357.4 to prepare coordinated plans shall be set forth in Technical Memoranda prepared by the Coordination Committee for each of the elements discussed in Sections 9, 10, 11, and 12 of this Coordination Agreement. The Technical Memoranda shall be subject to the unanimous approval of the Coordination Committee and once approved, shall be attached to and incorporated by reference into this Coordination Agreement without

formal amendment of the Coordination Agreement being required. The Parties agree that they shall not submit this Coordination Agreement to DWR until the Technical Memoranda described herein have been added to the Coordination Agreement. The Technical Memoranda created pursuant to this Agreement shall be utilized by the Parties during the development and implementation of their GSPs in order to assure coordination of the GSPs in compliance with SGMA.

SECTION 9 – MONITORING NETWORK

9.1 In accordance with SGMA, the Parties hereby agree to coordinate the development and maintenance of a monitoring network at a Subbasin level through the coordination of the respective monitoring networks established pursuant to the GSPs in which each of the Parties hereto are participating. The Subbasin monitoring network description shall include monitoring objectives, protocols, and data reporting requirements specific to enumerated sustainability indicators. Each GSP Group's network shall facilitate the collection of data in order to characterize groundwater and related surface water conditions in the Subbasin and evaluate changing conditions that occur from implementation of the individual GSPs. Each Party's GSP will describe the monitoring network's objectives for the Subbasin, including an explanation of network development and implementation to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater.

9.2 Each GSP Group shall provide the Coordination Committee all relevant data and information for their respective representative monitoring sites established in accordance with Title 23, California Code of Regulations, section 354.36, as amended from time to time.

SECTION 10 – COORDINATED WATER BUDGET

10.1 In accordance with SGMA, the Parties hereby agree to prepare a single coordinated water budget for the Subbasin as described in this subsection for use in the respective GSP in which each of the Parties hereto are participating. The water budget will provide an estimate of the total annual volume of groundwater and surface water entering and leaving the Subbasin, including historical, current and projected water budget conditions, and the change in the volume of water stored and the safe yield for differing aquifers.

10.2 To the extent feasible, the Parties will consider the best available information and best available science to quantify the water budget for the Subbasin in order to provide an

understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow.

SECTION 11 – COORDINATED DATA MANAGEMENT SYSTEM

11.1 The Parties will develop and maintain a coordinated data management system that is capable of storing and reporting information relevant to the reporting requirements and/or implementation of the GSPs and monitoring network of the Subbasin.

11.2 The Parties also will develop and maintain separate data management systems. Each separate data management system developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Coordination Committee will ensure the data is stored and managed in a coordinated manner throughout the Subbasin and reported to DWR annually as required.

SECTION 12 – ADOPTION AND USE OF THE COORDINATION AGREEMENT

12.1 Coordination of GSPs

Each Party is responsible to ensure that its own GSP complies with the statutory requirements of SGMA, including but not limited to the filing deadline. The Parties to this Coordination Agreement intend that their individual GSPs be coordinated together in order to satisfy the requirements of SGMA and to be in substantial compliance with the California Code of Regulations. The collective GSPs will satisfy the requirements of sections 10727.2 and 10727.4 of the Water Code by providing a description of the physical setting and characteristics of the separate aquifer systems within the Subbasin, the measurable objectives for each such GSP, interim milestones, and monitoring protocols that together provide a detailed description of how the Basin as a whole will be sustainably managed.

12.2 GSP and Coordination Agreement Submission

The Parties agree to submit their respective GSPs to DWR through the Coordination Committee and Plan Manager, in accordance with all applicable requirements. Subject to the subsequent attachment of the Technical Memoranda described in Sections 8-12, the Parties intend that this Coordination Agreement fulfill the requirements of providing an explanation of how the GSPs implemented together satisfy the requirements SGMA for the entire Subbasin.

SECTION 13 – MODIFICATION AND TERMINATION OF THE COORDINATION AGREEMENT

13.1 Modification or Amendment of Exhibit "A"

The Parties agree that Exhibit "A," except for the withdrawal or addition of Parties to this Agreement, may be updated by unanimous vote of the Coordination Committee from time to time. Upon such modification, the updated Exhibit "A" shall be attached to this Agreement as a replacement to the previously existing Exhibit "A." Upon such attachment, the updated "Exhibit "A" shall become a part of this Coordination Agreement without further Amendment of the Coordination Agreement being required. The Secretary shall provide notice of such change to all Group Contacts.

13.1.1 Addition of a Party

A Party may be added to this Coordination Agreement only upon its execution of a counterpart of this Agreement and its provision of any additional documentation required by Sections 3.1.2 a) through 3.1.2 d) of this Coordination Agreement. No Party may be added that is not within the Delta-Mendota Subbasin or that fails to execute an agreement to share in Coordinated Plan Expenses, unless such payment is waived by consent of all Parties.

13.2 Modification or Amendment of Coordination Agreement

Except as provided in Sections 13.1 and 13.3, the Parties hereby agree that this Coordination Agreement may be supplemented, amended, or modified only by a writing signed by all Parties.

13.3 Amendment for Compliance with Law

Should any provision of this Coordination Agreement be determined to be not in compliance with legal requirements under circumstances where amendment of the Agreement to include a provision addressing the legal requirement will cure the non-compliance, the Parties agree to promptly prepare and approve such amendment.

SECTION 14 – WITHDRAWAL, TERM, AND TERMINATION

14.1 Withdrawal

Subject to the requirements identified in SGMA and the any coordination guidelines or regulations issued by DWR, a Party may unilaterally withdraw from this Coordination Agreement without causing or requiring termination of this Coordination Agreement, effective upon thirty (30) days written notice to the Secretary and all other Parties. The Plan Coordinator shall report any such withdrawal to DWR within five (5) days of receipt of the written notice.

14.1.1 Any Party who withdraws shall remain obligated for Coordinated Plan Expenses as provided in a separate Cost Sharing Agreement. If no separate Cost Sharing Agreement is then in effect or enforceable against the withdrawing Party, the Party is obligated to pay its share of all debts, liabilities, and obligations the Party incurred or accrued under the Coordination Agreement prior to the effective date of such withdrawal, as established under its separate GSP Group agreement concerning such share of obligations.

14.1.2 Upon withdrawal, a Party agrees that it has a continuing obligation to comply with SGMA and any coordination guidelines or regulations issued by DWR, which require a coordination agreement if there are multiple GSPs in the Subbasin. This obligation shall survive the withdrawal from this Coordination Agreement and is for the express benefit of the remaining Parties.

14.1.3 In the event any GSP Group Representative(s) prevents/prevent a required unanimous vote of the Coordination Committee after following all procedures described in 5.3.1 or Section 15 of this Agreement, the Parties in such GSP Group agree to provide notice that such GSP Group has unilaterally withdrawn from this Agreement in accordance with this Section.

14.2 Term

As modified pursuant to Section 13 and unless terminated in accordance with Section 14.2.3, this Coordination Agreement shall continue for a term that is coterminous with the requirements of SGMA for the existence of a Coordination Agreement.

14.3 Termination

This Coordination Agreement may be terminated or rescinded and the coordinated implementation of GSPs terminated by unanimous written consent of all the Parties. Nothing

in this Coordination Agreement shall prevent the Parties from entering into another coordination agreement for coordination with any other subbasin.

SECTION 15 – PROCEDURES FOR RESOLVING CONFLICTS

In the event of any dispute arising from or relating to this Agreement, the disputing Party shall, within thirty (30) calendar days of discovery of the events giving rise to the dispute, notify all Parties to this Agreement in writing of the basis for the dispute. Within thirty (30) calendar days of receipt of said notice, all interested Parties shall meet and confer in a good-faith attempt to informally resolve the dispute. All disputes that are not resolved informally shall be settled by arbitration. Within ten (10) days following the failed informal proceedings, each interested Party shall nominate and circulate to all other interested Parties the name of one arbitrator. Within ten (10) days following the nominations, the interested Parties shall rank their top three among all nominated arbitrators, awarding three points to the top choice, two points to the second choice, one point to the third choice and zero points to all others. Each interested Party shall forward its tally to the Secretary, who shall tabulate the points and notify the interested Parties of the arbitrator with the highest cumulative score, who shall be the selected arbitrator. The Secretary may also develop procedures for approval by the Parties, for selection in the case of tie votes or in order to replace the selected arbitrator in the event such arbitrator declines to act. The arbitration shall be administered in accordance with the procedures set forth in the California Code of Civil Procedure, section 1280, et seq., and of any state or local rules then in effect for arbitration pursuant to said section. Upon completion of arbitration, if the controversy has not been resolved, any Party may exercise all rights to bring a legal action relating to the controversy.

SECTION 16 – GENERAL PROVISIONS

16.1 Authority of Signers

The individuals executing this Coordination Agreement represent and warrant that they have the authority to enter into this Coordination Agreement and to legally bind the Party for whom they are signing to the terms and conditions of this Coordination Agreement.

16.2 Governing Law

The validity and interpretation of this Coordination Agreement will be governed by the laws of the State of California without giving effect to the principles of conflict of laws, with venue for all purposes to be proper only in the County of Merced, State of California.

16.3 Severability

Except as provided for cure by amendment in Section 13.3, if any term, provision, covenant, or condition of this Coordination Agreement is determined to be unenforceable by a court of competent jurisdiction, it is the Parties' intent that the remaining provisions of this Coordination Agreement will remain in full force and effect and will not be affected, impaired, or invalidated by such a determination.

16.4 Counterparts

This Coordination Agreement may be executed in any number of counterparts, each of which will be an original, but all of which will constitute one and the same agreement.

16.5 Good Faith

The Parties agree to exercise their best efforts and utmost good faith to effectuate all the terms and conditions of this Coordination Agreement and to execute such further instruments and documents as are reasonably necessary, appropriate, expedient, or proper to carry out the intent and purposes of this Coordination Agreement.

SECTION 17 – SIGNATORIES

PARTIES:

<table>
<tr><td colspan="4">PATTERSON IRRIGATION DISTRICT GSA</td></tr>
<tr><td colspan="2">Patterson Irrigation District</td><td colspan="2">Date: 05/22/2018</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative: Vince Lucchesi</td></tr>
<tr><td colspan="4">WEST STANISLAUS IRRIGATION DISTRICT GSA 1</td></tr>
<tr><td colspan="2">West Stanislaus Irrigation District</td><td colspan="2">Date:</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative:</td></tr>
<tr><td colspan="4">DM II GSA</td></tr>
<tr><td>Del Puerto Water District</td><td>Date:</td><td>Oak Flat Water District</td><td>Date:</td></tr>
<tr><td colspan="2">Signature</td><td colspan="2">Signature</td></tr>
<tr><td colspan="2">Name of Representative:</td><td colspan="2">Name of Representative:</td></tr>
<tr><td colspan="4">CITY OF PATTERSON GSA</td></tr>
<tr><td colspan="2">City of Patterson</td><td colspan="2">Date:</td></tr>
<tr><td colspan="4">Signature</td></tr>
<tr><td colspan="4">Name of Representative:</td></tr>
</table>

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SECTION 17 – SIGNATORIES

PARTIES:

PATTERSON IRRIGATION DISTRICT GSA			
Patterson Irrigation District	**Date:**		
Signature			
Name of Representative:			
WEST STANISLAUS IRRIGATION DISTRICT GSA 1			
West Stanislaus Irrigation District	**Date:** 5/16/18		
Signature Robert Pierce			
Name of Representative: Robert Pierce, General Manager			
DM II GSA			
Del Puerto Water District	**Date:**	**Oak Flat Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CITY OF PATTERSON GSA			
City of Patterson	**Date:**		
Signature			
Name of Representative:			

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Except as provided for cure by amendment in Section 13.3, if any term, provision, covenant, or condition of this Coordination Agreement is determined to be unenforceable by a court of competent jurisdiction, it is the Parties' intent that the remaining provisions of this Coordination Agreement will remain in full force and effect and will not be affected, impaired, or invalidated by such a determination.

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SECTION 17 – SIGNATORIES

PARTIES:

PATTERSON IRRIGATION DISTRICT GSA			
Patterson Irrigation District	**Date:**	**Twin Oaks Irrigation Company**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
WEST STANISLAUS IRRIGATION DISTRICT GSA 1			
West Stanislaus Irrigation District	**Date:**		
Signature			
Name of Representative:			
WEST STANISLAUS IRRIGATION DISTRICT GSA 2			
West Stanislaus Irrigation District	**Date:**		
Signature			
Name of Representative:			
DM II GSA			
Del Puerto Water District	**Date:** 8/28/18	**Oak Flat Water District**	**Date:** 8/28/18
Signature Anthea C Hansen		**Signature** Anthea C Hansen	
Name of Representative: Anthea C Hansen		**Name of Representative:** Anthea C Hansen	

16.3 Severability

Except as provided for cure by amendment in Section 13.3, if any term, provision, covenant, or condition of this Coordination Agreement is determined to be unenforceable by a court of competent jurisdiction, it is the Parties' intent that the remaining provisions of this Coordination Agreement will remain in full force and effect and will not be affected, impaired, or invalidated by such a determination.

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SECTION 17 – SIGNATORIES

PARTIES:

PATTERSON IRRIGATION DISTRICT GSA			
Patterson Irrigation District	**Date:**		
Signature			
Name of Representative:			
WEST STANISLAUS IRRIGATION DISTRICT GSA 1			
West Stanislaus Irrigation District	**Date:**		
Signature			
Name of Representative:			
DM II GSA			
Del Puerto Water District	**Date:**	**Oak Flat Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CITY OF PATTERSON GSA			
City of Patterson	**Date:** 9/20/18		
Signature			
Name of Representative: Ken Irwin			

CITY OF PATTERSON GSA			
City of Patterson	**Date:**		
Signature			
Name of Representative:			
NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:** 7/31/18	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative: Jerald R. O'Banion		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:** 7/31/18	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative: Jerald R. O'Banion		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	

CITY OF PATTERSON GSA			
City of Patterson	Date:		
Signature			
Name of Representative:			
NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date: 10/9/18
Signature		Signature	
Name of Representative:		Jim DeMartini, Chariman:	
APPROVED AS TO FORM John P. Doering County Counsel Stanislaus County		BY: Asst County Counsel	Date: 10/3/18
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	Date:	Columbia Canal Company	Date:
Signature		Signature	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date: 8/13/18	Panoche Water District	Date:
Signature		Signature	
Name of Representative: Lon Martin		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	Date:	Columbia Canal Company	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Firebaugh Canal Company	Date:	San Luis Canal Company	Date:
Signature		Signature	

CITY OF PATTERSON GSA			
City of Patterson	**Date:**		
Signature			
Name of Representative:			
NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature** 07/31/18	
Name of Representative:		**Name of Representative:** John Bennett	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature** 8/7/18	
Name of Representative:		**Name of Representative:** Aaron Barcellos	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:** 7/31/18
Signature		**Signature**	
Name of Representative:		**Name of Representative:** Michael Linneman	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	

CITY OF PATTERSON GSA			
City of Patterson	**Date:**		
Signature			
Name of Representative:			
NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:** 6/20/18	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative: Jerry Salvador		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:** 8-6-18
Signature		**Signature**	
Name of Representative:		**Name of Representative:** Elizabeth Reeves	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Firebaugh Canal Company	**Date:**	**San Luis Canal Company**	**Date:**
Signature		**Signature**	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature Randall S Miles 6-27-18		**Signature**	
Name of Representative: Randall Miles		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Firebaugh Canal Company	**Date:**	**San Luis Canal Company**	**Date:**
Signature		**Signature**	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative: Amy Montgomery		Name of Representative:	
Santa Nella County Water District	Date: 9/14/18	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	Date:	Columbia Canal Company	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Firebaugh Canal Company	Date:	San Luis Canal Company	Date:
Signature		Signature	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	**Date:**	**County of Stanislaus**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	**Date:**	**Panoche Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Tranquillity Irrigation District	**Date:**	**Fresno Slough Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Eagle Field Water District	**Date:**	**Pacheco Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Santa Nella County Water District	**Date:**	**Mercy Springs Water District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
County of Merced	**Date:**	**County of Fresno**	**Date:** 8/21/18
Signature		**Signature** Sal Quintero	
Name of Representative:		**Name of Representative:** Sal Quintero	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	**Date:**		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	**Date:**		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	**Date:**	**Columbia Canal Company**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	
Firebaugh Canal Company	**Date:**	**San Luis Canal Company**	**Date:**
Signature		**Signature**	

ATTEST:
BERNICE E. SEIDEL
Clerk of the Board of Supervisors
County of Fresno, State of California
By _____ Deputy

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative: Steve Sloan			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	Date:	Columbia Canal Company	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Firebaugh Canal Company	Date:	San Luis Canal Company	Date:
Signature		Signature	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative: Jean Sagouspe			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	Date:	Columbia Canal Company	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Firebaugh Canal Company	Date:	San Luis Canal Company	Date:
Signature		Signature	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	Date: 9-7-2018	Columbia Canal Company	Date:
Signature		Signature	
Name of Representative: James O'Banion		Name of Representative:	
Firebaugh Canal Company	Date:	San Luis Canal Company	Date:
Signature		Signature	
Name of Representative: Mike Stearns		Name of Representative: Jim Nickel	

NORTHWESTERN DELTA-MENDOTA GSA			
County of Merced	Date:	County of Stanislaus	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
CENTRAL DELTA-MENDOTA REGION MULTI-AGENCY GSA			
San Luis Water District	Date:	Panoche Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Tranquillity Irrigation District	Date:	Fresno Slough Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Eagle Field Water District	Date:	Pacheco Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
Santa Nella County Water District	Date:	Mercy Springs Water District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
County of Merced	Date:	County of Fresno	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
ORO LOMA WATER DISTRICT GSA			
Oro Loma Water District	Date:		
Signature			
Name of Representative:			
WIDREN WATER DISTRICT GSA			
Widren Water District	Date:		
Signature			
Name of Representative:			
SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GSA			
Central California Irrigation District	Date:	Columbia Canal Company	Date:
Signature		Signature	
Name of Representative:		Name of Representative: Kimberly Brown	
Firebaugh Canal Company	Date:	San Luis Canal Company	Date:
Signature		Signature	

Name of Representative:	Name of Representative:
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	Date: 8/6/2018
Signature President	
Name of Representative: DONALD SKINNER, President	
CITY OF MENDOTA GSA	
City of Mendota	Date:
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	Date:
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	Date:
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	Date:
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	Date:
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	Date:
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	Date:
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	Date:
Signature	
Name of Representative:	

Name of Representative:	**Name of Representative:**
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:** 12/12/18
Signature	
Name of Representative: Cristian Gonzalez	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

Name of Representative:	**Name of Representative:**
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:** 9-25-18
Signature	
Name of Representative: Ben Gallegos	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

Name of Representative:	**Name of Representative:**
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:** November 14, 2018
Signature	
Name of Representative: Alex Terrazas, City Manager	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	**Date:**
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

Name of Representative:	Name of Representative:
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	Date:
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	Date:
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	Date:
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	Date:
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	Date:
Signature 7/9/2018	
Name of Representative: April Hogue	
CITY OF GUSTINE GSA	
City of Gustine	Date:
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	Date:
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	Date:
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	Date:
Signature	
Name of Representative:	

Name of Representative:	Name of Representative:
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	Date:
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	Date:
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	Date:
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	Date:
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	Date:
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	Date: September 18, 2018
Signature	
Name of Representative: Doug Dunford	
CITY OF NEWMAN GSA	
City of Newman	Date:
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	Date:
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	Date:
Signature	
Name of Representative:	

Name of Representative:	Name of Representative:
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	Date:
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	Date:
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	Date:
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	Date:
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	Date:
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	Date:
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	Date: 15 AUG 18
Signature	
Name of Representative: Michael E. Holland	
COUNTY OF MADERA-3 GSA	
County of Madera	Date:
Signature	
Name of Representative:	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	Date:

Name of Representative:	**Name of Representative:**
TURNER ISLAND WATER DISTRICT -2 GSA	
Turner Island Water District	**Date:**
Signature	
Name of Representative:	
CITY OF MENDOTA GSA	
City of Mendota	**Date:**
Signature	
Name of Representative:	
CITY OF FIREBAUGH GSA	
City of Firebaugh	**Date:**
Signature	
Name of Representative:	
CITY OF LOS BANOS GSA	
City of Los Banos	**Date:**
Signature	
Name of Representative:	
CITY OF DOS PALOS GSA	
City of Dos Palos	**Date:**
Signature	
Name of Representative:	
CITY OF GUSTINE GSA	
City of Gustine	**Date:**
Signature	
Name of Representative:	
CITY OF NEWMAN GSA	
City of Newman	**Date:**
Signature	
Name of Representative:	
COUNTY OF MADERA-3 GSA	
County of Madera	**Date:** 10-02-2018
Signature	
Name of Representative: Tom Wheeler	
COUNTY OF MERCED DELTA-MENDOTA GSA	
County of Merced	**Date:**
Signature	
Name of Representative:	

9-11-18

MICHAEL TURNER, DEP COUNTY COUNSEL

COUNTY OF MERCED DELTA-MENDOTA GSA			
County of Merced	Date: 7/31/18		
Signature Name of Representative: Jerald R. O'Banion			
GRASSLAND WATER DISTRICT GSA			
Grassland Water District	Date:	Grassland Resource Conservation District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
FARMERS WATER DISTRICT GSA			
Farmers Water District	Date:		
Signature			
Name of Representative:			
FRESNO COUNTY GSA			
County of Fresno	Date:		
Signature			
Name of Representative:			
ALISO WATER DISTRICT GSA			
Aliso Water District	Date:		
Signature			
Name of Representative:			

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	Date:
Signature	
Name of Representative:	

GRASSLAND WATER DISTRICT GSA			
Grassland Water District	**Date:** 7-10-2018	**Grassland Resource Conservation District**	**Date:** 7-10-2018
Signature		**Signature**	
Name of Representative: Pepper Snyder		**Name of Representative:** Dennis Campini	
FARMERS WATER DISTRICT GSA			
Farmers Water District	**Date:**		
Signature			
Name of Representative:			
FRESNO COUNTY MANAGEMENT AREA A and B GSAs			
County of Fresno	**Date:**		
Signature			
Name of Representative:			
ALISO WATER DISTRICT GSA			
Aliso Water District	**Date:**		
Signature			
Name of Representative:			

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	**Date:**
Signature	
Name of Representative:	

GRASSLAND WATER DISTRICT GSA			
Grassland Water District	Date:	Grassland Resource Conservation District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
FARMERS WATER DISTRICT GSA			
Farmers Water District	Date: 9-14-18		
Signature			
Name of Representative: JIM STILWELL			
FRESNO COUNTY MANAGEMENT AREA A and B GSAs			
County of Fresno	Date:		
Signature			
Name of Representative:			
ALISO WATER DISTRICT GSA			
Aliso Water District	Date:		
Signature			
Name of Representative:			

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	Date:
Signature	
Name of Representative:	

GRASSLAND WATER DISTRICT GSA			
Grassland Water District	**Date:**	**Grassland Resource Conservation District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	

FARMERS WATER DISTRICT GSA	
Farmers Water District	**Date:**
Signature	
Name of Representative:	

FRESNO COUNTY MANAGEMENT AREA A and B GSAs	
County of Fresno	**Date:** August 21, 2018
Signature	
Name of Representative: Sal Quintero	

ATTEST:
BERNICE E. SEIDEL
Clerk of the Board of Supervisors
County of Fresno, State of California
By _____ Deputy

ALISO WATER DISTRICT GSA	
Aliso Water District	**Date:**
Signature	
Name of Representative:	

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	**Date:**
Signature	
Name of Representative:	

GRASSLAND WATER DISTRICT GSA			
Grassland Water District	**Date:**	**Grassland Resource Conservation District**	**Date:**
Signature		**Signature**	
Name of Representative:		**Name of Representative:**	

FARMERS WATER DISTRICT GSA	
Farmers Water District	**Date:**
Signature	
Name of Representative:	

FRESNO COUNTY GSA	
County of Fresno	**Date:**
Signature	
Name of Representative:	

ALISO WATER DISTRICT GSA	
Aliso Water District	**Date:** 10-23-18
Signature Roy Cotanda	
Name of Representative: ROY COTANDA, BOARD PRESIDENT	

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	**Date:**
Signature	
Name of Representative:	

GRASSLAND WATER DISTRICT GSA			
Grassland Water District	Date:	Grassland Resource Conservation District	Date:
Signature		Signature	
Name of Representative:		Name of Representative:	
FARMERS WATER DISTRICT GSA			
Farmers Water District	Date:		
Signature			
Name of Representative:			
FRESNO COUNTY MANAGEMENT AREA A and B GSAs			
County of Fresno	Date:		
Signature			
Name of Representative:			
ALISO WATER DISTRICT GSA			
Aliso Water District	Date:		
Signature			
Name of Representative:			

EXECUTING NOT AS A PARTY:

SAN LUIS & DELTA-MENDOTA WATER AUTHORITY	
San Luis & Delta-Mendota Water Authority	Date: 8/6/18
Signature: Frances C Mizuno	
Name of Representative: Frances Mizuno	

EXHIBIT "A" – Groundwater Sustainability Plan (GSP) Groups

	Groundwater Sustainability Plan Group & Representation on Coordination Committee	Group Contact Agency	Participation Percentage
1	**Northern / Central Delta-Mendota Region – 2 Representatives** Central DM Subgroup – 1 Member representing the following: Central Delta-Mendota Multi-Agency GSA Oro Loma Water District GSA Widren Water District GSA Northern DM Subgroup – 1 Member representing the following: City of Patterson GSA DM-II GSA Northwestern Delta-Mendota GSA Oak Flat Water District GSA Patterson Irrigation District GSA West Stanislaus Irrigation District GSA	West Stanislaus Irrigation District	16.7%
2	**San Joaquin River Exchange Contractors – 2 Representatives** City of Dos Palos GSA City of Firebaugh GSA City of Gustine GSA City of Los Banos GSA City of Mendota GSA City of Newman GSA Madera County GSA Merced County Delta-Mendota GSA San Joaquin River Exchange Contractors GSA Turner Island Water District-2 GSA	San Joaquin River Exchange Contractors	16.7%
3	**Farmers Water District – 1 Representative** Farmers Water District GSA	Farmers Water District	16.7%

4	**Aliso Water District – 1 Representative** Aliso Water District GSA	Aliso Water District	16.7%
5	**Grassland Water District – 1 Representative** Grassland Water District GSA Grassland WD and Grassland Resource Conservation District Merced County Delta-Mendota GSA	Grassland Water District	16.7%
6	**Fresno County Management Area A & B – -1 Representatives** Fresno County Management Area A GSA Fresno County Management Area B GSA	Fresno County	16.7%

APPENDIX – SGMA DEFINITIONS

1. "**Agency**" or "**GSA**" shall mean a groundwater sustainability agency as defined in SGMA.

2. "**Coordination Agreement**" shall mean this Coordination Agreement, unless indicated otherwise.

3. "**Annual Report**" shall mean the report required by Water Code Section 10728 and SGMA Regulations Section 356.2.

4. "**Basin**" shall mean the Delta-Mendota subbasin and defined in Bulletin 118 as Basin 5- 22.07; for purposes of the Coordination Agreement, "Basin" and "Subbasin shall have the same meaning.

5. "**Basin Setting**" shall mean the information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to California Code of Regulations, title 23, sections 354.12-354.20.

6. "**CASGEM**" shall mean the California Statewide Groundwater Elevation Monitoring Program developed by the DWR.

7. "**DWR**" shall mean the Department of Water Resources.

8. "**Groundwater**" shall mean the water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water, but does not include water that flows in known and definite channels.

9. "**Groundwater flow**" shall mean the volume and direction of groundwater movement into, out of, or throughout a basin.

10. "**Interconnected surface water**" shall mean the 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 completely depleted.

11. "**Measureable objectives**" shall mean specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted GSP to achieve the sustainability goal for the basin.

12. "**Principal Aquifers**" shall mean aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

13. "**Representative Monitoring**" shall mean a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin.

14. "**Sustainability Indicator**" shall mean any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results.

15. "**Water Source Type**" shall mean the source from which water is derived to meet the applied beneficial uses, including groundwater, precipitation, recycled water, reused water, and surface water sources.

16. "**Water Use Sector**" shall mean categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.

Appendix C
Formation of GSA

County of Fresno

DEPARTMENT OF PUBLIC WORKS AND PLANNING
STEVEN E. WHITE, DIRECTOR

May 26, 2017

Mr. Mark Nordberg
Sustainable Groundwater Management Program
California Department of Water Resources
901 P Street, Room 213A
P.O. Box 942836
Sacramento, CA 94236-0001
Mark.norberg@water.ca.gov

RE: Notice of the County of Fresno's Intent to serve as a Groundwater Sustainability Agency for a Portion of the Delta-Mendota Subbasin (Management Area B)

Dear Mr. Nordberg,

This letter serves as notification to the California Department of Water Resources that the County of Fresno (County) has elected to undertake sustainable groundwater management for a portion of the Delta-Mendota Subbasin identified on Exhibit "A" by electing to become a Groundwater Sustainability Agency (GSA) pursuant to Water Code Section 10723.8(a) and the Sustainable Groundwater Management Act.

On May 2, 2017, the County held a public hearing to consider serving as a GSA and after allowing public comment, the County Board of Supervisors approved a resolution electing to serve as shown in Exhibit "B". The public hearing was noticed in compliance with Water Code Section 10723(b) and Government Code Section 6066 as evidenced by Exhibit "C".

Pursuant to Water Code Section 10723.2, the County will consider the interest of all beneficial uses and users of groundwater, as well as those responsible for implementing a Groundwater Sustainability Plan. A list of those users is included in Exhibit "D".

Should you have any questions or need additional information, please contact Bernard Jimenez, Deputy Director of Planning, at (559) 600-4500.

Sincerely,

Steven E. White, Director
Public Works and Planning

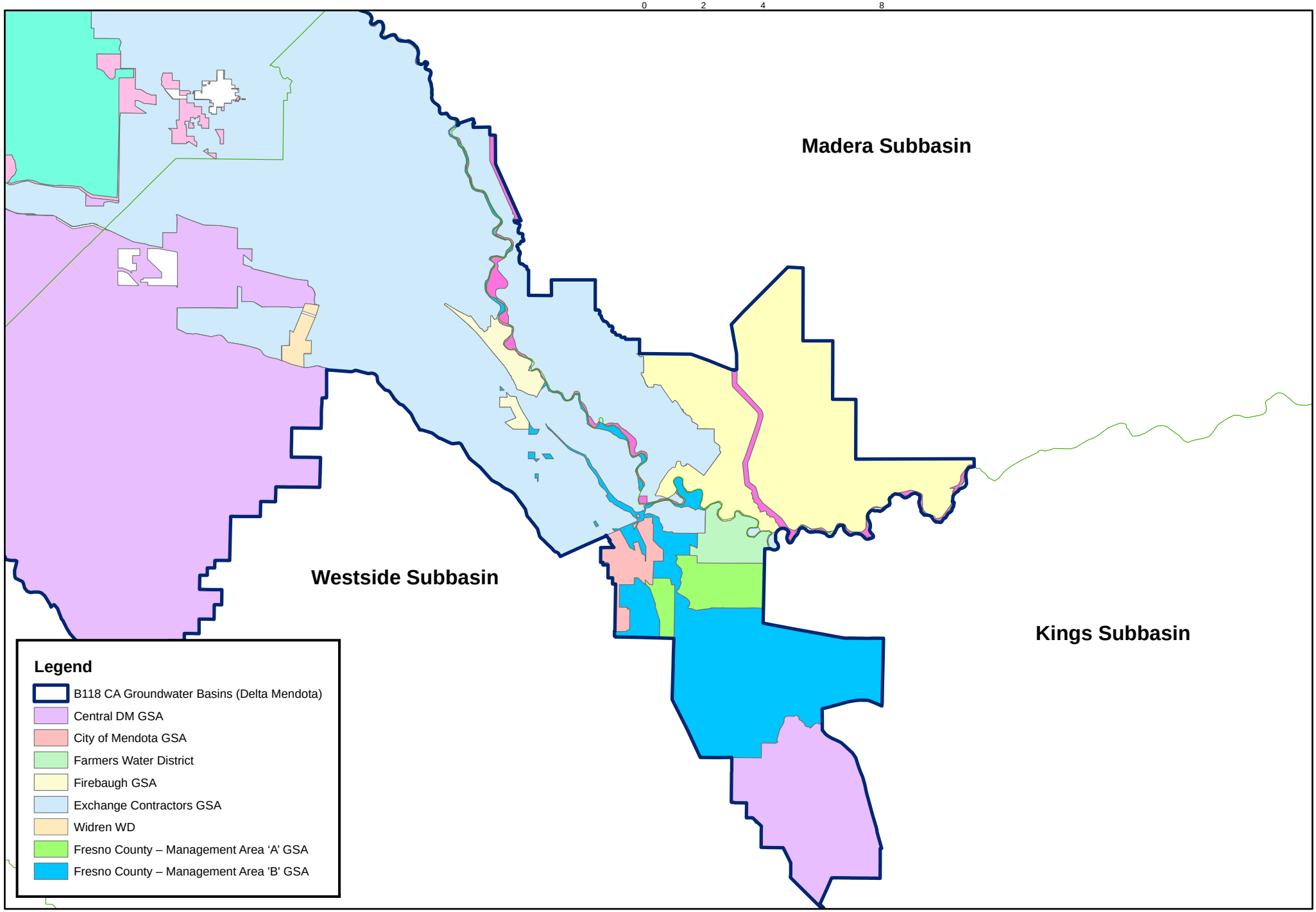
Attachments:

Exhibit "A":	Map of GSA Boundaries
Exhibit "B":	Board Resolution
Exhibit "C":	Notice of Public Hearing
Exhibit "D"	List of Interested Parties

Exhibit A

Sustainable Groundwater Management

Delta-Mendota Subbasin



Resolution No. 17-276

BEFORE THE BOARD OF SUPERVISORS
OF THE COUNTY OF FRESNO
STATE OF CALIFORNIA

RESOLUTION OF INTENTION TO UNDERTAKE SUSTAINABLE GROUNDWATER MANAGEMENT AND TO SERVE AS THE EXCLUSIVE GROUNDWATER SUSTAINABILITY AGENCY FOR PORTIONS OF THE DELTA-MENDOTA GROUNDWATER SUBBASIN (MANAGEMENT AREA B)

WHEREAS, the Sustainable Groundwater Management Act of 2014 ("SGMA"), signed into law on September 16, 2014, requires that each California groundwater basin or subbasin be managed by a Groundwater Sustainability Agency ("GSA"), or multiple GSAs, and that such management be implemented pursuant to an approved Groundwater Sustainability Plan ("GSP") or multiple GSPs; and

WHEREAS, the County of Fresno ("County") is a local agency as defined in California Water Code section 10721, subdivision (n); and

WHEREAS, the County desires to declare its intention to undertake sustainable groundwater management and to serve as GSA in those portions of the Delta-Mendota Subbasin that are identified in Exhibit A to this resolution, to be designated "Management Area B of the Delta-Mendota Subbasin" ("Management Area B"); and

WHEREAS, Water Code section 10723, subdivision (a), authorizes a local agency under Water Code section 10721, subdivision (n), with water supply, water management, or land use responsibilities, overlying a groundwater basin to elect to become a GSA; and

WHEREAS, Water Code section 10723, subdivision (b), provides that, before deciding to become a GSA, a local agency must publish notice pursuant to Government Code section 6066 and hold a public hearing in the county overlying the groundwater basin where the agency intends to undertake sustainable groundwater management; and

WHEREAS, Water Code Section 10723.2 requires that a GSA consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing GSPs; and

WHEREAS, on April 12, 2017, and April 19, 2017, the County published notice of a public hearing pursuant to Government Code section 6066; and

WHEREAS, the County held a public hearing on May 2, 2017, to consider the adoption of this Resolution and its decision to become a GSA for Management Area B; and

WHEREAS, after considering the issue and allowing for public testimony, the Board of Supervisors determined it to be in the best interest of the County to decide to become a GSA for Management Area B.

NOW, THEREFORE IT IS ORDERED as follows:

1. The County hereby elects to be the exclusive GSA for Management Area B.

2. The Director of the Department of Public Works and Planning (Director) is directed to submit within 30 days of this resolution a notice of intent to the California Department of Water Resources, pursuant to California Water Code section 10723.8, subdivision (a).

3. The Director shall create and maintain a list of persons interested in receiving notices regarding GSP preparation, meeting announcements, and the availability of draft plans, maps, and other relevant documents, pursuant to Water Code section 10723.4. Any person may request, in writing, to be placed on the list of interested persons.

THE FOREGOING was passed and adopted by the following vote of the Board of Supervisors of the County of Fresno this 2nd day of May 2017, to wit:

AYES: Supervisors Borgeas, Magsig, Mendes, Pacheco, Quintero
NOES: None
ABSENT: None

CHAIRMAN, Board of Supervisors

ATTEST:

BERNICE E. SEIDEL
Clerk to the Board of Supervisors

By: _____
Deputy

Exhibit A

County of Fresno

Delta-Mendota Subbasin

Groundwater Sustainability Agencies

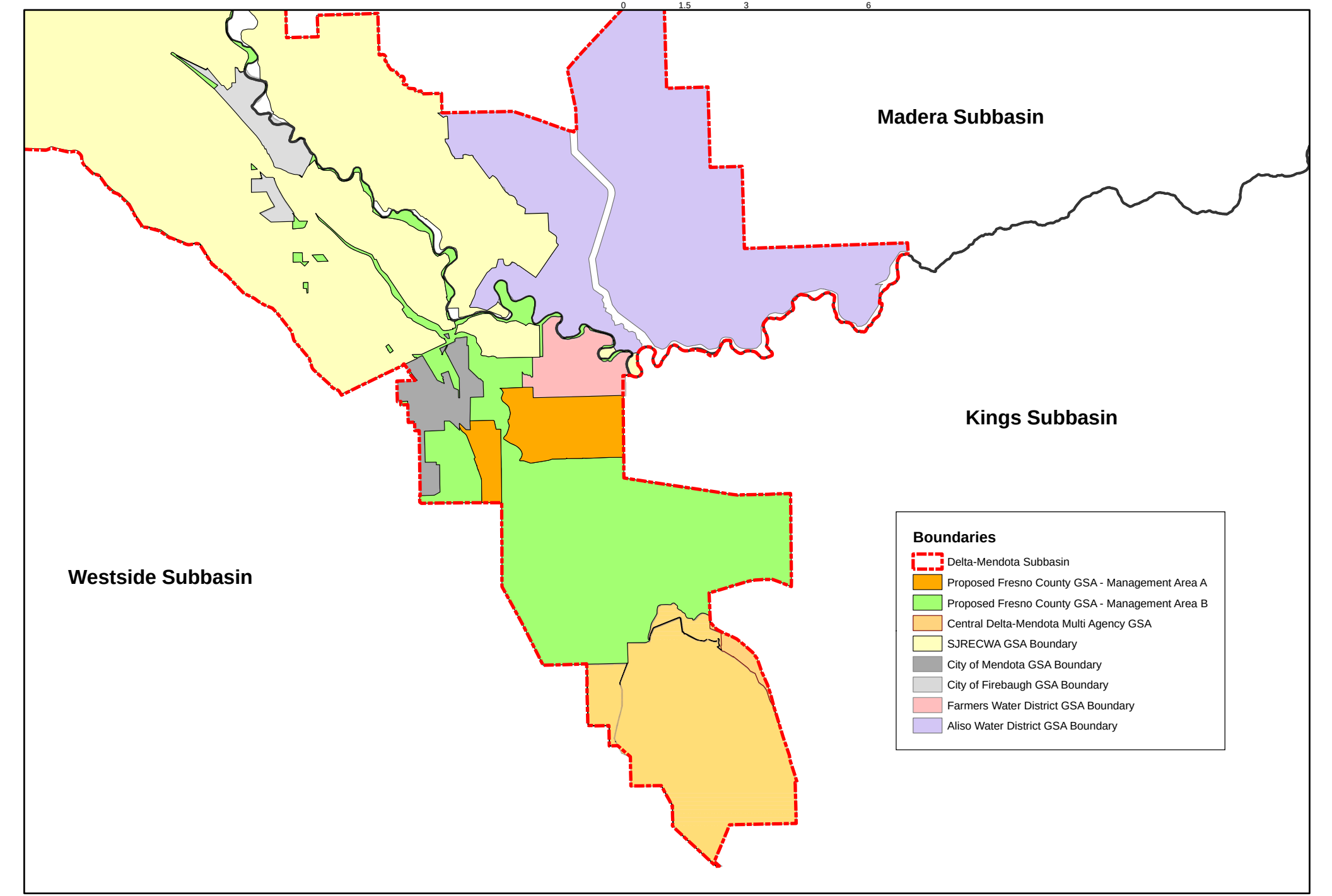


Exhibit A

County of Fresno

Delta-Mendota Subbasin

Groundwater Sustainability Agencies

0 0.75 1.5 3 Miles

N W E S

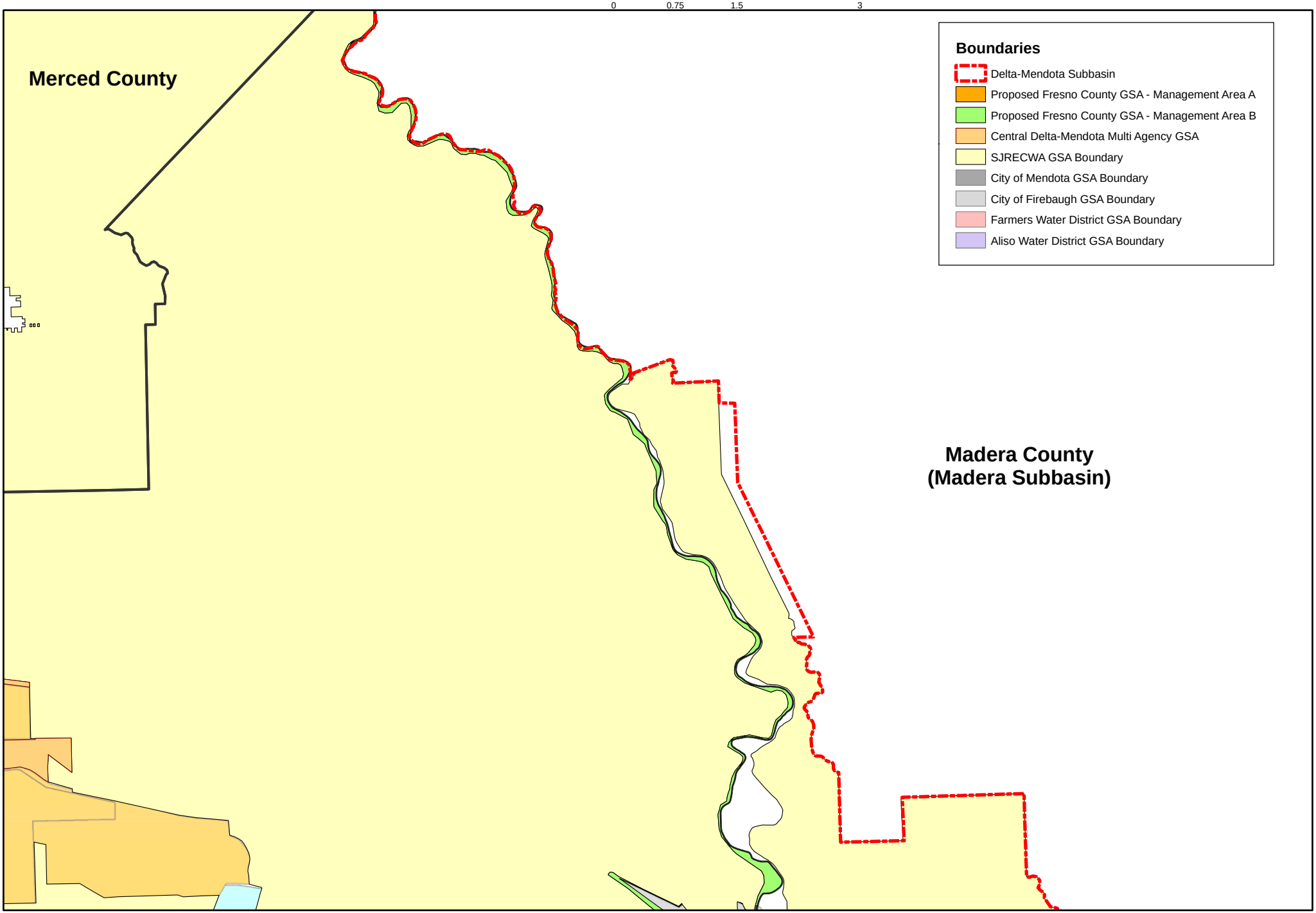


Exhibit C

THE BUSINESS JOURNAL
FRESNO | KINGS | MADERA | TULARE
P.O. Box 126
Fresno, CA 93707
Telephone (559) 490-3400

(Space Below for use of County Clerk only)

IN THE COUNTY OF FRESNO, STATE OF CALIFORNIA

NOTICE OF PUBLIC HEARING
FRESNO COUNTY BOARD OF SUPERVISORS

To determine whether the County will elect to undertake sustainable groundwater management and serve as a Groundwater Sustainability Agency for a portion of the Delta-Mendota Groundwater Subbasin (Management Area B)

MISC. NOTICE

DATE AND TIME OF PUBLIC HEARING:
MAY 2, 2017 AT 9:00 A.M.

STATE OF CALIFORNIA

COUNTY OF FRESNO

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not a party to or interested in the above entitled matter. I am the principal clerk of **THE BUSINESS JOURNAL** published in the city of Fresno, County of Fresno, State of California, Monday, Wednesday, Friday, and which newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of Fresno, State of California, under the date of March 4, 1911, in Action No.14315; that the notice of which the annexed is a printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

APRIL 14, 21, 2017

I declare under penalty of perjury that the foregoing is true and correct and that this declaration was executed at Fresno, California,

APRIL 21, 2017

ON .....

DECLARATION OF PUBLICATION (2015.5 C.C.P.)

NOTICE OF PUBLIC HEARING FRESNO COUNTY BOARD OF SUPERVISORS

Notice is hereby given that the Fresno County Board of Supervisors ("Board") will hold a public hearing on **Tuesday, May 2, 2017 at 9:00 a.m.** or as soon thereafter, in the Board Chambers, Hall of Records, Third Floor, Room 301, 2281 Tulare Street, Fresno, California, 93721.

The purpose of the hearing will be to consider and determine whether the County will elect to undertake sustainable groundwater management and serve as a Groundwater Sustainability Agency (GSA), for a portion of the Delta-Mendota Groundwater Subbasin (Management Area 'B'). The hearing will be open to the public and any person present will have an opportunity to be heard. The Chairman may limit oral comments to a reasonable length.

After the public portion of the hearing, the Board may choose to adopt a Resolution of Intent to undertake sustainable groundwater management and serve as a GSA and direct Department staff to submit notification to the California Department of Water Resources, pursuant to California Water Code Sections 10723.8 and 10724(b).

Information regarding this item may be obtained by contacting Steven Sopp at 559-600-4225, during regular business hours.

04/14/2017, 04/21/2017

EXHIBIT "D"

LIST OF INTERESTED PARTIES
(PURSUANT TO SECTION 10723.2)

California Water Code section 10723.8 requires that a Groundwater Sustainability Agency notification include a list of interested parties developed pursuant to Section 10723.2 and an explanation of how their interests will be considered in the development and operation of the groundwater sustainability agency and the development and implementation of the agency's sustainability plan.

Section 10732.2 requires that the groundwater sustainability agency consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans. A listing of these interests is provided below.

a) <u>Holders of overlying groundwater rights, including:</u>

1.) **Agricultural users** – Fresno County – Management Area 'B' largely consists of agricultural users. The County will consider the interests of agricultural users when developing a Groundwater Sustainability Plan (GSP).

2.) Domestic Well Users – including rural residents within the Groundwater Sustainability Agency (GSA) boundaries who are reliant upon groundwater to meet their domestic needs. The County will reach out to rural residents through direct communications. The County will afford rural residents every opportunity to engage in groundwater planning and management efforts that may have an impact on their domestic wells.

b) <u>Municipal well operators</u>

There are no municipal well operators within the boundaries of the GSA. The Cities of Mendota and Firebaugh have filed to become GSAs are adjacent to the boundaries of the GSA. The County will work to coordinate with all other GSAs within the subbasin as required by SGMA.

c) <u>Public water systems</u>

There are no public water systems within the boundaries of the GSA. The Cities of Mendota and Firebaugh operate public water systems and have filed to become GSAs and are adjacent to the boundaries of the GSA. The County will work to coordinate with all other GSAs within the subbasin as required by SGMA.

d) Local land use planning agencies

The County of Fresno is the overlying land use planning agency within the boundaries of the GSA and has elected to undertake groundwater management for unmanaged areas of the Delta-Mendota Subbasin.

e) Environmental Users of Groundwater

The State of California owns land within to the GSA boundary. The lands are managed by the California Department of Fish and Wildlife ("CDFW")

The County will consult with CDFW on any groundwater management efforts that may have an impact on environmental uses.

f) Surface water users, if there is a hydrologic connection between surface and groundwater bodies

If there is a hydrologic connection between surface and groundwater bodies it is unknown at this time. During preparation of a GSP the county will consider and evaluate if such users do exist within the GSA.

g) Federal Government

The County is not aware of any federal government lands within the GSA area. There are no military facilities in the vicinity of the GSA area.

h) California Native American Tribes

At this time, the County is not aware of any Native American Tribal interests in the GSA area. The County will continue to investigate any possible Native American Tribal interests and will coordinate its activities with any identified interests.

i) Disadvantaged Communities

The County is unsure what disadvantaged communities exist within the boundaries of the GSA. The County will continue to investigate and determine if any disadvantaged communities do exist. The County will consider the interest of any disadvantaged community that is identified.

j) Entities listed in Water Code section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin to be managed by the GSA.

The County is unaware of any entities listed in Water Code section 10927 that are monitoring and reporting groundwater elevations within the GSA. The San Joaquin

River Exchange Contractors Water Authority and the San Luis and Delta-Mendota Water Authority are entities that are monitoring and reporting groundwater elevations within the subbasin in proximity to the GSA.

County of Fresno

DEPARTMENT OF PUBLIC WORKS AND PLANNING
STEVEN E. WHITE, DIRECTOR

May 15, 2017

Mr. Mark Nordberg
Sustainable Groundwater Management Program
California Department of Water Resources
901 P Street, Room 213A
P.O. Box 942836
Sacramento, CA 94236-0001
Mark.norberg@water.ca.gov

RE: Notice of the County of Fresno's Intent to serve as a Groundwater Sustainability Agency for a portion of the Delta-Mendota Subbasin – Management Area 'A'

Dear Mr. Nordberg,

This letter serves as notification to the California Department of Water Resources that the County of Fresno (County) has elected to undertake sustainable groundwater management for a portion of the Delta-Mendota Subbasin identified on Exhibit "A" by electing to become a Groundwater Sustainability Agency (GSA) pursuant to Water Code Section 10723.8(a) and the Sustainable Groundwater Management Act.

On May 2, 2017, the County held a public hearing to consider serving as a GSA and after allowing public comment, the County Board of Supervisors approved a resolution electing to serve as shown in Exhibit "B". The public hearing was noticed in compliance with Water Code Section 10723(b) and Government Code Section 6066 as evidenced on Exhibits "C"

Pursuant to Water Code Section 10723.2, the County will consider the interest of all beneficial uses and users of groundwater, as well as those responsible for implementing a Groundwater Sustainability Plan. A list of those users is included in Exhibit "D".

Should you have any questions or need additional information, please contact Bernard Jimenez, Deputy Director of Planning, at (559) 600-4500.

Sincerely,

Steven E. White, Director
Public Works and Planning

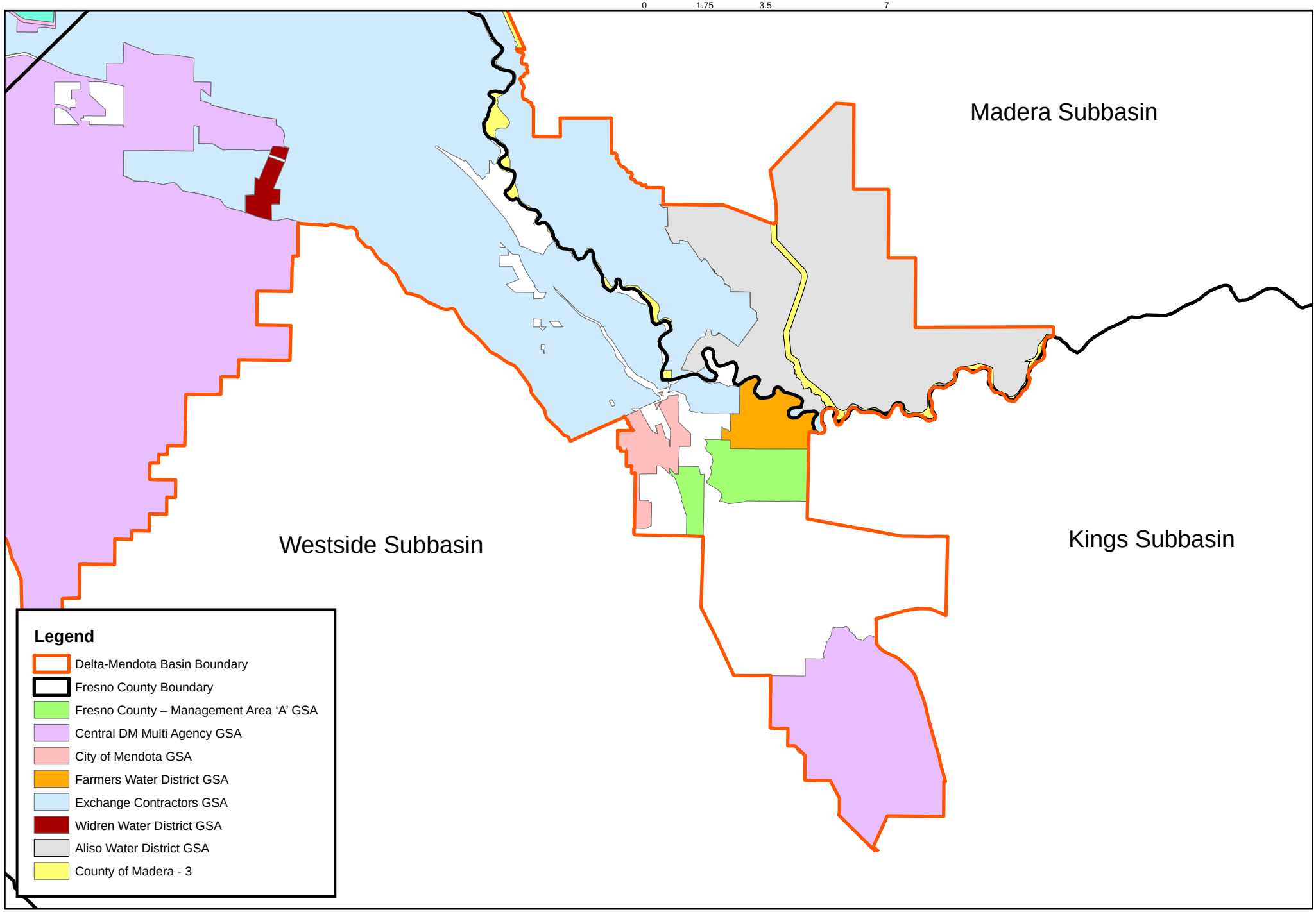
Attachments:

	Exhibit "A"	Map of GSA Boundaries
	Exhibit "B"	Board Resolution
	Exhibit "C"	Notice of Public Hearing
	Exhibit "D"	List of Interested Parties

Exhibit A

Sustainable Groundwater Management Act

Fresno County - Management Area 'A' GSA



Resolution No. 17-274

BEFORE THE BOARD OF SUPERVISORS
OF THE COUNTY OF FRESNO
STATE OF CALIFORNIA

RESOLUTION OF INTENTION TO UNDERTAKE SUSTAINABLE GROUNDWATER MANAGEMENT AND TO SERVE AS THE EXCLUSIVE GROUNDWATER SUSTAINABILITY AGENCY FOR PORTIONS OF THE DELTA-MENDOTA GROUNDWATER SUBBASIN (MANAGEMENT AREA A)

WHEREAS, the Sustainable Groundwater Management Act of 2014 ("SGMA"), signed into law on September 16, 2014, requires that each California groundwater basin or subbasin be managed by a Groundwater Sustainability Agency ("GSA"), or multiple GSAs, and that such management be implemented pursuant to an approved Groundwater Sustainability Plan ("GSP") or multiple GSPs; and

WHEREAS, the County of Fresno ("County") is a local agency as defined in California Water Code section 10721, subdivision (n); and

WHEREAS, the County desires to declare its intention to undertake sustainable groundwater management and to serve as GSA in those portions of the Delta-Mendota Subbasin that are identified in exhibit A to this resolution, to be designated "Management Area A of the Delta-Mendota Subbasin" ("Management Area A"); and

WHEREAS, Water Code section 10723, subdivision (a), authorizes a local agency under Water Code section 10721, subdivision (n), with water supply, water management, or land use responsibilities, overlying a groundwater basin to elect to become a GSA; and

WHEREAS, Water Code section 10723, subdivision (b), provides that, before deciding to become a GSA, a local agency must publish notice pursuant to Government Code section 6066 and hold a public hearing in the county overlying the groundwater basin where the agency intends to undertake sustainable groundwater management; and

WHEREAS, Water Code Section 10723.2 requires that a GSA consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing GSPs; and

WHEREAS, on April 12, 2017, and April 19, 2017, the County published notice of a public hearing pursuant to Government Code section 6066; and

WHEREAS, the County held a public hearing on May 2, 2017, to consider the adoption of this Resolution and its decision to become a GSA for Management Area A; and

WHEREAS, after considering the issue and allowing for public testimony, the Board of Supervisors determined it to be in the best interest of the County to decide to become a GSA for Management Area A.

NOW, THEREFORE IT IS ORDERED as follows:

1. The County hereby elects to be the exclusive GSA for Management Area A.

2. The Director of the Department of Public Works and Planning (Director) is directed to submit within 30 days of this resolution a notice of intent to the California Department of Water Resources, pursuant to California Water Code section 10723.8, subdivision (a).

3. The Director shall create and maintain a list of persons interested in receiving notices regarding GSP preparation, meeting announcements, and the availability of draft plans, maps, and other relevant documents, pursuant to Water Code section 10723.4. Any person may request, in writing, to be placed on the list of interested persons.

THE FOREGOING was passed and adopted by the following vote of the Board of Supervisors of the County of Fresno this 2nd day of May 2017, to wit:

AYES: Supervisors Borgeas, Magsig, Mendes, Pacheco, Quintero
NOES: None
ABSENT: None

CHAIRMAN, Board of Supervisors

ATTEST:

BERNICE E. SEIDEL
Clerk to the Board of Supervisors

By: _____
Deputy

Exhibit A

County of Fresno

Delta-Mendota Subbasin

Groundwater Sustainability Agencies

0 1.5 3 6 Miles

N W E S

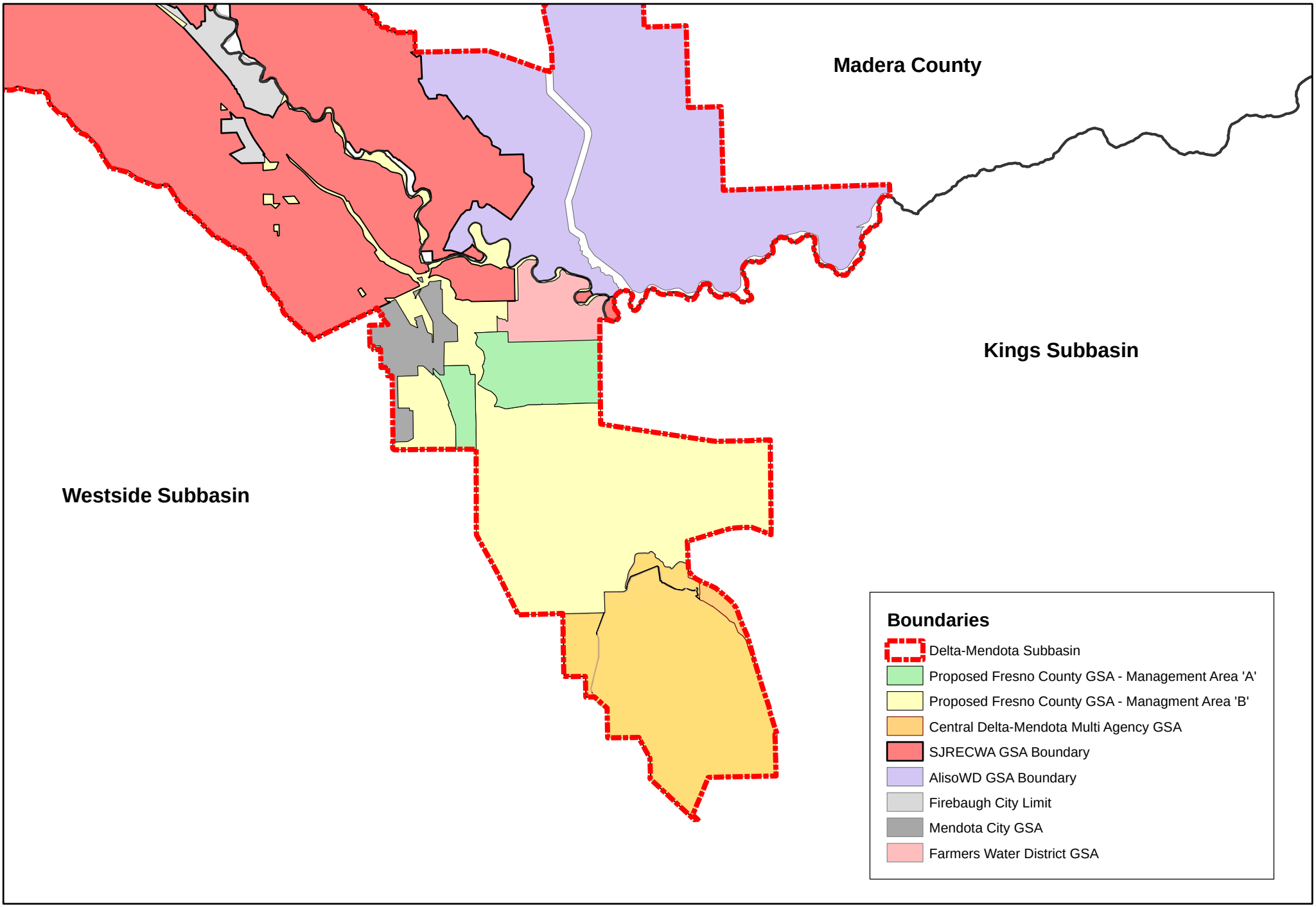


Exhibit C

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IN THE COUNTY OF FRESNO, STATE OF CALIFORNIA

NOTICE OF PUBLIC HEARING
FRESNO COUNTY BOARD OF SUPERVISORS

To determine whether the County will elect to undertake sustainable groundwater management and serve as a Groundwater Sustainability Agency for a portion of the Delta-Mendota Groundwater Subbasin (Management Area A)

MISC. NOTICE

DATE AND TIME OF PUBLIC HEARING:
MAY 2, 2017 AT 9:00 A.M.

DECLARATION OF PUBLICATION (2015.5 C.C.P.)

STATE OF CALIFORNIA

COUNTY OF FRESNO

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not a party to or interested in the above entitled matter. I am the principal clerk of **THE BUSINESS JOURNAL** published in the city of Fresno, County of Fresno, State of California, Monday, Wednesday, Friday, and which newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of Fresno, State of California, under the date of March 4, 1911, in Action No.14315; that the notice of which the annexed is a printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

APRIL 14, 21, 2017

I declare under penalty of perjury that the foregoing is true and correct and that this declaration was executed at Fresno, California,

APRIL 21, 2017

ON .....

NOTICE OF PUBLIC HEARING FRESNO COUNTY BOARD OF SUPERVISORS

Notice is hereby given that the Fresno County Board of Supervisors ("Board") will hold a public hearing on **Tuesday, May 2, 2017 at 9:00 a.m.** or as soon thereafter, in the Board Chambers, Hall of Records, Third Floor, Room 301, 2281 Tulare Street, Fresno, California, 93721.

The purpose of the hearing will be to consider and determine whether the County will elect to undertake sustainable groundwater management and serve as a Groundwater Sustainability Agency (GSA), for a portion of the Delta-Mendota Groundwater Subbasin (Management Area 'A'). The hearing will be open to the public and any person present will have an opportunity to be heard. The Chairman may limit oral comments to a reasonable length.

After the public portion of the hearing, the Board may choose to adopt a Resolution of Intent to undertake sustainable groundwater management and serve as a GSA and direct Department staff to submit notification to the California Department of Water Resources, pursuant to California Water Code Sections 10723.8 and 10724(b).

Information regarding this item may be obtained by contacting Steven Sopp at 559-600-4225, during regular business hours.

04/14/2017, 04/21/2017

EXHIBIT "D"

LIST OF INTERESTED PARTIES
(PURSUANT TO SECTION 10723.2)

California Water Code section 10723.8 requires that a Groundwater Sustainability Agency notification include a list of interested parties developed pursuant to Section 10723.2 and an explanation of how their interests will be considered in the development and operation of the groundwater sustainability agency and the development and implementation of the agency's sustainability plan.

Section 10732.2 requires that the groundwater sustainability agency consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans. A listing of these interests is provided below.

a) <u>Holders of overlying groundwater rights, including:</u>

1.) **Agricultural users** – Fresno County – Management Area 'A' GSA consists of lands owned by Meyers Farming LLC in association with a water banking storage and recovery facility. Banking operations are utilized for agricultural use. The County will consider the interests of agricultural users when developing a Groundwater Sustainability Plan (GSP).

2.) Domestic Well Users – The County is not aware of and Domestic Well Users within the boundary of the GSA.

b) <u>Municipal well operators</u>

There are no municipal well operators within the boundaries of the GSA.

c) <u>Public water systems</u>

There are no public water systems within the boundaries of the GSA.

d) <u>Local land use planning agencies</u>

The County of Fresno is the overlying land use planning agency within the boundaries of the GSA and has elected to undertake groundwater management for unmanaged areas of the Delta-Mendota Subbasin.

e) <u>Environmental Users of Groundwater</u>

The State of California owns land in proximity to the GSA boundary. The lands are managed by the California Department of Fish and Wildlife ("CDFW")

The County will consult with CDFW on any groundwater management efforts that may have an impact on environmental uses.

f) Surface water users, if there is a hydrologic connection between surface and groundwater bodies

If there is a hydrologic connection between surface and groundwater bodies it is unknown at this time. During preparation of a GSP the county will consider and evaluate if such users do exist within the GSA.

g) Federal Government

The County is not aware of any federal government lands within the GSA area. There are no military facilities in the vicinity of the GSA area.

h) California Native American Tribes

At this time, the County is not aware of any Native American Tribal interests in the GSA area. The County will continue to investigate any possible Native American Tribal interests and will coordinate its activities with any identified interests.

i) Disadvantaged Communities

There are no disadvantaged communities within the boundaries of the GSA.

j) Entities listed in Water Code section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin to be managed by the GSA.

The County is unaware of any entities listed in Water Code section 10927 that are monitoring and reporting groundwater elevations within the GSA. The San Joaquin River Exchange Contractors Water Authority and the San Luis and Delta-Mendota Water Authority are entities that are monitoring and reporting groundwater elevations within the subbasin in proximity to the GSA.

Appendix D
Memorandum of Understanding with the San Joaquin River Exchange Contractors

FIRST AMENDMENT TO MEMORANDUM OF UNDERSTANDING BETWEEN THE COUNTY OF FRESNO AND THE SAN JOAQUIN RIVER EXCHANGE CONTRACTORS WATER AUTHORITY WITH RESPECT TO IMPLEMENTATION OF THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT IN A PORTION OF THE DELTA – MENDOTA SUBBASIN

This First Amendment to the Memorandum of Understanding Between the County of Fresno and the San Joaquin River Exchange Contractors Water Authority ("Authority") With Respect to Implementation of the Sustainable Groundwater Management Act in a Portion of the Delta – Mendota Subbasin ("First Amendment") is entered by and among the County of Fresno ("County") and the San Joaquin River Exchange Contractors Groundwater Sustainability Agency ("Agency"), and is made with reference to the following:

RECITALS:

A. On March 15, 2016, the County and Authority entered into the Memorandum of Understanding Between the County of Fresno and the San Joaquin River Exchange Contractors Water Authority with Respect to Implementation of the Sustainable Groundwater Management Act in a Portion of the Delta – Mendota Subbasin ("MOU") for the purpose of coordinating operations with respect to implementing the Sustainable Groundwater Management Act ("SGMA") in order to achieve sustainable groundwater management and avoid conflicts between the Authority's implementation of SGMA and the County's land use planning authorities.

B. On September 28, 2017, the Governor signed into law SB 372, creating the San Joaquin River Exchange Contractors Groundwater Sustainability Agency ("Agency"). Pursuant to SB-372, the Agency is the successor in interest to the Authority for all purposes related to SGMA, including the rights and responsibilities of the MOU, and is the exclusive Groundwater Sustainability Agency ("GSA") empowered to implement and enforce SGMA within the Agency's GSA boundary. The Agency's SGMA GSA boundary is designated in the interactive GSA map maintained by the California Department of Water Resources.

C. Within the exterior boundary of the Agency there exist islands of areas managed by Fresno County GSA Management Area "B". For purposes of this First Amendment, such areas shall be referred to as the "County Islands."

D. The purpose of this First Amendment is to coordinate SGMA implementation and enforcement, including without limitation, the establishment of monitoring protocols and data exchange, fee recovery and enforcement mechanisms, applicable to the County Islands.

NOW, THEREFORE, IT IS HEREBY AGREED AS FOLLOWS.

1. Territory Subject to the Terms of this First Amendment. The County Islands subject to the terms and conditions of this First Amendment are described and depicted in Exhibit A attached hereto and incorporated herein by this reference.

2. Monitoring Network and Locations. In the opinion of the Agency, the current groundwater monitoring network existing within the County Islands meets the requirements 23 CCR § 354.34. In order to satisfy SGMA requirements, the parties agree:

    a. The County shall ensure that:
        i. With respect to monitoring locations existing as of the date of execution of this Agreement, the County shall either provide monitoring data it has available from each such location requested by the Agency; or provide year-round legal access to the Agency for each such location.
        ii. With respect to monitoring locations to be developed by the County after the date of execution of this Agreement, the Agency shall possess year-round legal access to each monitoring location to collect data for the GSP.

    b. If, at any time, a professionally licensed engineer/ hydrogeologist retained by the Agency determines that the groundwater monitoring network existing within the County Islands does not satisfy the requirements of 23 CCR § 354.34, the Agency shall be authorized improve the monitoring network to comply with SGMA. The Agency shall notify the County of the anticipated costs and expenses of the improvement prior to taking any action to improve the monitoring network to comply with SGMA. All reasonable costs of improvements to the monitoring network within the County Islands shall be borne by the County.

3. Establishment of Monitoring Protocols. The Groundwater Sustainability Plans established for the County Islands shall establish Groundwater monitoring protocols consistent with 23 CCR § 352.2. The Agency shall perform all testing and monitoring within the County Islands in accordance with established protocols. The costs of such testing and monitoring shall be considered a "cost of implementing SGMA" and be borne by the County in accordance with the cost allocation provisions of Section 7 of this First Amendment.

    a. *Additional Monitoring Information.* The County is permitted to collect and report information in addition to the testing and monitoring performed by the Agency. Such categories of information may include, without limitation:

i. Quantity, quality, and duration of surface water deliveries.

4. Data Exchange. Any data collected by the County with respect to SGMA implementation in the County islands shall be provided to the Agency as soon as practicable in a form compatible with the Agency's Data Management System (DMS). Similarly, any data obtained by the Agency with respect to SGMA implementation in the County islands shall be provided to the County as soon as practicable in a form compatible with the County's Data Management System (DMS).

5. Agency to Prepare Groundwater Sustainability Plan Applicable to County Islands. The Agency intends to develop the Groundwater Sustainability Plan (GSP) for lands within the Agency territory. The County and Agency desire that the Agency GSP be adopted, implemented, and enforced by the County within the County Islands.

   a. *Necessary Terms of Agency GSP For the County Islands:*

      i. The Agency GSP shall assign a discrete chapter to the County Islands within each Agency Management Area (collectively hereafter, the "County Island GSPs").
      ii. The GSP chapter for the County Islands shall include, without limitation, the necessary "Plan Contents" set forth in Article 5 of Subchapter 2 of Chapter 1.5 of Division 2 of Title 23 of the California Code of Regulations.

6. County to Adopt and Enforce County Island GSPs.

   a. County shall adopt the 'County Island' portions of the Agency GSP for the territories designated therein. County shall comply with the requirements of Water Code section 10728.4, including the noticing and convening of the required public hearing prior to adoption of the County Island GSPs.

   b. The County shall exercise, or cause to be exercised the 'Powers and Authorities' described in Chapter 5 of Part 2.74 of Division 6 of the California Water Code (§ 10725 *et.seq.*) necessary to implement and enforce the County Islands.

   c. The County shall adopt rules and regulations, by ordinance or resolution, or both as appropriate, for the purpose of implementing and enforcing the County Island GSPs in accordance with SGMA. Such rules and regulations may be, at the County's option, modeled upon the rules and regulations adopted by the Agency for SGMA implementation within Agency territory, or unique rules and regulations

which provide for implementation and enforcement of the County Island GSPs in accordance with their terms.

7. Compensation to Agency For Development of County Island GSPs and SGMA Implementation.

   a. County agrees to reimburse the Agency for costs incurred by the Agency to develop and update the Agency GSP including the County Islands.

      i. The precise cost attributable to the development of the Agency GSP will be impossible to discern. As a result, the parties agree to calculate such costs on the basis of acreage covered by the County Island GSP in proportion to remaining acreage covered by the Agency GSP. By way of example, in the event the GSP adopted by the Exchange Contractors covers 10,000 acres total, and the area covered by the County Island GSPs totals 500 acres, County shall pay the Agency five percent (5%) of the total costs of developing the Agency GSP.

   b. County Agrees to reimburse the Agency for the costs incurred by the Agency in implementing SGMA within the County Islands.

      i. Such costs of implementing SGMA shall be set forth in the County Island GSP and shall include, without limitation, the costs of testing and monitoring conducted by the Agency within the County Islands.

      ii. The precise costs incurred by the Agency attributable to implementing SGMA within the County Islands will be impossible to discern. As a result, the costs of implementation shall be borne in accordance with the proportionality provisions set forth in Section 7.a above.

   c. Cost Estimates.

      i. Upon execution of this First Amendment, the Agency will develop a work plan and estimated costs to annually monitor & manage groundwater and develop the GSP and shall provide such estimate to County upon completion.

9. Except as modified by this First Amendment, the MOU remains in full force and effect.

10. The Agency is the successor in interest to the San Joaquin River Exchange Contractors Water Authority for SGMA related purposes, and assumes the rights and responsibilities of the original Memorandum of Understanding and this First Amendment.

11. Each party represents and warrants to the other that the person who signs this First Amendment on its behalf is duly authorized to execute this First Amendment and to legally bind the party on whose behalf he or she signs.

The parties are signing this First Amendment on the dates written below their respective signatures.

SAN JOAQUIN RIVER EXCHANGE CONTRACTORS GROUNDWATER SUSTAINABILITY AGENCY:

By: _____
Board President

Date: 11/3/17

ATTEST:

Date: 11/3/17

_____
Secretary to the Board

COUNTY OF FRESNO:

By: _____

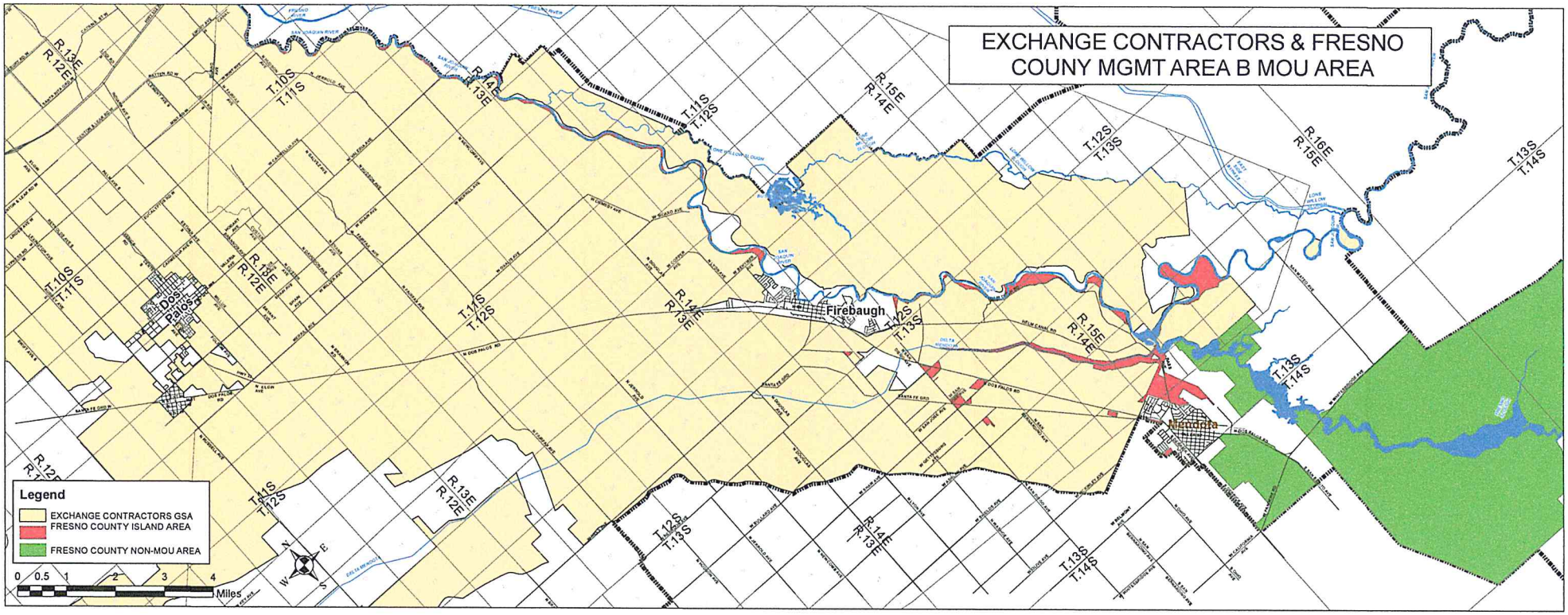
Date: December 12, 2017

ATTEST:

Date: December 12, 2017

_____
Secretary to the Board

Exhibit "A"
Location Map



Appendix E
Technical Memoranda

TECHNICAL MEMORANDUM #1

RE: Common Datasets and Assumptions used in the Delta-Mendota Subbasin GSPs

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation.

The following datasets and assumptions were used in a coordinated fashion by those preparing the six GSP for the Delta-Mendota Subbasin. These data sets and assumptions were agreed upon by the Delta-Mendota Subbasin Technical Working Group and approved by the Delta-Mendota Coordination Committee over the period extending from December 2017 through June 2019.

1. DATASETS

The technical development for the six GSPs in the Subbasin relied on the best available data for their respective Plan areas. The following outlines common datasets and instances of localized data use during the development of the GSPs.

<u>Groundwater Level Data and Contour Mapping</u>

1. Subbasin-wide groundwater level contour maps for the upper aquifer were developed for the selected historic water budget period (Spring 2003 and 2012) and current water budget period (Spring 2013 and Fall 2013). Contours were developed for the upper aquifer for the years identified. Thirty-foot contour intervals were used; individual GSAs compromised on this contour spacing following initial attempts at smaller contours due to variability in data. The lower aquifer's historic water surface elevation (WSE) data inventory was too limited to develop groundwater level contours for the entire Subbasin and is anticipated to be addressed in future GSPs and annual reports as these data gaps are addressed. Water level contour maps were composed from the following data sources:
    i. California Department of Water Resources (DWR):
        1. California Statewide Groundwater Elevation Monitoring (CASGEM) Program
        2. Water Data Library (WDL)
    ii. Water level data from local monitoring programs.

2. Subbasin-wide change in storage was evaluated for the upper aquifer using annual groundwater contour maps from Spring 2003 to Spring 2013 developed from the same datasets identified above and compared to each GSP's change in groundwater storage as calculated from historic and current water budgets for consistency. Change in storage for the lower aquifer was evaluated using specific yield and historic land subsidence provided by each GSP Group along with change in groundwater levels and storativity where lower aquifer groundwater level data were available. Datasets used to assess subsidence are discussed below.

Subsidence

3. Each GSP Group determined the historic rate of subsidence in their respective Plan area using the following data sources and period of record. The subsidence rates were combined using a 'sum-of-the-parts' methodology to develop an understanding of subsidence in the Subbasin.

    a. Aliso Water District GSP: United States Bureau of Reclamation (USBR) San Joaquin River Restoration Program (SJRRP) 2011-2017.

    b. Farmers Water District GSP: United States Geological Survey (USGS) and University-NAVSTAR Consortium (UNAVCO) 2004-2017.

    c. Fresno Management Areas A & B GSP: USGS and UNAVCO 2004-2017.

    d. Grassland GSP: USBR 2011-2017 with Ken D. Schmidt & Associates (KDSA) edits.

    e. Northern & Central Delta-Mendota GSP (without Tranquillity Irrigation District): USBR's Delta-Mendota Canal subsidence surveys interpolated from 1984 to 2014 (Pools 3 through 18) as well as the Department of Water Resources 2017 CA Aqueduct Subsidence Study.

    f. Northern & Central Delta-Mendota GSP (Tranquillity Irrigation District): Tranquillity Irrigation District's (TRID) local subsidence data from 2014 to 2018.

    g. San Joaquin River Exchange Contractors GSP: USBR's SJRRP subsidence monitoring network, USBR's Delta-Mendota Canal subsidence survey data, USGS continuous monitoring sites (including extensometers and CPGS sites), and local surveying data for years 2003-2012, 2013, and 2014-2018.

Water Budgets

4. Each GSP group developed Historic, Current, and Projected Water Budgets using the best available local and publicly available data for their respective Plan area. The six individually-developed water budgets were compared and combined for the Delta-Mendota Subbasin water budgets. Instances in which common data sources were used are as follows:

    a. The Historic, Current, and Projected Water Budgets relied on a common data source for water year type; the California Data Exchange Center (CDEC): San Joaquin River Index was used. The San Joaquin River Exchange Contractors water year type behavior is influenced by inflow to Shasta Reservoir, as does the managed wetlands in the Grassland GSP area that have federal contracts for refuge water supplies. Therefore, the Full Natural Flow (FNF) into Shasta Reservoir was considered to refine the water year type to distinguish between a critically dry year under the San Joaquin River Index and a critically dry year with reduced surface water deliveries to the San Joaquin River Exchange Contractors and the refuges due to a critical year under the Exchange Contract and refuge contracts (reduced inflows to Shasta Reservoir).

    b. The six GSP Groups also coordinated the use of DWR's 2030 and 2070 Climate Change Factors (CCF or CCFs) for the Projected Water Budget.

Groundwater Dependent Ecosystems

5. Groundwater Dependent Ecosystems (GDEs) were evaluated by each GSP Group. The Natural Communities (NC) Dataset Viewer's GDE delineations, produced by The Nature Conservancy (TNC) in partnership with the Department of Fish and Wildlife and DWR, was reviewed and vetted using the following data sources:

a. Aliso Water District GSP, Farmers Water District GSP, Fresno Management Areas A & B GSP, Northern & Central Delta-Mendota Regions GSP, and the San Joaquin River Exchange Contractors GSP used 2015 groundwater contours comprised of local and DWR's WDL depth to water data.

b. Grassland GSP used current Ducks Unlimited Wetland Inventory data for the Wetland GDE map, because the NC Dataset for wetland GDEs in this unique wetland habitat area is not accurate. The Wetland GDE map assumes that all wetlands identified by Ducks Unlimited are possible GDEs, and the Vegetative GDE map assumes that all TNC-delineated Vegetative GDEs are possible GDEs. The GSP Groups reserve the opportunity to gather more local data to refine the GDE maps in future updates.

c. Northern & Central Delta-Mendota Regions GSP used aerial satellite photos and field verification at locations with infrastructure, farms, ditches and canals, etc. to ground-truth the GDE data produced by TNC.

2. ASSUMPTIONS

Coordination and limited data required assumptions to be made to meet GSP requirements. Assumptions that affected the Delta-Mendota Subbasin's coordinated effort are outlined below along with the data and methodologies applied. The basis upon which the methodologies and assumptions were developed includes data and information provided by local agencies, State and federal data, best management practices, and/or best modeled or projected data available.

Mapping

1. Historic WSE Mapping – Assumed accurate and best available locally provided data

a. Upper Aquifer

i. Spring 2003 and Spring 2013 WSE contours were developed for the upper aquifer using datasets identified in item 1.1 above. Spring data was defined as being measured from January 1 through April 8.

ii. The groundwater levels at individual wells were plotted for both Spring 2003 and Spring 2013. Contours were refined by Luhdorff & Scalmanini, Consulting Engineers (LSCE) in the southern portion of the Subbasin and by KDSA for the entire Delta-Mendota Subbasin.

iii. The Spring 2003 and 2013 surfaces were overlaid to produce a change in groundwater level map for the historic period.

iv. The contour maps for the upper aquifer were developed on the following dates:
1. UPPER Change Spring 2003 vs. 2013 – Last edited February 7, 2019
2. UPPER Spring 2003 – Last edited February 6, 2019
3. UPPER Spring 2013 – Last edited February 6, 2019

a. Lower Aquifer

i. All available wells from the inventory identified in the datasets section above that had lower aquifer WSE readings in Spring 2013 and Fall 2013 were used to generate two maps showing lower aquifer 2003 and 2013 water levels (WSE values at individual wells). The spatial coverage was insufficient for contouring due to the distribution aligning linearly

along the Delta-Mendota Canal and the limited well count. This effort was ultimately determined to be a data gap by the Technical Working Group on January 15, 2019.

1. Spring 2013: 37 water elevation measurements
2. Fall 2013: 48 water elevation measurements
3. Final maps for depiction of the lack of coverage and to meet GSP regulations were developed on February 6, 2019. Contours were unable to be developed for reasons noted above. Data will be collected in the future allowing for the development of lower aquifer contour maps as required in future annual reports.

2. Current WSE Mapping – Assumed accurate and best available locally provided data

a. Upper Aquifer

i. The upper aquifer Spring 2013 contour map developed on February 6, 2019 was also used to meet the requirements of the Current WSE contour maps. An additional upper aquifer Fall 2013 contour map was developed on March 1, 2019 using similar methodology and data from September 1 to October 31.

b. Lower Aquifer

i. As with the determination for the historic period, the spatial coverage was insufficient, and this effort has been determined to be a data gap by the Technical Working Group on January 15, 2019.

3. Groundwater Extraction Data

Extraction data were estimated or measured by local GSAs for use in the development of individual GSPs. Groundwater extraction volumes used for the Delta-Mendota Subbasin water budgets were compiled from the six individual GSP water budgets.

4. Surface Water Supply

Surface Water Supply allocations, deliveries, imports, and projected supplies were provided or estimated by local GSAs for use in the development of individual GSPs. Applied surface water volumes used for the Delta-Mendota Subbasin water budgets were compiled from the six individual GSP water budgets.

5. Total Water Use

Total Water Use was estimated or measured by local GSAs for use in the development of individual GSPs. Total water use included in the Delta-Mendota Subbasin water budgets was compiled from the individual GSP water budgets.

6. Change in Groundwater Storage

a. Upper Aquifer

i. Upper aquifer change in groundwater storage was evaluated using annual groundwater level contours from Spring 2003 to Spring 2013 developed using the same datasets identified above and applying specific yield (defined as the volume of water released from storage by an unconfined aquifer per unit surface area of aquifer per unit decline of the water table) provided by each individual GSP Group. The Delta-Mendota Subbasin upper aquifer change in groundwater storage assessment considered a 'sum-of-the-parts' methodology, combining the change in groundwater storage for each GSP to determine the overall change in groundwater storage for the Subbasin.

b. Lower Aquifer

i. On January 15, 2019, the Technical Working Group discussed addressing the historic period change in groundwater storage in the lower aquifer. Instead of using scarce data, the change was compared against loss of storage from inelastic land subsidence as calculated using change in land surface elevation multiplied by the area and supplemented by change in groundwater levels and storativity in areas of the Subbasin where those data were available.

7. GDEs

The Natural Communities Dataset Viewer's (NC Dataset Viewer) GDE delineations, produced by The Nature Conservancy (TNC) in partnership with the Department of Fish and Wildlife and DWR, were reviewed and vetted by each GSP Group. The primary reasons for not fully utilizing the NC Dataset Viewer GDE delineations were as follows: (1) A mapping error was identified, noting the land use is incompatible with the presence of GDEs; (2) for wetlands within the Grassland GSP, a more accurate and comprehensive wetland data set was available; and (3) The depth to groundwater exceeds 30 feet. The 30-foot criterion was used with the understanding that the deepest rooting depth of a vegetative GDE identified in NC Dataset Viewer is 30 feet, and further refined using effective rooting depths published by TNC. The GDE determinations and Spring 2015 depth to groundwater contours were compiled into a Wetland GDE map and Vegetative GDE map on May 29, 2019 and approved by the Subbasin Coordination Committee

The methods for GDE determinations are as follows.

a. Aliso Water District GSP:

i. Spring 2013 and 2015 groundwater contours were assessed in Aliso Water District to evaluate areas in which the depth to water exceeded 30 feet, demonstrating unsuitable hydrologic conditions for vegetative or wetland GDEs. Aliso WD GSP's GDE determinations remained constant when using either Spring 2013 or Spring 2015 water levels for consideration.

ii. GDEs identified within a 100-foot buffer from the San Joaquin River remained "Possible GDEs," as consistent with a typical wetland setback standard used by CalTrans. (See the Aliso Water District GSP for detailed references relating to this standard.)

b. Farmers Water District GSP:

i. Using GIS, Spring 2015 groundwater elevation contours were overlain on the TNC GDE delineations identified in Farmers Water District to evaluate areas in which the depth to water exceeded 30 feet, demonstrating unsuitable hydrologic conditions for vegetative or wetland GDEs.

ii. Local understanding of recent land use was also considered when vetting the TNC GDE delineations.

c. Fresno Management Areas A & B GSP:

i. Spring 2015 groundwater contours were overlain on the TNC GDE delineations used for Fresno Management Areas A & B to evaluate areas in which the depth to water exceeded 30 feet, demonstrating unsuitable hydrologic conditions for vegetative or wetland GDEs.

ii. Local understanding of recent land use was also considered when vetting the TNC GDE delineations.

d. Grassland GSP:

   i. The Ducks Unlimited Wetland Inventory data were used in place of TNC GDE delineations for the identification of possible Wetland GDEs, with the understanding that the TNC GDE delineations for wetlands did not cover the full extent of wetlands in the Grassland Plan area. The Ducks Unlimited wetland delineations were more comprehensive and were developed with ground-truthing surveys which improved accuracy. This deviation in the use of a common dataset for the Subbasin was necessary as this GSP Plan area contains extensive acres of heavily vegetated, shallow seasonal wetlands and therefore required a supplemental approach to GDE delineation beyond the TNC GDE delineation.

   ii. All TNC Vegetative GDEs were also considered "Possible GDEs" and the Grassland GSP Group recognizes the opportunity to gather more local data to refine this position in future GSP updates, if applicable.

e. Northern & Central Delta-Mendota Regions GSP:

   i. Spring 2015 groundwater elevation contours were overlain on the TNC GDE delineations to identify areas in which the depth to water exceeded 30 feet, demonstrating unsuitable hydrologic conditions for vegetative or wetland GDEs.

   ii. GDEs identified within a 100-foot buffer from the San Joaquin River remained "Possible GDEs," as consistent with a typical wetland setback standard in California.[1,2]

   iii. Local understanding of recent land use was also considered when vetting the TNC GDEs.

f. San Joaquin River Exchange Contractors GSP:

   i. Aerial imagery was reviewed for possible mapping errors based on land use and infrastructure. Remaining potential GDE's used Spring 2015 groundwater contours to identify areas in which the groundwater level exceeded the effective rooting depth published by TNC.

8. Subsidence

a. NASA JPL and USBR subsidence maps were provided to the Technical Working Group on October 16th, 2018.
   i. These maps were used for discussion purposes.

b. Subsidence values were produced by each GSP Group, using the most temporally and spatially representative data for their respective GSP on February 7, 2019. The GSP-specific subsidence values are listed in the table below. See the individual GSPs for more detailed information as to how the GSP-specific subsidence values were derived.

GSP Region	Subsidence Rate	Units	Rate	Period of Record	Source	Additional Notes
Aliso	0.15	ft/year	Annual	2011-2017	USBR	Local Surveys and SJRRP monitoring data
Farmers	0.689	ft	Cumulative	2004-2017	USGS and UNAVCO	USGS Fordel-upper aquifer Compaction, Total = 0.031 ft P304-Total Subsidence = 0.72 ft Lower aquifer Compaction, Total = 0.689 ft
Fresno	0.689	ft	Cumulative	2004-2017	USGS and UNAVCO	USGS Fordel-upper aquifer Compaction, Total = 0.031 ft P304-Total Subsidence = 0.72 ft Lower aquifer Compaction, Total = 0.689 ft
Grassland	0.075	ft/year	Annual	2011-2017	USBR and KDSA	The estimated rate of subsidence is based on monitoring points outside of the GSA and therefore has not been verified; Initial data came from USBR, KDSA provided edits to that data.
Northern & Central	Varies by DMC Pool, ranges from 0.7 to -0.88	ft	Cumulative	2003-2013	SLDMWA	Interpolated from 1984 and 2014 Subsidence Surveys for Pools 3-18
Northern & Central	0.53	ft/year	Annual	2014-2018	TRID	Survey data
San Joaquin River Exchange Contractors	0.35	ft	Cumulative	2003-2012	Various datasets	Local surveys, CGPS/CORS/Extensometer data, SJRRP monitoring data, DMC surveys

HCM/Groundwater Conditions

1. Four distinct hydrogeologic layers were initially identified for the Hydrogeological Conceptual Model: shallow layer (0-30 ft), medium layer (30 ft – top of Corcoran Clay), Corcoran Clay, and below Corcoran Clay. However, given that some areas in the Subbasin have more complex hydrogeology than others, these layers were consolidated to three regionally-recognized hydrogeologic features with management areas used further define localized hydrogeologic complexities as needed for SGMA compliance. At the Subbasin level, the three regionally-recognized hydrogeologic features are two principle aquifers – an upper aquifer (unconfined to semi-confined above the Corcoran Clay) and a lower aquifer (confined below the Corcoran Clay), and the intervening regional aquitard known as the Corcoran Clay. This hydrogeologic conceptual model was recommended by the Technical Working Group and approved by the Coordination Committee.
2. SGMA requires a description of the definable bottom of the basin (§354.14 of the GSP Emergency Regulations). The agreed-upon definable bottom of the basin for the Delta-Mendota Subbasin is the base of fresh water consistent with the published definition of the Base of Fresh Water found in R. W. Paige (USGS, Hydrologic Investigations Atlas HA-489, 1973), defined as >3,000 micromhos/cm [µmhos/cm] at 25°C.
3. The current year (2013) seasonal high (spring) ranges from January to April, and seasonal low (fall) ranges from August to October. Data collected during these periods were used for WSE mapping.
4. Data collected during the aforementioned period (as noted in #3, above) were used to prepare water surface contour maps for the upper aquifer. No water surface elevation contour maps were prepared for the lower aquifer for 2013 Fall and Spring (as required by the GSP regulations) due to a lack of aquifer-specific data in most areas of the Subbasin. However, lower aquifer data collected during the aforementioned period were plotted on maps in lieu of the required contour maps. Woodard & Curran / Provost & Pritchard prepared 2013 Fall and Spring WSE contouring for the upper aquifer.

5. Timeframe for upper aquifer WSE mapping defined spring as January 1st to April 8th and fall as September 1st to October 31st.
6. The water year types for water year (WY) 2011 (wet water year), WY2012 (dry water year), and WY2015 (Shasta dry/critical water year) were used to compare WSE maps between GSP Plan areas.
7. Kenneth D. Schmidt & Associate's (KDSA) mapping of interconnected reaches of the San Joaquin River (SJR) based on the SJRRP was used for areas within the SJREC and Grassland GSP Plan areas. A table is included in the Common Chapter showing which SJR reaches are within each GSP Plan area and whether those reaches are gaining or losing. For other GSP Plan areas adjacent to the San Joaquin River, determinations of interconnectedness were provided by those preparing individual GSPs.

Water Budget

1. Historic Water Budget

The historic period was defined as WY2003 through WY2012 by the Technical Working Group on August 8, 2018 and confirmed by the Coordination Committee on August 13, 2018. The historic water budget period was ratified by the Coordination Committee on January 14, 2019 following the Coordination Agreement and Cost Share Agreement being finalized on December 12, 2018.

Each GSP Group determined the surface and groundwater inputs and outputs using the best available public and local data for each respective GSP Plan area. The historic water budget was split into 1) a land interactions water budget and 2) a groundwater budget. The parameters that each GSP Group evaluated were coordinated and summed to develop the Subbasin-wide water budget used to assess the change in storage in the upper aquifer for each GSP Group on February 15, 2019. For details regarding the approach to developing the Subbasin water budgets using numerical and non-numerical tools and the associated discussions with DWR staff, see Technical Memorandum #3 – Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check, and Sustainable Yield.

The change in lower aquifer groundwater storage considered the best available subsidence data per GSP Group and the respective specific yield. The lower aquifer change in storage for the Subbasin total was compiled on February 15, 2019.

2. Current Water Budget

The current Water Budget follows similar methodology to the historic water budgets for both upper and lower aquifer change in groundwater storage. The current period was defined as WY2013 by the Technical Working Group on August 8, 2018 and confirmed by the Coordination Committee on August 13, 2018. The current water budget period was formally ratified by the Coordination Committee on January 14, 2019 following the Coordination Agreement and Cost Share Agreement being finalized on December 12, 2018.

3. Projected Water Budget

Each GSP Group developed their own projected water budgets, using a similar comparison strategy to the historic and coordinated water budgets. The Subbasin-wide projected water budget was presented to the Technical Working Group and Coordination Committees on April 1, 2019. For more details regarding determinations of the projected water budget period and associated representative water years, see Technical Memorandum #3 – Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check, and Sustainable Yield.

The representative period, functioning as surrogate years, for a 50(+)-year historic period (WY2014-2070) was proposed by the Technical Working Group on January 15, 2019. Use of DWR's CCF modeling was also coordinated for changes in precipitation, evapotranspiration and streamflows.

For years 1 through 4 of the projected water budgets (WY2014 through WY2017), actual data were used and no CCF's were applied. Water year types are based on the SJR index except for Shasta Critical years. The following water year types will therefore be used: Shasta Critical, Critical, Dry, Below Normal, Above Normal, and Wet, with all designations based on the San Joaquin River Index except Shasta Critical, which is defined by Shasta indices under the Exchange Contract and refuge water supply contracts. For the projected simulation, four water year types were used for representative water years: Average (above or below normal), Dry (dry or critical), Wet and Shasta Critical.

Climate Change Factors for precipitation and evapotranspiration (ET) were applied considering representative historical water years surrogating for the future year until 2070. Fifty-three years of historical data (1965-2017) were used to model the projected water budget. However, to better match the existing hydrologic cycle, the six GSP Groups decided to begin the projected period with the representative year of 1979 for WY2018 (versus 1965 for WY2018). The coordinated representative year pattern is as follows:

- 1979 data represents WY2018
- 1980 data represents WY2019 (and so on until WY2056)

  and
- 1965 data represents WY2057
- 1966 data represents WY2058 (and so on until WY2070)

For years 38-43 (repeated WY2012-2017), the DWR model did not establish precipitation or ET CCF. The following CCFs for ET and precipitation were used:

- WY 2012 used 2001's 2070 CCF
- WY 2013 used 1992's 2070 CCF
- WY 2014 used 1976's 2070 CCF
- WY 2015 used 1977's 2070 CCF
- WY 2016 used 2002's 2070 CCF
- WY 2017 used 2011's 2070 CCF

For years 30 – 43 (repeated WY 2004-2017), the DWR modeling did not establish streamflow CCFs. For this reason, DWR suggested to use surrogate years' CCFs for the projection. The following CCFs were selected for streamflows:

- WY2004 used 2002's 2030 CCF
- WY2005 used 2002's 2030 CCF
- WY2006 used 1998's 2030 CCF
- WY2007 used 1992's 2070 CCF
- WY2008 used 1992's 2070 CCF
- WY2009 used 2002's 2070 CCF
- WY2010 used 2003's 2070 CCF
- WY2011 used 1997's 2070 CCF
- WY2012 used 1992's 2070 CCF
- WY2013 used 1992's 2070 CCF
- WY2014 used 1976's 2070 CCF
- WY2015 used 1977's 2070 CCF
- WY2016 used 2002's 2070 CCF
- WY2017 used 1998's 2070 CCF

9. Sustainable Yield

Methodologies for calculating upper aquifer sustainable yield were discussed by both the Coordination Committee and the Technical Working Group. After reviewing several options for this calculation, the Coordination Committee requested that the Technical Working Group further discuss potential options and provide a recommendation back to the Coordination Committee for adoption. On April 16, 2019, a joint workshop of the Coordination Committee and the Technical Working Group was held to discuss options for upper aquifer sustainable yield estimation and to identify a recommendation.

During the April workshop, several basic concepts and principles were discussed to calculate the upper aquifer sustainable yield value. Consideration was given to several potential options with increasing detail, including some combination of the following: total Subbasin upper aquifer pumping volumes, total Subbasin upper aquifer change in storage (which includes the effects of precipitation, evapotranspiration, and deep percolation), and Subbasin upper aquifer subsurface inflows and outflows. Inflow from certain neighboring subbasins, based on groundwater flow direction, as well as subsurface inflow from the Coast Range at existing gradients (as part of the inflow to the Northern & Central Delta-Mendota GSP area) was considered. Outflow to neighboring subbasins at existing gradients was also considered in certain applicable areas along the Delta-Mendota Subbasin boundary based on groundwater flow characteristics. Outflow from the Aliso GSP area, which lies east of the San Joaquin River, was not considered as outflow for purposes of developing these principles.

The formula for determining upper aquifer sustainable yield was applied to rolled-up Delta-Mendota Subbasin projected water budgets (WY2014-2070) in two categories:

- *Projected Baseline values with Climate Change Factors*
- *Projected Baseline values with Climate Change Factors and Projects and Management Actions*

If the projected baseline values for the Subbasin are expected to have undesirable results, the GSAs are required to implement projects or management actions that will offset the overdraft and result in a sustainable condition. The Technical Working Group recommended calculation of both a projected baseline for sustainable yield with applied climate change factors and a projected baseline for sustainable yield with climate change factors plus planned projects and management actions. Staff completed preliminary calculations for both baselines using average annual values from the Subbasin projected water budgets and following the formula below:

Upper Aquifer Sustainable Yield = Pumping + Change in Storage + (Outflow– Inflow)

The Technical Working Group determined that a +/- 10% factor should be applied to determine a range for the upper aquifer sustainable yield value. The +/- 10% factor is applied based on the percentage difference between the values from change in storage contour mapping (prepared by Provost & Pritchard) and reported changes in storage from the Subbasin consolidated historic water budgets (WY2003-2012) for the upper aquifer.

In summary, the most detailed range for the upper aquifer sustainable yield is calculated using the above formula for both categories of water budgets: projected baseline with climate change factors and projected baseline with climate change factors plus projects and management actions. The 10% factor is applied to the results for both categories. This range aims to demonstrate the Subbasin's upper aquifer sustainable yield without implementing any projects and management actions (low end of range) and how the Subbasin's upper aquifer sustainable yield will be impacted by implementing planned projects and management actions (high end of range).

Within the Delta-Mendota Subbasin, the distribution of known lower aquifer water level data and extraction volume data are limited and not sufficient to allow for a calculation of lower aquifer sustainable yield. The Technical Working Group therefore look to studies and/or analysis conducted in adjoining subbasins with similar hydrogeologic conditions for consideration in developing a preliminary sustainable yield estimate. A recent study conducted in the adjoining Westside Subbasin was identified and selected for use in developing this preliminary estimate.

The Westlands Water District GSA completed a recent study using groundwater modeling, in conjunction with the Westside Subbasin GSP development, to estimate sustainable yield for that subbasin. An analysis of their data reflected an initial assumption of lower aquifer sustainable yield equivalent to approximately 0.35 acre-feet per acre within the Westside Subbasin (Westlands Water District GSA, *Groundwater Management Strategy Concepts* presentation to the WWD Board on October 16, 2018). Using this analysis, a slightly lower (and therefore more conservative) sustainable yield value for the lower aquifer was selected (0.33 acre-feet per acre), amounting to approximately 250,000 acre-feet per year over the approximately 750,000-acre Delta-Mendota Subbasin.

The lower criteria for a lower aquifer sustainable yield estimation compared to that considered by Westlands Water District reflects DWR's classification of the Delta-Mendota Subbasin as critically overdrafted due to the subsidence issues and was therefore considered to be more protective against the potential for future inelastic land subsidence. After more data are obtained in future years, the lower aquifer sustainable yield value may undergo revisions.

For both the upper and lower aquifer sustainable yield, the Delta-Mendota Coordination Committee acknowledges that sustainable management criteria will be the primary indicator for managing lower aquifer extractions.

10. Boundary Flows

Boundary flows were evaluated by comparing inflows and outflows assessed by each GSP Group's water budget analyses and associated data, as well as groundwater flow trends from groundwater contours and hydrogeologist input. Each set of neighboring GSP Groups had independent meetings to coordinate and compare their respective contributions to inflows and outflows, and the results were provided and discussed by the Delta-Mendota Subbasin's Technical Working Group and Coordination Committee. More details on the applicable datasets can be found in the water budgets and groundwater contours sections of this Technical Memo.

DELTA-MENDOTA SGMA

TECHNICAL MEMORANDUM #2

RE: Assumptions for Hydrogeological Conceptual Model of the Delta-Mendota Subbasin

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation.

The following common assumptions for the Delta-Mendota Hydrogeological Conceptual Model were agreed upon by the Delta-Mendota Subbasin Technical Working Group and approved by the Delta-Mendota Coordination Committee over the period extending from December 2017 through April 2019.

1. Four distinct hydrogeologic layers were initially identified for the Hydrogeological Conceptual Model: shallow layer (0-30 ft), medium layer (30 ft – top of Corcoran Clay), Corcoran Clay, and below Corcoran Clay. However, given that some areas in the Subbasin have more complex hydrogeology than others, these layers were consolidated to three regionally-recognized hydrogeologic features with management areas used further define localized hydrogeologic complexities as needed for SGMA compliance. At the Subbasin level, the three regionally-recognized hydrogeologic features are two principle aquifers – an upper aquifer (unconfined to semi-confined above the Corcoran Clay) and a lower aquifer (confined below the Corcoran Clay), and the intervening regional aquitard known as the Corcoran Clay. This hydrogeologic conceptual model was recommended by the Technical Working Group and approved by the Coordination Committee.
2. SGMA requires a description of the definable bottom of the basin (§354.14 of the GSP Emergency Regulations). The agreed-upon definable bottom of the basin for the Delta-Mendota Subbasin is the base of fresh water consistent with the published definition of the Base of Fresh Water found in R. W. Paige (USGS, Hydrologic Investigations Atlas HA-489, 1973), defined as >3,000 micromhos/cm [µmhos/cm] at 25°C.
3. For the required water surface elevation mapping for the defined current year (WY2013), data from January to April were used for the seasonal high (spring) mapping, and data from August to October were used for the seasonal low (fall) mapping to provide sufficient spatial distribution of data for mapping (recommended by the Technical Working Group during the period from March 2018 through August 2018).
4. Data collected during the aforementioned period (as noted in #3, above) were used to prepare water surface contour maps for the upper aquifer. No water surface elevation contour maps were prepared for the lower aquifer for 2013 Fall and Spring (as required by the GSP regulations) due to a lack of aquifer-specific data in most areas of the Subbasin. However, lower aquifer data collected during the aforementioned period were plotted on maps in lieu of the required contour maps.

5. The Technical Working Group used WY2011 (wet water year), WY2012 (dry water year), and WY2015 (Shasta critical water year) to compare groundwater elevation mapping prepared by the various GSP Groups for their respective GSP Plan areas.
6. Kenneth D. Schmidt & Associates mapping of interconnected reaches of the San Joaquin River based on the San Joaquin River Restoration Program was used for areas within the SJREC and Grassland GSP Plan areas. For other GSP Plan areas adjacent to the San Joaquin River, determinations of interconnectedness were provided by those preparing individual GSPs. A table will be provided showing which San Joaquin River reaches are within each GSP Plan area and whether those reaches are interconnected. If necessary to implement the sustainability goal of the Subbasin, the GSAs will coordinate estimating volumes of gains and losses at these reaches of the San Joaquin River.

TECHNICAL MEMORANDUM #3

RE: Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check and Sustainable Yield

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation.

The following common assumptions were utilized by each GSP Group in the Subbasin in developing the historic and projected water budgets for their respective GSP Plan areas. These GSP-specific water budgets were then compiled (rolled-up) to the Subbasin level for inclusion in the Common Chapter. Also included herein are the assumptions used in developing Subbasin-level sustainable yield estimates for each principal aquifer. These assumptions were recommended by the Delta-Mendota Subbasin Technical Working Group and approved by the Delta-Mendota Coordination Committee.

1. Water Budgets

On September 25, 2017, the Delta-Mendota Subbasin Technical Working Group met with Trevor Joseph (Senior Engineering Geologist) and Mark Nordberg (Senior Engineering Geologist) from the California Department of Water Resources (DWR) to discuss how the development of six GSPs for the Subbasin will be coordinated to implement the best available science while also coordinating to use the same data and methodologies. DWR expressed concerns regarding coordination between those GSPs using a numerical model and those using a non-numerical (spreadsheet) model. Mr. Joseph advised that SGMA requires sustainability for the entire subbasin and was concerned about coordinating a subbasin water budget. The SJREC have experience sustainably managing groundwater using a non-numerical model. A follow-up meeting took place on November 17, 2017 with DWR representatives Trevor Joseph, Tyler Hatch (Senior Engineer) and Amanda Peisch-Derby (Regional SGMA Coordinator) to showcase how this spreadsheet model has been used. It was further discussed that the hydrogeologic principles and equations used for both types of modeling in the Delta-Mendota Subbasin are the same. DWR agreed that coordination amongst the GSP Groups, ensuring use of the same data and methodologies, can be achieved for SGMA modeling purposes in the Subbasin.

Historic Water Budget

The historic period adopted by the Subbasin Coordination Committee was defined as Water Year (WY) 2003 through WY2012. A water year is the period beginning October 1st and ending on September 30th of the subsequent year. The historic water budget period was ratified by the Coordination Committee on January 14, 2019.

Each GSP Group in the Delta-Mendota Subbasin developed land surface water budgets and groundwater budgets for the historic period using the best available public and local data for each respective GSP Plan area. The parameters (specific inputs and outputs) that each GSP Group evaluated were coordinated and summed to develop the Subbasin-wide water budget and to estimate the change in groundwater storage in the upper aquifer in each GSP Plan area. Parameters included pumping/tile drainage, subsurface inflows/outflows, and deep percolation of precipitation and applied surface water. Estimates of changes in groundwater levels in the upper aquifer over the historic water budget period were also utilized to estimate change in groundwater storage. The estimated change in groundwater storage for the upper aquifer from the compiled water budgets was compared to that estimated from changes in groundwater level. For purposes of developing a change in groundwater storage in the upper aquifer over the historic water budget period, the estimates developed from the water budget methodology were used for the Subbasin.

Development of the change in lower aquifer storage value was limited as a result of a lack of available aquifer-specific groundwater level data in most areas of the Subbasin. As a result, a methodology for estimating change in lower aquifer storage from subsidence, along with changes in potentiometric head (where groundwater level data were available), was used. For GSP Plan areas where groundwater level data were not available to support calculations of change in lower aquifer storage, change in land surface elevations was used as a proxy for estimates of change in lower aquifer storage. The best available subsidence data by GSP Group and representative specific yield values (defined as the volume of water released from storage by an unconfined aquifer per unit surface area of aquifer per unit decline of the water table) were used to estimate change in lower aquifer storage from subsidence.

Change in Storage Cross-Check

Groundwater elevation contour maps were developed for the upper aquifer for Spring 2003 and Spring 2013 to assess changes in groundwater storage during the historic and current water budget periods. The contour maps were used to estimate upper aquifer change in storage during the historic and current period by subtracting the Spring 2013 contours from the Spring 2003 contours and multiplying the change in groundwater elevations by GSP Plan area and specific yield of the aquifer. Estimates were made for each GSP Plan area and compared to the overall change in storage estimated in the individual GSP historic and current groundwater budgets. The results of the two methodologies were comparable (within 20%).

Change in land surface elevation is used as a proxy for lower aquifer change in storage using a similar methodology, multiplying the change in land surface elevation between 2003 and 2013 by the area covered by individual GSP Plan areas to estimate the change in lower aquifer storage.

Current Water Budget

The current year for the associated water budget was set as WY2013 by the Delta-Mendota Technical Working Group on August 8, 2018 and confirmed by the Delta-Mendota Coordination Committee on August 13, 2018. The current water budget and associated changes in storage (by principal aquifer) were calculated in the same manner as the historic water budgets. The current water budget period was ratified by the Coordination Committee.

Projected Water Budget

Each GSP Group developed their own GSP-specific projected water budgets using a similar methodology to the historic and current water budgets. GSP-specific water budgets were compiled at the Subbasin level, and the Subbasin projected water budget was recommended and approved at a joint meeting of the Delta-Mendota Technical Working Group and Coordination Committee.

Per SGMA and the GSP regulations, the projected water budget period begins with the year subsequent to the current water budget year and extends for a projection period of at least 50 years to WY2070 for application of the required climate change factors. For the Delta-Mendota Subbasin, the current water budget is WY2013, and the projected water budget period is WY2014 through WY2070.

As future hydrology (e.g. precipitation totals) is not known, historic hydrology is used to simulate projected future hydrology. As a result, each year in the projected water budget is assigned a representative water year from the historic period. For example, WY2018 is assumed to have hydrology similar to that of WY1979; WY2019 is assumed to have hydrology similar to that of WY1980; and so forth. The pattern of historic hydrology used to simulate future hydrology is established based on actual hydrology from WY2014 - WY2017 (known water year types at the start of the projected water budget period). This resulted in the following projected hydrologic pattern.

For the first four years of the projected water budget (WY2014 through WY2017), actual data are used and no climate change factor is applied. For WY2018 through WY2070, the following representative water year sequencing is used:

- WY2018 is equivalent to WY1979.
- Each subsequent projected water year (WY2019 through WY2056) will follow the equivalent subsequent historic water year (e.g. WY2019 is equivalent to WY1980; WY2020 is equivalent to WY1981, and so forth, with WY2056 being equivalent to WY2017).
- WY2057 is equivalent to WY1965 with each subsequent water year (WY2058 through WY2070) equivalent to the subsequent historic water year (with WY2070 being equivalent to WY1978).

Representative water years used the associated historic water year types for assumptions relative to projected hydrology (precipitation, stream flows, and evapotranspiration [ET]). Water year types were based on the San Joaquin River Index except for Shasta Critical Years, which required simulation of the SJREC and wildlife refuge surface water deliveries. Therefore, in summary, the following water year types were assigned to projected water years based on the associated representative water year type: Shasta Critical, Critical, Dry, Below Normal, Above Normal, and Wet, with all designations based on the San Joaquin River Index, except Shasta Critical defined by Shasta index (as recommended by the Technical Working Group). For projected simulations, water year types were 'lumped' into four categories as follows: wet, average (above and below normal), dry (dry and critical) and Shasta critical (as recommended by the Technical Working Group).

As agreed, upon, Climate Change Factors (CCFs) for precipitation and ET were applied considering representative historical year types surrogating for future years through WY2070. For projected years WY2038 through WY2043 (repeated WY2012 through WY2017), DWR did not establish precipitation or ET CCFs. Based on conversations with DWR, the following CCFs for precipitation and ET were used for this intervening period:

- WY 2012 used the 2001 2070 CCF
- WY 2013 used the 1992 2070 CCF
- WY 2014 used the 1976 2070 CCF
- WY 2015 used the 1977 2070 CCF
- WY 2016 used the 2002 2070 CCF
- WY 2017 used the 2011 2070 CCF

For projected years WY2030 - WY2043 (repeated WY2004 - WY2017), DWR did not establish streamflow CCFs. For this reason, DWR suggested to use surrogate years' CCFs for the projected period. The following CCFs were selected for streamflows:

- WY 2004 used the 2002 2030 CCF
- WY 2005 used the 2002 2030 CCF
- WY 2006 used the 1998 2030 CCF
- WY 2007 used the 1992 2070 CCF
- WY 2008 used the 1992 2070 CCF
- WY 2009 used the 2002 2070 CCF
- WY 2010 used the 2003 2070 CCF
- WY 2011 used the 1997 2070 CCF
- WY 2012 used the 1992 2070 CCF
- WY 2013 used the 1992 2070 CCF
- WY 2014 used the 1976 2070 CCF
- WY 2015 used the 1977 2070 CCF
- WY 2016 used the 2002 2070 CCF
- WY 2017 used the 1998 2070 CCF

The projected water budget period and associated representative water years were recommended by the Technical Working Group. Use of DWR's CCFs was also coordinated, and it was agreed that CCFs will only be applied to hydrology.

2. Sustainable Yield

The following methodologies were recommended by the Delta-Mendota Technical Working Group and approved by the Coordination Committee for establishing the required sustainable yield estimate for each principal aquifer:

Upper Aquifer Sustainable Yield

The following formula was agreed upon for the calculation of the sustainable yield of the upper aquifer:

Sustainable Yield = (Pumping + Change in Storage) + (Outflow – Inflow)

Data used in the calculation are from the Delta-Mendota Subbasin compiled projected water budget with Climate Change Factors and Projects/Management Actions, as well as Baseline Projected Water Budget with Climate Change Factors. A ± 10% factor was applied to the resulting sustainable yield estimate; this factor was estimated based on the percent difference in the WY2003-2012 upper aquifer change in storage calculations between the compiled historic water budget and the estimate of change in storage utilizing change in groundwater level contours cross-check analysis (see above). Data incorporated into the equation are the average annual values from the indicated projected water budgets (WY2014 - WY2070) using only upper aquifer values.

Sustainable management criteria (Minimum Thresholds and Measurable Objectives) will be the primary indicator governing upper aquifer extractions. The sustainable yield estimates will be updated as part of the five-year GSP review.

Lower Aquifer Sustainable Yield

Within the Delta-Mendota Subbasin, the distribution of known lower aquifer water level data and extraction volume data are limited and not sufficient to allow for a calculation of lower aquifer sustainable yield. A Northern & Central Delta-Mendota Region Management Committee memo dated April 10, 2019 outlined the alternative method used to estimate sustainable yield method for the lower aquifer and is summarized below.

The Westlands Water District GSA has completed a recent study using groundwater modeling, in conjunction with the Westside Subbasin GSP development, to estimate sustainable yield for that subbasin. Based on an analysis of their data and reflected an initial assumption of lower aquifer sustainable yield equivalent to approximately 0.35 acre-feet per acre within the Westside Subbasin (Westlands Water District GSA, Groundwater Management Strategy Concepts presentation to the WWD Board on October 16, 2018). Using this analysis, a slightly lower sustainable yield value for the lower aquifer was selected (0.33 acre-feet per acre), amounting to approximately 250,000 acre-feet per year over the approximately 750,000-acre Delta-Mendota Subbasin.

The lower criteria for a lower aquifer sustainable yield estimation compared to that considered by Westlands Water District reflects DWR's classification of the Delta-Mendota Subbasin as critically-overdrafted due to the subsidence issues. After more data are obtained in future years, the lower aquifer sustainable yield value may undergo revisions.

3. Other

The Technical Working Group of the Subbasin Coordination Committee discussed that not-yet implemented plans or programs (e.g. Delta conveyance, Updates to the Bay-Delta Water Quality Control Plan/SED, proposed large storage projects, etc.) would not be incorporated into the current GSPs. However, projects or programs may be qualitatively incorporated or described in individual GSPs, and such programs will be monitored during the next five years and incorporated into the GSPs in future updates as appropriate.

TECHNICAL MEMORANDUM #4

RE: Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Management Criteria

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation.

The following common assumptions were utilized by each GSP Group in the Subbasin for preparing a subbasin-level description of management areas and sustainable management criteria.

1. Management Areas

The Coordination Committee left management areas and management of their respective GSPs to the six GSP Groups. Management areas were determined individually by each GSP Group with Woodard & Curran preparing a map showing all management areas ('sum of the parts' approach).

2. Sustainable Management Criteria

Per the GSP Regulations, definitions of undesirable results must be provided at the Subbasin level. The Technical Working Group defined these as follows:

- Chronic Lowering of Groundwater Levels: Significant and unreasonable chronic change in water levels, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions.
- Long-term Reduction of Groundwater Storage: Significant and unreasonable chronic decrease in groundwater storage, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions.
- Degraded Water Quality: Significant and unreasonable degradation of groundwater quality, as defined by each GSP Group, that has an impact on the beneficial users of groundwater in the Subbasin through either intra- and/or inter-basin actions and/or activities.
- Depletions of Interconnected Surface Water: Depletions of interconnected surface water, as defined by each GSP Group, that have significant and unreasonable adverse impacts on the beneficial uses of surface water

- Land Subsidence: Changes in ground surface elevation that cause damage to critical infrastructure that would cause significant and unreasonable reductions of conveyance capacity, damage to personal property, impacts to natural resources or create conditions that threaten public health and safety.
- Seawater Intrusion: The Coordination Committee recognized that the Subbasin is not in a coastal location and therefore seawater intrusion is unable to occur and therefore a definition of an undesirable result is not necessary.

Each GSP Group individually defined significant and unreasonable for each sustainability indicator, as well as established sustainability goals, interim milestones, minimum thresholds and measurable objectives. This process was discussed during the February 2019 meetings of the Technical Working Group, and ultimately recommended and approved by the Coordination Committee.

TECHNICAL MEMORANDUM #5

RE: Assumptions for Delta-Mendota Subbasin Monitoring Network

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation.

The following common assumptions and approaches were utilized in developing the required Subbasin monitoring network for sustainability indicators:

- The required Subbasin-level monitoring networks will be a compilation of networks developed by each individual GSP Group.
- The compilation of the individual GSP monitoring networks will provide sufficient data in order to develop required water surface elevation contouring for each principal aquifer in the Subbasin, if applicable.
- The GSP groups will use CASGEM monitoring network data for 2018 and 2019 data collection and will supplement with locally collected data where available.
- Each monitoring location or point within the GSP network will be monitored, at a minimum, at the agreed upon frequency for each of the data types.
- Field Collection will follow agreed-upon protocols which may be the same as, or equal to, data collection protocols (i.e. industry standards and best management practices).
- For non-monitored data to be reported as part of the annual reports (e.g. groundwater extractions, surface water deliveries), actual metered data will be used where such data exists, and when direct data do not exist, estimated quantities will be calculated based on existing indirect data (e.g. electrical usage, crop demand, ET) and/or other industry best practices.
- Seasonal high groundwater elevation data will be collected between February and April, and seasonal low groundwater elevation data will be collected between September and October.
- Each GSP Group may use supplemental data in addition to the SGMA-required monitoring network documented in their GSP in order to comply with these requirements and those set forth in the Coordination Agreement.

- Individual data gaps in the monitoring networks and monitoring data identified in the GSPs will progressively be addressed by the applicable GSA or GSP Group during the 20-year GSP implementation timeframe (2020 to 2040).

TECHNICAL MEMORANDUM #6

RE: Coordination of the Delta-Mendota Subbasin Data Management System

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

The Technical Memoranda will be utilized by the Coordination Agreement Parties (representing the twenty-three GSAs in the Subbasin) during the implementation of their GSPs in order to ensure coordination of the GSPs. The Coordination Committee is responsible for ongoing review and updating of the Technical Memoranda, as needed, during GSP implementation. This Technical Memorandum describes the development and anticipated use of the coordinated Subbasin Data Management System (DMS) for GSP implementation.

Coordinated Data Management System

As required in Section 352.6, Data Management System, of the GSP regulations, the Delta-Mendota Subbasin GSAs will develop and maintain a data management system that is capable of storing and reporting information relevant to the reporting requirements, implementation of the GSPs, and the monitoring networks of the Subbasin. Additionally, per Section 354.4, Reporting Monitoring Data to the California Department of Water Resources (DWR), all monitoring data are to be stored in a DMS with copies of the monitoring data included in the annual report and submitted electronically on forms provided by DWR. Recognizing that GSP implementation, including annual reporting, will require some efforts at the subbasin level, the 23 GSAs overlying the Delta-Mendota Subbasin have chosen to develop a coordinated DMS that can be utilized by each GSP Group for management of their data but which will allow for the required compilation of data sets for preparation of Subbasin annual reports. The coordinated DMS, once developed, will provide a generic framework that can be used by any GSP Group or GSA in the Subbasin for individual data management while allowing for consistent formatting and the simplified uploading of compiled datasets into the Subbasin-wide coordinated DMS.

The Parties have also developed and will maintain separate data storage processes or Data Management Systems. Each separate DMS developed for each GSP will store information related to implementation of each individual GSP, monitoring network data and monitoring sites requirements, and water budget data requirements. Each system will be capable of reporting all pertinent information to the respective GSA and/or GSP Group, and ultimately to the Coordination Committee. After providing the Coordination Committee with data from the individual GSPs, the Subbasin Plan Manager and Coordination Committee will ensure the data are stored and managed in a coordinated manner throughout the Subbasin and reported to DWR on an annual basis.

Leading up to the development of the DMS, the Subbasin used an *ad hoc* DMS working group and survey to develop a conceptual design for the software requirements. This was followed by the software vendor creating wireframes to communicate the functionality of the DMS. This *ad hoc* working group developed data standards for each data type to make the aggregation feasible at a subbasin level and established weekly calls to develop import wizards, attribute

tables, interpretations of reporting requirements, and an annual report format. Data provided by Santa Nella County Water District were used to beta-test the completed DMS prior to release as a generic system for Subbasin-wide use.

The DMS includes permissions and business rules so each GSP can only upload data for their GSP based upon usernames and roles. GSP Groups, or GSAs within a GSP Group, are also not allowed to see other GSP Groups' data until all annual reporting has been completed and accepted by the Plan Manager. DMS development is ongoing, with development concurrent with final GSP development, and has been designed to support the needs of the severely disadvantaged communities, disadvantaged communities, and GSAs within the Subbasin. The DMS is scheduled to be completed for use in developing annual reports by January 2020.

The DMS constructed for the Delta-Mendota Subbasin is a secured web-based application hosted on Amazon Web Services (AWS). The DMS focuses on five core business requirements including: centralized data warehouse, security of data, permissioned based access, data visualization and reporting. Other goals of the DMS focus around improving data collection/aggregation processes, creating data standards, gaining efficiencies in reporting and improving data sharing with stakeholders. The DMS is designed to aggregate data through import processes by GSP to support data visualization and annual report generation.

Underlying the web application is a relationship database used to store the information aggregated from GSPs across primary data types identified to support monitoring and Annual Report development. Those data types include groundwater extractions, surface water deliveries, groundwater storage, groundwater elevations, groundwater quality, interconnected surface water and land subsidence. The web application functionality includes an embedded GIS viewer, screens to view tables of time series data, and charting capabilities for hydrographs. The embedded GIS viewer contains functionality to store map layers such as reference data, GSA/GSP boundaries and derived information such as water level contours.

In order to facilitate data synthesis, the GSP Groups agreed on the following frequencies for monitoring data collection:

- Groundwater elevations – twice a year (seasonal high and seasonal low)
- Interconnected surface water – twice a year (seasonal high and seasonal low)
- Groundwater quality – once a year
- Land subsidence – continuous monitoring sites or by Management Area

These datasets will be augmented with other data collection required for annual report preparation, including estimates of groundwater extractions and surface water diversions.

Additionally, the GSP Groups agreed to utilize the same general monitoring protocols or similar industry standards to ensure that the data were collected in a consistent and coordinated fashion. All monitoring locations in the Delta-Mendota Subbasin were assigned a unique identifier in the DMS. The number system is in a format of ##-####, where the first two digits indicates which GSA the monitoring location is associated with, and the subsequent four digits indicate the specific monitoring location in that GSA area. The general methodology agreed upon for data import and management is as follows:

- Each GSA collects their respective data per agreed-upon protocols and transmits it to the GSA representative.
- Each GSA representative then compiles the data and conducts a quality control check.
- The GSA representative transmits the compiled data set to the GSP Lead or Representative, who then aggregates the data from all GSAs and conducts a second quality control check.
- The GSP Lead or Representative uploads the data set into the DMS using import wizards designed specifically for this process.

- The Subbasin Plan Manager then uses the data in the DMS to compile information as required for the annual report.

Compiled data sets from the DMS will be augmented with required maps generated externally to produce the required annual report. Mapping prepared outside the DMS will be subsequently imported into the DMS as GIS files to ensure all data are kept in one place.

The DMS will be maintained by the San Luis & Delta-Mendota Water Authority, while acting as the Plan Manager, with a contract with the software vendor for hosting, maintenance and future updates. Each GSP will pay a maintenance fee for the continued hosting and support of the Subbasin coordinated DMS.

The Subbasin-level DMS, as described herein, may be supplemented by additional DMSs developed and maintained by each GSP Group or GSA in the Subbasin. The reader is referred to each of the six Subbasin GSPs for specific information relative to data collection and management in each GSP Plan area.

TECHNICAL MEMORANDUM #7

RE: Adoption and Use of the Subbasin Coordination Agreement

PREPARED BY: Woodard & Curran

DATE: July 25, 2019

During development of the six coordinated Groundwater Sustainability Plans (GSPs) for the Delta-Mendota Subbasin (Subbasin), the twenty-three Groundwater Sustainability Agencies (GSAs) in the Subbasin agreed upon methodologies and assumptions for water budgets, change in storage, and sustainable yield. The common data and methodologies required in Water Code Section 10727.6 and Title 23, California Code of Regulations, Section 357.4 to prepare coordinated plans and utilized in preparation of the Delta-Mendota Subbasin GSPs are set forth in Technical Memoranda. Each of the individual Memoranda satisfies a requirement agreed upon in the Coordination Agreement and, collectively when combined with the Coordination Agreement, provides an explanation of how the six Subbasin GSPs implemented together satisfy the requirements of the Sustainable Groundwater Management Act (SGMA) for the entire Subbasin.

This Technical Memorandum describes the Delta-Mendota Subbasin governance structure, participating parties, the Delta-Mendota Subbasin Coordination Agreement (Coordination Agreement), and details of this Coordination Agreement. Each GSA in the Subbasin is included in this memorandum. Additional details of the organization, management structure, and legal authority of each GSA and their associated GSPs, and accompanying GSA boundary maps, are described in the Delta-Mendota Subbasin Common Chapter (Common Chapter). Descriptions of intrabasin and interbasin coordination agreements in place for the development and implementation of the GSPs overlying the Subbasin are also referenced.

1. GSP and Coordination Agreement Submission

A Delta-Mendota Subbasin Common Chapter has been developed to "knit" the six Delta-Mendota GSPs together for cohesive implementation. The Common Chapter includes a separate signature page that contains a disclosure statement and professional stamp for the consultant charged with compiling the chapter (Woodard & Curran), as agreed upon by the Technical Working Group on April 17, 2018 and January 15, 2019. Each Subbasin GSP is stamped and signed by the professional overseeing their preparation. The Common Chapter was developed as part of a collaborative process, with input from the various GSAs, technical consultants, and stakeholders. The Coordination Agreement, Common Chapter, and Technical Memoranda collectively serve as the mechanism through which the GSAs and individual GSPs are coordinated during implementation.

The GSAs have agreed to submit their respective GSPs to the California Department of Water Resources (DWR) through the Delta-Mendota Subbasin Coordination Committee (Coordination Committee) and the Plan Manager, along with all developed Common Chapter and Technical Memoranda, by January 31, 2020. When submitted to DWR, the collective documents will be available for public review and comment as part of the 60-day public comment period per SGMA regulations.

2. GSP Groups and GSAs in the Delta-Mendota Subbasin

Below is a summary of the six GSP Groups and twenty-three GSAs (and their respective signatories) to the Coordination Agreement. Some signatories (also referred to as parties) are participating in multiple GSAs and/or GSPs.

Northern & Central Delta-Mendota Region GSP

- Patterson Irrigation District GSA
  - Patterson Irrigation District, Twin Oaks Irrigation District
- West Stanislaus Irrigation District GSA
  - West Stanislaus Irrigation District
- DM-II GSA
  - Del Puerto Water District, Oak Flat Water District
- City of Patterson GSA
  - City of Patterson
- Northwestern Delta-Mendota GSA
  - Merced County, Stanislaus County
- Central Delta-Mendota GSA
  - San Luis Water District, Santa Nella County Water District, Panoche Water District, Mercy Springs Water District, Tranquillity Irrigation District, Merced County, Fresno Slough Water District, Fresno County, Eagle Field Water District, Pacheco Water District
- Widren Water District GSA
  - Widren Water District
- Oro Loma Water District GSA
  - Oro Loma Water District

San Joaquin River Exchange Contractors (SJREC) GSP

- San Joaquin River Exchange Contractors Water Authority GSA
  - Central California Irrigation District, Columbia Canal Company, Firebaugh Canal Water District, San Luis Canal Company
- Turner Island Water District-2 GSA
  - Turner Island Water District
- City of Mendota GSA
  - City of Mendota
- City of Firebaugh GSA
  - City of Firebaugh
- City of Los Banos GSA
  - City of Los Banos
- City of Dos Palos GSA
  - City of Dos Palos
- City of Gustine GSA
  - City of Gustine
- City of Newman GSA
  - City of Newman
- Madera County GSA
  - Madera County
- Portion of Fresno County Management Area B GSA
  - Fresno County
- Portion of Merced County – Delta-Mendota GSA
  - Merced County

Grassland GSP

- Grassland GSA
  - Grassland Water District, Grassland Resource Conservation District
- Portion of Merced County GSA
  - Merced County

Farmers Water District GSP

- Farmers Water District GSA
  - Farmers Water District

Fresno County GSP

- Fresno County Management Area A GSA
  - Fresno County
- Fresno County Management Area B GSA
  - Fresno County

Aliso Water District GSP

- Aliso Water District GSA
  - Aliso Water District

With respect to the San Benito County portion of the Delta-Mendota Subbasin, this area will be included in the Central Delta-Mendota GSA of the Northern & Central Delta-Mendota Region GSP. In 2017, the San Benito County Water District Groundwater Sustainability Agency indicated its intent to act as the GSA for certain areas within its jurisdiction, but not for the unmanaged *de minimis* area in the most southwest portion of the Delta-Mendota Subbasin. For purposes of assuring that all land within the Subbasin is part of a GSP as required by DWR regulations, the Central Delta-Mendota GSA entered into a Memorandum of Understanding with San Benito County to include the unmanaged *de minimis* area in the Northern & Central Delta-Mendota Region GSP.

3. Delta-Mendota Subbasin Intrabasin Coordination Agreement

The aforementioned GSAs are coordinating development and implementation of the six GSPs under the Delta-Mendota Subbasin Coordination Agreement. All GSAs within the Subbasin agree to work collaboratively to meet the objectives of SGMA and the Coordination Agreement. Each GSA acknowledges that it is bound by the terms of this Coordination Agreement.

The Coordination Agreement for the Delta-Mendota Subbasin covers the following topics:

1. Purpose of the Agreement, including:
   a. Compliance with SGMA and
   b. Description of Criteria and Function;
2. Definitions
3. General Guidelines, including:
   a. Responsibilities of the Parties and
   b. Adjudicated or Alternative Plans in the Subbasin;
4. Role of San Luis & Delta-Mendota Water Authority (SLDMWA), including:
   a. Agreement to Serve,
   b. Reimbursement of SLDMWA, and
   c. Termination of SLDMWA's Services;

5. Responsibilities for Key Functions, including:
    a. Coordination Committee,
    b. Coordination Committee Officers,
    c. Coordination Committee Authorized Action and Limitations,
    d. Subcommittees and Workgroups,
    e. Coordination Committee Meetings, and
    f. Voting by Coordination Committee;
6. Approval by Individual Parties;
7. Exchange of Data and Information, including:
    a. Exchange of Information and
    b. Procedure for Exchange of Information;
8. Methodologies and Assumptions, including:
    a. SGMA Coordination Agreements,
    b. Pre-GSP Coordination, and
    c. Technical Memoranda Required;
9. Monitoring Network
10. Coordinated Water Budget
11. Coordinated Data Management System
12. Adoption and Use of the Coordination Agreement, including:
    a. Coordination of GSPs and
    b. GSP and Coordination Agreement Submission;
13. Modification and Termination of the Coordination Agreement, including:
    a. Modification or Amendment of Exhibit "A" (Groundwater Sustainability Plan Groups including Participation Percentages),
    b. Modification or Amendment of Coordination Agreement, and
    c. Amendment for Compliance with Law;
14. Withdrawal, Term, and Termination;
15. Procedures for Resolving Conflicts;
16. General Provisions, including:
    a. Authority of Signers,
    b. Governing Law,
    c. Severability,
    d. Counterparts, and
    e. Good Faith; and
17. Signatories of all Parties

The Coordination Agreement, effective as of December 12, 2018, has been signed by all thirty-six parties in the Delta-Mendota Subbasin. These signatories to the Coordination Agreement have formed a total of 23 GSAs in the Subbasin. A key goal of basin-wide coordination is to ensure that the Subbasin GSPs utilize the same data and methodologies during their plan development and that the elements of the Plans necessary to achieve the sustainability goal for the Subbasin are based upon consistent interpretations of the basin setting, as required by SGMA and associated regulations. It is the intent that the Coordination Agreement become part of each individual GSP within the Delta-Mendota Subbasin.

Delta-Mendota Subbasin Coordination Committee

The Delta-Mendota Subbasin Coordination Agreement establishes the Delta-Mendota Subbasin Coordination Committee (Coordination Committee), which provides representation from each of the six GSP groups. The Coordination Committee complies with requirements of the Brown Act. The Coordination Agreement describes the Coordination Committee's requirements for meeting noticing, attendance, voting, data sharing, governance of subcommittees and working groups, and approval of Subbasin documents.

The Coordination Agreement allows for development of individual subcommittees or working groups to support the development of the Technical Memorandums and to coordinated data, methodologies, and assumptions. For this purpose, the Coordination Committee recommended formation of an ad hoc Technical Working Group, Communications Working Group, and Data Management System Working Group.

The Coordination Committee provides specific direction to the Plan Manager. The initial Plan Manager for the six coordinated GSPs is Andrew Garcia, Senior Civil Engineer for San Luis & Delta-Mendota Water Authority (SLDMWA); however, the Coordination Committee and Coordination Agreement allow for a consultant of the SLDMWA to act as Plan Manager, if necessary. If the SLDMWA ceases to serve as Plan Manager, the Coordination Committee can name a successor per the Coordination Agreement. In the meantime, Mr. Garcia's contact information is included below:

Mr. Andrew Garcia, Plan Manager
San Luis & Delta-Mendota Water Authority
842 6th Street
Los Banos, CA 93635
Phone: (209)-832-6200 / Fax (209)-833-1034
andrew.garcia@sldmwa.org

Contact information for each GSP plan administrator is included in the respective GSPs.

Technical Memoranda

The Coordination Agreement describes the development of Technical Memoranda. These memoranda collectively explain the data, methodologies, and assumptions approved and used by the six GSP Groups within the Subbasin. The Coordination Agreement specifically referenced four Technical Memoranda; the Technical Working Group of the Coordination Committee subsequently recommended development of additional Technical Memoranda during the GSP development efforts. The Technical Memoranda are subject to the Coordination Committee's review and unanimous approval and will be submitted along with the Coordination Agreement to DWR. The Technical Memoranda will be used throughout GSP implementation to ensure continued coordination and compliance with SGMA.

The Technical Memoranda include:

1. Common Datasets Used in the Delta-Mendota Subbasin GSPs
2. Assumptions for Hydrogeological Conceptual Model of the Delta-Mendota Subbasin
3. Assumptions for the Historic, Current and Projected Water Budgets of the Delta-Mendota Subbasin, Change in Storage Cross-Check and Sustainable Yield
4. Assumptions for Delta-Mendota Subbasin Management Areas, Sustainability Management Criteria
5. Assumptions for Delta-Mendota Subbasin Monitoring Network
6. Coordination of the Delta-Mendota Subbasin Data Management System
7. Adoption and Use of the Subbasin Coordination Agreement
8. Coordinated Noticing, Communication, and Outreach Activities in the Delta-Mendota Subbasin

Interbasin Coordination

The Delta-Mendota Subbasin adjoins nine neighboring subbasins. These subbasins range in basin condition as determined by DWR, so some subbasins are also on the January 31, 2020 GSP submission deadline, while others have a 2022 deadline. With this multitude of neighbors and variety of timelines, the Delta-Mendota Subbasin has initiated interbasin coordination efforts with all of the adjoining subbasins. The SLDMWA, on behalf of the Northern and Central Delta-Mendota Regions, executed an interbasin data sharing agreement with Westlands Water District, the coordinating agency for the Westside Subbasin. The agreement establishes common assumptions for groundwater conditions as well as a process for continued data sharing for data located within five miles of the boundary between Westside Subbasin and the Delta-Mendota Subbasin.

Additional interbasin coordination efforts have been initiated with other adjoining subbasins. No other agreements have been formalized at the time of the Delta-Mendota Subbasin's GSP submissions, but may be developed later. The Delta-Mendota Subbasin intends to coordinate with neighboring subbasins to develop shared understandings of data and technical approaches.

DELTA-MENDOTA SGMA

TECHNICAL MEMORANDUM #8

RE: Coordinated Noticing, Communication, and Outreach Activities in the Delta-Mendota Subbasin

PREPARED BY: Stantec

DATE: July 25, 2019

---

1. Introduction

The Sustainable Groundwater Management Act of 2014 (SGMA) and subsequent Emergency Regulations developed by the California Department of Water Resources (DWR) in May 2016 identified a number of requirements for public notice and communication related to Groundwater Sustainability Agency (GSA) formation and Groundwater Sustainability Plan (GSP) development. California Code of Regulations §354.10 identifies the requirements for notice and communication information in a GSP:

> "Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:
>
> (a) A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.
>
> (b) A list of public meetings at which the Plan was discussed or considered by the Agency.
>
> (c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.
>
> (d) A communication section of the Plan that includes the following:
>
> (1) An explanation of the Agency's decision-making process.
>
> (2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.
>
> (3) A description of how the Agency encourages the active involvement of diverse social, cultural and economic elements of the population within the basin.
>
> (4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions."

Pursuant to these requirements, GSAs in the Delta-Mendota Subbasin (Subbasin) conducted a number of activities to engage beneficial users of groundwater, interested parties, and the general public in the development of the six Subbasin GSPs. Each GSA was responsible for conducting outreach and engagement related to SGMA within its service area; however, recognizing efficiencies in pooling resources and the importance of consistent messaging, the GSAs also conducted a series of coordinated activities aimed at engaging stakeholders across the Subbasin. This document describes the coordinated tools, methods, and activities the GSAs used to inform and engage stakeholders in development of the Subbasin GSPs.

2. Situation Assessment and Communications Plan

To assist in GSA formation and GSP development, agencies in the Subbasin sought and received Facilitation Support Services funding from DWR in August 2016. Under this funding, a neutral, third-party facilitation team conducted a situation assessment on behalf of the Subbasin GSAs. The purpose of the assessment was to

understand how stakeholders perceived the status of the Subbasin's groundwater resources and identify potential barriers to the successful development of the GSPs.

The facilitation team, with input from local agencies, identified 30 stakeholders representing diverse interests and beneficial users in the Subbasin, together with disadvantaged communities, agricultural well owners, government and land use agencies, and environmental and ecosystem interests. From February 2017 to May 2017, the facilitators conducted over 30 phone and in-person interviews with stakeholders. The facilitators recorded the interview responses and summarized the results in a presentation made to the GSA representatives.

The assessment results were used to inform the development of the Delta-Mendota Subbasin Sustainable Groundwater Management Act Communications Plan (Communications Plan), which is provided with this document as **Attachment A**. The Communications Plan identifies near- and long-term outreach and engagement strategies, tactics, and tools for stakeholder engagement in GSP development and implementation. The Subbasin GSAs used the Communications Plan as a framework for conducting the stakeholder outreach and engagement activities described in this document.

3. Public Noticing and Information

Legal Requirements:

> **§354.10 (d):** A communication section of the Plan that includes the following:
> (3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of population within the basin.

The Subbasin GSAs developed and used several tools to inform members of the public about GSP development activities and promote opportunities for public engagement. These tools are described below.

- Website: The Subbasin website – www.deltamendota.org – is the primary location for information related to SGMA implementation in the Subbasin. Information provided on the website includes: an overview of SGMA, a description of each of the GSP groups, contact information for each of the GSAs, and upcoming workshops and public meetings. The website also serves as a repository for outreach collateral, workshop materials, and meeting packets and minutes for the Delta-Mendota Subbasin Coordination Committee, Technical Working Group, and Communications Working Group (described below).

- Delta-Mendota Subbasin Newsletter: The Delta-Mendota Subbasin Newsletter is distributed on a monthly basis and serves as an informational tool to keep interested parties, beneficial users, and members of the general public informed about the development and status of the GSPs. Newsletter topics include Subbasin-wide activities, general announcements, upcoming meetings and workshops, and past and upcoming GSP development activities. Copies of the newsletters are archived on the Subbasin website.

- Informational Materials: GSAs in the Subbasin developed a suite of materials in English and Spanish to educate and inform members of the public about SGMA and topics covered in the GSP. These materials include bilingual presentations, fact sheets, handouts, frequently asked questions, and videos. Copies of the materials are available on the Subbasin website. GSA representatives distributed these materials during meetings, workshops, and other outreach activities.

4. Public Engagement in GSP Development

Legal Requirements:

> **§354.10(b): A list of public meetings at which the Plan was discussed or considered by the Agency;**
>
> **§354.10 (d): A communication section of the Plan that includes the following:**
> **(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.**
> **(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of population within the basin.**

This section describes outreach activities coordinated among the Subbasin GSAs to inform, engage, and consult stakeholders in GSP development. Coordinated outreach activities fell into two main categories: general public outreach and targeted outreach. General public outreach activities primarily consisted of committee and working group meetings, and coordinated workshops aimed at informing and receiving public input on the content of the GSPs. The GSAs also conducted outreach activities targeted at hard-to-reach communities and beneficial users, including agricultural interests, school districts, and disadvantaged communities.

General Public Engagement Activities

There were two primary opportunities for members of the public to engage in development of the Subbasin GSPs: Coordination Committee and working group meetings and coordinated public workshops. These activities are further described below. In addition, the GSAs also informed and engaged members of the public by posting information on the Subbasin and member-agency websites, distributing the monthly newsletter, disseminating bilingual informational materials, and tabling at public events.

Committee Meetings

Comprised of members representing the entities preparing the Subbasin GSPs, the Coordination Committee was formed to provide overall guidance and resolve conflicts among the GSAs to ensure that the GSPs were coordinated as required by SGMA. The Technical Working Group and Communications Working Group were formed under the Coordination Committee to specifically coordinate technical and communication activities, respectively. Public meetings of the Coordination Committee and working groups served as key opportunities for stakeholders to engage and consult in development of the GSPs. Public comments were recorded in the meeting minutes, posted on the Subbasin website, and considered during development of the GSPs.

Coordinated Public Workshops

The Subbasin GSAs planned and held a series of public workshops from May 2018 – May 2019 aimed at educating and soliciting input from the public about topics covered in the GSPs. Table 1 identifies the workshop dates, locations, and topics. At these workshops, GSA representatives and their technical consultants presented information on each GSP development phase. Presentations were followed by an open house period to allow participants to talk directly with their GSA representatives. Bilingual interpreters were present at all workshops to provide interpretation services. All workshop materials, in both English and Spanish, are available on the Subbasin website.

Questions, comments, and input from workshop participants were recorded by facilitation staff and summarized the workshop summaries, provided with this document as **Attachment B**. All public comments were taken in consideration by GSAs and technical consultants during development of the GSPs.

The GSAs used a variety of methods to promote the workshops. These methods included distribution of bilingual flyers and utility bill inserts, email notifications, social media posts, website posts, newspaper notices, and press releases. **Attachment C** includes example workshop promotion activities. GSA representatives also directly contacted local organizations throughout the Subbasin. A list of organizations contacted is provided with this document as **Attachment D**.

Table 1. Coordinated Public Workshops

Date	Location, Venue	Topic
Spring 2018 Workshop		
May 14, 2018	Los Baños, San Luis & Delta-Mendota Water Authority	• Sustainable Groundwater Management Act overview • Delta-Mendota Subbasin overview • Opportunities for engagement
May 16, 2018	Patterson, Hammon Senior Center	
May 17, 2018	Mendota, Mendota Library	
Fall 2018 Workshops		
October 22, 2018	Firebaugh, Firebaugh Middle School	• GSP development and implementation process • Data collection • Hydrogeologic Conceptual Model • Numerical & Analytical Models • Water budgets
October 24, 2018	Los Baños, College Greens Building	
October 25, 2018	Patterson, Patterson Senior Center	
Winter 2019 Workshops		
February 19, 2019	Los Baños, College Greens Building	• Historic and current water budgets • Sustainability criteria • Undesirable results • Projects and management actions
February 20, 2019	Patterson, Patterson City Hall	
March 4, 2019	Santa Nella, Romero Elementary School	
Spring 2019 Workshops		
May 20, 2019	Patterson, Patterson City Hall	• Projected water budgets • Sustainable yield • Groundwater monitoring networks • Projects and management actions
May 21, 2019	Los Baños, College Greens Building	
May 22, 2019	Santa Nella, Romero Elementary School	
May 23, 2019	Mendota, Mendota Library	

Targeted Stakeholder Engagement

The Subbasin GSAs also conducted targeted outreach and engagement to hard-to-reach communities, interested parties, and stakeholders that were previously underrepresented in other engagement activities. This included outreach to the following stakeholder types:

- *Agricultural Interests:* Agricultural stakeholders in the Subbasin include agricultural well operators, growers, ranchers, farmworkers, and agricultural landowners. Strong agricultural representation exists within the leadership of the GSAs. To augment direct outreach being conducted by individuals GSAs, Subbasin representatives also coordinated closely with local county farm bureaus to disseminate information related to GSP development and public workshops.

- *School Districts:* Schools districts are considered for both beneficial users of groundwater (for drinking water), as well communication channels to disseminate information about SGMA and GSP development. GSA representatives directly contacted local school districts to notify them of the public workshops. Some schools also help distributed informational materials and workshop flyers to their students and parents.

- *Disadvantaged Communities:* The GSAs followed best practices identified in Collaborating for Success: Stakeholder Engagement for Sustainable Groundwater Management Act Implementation (Community Water Center, 2015) and other guidance documents to engage disadvantaged and severely disadvantaged communities. This included holding meetings in disadvantaged communities; holding meetings in the evening at known local venues, such as schools, civic centers, and community centers; translating fact sheets, meeting materials, and presentations into other languages; and providing interpreting services at all public workshops.

5. GSP Implementation

Legal Requirements:

> **§ 354.10(b)(4): The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.**

Each GSA will utilize its own methods to inform the public about progress implementing its GSP and the status of any projects and management actions. The Subbasin website will continue to be the main source of information for Subbasin- wide announcements, public meetings, workshops, and informational materials. In addition, the GSAs will continue to coordinate public outreach and stakeholder engagement activities related to GSP implementation as-needed.

Attachments: Attachment A - Delta-Mendota Subbasin Sustainable Groundwater Management Act Communications Plan Attachment B – Coordinated Public Workshop Summaries
Attachment C – Example Public Workshop Promotion Materials
Attachment D – Stakeholder and Community Organizations Contacted Regarding Coordinated SGMA Workshops

ATTACHMENT A. DELTA-MENDOTA SUBBASIN SUSTAINABLE GROUNDWATER MANAGEMENT ACT COMMUNICATIONS PLAN



Delta Mendota Subbasin Groundwater Management

Sustainable Groundwater Management Act Communications Plan

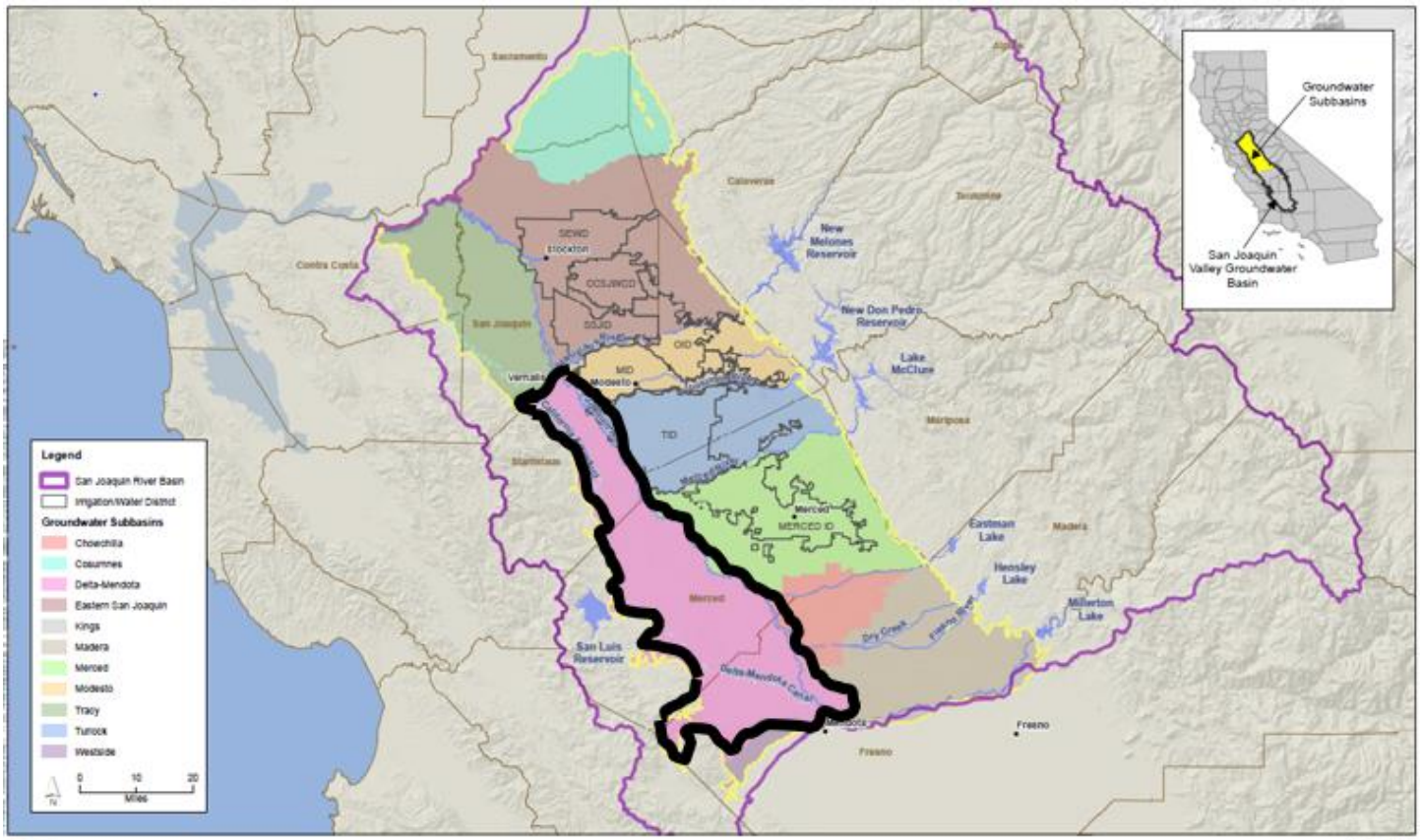


Figure 9-1
Vicinity Map of Groundwater Subbasins

Prepared by:
Lisa Beutler, MWH/Stantec,
Via CA Dept. of Water Resources,
Facilitation Services Technical Assistance

June 2017

Forward: How to use this Plan

This Communication Plan provides a high-level overview of near and long-term outreach and engagement strategies, tactics and tools. Its purpose is to assist the Groundwater Sustainability Agencies (GSAs) of the Delta Mendota Subbasin with stakeholder outreach and other related actions as required by the Sustainable Groundwater Management Act (SGMA) of 2014. It is presented as a working public draft, and should be considered a living document that is continuously refined and updated as circumstances suggest.

Chapter 1*: Introduction and Background* provides text and information about SGMA and the Delta Mendota Subbasin that can be repurposed directly into websites or printed materials by agencies and/or entities with an interest in SGMA and how it will affect the subbasin. This section also describes the communications activities mandated by SGMA.

Chapter 2: *Communications Plan Overview* provides communications planning goals and objectives as well as the scope. This section can be used in support of project management activities.

Chapter 3: *Situation Assessment* provides some of the context for communications activities. This section can be used in developing required assessments of stakeholder issues and interests. It also informs project management activities.

Chapter 4: *Audiences and Messages* identifies key subbasin audiences and message points for specific audience segments. The goal of this chapter is to provide information that can be used by the subbasin GSAs in preparing to work with key stakeholders.

Chapter 5: *Risk Management* is the summary of a communications risk assessment that considers subbasin communications strengths and weakness and proposes on-going adjustments based on best communication management practices. This section informs project management activities and provides a context for some of the recommended communications tactics.

Chapter 6: *Tactical Approaches* offers a communications to do list with specific communications activities relevant for project phases and subbasin audiences.

Chapter 7: *Measurements and Evaluation* outlines methods to determine the effectiveness of outreach and engagement.

Chapter 8: *Roles and Responsibilities* provides a sample list of tasks and illustrates the types of communications roles and responsibilities which might be assigned. This section should be incorporated into project management plans.

Subbasin GSAs should feel free to repurpose any or all parts of the document that will assist them in meeting SGMA requirements.

This document was developed with technical support provided by the California Department of Water Resources' (DWR) SGMA Facilitation Support Services Program and completed by the Communication and Engagement Group of MWH/Stantec.

Delta Mendota Subbasin
Sustainable Groundwater Management Act
Communications Plan
Working Draft

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List of Acronyms and Abbreviations

Item	Description
Basin	Groundwater Basin or Subbasin
Coms Plan	Delta Mendota Subbasin, Sustainable Groundwater Management Act, Working Draft Communications Plan
CSD	Community Service District(s):
CV-SALTS	Central Valley Salinity Alternatives for Long-Term Sustainability
DAC	Disadvantaged Communities
DMC	Delta-Mendota Canal
DWR	California Department of Water Resources
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
IRWMP	Integrated Resource Water Management Plan
PDF	Portable Document Format
RCD	Resource Conservation District(s)
SGMA	Sustainable Groundwater Management Act
SLDMWA	San Luis Delta- Mendota Water Authority
State Board	State Water Resources Control Board

Item	Description
SA	Situation Assessment
USGS	United States Geological Survey

Revision History

Table 1. Revision History

Revision History			
Revision/Dock Title #	Date of Release	Author	Summary of Changes

INTRODUCTION AND BACKGROUND

The purpose of this Communication Plan is to assist the Groundwater Sustainability Agencies (GSAs) of the Delta Mendota Subbasin with stakeholder outreach and other related actions as required by the Sustainable Groundwater Management Act (SGMA) of 2014. Its chapters identify key stakeholders and provide a high-level overview of near and long-term outreach and engagement strategies, tactics and tools. The plan was developed with technical support provided by the California Department of Water Resources' (DWR) SGMA Facilitation Support Services Program.

1.1. SGMA Basics[1]

After decades of debate, in 2014 California lawmakers adopted SGMA. This far-reaching law seeks to bring the State's critically important groundwater basins into a sustainable regime of pumping and recharge. The change in water management laws has created new obligations for residents and water managers in the Delta-Mendota Groundwater Subbasin. The San Luis Delta- Mendota Water Authority (SLDMWA) is assisting its members in implementation of this law.



SGMA requires, **by June 30, 2017**, the formation of locally-controlled GSAs in many of the State's groundwater basins and subbasins (basins). A GSA is responsible for developing and implementing a **groundwater sustainability plan** (GSP). These plans assist the basins in meeting sustainability goals. The primary goal is to maintain sustainable yields without causing undesirable results.

1.1.1. GSAs & GSPs

Any local public agency that has water supply, water management, or land use responsibilities in a basin can decide to become a GSA. A single local agency can decide to become a GSA, or a combination of local agencies can decide to form a GSA by using either a Joint Power Authority (JPA), a memorandum of agreement (MOA), or other legal agreement. If no agency assumes this role the GSA responsibility defaults to the County; however, the County may decline.

A GSP may be any of the following *(Water Code § 10727(b)):*

- A single plan covering the entire basin developed and implemented by one GSA.
- A single plan covering the entire basin developed and implemented by multiple GSAs.

[1] Sections on SGMA are largely drawn, in whole or in part, from publicly available materials from the Department of Water Resources. For more see: http://www.water.ca.gov/groundwater/sgm

- Subject to Water Code Section 10727.6, multiple plans implemented by multiple GSAs and coordinated pursuant to a single coordination agreement that covers the entire basin.

If local agencies are unable to form an approved GSA and/or prepare an approved GSP in the required timeframe, then the basin or subbasin would be considered unmanaged. Unmanaged groundwater basins and subbasins are subject to State Water Resources Control Board (State Board) oversight. This is true even if the vast majority of the subbasin is covered by a plan. Should intervention occur, the State Board is authorized to recover its costs from the GSAs.

1.2. SGMA Communications and Engagement Requirements

SGMA includes specific requirements for communications and engagement by each planning phase. **Figure 1** (next page) illustrates the requirements and provides water code references. The GSP submittal guidelines also describe the outreach and engagement documentation to be submitted with the plan. **Table 2** describes the submittal requirements. A full list of codes and requirements is also provided in **Appendix 1**.

Table 2. GSP Submittal Requirements[2]

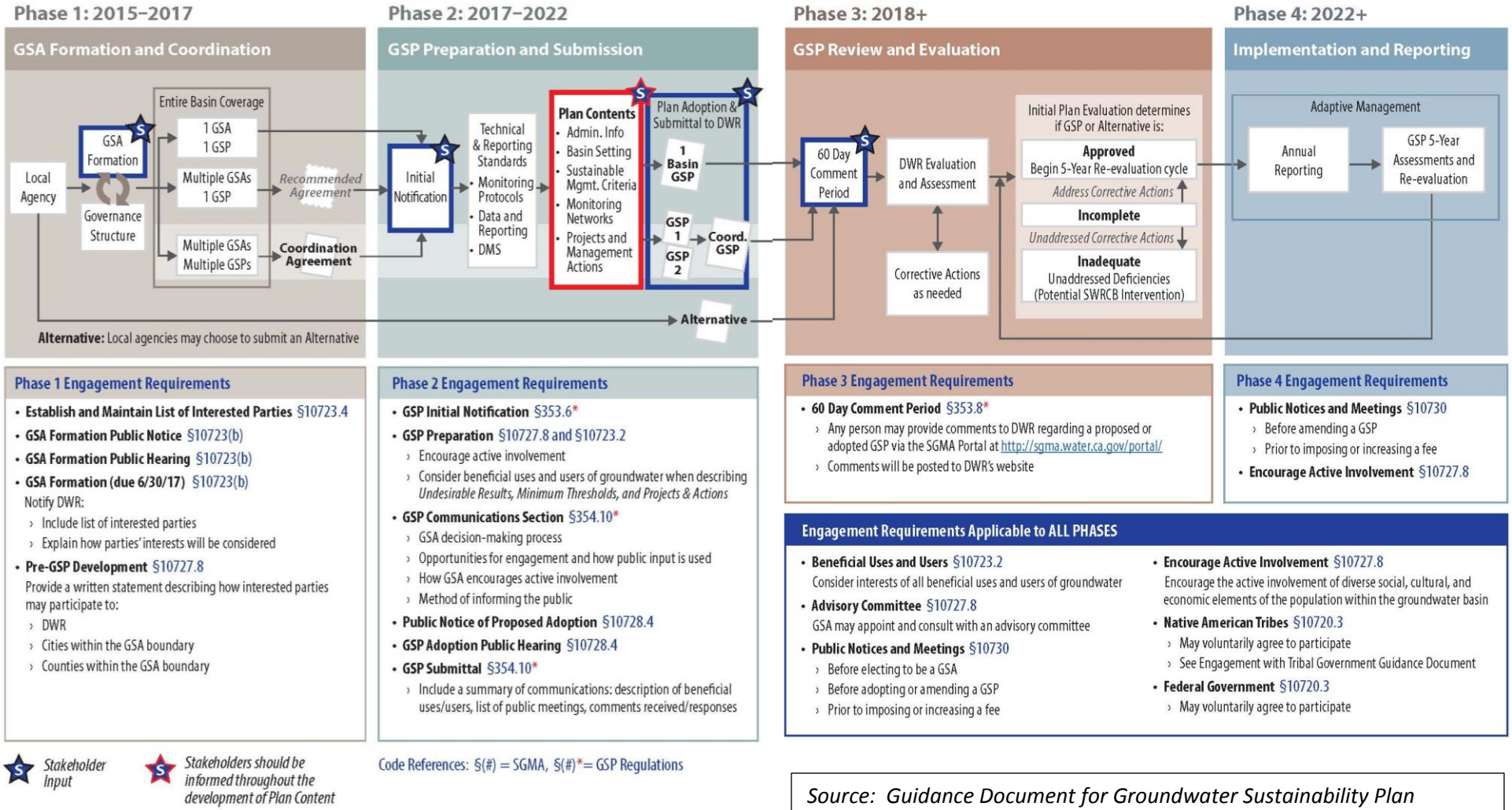
GSP Regulations Section	Requirement	Description
Article 5. Plan Contents, Sub-article 1. Administrative Information		
354.10	Notice and Communication	• Description of beneficial uses and users • List of public meetings with dates • GSP comments and responses • Decision-making process • Public engagement process • Method(s) to encouraging active involvement • Steps to inform the public on GSP implementation progress

1.3. Planning Approach

While the SLDMWA is assisting with the coordination of GSP(s) development, this Communications Plan (Coms Plan) is offered for the voluntary use of all of the GSAs of the Delta-Mendota Subbasin. A full Coms Plan schedule should be developed in conjunction with the overall GSP(s) development schedule. One additional option is for the Coordination Committee of GSAs to provide overall communications guidance. This could potentially be included in a section of the Coordination Agreement.

[2] Guidance Document for the Sustainable Management of Groundwater, Preparation Checklist for GSP Submittal, Department of Water Resources, December 2016

Figure 1. Stakeholder Engagement Requirements



Source: Guidance Document for Groundwater Sustainability Plan Stakeholder Communication and Engagement Department of Water Resources, June 2017

An important additional step will be establishing, in conjunction with the multiple GSAs, the roles and responsibilities for implementing the Coms Plan.

1.4. SGMA and the Delta Mendota Subbasin[3]

The Delta-Mendota Subbasin of the San Joaquin Valley Groundwater Basin is a long, relatively narrow groundwater basin that covers portions of five counties, from north to south, San Joaquin, Stanislaus, Merced, Madera and Fresno Counties (see **Figure 2**). The Delta-Mendota sub-basin is bounded on the west by the Tertiary and older marine sediments of the Coast Ranges. The northern boundary (from west to east) begins on the west by following the Stanislaus/San Joaquin County line, then deviates to the north to encapsulate all of the Del Puerto Water District before returning back to the Stanislaus/San Joaquin County line. The boundary continues east then deviates north again to encapsulate all of the West Stanislaus Irrigation District before returning back to the Stanislaus/San Joaquin County line. The boundary continues to follow the Stanislaus/San Joaquin County line east until it intersects with the San Joaquin River.

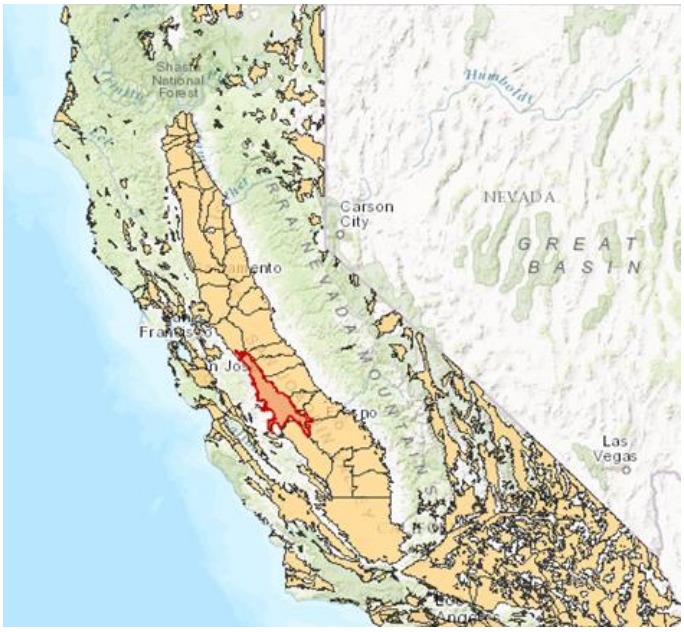


Figure 2. Delta Mendota Subbasin

The eastern boundary (from north to south) follows the San Joaquin River to within Township 11S, where it jogs eastward along the northern boundary of Columbia Canal Company and then follows the eastern boundary of Columbia Canal company until intersecting the northern boundary of the Aliso Water District. The boundary then heads east following the northern and then eastern boundary of the Aliso Water District until intersecting the Madera/Fresno County line. The boundary then heads westerly following the Madera/Fresno County line to the eastern boundary of the Farmers Water District. The boundary then heads southerly along the eastern boundary of the Farmers Water District, and continues southerly along the section line to the intersection with the northern right-of-way of the railroad. The boundary then heads east along the northern right-of-way of the railroad until intersecting with the western boundary of the Mid-Valley Water District. The boundary then heads south along the western boundary of the Mid-Valley Water District to the intersection with the northern boundary of Reclamation District 1606. The boundary then heads west and then south following the boundary of Reclamation District 1606 and James Irrigation District until its intersection with the Westlands Water District boundary.

The southern boundary (from east to west) matches the northerly boundaries of Westlands Water District legal jurisdictional boundary last revised in 2006. The boundary then

[3] Information related to the Delta Mendota subbasin is drawn directly from http://sgma.water.ca.gov/basinmod/basinrequest/preview/23.

proceeds west along the southernmost boundary of the San Luis Water District. The boundary then projects westward from this alignment until intersecting the Delta-Mendota sub-basin Western boundary described above.

1.5. Delta-Mendota Subbasin GSP Planning

The GSAs of the Delta-Mendota Subbasin intend to work together to meet Sustainable Groundwater Management Act (SGMA) requirements and prepare a Groundwater Sustainability Plan (GSP) or coordinated Sustainability Plans by June 31, 2020. The San Luis Delta- Mendota Water Authority (SLDMWA) is assisting its members and non-members in planning and implementation of this law and has been directly assisting a subset of the local GSA eligible agencies in organizing to accomplish required SGMA tasks. The SLDMWA has also hosted informal, information meetings with all of the subbasin GSAs.

While SLDMWA coordinated GSAs are confident in their ability to prepare a GSP for the areas under their jurisdiction, SGMA requires that an approved GSP or multiple coordinated GSPs are in place to provide sustainable management for the entire subbasin. The identified GSAs have been asked to determine how they wish to proceed in individual GSP development or a coordinated single GSP by July 2017 and whether or not they wish to participate in the Prop 1 Sustainable Groundwater Planning Grant as a joint request.

1.6. Delta Mendota Subbasin GSAs

Following are the DWR identified agencies (as of June 15, 2017).[4]

1. Aliso Water District
2. Central Delta-Mendota Region Multi-Agency GSA
3. City of Dos Palos
4. City of Firebaugh
5. City of Gustine
6. City of Los Baños
7. City of Mendota
8. City of Newman
9. City of Patterson
10. County of Madera—3
11. DM-II
12. Farmers Water District
13. Fresno County—Management Area 'A'
14. Fresno County—Management Area 'B'
15. Grasslands Groundwater Sustainability Agency
16. Merced County—Delta-Mendota

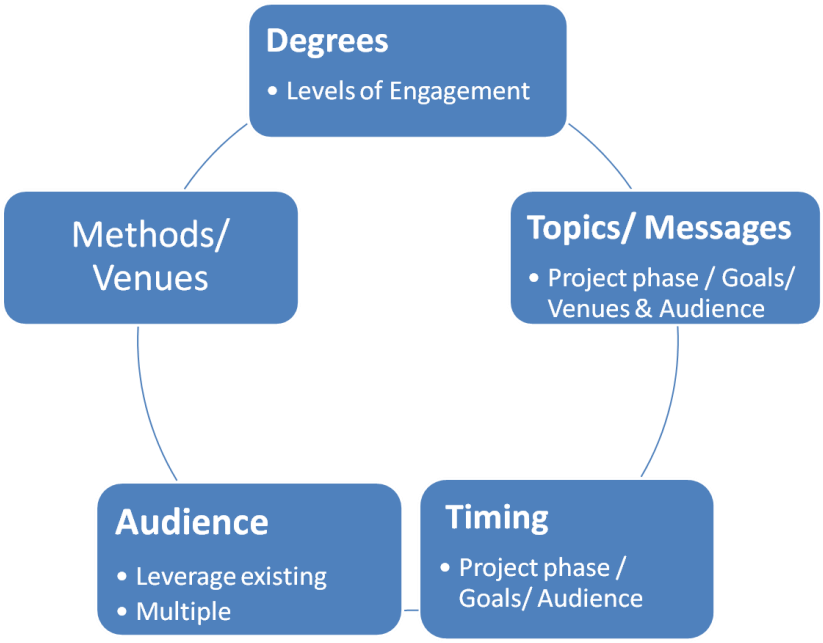
[4] See: http://sgma.water.ca.gov/portal/

17. Northwestern Delta-Mendota GSA
18. Ora Loma Water District
19. Patterson Irrigation District
20. San Joaquin River Exchange Contractors Water Authority
21. Turner Island Water District-2
22. West Stanislaus Irrigation District GSA
23. Widren Water District GSA

COMMUNICATIONS PLAN OVERVIEW

Communication is the process of transmitting ideas and information. According to the Project Management Institute, 75%-90% of a project manager's time is spent communicating. A Coms Plan provides the purpose, method, messages, timing, intensity, and audience of the communication, then describes who will do the communicating, and the frequency of the communication (see **Figure 3**.)

Figure 3. Elements of a Communications Plan



2.1. Purpose

The purpose of the Delta-Mendota Subbasin, Sustainable Groundwater Management Act, Coms Plan is to outline the information and communications needs of the project stakeholders and provide a roadmap to meet them. The Coms Plan then identifies how communications activities, processes, and procedures will be managed throughout the project life cycle.

2.2. Importance

While communications are important in every project, a well-executed communications strategy will be essential to the success of the GSP(s) development and adoption process. The financial and regulatory stakes are high and communication missteps can create project risks. Further, development of a viable GSP(s) will require an on-going collaboration among all the stakeholders, both organizational and external. The plan will be comprehensive and consider multiple variables, a range of system elements and project costs and benefits. Stakeholder input will be needed to refine GSP requirements and fully

define the water management system, and potential impacts, costs and benefits that may result in managing for sustainability.

2.3. Scope

The plan focuses on formal communication elements. Other communication channels exist on informal levels and enhance those discussed within this plan. This plan is not intended to limit, but to enhance communication practices. Open, ongoing communication between stakeholders is critical to the success of the project.

2.4. Communications Goal

Development, adoption and implementation of the GSP(s) will require basin external stakeholders, other agencies, staff, managers, and the multiple GSA Boards to evaluate choices, make decisions and commit resources.

The core communications goal is to plan for and efficiently deliver clear and succinct information:

- At the right time
- To the right people
- With a resonating message

This is done to facilitate quality decision making and build accompanying public support

2.5. Communications Objectives

The Coms Plan Objectives are to present strategies and actions that are:

- Realistic and action-oriented
- Specific and measurable
- Minimal in number (a few well delivered are better than many mediocre efforts)
- Audience relevant

2.6. Strategic Approach

Three primary communications strategies have been identified for the GSP(s) development.

1) Fully leverage the activities of existing groups. This practical approach is cost effective and respectful of the limited time that stakeholders have to participate in collaborative processes.
2) Provide targeted, communications and outreach to opinion leaders in key stakeholder segments.
3) Provide user friendly information and intermittent opportunities through existing communication channels and open houses or workshops to allow interested stakeholders (internal and external) to engage commensurate with their degree of interest.

2.7. Communications Governance, Communications Team

Given the relatively large number of stakeholders, a recommendation for coordinated efforts, and the legal requirements for outreach[5], some form of communications governance is recommended. Several governance options for consideration are offered in Appendix 2. The actual form of the governance is less important than a clear understanding of the roles and responsibilities of those responsible for ensuring required communication. For the purpose of this document, an assumption is made that some form of governance will be identified and a communications team (which may be an individual or multiple individuals, and/or include the project consultants) is designated.

A driving consideration for this recommendation is the level of effort associated with required activities and the fact that communications are highly time dependent. That means that communications activities should be occurring that may happen outside of regularly scheduled GSA meetings. In this case delegation with guidance is efficient and effective.

2.8. Constraints

All projects are subject to limitations and constraints as they must be within scope and adhere to budget, scheduling, and resource requirements. These constraints can be even more challenging in projects with multiple agencies as will be the case with the development and coordination of multiple GSPs.

There are also legislative, regulatory, technology, and other organizational policy requirements which must be followed as part of communications management. These limitations must be clearly understood and communicated where appropriate. While communications management is arguably one of the most important aspects of project management, it must be done in an effective and strategic manner recognizing and balancing the multiple constraints.

All project communication activities should occur within the project's approved budget, schedule, and resource allocations. The GSP(s) project managers and the leadership of the participating GSAs should have identified roles in ensuring that communication activities are performed.

To the extent possible, to support collaboration and reduce costs, GSP(s) partners should utilize standardized formats and templates as well as project file management and collaboration tools.

[5] See Appendix 1

SITUATION ASSESSMENT

3.1. *Introduction*

The challenges of asking a community to make changes in how things are done, or forging an agreement among multiple parties are often large. Prior to preparing a Coms Plan, a neutral, 3rd party facilitator conducted a stakeholder Situation Assessment (SA).

The facilitator's role was to provide an independent evaluation of potential stakeholder's interest in coordination and governance for GSA formation and GSP development and identify any barriers or concerns that would need to be addressed for the GSA formation process and GSP(s) development to be successful.

3.2. *Situation Assessments*

An SA is an information-gathering process that informs outreach, engagement and collaboration. As part of preparing the basin communication's process, it was important to know more about:

- Stakeholder Categories
- Opinion leaders
- Regulatory and political context
- Advocates and detractors
- Attitudes and knowledge
- Other elements useful to the crafting of decisions

An assessment is also a low risk approach to education and signaling a future relationship. It facilitates the community's appraisal of its needs, wants and values. A well-crafted assessment sets the stage for the parties to better understand and interpret their situation so that they can make informed decisions for actions, in the short term and for the future.

The Delta-Mendota subbasin SA included background research and interviews. Interviews were usually with individuals but in a few cases a very small group was convened. To encourage candor, the results of the input process were bundled so those interviewed were not individually identified unless they explicitly indicated they wished to share their individual response.

3.3. *Background Research*

The facilitator worked closely with the SLDMWA and DWR to identify useful documents, plans and activities that might inform the overall communications planning process.

3.4. *Interviews and Consultations*

Using information gathered during the background research and similar GSA formation efforts throughout the state, the facilitator worked with the SLDMWA to craft interview questions. The facilitator also provided some selection criteria to the SLDWMA to help identify a representative group of interview candidates. Once selected, the SLDMWA staff and facilitation team invited the interviewees to participate. In addition to full interviews,

additional calls and in person communications were conducted to acquire amplifying information. **Figure 4** provides a quick overview.

Figure 4. Interview and Consultation Quick Facts



Selected participants were all engaged or otherwise stakeholders in some aspect of the basin GSA development process.

A project background sheet was provided in advance of each formal interview and used again during the interviewee discussions with the facilitator. Each interview followed the same format and included 16-18 questions (depending on whether or not a follow-up question was needed).

The questions covered the following topics pertaining to the GSA formations and GSP(s) development:

1. Overarching perspectives from each key stakeholder on general groundwater conditions, GSA governance; subbasin management and associated SGMA compliance
2. Preferred methods to achieve groundwater sustainability consistent with SGMA requirements
3. The level of agreement/conflict around groundwater governance across the range of stakeholder perspectives
4. Experience with facilitated processes, outreach and engagement, and the goals for such support
5. Potential configurations of governance and formations of GSAs and GSP development

3.5. *Summary of key findings*

Interview results indicate an overall positive environment for the project and project communications; however, the effort will require interactions of a large number of parties and planning for an extremely complex system. Following are the reflections, ideas and suggestions of those contacted.

3.5.1. Related to Groundwater Sources and Trends

- *Significant observed impacts associated with Weather, Water Project Deliveries and Cropping Patterns* – Participants observed a declining

groundwater situation and were able to attribute it to drought and weather (particularly timing of seasonal rainfall and periods of prolonged, higher temperatures), conversion to permanent crops, and significant changes in access to surface water.

- *Surface & Groundwater Nexus* – As noted in comments related to access to surface water, there was a clear understanding of the surface/groundwater nexus. Many believed that any realistic solution would have to include a full assessment of the region's surface water future.

- *Extremely Complex Systems* – Many of those interviewed reported that parts of the subbasin were doing fine and could, with good management, be sustainable. They described problems as being primarily in pockets of the subbasin. They also characterized some parts of the subbasin as not being managed sustainably and indicated that they believe this would have continued had SGMA not passed. While it was generally agreed that it would have been better if SGMA was not driving the change, they felt change would not occur without something like SGMA. Several of the participants were able to describe specific locations and situations that illustrated this.

  Issues related to operations of the Bureau of Reclamation, the Delta-Mendota Canal (DMC), the Mendota Pool and restoration activities are of keen interest to all the stakeholders. Everyone was familiar with issues of subsidence and with the facts and figures represented in graphics like those in **Figure 5**, prepared by the United States Geological Survey (USGS).[6]

  Many perceived that groundwater supplies for municipal uses in some parts of the basin were at risk.

- *Historic Rights and Arrangements* – Access to surface water is based on numerous historic rights and agreements as well as more contemporary agreements. As such there is no **single** description of the status of surface water availability among the many subbasin GSAs,[7] although there is a strong understanding of the rights and arrangements that do exist.[8]

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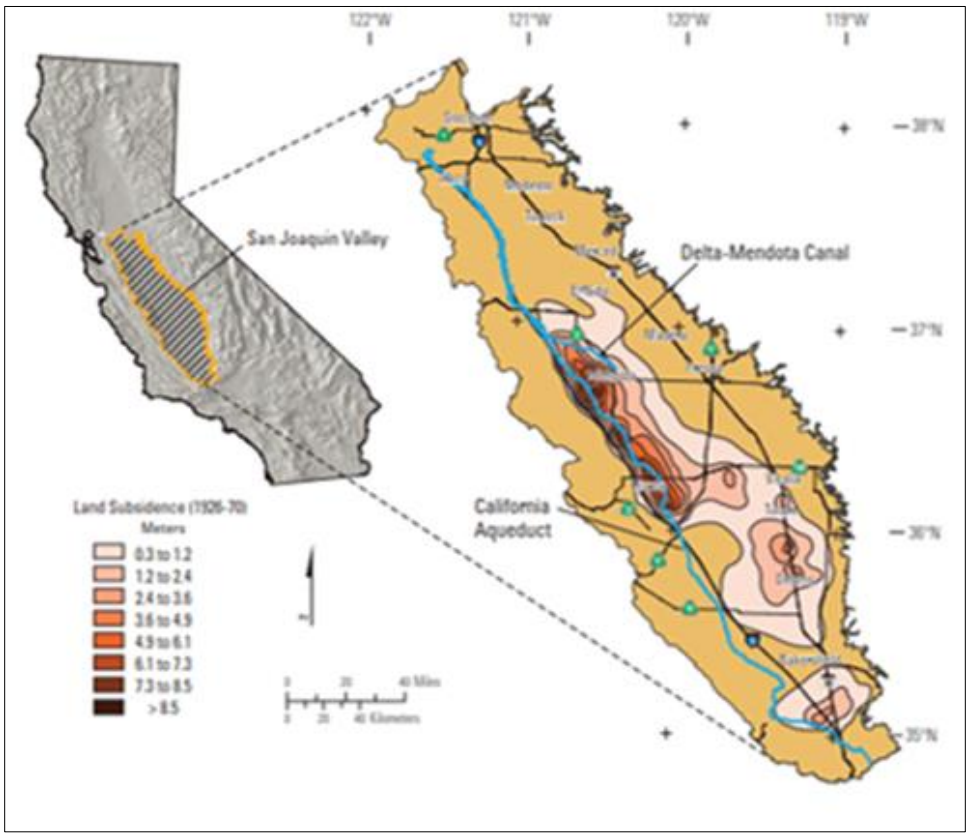
[6] U.S. Department of the Interior | U.S. Geological Survey: https://ca.water.usgs.gov/projects/central-valley/delta-mendota-canal.html, Page Last Modified: Monday, 20-Mar-2017 22:39:47 EDT

[7] A full inventory of water rights and arrangements for the subbasin GSAs is recommended to be prepared as part of the GSP planning process.

[8] In 2010 there were 1,403 water rights claimed in the San Joaquin Delta watershed, the largest number of any watershed in the State. [Source: Associated Press: Original data source is State Water Resources Control Board eWRIMS, Database

Figure 5. USGS Illustration of the DMC and Subsidence



The hierarchy of water rights as well as laws related to groundwater rights will be a significant factor in GSP negotiations.

Another historical factor related to sustainability is the character of land ownership. There was a perceived difference in the values placed on sustainability by multi-generational family farms versus investor driven agriculture and/or water development.

3.5.2. Related to GSA Governance; Subbasin Management and SGMA Compliance

- *Numbers* - The subbasin includes numerous Water Agencies (35) and other potential GSA eligible agencies including Cities and Counties (such as Dos Palos, Firebaugh, Gustine, Los Baños, Mendota, Newman, Patterson, Fresno, Madera, Merced, San Joaquin, and Stanislaus) and Community Service Districts (CSDs) including among others Grayson, Westley, and Volta, as well as multiple Resource Conservation Districts (RCDs) that for the most part were within the general boundaries of other GSA eligible authorities (Panoche, Poso and Grasslands as an example).

  By the June 30, 2017 filing deadline, 23 eligible entities had formally filed GSA formations and met SGMA requirements for subbasin coverage.

Even with this large number of GSA entities, during the SA interviews and in a follow-up survey, most agencies indicated a preference for a reduced number of GSPs and potentially just one or two.

At the time of this assessment there was not a full understanding of all of the potential requirements of being a GSA and ultimately what might be required to prepare a compliant GSP.

Table 3. Number of Subbasin Public Water Agencies

Number of Public Water Agencies		
• Merced County	• Foothill WD	• Panoche WD
• Fresno County	• Fresno Slough WD	• Patterson WD
• Broadview WD	• Grasslands WD	• Romero WD
• Centinella WD	• Hospital WD	• Salado WD
• Central California ID,	• Kern Canon WD	• San Luis Canal Company
• Davis WD	• Laguna WD	• San Luis WD
• Del Puerto WD	• Mercy Springs WD	• Santa Nella C.WD
• Eagle Field WD	• Mustang WD	• Sunflower WD
• El Solyo WD	• Oak Flat WD	• Tranquility ID
• Farmers WD	• Orestimba WD	• West Stanislaus ID
• Firebaugh Canal WD	• Oro Loma WD	• Widren WD
	• Pacheco WD	• Quinto WD

At the time of this assessment participants did not fully recognize the potential number of stakeholders and/or the requirements to conduct outreach.

- *Subbasin Governance Structures* – Many individuals and entities within the subbasin have experience working in cooperative governance and related structures. For example, the SLDMWA provides leadership for an Integrated Resource Water Management Plan (IRWMP) illustrated in **Figure 6**[9] on the following page. Many of the stakeholders are also involved with Irrigated Lands Coalitions (see **Figure 7**).[10]

  Likewise, many are also involved in efforts related to the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) initiative (see **Figure 8**).

[9] Source : San Luis & Delta-Mendota Water Authority, Westside-San Joaquin Integrated Water Resources Plan, July 2014

[10] Source: Central Valley Regional Water Resources Control Board

Existing Cooperative / Collaborative Governance Structures with Delta Mendota Subbasin Stakeholders

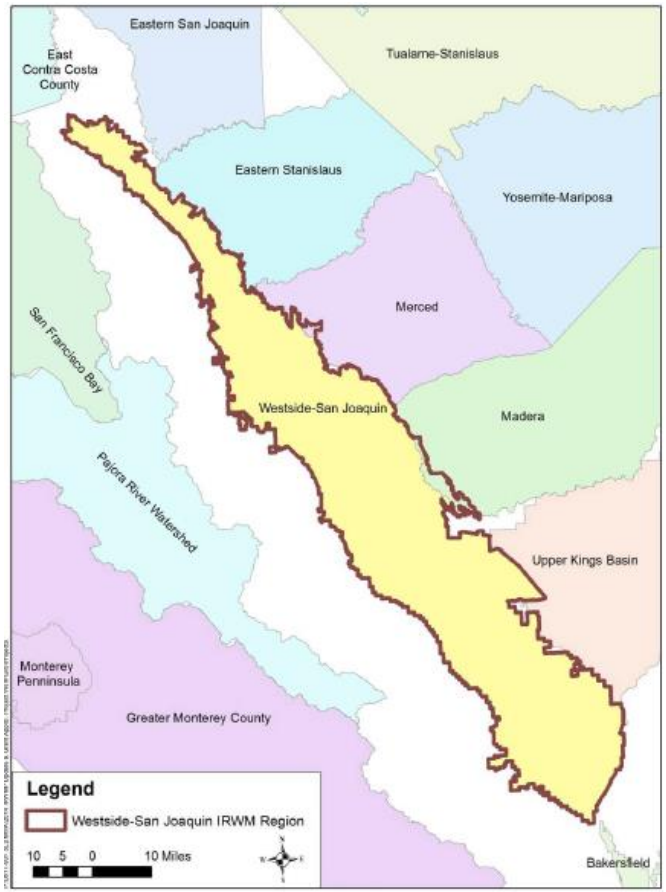


Figure 6. Integrated Regional Water Management Groups

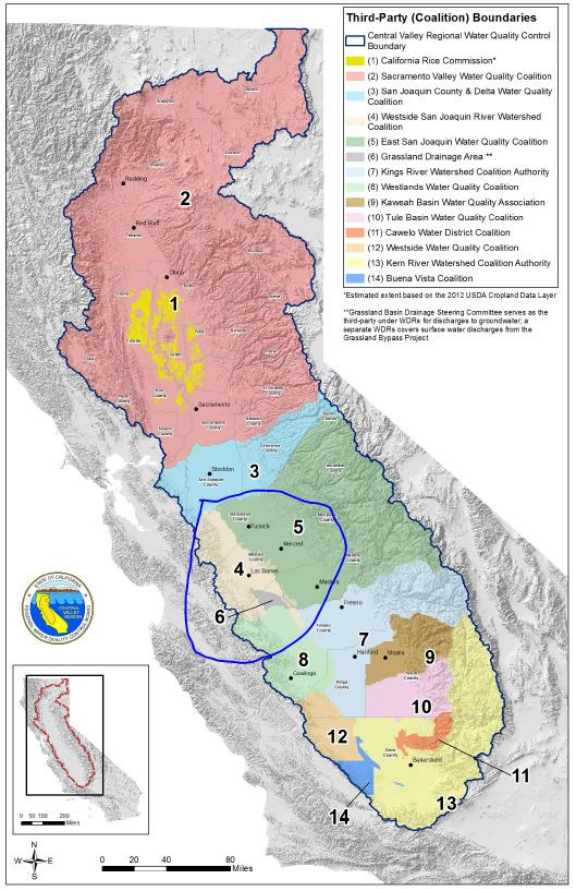


Figure 7. Irrigated Lands Coalitions

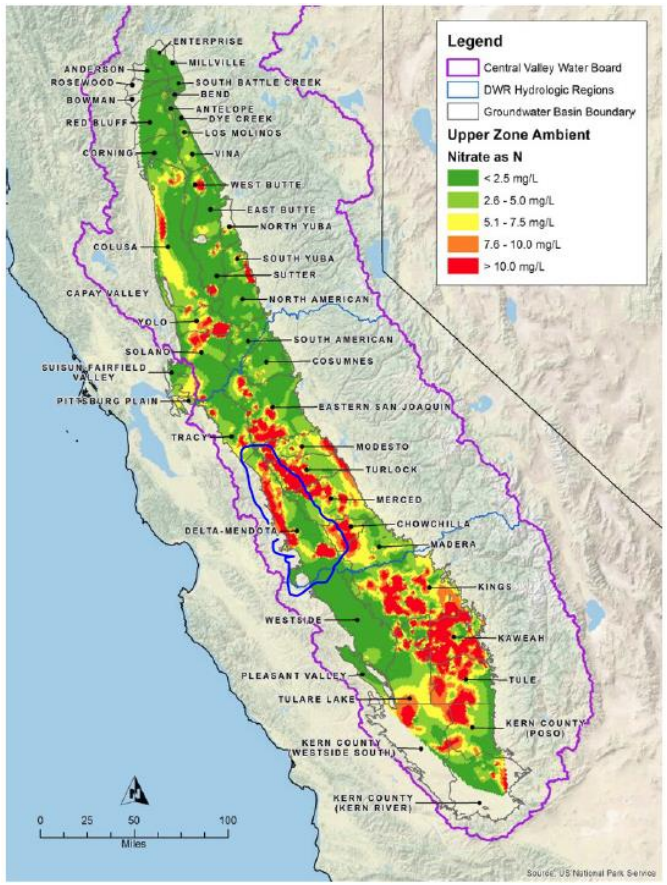


Figure 8. CV-Salts Initiative

CV-Salts was launched to develop sustainable salinity and nitrate management planning for the Central Valley. (See **Figure 8**.[11])

Finally, there are multiple arrangements in place related to surface water transfers and other previous groundwater management planning efforts.

Experience with these programs has created a capacity for collaborative planning that will be essential for GSP development. It also creates opportunities to access and leverage existing stakeholder meetings and events rather than needing to convene multiple new stakeholder processes.

3.5.3. Issues to be Addressed in Creating a Sustainability Plan

Some of the participants indicated they had an extremely good understanding of their section of the subbasin, with exact and extensive records to support their perspective. They found that making projections using historical data had been more reliable than some of the groundwater models that were in use.

In thinking about development of a GSP they felt there could be some difficulty in developing water balances due to lack of quality data for some locations. Another mild concern was the potential for disagreements about the selection of a groundwater model(s) or reconciling differences among methods.

Still another concern was the capacity of the GSAs and/or GSA members to fully participate. Some of these agencies are very lightly staffed and have varying levels of knowledge related to groundwater management. All of the participants had significant other duties prior to the passage of SGMA.

One concern, expressed after completion of the assessment, was the potential for some agencies to simply opt out of participating in the development of a GSP but still receive the benefits of the region having an approved plan without having contributed to the larger good of the subbasin.

3.5.4. Representation

The State Board lists the following as Required Interested Parties for the purpose of SGMA outreach:

- All Groundwater Users
- Holders of Overlying Rights (agriculture and domestic)
- Municipal Well Operators and Public Water Systems
- Tribes
- Counties
- Planning Departments /Land Use
- Local Landowners
- Disadvantaged communities
- Business

[11] Ibid



- Federal Government
- Environmental Uses
- Surface Water Users (if connection between surface and ground water)

All of these stakeholder categories were contacted in the interview process excepting tribes. In the case of tribes, there are no classified tribal lands in the Delta-Mendota subbasin, therefore no planning, outreach or communication needs are currently anticipated for tribes.

Due to subbasin characteristics, a primary focus of the assessment was on agricultural, disadvantaged communities (DACs) and municipal groundwater users.



- *Related to Agricultural Representation* - most respondents believed that the elected leadership of the GSA agencies would do a good job in representing agriculture and noted that many of them were growers themselves. It was also noted that farmers were busy and would be far more interested in any specifics of a GSP that would impact operations or the degree of certainty about water availability than the particulars of GSA governance.

- *Regarding DACs* - Much of the subbasin and its counties (San Joaquin, Stanislaus, Merced, and Fresno) have communities that meet the DAC definition and the region is generally considered disadvantaged. The ability of DACs to participate in GSP development was considered limited and it was thought that there would be a need for specific and direct outreach to DACs through elected leadership and via use of trusted community advocates. As part of the SA, several of those interviewed identified themselves as being able to represent a DAC perspective and one in particular was particularly concerned about the availability of Spanish language materials. As a result, Spanish language materials were included in the meeting materials of the public GSA adoption meetings and the SLDMWA provided a fluent Spanish speaker to assist with meetings.

  In the past, to promote DAC identification and involvement, the Westside-San Joaquin IRWM previously conducted an extensive survey of private and public community representatives to educate and encourage understanding of the IRWM process, to help understand the issues confronted by DACs, and to

better address the needs of minority and/or low-income communities. This effort resulted in identification of DACs in the Region and an initial list of 22 projects that would benefit DACs and low-income communities. Given known constraints on this community it is recommended that more focused DAC outreach should be coordinated with the IRWM. This effort is now in progress.

- *Regarding Municipals* - The SA outreach also included interviewing Municipal Stakeholders. A significant number of the Cities are fully dependent on wells for water supply and issues related groundwater management are of grave concern. These representatives all felt that even while it would be difficult to make time to participate in GSAs and GSP development, that they must make the time. Many had also determined that they wished to form their own GSA to reflect their specific interests in any kind of broader GSP negotiation.

- *Regarding Environmental Interests* - There appeared to be a less defined stakeholder segment representing traditional, environmentally focused issues. Outreach was made to subbasin government agencies that often serve as a surrogate for these interests and an informal consultation occurred with a representative of the Planning and Conservation League to identify any known, active stakeholders. However, no specific entity or individual was identified by those contacted. A general perception was that this community would desire engagement and would designate representatives if the GSP development was thought to potentially impact existing restoration or other environmental concerns but the formation of GSAs per-se, was of less interest. The next phase of communications should include outreach to organizations such as Audubon, the Nature Conservancy and Ducks Unlimited just to ensure due diligence. These connections will be important going forward, particularly if environmental issues are identified.

- *Regarding Industrial Users* – The region includes some industrial water users. This sector has a relatively lower percent of water use compared to other subbasins users; however, representatives of the sector pointed out how essential access to water was to their industry. The interviewees also emphasized how important these industries were to the local economies. There was a stated concern about representation since there didn't appear to be a direct way to engage, particularly with multiple GSAs being formed.





- *Regarding Counties & Planning Agencies* – All of the subbasin counties have designated representatives and all are assisting with GSA coverage for areas not otherwise covered by a GSA. All of the city and county representatives had direct engagement with the planning arms of their jurisdictions, or were staff to the planning departments. These representatives, like the municipal representatives, viewed this as critical issue even as it creates new workload for the already busy entities.

3.5.5. Communications and Facilitation Preferences

Participants were asked to describe their communications preferences. Several offered specific suggestions on written materials. Most did not believe there would be a need for a high frequency of communications directly with non-GSA stakeholders.

Several suggested using regularly scheduled activities of existing groups and gatherings to share information rather than creating stand-alone events. They listed annual meetings of the water agencies as one good venue as well as meetings related to the IRWM and Irrigated Lands. Several also thought that it would be good to go to places like Farmers Markets, particularly for the disadvantaged communities, and County Fairs.

Farm Bureau representatives also indicated a willingness to support outreach efforts. The Merced Farm Bureau, in particular, has already helped to advertise public meetings related to GSA formations.

Related to facilitation there was not a broad exposure to professional facilitators among many of the stakeholders. Even so, participants consistently listed qualities such as fairness and transparency, a good understanding of the issues, and confidence as helpful facilitator strengths. There was a sense that the GSAs would not need hand holding but that facilitation could be useful for helping the stakeholders forge decisions and making what many believed would need to be compromises.

3.5.6. Success Factors, Barriers to Success

The participants were asked to describe their view on the odds for success as well as any barriers that would prevent successful completion of a GSP.

Overall, most participants expressed a medium to high likelihood for success. They noted that the carrot (grants and technical support) and stick (significant regulatory intervention) by the State creates a dynamic that is supportive to success.

Participants stated barriers related to the capacity of the GSAs to participate and ultimately agree to, and implement changes. The much diffused governance structure of multiple GSAs amplifies this dilemma as do actions beyond the control of the subbasin entities (such as climate and water deliveries).

In addition to perceived barriers, participants outlined their thoughts on opportunities and success strategies.

- *Drought* – While the drought was unwelcome it increased awareness of the need for changes. Many felt it would be easier to move forward while the topic is prominent in everyone's minds.
- *Short and Long Game* – Several suggested it will be important to have a plan that includes long and short term strategies and activities.
- *Integrated Planning* – Many of the participants emphasized the importance of integrated planning.

3.5.7. Other Comments and Advice

Many participants expressed appreciation for being contacted and invited the facilitator to contact them again if there were questions.

3.6. *Promising messages and methods*

Three primary communications strategies have already been identified for the GSP(s) development:

- Leveraging the activities of existing groups
- Providing targeted, communications and outreach to opinion leaders in key stakeholder segments
- Providing user friendly information and intermittent opportunities for a broader range of stakeholders

The same strategies aligned with the recommendations of the SA participants. These methods will allow stakeholders to engage commensurate with their degree of interest while providing sufficient information to ensure long-term success for plan development and implementation.

AUDIENCES AND MESSAGES

GSA formation and GSP(s) development**,** like most large planning efforts, consists of a broad range of stakeholders with differing interests and influence.

4.1. Two Core Audience Segments

This Coms Plan Anticipates two core audience segments. First is the subbasin GSA Boards and the communications among and between themselves. This audience segment is significant in size given that 23 GSAs will be working to develop a GSP(s) and each GSA has its own Board and audiences.

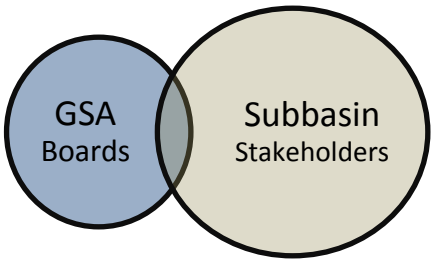


Figure 9. Two Core Audience Segments

The second audience is the subbasin stakeholders as identified in SGMA. This audience is also large. Many of the stakeholders are shared by the GSA Boards and some of the larger stakeholder segments are also represented on the GSA Boards (see **Figure 9**).

Nearly all of the communications strategies apply to both segments; however, some strategies apply to one or the other specifically and are so identified.

4.2. Communications and Change Management

The process of adopting and implementing a GSP will require significant change management. Communications planning should encompass basic change management approaches. Messages should also evolve over time and be tied to the planning process and key decision points. Then, for each audience and each major planning step, communications must do the following:

1. Describe what the actual proposed plan (change) is
2. Articulate how the change will directly impact the category of stakeholder involved
3. Outline the methods that will be used to implement the plan (change)
4. Define the costs and benefits of changing and not changing, and what future conditions will be if change does not occur
5. Consider unintended consequences and others that may also be impacted by the same change then develop a strategy to engage them
6. Offer opportunities for input and for stakeholders and others to improve the approach

The communications requirements for large changes are often underestimated. Some experts indicate that messages may need to be delivered up to 8 different times to be fully absorbed. Communications needs will also evolve as the GSP planning progresses. **Table 4** provides a sample of early communications that focus on SGMA and groundwater basics.

Table 4. Sample – Early Phase Message Elements for Subbasin Stakeholders

Element	What the Change Is	How it will affect the Stakeholder	How the change will be Implemented	Why it is a good idea
Early Phase GSP Development	• Locally governed GSAs will work together to sustainably manage ground water. • The Subbasin /Basin is required to ensure Sustainable Groundwater Management by submitting a sustainability plan by 2020. • The plan must be implemented and found to result in sustainable management by 2040.	(Unique to audience type) • Changes in the current methods of acquiring and utilizing groundwater may occur. • May affect future decisions related to crop types and decisions related to conjunctively using surface water. • May provide additional project resources to the DAC communities.	A collaborative approach is being undertaken to prepare the plan with multiple GSAs coordinating with the SLDMWA as the planning organizer.	• Sustainable and wise use of groundwater allows for the success of future generations and creates greater certainty for today's beneficial users. • Failure to act may result in negative regulatory consequences.

As part of the GSP planning process, the next phase of communications will also need to communicate the requirements for sustainability and how they are achieved in the context of the Delta-Mendota subbasin. Then, communications related to GSP specifics and adoption will require additional outreach, targeted to specific audiences.

4.3. Tied to Decision Making

Communications should also be tightly linked to decision making. For each anticipated decision, stakeholders for that decision should be identified and the following addressed.

1. Who (Is the stakeholder)
    a. An impacted party?
    b. A potential planning partner?
    c. A potential provider of services or resources?
    d. A regulator of the activity?

    (Note: Maybe more than one category.)

2. What (What is the interest of the stakeholder? How will the stakeholder be affected? What are the stakeholders' needs?)
3. Who (Who is the right messenger for the information)
4. How (How should the information be delivered? What are the best methods?)
5. When (What is the appropriate timing for the messages?)
6. Engagement and Knowledge Transfer (How do we create two-way communications?))

Table 5 illustrates some of these ideas.

Table 5. Communications Planning Questions

Who	Interest	Messenger	Delivery	Timing	Knowledge Transfer
• Impacted • Partner • Provider • Regulator	• How will decision affect? • What will stakeholder need?	• Who is a trusted information Source? • How do we ID and Partner	• What are the best delivery methods?	• When should we conduct outreach?	• What do the stakeholders know that we need to know?

4.4. GSA Boards

Due to the multiple subbasin GSAs, specific focus is needed on communications to keep them informed, provide consistent updates and information that the Boards can use in their own outreach, and support their decision making. Primary objectives for communications with the subbasin GSA Boards are to ensure:

- Consistent understanding of the requirements for a GSP and/or GSP coordination
- On-going access to current information
- Timely notice of any significant developments or decision points that may require changes to policies and/or require some other board action
- Confidence that the GSP(s) will be accepted by the GSA's stakeholders

Key communications activities involving the Board include;

1. Providing short and digestible pieces of information to ensure each Board member can quickly articulate to his/her constituents on key matters and remain sufficiently informed so that no decision points are surprises.
2. Provide user-friendly informational materials to be used with public audiences, and will support the Board with their own constituent outreach.
3. Utilize regular Board communications for routine updates and reserve specific Board agenda items for highly significant discussion items.

4.5. Primary Audiences

There are several core stakeholder groups that will require ongoing communications and tailored messaging throughout the planning process. They are:

- Agriculture
- Disadvantaged Communities
- Municipals

Other stakeholders requiring special consideration include:

- Industrial Users/ Business
- Regulators (State and Federal)
- Potential Partners
- Environmental Organizations
- Federal Agencies

While all of the stakeholder types are important to engage for development of a GSP, the first three will be most affected by any changes that might be proposed as a result of the *GSP(s)*.

The following provides an outline of key messages and activities in support of each of the audience types.

4.2.1. Agricultural

Messages about the GSP(s) development should feature the overall desirability of a sustainable management approach how the plan will contribute to management certainty and protect against regulatory oversight.

In thinking about irrigation users it is also important to remember that one size does not fit all.

4.2.2. Disadvantaged Communities

Messages developed for this sector should be tailored and specific to the community. This type of outreach is often best served by use of surrogates and trusted messengers. As identified in the SA, these messages should be aligned with activities of the IRWM, especially given the high, current dependence of many on unsustainable water sources. Messages about ways to access the increased availability of resources due to grant incentives should also be considered.

A specific outreach method to consider relates to the predominance of cells phones within the communities. According to the Pew Research Center, "over 50 percent of low-income households own a smartphone. Smartphone penetration in this demographic creates substantial opportunities for utilities to reach disadvantaged communities with software solutions like customer self-service platforms and targeted digital communications."[12]

4.2.3. Municipals

[12] Secondary Source: Water Smart. https://www.watersmart.com/rethinking-disadvantaged-community-engagement/ (accessed June 1, 2017)

Some care will be needed to address tensions related to the relative percentages of use by Municipal agencies and what constitutes highest and best beneficial uses within an agricultural region. A promising interaction with this community would involve collaboration on messaging to achieve mutually beneficial goals.

Some thought it might be possible for the municipal agencies to provide in-kind support to the GSP development process through support for project websites and mailing lists, production of meeting notices, assistance to the planning process from in-house public information professionals and offering access to physical meeting spaces.

Municipals may need assistance in making the case for the need to think at a Basin scale rather than more local terms.

4.2.4. Business and Industry Interests

Business and industry interests seek assurances about the availability of water for operations and the viability of the farming industry in the region. Messages for these audiences should focus on how the GSP(s) development will contribute to sustainability and how these audiences can participate in discussion specific to their interests.

4.2.5. Regional/Statewide Interests and Regulators

Some degree of uncertainty remains in the overall legal, legislative and regulatory environment as it relates to SGMA implementation.

It is in the interest of the subbasin stakeholders to engage state and federal agencies and regulators throughout the process. These parties may have resources to assist the subbasin and a cooperative attitude will build good will in the event that adjustments are needed to achieve SGMA compliance.

4.2.6. Potential Agency Partners

A variety of collaborations to achieve GSP(s) development goals may be possible. The GSAs should consider the potential for collaboration with non-GSA members and inter-basin (adjacent subbasin) partners, as part of plan deliberations.

4.2.7. GSP Coordinators Planning Forum

A planning forum for subbasin GSP coordinators should be established to further inform a coordination strategy. This forum would include agency representatives as well as the consultant teams and be used for the sole purpose of coordination and mutual support. It is anticipated that this body might meet on a quarterly or as needed basis. This forum would also provide a central point of contact for adjacent subbasin coordinators.

4.2.8. Environmental Community

As noted in the SA, this community will be interested in a GSP features. The focus of messaging for this group being on how the GSP(s) development will contribute to a sustainable regional water portfolio. Special effort should be made to identify specific

topics of interest. For example, as part of GSP development, a list of groundwater dependent species may be created, or impacts to wetlands may be identified. These types of lists would highlight where input from the environmental community might be needed.

4.2.9. Federal Government

Federal representatives interviewed for the assessment asked to be kept informed of subbasin SGMA activities. These agencies have a direct interest in surface water integration as well as SGMA activities that could impact wetlands restoration efforts or groundwater dependent ecosystems and species.

RISK MANAGEMENT

Risk management is the identification, assessment, and prioritization of risks (defined as *the effect of uncertainty on achieving objectives*) followed by coordinated, efficient and economical strategies and actions to minimize, monitor, and control the probability and/or impact of negative events. Strategies and actions may also be used to avert risk by leveraging strengths and opportunities.

Risks can come from uncertainty in economic factors, threats from project failures (at any phase), regulatory and legal uncertainties, natural causes and disasters (drought, flood, etc.), as well as dissention from adversaries, or events of uncertain or unpredictable circumstances. Several risk management standards have been developed. This analysis utilizes those from the Project Management Institute.

Table 6 outlines standardized risk categories and translates them to outreach risks.

Table 6. Risk Factors

RISK CATEGORY	Outreach RISK FACTORS
Technical, quality, or performance	• Realistic performance goals, scope and objectives
Project management	• Quality of outreach design • Outreach deployment and change management • Appropriate allocation of time and resources • Adequate support for Outreach in project management plans
Organizational / Internal	• Executive Sponsorship • Proper prioritization of efforts • Conflicts with other functions • Distribution of workload between organizational and consultant teams
Historical	• Past experiences with similar projects • Organizational relations with stakeholders • Policy and data adequacy • Media and stakeholder fatigue*
External	• Legal and regulatory environment • Changing priorities • Risks related to political dynamics

5.1. Technical, quality, or performance

The subbasin is fortunate to have a high level of water knowledge and skilled personnel available to assist with GSP planning. In general, stakeholder expectations for outreach and performance goals, scope and objectives are attainable. The larger concern in this category is properly communicating the scope of the GSP(s) development and the need for extensive coordination and outreach among a number of parties. Communication of SGMA

requirements for outreach as a planning requirement should be an ongoing consideration and appears to be underestimated in emphasis.

5.2. Project management

A number of positive project management factors are present for the GSP(s) development outreach. Project managers view outreach as an important planning element. The outreach design is based on best management practices and industry standards. It is not overly complicated and with technical services support from DWR and other sources, sufficient resources should be available to properly execute it. Procedures and practices are already in place that can be leveraged to achieve communication goals.

The primary concern in this category relates to GSP coordination. This type of outreach will require additional assessment as the individual GSAs will determine their own protocols for representation.

5.3. Organizational / Internal

Conflicts with other GSA member functions and/or conflicts with outreach activities by efforts that include the same stakeholders (e.g. Irrigated Lands, IRWM, and CV-Salts) should be monitored.

One additional consideration will be the distribution of workload between GSA, organizational and consultant teams. Clear roles and responsibilities must be defined and continuous interaction in place to ensure successful execution.

The GSP(s) development process will also need identified, high level spokespersons or champions. These individuals should be able to discuss subbasin planning with the media, in discussions with regulators and potentially at professional conferences.

5.4. External

The legal and regulatory environment of the GSP(s) development process is complex and evolving. Ongoing issues with surface water deliveries and changing agricultural market conditions are outside of the control of the parties. It will be important for mechanisms to be in place that allow for relatively rapid responses to changing conditions.

5.5. Historical

The primary stakeholders in this process generally view interactions and meetings as productive. There is a history of cooperation and a willingness to work together to save costs and achieve better outcomes.

TACTICAL APPROACHES

Following are specific tactical approaches that may be utilized to deliver the activities, messages, and recommendations of the previous chapters. These approaches are based on best communication practices and grounded in the public participation philosophy of the International Association for Public Participation, Public Participation Spectrum as illustrated in **Table 7**.

The Spectrum represents a philosophy that outreach should match the desired level of input from both the stakeholder and the organizational entity.

Table 7. IAP2 Public Participation Spectrum

IAP2 Public Participation Spectrum

Developed by the International Association for Public Participation

INCREASING LEVEL OF PUBLIC IMPACT

INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
Public Participation Goal:	**Public Participation Goal:**	**Public Participation Goal:**	**Public Participation Goal:**	**Public Participation Goal:**
To provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public issues and concerns are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.
Promise to the Public:	**Promise to the Public:**	**Promise to the Public:**	**Promise to the Public:**	**Promise to the Public:**
We will keep You informed.	We will keep you informed, listen to and acknowledge concerns and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and issues are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for direct advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.
Example Tools:	**Example Tools:**	**Example Tools:**	**Example Tools:**	**Example Tools:**
• Fact sheets • Web Sites • Open houses	• Public comment • Focus groups • Surveys • Public meetings	• Workshops • Deliberate polling	• Citizen Advisory Committees • Consensus-building • Participatory decision-making	• Citizen juries • Ballots • Delegated decisions

Based on the assessment findings for the GSP(s) development, most stakeholders would simply like to be INFORMED unless there is a potential for significant changes that may include that stakeholder. Tactics for this group will include fact sheets, websites, open houses, briefings, and informational items placed in publications they already read.

The next largest group of stakeholders, primarily groundwater pumpers and disadvantaged communities, wish to be CONSULTED. This group will have access to all the materials

prepared as part of the informational phase. In addition they should be invited to provide comments on written materials and planning concepts and participate in focused workshops and/or briefings. They should also be invited to attend larger public meetings.

The development of some GSP features may require a higher degree of INVOLVEMENT. This would focus on engagement of a subset of stakeholders that may experience significant impacts associated with SGMA.

COLLABORATION opportunities have also been identified; however, they are of a different character than defined in the Spectrum. Collaboration in this GSP(s) development process will focus on working with partners that have mutual goals to achieve those goals together. This will more resemble a partnership than a public engagement activity.

6.1. Communications Coordination.

Each GSA is required to perform legally mandated outreach activities and the GSP submission guidelines require a minimum level of engagement.

The subbasin GSAs should coordinate outreach activities even if there is a decision to move forward with multiple GSPs. In addition to efficiency and cost savings (the GSAs can share resources) this strategy will allow for consistency in messaging and reduce confusion for stakeholders that may not know what GSA jurisdiction they are in, and/or are in multiple GSA jurisdictions. Following are suggested options for communications coordination.

1. Website
2. Meeting calendar
3. Branded informational Flyers, Templates, PowerPoint Presentations, etc.
4. Periodic newsletter
5. GSP related mailing lists
6. Descriptions of interested parties
7. Issues and interest statements for legally mandatory interested parties
8. Public workshops
9. Message calendar
10. Press releases and guest editorials
11. Speakers Bureau
12. Existing group venues
13. Outreach documentation



6.2. Tactics

6.2.1. Website

As part of the communications plan development, a list of website concepts and draft website content was prepared. The following describes the proposed approach:

a. Centralized – Establish a centralized website for the entire subbasin.
b. Individual GSAs – Posting of material to a website is part of the SGMA requirements. Those GSAs with their own webpages can link to and from the centralized site if they wish to provide their own customized information. For those GSAs without their own website, courtesy pages would be provided as an added feature of the main site. The courtesy pages would all use a single template with the same information to facilitate easy management and updates. Individual GSAs choosing to take advantage of the courtesy pages would be responsible for ensuring that information is current. The page should include a "Last Updated" box to indicate the timeliness of the information.
c. **Basic features** – A basic website framework has already been developed along with introductory information that has prepopulated each page. **Figure 10** illustrates the basic content of the site and includes:
    1. Background information
    2. Information about getting involved, including meeting information
    3. A separate link for Spanish Language materials
    4. Frequently asked questions
    5. Links to GSAs
    6. Contact information

    Should a GSA decide to not participate in the Central website, a similar structure could be utilized.

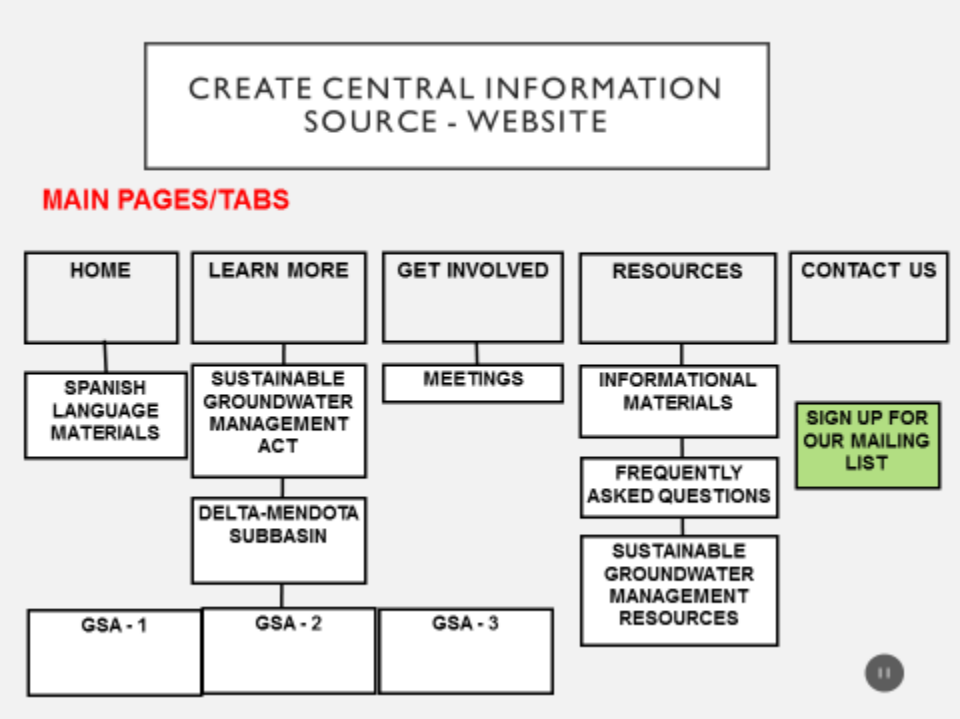


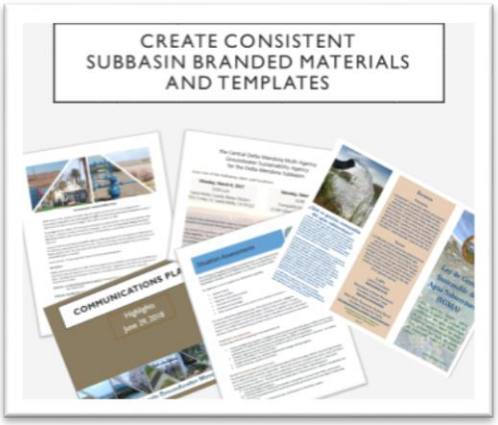
Figure 10. Website Structure

6.2.2. Meeting Calendar

A shared meeting calendar will provide a one-stop shop for stakeholders and assist in preventing meeting conflicts while creating more potential for shared activities. This calendar should include current and scheduled meetings and workshops as well as serve as the repository for agendas and meeting notes, along with copies of meeting materials and presentation.

An integrated project calendar should also be developed that links planning project milestones with communications milestones.

6.2.3. Branded Informational Flyers, Templates, PowerPoint Presentations, etc.



Subbasin level materials should have a single look and feel to create on-going consistency and visual recognition by stakeholders. Use of templates, shared presentations and flyers will create efficiencies and reinforce messaging. This communications plan incorporates some of this type of branding.

6.2.4. Periodic Newsletter

The need for regular communications cannot be overstated. One option is production of a periodic newsletter. Given the relatively short GSP(s) development process timeframe and the GSP development requirements for periodic outreach to identified stakeholders, a quarterly schedule would be realistic and achieve compliance with SGMA requirements for periodic updates to stakeholders. The newsletter should be designed so that individual GSAs can add tailored information if they choose to. For Portable Document Format (PDF) versions of the newsletter, a GSA could add a simple one or two page insert and the edition could be used as a handout or mailer. For a professional looking, email version of the newsletter, we recommend free or low cost services such as Mail Chimp or Constant Comment, which can be integrated with mailing lists.

Adding GSA specific information to an email newsletter can be done with web-links in the email to the very same PDF page prepared for the hardcopy mailer. An alternative is emailing the entire newsletter PDF as an attachment (although this format is less likely to be read than the mailer services).

6.2.5. GSP related mailing lists

Each GSA is required to develop notification lists. A central list may be utilized for GSP(s) related notifications.

6.2.6. Descriptions of Interested Parties

Each GSA is required to develop descriptions of interested parties. These lists should be updated and merged for use in the GSP(s) submittal(s). These can also be provided as background information on the website as part of constructing an administrative record. The SA in Chapter 4 provides an initial start for this documentation.

6.2.7. Issues and Interest Statements for Legally Mandatory Interested Parties

A GSP submission must include a statement of interests for listed stakeholders. As suggested earlier, this can also be included on the website.

6.2.8. Coordinated Public Workshops

SGMA requires a series of public hearings and some public workshops. Such workshops should be coordinated with other subbasin entities.

During the GSA formation process the County of Merced and a forming GSA body conducted a joint workshop to explain more about SGMA and the proposed GSA formation. Distribution of meeting flyers and notices was done concurrently, and DWR attended the event to answer questions. The GSP development process will offer similar opportunities, not only within the subbasin, but with adjacent subbasins.

6.2.9. Message Calendar



Basic messages should be associated with the planning schedule and each stage of GSP(s) development and serve as the theme for the communications materials being generated. For example, during the GSA formation period there was a need to communicate the basics of SGMA and groundwater management. During the GSP(s) initiation phase messages should focus on the basics of groundwater sustainability and the current state of the subbasin. As the GSP(s) begins to take form the specifics of the GSP(s) and what it means for each stakeholder would be the focus.

6.2.10. Press Releases and Guest Editorials

At some point in the GSP development and implementation process, it is likely that stakeholders will be asked to make changes and/or financially support a sustainability effort. It will be more productive for the GSAs and their GSP collaboration partners to frame discussions about these changes than to have others, perhaps with less knowledge, do so on their behalf. For that reason there is a need for press releases and/or guest editorials to offer the media and stakeholders accurate information offered in the context of SGMA. This type of outreach should be closely coordinated as consistency in messages is critical to stakeholder acceptance.

6.2.11. Speakers Bureau

Efforts should be made to conduct outreach at events and meetings that already occur (e.g. Farm Bureau meetings, Rotary Club, etc.). A list of knowledgeable presenters should be developed in the event an organization or other entity would like a presentation. Speakers Bureau engagements should be recorded on the planning project meeting calendar.

6.2.12. Existing Group Venues

Fully leverage the activities of existing groups.

- Maintain a roster of existing groups and typical meeting schedules with a nexus to GSP(s) development. Add the dates to the messaging calendar.
- The list of audiences, messages and existing groups should be referenced when there is a need to deploy information.
- Conduct informal outreach with the leaders of such groups to determine the best way to interact.
- Determine what communications channels these groups are using and equally leverage these, for example by placement of articles in newsletters.

6.2.13. Outreach Documentation

A central point of contact should be identified on the website and an outreach statistics inventory should be established that identifies dates, times, audiences and attendance. This information will be also be useful in conducting follow up with stakeholders as well as documenting outreach as part of GSP submittal guidelines.

6.3. Procedural and Legally Mandated Outreach

A discussion of SGMA outreach requirements was provided in Chapter 1 and a full list of requirements is contained in Appendix 1. One major feature of the requirements is a submission to DWR of the opportunities that interested parties will be given to participate in the GSP deliberations. The Situation Assessment provides an initial description that can be added to with additional outreach.

Following are the Required Interested Parties for the purpose of mandated outreach:

Table 9 provides a list of the mandated outreach and the timeframe in which is required.

Table 8. Mandated Outreach

Timeframe	Item
Prior to initiating plan development	1. Statement of how interested parties may contact the Agency and participate in development and implementation of the plan submitted to DWR.

Timeframe	Item
	2. Web posting of same information.
Prior to plan development	1. Must establish and maintain an interested persons list. 2. Must prepare a written statement describing the manner in which interested parties may participate in GSP development and implementation. Statement must be provided to: a. Legislative body of any city and/or county within the geographic area of the plan b. Public Utilities Commission if the geographic area includes a regulated public water system regulated by that Commission c. DWR d. Interested parties (see Section 10927) e. The public
Prior to and with GSP submission	1. Statements of issues and interests of beneficial users of basin groundwater, including types of parties representing the interests and consultation process 2. Lists of public meetings 3. Inventory of comments and summary of responses 4. Communication section in plan that includes: • Agency decision making process • ID of public engagement opportunities and response process • Description of process for inclusion • Method for public information related to progress in implementing the plan (status, projects, actions)
90 days prior to GSP Adoption Hearing	1. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must notify cities and/or counties of geographic area 90 days in advance.
90 days or less prior to GSP Adoption Hearing	2. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must: a. Consider and review comments b. Conduct consultation within 30 days of receipt with cities or counties so requesting
GSP Adoption or Amendment	1. GSP must be adopted or amended at Public Hearing.
60 days after plan submission	1. 60-day comment period for plans under submission to DWR. Comments will be used to evaluate the submission.
Prior to adoption of fees	1. Public meeting required prior to adoption of, or increase to fees. Oral or written presentations may be made as part of the meeting. 2. Public notice shall include: a. Time and place of meeting b. General explanation of matter to be considered

Timeframe	Item
	c. Statement of availability for data required to initiate or amend such fees d. Public posting on Agency Website and provision by mail to interested parties of supporting data (at least 20 days in advance) 3. Mailing lists for interested parties are valid for 1 year from date of request and may be renewed by written request of the parties on or before April 1 of each year. 4. Includes procedural requirements per Government Code, Section 6066.
Prior to conducting a fee adoption hearing.	1. Must publish notices in a newspaper of general circulation as prescribed. 2. Publication shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. 3. The period of notice begins the first day of publication and terminates at the end of the fourteenth day, (which includes the first day.)

6.4. Items for Future Consideration

This GSP(s) Coms Plan outlines an outreach effort based on project and stakeholder needs and preferences. This document has been prepared as a working draft living document and should be updated as new information and the GSP(s) development process needs are developed.

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MEASUREMENTS & EVALUATION

A guiding principle for evaluation and measurement of the Coms Plan's success is to provide regular, unbiased reporting of progress toward achieving goals. Success may be evaluated in several ways, including process measures, outcome measures, and an annual evaluation of accomplishments. Optional evaluation measures are described below.

As part of each outreach effort debrief the following process and outcome measures will be discussed and recorded in a check sheet. The check sheets will be prepared with the goal of continuous improvement rather than criticisms.

7.2. Process Measures

Process measures track progress toward meeting the goals of the Coms Plan. These include:

- Level of attendance at outreach meetings
- Shared understanding of the overarching aims, activities, and opportunities presented by different planning approaches and project activities
- Productive dialogue among participants at meetings and events
- Sense of authentic engagement; people understand why they have been asked to participate, and feel that they can contribute meaningfully
- Timely and accurate public reporting of planning milestones
- Feedback from Coordinating Body and GSA members, regulators, stakeholders, and interested parties about the quality and availability of information materials
- Level of stakeholder interest in the GSP(s) development process information

7.3. Outcome Measures

Outcome measures track the level of success of the Coms Plan in meeting its overall goals. Some outcome measures considered for the GSP(s) development process include the following:

- Consistent participation by key stakeholders and interested parties in essential activities. Participants should have no difficulty locating the meetings, and should be informed as to when and where they will be held.
- Response from meeting participants that the engagement methods provided for a fair and balanced exchange of information.
- Feedback from interested parties that they understand how their input is used, where to track data, and what results to expect.
- The project receives quality media coverage that is accurate, complete and fair.

7.4. Mid-cycle Evaluation of Accomplishments

A mid-cycle evaluation provides an opportunity to examine the current effectiveness of the Coms Plan and provides a chance to reevaluate strategies to meet the GSP(s) development process objectives. The evaluation tasks may include:

- Preparation of an executive-level summary detailing high-level initiatives and accomplishments of the previous cycle. This evaluation should also include positive news, best practices, goals and objectives, notable changes, timelines, and priorities.
- Identifying gaps and areas for improvement.
- Highlighting how gaps and areas for improvement in the cycle has been addressed.
- Outlining process and outcome measures and their current results.

ROLES AND RESPONSIBILITIES

The GSP(s) development Coms Plan outlines numerous strategies, activities and tactics. While none are highly complex, there is a requirement for coordination and clarity regarding who will be responsible for executing the tasks.

After the planning team evaluates the timelines and priorities for each of the communications activities a recommended next step is completion of a Responsible, Accountable, Consulted, and Informed (RACI) Chart. This Chart, as displayed in **Table 10**, outlines key tasks and the assignment of roles and responsibilities for accomplishing them.

Table 9. Sample RACI Chart

Activity TYPE	SPECIFIC PRODUCT	RESPONSIBLE	ACCOUNTABLE	CONSULTED	INFORMED
Internal Staff Communications, information materials for/briefings	Draft	Person A	Person E	Person I	
	Final Draft	Person A	Person E	Person I	Project Team
List Serves, mailing lists	Customer Contacts	Person B - Person A	Person E	Person I	Project Team
	Concurrent jurisdictions	Lisa Beutler/MWH	Person G	Person I	Project Team
	Other - identified stakeholders	Person A	Person G	Person I	Project Team
Web Content and Maintenance	Draft Content and Content Refresh	Lisa Beutler/MWH/	Person G	Person H	Project Team
	Site Administration	Person A	Person G	Person H	
General public Intro Packets, Fact Sheets and Brochures	Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Revised Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Final Draft	Person D	Person E	Person I- Subject Matter Experts	Project Team
Newsletter Content	Draft	Lisa Beutler/MWH	Person E	Person I- Subject Matter Experts	Person J
	Revised Draft	Person D	Person E	Person I- Subject Matter Experts	Person J
	Final Draft	Person D	Person E	Person I- Subject Matter Experts	Project Team

Responsible
Those who do the work to achieve the task. There is at least one person with a role of *responsible*, although others can be delegated to assist in the work required.

Accountable (also approver or final approving authority)
This is the person ultimately answerable for the correct and thorough completion of the deliverable or task, and the one who delegates the work to those responsible. There **may only** be only one *accountable* specified for each task or deliverable.

Consulted
Those whose opinions are sought, typically subject matter experts were people that are impacted by the activity; and with whom there is two-way communication.

Informed
Those who are kept up-to-date on progress, typically on the launch and completion of the task or deliverable. This is one way communication.

Role distinction
There is a distinction between a role and the individual assigned the task. Role is a descriptor of an associated set of tasks that could be performed by just one or many people.

In the case of the RACI Chart, the team may list as many people as is logical except for the Accountable role.

Scope of Work
Completion of the RACI Chart will also support development of any future scopes of work for consultant provided communication and outreach services.

LIST OF APPENDICES

Appendix 1-Public Outreach Requirements under SGMA

Appendix 2-Communications Governance

Appendix 1. Public Outreach Requirements under SGMA

GSP Regulations

CODE	PUBLIC OUTREACH REQUIREMENT
§ 353.6. Initial Notification (a) Each Agency shall notify the Department, in writing, prior to initiating development of a Plan. The notification shall provide general information about the Agency's process for developing the Plan, including the manner in which interested parties may contact the Agency and participate in the development and implementation of the Plan. The Agency shall make the information publicly available by posting relevant information on the Agency's website.	1. Statement of how interested parties may contact the Agency and participate in development and implementation of the plan submitted to DWR. 2. Web posting of same information. **Timing**: *Prior to initiating development of a plan.*
§ 353.8. Comments (a) Any person may provide comments to the Department regarding a proposed or adopted Plan. (b) Pursuant to Water Code Section 10733.4, the Department shall establish a comment period of no less than 60 days for an adopted Plan that has been accepted by the Department for evaluation pursuant to Section 355.2. (c) In addition to the comment period required by Water Code Section 10733.4, the Department shall accept comments on an Agency's decision to develop a Plan as described in Section 353.6, including comments on elements of a proposed Plan under consideration by the Agency.	1. 60-day comment period for plans under submission to DWR. Comments will be used to evaluate the submission. 2. Parties may also comment on a GSA's (or GSAs') statements submitted under section 353.6 **Timing**: For GSP Submittal - *60 days after submission to DWR*
§ 354.10. Notice and Communication Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following: (a) A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties. (b) A list of public meetings at which the Plan was discussed or considered by the Agency. (c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency. (d) A communication section of the Plan that includes the following: (1) An explanation of the Agency's decision-making process. (2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.	5. Statements of issues and interests of beneficial users of basin groundwater, including types of parties representing the interests and consultation process 6. Lists of public meetings 7. Inventory of comments and summary of responses 8. Communication section in plan that includes: • Agency decision making process • ID of public engagement opportunities and response process • Description of process for inclusion • Method for public information related to progress in implementing the plan (status, projects, actions) **Timing**: For GSP Submittal – *with plan* For GSP Development – *continuous. [Note: activities should be included*

CODE	PUBLIC OUTREACH REQUIREMENT
(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin. (4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.	*in the project schedule and information posted on web.]*
§ 355.2. (c) Department Review of Adopted Plan (c) The Department (DWR) shall establish a period of no less than 60 days to receive public comments on the adopted Plan, as described in Section 353.8.	1. 60 day public review period for public comment on submitted plan. **Timing**: After GSP Submittal to DWR – *60 days*
§ 355.4. & 355.10 Criteria for Plan Evaluation The basin shall be sustainably managed within 20 years of the applicable statutory deadline consistent with the objectives of the Act. The Department shall evaluate an adopted Plan for compliance with this requirement as follows: (b) (4) Whether the interests of the beneficial uses and users of groundwater in the basin, and the land uses and property interests potentially affected by the use of groundwater in the basin, have been considered. … (10) Whether the Agency has adequately responded to comments that raise credible technical or policy issues with the Plan.	1. Required public outreach and stakeholder information is submitted, including statement of issues and interests of beneficial users. 2. Public and stakeholder comments and questions adequately addressed during planning process. **Timing**: For GSP Submittal – *with plan* For resubmittal related to corrective action – *with submittal*

California Water Code

CODE	PUBLIC OUTREACH REQUIREMENT
10720. This part shall be known, and may be cited, as the "Sustainable Groundwater Management Act." **10720.3** (a) This part applies to all groundwater basins in the state. … (c) The federal government or any federally recognized Indian tribe, appreciating the shared interest in assuring the sustainability of groundwater resources, may voluntarily agree to participate in the preparation or administration of a groundwater sustainability plan or groundwater management plan under this part through a joint powers authority or other agreement with local agencies in the basin. A participating tribe shall be eligible to participate fully in planning, financing, and management under this part, including eligibility for grants and technical assistance, if any exercise of regulatory authority, enforcement, or imposition and collection of fees is pursuant to	1. Tribes and the federal government may voluntarily participate in GSA governance and GSP development. **Timing**: *Prior to initiating development of a plan.*

CODE	PUBLIC OUTREACH REQUIREMENT
the tribe's independent authority and not pursuant to authority granted to a groundwater sustainability agency under this part.	
CHAPTER 4. Establishing Groundwater Sustainability Agencies [10723 - 10724]	
10723. a) Except as provided in subdivision (c), any local agency or combination of local agencies overlying a groundwater basin may decide to become a groundwater sustainability agency for that basin. (b) Before deciding to become a groundwater sustainability agency, and after publication of notice pursuant to Section 6066 of the Government Code, the local agency or agencies shall hold a public hearing in the county or counties overlying the basin.	1. Must hold public hearing in the county or counties overlying the basin, prior to becoming a GSA **Timing**: *Prior to becoming a GSA.*
10723.2 The groundwater sustainability agency shall consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans. These interests include, but are not limited to, all of the following: (a) Holders of overlying groundwater rights, including: (1) Agricultural users. (2) Domestic well owners. (b) Municipal well operators. (c) Public water systems. (d) Local land use planning agencies. (e) Environmental users of groundwater. (f) Surface water users, if there is a hydrologic connection between surface and groundwater bodies. (g) The federal government, including, but not limited to, the military and managers of federal lands. (h) California Native American tribes. (i) Disadvantaged communities, including, but not limited to, those served by private domestic wells or small community water systems. (j) Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.	1. Must consider interest of all beneficial uses and users of groundwater. 2. Includes specific stakeholders as listed. **Timing**: *During development of a GSP.*
10723.4. The groundwater sustainability agency shall establish and maintain a list of persons interested in receiving notices regarding plan preparation, meeting announcements, and availability of draft plans, maps, and other relevant documents. Any person may request, in writing, to be placed on the list of interested persons.	3. Must establish and maintain an interested persons list. 4. Any person may ask to be added to the list **Timing**: *On forming a GSA.*
10723.8. (a) Within 30 days of deciding to become or form a groundwater sustainability agency, the local agency or combination of local agencies shall inform the department of its decision and its intent to undertake sustainable groundwater management. The	1. Creates notification requirements that include: a. A list of interested parties b. An explanation of how interests will be considered

CODE	PUBLIC OUTREACH REQUIREMENT
notification shall include the following information, as applicable: … (4) A list of interested parties developed pursuant to Section 10723.2 and an explanation of how their interests will be considered in the development and operation of the groundwater sustainability agency and the development and implementation of the agency's sustainability plan.	**Timing**: *On forming a GSA & with submittal of GSP*
10727.8 (a) Prior to initiating the development of a groundwater sustainability plan, the groundwater sustainability agency shall make available to the public and the department a written statement describing the manner in which interested parties may participate in the development and implementation of the groundwater sustainability plan. The groundwater sustainability agency shall provide the written statement to the legislative body of any city, county, or city and county located within the geographic area to be covered by the plan. The groundwater sustainability agency may appoint and consult with an advisory committee consisting of interested parties for the purposes of developing and implementing a groundwater sustainability plan. The groundwater sustainability agency shall encourage the active involvement of diverse social, cultural, and economic elements of the population within the groundwater basin prior to and during the development and implementation of the groundwater sustainability plan. If the geographic area to be covered by the plan includes a public water system regulated by the Public Utilities Commission, the groundwater sustainability agency shall provide the written statement to the commission. (b) For purposes of this section, interested parties include entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.	2. Agencies preparing a GSP must prepare a written statement describing the manner in which interested parties may participate in its development and implementation. 3. Statement must be provided to: a. Legislative body of any city and/or county within the geographic area of the plan b. Public Utilities Commission if the geographic area includes a regulated public water system regulated by that Commission c. DWR d. Interested parties (see Section 10927) e. The public 4. GSP entities may form an advisory committee for the GSP preparation and implementation. 5. The GSP entities are to encourage active involvement of diverse social, cultural and economic elements of the affected populations. **Timing**: *On initiating GSP*
10728.4 Public Notice of Proposed Adoption, GSP Adoption Pubic Hearing A groundwater sustainability agency may adopt or amend a groundwater sustainability plan after a public hearing, held at least 90 days after providing notice to a city or county within the area of the proposed plan or amendment. The groundwater sustainability agency shall review and consider comments from any city or county that receives notice pursuant to this section and shall consult with a city or county that requests consultation within 30 days of receipt of the notice. Nothing in this section is intended to	3. GSP must be adopted or amended at Public Hearing. 4. Prior to Public Hearing for adoption or amendment of the GSP, the GSP entities must: a. Notify cities and/or counties of geographic area 90 days in advance. b. Consider and review comments

CODE	PUBLIC OUTREACH REQUIREMENT
preclude an agency and a city or county from otherwise consulting or commenting regarding the adoption or amendment of a plan.	c. Conduct consultation within 30 days of receipt with cities or counties so requesting
10730 Fees. (a) A groundwater sustainability agency may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activity, to fund the costs of a groundwater sustainability program, including, but not limited to, preparation, adoption, and amendment of a groundwater sustainability plan, and investigations, inspections, compliance assistance, enforcement, and program administration, including a prudent reserve. A groundwater sustainability agency shall not impose a fee pursuant to this subdivision on a de minimis extractor unless the agency has regulated the users pursuant to this part. (b) (1) Prior to imposing or increasing a fee, a groundwater sustainability agency shall hold at least one public meeting, at which oral or written presentations may be made as part of the meeting. (2) Notice of the time and place of the meeting shall include a general explanation of the matter to be considered and a statement that the data required by this section is available. The notice shall be provided by publication pursuant to Section 6066 of the Government Code, by posting notice on the Internet Web site of the groundwater sustainability agency, and by mail to any interested party who files a written request with the agency for mailed notice of the meeting on new or increased fees. A written request for mailed notices shall be valid for one year from the date that the request is made and may be renewed by making a written request on or before April 1 of each year. (3) At least 20 days prior to the meeting, the groundwater sustainability agency shall make available to the public data upon which the proposed fee is based. (c) Any action by a groundwater sustainability agency to impose or increase a fee shall be taken only by ordinance or resolution. (d) (1) As an alternative method for the collection of fees imposed pursuant to this section, a groundwater sustainability agency may adopt a resolution requesting collection of the fees in the same manner as ordinary municipal ad valorem taxes. (2) A resolution described in paragraph (1) shall be adopted and furnished to the county auditor-controller and board of supervisors on or before August 1 of each year that the alternative collection of the fees is being requested. The resolution shall include a list of parcels and the amount to be collected for each parcel. (e) The power granted by this section is in addition to any powers a groundwater sustainability agency has under any other law.	Related to GSAs 5. Public meeting required prior to adoption of, or increase to fees. Oral or written presentations may be made as part of the meeting. 6. Public notice shall include: a. Time and place of meeting b. General explanation of matter to be considered c. Statement of availability for data required to initiate or amend such fees d. Public posting on Agency Website and provision by mail to interested parties of supporting data (at least 20 days in advance) 7. Mailing lists for interested parties are valid for 1 year from date of request and may be renewed by written request of the parties on or before April 1 of each year. 8. Includes procedural requirements per Government Code, Section 6066. **Timing**: *Prior to adopting fees.*

California Government Code

CODE	PUBLIC OUTREACH REQUIREMENT
6060 Whenever any law provides that publication of notice shall be made pursuant to a designated section of this article, such notice shall be published in a newspaper of general circulation for the period prescribed, the number of times, and in the manner provided in that section. As used in this article, "notice" includes official advertising, resolutions, orders, or other matter of any nature whatsoever that are required by law to be published in a newspaper of general circulation. **6066** Publication of notice pursuant to this section shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. The period of notice commences upon the first day of publication and terminates at the end of the fourteenth day, including therein the first day.	4. Must publish notices in a newspaper of general circulation as prescribed. 5. Publication shall be once a week for two successive weeks. Two publications in a newspaper published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates, are sufficient. 6. The period of notice begins the first day of publication and terminates at the end of the fourteenth day, (which includes the first day.) **Timing**: *Prior to adopting fees*

Appendix 2. Communications Governance

Given the relatively large number of stakeholders, a recommendation for coordinated efforts, and the legal requirements for outreach[13] some form of communications governance is recommended.

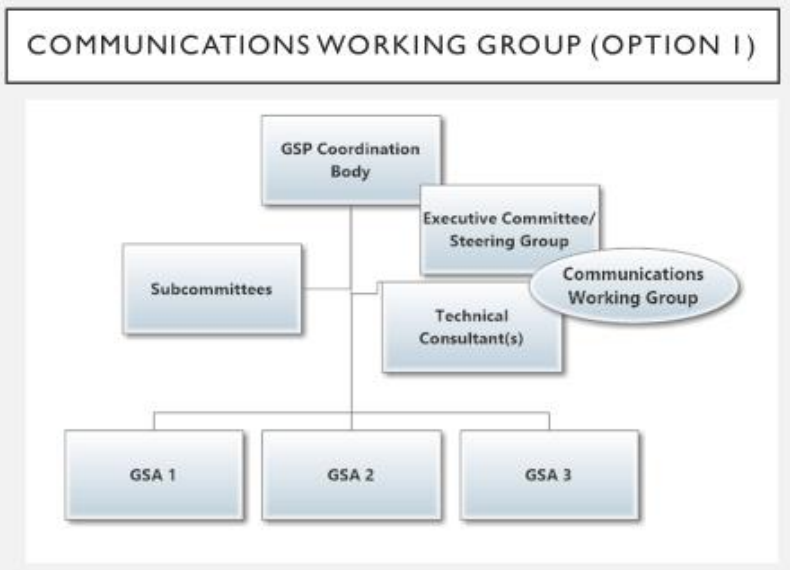
Execution of communications activities can be accomplished by an individual or multiple individuals, and/or include or be solely managed by project consultants. The actual form of the governance is less important than a clear understanding of the roles and responsibilities of those responsible for ensuring required communication. Also essential is a clear chain of command that ensures the elected representatives of GSAs are able to retain communications leadership and guidance.

A driving consideration for establishing a communications governance structure is the level of effort associated with required activities and the fact that communications are highly time dependent. That means that communications activities should be occurring that may happen outside of regularly scheduled GSA meetings. In this case delegation with guidance to a communications team is efficient and effective.

Several governance options for consideration are offered below.

Communications Option 1

Communications Option 1 is based on an overall GSP(s) development structure that includes a GSA member based leadership function that is guiding the Technical Consultants. A communications working group which might include staff, consultants and GSA elected officials, or some combination of those roles could be formed to serve as a communications working group that would ultimately report to the larger GSP coordinating body.



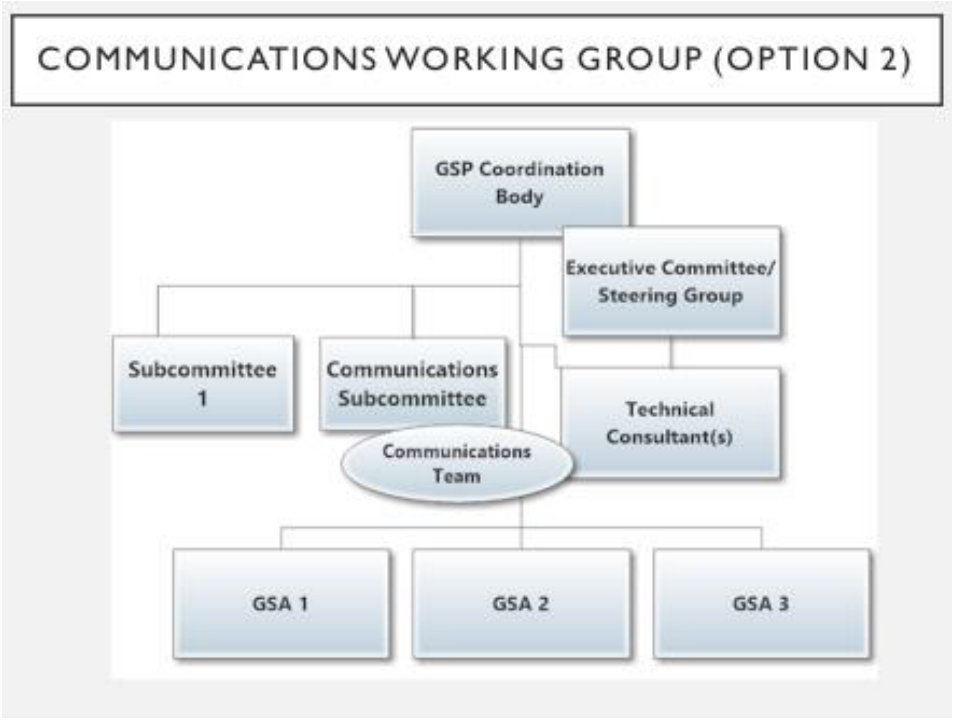
Communications Governance Option 1

Communications Option 2

[13] See Appendix 1

Appendix 1

Communications Option 1 is based on an overall GSP(s) development structure that includes a GSA member based subcommittee guiding the Technical Consultants. A communications working group which might include staff, consultants and GSA elected officials, or some combination of those roles could be formed to serve as a communications team that is affiliated with a subcommittee and would ultimately report to the larger GSP coordinating body



Communications Governance Option 2

ATTACHMENT B. COORDINATED PUBLIC WORKSHOP SUMMARIES

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
SPRING 2018 COORDINATED WORKSHOPS

Monday, May 14, 2018, Los Banos
Wednesday, May 16, 2018, Patterson
Thursday, May 17, 2018, Mendota

WORKSHOP SUMMARY

- Three workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin. The purpose of the workshops was to educate stakeholders and members about the public about the Sustainable Groundwater Management Act (SGMA) and introduce participants to their local Groundwater Sustainability Agency representatives. Topics covered during the workshop included what is SGMA, the Delta-Mendota Subbasin, and opportunities for public engagement.
- Workshop participants' questions and feedback are summarized as follows:
    - Are the local groundwater regulations going to be re-set on an annual basis based on the water year, snowpack, etc.?
    - Who is the governing board that will make these decisions?
    - If this is a state-wide initiative, who is the decision-making body?
    - Will the California Department of Fish and Wildlife be involved?
    - Has the State provided criteria to what is considered a "chronic loss" of groundwater?
    - Are natural springs included under SGMA?
    - What criteria will you use to measure whether or not springs are overused?
    - What is the ultimate goal of SGMA? What does it mean to us?
    - How is the water budget going to be developed?
    - The Irrigated Lands Program already has a lot of requirements for growers. Is this going to be the same level of detail and effort?
    - What is the goal SGMA is trying to achieve? How are we going to get to sustainability?
    - What will happen when the State and districts do not receive their full surface water allocation and cities keep expanding?
    - It seems to me that the biggest problem is that the State wants to export water to Southern California. How can we come up with a solution if there are factors out of our control?

- How will you know how much I am pumping?

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
FALL 2018 COORDINATED WORKSHOPS

Monday, October 22, Firebaugh
5:00 – 7:00 PM
Firebaugh Middle School MPR

Wednesday, October 24, Los Banos
4:00 – 6:00 PM
College Greens Building

Thursday, October 25, Patterson
4:00 – 6:00 PM
Patterson Senior Center

WORKSHOP SUMMARY

- Three workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin. The purpose of the workshops was to educate stakeholders and members about the public about key Sustainable Groundwater Management Act (SGMA) topics in preparation for Groundwater Sustainability Plan (GSP) development workshops in 2019.
- The format and content of each workshop was the same. The workshops began with a 45-minute presentation, followed by an open house period for participants to talk with their Groundwater Sustainability Agency (GSA) representative. Spanish interpretation was provided at each workshop.
- In total, approximately 45 individuals (not including GSA representatives and supporting staff) participated in the workshops. Attendance by location was as follows: Firebaugh – 5 participants; Los Banos – 23 participants; Patterson – 17 participants. Three participants requested Spanish interpretation.
- Most participants heard about the workshops through emails from their local water or irrigation district, or direct flyers and bill inserts sent to them by their water/irrigation district or municipality.
- Presentation topics included: Overview of SGMA, GSP development and implementation process, data management, hydrogeologic conceptual model, numerical and analytical models, and the water budget.
- Workshop participants' questions and feedback are summarized as follows:

    Data

    - How much historical data are the GSAs using to make their assumptions?
    - Will data from counties be used?

- Is the numerical data available on the Delta-Mendota website?
- How big will the GSAs' monitoring network be? Do the GSAs anticipate drilling new monitoring wells?
- How will the GSAs monitor water quality and subsidence? Do the GSAs already have subsidence monitoring wells and data?
- How much data have the GSAs gathered? When will the GSAs stop gathering data?
- How much data will the GSAs be collecting from individual landowners?

Models

- Will the models take into account availability of surface water supplies?
- Will the models take into account changing crops?
- Will the models take into account agricultural areas that are being converted to commercial or urban areas?

Water Budget and Sustainable Yield

- What is the sustainable yield for the Delta-Mendota Subbasin?
- It sounds like the sustainable yield will be a number that oscillates around a baseline. What is this baseline?
- How will the GSAs determine the minimum threshold for the subbasin?
- How will the water budgets account for existing and new wells?
- What are the years for the historic water budget? How was this period set?

Projects and Management Actions

- Based on what is currently known, will the GSAs be able to limit groundwater pumping in the future?
- When the GSAs come up with groundwater management policies, will the policies impact groundwater pumping on an individual level, regional level, or basin-wide level?
- Will the California Department of Water Resources (DWR) or the GSAs be the ones to limit pumping?
- Could a potential management action be limiting pumping?
- Will the GSAs be the agencies to determine if new wells can or cannot be drilled?

Integration with Other Programs/Organizations

- How much are the GSAs integrating with the Irrigated Lands Program?
- How closely do GSAs work with local farm bureaus?

Other

- Will there be an administrative fee for the GSAs to oversee GSP implementation?
- How will the costs for GSP development and implementation be covered?
- Do the GSAs know what DWR's GSP review and certification process will consist of?

- Will the GSAs in the region have influence over how surface water resources are managed on a state-wide level?
- How many GSAs were formed after SGMA passed in 2014?

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
WINTER 2019 COORDINATED WORKSHOPS

Tuesday, February 19, 2019, Los Banos
4:00 – 6:00 PM
College Greens Building

Wednesday, February 20, 2019, Patterson
4:00 – 6:00 pm
City of Patterson City Hall

Monday, March 4, 2019, Santa Nella
6:00 – 8:00 PM
Romero Elementary School

WORKSHOP SUMMARY

- Three workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin during February and March 2019. The purpose of the workshops was to educate stakeholders and members about the public about topics covered in the draft Groundwater Sustainability Plans (GSP) being developed for the subbasin. Topics covered during the workshop included historic and current water budgets, sustainability criteria, undesirable results, and projects and management actions.
- Workshops were promoted via emails sent to each GSA's interested parties database, flyers and utility bill inserts, and social media posts.
- The format and content of each workshop was the same. The workshops began with a short presentation, followed by an open house period for participants to talk with their Groundwater Sustainability Agency (GSA) representative. Spanish interpretation was provided at each workshop.
- In total, approximately 30 individuals (not including GSA representatives and supporting staff) participated in the workshops. Attendance by location was as follows: Patterson – 14, Los Banos – 4, and Santa Nella – 12. Participants represented a range of beneficial users in the subbasin, including domestic well owners, agricultural water users, public water systems, and disadvantaged communities.

- Workshop participants' questions and feedback are summarized as follows:

  Water Budgets

  - Does the land surface budget include inflows from precipitation and applied water to crops?
  - Who provides the information about the inflows and outflows of the aquifer?
  - How is the aquifer recharged?
  - Do reservoirs lose water?
  - What happened between 1985 – now [regarding the historic water budget]?
  - What affect does precipitation have on the aquifer?

  Projects and Management Actions

  - Who will make the decision on who can drill wells and how much can well owners can pump?
  - Will GSAs in the subbasin be able to restrict selling of groundwater outside of the subbasin?
  - Projects and management actions should emphasize flood and stormwater capture and increased stormwater storage.
  - Will use of recycled water in new developments be considered a source of water to balance the water budget?
  - Are there percolation ponds by golf course?

  Sustainability Criteria and Undesirable Results

  - Is it the GSAs' responsibility to set the sustainability criteria for the subbasin?
  - Could this region experience seawater intrusion?
  - What's going to happen in areas like Dos Palos that have poor groundwater quality?

  Other

  - Does the GSP only cover of agricultural uses of groundwater or does it also cover residential and commercial uses of groundwater?
  - Who is doing the work to prepare the GSP?
  - How much does it cost to prepare a GSP?
  - Are there any agencies currently monitoring groundwater pumping and levels?
  - How is groundwater currently being removed from the groundwater basin?
  - How many monitoring stations have been identified? Have GSAs already identified where these monitoring pumps are?
  - Does the California Aqueduct affect the water table in the subbasin?
  - What is the rationale for the North-Central GSP group's boundaries? The north and south areas of the North-Central GSP group are very different.
  - Do water agencies in the subbasin send water to the Santa Clara Valley Water District?
  - Where are the coordinated meetings are held? What time are these meetings?
  - Will this raise our water rates?
  - The community of Tranquillity is currently experiencing land subsidence.

DELTA-MENDOTA SUBBASIN
SUSTAINABLE GROUNDATER MANAGEMENT ACT
SPRING 2019 COORDINATED WORKSHOPS

Monday, May 20, 2019, Patterson
4:00 – 6:00 pm
City of Patterson City Hall

Tuesday, May 21, 2019, Los Banos
4:00 – 6:00 PM
College Greens Building

Wednesday, May 22, 2019, Santa Nella
6:30 – 8:30 PM
Romero Elementary School

Thursday, May 23, 2019, Mendota
6:00 – 8:00 PM
Mendota Library

WORKSHOP SUMMARY

- Four workshops were held in the northern, central, and southern parts of the Delta-Mendota Subbasin. The purpose of the workshops was to educate stakeholders and members about the public about topics covered in the draft Groundwater Sustainability Plans (GSP) being developed for the subbasin. Topics covered during the workshop included water budgets, sustainable yield, projects and management actions, and groundwater monitoring networks.
- Workshops were promoted via emails sent to each GSA's interested parties database, flyers and utility bill inserts, social media posts, and direct outreach to community stakeholders.
- The format and content of each workshop was the same. The workshops began with a short presentation, followed by an open house period for participants to talk with their Groundwater Sustainability Agency (GSA) representative. Spanish interpretation was provided at each workshop.
- In total, approximately 30 individuals participated in the workshops. Attendance by location was as follows: Patterson – 7, Los Banos – 10, Santa Nella – 4, and Mendota – 9. Participants represented a range of beneficial users in the subbasin, including domestic well owners, agricultural water users, public water systems, and disadvantaged communities.

- Workshop participants' questions and feedback are summarized as follows:

  Water Budgets

  - Why is there a difference between the water budgets for the upper and lower aquifers?
  - Why is the change in storage negative?
  - Is there a water budget for each aquifer?
  - When the projected water budgets are finalized, will they include specific projects and management actions?
  - How was the data for the climate change factors developed?
  - Historically, California goes through periodic droughts. Do the projected water budgets account for future droughts?
  - Do the projected water budgets account for future population growth and new developments?
  - Do the water budgets account for percolation from water applied to crops?

  Projects and Management Actions

  - Will management actions include a charge for water pumping?
  - Will pumping restrictions be implemented during dry periods or drought?
  - Will the GSPs identify specific projects and management actions?
  - Will GSAs in the subbasin form a water bank?
  - If pumping restrictions are enacted, GSPs should include a provision that allows private well owners to demonstrate that they aren't overpumping or causing undesirable results.
  - The region needs more surface water storage to supplement groundwater pumping.
  - There should be restrictions on development in the region.

  Sustainable Yield

  - Does increases in groundwater demand relate to the cost of surface water supplies?

  Groundwater Monitoring

  - When local agencies monitor for groundwater, how far down do they monitor?

  GSP Adoption, Implementation and Enforcement

  - What agency approves the GSPs?
  - Will the California Department of Water Resources be the lead agency for providing oversight after the GSP is submitted?
  - Could the State Water Resources Control Board mandate pumping restrictions?
  - Will the state be looking at the drawdown of individual, private wells?
  - Where does the funding to implement GSPs come from?
  - How much will GSP implementation cost?
  - Who has to submit the annual report?

  Other

  - GSAs should be divided into even smaller units to manage projects and management actions locally.

ATTACHMENT C. EXAMPLE PUBLIC WORKSHOP PROMOTION MATERIALS

Groundwater management in our community is changing.

Learn more about how this may impact you.

Collaborating local agencies are hosting a series of public workshops about the Sustainable Groundwater Management Act. Come learn how this landmark legislation may impact our community, what we are doing about it, and how you can get involved. Representatives from local groundwater sustainability agencies will be available to answer questions. You have three opportunities to attend:

Los Banos
Monday, May 14
4:00 - 6:00 PM
San Luis & Delta-Mendota Water Authority Office
842 6th St, Los Banos

Patterson
Wednesday, May 16
4:00 - 6:00 PM
Hammon Senior Center
1033 W Las Palmas Ave, Patterson

Mendota
Thursday, May 17
4:00 - 6:00 PM
Mendota Branch Library
Mendota Meeting Room
1246 Belmont Ave, Mendota

The content of each workshop will be the same. The first thirty minutes of each workshop will consist of an informational presentation, followed by an open house until 6:00 PM. For more information, please visit our website at: www.deltamendota.org.

We look forward to seeing you there!

El manejo del agua subterránea en nuestra comunidad está cambiando.

Obtenga más información sobre como esto puede afectarlo.

Las agencias locales colaboradoras están organizando una serie de talleres públicos sobre la Ley de gestión sostenible del agua subterránea. Venga y aprenda como esta histórica legislación puede afectar a nuestra comunidad, que estamos haciendo al respecto y como puede participar. Los representantes de las agencias locales de sostenibilidad del agua subterránea estarán disponibles para responder preguntas. Tienes tres oportunidades para asistir:

Los Baños
Martes, 14 de Mayo
4:00 - 6:00 PM
San Luis & Delta-Mendota
Water Authority Office
842 6th St, Los Baños

Patterson
Miércoles, 16 de Mayo
4:00 - 6:00 PM
Hammon Senior Center
1033 W Las Palmas Ave, Patterson

Mendota
Jueves, 17 de Mayo
4:00 - 6:00 PM
Mendota Branch Library
Mendota Meeting Room
1246 Belmont Ave, Mendota

El contenido de cada taller será el mismo. Los primeros treinta minutos de cada taller serán consisten de una presentación informativa, seguida de una jornada de puertas abiertas hasta las 6:00 P.M. Para obtener más información, visite nuestro sitio web en: www.deltamendota.org.

Public Notice

Public Groundwater Meeting

Santa Nella County Water District and other local water agencies are developing plans for the future of our groundwater resources. We want to hear from you! Come to an upcoming public workshop to learn more:

Santa Nella
Monday, March 4, 6:000 - 8:00 PM
Romero Elementary School MPR
13500 Luis Ave, Gustine, CA 95322

The first forty minutes of the workshop will consist of a bilingual informational presentation. The presentation will be followed by an interactive discussion on the region's groundwater "budget" and how to define "sustainability" for our groundwater resources. This workshop is open to people with all level of knowledge about water.

Spanish-language interpreters and materials will be available.

For more information, please visit our website at www.deltamendota.org and www.sncwd.com.

For questions or comments, email DMSGMA@sldmwa.org or contact Amy Montgomery, Santa Nella County Water District, at amontgomery@sncwd.com.

We look forward to seeing you there!

Engage in the Future of Our Water Resources!

Week of May 20th



Delta-Mendota SGMA invite you to learn why your local agencies are developing groundwater sustainability plans for the future of our groundwater. Please come to one

- **Patterson**: Mon., May 20, 4:00 – 6:00pm Patterson City Hall 1 Plaza Circle
- **Los Banos**: Tue., May 21, 4:00 – 6:00pm College Greens Building 1815 Scripps Drive
- **Santa Nella**: Wed., May 22, 6:30 – 8:30pm Romero Elem. School 13500 Luis Ave.
- **Mendota**: Thu., May 23, 6:00 – 8:00pm Mendota Library 1246 Belmont Ave.

For more information please visit www.deltamendota.org, To register visit: tinyurl.com/y3bxw3yv

PROP 1 WATER BOND 2014

#DeltaMendotaSGMA | #SLDMWA | #SGMA2020

DELTA-MENDOTA SGMA



Su Opinión es Importante!

Participe en una serie de talleres sobre el futuro de sus recursos hídricos!

Semana del 20 de mayo

Agencias locales están desarrollando planes de sostenibilidad para el futuro de los recursos hídricos del agua subterránea en la región y necesitan su opinión.
Acompáñenos en uno de los siguientes talleres:

- **Patterson**: Lun.,20 de Mayo , 4–6pm Ayuntamiento de Patterson 1 Plaza Circle
- **Los Banos**: Mar., 21 de May, 4–6pm College Greens Building 1815 Scripps Dr.
- **Santa Nella**: Mie., 22 de Mayo, 6:30–8:30pm Escuela Pri. Romero 13500 Luis Ave.
- **Mendota**: Jue., 23 de Mayo, 6–8pm Biblioteca de Mendota 1246 Belmont Ave.

PROP 1 WATER BOND 2014

Para más información visite:
www.deltamendota.org
Tel: 916-418-8288
#DeltaMendotaSGMA | #SLDMWA

DELTA-MENDOTA SGMA

Contact: Kirsten Pringle, Delta-Mendota Subbasin, Stantec
(916) 418-8243, Kirsten.Pringle@stantec.com

FOR IMMEDIATE RELEASE
October 19, 2018

MEDIA ADVISORY

Sustainable Groundwater Management Act Public Workshops

What: Collaborating local agencies are hosting a series of public workshops about the Sustainable Groundwater Management Act. Learn how this landmark legislation may impact our communities, the planning process, and how people can get involved. Spanish translation will be provided.

Format: There are three workshop opportunities to attend; the content of each workshop will be the same. The first 45 minutes of each workshop will consist of an informational presentation, followed by an open house.

When:

Firebaugh – Monday, October 22, 2018
5:00 - 7:00 PM
Firebaugh Middle School MPR
1600 16th Street, Firebaugh, CA

Los Banos – Wednesday, October 24, 2018
4:00 – 6:00 PM
College Greens Building
1815 Scripps Drive, Los Banos, CA

Patterson – Thursday, October 25, 2018
4:00 – 6:00 PM
Hammon Senior Center
1033 W. Las Palmas Avenue, Patterson, CA

Who: Representatives from local groundwater sustainability agencies will be available to answer questions.

Additional Resources: The Sustainable Groundwater Management Act, www.deltamendota.org/,

Background: *The Sustainable Groundwater Management Act (SGMA) is a package of three bills (AB 1739, SB 1168, and SB 1319) that provides local agencies with a framework for managing groundwater basins in a sustainable manner. Recognizing that groundwater is most effectively managed at the local level, the SGMA empowers local agencies to achieve sustainability within 20 years.*

ATTACHMENT D. STAKEHOLDER AND COMMUNITY ORGANIZATIONS CONTACTED REGARDING COORDINATED PUBLIC WORKSHOPS

Stakeholder and Community Organizations Contacted Regarding Coordinated SGMA Workshops

Organization Name	Organization Type
Fresno County Farm Bureau	Agriculture
Merced County Farm Bureau	Agriculture
North Grassland Wildlife Foundation	Agriculture
Patterson Apricot Fiesta	Agriculture
Stanislaus County Farm Bureau	Agriculture
Asociación de Charros La Internacional del Valle de Patterson	Business
Adobe Valley Ranch	Business
Gustine Chamber of Commerce	Business
Los Banos Chamber of Commerce	Business
Patterson-Westley Chamber of Commerce	Business
Santa Nella Chamber of Commerce	Business
American Association of University Women	Civic
Gustine Rotary Club	Civic
International Association of Lions Clubs - Patterson	Civic
League of United Latin American Citizens	Civic
Los Banos Lions Club	Civic
Los Banos Rotary Club	Civic
Mendota Community Corporation	Civic
Newman Lions Club	Civic
Newman Rotary Club	Civic
Newman Women's Club	Civic
Patterson Lions Club	Civic
International Association of Lions Clubs - Mendota	Civic
International Association of the Lions Clubs - Los Banos	Civic
Italian Catholic Federation of CA Inc.	Civic
Kiwanis International	Civic
Rotary International - Los Banos	Civic
Rotary International - Patterson	Civic
Firebaugh Rotary Club Inc.	Community General Public
Casa Mobile Home Park	Community/General Public
Center for Environmental Science Accuracy & Reliability	Community/General Public
Firebaugh Senior Center	Community/General Public
Friends of Green Valley Charter	Community/General Public
Friends of the Public Library	Community/General Public
Habitat for Humanity International	Community/General Public
Los Banos Senior Center	Community/General Public
Mendota Community Center	Community/General Public
Mendota Senior Center	Community/General Public
Merced County Library - Dos Palos	Community/General Public
Merced County Library - Gustine	Community/General Public
Merced County Library - Los Banos	Community/General Public
Merced County Library - Santa Nella	Community/General Public
San Joaquin River Resource Mgmt. Coalition	Community/General Public

Santa Nella RV Park	Community/General Public
Stanislaus County Library - Newman	Community/General Public
Stanislaus County Library - Patterson	Community/General Public
Dos Palos Oro Loma Joint Unified School District	Education
Firebaugh-Las Deltas Unified School District	Education
Gustine Unified School District	Education
Los Banos Unified School District	Education
Mendota Unified School District	Education
Merced College	Education
Creekside Parent Club	Education
Academy West Insurance	Other
Academy West Insurance Firebaugh	Other
Amaral & Associates Realty	Other
American Legion	Other
American Legion Auxiliary Elijah B Hayes	Other
Andrea Brandt State Farm Insurance	Other
Benevolent & Protective Order of Elks	Other
Borelli Real Estate Services	Other
California Garden Clubs Inc.	Other
Century 21 M&M & Assoc - Los Banos	Other
Century 21 M&M & Assoc - Patterson	Other
Coldwell Banker Kaljian & Assoc	Other
Eric Rodriguez - Patterson	Other
Farmers Insurance Antonio Gonzales	Other
First Prioirty of the Central Valley	Other
Greg Nunes Real Estate	Other
Joe G. Gutierez State Farm Insurance	Other
Mendota Land Co	Other
Noah's Ark Foundation of Tracy Inc.	Other
PMZ Real Estate - Patterson	Other
PMZ Real Estate - Los Banos	Other
Rafael Ruiz - Patterson	Other
Shane P. Donion Ranch Broker	Other
The Boyd Company	Other
Valley West Properties	Other
Adventure Christian Church of Patterson	Religious
Agape Baptist Church	Religious
Bethel Community Church	Religious
Church of Christ of Patterson	Religious
Church of God of Prophecy	Religious
Connections Christian Church	Religious
Evangelical Church of Los Banos	Religious
Family Christian Center	Religious
First Baptist Church	Religious
Full Gospel Businessmen's Fellowship International	Religious
Harvest Samoan Assembly of God	Religious

Mountain House Foursquare Church	Religious
Movimiento Familiar Cristiano Catolico	Religious
Patterson Covenant Church	Religious
Patterson Christian Fellowship	Religious
Patterson Seventh Day Adventist Church	Religious

Appendix F
Fresno County Well Documents

FRESNO COUNTY DEPARTMENT OF PUBLIC HEALTH
ENVIRONMENTAL HEALTH DIVISION
P.O. Box 11867, Fresno, California 93775 Tel: (559) 600-3357 FAX: (559) 600-3379
Website: www.fcdph.org

REQUIREMENTS FOR MAINTAINING AN INACTIVE WATER WELL

An inactive water well is considered "abandoned" if it has not been used for a period of one year and must be destroyed by a licensed C-57 water well contractor unless the owner demonstrates intention to use the well again. In accordance with Section 115700 of the California Health and Safety Code, the well owner shall properly maintain an inactive well as evidence of intention for future use in such a way that the following requirements are met:

1. The well shall not impair the quality of water in the well and groundwater encountered by the well.

2. The top of the well or well casing will be provided with a cover, that is secured by a lock or by other means to prevent its removal without the aid of equipment or tools, to prevent unauthorized access, to prevent a safety hazard to humans and animals, and to prevent illegal disposal of wastes in the well.

   The cover will be watertight where the top of the well casing or other surface openings to the well are below ground level, such as in a vault or below known levels of flooding. The cover will be watertight if the well is inactive for more than five consecutive years. A pump motor, angle drive, or other surface feature of a well, when in compliance with the above provisions, shall suffice as a cover.

3. The well will be marked so as to be easily visible and located, and labeled so as to be easily identified as a well.

4. The area surrounding the well will be kept clear of brush, debris, and waste materials.

FRESNO COUNTY DEPARTMENT OF PUBLIC HEALTH
ENVIRONMENTAL HEALTH DIVISION
P.O. Box 11867, Fresno, California 93775 Tel: (559) 600-3357 FAX: (559) 600-7629

WELL DESTRUCTION REQUIREMENTS

References: California Well Standards Ordinance [WSO]
(including DWR Water Well Standards Bulletin 74-81
and 74-90, and subsequent revisions)
http://wwwdpla.water.ca.gov/sd/groundwater/california_well_standards/well_standards_content.html
California Water Code [WC]

ONLY persons who possess an active C-57 Water Well Contractors License may perform well destructions. [WC Section 13750.5; WSO Section 2.4.3] Well destruction performed as an "incidental part" of a larger job by a contractor not possessing a C-57 license is **not** allowed.

No person shall destroy any well without first applying for and receiving a **Permit** issued by the Fresno County Department of Public Health. [WSO Section 2.1.1] All available well construction data shall be submitted with the application for a well destruction permit.

All well destructions shall be performed according to Part III, Sections 20-23, Bulletin 74-81 and 74-90 [WSO Section 3].

1. A hole shall be excavated around the well casing to a depth of 5 feet below the ground surface and the well casing removed to the bottom of the excavation (a variance to not excavate the casing may be requested for special circumstances).

2. The sealing material used for the upper portion of the well shall be allowed to spill over the casing into the excavation to form a cap.

3. After the well has been properly filled, including sufficient time for the sealing material in the excavation to set, the excavation shall be filled with native soil.

4. A State of California Well Completion Report ("Well Log") shall be submitted to the Fresno County Department of Public Health within 30 days of the completion of any well destruction. [WC Section 13751; WSO Section 7.1].

Materials used for sealing and fill materials are as follows:

1. Impervious Sealing Materials. Approved imperious materials include neat cement, sand-cement grout, concrete, and betonite clay.

2. Filler Material. These include clay, silt, sand, gravel, crushed stone and clean native soils.

DEPARTMENT OF PUBLIC HEALTH - ENVIRONMENTAL HEALTH DIVISION

P.O. Box 11867 Zip 93775, 1221 Fulton Street, Fresno, California 93721
Telephone: (559) 600-3357 Fax: (559) 600-7629 Website: www.fcdph.org/water

PERMIT TO CONSTRUCT, DEEPEN, DESTROY, RECONDITION, OR REPAIR A WELL

OFFICE USE ONLY

Well Permit # _____ **PE**_____

FA# _____ **CT**_____

☐ **Corcoran Clay Depth** _____ **Ft**
(see Special Corcoran Clay Annular Seal Requirements on attachment)

☐ **Well Location in Flood Zone** **Zone:**_____
(Extend Casing above known flood level; Flood Elevation Certificate required to be submitted to the Fresno Co. Public Works. Dept. prior to approval of the well electrical permit.)

Approved _____ **Date**_____ **Seal Insp.**_____ **Date** _____

Final Insp._____ **Date** _____**Supervisor**_____

_____ _____
Application Date **Estimated Start Date**

T_____ **R**_____ **S**_____

APN _____ - _____ - _____
(*ex### -### -##*)
Contractor _____

License # _____

Phone _____

FAX _____

Job Address/Location _____ **Parcel Size** _____

Owner Name _____ **Owner Phone** _____

Owner Address_____ **City** _____ **State** _____ **Zip**_____

Type of Work
☐ New Well
☐ Replacement Well
☐ Reconstruction/Deepening
☐ Test Hole
☐ Destruction

Type of Well
☐ Casing Driven
☐ Cable Tool
☐ Hardrock
☐ Auger
☐ Direct Rotary
☐ Reverse Rotary

Intended Use
☐ Domestic Private
☐ Domestic Public
☐ Agricultural
☐ Industrial
☐ Cathodic
☐ Test Hole
☐ Monitoring
☐ Soil-Boring
☐ Other

Well Construction
Well Casing Material_____
Well Casing Diameter_____ in
Well Casing Gauge_____
Conductor Casing Material_____
Conductor Casing Diameter_____
Conductor Casing Depth_____ Ft
Annular Seal Depth_____ Ft
Borehole Diameter_____ in
Gravel Pack ☐ Yes ☐ No

Well Destruction
Type ☐ Gravel Pack ☐ Open Bottom ☐ Uncased ☐ Other_____
Well Diameter_____ In Total Depth_____ Ft
Depth to Water_____ Ft Seal Depth_____ Ft
Casing Perforated _____ Ft to _____ Ft
☐ Casing cut off_____ Ft Below Grade (6ft max allowed)
☐ Oil lubricated pump **(Any oil in the well shall be removed and properly disposed of prior to destruction)**

Sealing Material/Seal Placement Method
☐ Neat Cement ☐ 11 Sack Sand Cement ☐ Concrete
☐ Bentonite Chips – Product Name_____
☐ Pumped ☐ Free Fall **(allowed only when the interval to be sealed is dry and less than 30 Ft depth)**

Setbacks ☐ All setbacks exceed 300 Feet ☐ Other Wells _____ Ft
☐ Leach Lines _____ Ft ☐ Septic Tank _____ Ft ☐ Cesspool _____Ft ☐ Seepage Pits _____ Ft
☐ Sewer Lines _____ Ft ☐ Animal/Fowl Enclosure _____ Ft ☐ Designated Sewage Replacement Area _____ Ft
☐ Flood Control Basins _____Ft ☐ Waste Water Disposal Ponds _____ Ft ☐ Lakes/Streams _____ Ft

FEE ☐ **$656** (Domestic/Agricultural/ Cathodic/Test Hole **PE4650,** Public/Industrial **PE4652**) ☐ **$441** (Well Destruction **PE4651**)
☐ **No Charge** (Monitoring Well/Soil Boring **PE4653**)
PAYMENT METHOD ☐ Cash ☐ Check ☐ Credit Card (Online Payment Receipt Attached)

I hereby certify that the information described herein is correct. I understand that all work is to be done in accordance with the California Well Standards Ordinance and the conditions of this permit application, including any conditions which are added by the Environmental Health Division upon review of this application and issuance of the permit. I certify that I have a current C-57 Contractor's License and, if I employ workers, a current certificate of Workers' Compensation Insurance. I further understand that any permit issued pursuant to this application is subject to such further conditions as may be deemed necessary to ensure compliance with the Ordinance. **Note: This permit is non-transferable and is valid for 180 days.**

CONTRACTOR SIGNATURE:

DATE:

OFFICE USE ONLY - ENVISION CLERICAL:

Account# _____ **Invoice#** _____

Entered By _____ **Date** _____

SPECIAL REQUIREMENTS: **Faxed by** _____

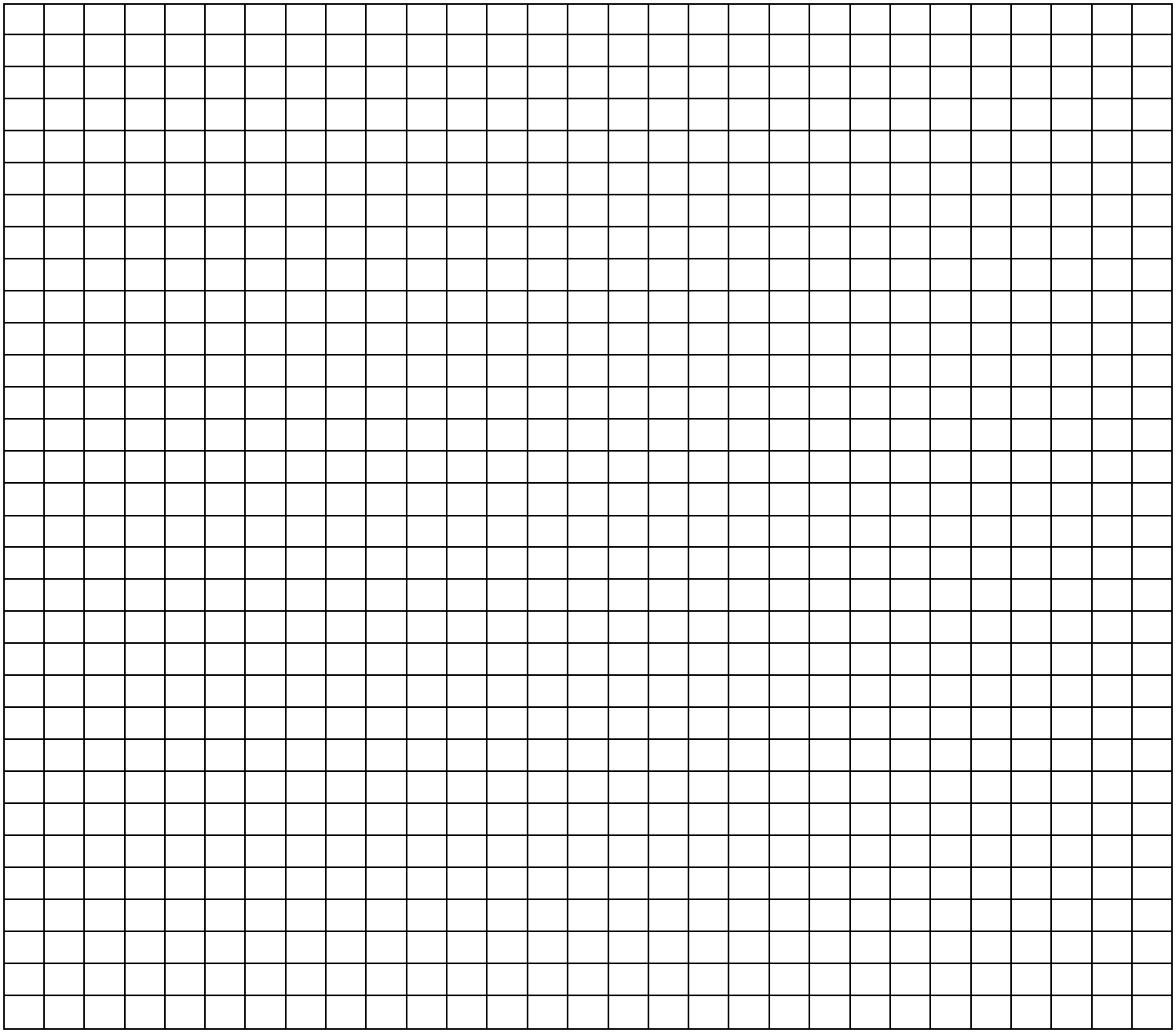
DEPARTMENT OF PUBLIC HEALTH - ENVIRONMENTAL HEALTH DIVISION
P.O. Box 11867 Zip 93775, 1221 Fulton Street, Fresno, California 93721
Telephone: (559) 600-3357 Fax: (559) 600-7629 Website: www.fcdph.org/water

PLOT PLAN TO ACCOMPANY PERMIT TO CONSTRUCT, DEEPEN, DESTROY, RECONDITION, OR REPAIR A WELL

Note: This permit is non-transferable and is valid for 180 days

Job Address / Location: _____ APN: _____/_____/_____ PERMIT # _____

Indicate distances in feet. Provide the names of streets or roads nearest to the property. Provide dimensions of the property and all existing or proposed structures. Provide locations of existing or proposed sewage disposal systems, including expansion or repair areas, within 250 feet of the new well. Provide locations of all other wells within 300 feet of the new well. Location information shall include all adjacent parcels, if within setbacks.



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Appendix G
Cleanup and Abatement Orders

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

CLEANUP AND ABATEMENT ORDER R5-2018-0033
FOR
SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE,
SPRECKELS SUGAR COMPANY, INC. AND MEYERS FARMING, LLC
FORMER SPRECKELS MENDOTA FACILITY
FRESNO COUNTY

This Order is issued to Southern Minnesota Beet Sugar Cooperative (SMBSC), Spreckels Sugar Company, Inc. (SSCI) and Meyers Farming LLC (Meyers) (*collectively*, Dischargers) pursuant to Water Code section 13304, which authorizes the California Regional Water Quality Control Board, Central Valley Region ("Central Valley Water Board" or "Board") to issue a Cleanup and Abatement Order (Order), and Water Code section 13267, which authorizes the Central Valley Water Board to require preparation and submittal of technical and monitoring reports.

The California Regional Water Quality Control Board, Central Valley Region ("Central Valley Water Board" or "Board") finds that:

GENERAL BACKGROUND

1. SSCI and its various corporate parents (see Finding No. 4, below) previously operated a sugar beet processing facility (Facility) in Fresno County, near the City of Mendota. The subject Facility covers approximately 1,863 acres, and is comprised in part of Assessor Parcel Nos. ("APN") 013-030-17S, 019-061-79S and 019-070-61S. A location map is attached to this Order as "Attachment A," and is incorporated herein.

2. Throughout the operational lifetime of the Facility, beet sugar was extracted from a dilute molasses solution using activated Precipitated Calcium Carbonate (PCC), commonly known as "lime." This operation is commonly referred to as the "Steffen's Process." The Steffen's Process resulted in a nutrient-rich, high-saline residual solution (Steffen's Waste), which consisted of organic and inorganic constituents contributing to high levels of Total Dissolved Solids (TDS). Specifically, Steffen's Waste consisted of total organic contents of approximately 9,500 milligrams per liter (mg/L) and inorganic salts concentrations of approximately 11,500 mg/L. Up until 1991, Steffen's Waste was discharged into a series of shallow, unlined pools (Steffen's Ponds) covering approximately 128 acres at the Facility. These discharges have resulted in the degradation of soil and groundwater beneath the Facility.

3. In addition to the Steffen's Waste discharge, approximately two to four million gallons per day of Facility process wastewater were applied to approximately 130 acres of ponds (Factory Ponds), which are situated to the southwest of the Steffen's Ponds. Analytical data collected from 2006 to 2008 from nine Facility wastewater samples indicate an average TDS concentration of approximately 1,800 mg/L. Waste discharges to the Factory Ponds, Sedimentation Ponds and PCC Ponds effectively ended when the Facility ceased sugar beet processing operations in 2008. Soil sample results collected in 2012 indicate elevated nitrates in soils beneath the former Factory Ponds.

4. SSCI began operating the Facility in approximately 1962. Although SSCI initially operated as a subsidiary of AMSTAR Corporation (AMSTAR), now ASR Group International, Inc. (ASR), corporate ownership of SSCI was eventually sold to Spreckels Industries, Inc. (SII)

in 1987. In 1996, SII was purchased by or merged with the Holly Sugar Corporation (HSC), a subsidiary of the Imperial Holly Corporation (IHC). In 2001, IHC filed for bankruptcy protection. SSCI assets were subsequently acquired by SMBSC in 2005. SSCI and SMBSC subsequently ended all sugar beet processing activity in fall 2008, and all sugar beet packaging operations in spring 2009. As SSCI's corporate parent and/or successor-in-interest, SMBSC is equally liable as a "discharger" under the Porter-Cologne Water Quality Control Act (Porter-Cologne Act), Water Code section 13000 et seq. SSCI, as it is presently organized, was not a direct discharger of waste material at the Facility. The discharge was discontinued in 1991 by the SSCI's ownership as it existed at the time. The parent companies who subsequently purchased the property, Imperial Sugar in 1996 and SMBSC, who purchased the Facility in 2005, assumed liability for the contamination and continued to work toward closing the Steffen's Ponds. The current SSCI ownership have worked cooperatively with staff in developing this Order.

5. In 2004, Meyers began purchasing the parcels of which the Facility is comprised. When Meyers purchased the final parcel in 2015, it became the sole owner of the Facility. As explained in further detail below, Meyers is deemed liable as a "discharger" under the Porter-Cologne Act.

6. The Dischargers and the public received an opportunity to review a draft of this Order. This Order may be revised to name other responsible parties in the future should the Board identify additional responsible parties.

GEOGRAPHIC OVERVIEW

7. Current uses of the Facility include farmland, commercial space, open land, and groundwater banking. The northernmost 240 acres of the Facility are currently occupied by olive trees, while the southernmost 220 acres of the Facility are currently occupied by pistachio trees. The 960 acres east of San Mateo Avenue—i.e., the easternmost portion of the Facility—remains open and undeveloped.

8. The westernmost portion of the Facility is used as a privately-owned groundwater bank—i.e., the Meyers Family Farm Trust Groundwater Bank—which consists of four large recharge ponds (Meyers Bank Ponds). Three of the Meyers Bank Ponds are situated approximately 1,000 feet west of the former Steffen's Ponds; the fourth Meyers Bank Pond is situated immediately north of the former Steffen's Ponds. As needed, the banked groundwater is extracted from a series of "shallow zone" extraction wells (see Finding 10, below) and pumped back to the Mendota Pool, where it is exchanged through an existing agreement with the United States Bureau of Reclamation (Bureau of Reclamation).

9. Farmers Water District (FWD) borders the northern portion of the Facility and encompasses 2,222 acres (see Attachment B). FWD infrastructure includes 10 irrigation supply wells and approximately 4.75 miles of underground pipeline. The Fresno Slough reach of the Mendota Pool borders the western portion of the Facility and is approximately three-quarters of a mile west of the former Steffen's Ponds while the San Joaquin River reach of the Mendota Pool is located approximately two miles north of the former Steffen's Ponds.

10. The Mendota Pool Group (MPG) is an unincorporated association of farmers with groundwater production wells located near the Mendota Pool. Groundwater from MPG production wells is exchanged with the Bureau of Reclamation for surface waters in accordance with the Agreement for Mendota Pool Transfer Pumping Project for use as irrigation water by MPG members in the Westlands and the San Luis Water Districts located to the west of the Mendota Pool. The Central Valley Water Board was involved in the permitting process by the Bureau of Reclamation.

GROUNDWATER CONDITIONS

11. In the vicinity of the Facility, the upper aquifer has been subdivided into water-bearing zones, the "shallow zone" (above A-clay) and the "deep zone" (between A-clay and E-Clay or Corcoran Clay).

12. Groundwater monitoring, other than for supply wells, began at the Facility in 1982, and most of the monitoring wells were installed between 1984 and 1990. The current groundwater monitoring network for the Facility is comprised of 24 "shallow zone" monitoring wells (MW-1 through MW-6, MW-9, MW-13, MW-15, MW-17 through MW-21, and MW-23 through MW-32) and eight "deep zone" monitoring wells (MW-7, MW-8, MW-10, MW-11, MW-12, MW-14, MW-16 and MW-22). Monitoring is conducted on a semi-annual basis.

13. In addition to monitoring wells, the Facility also currently has a line of eight "deep zone" production wells (i.e., PW-1 and PW-6 through PW-12; PW-1 and PW-8 have been sealed and closed) that stretch along its northernmost boundary (west to east) and border FWD. Based on a review of historical groundwater monitoring data collected from FWD wells downgradient of the Steffen's Plume, measurements of electrical conductivity (EC) have shown an increasing trend in wells R-1, R-3 and R-11 summarized as follows: R-1: 430 µmhos/cm (2001) to 1,030 µmhos/cm (2016); R-3: 560 µmhos/cm (1987) to 1,100 µmhos/cm (2016); R-11: 808 µmhos/cm (2000) to 1,420 µmhos/cm (2016). In general, EC has shown a steady increase in wells R-1 and R-3. The EC values in R-11 initially showed a decreasing trend between 2000 and 2002 but have steadily increased since that time.

14. In 2012, soil sampling and analysis revealed elevated nitrate and salt concentrations in the soils beneath the Steffen's Ponds, and elevated nitrate concentrations in soils beneath the Factory Ponds.

15. In February 2014, SSCI and SMBSC submitted a "Fate and Transport Report" from Ground Zero Analysis, Inc. (Ground Zero Report). The Ground Zero Report discussed groundwater conditions at the Facility, and recommended natural attenuation for groundwater. The Ground Zero Report went on to recommend that if mitigation were required, 160 gallons per minute should be pumped from two "shallow zone" and two "deep zone" monitoring wells. The Ground Zero Report also recommended that, during the irrigation season, the existing production wells be pumped at a minimum of 225 gallons per minute in order to mitigate offsite migration of groundwater with elevated salinity.

16. Groundwater pumping of shallow wells surrounding the Mendota Pool with discharge of the water to the Pool creates a groundwater depression, most evident during the irrigation season. This depression caused groundwater from the immediate vicinity to flow towards that depression from all directions. The propagation of the depression to the east towards the Facility is mitigated by recharge from Mendota Pool. The groundwater flow direction in the shallow zone underlying the western portion of the Facility is influenced by the operations of the Meyers Water Bank. During recharge operations, a groundwater mound is produced, thereby causing groundwater to flow radially outward. In other periods of time when recharge at the bank is not conducted, there is an easterly direction of flow in the western part of the Facility. Salinity concentrations at the Facility in the shallow zone are greatest to the east of the former Steffen's Ponds and lower to the west. This indicates the influence of the Meyer's Water Bank in the west and that higher concentrations in the central and eastern portions of the Facility originated from the Steffen's process discharge.

17. The migration of the Steffen's Plume from the shallow to deep zone and subsequent north and northeastward migration likely resulted from downward migration from the shallow zone to the deep zone where the A-Clay is not a limiting factor. The north and northeastward migration in the deep zone is a result of a predominant groundwater flow direction caused by on-site and off-site groundwater pumping.

18. Analyses of groundwater samples from on-site monitoring wells indicate that discharges of wastes from previous activities at the Facility have degraded groundwater. The TDS concentrations detected in monitoring wells are presented in **Table 1**, below.

Table 1—TDS Concentrations in Shallow Zone and Deep Zone Monitoring Wells (mg/L)

Zone	Well	Historic High	Oct. 1991, End of Steffen's Pond Discharge	Sept. 2008, End of Facility Ops.	Oct. 2015	Oct. 2015 divided by Historic High	Oct. 2015 divided by Oct. 1991	Oct. 2015 divided by Sept. 2008
Shallow Zone	MW-1	3,045	1,365	1,100	1,900	0.62	1.39	1.73
	MW-2	2,190	1,255	1,600	1,500	0.68	1.20	0.94
	MW-3	3,040	1,995	940	650	0.21	0.33	0.69
	MW-4	1,623	1,120	1,200	1,100	0.68	0.98	0.92
	MW-5	1,500	775	870	960	0.64	1.24	1.10
	MW-6	1,500	950	1,300	1,600	1.07	1.68	1.23
	MW-9	1,300	650	1,000	770	0.59	1.18	0.77
	MW-13	1,900	1,310	380	420	0.22	0.32	1.11
	MW-15	17,300	11,200	5,600	3,400	0.20	0.30	0.61
	MW-17	4,700	1,985	2,700	2,100	0.45	1.06	0.78
	MW-18	4,660	2,930	2,200	1,400	0.30	0.48	0.64
	MW-19	9,600	7,320	5,000	4,500	0.47	0.61	0.90
	MW-20	2,520	2,125	1,800	1,800	0.71	0.85	1.00
	MW-21	3,900	2,340	N/A	2,300	0.59	0.98	N/A
	MW-23	4,460	3,930	N/A	2,300	0.52	0.59	N/A

Table 1—TDS Concentrations in Shallow Zone and Deep Zone Monitoring Wells (mg/L)								
Zone	**Well**	**Historic High**	**Oct. 1991, End of Steffen's Pond Discharge**	**Sept. 2008, End of Facility Ops.**	**Oct. 2015**	**Oct. 2015 divided by Historic High**	**Oct. 2015 divided by Oct. 1991**	**Oct. 2015 divided by Sept. 2008**
	MW-24	2,900	1,280	1,400	2,100	0.72	1.64	1.50
	MW-25	8,100	1,635	2,300	2,200	0.27	1.35	0.96
	MW-26	10,800	8,400	4,000	1,400	0.13	0.17	0.35
	MW-27	7,020	2,560	3,700	1,200	0.17	0.47	0.32
	MW-28	1,500	N/A	1,200	1,500	1.00	N/A	1.25
	MW-29	1,760	N/A	1,300	1,100	0.63	N/A	0.85
	MW-30	900	N/A	590	640	0.71	N/A	1.08
	MW-31	650	N/A	590	610	0.94	N/A	1.03
	MW-32	600	N/A	210	290	0.48	N/A	1.38
	MF-1	1,400	1,400	740	730	0.52	N/A	0.99
	MF-2	1,400	1,400	510	900	0.64	N/A	1.76
	MF-3	1,700	1,700	570	1,100	0.65	N/A	1.93
	MF-4	1,600	1,600	1,200	640	0.40	N/A	0.53
	MF-5	1,800	1,800	680	560	0.31	N/A	0.82
	MF-6	1,400	1,400	1,300	630	0.45	N/A	0.48
	MF-7	2,600	2,600	480	540	0.21	N/A	1.13
	MF-8	3,100	3,100	1,700	1,800	0.58	N/A	1.06
	MF-9	2,100	2,100	1,200	1,500	0.71	N/A	1.25
	AVE.	3,472	2,901	1,592	1,398	0.53	0.88	1.00
Deep Zone	MW-7	5,000	3,860	4,000	3,800	0.76	0.98	0.95
	MW-8	1,100	485	1,000	920	0.84	1.90	0.92
	MW-10	900	1,000	880	1,200	1.33	1.20	1.36
	MW-11	1,400	1,000	1,400	1,300	0.93	1.30	0.93
	MW-12	3,540	2,540	2,100	1,300	0.37	0.51	0.62
	MW-14	1,190	860	640	690	0.58	0.80	1.08
	MW-16	6,800	4,360	3,300	3,000	0.44	0.69	0.91
	MW-22	2,780	2,540	1,700	2,100	0.76	0.83	1.24
	AVE.	2,839	2,081	1,878	1,789	0.75	1.03	1.00

19. Twelve supply wells have been installed on-site. Initial and highest total TDS concentrations for each well are presented in **Table 2**, below.

Table 2—TDS Concentrations in On-Site Supply Wells (mg/L)							
Well	**Initial Conc.**	**Well Installed**	**Last Test**	**High Conc. Date Tested**	**High Conc.**	**Last Conc.**	**Last Conc. divided by High Conc.**

Table 2—TDS Concentrations in On-Site Supply Wells (mg/L)							
Well	**Initial**	**Well**	**Last Test**	**High**	**High**	**Last Conc.**	**Last**
PW-1	235	Mar-62	Mar-03	Apr-87	1,975	1700 Closed & sealed	0.86
PW-2	121	Oct-63	Mar-88	Mar-88	1,605	1605 Closed & sealed	1.00
PW-3	138	Oct-63	Mar-88	Nov-81	617	415 Closed & sealed	0.67
PW-4	382	Oct-63	May-02	Sep-94	1,600	1300 Closed & sealed	0.81
PW-5	134	Oct-63	Apr-88	Oct-81	4,433	257 Closed & sealed	0.06
PW-6	310	Apr-83	May-16	Oct-12	1,600	640	0.40
PW-7	270	May-83	Oct-15	Sep-08	1,200	870	0.73
PW-8	265	Sep-84	May-02	Oct-98	2,300	1500 Closed & sealed	0.65
PW-9	670	Nov-84	May-16	May-11	2,400	1,500	0.63
PW-10	390	Dec-88	May-16	Oct-12	840	770	0.92
PW-11	96	Oct-01	Oct-16	Oct-16	510	510	1.00
PW-12	320	Mar-04	Oct-16	Oct-15	900	510	0.57
Avg.	278				1665	965	0.69

20. Monitoring data from groundwater monitoring wells indicate that the wastes discharged at the facility have impacted underlying groundwater. Concentrations of TDS, chloride, and sulfate for water samples collected in October 2015 from monitoring wells for the "shallow zone" of the upper unconfined aquifer are presented in Table 3, below.

Table 3—October 2015 TDS, Chloride and Sulfate Concentrations (mg/L) in "Shallow Zone" Monitoring Wells			
Well	**TDS**	**Chloride**	**Sulfate**
MW-1	1,900	270	420
MW-2	1,500	250	7
MW-3	650	99	86
MW-4	1,100	240	150

Table 3—October 2015 TDS, Chloride and Sulfate Concentrations (mg/L) in "Shallow Zone" Monitoring Wells			
Well	**TDS**	**Chloride**	**Sulfate**
MW-5	960	210	130
MW-6	1,600	440	180
MW-9	770	130	190
MW-13	420	100	79
MW-15	3,400	400	1,000
MW-17	2,100	450	260
MW-18	1,400	260	130
MW-19	4,500	730	850
MW-20	1,800	330	240
MW-21	2,300	330	160
MW-23	2,300	360	140
MW-24	2,100	490	120
MW-25	2,200	440	170
MW-26	1,400	210	180
MW-27	1,200	250	160
MW-28	1,500	240	470
MW-29	1,100	170	410
MW-30	640	39	240
MW-31	610	59	210
MW-32	290	19	98

21. Concentrations of TDS, chloride and sulfate for water samples collected in October 2015 from monitoring wells and supply wells for the "deep zone" of the upper unconfined aquifer are summarized in Table 4, below.

Table 4—October 2015 TDS, Chloride and Sulfate Concentrations (mg/L) in "Deep Zone" Monitoring Wells			
Well	TDS	Chloride	Sulfate
MW-7	3,800	1,000	<1
MW-8	920	210	12
MW-10	1,200	280	9
MW-11	1,300	300	5
MW-12	1,300	260	16
MW-14	690	120	97

Table 4—October 2015 TDS, Chloride and Sulfate Concentrations (mg/L) in "Deep Zone" Monitoring Wells			
Well	TDS	Chloride	Sulfate
MW-16	3,000	530	130
MW-22	2,100	430	13
PW-6	750	140	68
PW-7	870	160	54
PW-9	1,500	320	87
PW-10	800	180	72
PW-11	450	50	97
PW-12	900	150	120

22. Because monitoring wells were installed at the site approximately 20 years after facility operations began, pre-facility operation groundwater data is unavailable. Upgradient groundwater (west of Mendota Pool) has high salinity originating from natural causes and irrigation practices and does not reflect background conditions for the Spreckels site.

23. In their 2 December 2009 report, Revised Comments on the Steffen's Ponds Closure Plan, Luhdorff & Scalmanini Consulting Engineers (Luhdorff & Scalmanini) estimated background groundwater quality for the Facility. Luhdorff & Scalmanini used historical and contemporaneous data from onsite and offsite wells not yet affected by the plume originating from the former Steffen's Ponds. Upper Tolerance limits were calculated for the western, central, and eastern portions of the site in both the shallow and deeper groundwater zones. The Central Valley Water Board concurs with Luhdorff & Scalmanini's background groundwater quality estimates, which are set forth in Table 5, below.

Table 5—Upper Tolerance Bounds for Background TDS Concentrations (mg/L)			
Zone	Location	Sample Size	Upper Tolerance Bound
Shallow	Western Area	51	1,170
	Central Area	55	740
	Eastern Area	70	362
Deep	Western Area	35	1,100
	Central Area	93	453
	Eastern Area	26	380

24. A calculation of background groundwater quality was also made by consulting engineer John Minney. Mr. Minney's calculation includes data from west of the Mendota Pool, as well as data from wells as much as three miles away from the Facility. Much of this data originates from groundwater regimes distinctly different than that of the Facility, which are not reflective of groundwater conditions beneath the Facility. Accordingly, the Central

Valley Water Board does not consider Mr. Minney's background estimates to be correct for the site.

LEGAL FRAMEWORK

25. The Central Valley Water Board's Water Quality Control Plan for the Tulare Lake Basin, Second Edition, revised July 2016 (Basin Plan), designates beneficial uses of the waters of the State and establishes water quality objectives (WQOs) to protect those areas. The Facility overlies groundwater within the Delta-Mendota Basin Hydrologic Unit, Detailed Analysis Unit (DAU) No. 235. Present and potential future beneficial uses of this groundwater include Municipal and Domestic Supply (MUN), Agricultural Supply (AGR), Industrial Supply (IND), Industrial Process Supply (PRO), Non-Contact Water Recreation (REC-2) and Wildlife Habitat (WILD).

26. The Basin Plan contains numeric and narrative WQOs to protect beneficial uses of groundwater. For MUN-designated groundwater, the Basin Plan incorporates by reference certain drinking water maximum contaminant levels (MCLs), as promulgated in title 22, chapter 15 of the California Code of Regulations (Title 22). The relevant Title 22 MCLs are 500 mg/L, with an upper limit of 1,000 mg/L, for TDS; 250 mg/L, with an upper limit of 500 mg/L, for chloride; and 250 mg/L, with an upper limit of 500 mg/L, for sulfate. However, if natural background values exceed WQOs, the background values are used as numerical limits in lieu of the otherwise-applicable Title 22 MCLs. In this case, the concentrations of the waste constituents listed above that are currently found in groundwater, or are likely to be found in groundwater after migration from soils, significantly exceed the applicable WQOs.

27. The Basin Plan also contains narrative WQOs that apply to groundwater for tastes and odors and for toxicity. The taste and odor WQO requires in part that, groundwater not contain substances in concentrations that cause nuisance, adversely affect beneficial uses, or impart undesirable tastes and odors to municipal and domestic water supplies. The toxicity WQO requires, in part, that groundwater be maintained free of toxic substances in concentrations that produce detrimental physiological responses in humans.

28. "Pollution" is defined by Water Code section 13050, subdivision (l)(1) as "an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects either … [¶] (A) The waters for beneficial uses[,] [or] [¶] (B) Facilities which serve these beneficial uses."

29. Consistent with the State Water Resources Control Board's (State Water Board's) longstanding interpretation of "discharge" under the Porter-Cologne Act (see, e.g., Zoecon Corp., State Water Board Order WQ 86-2), the passive migration of waste from soils to groundwater constitutes a continuing "discharge" to the waters of the State.

30. Cleanup and Abatement Orders are issued pursuant to Water Code section 13304, subdivision (a), which provides in pertinent part as follows:

> A person who has discharged or discharges waste into the waters of this state in violation of any waste discharge requirement or other order or prohibition issued by a regional board or the state board, or

> who has caused or permitted, causes or permits, or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged into the waters of the state and creates, or threatens to create, a condition of pollution or nuisance, shall, upon order of the regional board, clean up the waste or abate the effects of the waste, or, in the case of threatened pollution or nuisance, take other necessary remedial action, including, but not limited to, overseeing cleanup and abatement efforts. A cleanup and abatement order issued by the state board or a regional board may require the provision of, or payment for, uninterrupted replacement water service, which may include wellhead treatment, to each affected public water supplier or private well owner. Upon failure of a person to comply with the cleanup or abatement order, the Attorney General, at the request of the board, shall petition the superior court for that county for the issuance of an injunction requiring the person to comply with the order. In the suit, the court shall have jurisdiction to grant a prohibitory or mandatory injunction, either preliminary or permanent, as the facts may warrant.

31. Subdivision (c)(1) of Water Code section 13304 further provides that

> If the waste is cleaned up or the effects of the waste are abated, or, in the case of threatened pollution or nuisance, other necessary remedial action is taken by a governmental agency, the person or persons who discharged the waste, discharges the waste, or threatened to cause or permit the discharge of the waste within the meaning of subdivision (a), are liable to that governmental agency to the extent of the reasonable costs actually incurred in cleaning up the waste, abating the effects of the waste, supervising cleanup or abatement activities, or taking other remedial action. The amount of the costs is recoverable in a civil action by, and paid to, the governmental agency and the state board to the extent of the latter's contribution to the cleanup costs from the State Water Pollution Cleanup and Abatement Account or other available funds.

32. Technical Reporting Orders are authorized under Water Code section 13267, subdivision (b)(1), which provides that:

> In conducting an investigation … the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste within its region … shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports.

33. On 18 June 1992, the State Water Board adopted Resolution 92-49, Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304 (Resolution 92-49). As amended, Resolution 92-49 sets forth the policies and procedures to be used in the investigation and cleanup of a polluted site, and requires that cleanup levels be consistent with the State Water Board's Resolution 68-16, the Statement of Policy with Respect to Maintaining High Quality of Waters in California (Anti-Degradation Policy).

34. Resolution 92-49 and the Basin Plan establish cleanup levels to be achieved. Resolution 92-49 requires the waste to be cleaned up in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored. Any alternative cleanup level to background must: (1) be consistent with the maximum benefit to the people of the State; (2) not unreasonably affect present and anticipated beneficial use of such water; and (3) not result in water quality less than that prescribed in the Basin Plan and applicable Water Quality Control Plans and Policies of the State Water Board. Resolution 92-49 also directs that investigation proceed in a progressive sequence. To the extent practical, Resolution 92-49 directs the Central Valley Water Board to require and review for adequacy written work plans for each element and phase, and the written reports that describe the results of each phase of the investigation and cleanup.

35. Chapter IV of the Basin Plan contains a policy for the Investigation and Cleanup of Contaminated Sites, which generally outlines a process that includes site investigation, source removal or containment, information requirements for the consideration of establishing cleanup levels, and a basis for establishing soil and groundwater cleanup levels.

36. California Code of Regulations, title 23, sections 3890–95 require that the dischargers submit analytical data electronically via the internet, using electronically deliverable formats (EDF) designated by the State Water Board that are both non-proprietary and available as public domain. All EDF data must be submitted over the Internet to the State Water Board Geographic Environmental Information Management System database (Geotracker). In addition, subdivision (b) of section 3895 permits the Central Valley Water Board to require submittal in alternative forms, provided the benefit or need bears a reasonable relationship to any increased burden of production.

DISCHARGERS' LIABILITY FOR CLEANUP AND ABATEMENT

37. The Facility has historically been regulated under Waste Discharge Requirements (WDRs) Resolution No. 61-147, adopted 14 December 1961. The 1961 WDRs provide in pertinent part that "[w]aste discharge shall not cause a pollution of useable ground or surface waters."

38. The prior discharges of waste to the Steffen's Ponds and Factory Ponds (see Finding Nos. 2-3), as well as the present passive migration of such waste into the groundwater of the State has created (or likely will create) a condition of pollution. In other words, the discharges have "cause[d] a pollution of useable ground … waters …" underneath the

Facility in violation of the 1961 WDRs. Accordingly, the 1961 WDRs do not preclude cleanup and abatement liability under Water Code section 13304.

39. Each of the Dischargers are subject to order under Water Code section 13304 because the Dischargers have discharged or deposited waste and/or caused or permitted waste to be discharged or deposited where it has discharged, or likely discharged to waters of the State and has created, or likely will create, a condition of pollution. The meaning of the term "discharge", as interpreted by the State Water Board in precedential orders, including State Water Board Order WQ 86-2 (*In the Matter of the Petition of Zoecon Corporation*), includes the passive migration of waste from soils to groundwater. The discharge, as stated in Finding No. 38, has resulted, or will likely result, in a condition of pollution. The condition of pollution is a priority violation and the issuance of a cleanup or abatement order pursuant to Water Code section 13304 is appropriate and consistent with policies of the Central Valley Water Board.

40. According to Meyers, SMBSC has agreed to bear the costs of cleanup and remediation at the Facility. Notwithstanding this purported agreement, Meyers remains liable as a "discharger" under the Porter-Cologne Act based on its current ownership and/or control of the Facility. However, to the extent that cleanup and remediation activities are undertaken and completed by SMBSC, such activities will be deemed to have been carried out on Meyers' behalf.

JUSTIFICATION FOR TECHNICAL REPORTS

41. The burden of preparing the reports required by this Order bears a direct relationship for the need for the reports and the benefits to be obtained from the reports. The technical reports required by this Order are necessary to assure compliance with the Water Code, the applicable Basin Plan, Resolution 92-49, Title 27, and this Order, which require the prompt identification and abatement of waste sources and the investigation and cleanup of affected areas to protect the beneficial uses of waters of the State, to protect against nuisance, and to protect human health and the environment. In accordance with Water Code section 13267(b), the Findings in this Order provide the Dischargers with a written explanation with regard to the need for remedial action and reports and identify the evidence that supports the requirement to implement cleanup and abatement activities and submit reports. The Dischargers named in this Order own and/or operated the Facility from which waste has been discharged, is discharging, or is suspected of discharging, and thus is appropriately responsible for providing the reports required by this Order.

CONSEQUENCES OF NONCOMPLIANCE

42. Should the Dischargers fail to take any of the cleanup actions specified in this Order, the Central Valley Water Board may impose administrative civil liability pursuant to Water Code section 13350, which states, in relevant part as follows:

> (a) Any person who (1) violates any cease and desist order or cleanup and abatement order hereafter issued, reissued, or amended by a regional board … shall be liable civilly, and remedies may be proposed, in accordance with subdivision (d) or (e).

***

(e) The state board or a regional board may impose civil liability administratively pursuant to Article 2.5 (commencing with Section 13323) of Chapter 5 either on a daily basis or on a per gallon basis, but not both.

(1) The civil liability on a daily basis may not exceed five thousand dollars ($5,000) for each day the violation occurs.

(A) When there is a discharge, and a cleanup and abatement order is issued, except as provided in subdivision (f), the civil liability shall not be less than five hundred dollars ($500) for each day in which the discharge occurs and for each day the cleanup and abatement order is violated.

(B) When there is no discharge, but an order issued by the regional board is violated, except as provided in subdivision (f), the civil liability shall not be less than one hundred dollars ($100) for each day in which the violation occurs.

(2) The civil liability on a per gallon basis may not exceed ten dollars ($10) for each gallon of waste discharged.

43. Should the Dischargers fail to submit any of the technical or monitoring reports required by this Order, the Central Valley Water Board may impose administrative civil liability pursuant to Water Code section 13268, which provides in relevant part as follows:

(a)(1) Any person failing or refusing to furnish technical or monitoring program reports as required by subdivision (b) of Section 13267 . . . or falsifying any information provided therein, is guilty of a misdemeanor and may be liable civilly in accordance with subdivision (b).

***

(b)(1) Civil liability may be administratively imposed by a regional board in accordance with Article 2.5 (commencing with Section 13323) of Chapter 5 for a violation of subdivision (a) in an amount which shall not exceed one thousand dollars ($1,000) for each day in which the violation occurs.

***

(c) Any person discharging hazardous waste, as defined in Section 25117 of the Health and Safety Code, who knowingly fails or refuses to furnish technical or monitoring program reports as required by subdivision (b) of Section 13267, or who knowingly falsifies any information provided in those technical or monitoring program reports, is guilty of a misdemeanor, may be civilly liable in

accordance with subdivision (d), and is subject to criminal penalties pursuant to subdivision (e).

(d)(1) Civil liability may be administratively imposed by a regional board in accordance with Article 2.5 (commencing with Section 13323) of Chapter 5 for a violation of subdivision (c) in an amount which shall not exceed five thousand dollars ($5,000) for each day in which the violation occurs.

EXEMPTION FROM CALIFORNIA ENVIRONMENTAL QUALITY ACT

44. The issuance of this Order is exempt from the requirements of the California Environmental Quality Act (Pub. Resources Code, § 21000 et seq.), as an enforcement action taken by a regulatory agency (see Cal. Code Regs., tit. 14, § 15321, subd. (a)(2)), and as an action by a regulatory agency for the protection of the environment (see *id*., § 15308).

REQUIRED ACTIONS

IT IS HEREBY ORDERED that, pursuant to Water Code sections 13304 and 13267, SMBSC, SSCI and Meyers (Dischargers) shall, as soon as reasonably possible without risk to health and safety: investigate the discharge of waste; cleanup the discharged waste and abate all effects of the discharge, including any impacts to soil and groundwater quality, in conformity with Resolution 92-49 and the Basin Plan (see Ch. IV); and complete each of the following tasks according to the specified schedule.

1. By **6 August 2018** (120 days after issuance), submit an **INVESTIGATION WORK PLAN** for Central Valley Water Board staff concurrence, and a **TIME SCHEDULE** for approval by the Executive Officer (or their designee).

    a. The **Investigation Work Plan** shall:

        i. Propose a systematic and logical sequence of tasks to delineate the lateral and vertical extent of groundwater degraded by constituents of concern originating from the Facility operations;

        ii. Contain all of the information outlined in **Attachment C**, the contents of which are incorporated as part of this Order; and

        iii. Be amended or supplemented to the satisfaction of Central Valley Water Board staff, particularly with regard to whether the proposed tasks will be capable of sufficiently delineating the extent of groundwater degradation.

    b. The **Time Schedule** shall:

        i. Be submitted concurrently with the Investigation Work Plan;

        ii. Propose a final date for submission of a **Site Assessment Report**, discussed in further detail below;

iii. Provide dates for completion of each and every task specified in the Investigation Work Plan; and

iv. Be revised as directed by Executive Officer.

c. Executive Officer approval of Time Schedule will be partly conditioned on staff concurrence regarding the Investigation Work Plan.

d. Upon Executive Officer approval, all tasks and deadlines set forth in the Time Schedule shall be incorporated (and enforceable) as part of this Order.

2. Within **90 days** of Time Schedule approval (see above), begin implementation of tasks identified in the Investigation Work Plan.

3. On the **date specified** in the approved Time Schedule, submit a **SITE ASSESSMENT REPORT** for acceptance by Central Valley Water Board staff.

a. The Site Assessment Report shall contain all information and findings outlined in **Attachment D**, the contents of which are incorporated as part of this Order.

b. If further investigation is warranted, the Site Assessment Report shall also make such recommendations, and include supplemental work plan for additional investigation.

c. If the Site Assessment Report is not accepted by Central Valley Water Board staff, it shall be revised or supplemented in accordance with staff direction.

4. Within **180 days** of Site Assessment Report acceptance, submit a **FEASIBILITY STUDY AND REMEDIAL OPTIONS EVALUATION** for concurrence by Central Valley Water Board staff.

a. The Feasibility Study and Remedial Options Evaluation shall contain all information outlined in **Attachment E**, the contents of which are incorporated as part of this Order.

b. The Dischargers shall attempt to clean up each constituent to background concentrations, or to the lowest level that is technically and economically achievable and which complies with all applicable water quality objectives of the Basin Plan.

c. Each of the three or more groundwater remediation alternatives analyzed in the report shall:

i. Meet the range of cleanup levels specified in the Basin Plan and in Resolution 92-49; and

ii. Be capable of remediation according to groundwater modeling (or a technically acceptable alternative).

5. Within **120 days** of staff concurrence with the *Feasibility Study and Remedial Options Evaluation*, submit a **CLEANUP PLAN** for Executive Officer approval.

    a. The Cleanup Plan shall:

        i. Describe the preferred groundwater remediation alternative(s) or alternatives with sufficient design and detail to construct and operate the cleanup, and includes a time schedule to conduct the cleanup activities; and

        ii. Contain all information outlined in **Attachment F**, the contents of which are incorporated as part of this Order.

    b. Upon final approval by the Executive Officer, the time schedule set forth in the Cleanup Plan shall be incorporated (and enforceable) as part of this Order.

6. Within **120 days** of *Cleanup Plan* approval, commence cleanup or installation of approved remedial systems.

7. Within **180 days** of *Cleanup Plan* approval, submit a **CLEANUP STATUS REPORT** that:

    a. Describes the status and results of the cleanup work.

    b. Clearly show whether the installation of any cleanup system is complete, and if not, give a schedule for installation of the remaining remedial systems.

8. Semi-annually after remediation system operations commence, submit **REMEDIATION PROGRESS REPORTS** to Central Valley Water Board staff.

    a. If remedial systems are optimized to improve overall efficiency, operating time or waste removal rates (see General Requirement No. 3.c), Remediation Progress Reports shall include a discussion as to whether any such optimizations were effective.

    b. If groundwater monitoring indicates the waste in groundwater has migrated beyond laterally or vertically defined limits during the half year, the Remediation Progress Report semi-annual monitoring reports must include a work plan and schedule, with work to begin within thirty days of Central Valley Water Board staff approval, to define the new plume limits.

9. If it is determined that the Steffen's Plume has impacted the beneficial uses of water, the Discharger can be further required upon notification by the Assistant Executive Officer to provide a replacement water supply or treat the water to allow continued use.

GENERAL REQUIREMENTS

1. **Reports Submitted to Central Valley Water Board**

a. All reports shall be (i) prepared by a registered professional engineer or geologist, or another individual working under their direction, and (ii) signed and stamped by the preparing or supervising professional.

b. Each report must be accompanied by a cover letter, signed by the submitting Discharger or their authorized representative, certifying, under penalty of perjury, that:

i. If applicable, that the representative is authorized by the submitting Discharger to speak on its behalf;

ii. After examining the report, he or she is familiar with its contents; and

iii. The attached report is, to the extent of their knowledge, true, complete, and accurate.

c. Each report shall be accompanied by a signed statement from the submitting Discharger or their representative indicating:

i. Whether the submitting Discharger agrees with any of the report's recommendations and proposals; and

ii. Whether the submitting Discharger approves implementation of the report's proposals.

2. **On-Site Work, Testing and Sampling**

a. Dischargers shall notify Central Valley Water Board staff at least 72 hours prior to commencing field work under the Cleanup Plan.

b. Dischargers shall not undertake any work without first obtaining:

i. Concurrence of Central Valley Water Board staff in the proposed work; and

ii. All State and local permits and access agreements necessary to fulfill the requirements of this Order.

b. Dischargers shall notify Central Valley Water Board staff at least three business days prior to conducting on-site work, testing or sampling if the subject activity:

i. Relates to environmental remediation and investigation; and

ii. Is not limited to routine monitoring, maintenance and inspection.

3. **Remediation, Treatment and Control Systems**

a. Except for brief maintenance or repair-related shutdowns, all remedial, treatment and control systems shall be **operated continually**.

b. If installed or operated as a means of treatment and control in compliance with the terms of this Order, all facilities, systems and equipment shall be **properly operated and maintained** at all times.

c. Remedial, treatment and control systems shall be **optimized as needed** to improve efficiency, operating time and waste removal rates; and any such optimizations shall be discussed in quarterly progress reports. (See Required Action No. 8.a, above.)

d. If a **planned shutdown** of any remedial, treatment or control system is expected to last more than three days, Central Valley Water Board staff shall be notified prior to the shutdown.

e. If an **unplanned shutdown** of any remedial, treatment or control system last longer than three days, Central Valley Water Board staff shall be notified of:

i. The estimated time needed to restart the offline system; and

ii. All steps being taken to restart the offline system.

4. **Continued Remediation and Monitoring**

a. The Dischargers shall maintain a number of monitoring wells sufficient to completely define and encompass all waste plumes.

b. If groundwater monitoring data indicates the waste in groundwater has migrated beyond laterally or vertically defined limits during the quarter of monitoring activity, then the quarterly monitoring reports must include a work plan and schedule, with work to begin within thirty days of Central Valley Water Board staff approval, to define the new plume limits.

c. All remediation and monitoring activity shall be continued until:

i. The Executive Officer determines that the discharge has been sufficiently assessed and/or remediated in compliance with this Order; and

ii. This Order has been amended or rescinded in writing.

5. **Requests for Extension**

a. If, for any reason, the Dischargers are unable to perform any activity or submit any report in compliance with the schedule set above (or any work schedule incorporated herein), the Dischargers may request an extension from the Executive Officer.

b. To be considered by the Executive Officer, an extension request must:

i. Be made in writing;

ii. Set forth a definite period of extension (no indefinite extensions); and

iii. Include justification for the delay.

c. Any extension request shall be submitted as soon as the situation is recognized and no later than the compliance date. Untimely requests may be disregarded.

d. All requests not approved by the Executive Officer in writing with reference to this Order, within 30 days of the original deadline, are denied.

e. An extension may be granted by revision of this Order, or by a letter from the Executive Officer.

6. **Reimbursement of Oversight Costs**

a. The Dischargers shall reimburse the Central Valley Water Board for all reasonable costs incurred in connection with oversight of the investigation and remediation of the Site, as provided in Water Code section 13304, subdivision (c)(1).

b. Failure to reimburse the Central Valley Water Board's reasonable oversight costs shall be considered a violation of this Order.

If, in the opinion of the Executive Officer, the Dischargers fail to comply with the provisions of this Order, the Executive Officer may refer this matter to the Attorney General for judicial enforcement, may issue a complaint for administrative civil liability, or may take other enforcement actions. Failure to comply with this Order may result in the assessment of Administrative Civil Liability of up to $5,000 per violation, per day, depending on the violation, pursuant to the Water Code, including sections 13268 and 13350. The Central Valley Water Board reserves its right to take any enforcement actions authorized by law.

Any person aggrieved by this action of the Central Valley Water Board may petition the State Water Board to review the action in accordance with Water Code section 13320 and California Code of Regulations, title 23, sections 2050 and following. The State Water Board must receive the petition by 5:00 p.m., 30 days after the date of this Order, except that if the thirtieth day following the date of this Order falls on a Saturday, Sunday, or State holiday, the petition must be received by the State Water Board by 5:00 p.m. on the next business day. Copies of the law and regulations applicable to filing petitions may be found on the Internet at:

http://www.waterboards.ca.gov/public_notices/petitions/water_quality

or will be provided upon request.

I, PAMELA C. CREEDON, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 6 April 2018.

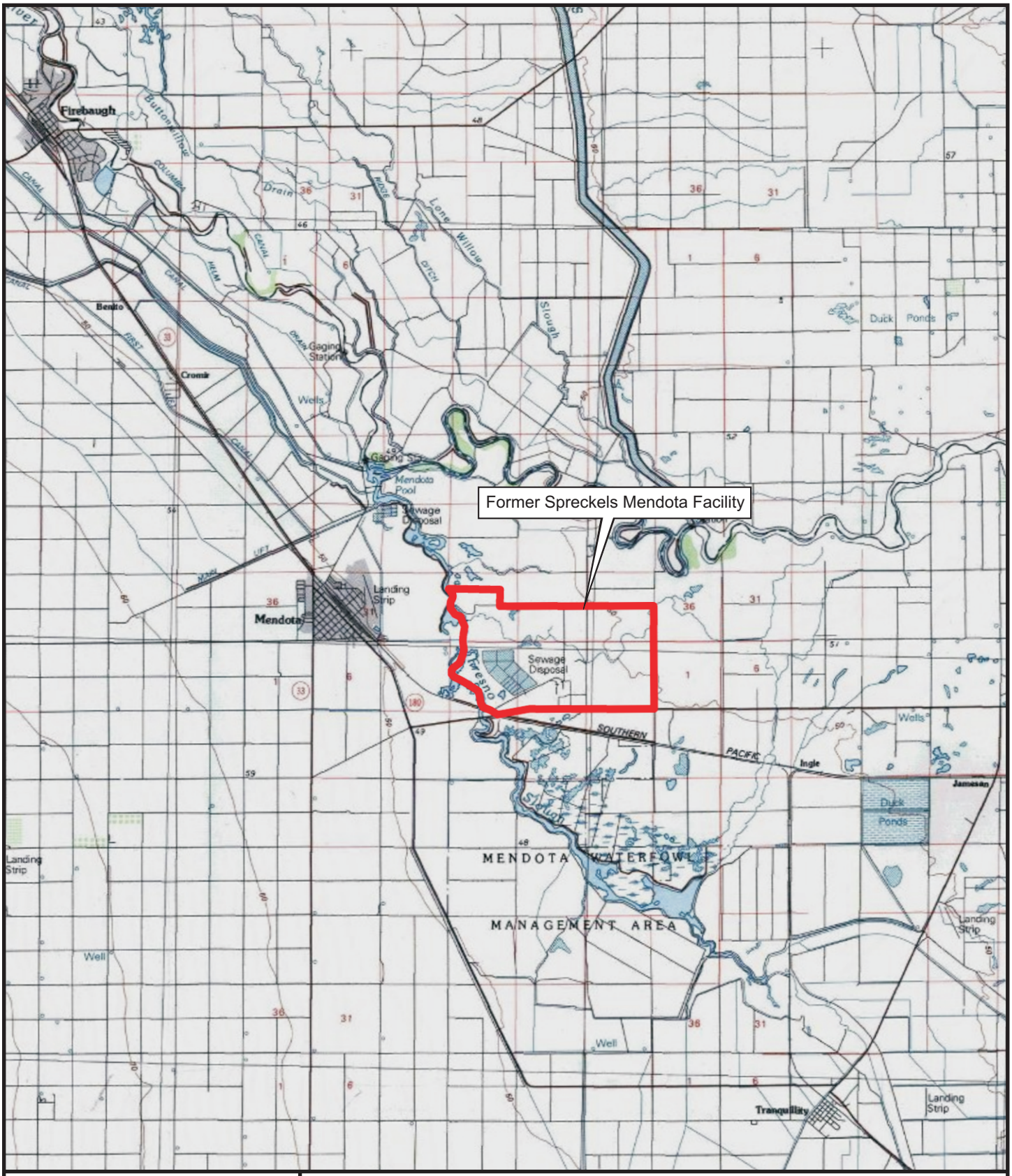
Original signed by

_____

PAMELA C. CREEDON, Executive Officer

4/6/2018

(Date)



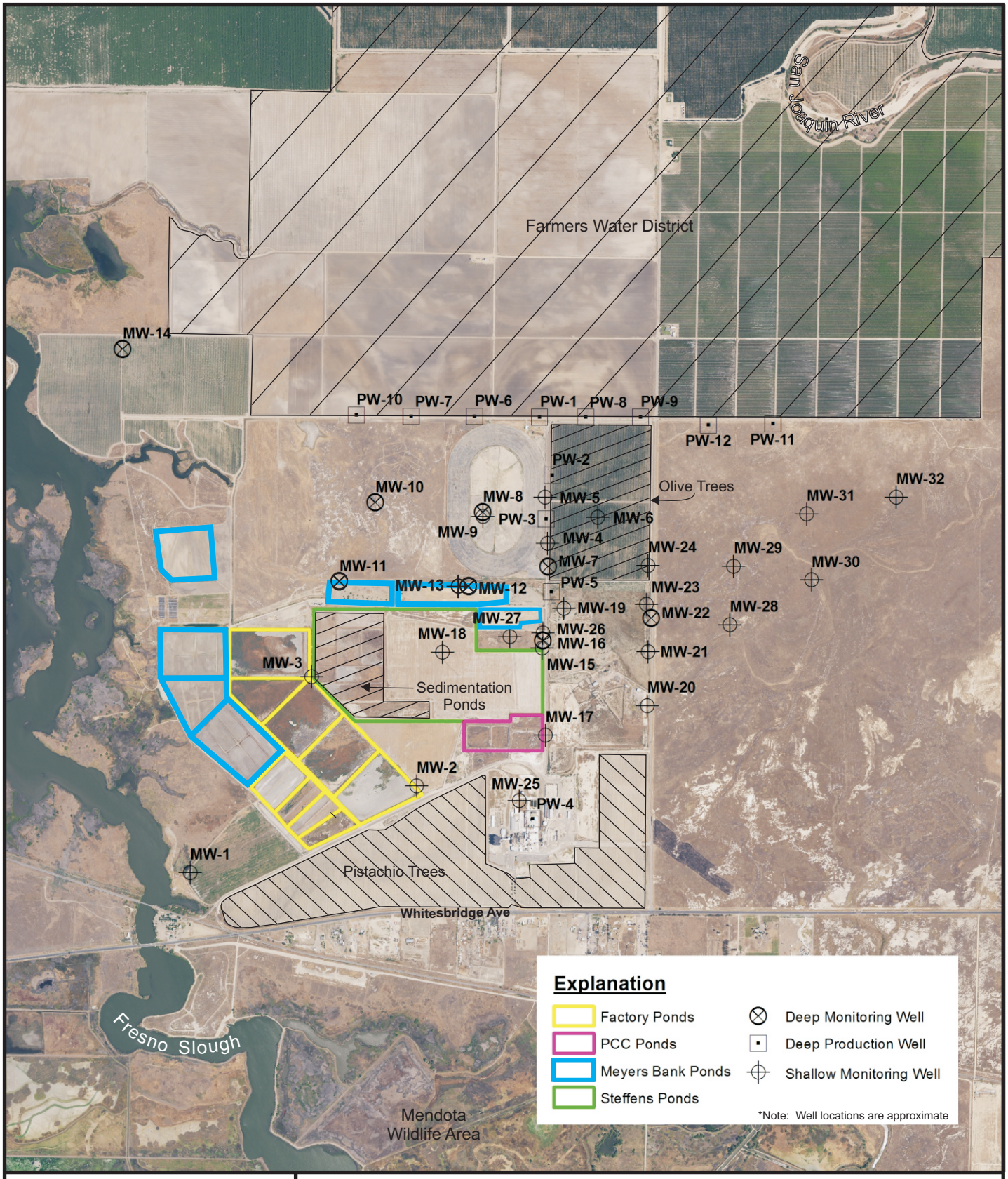
Map Source:
ArcGIS Online Premium Services
USA Topo Maps, National Geographic Society

SCALE IN MILES
0 1 2

LOCATION MAP

ORDER NO. R5-2018-0033
CLEANUP AND ABATEMENT ORDER
FOR
SPRECKELS SUGAR COMPANY INC, SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE, AND MYERS FARMING LLC
FORMER SPRECKELS MENDOTA FACILITY
FRESNO COUNTY

ATTACHMENT A



Map Source:
USDA, NAIP Aerial Photograph, 2014
Sections 33, 34, and 35, T13S, R15E, MDB&M
Sections 2, 3, and 4, T14S, R15E, MDB&M

SCALE IN FEET
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SITE MAP

ORDER NO. R5-2018-0033
CLEANUP AND ABATEMENT ORDER
FOR
SPRECKELS SUGAR COMPANY INC, SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE, AND MYERS FARMING LLC
FORMER SPRECKELS MENDOTA FACILITY
FRESNO COUNTY

ATTACHMENT B

ATTACHMENT C

ITEMS TO BE INCLUDED IN A SITE ASSESSMENT WORK PLAN

The outline below is a minimum requirement for items to be included and discussed in the text of all site assessment work plans submitted to the Board. All work plans must be signed by a registered geologist, certified engineering geologist, or civil engineer registered or certified by the State of California. Other pertinent information specific to each individual investigation also should be included.

I. **BACKGROUND**

A. *Site History*

State all operations conducted at the site.
Identify present and historic chemical usage and handling procedures.
List all chemical spills and their disposition.
Identify all past and present above ground and underground tank locations.
Identify tank capacities and other specifications as necessary.
Identify tank contents, past and present.
Submit all records of tests or repairs on fuel lines and tanks.
Identify locations of maintenance shops, chemicals used in the shops, method of chemical storage and disposal.
Identify past and present land uses and future as applicable.

B. *Topographic map of site vicinity showing:*

All natural and man-made drainage features including ditches and surface impoundments, and the drainages destination;
Utilities, especially storm drain system;
Location of existing monitoring wells, including those installed by other parties;
Locations of above ground and underground storage tanks, septic tanks, leach lines, other waste-handling facilities, and/or spill site;
Location of a major body of water relative to the site;
Location of any nearby private, municipal, or irrigation wells; and
Other major physical and man-made features.

C. *Geology/Hydrogeology*

Include proposal for logging of boreholes and characterizing site geology, and identifying unconfined or confined aquifers and contaminant flowpaths.

II. **PREVIOUS SITE ASSESSMENTS**

Provide a detailed description of any previous site assessment conducted to determine if there is any soil or ground water contamination. Include analytical results of all soil and water samples analyzed, and water level and floating product measurements.

III. **FIELD INVESTIGATION**

A. *General*
- Monitoring well or other assessment activity locations and rationale
- Survey details
- Equipment decontamination procedures
- Health and safety plan

B. *Drilling Details*
- Describe drilling and logging methods

C. *Monitoring Well Design*
- Casing diameter
- Borehole diameter
- Depth of surface seal
- Well construction materials
- Diagram of well construction
- Type of well cap
- Size of perforations and rationale
- Grain size of sand pack and rationale
- Thickness and position of bentonite seal and sand pack
- Depth of well, length and position of perforated interval

D. *Well Development*
- Method of development to be used
- Method of determining when development is complete
- Method of development water disposal

E. *Soil Sampling*
- Cuttings disposal method
- Analyses to be run and methods
- Sample collection and preservation method
- Intervals at which soil samples are to be collected
- Number of soil samples to be analyzed and rationale
- Location of soil samples and rationale
- QA/QC procedures

F. *Well Sampling*
- Minimum time after development before sampling (48 hours)
- Well purging method and amount of purge water
- Sample collection and preservation method
- QA/QC procedures

G. *Water Level Measurement*

Elevation reference point at each monitoring well shall be within 0.01 foot. Ground surface elevation at each monitoring well shall be within 0.1 foot. Method and time of water level measurement shall be specified.

IV. **QA/QC PROCEDURES**

Specify number of field blanks and duplicates.

V. **TIME SCHEDULE FOR PROPOSED WORK**

The work plan shall include a time schedule for implementation of work.

ATTACHMENT D

ITEMS TO BE INCLUDED IN A SITE ASSESSMENT REPORT

The outline below is a minimum requirement for items to be included and discussed in the text of all site assessment reports submitted to the Board. Other supporting data to be included in the report, either within the text of the report or in appendices, are italicized at the end of each section. All reports must be signed by a registered geologist, certified engineering geologist, or civil engineer registered or certified by the State of California. Other pertinent information specific to each individual investigation also should be included.

I. INTRODUCTION

Summary of past investigations
Purpose of the recent investigation
Scope of the recent investigation
Time period in which the recent investigation was carried out

II. SUMMARY

Number of wells drilled
Results of soil and water analyses
Ground water flow direction and gradient
Possible source determination

III. FIELD INVESTIGATION

Well Construction

- Number and depth of wells drilled
- Date(s) wells drilled
- Description of drilling and construction
- Approximate locations relative to facility site(s)

Supporting Data:
A well construction diagram for each well should be included in the report which shows the following details:

- Total depth drilled
- Depth of open hole (same as total depth drilled if no caving occurs)
- Footage of hole collapsed
- Length of slotted casing installed
- Depth of bottom of casing
- Depth to top of sand pack
- Thickness of sand pack
- Depth to top of bentonite seal
- Thickness of bentonite seal
- Thickness of concrete grout
- Boring diameter
- Casing diameter

Casing material
Size of perforations
Number of bags of sand
Well elevation at top of casing
Depth to ground water
Date of water level measurement
Monitoring well number
Date drilled
Location

Well Development
Date(s) of development of each well
Method of development
Volume of water purged from well
How well development completion was determined
Method of effluent disposal

Supporting Data:
Field notes from well development should be included in report.

Water Sampling
Date(s) of sampling
How well was purged
How many well volumes purged
Levels of temperature, EC, and pH at stabilization
Sample collection, handling, and preservation methods
Sample identification
Analytical methods used

Soil Sampling
Date(s) of sampling
Sample collection, handling, and preservation method
Sample identification
Analytical methods used

IV. FINDINGS OF THE INVESTIGATION

Lithology
Types of sediments encountered
Presence, location, and lateral continuity of any significant sand, silt, or clay layers
Any visual signs of contamination

Supporting Data:
Well logs geologic cross-sections should be included in the report.

Analytical Results of Soil and Ground Water Sampling
Analytical results of each monitoring well should be summarized

Supporting Data:
Laboratory analytical sheets
Chain-of-custody forms

Water Levels

Static water levels measured when well drilled
Date(s) of water level measurements
Water levels determined prior to sampling

Supporting Data:

Dates of water level measurement, depths to ground water, and ground water elevations should be tabulated and included in the report.

Ground Water Gradient and Flow Direction

Ground water gradient and flow direction determined by the investigation should be discussed and compared to the regional gradient and flow direction.

Supporting Data:

A ground water contour map, drawn to scale, should be provided which shows each well, its ground water elevation, and lines of equal ground water elevation. Ground water gradient and flow direction should be shown on the map. The calculation of the gradient should be included.

V. RESULTS OF QA/QC

QA/QC procedures
QC sample identification
Field blank analyses
Comparison of duplicate sample results

VI. CONCLUSIONS AND RECOMMENDATIONS

Evaluate any contamination found;
Compare to background levels and appropriate screening levels;
Identify any suspected source of contamination;
Recommend any further investigative needs based on data gaps; interim remedial measures; public participation;

ATTACHMENT E

ITEMS TO BE INCLUDED IN A
FEASIBILITY STUDY/REMEDIAL OPTIONS EVALUATION REPORT

The outline below is a minimum requirement for items to be included and discussed in the text of all feasibility studies/remedial option evaluation reports submitted to the Board. Reports must be signed by a registered geologist, certified engineering geologist, or civil engineer registered or certified by the state of California.

I. Purpose of Feasibility Study/Remedial Options Evaluation

II. Background

A. Description of Facility
B. Site History
   1. Years of Operation
   2. Chemical Use
   3. Chemical Releases (Potential and Documented)
C. Geology
   1. Regional
   2. Local, soil type, lithology, lateral extent of lithologic units
D. Hydrogeology
   1. Aquifers, Aquitards, Perched Aquifers
   2. Groundwater flow rates, directions, recharge, discharge
   3. Groundwater Use
   4. Effect of extraction and injection wells on groundwater flow
E. Surface Water
   1. Losing or gaining streams, ponds etc.
   2. Hydraulic connection with aquifers
F. Local Land Use
G. Previous Investigation and Remedial Actions

III. Nature and Extent of Contamination

A. Contaminants in Soils
   1. Types and Concentrations
   2. Lateral and Vertical Extent

B. Pollutants in Groundwater
   1. Types and Concentrations
   2. Lateral and Vertical Extent (including Perched Zones)

IV. Contaminant Fate and Transport

A. Contaminant Properties
   1. Mobility
   2. Toxicity
   3. Half-life
   4. Chemical and biological degradation
B. Contaminant Transport based on Soil and Aquifer Properties

V. Remedial Action Objectives

VI. Description of Remedial Action Alternatives – at a minimum, 3 alternatives must be considered

A. Alternative that meets background levels
B. Alternative that meets water quality objectives
C. Alternative that meets levels between background and water quality objectives

VII. Evaluation of Remedial Action Alternatives

A. Overall Protectiveness of Human Health and the Environment
B. Compliance with Laws and Regulations
C. Long Term Effectiveness and Permanence
D. Reduction of Toxicity, Mobility, and Volume
E. Short Term Effectiveness
F. Implementability
G. Cost
H. State and Community Acceptance

VIII. Potential Impacts of Remedial Actions

IX. Estimated Project Schedule for Each Alternative

X. Preferred Alternative

ATTACHMENT F
ITEMS TO BE INCLUDED IN A CLEANUP PLAN

The outline below is a minimum requirement for items to be included and discussed in the text of all cleanup plans submitted to the Regional Board. All reports must be signed and stamped by a registered geologist, certified engineering geologist, or civil engineer registered or certified by the State of California. Other pertinent information specific to each individual investigation also should be included.

I. INTRODUCTION

A. Site Assessment and characteristics
Site Background
Site description and location
Site history
Historic and current operations conducted at the site correlated to site contamination
Existing and planned use of the site
Present and historic chemical usage and handling procedures
Site geology and hydrogeology
Condition of surface and/or subsurface soil
All previous investigations with reference to relevant documents

B. Nature and Extent of Soil and Groundwater Contamination
1. Constituents and concentrations, including background concentrations
2. Lateral and vertical extent
3. Site maps to show above, including locations of any groundwater monitoring wells relative to soil and groundwater contamination

II. SUMMARY OF SELECTED REMEDIATION ALTERNATIVE

Discussion of selected remedial alternative
Discussion of implementation of remedial alternative
Summary of field activities
Summary of bench-scale testing
Summary of aquifer testing
Remedial investigation results
Summary of remedial goals
Compliance with Federal and State regulations, if applicable

III. TREATMENT SYSTEM DESIGN AND IMPLEMENTATION

Conceptual Model/Remedial Design
Overview
Equipment selection and operation
System schematics (layout, instrumentation, and controls)
Treatment processes
Construction activities and utility requirements
Operation, maintenance and performance monitoring

Start-up sampling and performance monitoring
Sampling and analysis plan to demonstrate system effectiveness, performance optimization, and long-term operation with respect to achieving cleanup goals
Potential for off-site migration
Emission and discharge controls
Handling and disposal procedures
Quality assurance/quality control plan

IV. CLOSURE AND POST-CLOSURE MONITORING

Cleanup Strategy
Field sampling plan for closure and post-closure monitoring
Long-term operation and maintenance of remedial action measures, if any are needed

V. TIME SCHEDULE FOR IMPLEMENTATION AND REPORTING

Appendix I
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The Nature Conservancy
Protecting nature. Preserving life.

CALIFORNIA WATER | **GROUNDWATER**

555 Capitol Mall, Suite 1290
Sacramento, California 95814
[916] 449-2850

nature.org
GroundwaterResourceHub.org

December 6, 2019

Fresno County
Water and Natural Resources Division
2220 Tulare Street 6th Floor
Fresno, CA 93721

Submitted via email to: waterandnaturalresources@fresnocountyca.gov

Re: Fresno County Management Areas A & B Groundwater Sustainability Plan (GSP)

Dear Basin Representatives,

The Nature Conservancy (TNC) appreciates the opportunity to comment on the Fresno County Management Areas A & B (FCMA) Groundwater Sustainability Plan (GSP) being prepared under the Sustainable Groundwater Management Act (SGMA).

TNC as a Stakeholder Representative for the Environment

TNC is a global, nonprofit organization dedicated to conserving the lands and waters on which all life depends. We seek to achieve our mission through science-based planning and implementation of conservation strategies. For decades, we have dedicated resources to establishing diverse partnerships and developing foundational science products for achieving positive outcomes for people and nature in California. TNC was part of a stakeholder group formed by the Water Foundation in early 2014 to develop recommendations for groundwater reform and actively worked to shape and pass SGMA.

Our reason for engaging is simple: California's freshwater biodiversity is highly imperiled. We have lost more than 90 percent of our native wetland and river habitats, leading to precipitous declines in native plants and the populations of animals that call these places home. These natural resources are intricately connected to California's economy providing direct benefits through industries such as fisheries, timber and hunting, as well as indirect benefits such as clean water supplies. SGMA must be successful for us to achieve a sustainable future, in which people and nature can thrive within the FCMA and California.

We believe that the success of SGMA depends on bringing the best available science to the table, engaging all stakeholders in robust dialog, providing strong incentives for beneficial outcomes and rigorous enforcement by the State of California.

Given our mission, we are particularly concerned about the inclusion of nature, as required, in GSPs. The Nature Conservancy (TNC) has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs. These tools and resources are available online at GroundwaterResourceHub.org. TNC's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Addressing Nature's Water Needs in GSPs

SGMA requires that all beneficial uses and users, including environmental users of groundwater, be considered in the development and implementation of GSPs (Water Code § 10723.2).

The GSP Regulations include specific requirements to identify and consider groundwater-dependent ecosystems (GDEs) [23 CCR §354.16(g)] when determining whether groundwater conditions are having potential effects on beneficial uses and users. GSAs must also assess whether sustainable management criteria may cause adverse impacts to beneficial uses and users, which include environmental uses, such as plants and animals. TNC has identified each part of GSPs where consideration of beneficial uses and users are required. That list is available here: https://groundwaterresourcehub.org/importance-of-gdes/provisions-related-to-groundwater-dependent-ecosystems-in-the-groundwater-s. Please ensure that environmental beneficial users are addressed accordingly throughout the GSP. Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decision, and using data collected through monitoring to revise decisions in the future. Over time, GSPs should improve as data gaps are reduced and uncertainties addressed.

To help ensure that GSPs adequately address nature as required under SGMA, TNC has prepared a checklist (**Attachment A**) for GSAs and their consultants to use. TNC believes the following elements are foundational for 2020 GSP submittals. For detailed guidance on how to address the checklist items, please also see our publication, *GDEs under SGMA: Guidance for Preparing GSPs*[1].

1. Environmental Representation
SGMA requires that groundwater sustainability agencies (GSAs) consider the interests of all beneficial uses and users of groundwater. To meet this requirement, we recommend actively engaging environmental stakeholders by including environmental representation on the GSA board, technical advisory group, and/or working groups. This could include local staff from state and federal resource agencies, nonprofit organizations and other environmental interests. By engaging these stakeholders, GSAs will benefit from access to additional data and resources, as well as a more robust and inclusive GSP.

2. Basin GDE and ISW Maps
SGMA requires that GDEs and interconnected surface waters (ISWs) be identified in the GSP. We recommend using the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) provided online[2] by the Department of Water Resources (DWR) as a starting point for the GDE map. The NC Dataset was developed through a collaboration between DWR, the Department of Fish and Wildlife and TNC. We also recommend using GDE Pulse, which is also available on the internet at https://gde.codefornature.org/#/home.

3. Potential Effects on Environmental Beneficial Users
SGMA requires that potential effects on GDEs and environmental surface water users be described when defining undesirable results. In addition to identifying GDEs in the basin, TNC recommends identifying beneficial users of surface water, which include environmental users. This is a critical step, as it is impossible to define "significant and unreasonable adverse impacts" without knowing *what* is being impacted. For your convenience, we've provided a

[1]GDEs under SGMA: Guidance for Preparing GSPs is available at: https://groundwaterresourcehub.org/public/uploads/pdfs/GWR_Hub_GDE_Guidance_Doc_2-1-18.pdf
[2] The Department of Water Resources' Natural Communities Commonly Associated with Groundwater dataset is available at: https://gis.water.ca.gov/app/NCDatasetViewer/

list of freshwater species within the boundary of the Delta-Mendota Subbasin (Subbasin) in **Attachment C**. Our hope is that this information will help your GSA better evaluate the impacts of groundwater management on environmental beneficial users of surface water. We recommend that after identifying which freshwater species exist in your basin, especially federal- and state-listed species, that you contact staff at the California Department of Fish and Wildlife (CDFW), United States Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Services (NMFS) to obtain their input on the groundwater and surface water needs of the organisms on the GSA's freshwater species list. We also refer you to the Critical Species Lookbook[3] prepared by TNC and partner organizations for additional background information on the water needs and groundwater reliance of critical species. Since effects to plants and animals are difficult and sometimes impossible to reverse, we recommend erring on the side of caution to preserve sufficient groundwater conditions to sustain GDEs and ISWs.

4. Biological and Hydrological Monitoring

If sufficient hydrological and biological data in and around GDEs is not available in time for the 2020/2022 plan, data gaps should be identified along with actions to reconcile the gaps in the monitoring network.

TNC has reviewed the Fresno County Management Areas A & B Draft GSP and appreciates the work that has gone into the preparation of various elements of this plan. However, we consider it to be **incomplete** under SGMA since key environmental beneficial uses and users are not adequately identified and considered. Specifically, GDEs are not evaluated for ecological importance or adequately considered in the basin's Sustainable Management Criteria. **Please present a more thorough analysis of the identification and evaluation of GDEs in subsequent drafts of the GSP**. **Additionally, they must be considered when defining Sustainable Management Criteria and evaluated for further monitoring needs**.

Our specific comments related to the FCMA GSP are provided in detail in **Attachment B** and are in reference to the numbered items in **Attachment A. Attachment C** provides a list of the freshwater species located in the Delta-Mendota Subbasin. **Attachment D** describes six best practices that GSAs and their consultants can apply when using local groundwater data to confirm a connection to groundwater for DWR's NC Dataset. **Attachment E** provides an overview of a new, free online tool (i.e., GDE Pulse) that allows GSAs to assess changes in GDE health using satellite, rainfall, and groundwater data.

Thank you for fully considering our comments as you develop your GSP.

Best Regards,



Sandi Matsumoto
Associate Director, California Water Program
The Nature Conservancy

[3] Available online at: https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/

Attachment A

Environmental User Checklist

The Nature Conservancy is neither dispensing legal advice nor warranting any outcome that could result from the use of this checklist. Following this checklist does not guarantee approval of a GSP or compliance with SGMA, both of which will be determined by DWR and the State Water Resources Control Board.

GSP Plan Element*		GDE Inclusion in GSPs: Identification and Consideration Elements	Check Box
Admin Info	**2.1.5 Notice & Communication** *23 CCR §354.10*	**Description of the types of environmental beneficial uses of groundwater that exist within GDEs and a description of how environmental stakeholders were engaged throughout the development of the GSP.**	1
Planning Framework	**2.1.2 to 2.1.4 Description of Plan Area** *23 CCR §354.8*	**Description of jurisdictional boundaries, existing land use designations, water use management and monitoring programs; general plans and other land use plans relevant to GDEs and their relationship to the GSP.**	2
		Description of instream flow requirements, threatened and endangered species habitat, critical habitat, and protected areas.	3
		Summary of process for permitting new or replacement wells for the basin, and how the process incorporates any protection of GDEs	4
Basin Setting	**2.2.1 Hydrogeologic Conceptual Model** *23 CCR §354.14*	**Basin Bottom Boundary:** Is the bottom of the basin defined as at least as deep as the deepest groundwater extractions?	5
		Principal aquifers and aquitards: Are shallow aquifers adequately described, so that interconnections with surface water and vertical groundwater gradients with other aquifers can be characterized?	6
		Basin cross sections: Do cross-sections illustrate the relationships between GDEs, surface waters and principal aquifers?	7
	2.2.2 Current & Historical Groundwater Conditions *23 CCR §354.16*	**Interconnected surface waters:**	8
		Interconnected surface water maps for the basin with gaining and losing reaches defined (included as a figure in GSP & submitted as a shapefile on SGMA portal).	9
		Estimates of current and historical surface water depletions for interconnected surface waters quantified and described by reach, season, and water year type.	10
		Basin GDE map included (as figure in text & submitted as a shapefile on SGMA Portal).	11

		If NC Dataset *was* used:	Basin GDE map denotes which polygons were kept, removed, and added from NC Dataset (Worksheet 1, can be attached in GSP section 6.0).	12
			The basin's GDE shapefile, which is submitted via the SGMA Portal, includes two new fields in its attribute table denoting: 1) which polygons were kept/removed/added, and 2) the change reason (e.g., why polygons were removed).	13
			GDEs polygons are consolidated into larger units and named for easier identification throughout GSP.	14
		If NC Dataset *was not* used:	Description of why NC dataset was not used, and how an alternative dataset and/or mapping approach used is best available information.	15
		Description of GDEs included:		16
		Historical and current groundwater conditions and variability are described in each GDE unit.		17
		Historical and current ecological conditions and variability are described in each GDE unit.		18
		Each GDE unit has been characterized as having high, moderate, or low ecological value.		19
		Inventory of species, habitats, and protected lands for each GDE unit with ecological importance (Worksheet 2, can be attached in GSP section 6.0).		20
	2.2.3 Water Budget *23 CCR §354.18*	Groundwater inputs and outputs (e.g., evapotranspiration) of native vegetation and managed wetlands are included in the basin's historical and current water budget.		21
		Potential impacts to groundwater conditions due to land use changes, climate change, and population growth to GDEs and aquatic ecosystems are considered in the projected water budget.		22
Sustainable Management Criteria	**3.1 Sustainability Goal** *23 CCR §354.24*	**Environmental stakeholders/representatives were consulted.**		23
		Sustainability goal mentions GDEs or species and habitats that are of particular concern or interest.		24
		Sustainability goal mentions whether the intention is to address pre-SGMA impacts, maintain or improve conditions within GDEs or species and habitats that are of particular concern or interest.		25
	3.2 Measurable Objectives *23 CCR §354.30*	**Description of how GDEs were considered and whether the measurable objectives and interim milestones will help achieve the sustainability goal as it pertains to the environment.**		26
	3.3 Minimum Thresholds *23 CCR §354.28*	**Description of how GDEs and environmental uses of surface water were considered when setting minimum thresholds for relevant sustainability indicators:**		27
		Will adverse impacts to GDEs and/or aquatic ecosystems dependent on interconnected surface waters (beneficial user of surface water) be avoided with the selected minimum thresholds?		28
		Are there any differences between the selected minimum threshold and state, federal, or local standards relevant to the species or habitats residing in GDEs or aquatic ecosystems dependent on interconnected surface waters?		29
	3.4 Undesirable Results *23 CCR §354.26*	**For GDEs, hydrological data are compiled and synthesized for each GDE unit:**		30
		If hydrological data *are available* within/nearby the GDE	Hydrological datasets are plotted and provided for each GDE unit (Worksheet 3, can be attached in GSP Section 6.0).	31
			Baseline period in the hydrologic data is defined.	32

			GDE unit is classified as having high, moderate, or low susceptibility to changes in groundwater.	33
			Cause-and-effect relationships between groundwater changes and GDEs are explored.	34
		If hydrological data *are not available* within/nearby the GDE	Data gaps/insufficiencies are described.	35
			Plans to reconcile data gaps in the monitoring network are stated.	36
		For GDEs, biological data are compiled and synthesized for each GDE unit:		37
		Biological datasets are plotted and provided for each GDE unit, and when possible provide baseline conditions for assessment of trends and variability.		38
		Data gaps/insufficiencies are described.		39
		Plans to reconcile data gaps in the monitoring network are stated.		40
		Description of potential effects on GDEs, land uses and property interests:		41
		Cause-and-effect relationships between GDE and groundwater conditions are described.		42
		Impacts to GDEs that are considered to be "significant and unreasonable" are described.		43
		Known hydrological thresholds or triggers (e.g., instream flow criteria, groundwater depths, water quality parameters) for significant impacts to relevant species or ecological communities are reported.		44
		Land uses include and consider recreational uses (e.g., fishing/hunting, hiking, boating).		45
		Property interests include and consider privately and publicly protected conservation lands and opens spaces, including wildlife refuges, parks, and natural preserves.		46
Sustainable Management Criteria	**3.5 Monitoring Network** *23 CCR §354.34*	Description of whether hydrological data are spatially and temporally sufficient to monitor groundwater conditions for each GDE unit.		47
		Description of how hydrological data gaps and insufficiencies will be reconciled in the monitoring network.		48
		Description of how impacts to GDEs and environmental surface water users, as detected by biological responses, will be monitored and which GDE monitoring methods will be used in conjunction with hydrologic data to evaluate cause-and-effect relationships with groundwater conditions.		49
Projects & Mgmt Actions	**4.0. Projects & Mgmt Actions to Achieve Sustainability Goal** *23 CCR §354.44*	Description of how GDEs will benefit from relevant project or management actions.		50
		Description of how projects and management actions will be evaluated to assess whether adverse impacts to the GDE will be mitigated or prevented.		51

* In reference to DWR's GSP annotated outline guidance document, available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/GD_GSP_Outline_Final_2016-12-23.pdf

Attachment B

TNC Evaluation of the
Fresno County Management Areas A & B Groundwater Sustainability Plan,
Public Review Draft

A complete draft of the Fresno County Management Areas A & B Groundwater Sustainability Plan (GSP) was provided for public review in September 2019. This attachment summarizes our comments on the complete public draft GSP. Comments are provided in the order of the checklist items included as Attachment A.

Checklist Item 1 - Notice & Communication (23 CCR §354.10)

[Section 2.5.1 Description of Beneficial Uses and Users of Groundwater (p.16)] 1-1

- Beneficial uses are listed as agricultural, domestic and environmental. There are no municipal beneficial users in FCMA. The Fresno County A & B GSP notes that the CDFW owns and operates the Mendota Wildlife Area (MWA). CDFW was contacted regarding the development of the GSP and to obtain access to construct new monitoring wells. There are no further descriptions of the environmental uses until GSP Section 3.1.7, Surface Water Features (p. 25), which describes the Mendota Pool, Fresno Slough, and the canal system near the Mendota Wildlife Area, but does not discuss the wildlife species that inhabit the areas. **Besides the Mendota Wildlife Area, please identify whether or not the following beneficial uses and users of groundwater in the Subbasin are present: Protected Lands, including refuges, conservation areas, and recreational areas; and Public Trust Uses, including wildlife, aquatic habitat, fisheries, and recreation.**
- The types and locations of environmental uses, species and habitats supported, instream flow requirements, and other designated beneficial environmental uses of surface waters that may be affected by groundwater extraction in FCMA should be specified. **To identify environmental users, please refer to the following:**
    - The NC Dataset (https://gis.water.ca.gov/app/NCDatasetViewer/) which identifies potential presence of groundwater dependent ecosystems.
    - The list of freshwater species located in the Delta-Mendota Subbasin in Attachment C of this letter. Please take particular note of the species with protected status.
    - CDFW's California Natural Diversity Database (CNDDB) - https://www.wildlife.ca.gov/Data/CNDDB
    - USFWS's IPAC report for the FCMA - https://ecos.fws.gov/ipac/

Checklist Items 2 to 4 - Description of general plans and other land use plans relevant to GDEs and their relationship to the GSP (23 CCR §354.8).

[Section 2.2 Water Resources Monitoring and Management Programs (p. 12)] 1-2

- The GSP states (p. 12): "The [Mendota Pool Group] MPG Monitoring Program was established in 1999, and over the past two decades of annual reporting has created an extensive record of groundwater, surface water, and geologic data. Some of the MPG monitoring data applicable to the FCMA GSP effort will be used to develop and implement the GSP for FCMA. Existing monitoring location (e.g. Wells, Extensometers, Surface Water Sampling Locations) will be incorporated, as necessary, into the Subbasin and FCMA monitoring network." **Please explain the relationship of existing stream flow monitoring to the protection of ISWs and GDEs.**

[Section 2.3.1 Fresno County General Plan (p. 13-14)] 1-3

- The Fresno County General Plan was adopted in 2000, prior to the formation of the GSA. FCMA is designated as "Agricultural" or "Open Space", which refers to The Mendota Wildlife Area. There are limits to the number of residential units that can be built in those areas. In this section, please include a discussion of General Plan goals and policies related to the protection and management of GDEs and aquatic resources that could be affected by groundwater withdrawals. **Please include a discussion of how implementation of the GSP may affect and be coordinated with General Plan policies and procedures regarding the protection of wetlands, aquatic resources and other GDEs and ISWs.** A
- This section should identify Habitat Conservation Plans (HCPs) or Natural Community Conservation Plans (NCCPs) within the Subbasin and if they are associated with critical, GDE or ISW habitats. **Please identify any relevant HCPs and NCCPs within the Subbasin, and address how GSP implementation will coordinate with the goals of these HCPs or NCCPs.** B
- Please refer to the Critical Species Lookbook[4] to review and discuss the potential groundwater reliance of critical species in the basin. **Please include a discussion regarding the management of critical habitat for these aquatic species and its relationship to the GSP.** C

[Section 2.4.4 Well Construction, Well Destruction, Abandonment (p. 13)] 1-4

- The county of Fresno has the authority to require permits for well abandonment, construction of new wells, reconstruction, repair, and deepening existing wells. Well permitting is currently handled by the Fresno County Environmental Health Department. The DWR well construction/destruction standards are followed (Bulletin 74-81 and 74-90). **Please include a discussion of how future well permitting will be coordinated with the GSP to assure achievement of the Plan's sustainability goals.**
- The State Third Appellate District recently found that Counties have a responsibility to consider the potential impacts of groundwater withdrawals on public trust resources when permitting new wells near streams with public trust uses (ELF vs.

[4] Available online at: https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/

SWRCB and Siskiyou County, No. C083239). **Compliance of well permitting programs with this requirement should be stated in the GSP.**

Checklist Items 5, 6, and 7 – Hydrogeologic Conceptual Model (23 CCR §354.14)

[Section 3.1.2 Local Geologic Setting (p. 19-22)] 1-5

- The basin-wide cross sections modified from Miller et al. (1971) (Figures 3-4 through 3-5) are regional, and do not include a graphical representation of the manner in which shallow groundwater may interact with ISWs or GDEs that would allow the reader to understand this topic. **Please include an example near-surface cross section that depicts the conceptual understanding of the interaction of shallow groundwater with the Fresno Slough, as well as any potential GDEs and ISWs**.

[Section 3.1.6 Definable Bottom of Basin (p. 25)] 1-6

- In the FCMA, the base of the usable aquifer corresponds with the base of freshwater, generally defined as groundwater with total dissolved solids (TDS) of 2,000 mg/L (Page, 1973), consistent with other GSAs in the Delta-Mendota Subbasin. As noted on page 9 of DWR's Hydrogeologic Conceptual Model BMP (https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_HCM_Final_2016-12-23.pdf) "the definable bottom of the basin should be at least as deep as the deepest groundwater extractions". **Thus, groundwater extraction well depth data should also be included in the determination of the basin bottom.** Properly defining the bottom of the basin will prevent the possibility of extractors with wells deeper than the basin boundary from claiming exemption from SGMA due to their well residing outside the vertical extent of the basin boundary.

[Section 3.1.3 Principal Aquifers and Aquitards (p. 22-24)] 1-7

- The GSP states (p. 22): "DWR Bulletin 118 defines three water-bearing zones within the Subbasin. These include the lower zone (defined as the Lower Aquifer), which contains confined fresh water in the lower section of the Tulare Formation, an upper zone (defined as the Upper Aquifer) which contains confined, semi-confined, and unconfined water in the upper section of the Tulare Formation and younger deposits, and a Shallow Zone which contains unconfined water within about 25 feet of the land surface (Davis 1959). This GSP defines two principal aquifers. The Lower Aquifer which is defined as the lower zone in Bulletin 118, and the Upper Aquifer which consists of the upper zone." **Please clarify in this section that the Upper Aquifer as referred to in this GSP consists of the upper zone and the shallow zone from DWR Bulletin 118, if that is the intended meaning. This seems to be confirmed in the following Section of the GSP (3.1.3.1 Upper Aquifer) but should be clearly stated in the first paragraph of Section 3.1.3 Principal Aquifers and Aquitards.**

[Section 3.1.7 Surface Water Features (p. 25-26)] 1-8

- The GSP states (p. 26): "There are not any naturally occurring springs, seeps, or wetlands in FCMA or within the model domain." This sentence seems inconsistent with other parts of the GSP, particularly section 3.2.7 Identification of Groundwater Dependent Ecosystems, which refers to wetland GDEs on the banks of the Fresno Slough. **Please revise the text to clarify the presence of wetlands, distinguishing between natural and managed wetlands if necessary.**

Checklist Items 8, 9, and 10 – Interconnected Surface Waters (ISW) (23 CCR §354.16)

[Section 3.2.6 Interconnected Surface Water Systems (p. 35)] 1-9

- The GSP confirms that the Fresno Slough is an ISW. The GSP states (p. 35): "Water levels in the Slough are controlled by the SJREC and USBR in coordination with the San Luis Delta-Mendota Water Authority (SLDMWA)." Table 3-2 provides seepage rater from the Fresno Slough to the Upper Aquifer. **Please state whether seepage rates have been quantified by reach or season and present these if known, based on the cited source [LSCE and KDSA (2000)] or other sources.**

Checklist Items 11 to 15, Identifying and Mapping GDEs (23 CCR §354.16)

[Section 3.2.7 Identification of Groundwater Dependent Ecosystems (p. 35-37)] 1-10

- The GSP states (p. 35): "GSP regulation (§ 351 m) defines GDEs as ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring within 30 feet of the ground surface." However, the exact text of the regulation is: "Groundwater dependent ecosystem refers to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." **Please revise the GSP text to correctly reflect the text of the regulation.** A
- The GSP states (p. 36): "For the vegetation data set, GDEs were first evaluated by using depth to water (DTW) measurements from Spring 2015 from Shallow Zone wells (screened above the A-Clay). Based on a water level threshold of 30 ft below ground surface (ft bgs), areas with water levels greater than 30 ft bgs were removed as containing GDEs, and areas with water levels shallower than the threshold were kept as GDEs." We have the following comments on this methodology:
    - **Please provide more details on how the depth to groundwater contours shown on Figure 3-37 were developed**: B
        - Are the wells used for interpolating depth to groundwater sufficiently close (<5km) to NC Dataset polygons to reflect local conditions relevant to ecosystems?
        - Is depth to groundwater contoured using groundwater elevations at monitoring wells to get groundwater elevation contours across the landscape? This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM) to estimate depth-to-groundwater contours across the landscape. This will provide much more accurate contours of depth-to-groundwater along streams and

other land surface depressions where GDEs are commonly found. Depth to groundwater contours developed from depth to groundwater measurements at wells assumes that the land surface is constant, which is a poor assumption to make. It is better to assume that water surface elevations are constant in between wells, and then calculate depth to groundwater using a DEM of the land surface to contour depth to groundwater.

- Spring 2015 is after the SGMA benchmark date of January 1, 2015. **Please ensure that groundwater condition data prior to the SGMA benchmark date of January 1, 2015 is included in the analysis.** C
- It is highly advised that seasonal and interannual groundwater fluctuations in the groundwater regime are taken into consideration. Utilizing groundwater data from one point in time (e.g., Spring 2015) can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. **We highly recommend using depth to groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. Please refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP <u>until</u> data gaps are reconciled in the monitoring network**. D
- **Please provide rationale for the 30-foot criteria cited in the text.** In TNC's GDE Guidance, the depth criteria of 30 feet is presented as a criterion for inclusion, not a standalone criterion for exclusion. In other words, if groundwater is within 30 feet of the ground surface, then a GDE can be identified. If it is not, then further analysis must be conducted (see Appendix III of the GDE Guidance, Worksheet 1, for other indicators of GDEs). **Please indicate what vegetation is present in the possible GDEs. The actual rooting depth of vegetation growing in the area should be a consideration, and this will vary by species dominance and habitats present.** For example, some phreatophytes can root to 120-feet deep in more arid and drought stressed environments. Furthermore, rooting depths are likely to spatially vary based on the local hydrologic conditions available to the plant. Maximum rooting depths do not take capillary action into consideration, which will vary with soil type and is an important consideration since woody phreatophytes generally do not prefer to have their roots submerged in groundwater for extended periods of time, and hence can access groundwater at deeper depths. E

- The GSP states (p. 36): "For the wetland's dataset, the areas of the Fresno Slough that were continually saturated based on historic imagery were designated as GDEs. The Fresno Slough runs through the entire FCMA. The banks of the Fresno Slough were classified as GDEi [sic] in the wetlands data set. Based on historic imagery these areas are only saturated during wet years such as 2011 and 2017. These areas

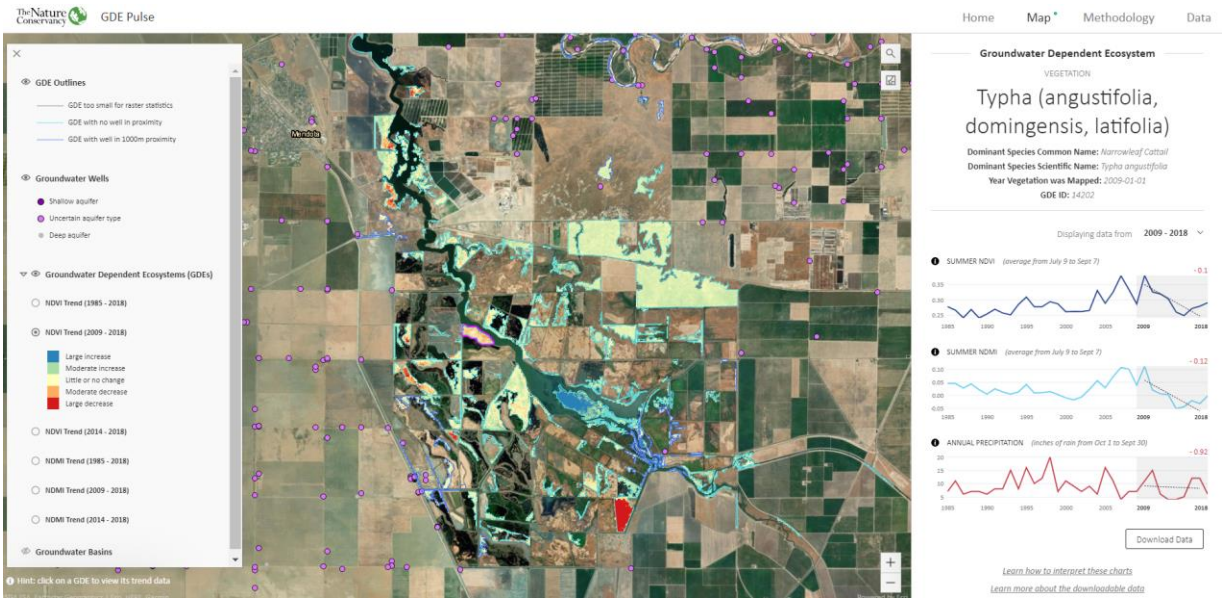
were removed as GDEs." SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface". GDEs can rely on multiple water sources simultaneously and at different temporal/spatial scales (e.g., precipitation, river water, reservoir water, soil moisture in the vadose zone, groundwater, applied water, treated wastewater effluent, urban stormwater, irrigated return flow). **Hence, we recommend that depth to groundwater (and not the level of inundation on aerial photography) be used to identify if a connection to groundwater exists. If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP <u>until</u> data gaps are reconciled in the monitoring network.** F

- **On Figure 3-37, please provide separate colors for Vegetation and Wetland GDEs removed, as was presented on Figure 2-9, and provide the removal reason. In the text or on the Figure, please cite the acreage of GDEs retained and removed. The basin's GDE shapefile, which is submitted via the SGMA Portal, should include two new fields in its attribute table denoting: 1) which polygons were kept/removed/added, and 2) the change reason (e.g., why polygons were removed).** G
- The GSP states (p. 37): "There is also significant seepage from the Mendota Pool to the Shallow Zone of the Upper Aquifer which helps maintain GDEs (Table 3-3)." **Please correct the text to refer to ***<u>Table 3-2</u>*** and seepage from the ***<u>Fresno Slough</u>*****.**

<u>Checklist Items 16 to 20, Describing GDEs (23 CCR §354.16)</u>

[Section 3.2.7 Identification of Groundwater Dependent Ecosystems (p. 35-37)] 1-11

- In Section 3.2.7.2, the GSP discusses mapped critical habitat of the endangered Fresno Kangaroo Rat as shown in Figure 3-38. However, this is only a very limited evaluation of ecological conditions and assessment of conservation value of GDEs. **Please provide an ecological inventory (see Appendix III, Worksheet 2 of the GDE Guidance) for all potential GDEs that includes the vegetation types or habitat types and rank the GDEs as having a high, moderate or low value; and what characterizes the rank.**
- **Please refer to GDE Pulse (https://gde.codefornature.org; See Attachment E of this letter for more details) or any other locally available data to describe depth to groundwater trends in and around GDE areas, as well as trends in plant growth (e.g., NDVI) and plant moisture (e.g., NDMI).** Below is a screenshot example of data available in GDE Pulse for NC dataset polygons found in FCMA:



[Section 3.2.7.3 Impacts to GDEs (p. 37)] 1-12

- The evaluation of impacts to GDEs is to be performed when defining undesirable results in the Sustainable Management Criteria section of GSP, not the Basin Setting section. **Please consider moving this discussion and consolidating it with Section 4.4 Undesirable Results**.

<u>Checklist Items 21 and 22 – Water Budget (23 CCR §354.18)</u>

[Section 3.3.6 Quantification of Current, Historic, and Projected Water Budget (p. 44-45)] 1-13

- The water budget was calculated with the USGS MODFLOW-NWT model (Niswonger et al., 2011) for an area larger than the boundaries of FCMA, as shown on Figure 3-39. **Please explain how the extended area affects the accuracy of the model projections for the FCMA.** A
- Appendix I (p. 19-20) states: "Crop coefficients for different land surface characteristics, including non-irrigated lands such as bare ground, barren/fallow lands and natural vegetation, were calculated based on the UC Davis Basic Irrigation Scheduling (BIS) application developed by Snyder et al. (2000, 2008) at monthly frequency." **Please clarify whether the term "natural vegetation" includes riparian vegetation for evapotranspiration for the historical, current, and future water budgets.** B
- The term "Other Direct Recharge" is not defined, and although it is shown in Current and Historic Groundwater Budget (Table 3-8), it is not included in the Projected Budget (Table 3-9). **Please explain how this term is derived and what it represents.** C

Checklist Items 23 to 25 – Sustainability Goal (23 CCR §354.24)

[Section 4.1 Sustainability Goal (p. 51)] 1-14

- The GSP states the Sustainability Goal as (p. 51): "FCMA will manage groundwater resources in a manner that results in the absence of undesirable results for the Upper Aquifer by the year 2040." The sustainability goal does not specifically mention beneficial uses or users of groundwater, including environmental users. **Please rephrase the Sustainability Goal to specifically call out beneficial uses and users of groundwater, including environmental users. Please state how the sustainability of environmental uses will be protected. In addition, a statement about any intention to address pre-SGMA impacts should be included.**

Checklist Item 26 – Measurable Objectives (23 CCR §354.30) 1-15

[Section 4.2.1 Measurable Objectives for Chronic Lowering of Water Levels (p. 52)]

- The description of Measurable Objectives does not explain how GDEs were considered. **Please include GDEs in this section and explain how the Measurable Objectives and Interim Milestones will help achieve the Sustainability Goal as it pertains to the environment.**

[Section 4.2.4 Measurable Objectives for Degraded Water Quality (p. 55)] 1-16

- The description of Measurable Objectives does not consider how water quality needs of GDEs were considered. **Please include a discussion about GDEs and water quality and whether the Measurable Objectives and Interim Milestones will help achieve the Sustainability Goal as it pertains to the environment.**
- This section describes how for this sustainability indicator, MAA and MAB are designated as separate management areas, based on existing groundwater quality studies and regulatory guidelines. **Please incorporate discussion of the management areas into the explanation of how GDEs will be protected by the Sustainable Management Criteria for this sustainability indicator.**

[Section 4.2.5 Measurable Objectives for Interconnected Surface Waters (p. 57)] 1-17

- The GSP states (p. 57): "This area has been designated as a management area because it has no control over water levels in the Fresno Slough. FCMA will prevent undesirable results to surrounding areas by managing groundwater elevations to sustainable levels." **Please describe the regulatory requirements that effect surface water deliveries to the Fresno Slough, and describe the conditions under which Undesirable Results *could* occur, even if outside of the control of FCMA.**

Checklist Item 27-29 – Minimum Thresholds (23 CCR §354.28)

[Section 4.3.1 Minimum Thresholds for Chronic Lowering of Groundwater Levels (p. 59)] 1-18

- The discussion of Minimum Thresholds does not consider GDEs. **Please include a discussion of GDEs and whether the measurable objectives and interim milestones will help achieve the sustainability goal as it pertains to the environment.** A
- The GSP states (p. 60): "For most of the FCMA, there was either no groundwater elevation data present where GDEs are present, primarily the MWA, or groundwater elevations were at a depth that exceeded the 30 ft threshold which was used to identify GDEs," and goes on to state (p. 61): "If water levels are ever to drop to MT levels, which is not projected to occur, further analysis of the vertical gradient in the Shallow Zone of the Upper Aquifer will be necessary to better understand the potential impacts to GDEs." **Please specifically cite the data gap in shallow groundwater levels across FCMA in this section, and state how the data gap will be reconciled or refer to a subsequent section of the document.** B

[Section 4.3.4 Minimum Thresholds for Groundwater Quality (p. 63)] 1-19

- The GSP states (p. 65): "The impact high salinity in groundwater could have on freshwater aquatic plants and animals is not well understood in the San Joaquin Valley (USBR, 2018)." **Please further discuss the possible impacts to environmental users from the Minimum Thresholds for TDS proposed in Table 4-10, in the context of information provided in USBR, 2018 and other sources.**

<u>Checklist Item 30-46 – Undesirable Results (23 CCR §354.26)</u> 1-20

[Section 4.4.1.1 Description of Undesirable Results for Groundwater Elevation (p. 69)]

- The GSP states (p. 69): "Undesirable results occur when more than 25% of wells in the Upper Aquifer exceed the established MT value for two consecutive years." The use of 25 percent to define an undesirable result does not allow for the occurrence of low water levels in one area, such as near a GDE, to be an Undesirable Result. Damage to GDEs can occur within a relatively short period of time and can be irreversible, leading to a permanent loss. A percentage violation trigger is therefore an insufficient method to prevent undesirable results to environmental users of groundwater. **Please consider the use of separate management areas for the GDE Units, so that Sustainable Management Criteria protective of GDEs can be established for the GDE Units. Please elaborate on how the exceedance criteria would be applied in a way that is protective of significant and unreasonable harm to GDEs.** A procedure could be included for violation of minimum thresholds that includes early identification of potential GDE impacts and appropriate response actions. This could be accomplished efficiently and cost-effectively using remote sensing tools, such as GDE Pulse. A
- **Please provide more specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs.** The definition of 'significant and unreasonable' is a qualitative statement that is used to describe when undesirable results would occur in the basin, such that a minimum threshold can be quantified. Potential B

effects on all beneficial users of groundwater in the basin need to be taken into consideration. According to the California Constitution Article X, §2, water resources in California must be "put to beneficial use to the fullest extent of which they are capable". **Please identify appropriate biological indicators that can be used to monitor potential impacts to environmental beneficial users due to groundwater conditions. Refer to Appendix E of this letter for an overview of a free, new online tool for monitoring the health of GDEs over time.** C

[Section 4.4.1.4 Description of Undesirable Results for Groundwater Quality (p. 69)] 1-21

- The GSP states (p. 69): "Undesirable Results occur when more than 25% of wells in MAA or MAB exceed the established MT for two consecutive years." As stated above, the use of 25 percent to define an undesirable result does not allow for the occurrence of low water levels in one area, such as near a GDE, to be an Undesirable Result. Damage to GDEs can occur within a relatively short period of time and can be irreversible, leading to a permanent loss. A percentage violation trigger is therefore an insufficient method to prevent undesirable results to environmental users of groundwater. **Please consider the use of separate management areas for the GDE Units, so that Sustainable Management Criteria protective of GDEs can be established for the GDE Units. Please elaborate on how the exceedance criteria would be applied in a way that is protective of significant and unreasonable harm to GDEs.** A procedure could be included for violation of minimum thresholds that includes early identification of potential GDE impacts and appropriate response actions. This could be accomplished efficiently and cost-effectively using remote sensing tools, such as GDE Pulse.

[Section 4.4.1.5 Description of Undesirable Results for Interconnected Surface Water (p. 70)] 1-22

- The GSP states (p. 70): "Undesirable results occur when stage values drop below the MT for two consecutive years. Undesirable results for interconnected surface waters will not trigger any management action as FCMA has no control over water levels in the Fresno Slough." The cause-effect relationship between surface water levels and the biological responses that could result in significant and unreasonable impacts to ISWs and GDEs depends on a number of factors, and this relationship is not characterized or discussed. **Please describe what Undesirable Results could be expected when stage values drop below the MT for two consecutive years.**

<u>Checklist Items 47, 48 and 49 – Monitoring Network (23 CCR §354.34)</u>

[Section 4.5.2 Groundwater Elevation Monitoring Network (p. 73)] 1-23

- **Please incorporate the discussion of data gaps presented in Section 3.1.8 (p. 27) into the Monitoring Network section.** As discussed on page 27, there are no wells in the Mendota Wildlife Area and the GSA has been unsuccessful in working with CDFW to obtain well construction information on existing wells or to obtain access to construct a new well. This is a data gap for which the GSA states that they A

will continue to work with DWR, CDFW and private duck clubs to obtain access to construct a new well.

- The five wells that are proposed for monitoring groundwater levels are shown in Figure 4-1. The single well for the Lower Aquifer, USGS 31J6, is located outside of the FCMA. The GSP states that there is no known pumping in the FCMA from the Lower Aquifer, and that the FCMA is not expected to extract groundwater from the Lower Aquifer. Lower Aquifer conditions will be monitored and managed in coordination with other entities that utilize the Lower Aquifer as a source of groundwater. **Please consider the installation of a nested well to study the impact of pumping from the Lower Aquifer in areas adjacent to FCMA to shallow groundwater levels in FCMA. Despite no current pumping from the Lower Aquifer in FCMA, pumping from this aquifer could occur in the future.** B
- Per the GSP Regulations (23 CCR §354.34 (a) and (b)), monitoring must address trends in groundwater *and related surface conditions* (emphasis added). Groundwater level monitoring alone may be insufficient to establish a linkage between groundwater extraction and potentially resulting impacts to environmental resources associated with GDEs and ISWs. The Mendota Pool staff gage will continue to be measured; it is the only monitoring that is planned for the ISWs. The cause-effect relationship between groundwater levels and the biological responses that could result in significant and unreasonable impacts to ISWs and GDEs depends on a number of factors, and this relationship is not characterized or discussed. **As such, it is not possible to determine whether the proposed monitoring is sufficiently protective to ensure significant and unreasonable impacts to GDEs and ISWs will be prevented. Please expand the discussion of the monitoring program to discuss how ISWs and GDEs will be protected.** C

Checklist Items 50 and 51 – Projects and Management Actions to Achieve Sustainability Goal (23 CCR §354.44)

[Section 5 Projects and Management Actions to Achieve Sustainability Goal (p. 80)] 1-24

- The GSP states that no PMAs (Projects and Management Actions) have been formally developed for FCMA. **If and when future projects are planned, please include environmental benefits and multiple benefits as criteria for assessing project priorities.** Environmental users and uses should be considered in establishing new projects. In addition, consistent with existing grant and funding guidelines for SGMA-related work, consideration may be given to multi-benefit projects that can address water quantity as well as providing environmental benefits or benefits to disadvantaged communities.
- **Please consider adding Management Actions which include education and outreach for protection of GDEs and ISWs.**

Attachment C

Freshwater Species Located in the Delta-Mendota Subbasin

To assist in identifying the beneficial users of surface water necessary to assess the undesirable result "depletion of interconnected surface waters", Attachment C provides a list of freshwater species located in the Delta-Mendota Subbasin. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the GSA's boundary. This database contains information on ~4,000 vertebrates, macroinvertebrates and vascular plants that depend on fresh water for at least one stage of their life cycle. The methods used to compile the California Freshwater Species Database can be found in Howard et al. 2015[5]. The spatial database contains locality observations and/or distribution information from ~400 data sources. The database is housed in the California Department of Fish and Wildlife's BIOS[6] as well as on TNC's science website[7].

Scientific Name	Common Name	Legally Protected Status		
		Federal	State	Other
BIRD				
Agelaius tricolor	Tricolored Blackbird	Bird of Conservation Concern	Special Concern	BSSC - First priority
Plegadis chihi	White-faced Ibis		Watch list	
Vireo bellii pusillus	Least Bell's Vireo	Endangered	Endangered	
Actitis macularius	Spotted Sandpiper			
Aechmophorus clarkii	Clark's Grebe			
Aechmophorus occidentalis	Western Grebe			
Aix sponsa	Wood Duck			
Anas acuta	Northern Pintail			
Anas americana	American Wigeon			
Anas clypeata	Northern Shoveler			
Anas crecca	Green-winged Teal			
Anas cyanoptera	Cinnamon Teal			
Anas discors	Blue-winged Teal			
Anas platyrhynchos	Mallard			
Anas strepera	Gadwall			
Anser albifrons	Greater White-fronted Goose			
Ardea alba	Great Egret			
Ardea herodias	Great Blue Heron			
Aythya affinis	Lesser Scaup			
Aythya americana	Redhead		Special Concern	BSSC - Third priority
Aythya collaris	Ring-necked Duck			
Aythya marila	Greater Scaup			
Aythya valisineria	Canvasback		Special	

[5] Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoSONE, 11(7). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710
[6] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS
[7] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

Botaurus lentiginosus	American Bittern			
Bucephala albeola	Bufflehead			
Bucephala clangula	Common Goldeneye			
Butorides virescens	Green Heron			
Calidris alpina	Dunlin			
Calidris mauri	Western Sandpiper			
Calidris minutilla	Least Sandpiper			
Chen caerulescens	Snow Goose			
Chen rossii	Ross's Goose			
Chlidonias niger	Black Tern		Special Concern	BSSC - Second priority
Chroicocephalus philadelphia	Bonaparte's Gull			
Cistothorus palustris palustris	Marsh Wren			
Cygnus columbianus	Tundra Swan			
Cypseloides niger	Black Swift	Bird of Conservation Concern	Special Concern	BSSC - Third priority
Dendrocygna bicolor	Fulvous Whistling-Duck		Special Concern	BSSC - First priority
Egretta thula	Snowy Egret			
Empidonax traillii	Willow Flycatcher	Bird of Conservation Concern	Endangered	
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Gallinula chloropus	Common Moorhen			
Geothlypis trichas trichas	Common Yellowthroat			
Grus canadensis	Sandhill Crane			
Haliaeetus leucocephalus	Bald Eagle	Bird of Conservation Concern	Endangered	
Himantopus mexicanus	Black-necked Stilt			
Icteria virens	Yellow-breasted Chat		Special Concern	BSSC - Third priority
Limnodromus scolopaceus	Long-billed Dowitcher			
Lophodytes cucullatus	Hooded Merganser			
Megaceryle alcyon	Belted Kingfisher			
Mergus merganser	Common Merganser			
Mergus serrator	Red-breasted Merganser			
Numenius americanus	Long-billed Curlew			
Numenius phaeopus	Whimbrel			
Nycticorax nycticorax	Black-crowned Night-Heron			
Oxyura jamaicensis	Ruddy Duck			
Pandion haliaetus	Osprey		Watch list	
Pelecanus erythrorhynchos	American White Pelican		Special Concern	BSSC - First priority
Phalacrocorax auritus	Double-crested Cormorant			

Phalaropus tricolor	Wilson's Phalarope			
Pluvialis squatarola	Black-bellied Plover			
Podiceps nigricollis	Eared Grebe			
Podilymbus podiceps	Pied-billed Grebe			
Porzana carolina	Sora			
Rallus limicola	Virginia Rail			
Recurvirostra americana	American Avocet			
Riparia riparia	Bank Swallow		Threatened	
Setophaga petechia	Yellow Warbler			BSSC - Second priority
Tachycineta bicolor	Tree Swallow			
Tringa melanoleuca	Greater Yellowlegs			
Tringa semipalmata	Willet			
Tringa solitaria	Solitary Sandpiper			
Vireo bellii	Bell's Vireo			
Xanthocephalus xanthocephalus	Yellow-headed Blackbird		Special Concern	BSSC - Third priority
CRUSTACEAN				
Branchinecta conservatio	Conservancy Fairy Shrimp	Endangered	Special	IUCN - Endangered
Branchinecta longiantenna	Longhorn Fairy Shrimp	Endangered	Special	IUCN - Endangered
Branchinecta lynchi	Vernal Pool Fairy Shrimp	Threatened	Special	IUCN - Vulnerable
Lepidurus packardi	Vernal Pool Tadpole Shrimp	Endangered	Special	IUCN - Endangered
Linderiella occidentalis	California Fairy Shrimp		Special	IUCN - Near Threatened
Artemia franciscana	San Francisco Brine Shrimp			
Branchinecta lindahli	Versatile Fairy Shrimp			
FISH				
Oncorhynchus mykiss irideus	Coastal rainbow trout			Least Concern - Moyle 2013
Pogonichthys macrolepidotus	Sacramento splittail		Special Concern	Vulnerable - Moyle 2013
Oncorhynchus mykiss - CV	Central Valley steelhead	Threatened	Special	Vulnerable - Moyle 2013
Acipenser medirostris ssp. 1	Southern green sturgeon	Threatened	Special Concern	Endangered - Moyle 2013
Acipenser transmontanus	White sturgeon		Special	Vulnerable - Moyle 2013
Archoplites interruptus	Sacramento perch		Special Concern	Endangered - Moyle 2013
Catostomus occidentalis occidentalis	Sacramento sucker			Least Concern - Moyle 2013
Cottus asper ssp. 1	Prickly sculpin			Least Concern - Moyle 2013
Entosphenus tridentata ssp. 1	Pacific lamprey		Special	Near-Threatened - Moyle 2013
Gasterosteus aculeatus microcephalus	Inland threespine stickleback		Special	Least Concern - Moyle 2013

Hysterocarpus traskii traskii	Sacramento tule perch		Special	Near-Threatened - Moyle 2013
Lampetra ayersi	River lamprey		Special Concern	Near-Threatened - Moyle 2013
Lampetra hubbsi	Kern brook lamprey		Special Concern	Vulnerable - Moyle 2013
Lampetra richardsoni	Western brook lamprey			Near-Threatened - Moyle 2013
Lavinia exilicauda exilicauda	Sacramento hitch		Special	Near-Threatened - Moyle 2013
Lavinia symmetricus symmetricus	Central California roach		Special Concern	Near-Threatened - Moyle 2013
Mylopharodon conocephalus	Hardhead		Special Concern	Near-Threatened - Moyle 2013
Oncorhynchus tshawytscha - CV fall	Central Valley fall Chinook salmon	Species of Special Concern	Special Concern	Vulnerable - Moyle 2013
Oncorhynchus tshawytscha - CV late fall	Central Valley late fall Chinook salmon	Species of Special Concern		Endangered - Moyle 2013
Orthodon microlepidotus	Sacramento blackfish			Least Concern - Moyle 2013
Ptychocheilus grandis	Sacramento pikeminnow			Least Concern - Moyle 2013
HERP				
Actinemys marmorata marmorata	Western Pond Turtle		Special Concern	ARSSC
Ambystoma californiense californiense	California Tiger Salamander	Threatened	Threatened	ARSSC
Anaxyrus boreas boreas	Boreal Toad			
Rana boylii	Foothill Yellow-legged Frog	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Rana draytonii	California Red-legged Frog	Threatened	Special Concern	ARSSC
Spea hammondii	Western Spadefoot	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Thamnophis gigas	Giant Gartersnake	Threatened	Threatened	
Thamnophis sirtalis sirtalis	Common Gartersnake			
Pseudacris regilla	Northern Pacific Chorus Frog			
Thamnophis atratus atratus	Santa Cruz Gartersnake			Not on any status lists
Thamnophis elegans elegans	Mountain Gartersnake			Not on any status lists
Thamnophis hammondii hammondii	Two-striped Gartersnake		Special Concern	ARSSC
INSECT & OTHER INVERTEBRATES				

Aeshnidae fam.	Aeshnidae fam.			
Anax junius	Common Green Darner			
Brillia spp.	Brillia spp.			
Callicorixa spp.	Callicorixa spp.			
Chironomus spp.	Chironomus spp.			
Coenagrionidae fam.	Coenagrionidae fam.			
Corisella spp.	Corisella spp.			
Cricotopus spp.	Cricotopus spp.			
Ischnura cervula	Pacific Forktail			
Ischnura denticollis	Black-fronted Forktail			
Paraleptophlebia associata	A Mayfly			
Paratanytarsus spp.	Paratanytarsus spp.			
Phaenopsectra spp.	Phaenopsectra spp.			
Procladius spp.	Procladius spp.			
Psectrocladius spp.	Psectrocladius spp.			
Tanypus spp.	Tanypus spp.			
Tipulidae fam.	Tipulidae fam.			
Trichocorixa spp.	Trichocorixa spp.			
Capnia hitchcocki	Arroyo Snowfly			
Mesocapnia bulbosa	Bulbous Snowfly			
MAMMAL				
Castor canadensis	American Beaver			Not on any status lists
Lontra canadensis canadensis	North American River Otter			Not on any status lists
Neovison vison	American Mink			Not on any status lists
Ondatra zibethicus	Common Muskrat			Not on any status lists
Anodonta californiensis	California Floater		Special	
Margaritifera falcata	Western Pearlshell		Special	
Pyrgulopsis diablensis	Diablo Range Pyrg		Special	E
PLANT				
Chloropyron molle hispidum			Special	CRPR - 1B.1
Chloropyron palmatum	NA	Endangered	Special	CRPR - 1B.1
Eryngium racemosum	Delta Coyote-thistle		Endangered	CRPR - 1B.1
Eryngium spinosepalum	Spiny Sepaled Coyote-thistle		Special	CRPR - 1B.2
Navarretia prostrata	Prostrate Navarretia		Special	CRPR - 1B.1
Puccinellia simplex	Little Alkali Grass			
Alopecurus saccatus	Pacific Foxtail			
Ammannia coccinea	Scarlet Ammannia			
Anemopsis californica	Yerba Mansa			
Arundo donax	NA			
Azolla filiculoides	NA			
Azolla microphylla	Mexican mosquito fern		Special	CRPR - 4.3
Baccharis salicina				Not on any status lists

Bacopa eisenii	Gila River Water-hyssop			
Bidens laevis	Smooth Bur-marigold			
Bolboschoenus glaucus	NA			Not on any status lists
Bolboschoenus maritimus paludosus	NA			Not on any status lists
Callitriche marginata	Winged Water-starwort			
Ceratophyllum demersum	Common Hornwort			
Cotula coronopifolia	NA			
Crassula aquatica	Water Pygmyweed			
Crypsis vaginiflora	NA			
Cyperus erythrorhizos	Red-root Flatsedge			
Cyperus squarrosus	Awned Cyperus			
Downingia bella	Hoover's Downingia			
Downingia pulchella	Flat-face Downingia			
Echinodorus berteroi	Upright Burhead			
Elatine brachysperma	Shortseed Waterwort			
Elatine californica	California Waterwort			
Eleocharis acicularis acicularis	Least Spikerush			
Eleocharis atropurpurea	Purple Spikerush			
Eleocharis coloradoensis				Not on any status lists
Eleocharis macrostachya	Creeping Spikerush			
Eleocharis montevidensis	Sand Spikerush			
Eleocharis quadrangulata	NA			
Elodea canadensis	Broad Waterweed			
Epilobium cleistogamum	Cleistogamous Spike-primrose			
Eragrostis hypnoides	Teal Lovegrass			
Eryngium castrense	Great Valley Eryngo			
Eryngium vaseyi vallicola				Not on any status lists
Eryngium vaseyi vaseyi	Vasey's Coyote-thistle			Not on any status lists
Euthamia occidentalis	Western Fragrant Goldenrod			
Hydrocotyle verticillata verticillata	Whorled Marsh-pennywort			
Juncus acuminatus	Sharp-fruit Rush			
Juncus xiphioides	Iris-leaf Rush			
Lasthenia ferrisiae	Ferris' Goldfields		Special	CRPR - 4.2
Lasthenia fremontii	Fremont's Goldfields			
Lemna aequinoctialis	Lesser Duckweed			
Lemna gibba	Inflated Duckweed			
Lemna minor	Lesser Duckweed			
Lepidium jaredii jaredii	Jared's Pepper-grass		Special	CRPR - 1B.2
Lepidium oxycarpum	Sharp-pod Pepper-grass			
Limnanthes douglasii douglasii	Douglas' Meadowfoam			

Limosella acaulis	Southern Mudwort			
Lipocarpha micrantha	Dwarf Bulrush			
Ludwigia peploides peploides	NA			Not on any status lists
Ludwigia repens	Creeping Seedbox			
Lythrum californicum	California Loosestrife			
Marsilea vestita vestita	NA			Not on any status lists
Mimulus cardinalis	Scarlet Monkeyflower			
Mimulus guttatus	Common Large Monkeyflower			
Montia fontana fontana	Fountain Miner's-lettuce			
Myosurus minimus	NA			
Myosurus sessilis	Sessile Mousetail			
Myriophyllum aquaticum	NA			
Najas guadalupensis guadalupensis	Southern Naiad			
Navarretia heterandra	Tehama Navarretia			
Navarretia leucocephala leucocephala	White-flower Navarretia			
Neostapfia colusana	Colusa Grass	Threatened	Endangered	CRPR - 1B.1
Panicum dichotomiflorum	NA			
Paspalum distichum	Joint Paspalum			
Persicaria hydropiperoides				Not on any status lists
Persicaria lapathifolia				Not on any status lists
Persicaria maculosa	NA			Not on any status lists
Persicaria pensylvanica	NA			Not on any status lists
Phacelia distans	NA			
Phyla lanceolata	Fog-fruit			
Phyla nodiflora	Common Frog-fruit			
Pilularia americana	NA			
Plagiobothrys acanthocarpus	Adobe Popcorn-flower			
Plagiobothrys greenei	Greene's Popcorn-flower			
Plagiobothrys humistratus	Dwarf Popcorn-flower			
Plagiobothrys leptocladus	Alkali Popcorn-flower			
Plantago elongata elongata	Slender Plantain			
Pluchea odorata odorata	Scented Conyza			
Pogogyne douglasii	NA			
Pogogyne zizyphoroides				Not on any status lists
Potamogeton diversifolius	Water-thread Pondweed			
Potamogeton foliosus foliosus	Leafy Pondweed			
Potamogeton nodosus	Longleaf Pondweed			
Potamogeton pusillus pusillus	Slender Pondweed			

Psilocarphus brevissimus brevissimus	Dwarf Woolly-heads			
Psilocarphus oregonus	Oregon Woolly-heads			
Psilocarphus tenellus	NA			
Ranunculus sceleratus	NA			
Rorippa curvisiliqua curvisiliqua	Curve-pod Yellowcress			
Rorippa palustris palustris	Bog Yellowcress			
Rotala ramosior	Toothcup			
Ruppia cirrhosa	Widgeon-grass			
Ruppia maritima	Ditch-grass			
Sagittaria longiloba	Longbarb Arrowhead			
Sagittaria montevidensis calycina				Not on any status lists
Salix exigua exigua	Narrowleaf Willow			
Salix gooddingii	Goodding's Willow			
Schoenoplectus acutus occidentalis	Hardstem Bulrush			
Schoenoplectus americanus	Three-square Bulrush			
Sinapis alba	NA			
Sparganium eurycarpum eurycarpum				
Stuckenia pectinata				Not on any status lists
Typha domingensis	Southern Cattail			
Typha latifolia	Broadleaf Cattail			
Veronica americana	American Speedwell			
Wolffiella lingulata	Tongue Bogmat			
Zannichellia palustris	Horned Pondweed			

Attachment D

The Nature Conservancy

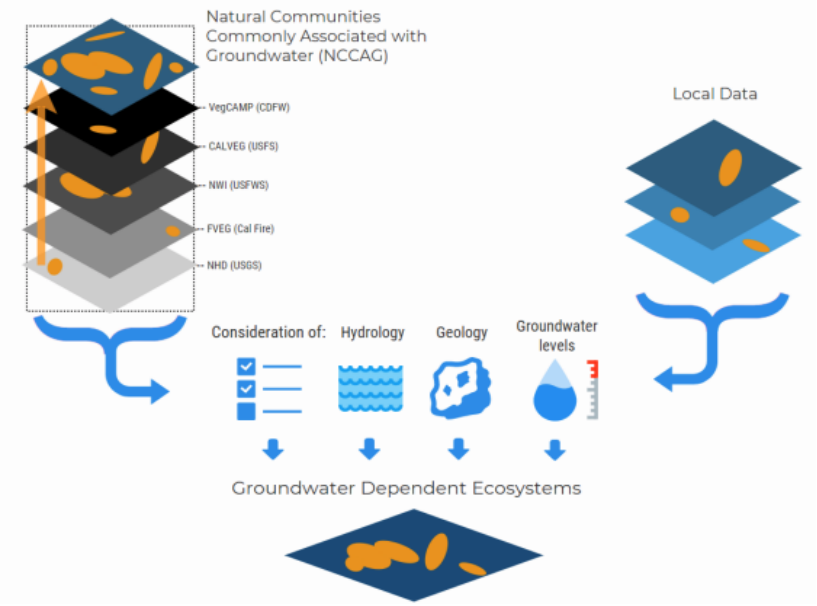
July 2019



IDENTIFYING GDEs UNDER SGMA

Best Practices for using the NC Dataset

The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online[8] to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)[9]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.



[8] *NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/*

[9] California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf

The NC Dataset identifies vegetation and wetland features that are good indicators of a GDE. The dataset is comprised of 48 publicly available state and federal datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California[10]. It was developed through a collaboration between DWR, the Department of Fish and Wildlife, and The Nature Conservancy (TNC). TNC has also provided detailed guidance on identifying GDEs from the NC dataset[11] on the Groundwater Resource Hub[12], a website dedicated to GDEs.

BEST PRACTICE #1. Establishing a Connection to Groundwater

Groundwater basins can be comprised of one continuous aquifer (Figure 2a) or multiple aquifers stacked on top of each other (Figure 2b). In unconfined aquifers (Figure 2a), using the depth-to-groundwater and the rooting depth of the vegetation is a reasonable method to infer groundwater dependence for GDEs. If groundwater is well below the rooting (and capillary) zone of the plants and any wetland features, the ecosystem is considered disconnected and groundwater management is not likely to affect the ecosystem (Figure 2d). However, it is important to consider local conditions (e.g., soil type, groundwater flow gradients, and aquifer parameters) and to review groundwater depth data from multiple seasons and water year types (wet and dry) because intermittent periods of high groundwater levels can replenish perched clay lenses that serve as the water source for GDEs (Figure 2c). Maintaining these natural groundwater fluctuations are important to sustaining GDE health.

Basins with a stacked series of aquifers (Figure 2b) may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, such as perched aquifers, that support springs, surface water, domestic wells, and GDEs (Figure 2). This is because vertical groundwater gradients across aquifers may result in pumping from deeper aquifers to cause adverse impacts onto beneficial users reliant on shallow aquifers or interconnected surface water. The goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. While groundwater pumping may not be currently occurring in a shallower aquifer, use of this water may become more appealing and economically viable in future years as pumping restrictions are placed on the deeper production aquifers in the basin to meet the sustainable yield and criteria. Thus, identifying GDEs in the basin should done irrespective to the amount of current pumping occurring in a particular aquifer, so that future impacts on GDEs due to new production can be avoided. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer*.

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[10] *For more details on the mapping methods, refer to: Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf*

[11] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at: https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/

[12] *The Groundwater Resource Hub: www.GroundwaterResourceHub.org*

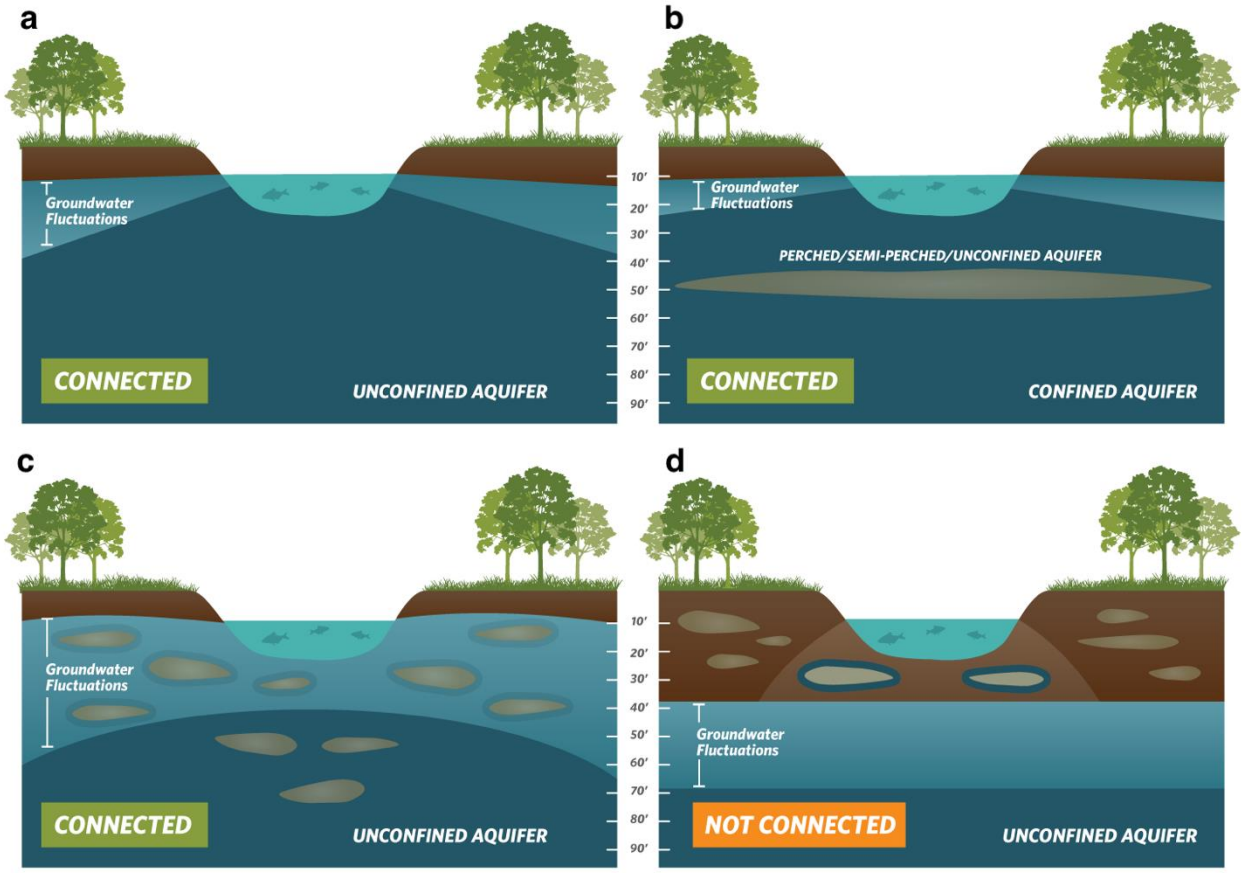


Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. **(b)** Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. **Bottom: (c)** Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem's connection to groundwater. **(d)** Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is due to direct recharge from precipitation and indirect recharge under the surface water feature. These areas are not connected to groundwater and typically support species that do not require access to groundwater to survive.

BEST PRACTICE #2. Characterize Seasonal and Interannual Groundwater Conditions

SGMA requires GSAs to describe current and historical groundwater conditions when identifying GDEs [23 CCR §354.16(g)]. Relying solely on the SGMA benchmark date (January 1, 2015) or any other single point in time to characterize groundwater conditions (e.g., depth-to-groundwater) is inadequate because managing groundwater conditions with data from one time point fails to capture the seasonal and interannual variability typical of California's climate. DWR's Best Management Practices document on water budgets[13] recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline[14] could be determined based on data between 2005 and 2015. Using this or a similar time period, depending on data availability, is recommended for determining the depth-to-groundwater.

GDEs depend on groundwater levels being close enough to the land surface to interconnect with surface water systems or plant rooting networks. The most practical approach[15] for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in TNC's GDE guidance document[4], one of the key factors to consider when mapping GDEs is to contour depth-to-groundwater in the aquifer that is supporting the ecosystem (see Best Practice #5).

Groundwater levels fluctuate over time and space due to California's Mediterranean climate (dry summers and wet winters), climate change (flood and drought years), and subsurface heterogeneity in the subsurface (Figure 3). Many of California's GDEs have adapted to dealing with intermittent periods of water stress, however if these groundwater conditions are prolonged, adverse impacts to GDEs can result. While depth-to-groundwater levels within 30 feet[4] of the land surface are generally accepted as being a proxy for confirming that polygons in the NC dataset are supported by groundwater, it is highly advised that fluctuations in the groundwater regime be characterized to understand the seasonal and interannual groundwater variability in GDEs. Utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Time series data on groundwater elevations and depths are available on the SGMA Data Viewer[16]. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network (see Best Practice #6).

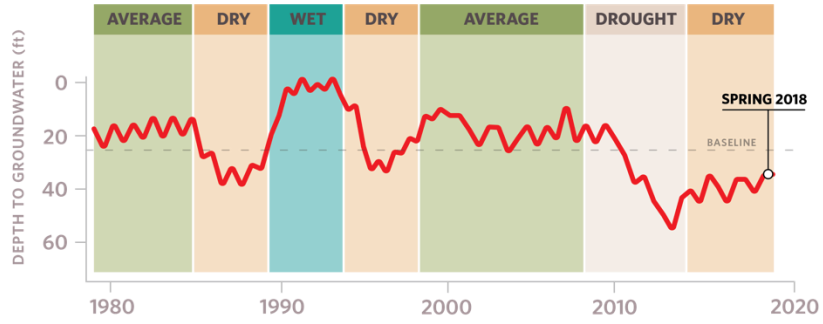


Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so adverse impacts are avoided.

[13] DWR. 2016. Water Budget Best Management Practice. Available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf

[14] *Baseline is defined under the GSP regulations as "historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin." [23 CCR §351(e)]*

[15] Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs[4]).

[16] *SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer*

BEST PRACTICE #3. Ecosystems Often Rely on Both Groundwater and Surface Water

GDEs are plants and animals that rely on groundwater for all or some of its water needs, and thus can be supported by multiple water sources. The presence of non-groundwater sources (e.g., surface water, soil moisture in the vadose zone, applied water, treated wastewater effluent, urban stormwater, irrigated return flow) within and around a GDE does not preclude the possibility that it is supported by groundwater, too. SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" [23 CCR §351(m)]. Hence, depth-to-groundwater data should be used to identify whether NC polygons are supported by groundwater and should be considered GDEs. In addition, SGMA requires that significant and undesirable adverse impacts to beneficial users of surface water be avoided. Beneficial users of surface water include environmental users such as plants or animals[17], which therefore must be considered when developing minimum thresholds for depletions of interconnected surface water.

GSAs are only responsible for impacts to GDEs resulting from groundwater conditions in the basin, so if adverse impacts to GDEs result from the diversion of applied water, treated wastewater, or irrigation return flow away from the GDE, then those impacts will be evaluated by other permitting requirements (e.g., CEQA) and may not be the responsibility of the GSA. However, if adverse impacts occur to the GDE due to changing groundwater conditions resulting from pumping or groundwater management activities, then the GSA would be responsible (Figure 4).

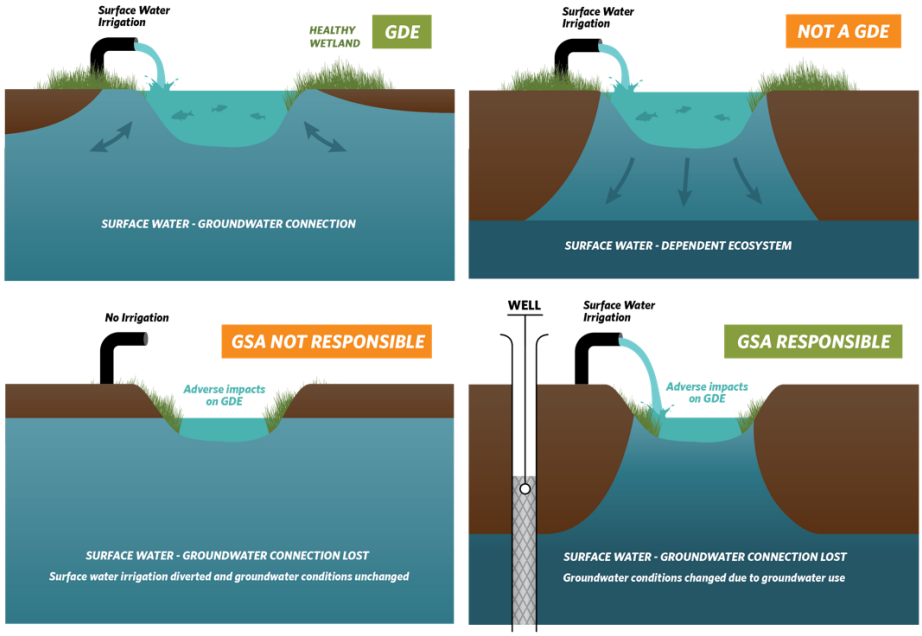


Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. **(Right)** Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. **Bottom: (Left)** An ecosystem that was once dependent on an interconnected surface water, but loses access to groundwater solely due to surface water diversions may not be the GSA's responsibility. **(Right)** Groundwater dependent ecosystems once dependent on an interconnected surface water system, but loses that access due to groundwater pumping is the GSA's responsibility.

[17] *For a list of environmental beneficial users of surface water by basin, visit: https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/*

BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin requires that groundwater conditions are characterized to confirm whether polygons in the NC dataset are supported by the underlying aquifer. To do this, proximate groundwater wells should be identified to characterize groundwater conditions (Figure 5). When selecting representative wells, it is particularly important to consider the subsurface heterogeneity around NC polygons, especially near surface water features where groundwater and surface water interactions occur around heterogeneous stratigraphic units or aquitards formed by fluvial deposits. The following selection criteria can help ensure groundwater levels are representative of conditions within the GDE area:

- Choose wells that are within 5 kilometers (3.1 miles) of each NC Dataset polygons because they are more likely to reflect the local conditions relevant to the ecosystem. If there are no wells within 5km of the center of a NC dataset polygon, then there is insufficient information to remove the polygon based on groundwater depth. Instead, it should be retained as a potential GDE until there are sufficient data to determine whether or not the NC Dataset polygon is supported by groundwater.

- Choose wells that are screened within the surficial unconfined aquifer and capable of measuring the true water table.

- Avoid relying on wells that have insufficient information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer. This type of well data should not be used to remove any NC polygons.

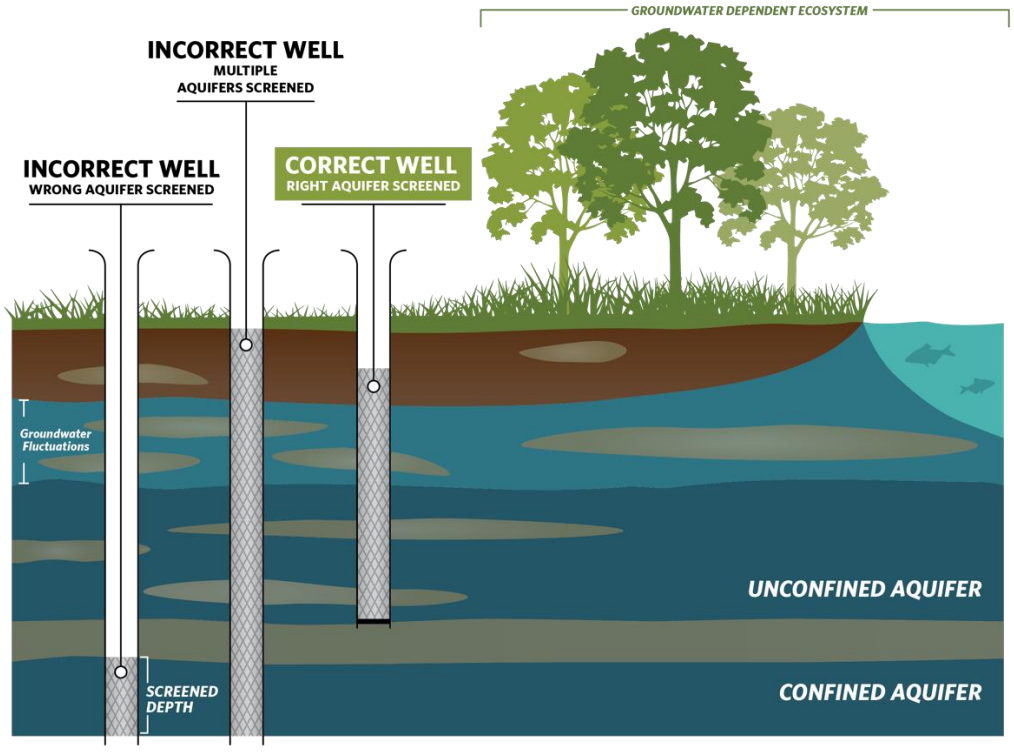


Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

BEST PRACTICE #5. Contouring Groundwater Elevations

The common practice to contour depth-to-groundwater over a large area by interpolating measurements at monitoring wells is unsuitable for assessing whether an ecosystem is supported by groundwater. This practice causes errors when the land surface contains features like stream and wetland depressions because it assumes the land surface is constant across the landscape and depth-to-groundwater is constant below these low-lying areas (Figure 6a). A more accurate approach is to interpolate **groundwater elevations** at monitoring wells to get groundwater elevation contours across the landscape. This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)[18] to estimate depth-to-groundwater contours across the landscape (Figure b; Figure 7). This will provide a much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found.

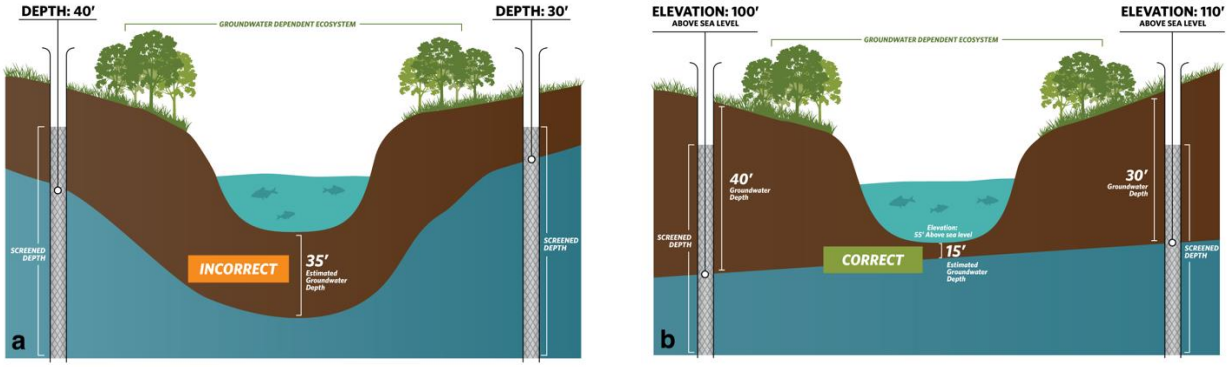


Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. **(b)** Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

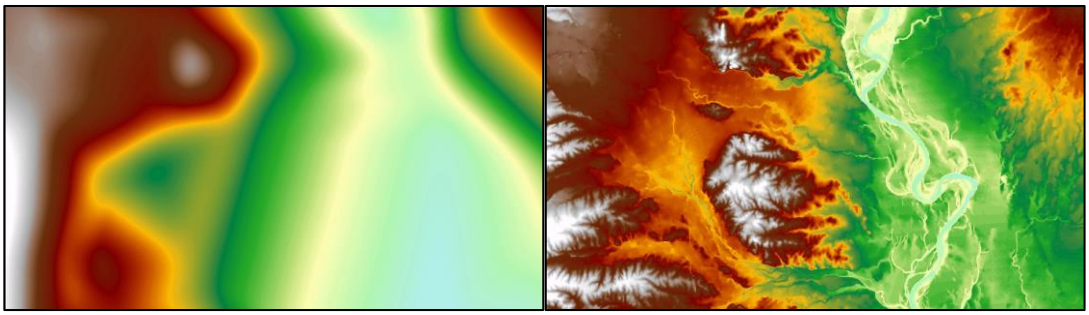


Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. **(Right)** Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation from DEM spatial data to generate depth-to-groundwater contours. The image on the right shows a more accurate depth-to-groundwater estimate because it takes the local topography and elevation changes into account.

[18] USGS Digital Elevation Model data products are described at: https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services and can be downloaded at: https://iewer.nationalmap.gov/basic/

BEST PRACTICE #6. Best Available Science

Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decisions, and using the data collected through monitoring programs to revise decisions in the future. In many situations, the hydrologic connection of NC dataset polygons will not initially be clearly understood if site-specific groundwater monitoring data are not available. If sufficient data are not available in time for the 2020/2022 plan, **The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network.** Erring on the side of caution will help minimize inadvertent impacts to GDEs as a result of groundwater use and management actions during SGMA implementation.

KEY DEFINITIONS

Groundwater basin is an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom. *23 CCR §341(g)(1)*

Groundwater dependent ecosystem (GDE) are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. *23 CCR §351(m)*

Interconnected surface water (ISW) 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 completely depleted. *23 CCR §351(o)*

Principal aquifers are aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. *23 CCR §351(aa)*

ABOUT US

The Nature Conservancy is a science-based nonprofit organization whose mission is *to conserve the lands and waters on which all life depends*. To support successful SGMA implementation that meets the future needs of people, the economy, and the environment, TNC has developed tools and resources (www.groundwaterresourcehub.org) intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

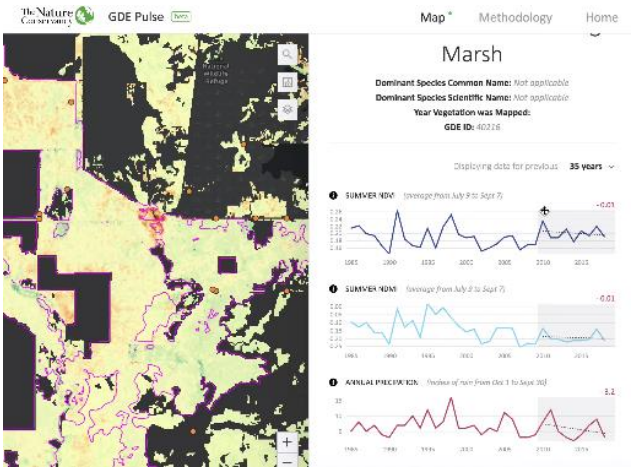
Attachment E

GDE Pulse

A new, free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data.

The Nature Conservancy
Protecting nature. Preserving life.®

Visit
https://gde.codefornature.org/



Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset[19]. The following datasets are included:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset[20]. The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

[19] The Natural Communities Commonly Associated with Groundwater Dataset is hosted on the California Department of Water Resources' website: https://gis.water.ca.gov/app/NCDatasetViewer/#

[20] The PRISM dataset is hosted on Oregon State University's website: http://www.prism.oregonstate.edu/

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CHARLTON H. BONHAM, Director

December 4, 2019

Via Mail and Electronic Mail

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Subject: Comments on the Fresno County Management Areas A and B Groundwater Sustainability Plan

Dear Ms. Guzman:

The California Department of Fish and Wildlife (Department) Central Region is providing comments on the Fresno County Management Areas A and B Draft Groundwater Sustainability Plan (GSP) prepared by the Fresno County Management Area (FCMA) Groundwater Sustainability Agency for its area at the southern portion of the Delta-Mendota Subbasin (GSP Area), pursuant to the Sustainable Groundwater Management Act (SGMA). As trustee agency for the State's fish and wildlife resources, the Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species (Fish & G. Code §§ 711.7 and 1802).

Development and implementation of Groundwater Sustainability Plans under SGMA represent a new era of California groundwater management. The Department has an interest in the sustainable management of groundwater, as many sensitive ecosystems and species depend on groundwater and interconnected surface waters. SGMA and its implementing regulations afford ecosystems and species specific statutory and regulatory consideration, including the following as pertinent to Groundwater Sustainability Plans:

- Groundwater Sustainability Plans must identify and consider impacts to groundwater dependent ecosystems (GDEs), pursuant to 23 CCR § 354.16(g) and Water Code § 10727.4(l); and

- Groundwater Sustainability Agencies must consider all beneficial uses and users of groundwater, including environmental users of groundwater pursuant to Water Code § 10723.2 (e); and Groundwater Sustainability Plans should identify and consider potential effects on all beneficial uses and users of groundwater,

pursuant to 23 CCR §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), and 354.34(f)(3); and

- Groundwater Sustainability Plans must establish sustainable management criteria that avoid undesirable results within 20 years of the applicable statutory deadline, including depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water, pursuant to 23 CCR § 354.22 *et seq.* and Water Code §§ 10721(x)(6) and 10727.2(b) and describe monitoring networks that can identify adverse impacts to beneficial uses of interconnected surface waters pursuant to 23 CCR § 354.34(c)(6)(D); and

- Groundwater Sustainability Plans must account for groundwater extraction for all Water Use Sectors including managed wetlands, managed recharge, and native vegetation, pursuant to 23 CCR §§ 351(al) and 354.18(b)(3).

Accordingly, the Department values SGMA groundwater planning that carefully considers and protects GDEs, fish and wildlife beneficial uses, and users of groundwater and interconnected surface waters.

COMMENT OVERVIEW

The Department supports ecosystem preservation in compliance with SGMA and its implementing regulations based on Department expertise and best available information and science.

The Department recommends that the GSP provide additional information and analysis that considers all environmental beneficial uses and users of groundwater in its sustainability management criteria and better characterize or consider surface water-groundwater connectivity. The Department is providing additional comments and recommendations below.

GSP COMMENTS AND RECOMMENDATIONS

1. **Comment #1. Plan Area.** Chapter 2 Description of Plan Area. Section 2.2 Water Resources Monitoring and Management Programs, Subsection 2.2.1 Mendota Pool Group (page 12). 2-1

   The Mendota Pool Group is a United States Bureau of Reclamation (USBR) project established in 1999 that exchanges freshwater from the Central Valley Project for more saline groundwater that is pumped into the Mendota Pool and Fresno Slough. Fresno Slough crosses through the Department's Mendota Wildlife Area (WA) and serves as the WA's only water delivery system. Mendota

WA Level 2 and Level 4 allocations from the Central Valley Project freshwater surface water supply are included in the groundwater exchange, and since 2002, monitoring of supply water to the Mendota WA has shown significantly increased salinity concentrations during periods of increased groundwater pumping. The Department has previously recommended and requested that the groundwater pumping cease during the fall flood up season from mid-August through October, to allow fresh surface water to be delivered to Mendota WA inlets.

2. **Comment #2. Water Quality.** Chapter 3 Basin Setting. Section 3.1 Hydrogeologic Conceptual Model, Subsection 3.1.4 General Groundwater Quality (page 24). Section 3.2 Current and Historic Groundwater Conditions, Subsection 3.2.3 Groundwater Quality (pages 31 to 32). 2-2

   As stated in Comment #1, the Mendota WA has recorded a significant increase in salinity in the wildlife area's water supply as a result of groundwater pumping into the Mendota Pool.

3. **Comment #3. Data Gaps.** Chapter 3 Basin Setting. Section 3.1 Hydrogeologic Conceptual Model, Subsection 3.1.8 Data Gaps (page 27). 2-3

   Stakeholders from the Delta-Mendota Subbasin have contacted the Department's Central Region numerous times about installing a monitoring well in the Mendota WA, and the Central Region has remained consistent with denying these requests. The Central Region has not granted access onto Department property for the following reasons:

   a) Providing access would require a Memorandum of Understanding (MOU), which is equivalent to issuing a permit and would trigger California Environmental Quality Act (CEQA) compliance. The Central Region lacks the funding and staff to prepare a CEQA document and MOU.

   b) A well drilling project on State property is considered a "public works project," which would add other regulatory requirements and require prevailing wages compliance. Because this is a public works project, other California state control agencies would require a complete review and approval of the project.

   c) The Department's Central Region is reluctant to accept the liabilities associated with the drilling activities required for well installation or the legal and logistical responsibilities connected with non-Department entities accessing State lands to monitor and maintain the wells.

d) Currently, there is only one shallow domestic water well on the Mendota WA that supplies water to one Department building (Hunter Check Station) during the dove and waterfowl hunting seasons and there are no future plans to increase groundwater extractions. Mendota WA is one of a few net contributors to groundwater within the GSP Area, and the Central Region has concerns that adding monitoring wells within the Mendota WA would skew groundwater recharge and availability within the GSP Area. The Central Region does not foresee any benefits from entering into this arrangement and encourages the Delta-Mendota Subbasin stakeholders to explore other private land options in the general vicinity of the Mendota WA.

4. **Comment #4. Subsidence.** Chapter 3 Basin Setting. Section 3.2 Current and Historic Groundwater Conditions, Subsection 3.2.5 Subsidence (pages 33 to 34). 2-4

Mendota WA has experienced substantial subsidence issues both north and south of its boundaries; this subsidence has impacted water deliveries to the Mendota WA. The GSP uses subsidence data from 1999 to present.

a. *Issues*: Subsidence has resulted in lowering of the Mendota Pool Dam elevation and an associated lowered water level. This adverse impact was later compounded when the California Department of Water Resources (CDWR), Division o3f Safety of Dams determined that the water levels at the Mendota Pool had to be lowered further to maintain the integrity of the dam. This has resulted in the reduced ability to back water up the Fresno Slough to the Department's water inlets in the Mendota WA. Because of these two incidents, Mendota WA's ability to deliver water using gravity flow have impacted its lift pump sites. During the recent drought, neighboring landowners to the south pumped groundwater, and increased subsidence along the southern portion of the Mendota WA has been observed. As a result, water flows backwards within the Mendota WA, affecting habitat management operations.

Within the GSP, a majority of land subsidence is attributed to the extraction of water in aquifers beneath the Corcoran Clay outside of the GSP Area, and the GSP acknowledges that minimal amounts of subsidence are occurring at shallower depths above the Corcoran Clay. Within the Basin Setting (Chapter 3), the GSP provides a description of the geologic materials encountered beneath the ground surface and provides a number of geologic cross sections depicting the hydrogeologic framework. Within these cross sections, the GSP identifies a number of confining layers (A & C clay layers) above the Corcoran Clay. The GSP describes that these clays act as semi-confining layers and uses these

clay members to divide the sediments within the upper aquifer into a shallow and deep zone. These clay layers act as confining beds and restrict the movement of groundwater.

The lowering of groundwater levels within the upper aquifer provides the potential to create groundwater-level-induced stresses that can promote subsidence. The GSP provides records for Yearout Extensometer station located just north of the GSP Area, and indicates that from 2003 to 2013 (Historic/Current Water Budget Period), total inelastic compaction of the upper aquifer was approximately 0.08 feet; however, when cosidering the total available record as provided on Figure 3-33, total compaction between the years of 1999 to 2017 is approximately 0.30 feet. Additional historic extensometer data was reviewed for the Yearout Extensometer station as provided by the USGS online database (https://www.usgs.gov/centers/ca-water-ls/science/extensometers-and-compaction?qt-science_center_objects=0#qt-science_center_objects). Records indicate that between the years of 1966 and 1983, approximately 0.30 feet of compaction in the upper aquifer was recorded. The GSP describes groundwater levels within the upper aquifer currently as being stable; however, compaction within the upper aquifer is occurring and increased during drought conditions as shown on Figure 3-33. When pumping induces groundwater levels to drop below critical head, preconsolidation stresses are surpassed and compaction of fine-grained materials occurs, resulting in subsidence.

b. *Recommendation*: The Department recommends that the GSP include a review of earlier historic subsidence data from before 1999; as stated above, the Mendota Pool Dam elevation has decreased since the late 1950s (USBR 2008). To avoid additional "significant and unreasonable" conditions within the Mendota WA, the Department recommends that the GSP and neighboring Groundwater Sustainability Plans include Mendota WA as a "subsidence management area" with a zero feet subsidence criterion that no longer reduces the ability to deliver surface water supplies to and within the wildlife area.

5. **Comment #5. Interconnected Surface Waters.** Chapter 3 Basin Setting. Section 3.2 Current and Historic Groundwater Conditions, Subsection 3.2.6 Interconnected Surface Water Systems (page 35). 2-5

The interconnected surface water narrative lacks a clear description of surface water-groundwater interaction.

a. *Issue:* To fall within SGMA's consideration for depletions of interconnected surface water, a surface water system must be "hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted" [23 CCR § 351(o)]. This means that even if groundwater elevation is lower than streambed elevation and the surface water body is 'losing,' there may still be hydraulic communication between the aquifer and the surface water if there is a saturated layer connecting the two, and pumping from a hydrologically connected aquifer may yet cause surface water depletion (Barlow and Leake 2012). The GSP notes that the Fresno Slough is a 'losing,' interconnected surface body of water and historically the Fresno Slough and Mendota Pool maintained consistent surface water elevations, but in recent years the Mendota Pool has demonstrated a gradual decline in surface water elevation as measured at the Mendota Pool Staff Gage (page 35, Figure 3-36, Figure 4-23). There is no discussion on how groundwater extraction in the shallow zone of the upper aquifer may impact this surface water decline, and the interconnected surface water narrative lacks specific estimations of the quantity and timing of streamflow depletions as specified in 23 CCR § 354.16(f).

b. *Recommendations:* The Department recommends that the GSP better characterize the relationship between shallow groundwater management and surface water levels in the Fresno Slough and Mendota Pool and identify the estimated quantity and timing of surface water depletions in the Delta-Mendota Subbasin attributable to groundwater pumping. If this information is not available, the Department recommends identifying an expeditious and specific path to estimating these values.

6. **Comment #6. Groundwater-Dependent Ecosystems**. Chapter 2 Description of Plan Area. Section 2.4 Additional GSP Elements, Subsection 2.4.8 Impacts on Groundwater Dependent Ecosystems (page 15 and Figures 2-8 and 2-9). Chapter 3 Basin Setting. Section 3.2 Current and Historic Groundwater Conditions (pages 35 to 37 and Figures 3-37 and 3-38). 2-6

   The GDE identification section, pursuant to 23 CCR § 354.16 (g), is based on limited information to demonstrate exclusion of ecosystems that may depend on groundwater.

   a. *Issue*: Methods applied to the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset to identify potential GDEs are not robust.

i. Depth to Groundwater: The removal of areas with a depth to groundwater greater than 30 feet in Spring 2015 relies on a single-point-in-time baseline hydrology, specifically a point in time that is several years into a historic drought when groundwater levels were trending significantly lower due to reduced surface water availability. Exclusion of potential GDEs based on this singular groundwater elevation measurement is questionable because it does not consider representative climate conditions (i.e., seasons and a range of water type years).

b. *Recommendations:* The Department recommends that the GSP consider the following for information gathering related to GDEs:

i. Depth to Groundwater: Develop a hydrologically robust baseline that includes areas with a depth to groundwater greater than 30 feet that relies on multiple, climatically representative years of groundwater elevation and that accounts for the inter-seasonal and inter-annual variability of GDE water demand.

ii. Include additional references for evaluation: The Department recognizes that NCCAG (Klausmeyer et al. 2018) provided by CDWR and use of the U.S. Department of Agriculture's National Agricultural Imagery (NAIP) were good starting references for GDEs; however, the Department recommends that the GSP include additional resources for evaluating GDE locations. The Department recommends consulting other references, including but not limited to the following tools and other resources: the California Department of Fish and Wildlife (CDFW) Vegetation Classification and Mapping Program (VegCAMP) (CDFW 2019A); the CDFW California Natural Diversity Database (CNDDB) (CDFW 2019B); the California Native Plant Society (CNPS) Manual of California Vegetation (CNPS 2019A); the CNPS California Protected Areas Database (CNPS 2019B); the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (USFWS 2018); the USFWS online mapping tool for listed species critical habitat (USFWS 2019); the U.S. Forest Service CALVEG ecological grouping classification and assessment system (USFS 2019); and other publications by Klausmeyer et al. (2019), Rohde et al. (2018), The Nature Conservancy (TNC) (2014, 2019), Naumburg et al. (2005), and Witham et al. (2014).

7. **Comment #7. Sustainable Management Criteria.** Chapter 4 Sustainable Management Criteria (SMC) (starting on page 49). 2-7

SMC acknowledge high uncertainty around impacts to, as well as potential harm to, environmental beneficial uses and users of groundwater but do not explicitly address how to prevent or mitigate potential negative impacts.

a. *Issues:*

i. The GSP acknowledges multiple times that Minimum Thresholds (MTs) may have uncertain or negative impacts on environmental beneficial users of groundwater:

1. "The impact of MTs for groundwater elevation on the environmental beneficial users of groundwater (i.e. GDEs) are not well understood but could potentially have negative affects if MT levels are sustained or exceeded for an extended period of time" (page 60).

2. "If water levels are ever to drop to MT levels, which is not projected to occur, further analysis of the vertical gradient in the Shallow Zone of the Upper Aquifer will be necessary to better understand the potential impacts to GDE" (page 61).

3. "MT values for interconnected surface waters could impact the environmental beneficial uses of groundwater if MT values remain for an extended period of time along with decline groundwater elevations" (page 67).

4. "For environmental beneficial uses of groundwater in FCMA [Fresno County Management Area], the most significant undesirable results subsidence and interconnected surface waters. Continued subsidence in the FCMA area will restrict the ability to flood areas in the MWA. Interconnected surface waters also are important to the beneficial uses of groundwater, but stage levels in the Mendota Pool have not historically show significant decline" (page 71).

The GSP mentions that it "will not implement any projects or management actions in the event of interconnected surface waters undesirable results" (page ES-12), and instead focuses on undefined coordination with neighboring Groundwater Sustainability Agencies and subbasins to address any SMC concerns (page 81). Absent agreed-upon specifics as to how this coordination will work (e.g., what conditions will trigger mitigation, who will undertake mitigation, etc.), the SMC

provide no actionable protections for environmental beneficial uses and users of groundwater.

ii. The Delta-Mendota Subbasin is designated as 'Critically Overdrafted,' meaning "continuation of present water management practices [in the basin] would probably result in significant adverse overdraft-related environmental, social, or economic impacts" (CDWR 2019). The GSP identifies minimum groundwater elevation thresholds for representative monitoring wells, each of which serves as a threshold beyond which significant and unreasonable effects (i.e., undesirable results) are expected when 25% of representative monitoring sites exceed MTs for two consecutive years (page 50). These MTs are established by subtracting the magnitude of the largest continual decline in groundwater elevation between 2011 and 2016 from the Measurable Objectives (page 59), which are the seasonal groundwater elevation highs in Spring 2015 – several years into a historic drought (page 50). These MTs, though moderate in the magnitude of groundwater decline they allow, suggest that groundwater elevations at representative wells can decrease from historically low drought groundwater elevations without witnessing undesirable results. At the same time, the GSP acknowledges that the potential to impact GDEs (see above) that can experience adverse impacts and threshold effects with marginal decreases in groundwater elevation, especially when sustained (Naumburg 2005). Furthermore, Figure 4-9 presents groundwater elevation data and SMC for well USGS 31J6. This well, presumably screened in the lower aquifer per Table 4-1, but cited as an 'upper aquifer deep zone' well in Figure 3-25, has a MT that accommodates an approximate 70-foot groundwater elevation decline before unreasonable results would be realized. Continued groundwater elevation decreases in either the upper aquifer deep zone or the lower aquifer will likely exacerbate subsidence (see Comment #4), and if USGS well 31J6 is screened in the upper aquifer deep zone, this groundwater elevation decline may also impact shallow groundwater elevations due to the vertical hydraulic gradient between the shallow and deep zones of the upper aquifer(page 29). Based on subsidence alone, it appears that undesirable results are already occurring. Therefore, the GSP's MTs that allow for continued groundwater table decline, mirroring the historical trends that led to the Delta-Mendota Subbasin's Critically Overdrafted status, may not protect against undesirable results. Conceptually, there is a disconnect between the Delta-Mendota Subbasin's 'Critically Overdrafted' designation and sustainable

management criteria the allow for continued groundwater level decline.

b. *Recommendations:* The Department recommends that the GSP reevaluate SMC with the following suggestions:

   i. Implement environmental monitoring to improve the understanding of SMC impacts on GDEs (page 15), identify actionable paths to mitigating potential adverse impacts if detected or anticipated, and revise SMC to prevent undesirable results for environmental beneficial users of groundwater.

   ii. Clarify historical groundwater trends by showing available data prior to 2003 within the figures that capture groundwater elevation SMC (Figures 4-5 through 4-9) and confirm in which aquifer well USGS 31J6 is screened. Revise sustainable management criteria to reflect a 'Critically Overdrafted' subbasin designation by seeking to slow or reverse recent negative trends in groundwater elevation such as those reflected in Figure 4-9.

8. **Comment #8 Project and Management Actions.** Chapter 5 Project and Management Actions (PMAs) to Achieve Sustainability Goal (starting page 80). 2-8

   The Project and Management Actions do not identify actionable paths to avoiding undesirable results for surface water depletions within Fresno County Management Areas A and B.

   a. *Issue*: The Department appreciates the demand management focus of the targeted pumping reductions mentioned as a possible management action in Section 5. However, the PMA chapter lacks specifics on when pumping restrictions would be triggered and how they would be implemented, citing that there has been no formal development of PMAs, because the FCMA Groundwater Sustainability Agency is projected to be sustainable throughout implementation (page 81). The GSP specifies that no PMAs have been formally developed, apart from continued coordination with neighboring Groundwater Sustainability Agencies and subbasins (page 81). Furthermore, the GSP explicitly states that undesirable results for interconnected surface waters will not trigger implementation of any management actions (page 70, 82). Earlier in the document the GSP states, "FCMA will not implement any projects or management actions in the event of undesirable results for interconnected surface waters but instead will manage groundwater elevations to sustainable levels" (page ES-12). These self-imposed management restrictions may prevent the

management area from addressing unsustainable surface water depletions and avoiding undesirable results (see Comment #7). Managing groundwater to sustainable levels may require project and management actions and may be a means to managing surface water depletions under circumstances of interconnectivity, such as those identified in the GSP (page 35) (see Comment #5). The FMCA comprises a management area specifically identified for the interconnected surface water sustainability indicator (pages ES-1, 48). Accordingly, the FMCA Groundwater Sustainability Agency may be positioned to manage groundwater to avoid undesirable surface water depletions, despite its abdicating PMA responsibility for interconnected surface waters.

b. *Recommendation:* The Department recommends clarifying the relationship between groundwater pumping in GSP Area and surface water depletions [23 CCR § 354.16(f)] and determining explicitly if/when surface water depletions should trigger pumping reductions in the GPS Area or for neighboring Groundwater Sustainability Agencies accordingly.

OTHER COMMENTS: Implementation of Future Project Actions Related to SGMA

SGMA exempts the preparation and adoption of GSPs from the California Environmental Quality Act (CEQA) (WC §10728.6); however, SGMA specifically states that implementation of project actions taken pursuant to SGMA are not exempt from CEQA (WC §10728.6). The Department is California's Trustee Agency for fish and wildlife resources and holds those resources in trust by statute for all the people of the State (Fish & G. Code, §§ 711.7, subd. (a) & 1802; Pub. Resources Code, § 21070; CEQA Guidelines § 15386, subd. (a)). The Department, in its trustee capacity, has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species (*Id.*, § 1802). Similarly, for purposes of CEQA, the Department is charged by law to provide, as available, biological expertise during public agency environmental review efforts, focusing specifically on projects and related activities that have the potential to adversely affect fish and wildlife resources.

The Department is also a Responsible Agency under CEQA (Pub. Resources Code, § 21069; CEQA Guidelines, § 15381), and the Department expects that it may need to exercise regulatory authority as provided by the Fish and Game Code for implementation of projects related to the GSP that are also subject to CEQA. These projects may be subject to the Department's lake and streambed alteration regulatory authority (i.e., Fish & G. Code, § 1600 et seq.). Notification pursuant to Fish and Game Code § 1602 is warranted if a project will (a) substantially divert or obstruct the natural flow of any river, stream, or lake; (b) substantially change or use any material from the bed, bank, or channel of any river, stream, or lake (including the removal of riparian

vegetation); and/or (c) deposit debris, waste or other materials that could pass into any river, stream, or lake. Likewise, to the extent that implementation of any project may result in "take" as defined by State law of any species protected under the California Endangered Species Act (CESA) (Fish & G. Code, § 2050 et seq.), related authorization as provided by the Fish and Game Code will be required. The Department is required to comply with CEQA in its issuance of a Lake or Streambed Alteration Agreement or an Incidental Take Permit.

The implementation of SGMA does not alter or determine surface or groundwater rights (WC § 10720.5). It is the intent of SGMA to respect overlying and other proprietary rights to groundwater, consistent with section 1200 of the Water Code (Section 1(b)(4) of AB 1739). The capture of unallocated stream flows to artificially recharge groundwater aquifers are subject to appropriation and approval by the State Water Resources Control Board (SWRCB) pursuant to Water Code § 1200 et seq. The Department, as Trustee Agency, is consulted by SWRCB during the water rights process to provide terms and conditions designed to protect fish and wildlife prior to appropriation of the State's water resources. Certain fish and wildlife are reliant upon aquatic and riparian ecosystems, which in turn are reliant upon adequate flows of water. The Department therefore has a material interest in assuring that adequate water flows within streams for the protection, maintenance and proper stewardship of those resources. The Department provides, as available, biological expertise to review and comment on environmental documents and impacts arising from project activities.

CONCLUSION

In conclusion, the GSP needs to address all SGMA statutes and regulations, and the Department recommends that the GSP seriously consider fish and wildlife beneficial uses and interconnected surface waters. The Department recommends that the GSP consider the above comments before the GSP is submitted to CDWR. The Department appreciates the opportunity to provide comments on the GSP. If you have any further questions, please contact Dr. Andrew Gordus, Staff Toxicologist, at Andy.Gordus@wildlife.ca.gov or (559) 243-4014 extension 239.

Sincerely,

Julie A. Vance
Regional Manager, Central Region

Enclosures (Literature Cited)

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December 06, 2019

Christina Guzman, Planner
Department of Public Works and Planning
Water and Natural Resources
Fresno County Management Areas A and B GSP
2220 Tulare Street. 6th Floor
Fresno, CA 93721

Sent via email to waterandnaturalresources@fresnocountyca.gov

Re: Comments on Draft Groundwater Sustainability Plan for County of Fresno Groundwater Sustainability Agency's Management Areas A and B.

Dear Ms. Guzman,

Audubon California appreciates the opportunity to provide public comment on the draft Groundwater Sustainability Plan (GSP) for the County of Fresno Groundwater Sustainability Agency's (GSA) Management Area A and Management Area B (MAB), together referred to as Fresno County Management Areas (FCMA) within the Delta-Mendota Subbasin.

Audubon California is a statewide nonprofit organization with a mission to protect birds and the places they need. Our organization has a long history of solutions-focused work in the Central Valley in collaboration with state and federal agencies, water districts, non-profits, and landowners. We are commenting on draft GSPs to provide technical information and to identify areas of opportunity to partner with landowners or GSAs to achieve groundwater and wildlife habitat benefits. Audubon is engaged in the Tulare Basin planning region, including Fresno County, as a member of the Central Valley Joint Venture.

Audubon California is reviewing GSPs as a stakeholder for the environment with a particular focus on wetlands. Over 90 percent of historic wetlands in the Central Valley have been replaced with agriculture or urban development. The remaining wetlands are a critical component of the Pacific Flyway, supporting millions of migratory waterfowl, hundreds of thousands of shorebirds, and listed species like the Tricolored Blackbird. Central Valley wetlands are part of California's commitment to national and international Pacific Flyway agreements and provide significant public trust benefits, including habitat for migratory birds, recharge of overdrafted aquifers, carbon sequestration, and recreation opportunities for birders, hunters, and disadvantaged communities.

Reflecting the critical importance of wetlands in the Tulare Basin planning region that includes Fresno County Management Areas, the Central Valley Joint Venture set a wetland restoration target of 11,000 acres to sustain waterfowl populations. The Central Valley Joint Venture, a collaboration of 19 public and private entities, including Audubon, sets science based bird population and habitat restoration objectives to support the goals of an international treaty between the United States, Canada, and Mexico, the North American Waterfowl Management Plan. The habitat restoration goals in the Tulare Basin planning region point to an already existing habitat deficit to supply the food energy needed for waterfowl populations. Any loss of managed wetlands will undermine Central Valley Joint Venture goals and only increase the existing habitat deficit.

The effects of groundwater overdraft, including subsidence and reduced water quality, have considerable negative impacts to the wetlands in this management region, mainly the Mendota Wildlife Area (MWA) owned and operated by the California Department of Fish and Wildlife. Disconnected from natural water sources as a consequence of surface water diversions and groundwater overpumping, wetland management now depends on unreliable surface water deliveries or increasingly poor quality groundwater to provide flooded habitat. Protecting these managed wetlands from further impacts will ensure they continue to provide public trust benefits, including habitat for migratory waterfowl, shorebirds, and listed species like the Tricolored Blackbird. Not only do these lands provide important habitat for waterbirds and wildlife, they provide multiple benefits to the basin such as recharge and water filtration.

Comment 1: In this draft plan, groundwater quality is identified as not being caused by human-based activities (3.2.3 Groundwater Quality, p 31-32). However, the Mendota Wildlife Area is known to show increasingly poor water quality during periods of increased groundwater pumping. Continued water quality degradation greatly diminishes the ability for these wetlands to function the way they were designed and provide the resources that are critical for waterbird and wildlife survival. This draft GSP does not clearly identify management actions to reduce poor water quality impacts. It is imperative that water quality be more closely evaluated and assigned a minimum threshold that is appropriately monitored, then acted on if conditions are further degraded. Please provide details for an actionable process that addresses water quality in the MWA, and FCMA as a whole, to minimize the risk of increasing poor water quality. 3-1

Comment 2: In the FCMA, subsidence is considered to have not occurred at significant levels to negatively impact the management areas (3.2.5 Subsidence, p 33-34). Though the amount of subsidence is reported at only 0.08 feet, this has still resulted in the sinking of the Mendota Pool Dam. As a result, the sinking of the dam has lowered water levels throughout Fresno Slough, the main conveyance for water to reach the MWA turnouts, impacting the ability of wetland managers to access water and effectively manage wetlands across the MWA. To ensure uncertain or negative impacts do not occur to the MWA it is recommended that subsidence goals are included in this plan, they be set to net-zero reduction, and project and management actions be identified to minimize the risk of further impacts. 3-2

Comment 3: This draft GSP identifies areas with several data gaps and highlights the challenges in acquiring the needed information to make informed decisions, in particular within the Mendota Wildlife Area (3.1.8 Data Gaps, p 27). We encourage the GSA to continue engaging with stakeholders to find common ground and work towards filling these data gaps. This will not only help the GSA move towards reaching sustainability but will ensure the wetlands in the management area will continue to provide the multiple benefits to birds, wildlife, and people. 3-3

Thank you for your consideration of Audubon California's comments. If you would like to discuss any of our comments in more detail, please do not hesitate to contact me at (916) 737-5707 or via email at sarthur@audubon.org.

Sincerely,



Samantha Arthur
Working Lands Program Director
Audubon California

SPRECKELS SUGAR COMPANY, INC.

October 31, 2019

Mr. Augustine Ramirez
County of Fresno
Department of Public Works and Planning
2220 Tulare Street,
Sixth Floor, Fresno, CA 93721

Mr. Ramirez,

Enclosed are comments in response to our review of the Draft *Groundwater Sustainability Plan (GSP): County of Fresno GSA's Delta-Mendota Subbasin Management Area A & Management Area B* dated September 2019, prepared by Luhdorff and Scalmanini.

Section 1.1.1.1: "The plume of saline-impacted water is migrating in a northerly direction." 4-1

> **Comment**: This statement oversimplifies the direction of groundwater flow and plume migration in the vicinity of MAA. Elsewhere in the document (section 3.2.1.1.1 and 3.2.1.1.2), it is stated that groundwater generally flows to the northeast in both the shallow and deep zones of the upper aquifer, which is generally consistent with available information specific to MAA. Groundwater flow in the area, however, is complicated by several artificial conditions such as the presence of shallow zone extraction wells to the west, deep zone pumping wells to the north and east, and water banking activities at MAA. Absent of these artificial conditions, the shallow water table is generally anticipated to mimic the ground surface topography and flow towards the Fresno Slough located west of MAA (USGS, 1999).

Section 3.1.2: "The extent of the A-Clay, or its equivalent, is shown on Figure 3-8. The depth to the top of the A-Clay ranges from about 80 to 120 ft bgs." Figure 3-8 shows an estimated depth of about 110 feet bgs at the Site. 4-2

> **Comment:** Based on our information, the top of the A-Clay layer is present at the site at an average depth of around 70 feet bgs.

Section 3.2.1.1.2: in a discussion about the deep zone of the upper aquifer: "A mound of groundwater is also present in the central-northern portion of FCMA potentially due to recharge from the Meyers Water Bank." 4-3

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Comment: Based on site-specific information, mounding is also present in the shallow zone of the upper aquifer. Should this be mentioned in section 3.2.1.1.1?

Section 3.4.1.1: "A CAO has been issued to the Spreckels Sugar Company and the current status of addressing the groundwater quality degradation is in the development of a "Site Assessment" report which will define the extent of the Steffens plume in the Upper Aquifer in 2019. Within 180 days of its submittal, a "Feasibility and Remedial Options Evaluation" is to be submitted to the Regional Board. Within 120 days of that, a "Cleanup Plan" is to be submitted." 4-4

Comment: This statement accurately summarizes requirements identified in the CAO.

Section 3.4.2.1: "The selection of wells to serve as monitoring sites were based on the historic movement of the Spreckels Plume which is discussed in section 3.2.5." 4-5

Comment: Section 3.2.5 is on Subsidence, not groundwater flow.

Section 4.3.4.1: "Wells located in MAA were assigned MT values based on the maximum observed TDS concentration." 4-6

Comment: The executive summary states that MT values were based on background concentrations established by LSCE. Please confirm that Section 4.3.4.1 is correct. a

Comment: Laboratory analytical results available for 2019 include a maximum value of 1,100 mg/L for PW-12 (current MT is 1,000 mg/L). b

Section 4.2.4.1**:** "MOs were developed in MAA based on the background concentration listed in the Spreckels CAO (Regional Board, 2018). These values were developed in a comment letter for the Steffen's Ponds Closure Plan (LSCE, 2009)." 4-7

Comment: Background values are based on whether monitoring points are in the west, central, or eastern portion of the Site. How were individual monitoring points determined to be in the western, central, or eastern areas?

Comments on Appendix I: Numerical Flow Model Report, in Draft Groundwater Sustainability Plan (GSP)

General comment: Appendix I is not a stand-alone document; therefore, cross reference should be made to the relevant figures and discussion in the main report or other appendices. For example, the discussion of pumping wells in Appendix I, section 4.2, should refer the reader to 4-8

Figures 2-5, 2-6, and 2-7 in the main report, because Appendix I does not include a figure showing pumping well locations.

Section 1, paragraph 2: "The modeling approach was developed to effectively quantify key hydrologic processes related to SGMA sustainability indicators that may occur or have occurred in FCMA: 4-9

1. Lowering of Groundwater Levels
2. Reduction of Groundwater Storage"

Comment: Given that potential past or future lowering of groundwater levels is of interest, why were groundwater level data not used as drawdown targets in model calibration?

Comment: Appendix I should include discussion of changes in groundwater levels and storage or reference to such discussion in other parts of the GSP.

Section 2.3, paragraph 1: "Parameter estimation was conducted using UCODE 2014 (Poeter et al., 2014)." Section 6, paragraph 1: "The groundwater flow model was calibrated largely by manually adjusting assigned aquifer parameters to achieve an agreeable fit between simulated and observed water levels at wells located in the model domain." 4-10

Comment: These statements should be reconciled to accurately convey the calibration technique(s).

Section 2.3, paragraph 2: "As part of the parameter estimation process, the sensitivity of the simulated values is calculated (Hill and Tiedman, 2007). The sensitivity of all (or groups) simulated parameters are summarized by the "composite scaled sensitivity" (CSS). The CSS is used to determine which parameters are most sensitive (those with higher CSS influence the model results to a greater degree) and provides a statistically robust approach to model sensitivity analysis (Hill and Tiedman, 2007)." 4-11

Comment: Parameter sensitivities are not discussed in Section 6 and sensitivity analysis was not included in this report. This paragraph suggests a more rigorous approach was used than is described in subsequent sections of the document.

Section 3.1, paragraph 1: "Each grid cell is a 440 ft x 440 ft square." 4-12

Comment: The uniform grid spacing and cell size is appropriate for the model's uses presented in the draft GSP, but additional refinement will be needed if the model is used to evaluate local-scale groundwater flow directions or drawdown.

Section 3.1, paragraph 2: "The top elevation of Layer 3 was estimated based on the top elevation of the A-clay, which generally occurs between 20 and 80 ft, above mean sea level (msl) or up to 125 ft bgs as determined by DWR Well Completion Reports, geophysical logs, and land surface elevations (Figure 3-3)." 4-13

Comment: Figure 3-3 shows the A-Clay depth as greater than 110 ft bgs, except along the eastern boundary of the FCMA. Based on our information, the A-Clay depth is approximately 70 ft bgs near Steffen's Ponds. Transmissivity of the unit above A-Clay could be overestimated by the model if the hydraulic conductivity of the unit is accurately represented and the thickness is overestimated.

Section 4, paragraph 2: "Climatic observations of 1979 through 2017 and 1965 through 1978 were sequentially used to represent expected conditions of 2018 through 2056 and 2057 through 2070, respectively (Table 4-1)." 4-14

Comment: Was any analysis completed to evaluate whether predictions of reductions in groundwater levels or storage are sensitive to the sequence of water years simulated (for example, if a prolonged wet period follows a dry period instead of preceding it)?

Section 4.3, paragraph 1: "Components of recharge that were simulated included recharge from precipitation, irrigation, and recharge facilities in the Meyers Water Bank, New Columbia Ranch, and Terra Linda Farms." 4-15

Comment: What is the distribution of recharge in the model? A figure showing modeled recharge from a single year, such as current conditions year 2013 would be helpful.
Comment: Based on our knowledge, the Steffen's Ponds should be represented in the model as areas of low recharge.

Section 5.2, paragraph 4: "The compressibility of water (1.4×10^{-6}/ft) estimated from previous studies (Faunt et al, 2009), was scaled with respect to the porosity of each model layer and assigned to all model layers as a specific storage. 4-16

Comment: What porosities were assumed?

Section 6.1.1, paragraph 1 and Table 6-1: "Calibrated vertical hydraulic conductivity in the A and C clays was 1.7×10^{-3} ft/day." 4-17

Comment: Is no vertical anisotropy in A-clay and C-clay reasonable for the properties of these units?

Section 6.2.1, paragraph 1: "A total of 6,403 measured groundwater levels at 117 dedicated monitoring and production wells were used as the primary source of information used to calibrate the groundwater flow model." 4-18

Comment: Was spatial distribution of groundwater level residuals reviewed?

Section 6.1.2, paragraph 2: "Calibrated vertical hydraulic conductivity of SJR streambed was 0.25 ft/day while that of the other canals was 5.0 x 10^{-3} ft/day (Table XX)."

Comment: Sentence refers to Table 6-2.

Please contact me at (760) 344-3110 ext. 107 or Raymond.Kellner@spreckelssugar.com with any questions.

Regards,

Raymond Kellner

Raymond Kellner
Manager, Environmental Affairs

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Appendix I
Fresno County
Management Areas Soils
Report

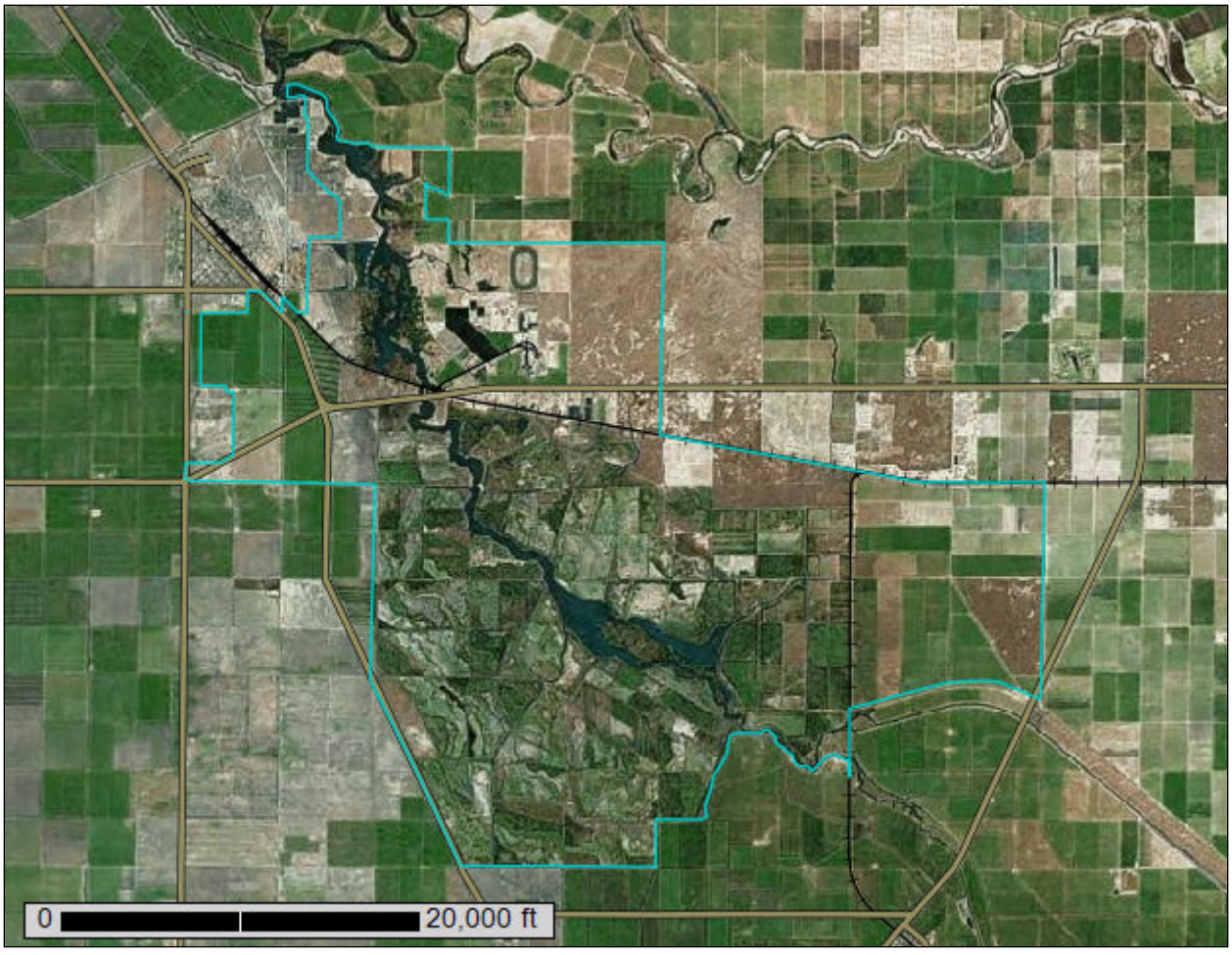
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Eastern Fresno Area, California; and Fresno County, California, Western Part



July 25, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

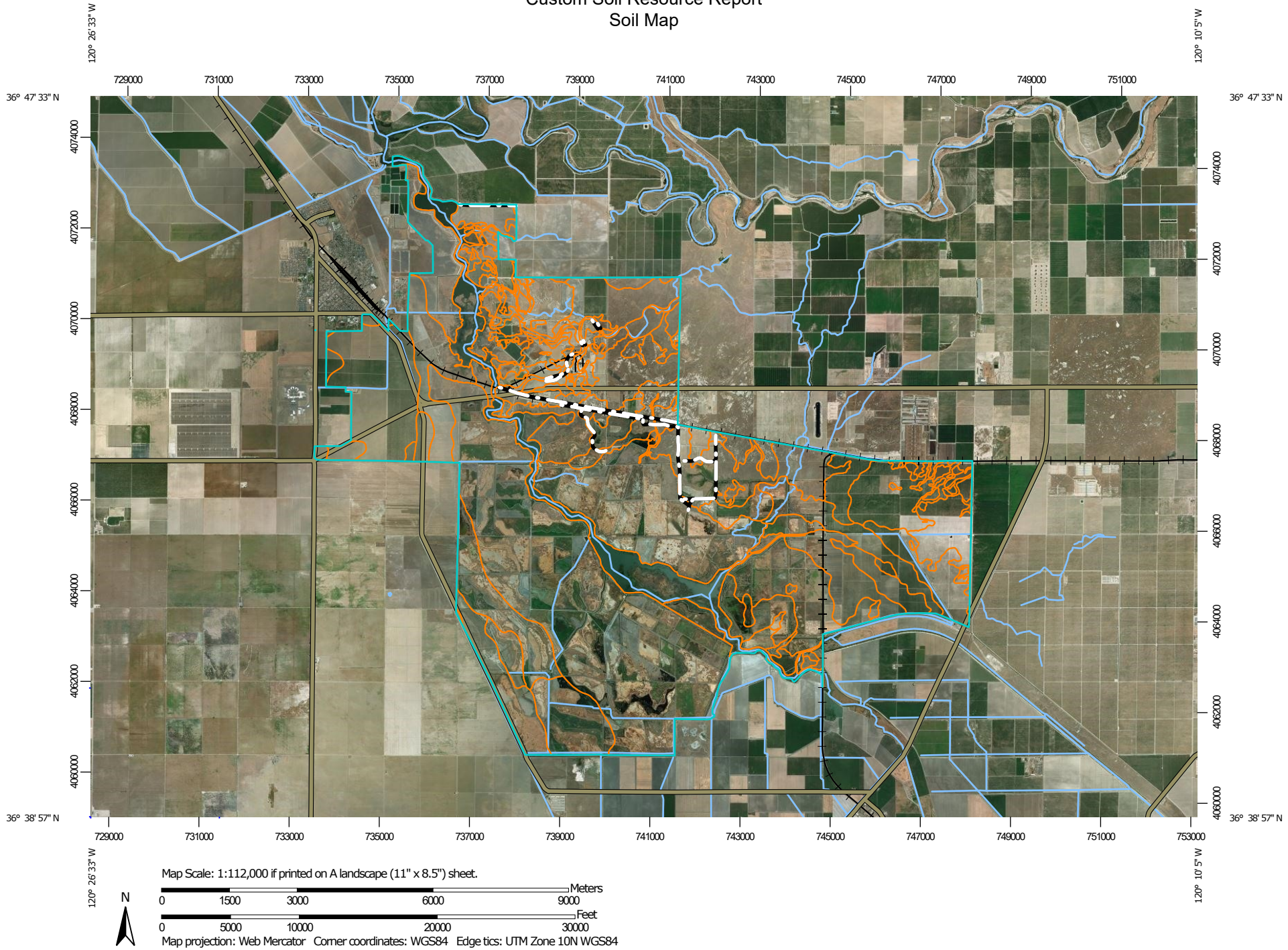
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Eastern Fresno Area, California
Survey Area Data: Version 11, Sep 12, 2018

Soil Survey Area: Fresno County, California, Western Part
Survey Area Data: Version 13, Sep 12, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 5, 2015—Mar 11, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
282wf	Tachi clay, 0 to 1 percent slopes	1,895.0	8.4%
Cb	Cajon loamy coarse sand, saline-alkali	16.6	0.1%
Cd	Cajon coarse sandy loam, saline alkali	11.8	0.1%
Cl	Chino sandy loam	82.6	0.4%
Cm	Chino sandy loam, saline-alkali	33.3	0.1%
Cn	Chino fine sandy loam	91.0	0.4%
Cr	Chino loam	724.6	3.2%
Cs	Chino loam, saline-alkali	913.2	4.1%
DA	Denied access	150.8	0.7%
Ga	Grangeville sandy loam	39.4	0.2%
Gf	Grangeville fine sandy loam, 0 to 1 percent slopes, MLRA 17	6.8	0.0%
Hsc	Hesperia coarse sandy loam, saline-alkali	93.3	0.4%
Hse	Hesperia sandy loam, saline-alkali	13.0	0.1%
Mf	Merced clay loam	14.4	0.1%
Mg	Merced clay loam, slightly saline	510.2	2.3%
Mh	Merced clay	433.2	1.9%
Mk	Merced clay, slightly saline	825.4	3.7%
Ml	Merced clay, moderately saline	42.1	0.2%
Mm	Merced clay, saline-alkali	250.0	1.1%
Pl	Playas	99.5	0.4%
Pr	Pond sandy loam	14.1	0.1%
Pt	Pond fine sandy loam	387.6	1.7%
Pu	Pond fine sandy loam, moderately deep	555.1	2.5%
Pv	Pond loam	199.7	0.9%
Pw	Pond loam, moderately deep	197.0	0.9%
Ro	Rossi fine sandy loam	602.7	2.7%
Rs	Rossi clay loam	557.5	2.5%
Td	Temple clay loam	11.3	0.1%
Te	Temple clay loam, saline	217.9	1.0%
Tg	Temple clay	20.9	0.1%
Tr	Traver sandy loam	604.4	2.7%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ts	Traver sandy loam, moderately deep	84.8	0.4%
Tt	Traver fine sandy loam	395.6	1.8%
Tu	Traver fine sandy loam, moderately deep	176.2	0.8%
TzbA	Tujunga loamy sand, 0 to 3 percent slopes	152.9	0.7%
W	Water	1,410.3	6.3%
Wa	Waukena fine sandy loam	173.6	0.8%
We	Waukena loam	1,275.7	5.7%
Subtotals for Soil Survey Area		**13,283.5**	**58.9%**
Totals for Area of Interest		**22,537.5**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
101	Armona loam, partially drained, 0 to 1 percent slopes	265.7	1.2%
282	Tachi clay, 0 to 1 percent slopes	5,278.3	23.4%
284	Lillis clay, 0 to 1 percent slopes	552.8	2.5%
285	Tranquillity-Tranquillity, wet, complex, saline-sodic, 0 to 1 percent slopes	2.3	0.0%
286	Tranquillity clay, saline-sodic, wet, 0 to 1 percent slopes	1,259.9	5.6%
320	Elnido sandy loam, drained, 0 to 1 percent slopes	58.3	0.3%
375	Lethent silt loam, 0 to 1 percent slopes, poorly drained, MLRA 17	571.0	2.5%
475	Posochanet clay loam, saline-sodic, wet, 0 to 1 percent slopes	1,127.0	5.0%
482	Calflax clay loam, saline-sodic, wet, 0 to 1 percent slopes, MLRA 17	137.1	0.6%
981	Sewage disposal pond	1.6	0.0%
Subtotals for Soil Survey Area		**9,254.0**	**41.1%**
Totals for Area of Interest		**22,537.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps.

The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Eastern Fresno Area, California

282wf—Tachi clay, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: hldj
Elevation: 120 to 210 feet
Mean annual precipitation: 7 to 8 inches
Mean annual air temperature: 62 to 65 degrees F
Frost-free period: 220 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Tachi, clay, and similar soils: 91 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tachi, Clay

Setting

Landform: Flood plains on basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Rise, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous rock and/or alluvium derived from sedimentary rock

Typical profile

Ap - 0 to 14 inches: clay
Bknssg - 14 to 35 inches: clay
Bkng - 35 to 70 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Gypsum, maximum in profile: 1 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Gepford, clay
Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Armona, loam, partially drained
Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Tachi, silt loam, 3-10 inch overwash
Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Lillis, clay
Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: Yes

Unnamed, river channel
Percent of map unit: 1 percent
Landform: Flood plains
Microfeatures of landform position: Channels
Hydric soil rating: Yes

Cb—Cajon loamy coarse sand, saline-alkali

Map Unit Setting
National map unit symbol: hl24
Elevation: 170 to 250 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Cajon and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cajon

Setting
Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Alluvium derived from granite

Typical profile

A - 0 to 2 inches: loamy coarse sand
C - 2 to 60 inches: loamy coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Unnamed, ls surface

Percent of map unit: 14 percent
Landform: Alluvial fans
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent
Landform: Depressions, alluvial fans
Hydric soil rating: Yes

Cd—Cajon coarse sandy loam, saline alkali

Map Unit Setting

National map unit symbol: hl26
Elevation: 170 to 250 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cajon and similar soils: 85 percent

Minor components: 14 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cajon

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: coarse sandy loam
C - 12 to 60 inches: loamy coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Unnamed, nonsaline-alkali

Percent of map unit: 10 percent
Landform: Fan skirts
Hydric soil rating: No

Unnamed

Percent of map unit: 4 percent
Landform: Fan skirts
Hydric soil rating: No

CI—Chino sandy loam

Map Unit Setting

National map unit symbol: hl2h
Elevation: 160 to 500 feet
Mean annual precipitation: 6 to 14 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 250 to 275 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

Chino and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chino

Setting

Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: sandy loam
AC - 12 to 40 inches: sandy clay loam
2C - 40 to 60 inches: stratified sandy loam to loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.1 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed, compact substratum

Percent of map unit: 10 percent
Landform: Alluvial fans, flood plains
Hydric soil rating: No

Unnamed

Percent of map unit: 5 percent
Landform: Alluvial fans, flood plains
Hydric soil rating: No

Cm—Chino sandy loam, saline-alkali

Map Unit Setting

National map unit symbol: hl2j
Elevation: 160 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 250 to 275 days
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition

Chino and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chino

Setting

Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: sandy loam
AC - 12 to 40 inches: sandy clay loam
2C - 40 to 60 inches: stratified sandy loam to loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 18.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed, strongly saline-alkali

Percent of map unit: 8 percent
Landform: Alluvial fans, flood plains
Hydric soil rating: No

Unnamed, non saline-alkali

Percent of map unit: 7 percent
Landform: Alluvial fans, flood plains
Hydric soil rating: No

Cn—Chino fine sandy loam

Map Unit Setting

National map unit symbol: hl2k
Elevation: 160 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 250 to 275 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

Chino and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chino

Setting

Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: fine sandy loam
AC - 12 to 18 inches: clay loam
2C - 18 to 24 inches: stratified fine sandy loam to clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed

Percent of map unit: 15 percent
Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Cr—Chino loam

Map Unit Setting

National map unit symbol: hl2n
Elevation: 160 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 250 to 275 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

Chino and similar soils: 85 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chino

Setting

Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: loam
AC - 12 to 18 inches: clay loam
2C - 18 to 24 inches: stratified fine sandy loam to clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Available water storage in profile: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed, compact substratum

Percent of map unit: 10 percent
Landform: Alluvial fans, flood plains
Hydric soil rating: No

Unnamed

Percent of map unit: 5 percent
Landform: Depressions on alluvial fans
Hydric soil rating: Yes

Cs—Chino loam, saline-alkali

Map Unit Setting

National map unit symbol: hl2p
Elevation: 160 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 250 to 275 days
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition

Chino and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chino

Setting

Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: loam
AC - 12 to 40 inches: sandy clay loam
2C - 40 to 60 inches: stratified sandy loam to loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 18.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s

Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed
Percent of map unit: 10 percent
Landform: Depressions on alluvial fans
Hydric soil rating: Yes

Unnamed, non saline-alkali
Percent of map unit: 5 percent
Landform: Depressions on alluvial fans
Hydric soil rating: Yes

DA—Denied access

Map Unit Composition
Denied access: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Ga—Grangeville sandy loam

Map Unit Setting
National map unit symbol: hl4t
Elevation: 160 to 500 feet
Mean annual precipitation: 8 to 12 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition
Grangeville and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grangeville

Setting
Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Recent alluvium derived from granite

Typical profile
Ap - 0 to 8 inches: sandy loam
C - 8 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Hydric soil rating: Yes

Minor Components

Unnamed, loam surface

Percent of map unit: 10 percent
Landform: Alluvial fans, flood plains
Hydric soil rating: No

Unnamed, channeled

Percent of map unit: 5 percent
Landform: Alluvial fans, channels on flood plains
Hydric soil rating: No

Gf—Grangeville fine sandy loam, 0 to 1 percent slopes, MLRA 17

Map Unit Setting

National map unit symbol: 2vncx
Elevation: 30 to 1,760 feet
Mean annual precipitation: 8 to 25 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 240 to 300 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

Grangeville and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grangeville

Setting

Landform: Flood plains, alluvial fans
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: fine sandy loam
C - 12 to 79 inches: fine sandy loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 3.0
Available water storage in profile: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Hydric soil rating: Yes

Minor Components

Traver

Percent of map unit: 5 percent
Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Hanford

Percent of map unit: 5 percent
Landform: Flood plains, alluvial fans
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Unnamed, hydric

Percent of map unit: 3 percent
Landform: Flood plains, alluvial fans
Landform position (two-dimensional): Toeslope

Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Unnamed, channeled

Percent of map unit: 2 percent
Landform: Alluvial fans on alluvial fans, channels on flood plains on alluvial fans, channels on flood plains on flood plains
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hsc—Hesperia coarse sandy loam, saline-alkali

Map Unit Setting

National map unit symbol: hl5w
Elevation: 200 to 400 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 250 days
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition

Hesperia and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hesperia

Setting

Landform: Abandoned channels on alluvial fans, abandoned channels on fan skirts
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope, rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

Ap - 0 to 11 inches: coarse sandy loam
C - 11 to 32 inches: coarse sandy loam
Ck - 32 to 60 inches: coarse sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Moderate (about 6.6 inches)

Interpretive groups
Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Unnamed
Percent of map unit: 15 percent
Landform: Abandoned channels on alluvial fans, abandoned channels on fan skirts
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hse—Hesperia sandy loam, saline-alkali

Map Unit Setting
National map unit symbol: hl5y
Elevation: 200 to 400 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 250 days
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition
Hesperia and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hesperia

Setting
Landform: Abandoned channels, fan skirts
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, rise
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile
Ap - 0 to 11 inches: sandy loam
C - 11 to 32 inches: sandy loam
Ck - 32 to 60 inches: sandy loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Moderate (about 6.6 inches)

Interpretive groups
Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Unnamed
Percent of map unit: 15 percent
Landform: Abandoned channels on fan skirts
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Mf—Merced clay loam

Map Unit Setting
National map unit symbol: hl6z
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition
Merced and similar soils: 85 percent

Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merced

Setting

Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

Ap - 0 to 12 inches: clay loam
C - 12 to 46 inches: clay
2Ck - 46 to 70 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed, silty clay loam surface

Percent of map unit: 14 percent
Landform: Basin floors
Hydric soil rating: No

Unnamed, depression

Percent of map unit: 1 percent
Landform: Depressions on basin floors
Hydric soil rating: Yes

Mg—Merced clay loam, slightly saline

Map Unit Setting

National map unit symbol: hl70
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition

Merced and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merced

Setting

Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

Ap - 0 to 12 inches: clay loam
C - 12 to 46 inches: clay
2Ck - 46 to 70 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C

Hydric soil rating: Yes

Minor Components

Merced, moderately saline
Percent of map unit: 10 percent
Landform: Basin floors
Hydric soil rating: Yes

Unnamed, silty clay loam surface
Percent of map unit: 5 percent
Landform: Basin floors
Hydric soil rating: No

Mh—Merced clay

Map Unit Setting
National map unit symbol: hl71
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition
Merced and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merced

Setting
Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile
Ap - 0 to 12 inches: clay
C - 12 to 46 inches: clay
2Ck - 46 to 70 inches: clay loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Available water storage in profile: Moderate (about 9.0 inches)

Interpretive groups
Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed, silty clay loam surface
Percent of map unit: 14 percent
Landform: Basin floors
Hydric soil rating: No

Unnamed, depression
Percent of map unit: 1 percent
Landform: Depressions on basin floors
Hydric soil rating: Yes

Mk—Merced clay, slightly saline

Map Unit Setting
National map unit symbol: hl72
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition
Merced and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merced

Setting
Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

Ap - 0 to 12 inches: clay
C - 12 to 46 inches: clay
2Ck - 46 to 70 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Available water storage in profile: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Temple

Percent of map unit: 5 percent
Landform: Basin floors
Hydric soil rating: No

Piper

Percent of map unit: 5 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Unnamed

Percent of map unit: 5 percent
Landform: Basin floors
Hydric soil rating: No

Ml—Merced clay, moderately saline

Map Unit Setting

National map unit symbol: hl73
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 225 to 275 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Merced and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merced

Setting

Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

Ap - 0 to 12 inches: clay
C - 12 to 46 inches: clay
2Ck - 46 to 70 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Available water storage in profile: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Merced, slightly saline

Percent of map unit: 14 percent
Landform: Basin floors
Hydric soil rating: Yes

Unnamed

Percent of map unit: 1 percent
Landform: Depressions on basin floors
Hydric soil rating: Yes

Mm—Merced clay, saline-alkali

Map Unit Setting

National map unit symbol: hl74
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Merced and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merced

Setting

Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

Ap - 0 to 12 inches: clay
C - 12 to 46 inches: clay
2Ck - 46 to 70 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C

Hydric soil rating: Yes

Minor Components

Unnamed

Percent of map unit: 15 percent
Landform: Basin floors
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Pl—Playas

Map Unit Setting

National map unit symbol: hl7v
Elevation: 150 to 230 feet
Mean annual precipitation: 8 to 20 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Playas: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Playas

Setting

Landform: Playas on fan skirts, playas on basin-floor remnants
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, dip, rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Properties and qualities

Slope: 0 to 2 percent
Runoff class: Negligible
Depth to water table: About 0 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Yes

Minor Components

Unnamed

Percent of map unit: 5 percent
Landform: Playas
Hydric soil rating: Yes

Pr—Pond sandy loam

Map Unit Setting

National map unit symbol: hl84
Elevation: 160 to 230 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Pond and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pond

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 8 inches: sandy loam
Bt - 8 to 20 inches: sandy clay loam
2C - 20 to 35 inches: sandy loam
3C - 35 to 60 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Strongly saline (16.0 to 30.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups
Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Unnamed
Percent of map unit: 13 percent
Landform: Fan skirts
Hydric soil rating: No

Unnamed
Percent of map unit: 2 percent
Landform: Depressions on fan skirts
Hydric soil rating: Yes

Pt—Pond fine sandy loam

Map Unit Setting
National map unit symbol: hl86
Elevation: 160 to 230 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Pond and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pond

Setting
Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile
A - 0 to 8 inches: fine sandy loam
Bt - 8 to 17 inches: sandy clay loam
2Bt - 17 to 20 inches: clay loam
3C - 20 to 35 inches: sandy loam

4C - 35 to 60 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Strongly saline (16.0 to 30.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Chino

Percent of map unit: 3 percent
Landform: Fan skirts
Hydric soil rating: No

Playas

Percent of map unit: 3 percent
Landform: Playas on fan skirts
Hydric soil rating: Yes

Fresno

Percent of map unit: 3 percent
Landform: Fan skirts
Hydric soil rating: No

Traver

Percent of map unit: 3 percent
Landform: Fan skirts
Hydric soil rating: No

Unnamed

Percent of map unit: 2 percent
Landform: Depressions on fan skirts
Hydric soil rating: Yes

Pond, reclaimed

Percent of map unit: 1 percent
Landform: Fan skirts
Hydric soil rating: No

Pu—Pond fine sandy loam, moderately deep

Map Unit Setting

National map unit symbol: hl87
Elevation: 160 to 230 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Pond and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pond

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 8 inches: fine sandy loam
Bt - 8 to 17 inches: sandy clay loam
2Bt - 17 to 35 inches: clay loam
3C - 35 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 40 inches to abrupt textural change
Natural drainage class: Somewhat poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Strongly saline (16.0 to 30.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D

Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 13 percent
Landform: Fan skirts
Hydric soil rating: No

Unnamed

Percent of map unit: 2 percent
Landform: Depressions on fan skirts
Hydric soil rating: Yes

Pv—Pond loam

Map Unit Setting

National map unit symbol: hl88
Elevation: 160 to 230 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Pond and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pond

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 8 inches: loam
Bt - 8 to 17 inches: sandy clay loam
2Bt - 17 to 20 inches: clay loam
3C - 20 to 35 inches: sandy loam
4C - 35 to 60 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Strongly saline (16.0 to 30.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups
Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Unnamed
Percent of map unit: 13 percent
Landform: Fan skirts
Hydric soil rating: No

Unnamed
Percent of map unit: 2 percent
Landform: Depressions on fan skirts
Hydric soil rating: Yes

Pw—Pond loam, moderately deep

Map Unit Setting
National map unit symbol: hl89
Elevation: 160 to 230 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Pond and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pond

Setting
Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Alluvium derived from granite

Typical profile

A - 0 to 8 inches: loam
Bt - 8 to 17 inches: sandy clay loam
2Bt - 17 to 35 inches: clay loam
3C - 35 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 40 inches to abrupt textural change
Natural drainage class: Somewhat poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Strongly saline (16.0 to 30.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 13 percent
Landform: Fan skirts
Hydric soil rating: No

Unnamed

Percent of map unit: 2 percent
Landform: Depressions on fan skirts
Hydric soil rating: Yes

Ro—Rossi fine sandy loam

Map Unit Setting

National map unit symbol: hl8w
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Rossi and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rossi

Setting

Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

Ap - 0 to 12 inches: fine sandy loam
Bt - 12 to 38 inches: clay loam
C - 38 to 53 inches: loam
2C - 53 to 65 inches: stratified loamy sand to loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed, sandy loam surface

Percent of map unit: 10 percent
Landform: Basin floors
Hydric soil rating: No

Unnamed, moderately deep compact subsoil

Percent of map unit: 5 percent
Landform: Basin floors
Hydric soil rating: No

Rs—Rossi clay loam

Map Unit Setting

National map unit symbol: hl8x
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Rossi and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rossi

Setting

Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

Ap - 0 to 12 inches: clay loam
Bt - 12 to 38 inches: clay loam
C - 38 to 53 inches: loam
2C - 53 to 65 inches: stratified loamy sand to loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed
Percent of map unit: 14 percent
Landform: Basin floors
Hydric soil rating: Yes

Unnamed
Percent of map unit: 1 percent
Landform: Depressions on basin floors
Hydric soil rating: Yes

Td—Temple clay loam

Map Unit Setting
National map unit symbol: hl9v
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition
Temple and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Temple

Setting
Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile
Ap - 0 to 11 inches: clay loam
Bk - 11 to 31 inches: clay loam
2C - 31 to 68 inches: stratified loamy sand to sandy loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: High (about 9.9 inches)

Interpretive groups
Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed, silty clay loam surface
Percent of map unit: 15 percent
Landform: Basin floors
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Te—Temple clay loam, saline

Map Unit Setting
National map unit symbol: hl9w
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Prime farmland if irrigated and reclaimed of excess salts and sodium

Map Unit Composition
Temple and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Temple

Setting
Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

Ap - 0 to 11 inches: clay loam
Bk - 11 to 31 inches: clay loam
2C - 31 to 68 inches: stratified loamy sand to sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed, moderately saline

Percent of map unit: 15 percent
Landform: Basin floors
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Tg—Temple clay

Map Unit Setting

National map unit symbol: hl9y
Elevation: 170 to 200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

Temple and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Temple

Setting

Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 18 inches: clay
Bk - 18 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Unnamed, slightly saline

Percent of map unit: 5 percent
Landform: Basin floors
Hydric soil rating: Yes

Temple, clay substratum

Percent of map unit: 5 percent
Landform: Basin floors
Hydric soil rating: No

Temple, sandy clay

Percent of map unit: 5 percent
Landform: Basin floors
Hydric soil rating: Yes

Tr—Traver sandy loam

Map Unit Setting

National map unit symbol: hlbg
Elevation: 170 to 240 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Traver and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Traver

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 10 inches: sandy loam
Bt - 10 to 23 inches: sandy clay loam
C - 23 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C

Hydric soil rating: No

Minor Components

Traver, non saline-sodic

Percent of map unit: 14 percent
Landform: Fan skirts
Hydric soil rating: No

Playas

Percent of map unit: 1 percent
Landform: Playas on fan skirts
Hydric soil rating: Yes

Ts—Traver sandy loam, moderately deep

Map Unit Setting

National map unit symbol: hlbh
Elevation: 170 to 240 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Traver and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Traver

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 10 inches: sandy loam
Bt - 10 to 23 inches: sandy clay loam
C - 23 to 36 inches: sandy loam
2C2 - 36 to 60 inches: silt

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups
Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Traver, non saline-sodic
Percent of map unit: 14 percent
Landform: Fan skirts
Hydric soil rating: No

Playas
Percent of map unit: 1 percent
Landform: Playas on fan skirts
Hydric soil rating: Yes

Tt—Traver fine sandy loam

Map Unit Setting
National map unit symbol: hlbj
Elevation: 170 to 240 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Traver and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Traver

Setting
Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile
A - 0 to 10 inches: fine sandy loam
Bt - 10 to 23 inches: sandy clay loam
C - 23 to 60 inches: sandy loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups
Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Unnamed, loam surface
Percent of map unit: 14 percent
Landform: Fan skirts
Hydric soil rating: No

Playas
Percent of map unit: 1 percent
Landform: Playas on fan skirts
Hydric soil rating: Yes

Tu—Traver fine sandy loam, moderately deep

Map Unit Setting
National map unit symbol: hlbk
Elevation: 170 to 240 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Traver and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Traver

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 10 inches: fine sandy loam
Bt - 10 to 23 inches: sandy clay loam
C - 23 to 36 inches: sandy loam
2C2 - 36 to 60 inches: silt

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Traver, non saline-sodic

Percent of map unit: 14 percent
Landform: Fan skirts
Hydric soil rating: No

Playas

Percent of map unit: 1 percent
Landform: Playas on fan skirts
Hydric soil rating: Yes

TzbA—Tujunga loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: hlc1
Elevation: 180 to 400 feet
Mean annual precipitation: 8 to 12 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Tujunga and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tujunga

Setting

Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 4 inches: loamy sand
C - 4 to 60 inches: stratified sand to loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Unnamed, loamy coarse sand
Percent of map unit: 12 percent
Landform: Flood plains, alluvial fans
Hydric soil rating: No

Unnamed, compact substratum
Percent of map unit: 2 percent
Landform: Flood plains, alluvial fans
Hydric soil rating: No

Unnamed, flooded
Percent of map unit: 1 percent
Landform: Flood plains
Hydric soil rating: Yes

W—Water

Map Unit Composition
Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Wa—Waukena fine sandy loam

Map Unit Setting
National map unit symbol: hlcy
Elevation: 160 to 180 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition
Waukena and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Waukena

Setting
Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 4 inches: fine sandy loam
Btk - 4 to 19 inches: sandy clay loam
C - 19 to 61 inches: stratified loamy fine sand to loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Unnamed, sandy loam surface

Percent of map unit: 14 percent
Landform: Fan skirts
Hydric soil rating: No

Unnamed, depression

Percent of map unit: 1 percent
Landform: Depressions on fan skirts
Hydric soil rating: Yes

We—Waukena loam

Map Unit Setting

National map unit symbol: hlcz
Elevation: 160 to 180 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 225 to 275 days
Farmland classification: Not prime farmland

Map Unit Composition

Waukena and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Waukena

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 4 inches: loam
Btk - 4 to 19 inches: sandy clay loam
C - 19 to 61 inches: stratified loamy fine sand to loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Unnamed, clay loam surface

Percent of map unit: 10 percent
Landform: Fan skirts
Hydric soil rating: No

Unnamed, channeled

Percent of map unit: 4 percent
Landform: Channels on fan skirts
Hydric soil rating: Yes

Unnamed, depression

Percent of map unit: 1 percent
Landform: Depressions on fan skirts

Hydric soil rating: Yes

Fresno County, California, Western Part

101—Armona loam, partially drained, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: hnyy
Elevation: 110 to 210 feet
Mean annual precipitation: 7 to 8 inches
Mean annual air temperature: 62 to 63 degrees F
Frost-free period: 220 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Armona, loam, partially drained, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Armona, Loam, Partially Drained

Setting

Landform: Flood plains on basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous and/or sedimentary rock

Typical profile

Ap - 0 to 14 inches: loam
Bkg - 14 to 22 inches: stratified loam to clay loam
Bkng - 22 to 42 inches: stratified loam to clay loam
B'kg - 42 to 60 inches: stratified loam to clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Gypsum, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 40.0
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Tachi, clay
Percent of map unit: 5 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Gepford, clay
Percent of map unit: 4 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Bisgani, sandy loam, drained
Percent of map unit: 3 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Elnido, sandy loam, drained
Percent of map unit: 3 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

282—Tachi clay, 0 to 1 percent slopes

Map Unit Setting
National map unit symbol: hnz2
Elevation: 120 to 210 feet
Mean annual precipitation: 7 to 8 inches
Mean annual air temperature: 62 to 65 degrees F
Frost-free period: 220 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Tachi, clay, and similar soils: 91 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tachi, Clay

Setting
Landform: Flood plains on basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf, rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous rock and/or alluvium derived from sedimentary rock

Typical profile
Ap - 0 to 14 inches: clay
Bknssg - 14 to 35 inches: clay

Bkng - 35 to 70 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Gypsum, maximum in profile: 1 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Gepford, clay

Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Armona, loam, partially drained

Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Tachi, silt loam, 3-10 inch overwash

Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Lillis, clay

Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: Yes

Unnamed, river channel

Percent of map unit: 1 percent
Landform: Flood plains
Microfeatures of landform position: Channels
Hydric soil rating: Yes

284—Lillis clay, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: hnz3
Elevation: 160 to 180 feet
Mean annual precipitation: 7 to 8 inches
Mean annual air temperature: 62 to 63 degrees F
Frost-free period: 230 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Lillis, clay, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lillis, Clay

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous and/or sedimentary rock

Typical profile

Ap1 - 0 to 2 inches: clay
Ap2 - 2 to 7 inches: clay
Bnssz - 7 to 13 inches: clay
Bnssyz - 13 to 21 inches: clay
Bnzg - 21 to 28 inches: clay
Bknzg1 - 28 to 39 inches: clay
Bknzg2 - 39 to 48 inches: clay
Bknzg3 - 48 to 60 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 35 inches to salic
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Very rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Gypsum, maximum in profile: 8 percent
Salinity, maximum in profile: Strongly saline (32.0 to 50.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 90.0

Available water storage in profile: Very low (about 1.0 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Tachi, clay

Percent of map unit: 7 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Tranquillity, clay, saline-sodic, wet

Percent of map unit: 4 percent
Landform: Fan skirts
Hydric soil rating: No

Ciervo, clay, saline-sodic, wet

Percent of map unit: 3 percent
Landform: Fan skirts
Hydric soil rating: No

Lethent, silt loam

Percent of map unit: 1 percent
Landform: Fan remnants
Hydric soil rating: No

285—Tranquillity-Tranquillity, wet, complex, saline-sodic, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: hnz4
Elevation: 130 to 360 feet
Mean annual precipitation: 7 to 8 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 220 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Tranquillity, clay, saline-sodic, and similar soils: 60 percent
Tranquillity, clay, saline-sodic, wet, and similar soils: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tranquillity, Clay, Saline-sodic

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 22 inches: clay
Bkss - 22 to 53 inches: clay
Bk - 53 to 71 inches: clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Gypsum, maximum in profile: 3 percent
Salinity, maximum in profile: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Tranquillity, Clay, Saline-sodic, Wet

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap1 - 0 to 6 inches: clay
Ap2 - 6 to 16 inches: clay
Bknssyz1 - 16 to 31 inches: clay
Bknssyz2 - 31 to 48 inches: clay
Bknyz - 48 to 65 inches: silty clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: About 48 to 60 inches
Frequency of flooding: Very rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Gypsum, maximum in profile: 8 percent
Salinity, maximum in profile: Moderately saline (8.0 to 15.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups
Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Ciervo, clay, saline-sodic, wet
Percent of map unit: 5 percent
Landform: Fan skirts
Hydric soil rating: No

Armona, loam, partially drained
Percent of map unit: 4 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Deldota, clay, partially drained
Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: No

Tachi, clay
Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Calflax, clay loam, saline-sodic, wet
Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: No

286—Tranquillity clay, saline-sodic, wet, 0 to 1 percent slopes

Map Unit Setting
National map unit symbol: hnz5
Elevation: 160 to 260 feet
Mean annual precipitation: 7 to 8 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 220 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Tranquillity, clay, saline-sodic, wet, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tranquillity, Clay, Saline-sodic, Wet

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap1 - 0 to 6 inches: clay
Ap2 - 6 to 16 inches: clay
Bknssyz1 - 16 to 31 inches: clay
Bknssyz2 - 31 to 48 inches: clay
Bknyz - 48 to 65 inches: silty clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Gypsum, maximum in profile: 8 percent
Salinity, maximum in profile: Moderately saline (8.0 to 15.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Ciervo, clay, saline-sodic, wet

Percent of map unit: 4 percent
Landform: Fan skirts
Hydric soil rating: No

Tranquillity, clay, saline-sodic

Percent of map unit: 3 percent
Landform: Fan skirts
Hydric soil rating: No

Calflax, clay loam, saline-sodic, wet
Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: No

Tachi, clay
Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Gepford, clay
Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Armona, loam, partially drained
Percent of map unit: 1 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Lethent, silt loam
Percent of map unit: 1 percent
Landform: Fan remnants
Hydric soil rating: No

320—Elnido sandy loam, drained, 0 to 1 percent slopes

Map Unit Setting
National map unit symbol: hnz7
Elevation: 110 to 170 feet
Mean annual precipitation: 8 to 9 inches
Mean annual air temperature: 62 to 63 degrees F
Frost-free period: 230 to 250 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Elnido, sandy loam, drained, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elnido, Sandy Loam, Drained

Setting
Landform: Flood plains on basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous rock

Typical profile

Ap - 0 to 14 inches: sandy loam
Bwg - 14 to 32 inches: sandy loam
Bkg - 32 to 40 inches: fine sandy loam
Cg1 - 40 to 53 inches: sandy loam
Cg2 - 53 to 60 inches: sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Salinity, maximum in profile: Nonsaline to slightly saline (1.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 20.0
Available water storage in profile: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A
Hydric soil rating: Yes

Minor Components

Bolfar, loam, drained

Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Dospalos, clay loam, drained

Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Palazzo, sandy loam, drained

Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Tachi, clay

Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Wekoda, clay, partially drained

Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Armona, loam, partially drained

Percent of map unit: 2 percent
Landform: Flood plains on basin floors

Hydric soil rating: Yes

Bisgani, sandy loam, drained

Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Hydric soil rating: Yes

Unnamed, river channel

Percent of map unit: 1 percent
Landform: Flood plains
Microfeatures of landform position: Channels
Hydric soil rating: Yes

375—Lethent silt loam, 0 to 1 percent slopes, poorly drained, MLRA 17

Map Unit Setting

National map unit symbol: 2vnd7
Elevation: 160 to 170 feet
Mean annual precipitation: 8 to 9 inches
Mean annual air temperature: 62 degrees F
Frost-free period: 240 to 270 days
Farmland classification: Not prime farmland

Map Unit Composition

Lethent, silt loam, poorly drained, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lethent, Silt Loam, Poorly Drained

Setting

Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary and igneous rock

Typical profile

Ap - 0 to 7 inches: silt loam
Btnzg - 7 to 20 inches: silty clay
Btknzg - 20 to 39 inches: silty clay
Bknzg - 39 to 79 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 4 to 10 inches to natric; 15 to 25 inches to salic
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 4 inches
Frequency of flooding: Very rare

Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Gypsum, maximum in profile: 4 percent
Salinity, maximum in profile: Strongly saline (30.0 to 60.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 60.0
Available water storage in profile: Very low (about 1.1 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Lillis, clay

Percent of map unit: 7 percent
Landform: Fan skirts
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Tranquillity, clay, saline-sodic, wet

Percent of map unit: 4 percent
Landform: Fan skirts
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Ciervo, clay, saline-sodic, wet

Percent of map unit: 4 percent
Landform: Fan skirts
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

475—Posochanet clay loam, saline-sodic, wet, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: hp0b
Elevation: 160 to 270 feet
Mean annual precipitation: 6 to 8 inches
Mean annual air temperature: 62 to 63 degrees F
Frost-free period: 230 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Posochanet, clay loam, saline-sodic, wet, and similar soils: 88 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Posochanet, Clay Loam, Saline-sodic, Wet

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap1 - 0 to 7 inches: clay loam
Ap2 - 7 to 15 inches: clay loam
Bw - 15 to 24 inches: stratified loam to silty clay loam
Bknz - 24 to 60 inches: stratified loam to silty clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 20.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Calflax, clay loam, saline-sodic, wet

Percent of map unit: 4 percent
Landform: Fan skirts
Hydric soil rating: No

Tranquillity, clay, saline-sodic, wet

Percent of map unit: 3 percent
Landform: Fan skirts
Hydric soil rating: No

Lethent, clay loam

Percent of map unit: 3 percent
Landform: Fan remnants
Hydric soil rating: No

Ciervo, clay, saline-sodic

Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: No

482—Calflax clay loam, saline-sodic, wet, 0 to 1 percent slopes, MLRA 17

Map Unit Setting

National map unit symbol: 2vncl
Elevation: 160 to 340 feet
Mean annual precipitation: 7 to 9 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 230 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Calflax, clay loam, saline-sodic, wet, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Calflax, Clay Loam, Saline-sodic, Wet

Setting

Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 8 inches: clay loam
Bw - 8 to 26 inches: clay loam
Bny - 26 to 33 inches: loam
Bnyz1 - 33 to 47 inches: silt loam
Bnyz2 - 47 to 65 inches: loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 3 percent
Gypsum, maximum in profile: 5 percent

Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 40.0
Available water storage in profile: Moderate (about 7.3 inches)

Interpretive groups
Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Ciervo, clay, saline-sodic, wet
Percent of map unit: 6 percent
Landform: Fan skirts
Hydric soil rating: No

Cerini, clay loam
Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

Posochanet, clay loam, saline-sodic, wet
Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: No

Lethent, clay loam
Percent of map unit: 2 percent
Landform: Fan remnants
Hydric soil rating: No

Kimberlina, fine sandy loam
Percent of map unit: 1 percent
Hydric soil rating: No

Garces, silt loam
Percent of map unit: 1 percent
Hydric soil rating: No

Twisselman, clay, saline-sodic
Percent of map unit: 1 percent
Hydric soil rating: No

981—Sewage disposal pond

Map Unit Setting
National map unit symbol: hp2n
Elevation: 140 to 650 feet
Farmland classification: Not prime farmland

Map Unit Composition

Sewage disposal pond: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sewage Disposal Pond

Properties and qualities

Slope: 0 percent

Frequency of flooding: Very rare

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Appendix J
Groundwater Model Report

Fresno County Management Areas A & B Numerical Flow Model Report

2019

Prepared for

The County of Fresno

Prepared By

Luhdorff & Scalmanini
Consulting Engineers

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ABBREVIATIONS & ACRONYMS

AFY	Acre-feet per Year
BAS	MODFLOW Basic Package
bgs	Below Ground Surface
BIS	UC Davis Basic Irrigation Scheduling
CDEC	California Data Exchange Center
CIMIS	California Irrigation Management Information
CVHM	USGS Central Valley Hydrologic Model
CVP	Central Valley Project
DIS	MODFLOW Discretization Package
DWR	California Department of Water Resources
ET	Evapotranspiration
ET_0	Reference Evapotranspiration
ft	Feet or foot
ft/d	feet per day
GHB	General-Head Boundary
GSP	Groundwater Sustainability Plan
LAK	Lake Package
LSCE	Luhdorff & Scalmanini, Consulting Engineers
MAE	Mean absolute error
ME	Mean error
MNW2	Multi-Node Well
MODFLOW	Modular three-dimensional finite-difference ground-water flow model
msl	Above Mean Sea Level
NRMSE	Normalized Root mean squared error
RMSE	Root mean squared error
SFR	Streamflow Routing Package
SGMA	Sustainable Groundwater Management Act

SUB	Subsidence Package
UPW	Upstream Weighting Package
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey

APPENDICES

Appendix A1 – Observed and Simulated Groundwater Level Elevations of Model Calibration Target Wells

1 INTRODUCTION

Analytical and numerical groundwater flow models were developed in a coordinated effort among the six GSP groups in the Delta-Mendota Subbasin (DM Subbasin) using the same methodologies to quantify groundwater conditions for the DM Subbasin and local GSP group areas. A numerical flow model (the model) was developed to simulate surface water and groundwater movement in the geographic extent of the Fresno County Management Areas A and B (FCMA) and adjacent areas. The model utilized data that is described in the "Basin Setting" chapter of the GSP Report (LSCE, 2019) to improve the understanding of hydrologic processes and their relationship to key sustainability metrics within FCMA. This Numerical Model Report has been prepared for Fresno County to summarize the development and calibration of the model, as well as the simulation results of the calibrated model.

Numerical groundwater flow models are structured tools developed to represent the physical hydrological settings and simulate groundwater flow by integrating a multitude of data (e.g. lithology, groundwater levels, surface water features, groundwater pumping, etc.) that compose the conceptualization of the natural geologic and hydrogeologic environment. The model of the FCMA was developed in accordance with the best management practices developed by the California Department of Water Resources (DWR, 2016 and 2017). The modeling approach was developed to effectively quantify key hydrologic processes related to SGMA sustainability indicators that may occur or have occurred in FCMA:

1. Lowering of Groundwater Levels
2. Reduction of Groundwater Storage

The integrated hydrologic model code based on the United States Geological Survey's MODFLOW-NWT (Niswonger et al., 2011) was selected as the modeling platform due to its versatility in simulating crop-water demands in the predominantly agricultural setting and groundwater surface-water interaction characteristics in the Subbasin. The model was calibrated to a diverse set of available historical data using industry standard techniques including trial and error and automated parameter estimation. Model sensitivity was evaluated using a mathematically and statistically robust approach provided in UCODE 2014 (Poeter et al., 2014).

2 MODEL CODE

The model codes selected for the flow model are in the public domain and suitable for GSP purposes. Below is a brief description of model codes.

2.1 MODFLOW-NWT

MODFLOW-NWT (MF-NWT) is an integrated hydrologic flow model developed by the U.S. Geological Survey (USGS) to evaluate groundwater-surface water interaction and conjunctive use (Niswonger et al., 2011). MF-NWT integrates various processes and packages to enable the robust and dynamic simulation of supply-and-demand agricultural water budgets, surface water, and groundwater flow.

2.2 Model Packages

The components utilized in the flow model (model packages) are described below.

Basic Package: The MODFLOW Basic (BAS) package specifies the location of active and inactive model cells and initial heads used at the start of the simulation.

Discretization Package: The MODFLOW Discretization (DIS) package specifies the spatial and temporal model geometry. The spatial discretization includes the row and column spacing and model cell top and bottom elevations. The temporal discretization includes the number and length of model stress periods and timesteps. A MODFLOW stress period is a length of time where specified model stresses are constant. A stress period may be broken up into one or more timesteps for which flow equations are solved.

Output Control Package: The Output Control (OC) package specifies the printing of simulated groundwater heads and volumetric budget.

Newton Solver: The Newton Solver (NWT) package is used to solve the system of hydrologic equations governing groundwater flow and groundwater-surface water interaction. The NWT package is used in models where there are a substantial number of dry cells (hydraulic head is below the cell bottom) within the model.

Upstream Weighting Package: The Upstream Weighting (UPW) package specifies the hydraulic properties within model cells. These include the horizontal hydraulic conductivity, vertical hydraulic conductivity, specific yield and specific storage.

Subsidence Package: The Subsidence (SUB) package is used to simulate changes in groundwater storage and compaction of aquifer systems. The SUB package accounts for storage changes due to the deformation of the aquifer system in confined aquifers, while the UPW package accounts for storage changes due to specific yield and the compressibility of water.

Multi-Node Well Package: The Multi-Node Well (MNW2) package is a head dependent flux boundary condition used to simulate pumping from wells which penetrate multiple model cells vertically.

Well Package: The Well (WEL) package is a head dependent flux boundary condition used to simulate pumping in wells that are completed in one model layer.

General-Head Boundary Package: The General-Head Boundary (GHB) package is a head dependent flux boundary condition used in this model to simulate lateral subsurface flow into and out of the model domain. The flux between a model cell and GHB cell is calculated based on the hydraulic head in the model and GHB cell and conductance specified between them.

Streamflow Routing Package: The Streamflow Routing (SFR) package is used to simulate streams and groundwater-surface water interaction in the model.

Lake Package: The Lake (LAK) package is used to simulate lakes and exchange between lakes and groundwater in the model. The LAK package also allows for interaction with streams within the model domain.

2.3 Parameter Estimation

Parameter estimation was conducted using UCODE 2014 (Poeter et al., 2014). UCODE is a parameter estimation code that calculates model parameter which minimize the model error (i.e., difference between observed data and simulated values). This is achieved using modified Gauss-Newton iteration (Marquardt-Levenberg method) which minimizes the least squares objective function value *(Sb).*

As part of the parameter estimation process, the sensitivity of the simulated values is calculated (Hill and Tiedman, 2007). The sensitivity of all (or groups) of simulated parameters are summarized by the "composite scaled sensitivity" (CSS). The CSS is used to determine which parameters are most sensitive (those with higher CSS influence the model results to a greater degree) and provides a statistically robust approach to model sensitivity analysis (Hill and Tiedman, 2007).

3 DISCRETIZATION

The discretization of the model describes the spatial extent of the modeled area, the model layering, model cell size, and the temporal element of the model. The discretization of the model focused on creating a model structure that would allow the model to simulate groundwater conditions on a scale of subareas that larger than approximately 100 acres within a subbasin with sufficient detail and resolution that is balanced by the length of time (run time) for each model run.

3.1 Spatial Discretization and Model Layering

The groundwater model domain includes an approximately 388 square mile rectangular portion of the western San Joaquin Valley encompassing parts of Delta-Mendota (157 sq. mile), Madera (117 sq. mile), Kings (79 sq. mile), Westside (33 sq. mile) and Chowchilla (2 sq. mile) subbasins (**Figure 3-1**). The model domain boundary was located at a minimum distance of about two miles to south and southwest sides from FCMA boundaries, and six miles to other sides. This buffer zone allows to identify hydrological interactions between FCMA and adjacent subareas under various simulated conditions. The model domain was discretized onto an orthogonal finite difference grid composed of 245 rows, 228 columns and 9 layers (**Figure 3-2**). Each grid cell is a 440 ft x 440 ft square. The top elevation of the model was based on the land surface as determined by a 10-meter digital elevation model developed by the USGS. The bottom of the model domain was initially set as the base of post-Eocene continental deposits and base of fresh water taken from the Central Valley Hydrologic Model (Faunt, et al., 2009).

Vertical discretization of 9 layers was primarily determined by the location and extent of lacustrine deposits including the A- Clay, B-Clay and Corcoran Clay (Croft and Gordon, 1968; Croft 1972). Model layers 1 and 2 represent the uppermost unconfined portions (shallow zone) of the upper aquifer deposited above the A-Clay where present. Model layer 1 is used to assign boundary conditions representing major natural surface water features and its thickness ranges from about 12 to 40 feet. Thickness of Layer 2 ranges from about 33 to 102 feet. Layer 3 is used to represent the A-clay or A-clay equivalent and is approximately to 18 ft thick. The top elevation of Layer 3 was estimated based on the top elevation of the A-clay, which generally occurs between 20 and 80 ft, above mean sea level (msl) or up to 125 ft bgs as determined by DWR Well Completion Reports, geophysical logs, and land surface elevations (**Figure 3-3**). Beyond the extent of the A-clay, the top of layer 3 follows the slope of the land surface. The deep zone of the upper aquifer is represented by model layers 4 through 6. Layers 4 and 6 represent the upper and lower portions of the deep zone, extending from the bottom of the A-clay or A-clay equivalent to the top of the Corcoran Clay. Layer 5 is about 20 ft thick and is used to represent the C-clay or C-clay equivalent, which bisects the deep zone in some areas, where this clay is present (**Figure 3-4**).The thickness of the deep aquifer zone as represented by model layers 4 and 6 range from about 80 to 455 ft.

Layer 7 is used to represent the Corcoran Clay which ranges in thickness from approximately 8 to 90 ft in areas where this clay exists. The thickest portion of the Corcoran Clay is in the northwestern portion of the model domain and it thins to the southeastern portion of the domain(. The thickness of this layer

was estimated from available DWR Well Completion Reports and geophysical logs available throughout the model domain. The depth to the top of the Corcorcan Clay in the model domain ranges from 190 to 560 ft, bgs. Layers 8 and 9 are used to represent the lower aquifer that underlies the Corcoran Clay (**Figure 3-5**). Layer 8 extends from the bottom of the Corcoran Clay to a thickness of about 195 to 685 ft (elevation of 700 ft below sea level or the maximum presumed depth of groundwater pumping). Layer 9 is included as a buffer between the bottom of layer 8 and the bottom of the model domain and may intersect the base of fresh water in some areas. Layer 9 ranges from 5 to 460 ft thick (-705 ft to -1160 ft, msl) and dips to the southwest. The bottom elevation of layer 9 corresponds to the bottom of layer 8 in the CVHM (Faunt et al., 2009). The minimum, maximum and mean thicknesses of model layers are given in **Table 3-1**.

Model layers in MODFLOW-NWT can be assigned as either confined (storage coefficient and transmissivity do not vary) or unconfined (storage coefficient and transmissivity dependent on saturated thickness). Model layers 1 through 6 are designated as unconfined while layers 7 through 9 are designated as confined.

Table 3-1: Thicknesses of Model Layers

Layer Number	Within Entire Model Domain (ft)			Within FCMA (ft)		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
1	12	40	34	16	37	31
2	33	102	54	43	102	86
3	17	19	18	18	19	18
4	68	122	91	91	122	94
5	20	21	20	20	20	20
6	11	323	153	170	305	203
7	8	89	40	22	60	41
8	246	684	464	249	396	366
9	5	464	270	323	451	372

3.2 Temporal Discretization

The groundwater model was used to calculate a water budget over three different time periods: historic (2003-2012), current (2013), and projected (2014-2070). The historic period was selected to meet the minimum 10-year GSP requirement and the current water year of 2013 was selected based on the availability of data for other GSP groups in the Subbasin and it follows the historic water budget period. Two model runs were developed for the projected period; a baseline run with comparable historic conditions, and a modified version of the baseline run that incorporated climate change factors provided by DWR (**DWR, 2018**) on rainfall, evapotranspiration, and streamflow.

Historic, current, and projected simulation periods were divided into 120, 12, and 684 monthly stress periods, respectively. Specified conditions such as groundwater pumpage, precipitation, evapotranspiration, surface water flows, surface water deliveries, and general head boundary conditions remain constant within each stress period and vary between stress periods. Each stress period is divided evenly into two timesteps where the flow equations are solved by the model.

4 BOUNDARY CONDITIONS

Boundary conditions specified in the model are general head conditions (groundwater levels immediately outside of the model domain), groundwater pumping, surface water flows (streams, canals and lakes) and recharge of groundwater from rainfall, irrigation water and artificial recharge facilities. Actual data were used to develop boundary conditions for the 2003 through 2017 period.

Climatic observations of 1979 through 2017 and 1965 through 1978 were sequentially used to represent expected conditions of 2018 through 2056 and 2057 through 2070, respectively (**Table 4-1**). General head conditions and surface water deliveries for irrigation observed in representative historical water years (2010, 2011 and 2013 for average, wet and dry years, respectively) were assigned to corresponding type of water years in 2018-2070 period. Water year types were determined using the San Joaquin River Index (SJR Index) developed by DWR (http://cdec.water.ca.gov/water_supply.html). Available annual land use data were used to estimate irrigation water demands when needed during 2000-2012 period, and 2013 land use data were used for this estimation for 2013 and later years. Water year types in simulation periods are given in **Tables 4-1 and 4-2**.

Table 4-1: Water Year Types in Delta-Mendota Subbasin for Historic and Current Simulation Periods

Year	SJR Index	Year Type
2003	Below Normal	Normal
2004	Dry	Dry
2005	Wet	Wet
2006	Wet	Wet
2007	Critical	Dry
2008	Critical	Dry
2009	Below Normal	Normal
2010	Above Normal	Normal
2011	Wet	Wet
2012	Dry	Dry
2013	Critical	Dry

Table 4-2: Water Year Types in Delta-Mendota Subbasin for Projected Simulation Period

Projected Year	Corresponding Historic Year	SJR Index	Year Type
2014	2014	Critical	Dry
2015	2015	Critical	Dry

2016	2016	Dry	Dry
2017	2017	Wet	Wet
2018	1979	Above Normal	Normal
2019	1980	Wet	Wet
2020	1981	Dry	Dry
2021	1982	Wet	Wet
2022	1983	Wet	Wet
2023	1984	Above Normal	Normal
2024	1985	Dry	Dry
2025	1986	Wet	Wet
2026	1987	Critical	Dry
2027	1988	Critical	Dry
2028	1989	Critical	Dry
2029	1990	Critical	Dry
2030	1991	Critical	Dry
2031	1992	Critical	Dry
2032	1993	Wet	Wet
2033	1994	Critical	Dry
2034	1995	Wet	Wet
2035	1996	Wet	Wet
2036	1997	Wet	Wet
2037	1998	Wet	Wet
2038	1999	Above Normal	Normal
2039	2000	Above Normal	Normal
2040	2001	Dry	Dry
2041	2002	Dry	Dry
2042	2003	Below Normal	Normal
2043	2004	Dry	Dry
2044	2005	Wet	Wet
2045	2006	Wet	Wet
2046	2007	Critical	Dry
2047	2008	Critical	Dry
2048	2009	Below Normal	Normal
2049	2010	Above Normal	Normal
2050	2011	Wet	Wet
2051	2012	Dry	Dry
2052	2013	Critical	Dry
2053	2014	Critical	Dry
2054	2015	Critical	Dry
2055	2016	Dry	Dry

2056	2017	Wet	Wet
2057	1965	Wet	Wet
2058	1966	Below Normal	Normal
2059	1967	Wet	Wet
2060	1968	Dry	Dry
2061	1969	Wet	Wet
2062	1970	Above Normal	Normal
2063	1971	Below Normal	Normal
2064	1972	Dry	Dry
2065	1973	Above Normal	Normal
2066	1974	Wet	Wet
2067	1975	Wet	Wet
2068	1976	Critical	Dry
2069	1977	Critical	Dry
2070	1978	Wet	Wet

4.1 General Head Boundary Condition

Flow model requires that the hydraulic heads immediately outside the model boundary (general head) are specified for all stress periods. These general head conditions affect the subsurface flow into and out of the model domain. Assigned general head values varied spatially (both laterally and vertically) and temporally. They were estimated using publicly available historical groundwater level data and data that LSCE had received from local entities.

Initial (i.e., at the beginning of flow simulation) hydraulic heads within the model domain, which are required to simulate flow in subsequent stress periods, were taken from the results of a calibrated model that simulated flow in the same area.

4.2 Groundwater Pumping

Groundwater is extracted to make up the estimated irrigation demand of crops that is not met by surface water and precipitation in each GSA zone. In addition, GSAs that belongs to MPG extracts groundwater to transfer to other GSAs in MPG (transfer pumping). Reliable information on location and construction of existing groundwater pumping wells in FCMA and some adjacent local entities was available. This information was used to place model wells, including the model layers where each well was screened. An approximately one-mile grid of virtual wells was used to simulate groundwater pumping in areas where sufficient information on existing wells was not available. Screen depths of virtual wells in different localities were determined after evaluating available well completion reports.

The same set of model wells (both actual and virtual wells) were used in historical, current and projected simulations. The model did not have pumping wells in Mendota Wildlife Area.

4.2.1 Known Pumping

For the simulations of historic and current periods, known groundwater pumping (for irrigation and transfer) was assigned to known wells in areas where relatively reliable records of pumping were available on monthly basis. In addition to MPG lands, these areas included portions of the CCID, Columbia Canal Company, New Columbia Ranch, and Meyers Farms.

4.2.2 Estimation of Unknown Pumping

For areas where groundwater pumping data was not available for historic and current simulation periods, required amount of groundwater for irrigation was estimated employing a water budget approach. Crop water demand of a model cell (D_{crop}) is equal to the product of effective crop coefficient of the cell (KC_{cell}) and reference evapotranspiration (ET_0). The amount of groundwater required to satisfy the crop water demand that was not met by precipitation and surface water deliveries was then calculated assuming an irrigation efficiency of 80%. Estimated groundwater demand of each model cell was then assigned to the nearest well to the centroid of that cell, provided that the well and model cell are located within the same local entity.
Total transfer pumping volume of the FCMA was set constant at 11,440 AFY throughout the projected period, and it was distributed between wells similar to the actual distribution in 2014-2016 period. This value was obtained after considering the annual transfer pumping average of 21,053 AFY contributed by all Mendota Pool Group entities (**USBR & WWD, 2018**), and historical contribution ratios by FCMA and FWD. Furthermore, extraction of water from Meyers Water Bank was active only during dry years of the projected period at a rate of 7,175 AFY.

Below is a brief description of parameters used to estimate the groundwater demand for irrigation.

Precipitation

Rainfall data was specified at each model cell for each stress period within each simulation period. Monthly precipitation data for the 1980-2017 period was taken from the PRISM Climate Group at Oregon State University (http://prism.oregonstate.edu/) at a spatial resolution of 2km x 2km. Precipitation values for the 1965-1979 period was taken from representative water years selected from the 1980-2017 period. Representative years were identified by comparing the total annual precipitations of recorded at Mendota and Madera rain gages (California Data Exchange Center Station ID “MEN” and “MDR”, respectively) for the two periods. The PRISM data was gridded and assigned to model cells based on whether the center of the model cell falls within each PRISM precipitation data cell (**Figure 4-1**).

Surface Water Deliveries

Imported water is used for irrigation in Coehlo Family Trust area in FCMA. Furthermore, Mendota Wildlife Area (MWA) receives surface water from Central Valley Project (CVP) through Mendota Pool and San Luis Canal. Imported surface water received by the entities located within the model domain through CVP were obtained from monthly delivery data published by USBR Central Valley Operations (https://www.usbr.gov/mp/cvo/deliv.html). Entities that partially fall within the model domain was assigned a portion of the delivered water volume based on the area located within the model domain. Surface water deliveries observed in representative water were assigned to corresponding type of water years in 2018-2070 period.

Land Use

Estimation of irrigation water demand for the historic period (2003-2012) was based on land surface characteristics that existed in this period on annual basis, while that for the current and projected periods was based on land surface characteristics of 2013. Land surface characteristics of the model domain were established after reviewing several land use data sources (DWR land use surveys - Fresno County 2000, Eastern Fresno County 2009, Land IQ 2014) and satellite imageries obtained from USDA National Agricultural Statistics Service (NASS) and Google Earth. Irrigated and non-irrigated lands were determined using the DWR land use descriptions and visual observation of Google Earth satellite imageries (**Figures 4-2 and 4-3**).

Reference Evapotranspiration

For a given stress period of the simulation (a period of one month), one reference evapotranspiration (ET_0) value was used for the entire model domain. This value was estimated from data available from two weather stations managed by the California Irrigation Management Information System (CIMIS). Monthly ET_0 of the model domain was set at that measured at Firebaugh/Telles station (Station ID 7) for the period of 1982 – 1991, and at the average of values measured at Westlands (Station ID 105) and Firebaugh/Telles stations for the 1992 – 2017 period. For the years prior to 1982, monthly ET_0 values were estimated using Fresno County monthly ET (from NOAA - Station ID USC00043261) based on simple linear regressions between NOAA data and CIMIS data.

Crop coefficients

The crop coefficient of a particular landcover type can vary with time as a function of growth stage of crops. Crop coefficients for different land surface characteristics, including non-irrigated lands such as bare ground, barren/fallow lands and natural vegetation, were calculated based on the UC Davis Basic

Irrigation Scheduling (BIS) application developed by Snyder et al. (2000, 2008) at monthly frequency. Values for the crops that were not provided in the BIS were taken from Allen et al. (1998), if available. For the remaining crops, values were approximated based on comparable crops available in BIS or Allen et al. (1998). For model cells that contained multiple landcover types, an area-weighted crop coefficient (KC_{cell}) was calculated.

Evapotranspiration of a model cell calculated using KC_{cell} was used to estimate the evapotranspiration and deep percolation components of precipitation. In order to determine the water demand of irrigated crops, an "effective crop coefficient" was calculated by setting the crop coefficient to zero for non-irrigated landcover types (e.g., fallow lands, pasture) and non-irrigated months of irrigated crops (e.g., time between the end of one growing season and the start of next growing season of a crop).

4.3 Areal Recharge

Areal recharge in the model was simulated using the Recharge (RCH) Package. Components of recharge that were simulated included recharge from precipitation, irrigation, and recharge facilities in the Meyers Water Bank, New Columbia Ranch, and Terra Linda Farms.

Precipitation that exceeds the crop water demand of a model cell at a given stress period was assumed to percolate to groundwater (i.e., no surface runoff from precipitation). It was also assumed that 20% of applied irrigation water and 30% of any known surface water supplies that exceeded irrigation demand during a particular stress period percolates into groundwater aquifers.

Water is diverted to Meyers Farm recharge ponds (Meyers Water Bank) and Terra Linda Recharge Canal via the pool during wet years. Meyers Water Bank receives Central Valley Project (CVP) water allocated to Meyers Farm by the San Luis Water District (SLWD), which is delivered to the pool via DMC, and subsequently drawn into the ponds. Percolated water is stored in the shallow aquifer and extracted through shallow wells during dry years. Terra Linda Recharge Canal receives flood flows from the Kings River (via James Bypass/ Fresno Slough). Monthly pond infiltration volumes during historical and current periods were estimated from reported monthly diversions to ponds/canal after adjusting for 4% evaporation. Monthly infiltration volumes for the projected period were estimated based on reported historical data. Surface water delivered to Meyers Recharge Ponds during the projected period was consistent with that of surrogate years (2010, 2011, 2013). Water diversion to Terra Linda Recharge Canal was active only when the total annual rainfall at the Madera rain gage (California Data Exchange Center Station ID "MDR") exceeded 10 inches during projected period. Assigned diversion volumes were consistent with reported diversions of 2011.

4.4 Groundwater-Surface Water Interaction

Surface water features were simulated using a combination of the Streamflow Routing (SFR) and Lake (LAK) packages. The SFR package routes the flow between adjacent stream cells, as well as calculates the flow between the stream and underlying aquifer at each model cell. Major streams and canals that were

simulated using the SFR package include the SJR, Delta Mendota Canal, Chowchilla Bypass, James Bypass and other major canals that divert water from the Pool (**Figure 4-4**). Flow and stage in these streams and canals were simulated based on known inflow and canal diversion data.

The LAK package was used in conjunction with the SFR package to simulate stage, volume, as well as exchanges between groundwater and surface water within the Mendota Pool and Fresno Slough. Lake bed hydraulic properties were based on previous estimates of seepage amounts from the Pool (KDSA and LSCE, 2000). In the northern branch of the Pool, the assigned lake bed conductance was slightly higher than the Fresno Slough portion of the Pool, because lake bed sediments are likely coarser due to influence from the San Joaquin River. In the northern branch of the Pool, the lake bed conductance was 0.02 ft/per day compared to 0.002 ft/per day in the Fresno Slough branch of the Pool.

4.4.1 Stream flow data

The primary surface water features located within the model domain are the San Joaquin River (SJR), Mendota Pool (the Pool), Delta Mendota Canal (DMC), Fresno Slough, James Bypass, Chowchilla Bypass, and other major irrigation canals divert water from the Pool. The Pool receives surface water from the SJR, DMC, and flood flows of Kings River via James Bypass/ Fresno Slough. Furthermore, pumped groundwater is also discharged into the Pool by the MPG and others for exchange and for irrigation of lands adjacent to the Pool using the Pool as a conveyance. Under normal conditions, flow of the Fresno Slough is to the south from the Pool. During flood events of the Kings River, flood flows are directed north into the Fresno Slough portion of the Pool creating a northerly flow. The primary canals that convey water from the northern end of the Pool are the CCID Main Canal, CCID Outside Canal, Firebaugh Intake Canal, and Columbia Canal. Several parties divert water from the southern end of the Pool via Lateral 6 and Lateral 7 canals.

Flow of the SJR measured downstream of Gravelly Ford (USGS #11253058) was used to simulate the flow along its path to the Pool. Any excess flood water beyond the capacity of the SJR is diverted through the Chowchilla Bypass at the SJR bifurcation. The flow between the bifurcation and the Pool is simulated after accounting for diversions, which are measured at the gaging station located downstream of the Chowchilla Bypass intake (USGS #11253115). Flow from the pool to SJR downstream of the Mendota Dam was calculated internally by the groundwater model based on the stage in the Pool and elevation of the Mendota Dam. Flow of James Bypass that is measured near San Joaquin (USGS #11253500, CDEC Station ID - JBP) was used to calculate its flow that enters the Pool. Flow of the DMC was specified based on data available from the San Luis Delta Mendota Water Authority (SLDMWA). Diversions from the Pool to the Firebaugh Canal, CCID Outside Canal, CCID Main Canal, and Columbia Canal were specified based monthly diversion volumes provided by the USBR.

4.5 Initial Conditions

Initial conditions define the state of the aquifer system at the beginning of the simulation period. For the historical period of the model, the initial conditions were representative of groundwater elevations existed in October 2002 (i.e, beginning of the water year 2003) within the model domain. Initial

conditions were developed for the shallow and deep zones of the upper aquifer (**Figures 4-5 and 4-6**), as well as for the lower aquifer (**Figure 4-7**) using simulation results of a previously developed and calibrated flow model (LSCE, 2018). Available measured groundwater level data of Fall 2002 were compared with simulated water levels for accuracy. Starting times of current and projected simulations were selected in such a way that their initial conditions could be taken from results of the historic and current simulations, respectively.

5 AQUIFER PROPERTIES

The hydraulic properties of an aquifer system, primarily the hydraulic conductivity and storage coefficients, control the groundwater flow and storage in it. Hydraulic conductivity is a measure of the ability of a material to transmit water through it. The volume of water which an aquifer can release or take into storage given a unit change in hydraulic head is defined as the storativity (for a confined aquifer) or specific yield (for an unconfined aquifer) of that aquifer.

While aquifer tests were used (where available) to quantify these parameters, values for these parameters are most often assigned using generally acceptable values for the sediment textures or the type of aquifer that is present, and where possible constrained using what limited aquifer test data may be available. In addition, analysis of seasonal variations in groundwater levels, subsurface geology, and well construction features were used in estimating the type of aquifer and storage coefficient in the absence of aquifer test data. Shallow wells that have minimal seasonal variations likely have high storage coefficients (specific yield). Deep wells that have large variations in seasonal water levels likely have low storage coefficients (storativity or specific storage).

5.1 Hydraulic Conductivity

Hydraulic conductivity within the model domain was developed following a three-step process and assigned to model cells using the Upstream Weighting (UPW) package. The first step was to utilize the texture analysis methods and data employed by the USGS in developing the CVHM groundwater model (USGS, 2009) to create a geostatistical representation of textures related to the percent of coarse-grained sediments that are present. The second step was to revise the geostatistical representation to more accurately reflect known and estimated depositional trends in the area of the model domain. Thirdly, textures were converted to hydraulic conductivities based on available aquifer test data (65 total tests for the shallow and deep zones within the model domain), CVHM values assigned within the model domain, and a review of literature values. This three-step process provided a comprehensive method for producing a reasonable representation of the distribution of hydraulic conductivity which incorporates lithologic data from relatively abundant DWR Well Completion Reports into a regional geologic framework. Hydraulic conductivities were adjusted as part of the calibration process within ranges of values associated with the observed aquifer materials.

5.2 Storage Properties and Aquifer Compaction

Aquifer storage properties and aquifer compaction were simulated using a combination of the Subsidence (SUB) and Upstream Weighting (UPW) packages. The UPW package was used largely to simulate storage changes at the water table. The SUB package was used to simulate aquifer compaction and storage changes occurring in the confined aquifer system.

In an unconfined system, the change in groundwater storage is largely controlled by the specific yield. The specific yield is a dimensionless storage coefficient equal to the ratio of water which an aquifer will yield due to gravity-driven drainage compared to the total bulk aquifer volume. The specific yield is approximately equal to the porosity of a bulk aquifer unit minus some volume of water which remains trapped in the pore spaces due to capillary forces. It is not uncommon for an unconfined aquifer to yield 20 to 30 percent of its total volume in water.

In a confined system, the amount of water a unit volume of aquifer releases or takes up per unit change in hydraulic head is determined by the specific storage. Since the porous medium in a confined aquifer is always saturated, changes in groundwater storage due to changes in hydraulic head are determined by the compressibility/expandability of the pore spaces leading to deformation of the aquifer skeleton and (to a lesser extent) the compressibility of water. Deformation of the aquifer skeleton can occur either elastically (recoverable) or inelastically (permanent) and is dependent on the composition of the aquifer material and the amount of stress (effective stress) within the aquifer. Inelastic deformation occurs when the effective stress within the fine-grained material in an aquifer system exceeds the maximum effective stress leading to permanent changes in the arrangement of grains and is represented by an inelastic specific storage. Elastic deformation occurs when the maximum effective stress is not exceeded and is represented using an elastic specific storage.

The specific yield and compressibility of water were specified in the UPW package. Values for specific yield were assigned to unconfined layers following a review of the CVHM model values used within the model domain and adjusted during model calibration. The compressibility of water (1.4×10^{-6}/ft) estimated from previous studies (Faunt et al, 2009), was scaled with respect to the porosity of each model layer and assigned to all model layers as a specific storage.

The SUB package solves for changes in compaction and groundwater storage based on changes in the hydraulic head, the preconsolidation stress (or preconsolidation head in the SUB package), and coefficients governing the elastic and inelastic skeletal storage (Hoffman et al., 2003). The elastic and inelastic skeletal storage properties were assigned in the SUB package. The elastic skeletal specific storage coefficients were estimated for fine- and coarse-grained materials and weighted by the respective fine- and coarse-grained volume fraction for each model layer. The inelastic skeletal specific storage coefficient for each model layer was calculated based on the volume fraction of fine-grained material multiplied by the inelastic specific storage. Initial specific storage values for fine- and coarse-grained materials were estimated from those reported in Faunt et al. (2009) and adjusted during model calibration to extensometer data collected from the Yearout and Fordel extensometers. Preconsolidation head input values were determined from the CVHM preconsolidation head simulations and assigned to each model cell at the beginning of the model simulation period. In instances where the initial groundwater head assigned in the MPG model is less than the preconsolidation head simulated in CVHM, the SUB Package assumed the preconsolidation head is equal to the lower of the two values.

6 MODEL CALIBRATION

Model calibration involves the adjustment of input parameters within the constraints of the conceptual model to best represent the hydrogeologic system being simulated. The groundwater flow model was calibrated largely by manually adjusting assigned aquifer parameters to achieve an agreeable fit between simulated and observed water levels at wells located in the model domain. Regional trends in simulated groundwater flow direction also compared to observed trends to qualitatively evaluate model performance. The flow model was calibrated for the period from 2000 through 2013 comparing measured groundwater levels and stream flow with simulation results.

6.1 Calibrated Parameter Values

Model calibration focused primarily on adjusting assigned aquifer properties within the model domain. Parameters modified during model calibration process included:

- Aquifer horizontal and vertical hydraulic conductivity
- Elastic and inelastic skeletal storage and specific yield coefficients
- Streambed and lakebed hydraulic conductivity

6.1.1 Calibrated Aquifer Hydraulic Conductivity

The horizontal hydraulic conductivity values in the model were adjusted within ranges consistent with observed data and interpretation of aquifer materials. Hydraulic conductivity data from aquifer tests and specific capacity were also used to constrain the range of hydraulic conductivity values. The final calibrated horizontal hydraulic conductivity values ranged from 1.7 x 10^{-3} ft/day in the Corcoran clay (model layer 7) to 490 ft/day in layer 3 (**Table 6-1**). Final calibrated vertical hydraulic conductivity values were from approximately one to two orders of magnitude less than the horizontal hydraulic conductivity and ranged from 2.5 x 10-4 ft/day in the Corcoran clay to approximately 50 ft/day in model layers 3, 4, and 6. Calibrated vertical hydraulic conductivity in the A and C clays was 1.7 x 10^{-3} ft/day. West of the Fresno Slough, the vertical hydraulic conductivity of the A-Clay was increased to 1.0 x 10^{-2} ft/day to better reflect results from well completion reports which suggest that the A-Clay is less continuous in this area. The distribution of final hydraulic conductivity values in the shallow and deep zones of the upper aquifer, lower aquifer and confining layers is presented in **Figures 6-1 through 6-9**.

Table 6-1: Calibrated Hydraulic Conductivity values in ft/day

Parameter	Model Layer(s)	Entire Model Domain (ft/day)			FCMA (ft/day)		
		Minimum	Maximum	Average	Minimum	Maximum	Average
Horizontal K	1,2	5.5×10^{-1}	2.3×10^{2}	9.4×10^{1}	4.6×10^{1}	2.1×10^{2}	8.4×10^{1}
Horizontal K	3	5.4×10^{-2}	4.9×10^{2}	9.6×10^{1}	5.4×10^{-2}	1.0	2.9×10^{-1}
Horizontal K	4	4.9×10^{1}	2.2×10^{2}	1.3×10^{2}	4.9×10^{1}	1.8×10^{2}	8.0×10^{1}
Horizontal K	5	3.8×10^{-1}	1.0×10^{1}	3.7	3.8×10^{-1}	4.1×10^{-1}	3.9×10^{-1}
Horizontal K	6	2.6×10^{1}	3.3×10^{2}	1.6×10^{2}	4.5×10^{1}	2.1×10^{2}	1.0×10^{2}
Horizontal K	7	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}
Horizontal K	8,9	8.1	1.0×10^{2}	4.3×10^{1}	1.1×10^{1}	7.1×10^{1}	2.5×10^{1}
Vertical K	1,2	8.4×10^{-2}	3.5×10^{1}	1.4×10^{1}	7.0	3.2×10^{1}	1.3×10^{1}
Vertical K	3	1.7×10^{-3}	5.1×10^{1}	1.0×10^{1}	1.7×10^{-3}	1.0×10^{-1}	2.6×10^{-2}
Vertical K	4	1.1×10^{1}	4.9×10^{1}	2.7×10^{1}	1.1×10^{1}	3.8×10^{1}	1.8×10^{1}
Vertical K	5	1.7×10^{-3}	1.3×10^{0}	4.2×10^{-1}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}
Vertical K	6	4.1	5.2×10^{1}	2.5×10^{1}	7.2	3.3×10^{1}	1.7×10^{1}
Vertical K	7	2.5×10^{-4}	2.5×10^{-4}	2.5×10^{-4}	2.5×10^{-4}	2.5×10^{-4}	2.5×10^{-4}
Vertical K	8,9	1.5	1.9×10^{1}	8.0	2.0	1.3×10^{1}	4.8
Vertical K (A Clay)	3	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}
Vertical K (C Clay)	5	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}	1.7×10^{-3}

6.1.2 Calibrated Streambed and Lakebed Hydraulic Conductivity

The hydraulic conductivity of the streambed for the San Joaquin River (SJR) and large irrigation canals was adjusted within a probable range of values to match observed discharge in the SJR and hydraulic heads in observation wells near the river and canals.

Calibrated vertical hydraulic conductivity of SJR streambed was 0.25 ft/day while that of the other canals was 5.0×10^{-3} ft/day (Table XX). Lakebed hydraulic conductivity was estimated by comparing the net seepage from the Pool and Fresno Slough to values previously estimated by KDSA and LSCE (2000). A value of 2.0×10^{-3} ft/day was used in the Fresno Slough branch of the Pool (**Table 6-2**). The SJR branch of the Pool was assigned a larger value of 2.0×10^{-2} ft/day to better match observed water levels in shallow wells in the area and because it is presumed that coarser sediments are present in this portion of Pool as compared to the Fresno Slough branch of the Pool, thereby resulting in a larger value.

Table 6-2: Calibrated Streambed and Lakebed Hydraulic Conductivity Values

Surface Water Feature	Hydraulic Conductivity (ft/day)
San Joaquin River	2.5×10^{-1}
Canals	5.0×10^{-3}
Mendota Pool	2.0×10^{-3} to 2.0×10^{-2}

6.1.3 Calibrated Storage Coefficients

Storage coefficients assigned to the models included specific yield and inelastic and elastic specific storage. The values for these parameters were adjusted to match observed water levels and compaction above the Corcoran Clay. Calibrated specific yield ranged from 0.18 to 0.31 (**Table 6-3**). Elastic skeletal specific storage assigned to fine-grained material was 1.0×10^{-6} per foot while elastic skeletal specific storage assigned to coarse-grained material was 5.5×10^{-6} per foot. Inelastic skeletal specific storage was 1.6×10^{-4} per foot. Calibrated inelastic specific storage was consistent with values assigned in previous studies (Faunt et al., 2009). Elastic specific storage values were greater than those used in CVHM in order to match observed compaction at extensometer sites, however, water levels in confined layers were not sensitive to this change.

Table 6-3: Calibrated Aquifer Storage Coefficient Values

Parameter	Layer(s)	Calibrated Value
Specific Yield	1,2,3	0.24 – 0.31
Specific Yield	4	0.18
Specific Yield	5	0.18 – 0.29
Specific Yield	6	0.20
Specific Storage - Elastic (per ft)	7	$1.0 \text{ X } 10^{-05}$
Specific Storage - Elastic (per ft)	8,9	$8.8 \text{ X } 10^{-06}$
Specific Storage - Inelastic (per ft)	7	$1.6 \text{ X } 10^{-04}$
Specific Storage - Inelastic (per ft)	8,9	$1.2 \text{ X } 10^{-04}$

6.2 Model Calibration Targets

The groundwater flow model was calibrated to measured groundwater level elevations, streamflow, and compaction above the Corcoran Clay.

6.2.1 Groundwater Levels

A total of 6,403 measured groundwater levels at 117 dedicated monitoring and production wells were used as the primary source of information used to calibrate the groundwater flow model. Sources of water level data include wells monitored by the MPG and other entities such as the USGS, DWR, and USBR. While an effort was made to rely on observations from wells screened in only discrete intervals in one model layer, wells screened over two model layers were used in some cases where available data were limited. Observations are generally concentrated near FCMA and surrounding areas where well construction information and consistent records of water level measurements were available for the calibration period (**Figures 6-10, 6-11, and 6-12**). The water level data was predominantly available for wells constructed in the shallow and deep zones of the upper aquifer, while a limited amount of data was available for the lower aquifer. This resulted in the model calibration effort focusing on the upper aquifer while less focus was provided to the lower aquifer.

6.2.2 Streamflow

The simulated values of flow from the pool to SJR downstream of the Mendota Dam were compared with measured flow at the USGS stream gage at San Joaquin River near Mendota Dam (USGS #11254000) for calibration (**Figure 4-4**).

6.2.3 Subsidence

The compaction data collected at two extensometers in the Mendota area; the Fordel extensometer located west of the Fresno Slough and the Yearout Ranch extensometer located east of the Slough, were used to calibrate the simulated compaction of the flow model (**Figure 6-13**). Both extensometers monitor compaction above the Corcoran Clay, the top of which was encountered at depths of 418 and 428 ft at the Fordel and Yearout Ranch sites, respectively.

6.2.4 Evaluation of Calibration

Model calibration was evaluated through four common statistics used to characterize model fit. These include the mean error (ME), mean absolute error (MAE), Root Mean Squared Error (RMSE), and the Normalized RMSE (NRMSE).

The mean error (ME), or model bias, is a measure of the overall tendency of the model to over-predict (-) or under-predict (+) measured values (Belitz and Phillips, 1993; Anderson and Woessner, 1992). The mean absolute error (MAE) is a measure of model accuracy calculated as the average magnitude of the error between observed and simulated values (Anderson and Woessner, 1992). The root mean square error (RMSE) is also a common measure of model accuracy quantifying the standard error (Anderson and Woessner, 1992). The normalized root mean squared error (NRMSE) is calculated to account for the scale dependency of the RMSE and is a measure of the RMSE divided by the range of observations (Anderson and Woessner, 1992).

Flow model calibration statistics are given in **Table 6-4**. Figure **6-14** shows the simulated vs observed groundwater levels at model calibration target wells, while the timeseries data of simulated and observed water level (groundwater level calibration hydrographs) are presented in **Appendix A1**. **Figure 6-15** shows observed and simulated values of SJR flow downstream of Mendota Dam. Observed and simulated compaction above the Corcoran Clay at Fordel and Yearout Ranch Extensometers are shown in **Figures 6-16 and 6-17**, respectively.

Table 6-4: Groundwater Flow Model Calibration Statistics

Aquifer Depth Zone	Number of Wells	Number of Observations	ME (ft)	MAE (ft)	RMSE (ft)	NRMSE
Shallow	64	4,110	-4.5	8.5	10.5	7.8%
Deep	46	2,038	-2.5	10.1	13.1	9.8%
Lower	6	255	-7.9	15.5	22.2	14.8%
All	116	6,403	-4.0	9.3	12.0	6.2%

7 MODEL UNCERTAINTY AND LIMITATIONS

Any groundwater flow model is a simplification of the natural environment, and therefore has recognized limitations. For this reason, some uncertainty exists in the ability of any numerical model to completely represent the groundwater flow in the natural environment. Considerable effort was expended to minimize model uncertainty by using measured values as model inputs whenever available, and by conducting numerous quality assurance and quality control assessments of data that were available of various sources.

Where availability of data is limited (spatially or temporally) to develop model input parameter datasets, conservative values were chosen for input parameters with high uncertainty. This is no warranty expressed or implied that this modeling study has considered or addresses all hydrogeological, hydrological, environmental, geotechnical or other characteristics and properties associated with the subject model domain and the simulated system. The finding and conclusions of this study are focused on a Subbasin-scale, and representation of site-scale conditions in the model may be approximate. The flow and transport models were developed in a manner consistent with the level of care and skill normally exercised by professionals practicing under similar conditions in the area.

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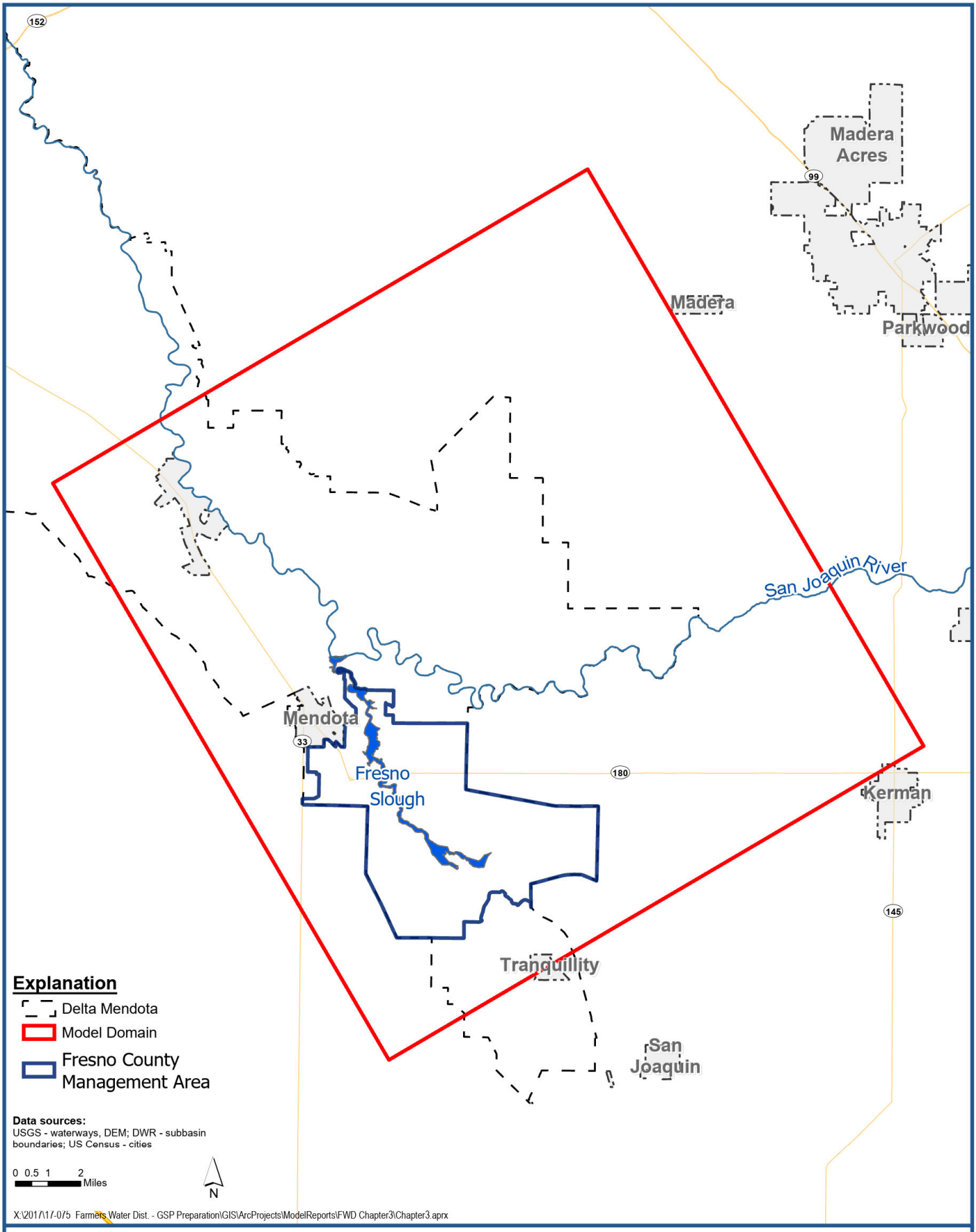

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Primary Study Area and Extent of Model Domain

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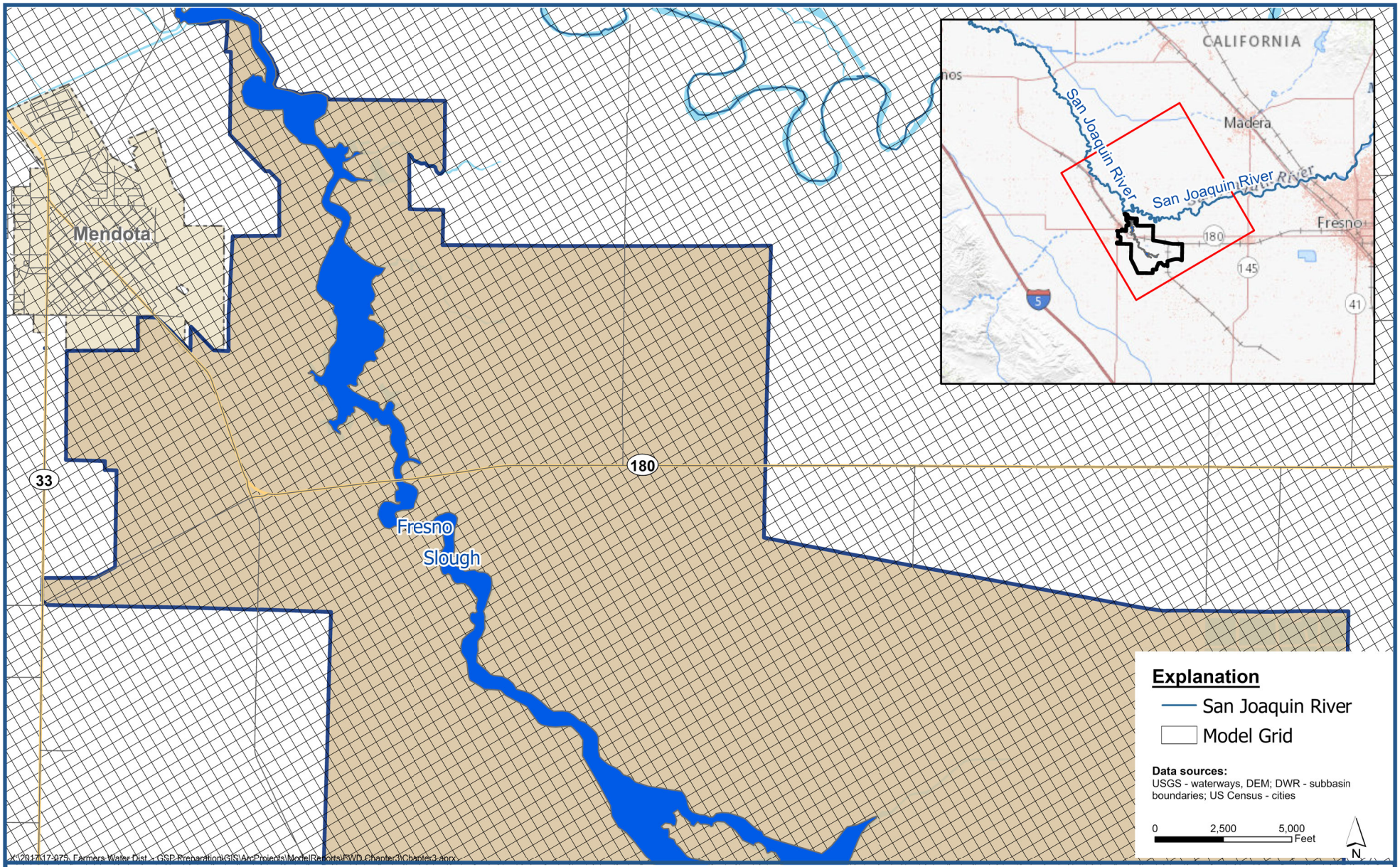
Figure 3-1



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Groundwater Flow Model Domain and Grid Spacing

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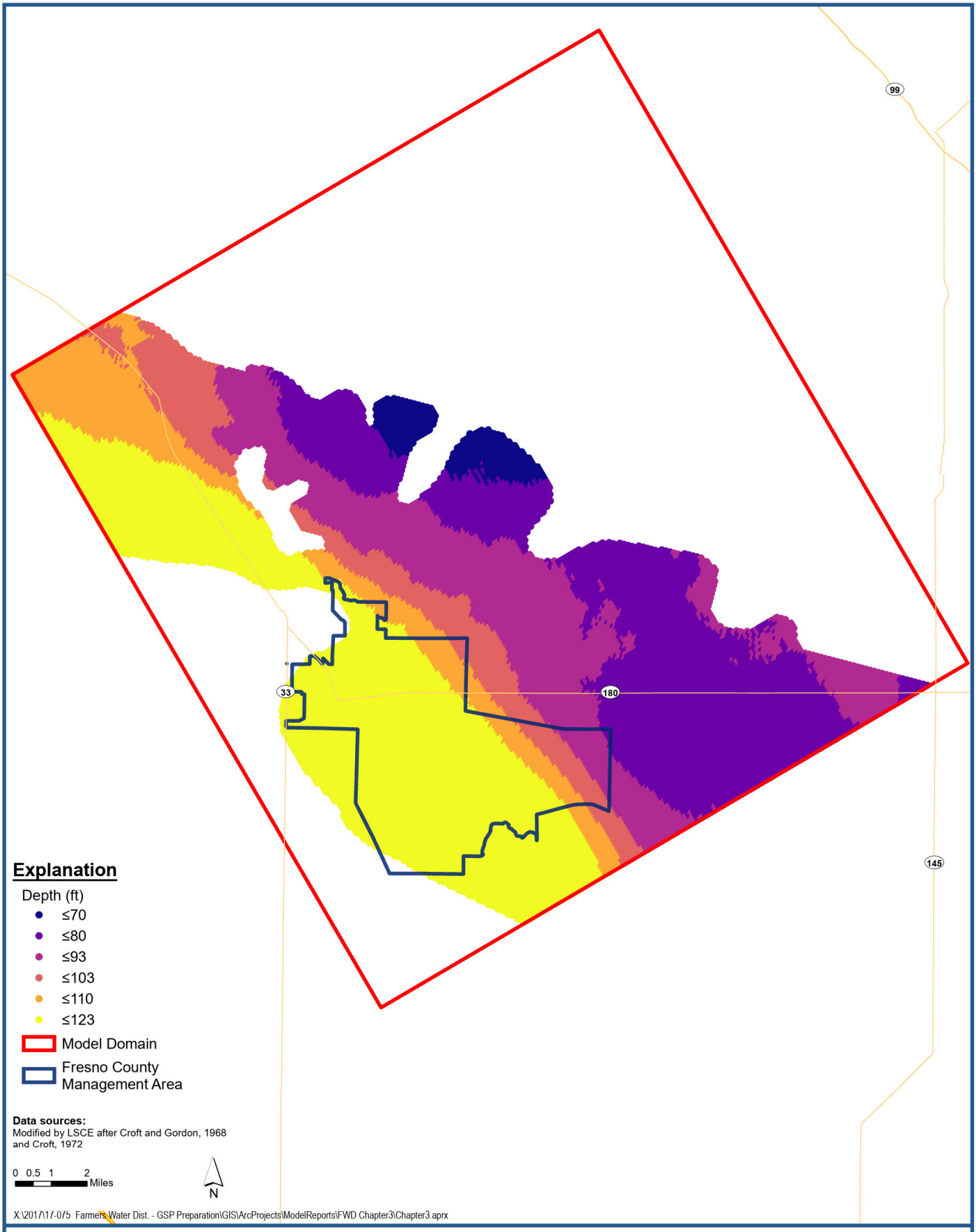
County of Fresno

Figure 3-2



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Approximate Extent and Depth of the A-Clay

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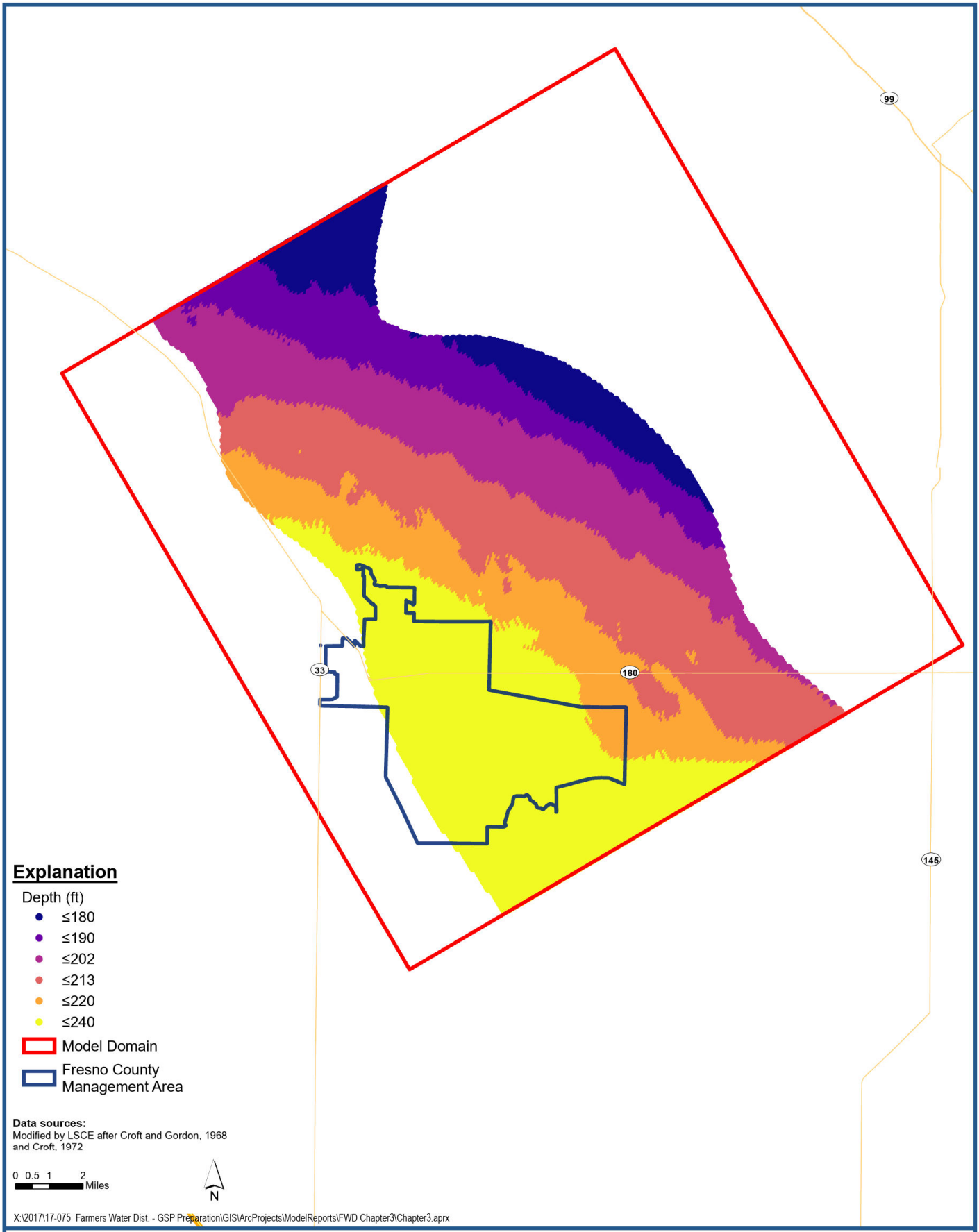
County of Fresno

Figure 3-3



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Approximate Extent of and Depth to the C Clay

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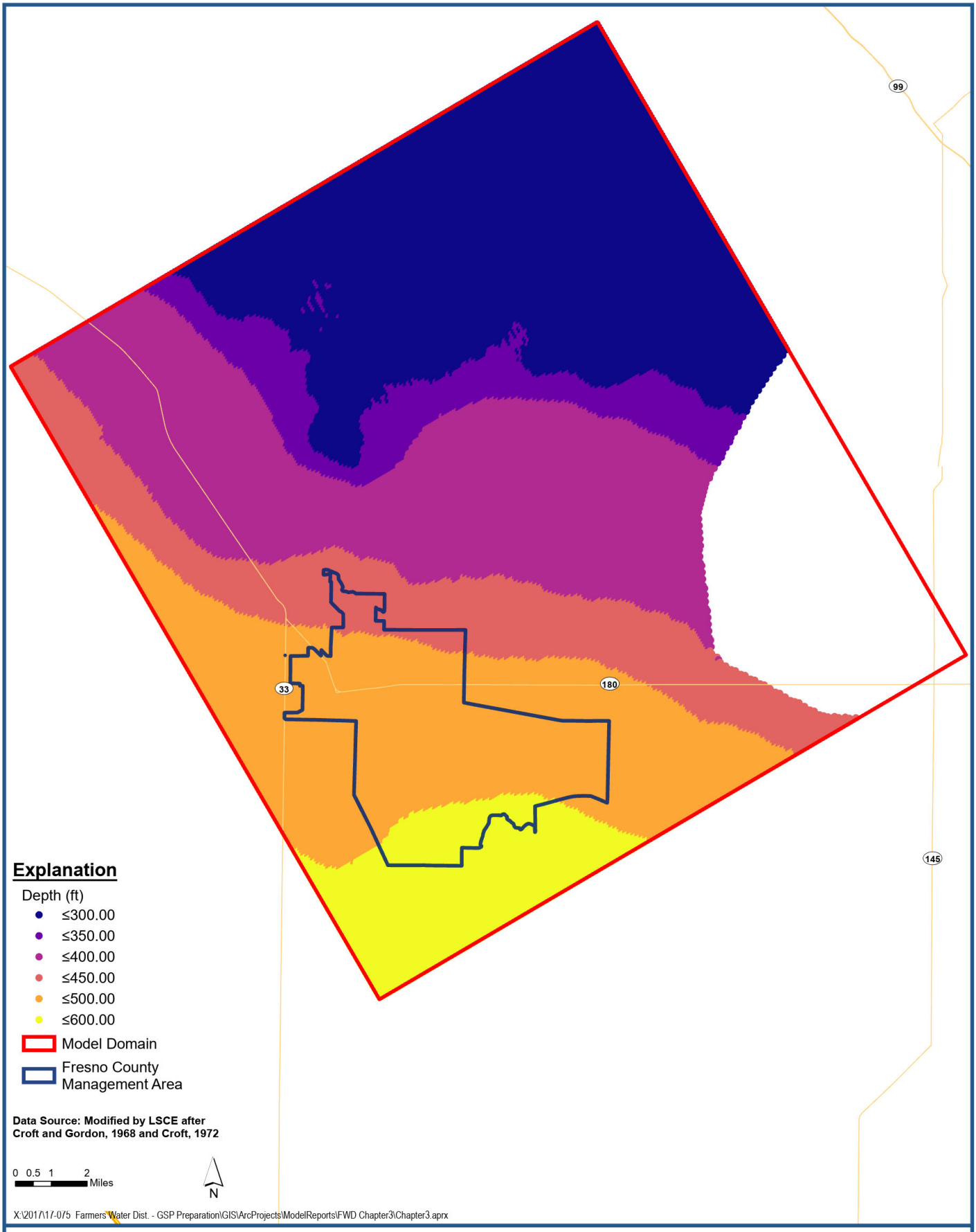
County of Fresno

Figure 3-4



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Approximate Extent of and Depth of the Corcoran Clay

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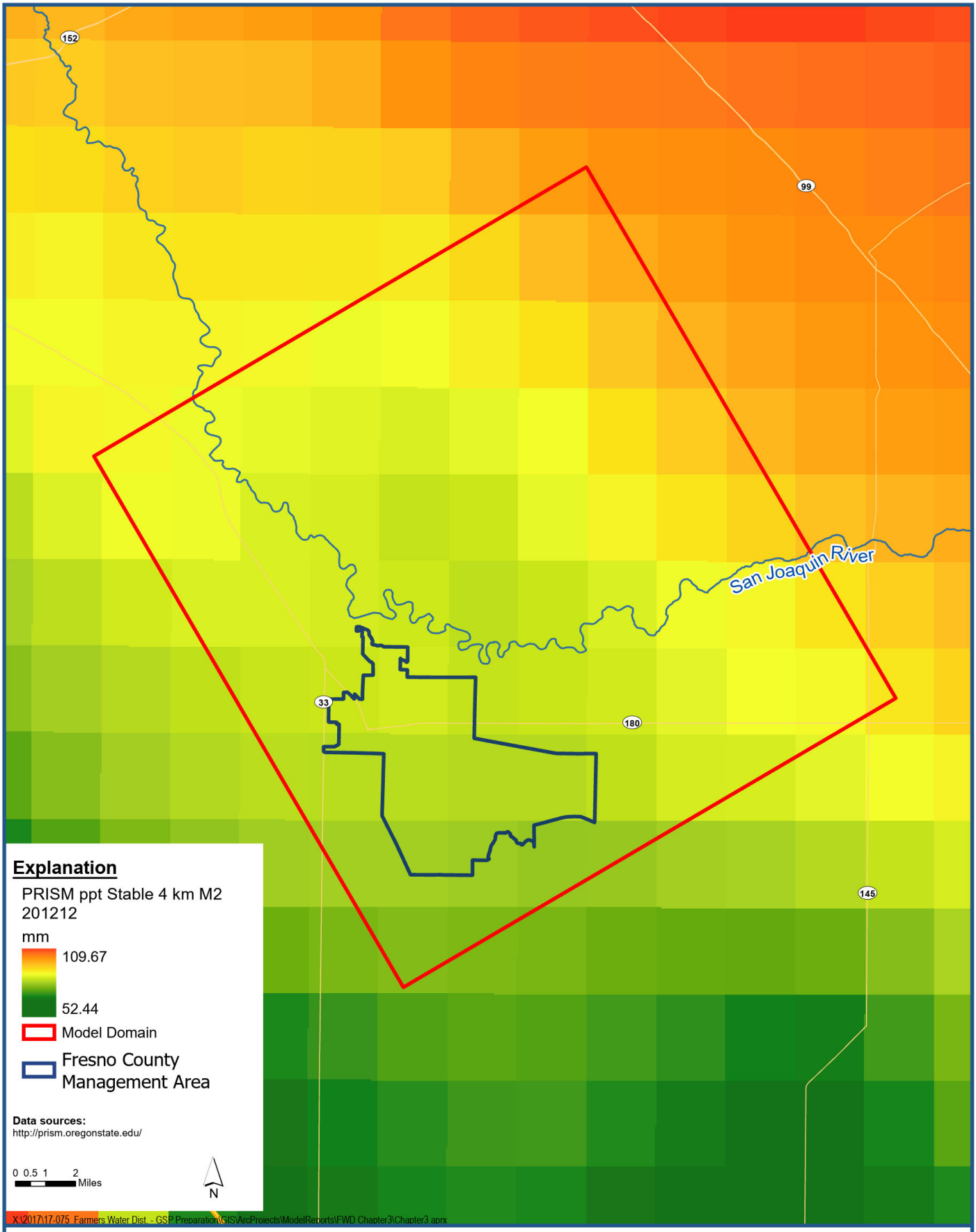
Figure 3-5



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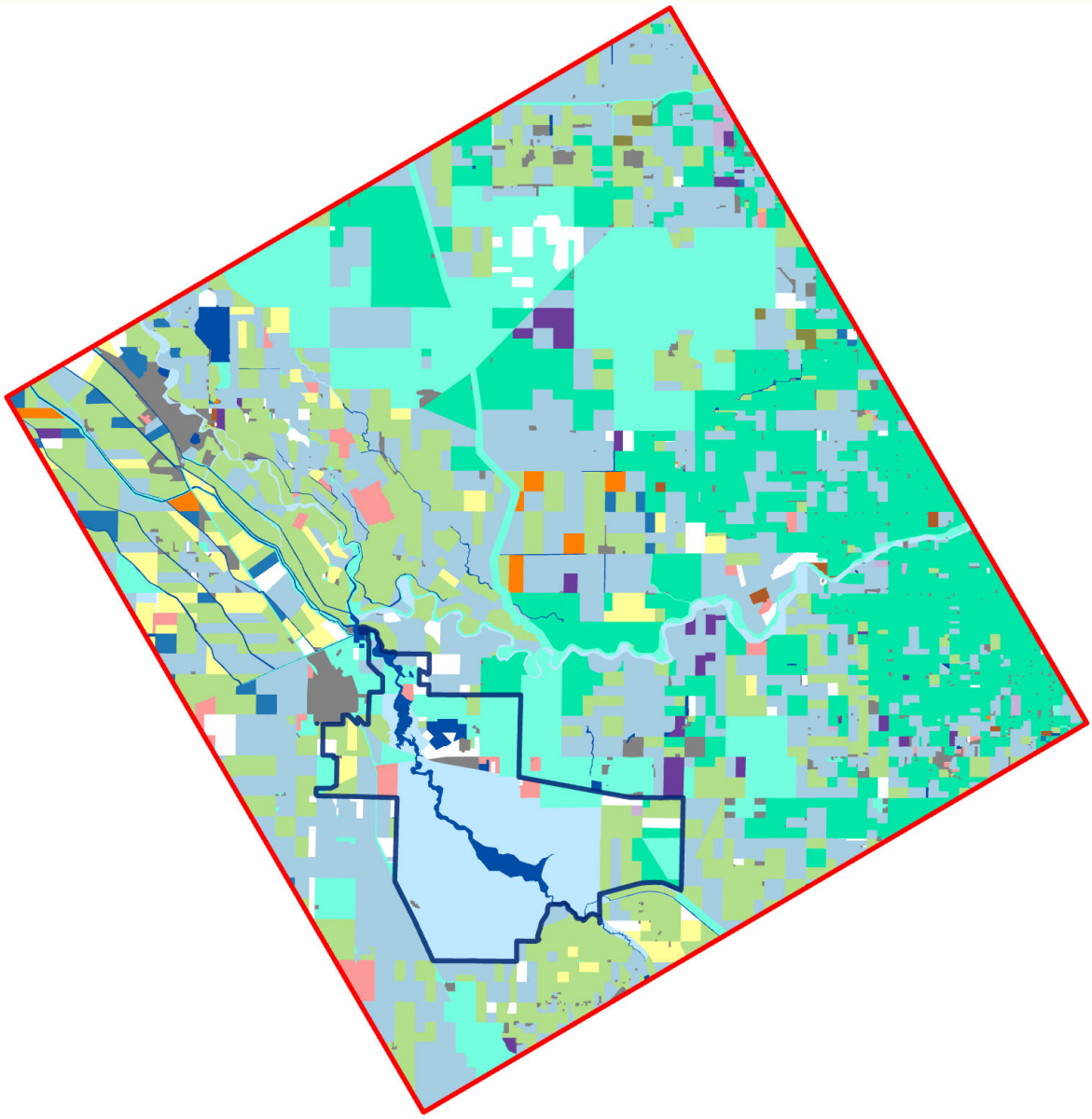
Assigned Precipitation from PRISM Data for December 2010

Figure 4-1

Groundwater Sustainability Plan
County of Fresno



Explanation

- Model Domain
- Fresno County Management Area

Land use Categories 2013

- Alfalfa
- Almonds
- Apricots
- Barley
- Blueberries
- Broccoli
- Mellons
- Carrots
- Cherries
- Corn
- Cotton
- Double Crop
- Developed
- Dry beans
- Durum wheat
- Fallow/idle cropland
- Garlic
- Grapes
- Grassland herbaceous
- Herbaceous wetlands; Woody wetlands
- Lettuce
- Misc vegs & fruits
- Mixed forest; Shrubland; Barren
- Oats
- Olives
- Onions
- Open water
- Oranges
- Other crops
- Other hay/non alfalfa
- Other tree crops
- Peaches
- Peas
- Pecans
- Peppers
- Pistachios
- Plums
- Pomegranates
- Rice
- Safflower
- Sorghum
- Sweet corn
- Tomatoes
- Triticale
- Winter wheat
- Walnuts

Data Sources: Modified by LSCE after DWR land use surveys - Fresno County 2000, USDA NASS and Google Earth imageries

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Land Use in the Model Area; 2003

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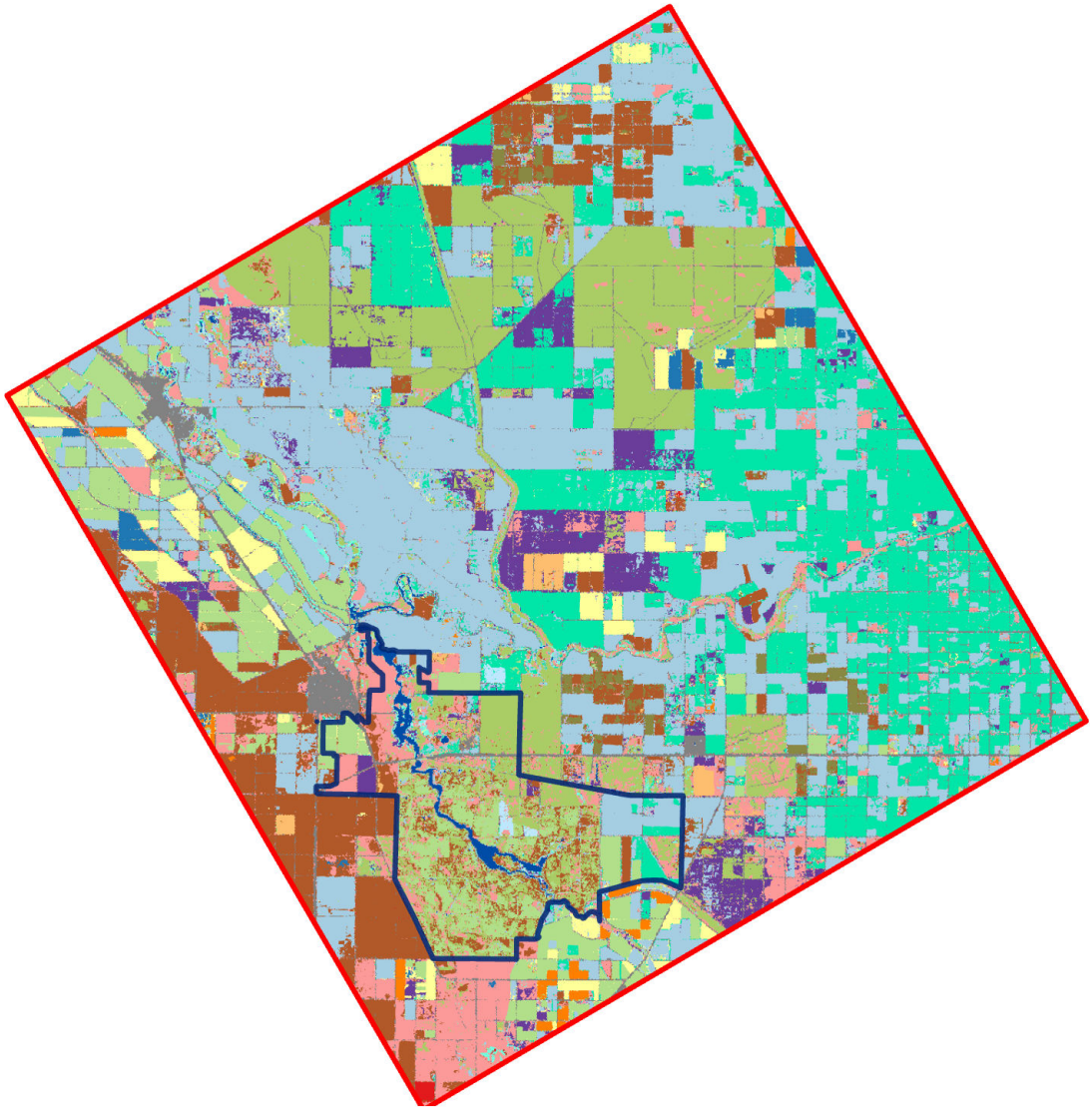
Figure 4-2



Explanation

- Model Domain
- Fresno County Management Area

Land use Categories 2013

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- Herbaceous wetlands; Woody wetlands
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- Misc vegs & fruits
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- Oats
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- Open water
- Oranges
- Other crops
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- Other tree crops
- Peaches
- Peas
- Pecans
- Peppers
- Pistachios
- Plums
- Pomegranates
- Rice
- Safflower
- Sorghum
- Sweet corn
- Tomatoes
- Triticale
- Winter wheat
- Walnuts

Data Sources: Modified by LSCE after DWR land use surveys - Fresno County 2000, Eastern Fresno County 2009, Land IQ 2014, USDA NASS and Google Earth imageries

0 2.5 5 Miles

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Land Use in the Model Area ; 2013

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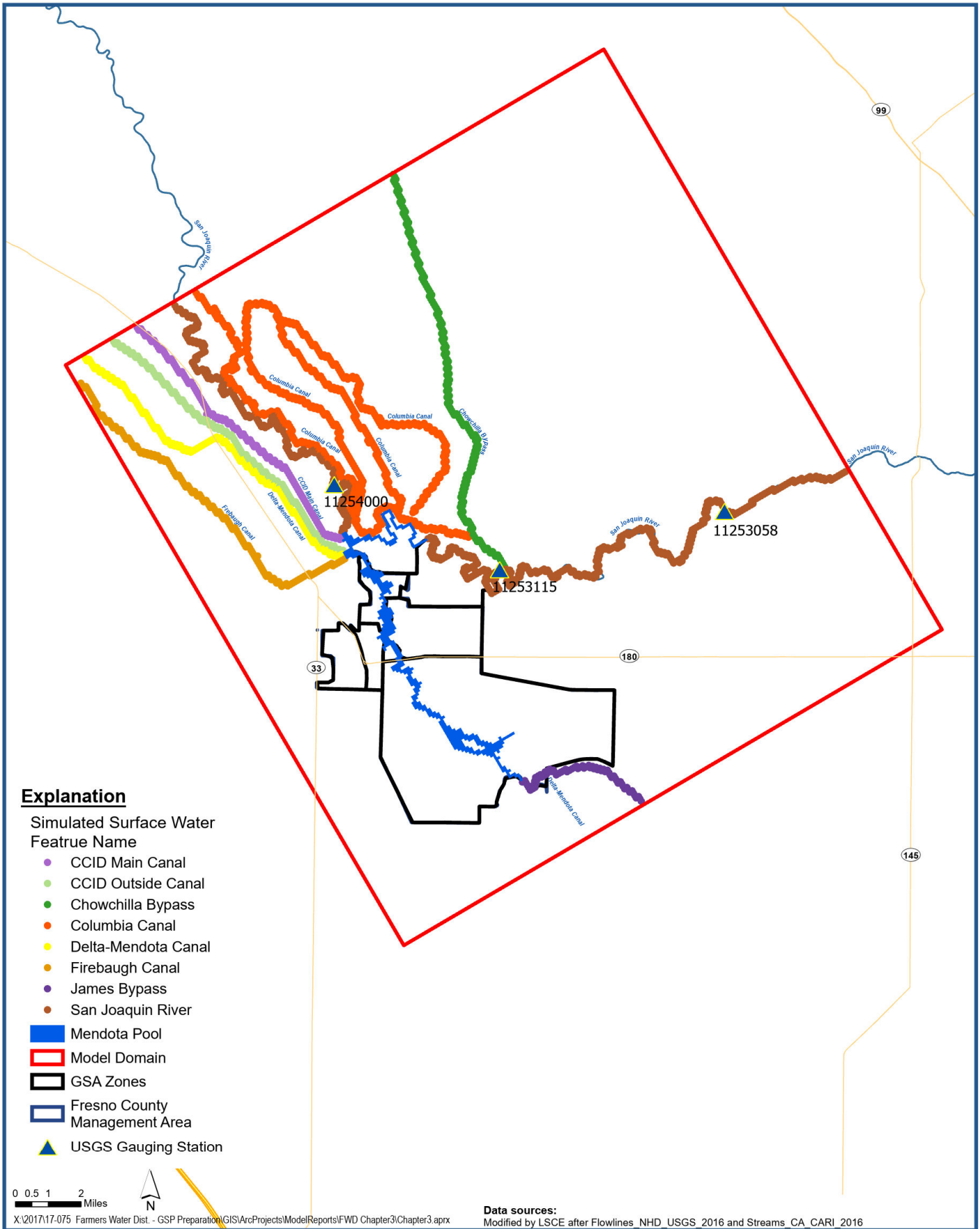
Figure 4-3



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Streams, canals and Mendota Pool that were Simulated in the Flow Model

Figure 4-4

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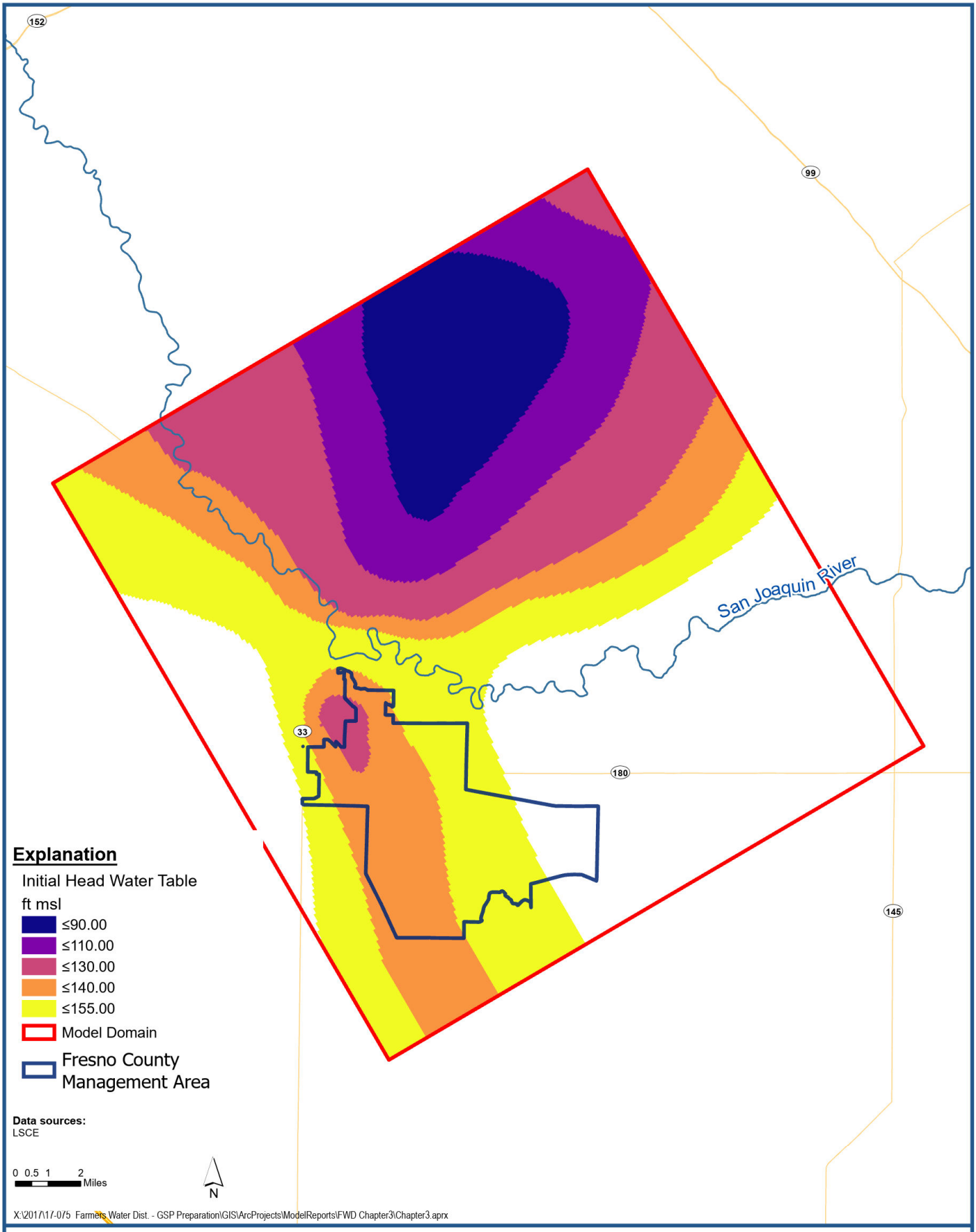

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Water Table Initial Heads

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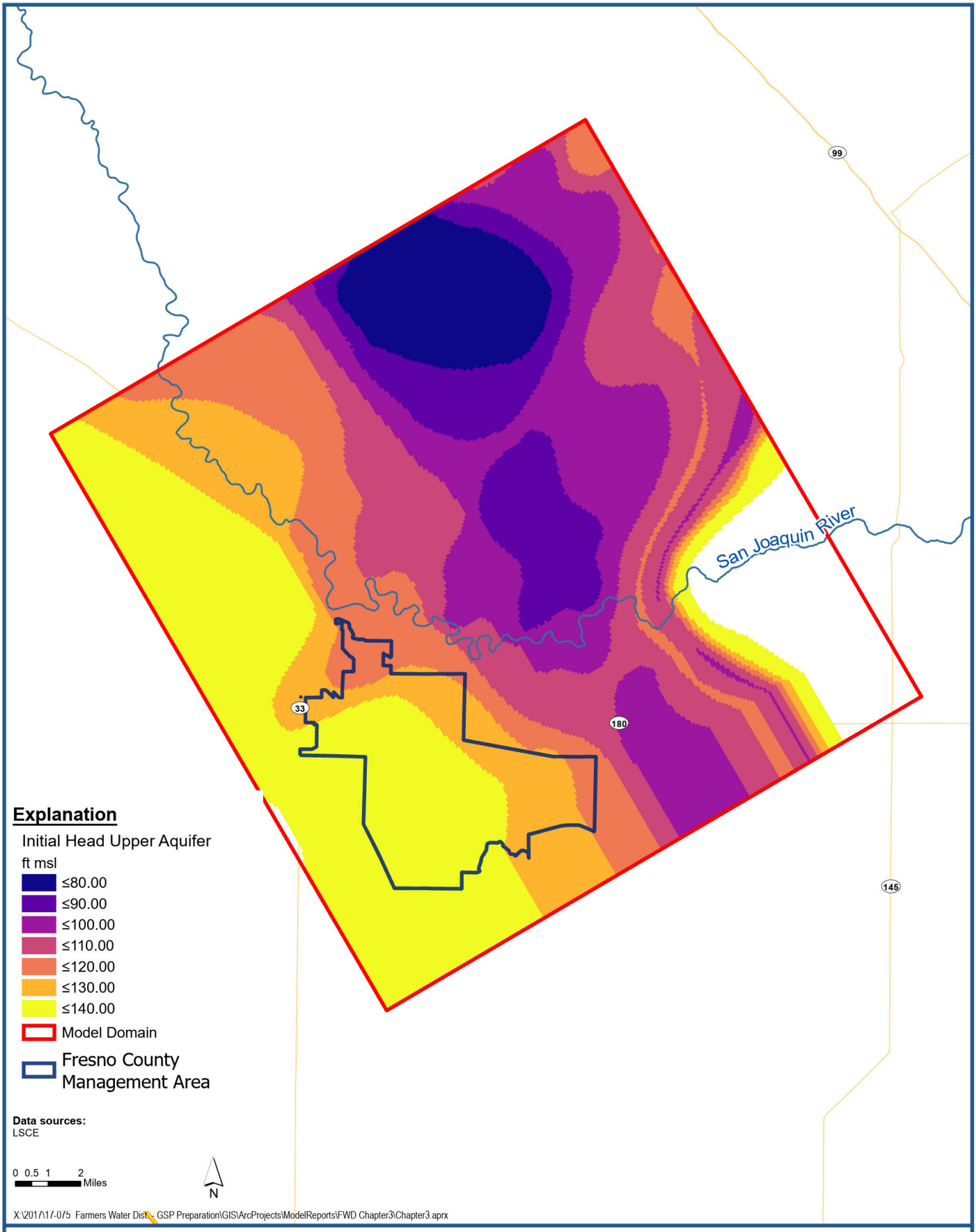
County of Fresno

Figure 4-5



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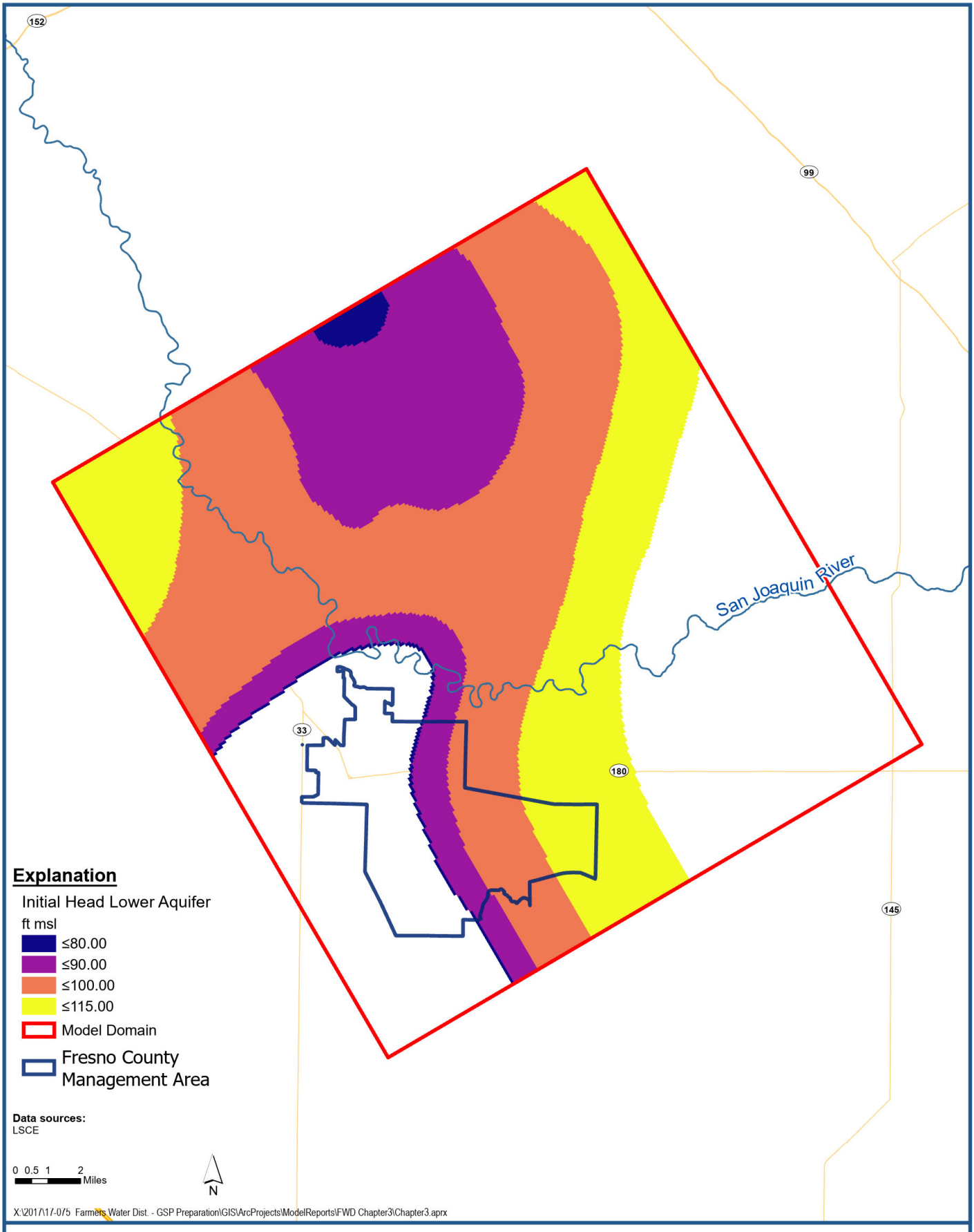
Upper Aquifer Initial Heads

Groundwater Sustainability Plan
County of Fresno

Figure 4-6



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Lower Aquifer Initial Heads

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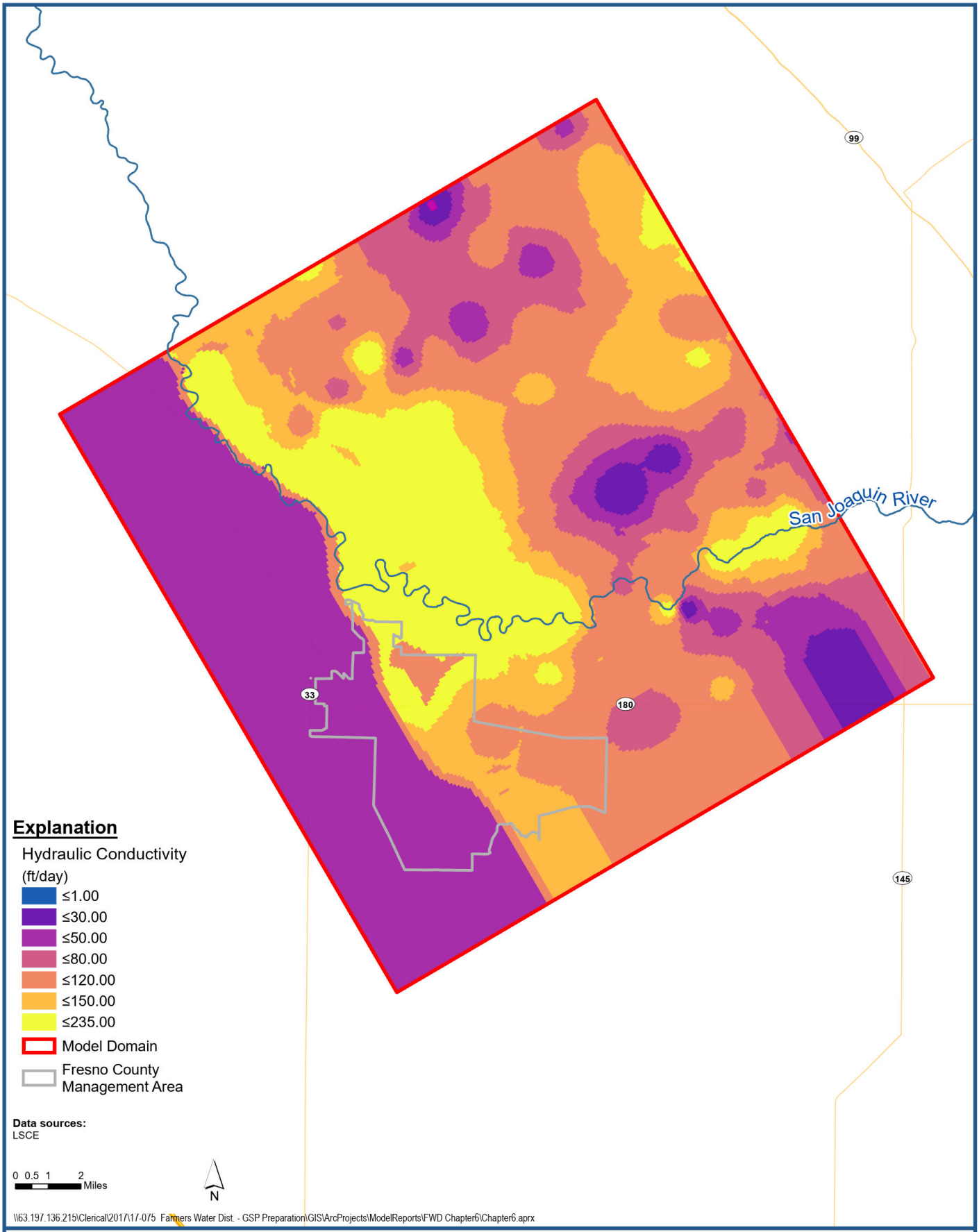
County of Fresno

Figure 4-7

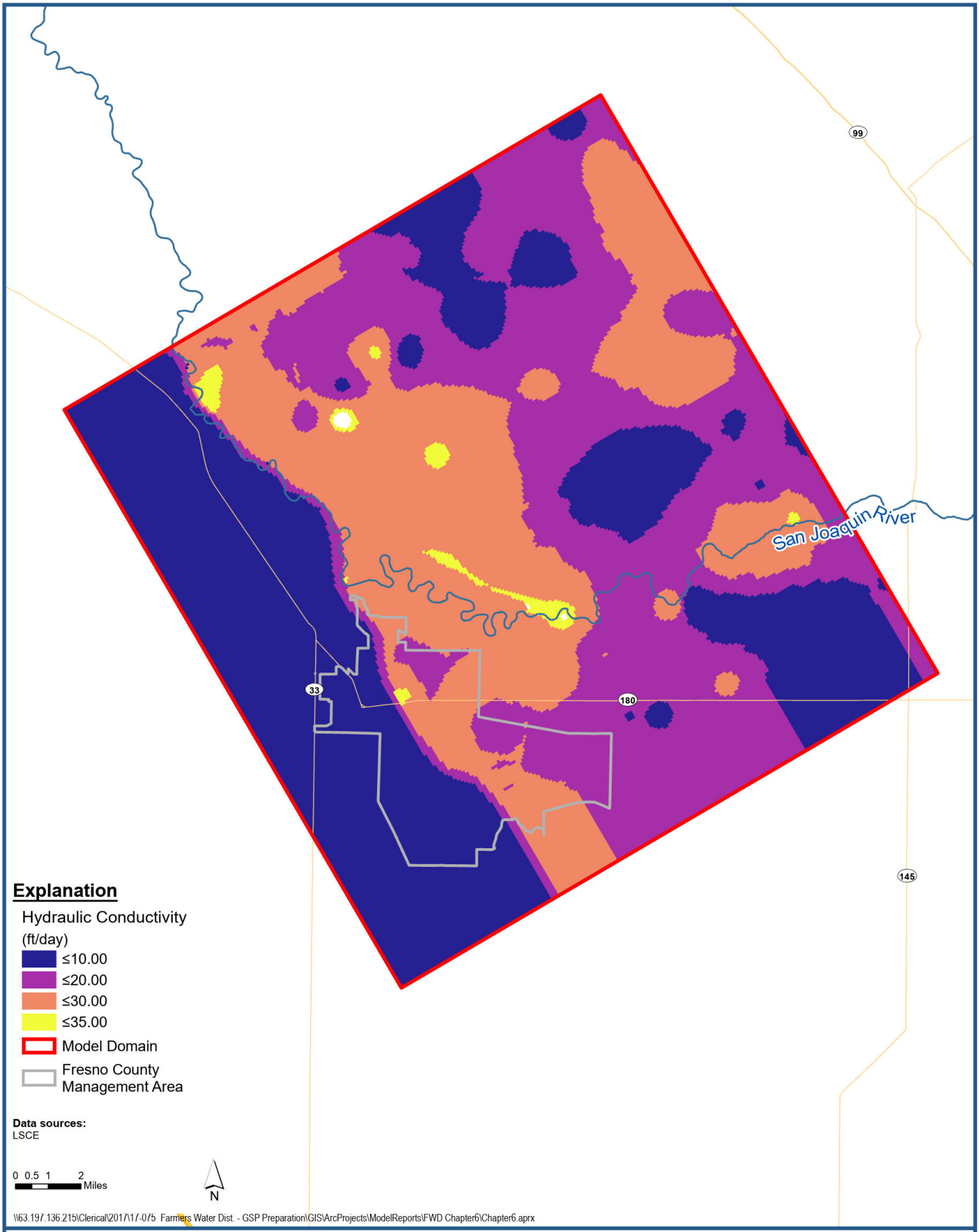


Luhdorff & Scalmanini
Consulting Engineers

Horizontal Hydraulic Conductivity Assigned to the Upper Aquifer Shallow Zone

Groundwater Sustainability Plan
County of Fresno

Figure 6-1

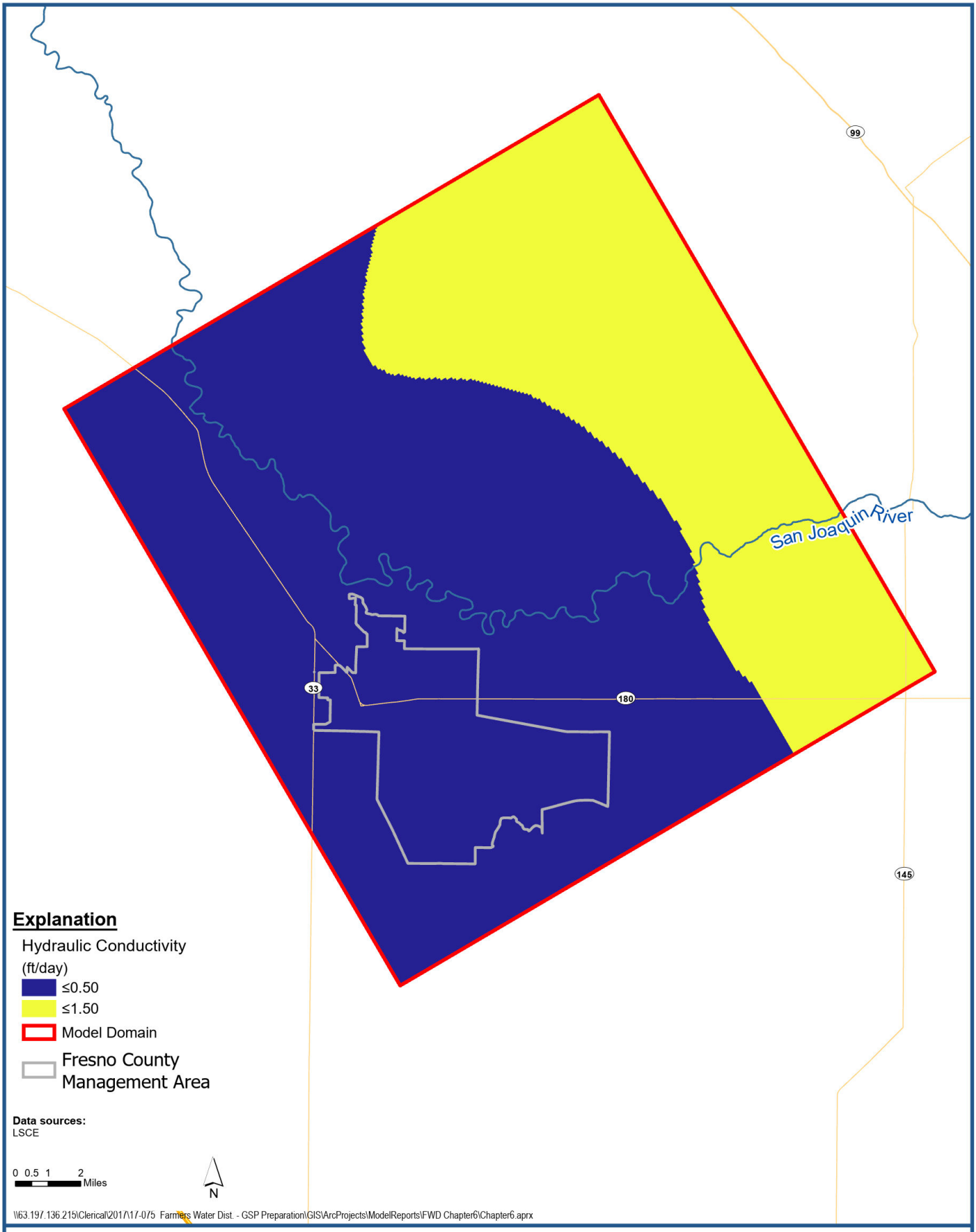


Luhdorff & Scalmanini
Consulting Engineers

Vertical Hydraulic Conductivity Assigned to the Upper Aquifer Shallow Zone

Groundwater Sustainability Plan
County of Fresno

Figure 6-2

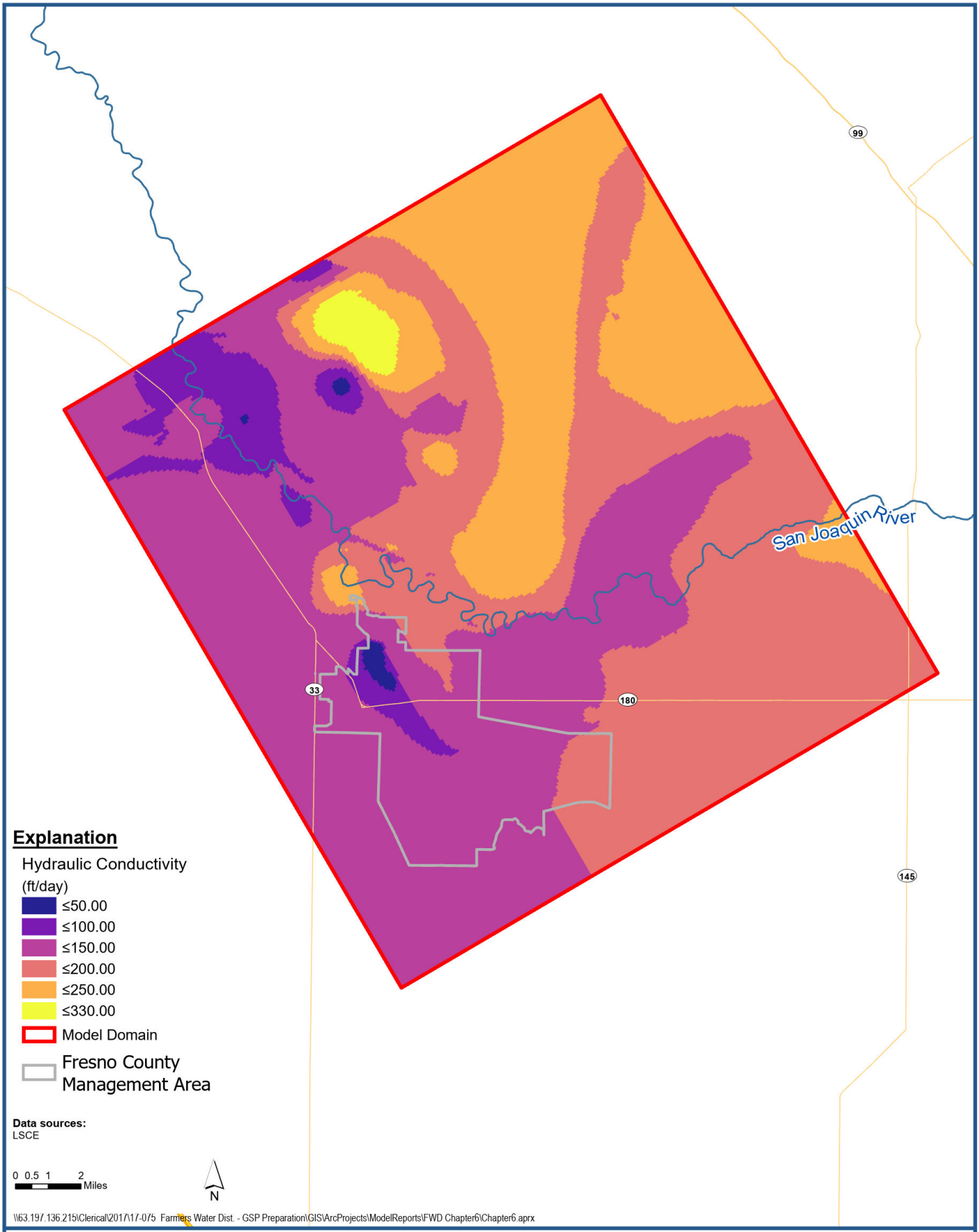


Luhdorff & Scalmanini
Consulting Engineers

Vertical Hydraulic Conductivity Assigned to the C Clay

Groundwater Sustainability Plan
County of Fresno

Figure 6-4

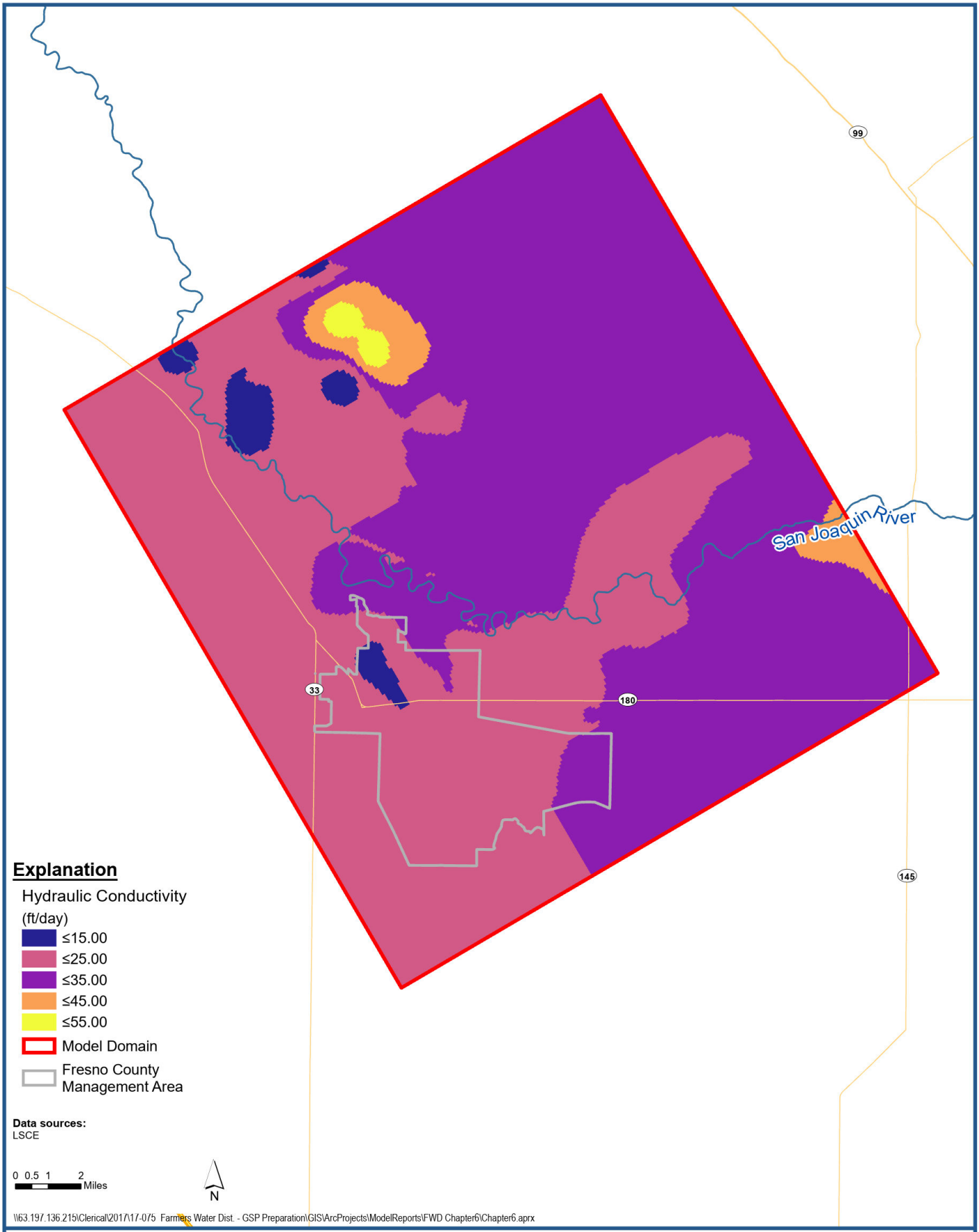


Luhdorff & Scalmanini
Consulting Engineers

Horizontal Hydraulic Conductivity Assigned to the Upper Aquifer Deep Zone

Groundwater Sustainability Plan
County of Fresno

Figure 6-5

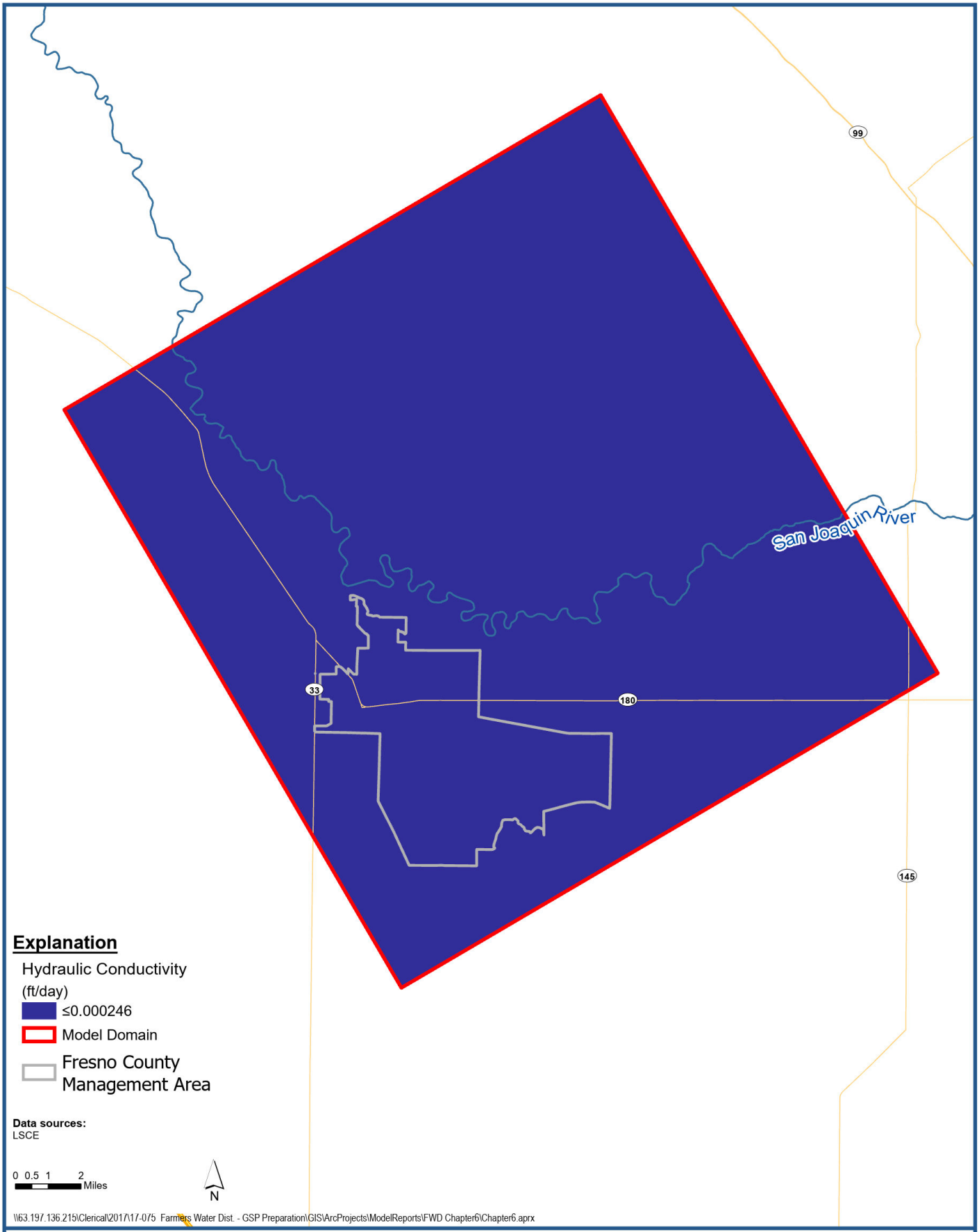


Luhdorff & Scalmanini
Consulting Engineers

Vertical Hydraulic Conductivity Assigned to the Upper Aquifer Deep Zone

Groundwater Sustainability Plan
County of Fresno

Figure 6-6



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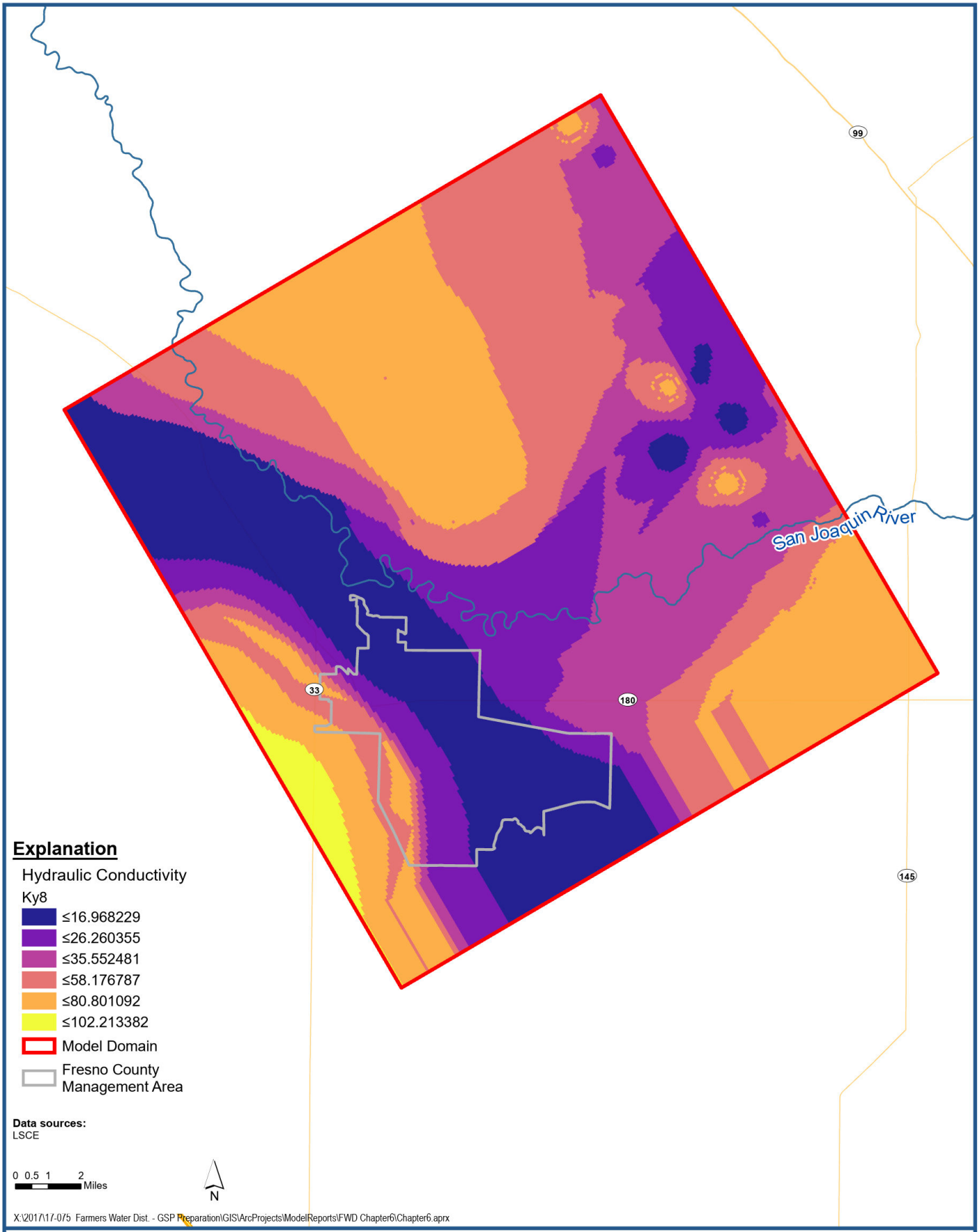
Vertical Hydraulic Conductivity Assigned to the Corcoran Clay

Groundwater Sustainability Plan
County of Fresno

Figure 6-7



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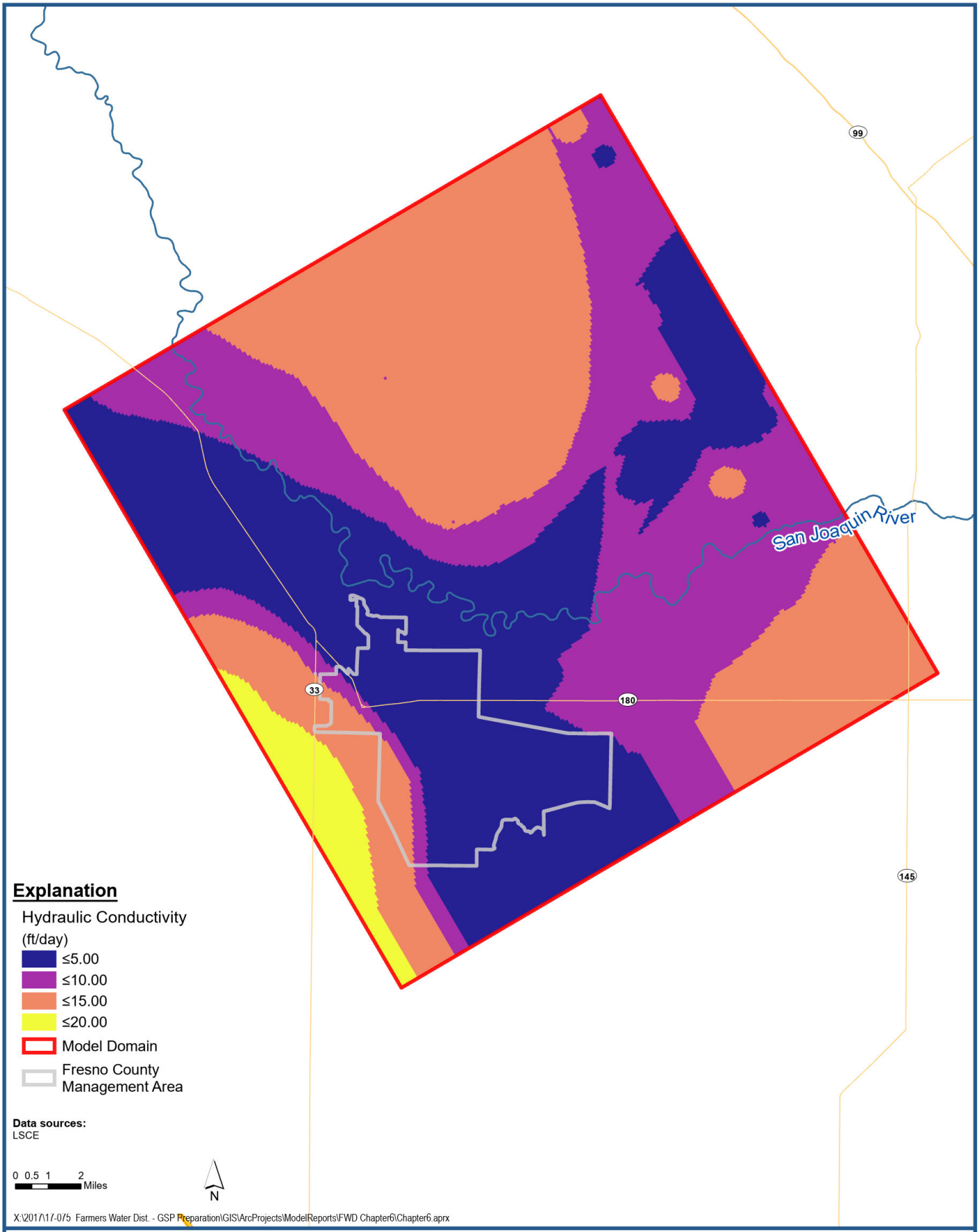
Consulting Engineers

Horizontal Hydraulic Conductivity Assigned to the Lower Aquifer

Groundwater Sustainability Plan
County of Fresno

Figure 6-8



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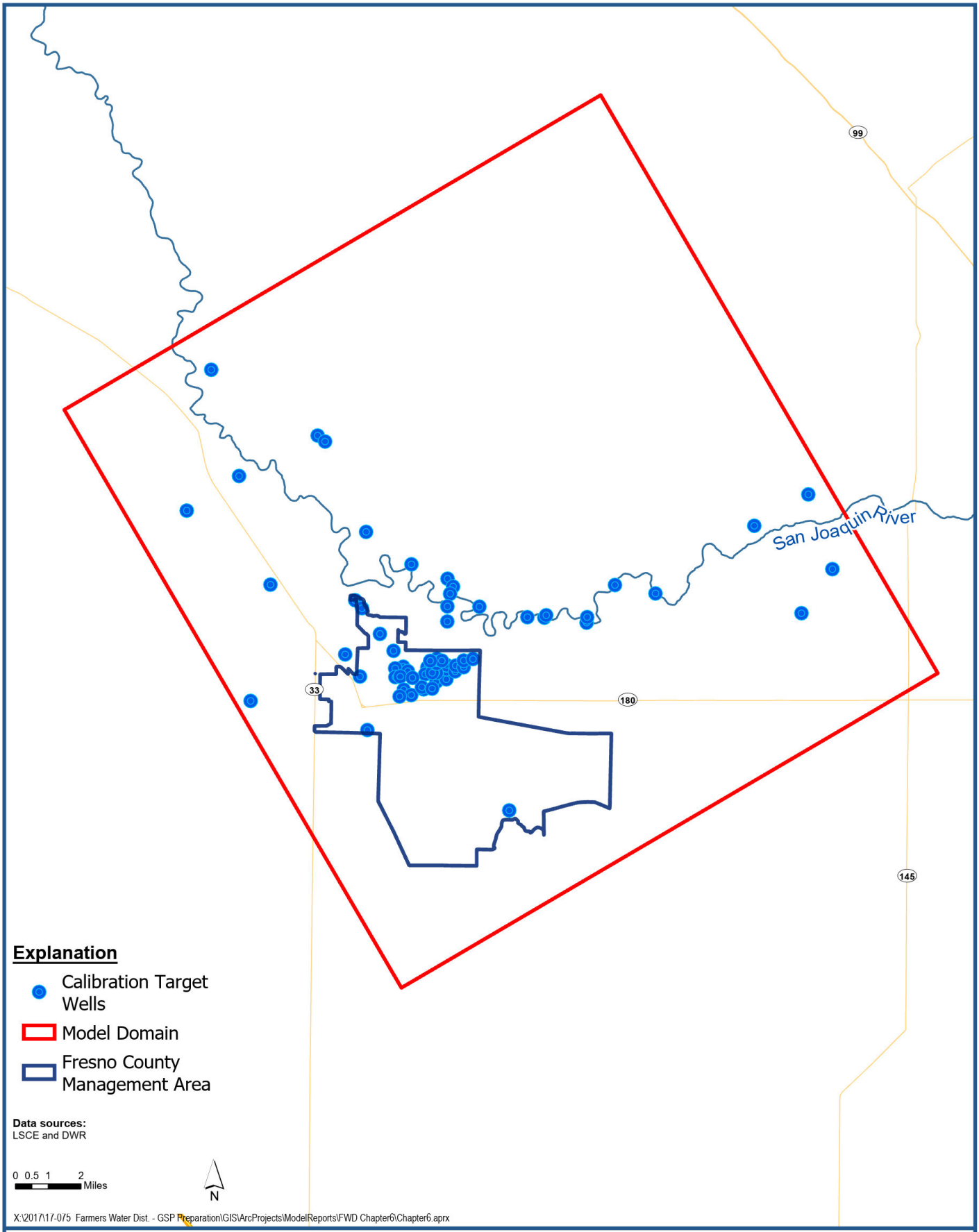
Vertical Hydraulic Conductivity Assigned to the Lower Aquifer

Groundwater Sustainability Plan
County of Fresno

Figure 6-9



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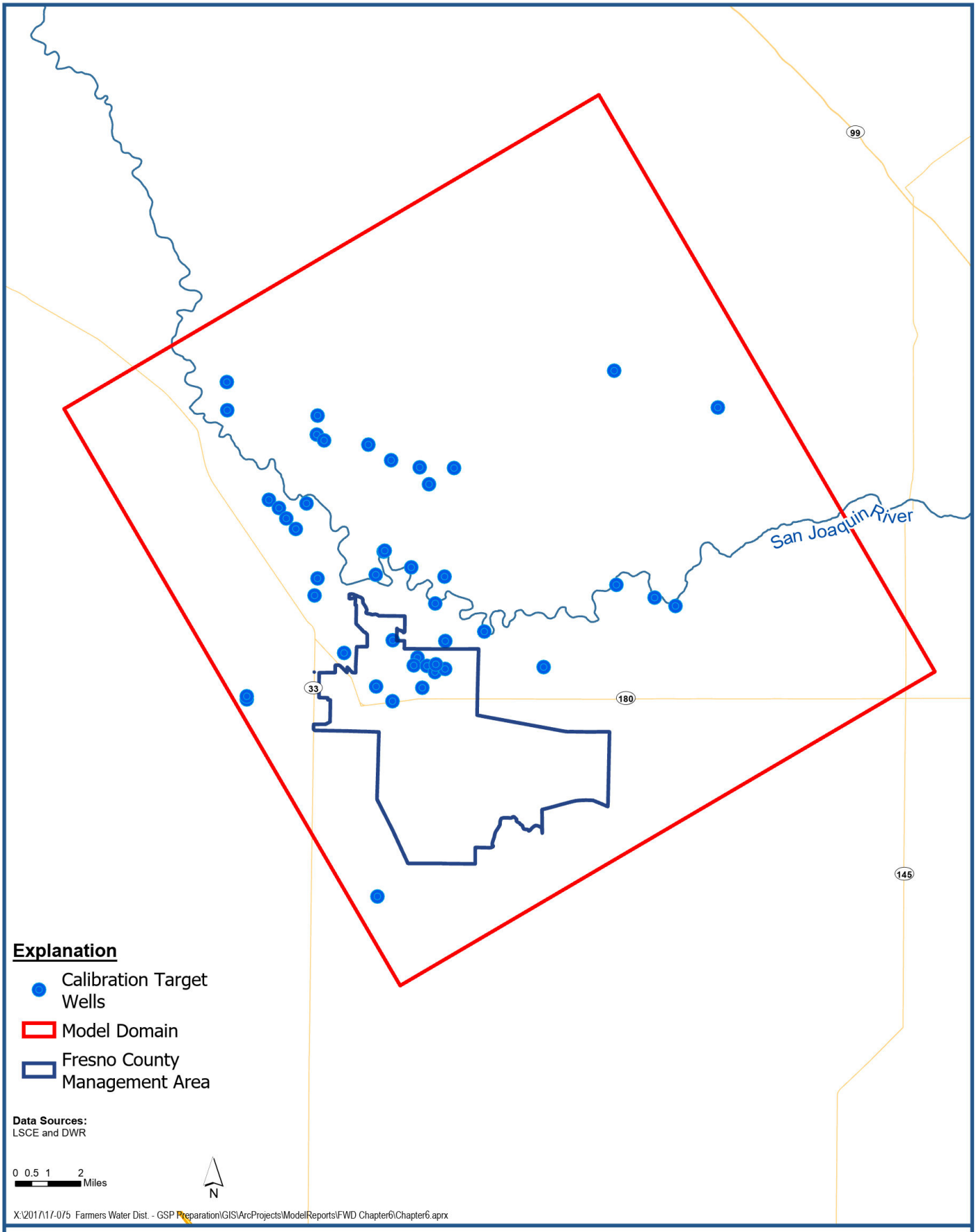
Locations of Upper Aquifer Shallow Zone Wells Used for Model Calibration

Groundwater Sustainability Plan
County of Fresno

Figure 6-10



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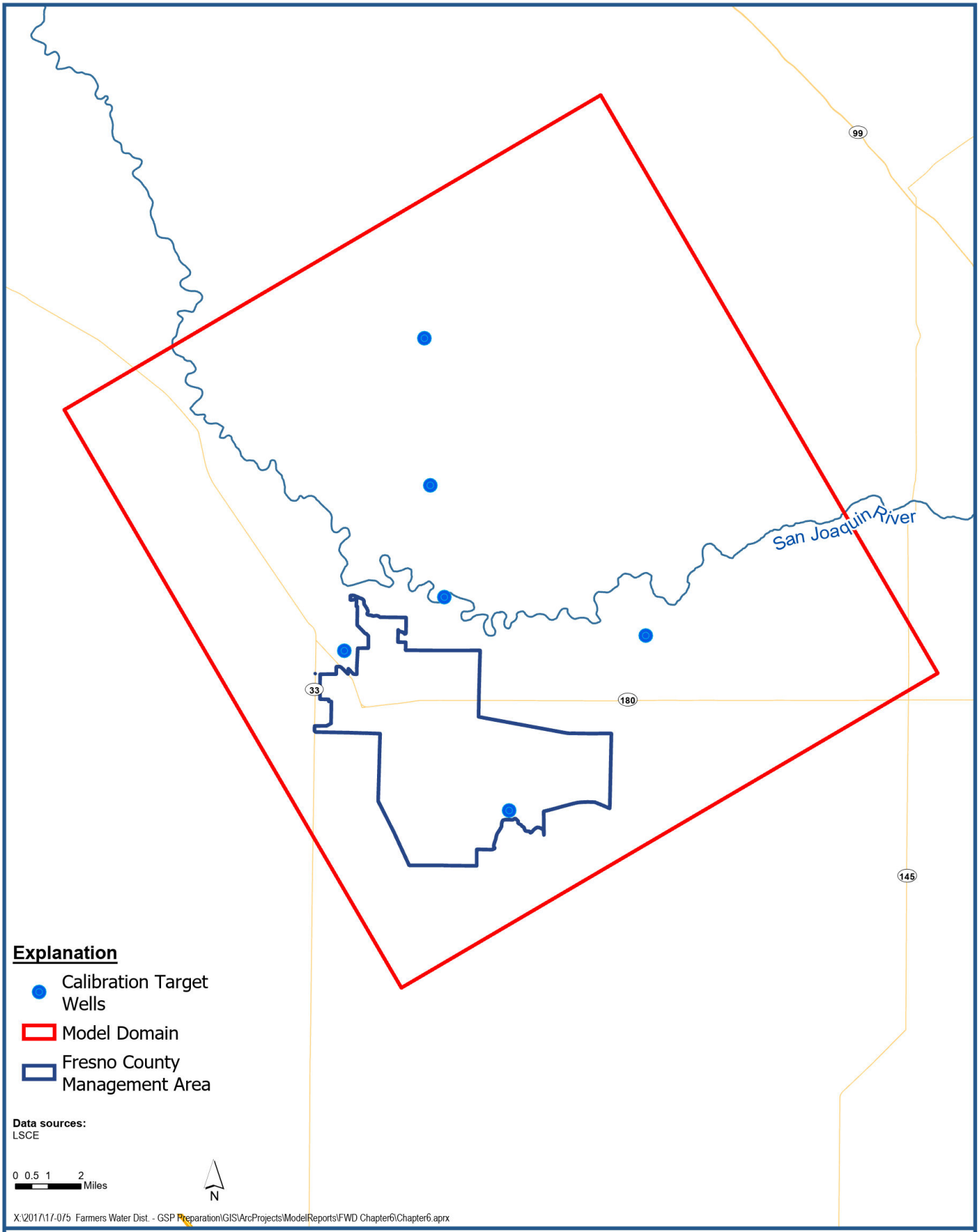
Locations of Upper Aquifer Deep Zone Wells Used for Model Calibration

Groundwater Sustainability Plan
County of Fresno

Figure 6-11



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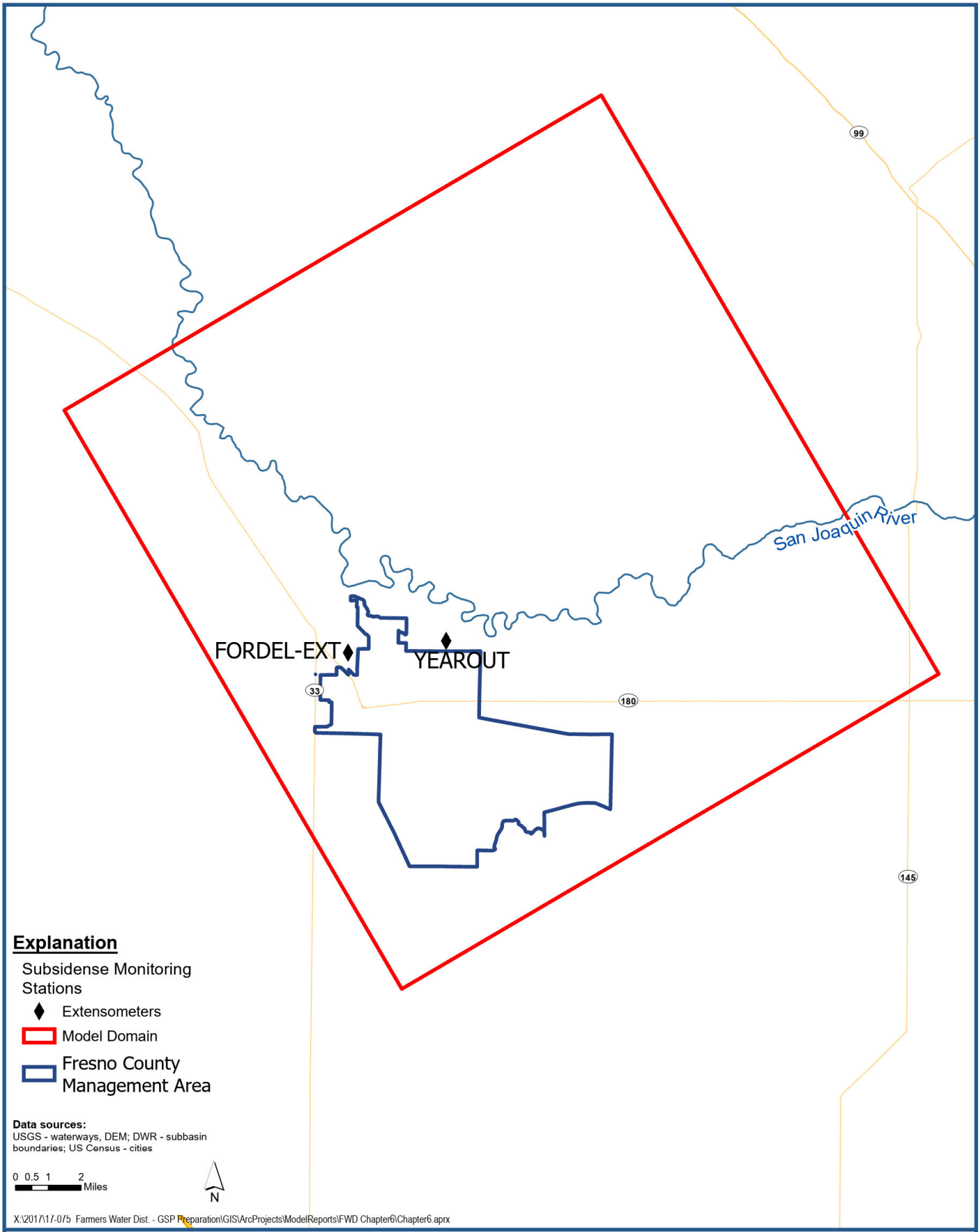
Locations of Lower Aquifer Wells Used for Model Calibration

Groundwater Sustainability Plan
County of Fresno

Figure 6-12



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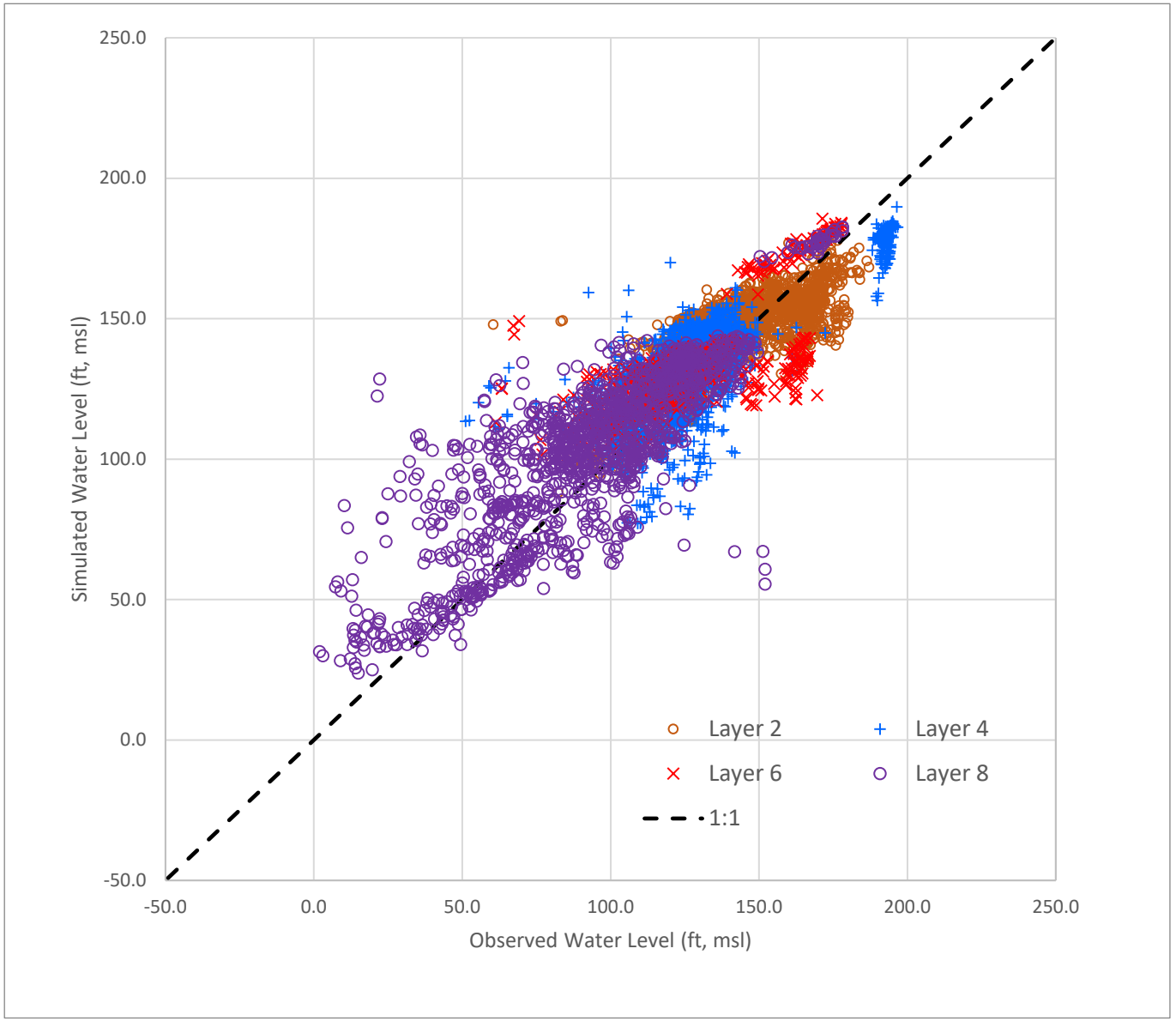
Location of Subsidence and Compaction Observations Used in Model Calibration

Groundwater Sustainability Plan
County of Fresno

Figure 6-13



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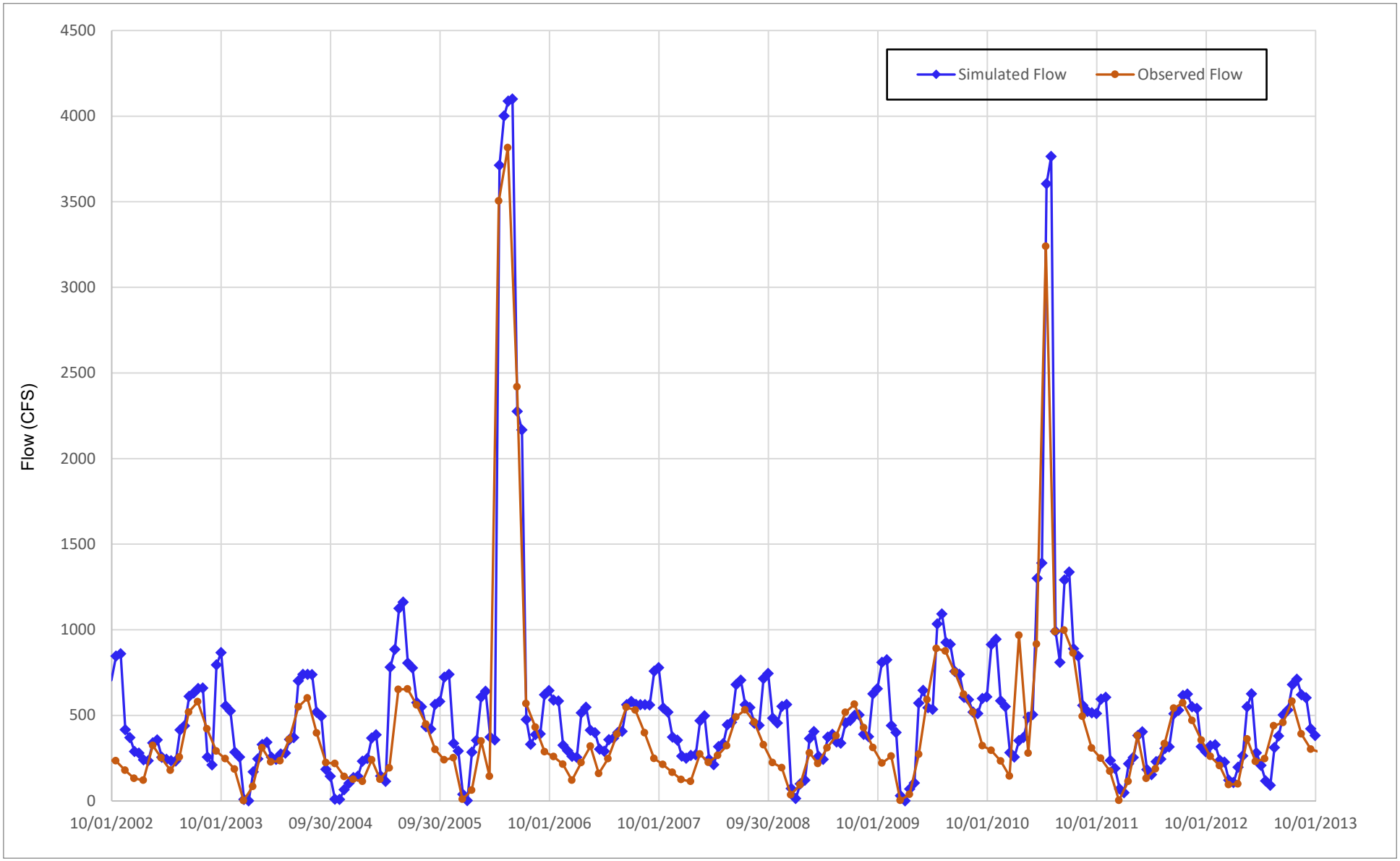
Simulated vs Observed Groundwater Level Elevations of Model Calibration Target Wells

Groundwater Sustainability Plan
County of Fresno

Figure 6-14



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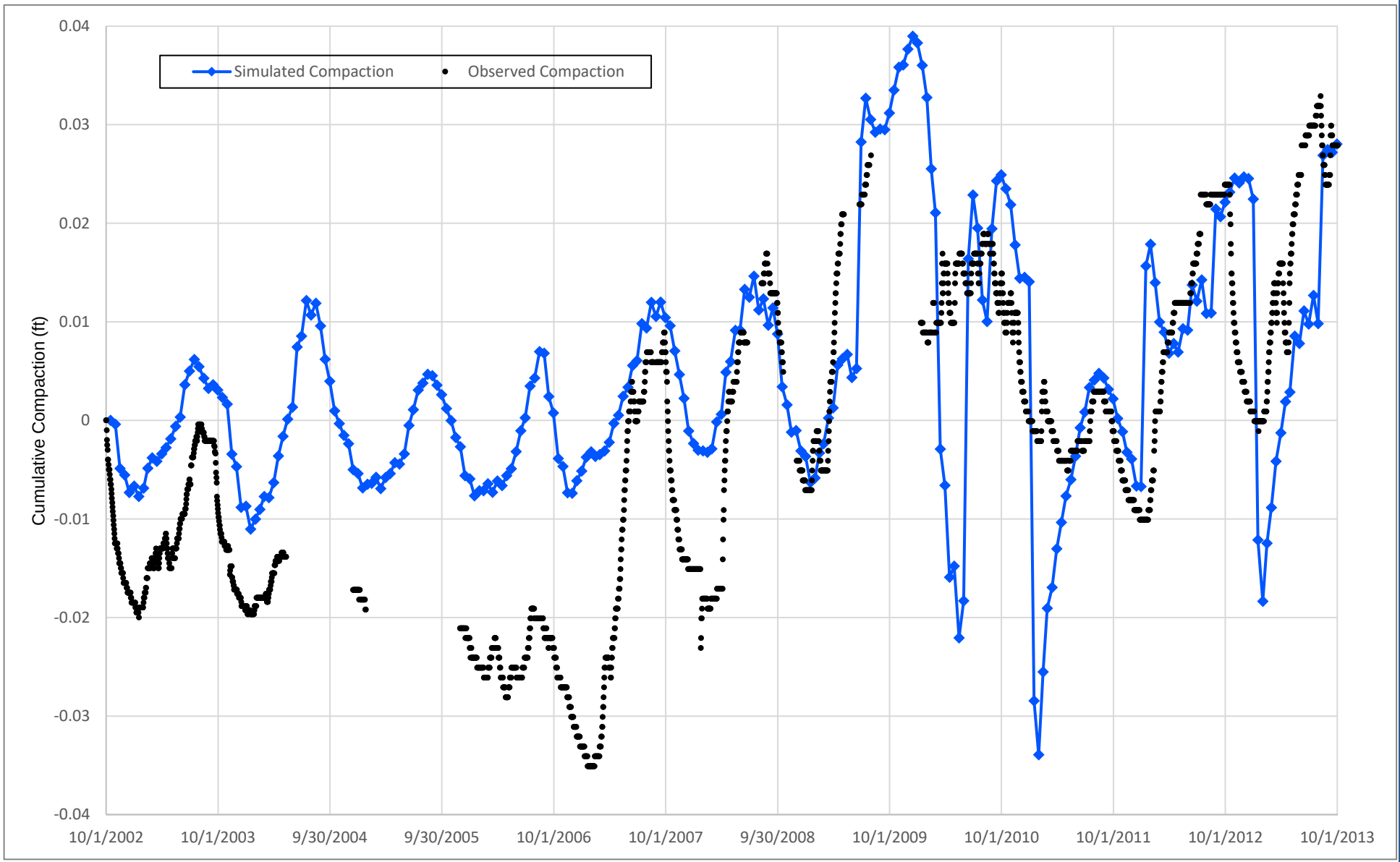
Observed and simulated flow of the San Joaquin River downstream of the Mendota Dam

Groundwater Sustainability Plan
County of Fresno

Figure 6-15

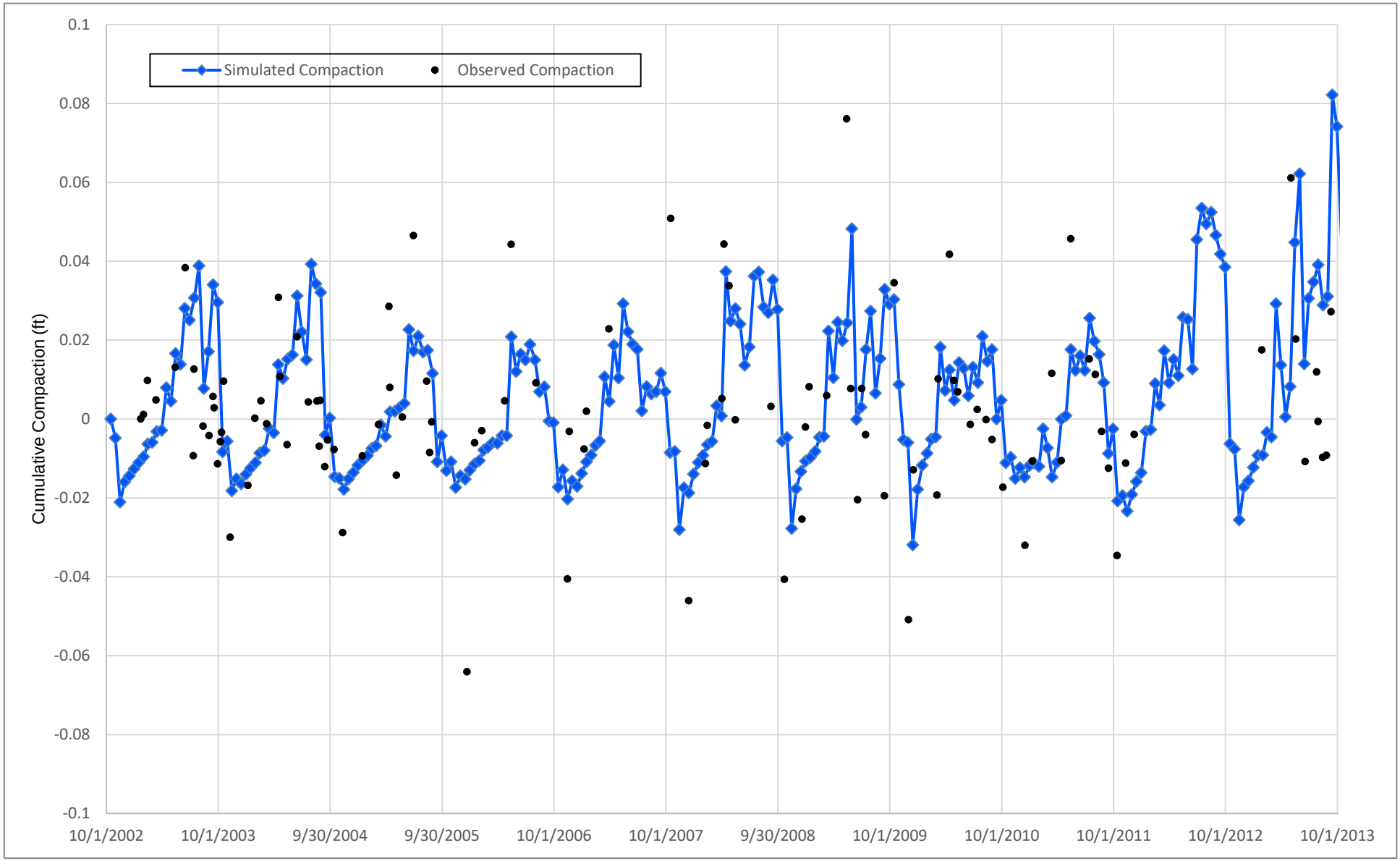


Luhdorff & Scalmanini Consulting Engineers

Observed and Simulated Compaction above the Corcoran Clay at Fordel Extensometer

Groundwater Sustainability Plan
County of Fresno

Figure 6-16



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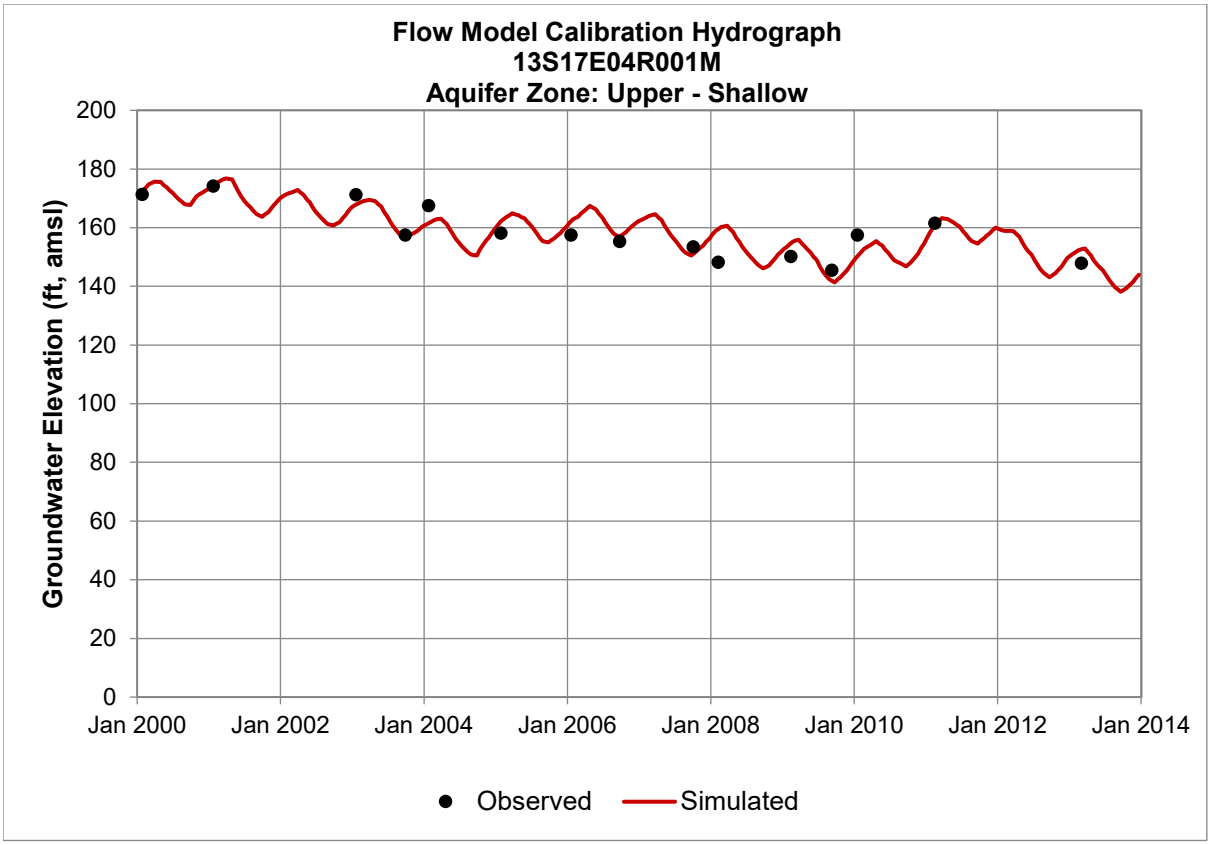
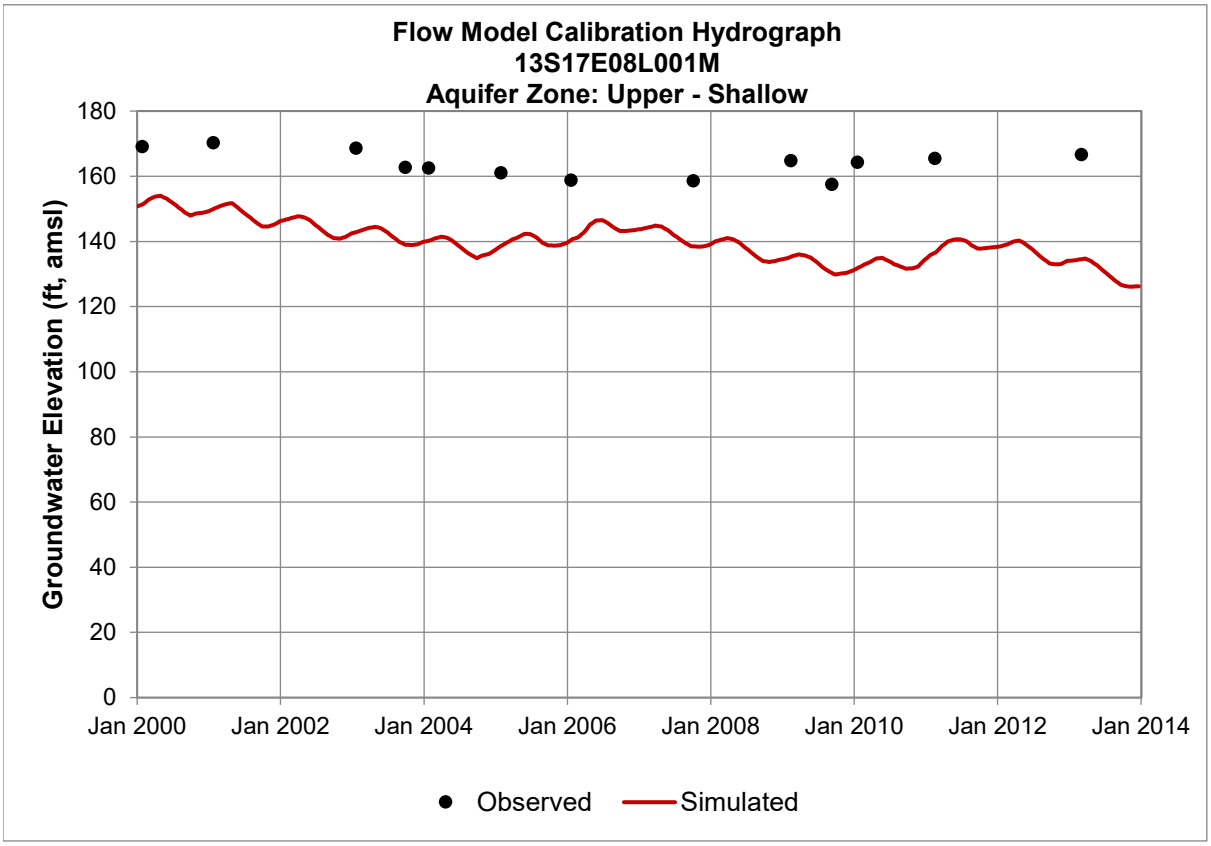
Observed and Simulated Compaction above the Corcoran Clay at Yearout Ranch Extensometer

Groundwater Sustainability Plan
County of Fresno

Figure 6-17


Flow Model Calibration Hydrograph
13S17E04R001M
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
200
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
13S17E08L001M
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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160
140
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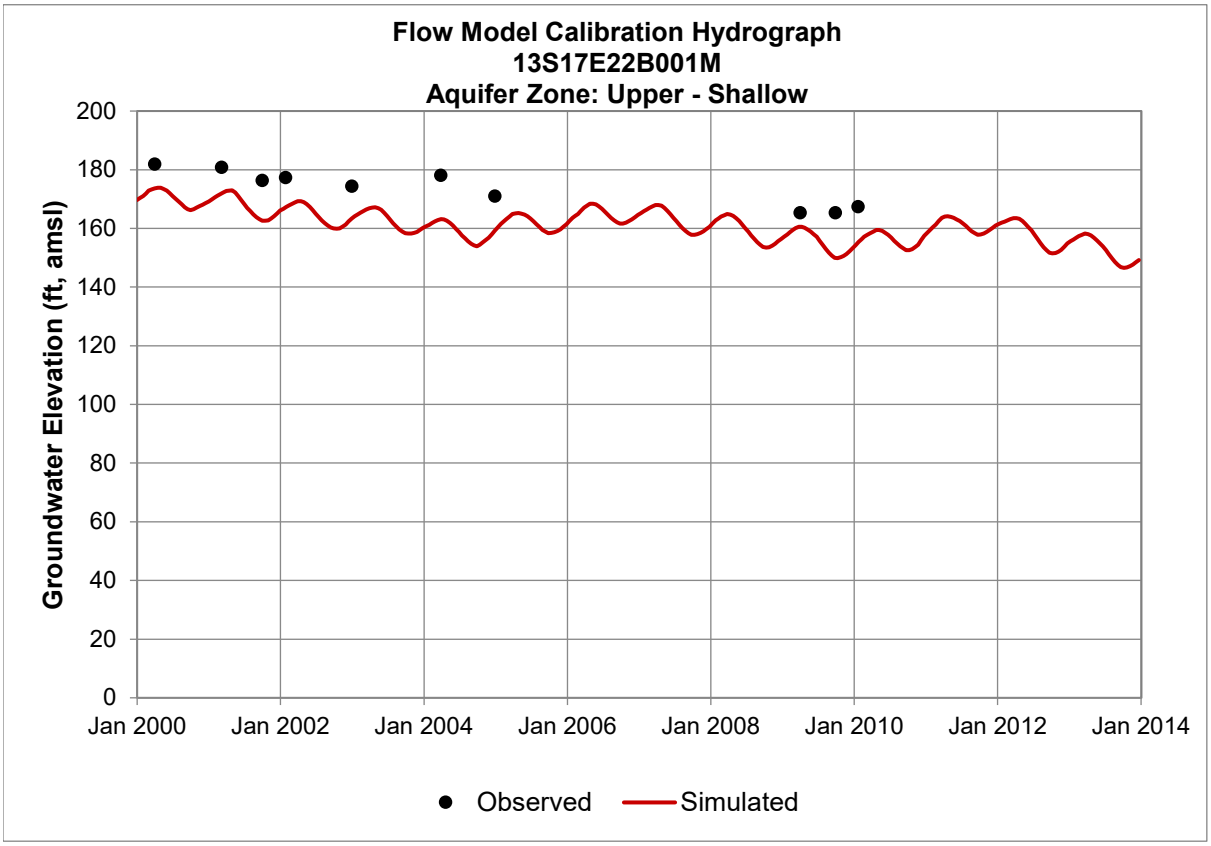
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
13S17E22B001M
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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140
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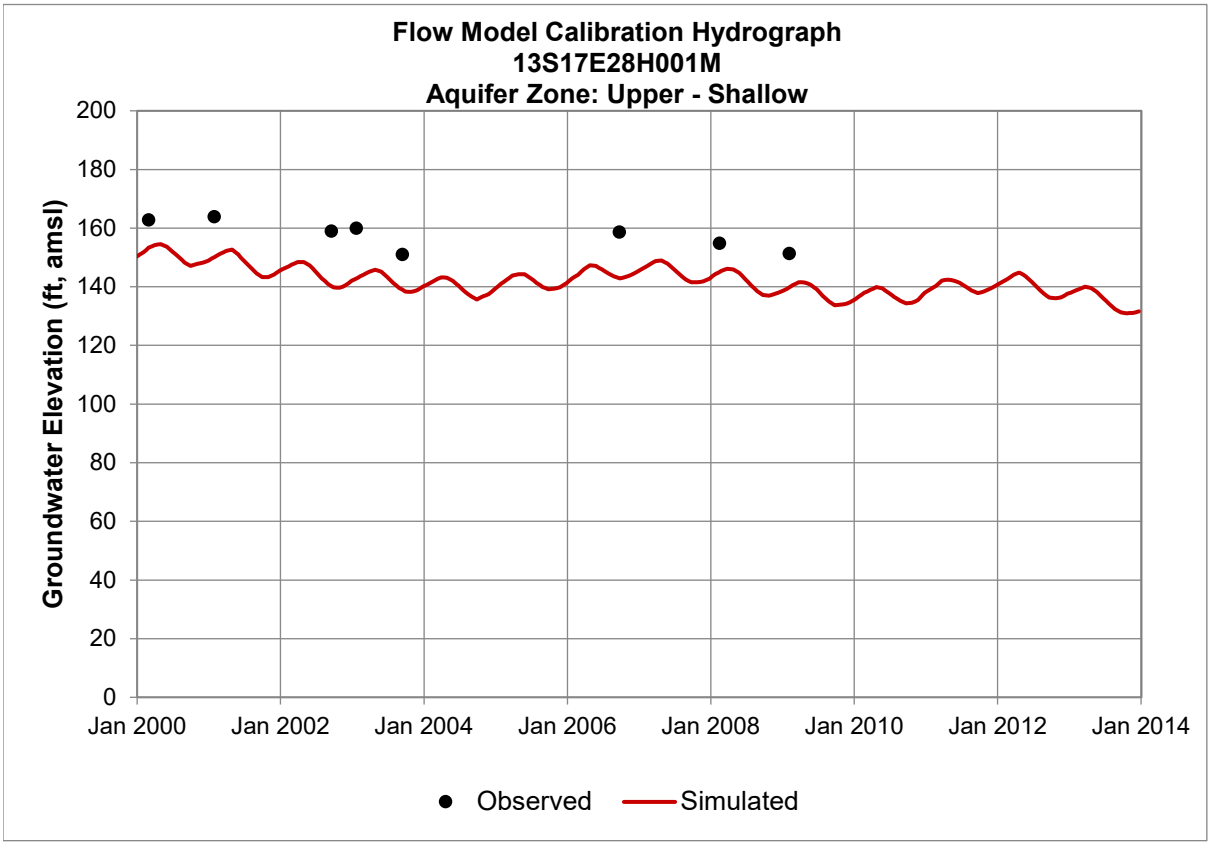
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
13S17E28H001M
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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140
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Jan 2000
Jan 2002
Jan 2004
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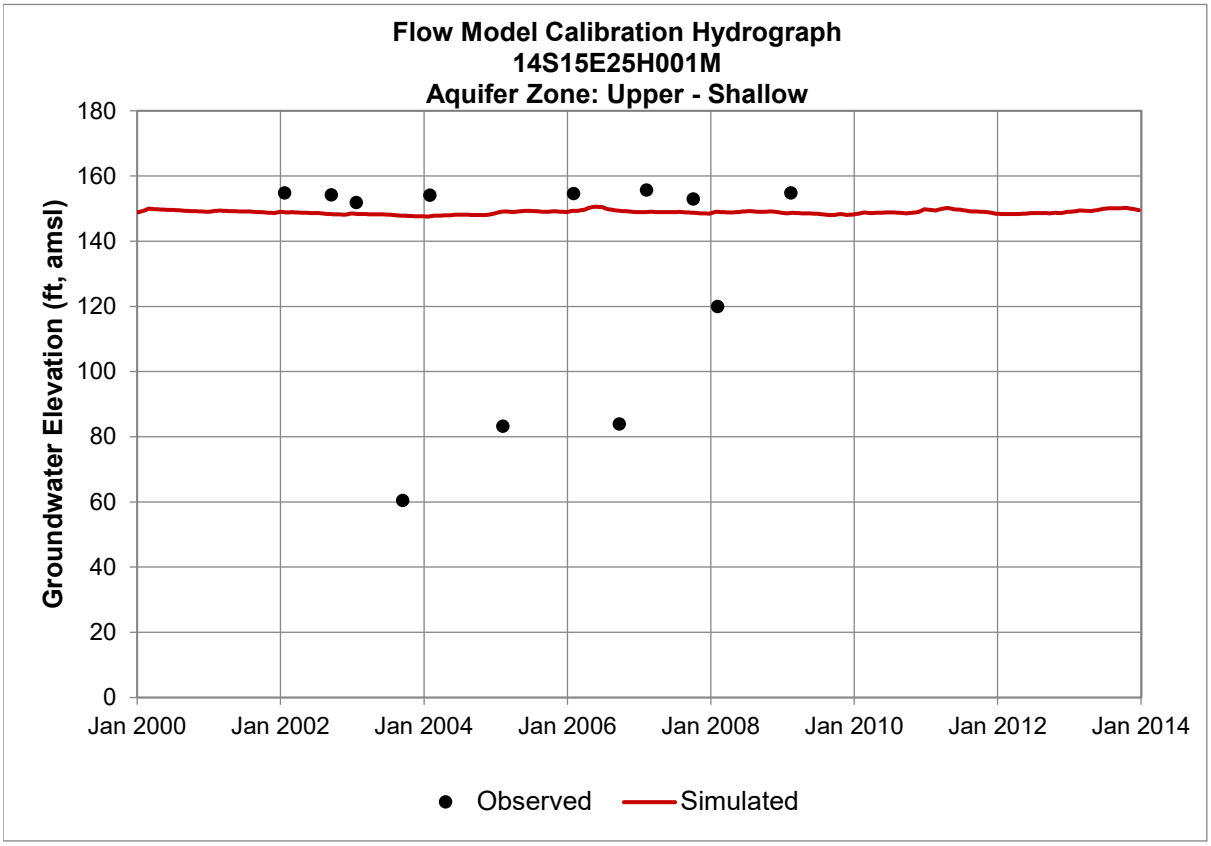
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
14S15E25H001M
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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160
140
120
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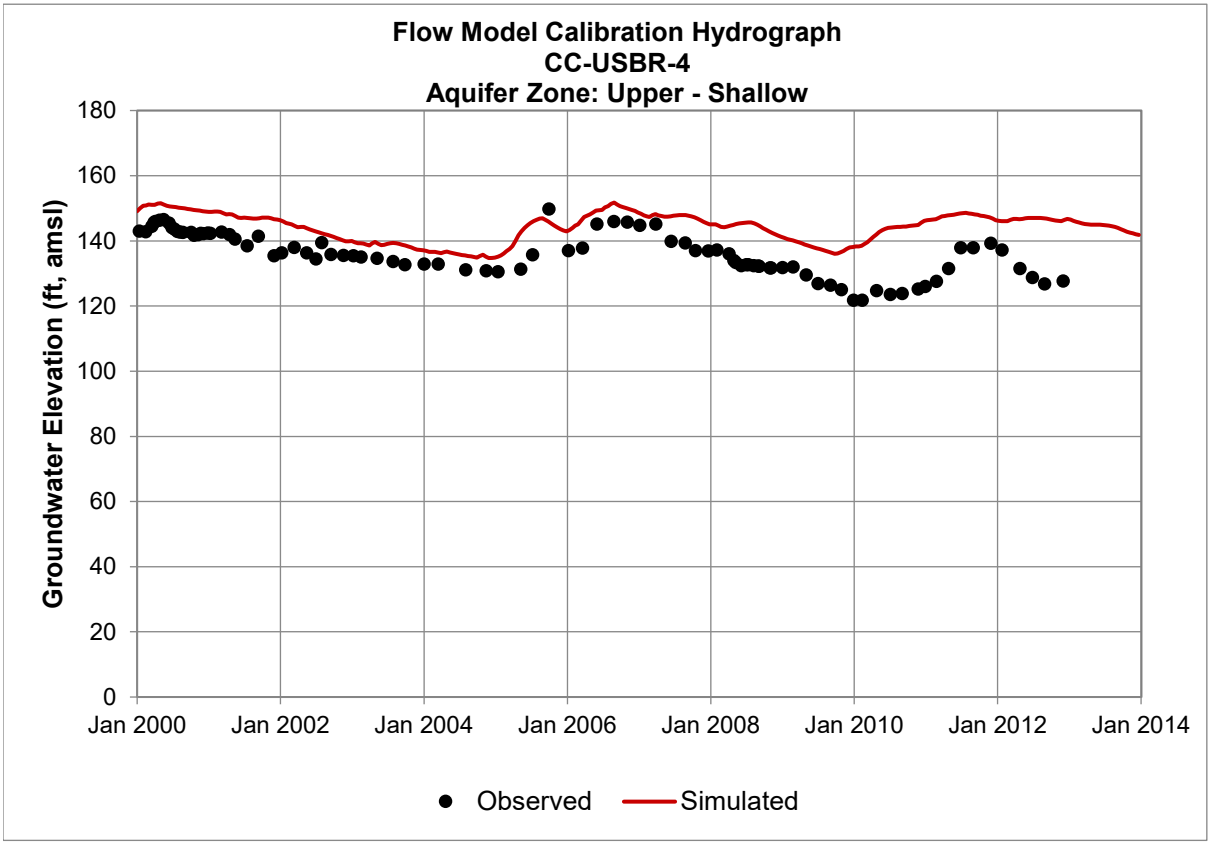
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
CC-USBR-4
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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160
140
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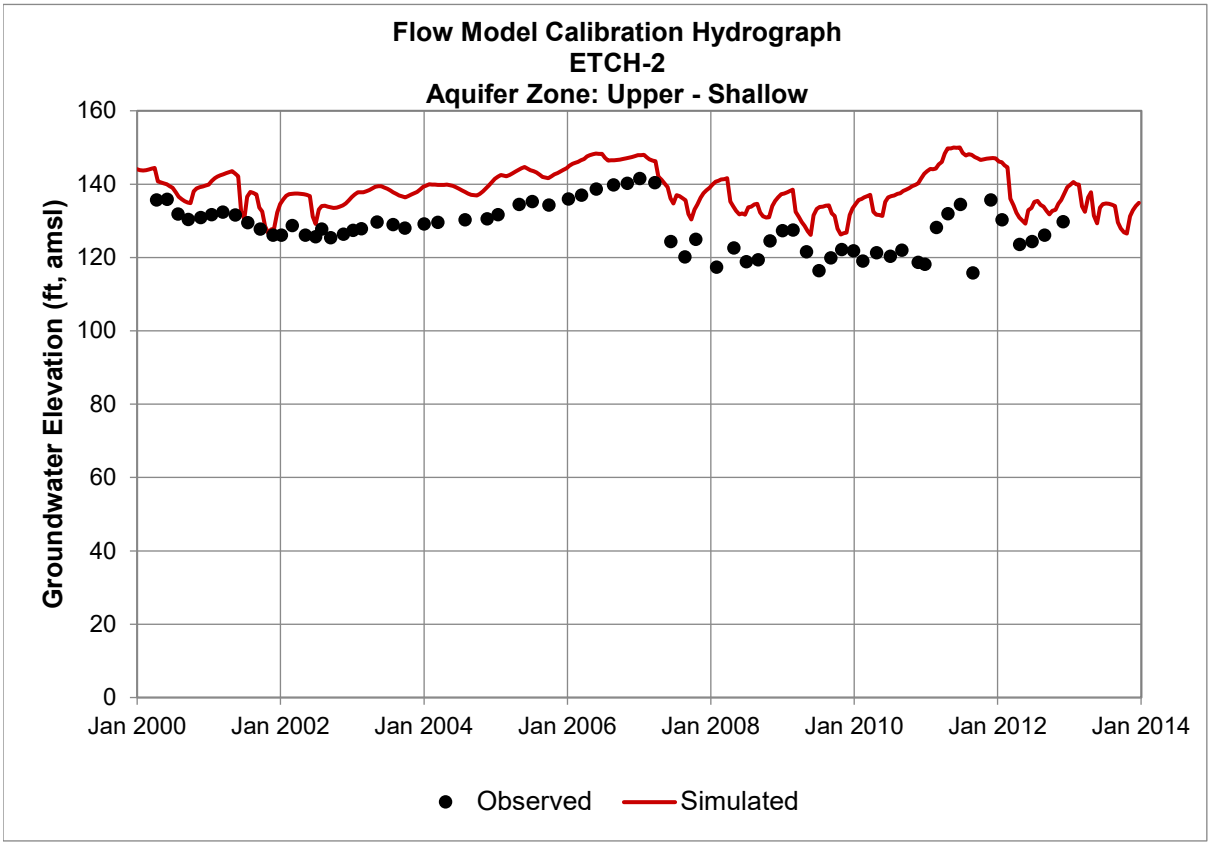
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
ETCH-2
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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140
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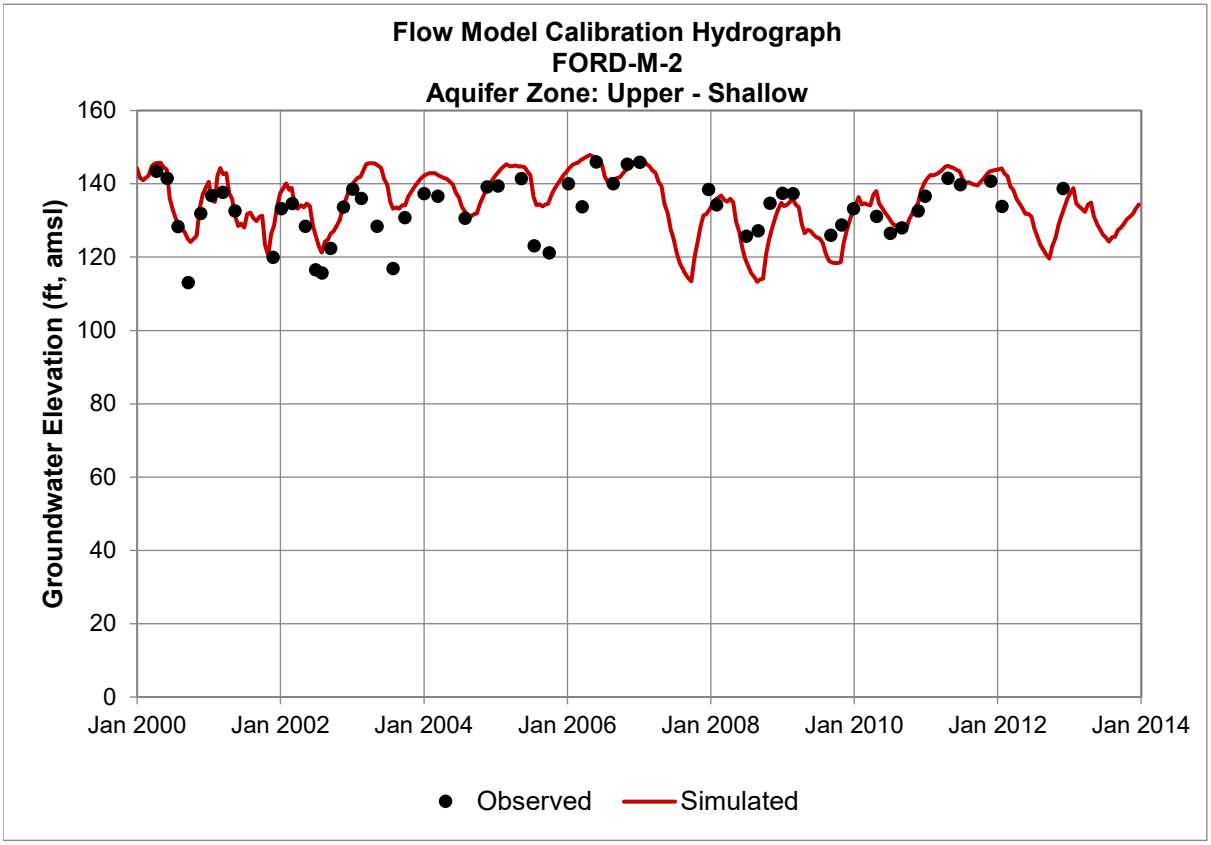
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
FORD-M-2
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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140
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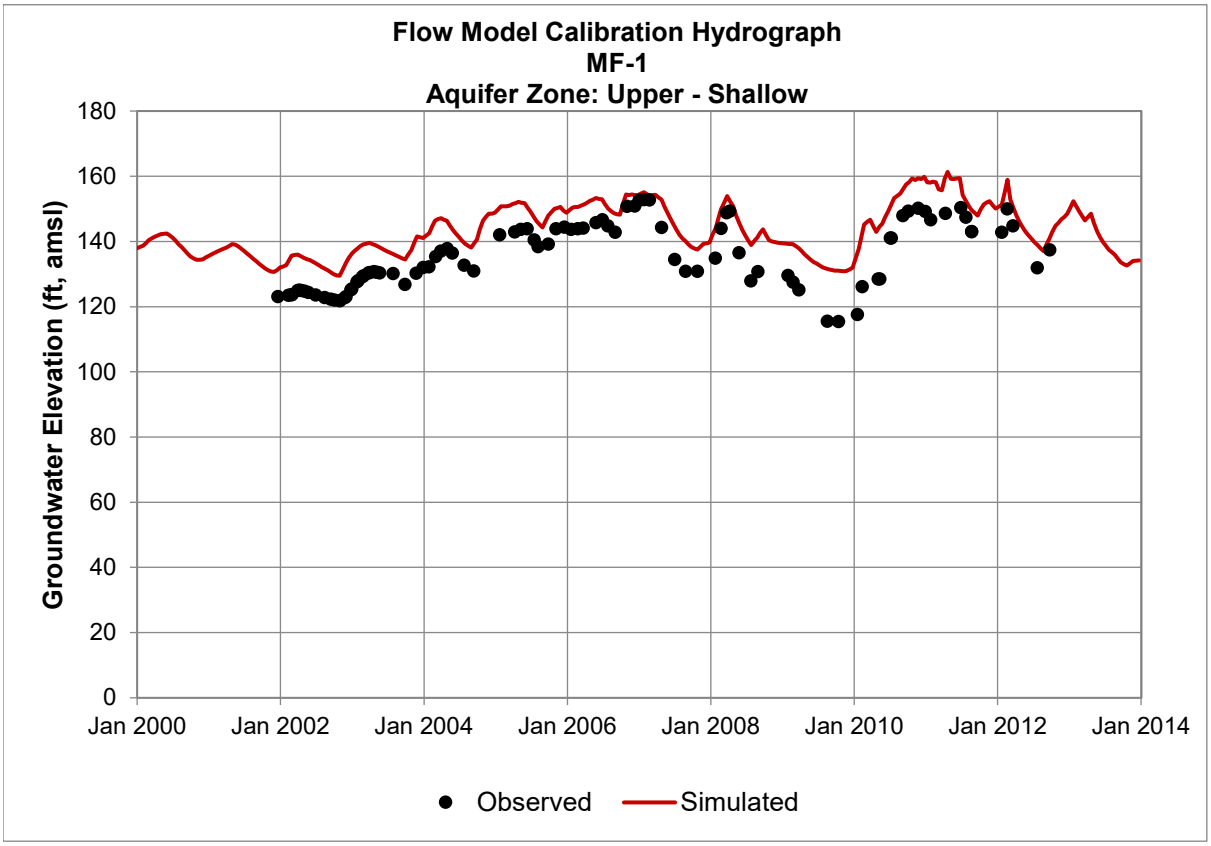
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MF-1
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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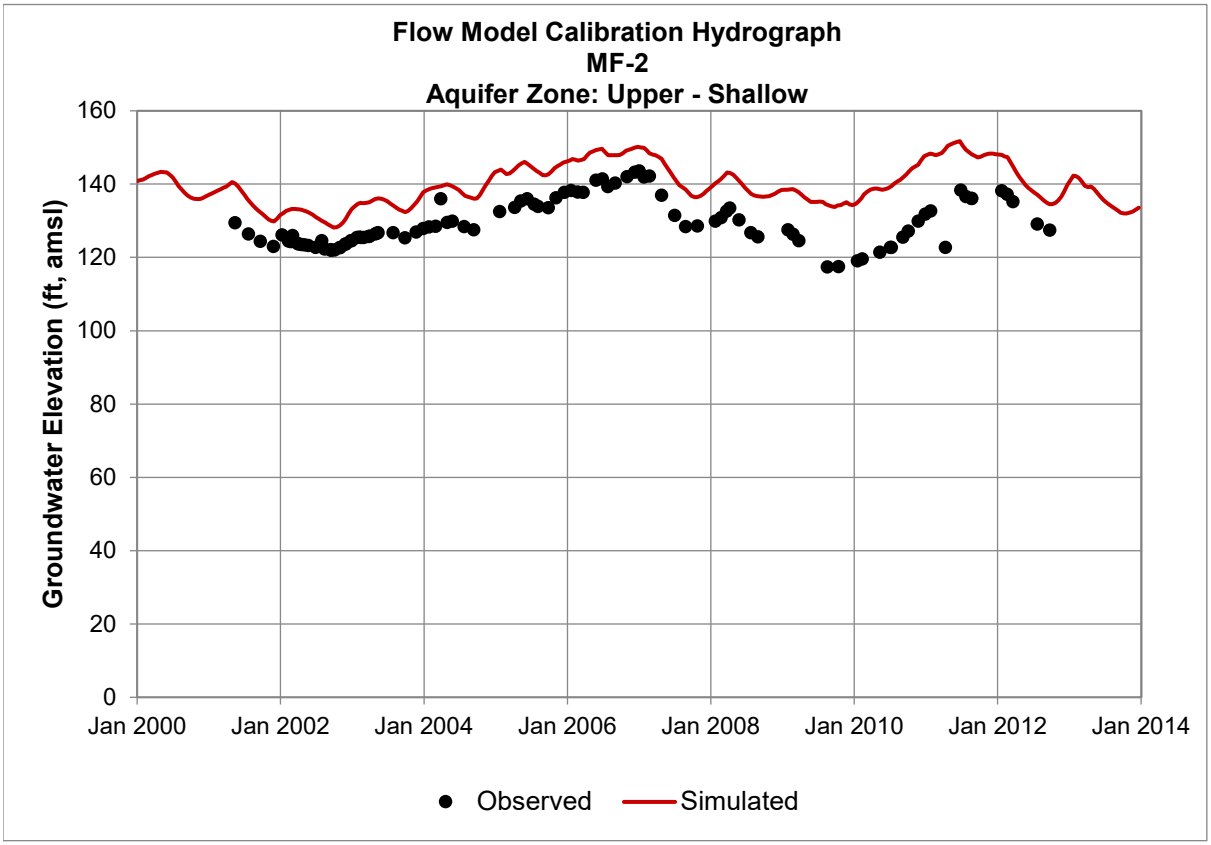
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MF-2
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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Jan 2002
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Jan 2008
Jan 2010
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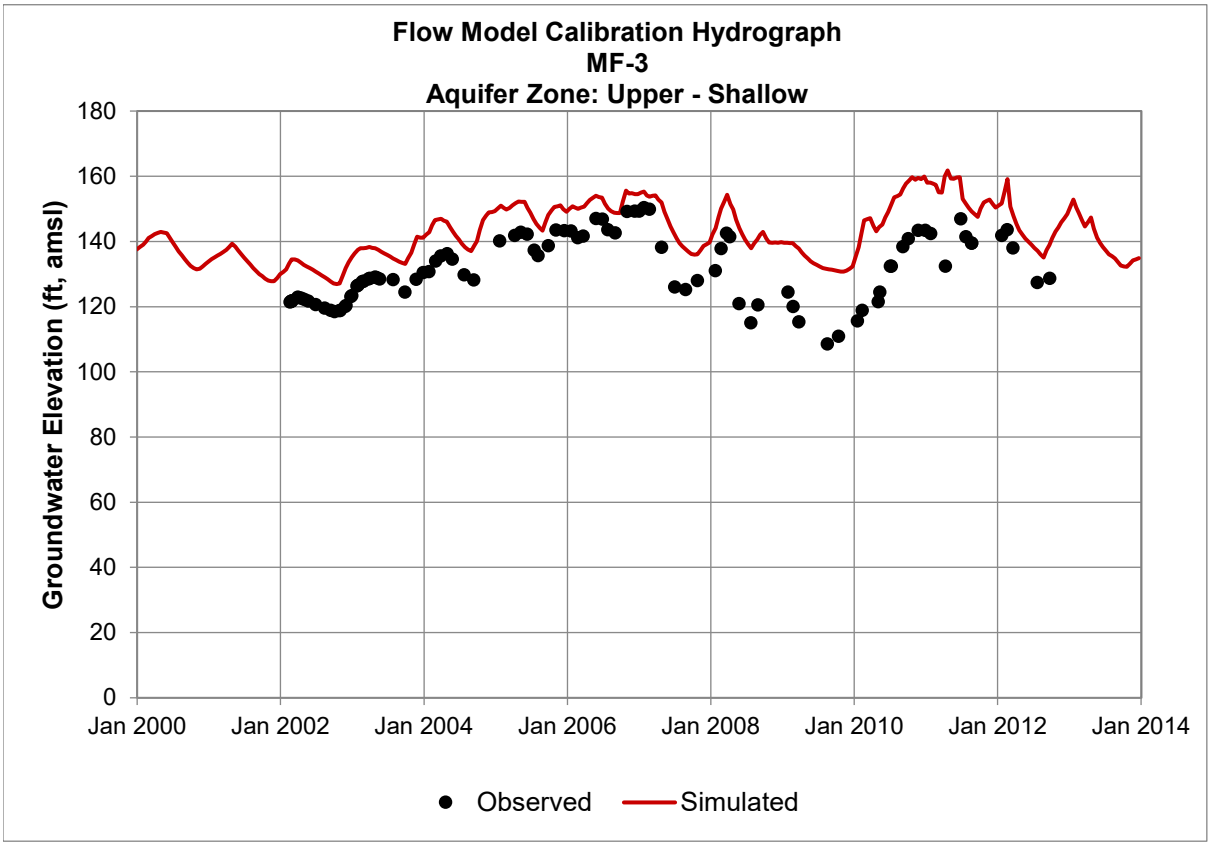
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MF-3
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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140
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Jan 2000
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Jan 2008
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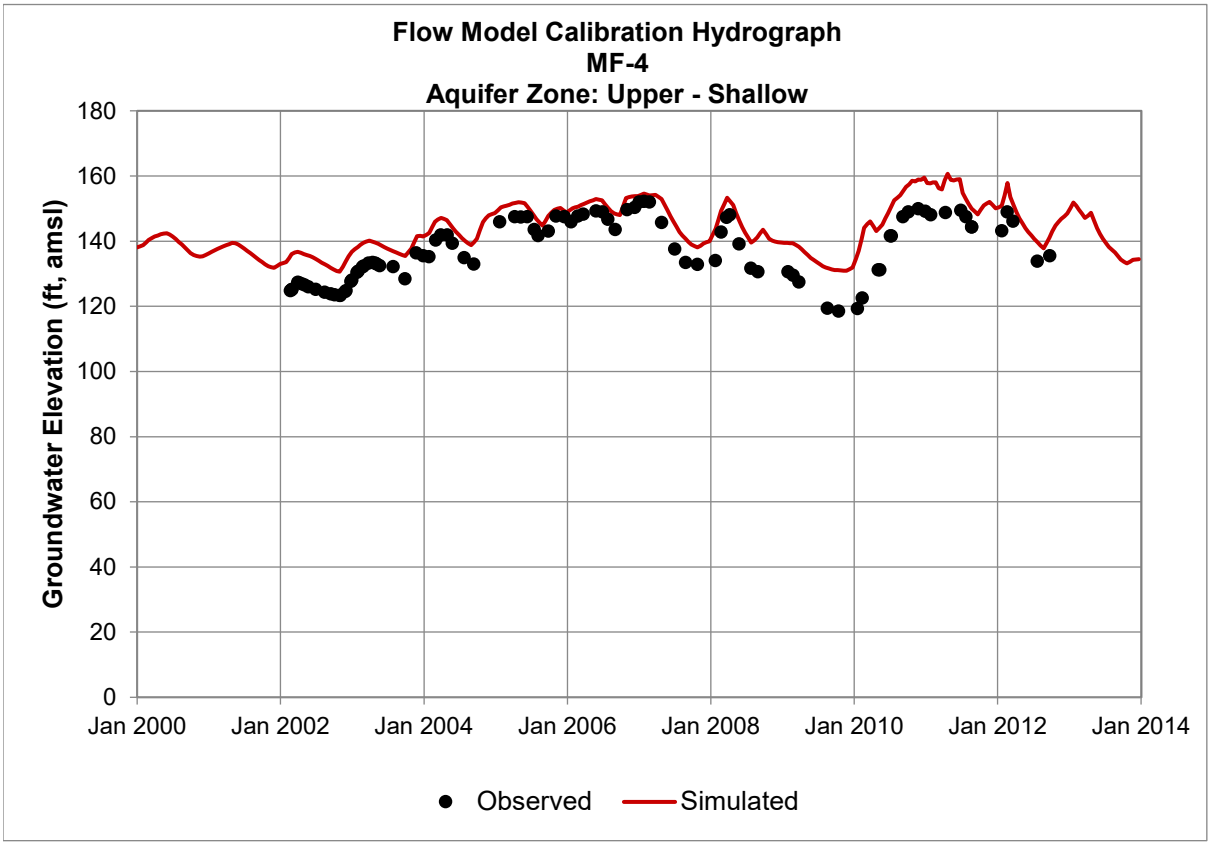
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MF-4
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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160
140
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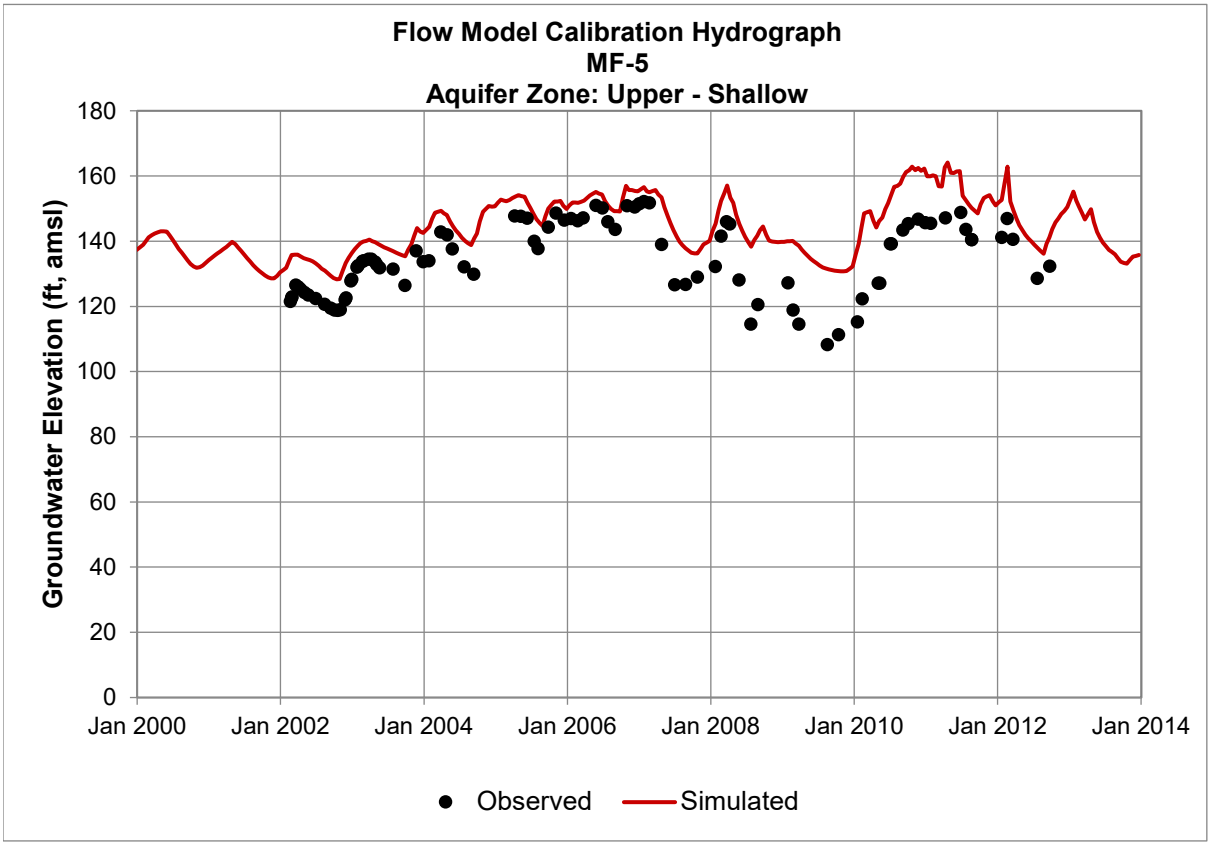
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MF-5
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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Jan 2002
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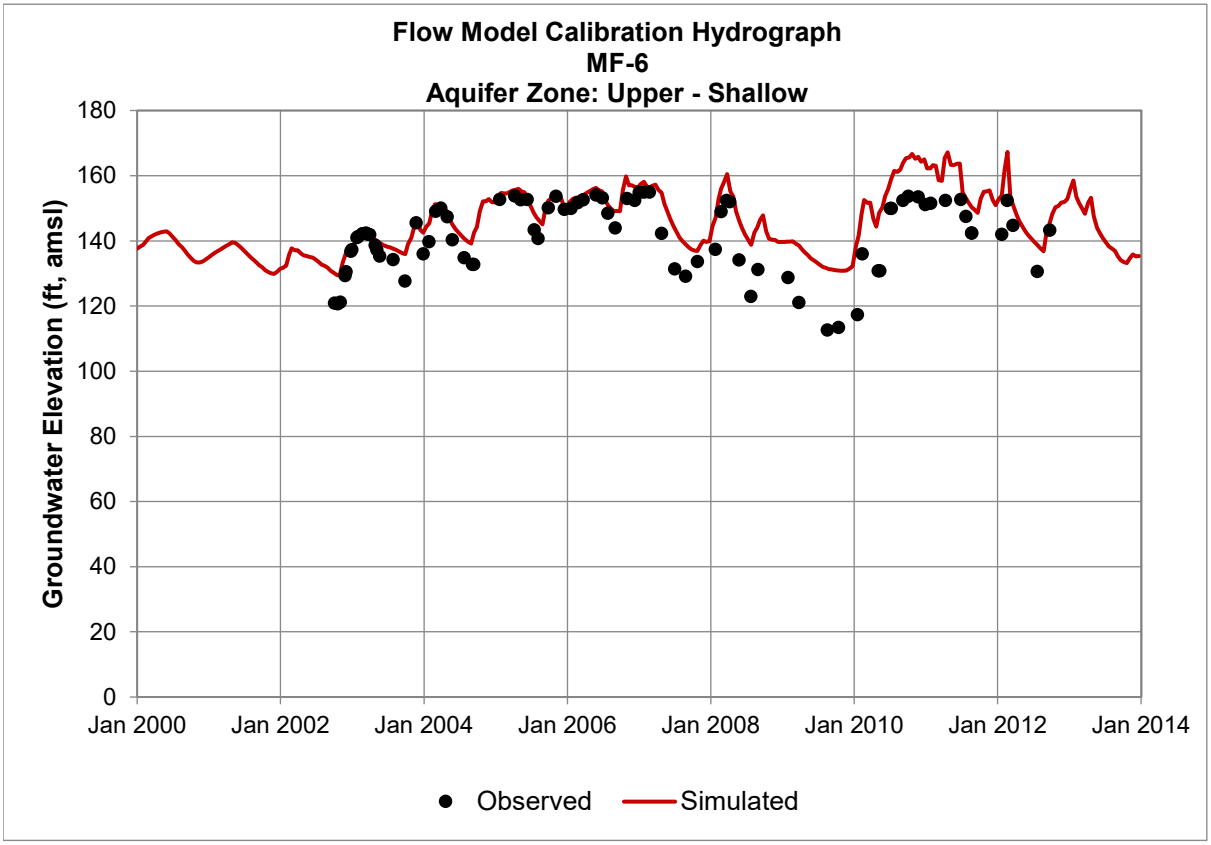
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MF-6
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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Jan 2008
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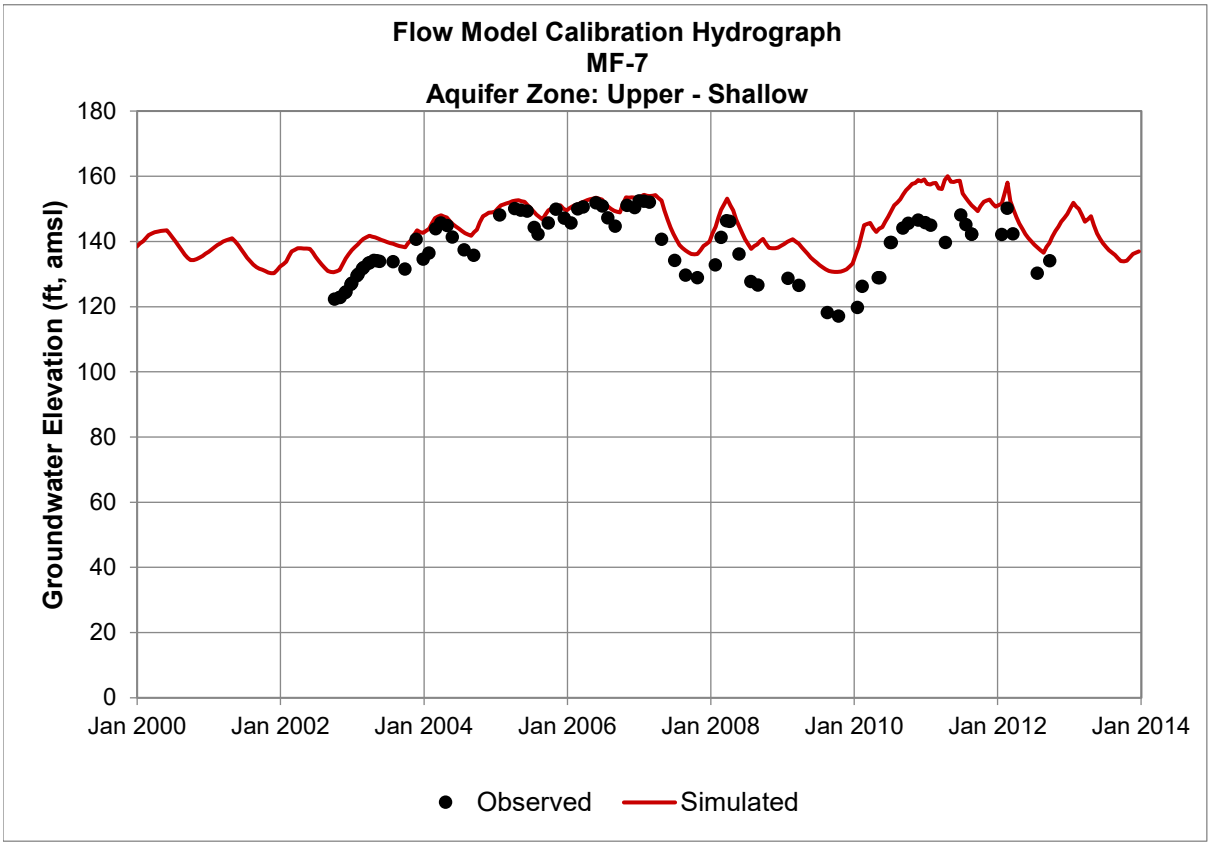
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MF-7
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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0
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Jan 2002
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Jan 2008
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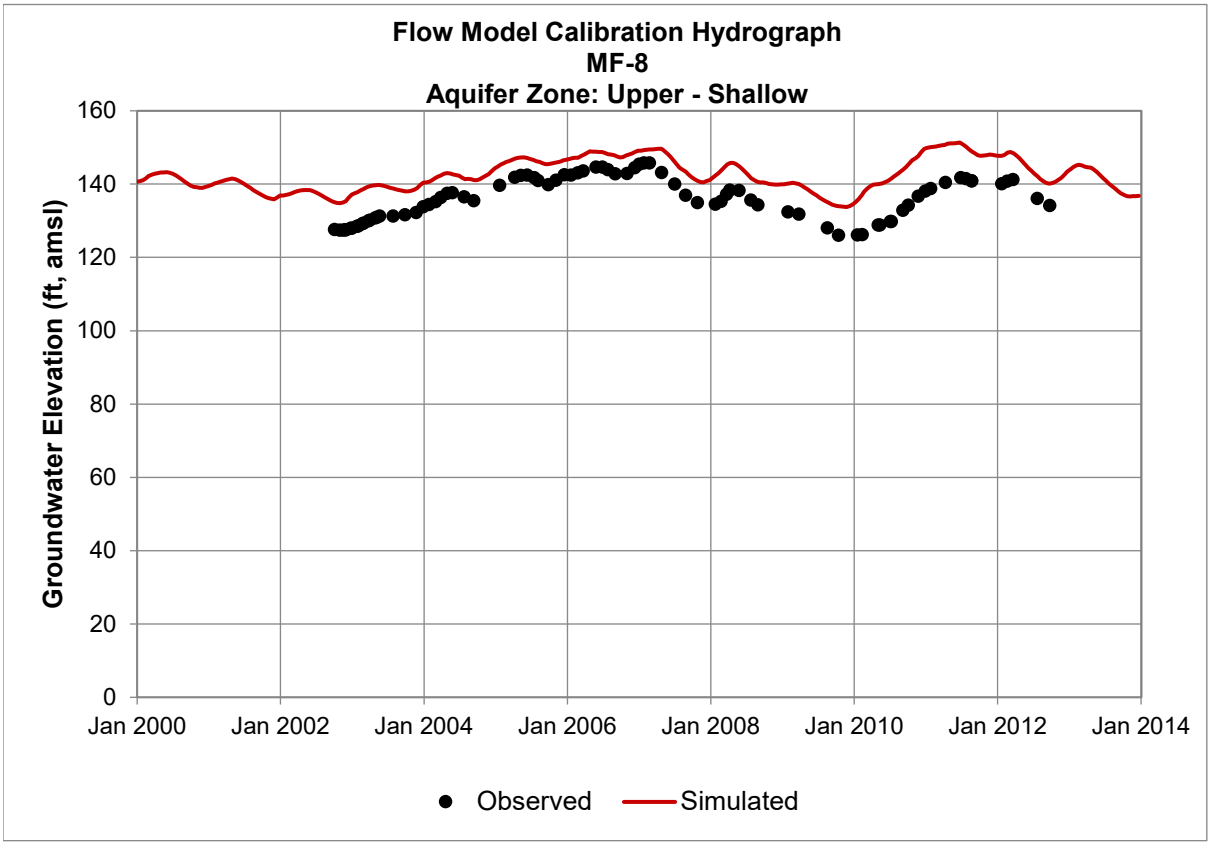
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MF-8
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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Jan 2002
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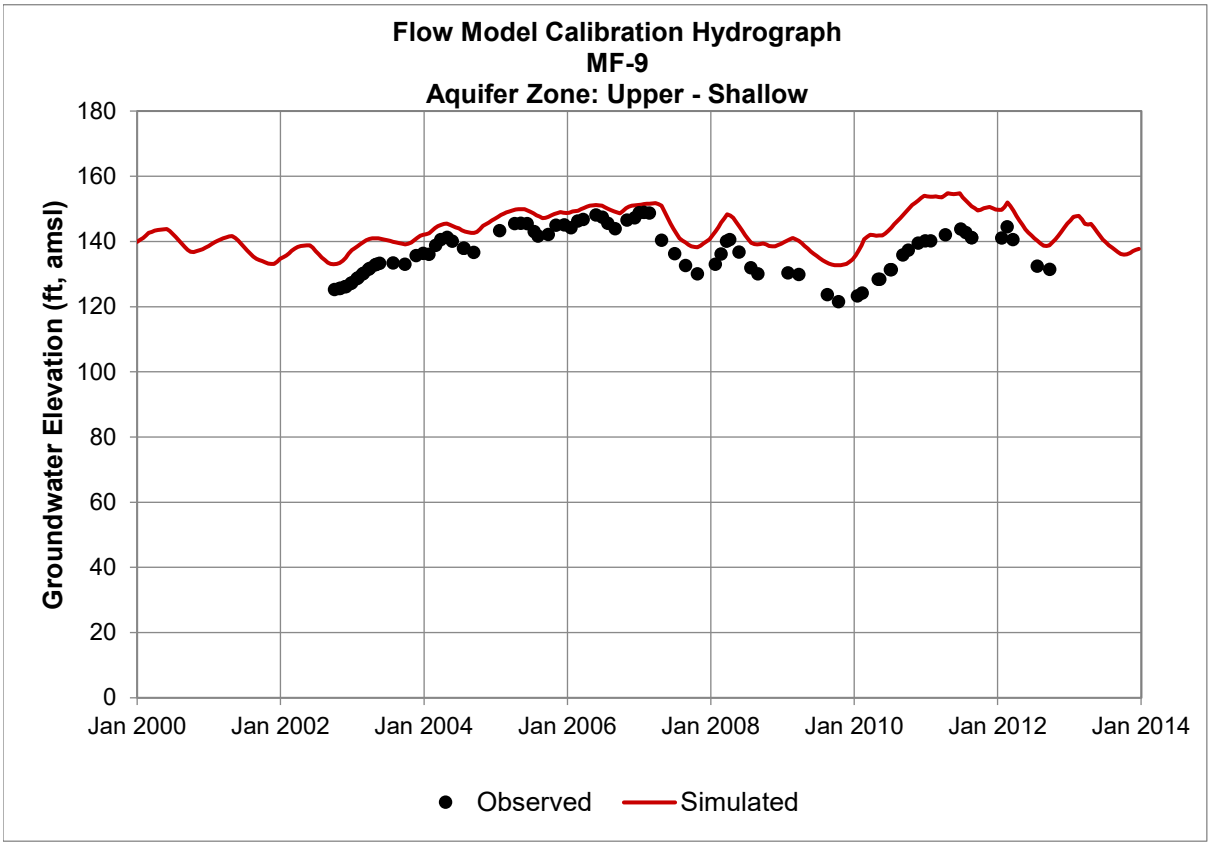
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MF-9
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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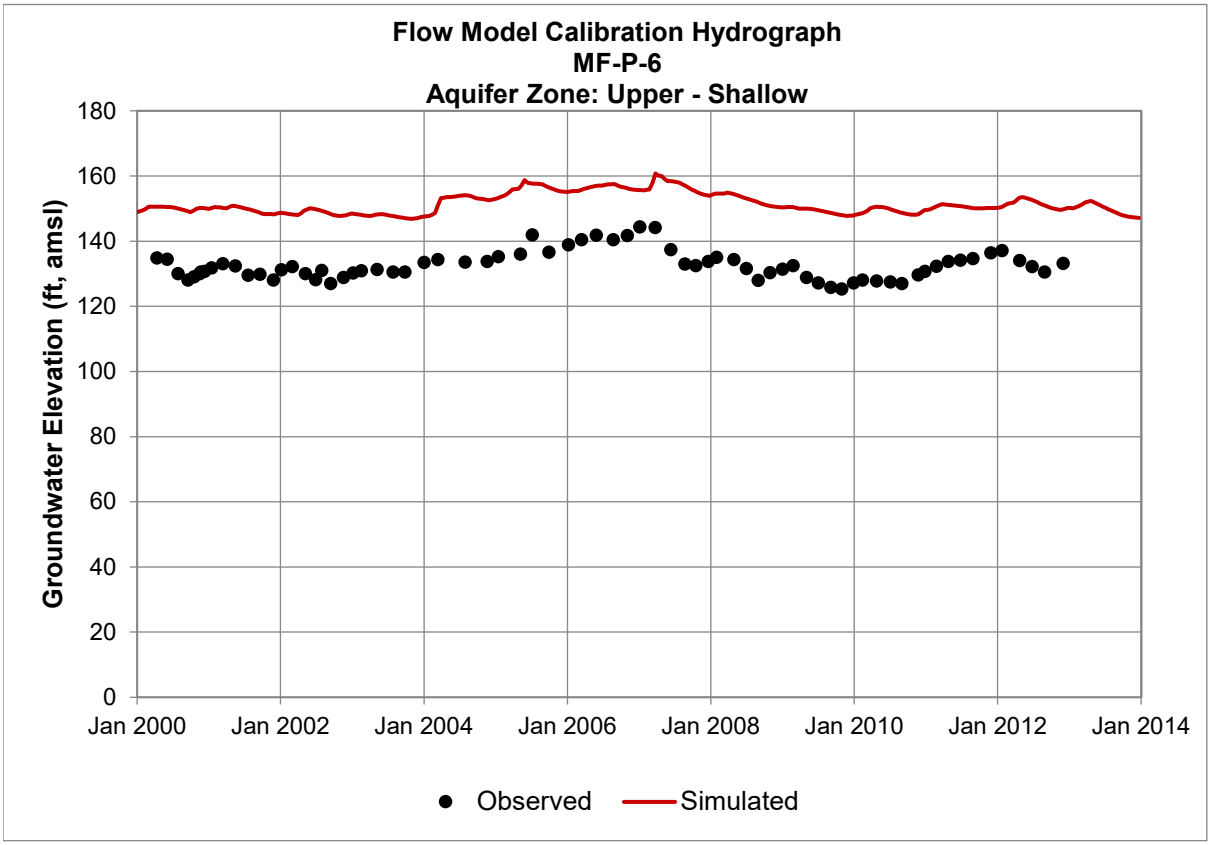
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MF-P-6
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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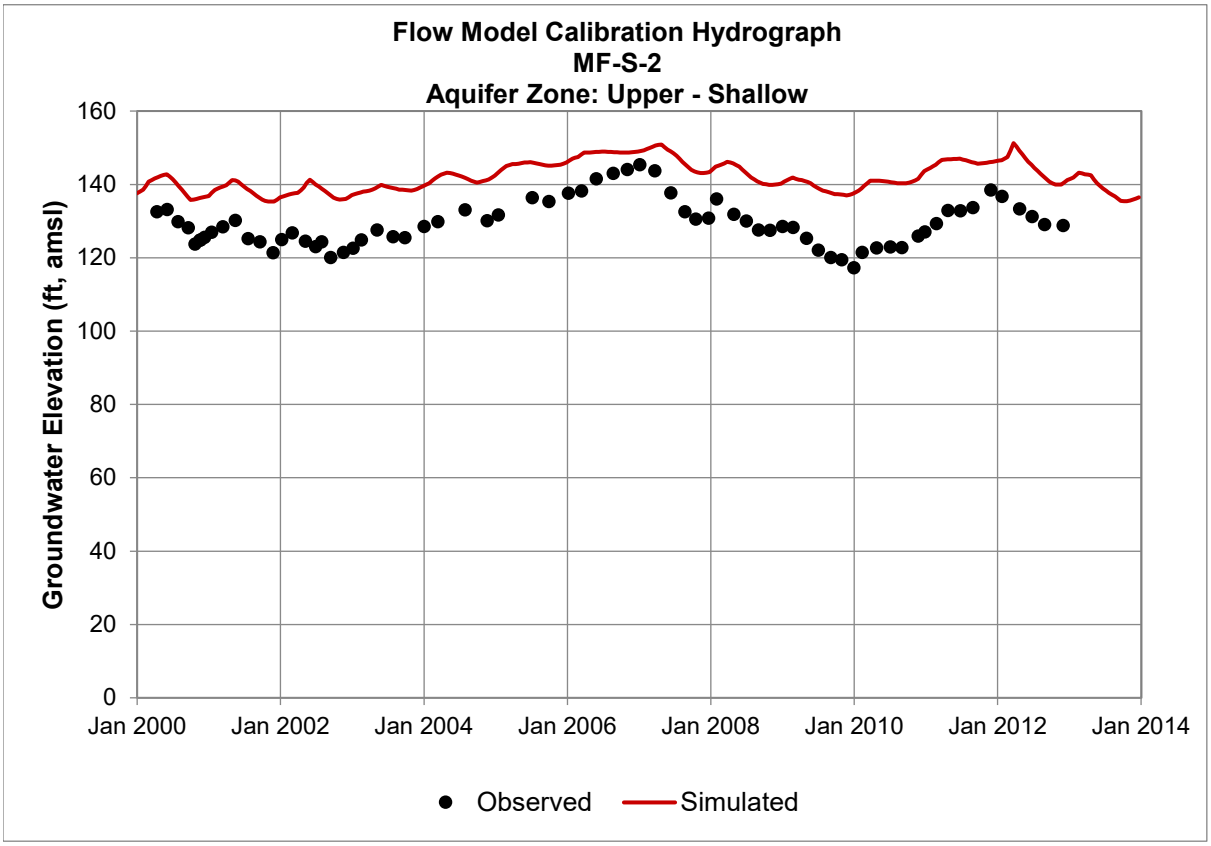
Observed
Simulated


Flow Model Calibration Hydrograph
MF-S-2
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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Jan 2000
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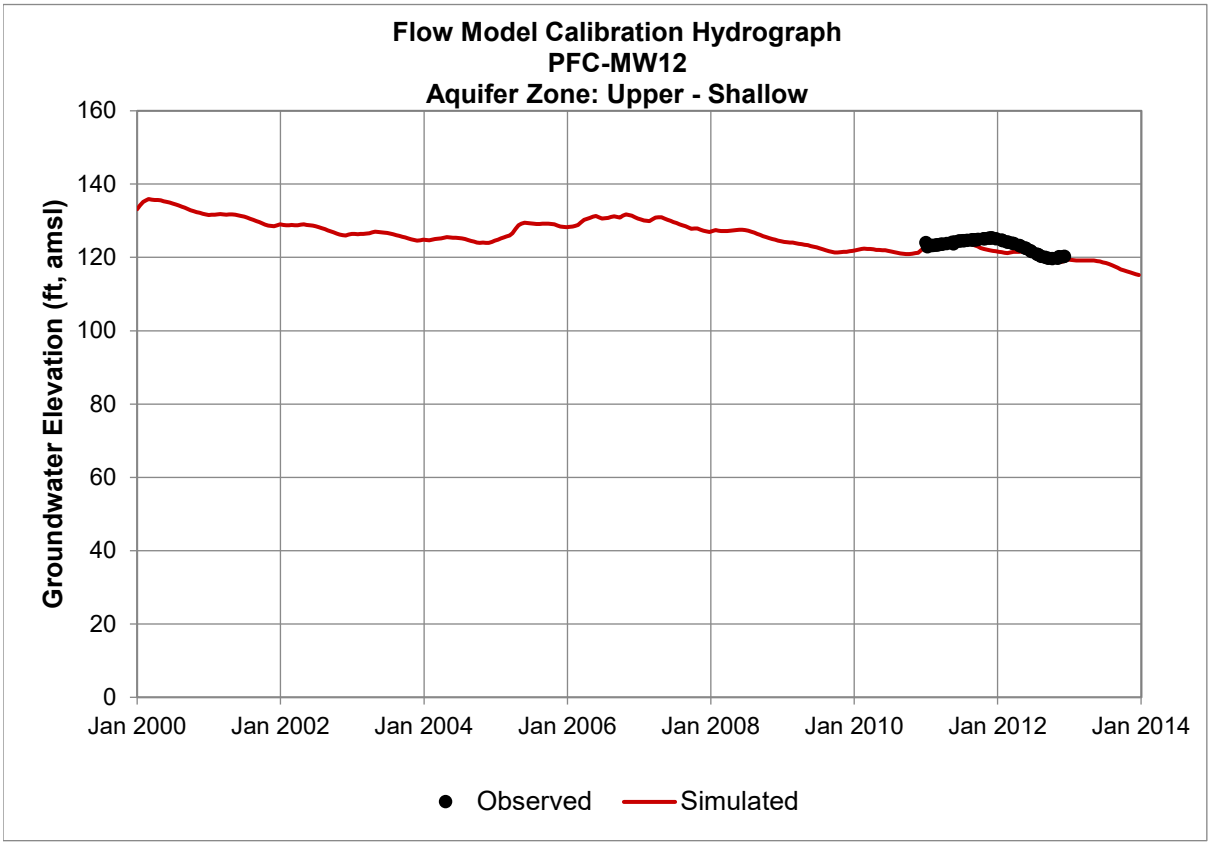
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-MW12
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
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Jan 2000
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Jan 2006
Jan 2008
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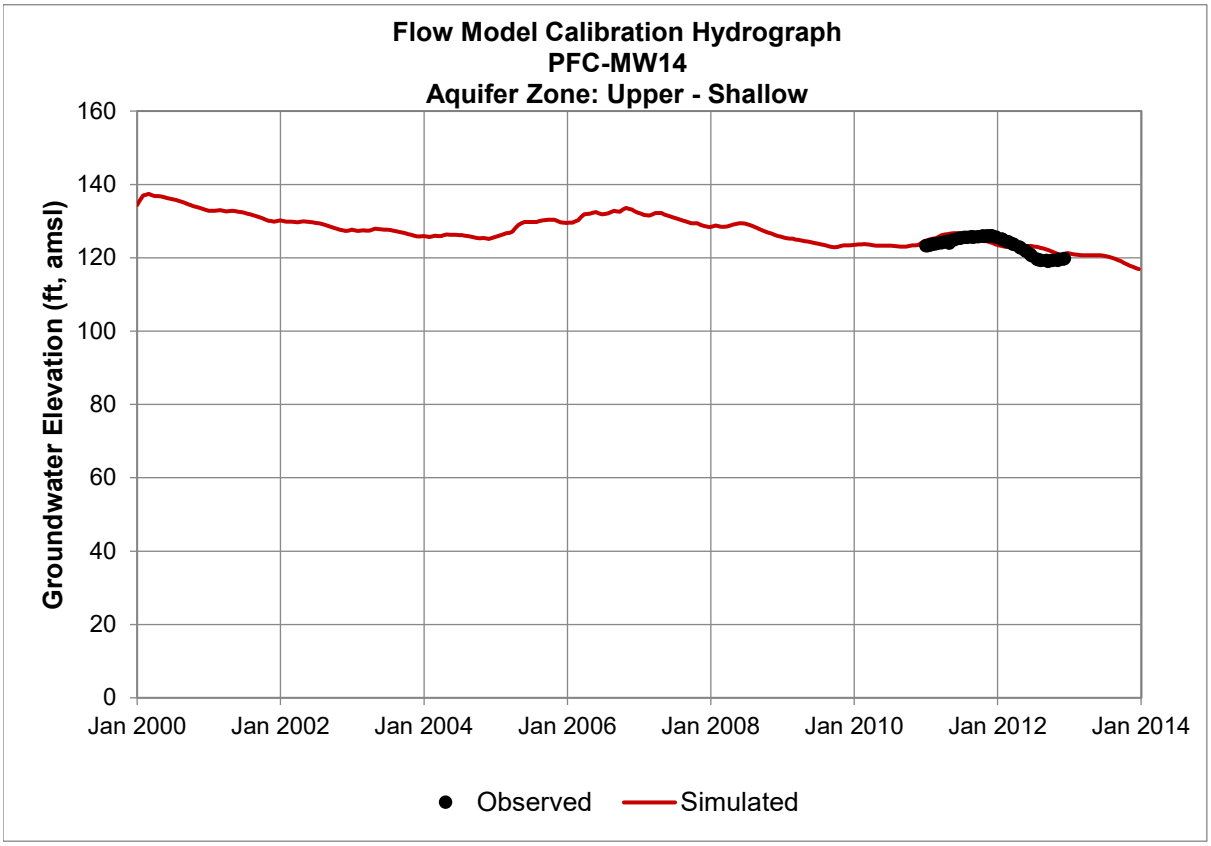
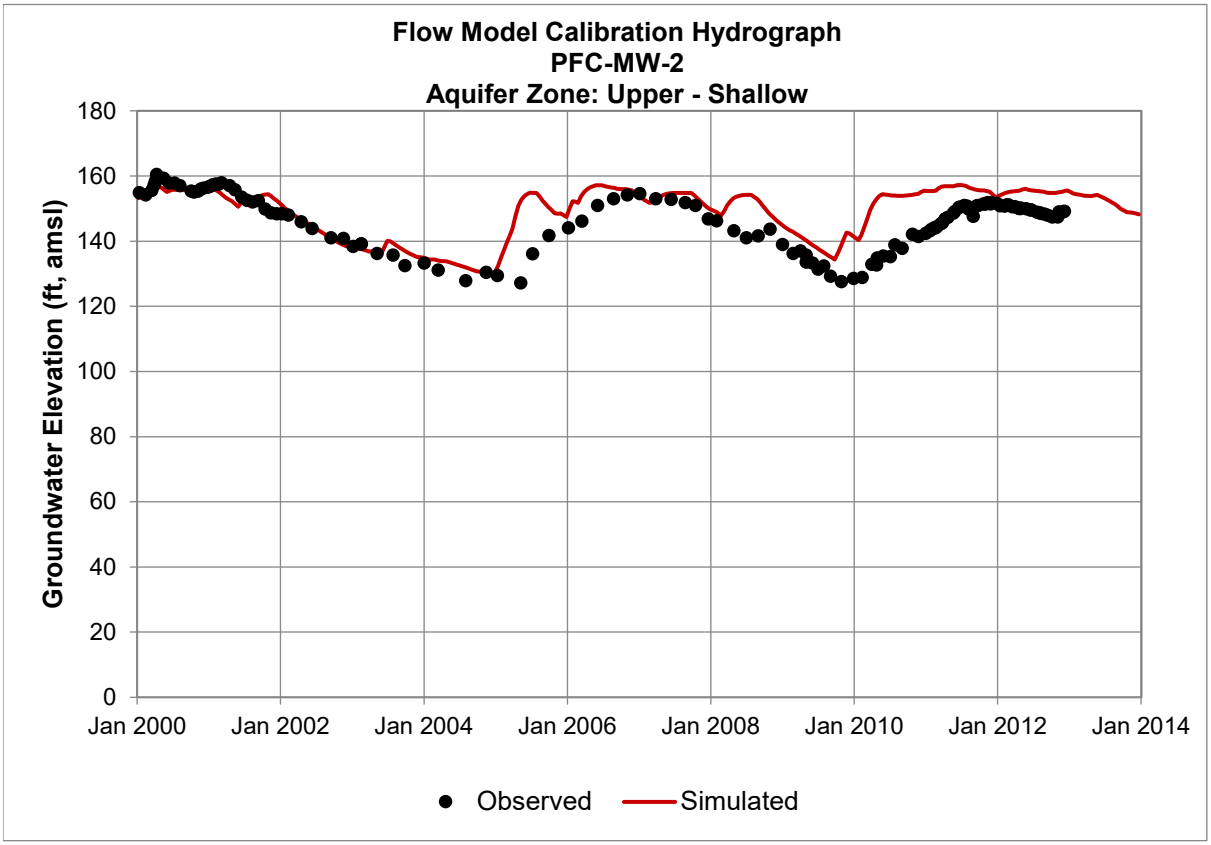
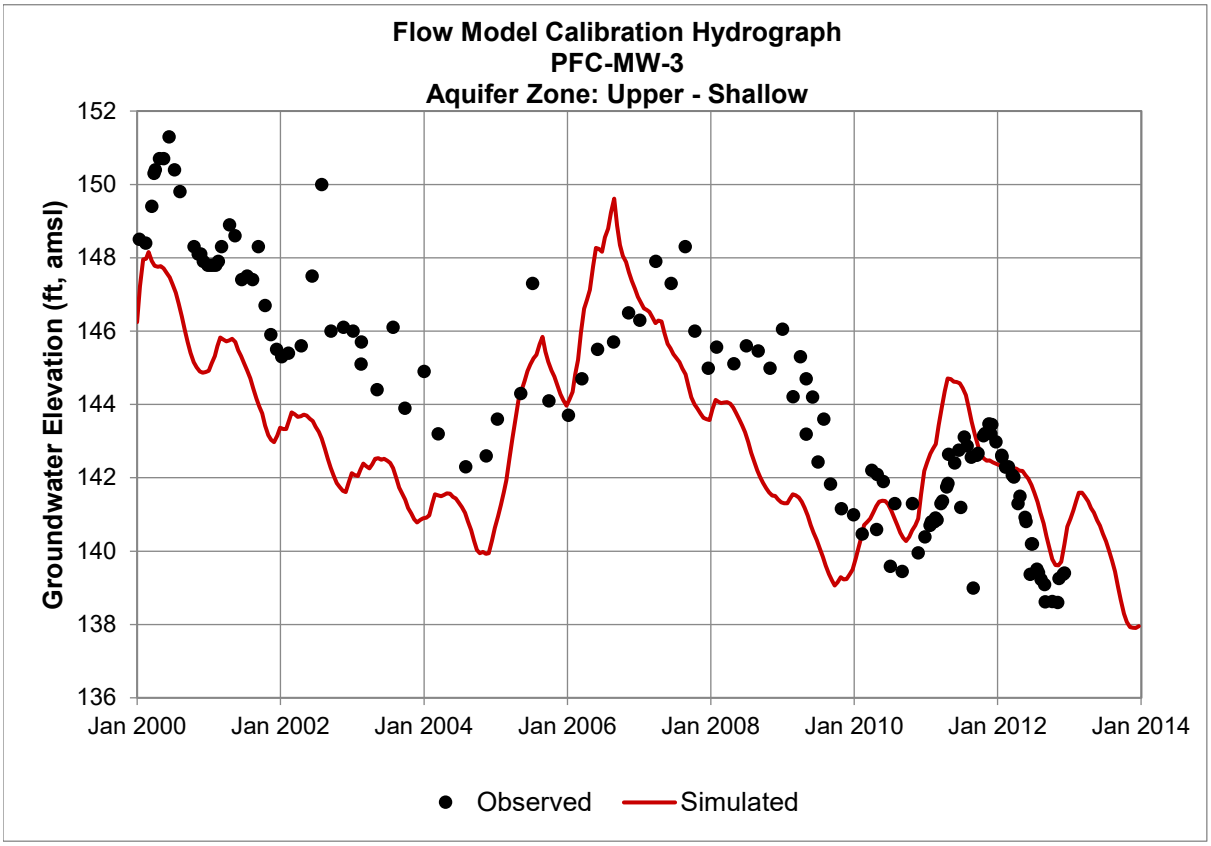
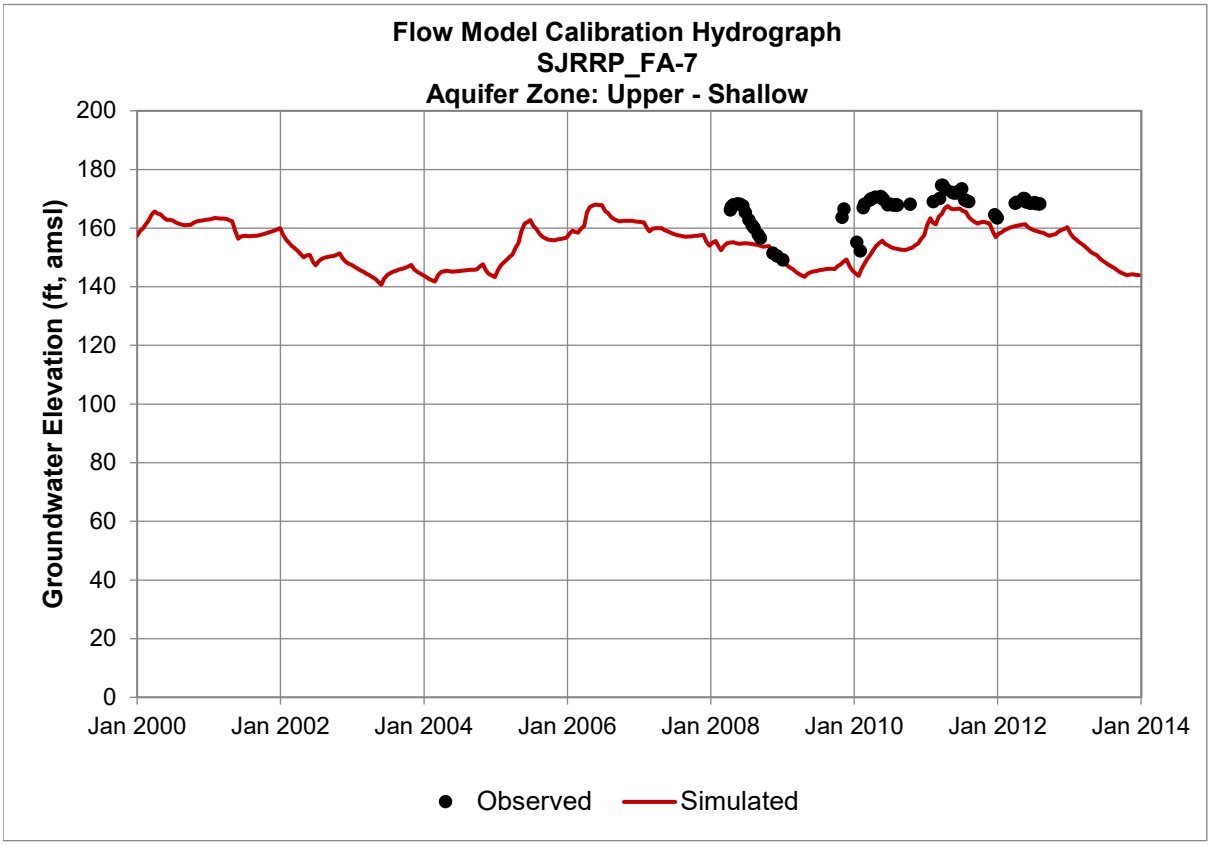
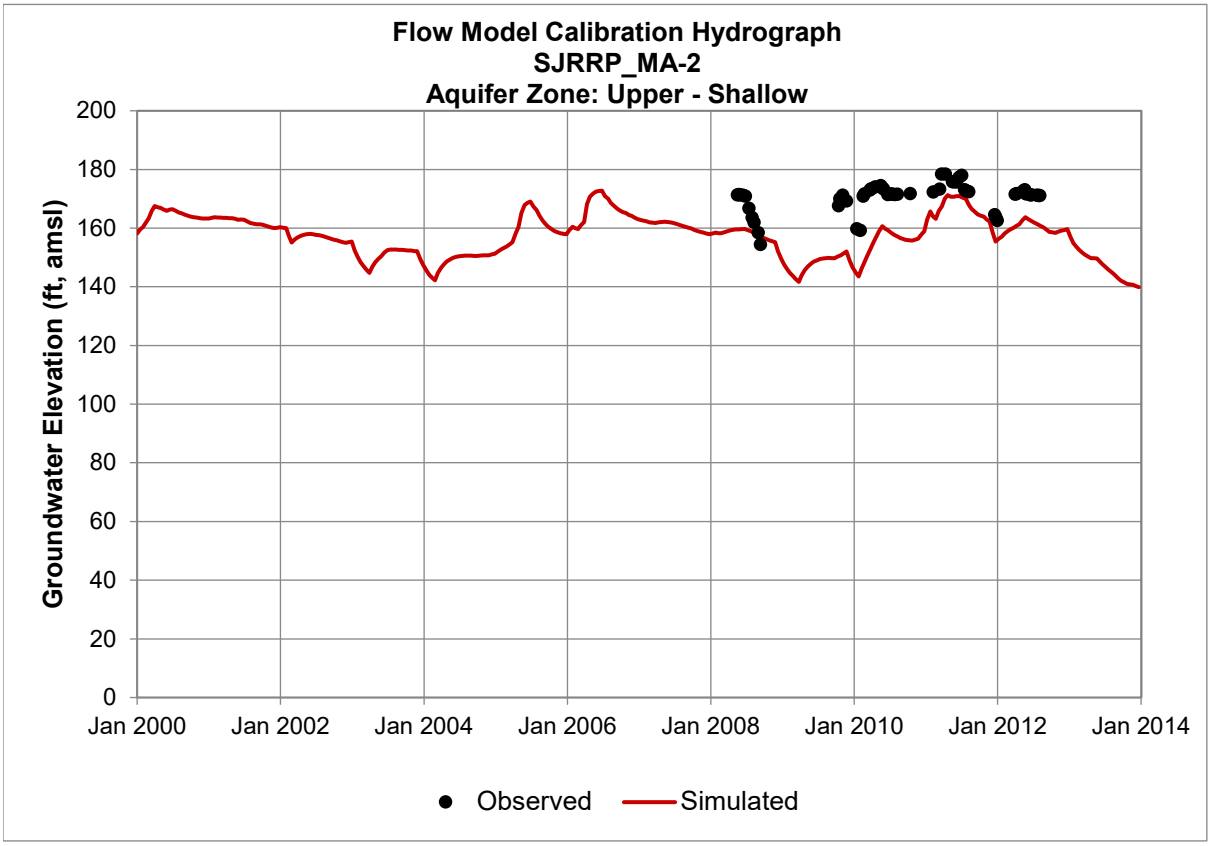
Jan 2012
Jan 2014
Observed
Simulated

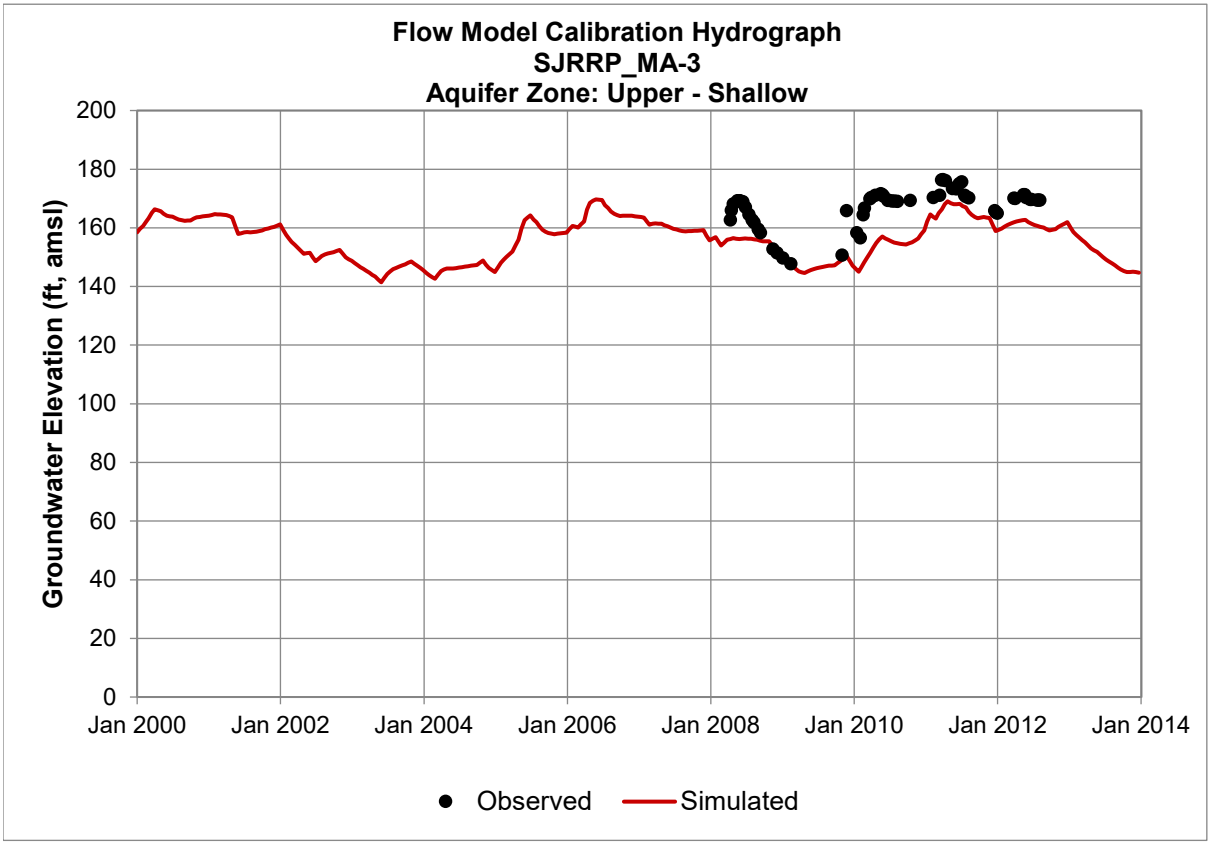

Flow Model Calibration Hydrograph
PFC-MW14
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

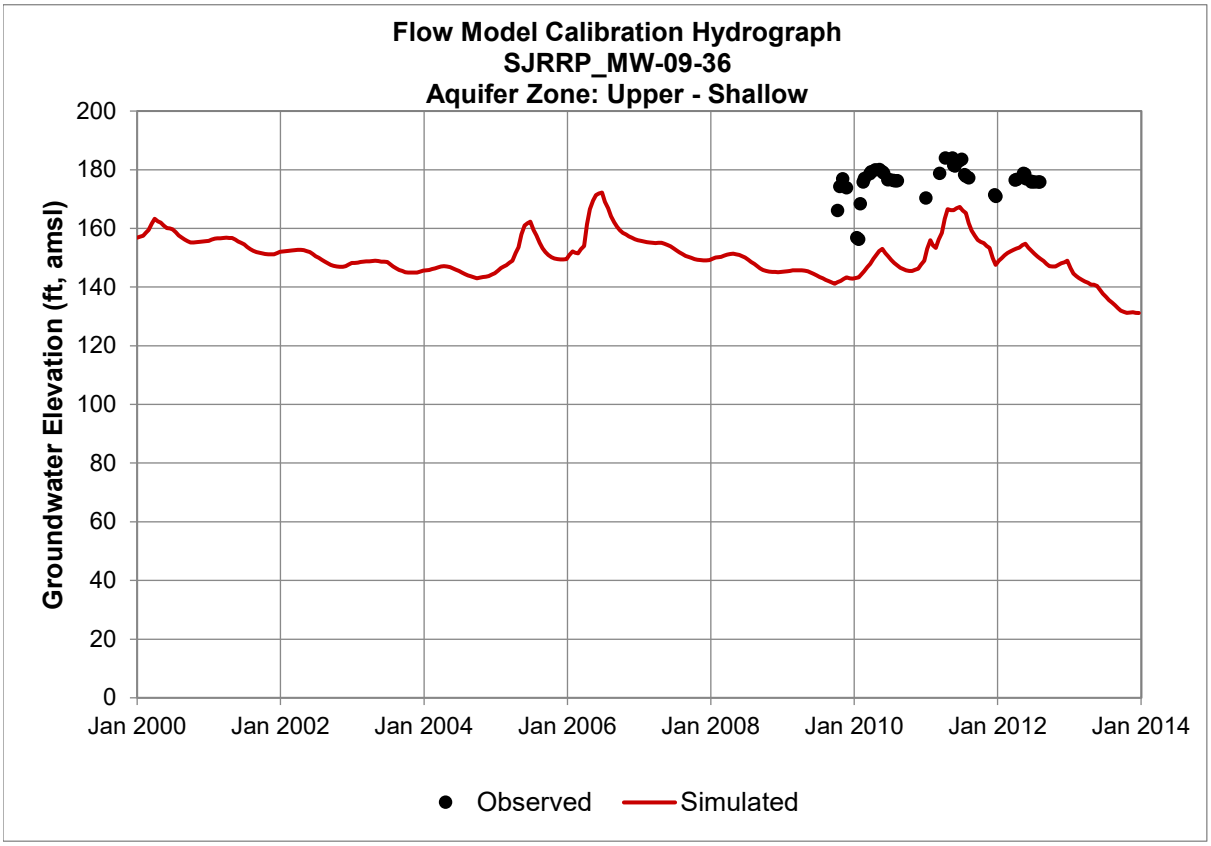

Flow Model Calibration Hydrograph
PFC-MW-2
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

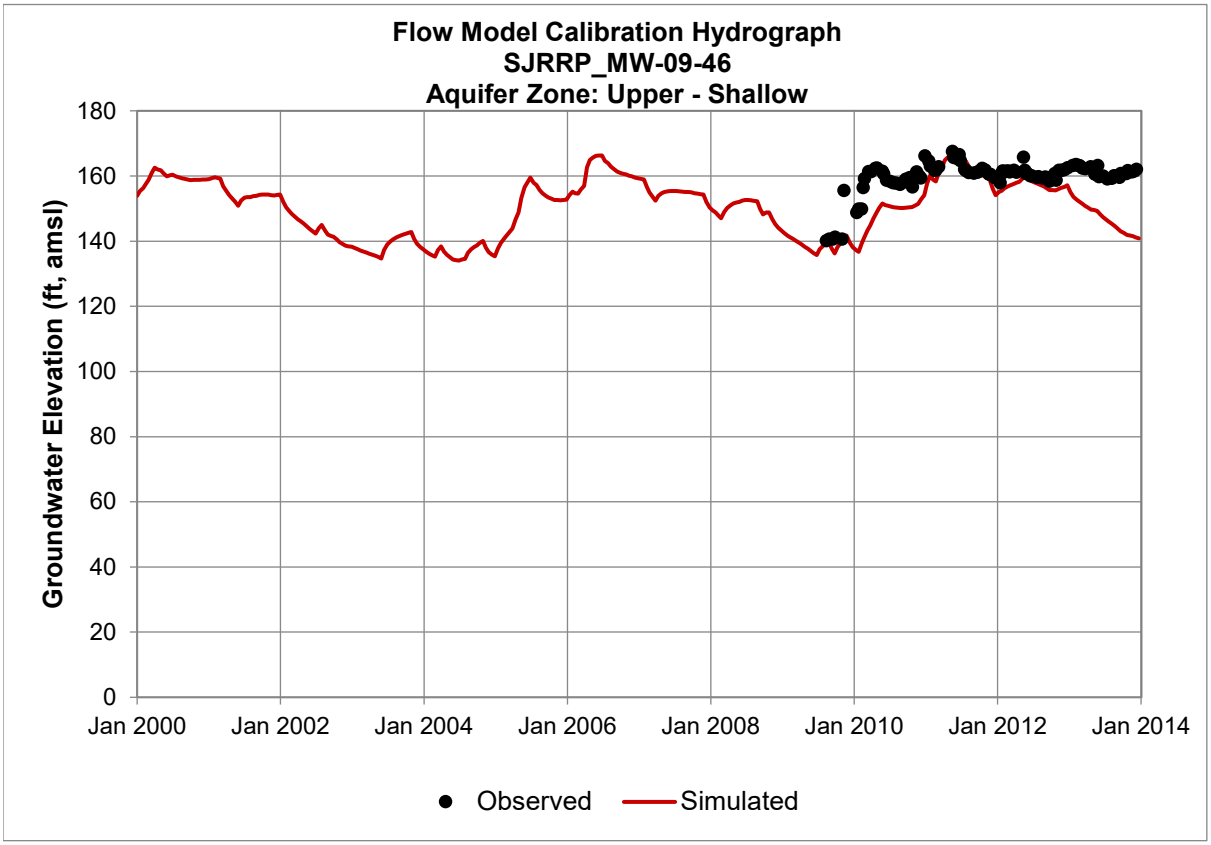

Flow Model Calibration Hydrograph
PFC-MW-3
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
152
150
148
146
144
142
140
138
136
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

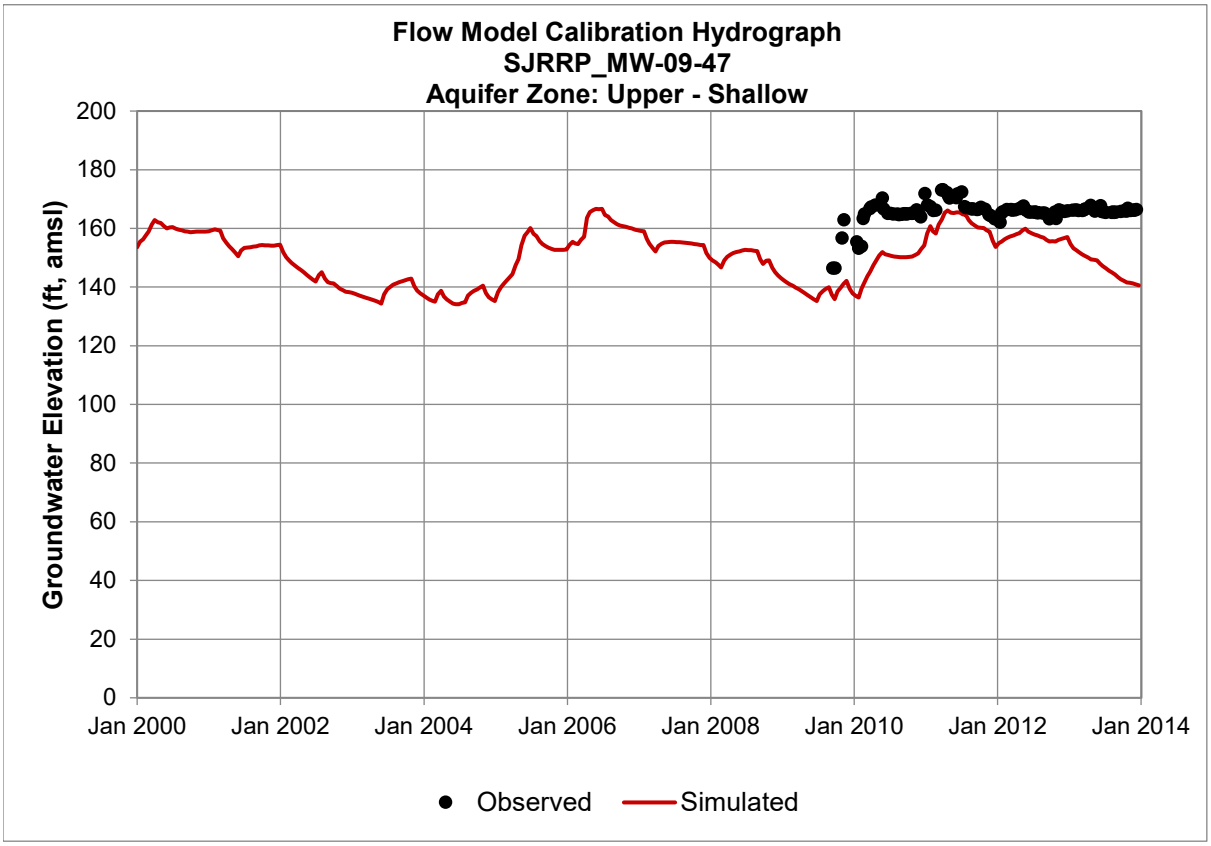

Flow Model Calibration Hydrograph
SJRRP_FA-7
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
200
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

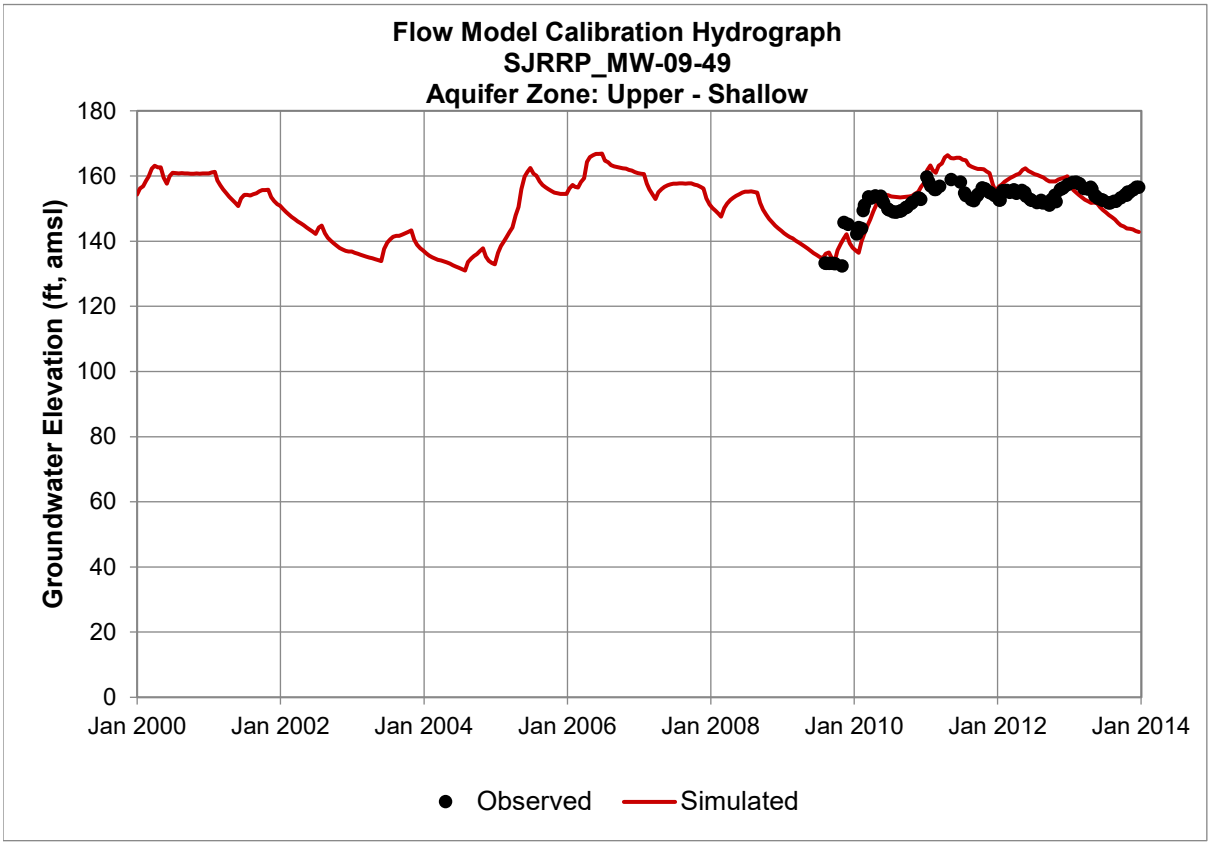

Flow Model Calibration Hydrograph
SJRRP_MA-2
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
200
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

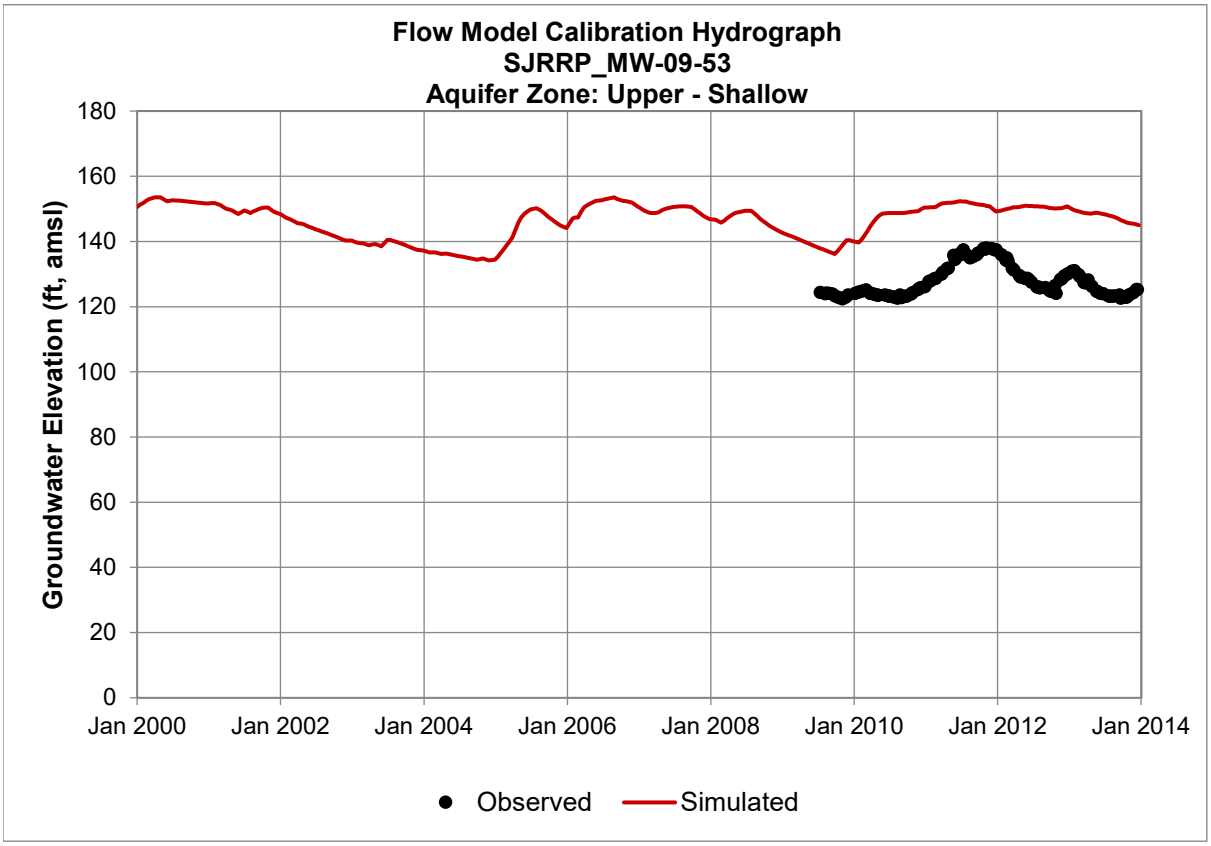

Flow Model Calibration Hydrograph
SJRRP_MA-3
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
200
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

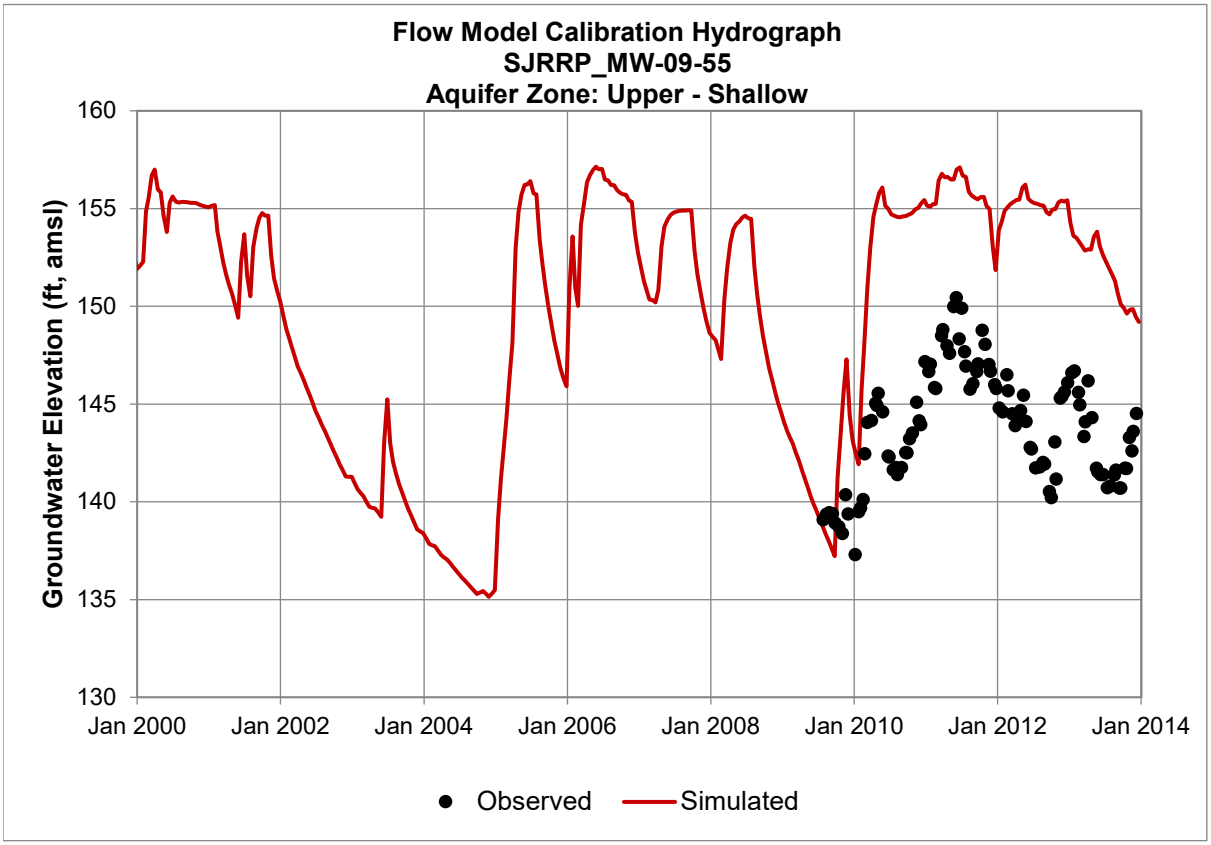

Flow Model Calibration Hydrograph
SJRRP_MW-09-36
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
200
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

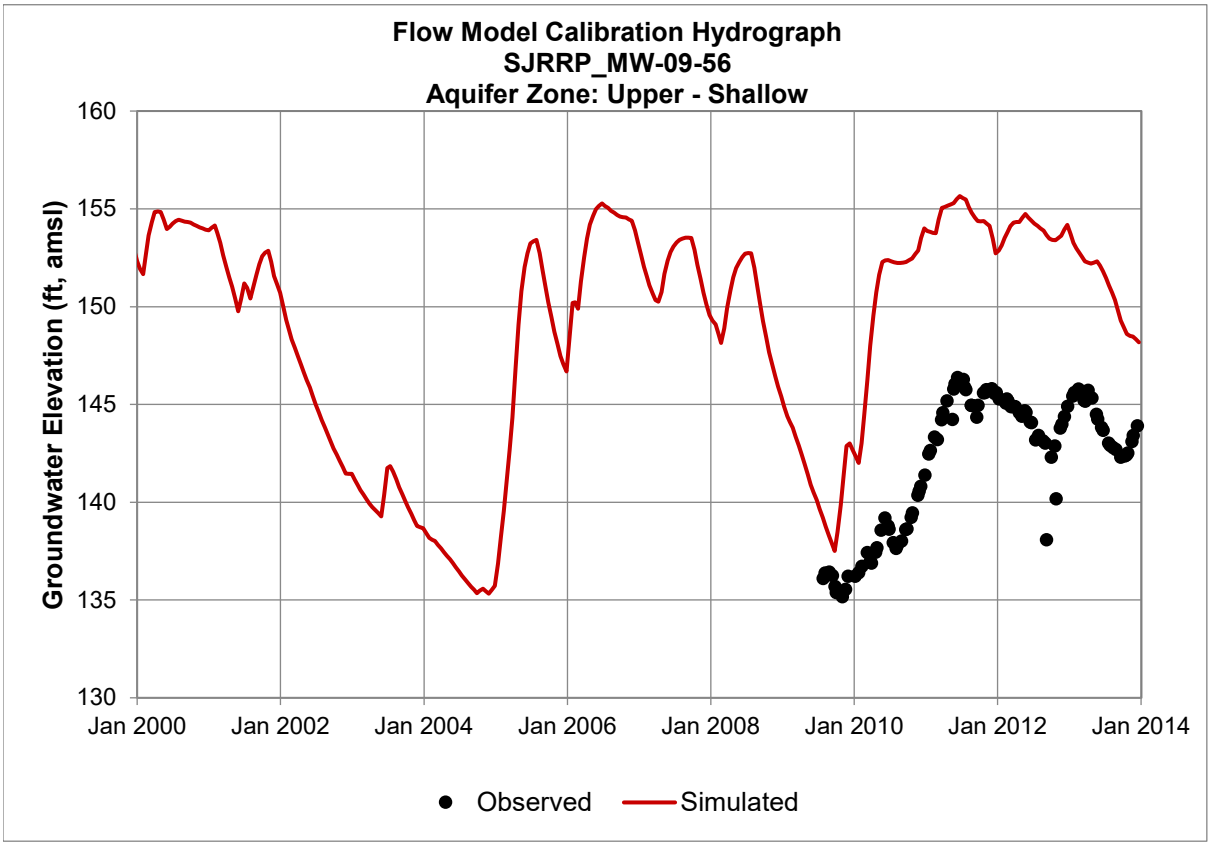

Flow Model Calibration Hydrograph
SJRRP_MW-09-46
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

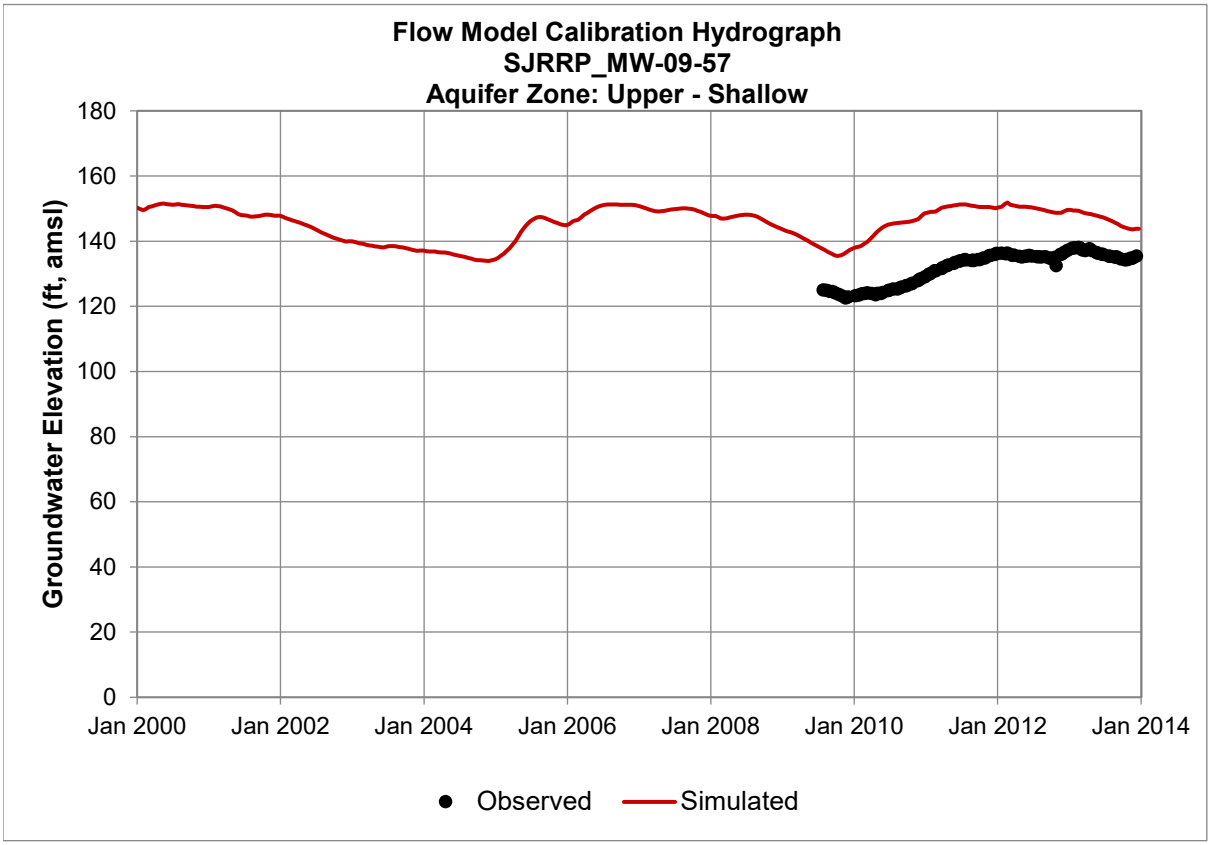

Flow Model Calibration Hydrograph
SJRRP_MW-09-47
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
200
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

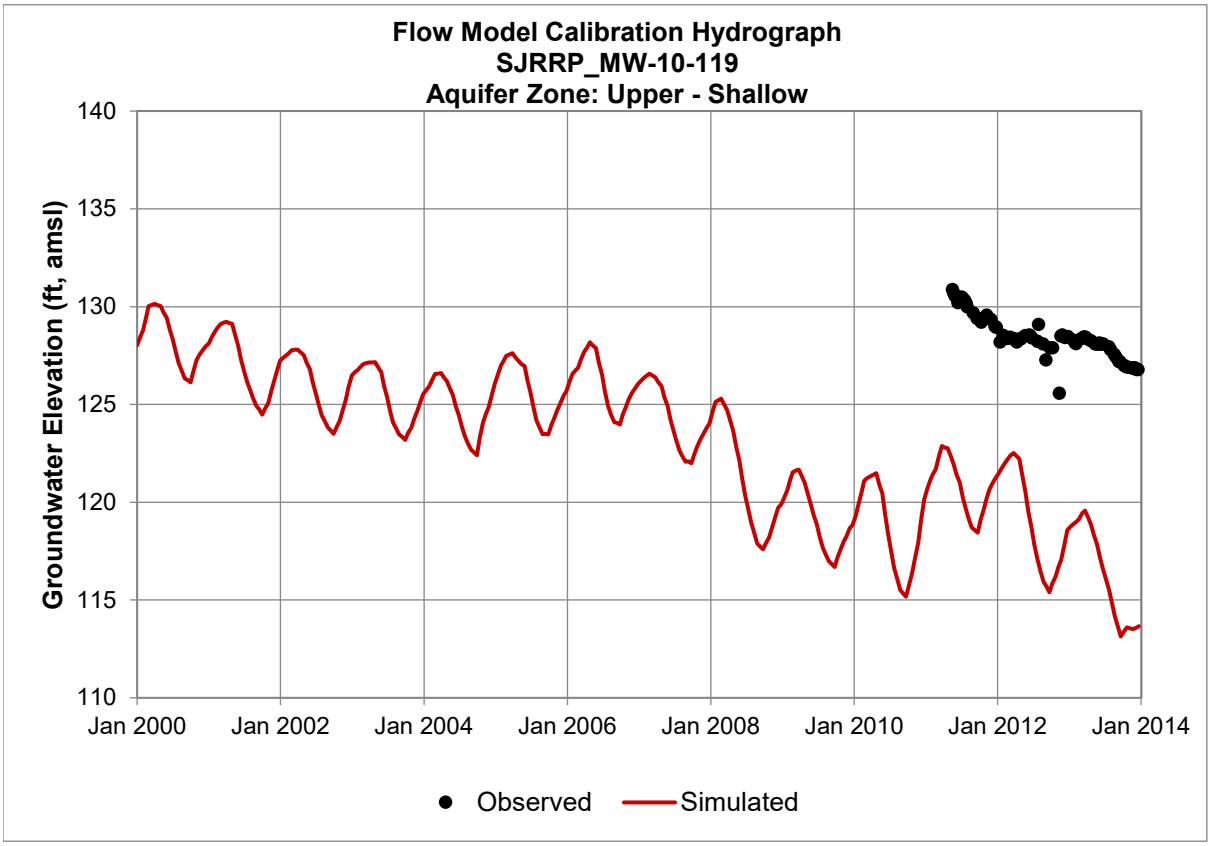

Flow Model Calibration Hydrograph
SJRRP_MW-09-49
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

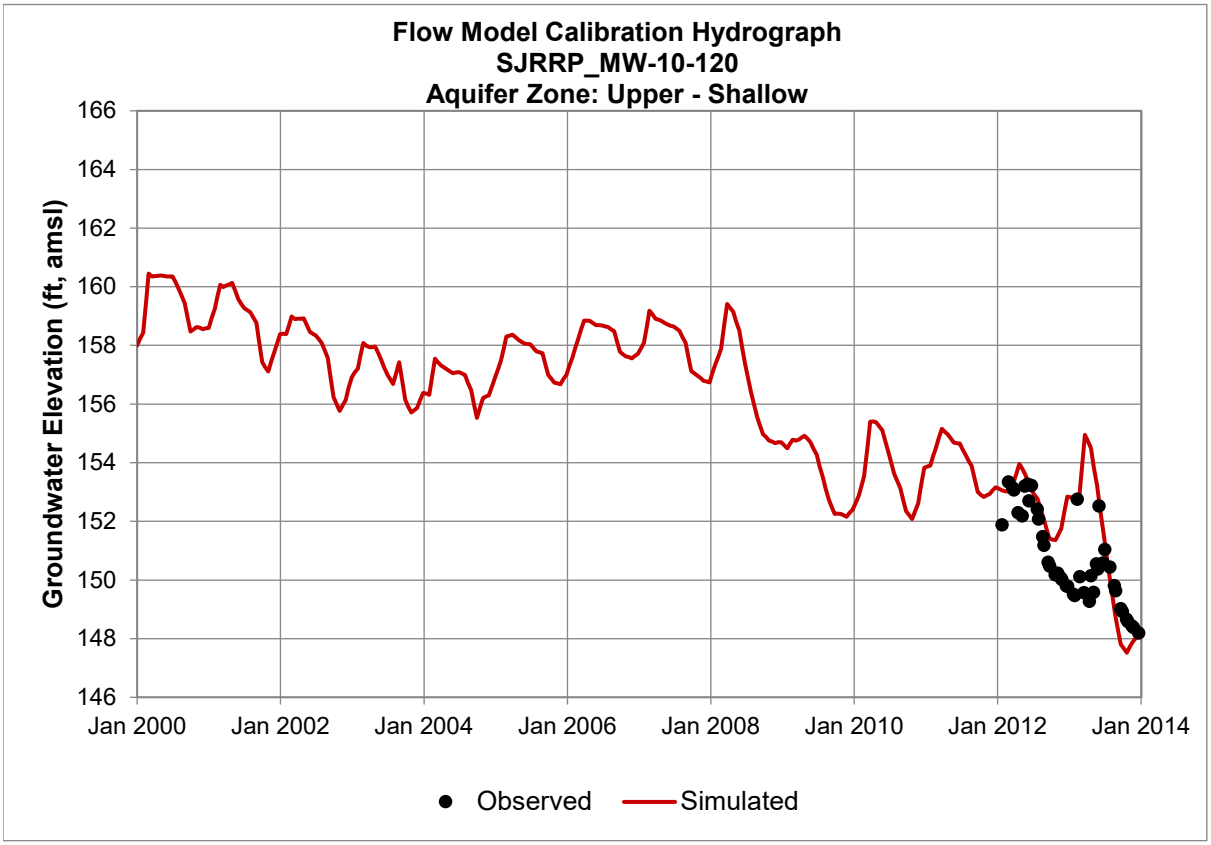

Flow Model Calibration Hydrograph
SJRRP_MW-09-53
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

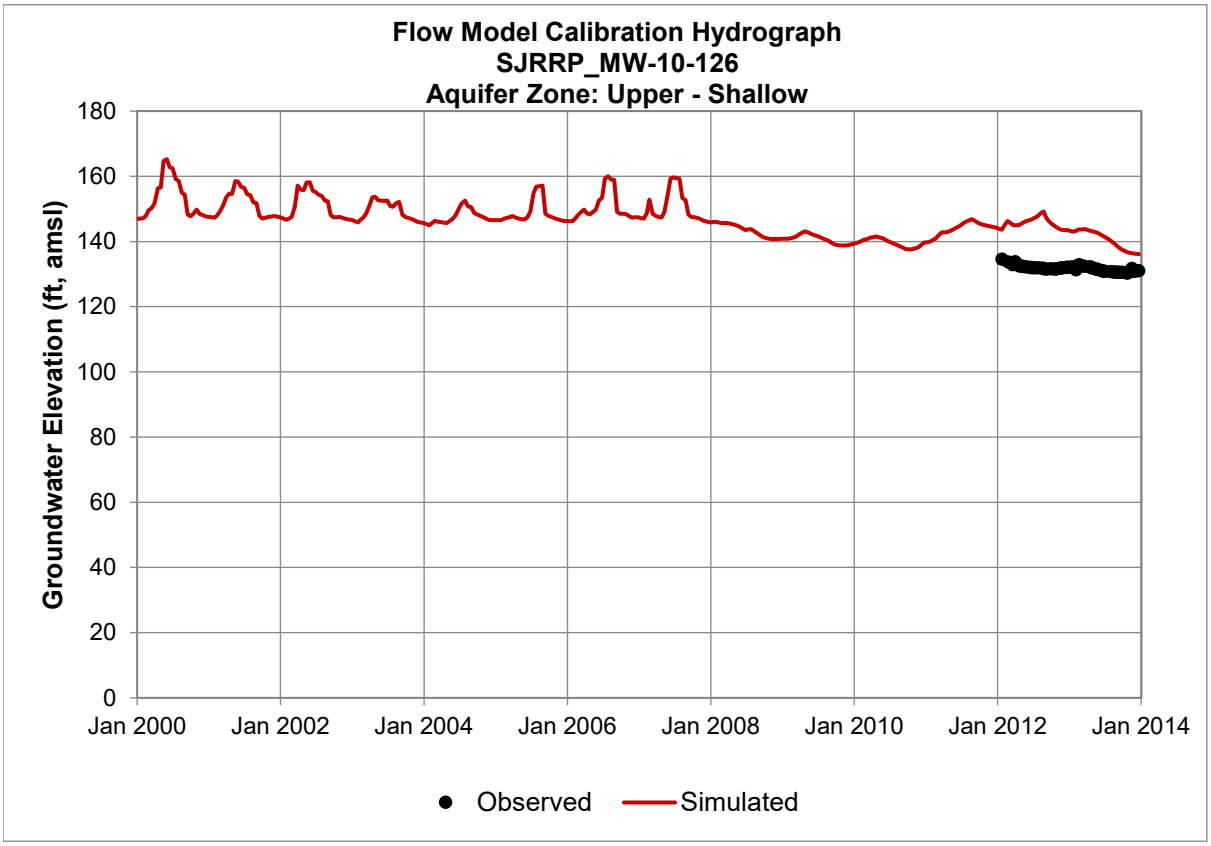

Flow Model Calibration Hydrograph
SJRRP_MW-09-55
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
160
155
150
145
140
135
130
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

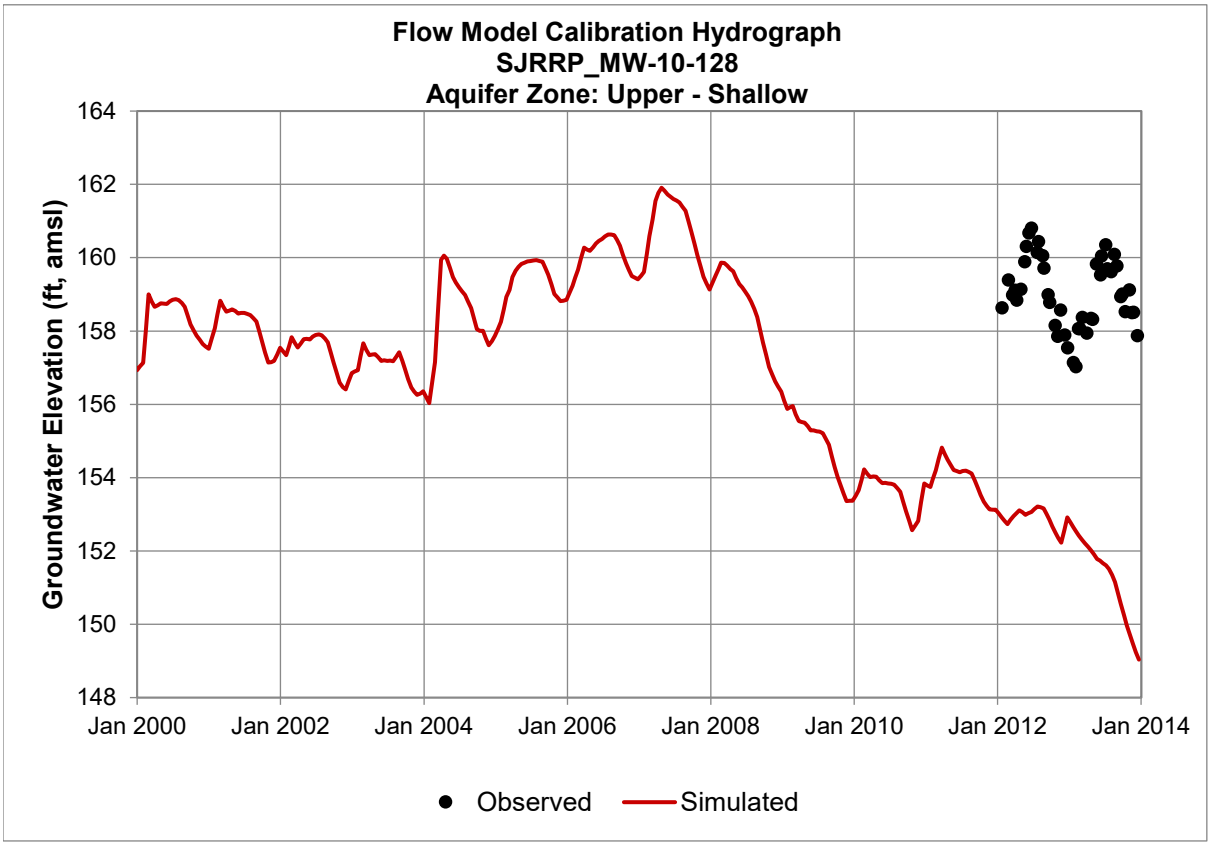

Flow Model Calibration Hydrograph
SJRRP_MW-09-56
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
160
155
150
145
140
135
130
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

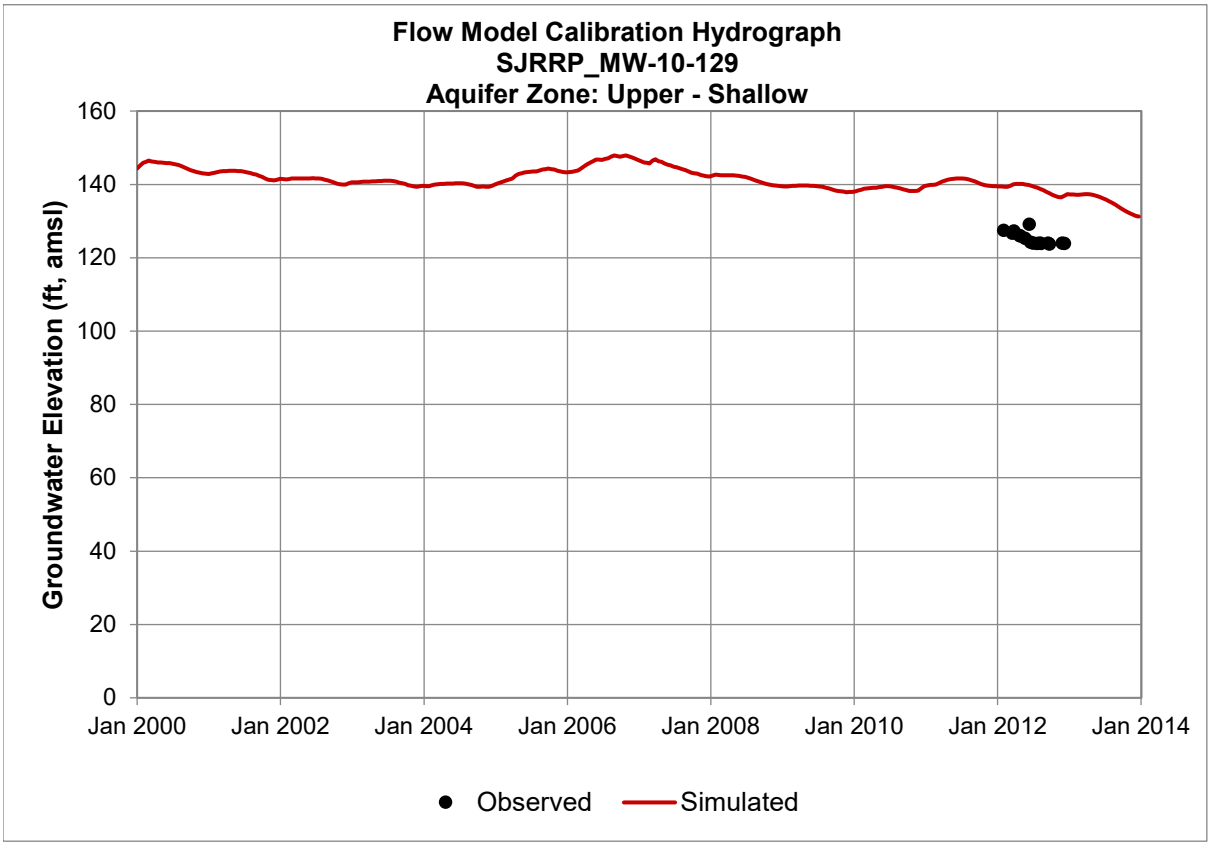

Flow Model Calibration Hydrograph
SJRRP_MW-09-57
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

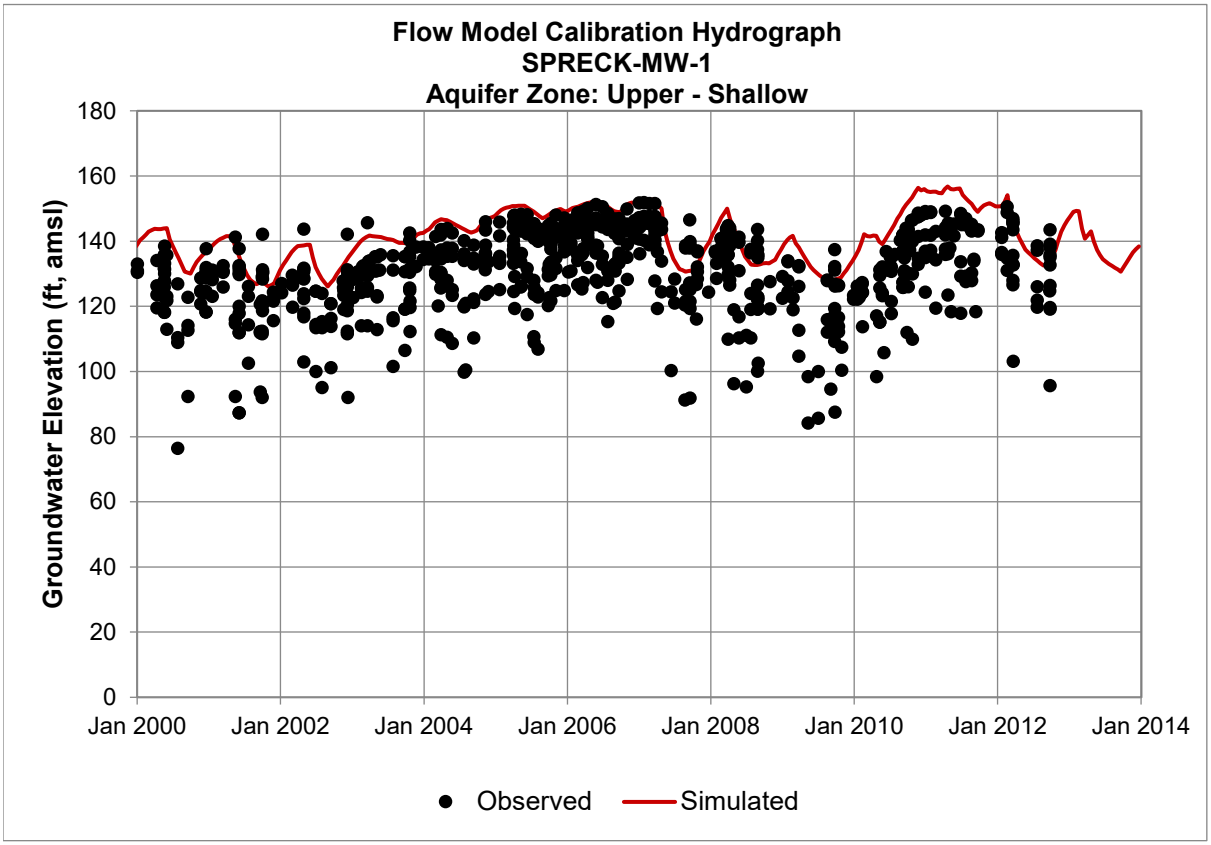

Flow Model Calibration Hydrograph
SJRRP_MW-10-119
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
140
135
130
125
120
115
110
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

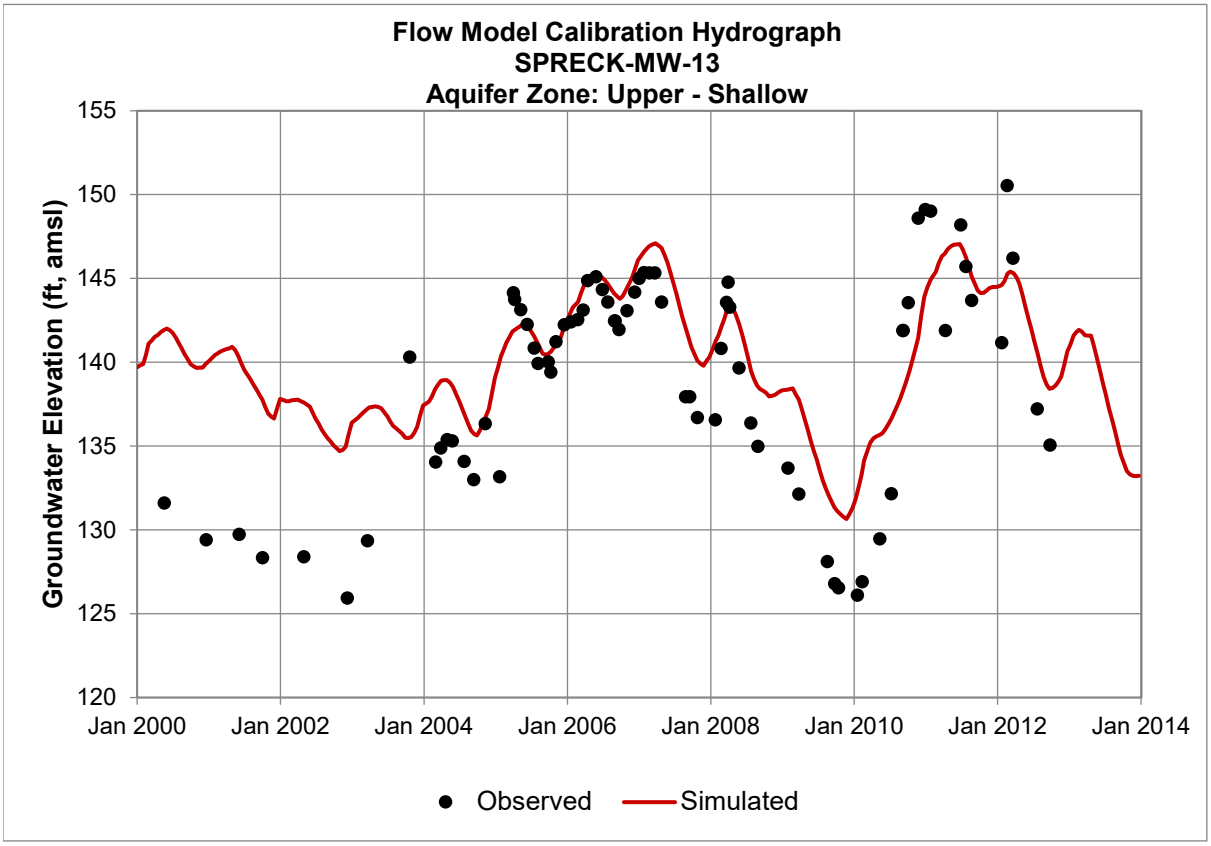

Flow Model Calibration Hydrograph
SJRRP_MW-10-120
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
166
164
162
160
158
156
154
152
150
148
146
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

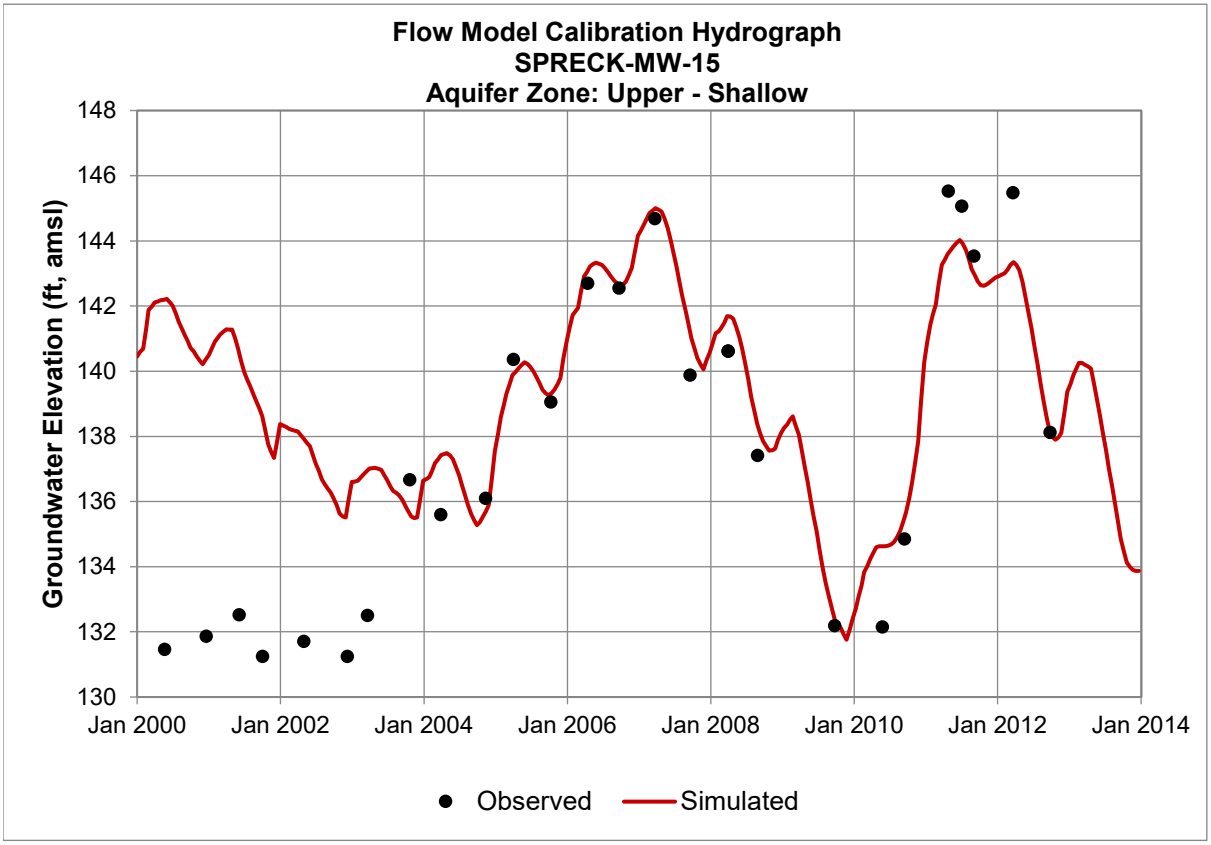

Flow Model Calibration Hydrograph
SJRRP_MW-10-126
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

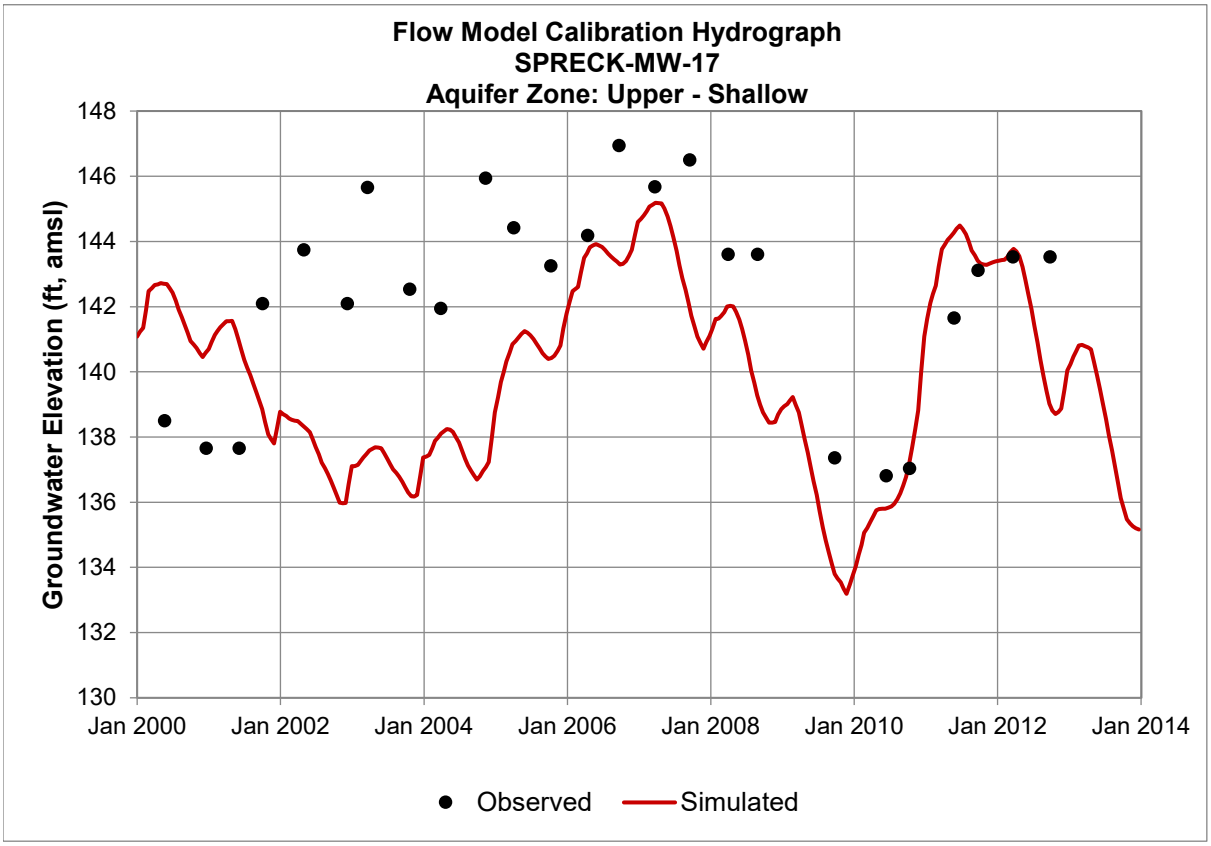

Flow Model Calibration Hydrograph
SJRRP_MW-10-128
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
164
162
160
158
156
154
152
150
148
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

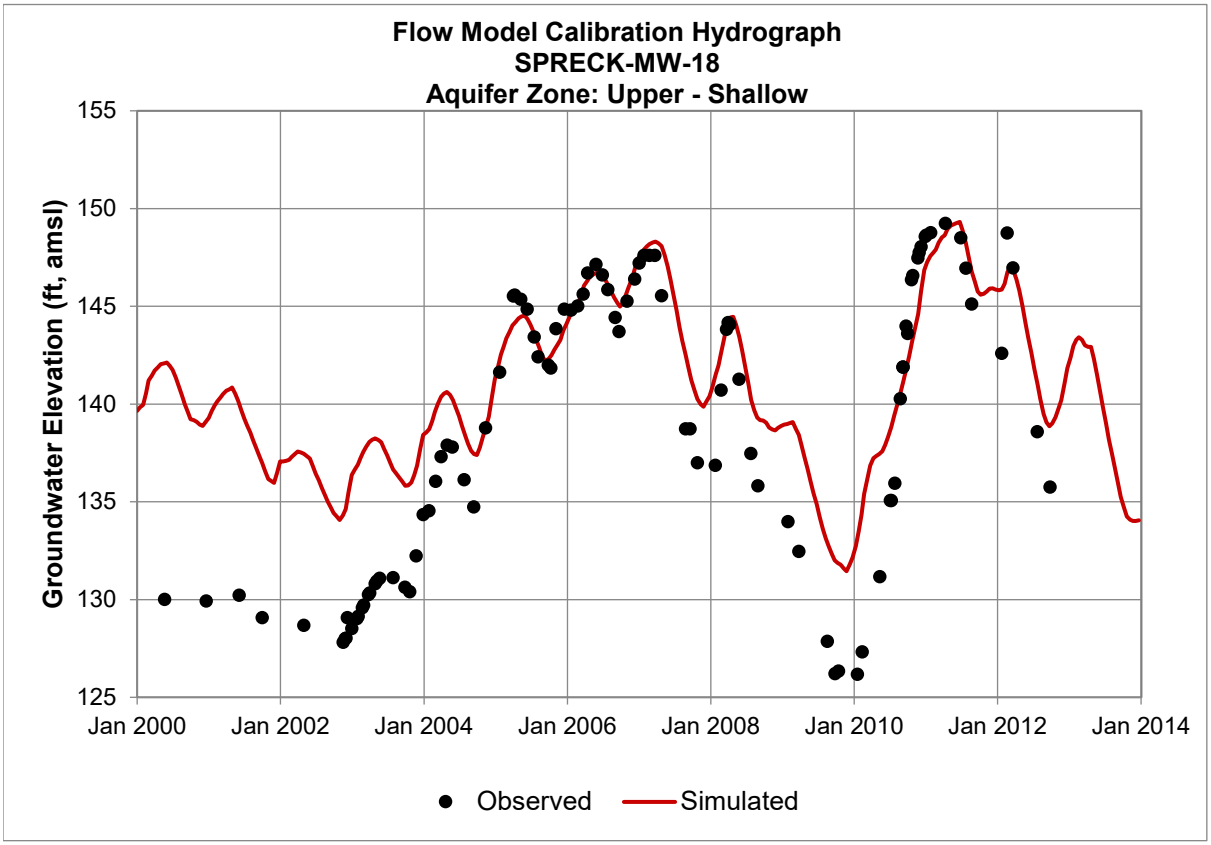

Flow Model Calibration Hydrograph
SJRRP_MW-10-129
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

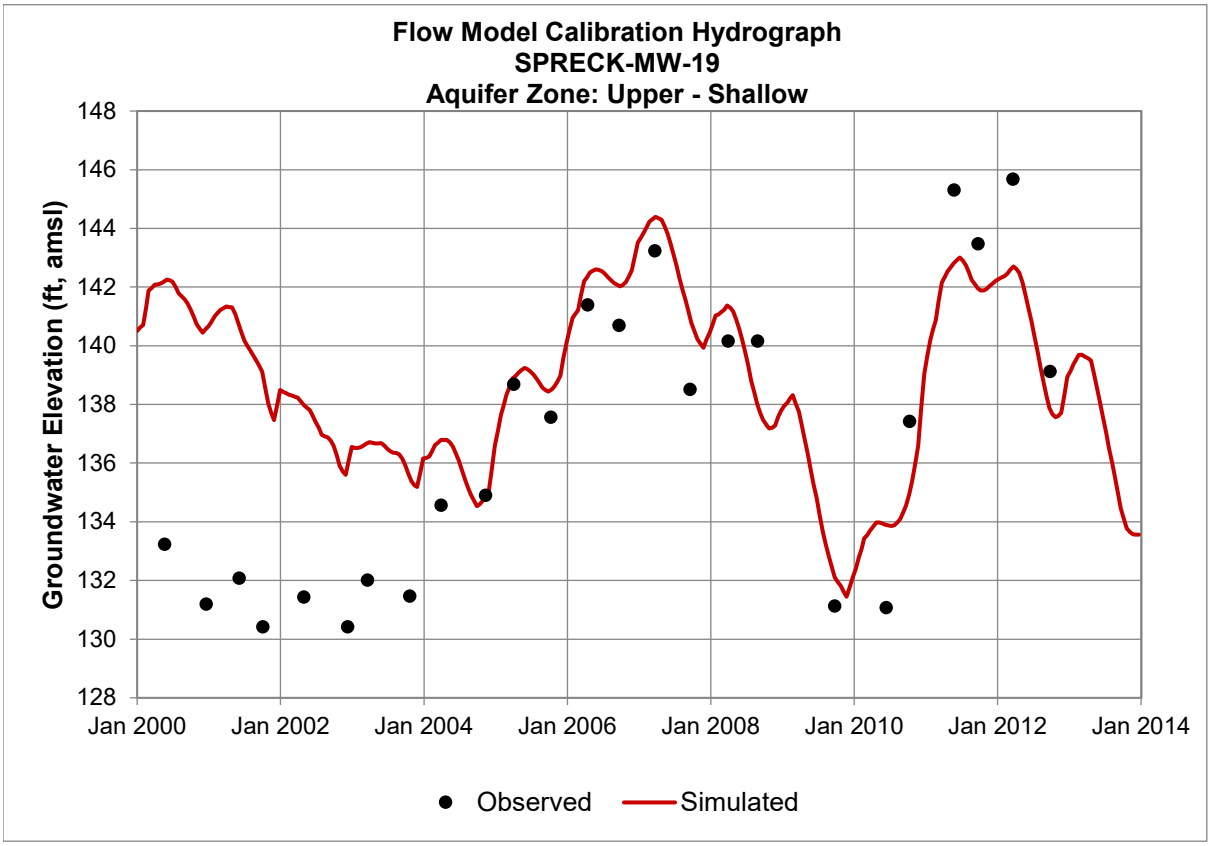

Flow Model Calibration Hydrograph
SPRECK-MW-1
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

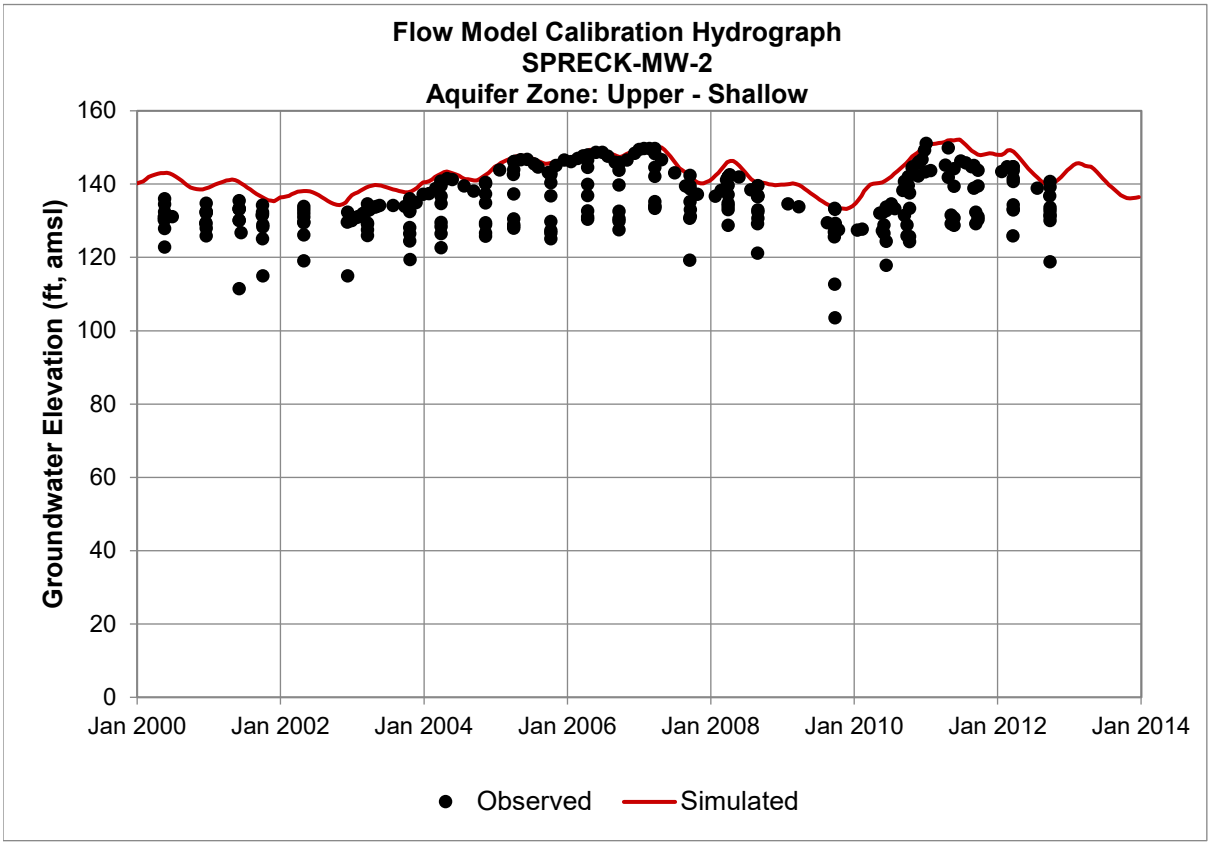

Flow Model Calibration Hydrograph
SPRECK-MW-13
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
155
150
145
140
135
130
125
120
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

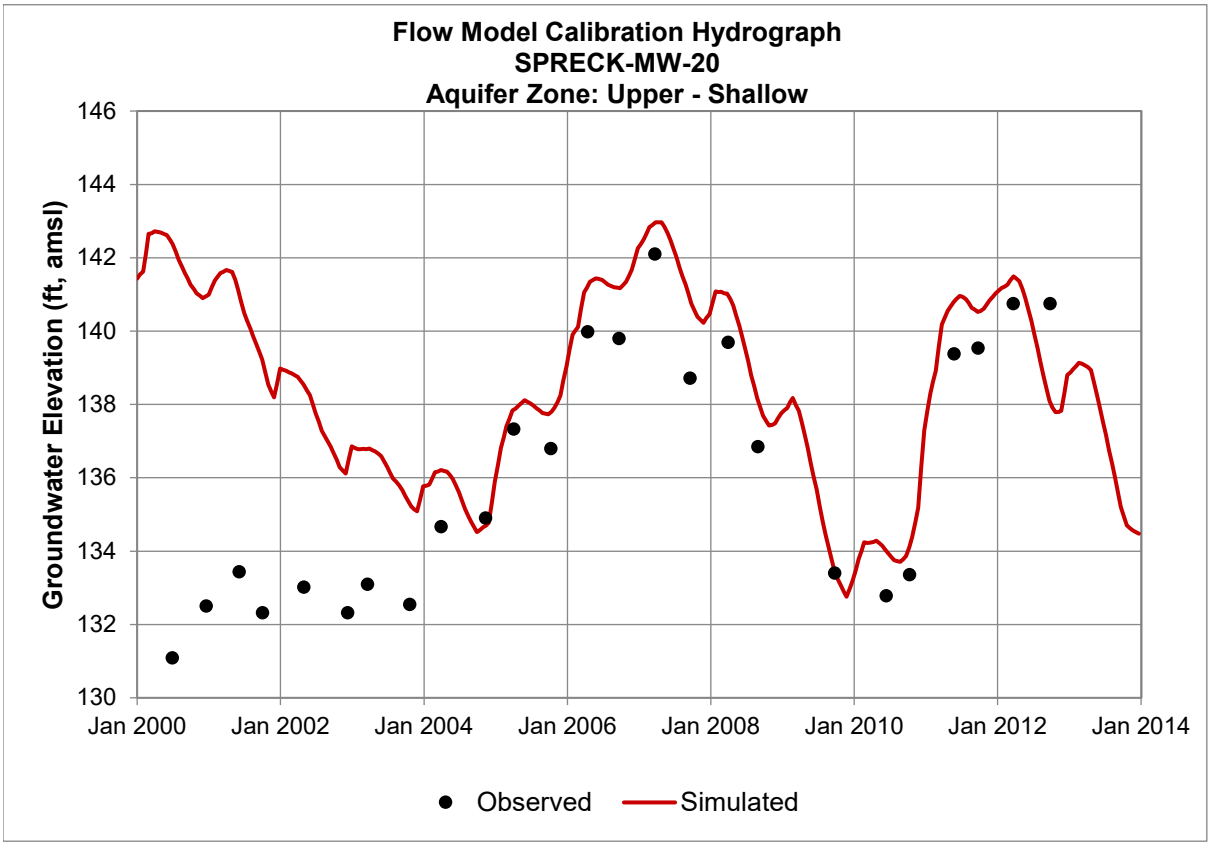

Flow Model Calibration Hydrograph
SPRECK-MW-15
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
148
146
144
142
140
138
136
134
132
130
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

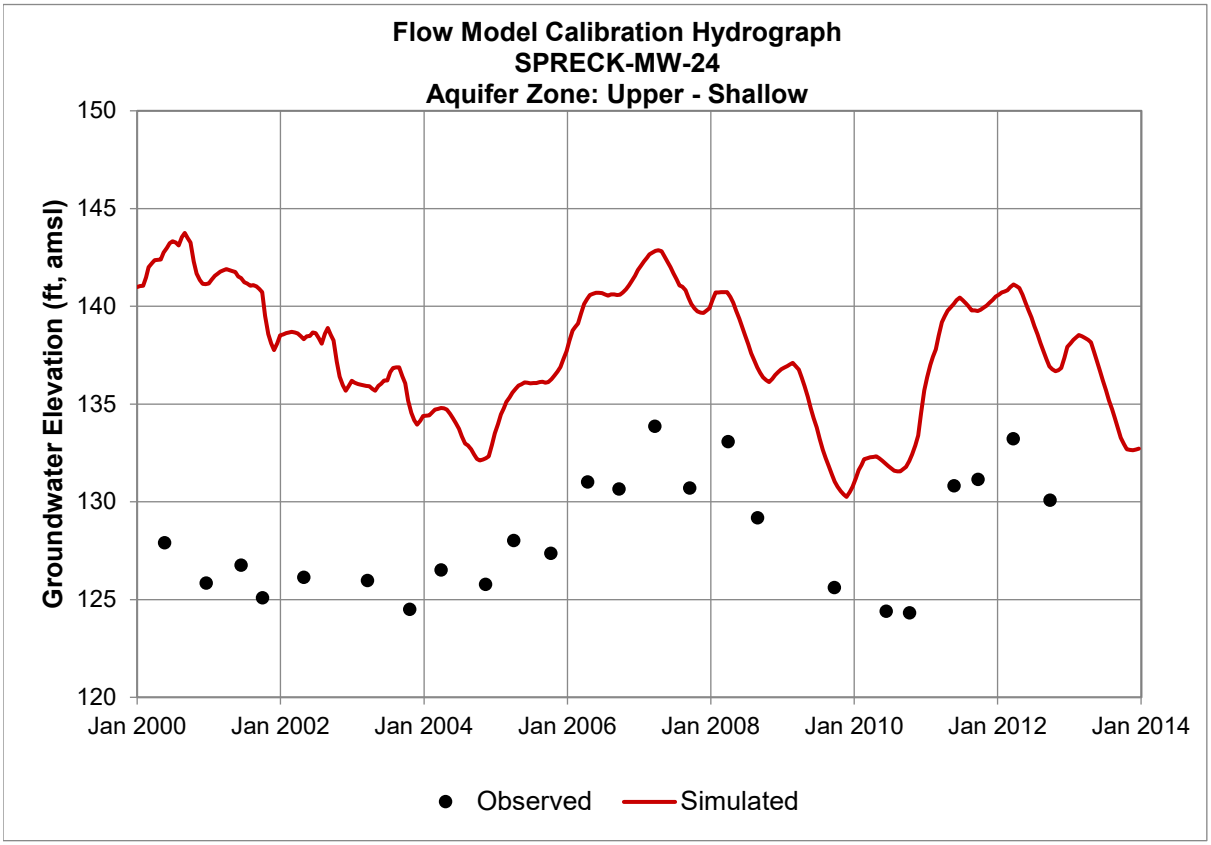

Flow Model Calibration Hydrograph
SPRECK-MW-17
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
148
146
144
142
140
138
136
134
132
130
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

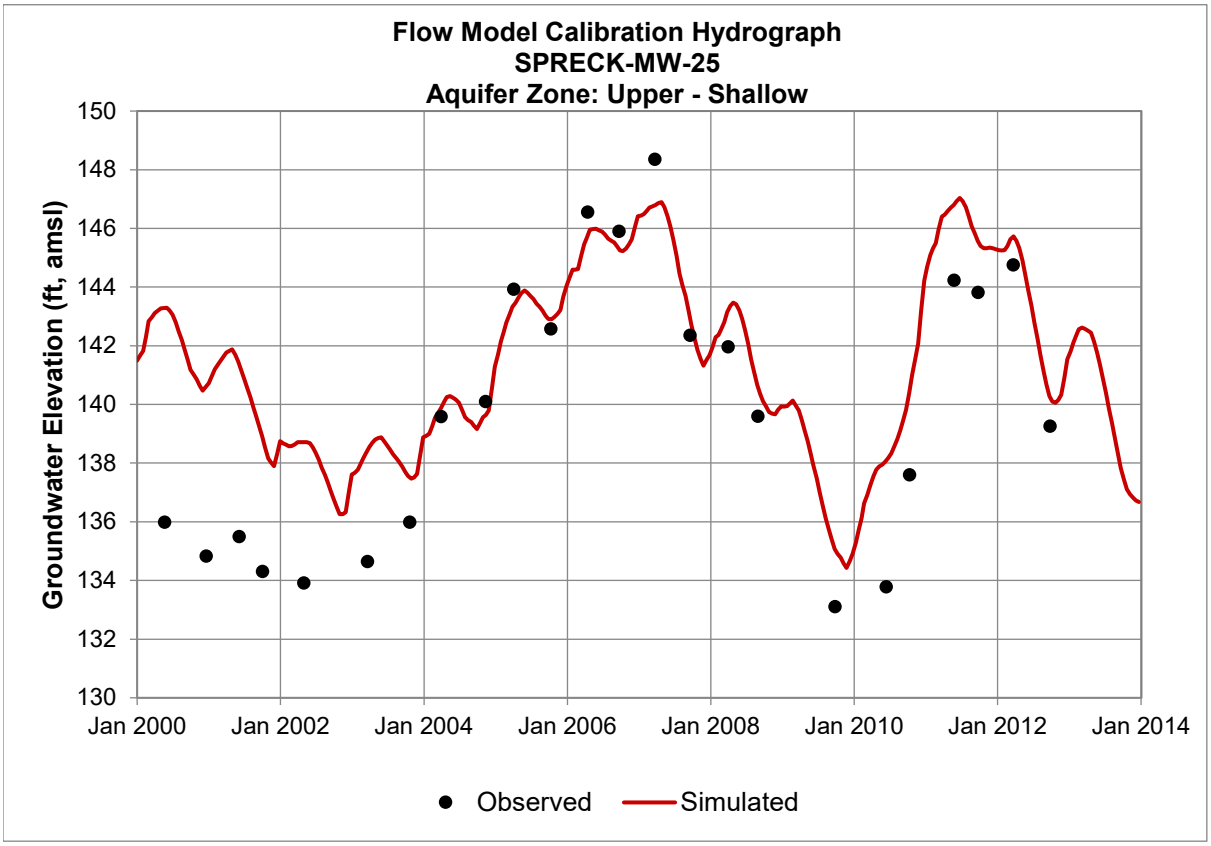

Flow Model Calibration Hydrograph
SPRECK-MW-18
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
155
150
145
140
135
130
125
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

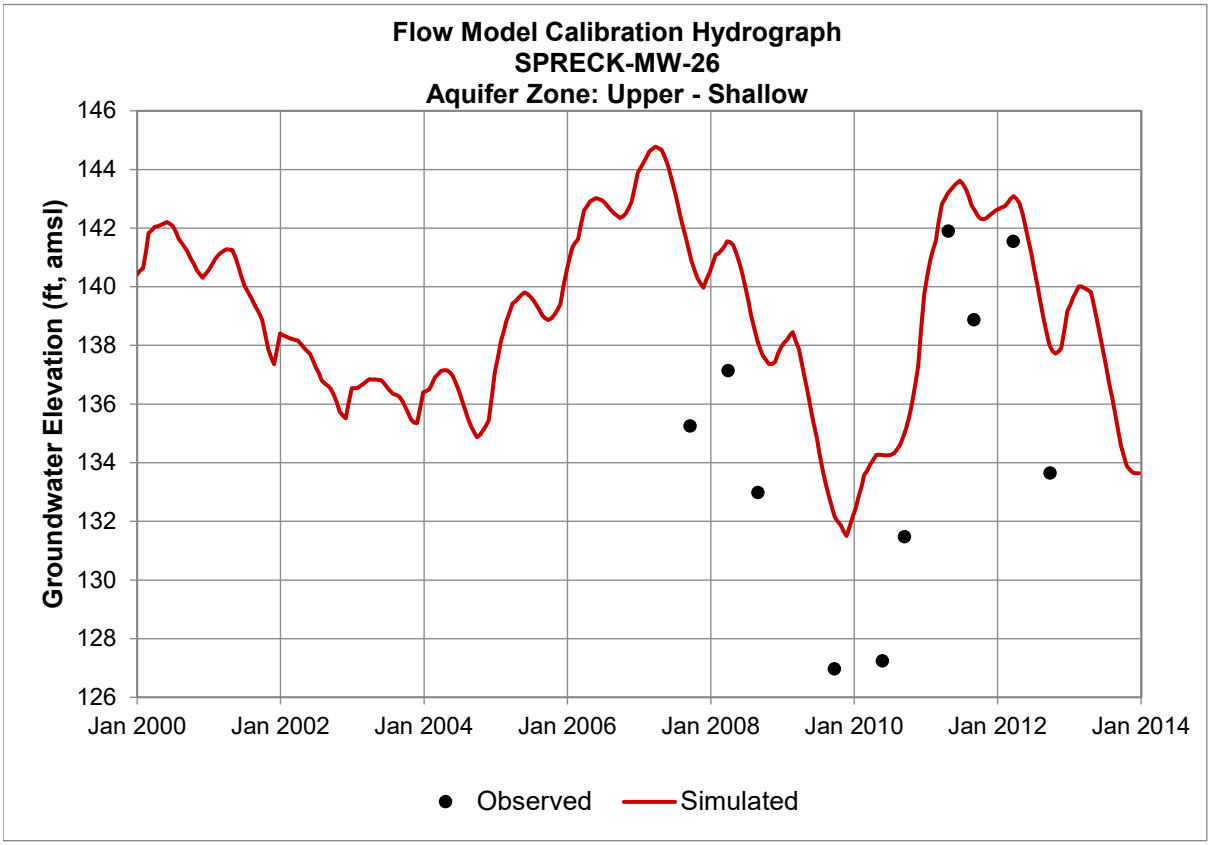

Flow Model Calibration Hydrograph
SPRECK-MW-19
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
148
146
144
142
140
138
136
134
132
130
128
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

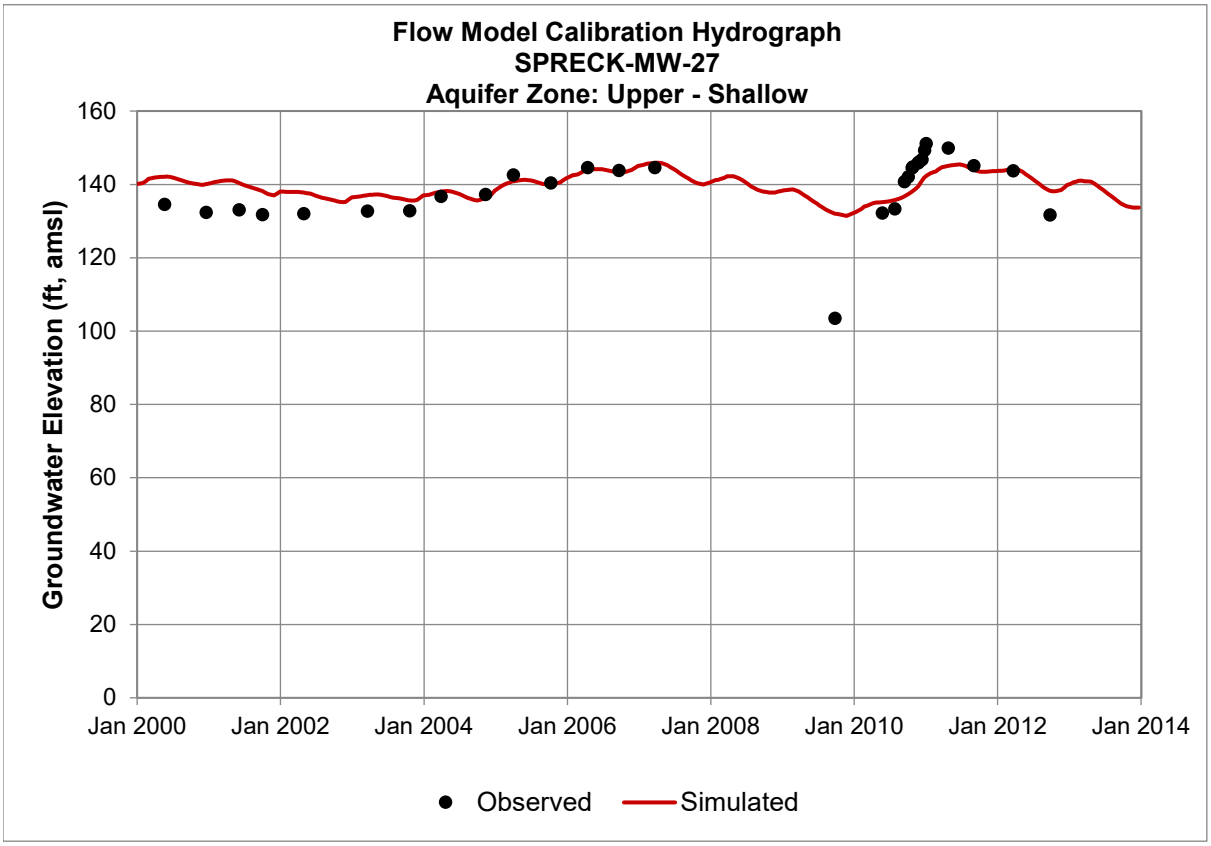

Flow Model Calibration Hydrograph
SPRECK-MW-2
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-20
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
146
144
142
140
138
136
134
132
130
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-24
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
150
145
140
135
130
125
120
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-25
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
150
148
146
144
142
140
138
136
134
132
130
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-26
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
146
144
142
140
138
136
134
132
130
128
126
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-27
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
160
140
120
100
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60
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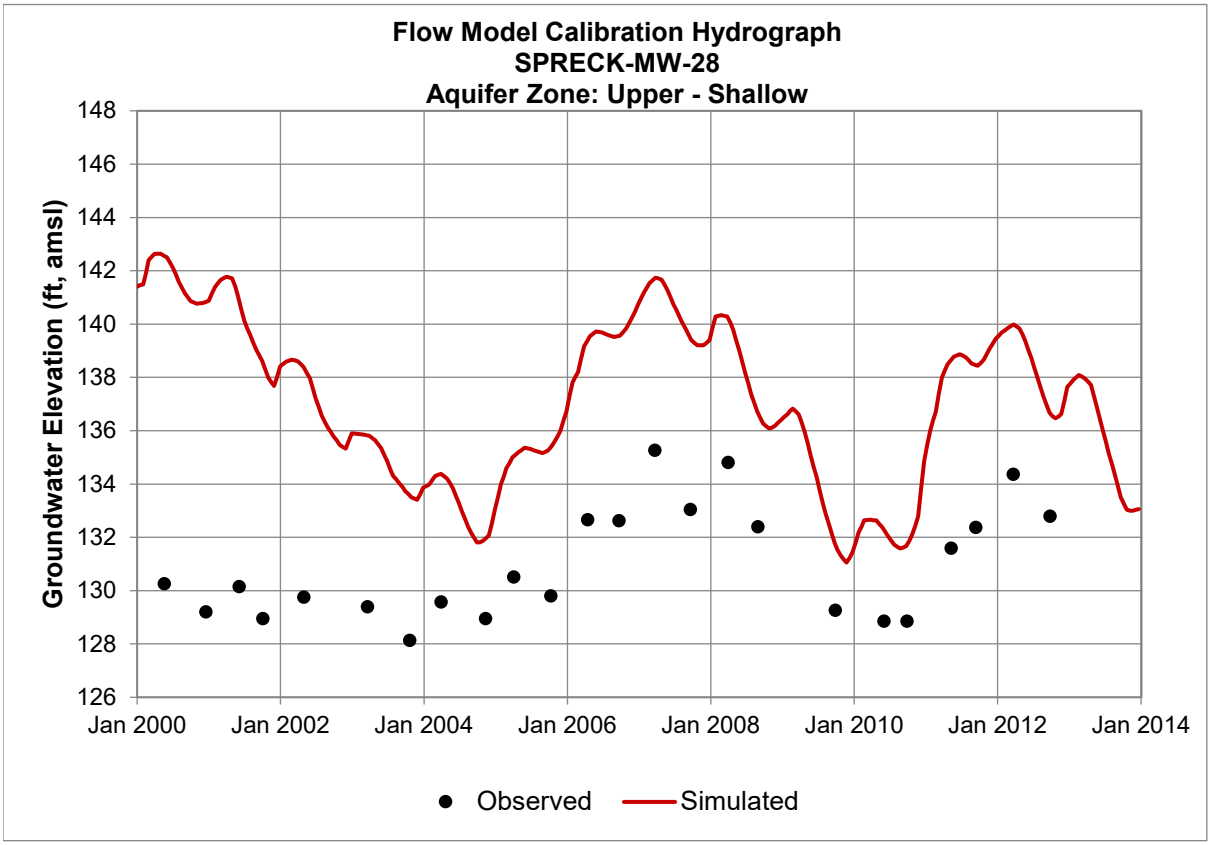
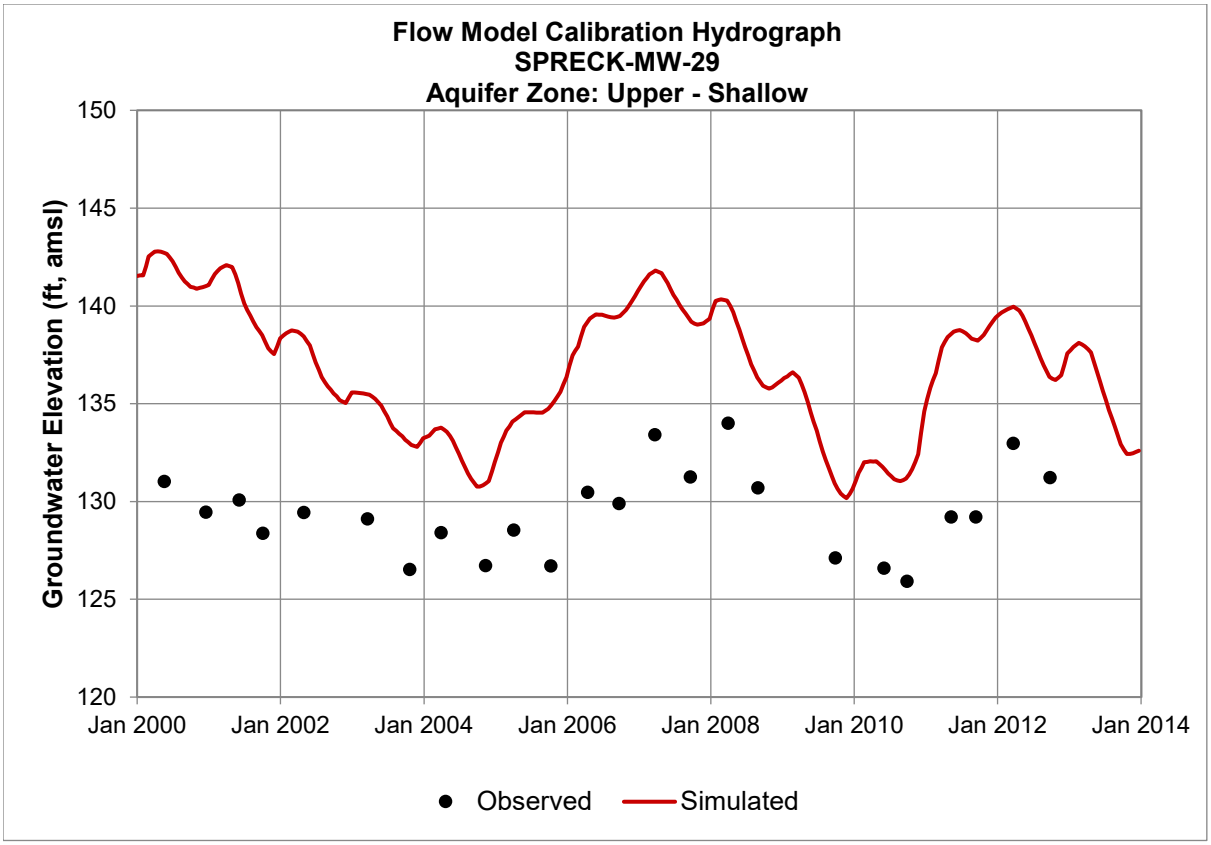
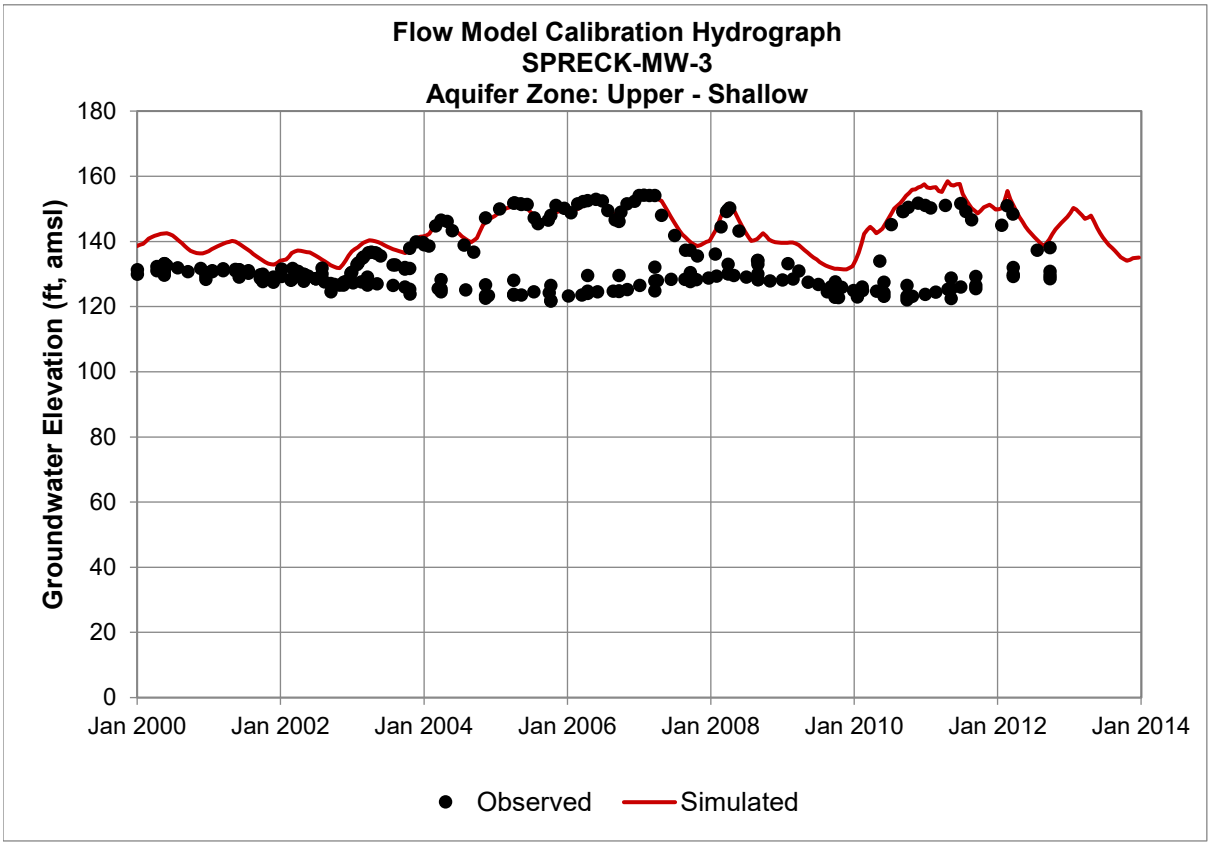
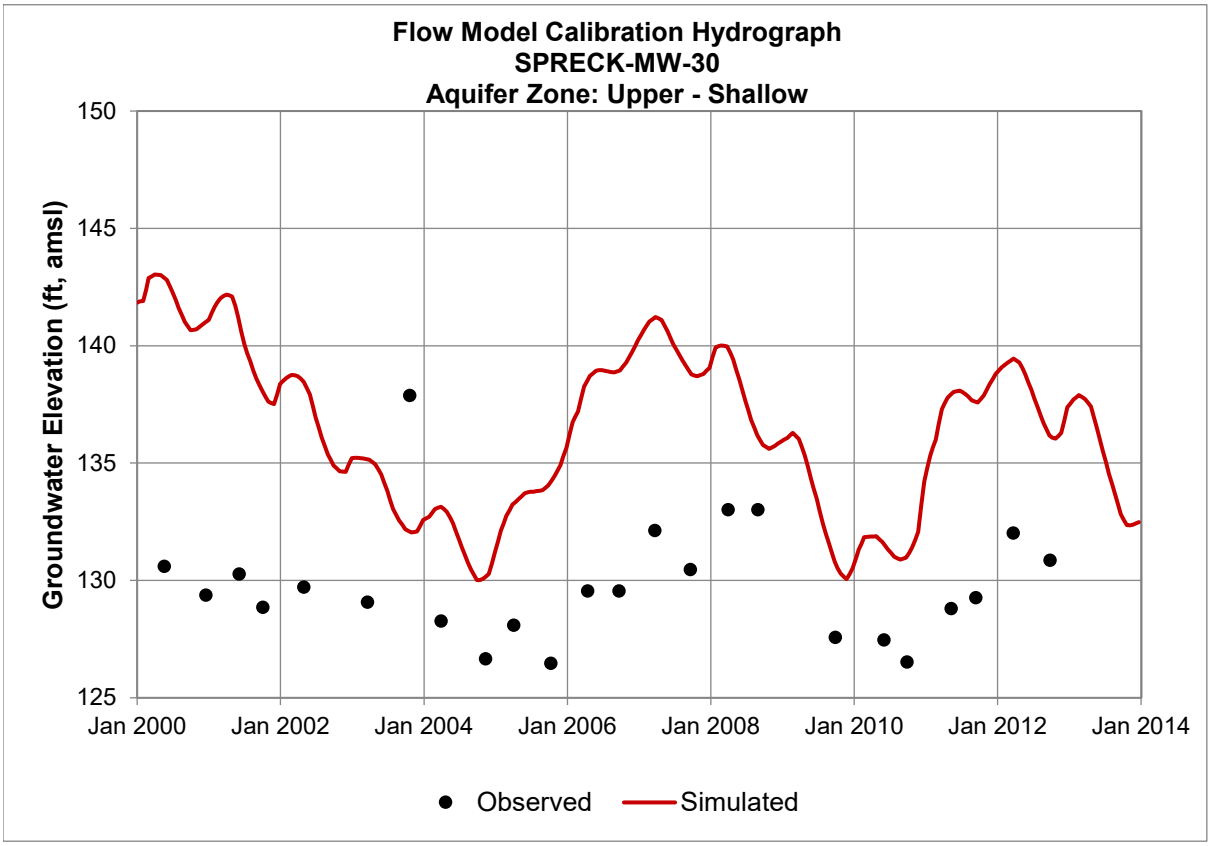
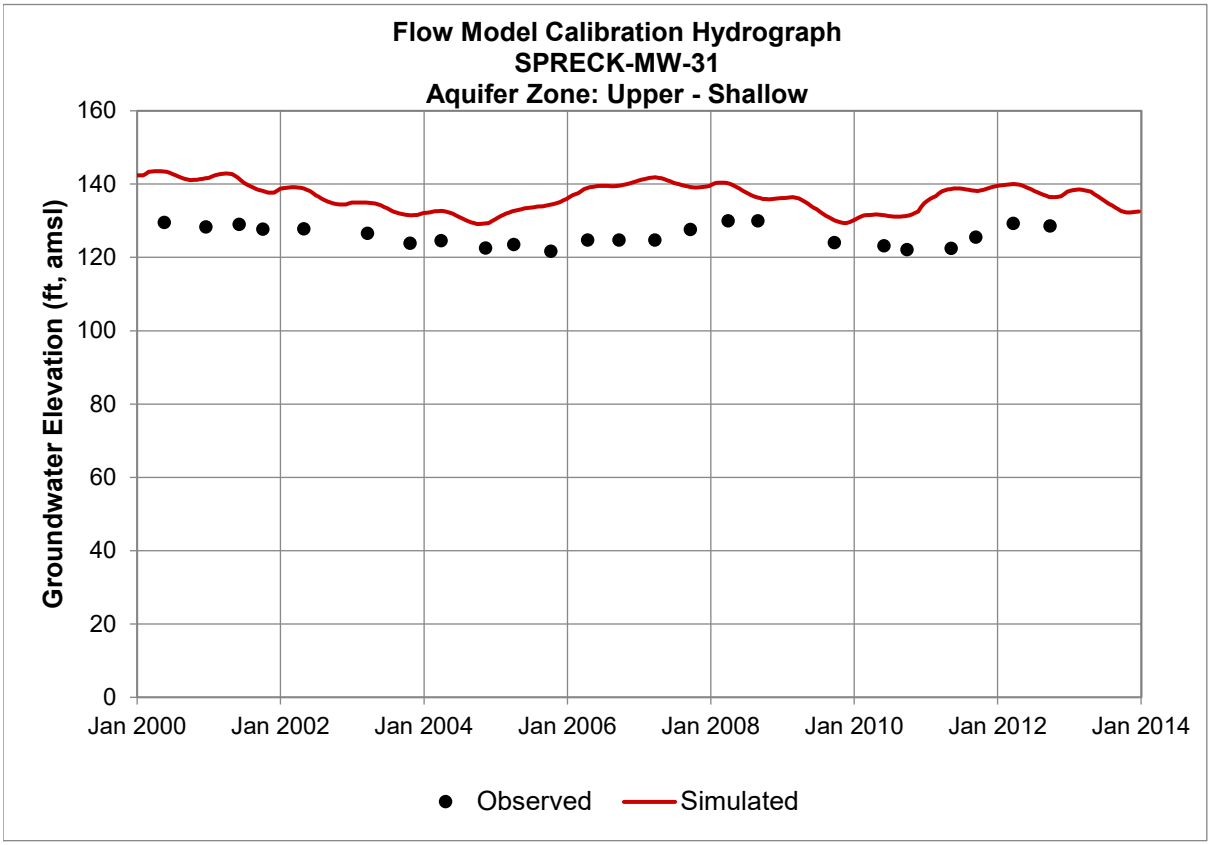
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

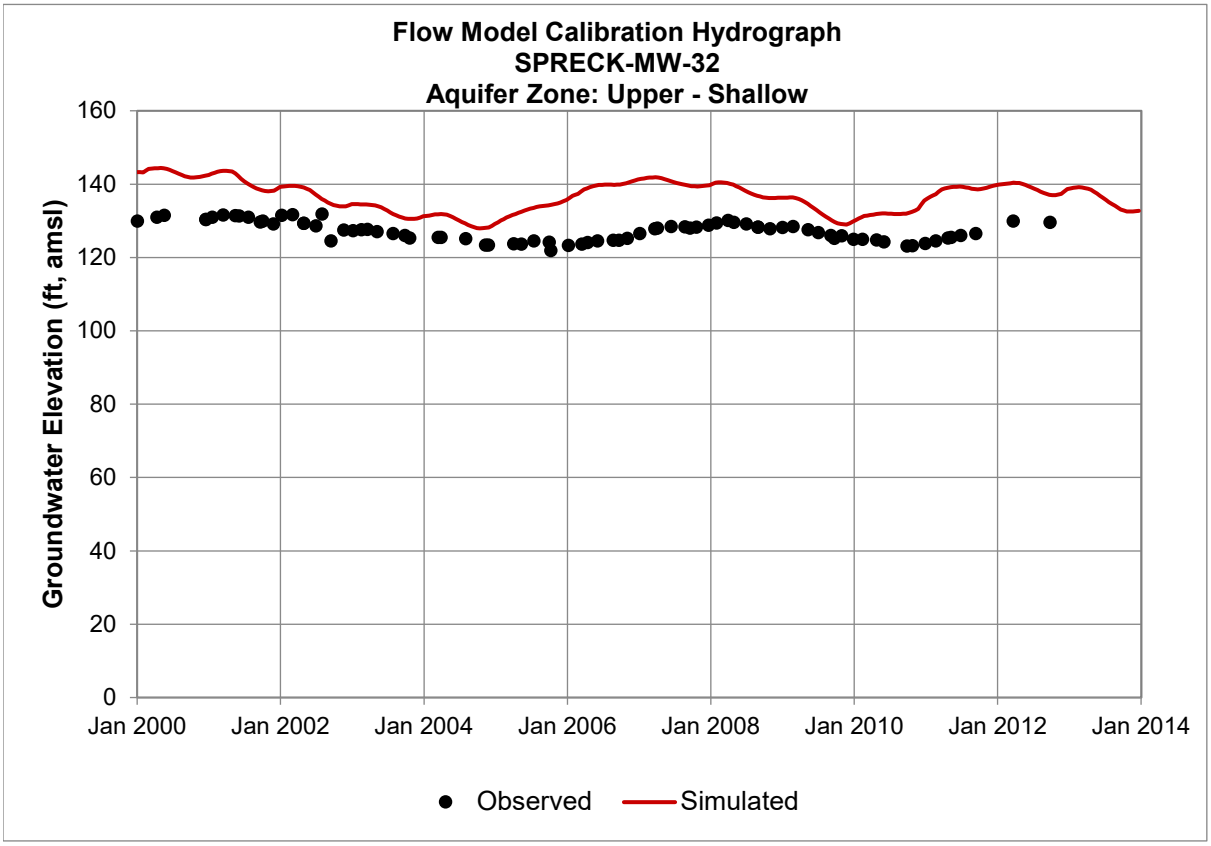

Flow Model Calibration Hydrograph
SPRECK-MW-28
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
148
146
144
142
140
138
136
134
132
130
128
126
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

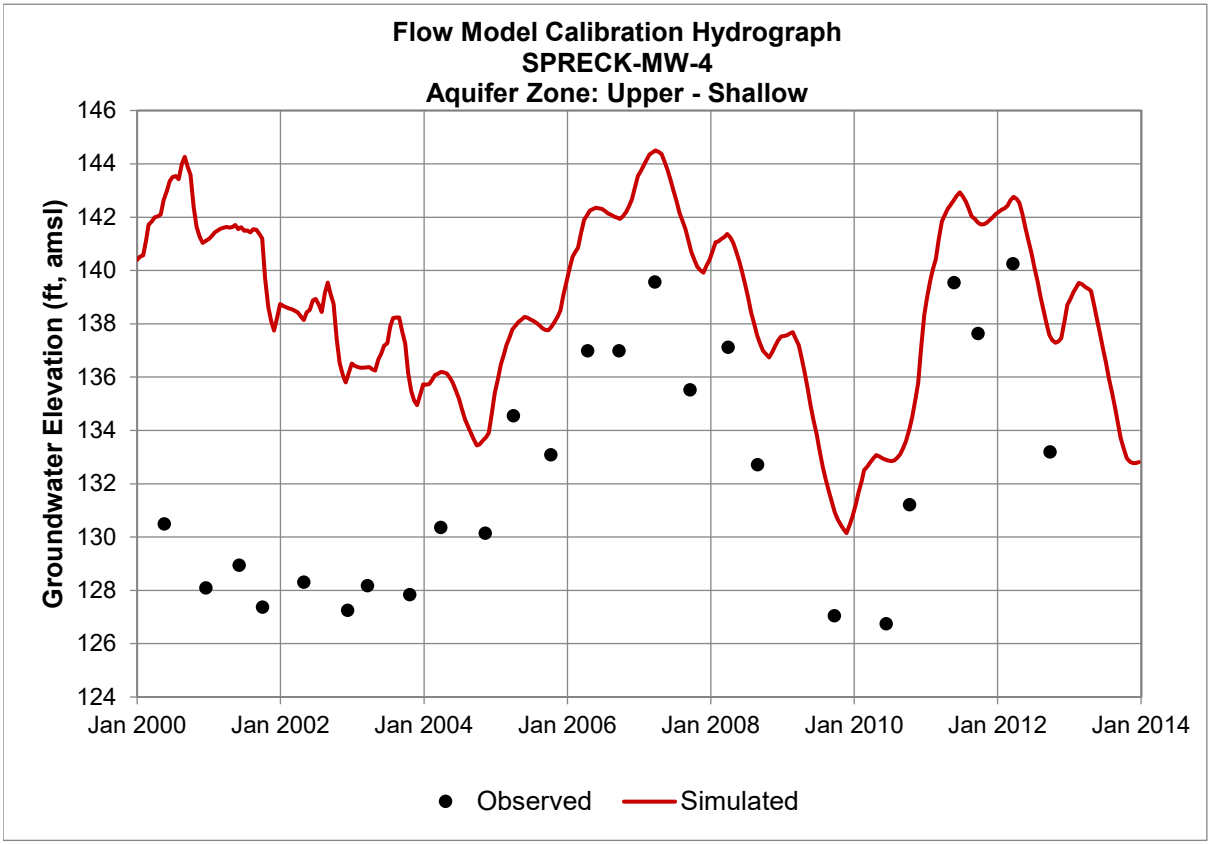

Flow Model Calibration Hydrograph
SPRECK-MW-29
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
150
145
140
135
130
125
120
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

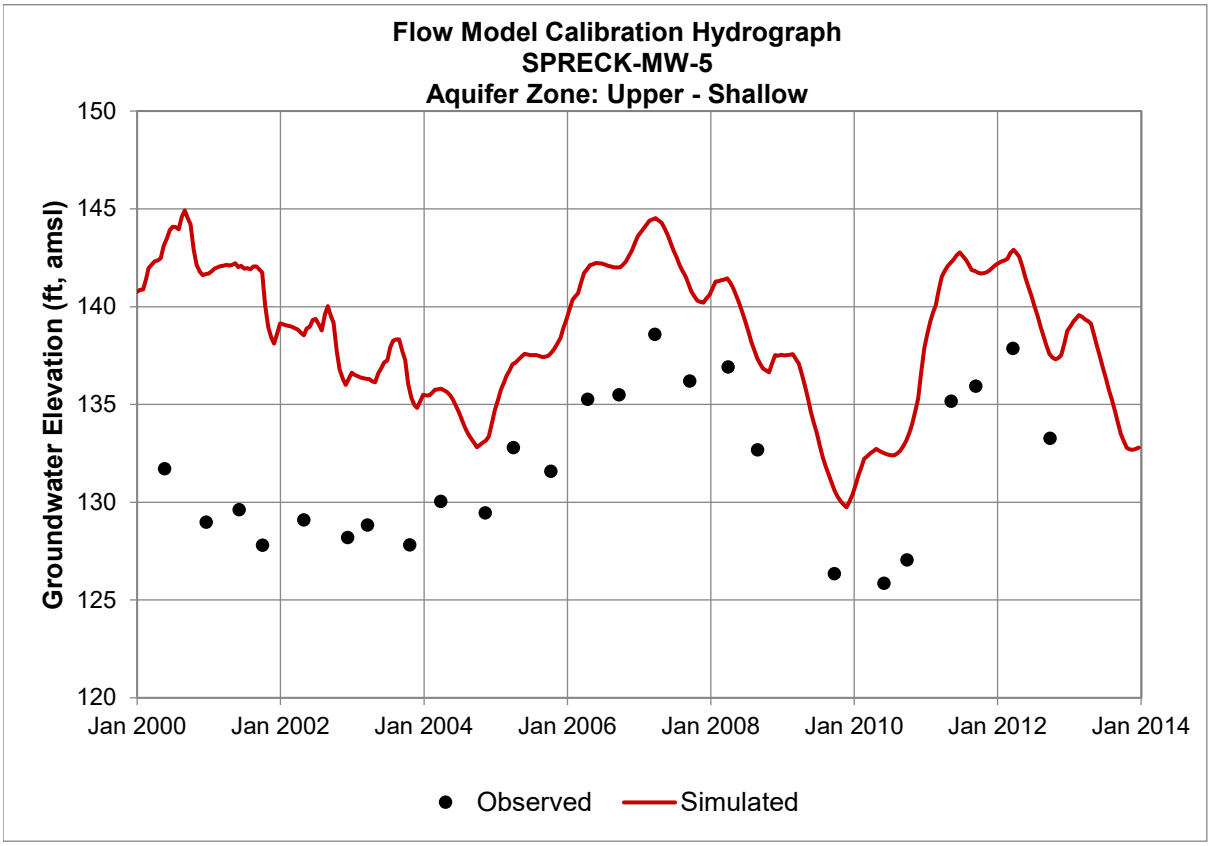

Flow Model Calibration Hydrograph
SPRECK-MW-3
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

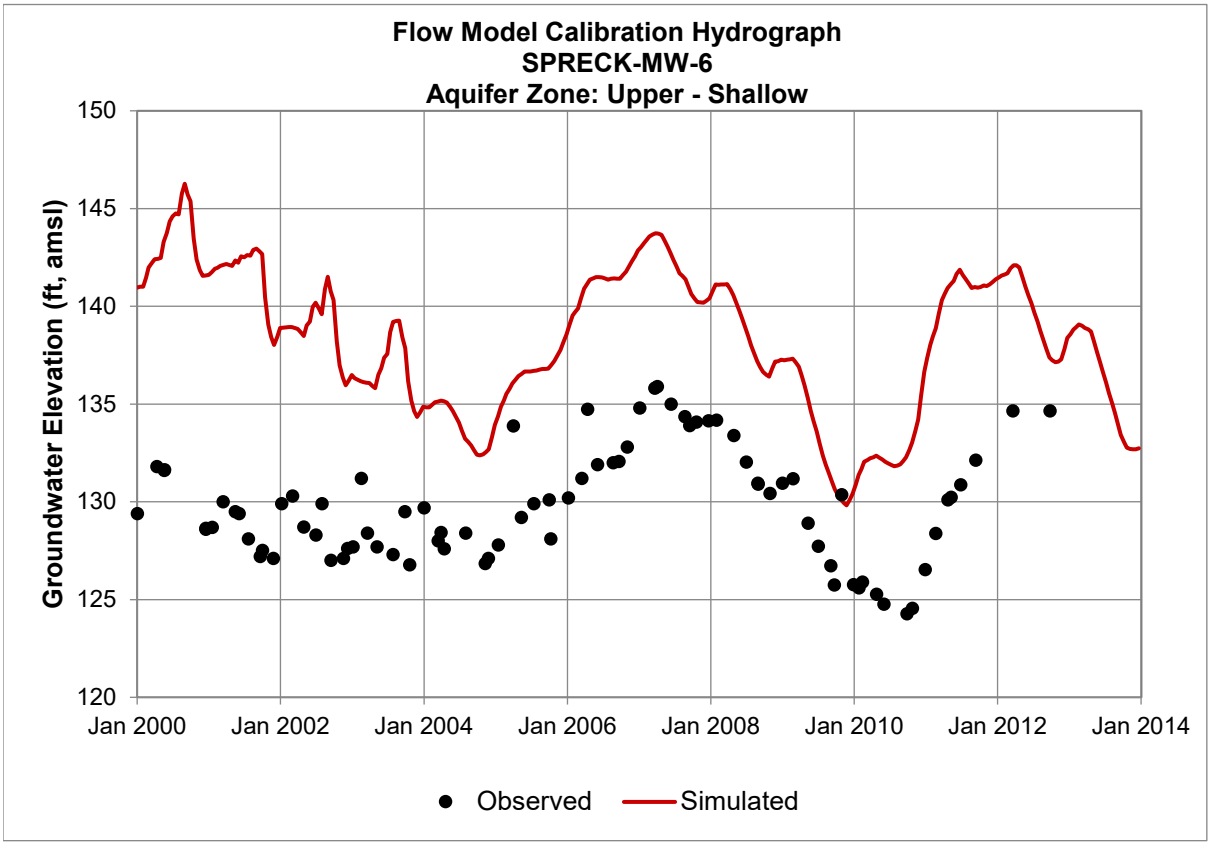

Flow Model Calibration Hydrograph
SPRECK-MW-30
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
150
145
140
135
130
125
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

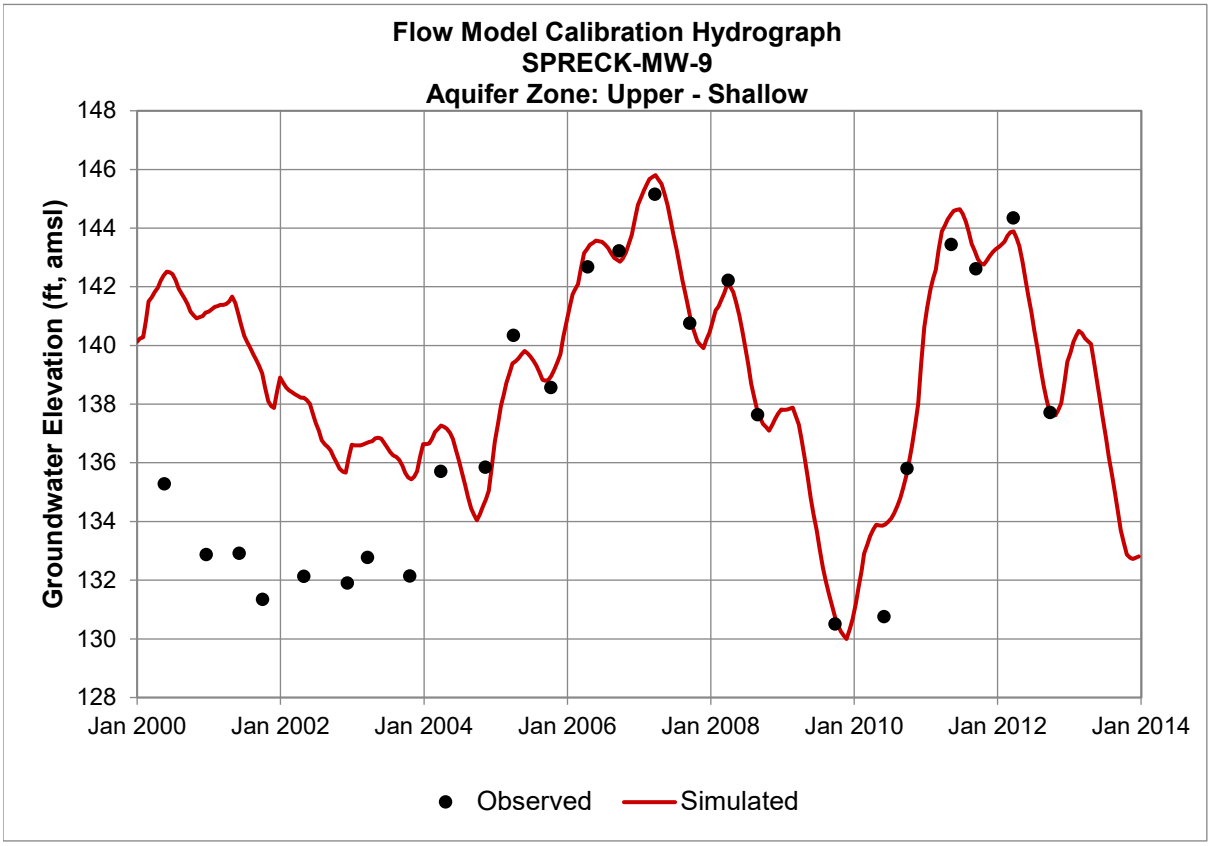

Flow Model Calibration Hydrograph
SPRECK-MW-31
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

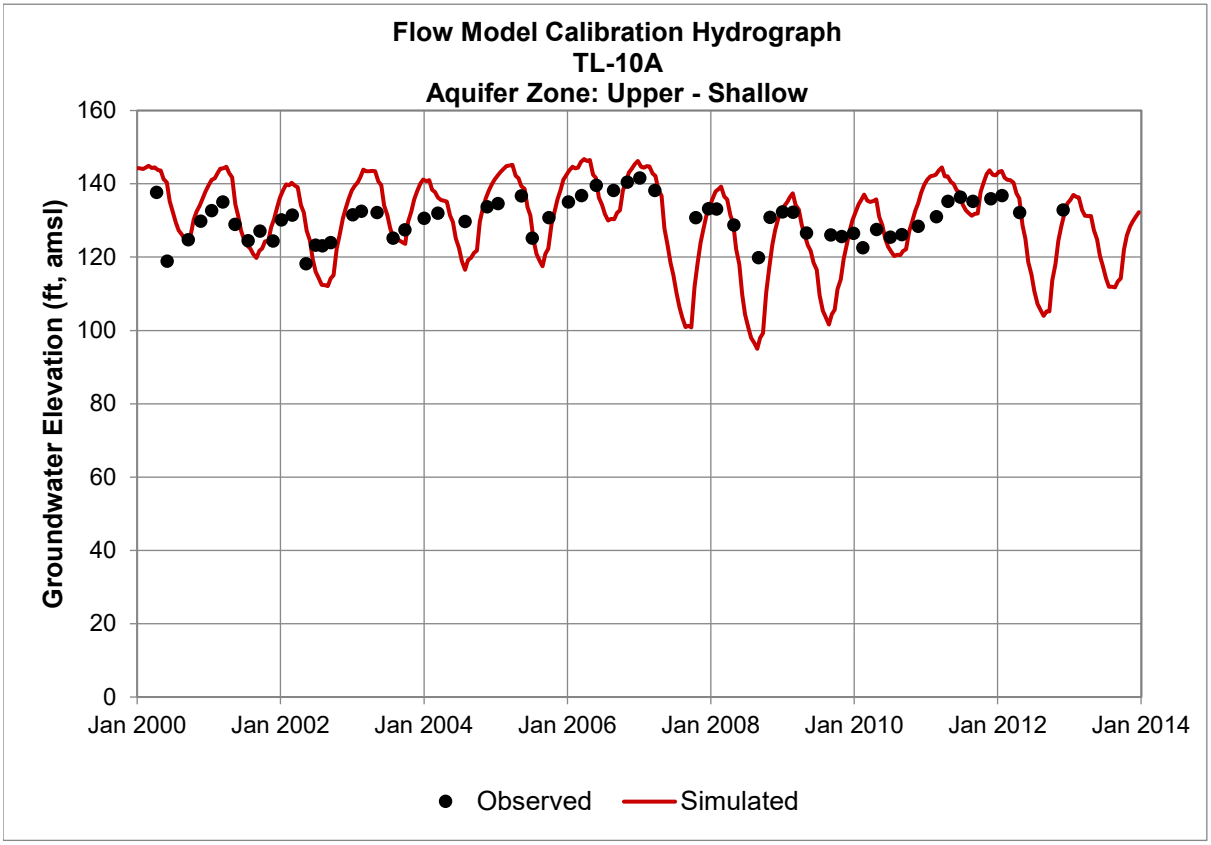

Flow Model Calibration Hydrograph
SPRECK-MW-32
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

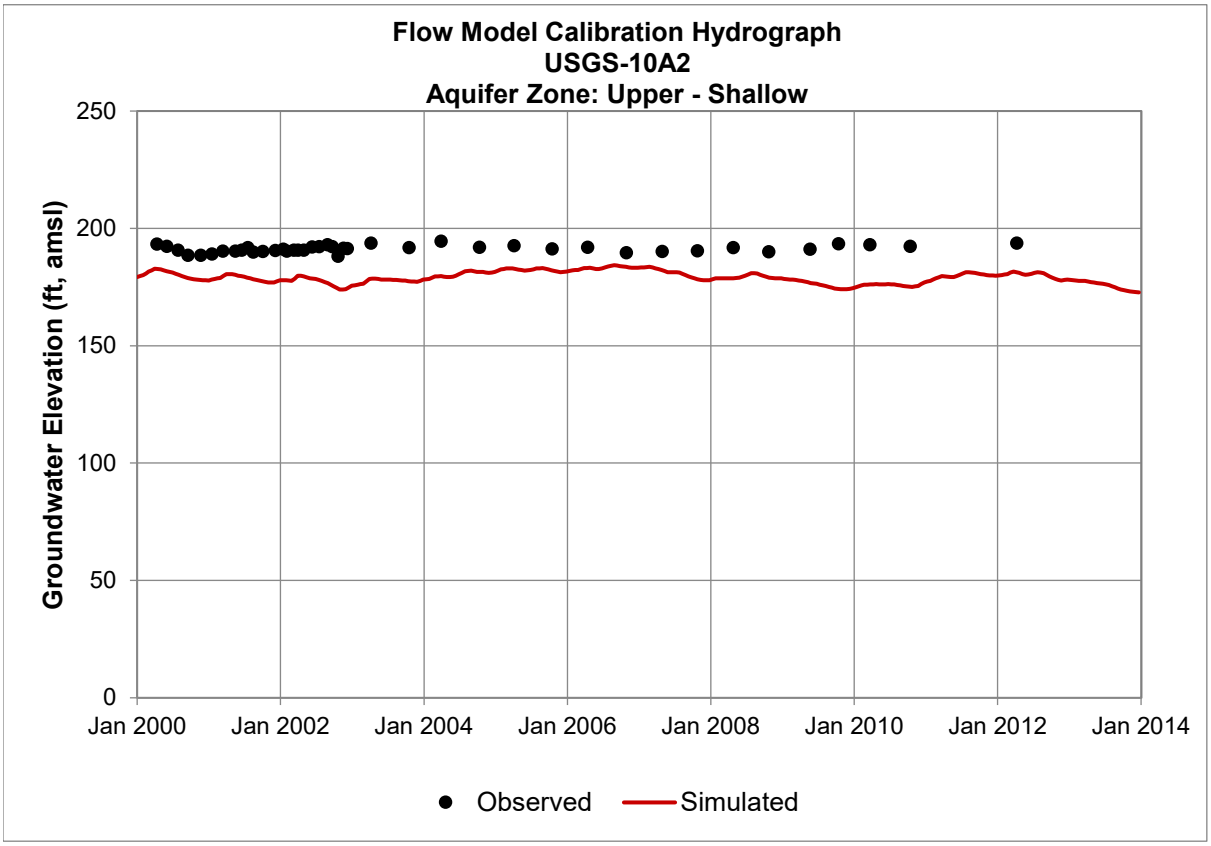

Flow Model Calibration Hydrograph
SPRECK-MW-4
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
146
144
142
140
138
136
134
132
130
128
126
124
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

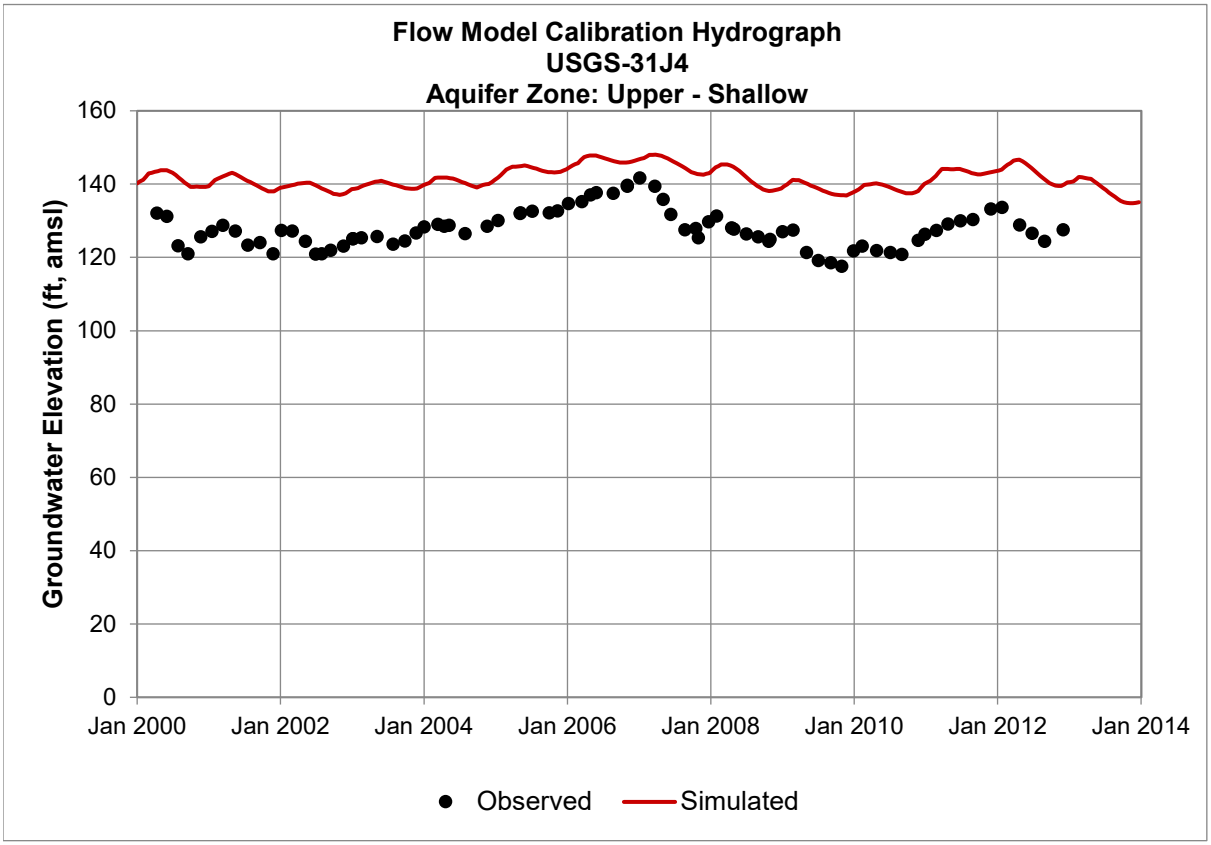

Flow Model Calibration Hydrograph
SPRECK-MW-5
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
150
145
140
135
130
125
120
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

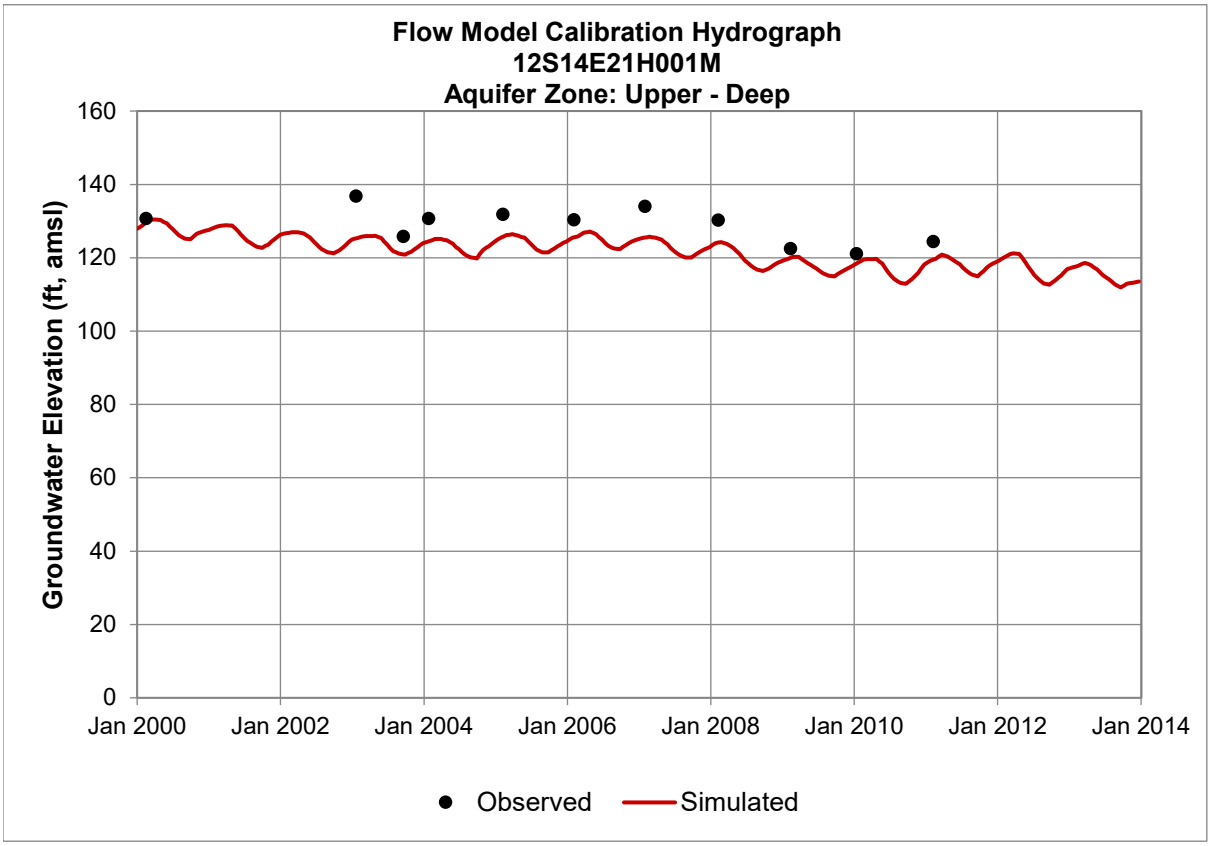

Flow Model Calibration Hydrograph
SPRECK-MW-6
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
150
145
140
135
130
125
120
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

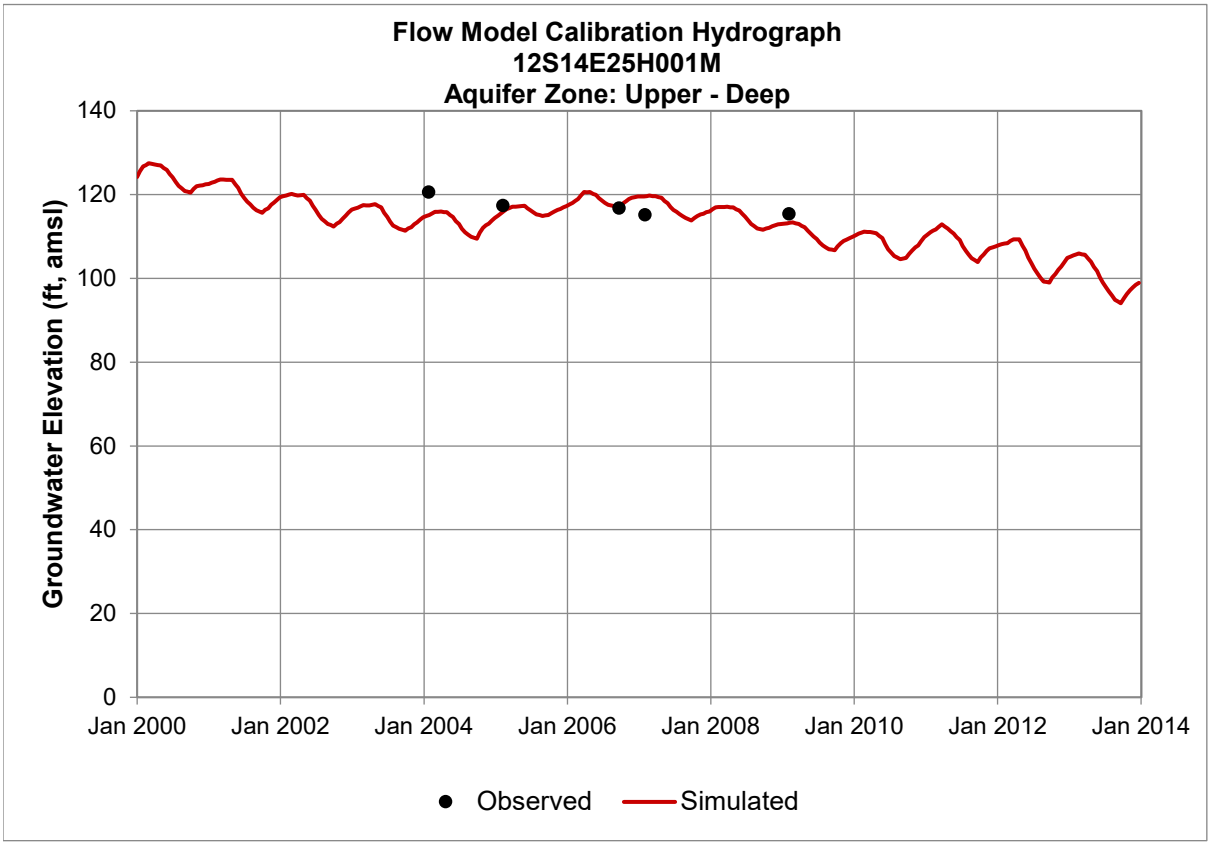

Flow Model Calibration Hydrograph
SPRECK-MW-9
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
148
146
144
142
140
138
136
134
132
130
128
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

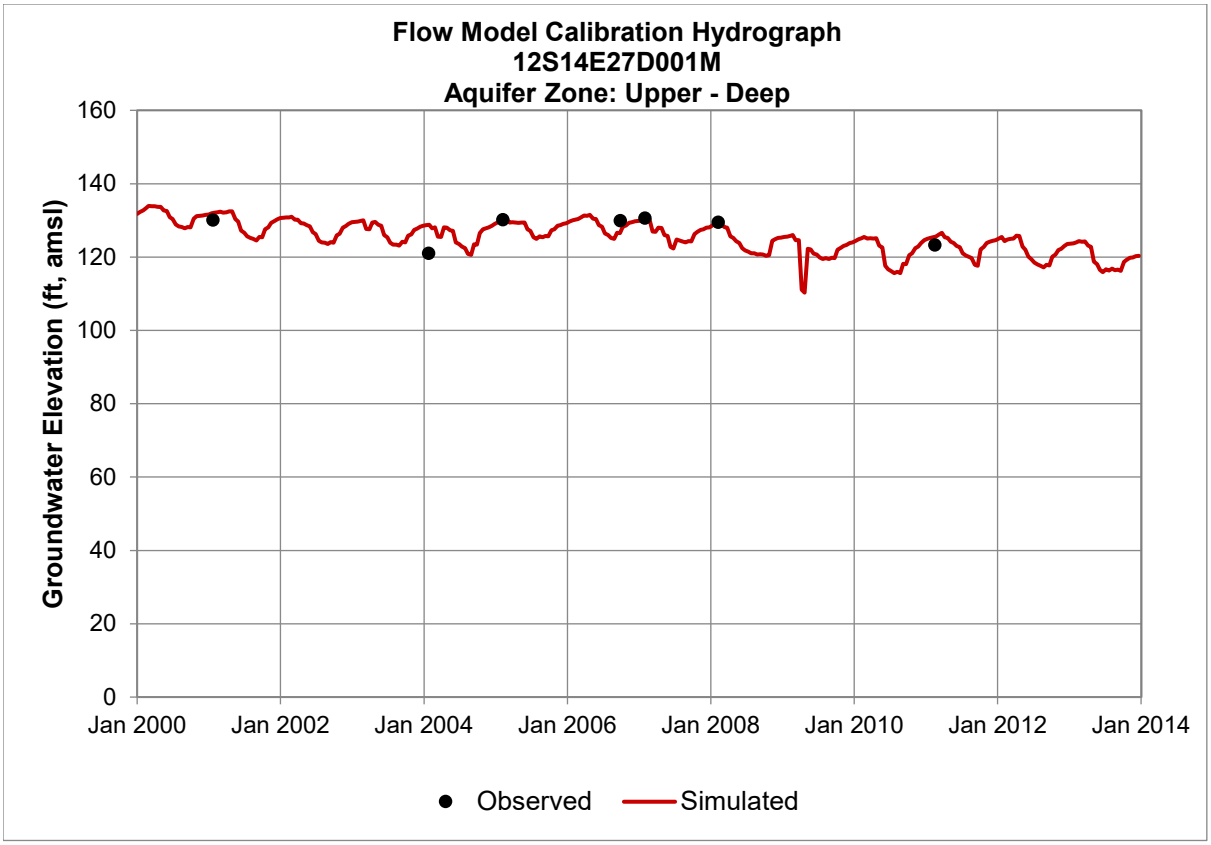

Flow Model Calibration Hydrograph
TL-10A
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated

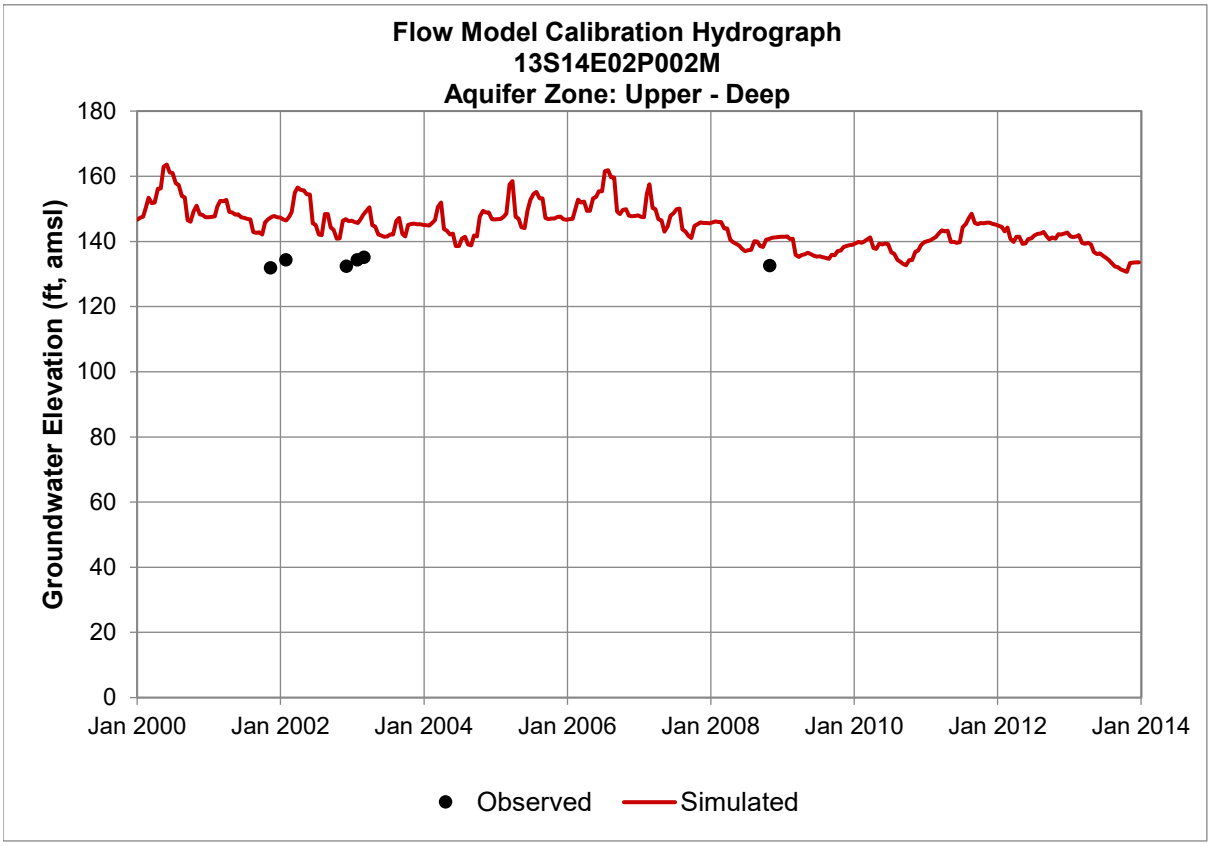

Flow Model Calibration Hydrograph
USGS-10A2
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
250
200
150
100
50
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
USGS-31J4
Aquifer Zone: Upper - Shallow
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
12S14E21H001M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
12S14E25H001M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
12S14E27D001M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
13S14E02P002M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
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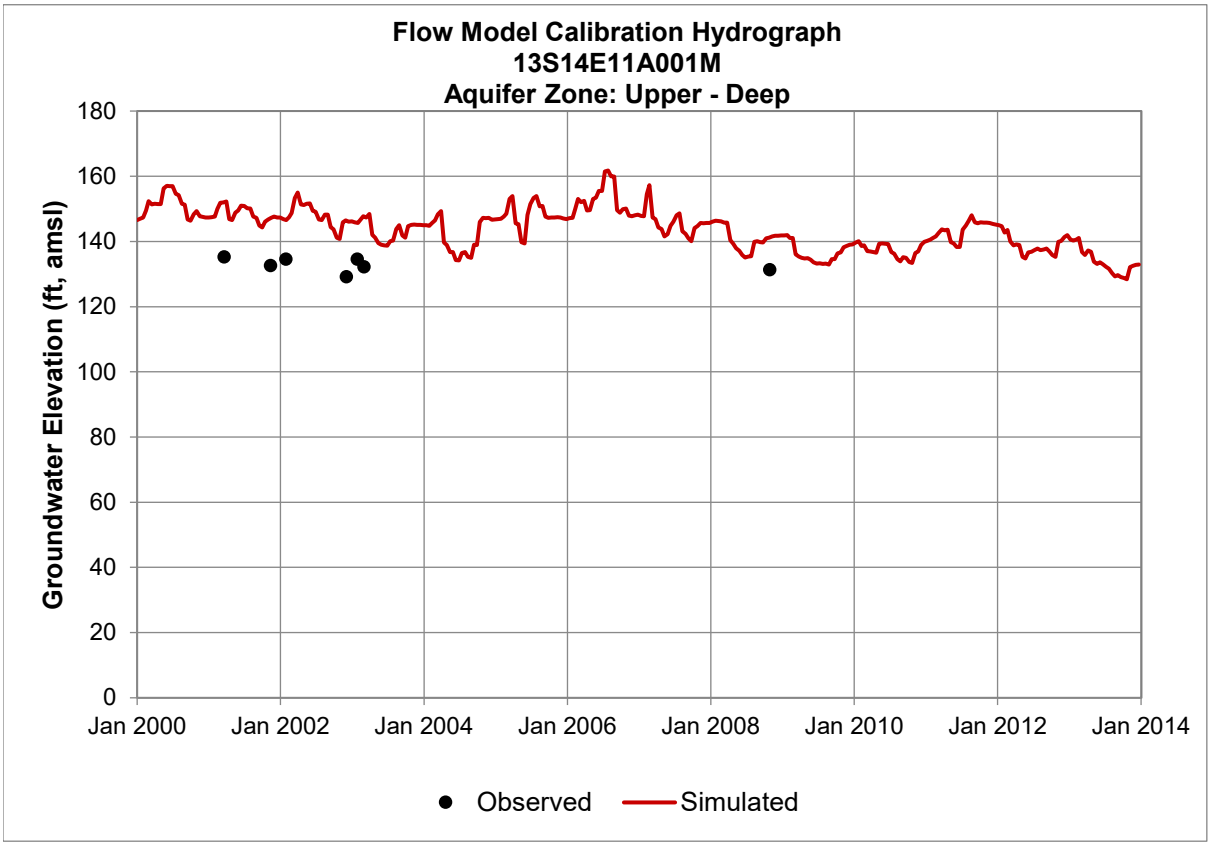
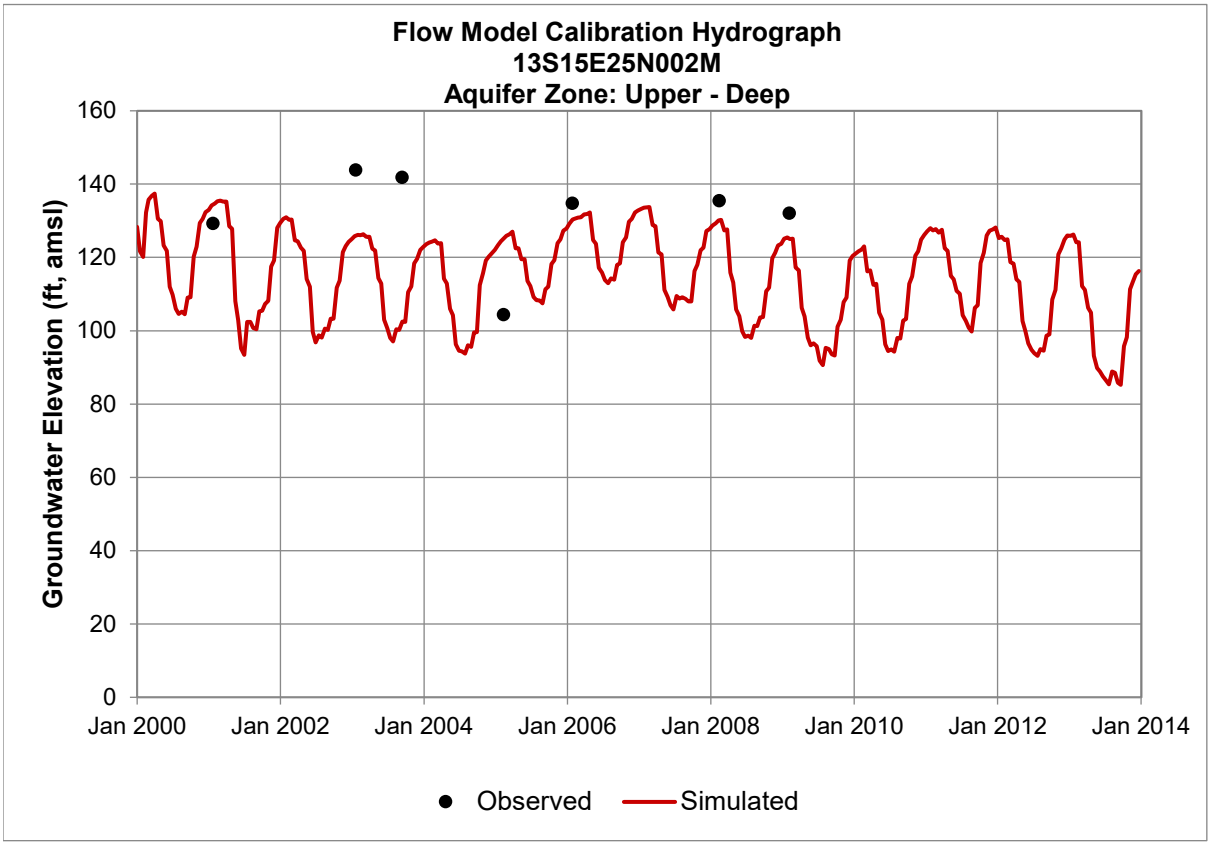
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
13S14E11A001M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
13S15E25N002M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
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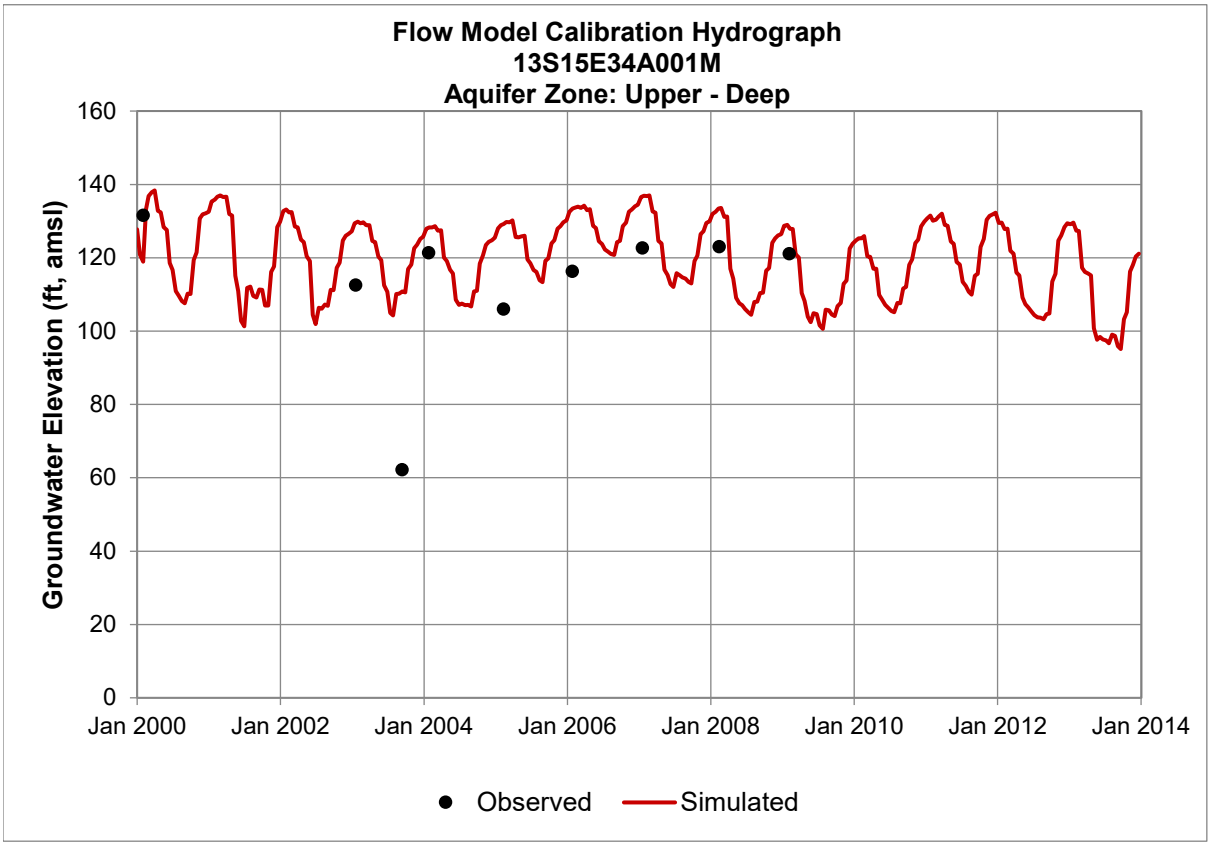
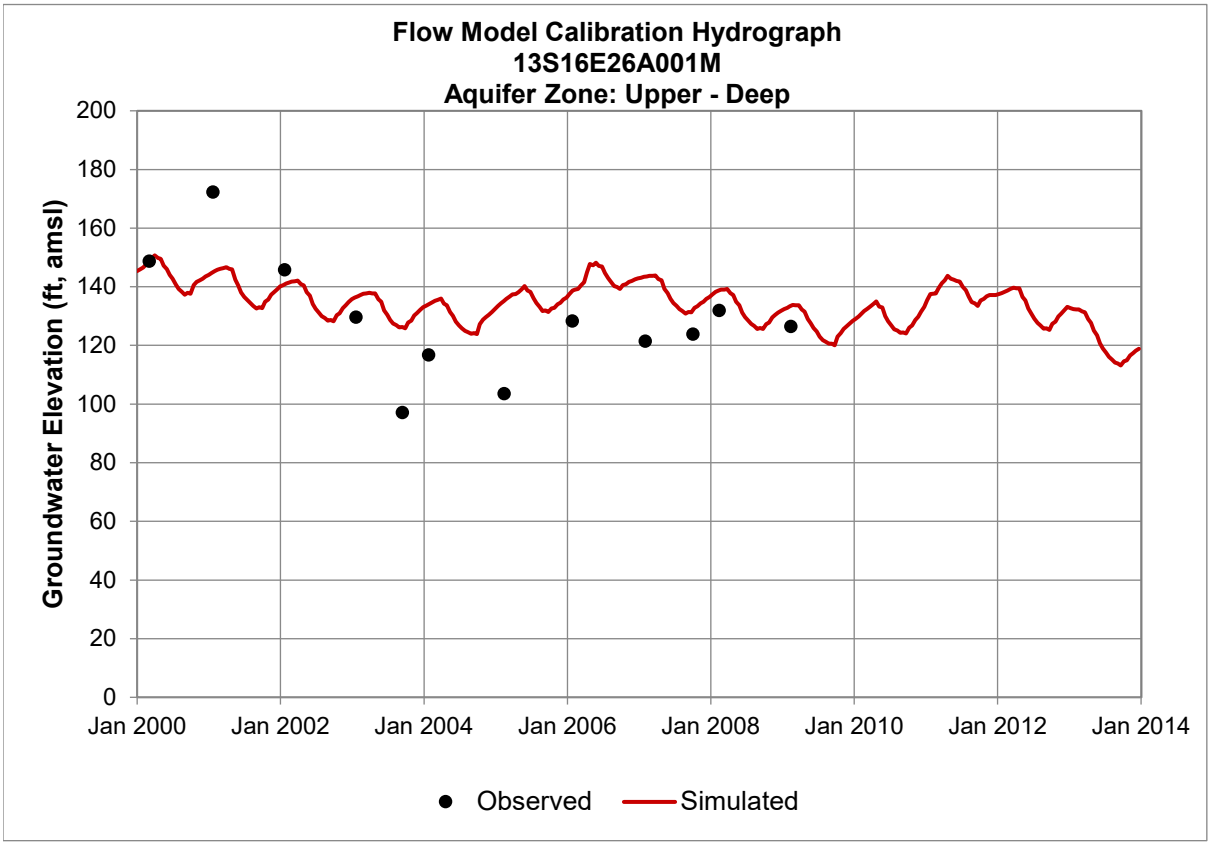
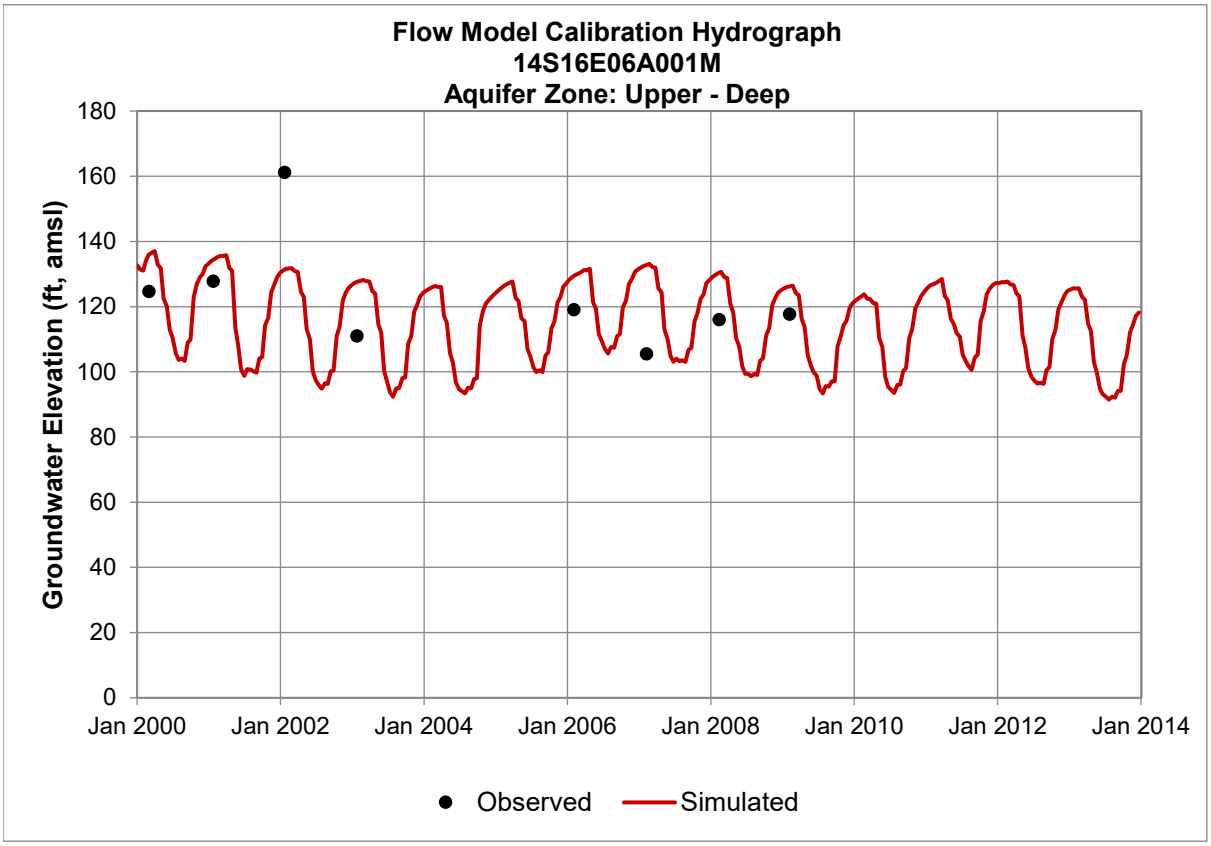
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
13S15E34A001M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
13S16E26A001M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
200
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
14S16E06A001M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
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Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
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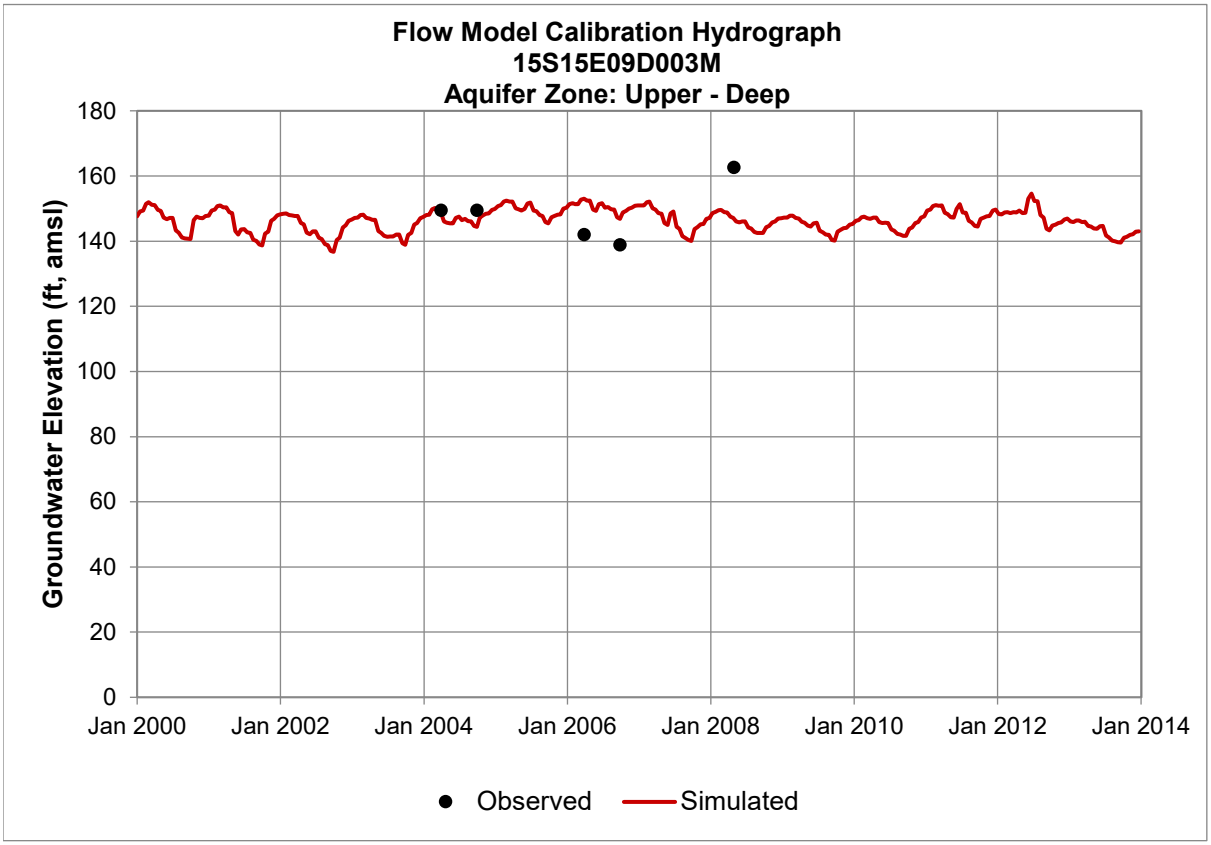
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
15S15E09D003M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
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160
140
120
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80
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Jan 2006
Jan 2008
Jan 2010
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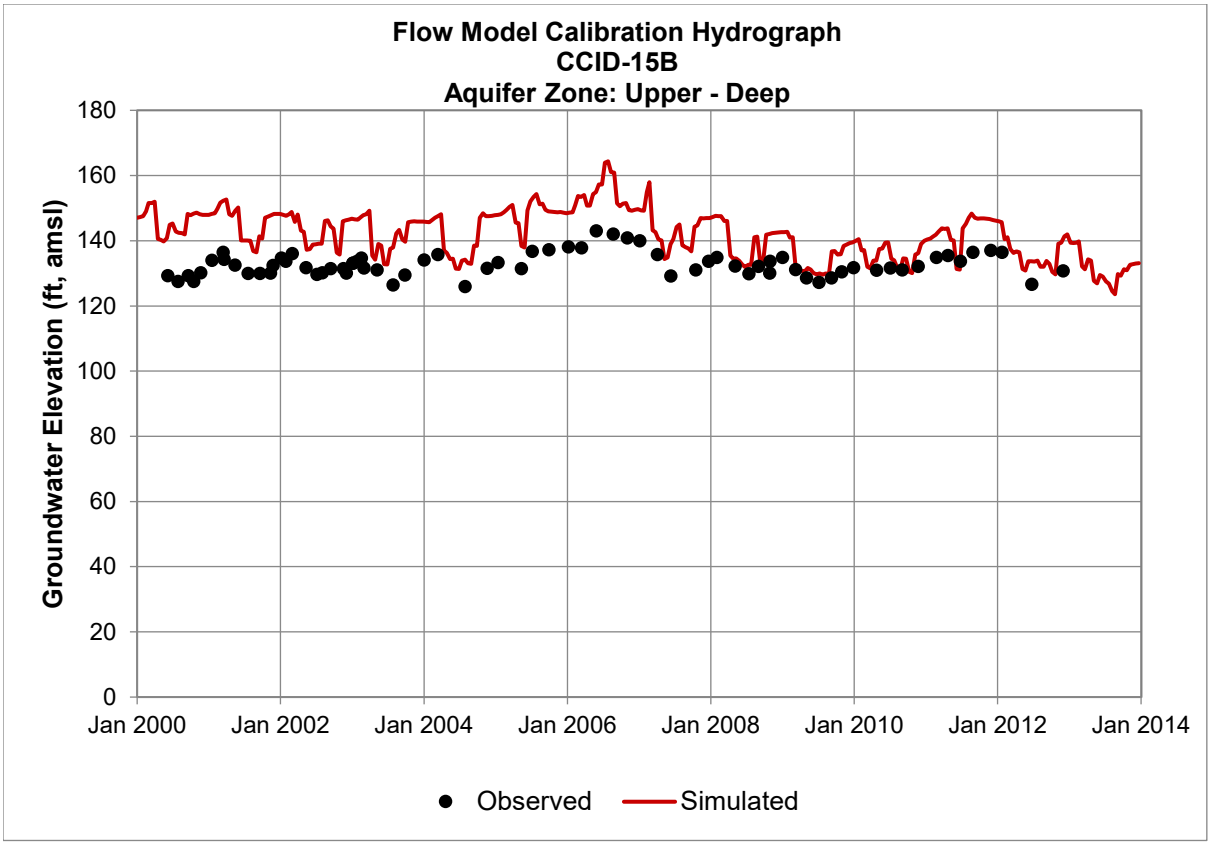
Observed
Simulated


Flow Model Calibration Hydrograph
CCID-15B
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
180
160
140
120
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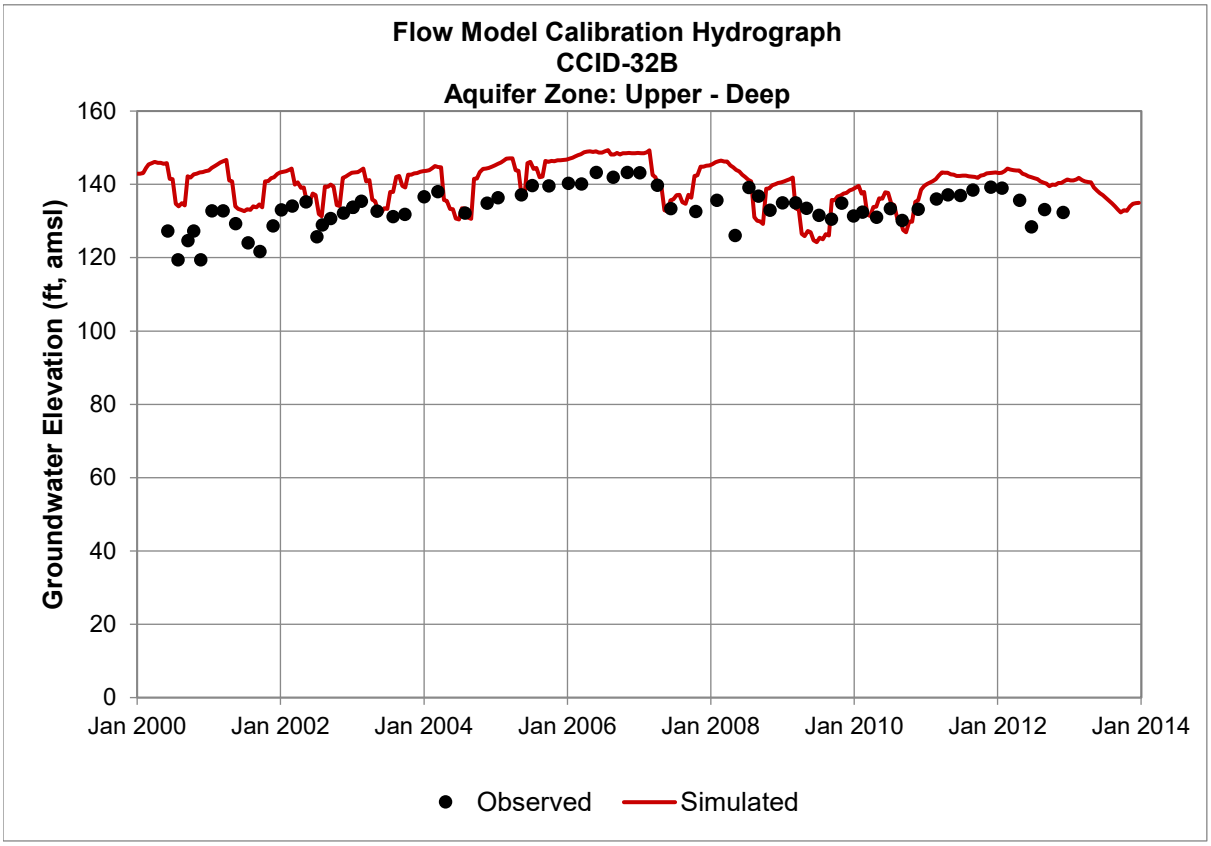
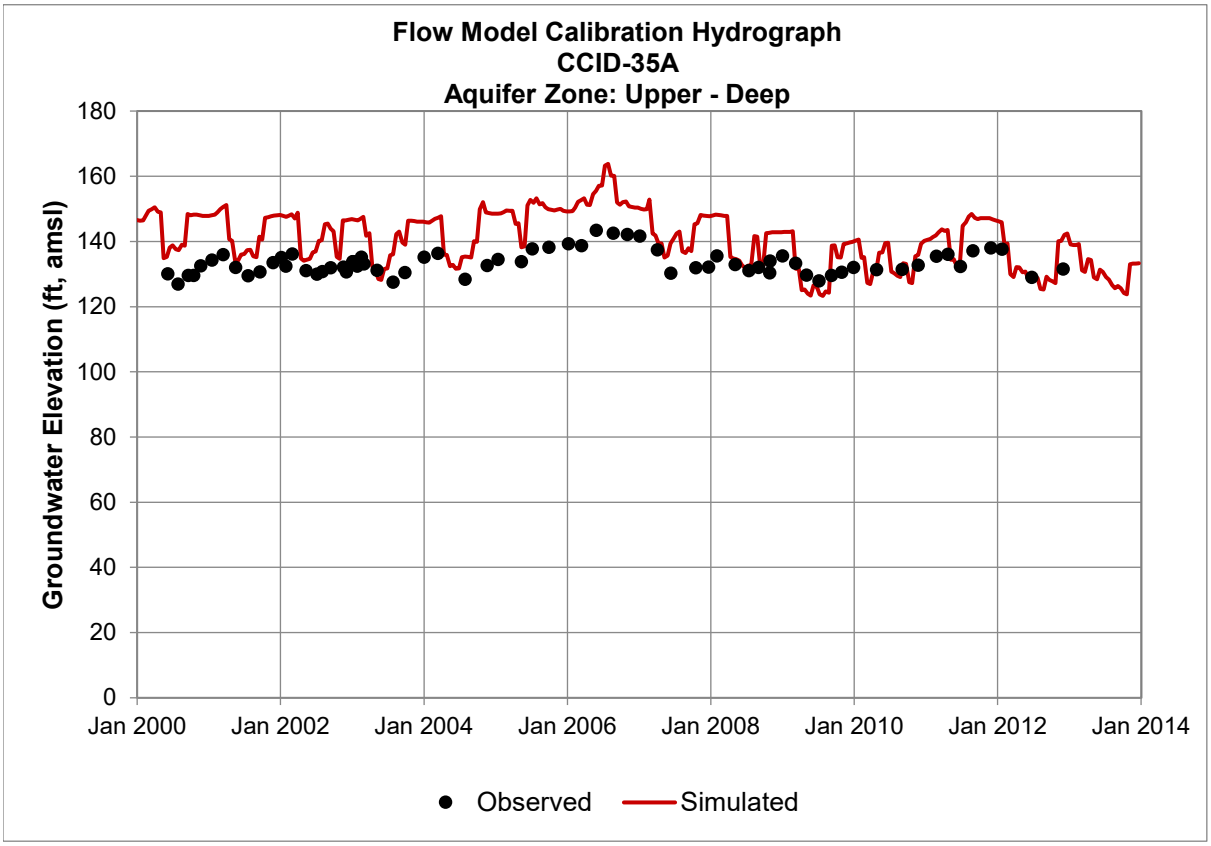
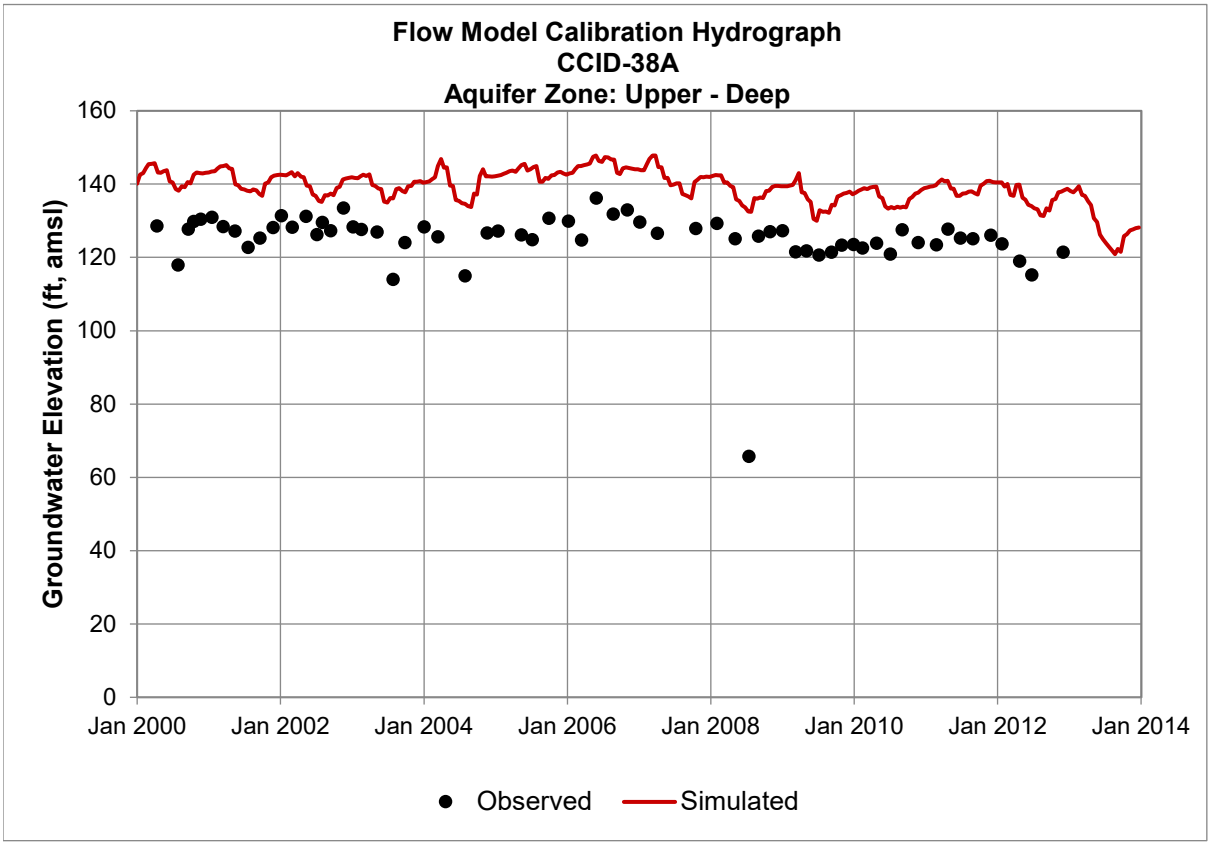
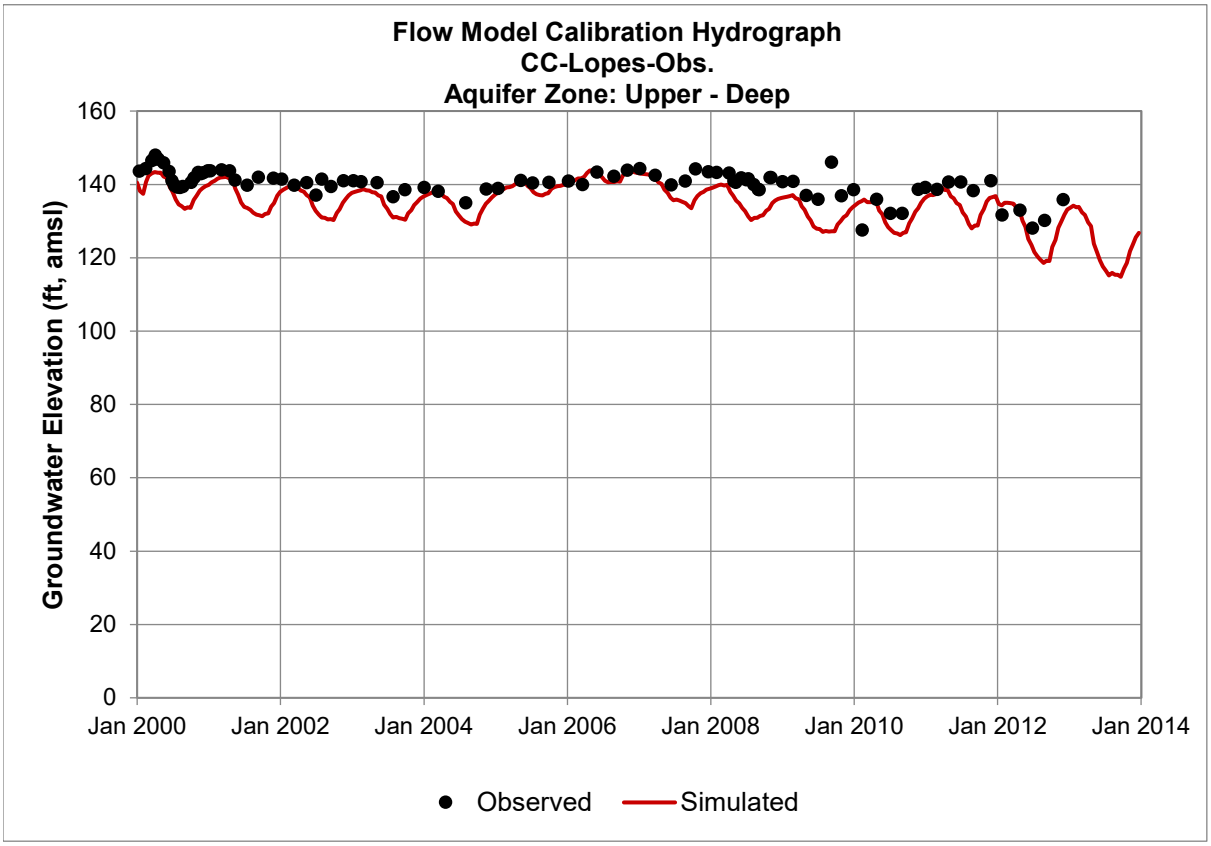
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
CCID-32B
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
CCID-35A
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
CCID-38A
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
CC-Lopes-Obs.
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
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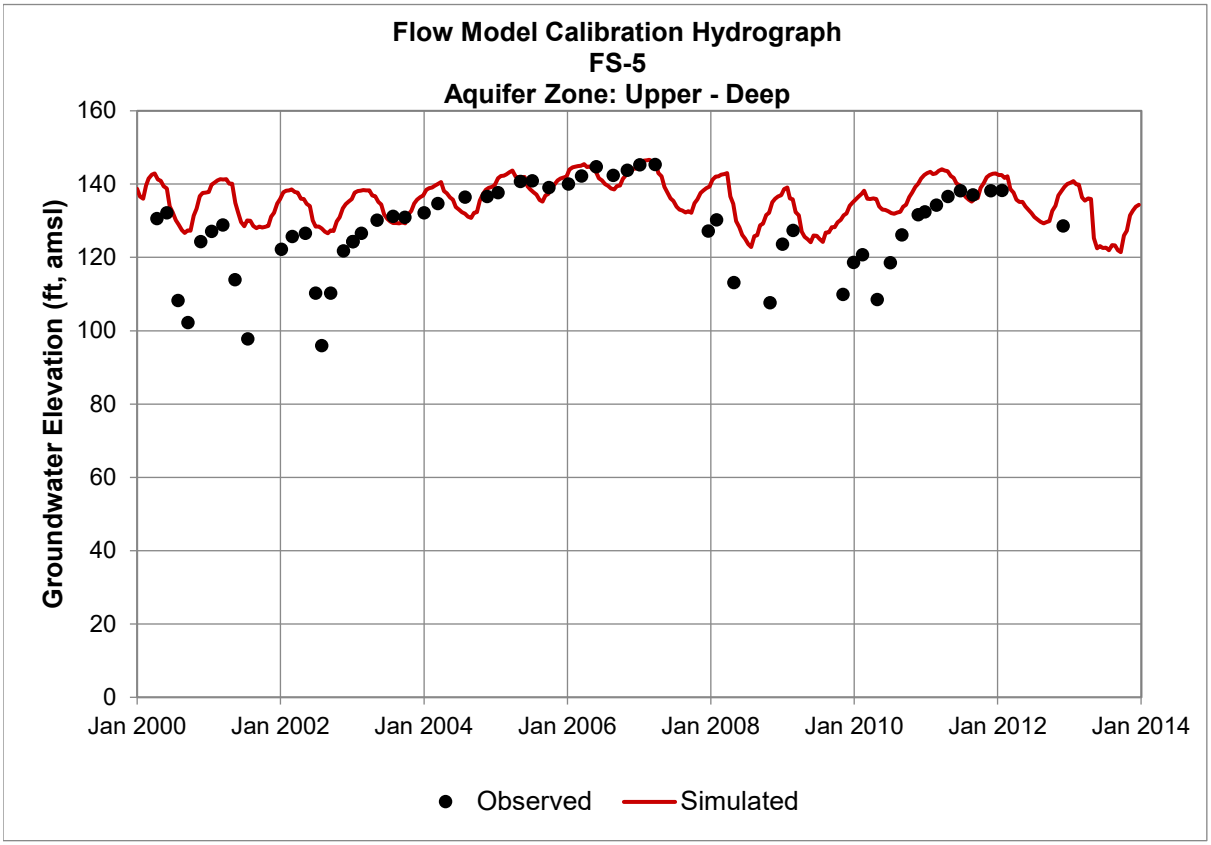
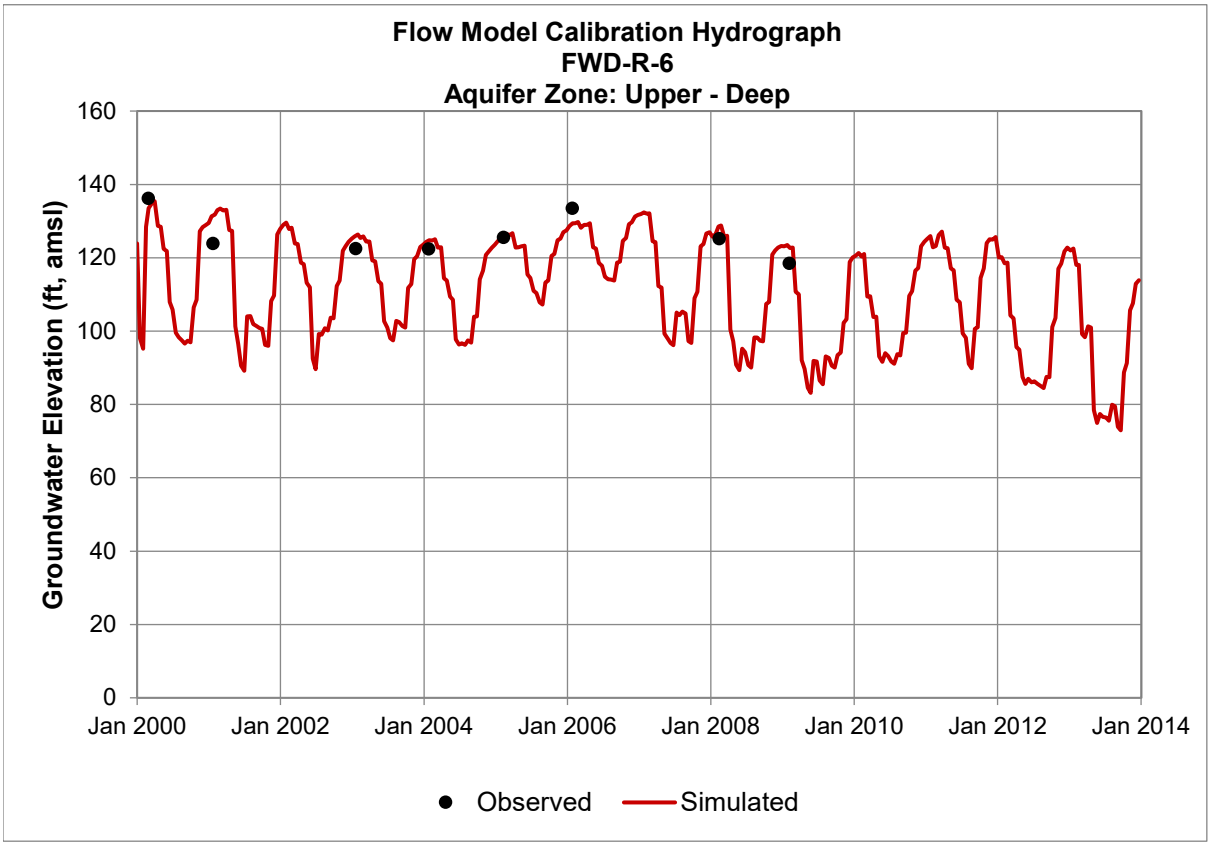
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
FS-5
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
FWD-R-6
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
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100
80
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Jan 2000
Jan 2002
Jan 2004
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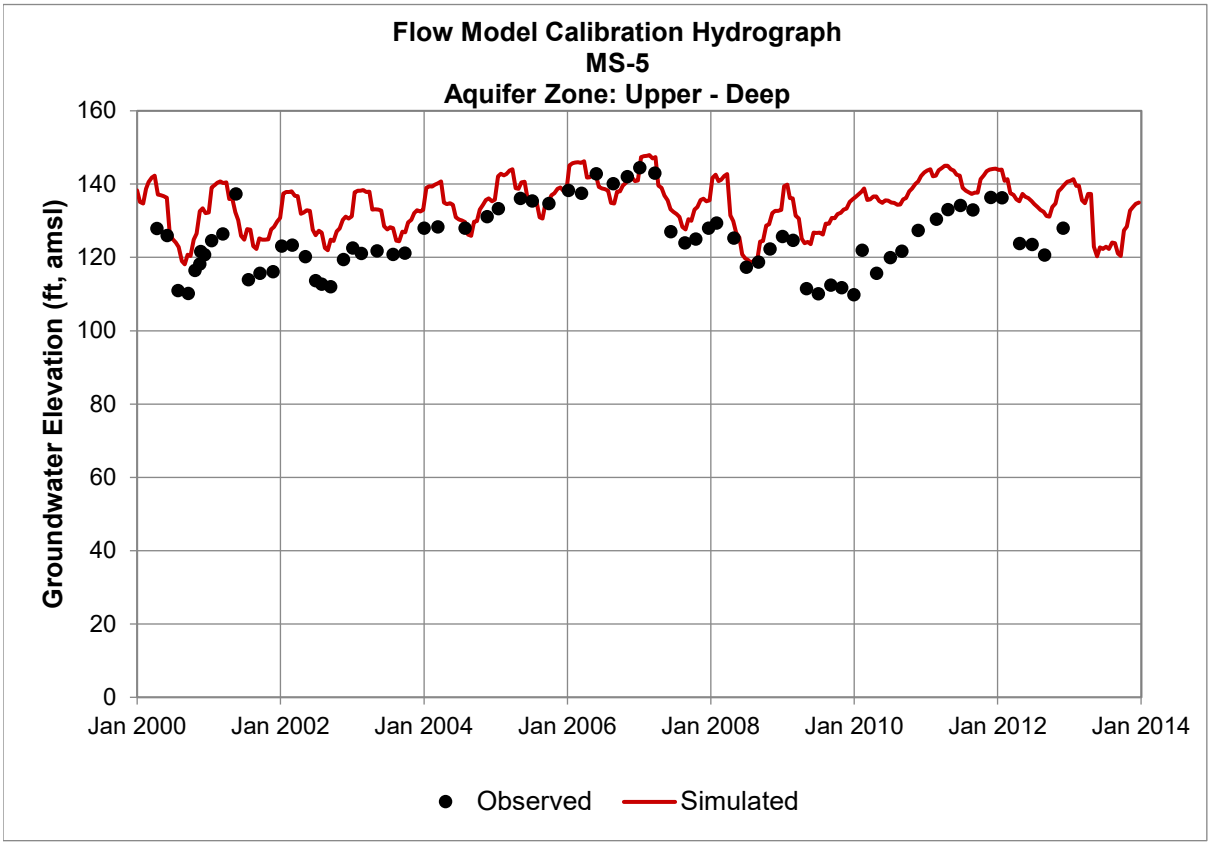
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
MS-5
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
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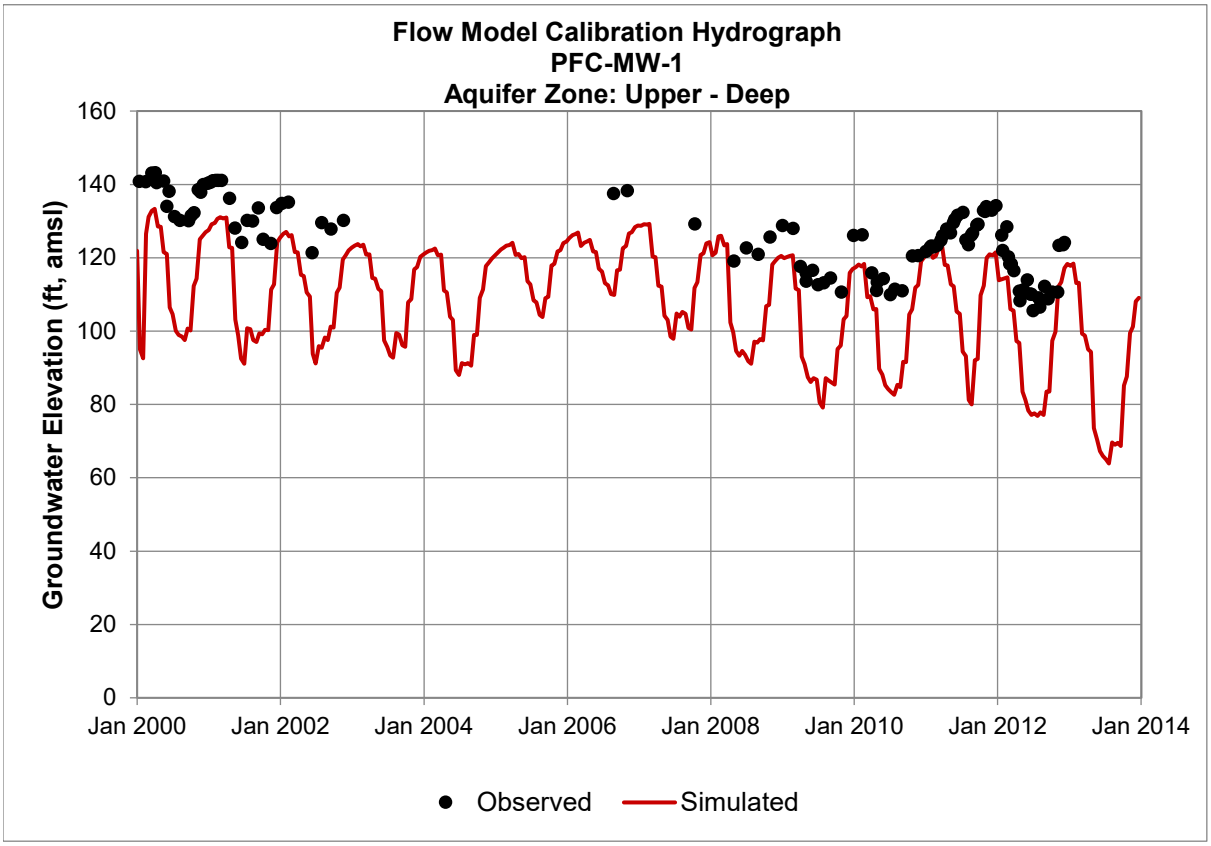
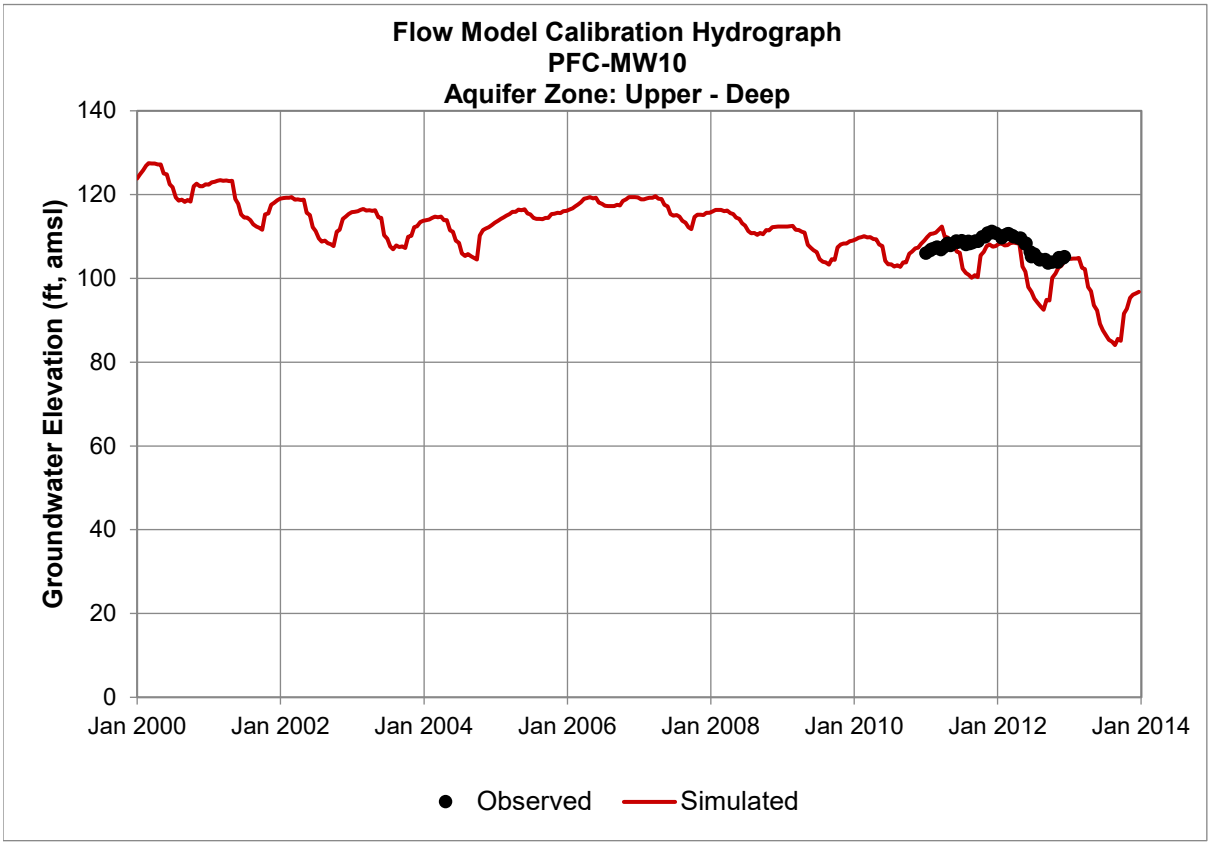
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-MW-1
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-MW10
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
140
120
100
80
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40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
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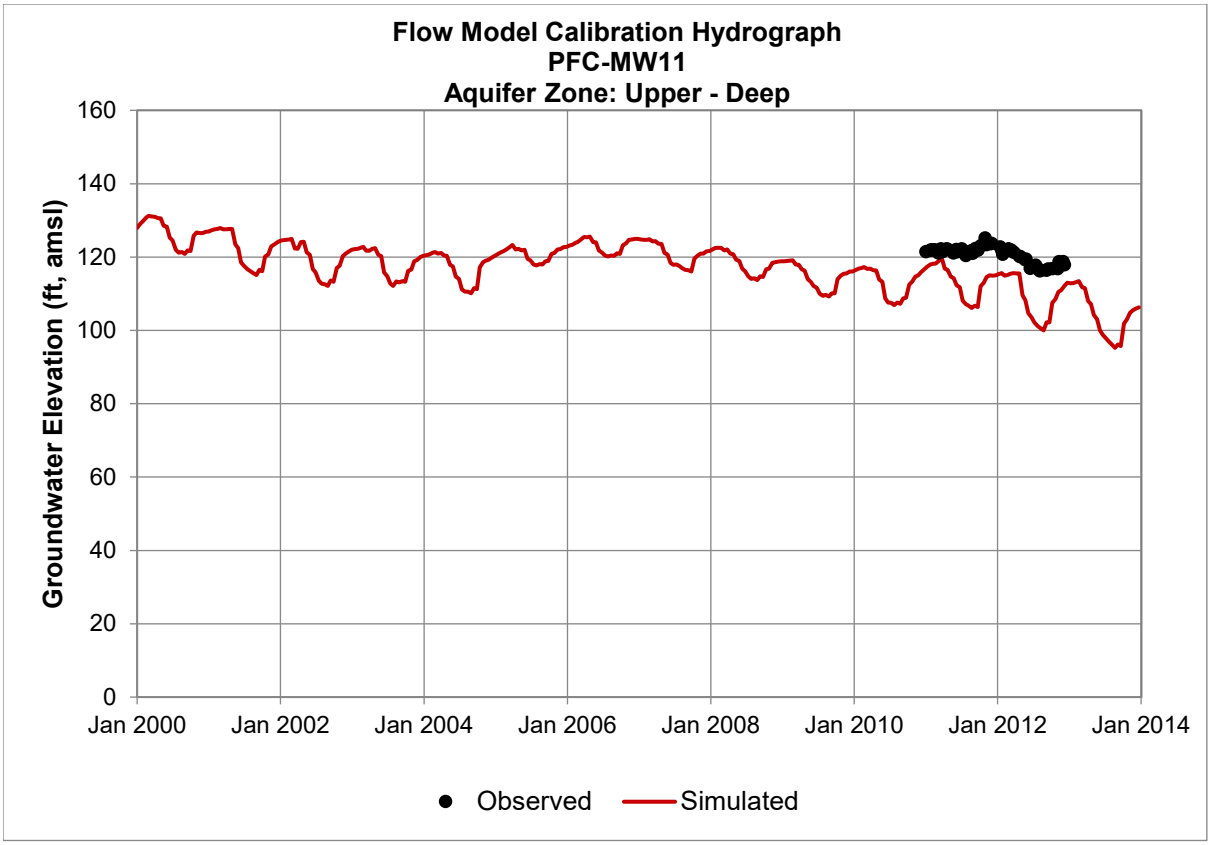
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-MW11
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
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40
20
0
Jan 2000
Jan 2002
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Jan 2008
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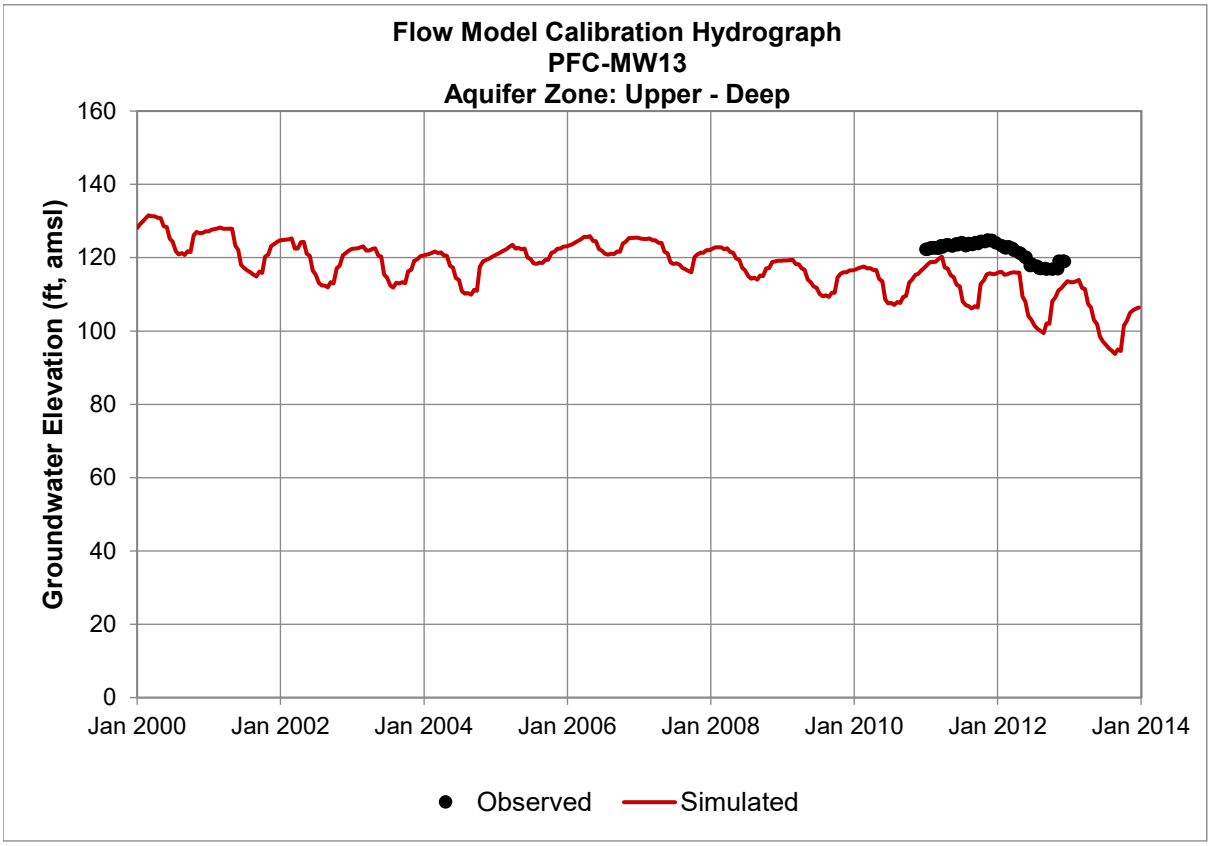
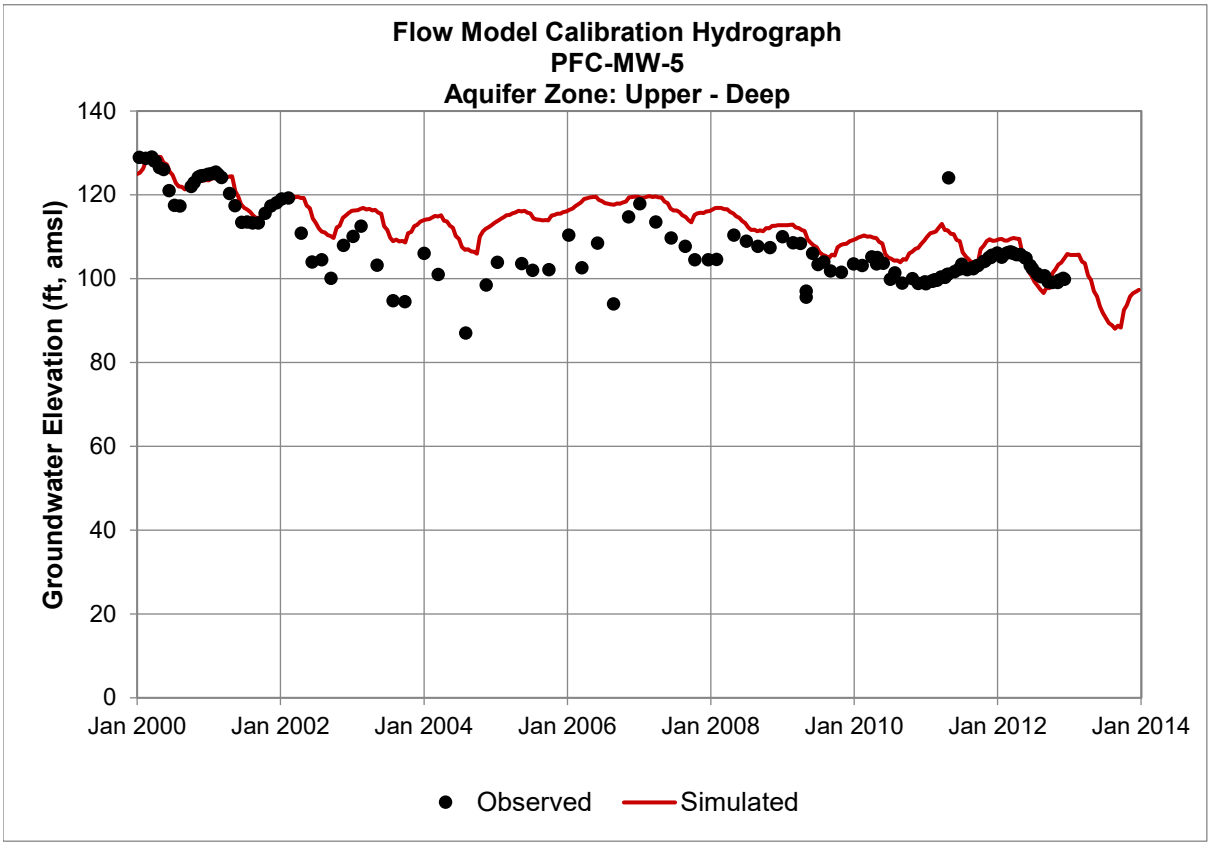
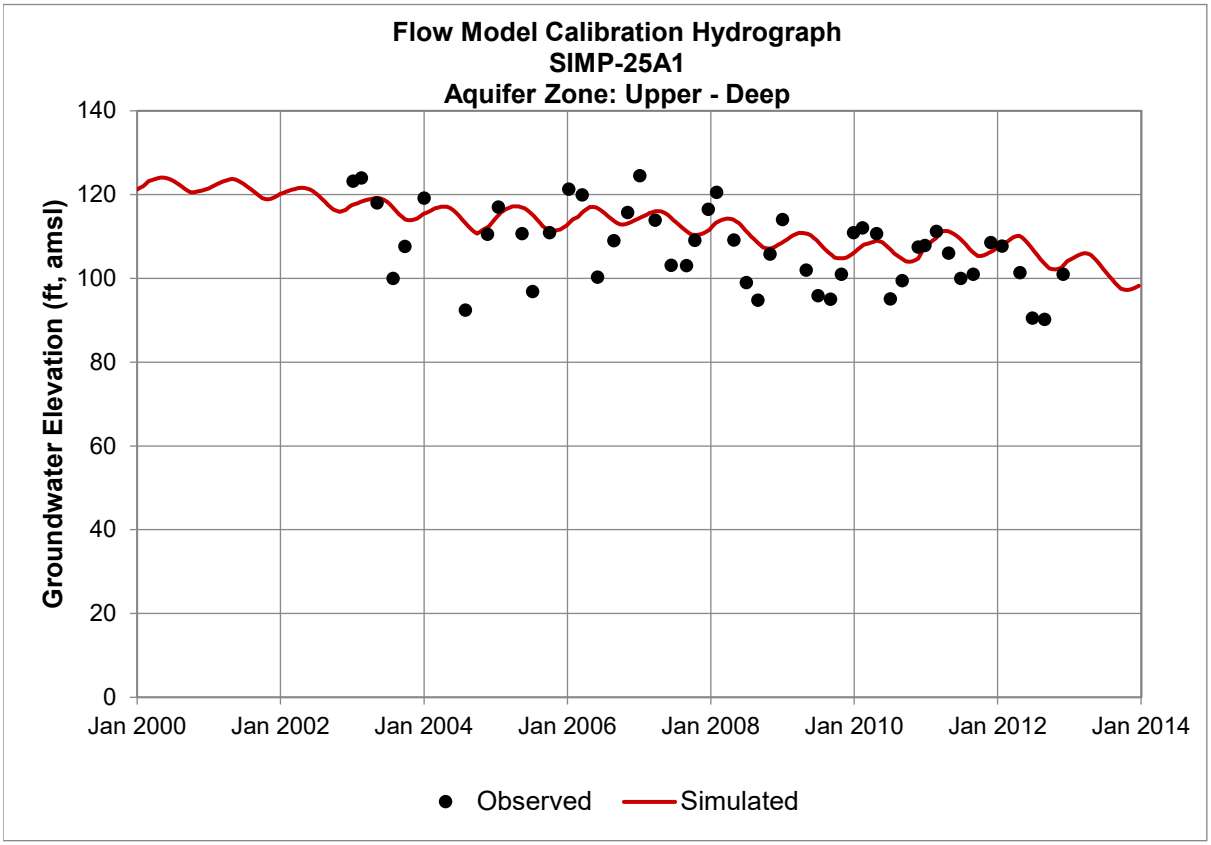
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-MW13
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-MW-5
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SIMP-25A1
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
140
120
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80
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20
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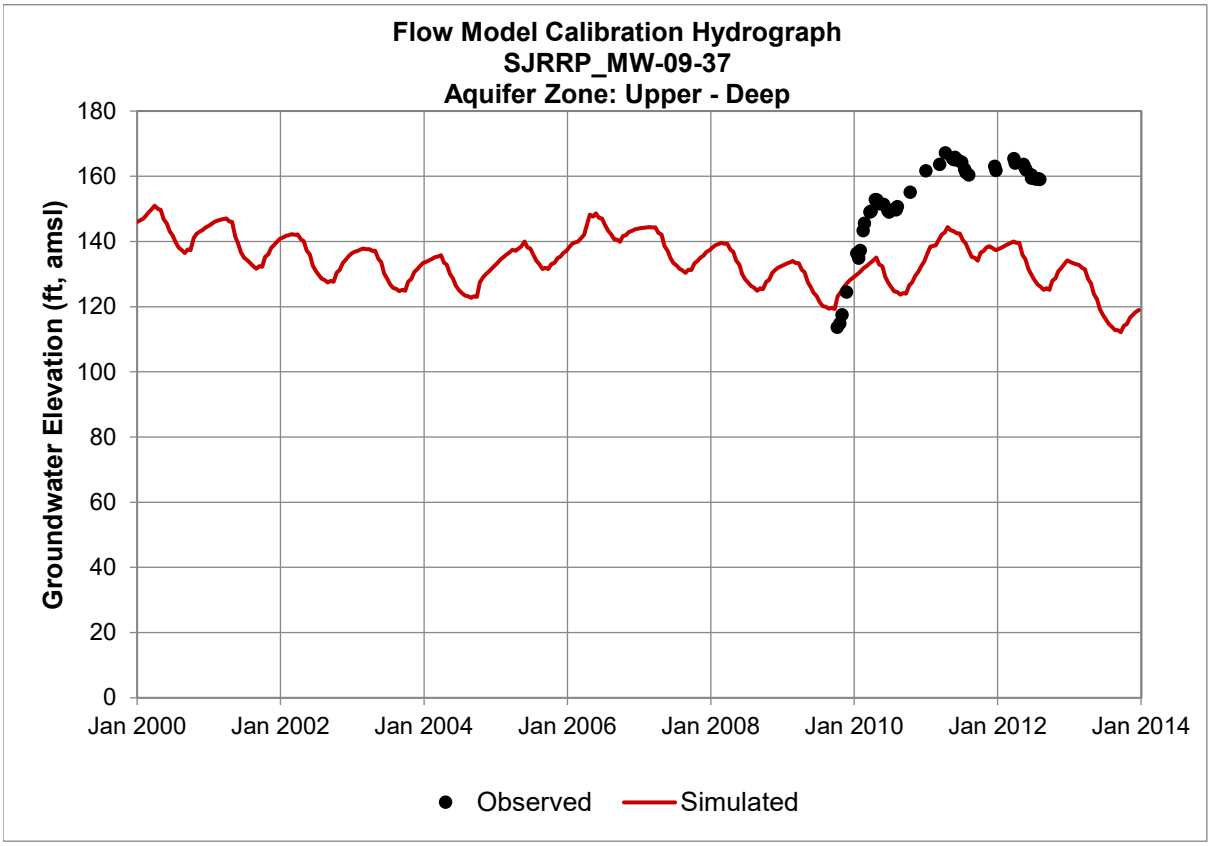
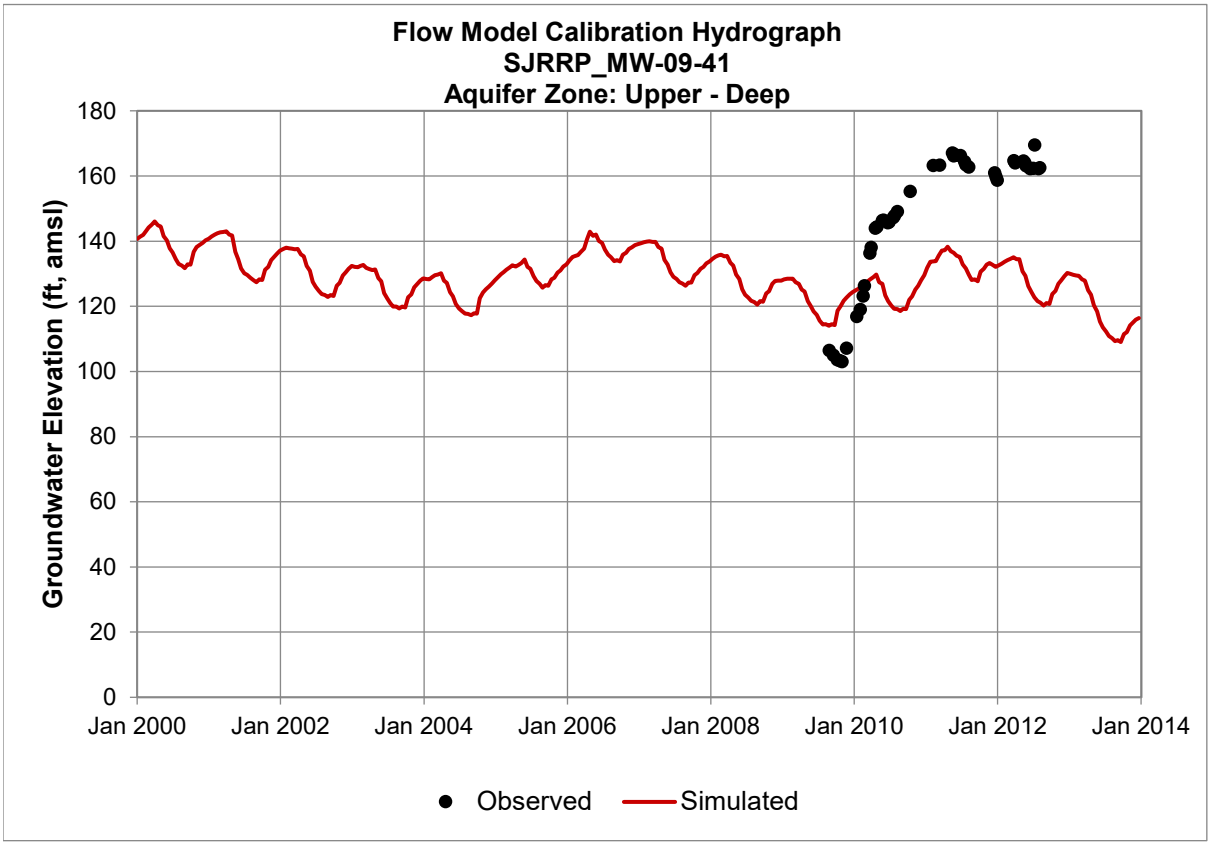
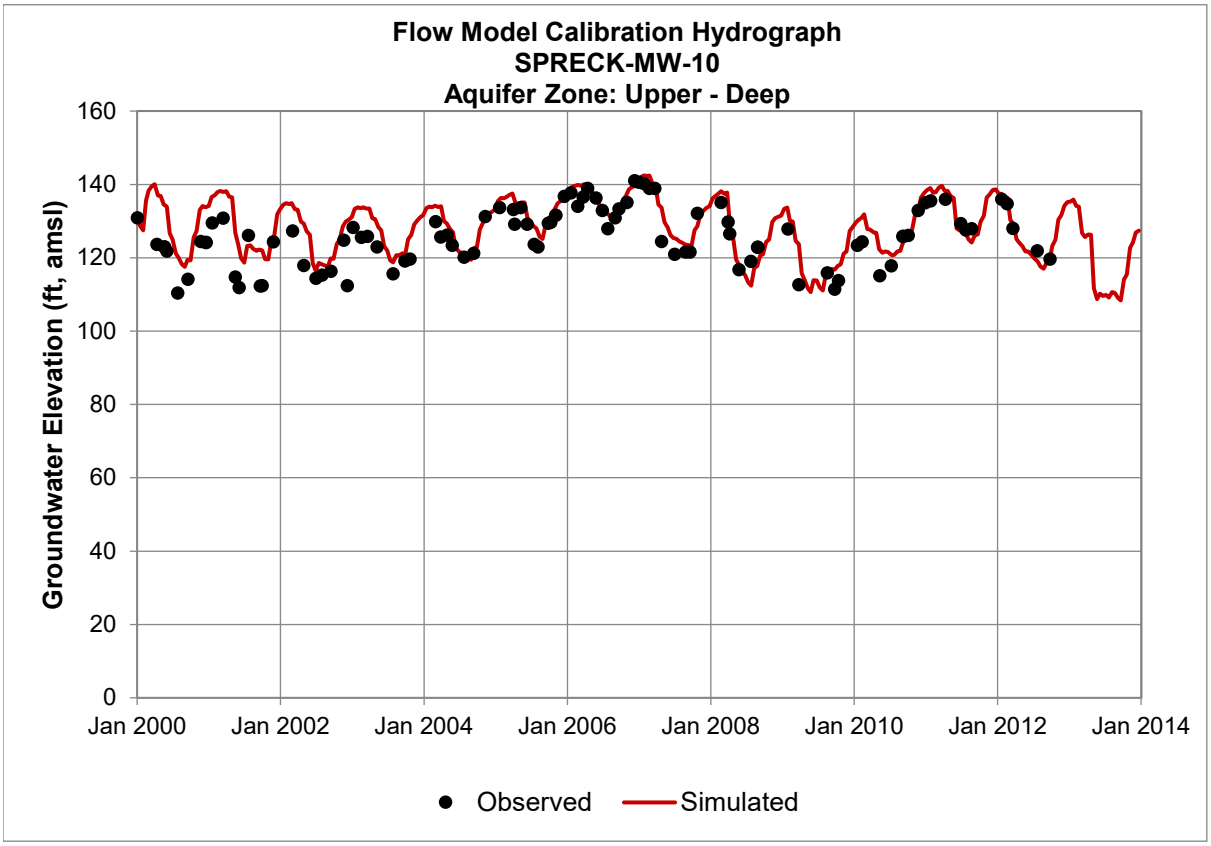
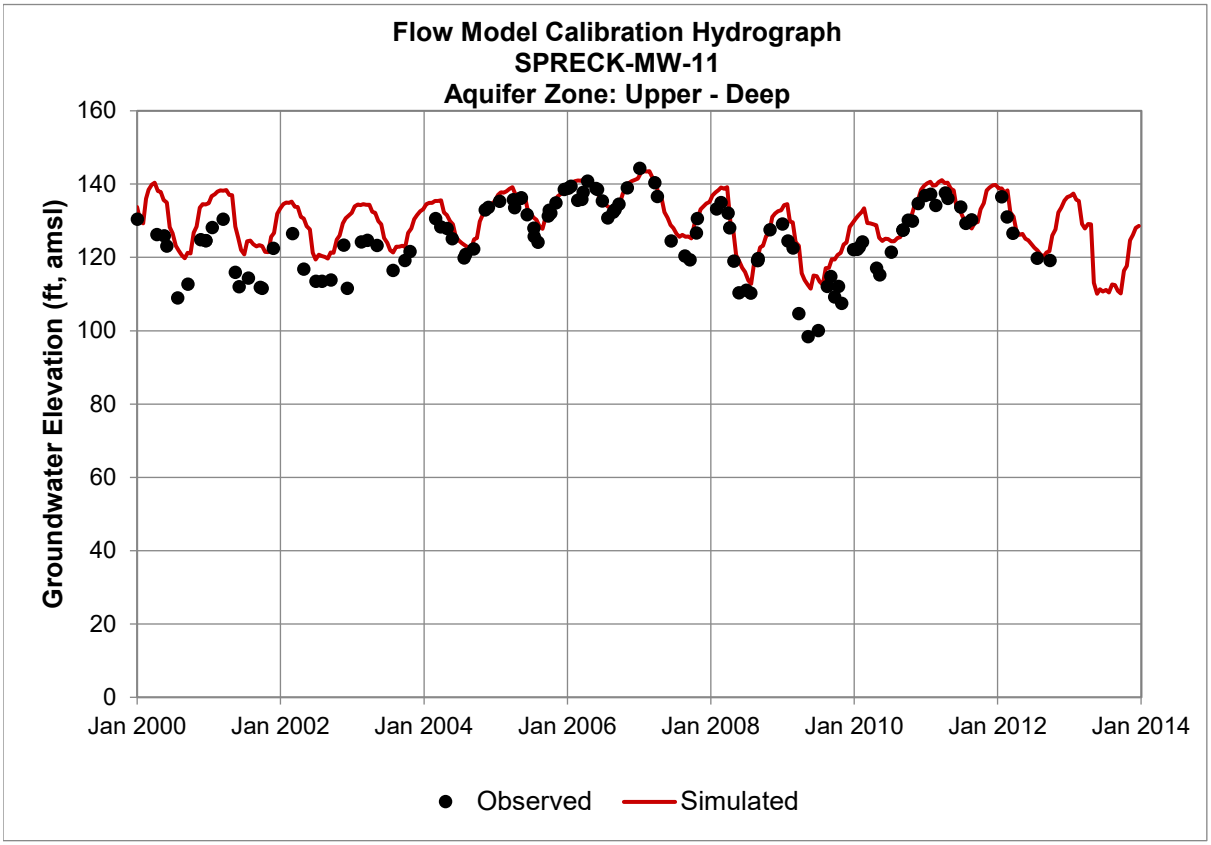
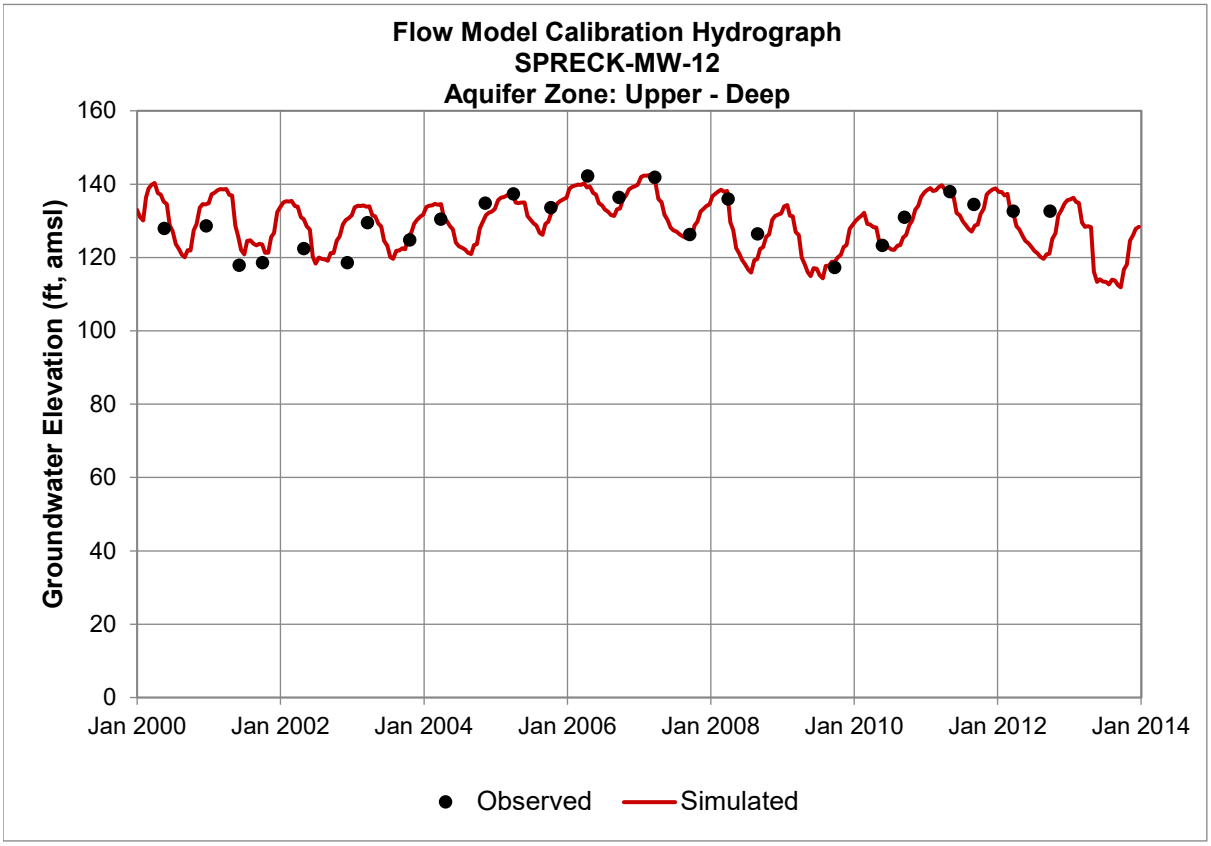
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SJRRP_MW-09-37
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SJRRP_MW-09-41
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-10
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-11
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-12
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
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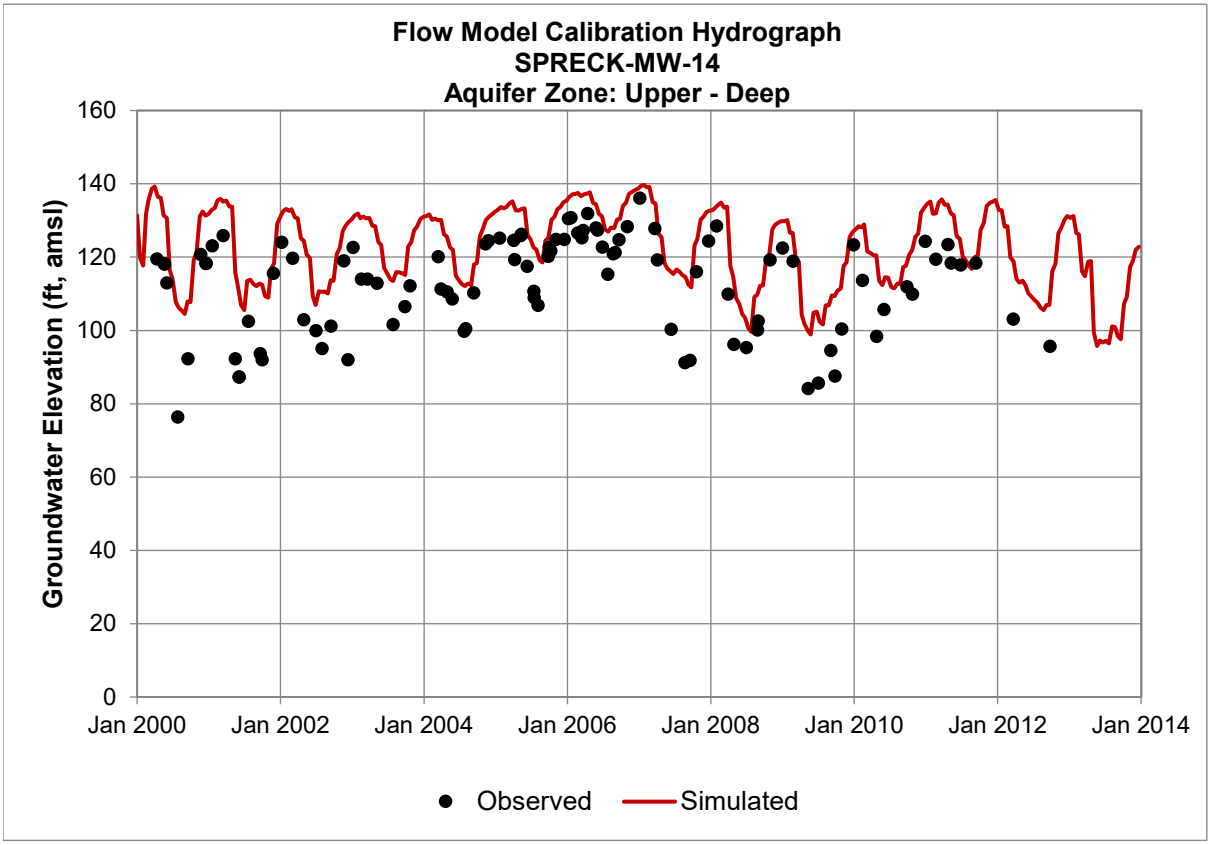
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-14
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
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40
20
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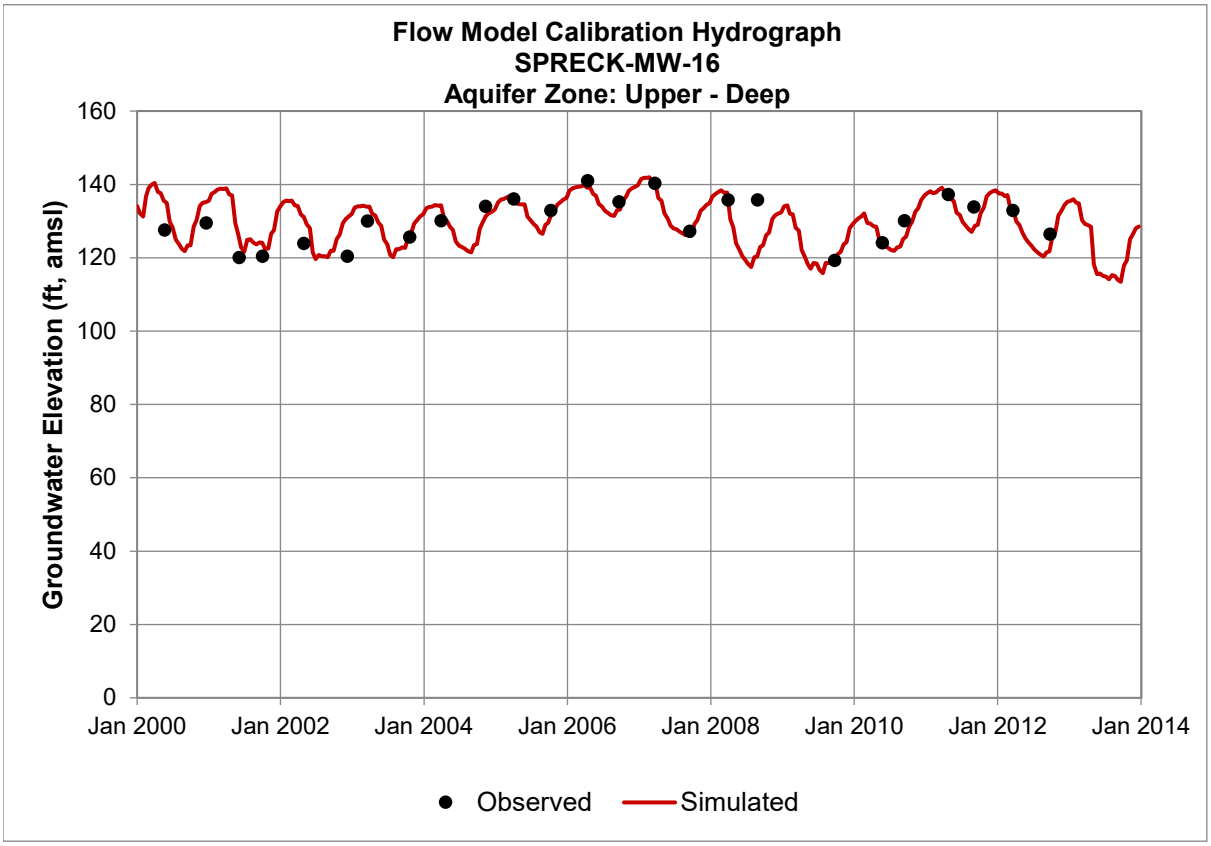
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-16
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
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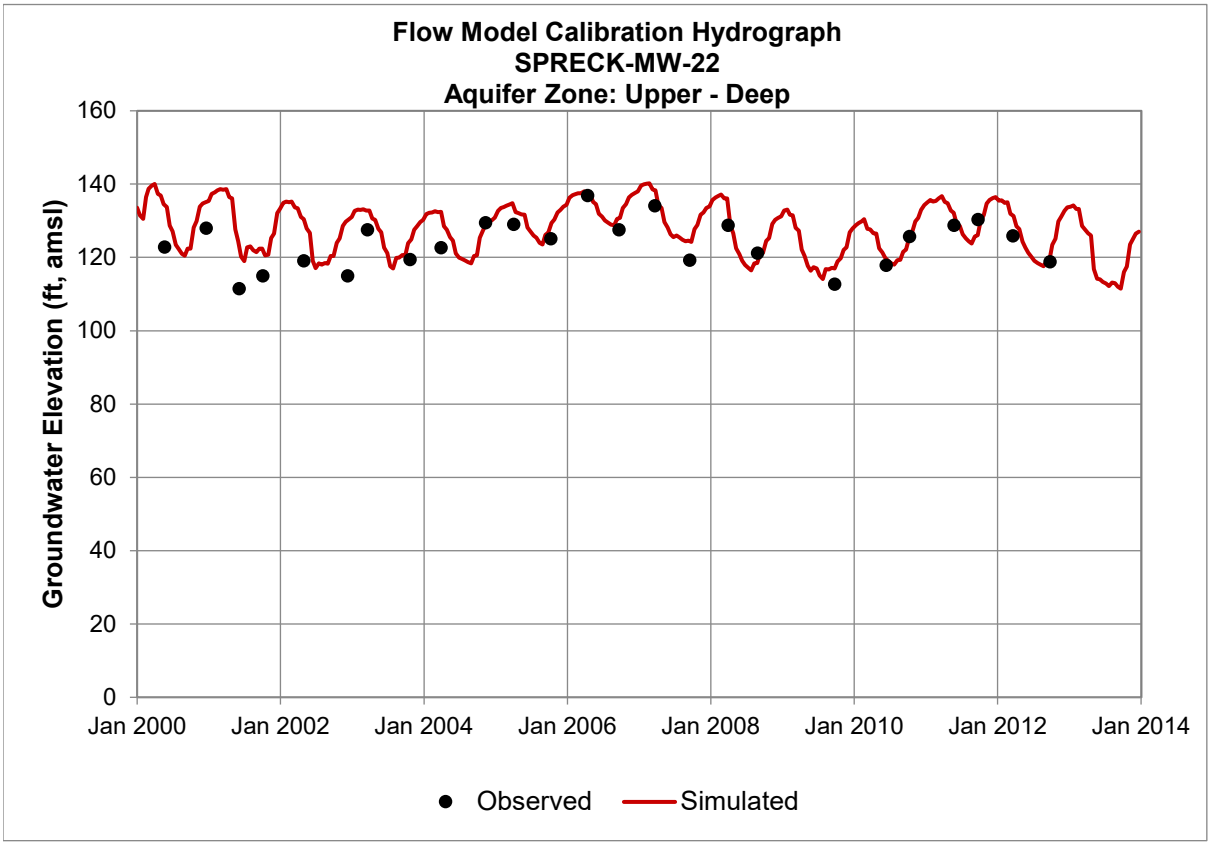
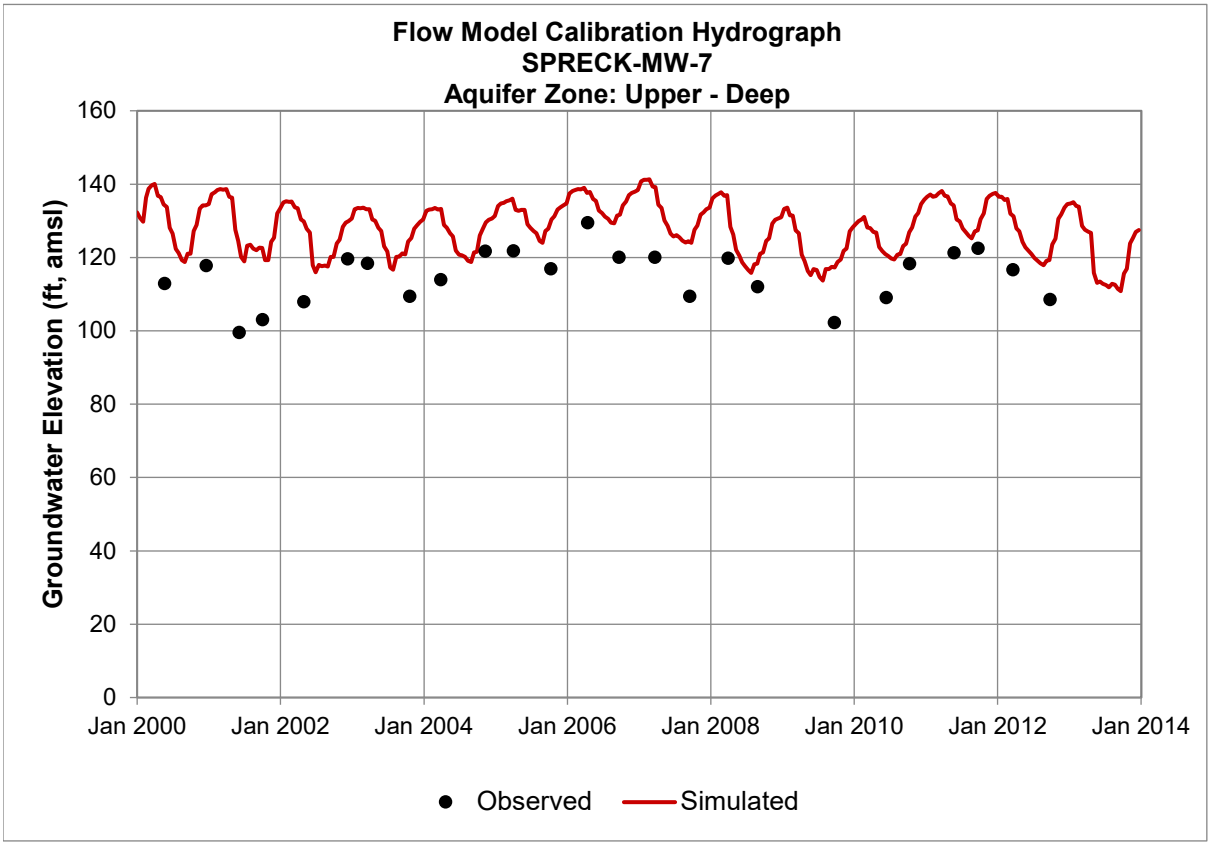
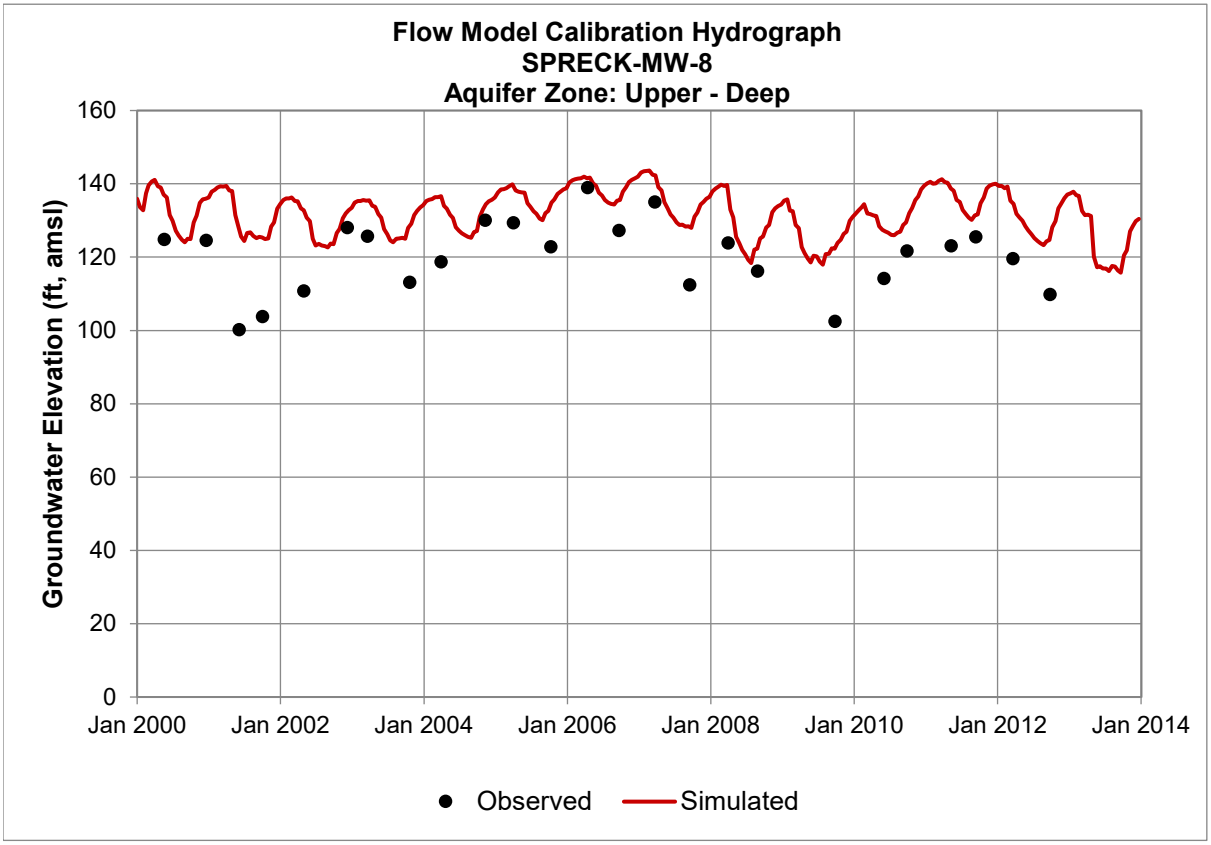
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-22
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-7
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
SPRECK-MW-8
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
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140
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80
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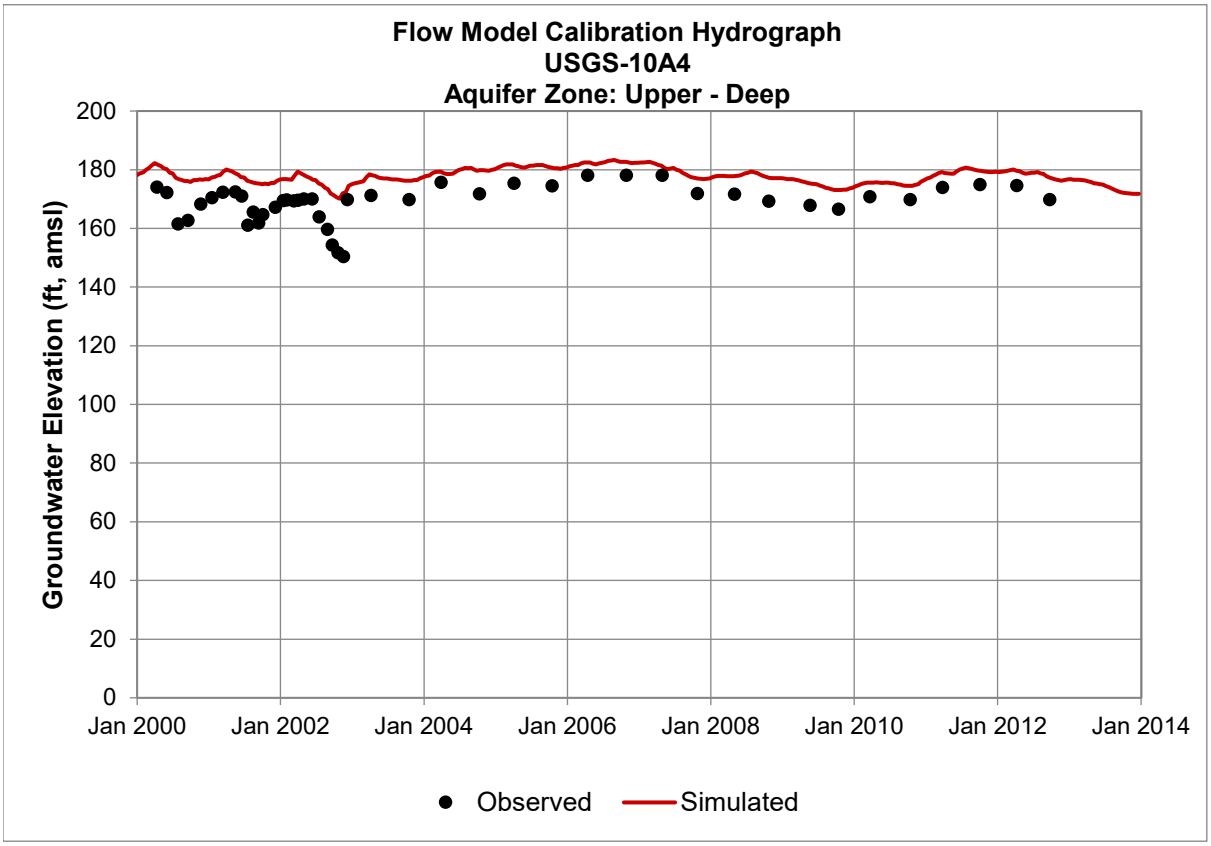
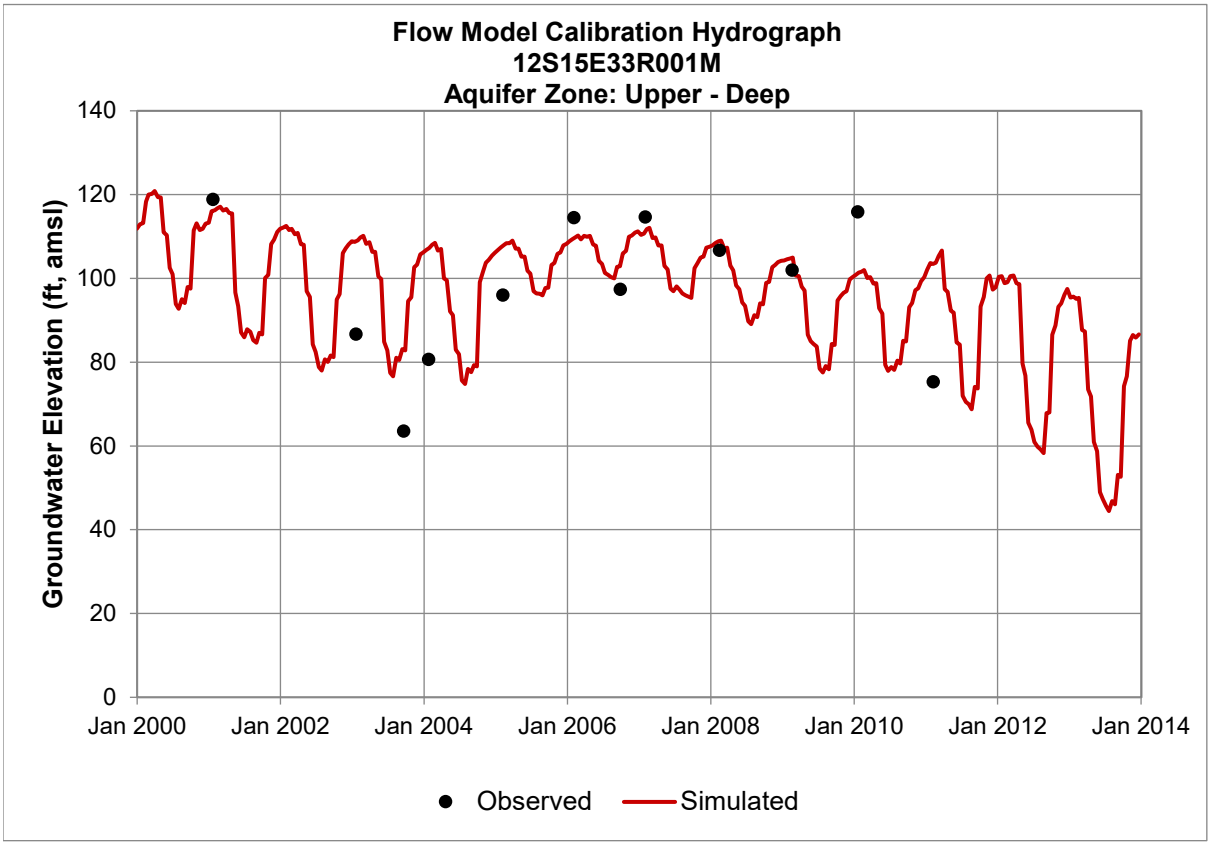
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
USGS-10A4
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
200
180
160
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
12S15E33R001M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
140
120
100
80
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40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
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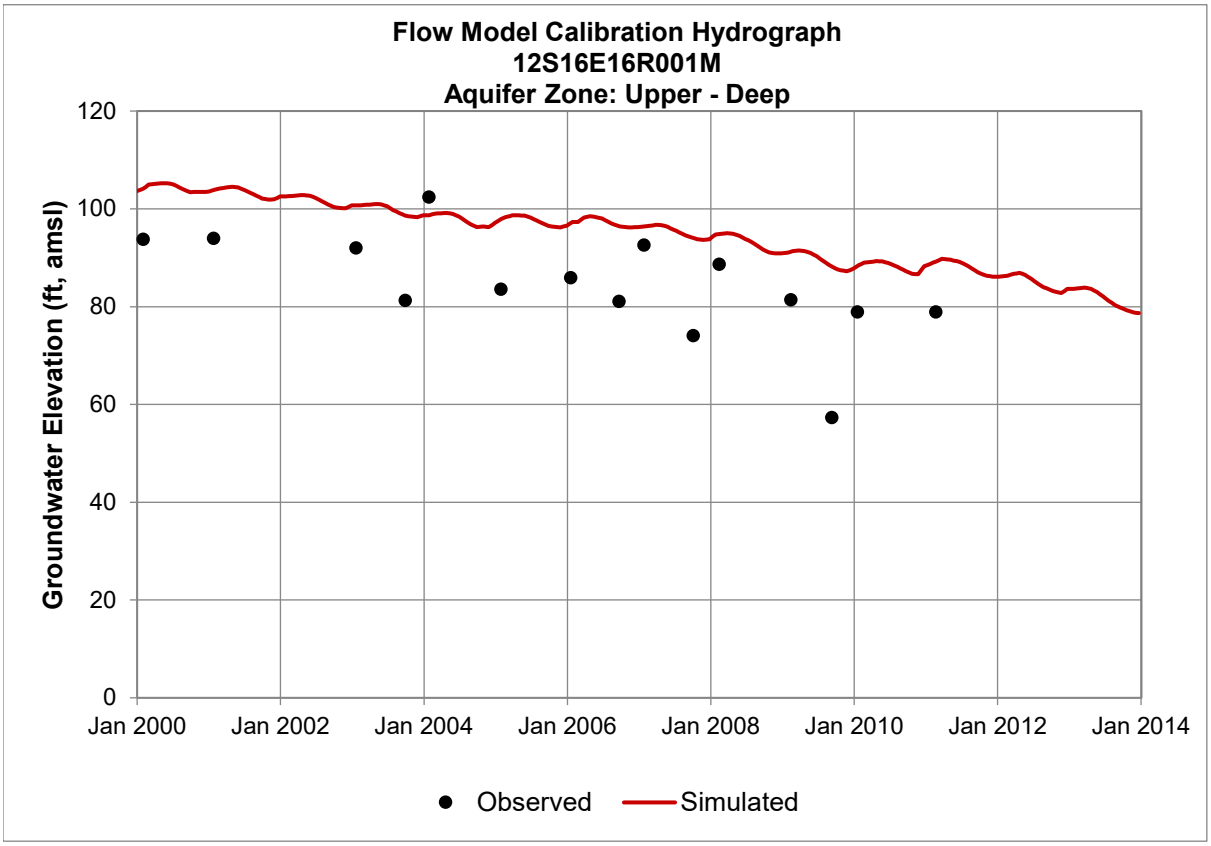
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
12S16E16R001M
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
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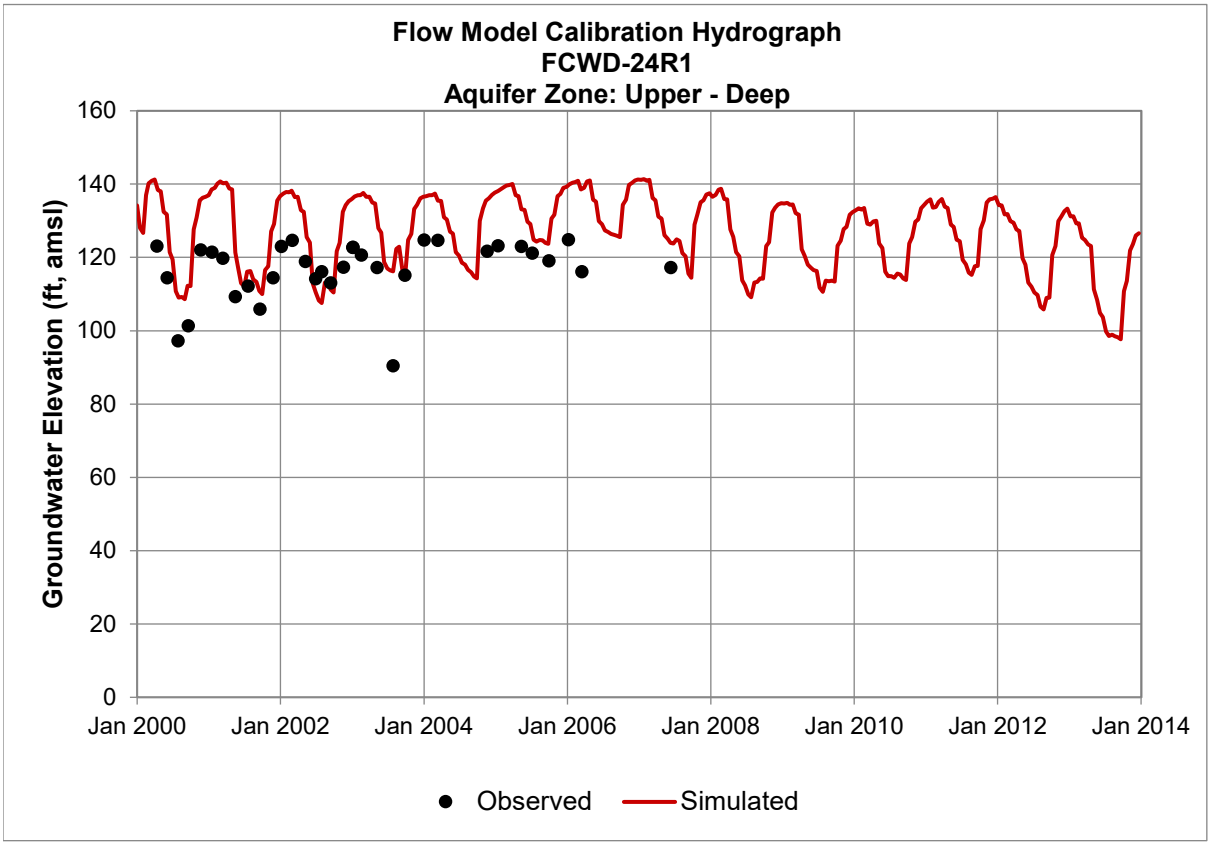
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
FCWD-24R1
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
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140
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80
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40
20
0
Jan 2000
Jan 2002
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Jan 2008
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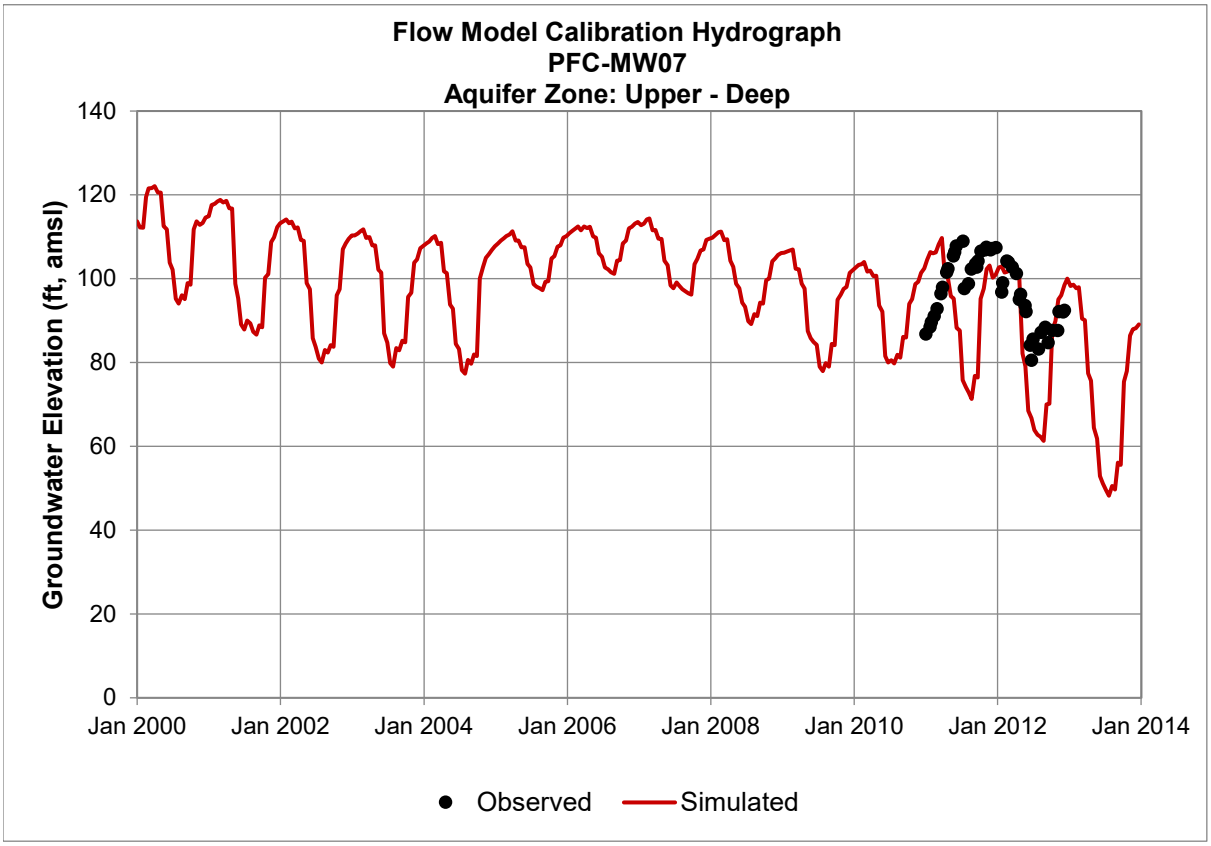
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-MW07
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
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40
20
0
Jan 2000
Jan 2002
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Jan 2008
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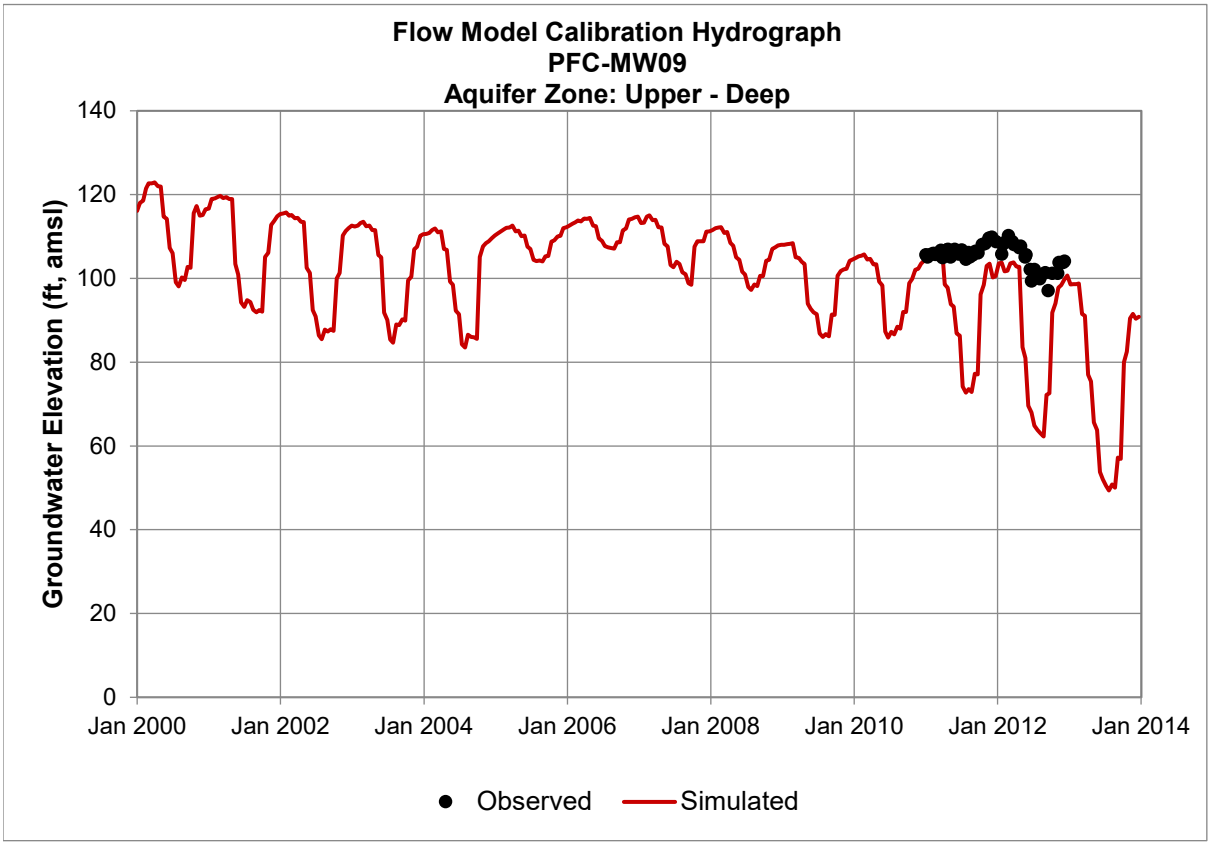
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-MW09
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
140
120
100
80
60
40
20
0
Jan 2000
Jan 2002
Jan 2004
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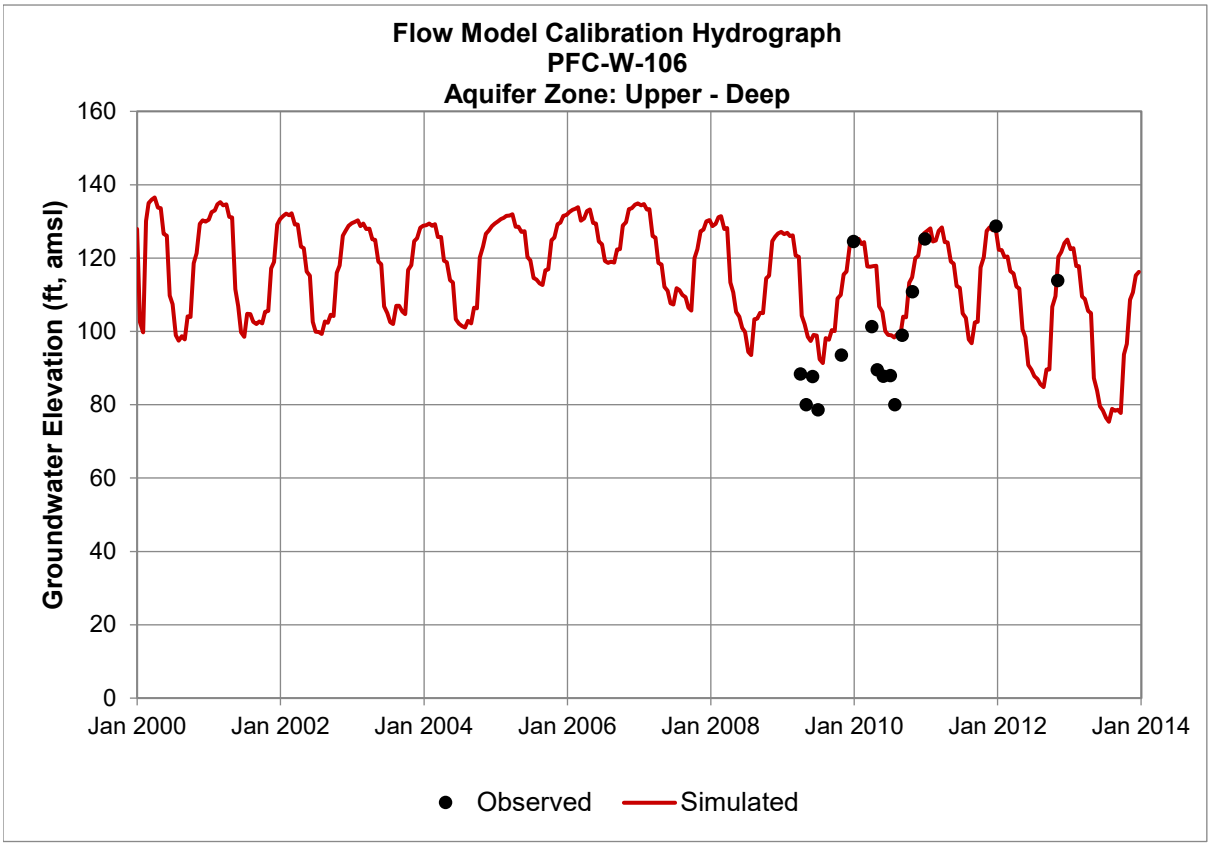
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-W-106
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
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80
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20
0
Jan 2000
Jan 2002
Jan 2004
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Jan 2008
Jan 2010
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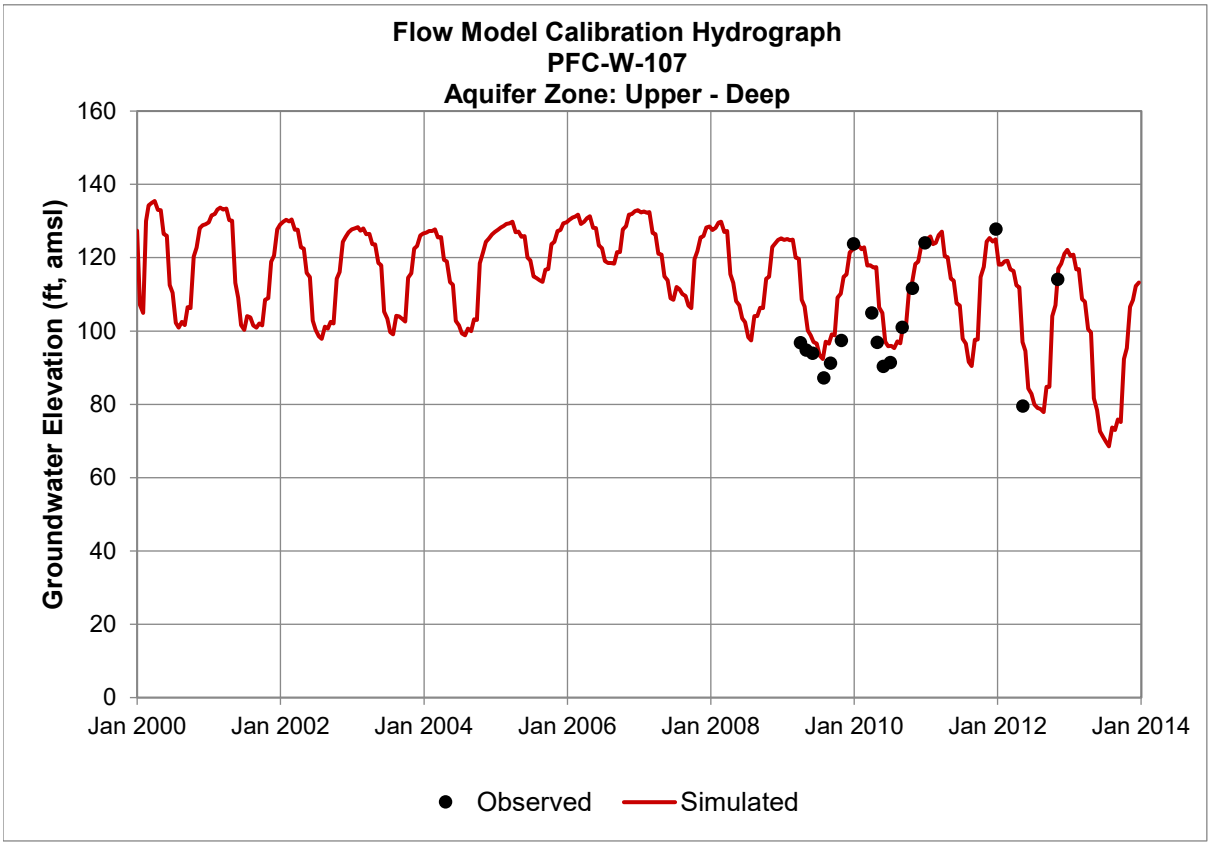
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-W-107
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
120
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20
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Jan 2000
Jan 2002
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Jan 2008
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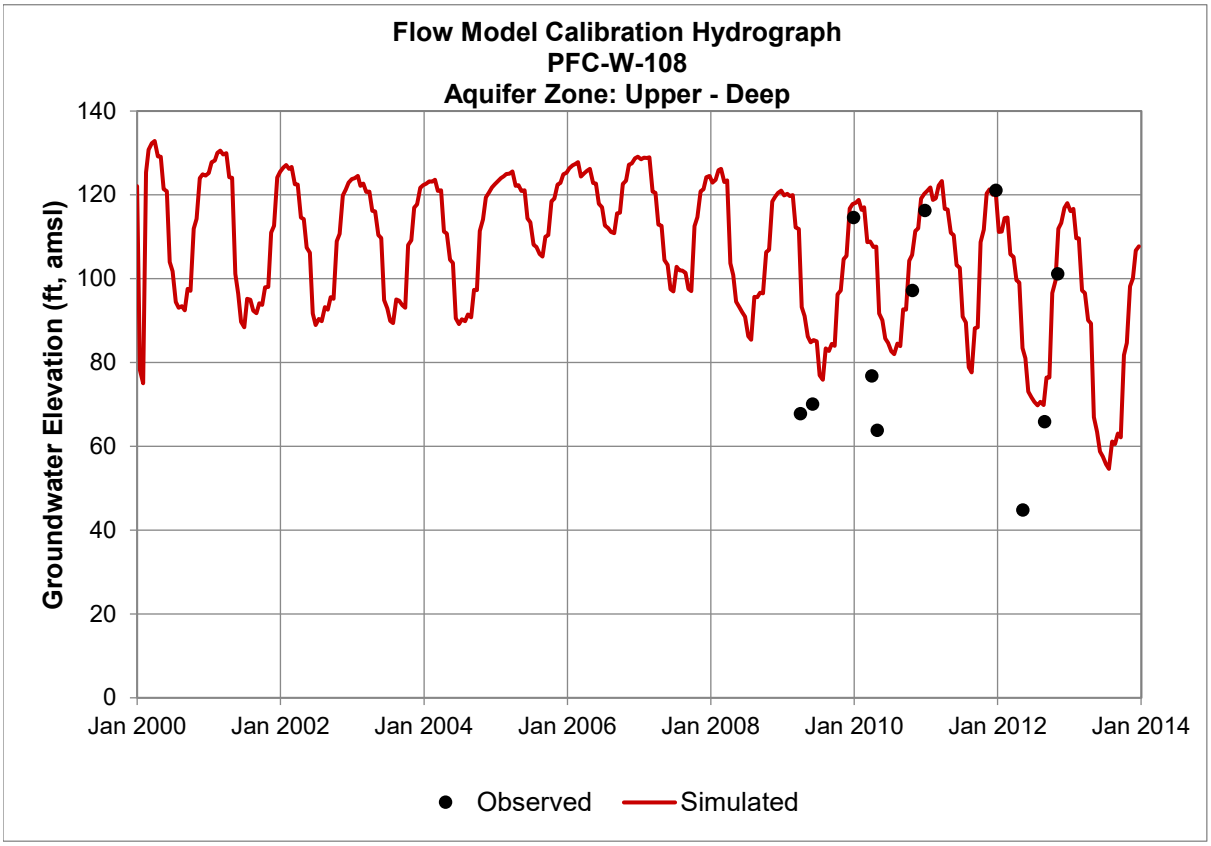
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-W-108
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
140
120
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20
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Jan 2000
Jan 2002
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Jan 2008
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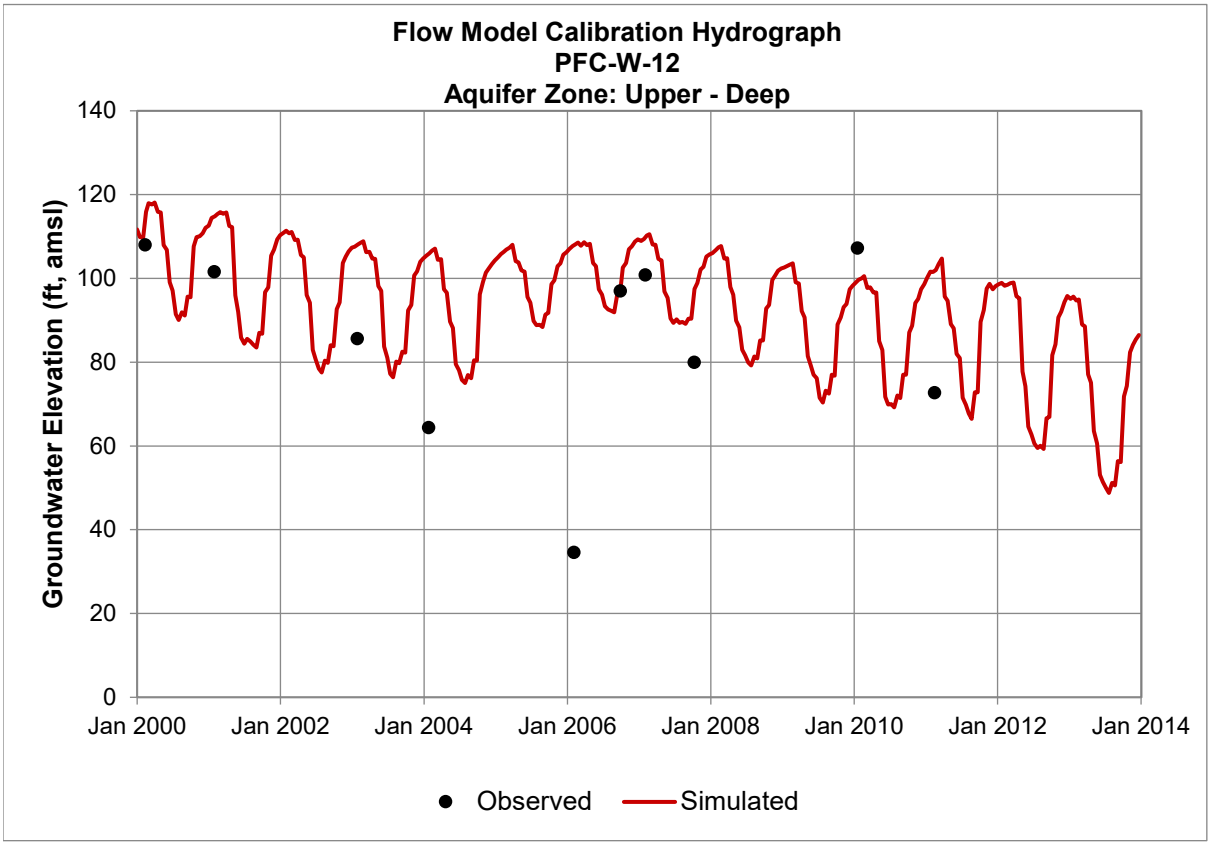
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-W-12
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
140
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Jan 2000
Jan 2002
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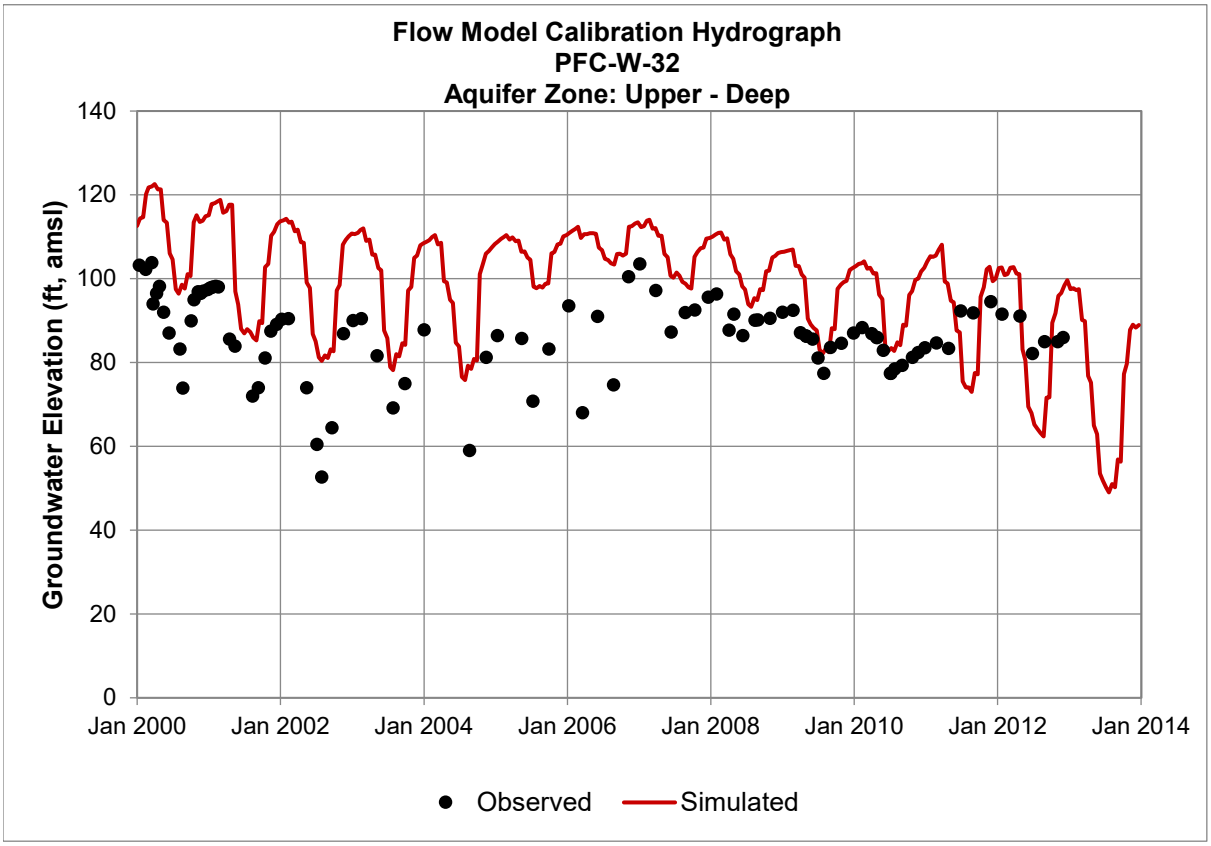
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-W-32
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
140
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Jan 2000
Jan 2002
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Jan 2008
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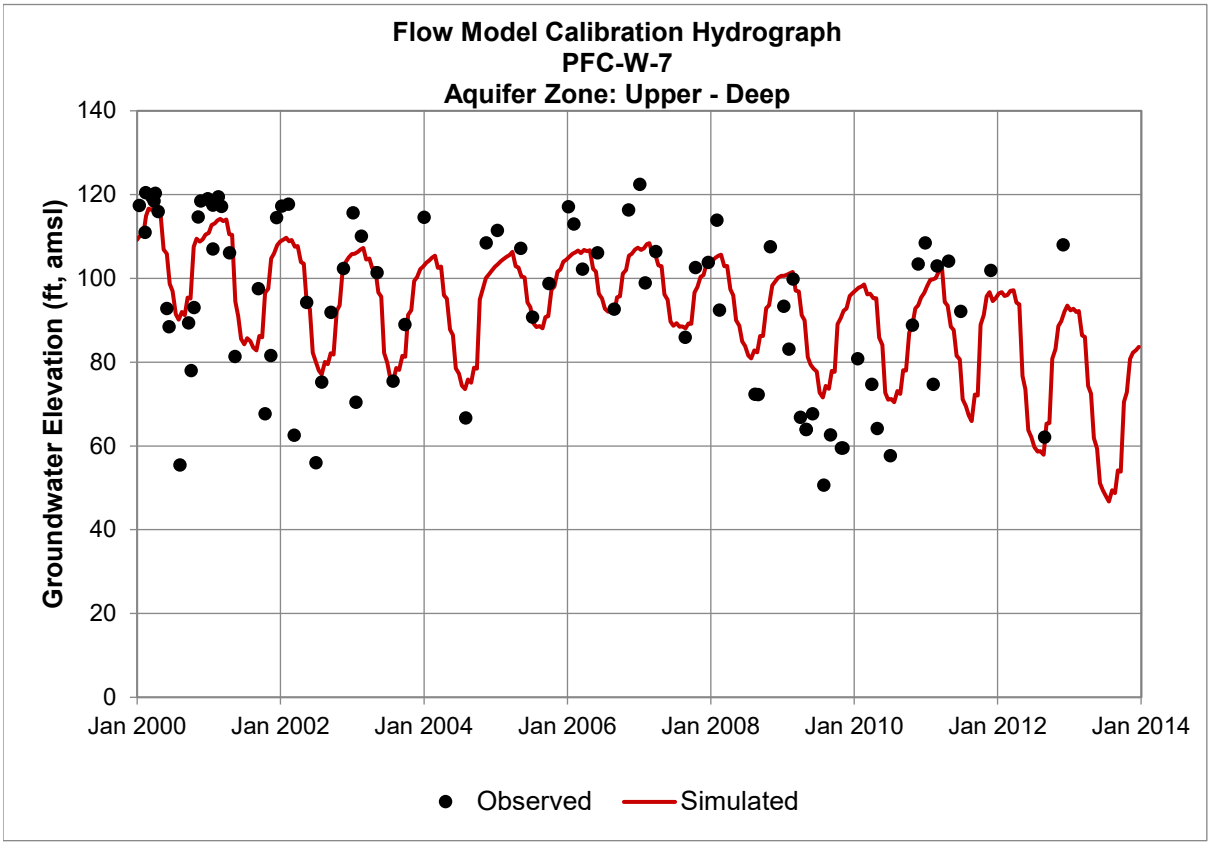
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-W-7
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
140
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Jan 2000
Jan 2002
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Jan 2008
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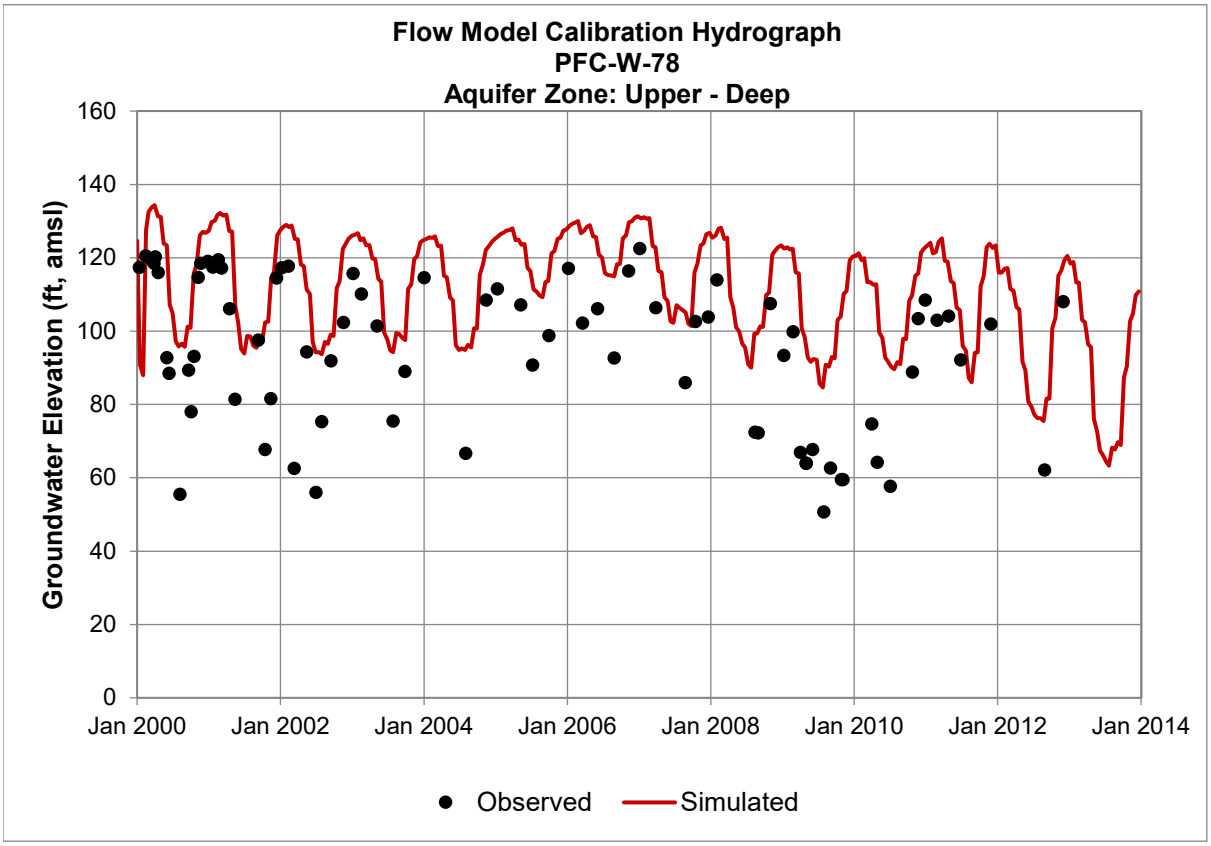
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-W-78
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
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Jan 2000
Jan 2002
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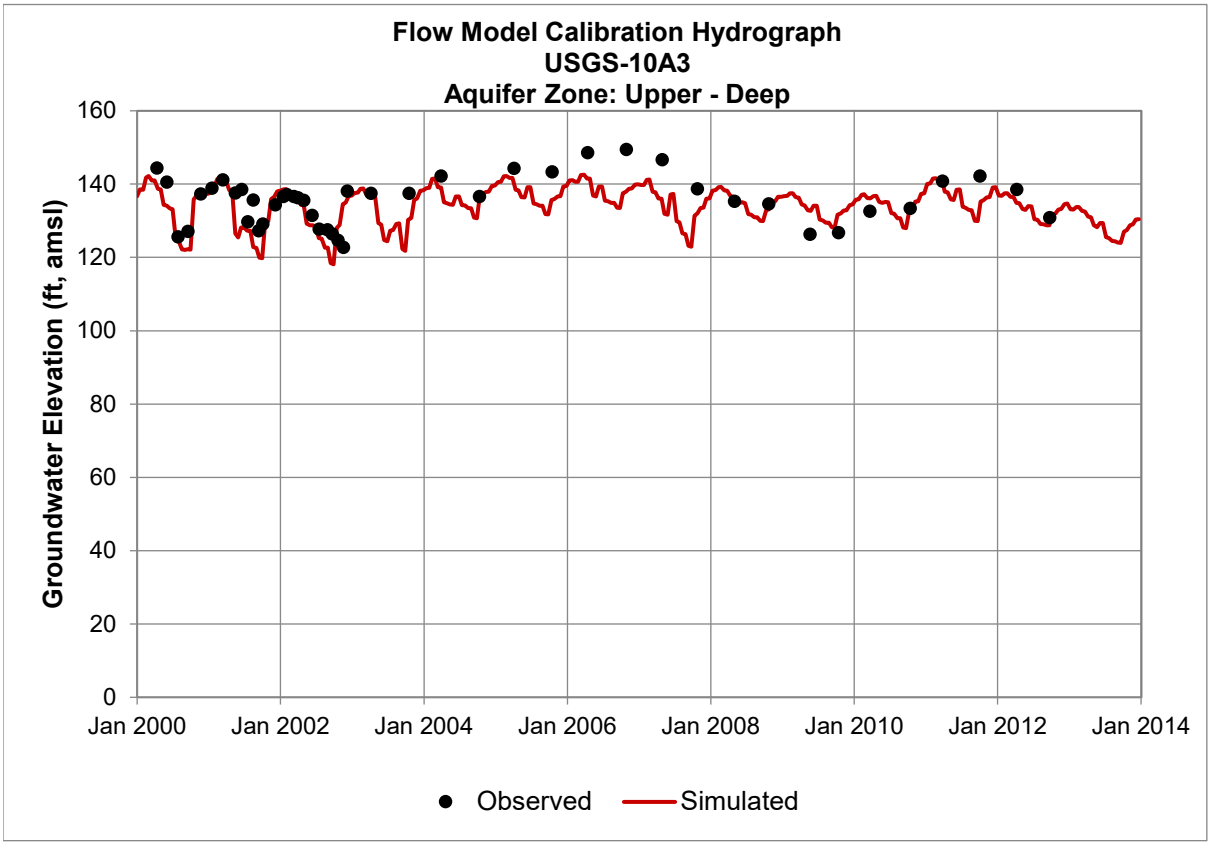
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
USGS-10A3
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
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Jan 2000
Jan 2002
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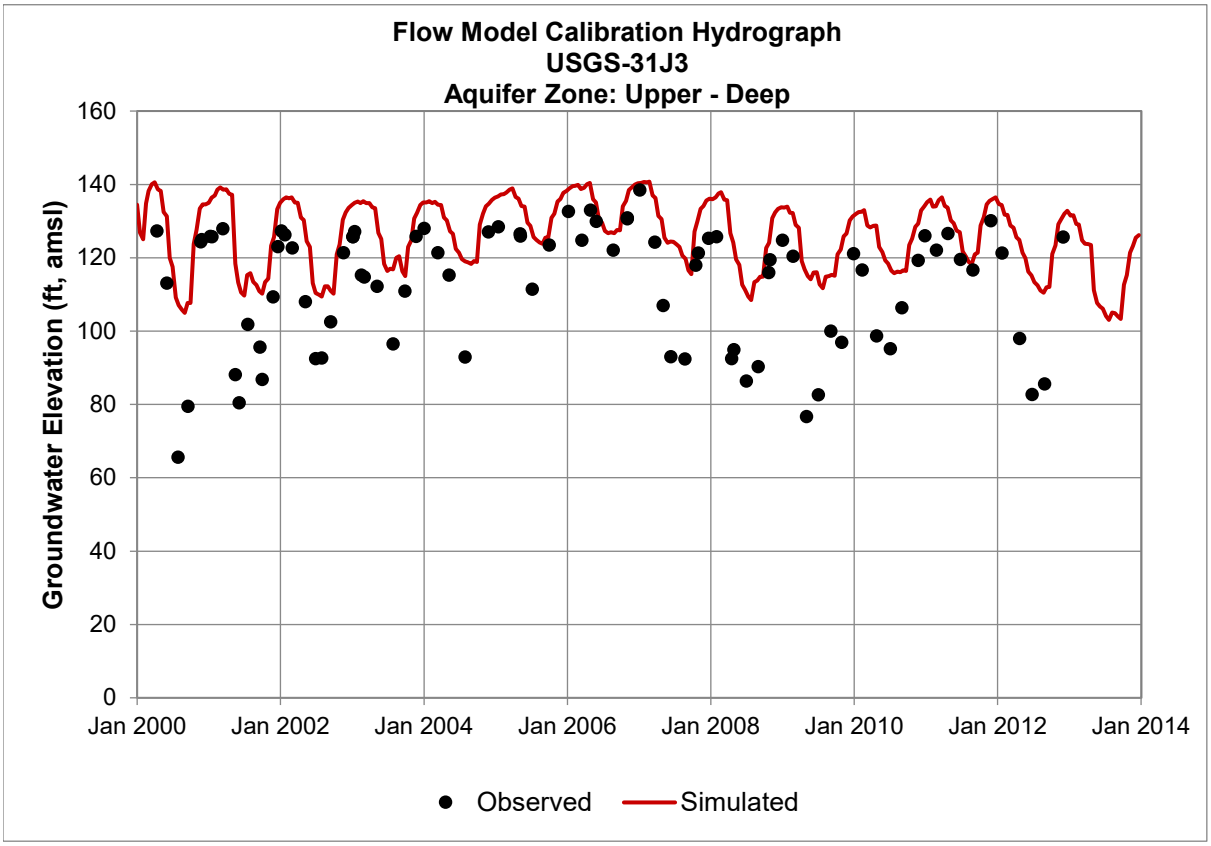
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
USGS-31J3
Aquifer Zone: Upper - Deep
Groundwater Elevation (ft, amsl)
160
140
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Jan 2000
Jan 2002
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Jan 2006
Jan 2008
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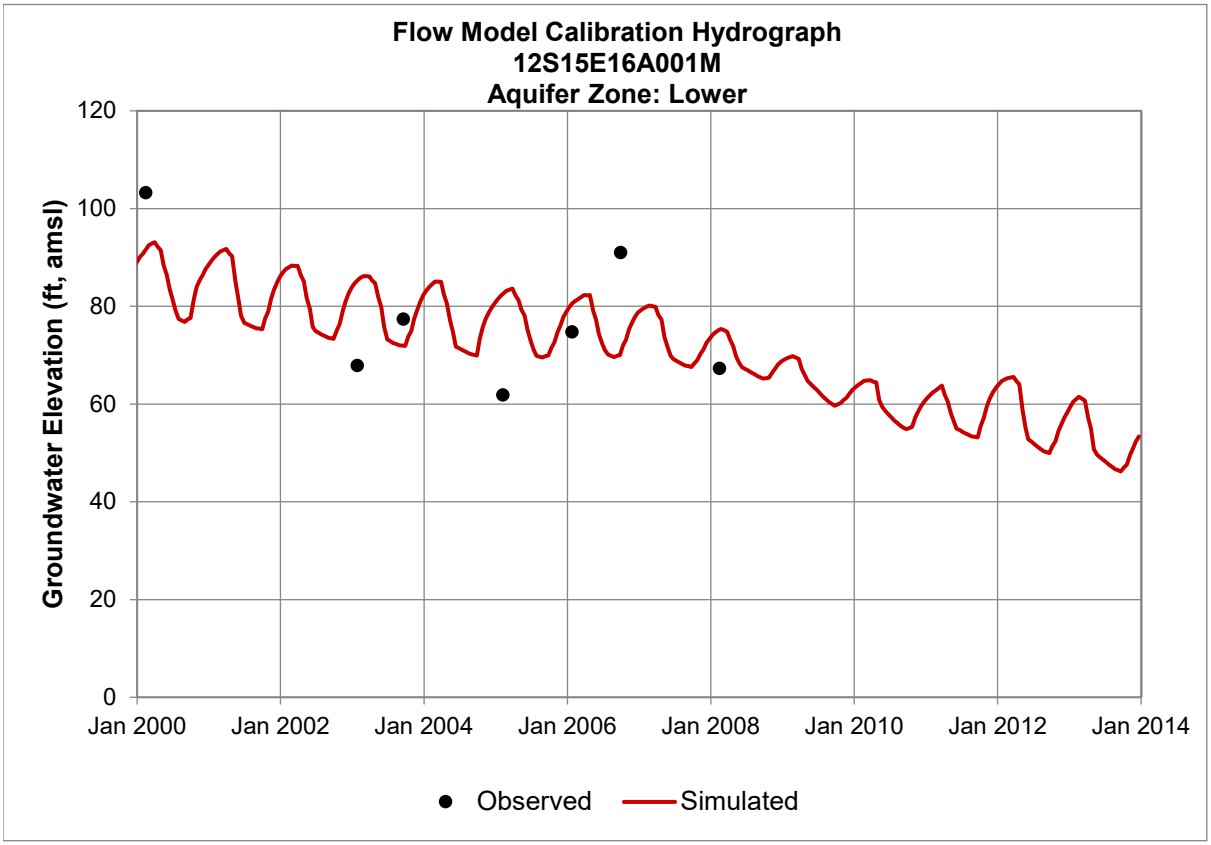
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
12S15E16A001M
Aquifer Zone: Lower
Groundwater Elevation (ft, amsl)
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Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
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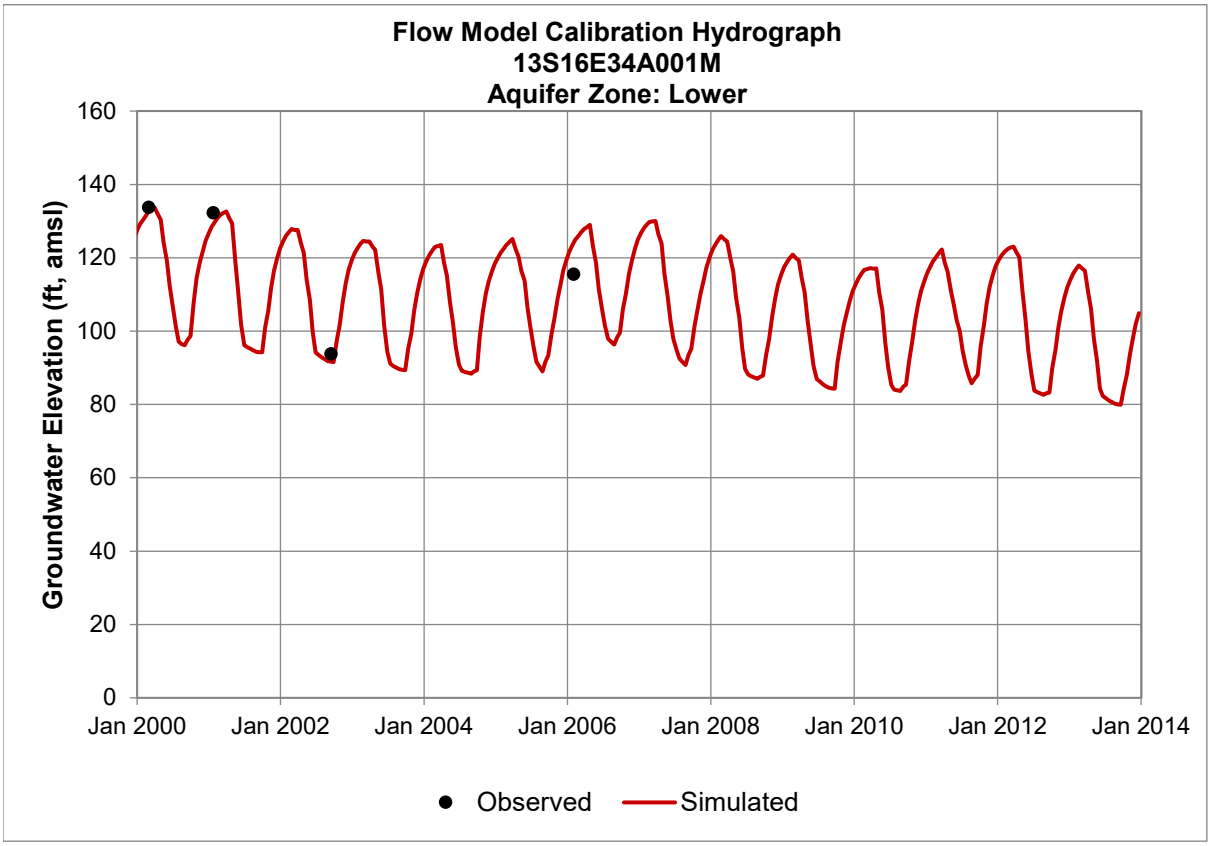
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
13S16E34A001M
Aquifer Zone: Lower
Groundwater Elevation (ft, amsl)
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140
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Jan 2000
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Jan 2008
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Jan 2012
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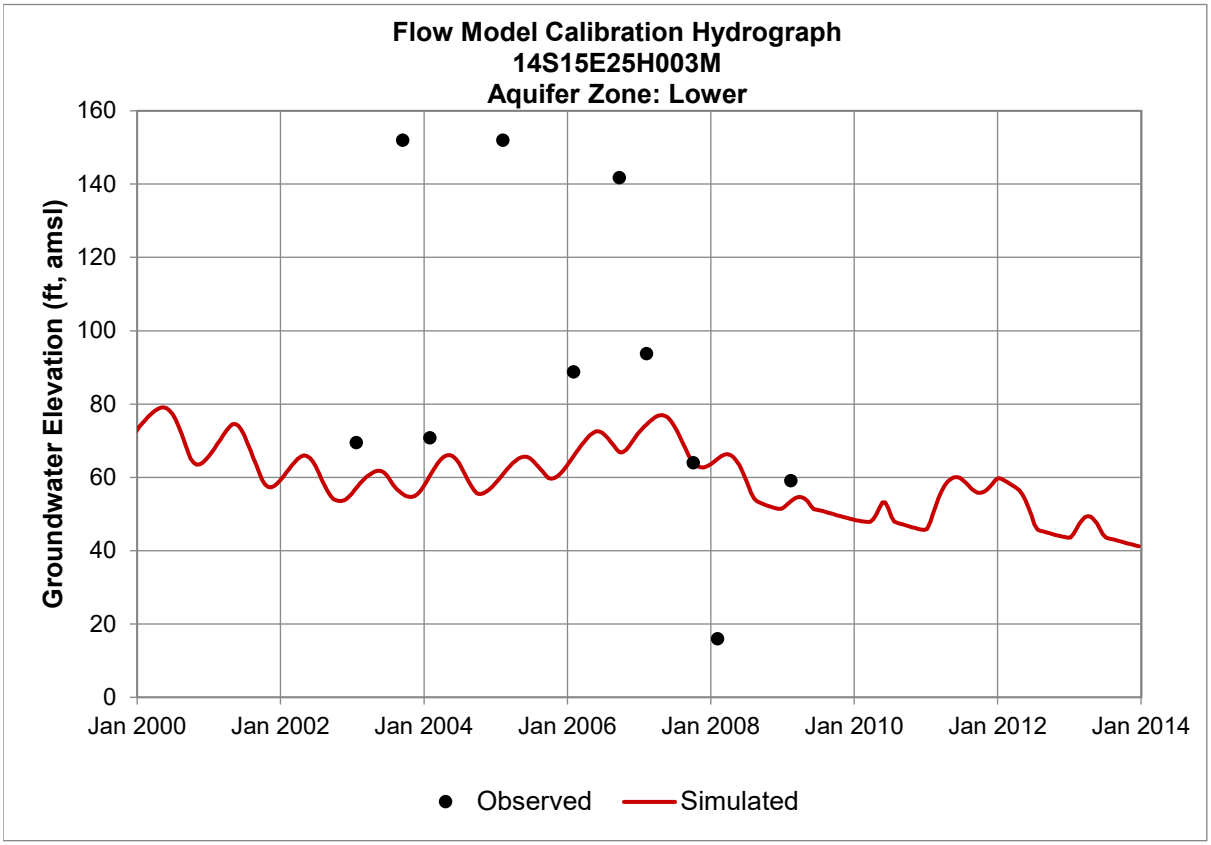
Observed
Simulated


Flow Model Calibration Hydrograph
14S15E25H003M
Aquifer Zone: Lower
Groundwater Elevation (ft, amsl)
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140
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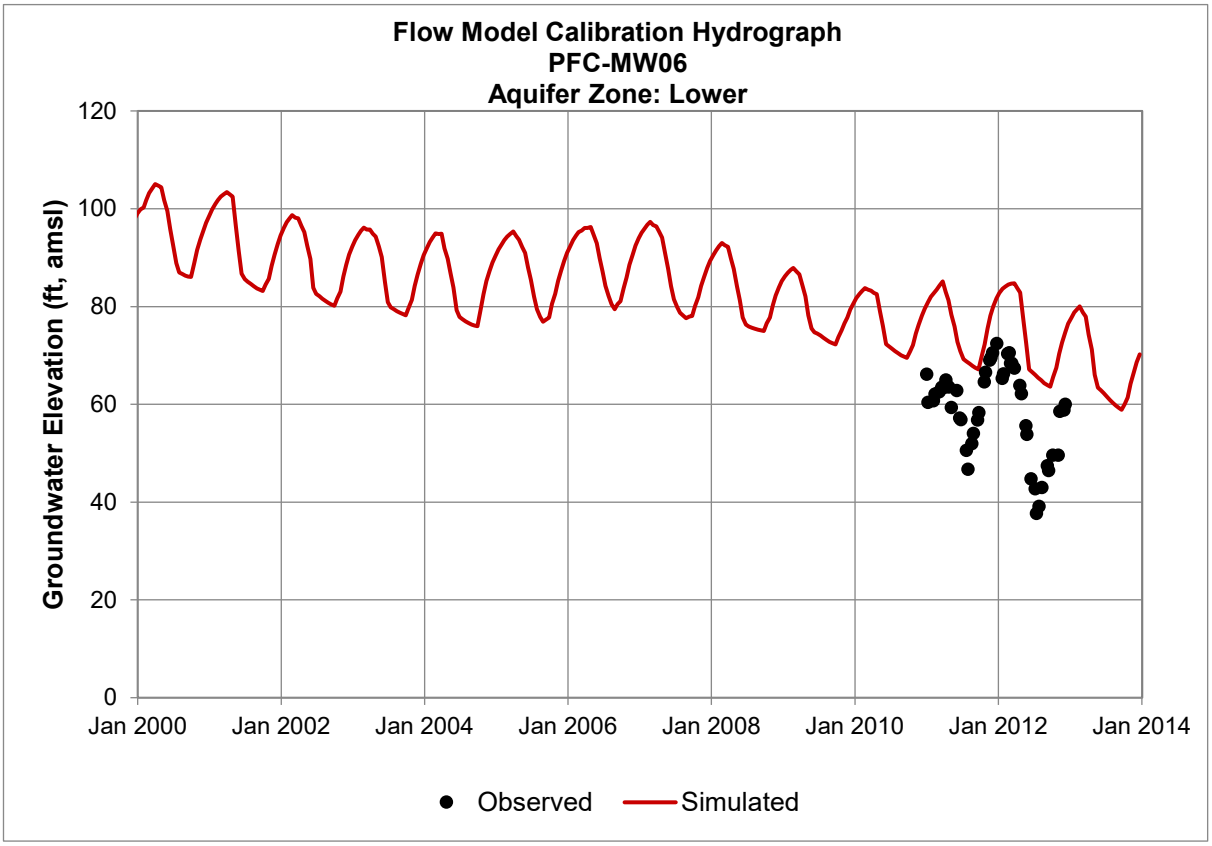
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-MW06
Aquifer Zone: Lower
Groundwater Elevation (ft, amsl)
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Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
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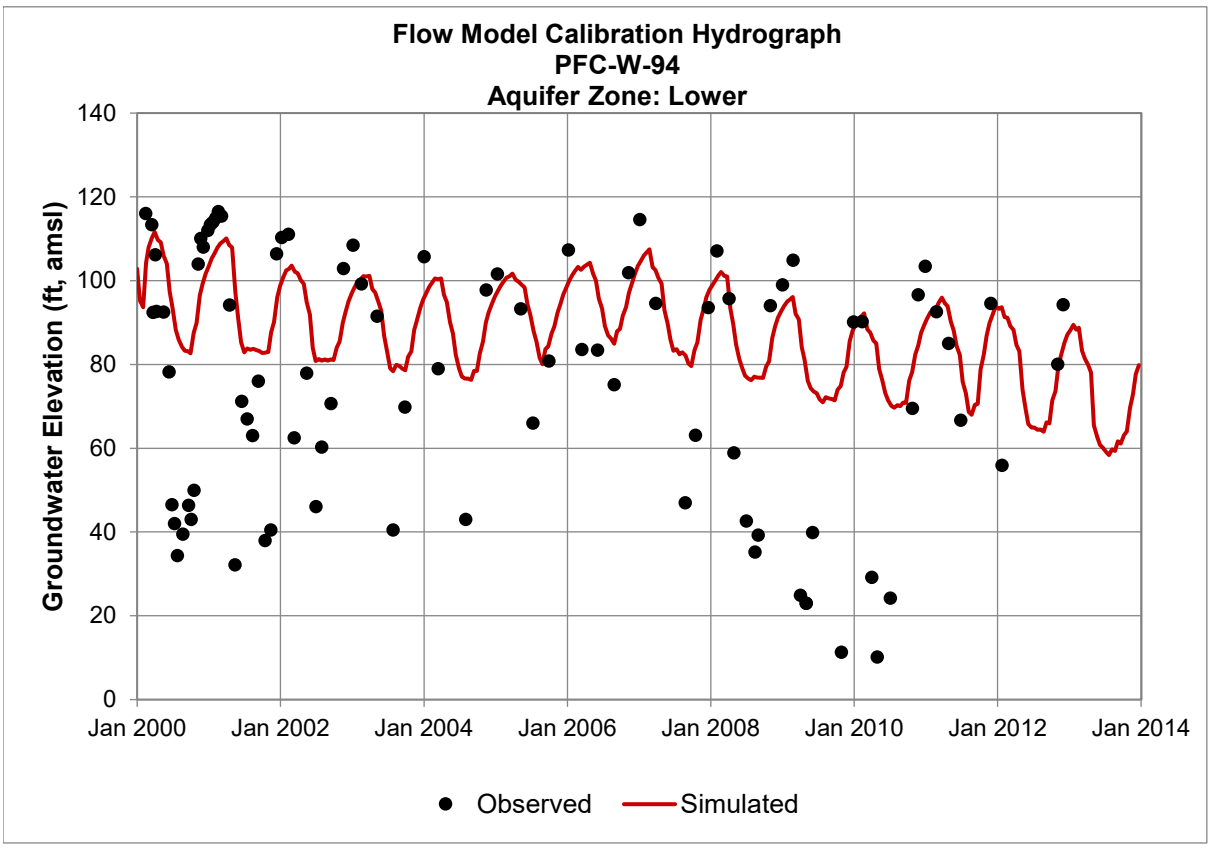
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
PFC-W-94
Aquifer Zone: Lower
Groundwater Elevation (ft, amsl)
140
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Jan 2000
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Jan 2008
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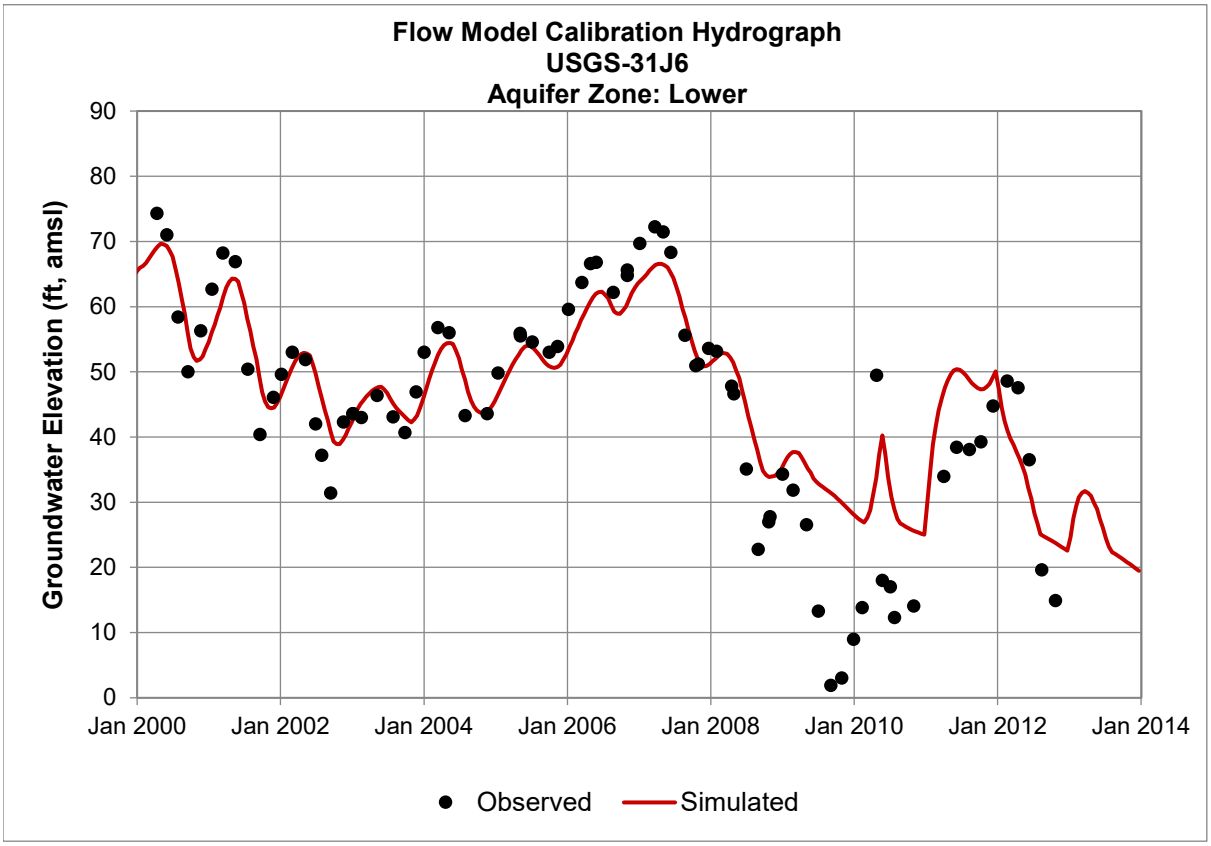
Jan 2014
Observed
Simulated


Flow Model Calibration Hydrograph
USGS-31J6
Aquifer Zone: Lower
Groundwater Elevation (ft, amsl)
90
80
70
60
50
40
30
20
10
0
Jan 2000
Jan 2002
Jan 2004
Jan 2006
Jan 2008
Jan 2010
Jan 2012
Jan 2014
Observed
Simulated