

Prepared by



**MONTGOMERY
& ASSOCIATES**

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**MID-KAWEAH
GROUNDWATER
SUSTAINABILITY
AGENCY**

GROUNDWATER SUSTAINABILITY PLAN

2ND AMENDED
OCTOBER 2024

**PUBLIC
REVIEW
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2024 Second Amended Groundwater Sustainability Plan

Mid-Kaweah Groundwater Sustainability Agency
Public Review Draft

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*Prepared under the Kaweah Subbasin Coordination Agreement with
Greater Kaweah GSA and East Kaweah GSA*

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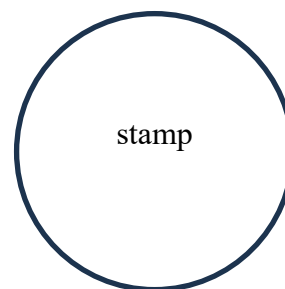
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Appendices

Appendices correspond with GSP Chapter. There is no appendix to Chapter 7 or 8

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- 1B Mid-Kaweah Groundwater Subbasin Joint Powers Agreement & First Amendment to Mid-Kaweah Groundwater Subbasin Joint Powers Agreement

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- 3C Kaweah Subbasin Groundwater Modeling Report

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- 4A 2019 First Semiannual Groundwater Monitoring Report, Visalia Water Conservation Plant
- 4B Tulare Irrigation District Groundwater Elevation Monitoring Plan
- 4C Friant-Kern Canal Monitoring and Action Plan (FMAP) in the Event of Future Subsidence

APPENDIX 5CHAPTER 5 APPENDIX

- 5A Technical Analysis to Support Establishment of SMC for Chronic Lowering of Groundwater Levels & Reduction of Groundwater Storage Sustainability Indicators
- 5B Land Subsidence and Lower Aquifer Chronic Lowering of Groundwater Level Sustainable Management Criteria Development Process for the Kaweah Subbasin
- 5C Technical Support for Land Subsidence Sustainable Management Criteria in the Kaweah Subbasin
- 5D Groundwater Level Sustainable Management Criteria Hydrographs
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- 5G Technical Memorandum: Development of the Relationship Between Modeled Aquifer Storage and Regional Groundwater Elevations
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- 6A Groundwater Recharge Capacity Evaluation Phase III: Hydrogeologic Investigations to Maximize Recharge Capacity
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- 6F Hydrogeologic Framework of Selected Areas of the Kaweah SubBasin Region in Tulare and Kings Counties, California
- 6G Tulare Irrigation District System Optimization Review Study Report
- 6H Appendix Y.1 – Y.4 Recharge Project Data

ACRONYMS & ABBREVIATIONS

AEM.....	Airborne Electromagnetic Surveying
AF	acre-feet
APPS	Automatic Precise Positioning Service
BMP	Best Management Practice
C&E	Communications and Engagement
CalOES	California Office of Emergency Services
CASGEM.....	California Statewide Groundwater Elevation Monitoring
CCR.....	California Code of Regulations
CEQA.....	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CVP.....	Central Valley Project
CVPIA.....	Central Valley Project Improvement Act
CAWSC	California Water Science Center
Cal Water Service	California Water Service Company
DMS.....	Data Management System
DQO	Data Quality Objective DQO
DWR	California Department of Water Resources
DWSAP.....	Drinking Water Source Protection
EKGSA	East Kaweah Groundwater Sustainability Agency
FEMA	Federal Emergency Management Agency
FMAP.....	Friant-Kern Canal Monitoring and Action Plan
FONSI.....	Finding of No Significant Impact
gpcd.....	gallons per capita per day
GEI.....	GEI Consultants, Inc.
GKGSA.....	Greater Kaweah Groundwater Sustainability Agency
GRAT.....	Groundwater Recharge Assessment Tool
GSA.....	Groundwater Sustainability Agency
GSP or Plan.....	Groundwater Sustainability Plan
HCM	Hydrogeologic Conceptual Model
ID	Irrigation District
IM.....	Interim milestone
InSAR	Interferometric Synthetic Aperture Radar
ISW	interconnected surface water
JPA.....	Joint Powers Authority
JPL	Jet Propulsion Laboratory
KDWCD	Kaweah Delta Water Conservation District
MCL.....	Maximum Contaminant Level
MKGSA	Mid-Kaweah Groundwater Sustainability Agency

MO	Measurable Objective
MT.....	Minimum Threshold
NASA.....	National Aeronautics and Space Administration
NAVD88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NGO.....	Non-Governmental Organization
OHAMWC.....	Okieville Highland Acres Mutual Water Company
OPUS	Online Positioning User Service
PPAP.....	Well Proactive & Protective Action Program
PWS	Public Water Systems
RMS	representative monitoring site
RO	Reverse Osmosis
RP.....	Reference Point
RSMAP	Regional Subsidence Monitoring and Action Plan
SCADA.....	Supervisory Control and Data Acquisition
SGMA.....	Sustainable Groundwater Management Act
SMARA	Surface Mining and Reclamation Act
SMC	Sustainable Management Criteria
State Board or SWRCB	State Water Resources Control Board
TAF.....	Thousand acre-feet
TDS	Total Dissolved Solids
TID.....	Tulare Irrigation District
UWMP	Urban Water Management Plan
USBR.....	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
WHPA.....	wellhead protection area
WWTP	wastewater treatment plant

DEFINITIONS

This list of definitions apply to this Groundwater Sustainability Plan (GSP) but may also be found in the Appendices or other attachments to the Mid Kaweah Groundwater Sustainability Agency's GSP.

AARD	Annual Allowable Rate of Decline
Adjudication action	An action filed in the superior or federal district court to determine the rights to extract groundwater from a basin or store water within a basin, including, but not limited to, actions to quiet title respecting rights to extract or store groundwater or an action brought to impose a physical solution on a basin.
AEM (also known as SkyTEM)	Airborne electromagnetic. The collection of subsurface information on the relative conductivity of subsurface material from ground surface to an approximate depth of 1,000 feet. This information is collected from a helicopter equipped with equipment to both transmit and receive information.
Agency	A groundwater sustainability agency as defined in the Sustainable Groundwater Management Act.
Agricultural water management plan	A plan adopted pursuant to the Agricultural Water Management Planning Act as described in Part 2.8 of Division 6 of the Water Code, commencing with Section 10800 <i>et seq.</i>
Annual report	The report required by Water Code Section 10728.
Baseline or baseline conditions	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.
Basin	A groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Chapter 3 (commencing with Section 10722).

Basin setting	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 Subarticle 2 of Article 5.
Best available science	The use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, that is consistent with scientific and engineering professional standards of practice.
Best management practice	A practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science.
Bulletin 118	DWR’s report entitled California’s Groundwater: Bulletin 118 updated in 2003, as it may be subsequently updated or revised in accordance with Section 12924.
CASGEM	California Statewide Groundwater Elevation Monitoring Program developed by the Department pursuant to Water Code Section 10920 <i>et seq.</i> , or as amended.
Confined Aquifer	Confined aquifer system comprising the Lower Aquifer below the Corcoran Clay
Coordination agreement	A legal agreement adopted between 2 or more groundwater sustainability agencies that provides the basis for coordinating multiple agencies or groundwater sustainability plans within a basin pursuant to this part.
Current water budget	For MKGSA, “current water budget” refers to the period between water years 2012 and 2022. For the Kaweah Subbasin this is a period over which existing supply, demand and change in storage under the most recent population, land use, and hydrologic conditions can be understood. This period is distinguished from the Historical Water Budget (1999-2022) and the projected future water budget (2023-2070).

Data gap	A lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation and could limit the ability to assess whether a basin is being sustainably managed.
<i>De minimis</i> extractor	A person who extracts, for domestic purposes, 2 acre-feet or less per year.
Dry Well Susceptibility Analysis	An impact-based analysis that evaluates the count of potentially impacted wells under different groundwater elevation surface scenarios. The Dry Well Susceptibility Analysis is used to inform (1) upper aquifer water level sustainable management criteria and (2) mitigation plan/program cost estimates.
Governing body	The legislative body of a groundwater sustainability agency.
GPS Monitoring Station	For this purpose of the MKGSA GSP, this term refers to survey benchmarks measured periodically using GPS technology for the purpose of measuring changing in elevation overtime.
Groundwater	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.
Groundwater dependent ecosystem	Ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.
Groundwater extraction facility	A device or method for extracting groundwater from within a basin.
Groundwater flow	The volume and direction of groundwater movement into, out of, or throughout a basin.
Groundwater recharge or recharge	The augmentation of groundwater, by natural or artificial means.

Groundwater sustainability agency	One or more local agencies that implement the provisions of this part. For purposes of imposing fees pursuant to Chapter 8 (beginning with Section 10730) or taking action to enforce a groundwater sustainability plan, groundwater sustainability agency also means each local agency comprising the groundwater sustainability agency if the plan authorizes separate agency action.
Groundwater sustainability plan or plan	A plan of a groundwater sustainability agency proposed or adopted pursuant to this part.
Historical Water Budget	Also known as a “base period,” the MKGSA “historical water budget” was selected to be between the years of 1999 and 2022. Fulfills DWR’s regulatory requirement that, “a quantitative assessment of the historical water starting with the most recently available information and extending a minimum of 10 years, or as sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.”
Individual impact	A singular impact that can be induced by groundwater conditions associated with sustainability indicators. A specific count or combination of individual impacts are what constitutes “significant and unreasonable effects.” Examples of individual impacts: a single domestic well going dry, a canal experiencing a loss of conveyance capacity, an ag well unable to meet production needs.
In-lieu use	The use of surface water by persons that could otherwise extract groundwater in order to leave groundwater in the basin.
Interconnected surface water	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.
Interested parties	Persons and entities on the list of interested persons established by the Agency pursuant to Water Code Section 10723.4.

Interim milestone	A target value representing measurable groundwater conditions, in increments of 5 years, set by an Agency as part of a Plan. Interim milestones are targets such as groundwater elevations that will be achieved every 5 years to demonstrate progress towards sustainability.
Land surface subsidence	The inelastic compaction that typically occurs in the fine-grained beds of the aquifers and in the aquitards due to the 1-time release of water from the inelastic specific storage of clay layers caused by groundwater pumping.
Local agency	A local public agency that has water supply, water management, or land use responsibilities within a groundwater basin.
Management area	An area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors.
Measurable objectives	Specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin. Measurable objectives are goals that the GSP is designed to achieve, and that groundwater management is being informed by.
Minimum threshold	A quantitative value that represents the groundwater conditions at a representative monitoring site that, when exceeded individually or in combination with minimum thresholds at other monitoring sites, may cause an undesirable result(s) in the basin. – (DWR – Sustainable Management Criteria BMP; page 6).
Mitigation Program	A Subbasin-wide program document that details the standardized Mitigation/Technical Assistance Claims Process, program qualification criteria, and considerations to be made in each GSA-specific Mitigation Plan.

Mitigation Plan	A GSA-specific planning document that details GSA-specific roll out of the Kaweah Subbasin Mitigation Program, GSA funding mechanism, and localized mitigation needs context.
Model calibration	Adjustment of model input parameters such as hydraulic conductivity and aquifer storativity to improve the match between simulated and observed data.
Model verification	Groundwater model runs performed for the purpose of checking or verifying how well the model generated heads match empirical values at representative monitoring sites.
NAD83	The North American Datum of 1983 computed by the National Geodetic Survey, or as modified.
NAVD88	The North American Vertical Datum of 1988 computed by the National Geodetic Survey, or as modified.
Operator	A person operating a groundwater extraction facility. The owner of a groundwater extraction facility shall be conclusively presumed to be the operator unless a satisfactory showing is made to the governing body of the groundwater sustainability agency that the groundwater extraction facility actually is operated by some other person.
Owner	A person owning a groundwater extraction facility or an interest in a groundwater extraction facility other than a lien to secure the payment of a debt or other obligation.
Personal information	Personal information has the same meaning as defined in Section 1798.3 of the Civil Code.
Plain language	Language that the intended audience can readily understand and use because that language is concise, well-organized, uses simple vocabulary, avoids excessive acronyms and technical language, and follows other best practices of plain language writing.
Plan or GSP	A groundwater sustainability plan as defined in the Act.

Plan implementation	An Agency’s exercise of the powers and authorities described in the Act, which commences after an Agency adopts and submits a Plan or Alternative to the Department and begins exercising such powers and authorities.
Plan manager	An employee or authorized representative of an Agency, or Agencies, appointed through a coordination agreement or other agreement, who has been delegated management authority for submitting the Plan and serving as the point of contact between the Agency and the Department.
Planning and implementation horizon	A 50-year time period over which a groundwater sustainability agency determines that plans and measures will be implemented in a basin to ensure that the basin is operated within its sustainable yield.
Principal aquifers	Aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.
Projected water budget	For the Kaweah basin, “projected water budget” refers to the period between water years 2023 and 2072, fulfilling the DWR regulatory requirement that the GSP utilize 50 years of hydrology, and consider the impact of climate change on precipitation, evapotranspiration, streamflow.
Protective threshold	A depth within a well where if groundwater levels were to decline below, the well is assumed to experience operational impacts. The Protective Threshold is established in recognition that operational impacts are experienced even before the groundwater levels fall below the bottom of a well. The protective threshold is a key component of the Dry Well Susceptibility Analysis, as all wells with available construction and location data were assessed under different groundwater level surface scenarios to evaluate if the groundwater level was falling below the protective threshold at and should not be confused with ‘minimum thresholds’ which are set only at representative monitoring sites.

Public water system	Public water system has the same meaning as defined in Section 116275 of the Health and Safety Code.
Recharge area	The area that supplies water to an aquifer in a groundwater basin.
Reference point	A permanent, stationary and readily identifiable mark or point on a well, such as the top of casing, from which groundwater level measurements are taken, or other monitoring site.
Representative monitoring	A monitoring site within a broader network of sites that typifies 1 or more conditions within the basin or an area of the basin.
Seasonal high	The highest annual static groundwater elevation that is typically measured in the spring and associated with stable aquifer conditions following a period of lowest annual groundwater demand.
Seasonal low	The lowest annual static groundwater elevation that is typically measured in the summer or fall and associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.
Seawater intrusion	The advancement of seawater into a groundwater supply that results in degradation of water quality in the basin and includes seawater from any source.
Significant and unreasonable	The tipping point at which the groundwater conditions throughout the Subbasin cause impacts to beneficial uses, users, land uses and property interests that cannot be sustained or mitigated. This must be stakeholder driven. Significant and unreasonable is not defined in the Regulations. However, the definition of undesirable results states, “Undesirable results occur when significant and unreasonable effects ... are caused by groundwater conditions....” This GSP adopts the phrase significant and unreasonable to be the qualitative description of undesirable conditions due to inadequate groundwater management. Minimum thresholds are the quantitative measurement of significant and unreasonable conditions.

Statutory deadline	The date by which an Agency must be managing a basin pursuant to an adopted Plan, as described in Water Code Sections 10720.7 or 10722.4.
Sustainability goal	The existence and implementation of 1 or more groundwater sustainability plans that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the applicable basin is operated within its sustainable yield.
Sustainability indicator	Any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x). The 5 sustainability indicators relevant to the Subbasin include chronic lowering of groundwater levels, reduction of groundwater storage; degraded groundwater quality, land subsidence, and depletion of interconnected surface water. Seawater intrusion is not applicable because the Subbasin is located over 100 miles from the Pacific Ocean.
Sustainable groundwater management	The management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.
Sustainable management criteria	Minimum thresholds, measurable objectives, and interim milestones and are quantitative criteria measured at a network of representative monitoring sites that provide adequate coverage such that undesirable results are avoided and the basin is on track with the sustainability goal.
Sustainable yield	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.

Uncertainty	A lack of understanding of the basin setting that significantly affects an Agency’s ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.
Unconfined Aquifer	Unconfined aquifer system comprising the Single Aquifer, east of the Corcoran clay, and the Upper Aquifer, above the Corcoran Clay
Undesirable result	A combination of minimum threshold exceedances that quantitatively reflect the presence of significant and unreasonable effects. Undesirable result is not defined in the Regulations. However, the description of undesirable results states that it should be a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the subbasin. Undesirable results should not be confused with significant and unreasonable conditions. Significant and unreasonable conditions are qualitative descriptions of conditions to be avoided; an undesirable result is a quantitative assessment based on minimum thresholds.
Urban water management plan	A plan adopted pursuant to the Urban Water Management Planning Act as described in Part 2.6 of Division 6 of the Water Code, commencing with Section 10610 <i>et seq.</i>
Water budget	An accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.
Water Accounting Framework	The agreed-upon methodology to account for various components of the water budget consistent with commonly accepted rules regarding surface water and groundwater rights. This framework is reflected in the Subbasin Coordination Agreement.
Water source type	The source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley

	Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.
Water use sector	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.
Water year	The period from October 1 through the following September 30, inclusive.
Water year type	The classification provided by the Department to assess the amount of annual precipitation in a basin.
Wellhead protection area	The surface and subsurface area surrounding a water well or well field that supplies a public water system through which contaminants are reasonably likely to migrate toward the water well or well field.
Unconfined Aquifer	Unconfined aquifer system comprising the Single Aquifer, east of the Corcoran clay, and the Upper Aquifer, above the Corcoran Clay
Undesirable result	A combination of minimum threshold exceedances that quantitatively reflect the presence of significant and unreasonable effects. Undesirable result is not defined in the Regulations. However, the description of undesirable results states that it should be a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the subbasin. Undesirable results should not be confused with significant and unreasonable conditions. Significant and unreasonable conditions are qualitative descriptions of conditions to be avoided; an undesirable result is a quantitative assessment based on minimum thresholds.
Urban water management plan	A plan adopted pursuant to the Urban Water Management Planning Act as described in Part 2.6 of Division 6 of the Water Code, commencing with Section 10610 <i>et seq.</i>

Water budget	An accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.
Watermaster	A watermaster appointed by a court or pursuant to other law.
Water Accounting Framework	The agreed-upon methodology to account for various components of the water budget consistent with commonly accepted rules regarding surface water and groundwater rights. This framework is reflected in the Subbasin Coordination Agreement.
Water source type	The source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.
Water use sector	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.
Water year	The period from October 1 through the following September 30, inclusive.
Water year type	The classification provided by the Department to assess the amount of annual precipitation in a basin.
Wellhead protection area	The surface and subsurface area surrounding a water well or well field that supplies a public water system through which contaminants are reasonably likely to migrate toward the water well or well field.

EXECUTIVE SUMMARY

§354.4 General Information. Each Plan shall include the following general information: (a) An executive summary written in plain language that provides an overview of the Plan and description of groundwater conditions in the basin.

ES-1. Introduction

The State of California enacted the Sustainable Groundwater Management Act (SGMA), effective January 1, 2015, to mandate comprehensive sustainable groundwater management. SGMA provides a statewide framework for groundwater management through locally formed Groundwater Sustainability Agencies (GSAs). The Mid-Kaweah Groundwater Sustainability Agency (MKGSA) was formed in 2015 to cover a portion of the Kaweah Subbasin, alongside 2 additional GSAs: the East Kaweah GSA (EKGSA) and the Greater Kaweah GSA (GKGSA) (Figure ES-1). The 3 GSAs jointly cover the entire Kaweah Subbasin. The Kaweah Subbasin is bordered by the Kings Basin to the north, the Tulare Lake Subbasin to the west, and the Tule Subbasin to the south (Figure ES-2).

Following the submittal of an initial notification in 2017, MKGSA began developing an initial Groundwater Sustainability Plan (GSP) to comply with SGMA's statutory and regulatory requirements. The initial planning included engaging with stakeholders and holding public meetings. MKGSA adopted the first amended GSP in 2022 to address comments and plan deficiencies identified by the California Department of Water Resources (DWR). This is the Second Amended GSP, which includes greater protections for the most vulnerable beneficial users, uses, and property interests through revised sustainable management criteria. This GSP additionally uses a more

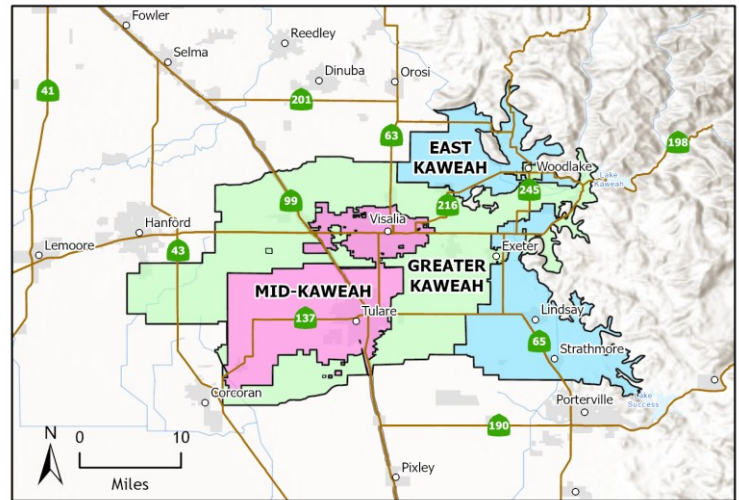


Figure ES-2. Kaweah Subbasin Groundwater Sustainability Agencies

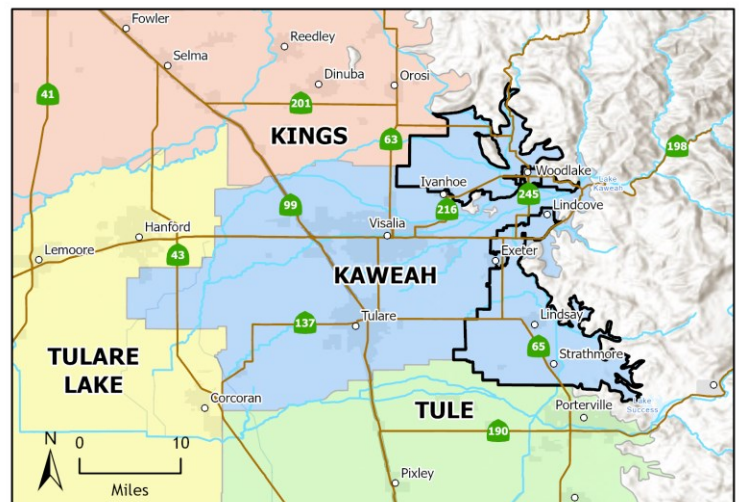


Figure ES-1. Neighboring Subbasins

coordinated methodology between GSAs and surrounding Subbasins, provides consistency between different sustainability indicators' sustainable management criteria, and a clarifies the path to sustainability using predictive modeling to demonstrate that the Kaweah Subbasin will eliminate overdraft and achieve sustainability by 2040.

The goal of this GSP is to sustainably manage the groundwater resources of MKGSA for the benefit of current and anticipated future beneficial users of groundwater and the welfare of the general public who rely directly or indirectly on groundwater. This GSP outlines the approach to achieve and maintain a sustainable groundwater resource free of undesirable results (URs) as defined in SGMA, and establish long-term reliability no later than 2040.

The content of the GSP includes administrative information, a description of the basin setting, sustainable management criteria that consider the interests of all beneficial uses and users of groundwater, projects and management actions that achieve sustainability, and monitoring networks that demonstrate how the Subbasin is managed sustainably.

This GSP is generally organized as follows:

Chapter 1 - Introduction

Chapter 2 - Plan Area

Chapter 3 - Basin Setting

Chapter 4 - Monitoring Networks

Chapter 5 - Sustainable Management Criteria

Chapter 6 - Projects and Management Actions

Chapter 7 - GSP Implementation

Chapter 8 - References & Technical Studies

ES-2. Plan Area

The MKGSA jurisdictional area is approximately 163 square miles, constituting 25% of the Subbasin. Figure ES-1 shows that the MKGSA area is located within the central to western side of the Subbasin and except for a portion of its western boundary, is surrounded by GKGSA.

MKGSA land use is predominantly dairy and irrigated agriculture. The MKGSA includes the Subbasin's 2 largest cities, Visalia and Tulare, which overlie 35% of the GSA. In addition to the City of Tulare, the communities of Okieville and Waukena are classified as Disadvantaged Communities. Outside of the municipal service areas and scattered throughout the agricultural areas of MKGSA are rural residential households that rely exclusively on groundwater supplies.

Beneficial uses of groundwater extracted from the MKGSA area include municipal, residential, industrial, commercial, and agricultural water supply (Table ES-1). To consider all beneficial uses and users, MKGSA has prioritized the stakeholder engagement process in development of this GSP and policy decision making (Figure ES-3).

Land surface uses that may be impacted by subsidence are also considered when setting SMC. In the MKGSA area, these include infrastructure such as water conveyance infrastructure (including canals, ditches, and flood control waterways), supply wells, roads, bridges, electrical power lines, gas and water pipelines, sanitary sewers, and railroad tracks.

Primary water supplies for MKGSA include surface water from the Friant Division of the Central Valley Project, Kaweah River water rights, and groundwater. The greatest user of groundwater in the MKGSA is agriculture (76%), followed by urban (22%), and industrial (2%).

Table ES-1. Beneficial Uses and Users in Kaweah Subbasin

Beneficial User	Beneficial User
Drinking Water Use	Domestic Well Users
	Small Community Well Users and Service Providers
	Municipal Well Users and Service Providers
	Commercial and Industrial Users
Environmental Use	Groundwater Dependent Ecosystems
	Habitat Conservation
	Native Vegetation
Agricultural Use	Conjunctive Use Growers (Irrigation)
	Groundwater-Dependent Growers (Irrigation)
	Small Family Farmers (Irrigation)
	Produce Packing Facilities (Ag-Industrial Use)
	Livestock Facilities (Ag-Industrial Use)
Non-Potable Municipal Use	Golf Courses Irrigation (Municipal Non-Potable Use)
	Park and Recreation Irrigation (Municipal Non-Potable Use)

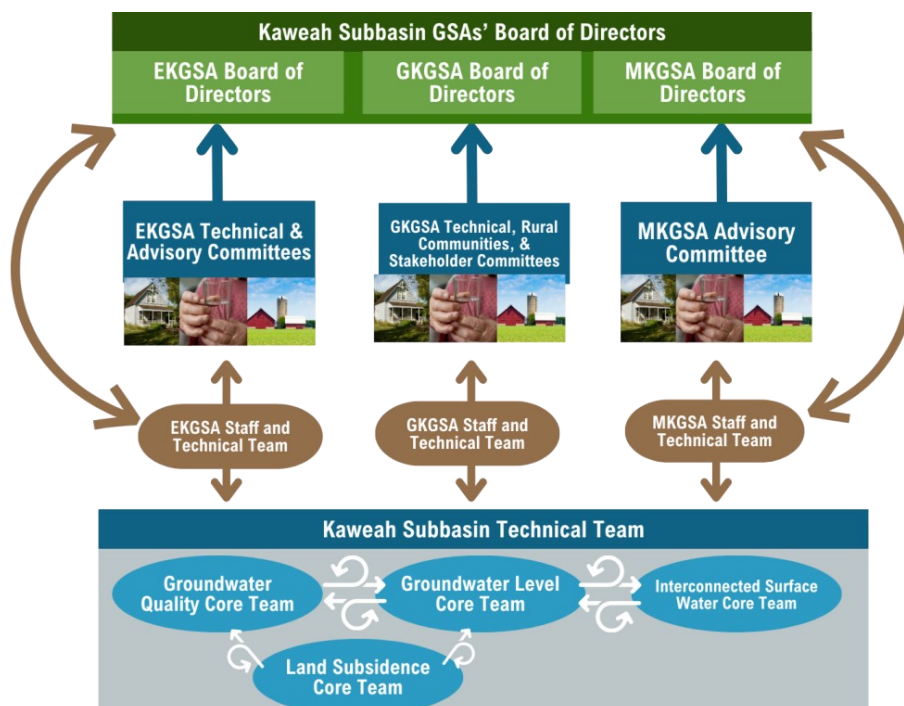


Figure ES-3. Kaweah Subbasin Stakeholder Engagement Process

ES-3. Basin Setting

The Kaweah Subbasin is located in the southeastern portion of the San Joaquin Valley. The San Joaquin Valley is a structural trough up to 200 miles long and 70 miles wide that constitutes the southern portion of the California's Central Valley. The Sierra Nevada rises along the San Joaquin Valley's eastern boundary, the coast ranges border it on the west, and the Tehachapi Mountains border it on the south. The lithology of the Central Valley comprises an accumulation of sediments up to 32,000 feet thick (Figure ES-4).

Much of the MKGSA is underlain by the Corcoran Clay, which creates an upper and lower aquifer system. A single aquifer system is present beneath the eastern half of Visalia in the northeastern section of the MKGSA. The thickness of the fresh groundwater system varies from about 900 feet on the northeastern corner of MKGSA to about 1,600 feet near the southwestern corner.

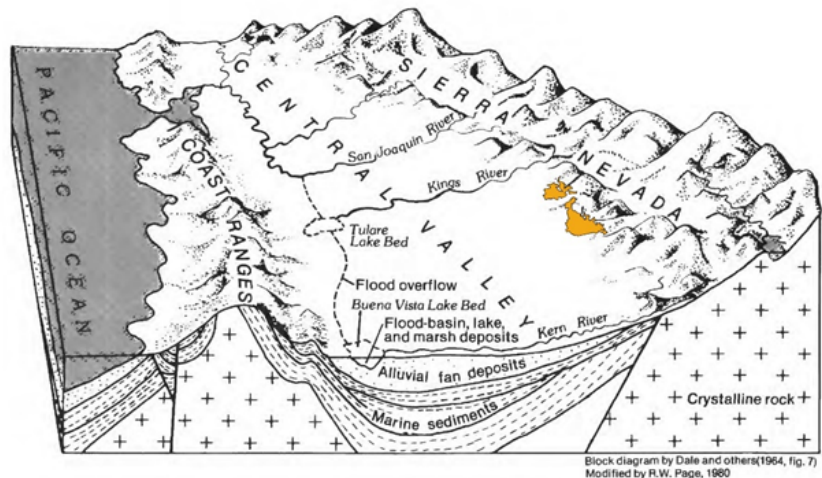


Figure ES-4. Isometric Block Diagram of the San Joaquin Valley

Rivers in the Kaweah Subbasin are part of a regional internally drained system. The rivers naturally flow west and south toward low areas with no outflow to the Pacific Ocean. The largest of these low areas is the Tulare Lakebed, which receives runoff from the Kaweah, Tule, and Kings Rivers.

Groundwater Level Trends

Upper aquifer (also referred to as unconfined aquifer) groundwater levels have long-term declines that are only interrupted in above normal or wet water years. Consecutive dry years greatly impact groundwater levels in the unconfined aquifer due to reduced natural and managed aquifer recharge. Groundwater levels are deepest in the southwest region of the MKGSA, where they can be 230 feet below ground. The shallowest groundwater levels in the MKGSA are observed in the northeast region of the MKGSA near the St. Johns River where they are approximately 60 feet below ground.

The lower aquifer (also referred to as confined aquifer) occurs below the Corcoran Clay in the western half of the MKGSA area. Similar to the upper aquifer, groundwater levels in the lower aquifer show downward trends. Groundwater elevations in wells screened in the lower aquifer are deeper than groundwater elevations the upper aquifer. In the southwest of the MKGSA, near

the boundary with the Tulare Lake Subbasin, depth to water can be greater than 300 feet below ground. In general, groundwater flows across the MKGSA in a southwesterly direction and to local cones of depression.

Land Subsidence

Land subsidence as a result of groundwater pumping has occurred throughout the San Joaquin Valley over the last 100 years. Areas within the Kaweah Subbasin's aquifer system that are most susceptible to subsidence are underlain by the Corcoran Clay—which is the primary regional confining layer—and other fine-grained units. The greatest subsidence in the Subbasin occurs along the western and southern boundaries of the MKGSA area. Subsidence estimates based on historical land survey supplemented with Interferometric Synthetic Aperture Radar (InSAR) data from 1948 on suggest that approximately 25 feet of total land subsidence has occurred in the southwestern corner of the MKGSA area. The amount of subsidence decreases from southwest to northeast across the MKGSA area and Subbasin. In northern Visalia, east of the Corcoran Clay, historical subsidence since 1949 is estimated to be around 6 feet.

Groundwater Quality

Groundwater quality is generally good, but available data are primarily located in the northern and eastern portions of the MKGSA corresponding with public water supply wells. Several constituents of concern (COC) have been identified for the Subbasin due to concentrations near Maximum Contaminant Levels (MCLs) or due to increasing trends. In the MKGSA, COCs in decreasing order of maximum contaminant level exceedances are: nitrate, 1,2,3-trichloropropane, arsenic, uranium, sodium, pH, tetrachloroethene (PCE), gross alpha, and boron. There are no exceedance of the following COC within MKGSA, but there are in other parts of the Subbasin: 1,2-dibromo-3-chloropropane, hexavalent chromium, perchlorate, specific conductivity, total dissolved solids, chloride, and sulfate.

Interconnected Surface Water

The depth to water in the upper principal aquifer is approximately 60-80 feet below ground north and northeast of the City of Visalia near the St. Johns River. Depth to groundwater is greatest in the southwest area of the MKGSA (200 feet). Because of the depth to groundwater in the MKGSA area being greater than 60 feet, there are no surface waters interconnected with groundwater.

Water Budgets

The Subbasin groundwater flow model was used to quantify water budgets for the historical, current, and projected conditions, including the evaluation of uncertainty due to climate change. The historical, current, and projected water budgets summarize overall groundwater conditions and the benefits of groundwater management activities on groundwater sustainability in the Subbasin.

This GSP includes both a groundwater budget and a land surface budget. In agricultural areas like the Kaweah Subbasin, a land surface budget is useful for assessing changes in water demands over time and to evaluate water demand versus water supply resulting from climatic variations and land use changes. A diagram of the land surface budget inflow and outflow components are available on Figure ES-5 and a diagram of the groundwater budget inflow and outflow components is available on Figure ES-6 .

The current groundwater budget for the Subbasin shows an average annual aquifer storage loss of 230,000 acre-feet per year (AFY). Recharge projects and demand management actions are already being implemented in the Subbasin and it is imperative they be expanded soon to achieve sustainable groundwater conditions and limit land subsidence during the GSP implementation period.

The projected water budget shows that implementing projects and pumping reductions results in a modest increase in groundwater storage of about 3,000 AFY. The elimination of overdraft, along with avoiding URs, demonstrates that demand reduction supplemented by recharge projects are sufficient to achieve sustainability during the GSP implementation period. Projections are based on the assumed future hydrology, surface water availability, and conditions in neighboring subbasins.

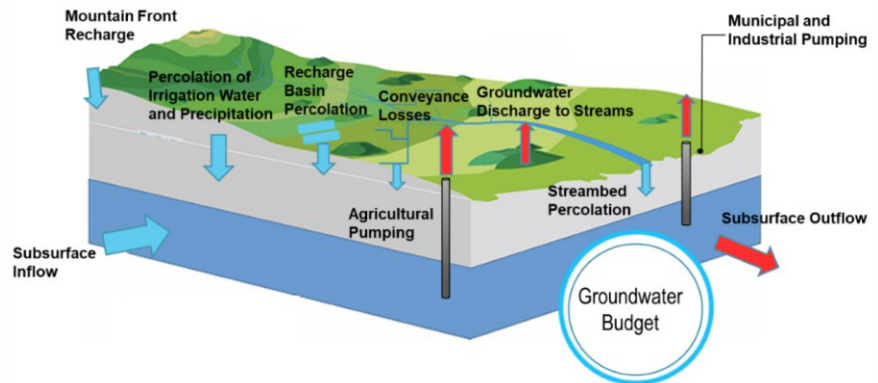


Figure ES-6. Diagram of Groundwater Budget Components

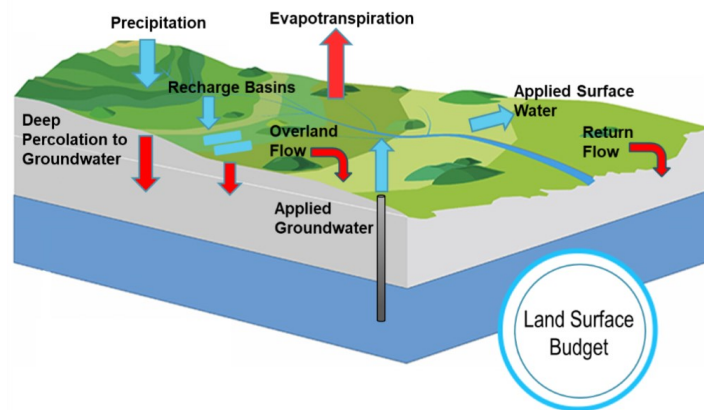


Figure ES-5. Diagram of Land Surface Budget Components

Sustainable Yield

The sustainable yield of the Subbasin is an estimate of the quantity of groundwater that can be pumped on a long-term average annual basis without causing undesirable results. Basin-wide pumping within the sustainable yield estimate is neither a measure, nor proof of, sustainability. Sustainability under SGMA is only demonstrated by avoiding URs for the applicable sustainability indicators. Sustainable yield using the current and projected simulations is useful for determining the need for projects and management actions to help achieve and maintain sustainability.

The groundwater model predictive scenario that simulates significant demand reduction and recharge projects indicates that if these actions are implemented, URs are unlikely. Projected groundwater levels fluctuate in response to climatic variation, but display no long-term rising or falling trends, indicating no significant change in aquifer storage between 2023 and 2070. Based on this approach, the sustainable yield for the Subbasin is 578,000 AFY, which represents the volume of pumping projected between 2023 and 2070 that results in no long-term change in storage.

ES-4. Monitoring Networks

Monitoring networks will demonstrate progress toward reaching measurable objectives (MOs) and groundwater sustainability. The Kaweah Subbasin and MKGSA representative monitoring network includes monitoring sites from existing programs and recently constructed wells dedicated to monitoring for SGMA and other purposes. The representative monitoring network is organized into 3 parts: (1) groundwater level representative monitoring network, (2) groundwater quality representative monitoring network, and (3) land subsidence monitoring network.

The MKGSA representative monitoring network includes 34 representative wells for monitoring groundwater levels, 16 representative wells for monitoring groundwater quality, and 11 land subsidence monitoring sites. The monitoring frequency for the representative monitoring network is summarized in Table ES-2. In addition to the representative monitoring network, MKGSA has a much larger, supplemental network of wells to monitor groundwater level and quality conditions.

Table ES-2. MKGSA Monitoring Frequency Summary

Sustainability Indicator	Representative Monitoring Type	Monitoring Frequency	Frequency of Reporting	Notes
Groundwater Levels	Wells	At least Bi-Annually <i>Seasonal High (Spring - March)</i> <i>Seasonal Low (Fall – October)</i>	Bi-Annually	MKGSA Plans to improve data gaps through the Well Registration Program, a new management action.
Land Subsidence	Subsidence Stations & InSAR	Annually	Annually	As new technologies, such as InSAR have become available, subsidence is no longer a data gap in the MKGSA.
Groundwater Quality	Wells	Twice per year (or more frequently pending on the Exceedance Policy)	Annually	MKGSA Plans to improve data gaps through the Well Registration Program, a new management action.
Groundwater Storage	Groundwater Elevation Change Contours	Annually	Annually	Both cumulative and annual change in groundwater storage are evaluated. The monitoring data is sourced from the groundwater level representative monitoring network.
Interconnected Surface Water	Not applicable in the MKGSA area			

ES-5. Sustainable Management Criteria

Sustainable Management Criteria (SMC) development involved a comprehensive stakeholder engagement process (Figure ES-3) and are based on the best available science and information for the Subbasin. Importantly, SMC were developed in close coordination with all 3 GSAs and their respective technical teams and stakeholder committees.

The 3 Kaweah Subbasin GSAs jointly established a sustainability goal for the Subbasin. The sustainability goal for the Kaweah Subbasin is:

For each GSA to manage groundwater resources to preserve the viability of existing agricultural enterprises of the region, domestic wells, and the smaller communities that provide much of their job base in the Subbasin, including the school districts serving these communities. The goal will also strive to fulfill the water needs of existing and amended county and city general plans that commit to continued economic and population growth within [the Kaweah Subbasin area within] Tulare County and within portions of Kings County.

MKGSA, along with the other 2 GSAs, characterized URs and established minimum thresholds (MTs), measurable objectives (MOs), and interim milestones (ImS) for each applicable sustainability indicator:

1. Chronic lowering of groundwater levels (Section 5.5)
2. Land subsidence (Section 5.6)
3. Reduction of groundwater storage (Section 5.7). *For this GSP and pursuant to GSP Emergency Regulations §354.28(d), groundwater elevations are used as a proxy for the depletion of groundwater storage.*
4. Degraded water quality (Section 5.8)

For the MKGSA area, SMCs are not developed for seawater intrusion due to the distance from the Pacific Ocean, or for depletion of interconnected surface water (ISW) because depth to groundwater is greater than 60 feet below ground and thus disconnected from surface water.

A key part of the SMC development process is defining URs for each sustainability indicator. The process for defining URs consisted of multiple steps:

1. Potential effects on the beneficial uses and users of groundwater and on land uses and property interests were evaluated and described qualitatively.
2. The qualitative statement was quantified into MTs at specific monitoring network sites.
3. A combination of MT exceedances representing URs in the Basin was established.

A summary of the revised SMC for the MKGSA is included in Table ES-3.

Table ES-3. Mid-Kaweah Groundwater Sustainability Agency Summary of Sustainable Management Criteria

	Chronic Lowering of Groundwater Levels	Reduction in Groundwater Storage	Degraded Groundwater Quality	Land Subsidence	Depletions of Interconnected Surface Water
Measure-ment	Groundwater elevations derived from measured depth to groundwater at RMS	Groundwater levels are used as a proxy for the reduction in groundwater storage.	Groundwater quality analysis from samples collected by the GSA or other public agencies	Total subsidence measured at RMS using DWR provided InSAR data	Groundwater elevations from measured depth, available surface water presence and flow data, aerial imagery. *Interconnected surface water monitoring remains a data gap, see more information on the Interconnected Surface Water Data Gap Workplan in Chapter 6
Undesirable Results	Upper Aquifer: 1. If more than 17 RMS wells in the Kaweah Subbasin exceed their minimum threshold in any given water year; AND 2. More than 30 domestic wells in the Kaweah Subbasin are impacted due to overdraft and require mitigation in any given water year. If 30 wells require mitigation for multiple years, no more than 350 wells shall be impacted cumulatively by 2040;. OR 3. If a GSA is unable to meet mitigation needs.	Since groundwater levels are used as a proxy for storage, the URs for Reduction in Groundwater Storage match those for Chronic Lowering of Groundwater Levels	1. Ten separate RMS wells with minimum threshold exceedances due to groundwater activities that occurred after January 1, 2015 (as determined by the Exceedance Policy) in a single water year for any single or combination of COCs. OR 2. The GSAs cannot meet mitigation demand for domestic wells impacted by groundwater quality degradation associated with groundwater activities after January 1, 2015.	When the cumulative subsidence MT is exceeded at any single RMS location.	The data and information gaps are too significant to establish URs at this time. URs will be established after the availability of the DWR Guidance Document and the completion of the Interconnected Surface Water Data Gap Workplan (Appendix 5H, Attachment A)
	Lower Aquifer:				
	A single groundwater level MT is exceeded AND				
	The corresponding subsidence MT (cumulative OR rate) is exceeded at any RMS in the Kaweah Subbasin				
Minimum Threshold	Upper Aquifer: MTs are set at a groundwater elevation at each RMS that is based on the GSAs collective ability to maintain groundwater supplies either through protective local supplies or through interim mitigation measures (when necessary) during the implementation period	Groundwater levels are used as a proxy for groundwater storage MTs	MTs are established at drinking water standards for most Constituents of Concern based on the California Primary MCL, California Secondary MCL, US EPA Secondary MCL, whichever is applicable. For sodium and boron, the MT is established at Agricultural Water Quality Goal. The MTs are consistent with Title 22 and the Basin Plan	Maximum subsidence limited to 7 feet, Average subsidence = 3.1 feet to be protective of beneficial users, uses, and land uses (varies by RMS location)	MTs are preliminarily established as depletions that would lead to flows lower than WY 2022 low flows for the two existing stream gage RMS which overlay likely connected surface waterbodies. This is considered an interim measure until the DWR Guidance document is available for consideration and until the Interconnected Surface Water Data Gap Workplan (Appendix 5H, Attachment A) is completed
	Lower Aquifer: MTs are based on the groundwater elevation that correlates with the subsidence MT at each specific RMS. These MTs are also protective of groundwater supplies in the lower aquifer				
Measurable Objective	Upper Aquifer: Established to allow reasonable operational flexibility and to be consistent with groundwater conditions necessary to achieve the conditions described in the Kaweah Subbasin’s sustainability goal. In areas with limited saturated thickness due to shallow bedrock (against the mountain front), the MOs were set at Spring 2017 groundwater levels. The groundwater levels west of this region were set at half the decline rate used for the basis of the minimum threshold. Between these areas, a multi-mile transitional area is included to smooth the gradient between the 2 water level criteria to provide hydrogeological plausible gradients from east to west. This is expected to be updated with the Subbasin Groundwater Flow Model.	Groundwater levels are used as a proxy for groundwater storage MOs	MOs and IMs are the same as MTs	0 feet per year of subsidence.	MOs and IMs are the same as MTs
	Lower Aquifer: MOs are based on pre-SGMA Fall 2012 lower aquifer groundwater levels.				

ES-6. Projects and Management Actions

The MKGSA has 2 methods to achieve sustainability: demand reduction and water supply/recharge augmentation. In the 2 previous GSPs, MKGSA prioritized groundwater recharge projects, surface water projects, and exchange programs, all of which relied upon excess wet year surface water to be imported and actively recharged into the groundwater system. Demand management was given a lower priority and only thought to be needed to fill any shortfalls in groundwater level improvements not met with projects. With groundwater levels falling in the drought of 2020-2022, the MKGSA, in coordination with the other Kaweah Subbasin GSAs, recognized demand management implemented through an allocation system was a priority to halt declining groundwater levels and continued overdraft. In this GSP, the MKGSA has shifted to demand management as the priority track to be used in conjunction with water supply/recharge augmentation. Predictive groundwater modeling has allowed the GSAs to better understand what pumping reductions and where recharge Table ES-4 and Table ES-5 list the projects and management actions, respectively, that have been completed or are planned by the MKGSA. The tables indicate the status of the project and management actions.

Table ES-4. MKGSA Projects and Status

Project ID	Project Name	Project Type
P1	Cordeniz Basin	Recharge
P2	Okieville Recharge Basin	Recharge
P3	KDWCD/Visalia/Tulare ID Packwood Creek Linear Recharge Project	Recharge
P4	On-Farm Recharge Program	Recharge
P5	City of Visalia/TID Exchange Program	Exchange Program, Recharge
P6	MKGSA Groundwater Banking Operations	Recharge, Banking, Storage
P7	Okieville Well #2 Resiliency Project	DAC Resiliency
P8	Visalia/Tulare ID Cameron Creek Linear Recharge Project	Recharge
P9	Visalia Eastside Regional Park/Groundwater Recharge Project	Recharge
P10	Sun World International / TID Exchange	Exchange Program, Recharge
P11	Groundwater Resources Assessment Tool	Recharge
P12	TID Existing Recharge Capacity Evaluation	Recharge
P13	Tulare ID/City of Tulare Catron Basin	Recharge
P14	McKay Point Reservoir	Flood Capture, Storage, Recharge
P15	Seaborn Reservoir	Flood Capture, Storage, Recharge
P16	Vadose Zone Well Battery Project	Recharge
P17	Kaweah Subbasin Multi-Benefit Recharge Facility	Recharge
P18	TID/GSA Multi-Benefit Land Repurposing Recharge Basin	Recharge
P19	TID/Friant Leveraged Exchange Program	Exchange Program, Recharge
P20	MKGSA Deep Well Injection Project	Recharge

Implemented	In-Progress (planning, design, construction)	Upcoming
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Table ES-5. MKGSA Management Actions and Status

Management Action ID	Management Action Name
MA1	Groundwater Extraction Allocation Implementation (Emergency Ordinance to Establish an Extraction Limitation for the Mid-Kaweah Groundwater Sustainability Agency)
MA2	Water Accounting Dashboard
MA3	Water Marketing Strategy (MKGSA Version 1.0 Kaweah Water Market Pilot)
MA4	Kaweah Subbasin Well Mitigation Program and the MKGSA Well Mitigation Plan
MA5	Small Community Well Proactive & Protective Action Plan (PPAP) <i>*new</i>
MA6	Well Registration Program <i>*new</i>
MA7	Well Permit Application Review and Technical Support <i>*new</i>
MA8	Collaboration with Other Agencies & Inter-Basin Coordination (Regional Subsidence)
MA9	Subsidence Mitigation Surface Water Allocation System <i>*new</i>
MA10	Lower Aquifer Groundwater Allocation
MA11	Geophysical Data Survey Project
MA12	Urban Water Conservation
MA13	Agricultural Water Conservation and Management Program
MA14	Replenishment Supply Allocation Program <i>*new</i>

Implemented	In-Progress (planning, design, construction)	Upcoming
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A key component of this Second Amended GSP is the establishment of a Subbasin Mitigation Program and GSA-specific Mitigation Plans that establishes requirements and funding for drinking water well mitigation. The Mitigation Program directly addresses the impacts of chronic lowering of groundwater levels, reduced groundwater in storage, groundwater quality, and land subsidence caused by lowered groundwater levels. The Program provides funding for replacement wells, well modifications, alternative water supplies, or critical infrastructure (if applicable) improvements to eligible landowners.

ES-7. GSP Implementation

Implementing the MKGSA GSP requires significant administrative and financial structures with adequate human resources and funding to ensure compliance with SGMA. Activities associated with GSP implementation are:

1. Agency administration
2. Legal counsel
3. Outreach and coordination
4. Monitoring (groundwater levels, groundwater quality, and land subsidence)
5. Addressing data gaps (groundwater monitoring wells and flow gages)
6. Required annual reporting

7. Developing projects and management actions
8. Updating the groundwater model
9. Updating the data management system
10. Evaluating/amending the GSP at least every 5 years
11. Responding to comments from DWR and State Water Resources Control Board (SWRCB)

From 2020 to 2024, administrative costs to implement the MKGSA GSP have been approximately \$1.7 million. MKGSA anticipates that annual administrative costs after 2025 will be about \$350,000 per year. Although a number of projects and management actions have been implemented since 2020, there will be a considerable effort to add recharge strategically within the MKGSA and to implement significant pumping reductions through the established allocation system. The effort is reflected in estimated 2025 to 2030 project capital costs of \$59.5 million (\$11.9 million per year). After 2030, the MKGSA expects capital costs to decrease to approximately \$2 million per year after most of the planned projects and management actions have been implemented. Additional recharge facilities will increase operations and maintenance costs by 380% from about \$31,000 to \$82,000 per year. The MKGSA Board approved generating funding for the Mitigation Plan via groundwater extraction fees and surface water transfer fees.

Results from predictive modeling supports the challenging decisions that MKGSA and the other GSAs have had to make when establishing strict demand management policies and revising sustainable management criteria to be even more protective of beneficial users, uses, and property interests in this Second Amended GSP. The model results provide confidence that the Kaweah Subbasin will achieve sustainability by 2040.

The predictive modeling incorporates

- Projects and management actions implemented per each GSA's planned schedule
- A 33% increase in managed aquifer recharge from current recharge volumes
- A 34% reduction in irrigated agriculture groundwater extractions

The graph on Figure ES-7 shows the predicted basin-wide change in storage over time if these recharge and demand management actions are implemented. The graph demonstrates how these actions reduce annual overdraft by 2040 and sustain a groundwater surplus through the remainder of the planning horizon.

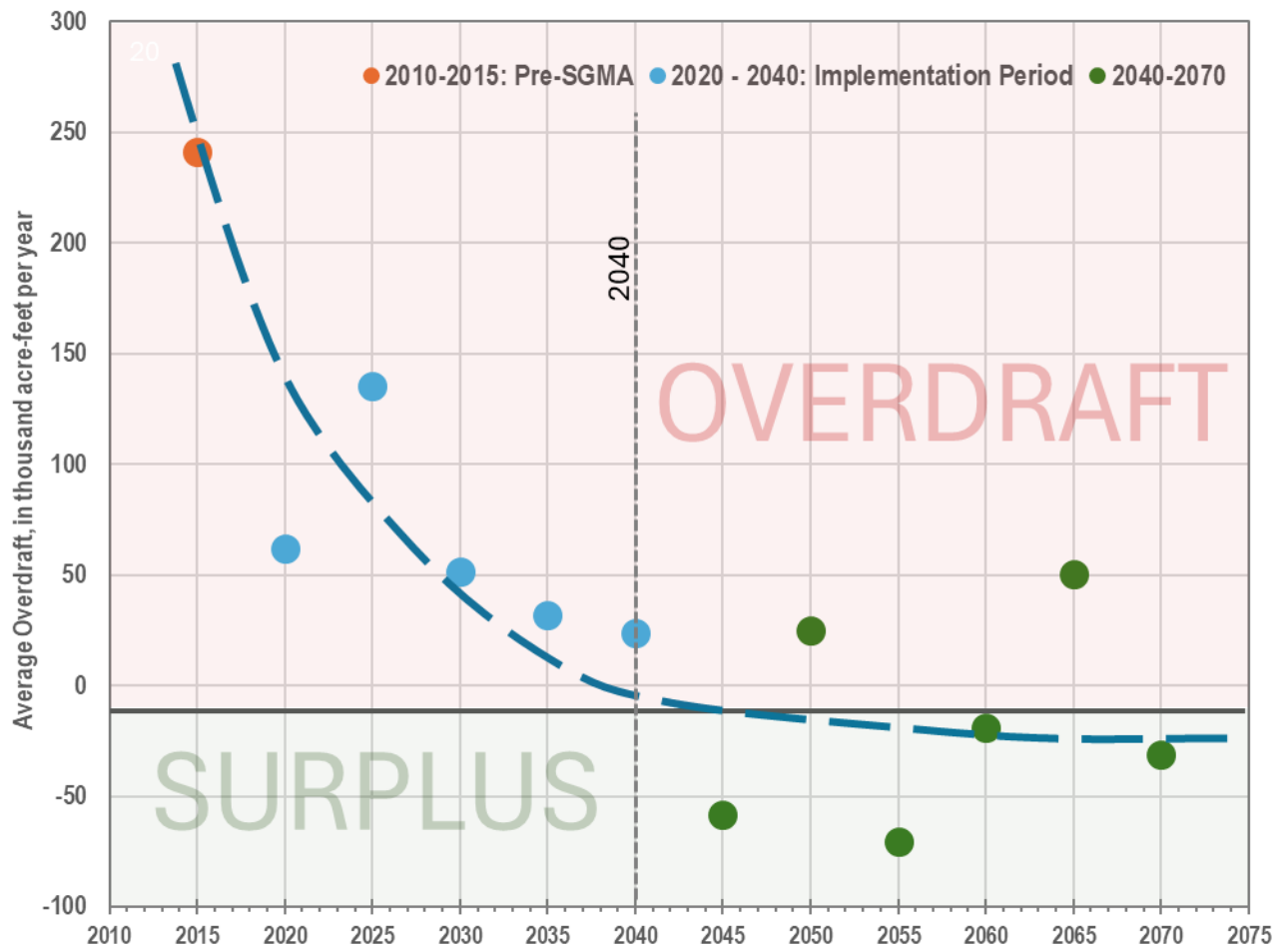


Figure ES-7. Kaweah Subbasin Projected Overdraft Reduction

1 INTRODUCTION TO THE KAWEAH SUBBASIN SECOND GROUNDWATER SUSTAINABILITY PLAN AMENDMENT

§354 Introduction to Plan Contents. This Article describes the required contents of Plans submitted to the Department for evaluation, including administrative information, a description of the basin setting, sustainable management criteria, description of the monitoring network, and projects and management actions.

1.1 Introduction

This second amended Groundwater Sustainability Plan (GSP) covers the Mid-Kaweah Groundwater Sustainability Agency’s (MKGSA’s) jurisdiction within the Kaweah Subbasin and has been prepared in compliance with the Sustainable Groundwater Management Act (SGMA).

The Kaweah Subbasin [#5-22.11 per DWR Bulletin 118] (DWR, 2003) occupies approximately 700 square miles within the larger San Joaquin Valley Basin and is situated primarily within Tulare County. It is one of the prime agricultural regions in the Central Valley and home to numerous small towns and communities, as well as the larger cities of Tulare and Visalia. The region’s surface water supplies include the local Kaweah River system and Friant Unit of the Central Valley Project (CVP). Conjunctive-use recharge operations, which make use of these sources, have been a longstanding practice in the Subbasin.

Most urban communities rely exclusively on groundwater and depending on location, agricultural lands possess a mix of surface supplies as well as groundwater. The Subbasin is considered to be in critical overdraft because of chronically lowered groundwater levels.. Land subsidence caused by historical groundwater overdraft is an issue also faced by the Subbasin. Groundwater quality concerns relate primarily to small-system and domestic wells are diffusely spread across the Subbasin and stem from legacy fertilizer applications in agricultural areas, contaminant plumes from other land uses, and possible degraded individual septic systems as a result of age, poor maintenance, and/or lack of routine service. Naturally occurring elevated uranium and arsenic are constituents of concern that also occur in places across the Subbasin.

1.2 Purpose

On September 16, 2014, Governor Jerry Brown signed into law a 3-bill legislative package, composed of AB 1739 (Dickinson), SB 1168 (Pavley), and SB 1319 (Pavley), collectively known as SGMA and is codified in Section 10720 *et seq.* of the California Water Code. In his signing statement, Governor Edmund G. Brown, Jr., emphasized that “groundwater management in California is best accomplished locally.” This legislation created a statutory framework for

groundwater management in a manner that can be sustained during the planning and implementation horizon without causing undesirable results (URs).

SGMA requires governments and water agencies of high and medium priority basins to achieve sustainability by avoiding URs. Under SGMA, these basins should reach sustainability within 20 years of implementing their sustainability plans. For critically over-drafted basins, including the Kaweah Subbasin in which the Mid-Kaweah Groundwater Sustainability Agency (MKGSA) is located, the deadline for achieving sustainability is 2040.

The 3 Groundwater Sustainability Agencies (GSAs) responsible for groundwater management of the Kaweah Subbasin initially received an incomplete determination from the California Department of Water Resources (DWR) for the 3 GSPs and coordination agreement (collectively referred to as the Plan for the Subbasin) on January 28, 2022. The revised Plan for the Kaweah Subbasin in response to DWR's incomplete determination was subsequently found to be inadequate by DWR on March 2, 2023. The inadequate determination¹ was made because actions taken to correct identified deficiencies were not sufficient. Two of the 3 deficiencies apply to the MKGSA GSP:

Deficiency 1 – the Plan does not set (SMC) for chronic lowering of groundwater levels in the manner required by SGMA and the GSP regulations.

Deficiency 2 - the Plan does not set SMC for subsidence in the manner required by SGMA and the GSP regulations.

Once DWR determines that a GSP is inadequate, primary jurisdiction shifts from DWR to the State Water Resources Control Board (State Board), which may designate the Subbasin probationary.

The MKGSA GSP addresses SGMA compliance aspects in a coordinated fashion with the 2 other Subbasin GSAs (EKGSAs and GKGSAs). The 8 chapters of this Plan, which in general introduce the MKGSA, describe the basin setting, monitoring networks, Subbasin sustainability goals, and SMC leading to sustainability, and projects and management actions needed to achieve those objectives. The content of the various chapters are listed below:

Chapter 2: Describe the GSP Plan Area.

Chapter 3: Describe the Basin Setting (Hydrogeologic Conceptual Model, HCM) to define and describe the geographic and geologic setting of the MKGSA boundaries. In order to comply with the requirements of SGMA, MKGSA and the 2 other Kaweah GSAs contracted with GEI Consultants, Inc. (GEI) for development of the basin setting

¹ <https://sgma.water.ca.gov/portal/service/gspdocument/download/9589>

used for the 2020 GSPs. This 2020 Basin Setting (Appendix 3A) still applies, but more current groundwater conditions updates have been added to Chapter 3.

Section 3.3: Describe historical and current groundwater conditions within the Kaweah Subbasin.

Section 3.4: Report the historical, current, and projected groundwater budgets for MKGSA and the Kaweah Subbasin.

Chapter 4: Describe the monitoring networks within the Kaweah Subbasin and those particular to MKGSA.

Chapter 5: Identify and describe the Sustainable Management Criteria (SMC) for the Kaweah Subbasin:

Identify and describe the URs for applicable sustainability indicators, as they pertain to the MKGSA.

Identify and describe the Minimum Thresholds (MTs) and Measurable Objectives (MOs) required for the MKGSA to achieve the Sustainability Goal.

Chapter 6: Define and describe Projects and Management Actions proposed by MKGSA to achieve the Sustainability Goal.

Chapter 7: Describe how the Projects and Management Actions and SMC together will result in the Kaweah Subbasin achieving sustainability by 2040.

Chapter 8: References & Technical Studies

1.3 Agency Information

§354.2 Introduction to Administrative Information. This Subarticle describes information in the Plan relating to administrative and other general information about the Agency that has adopted the Plan and the area covered by the Plan.

§354.6 Agency Information. When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:

- (a) The name and mailing address of the Agency.
- (b) The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan.
- (c) The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.

Agency's Name: Mid-Kaweah GSA (MKGSA)

Agency's Address: 6826 Ave 240
Tulare, CA 93274

Agency's Phone Number: (559) 686-3425

Agency's Website: www.midkaweah.org

Contact Person: Aaron Fukuda

Contact Person's Title: Interim General Manager

The MKGSA, formed in September 2015, was one of the first GSAs in the state. Its Members consist of the City of Tulare, the City of Visalia, and the Tulare Irrigation District (TID). These agencies desire to expand upon several water management agreements in a collective effort to comply with SGMA. These agreements are listed following:

- Tulare-TID Assessment Agreement – circa 1954
- Tulare-TID Recharge Agreement – circa 2008
- Tulare-TID Joint Recharge Facilities Construction – circa 2007
- Visalia-TID Channel Use Agreements – circa 2001
- Visalia-TID Tertiary-Treated Water Exchange Agreement – circa 2013

Each of the above-listed agreements operates in furtherance of groundwater management and preservation within the region.

1.4 Legal Authority

§354.6 Agency Information. When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:

- (d) The legal authority of the Agency, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agency, demonstrating that the Agency has the legal authority to implement the Plan.

In accordance with the State of California’s Sustainable Groundwater Management Act (AB1739, SB1168, SB1319) signed into law on September 16, 2014, by Governor Jerry Brown, the City of Visalia, the City of Tulare, and TID entered into a Joint Powers Authority (JPA) Agreement to form the MKGSA on September 14, 2015. Per the law, a public agency or agencies are permitted to form GSAs within the Subbasin (Division 6 of the Water Code, Part 2.74, Chapter 4, Section (§) 10723 *et seq.* and amendments made to SGMA by Senate Bill (SB) 13 in September 2015).

Under the JPA Agreement, the MKGSA was granted the authority to do all acts necessary for the exercise of all the powers authorized under SGMA as necessary to satisfy the requirements of SGMA while allowing the Members of the GSA to maintain control and autonomy over the surface and groundwater assets to which they are currently legally entitled. The original JPA Agreement and Amendment 1 are included as Appendix 1B.

1.5 GSP Implementation Costs

§354.6 Agency Information. When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:

- (e) An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.

The MKGSA on behalf of its Members incurs costs to implement the GSP and to maintain the Plan. These costs and sources of funding are described below.

Table 1-1 presents a description and estimate of the costs associated with the implementation of the MKGSA GSP and measures associated with SGMA compliance.

Table 1-1. Estimated Costs for MKGSA GSP Implementation in 5-Year Increments

Budget Category	2020-2025	2025-2030	2030-2035	2035-2040
1. Regular/Ongoing SGMA Compliance Activities	\$1,790,980	\$1,744,930	\$1,799,000	\$1,853,200
2. GSP Amendments (Deficiency Amendments & Periodic Evaluations)	\$1,380,000	\$500,000	\$500,000	\$500,000
3. Plans to Fill Data Gaps	\$210,000	\$250,000	\$250,000	\$250,000
4. Priority Projects (completed or in-process)	\$29,435,000	\$40,325,000	\$575,000	\$5,125,000
5. Priority Management Actions (completed or in-process)	\$5,065,000	\$8,625,000	\$8,625,000	\$8,625,000
6. Optional Projects	TBD	TBD	TBD	TBD
7. Optional Management Actions	TBD	TBD	TBD	TBD
Total	\$37,880,980	\$51,444,930	\$11,749,000	\$16,353,200

1.6 Agency Coordination

The 3 Kaweah Subbasin GSAs worked to coordinate the Subbasin-wide sustainability goal, URs, and SMC, among many other items pertaining to this Second Amended GSP. Coordination Agreements were submitted with the 2020 GSP and First Amended GSP. For this draft GSP, a revised Coordination Agreement has not yet been completed because there are additional deficiencies contained in the draft Staff Report that need to be addressed in the GSPs before the Coordination Agreement can be signed by the GSAs.

2 PLAN AREA

The MKGSA is located entirely within the Kaweah Subbasin—as defined in DWR Bulletin 118—in the Tulare Lake Hydrologic Region of the San Joaquin Valley Groundwater Basin. The Kaweah Subbasin is bounded by the Kings River Subbasin to the north, the Tulare Lake Subbasin to the west, the Tule River Subbasin to the south, and the Sierra Nevada Mountains to the east. The MKGSA is roughly bisected by California State Highway 99. The section below describes the area covered by the MKGSA’s GSP.

2.1 Geographic Area Covered

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

- (a) One or more maps of the basin that depict the following, as applicable:
 - (1) The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.
 - (2) Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.

Shown on Figure 2-1, the MKGSA’s jurisdictional area (163 square miles) represents approximately 23% of the area within the Kaweah Subbasin (696 square miles). The MKGSA is adjacent to the Tule River Subbasin to the south and the Greater Kaweah GSA and Tulare Lake Subbasin to the west, with the Greater Kaweah GSA to the north and east. Disadvantaged Communities (DACs) exist in the MKGSA and are shown on Figure 2-2. DACs within the MKGSA area include Okieville, Waukena, and City of Tulare.

The St. Johns River runs along the northern boundary of MKGSA and the City of Visalia and the Lower Kaweah River becomes Mill Creek east of the City of Visalia before entering the MKGSA jurisdictional area. Mill Creek roughly bisects the City of Visalia as it drains to the southwest toward Cross Creek and the Tulare Lake Subbasin. Several other creeks and seasonal streams reach their terminus within the boundaries of MKGSA, including Packwood Creek and Cameron Creek. Elk Bayou drains along the eastern boundary of MKGSA near the City of Tulare and through the southwestern portion of Greater Kaweah GSA until it reaches the Tule River at the boundary of the Kaweah Subbasin.

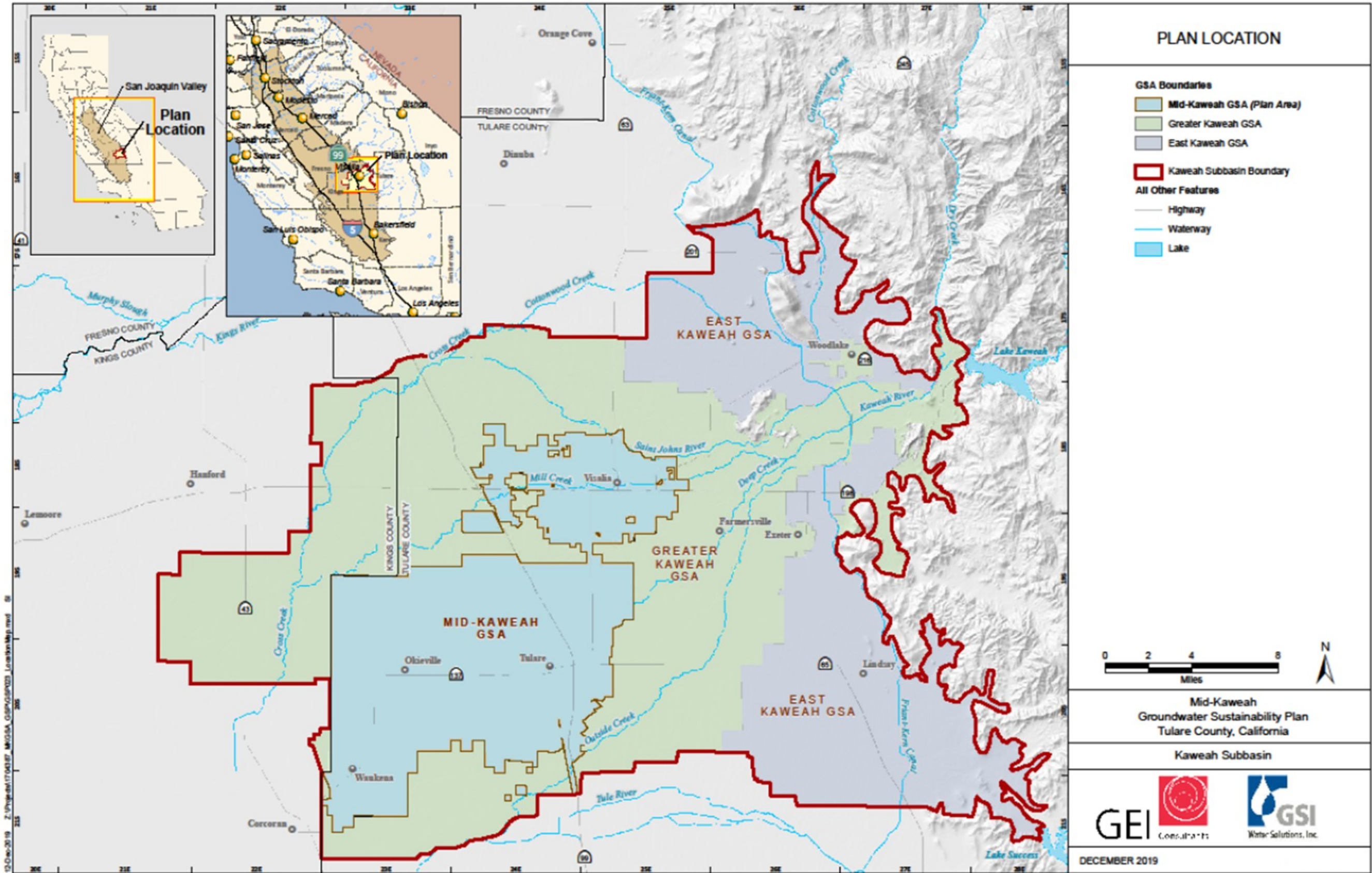


Figure 2-1. MKGSA Plan Location Map



2.2 Plan Area Setting

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

- (a) One or more maps of the basin that depict the following, as applicable:
 - (4) Existing land use designations and the identification of water use sector and water source type.

Land use within the MKGSA is 65% agricultural with 35% urban. Figure 2-3 depicts land-use types for the Subbasin. Agricultural use in MKGSA can be described as mostly seasonal field crops and grain and hay crops, interspersed with deciduous fruits and nuts and pasture. Urban land use is within the limits of the cities of Tulare and Visalia and the surrounding unincorporated areas within the sphere of influence for the cities. There are also several small unincorporated disadvantaged communities (DACs) in the MKGSA, specifically Okieville, and Waukena. Land use maps included in the most recent General Plans for the City of Tulare (2014), City of Visalia (2014), and Tulare County (2012) are included as Appendix 2A.

The MKGSA area has used local surface water for agriculture since the late 1800s. TID was formed in 1889. The area experiences regular cycles of drought and flood, but the groundwater recovery during flood periods does not completely offset the groundwater drops in the drought years. Long-term groundwater levels in the western part of the Subbasin declines approximately 2 to 3 feet per year. Subsidence has been a historical issue in the area; a product of local geology and wells being drilled to deeper zones when they are replaced. Local subsidence issues have been accommodated for many years prior to the enactment of SGMA, but subsidence rates have significantly increased in response to the 2007 to 2016 dry climatic cycle.

It is important to monitor groundwater levels throughout the Plan area. There are several water resource monitoring programs tracking groundwater elevation trends throughout numerous groundwater basins. California Statewide Groundwater Elevation Monitoring (CASGEM)² is a state-wide system managed by DWR with local agencies, counties, and associations providing groundwater level data. CASGEM has in large part been replaced by the Monitoring Network Module in the SGMA Portal.

Within the Kaweah Subbasin, numerous programs exist for monitoring and management of groundwater. These programs are described in detail in Section 2.3 of the Kaweah Subbasin Basin Setting report included as Appendix 3A of this Plan. The monitoring and management programs within the MKGSA are presented and described in Chapter 4 of this GSP, including activities associated with monitoring and management of groundwater, surface water, climate, and land surface subsidence.

² [https://www.casgem.water.ca.gov/OSS/\(S\(pjww1s3s4mocqq0rft2t2g1n\)\)/GIS/PopViewMap.aspx?Public=Y](https://www.casgem.water.ca.gov/OSS/(S(pjww1s3s4mocqq0rft2t2g1n))/GIS/PopViewMap.aspx?Public=Y)

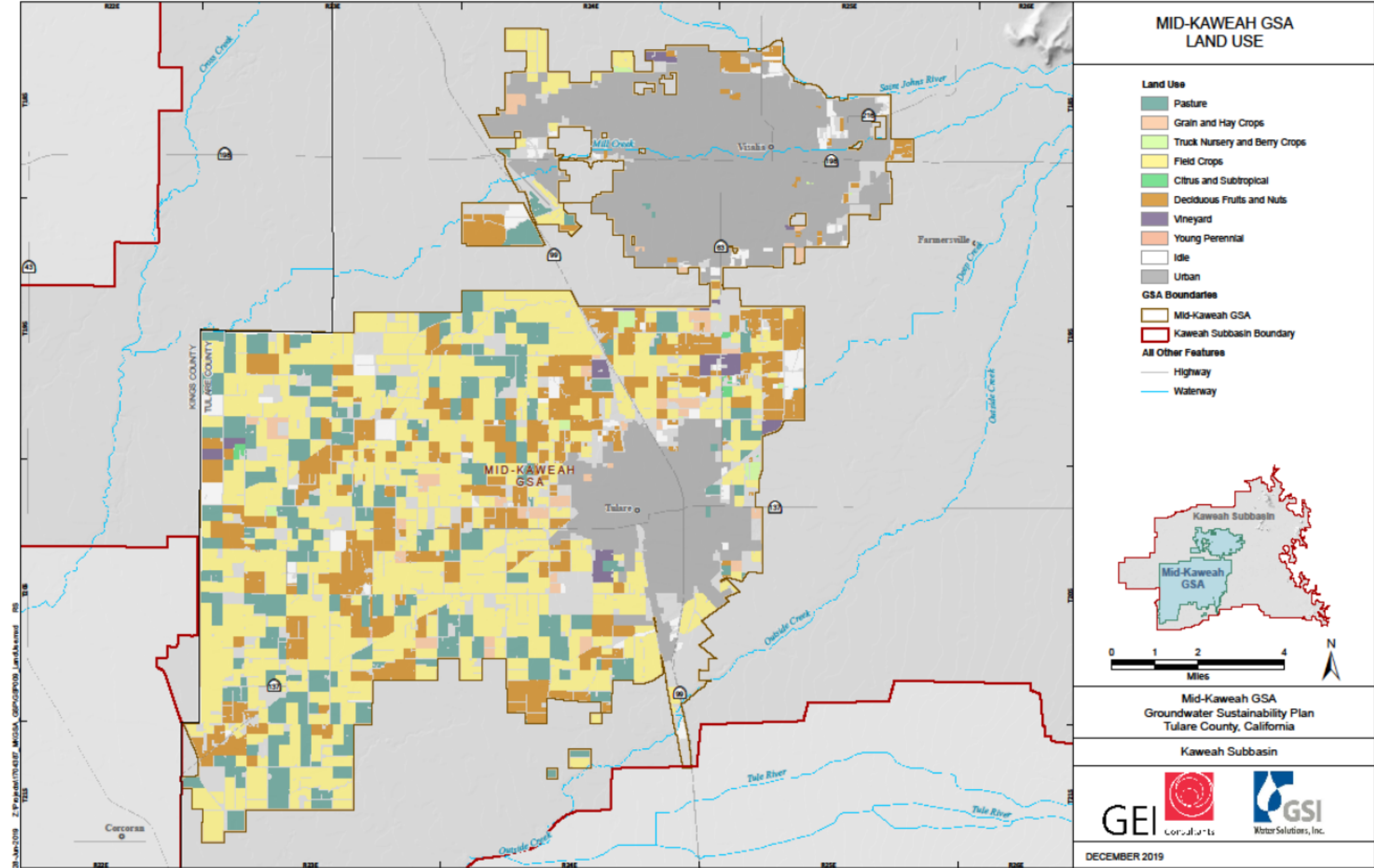


Figure 2-3. MKGSA Land Use

2.3 Jurisdictional Boundaries within Plan Area

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

- (a) One or more maps of the basin that depict the following, as applicable:
 - (1) The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.
 - (2) Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.
 - (3) Jurisdictional boundaries of federal or state land (including the identity of the agency with jurisdiction over that land), tribal land, cities, counties, agencies with water management responsibilities, and areas covered by relevant general plans.

2.3.1 Local Agencies within Plan Area

Two incorporated cities are located completely within MKGSA’s jurisdictional area, including the City of Tulare and the City of Visalia, as shown on Figure 2-4. Groundwater is the sole source of water for both cities, which combined have a service population of approximately 217,300. In addition to the cities, TID also has jurisdiction within the MKGSA area. TID is a political subdivision of the State of California operating as an independent agency under the California Water Code. TID obtains and delivers surface water supplies for irrigation of farms and groundwater recharge of the Kaweah Subbasin underlying TID’s jurisdictional area. TID delivers surface water to approximately 215 farms and serves approximately 58,850 irrigated acres.

2.3.2 State and Federal Agencies within Plan Area

There are no state or federal agencies with jurisdiction in the MKGSA Plan area.

2.3.3 Tribal Lands within Plan Area

There are no lands designated as tribal lands within the Kaweah Subbasin; however, MKGSA respects the past, present, and future connection that local tribes of the San Joaquin Valley have to the region’s land, water, and other natural resources. MKGSA identified 5 California Native American Tribes within or near the Kaweah Subbasin: the Santa Rosa Rancheria Tachi-Yokut Tribe of Lemoore, the Wuksachi Indian Tribe, California Valley Miwok Tribe, Wutchumni Tribe, and the Tule River Indian Tribe. The Santa Rosa Rancheria Tachi-Yokut Tribe reservation is in the Tulare Lake Subbasin. Details for the other 4 Tribes are not available.

2.3.4 Absence of Adjudicated Areas or Areas Covered by Alternative Plans

Adjudicated Areas have not been established within the MKGSA or the Kaweah Subbasin.

2.4 Water Use by Service Sector within Plan Area

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

- (a) One or more maps of the basin that depict the following, as applicable:
 - (4) Existing land use designations and the identification of water use sector and water source type.

Figure 2-5 provides locations on water use sector and water source type within the MKGSA. This map shows land use areas occupied by wetlands, recharge basins, and commercial/industrial including confined animal facilities, urban areas, and agricultural areas. It also shows areas receiving a mix of groundwater and surface water, the approximate locations for municipal supply wells in the cities of Visalia and Tulare, which are both supplied by 100% groundwater, and the locations of water recycling facilities which treat wastewater for use in agricultural irrigation. A detailed water budget accounting for the entire Kaweah Subbasin is provided in the comprehensive Basin Setting (Appendix 3A). Section 3.4 of this GSP presents the water budget accounting for the Subbasin and MKGSA.

2.4.1 Surface Water and Conjunctive Use

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

- (e) A description of conjunctive use programs in the basin.

Surface water use within the MKGSA includes farm, ranch, and dairy operations that purchase runoff from the Kaweah River and San Joaquin River watersheds from TID. San Joaquin River supplies are delivered by Friant Water Authority, which provides operation and maintenance of the Friant Division of the Central Valley Project. Kaweah supplies are managed by Kaweah & St. Johns Rivers Association. Members of this agricultural community attend meetings and serve on the MKGSA Advisory Committee and Board.

TID provides local and imported surface water to supplement groundwater uses of its landowners. TID also diverts its surface water supplies for groundwater recharge purposes, particularly in wet years. TID has a contract with the United States Bureau of Reclamation (USBR, Contract No. I75r-2485D) for 30,000 AF of Class 1 water and 141,000 AF of Class 2 water from the Friant Division of the Central Valley Project. TID also has Pre-1914 water rights on the Kaweah River, which is a Fully Appropriated Stream according to the SWRCB. On average, TID delivers approximately 150,000 AF of surface water supplies to 58,850 irrigated acres and its groundwater recharge partners (City of Tulare and City of Visalia). In very wet years, TID has diverted as much as 420,000 AF and in dry years, as little as 10,000 AF.

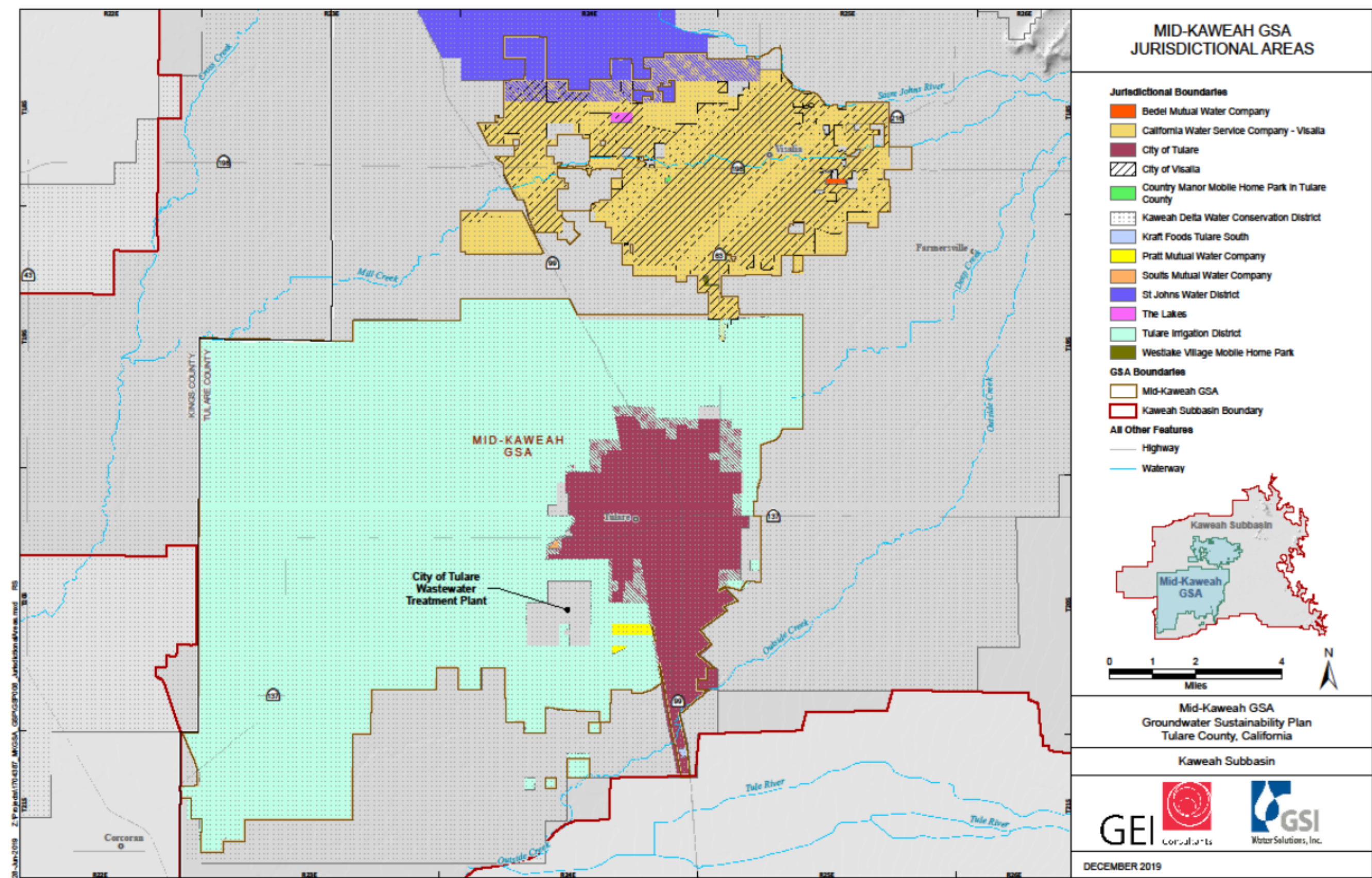


Figure 2-4. MKGSA Jurisdictional Boundaries

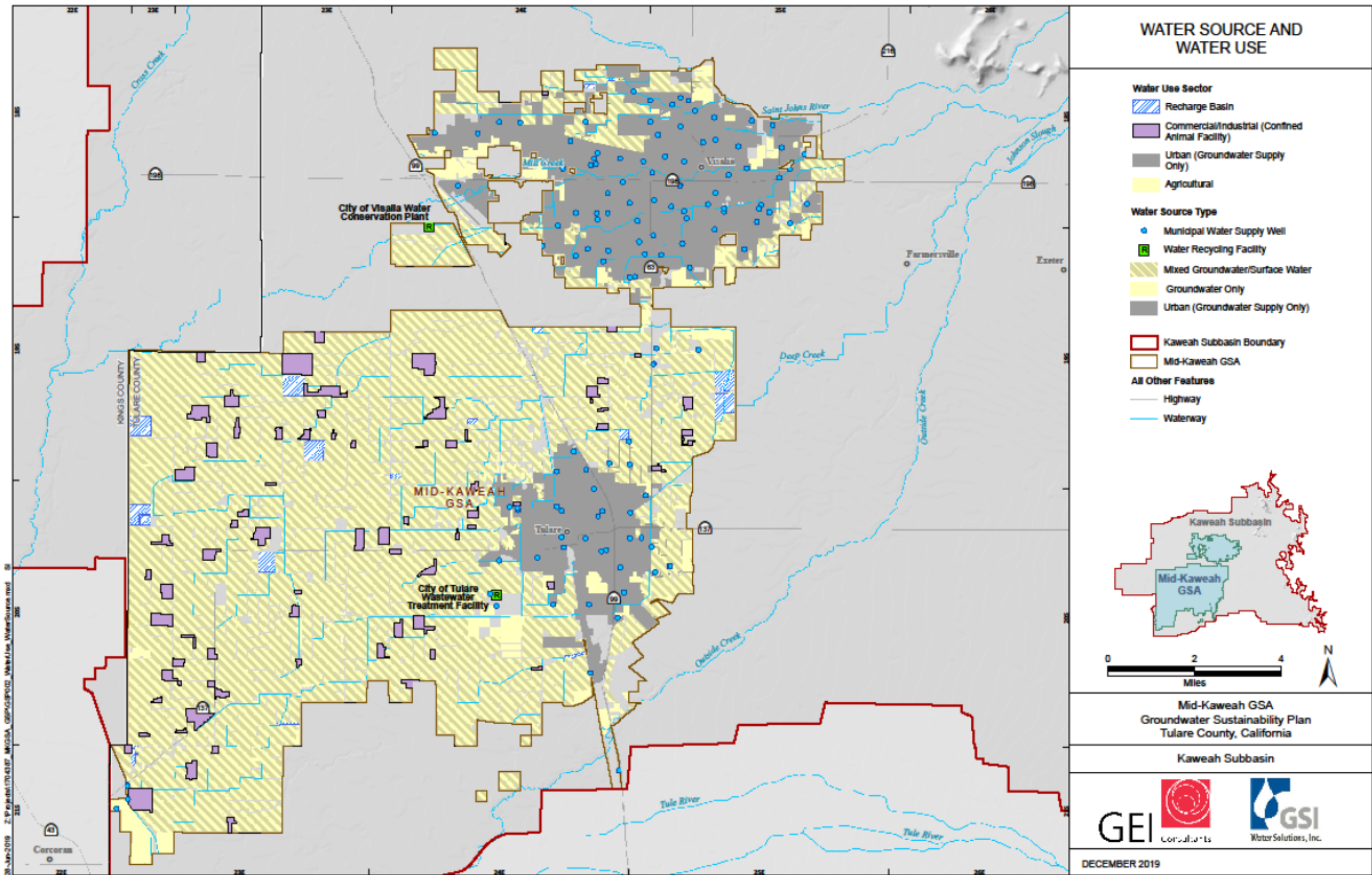


Figure 2-5. Water Source and Water Use

2.4.2 Groundwater-Dependent Use

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

- (g) Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

All the communities in the MKGSA are groundwater dependent (Figure 2-6). These include the 2 incorporated cities and the state small systems owned and operated by California Water Services Company (Cal Water) and 1 private mutual water company (Okieville). Two other private mutual water companies are now connected to the City of Tulare’s water supply system (Soultis Tract and Matheny Tract). The *de minimis* domestic water users and multi-parcel water systems located within the MKGSA are also groundwater dependent. The approximate locations of these water users are shown on Figure 2-7 through Figure 2-8

MKGSA’s average groundwater extraction between 2012 and 2022 is 208,700 AF is distributed by sectors as follows:

- Agricultural use –159,400 AF (28%)
- Urban use – 45,700 AF (64%)
- Industrial use – 3,600 AF (8%)

2.4.3 Well Density within Plan Area

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

- (a) One or more maps of the basin that depict the following, as applicable:
- (5) The density of wells per square mile, by dasymetric or similar mapping techniques, showing the general distribution of agricultural, industrial, and domestic water supply wells in the basin, including de minimis extractors, and the location and extent of communities dependent upon groundwater, utilizing data provided by the Department, as specified in Section 353.2, or the best available information.

Figure 2-7 through Figure 2-8 are well-density maps showing the general distribution of domestic, agricultural irrigation, and public water system, and industrial supply wells within the MKGSA. The data are based on DWR’s Online System of Well Completion Reports (OSWCR) through April 2023. A Well Registration Program for the Subbasin is to be completed in phases and available for full implementation in Summer 2025. The purpose of the program is to improve understanding of the number of wells, their use and construction, and to create a baseline record for each well in the event of a future mitigation claim (see Section 6.7.6 for details).

Table 2-1 summarizes well count and well density information for domestic, agricultural irrigation, and public water system and industrial supply wells. Overall, a total of 2,976 wells are identified within the MKGSA boundary. The total number of domestic wells is slightly higher (748) than agricultural wells (669) and the number of public and industrial supply wells is relatively small (146). Note that these counts include all wells from the OSWCR database and do not necessarily represent current usable wells.

The maximum total well density of known use is 43 wells per nominal square mile (Table 2-1). Higher well densities are generally for domestic wells located in the northeastern portions of MKGSA, in the Visalia area or north of Tulare. Increased domestic well densities are often associated with DACs, such as Okieville (Figure 2-7). Lower well densities are generally found in the southwestern portion of MKGSA area. Agricultural wells are distributed more uniformly across the MKGSA area, with only 6 sections within the MKGSA having greater than 10 wells per nominal square mile (Figure 2-7). Municipal and industrial wells densities are greater in the cities of Visalia and Tulare, with usually 3 wells or less per nominal square mile in the western portion of the MKGSA area (Figure 2-8). 44% of wells in the OSWCR database are not assigned a use. This means they could be non-water supply related monitoring wells or for cathodic protection. With this uncertainty in mind, Figure 2-9 shows the well density of the unknown use wells. The distribution of unknown use well density is similar to the distribution of domestic wells. The maximum density of wells with unknown use in a section is 59 which is found in the City of Visalia, and likely represents mainly domestic wells and some monitoring wells.

Table 2-1. Well Distribution Summary within the Mid-Kaweah Groundwater Sustainability Agency

Well Use	Number of wells within MKGSA	Well Density Over MKGSA Area (wells per square mile)	Maximum Section Well Density (wells per square mile)
Domestic	748	1	43
Agricultural	669	1	17
Public Water System s & Industrial	146	0.2	4
Unknown	1,253	1.8	59
Total	2,819	4	

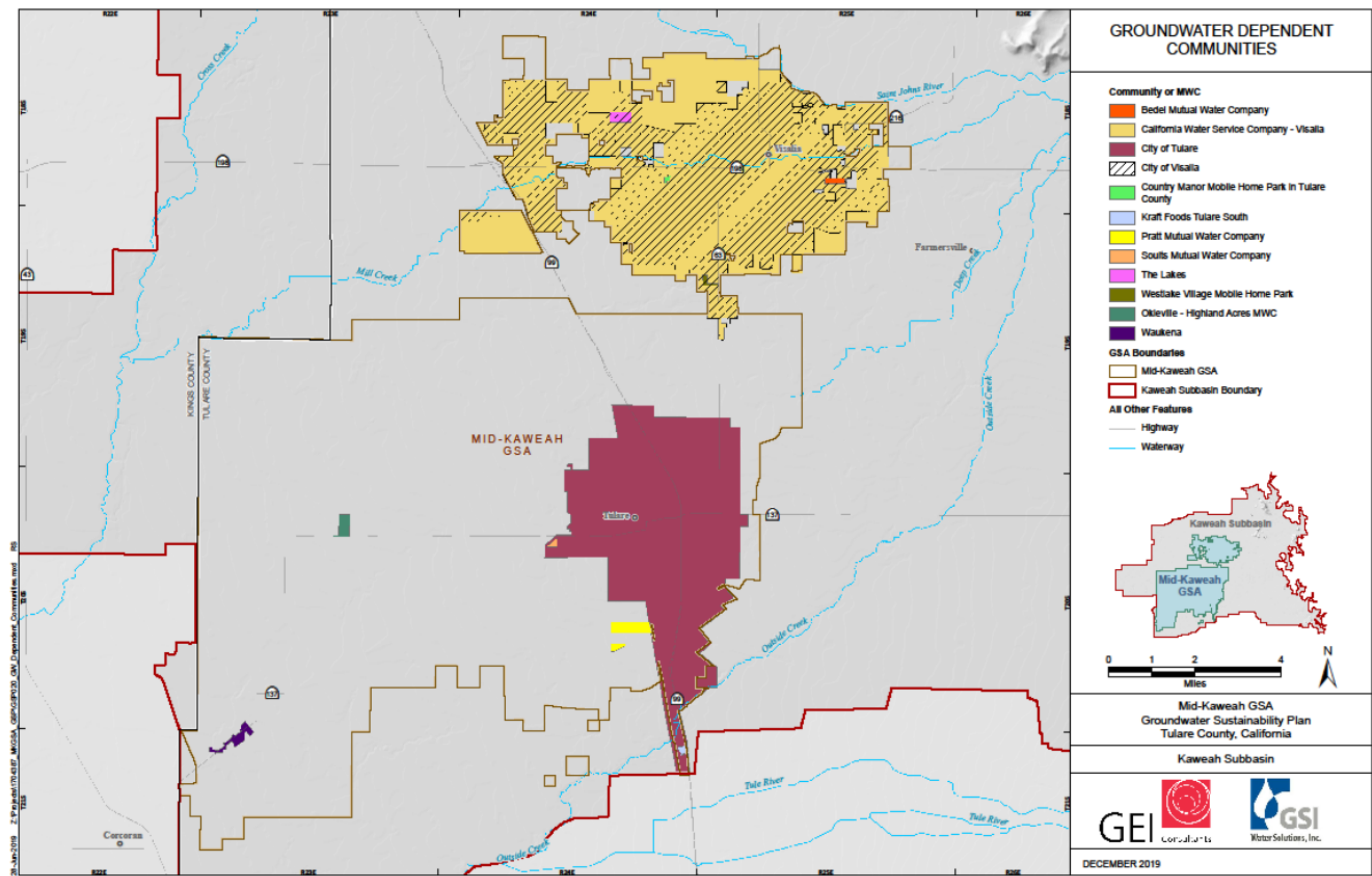


Figure 2-6. Groundwater Dependent Communities

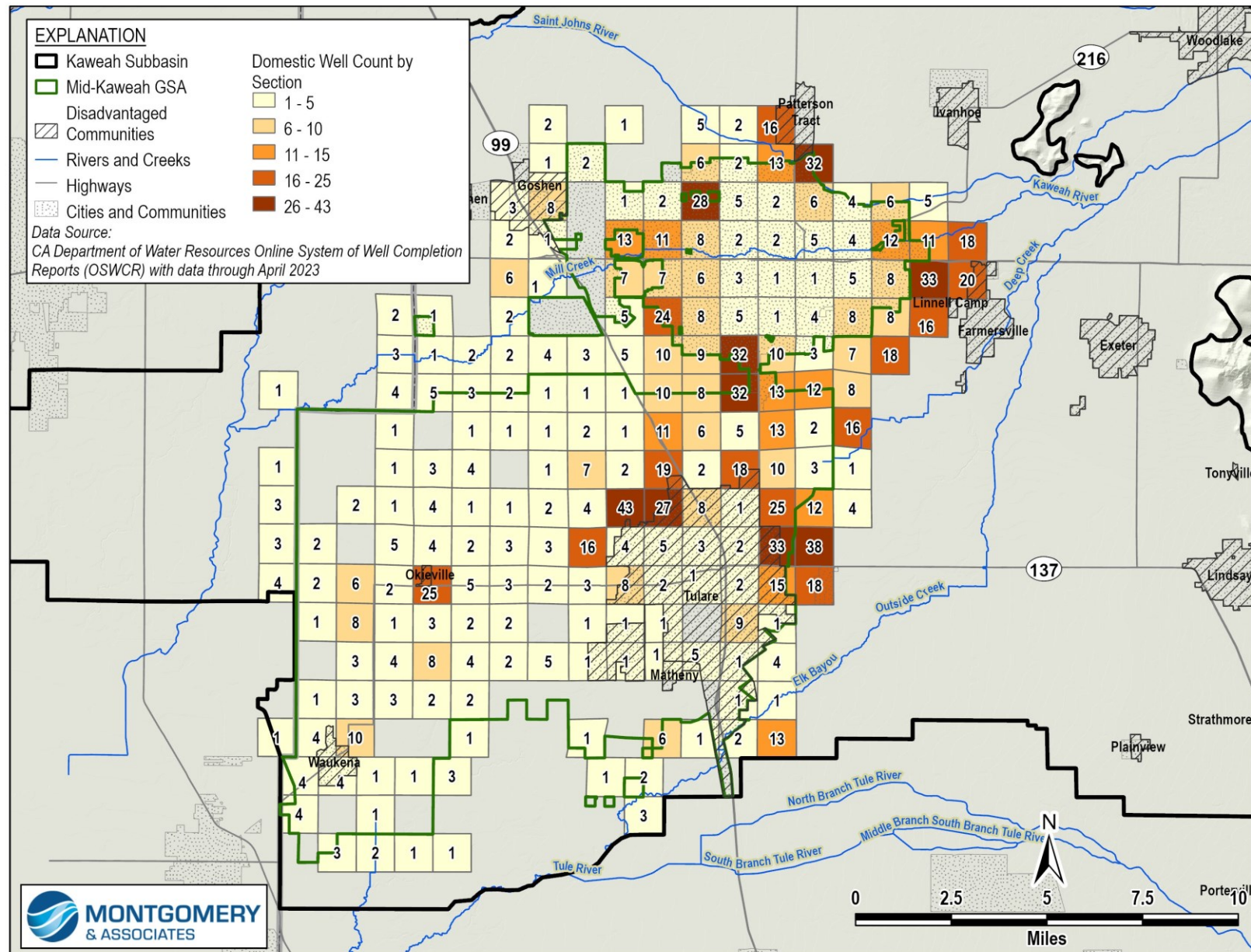


Figure 2-7. Density of Domestic Wells

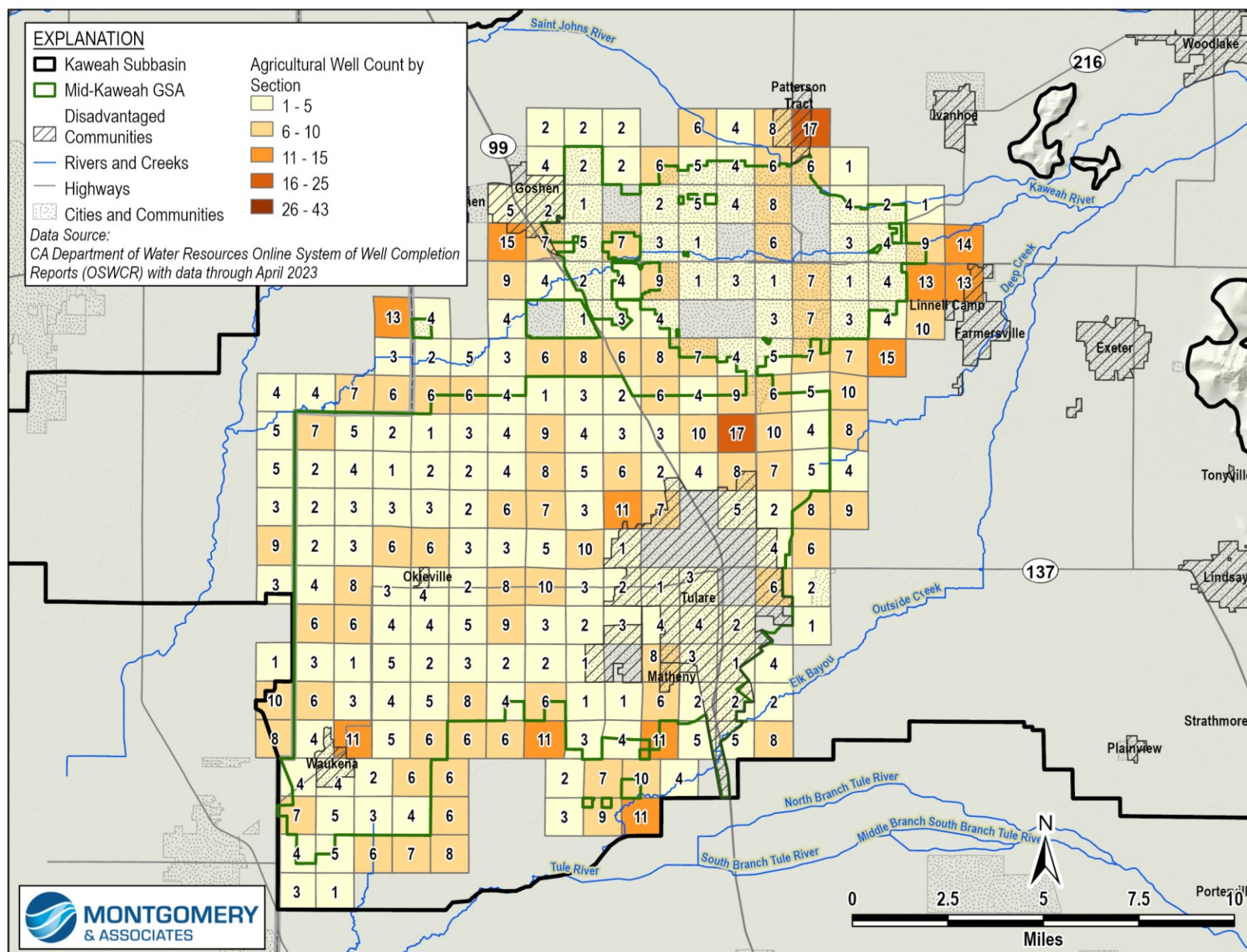


Figure 2-8. Density of Agricultural Production Wells

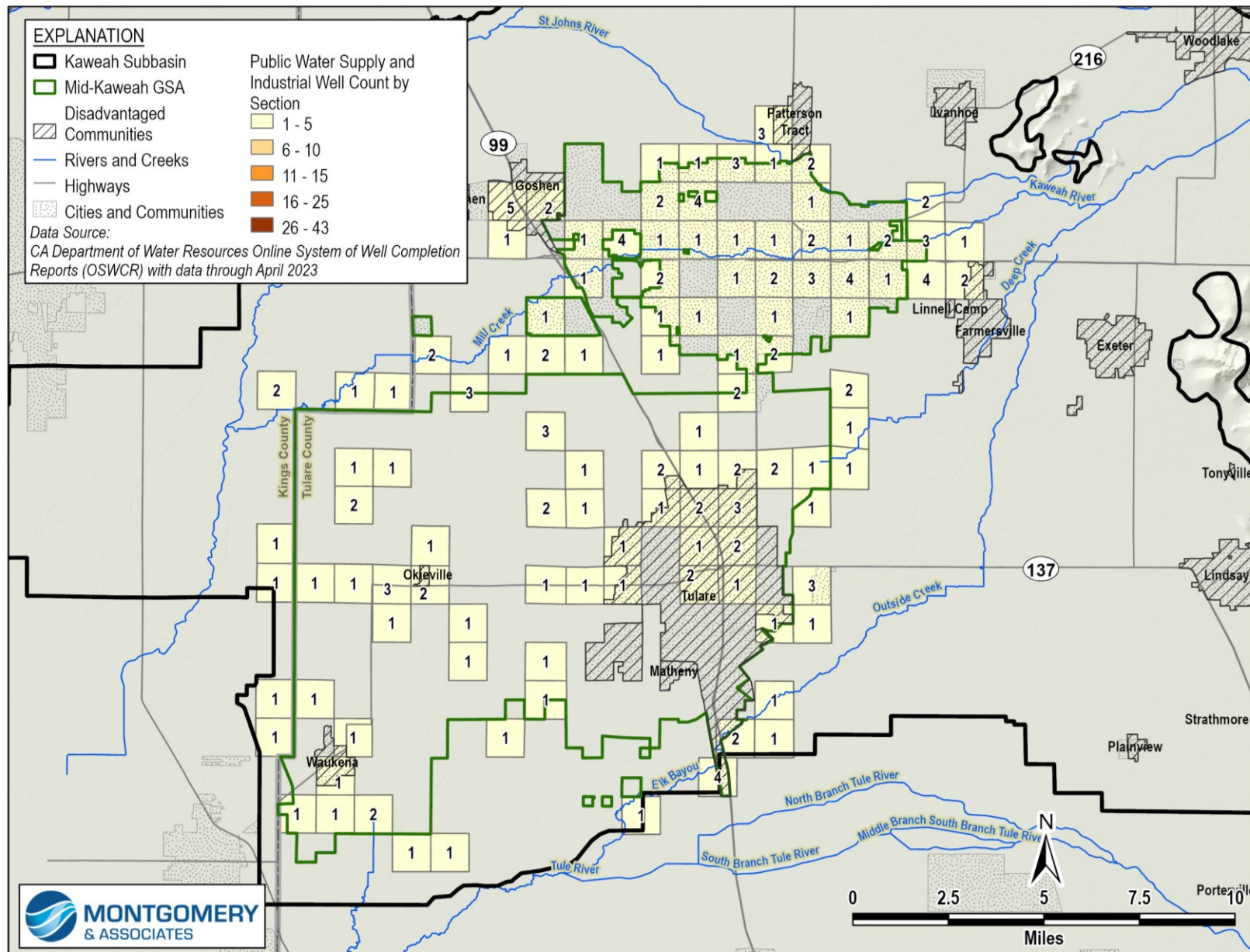


Figure 2-9. Density of Public Water Supply and Industrial Wells

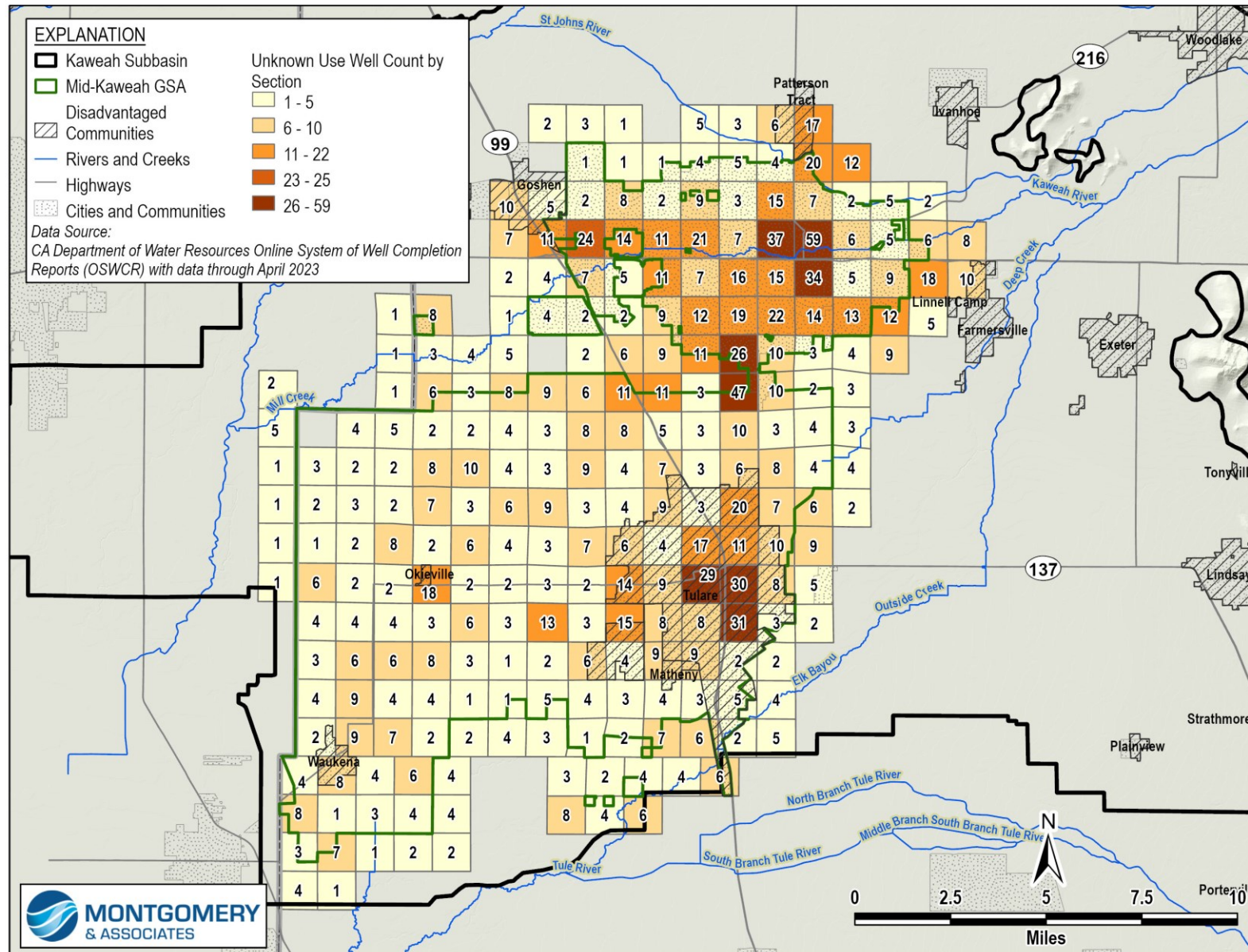


Figure 2-10. Density of Wells with Unknown Use

2.5 Land Use Planning in Plan Area

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

- (b) A written description of the Plan area, including a summary of the jurisdictional areas and other features depicted on the map.
- (c) Identification of existing water resource monitoring and management programs, and description of any such programs the Agency plans to incorporate in its monitoring network or in development of its Plan. The Agency may coordinate with existing water resource monitoring and management programs to incorporate and adopt that program as part of the Plan.
- (f) A plain language description of the land use elements or topic categories of applicable general plans that includes the following:
 - (1) A summary of general plans and other land use plans governing the basin.
 - (2) A general description of how implementation of existing land use plans may change water demands within the basin or affect the ability of the Agency to achieve sustainable groundwater management over the planning and implementation horizon, and how the Plan addresses those potential effects.
 - (3) A general description of how implementation of the Plan may affect the water supply assumptions of relevant land use plans over the planning and implementation horizon.
 - (4) A summary of the process for permitting new or replacement wells in the basin, including adopted standards in local well ordinances, zoning codes, and policies contained in adopted land use plans.
 - (5) To the extent known, the Agency may include information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management.

Each of the 2 incorporated cities in MKGSA’s area have adopted General Plans. For the areas not within the limits of the incorporated cities, the Tulare County General Plan applies. The General Plans for the cities and the General Plan for the county each have land use elements which address water usage. These plans promote the conservation of water and the protection of the quantity and quality of groundwater in their respective areas and were considered in this GSP.

The 2020 Urban Water Management Plans were reviewed for the cities of Visalia (Cal Water Service, 2021) and Tulare (City of Tulare, 2020) and the California Department of Finance population projections (California Department of Finance, 2023). Information in these documents is useful in understanding both current and projected future water supplies and demands.

2.5.1 County of Tulare General Plan

The 2030 General Plan Update for the County of Tulare, adopted on August 28, 2018, does not have a specific update to address water usage and supply. However, the Tulare County 2012 General Plan has a Water Resources Element that requires the County to adopt ordinances and measures to:

- Regulate the permanent extraction and exportation of groundwater from the County
- Assure that all watershed planning is done on a complete regional and watershed basis, and that such planning considers a balance between urban and agricultural demands
- Participate in coordinated local, regional, and statewide groundwater monitoring and planning programs, where feasible
- Encourage active participation by local stakeholders and develop groundwater monitoring partnerships with local groundwater users and developers
- Avoid the destruction of established recharge sites
- Work with federal, state, local, and regional agencies to improve local groundwater pollution detection and monitoring
- Encourage responsible agencies and organizations to install and monitor additional groundwater monitoring wells in areas where data gaps exist
- Research the development of an education program to inform homeowners in the valley and mountain areas regarding water quality concerns
- Incorporate provisions, including evaluating incentives, for the use of reclaimed wastewater, water-conserving appliances, drought-tolerant landscaping, and other water conservation techniques into the county's building zoning
- Identify and evaluate conditions within established watersheds which are causing deterioration of the water quality, water supply, or declining water yields
- Develop an education program to inform residents of water conservation techniques and the importance of water quality and adequate water supplies
- Protect groundwater recharge areas
- Amend county ordinances to include development standards which protect groundwater basins and surface water drainage areas and provide incentives for use of conservation techniques
- Establish development or design standards for the protection of groundwater recharge areas
- Work with other local/regional agencies, water purveyors, and interest groups to seek funding sources to implement a variety of surface and groundwater restoration activities

The Tulare County General Plan includes both policies and implementation measures that address water supply, wastewater treatment, adequate infrastructure, plans, programs, and funding in the following elements:

- Planning Framework (Chapter 2)
- Agriculture (Chapter 3)
- Land Use (Chapter 4)
- Economic Development (Chapter 5)
- Housing (Chapter 6)
- Environmental Resources Management (Chapter 8)
- Health and Safety (Chapter 10)
- Water Resources Chapter 11)
- Public Facilities and Services Chapter 14)

General Plan Water Resources Element Policies Include:

- Water Supply WR-1.1
- Groundwater Withdrawal, WR-1.3
- Water Export Outside County, WR-1.4
- Conversion of Agricultural Water Resources, WR-1.5
- Expand Use of Reclaimed Wastewater, WR-1.6
- Expand Use of Reclaimed Water, WR 1.7
- Collection of Additional Groundwater Information, WR-1.8
- Groundwater Basin Management, WR-1.9
- Collection of additional Surface Water Information, WR-1.10
- Channel Modification, WR-3.1
- Develop Additional Water Sources, WR-3.2
- Develop an Integrated Regional Water Master Plan, WR-3.3
- Adequate Water Availability, WR-3.4
- Water Resource Planning, WR-3.5
- Use of Native and Drought Tolerant Landscaping, WR-3.6
- Agricultural Irrigation Efficiency, WR 3.7
- Emergency Water Conservation Plan, WR-3.8

Educational Programs, WR-3.9
Establish Critical Water Supply Areas WR-3.10
Diversion of Surface Water, WR-3.11
Policy Impacts to Water Resources, WR-3.12
Joint Water Projects with Neighboring Counties, WR-3.13
Coordination of Watershed Management on Public Land PFS-2.1
Water Supply, PFS-2.2
Adequate Systems, PFS-2.3
Well Testing, PFS-2.5
New Systems or Individual Wells, Water Quality, WR-1.2
Groundwater Monitoring, WR 1.7
Collection of Additional Groundwater Information, WR-1.8
Groundwater Basin Management, WR-2.1
Protect Water Quality, WR-2.2
NPDES Enforcement, WR-2.3
Best Management Practices, WR-2.4
Construction site Sediment, WR-2.5
Major Drainage Management, WR-2.6
Degraded Water Resources, WR-2.7
Industrial and Agricultural Sources, WR-2.8
Point Source Control, WR-2.9
Private Wells, PFS-2.1
Water Supply, PFS-2.5

In addition to the county's ongoing efforts to address these objectives in the Water Resources Element of the General Plan, the MKGSA will address these issues with the adoption and implementation of its GSP, pursuant to California Water Code § 10726.9. This GSA, as well as others within Tulare County, meet on a monthly basis to coordinate relevant county datasets, ordinances, and related needs of the GSAs regarding new wells and enforcement measures.

2.5.2 City of Visalia General Plan

The 2030 General Plan Update for the City of Visalia, adopted on October 14, 2014, has several objectives related to water resources in general and groundwater in particular. These objectives can be found in the Open Space and Conservation Element of the Plan in Chapter 6.

One of the objectives is to “work with the county and other organizations to protect prime farmland and farmland of statewide importance outside the city’s Urban Development Boundary for agricultural production, and to preserve areas for groundwater recharge.”

Two policies are listed to further this objective:

1. Open Space Policy #1: “Conduct an annual review of cancelled Williamson Act contracts and development proposals on agricultural land within the Planning Area Boundary to foresee opportunities for acquisition, dedication, easements or other techniques to preserve agricultural open space or for groundwater recharge.”
2. Open Space Policy #6: “Continue cooperative efforts with the Kaweah Delta Water Conservation District, Integrated Regional Water Management Planning group, and others to partner on pursuing grant funding and development of water resource, recharge, and conservation projects and programs.”

The Water Resources section of the city’s General Plan Open Space and Conservation Element includes a description of both surface water resources and groundwater resources. The objectives of the Water Resources section are to:

- Protect water resources vital to the health of the community’s residents and important to the Planning Area’s ecological and economic stability
- Preserve and enhance Planning Area waterways and adjacent corridors as valuable community resources which serve as plant and wildlife habitats, as groundwater recharge facilities, as flood control and irrigation components, and as connections between open space areas
- Continue to participate in a waterway program involving the TID, irrigation companies, private water companies, and state agencies

Among the policies listed in the General Plan to meet these objectives, the City of Visalia included:

- Protect, restore and enhance a continuous corridor of native riparian vegetation along Planning Area waterways, including the St. Johns River; Mill, Packwood, and Cameron Creeks; and segments of other creeks and ditches where feasible, in conformance with the Parks and Open Space diagram of this General Plan

- Establish design and development standards for new projects in waterway corridors to preserve and enhance irrigation capabilities, if provided, and the natural riparian environment along these corridors. In certain locations or where conditions require it, alternative designs may be appropriate (e.g., terraced seating or a planted wall system)
- Place special emphasis on the protection and enhancement of the St. Johns River Corridor by establishing extensive open space land along both sides
- Where no urban development exists, maintain a minimum riparian habitat development setback from the discernible top of the bank: 50 feet for both sides of the Mill, Packwood, and Cameron Creek corridors and 25 feet for both sides of Modoc, Persian, and Mill Creek ditches. Where riparian trees are located within 100 feet of the discernible top of the banks of the creek corridors and 50 feet from the banks for the ditches, the setback shall be wide enough to include 5 feet outside the drip line of such trees. Restore and enhance the area within the setback with native vegetation as follows:
 - a. Where existing development or land committed to development prohibits the 50-foot setback on Mill, Packwood, and Cameron Creek corridors, provide the maximum amount of land available for a development setback
 - b. Where existing development or land committed to development prohibits the 25-foot setback along Modoc, Persian, and Mill Creek ditches, provide the maximum amount of land available for a development setback

These objectives and policies are addressed in the projects and management actions portion of this GSP, particularly with respect to groundwater recharge facilities and use of riparian habitat corridors for groundwater recharge (City of Visalia, 2014).

2.5.3 City of Tulare General Plan

The 2035 General Plan Update for the City of Tulare, adopted on October 7, 2014, addresses water supply and usage in several of its elements (City of Tulare, 2014). Under its Land Use Element, the Tulare General Plan addresses existing water supply by requiring that “water supply systems be adequate to serve the size and configuration of land developments. Standards as set forth in the subdivision ordinance shall be maintained and improved as necessary.” To address future water supply, the General Plan calls for “all new development, prior to the approval of any subdivision applications, the developers shall assure that there is sufficient available water supply to meet projected buildout.”

The Plan Implementation Measures adopted in the General Plan, with respect to water supply, include the following:

“The City shall update its water master plan to address future water supply treatment, and distribution system. The water master plan shall explore:

- a. Water supply alternatives*
- b. Treatment alternatives, including wellhead and centralized treatment*
- c. Alternatives for reuse of grey water*
- d. Water conservation program”*

While the General Plan does not have specific actions to meet these objectives, it refers to maintaining and improving infrastructure to support these objectives. The adoption of the MKGSA GSP will address these measures, particularly with respect to promotion of water supply alternatives and water conservation.

The Conservation and Open Space Element of the Tulare General Plan also addresses the issue of water resources for the City. One of the element’s objectives is to “ensure a reliable, adequate water supply to sustain a high quality of life, while protecting and enhancing the environment.”

The Water Resources Section of the Conservation and Open Space Element states that the City’s Goal is “to preserve and enhance surface waterways and aquifers.” This section of the plan includes the following policies, pertaining to groundwater and water conservation:

- **Regional Groundwater Protection.** The City shall work with Tulare County and special districts to help protect groundwater resources from overdraft by promoting water conservation and groundwater recharge efforts.
- **Groundwater Recharge Area Protection.** When considering new development, the City shall protect existing open spaces, natural habitat, floodplains, and wetland areas that serve as groundwater recharge areas.
- **Continued Recharge of Groundwater Basin.** In known or identified groundwater recharge areas, the predominant land use and resource activities should be designed to promote recharge of the groundwater basin and protection of groundwater quality at a level superior to standard development practices. When appropriate to the land use designation, clustered development should be encouraged to promote open space and continue infiltration.
- **Groundwater Wells.** The City shall protect and monitor its groundwater wells to ensure a sufficient groundwater supply.

- **Water Source.** The city shall cooperate with other jurisdictions to jointly study the potential for using surface water sources to help protect the groundwater supply.
- **Water Conservation.** The City shall promote efficient water use and reduced water demand by:
 - Requiring water-conserving design and equipment in new construction
 - Encouraging water-conserving landscaping and other conservation measures
 - Encouraging retrofitting of existing development with water-conserving devices
 - Providing public education programs
 - Distributing outdoor lawn watering guidelines
 - Promoting water audit and leak detection programs
 - Enforcing water conservation programs

These City and County policies are complimentary to the MKGSA GSP or are addressed indirectly as a result of the GSP implementation. The outreach and education policies and actions are addressed in the Communication & Engagement (C&E) Plan, developed by Stantec for MKGSA and adopted on August 14, 2018, and included as Appendix 2B.

2.6 Additional GSP Elements

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

- (g) A description of any of the additional Plan elements included in Water Code Section 10727.4 that the Agency determines to be appropriate.

2.6.1 Wellhead Protection

A wellhead protection area (WHPA) is a surface and subsurface land area regulated to prevent contamination of a well or well-field supplying a public water system (PWS). This program, established under the Safe Drinking Water Act (SDWA) (42 U.S.C. 330f-300j), is implemented through state governments. The WHPA may also be the recharge area that provides the water to a well or wellfield. WHPAs can vary in size and shape depending on subsurface geologic conditions, the direction of groundwater flow, pumping rates and aquifer characteristics.

While the Wellhead Protection Program (WHPP) was established following the 1986 amendments to the Federal SDWA, the program was designed to protect groundwaters that supply drinking water to wells at PWS across the nation. The 1996 Federal SDWA amendments require each state to develop and implement a Source Water Assessment Program. Section 11672.60 of the California Health and Safety Code requires the Department of Health Services

(DHS, the precursor to CDPH) to develop and implement a program to protect sources of drinking water, specifying that the program must include both a source water assessment program and a wellhead protection program. In response to both legal mandates, DHS developed the Drinking Water Source Assessment and Protection (DWSAP) Program.

California's DWSAP Program addresses both groundwater and surface water sources. The groundwater portion of the DWSAP Program serves as the State's wellhead protection program. In developing the surface water components of the DWSAP Program, DHS integrated the existing requirements for watershed sanitary surveys. DHS submitted the DWSAP Program in January 1999. The United States Environmental Protection Agency (EPA) approved the DWSAP as California's wellhead protection program in January 1999. In November 1999, EPA gave final approval of the DWSAP Program as California's sources water assessment and protection program. DHS was responsible for the completion of all assessments by May 2003.

WHPAs are not regulatory in nature, nor do they address specific sources. They are designed to focus on the management of the resource rather than control a limited set of activities or contaminant sources. Contaminants from the surface can enter an improperly designed or constructed well along the outside edge of the well casing or directly through openings in the wellhead. A well is also the direct supply source to the customer, and such contaminants entering the well could then be pumped out and discharged directly into the distribution system. Therefore, essential to any WHPP are proper well design, construction, and site grading to prevent intrusion of contaminants into the well from surface sources.

Wellhead protection is performed primarily during design and can include requiring annular seals at the well surface, providing adequate drainage around wells, constructing wells at high locations, and avoiding well locations that may be subject to nearby contaminated flows. Wellhead protection is required for potable water supplies and is not generally required, but is still recommended for agricultural wells.

Municipal and agricultural wells constructed by the member agencies are designed and constructed in accordance with Tulare County code requirements. A permit is needed from the County to construct a new well. In addition, the member agencies encourage landowners to follow the same standard for privately owned wells. Tulare County Code Part IV. Article 9 provides specifications pertaining to wellhead protection:

- Location of wells
- Well casings – casing materials and casing thickness
- Methods for sealing the well from intrusion of surface contaminants

- Covering or protecting the boring at the end of each day from potential pollution sources or vandalism
- Site grading to assure drainage is away from the wellhead

2.6.2 Well Construction Policies

Proper well construction is important to ensure reliability, longevity, and protection of groundwater resources from contamination. Tulare County has adopted a well construction \permitting program consistent with State Well Standards (DWR Bulletin 74-81 and 74-90) to help ensure proper construction of private wells. The County maintains records of all wells drilled in the area. As of September 2017, the implementation of the Tulare county new well ordinance took effect. This ordinance, among other things, place restrictions on the drilling of new wells on previously non-irrigated land where the land has not had a well or has not had surface water in the past. Drilling a new well or deepening or destroying existing wells requires a County permit. Usually, the process takes about a week. Under the authority of the Health Officer, staff from Tulare County Environmental Health Division can assist to ensure accuracy and timeliness of permits processed for the unincorporated areas of Tulare County. Electrical connection and other associated permits may be required by the Tulare County Resource Management Agency. State Well Standards also address annular seals, surface features, well development, water quality testing and various other topics. Well construction policies intended to ensure proper wellhead protection are discussed above in Section 2.6.1: Wellhead Protection.

2.6.3 Well Permitting Process

Well permits are required by Tulare County pursuant to various sections (4-13) of Tulare County Code Part IV, Chapter 13, Article 1. The ordinance is administered by the County Environmental Health Division and regulates the location, construction, reconstruction, destruction, and inactivation of all wells to ensure each well will produce high-quality water and to protect the quality of the groundwater. The ordinance incorporates the various DWR bulletins related to well standards (74-81 and 74-90). The City of Visalia has a well permit application for the construction or destruction of wells within its jurisdiction. The county has updated and revised their well permit application in collaboration with GSAs with jurisdiction in the County. The revised permit application is intended to meet the needs of the County in permitting new wells and to meet the needs of the GSAs in implementing their authorities in accordance with SGMA. The County has revised the well permit application to include more robust data collection, providing the MKGSA with a better understanding of how groundwater is used in the Subbasin. The County has also implemented, in cooperation with local GSAs, a well permit notification and comment process. GSAs are notified when a well permit is submitted, along with receiving the well permit request. GSAs are allowed to review and comment on the well permit prior to issuance. Upon issuance of a well permit, the County notifies the GSA of the issuance.

More information on Tulare County’s well permitting process is available at <https://tularecountyeh.org/eh/our-services/water-wells/> and includes the following information as of June 2024:

- Water Well Guidance
- Water Well Forms
- Water Well Contractors
- Voluntary Water Well Testing Program

In 2022, Governor Newsome implemented Executive Order No. N-7-22 and under Action 9: Drought Well Permitting Requirements, required local agencies responsible for well permitting to consult with GSAs prior to issuance of a well permit. The MKGSA, in coordination with the other Kaweah Subbasin GSAs and immediately upon issuance of the Executive Order, collaborated with the Tulare County Environmental Health Division to enhance existing collaboration on well permitting to establish a GSA attestation process. Prior to issuance of a well permit, the permit applicant (excluding domestic wells) must contact the MKGSA to be made aware of groundwater conditions. Furthermore, the location and depths of new wells are coordinated to comply with the MKGSA GSP. The MKGSA has also collaborated with Tulare County to receive domestic well permit applications, and upon receipt, MKGSA staff reaches out to landowners to discuss GSA responsibilities, including well mitigation.

More recently, the MKGSA has coordinated with the Tulare County Environmental Health Division to receive domestic well permit requests. MKGSA staff use these permits to contact landowners to inform them of availability of the MKGSA Well Mitigation Plan (Section 6.7.4) and other key information like recent depth to groundwater in their area and the Minimum Thresholds for groundwater levels set in their area.

2.6.4 Well Abandonment/Well Destruction Program

Well abandonment generally includes properly capping and locking a well. Tulare County Code stipulates that any well which has been placed inactive for a period of more than 1 year shall be deemed abandoned and be required to properly destroyed unless the owner provides evidence of his intentions for continued use. Well destruction includes completely filling in a well in accordance with standard procedures. Proper well destruction and abandonment accomplishes the following: 1) eliminates the physical hazard of the well, 2) eliminates a pathway for migration of contamination, and 3) prevents hydrologic changes in the aquifer changes in hydraulic head and the mixing of water between aquifers. They are necessary to protect groundwater resources and public safety.

The administration of a well construction, abandonment, and destruction program has been delegated to the Counties by the State legislature. Tulare County requires that wells be abandoned according to Tulare Code Part IV. Article 13. Defective, Inactive, and Well Destruction Standards. Enforcement of the well abandonment policies is faced with limitations in staff and funding.

The MKGSA, in cooperation with the County, will strive to properly destroy any of their wells that are no longer used and will encourage proper well destruction procedures for private wells. In addition, the MKGSA may request that rather than destroy them, some unusable wells be converted to monitoring wells.

2.6.5 Control of Saline Water Intrusion

There are no known bodies of saline water in the Subbasin that have intruded productive aquifers. Deep connate water exhibiting high total dissolved solids (TDS) is beyond the reach of existing producing wells and is considered isolated from the freshwater aquifers.

2.6.6 Migration of Contaminated Water

The MKGSA does not actively participate in enforcement programs to address the presence and migration of contaminated groundwater as state and local agencies have established programs to address this topic. The MKGSA will encourage prompt and timely actions from responsible parties and those regulatory agencies to address/resolve the presence of contaminated groundwater and will not implement projects or management actions that exacerbate the condition. Regular coordination between the MKGSA and regulatory agencies responsible for oversight of contaminated sites is important for the MKGSA and its member agencies to be kept informed.

2.6.7 Measures Addressing Groundwater Contamination

Existing programs, plans, and actions have been in place prior to GSA formation as a product of parallel regulatory programs within the Kaweah Subbasin such as CV-SALTS and ILRP. These programs take proactive measures to prevent contamination of groundwater quality due to agricultural or other land-management activities. In addition, the Kaweah Subbasin Mitigation Program and MKGSA Mitigation Plan outlines the GSA's commitment to mitigating impacts related to groundwater quality and impacts that are induced by groundwater management activities, such as recharge or pumping. More information on the Subbasin Mitigation Program and the MKGSA Mitigation Plan is in Section 6.7.4.

The California Regional Water Quality Control Board, Central Valley Region (RWQCB) has implemented 2 long-term water quality programs to address widespread agricultural impacts

throughout the Central Valley. These efforts include the Irrigated Land Regulatory Program (ILRP) and the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) program. These programs are detailed in Section 4.2.3.

Tulare County recognizes the presence of groundwater contamination in some areas and has a voluntary well testing program for selected constituents, including bacteriological, nitrate, dibromochloropropane, and gross alpha. The County charges reasonable fees for the collection and analysis of samples from new private and public domestic wells.

2.6.8 Groundwater Dependent Ecosystems

Based on the recent past (pre-SGMA) and current depth-to-groundwater conditions in the MKGSA as shown on the groundwater level hydrographs provided on and depth to groundwater described in Section 3.3.4, groundwater is disconnected from surface water. Any species present along surface water features in MKGSA do not require access to groundwater for survival, but instead are accessing surface water for their survival.

Areas identified as being potential Groundwater Dependent Ecosystems (GDEs) are presented on Figures 3-5 and 3-6 of Appendix 5H. The information presented originates from data compiled by the Nature Conservancy, which used vegetative cover and historical maps to develop a statewide map showing the locations of potential GDEs and VegCamp as described in Section 5.8.1.

2.6.9 Groundwater Replenishment

TID recharges groundwater through its unlined canals and recharge basins. Current estimated recharge capacity is 552 AF/day using 1,350 acres of TID recharge basins. On average, between Water Years 1997 – 2021, TID recharged approximately 34,700 AF per year through its distribution facilities and 40,000 AF per year in its recharge basins. TID and other Member Agencies continue to investigate additional recharge opportunities and funding sources to increase recharge capacity in the MKGSA. There are multiple recharge projects included in Section 6.6 that will add substantial recharge capacity.

Landowners also carry out on-farm recharge during period of surplus surface water to build groundwater credits for recharging groundwater. On-farm recharge programs are described under projects in Section 6.6.4. This program has been implemented since 2017 and in combination with groundwater allocations (outlined in Section 6.7.1), realized a significant amount of recharge during the wet year 2023.

2.6.10 Efficient Water Management Practices

Water management is an important element of irrigated crop production. Efficient irrigation systems and water management practices can help maintain farm profitability in an era of limited, higher-cost water supplies. Efficient water management may also reduce the impact of irrigated production on offsite water quantity and quality. As is often the case, technology is not the whole solution anywhere, but part of the solution almost everywhere. TID has become a proponent of high efficiency irrigation in dry years and flood irrigation in wet years to maximize efficiency and to recharge groundwater, respectively. Water conservation has been, and will continue to be, an important tool in local water management, as well as a key strategy in achieving sustainable groundwater management. Recycled water use is considered as an efficient water practice. Where possible, this practice is already being utilized by Members of the MKGSA. Tertiary treated wastewater from the City of Visalia is delivered to TID for irrigation purposes. Secondary treated wastewater from the City of Tulare is directly diverted to growers downstream of the treatment plant for irrigation purposes. Future efforts will continue to look to bolster efficient water management and use of recycled water.

In compliance with DWR and the United States Department of Interior, USBR, TID has prepared a 2020 Agricultural Water Management Plan for DWR and an Agricultural Water Management Plan for USBR. Both Plans establish actions taken by TID to efficiently manage agricultural water supplies.

According to its 2020 UWMP, the City of Tulare has implemented all 7 demand management measures in Water Code §10631 in whole or in part that includes the following measures:

- A water conservation ordinance (Ordinance 2020-07) adopted in July 2020. The ordinance applies to landscape irrigation, commercial, industrial, and institutional establishments. It contains restrictions and prohibitions related to water features and swimming pools.
- The City of Tulare is 100% metered and has begun to review and replace its oldest in-service meters to ensure accuracy. The City has invested in Advanced Metering Infrastructure (AMI) with its 4G meter replacement program. It is the goal of the City to inform residents of how much water they're using during the course of a day and warn them when they are about to enter the upper tiers of the water pricing structure. More than half of the city's residential water meters are of the 4G variety.
- To encourage water conservation by all customers, a new rate structure beginning in October 2016 was implemented. The water rates include a fixed rate for each meter size and volumetric pricing, which encourage water conservation.

- A public education and outreach program that distributed information to the public through a variety of methods including brochures, radio, and television, school presentation and videos, and websites³.
- Unaccounted water can be tracked since connections are fully metered. With these data, the City of Tulare can compare the water produced to water delivered and make more accurate water loss approximations. In addition to full metering, the City evaluates the large diameter meters that service industrial water consumption accounts and replaces them based on age and levels of inaccuracy. Additionally, the City Municipal Code includes guidelines and penalties to encourage customers to repair leaks.
- Conservation coordination activities are conducted by the City of Tulare's Water Manager in the Public Works Department, and the Management Analyst and Department Assistant.

Other demand management measures include the City of Tulare aggressively pursued water conservation savings. The City of Tulare has achieved its 2020 conservation target, due in part to implementation of demand management measures over the past 10 years. Additionally, the City partners with Proteus, Inc. to manage several water conservation programs. Similar to the City of Tulare, the City of Visalia has implemented demand management measures documented in the Cal Water Service 2020 UWMP for its Visalia District encompassing the City of Visalia and some unincorporated areas of Tulare County.

- Cal Water Service enforcement of water waste prevention and water use restrictions is authorized and overseen by the California Public Utilities Commission via Rule 14.1 or Schedule 14.1. Rule 14.1 includes prohibitions on water waste and restrictions on water use.
- Cal Water Service meters all service connections and bills customers for water use monthly. It may install AMI in the future to improve metering accuracy and supply prompt feedback to customers about water use and leaks.
- Cal Water Service uses a 3-tier increasing block rate design for residential water use and a single-tier uniform rate design for non-residential use.
- A public outreach programs with 4 components: a school education program; a Smart Landscape tune-up program; a residential customer portal to provide customized water-efficiency targets water savings calculators, and customer-specific recommendations for programs and water-saving tips; and non-residential customer assistance which tailors

³ <https://www.tulare.ca.gov/government/departments/public-works/water/water-conservation>

assistance to commercial customers through customized incentives, commercial water surveys, and large landscape water use surveys.

- Cal Water Service has 10 staff who manage all aspects of its conservation programs that are run in 24 districts serving a combined population of 1.8 million people.
- Cal Water Service offers rebate, give-away, and direct installation programs aimed at plumbing fixture replacement and irrigation equipment and landscape efficiency improvements.

2.6.11 Existing Monitoring and Management Programs

Existing monitoring programs are described in Section 4.1 of this GSP.

2.6.12 Relationships with State and Federal Agencies

From a regulatory standpoint, the MKGSA members have numerous relationships with State and Federal agencies related to flood water supply, water quality, and water management. The relationship most unique to the MKGSA area is the relationship with USBR for Friant CVP supplies of the San Joaquin River. TID is the only MKGSA Member agency that has a contract with USBR. The Friant Dam is owned and operated by USBR. USBR is also the lead agency for the San Joaquin River Restoration, which has resulted in significant delivery curtailments to Friant contractors.

TID is also a water rights holder on the Kaweah River, which is the downstream river of Lake Kaweah, impounded by Terminus Dam. Terminus Dam is operated by the U.S. Army Corp of Engineers (Corp) for flood control and water conservation. TID coordinates with the Corp via the Kaweah and St. Johns Rivers Association which administers the water rights on the Kaweah River and coordinates flows from Terminus Dam with the Corp.

MKGSA members are also eligible to receive grants from various agencies for water-related projects. Grants can be obtained from USBR, DWR, SWRCB, and others. The MKGSA will work to track grant programs and, when successful, administer and implement grant contracts.

2.7 Notice and Communication

§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.
 - (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.

SGMA and subsequent Emergency Regulations developed by the DWR in May 2016 identified a number of requirements for public notice and communication related to GSA formation and GSP development. Pursuant to these requirements, MKGSA conducted several activities to engage beneficial users of groundwater, interested parties, and the general public in the development of the GSP and subsequent amended GSPs. MKGSA was responsible for conducting outreach and engagement related to SGMA and conducted a series of coordinated activities aimed at engaging stakeholders within its service area. This section describes the coordinated tools, methods, and activities the MKGSA used to inform and engage stakeholders in development of the GSP and subsequent amendments.

2.7.1 Beneficial Uses and Users

§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.

Beneficial uses of groundwater within MKGSA primarily include agricultural water supply, industrial process supply, and municipal and domestic water supply. MKGSA serves as GSA for the area comprising the collective jurisdictional area of its members, which is approximately 1 quarter of the Kaweah Subbasin, or 163 square miles of the 700 square-mile Subbasin. Beneficial users of groundwater were identified and engaged by MKGSA based on the place-based and interest-based categories described in SGMA and codified in Water Code §10723.2.

A list of specific beneficial uses and users is available in Table 2-2 and a description of the general beneficial user categories present in MKGSA is available below the table.

Table 2-2. Beneficial Users and Uses in the Kaweah Subbasin

Beneficial Use	Beneficial User
Drinking Water Use	Domestic Well Users
	Small Community Well Users and Service Providers
	Municipal Well Users and Service Providers
	Commercial and Industrial Users
Environmental Use	Groundwater Dependent Ecosystems
	Habitat Conservation
	Native Vegetation
Agricultural Use	Conjunctive Use Growers (Irrigation)
	Groundwater-Dependent Growers (Irrigation)
	Small Family Farmers (Irrigation)
	Produce Packing Facilities (Ag-Industrial Use)
	Livestock Facilities (Ag-Industrial Use)
Non-Potable Municipal Use	Golf Courses Irrigation (Municipal Non-Potable Use)
	Park and Recreation Irrigation (Municipal Non-Potable Use)

2.7.1.1 Agricultural Users

Agriculture and rangeland cover a broad area of the Kaweah Subbasin and account for about 50% of the land area within the MKGSA. Representatives from the agricultural community serve on MKGSA’s Board of Directors and Advisory Committee. Agricultural interests are represented in GSP development by landowners and water users within the TID service area. Other types of parties representing agricultural users include Tulare County Farm Bureau, agricultural-based interest organizations, farmworkers, individual growers, and ranchers. Consultation with these parties included periodic briefings led by TID, and through information discussed during meetings of the MKGSA’s Board of Directors and Advisory Committee and during development and review of this GSP.

2.7.1.2 Private Domestic Well Owners

Private domestic well owners within the MKGSA primarily include rural residents interspersed with active farmlands. Domestic wells are located in the unincorporated area of Tulare County and are represented on the MKGSA Board of Directors by TID. Stakeholders have the opportunity to consult on the GSP during the MKGSA’s Board of Directors and Advisory Committee meetings, and during review of this GSP.

2.7.1.3 Public Water System and Industrial Well Operators

Municipal public water system water supplies within the MKGSA are provided by the City of Tulare and by California Water Service, a private water company regulated by the California Public Utilities Commission, for the City of Visalia. Some food and industrial manufacturers maintain deep wells as backup supplies in the event of service interruption by municipal and industrial well operators. The City of Tulare and the City of Visalia account for 12.7% and 21.7% of the land area within the MKGSA, respectively. Consultation with the City of Tulare consists of information dissemination and coordination with the Tulare Board of Public Utilities and through the City of Visalia's participation as MKGSA member agency. California Water Services Company was consulted during the development of the GSPs as members of the MKGSA's Advisory Committee and Technical Advisory Subcommittee.

The communities of Waukena and Okieville/Highland acres; and rural schools including Waukena Joint Union Elementary, Buena Vista Elementary, Buena Vista School, Oak Valley Union School, Liberty School, and Packwood School are small public water systems that are located in the unincorporated area of Tulare County and are represented on the MKGSA Board of Directors by TID.

2.7.1.4 Environmental and Ecosystem Interests

Environmental and ecosystem interests in MKGSA include representatives of the Tulare Basin Wildlife Partners, Sierra Club Mineral King Group, and Sequoia Riverlands Trust (SRT). Members of the Sierra Club Mineral King Group and SRT historically and currently hold seats and participate in the MKGSA Advisory Committee.

2.7.1.5 Surface Water Users

Surface water users within the MKGSA include farm, ranch, and dairy operations that purchase runoff from the Kaweah River and San Joaquin River watersheds from TID. San Joaquin River supplies are delivered by Friant Water Authority, which provides operation and maintenance of the Friant Division of the Central Valley Project. Kaweah supplies are managed by Kaweah Delta Water Conservation District (KDWCD). Members of this agricultural community attend meetings and serve on the MKGSA Advisory Committee and Board of Directors.

2.7.1.6 Disadvantaged Communities

The MKGSA region includes 5 areas identified as a Census Designated Place or Census Designated Tract by the 2016 U.S. Census Bureau as disadvantaged or severely disadvantaged communities. Census Designated Places within the GSA include the City of Tulare and the unincorporated communities of Matheny Tract and Waukena (Figure 2-2). The City of Tulare has been identified as a Disadvantaged Community, while Matheny Tract and Waukena have been identified as Severely Disadvantaged Communities. The unincorporated communities of

Okieville/Highland Acres, Lone Oak Tract, and Soultis Tract have been identified as severely disadvantaged Census Designated Tracts. The Stakeholders in these communities have had the opportunity to consult on the plan during the agency’s Board of Directors meetings, Advisory Committee meetings, and during review of this GSP. Representatives from Okieville and Waukena have in the past and currently serve on the MKGSA Advisory Committee, respectively.

2.7.2 Participating Agencies

The MKGSA was formed September 14, 2015, through execution of a joint powers agreement between the City of Tulare, City of Visalia, and TID to establish the Mid-Kaweah Groundwater Subbasin Joint Powers Authority. Pursuant to Water Code §10723.8, these members notified DWR on September 16, 2015, of the agency’s formation and its intent to develop a GSP. The decision-making structure of the MKGSA Board of Directors (Figure 2-11) is supported through hierarchical structure that includes the GSA’s Manager, a Management Committee comprised of key staff from each member agency, and a Technical Advisory Sub-Committee. To provide a venue for consultation with community members, the agency formed an 11-member Advisory Committee. Committee meetings are held monthly, or otherwise announced, and publicly noticed consistent to the Brown Act.

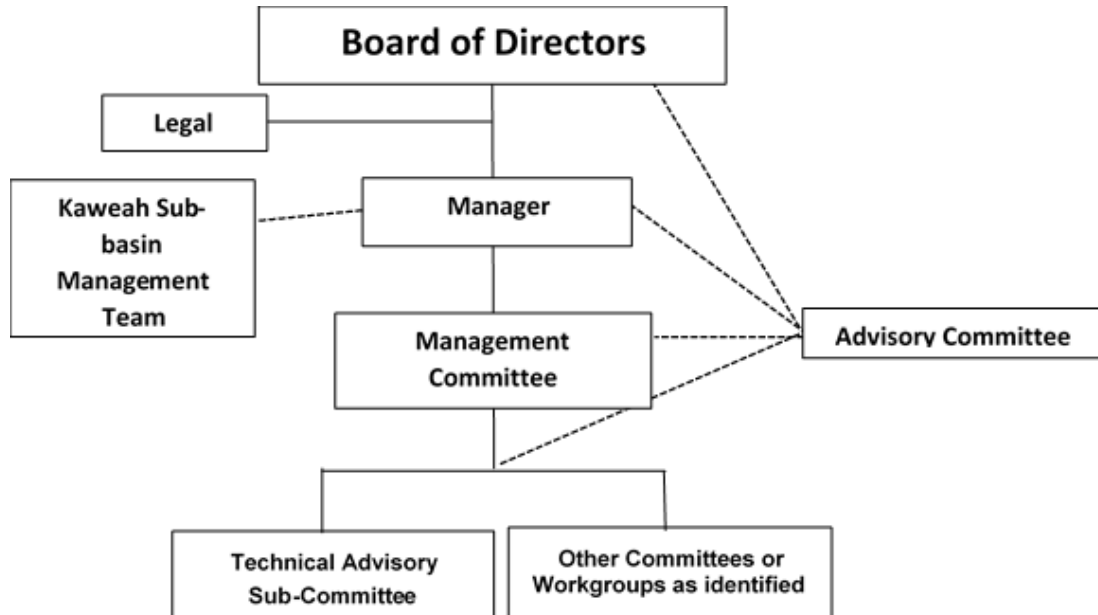


Figure 2-11. Mid-Kaweah Groundwater Sustainability Agency Decision-Making Structure

The governing body of the JPA consists of a 6-member Board of Directors that includes 2 representatives from each of the founding JPA members. Members eligible to sit on the Board of Directors are the elected officials of each member agency, with the City of Tulare able to

appoint a member of the Tulare Board of Public Utilities to serve on its behalf. Members may also appoint up to 2 members to serve as an alternate in the event of an absence. All decisions require a majority vote of the present and voting Board of Directors, except the following authorities listed in Table 2-3.

Table 2-3. MKGSA Voting Thresholds

Key Authority	Threshold
Adoption of initial budget	Unanimous vote by entire Board (which may include alternates)
Adoption or modification of the annual budget	Modified majority of the Board ^(*) (which may include alternates)
Contracts over \$25,000 and for terms in excess of two (2) years	Modified majority of the Board ^(*) (which may include alternates)
Admissions of additional members	Modified majority of the Board ^(*) (which may include alternates)
Appointment, employment, or dismissal of an employee, including any independent contractor who functions as an employee	Modified majority of the Board ^(*) (which may include alternates)
Setting the amounts of any contributions or fees to be made or paid to the Authority from any Member	Modified majority of the Board ^(*) (which may include alternates)
Compromise or payment of any claim against the Authority	Modified majority of the Board ^(*) (which may include alternates)
Acquisition by grant, purchase, lease, gift, devise, contact, construction, or otherwise, and hold, use, enjoy, sell, let, and dispose of, real and personal property of every kind, including lands, water rights, structures, buildings, rights-of-way, easements, and privileges, and construct, maintain, alter, and operate any and all works or improvements, within or outside the agency, necessary or proper to carry out any of the purposes of the Authority	Modified majority of the Board ^(*) (which may include alternates)
Adoption and imposition of any fees pursuant to Water Code §§ 10730-10731	Modified majority of the Board ^(*) (which may include alternates)
Replacement of the annual special audit required by Government Code § 6505 with an audit covering a 2-year period	Unanimous vote by entire Board (which may include alternates); A Tulare County requirement.
Approval of a GSP for the portions of the Subbasin identified by the GSA boundaries.	Modified majority of the Board ^(*) (which may include alternates)
(*) Modified majority is defined in the amended JPA to mean 4 affirmative votes, with at least 1 from each Member.	

2.7.3 Communication and Outreach Plan

§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:

- (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 the population within the basin.

Notification and communication activities for development of this Plan were guided by the MKGSA C&E Plan (August 2018) contained in Appendix 2B. The C&E Plan serves to identify notification and communication activities that would meet or exceed the requirements and intent of the State legislature in passage of SGMA.

The nature of the consultation to beneficial users of groundwater and other interested parties was approached by segmenting stakeholders into 1 of 3 “groups” based on a stakeholder’s level of interest in, or contribution to, GSP development. These groupings are as follows:

Group 1: Collaborated (*Inform + Consult + Collaborate*) – This group has been closely connected during the planning process through direct engagements aimed to exchange information through active 2-way communication. As a proactive and reactive activity, these engagements gather information and develop solutions to existing and emerging issues.

Group 2: Consulted (*Inform + Consult*) – This group has been connected during planning through written informational materials and scheduled presentations. This engagement is a proactive activity that seeks to gather stakeholder opinions to information presented by MKGSA.

Group 3: Connected (*Inform*) – This group has been connected during planning through distribution of written informational materials and prepared informational presentations. Presentations would be held in response to stakeholder requests.

These groupings framed the approach MKGSA implemented to engage interested parties and stakeholder groups to participate in development of the GSP. Individuals and organizations were initially assigned 1 of the 3 groups by the MKGSA’s Advisory Committee, with the anticipation that each stakeholder’s involvement would change based on consultation with stakeholder and GSP content needs. All outreach efforts and engagement activities were tracked in a Community Engagement and Activities Database (CE & AD) that was continuously monitored and updated, consistent with DWR Emergency Regulations §354.10 (b) and §354.10 (d).

To encourage active participation during Plan development by the diverse social, cultural, and economic interests in the region, the agency in coordination with its Kaweah Subbasin sister

agencies – East Kaweah GSA and Greater Kaweah GSA – established the Kaweah Groundwater Communication Portal (GCP). Established pursuant to Water Code §10723.4, the Kaweah GCP is a shared database of interested parties in the Kaweah Subbasin and provides for distribution of notices and announcements by email. In addition to the Kaweah GCP, the platform supports self-enrollment to an email database of the GSA or GSAs of the stakeholder’s choice.

Additional tools to support public and stakeholder engagement included the MKGSA website, the primary location for stakeholders within the GSA’s boundaries to review information related to SGMA and implementation of this Plan. Information provided on the website includes: an overview of SGMA, MKGSA member agencies, Board of Directors, Board meeting notices and summaries, public outreach and timeline information, frequently asked questions, news, links and a contact list. Past and upcoming workshops and public meetings are also on the site. The website also serves as a repository for outreach collateral, workshop materials, and meeting packets and minutes for the MKGSA Board, the Advisory Committee, and the Kaweah Subbasin Management Team (See Section 1.5.5. Intra-Basin and Inter-Basin Coordination). The site is cross-linked to the Greater Kaweah GSA and the East Kaweah GSA websites, the DWR SGMA information portal, and other related sites.

The MKGSA has implemented a public noticing and information outreach platform via Intuit Mailchimp. Mailchimp is an email and noticing platform allowing MKGSA to distribute notices and emails. MKGSA keeps a database of interested parties and has a page on the MKGSA Website that collects interested party emails.

2.7.4 Public Meetings

§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:

(b) A list of public meetings at which the Plan was discussed or considered by the Agency.

To encourage active involvement in the diverse social, cultural, and economic communities in the development of this Plan, MKGSA staff and Advisory Committee members coordinated several types of targeted stakeholder outreach meetings and presentations. Initial outreach activities focused on raising awareness of SGMA and establishment of MKGSA as the local public agency responsible for complying with the new law. These later matured to technically oriented presentations during regularly scheduled public meetings of the MKGSA Advisory Committee and other venues, as appropriate. These meetings are described as follows:

MKGSA Public Workshops

The MKGSA ensures extensive public engagement as projects and management actions are developed and implemented. Below is a list of projects and management actions and public workshops and meetings that were held.

- The Adoption of the Emergency Ordinance to Establish an Extraction Limitation for the MKGSA (“Emergency Ordinance”) involved continual collaboration and input from the Advisory Committee, Board of Directors, and growers in the 16 months following the first draft. Upon completion of the final draft, the MKGSA hosted 6 public workshops as well as four 2-hour “office hours” where staff were available for individualized questions or concerns.
- The development and adoption of the Mid-Kaweah Water Marketing Pilot Program was established with a Water Market Strategy Committee, consisting of an 11-member committee representing the different beneficial uses of groundwater. The Water Market Pilot Program provides MKGSA growers the ability to reallocate available water on a supply-and-demand basis, promoting efficient use while affording flexibility under the Emergency Ordinance. The Water Market Pilot program was developed through 21 public committee meetings and 4 public workshops. After each public workshop the MKGSA and TID staff held Office Hours (online office hours) for attendees and other interested parties to ask questions and discuss the program.
- The domestic well program establishes the minimum requirement for mitigation of wells and critical infrastructure demonstrated to have been adversely affected by declining groundwater levels, land subsidence, and groundwater quality degradation associated with groundwater overdraft. To implement the subbasin-wide mitigation program and MKGSA-specific mitigation plan, a public workshop was held in both Spanish and English at the Waukena School District.
- The MKGSA in partnership with the Kaweah Subbasin GSAs hosted a grower event in August 2023 titled “My Job Depends on Water: Farming in the SGMA Era.” Growers in the Kaweah Subbasin were updated on SGMA implementation and water efficiency presentations were given to help growers better manage water.

Speaker’s Bureau Program

During initial GSP development, the MKGSA reached out to more than 40 community organizations, stakeholder groups and agencies as part of a Speaker’s Bureau Program to raise awareness of the agency and encourage participation development of this Plan at Board and Advisory Committee meetings. The Speaker’s Bureau Program sought to present information about the agency and status of Plan development during meetings hosted by the identified group.

While the focus of the Speaker’s Bureau Program is to secure placement on the agenda of meetings where members of a community gather, it is also a method to raise awareness in a stakeholder community by sharing information to individuals active in the community. Overall, the Speaker’s Bureau resulted in 15 presentations and the distribution of MKGSA information to an additional 27 organizations. Table 2-4 includes the list of presentations provided during development of this Plan. Table 2-5 provides the list of organizations that received information from MKGSA representatives through the Speaker’s Bureau Program.

Table 2-4. Speakers Bureau Program Presentations

Presentation	Organization Name	Organization Type	Point of Contact	Email
Jun. 14, 2019	Tulare Noon Rotary	Citizens Groups	Kathy Mederos	
May 16, 2019	Sycamore Valley Academy	Domestic Well Users, Rural School	Ruth Dutton	
May 14, 2019	Almond Board: "Navigating the Waters"	Agriculture	J.P. Cativiela	Jp.cativiela@padillaco.com
May 8, 2019	Buena Vista School	Domestic Well Users, Rural School	Carole Mederos	cmederos@buenavistaeagles.org
May 1, 2019	Tulare Sunrise Rotary	Citizens Groups	Brett Schroder	
Apr. 21, 2019	Leadership Tulare – Tulare Chamber of Commerce	Citizens Groups	Darcy Phillips	
Apr. 16, 2019	Tulare County League of Women Voters	Citizens Groups	Maile Melkonian	maile@melkonian.org
Apr. 15, 2019	Leadership Visalia – Visalia Chamber of Commerce	Agriculture	Dante Rosh	
Apr. 8, 2019	210 Connect (Visalia Times-Delta & first Presbyterian Church)	Citizens Groups	Teresa Douglas	
Mar. 26, 2019	Visalia County Center Rotary Club	Citizens Groups	Sam Logan	sam-logan@ml.com
Mar. 25, 2019	Visalia Planning Commission, Parks and Recreation Department, Environmental Committee	Government and Land Use Planning Agency	Paul Bernal	paul.bernal@visalia.city
Mar. 19, 2019	Downtown Visalia Kiwanis Club	Citizens Groups	Olivia Velasquez	oliviaspost@yahoo.com , kiwanisvisalia@gmail.com
Mar. 6, 2019	Sequoia-Visalia Kiwanis Club	Citizens Groups	Jeff Sweeney	info@sequoia-visaliakiwanis.org
Mar. 3, 2019	Visalia Host Lions Club	Citizens Groups	Ruth McKee	rmckee.2@netzero.net
Feb. 20, 2019	Tulare International Kiwanis Club	Citizens Groups	Kenneth Hood	kenneth.hood@usw.salvationarmy.org

Table 2-5. Speakers Bureau Program Information Dissemination

Organization Name	WC 10723.2	Point of Contact
Rotary Club of Visalia Breakfast	Citizens Group	Daniel Evans
Rotary Club of Visalia	Citizens Group	Paul Hurley
Tulare Host Lions Club	Citizens Group	Ruth McKee
Tulare Morning Kiwanis	Citizens Group	Kent Jensen, Neva Stevenson
Visalia Breakfast Lions Club	Citizens Group	Karen McVeigh
Visalia Economic Development Corporation	Citizens Group	Nancy Lockwood
Visalia Latino Rotary	Citizens Groups	Lina Contreras
Visalia Masonic Lodge	Citizens Groups	Linda Godsave
Visalia Sequoia Lions Club	Citizens Groups	Steve Gerard
Visalia Sunset Rotary	Citizens Group	Barbara Hood
West Visalia Kiwanis Club	Citizens Group	Buz Southard
Building Industry Association	Commercial & Industrial Self-Supplied	Brian Todd
Kraft Foods	Commercial & Industrial Self-Supplied	Laura Burns Manager
Land O Lakes	Commercial & Industrial Self-Supplied	Pete Garboni
Saputo Dairy Foods USA	Commercial & Industrial Self-Supplied	Michael “Buck” Buchanan
County Manor Mobile Home Community	Disadvantaged Community	George or Carolyn
Mooney Grove Manor Mobile Home Park	Disadvantaged Community	Neil Pilegard
Mountain View Mobile Home Park	Disadvantaged Community	Lonny Fulton
Royal Oaks Mobile Home Park	Disadvantaged Community	Laura Fierro
Westlake Village Mobile Home Park	Disadvantaged Community	Richard Popkins
Willow Glen Mobile Estates	Disadvantaged Community	Linda McCuin
Liberty School	Domestic Well Owner, Rural School	Keri Montoya
Oak Valley School	Domestic Well Owner, Rural School	Fernie Marroquin
Palo Verde School	Domestic Well Owner, Rural School	Phil Anderson
Sundale School District	Domestic Well Owner, Rural School	Terri Rufert
Waukena Joint Union School District	Domestic Well Owner, Rural School	Superintendent Terri Lancaster
City of Tulare, Planning Department	Governmental and Land Use Agencies	Josh McDonnell

Board of Directors Meetings

Meetings of the Board of Directors served, in part, as a venue for planning staff to receive direction for major technical and policy issues. Comments on these topics from the public, Advisory Committee members, and other stakeholders were welcomed during scheduled public comment sessions. Comments received during these sessions were responded to by Board members or staff, as appropriate. These meetings also served as key opportunities for the public and stakeholders to engage and consult on GSP development and to track its progress. Information and notification of Board meetings were publicly provided in accordance with the Brown Act. Meeting agendas and summaries were additionally posted on the agency website and distributed to stakeholders that registered as an interested party on the Kaweah GCP as well as on the MKGSA website interested persons sign up.

The MKGSA Board of Directors meet monthly, unless otherwise publicly noticed in accordance with the Brown Act. Since September 14, 2015, the Board has held 74 meetings, with 2 work sessions on July 6, 2022, and March 12, 2024, at the Board level. All Board meetings are provided in a hybrid fashion with in-person and virtual options available to the public. A list of meetings is available at the agency website (www.midkaweah.org). The meetings represented opportunities for the public and stakeholders to participate in Plan development and exchange ideas and concerns with Board members and agency staff. Standard agenda items at each Board meeting included a public comment session, an update on intra-basin coordination activities, and a report of activities of the Advisory Committee and Technical Advisory Committee.

Advisory Committee Meetings

The publicly noticed Advisory Committee meetings are important venues for development of recommendations to the Board of Directors to key technical and policy issues. The public was encouraged to engage and consult in these discussions and assist Advisory Committee members in their consideration of a preferred approach. These recommendations were later provided to the Board of Directors for their consideration. Written notification of each meeting was posted on the MKGSA website and by email to all parties that subscribed to the Kaweah GCP. Notifications were additionally posted for public review at the meeting location, as required by the Brown Act.

The MKGSA Advisory Committee holds monthly meetings, unless otherwise publicly noticed. MKGSA has held 48 Advisory Committee meetings since the committee's May 9, 2016, formation. Common agenda topics include a public comment session, status and planning of outreach activities, committee reports and updates, and technical presentation. Another frequent agenda topic included brief presentations focused on water resource supplies and supply reliability applicable to the Mid-Kaweah region. These educational briefings were provided by staff of member agencies of the MKGSA and other parties. For a full schedule of the Advisory

Committee meetings, meeting materials, agendas and meeting summaries, visit the MKGSA website.

2.7.5 Comments Received

§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:

(c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.

2024 GSP Amendment

The MKGSA held a public comment period on the second amended public draft GSP from June 13, 2024, to July 15, 2024. The amendment primarily included revisions to the chronic lowering of groundwater level and land subsidence SMC, although revisions were also made to water budgets and monitoring networks. The MKGSA received 2 comment letters on the June 2024 public draft GSP. A summary of responses to the comments is provided in Appendix 2C.

2022 GSP Amendment

The MKGSA held a public comment period on the first amended GSP from July 7, 2022, to July 12, 2022. A redline Draft GSP and clean Draft GSP was posted on the MKGSA, as well as communicated via meetings and webinars. The MKGSA received 5 comment letters on the resubmitted Draft GSP during the public comment period. The MKGSA Advisory Committee met consistently during the 120 days of technical work prior to resubmittal to ensure their continual engagement and so that their input could be considered by the MKGSA Board. Where appropriate, feedback from the MKGSA Board was incorporated in the final amended GSP.

2020 GSP Submission

The MKGSA held a public comment period on the Draft GSP from July 31 to September 16, 2019. The Draft GSP was posted on the MKGSA website, as well made available for review at multiple public locations. Written comments on the Draft GSP could be submitted electronically via email or hard copy via mail or hand delivery. The MKGSA received 13 comment letters on the Draft GSP during the public comment period. The 13 letters contained a total of 197 individual comments. MKGSA staff and consultants reviewed and categorized each comment. Every comment was provided a response, which was recorded in a comment matrix tool. The GSP was revised to address any comments that raised credible technical or policy issues. Appendix 2C Public Comment Summary further describes the MKGSA's process to solicit, review, and address comments on the Draft GSP. This summary further describes external peer review processes that were led by Member agencies of the MKGSA Joint Powers Authority. Copies of comments received on the Draft GSP are provided as Attachment B to Appendix 2C.

Pursuant to California Water Code § 10728.4, the MKGSA also provided notice of the MKGSA's intent to adopt the GSP to cities and counties within the plan area. This notification included a letter sent to the cities of Tulare and Visalia and the county of Tulare on August 13, 2019, provided as Attachment A to Appendix 2C. The MKGSA also provided notice to California Water Service Company, which serves as the water purveyor for the City of Visalia. Cities and counties within the GSP area were provided 30 days from receipt of the notice to request consultation on the Draft GSP. The MKGSA did not receive any requests for consultation during this time. Cities and counties within the GSP area will be notified of any future amendments to the GSP and GSP implementation activities.

2.7.6 Inter-Basin Coordination

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:

(d) A communication section of the Plan that includes the following:

(4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.

During development of this amended GSP, Kaweah Subbasin technical staff met with neighboring Subbasin technical staff to coordinate and share data for modeling boundary conditions and to ensure SMC compatibility.

Specific to land subsidence, the Kaweah Subbasin GSAs will develop a Regional Subsidence Monitoring and Action Plan (RSMAP). The objective of the RSMAP is to meet with regional surface water and groundwater agencies to understand the underlying activities contributing to subsidence, both active and historical, the impacts of subsidence, and establish a monitoring and action plan to avoid the MTs established by Subbasin GSAs and achieve sustainability by 2040. Section 6.7.8 summarizes the process to develop a RSMAP with more details provided in Appendix 6E.

Inter-basin coordination activities included participation in events scheduled by other organizations, or events led by Kaweah Subbasin GSAs. These inter-basin activities focused GSAs within the groundwater subbasins that comprise the Tulare Lake Basin, and provided opportunities for GSA managers, technical consultants, and the public to collaborate on topics of mutual concern. The schedule of meetings during development of the 2020 GSP is provided in Table 2-6.

Table 2-6. Inter-Basin and Intra-Basin Coordination Meetings

Date	Type	Event Name	Location	Participating GSAs or Subbasin	Key Agenda Topics
Jun. 19, 2019	Intra-basin	Management Team Committee Meeting	City of Visalia Wastewater Treatment Plan, Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement, consultant presentation and recommendations
May. 15, 2019	Intra-basin	Management Team Committee Meeting	Tulare County Board of Supervisors Chambers, Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	Public comment, GSA updates and progress, coordination agreement status, consultant and SkyTEM presentations
Apr. 23, 2019	Inter-basin	Farmer-Rancher Meeting	International Agri - Center, Tulare, CA	Tulare Lake Subbasin	SGMA and GSP development
Apr. 17, 2019	Intra-basin	Management Team Committee Meeting	Tulare County Board of Supervisors Chambers, Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement status, consultant presentation
Mar. 20, 2019	Intra-basin	Management Team Committee Meeting	Exeter Museum, Exeter, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement status, consultant presentation
Jan. 16, 2019	Intra-basin	Management Team Committee Meeting	Tulare County Board of Supervisors Chambers, Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement elements, next steps and future activities
Dec. 18, 2018	Inter-basin	South Valley SGMA Practitioners Roundtable IV	Tulare County Agricultural Commissioner's Office, Tulare, CA	Tulare Lake Subbasin	SGMA updates, inter-basin coordination, basin boundary flows and MTs, mapping aquifers and hydrogeologic frameworks near Tulare, SkyTEM, DACs and groundwater marketing
Dec. 14, 2018	Inter-basin	South Valley Technical Group Meeting	Greater Kaweah GSA, Farmersville, CA	Tulare Lake Subbasin	Technical GSP development and coordination
Sep. 19, 2018	Intra-basin	Management Team Committee Meeting	Kaweah Delta Water Conservation District, Farmersville, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement elements, next steps and future activities
May 16, 2018	Intra-basin	Management Team Committee Meeting	Tulare County Board of Supervisors Chambers Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, memorandum of understanding amendment, coordination agreement elements, next steps and future activities (Appendix 2B)
Apr. 18, 2018	Intra-basin	Management Team Committee Meeting	Tulare County Board of Supervisors Chambers Visalia, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, coordination agreement elements, GSA coordination, management teamwork plan, next steps and future activities

Date	Type	Event Name	Location	Participating GSAs or Subbasin	Key Agenda Topics
Apr. 10, 2018	Inter-basin	The Community Water Center: Drinking Water Vulnerability Assessment Web Tool Kick-Off Meeting	Resources Legacy Fund Sacramento, CA	Tulare Lake Subbasin	Development of an accessible, interactive and publicly available drinking water vulnerability assessment web tool, groundwater management needs of SDACs for GSPs
Mar. 2, 2018	Inter-basin	Technical Group Meeting	Kaweah Delta WCD Office, Farmersville, CA	Tulare Lake Subbasin	SkyTEM proposal, technical memorandum discussing accounting framework, water budgets
Feb. 16, 2018	Inter-basin	South Valley Technical Group Meeting	Technical 3- hour Webinar	Tulare Lake Subbasin	SGMA overview, DWR inter-basin relationships regulations, subbasin perspectives, hydrogeologists/modelers subbasin concerns, hydrogeologic conceptual model development, subbasin numerical surface water and groundwater modeling efforts, adjacent subbasins, next steps
Jan. 30, 2018	Intra-basin	Management Team Committee Meeting	Kaweah Delta Water Conservation District, Farmersville, CA	East Kaweah GSA, Greater Kaweah GSA, Mid-Kaweah GSA	GSA updates and progress, subbasin Memorandum of Understanding, management team administration, consultant presentation, subbasin water budget apportionment, management teamwork outlook
Oct. 20, 2017	Inter-basin	South Valley SGMA Practitioners Roundtable III	International Agri-Center Heritage Complex, Tulare, CA	Tulare Lake Subbasin	Subbasin updates, DWRs SGMA technical assistance, SkyTem in the South Valley, headwaters coordination
Mar. 17, 2017	Inter-basin	South Valley SGMA Practitioners Roundtable II	International Agri-Center Heritage Complex, Tulare, CA	Tulare Lake Subbasin	Inter-basin coordination, objectives and best practices, groundwater flows between subbasins, next steps
Jul. 22, 2016	Inter-basin	South Valley SGMA Practitioners Roundtable I	Southern California Edison, Ag Technology Application Center, Tulare, CA	Tulare Lake Subbasin	Perspective from a functioning GSA, coordinating the uncoordinated, SGMA fees, and SGMA implementation in the South Valley updates.

Development of the original 2020 GSP was supported through a series of intra-basin and inter-basin coordination activities. The key intra-basin coordination activity was the Kaweah Subbasin Management Team (KSMT), a committee comprised of representatives from each of the 3 Kaweah Subbasin GSAs: East Kaweah, Greater Kaweah, and Mid-Kaweah. As members of the KSMT are appointed by their respective Board of Directors, all meetings of this group were publicly noticed, consistent with the Brown Act. These meetings focused on development and evaluation of key policy and technical issues mutually shared by Kaweah Subbasin GSAs. Members of the public that attended these meetings were invited to provide comments to these topics. The schedule of KSMT and other intra-basin activities is provided in Table 2-6. For the subsequent GSP amendments, intra-basin coordination continued with technical and coordination meetings at least twice a week with GSA managers, technical staff, and consultants.

3 BASIN SETTING

3.1 Introduction to Basin Setting

§354.12 Introduction to Basin Setting. This Subarticle describes the information about the physical setting and characteristics of the basin and current conditions of the basin that shall be part of each Plan, including the identification of data gaps and levels of uncertainty, which comprise the basin setting that serves as the basis for defining and assessing reasonable sustainable management criteria and projects and management actions. Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.

As part of the 2020 GSP, the 3 GSAs in the Kaweah Subbasin coordinated and jointly prepared a comprehensive Basin Setting which is included as Appendix 3A of this Plan. The process and work effort to prepare this document were in accordance with the “MOU for Cooperation and Coordination of the Kaweah Subbasin” executed by the GSAs in 2017 for the purposes of (a) retaining consultants to conduct the necessary technical work sufficient to support a Coordination Agreement and (b) to establish a committee structure and associated public vetting process leading to an acceptable HCM, which describes and depicts groundwater conditions and water budgets within the Subbasin.

Building on the Kaweah Subbasin Basin Setting document provided in Appendix 3A, this section provides an overview of the basin setting followed by more detail on elements unique to the MKGSA and updates since 2020, including:

- MKGSA Groundwater Level Trends
- MKGSA Land Subsidence
- MKGSA Interconnected Surface Water
- MKGSA Water Budget for Historical, Current, and Projected Period

The Kaweah Subbasin’s sustainable yield has been re-estimated to be 578,000 AF per year. This revised sustainable yield represents the volume of groundwater extraction that can occur over the 2040-2070 period without causing URs or long-term reductions in groundwater storage. This estimated sustainable yield will continue to be revised pursuant to the monitoring of sustainability indicators and avoidance of URs.

A description of management areas is also provided in this section.

3.2 Hydrogeologic Conceptual Model

§354.14 Hydrogeological Conceptual Model.

- (a) Each Plan shall include a descriptive hydrogeologic conceptual model of the basin based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems in the basin.

Below is a summary of the HCM developed for the 2020 GSP. Please refer to Section 2.2 of Appendix 3A for the full HCM which includes the following subsections:

- Regional Setting
 - Subbasin Features
 - Regional Geology
 - Kaweah Subbasin Geology
- Geologic Features that Affect Groundwater Flow in the Kaweah Subbasin
- Lateral Boundaries of the Subbasin
- Bottom of the Subbasin
- Principal Aquifers and Aquitards of the Subbasin
 - Formation Names
 - Physical Characteristics
 - Structural Properties that Restrict Groundwater Flow
 - General Water Quality of Principal Aquifers
 - Primary Use of Aquifers
- Geologic Cross Sections
- Physical Characteristics
 - Sufficient Geology
 - Soil Recharge Characteristics Delineation of Recharge Areas, Potential Recharge Areas, and Discharge Areas, Including Springs, Seeps and Wetlands
 - Surface Water Bodies
 - Source And Point of Delivery for Imported Water Supplies

Some of the HCM sections in Appendix 3A have been replaced by text that follows in Section 3.3. The MKGSA intends to fully update this basin setting section of the GSP as part of the next GSP amendment.

The MKGSA is located within the central to southwestern side of the Kaweah Subbasin, midway between the mountain front and the center of the San Joaquin Valley. Approximately half of the GSA is underlain by the Corcoran Clay, which creates an upper and lower aquifer system, as shown by Sections B-B' and E-E' of Appendix 3A. A single aquifer system is present beneath the eastern half of Visalia in the northeastern GSA. The thickness of the fresh groundwater system varies from about 900 feet on the northeastern corner of MKGSA to about 1,600 feet near the southwestern corner. In general, groundwater flows across the MKGSA in a southwesterly direction and towards local irrigation season cones of depressions. The vertical flow gradient is mostly downward.

Groundwater quality is generally good, but available data are primarily located in the northern and eastern portions of the MKGSA associated with PWS. Several COCs have been identified due to concentrations near Maximum Contaminant Levels (MCLs) or due to increasing trends, including 1,2,3-TCP, 1,2-DBCP, arsenic, boron, chloride, gross alpha, hexavalent chromium, nitrate as N, perchlorate, pH, sodium, specific conductivity, sulfate, tetrachloroethene (PCE), Total Dissolved Solids (TDS), and uranium.

Land subsidence due to overpumping has occurred throughout the MKGSA area over the past 100 years. The Corcoran Clay and other fine-grained units within the Subbasin's aquifer systems are susceptible to subsidence. The aquifer system can become depressurized when long-term groundwater pumping and overdraft occurs, and water originally deposited within the fine-grained units can be released from the clay layers. This depressurization allows for the permanent collapse and rearrangement of the structure, or matrix, of particles in fine-grained layers. An estimated 25 feet of total land subsidence has occurred in the southwestern portion of the MKGSA area since the 1940's. The amount of subsidence decreases to the northeast where an estimated total subsidence of 6 feet has occurred in northern Visalia since the 1940's. The northeast to southwest subsidence gradient direction is similar to the gradient direction of most canals and waterways in the MKGSA area.

Within the MKGSA Plan area, the following data gaps in the HCM are identified:

- Accurate count of wells in the MKGSA area, including well type (domestic, irrigation, etc.) and status (active, inactive, abandoned)
- Construction details of wells, especially production/screen interval(s). This was a significant data gap that prevented a comprehensive understanding of groundwater level and groundwater quality conditions above and below the Corcoran Clay

- Groundwater extraction records from direct measurement and locally generated estimates of groundwater use in rural areas of the MKGSA. This information will improve the water budget.
- Lithologic composition of aquifer, including geophysical logs at strategic locations
- Hydraulic parameters of principal aquifers such as transmissivity, storativity and porosity preferably based on pumping tests. This information could then help with the interpretation of Airborne Electromagnetic (AEM) data available for the Subbasin
- Water quality data for small rural community, domestic (rural residential homeowners) and agricultural irrigation wells
- Understanding of groundwater quality trends with depth (i.e. between upper and lower principal aquifers and vertical changes within each principal aquifer). With this information, an improved understanding is possible regarding depth of base of freshwater throughout the MKGSA as well as the Kaweah Subbasin as a whole.
- Measurements of subsidence within the MKGSA. The historical record of measured subsidence is incomplete and provides no information to inform an understanding of subsidence with depth. Correlation between subsidence and release of arsenic from clay mineralogy represents a data gap that needs to be filled through improved sampling and subsidence monitoring.
- Expanded monitoring of groundwater levels and groundwater quality in small rural communities and disadvantaged communities
- Understanding of the movement/or lack thereof of groundwater flow between the confined and unconfined aquifers
- Understanding of where extraction wells are screened in relation to the Corcoran Clay, delineating the confined aquifer, and determining the volume of extraction from the confined aquifer
- Expanded monitoring to gather information on the semi-confined aquifer east of the defined limit of the Corcoran Clay and the interaction between groundwater pumping and land subsidence

The data gaps will be addressed as MKGSA implements the management actions designed to close such gaps.

3.3 Current and Historical Groundwater Conditions

§ 354.16. Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

- (a) Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:
 - (1) Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin.
 - (2) Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.
- (b) A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.
- (c) Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.
- (d) Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.
- (e) The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.
- (f) Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.
- (g) Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

3.3.1 Groundwater Level Trends

Historical groundwater level trends for the Subbasin are provided in Section 2.4.1 and Appendix B of the Basin Setting document (Appendix 3A). This section of the GSP provides more recent information on groundwater level trends throughout the MKGSA area since the initial 2020 GSP.

Interpreting trends in groundwater level requires understanding climatic conditions. Groundwater levels are influenced by precipitation, with drier years resulting in less natural and managed aquifer recharge, less surface water availability, and more groundwater extraction. Figure 3-1 illustrates changing hydrologic conditions within the Subbasin for rainfall recorded in Visalia from water year 1905 through 2023. Precipitation data prior to 1905 are available but excluded from the chart because the annual totals appeared incomplete.

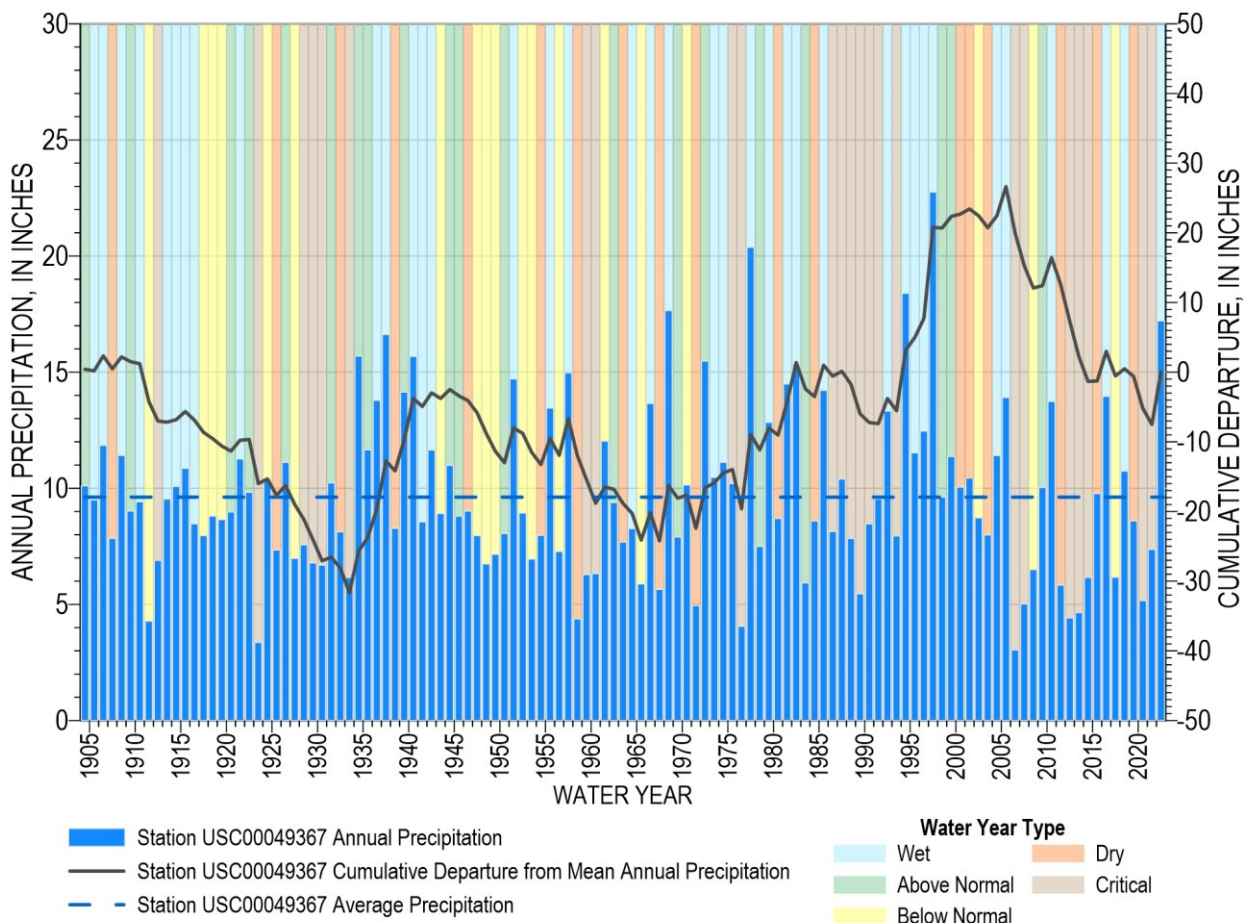


Figure 3-1. Annual Precipitation at the Visalia NOAA Station USC49367 (1905 – 2023)

Long-term average precipitation from 1905 through 2023 is 9.7 inches per year. The bottom half of the chart shows the annual precipitation as bars. The line on the chart represents climatic variability as cumulative departure from mean annual precipitation, such that upward trends represent wet periods and downward trends represent drought periods. The water year type for the southern San Joaquin Valley is color coded in the background of the chart.

Figure 3-1 and Table 3-1 emphasize the highly variable climatic cycles common to the southern San Joaquin Valley consisting of prolonged periods of modest drought punctuated by short, intense wet periods. Notable wet and dry cycles on Figure 3-1 include:

- A 23-year drought including water years 1946 through 1968 received below-average precipitation, when an average of 0.9 inches below normal fell each year.
- A wet period from 1978 through 1983 received an annual average precipitation of 3.5 inches above normal each year.
- A 9-year drought period between 1984 and 1992 received an average of 1 inch below normal precipitation each year.
- A wet period from 1993 through 1998 was recorded as wetter than the previous wet period. Annual rainfall averaged a full 4.7 inches above normal each year.

The most recent drought changed the long-term pattern of prolonged, but somewhat modest, droughts. For 10 years—during water years 2007 to 2016—the area received a total of 27.9 inches less rainfall than the long-term average, which is equal to an annual rainfall of 2.8 inches less than normal each year. The Subbasin received 29% less rainfall than the long-term average during this decade; the most severe drought on record. Hydrographs show groundwater level decline rates in the Subbasin increased over the 2007 – 2016 period.

Table 3-1. Kaweah Subbasin Historical Hydrologic Conditions (1905 – 2023)

Period (Water Years)	Hydrologic Condition	Duration, No. of Years	Precipitation Deviation from Average, inches	Deviation Rate, inches per year
1905-1911	Variable	7	1.2	0.2
1912-1934	Drought	23	-32.9	-1.4
1935-1941	Wet	7	27.9	4.0
1942-1945	Variable	4	1.3	0.3
1946-1968	Drought	23	-21.7	-0.9
1969-1977	Variable	9	4.6	0.5
1978-1983	Wet	6	21.0	3.5
1984-1992	Drought	9	-8.8	-1.0
1993-1998	Wet	6	28.2	4.7
1999-2006	Variable	8	5.9	0.7
2007-2016	Drought	10	-27.9	-2.8
2017-2023	Variable	7	1.3	0.2

Precipitation data from Visalia California NOAA gauge.

Precipitation Deviation is the cumulative departure from average precipitation for the period

Deviation Rate provides a relative sense of the severity of the wet or dry periods.

Groundwater level trends through WY 2023 for the unconfined aquifers are shown on Figure 3-2. The unconfined aquifers represent the upper aquifer found above the Corcoran Clay on the western side of the Subbasin and the single aquifer in areas where the Corcoran Clay is absent on the eastern side of the Subbasin. The hydrographs on Figure 3-2 all have long-term

decreasing trends that are only interrupted in above normal or wet water years. Consecutive dry years greatly impact groundwater levels in the unconfined aquifers due to reduced natural and managed aquifer recharge, e.g., 2007 to 2016. Groundwater levels are deepest in the southwest region of the MKGSA where they can be 230 feet below ground as shown on the KSB-0922 hydrograph. The highest groundwater levels in the GSA are observed in the northeast region of the GSA near the St. Johns River where depth to groundwater is in the range of 120 to 140 feet below ground surface as shown on KSB-1977 on Figure 3-2.

Groundwater levels for the deeper confined aquifers found below the Corcoran Clay have similar downward trends to the unconfined aquifers. Depth to groundwater in wells screened in the confined aquifer is deeper than in the unconfined aquifers. Depth to water can be greater than 300 feet below ground as shown on the hydrographs for WK-1 on Figure 3-3. Fall and spring 2023 groundwater elevation contours for the unconfined and confined aquifers are provided on Figure 3-4 and Figure 3-5, respectively. The contour maps both show a general groundwater gradient from the northeast to the southwest (Lake Kaweah toward Corcoran). Fall groundwater elevations are generally lower than spring groundwater elevations reflecting seasonal irrigation pumping. The fall contours highlight areas where higher intensity extraction creates pumping depressions. In the MKGSA area, pumping depressions are found in the City of Tulare and western side of the MKGSA area. Groundwater flow at the Subbasin's southern boundary with the Tule Subbasin is generally perpendicular indicating balanced flows between the subbasins. This is likely influenced by flows in the Tule River just south of the Kaweah Subbasin's southern boundary. The boundary between western Kaweah Subbasin and Tulare Lake Subbasin has more complexity due to the influence of multiple clay layers, surface water deliveries, and groundwater pumping. At the Kaweah-Tulare Lake Subbasin boundary, groundwater levels in the MKGSA are also impacted from concentrated lower aquifer agricultural wellfield pumping in the Tulare Lake Subbasin occurring several miles away from MKGSA. Contours show a mix of outflow from the Kaweah Subbasin into the Tulare Lake Subbasin and vice versa. In the far western extent of the Kaweah Subbasin, where the Tulare Lake Subbasin borders on 3 sides, there appears to be some flow from north to southwest.

Confined aquifer groundwater elevation contours are not included because there are few monitoring locations perforated solely below the Corcoran Clay. As part of GSP implementation, the Subbasin GSAs have and will continue to add dedicated confined aquifer monitoring wells to the monitoring network.

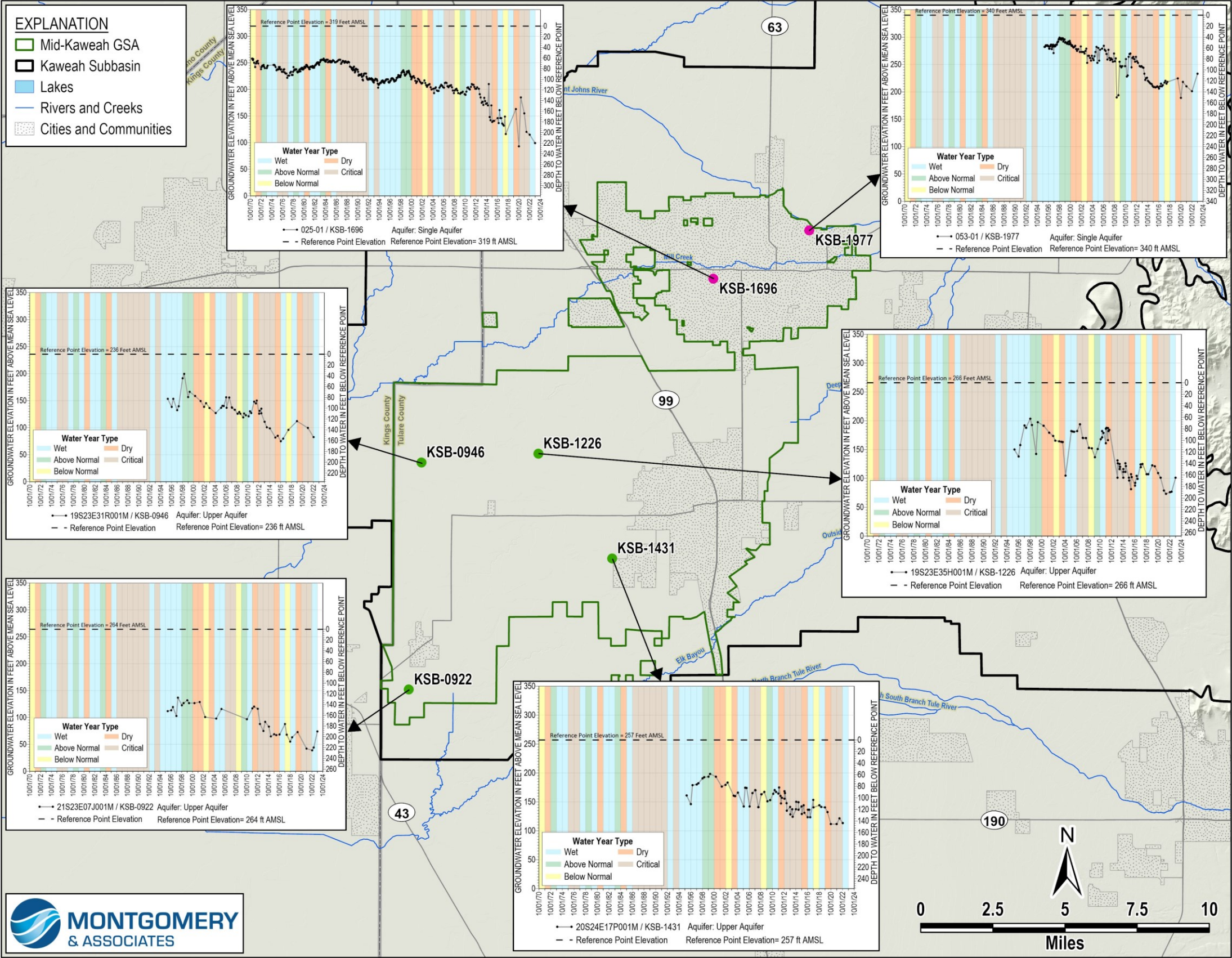


Figure 3-2. Long-Term Unconfined Aquifer Groundwater Level Trends in the MKSA Plan Area

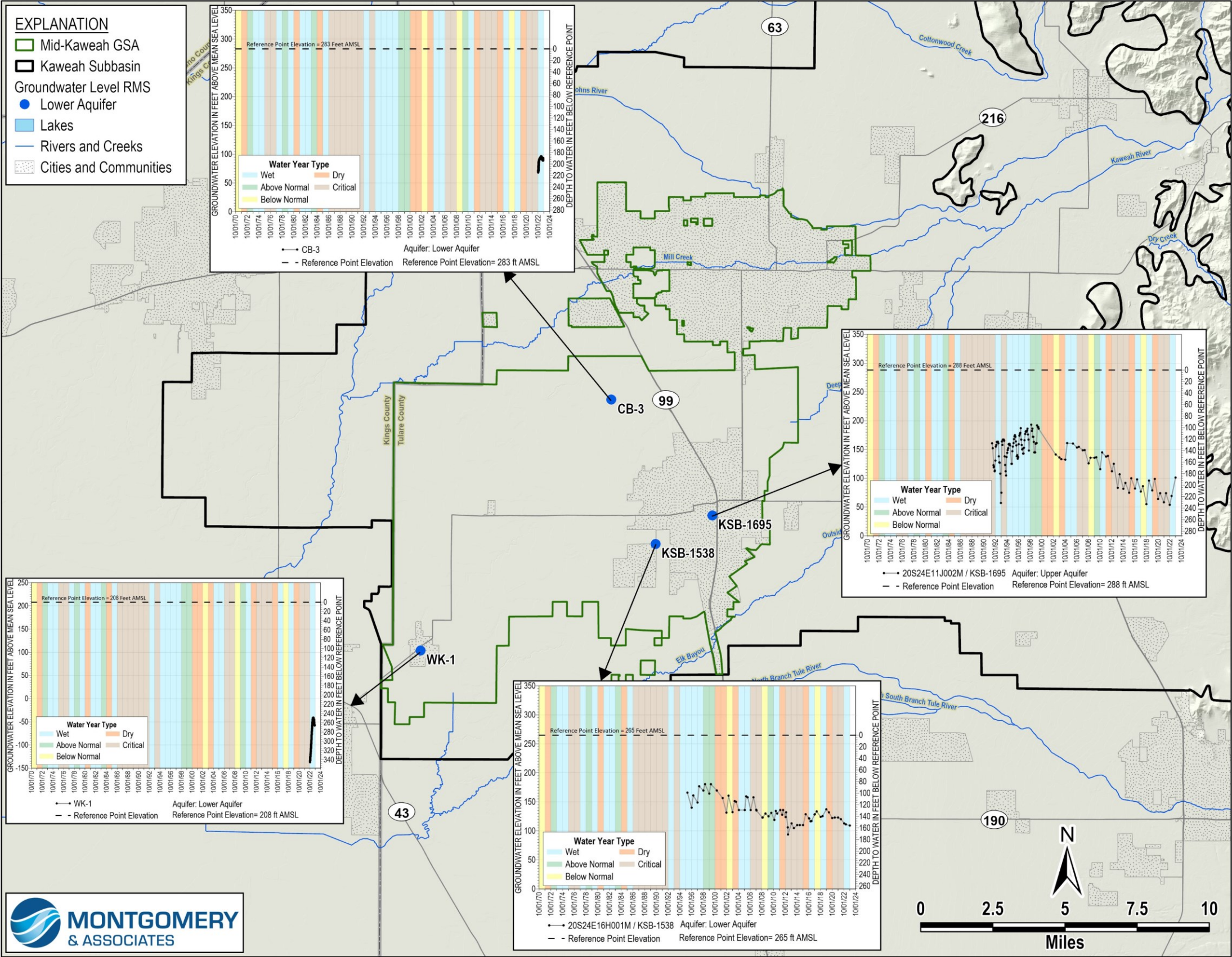
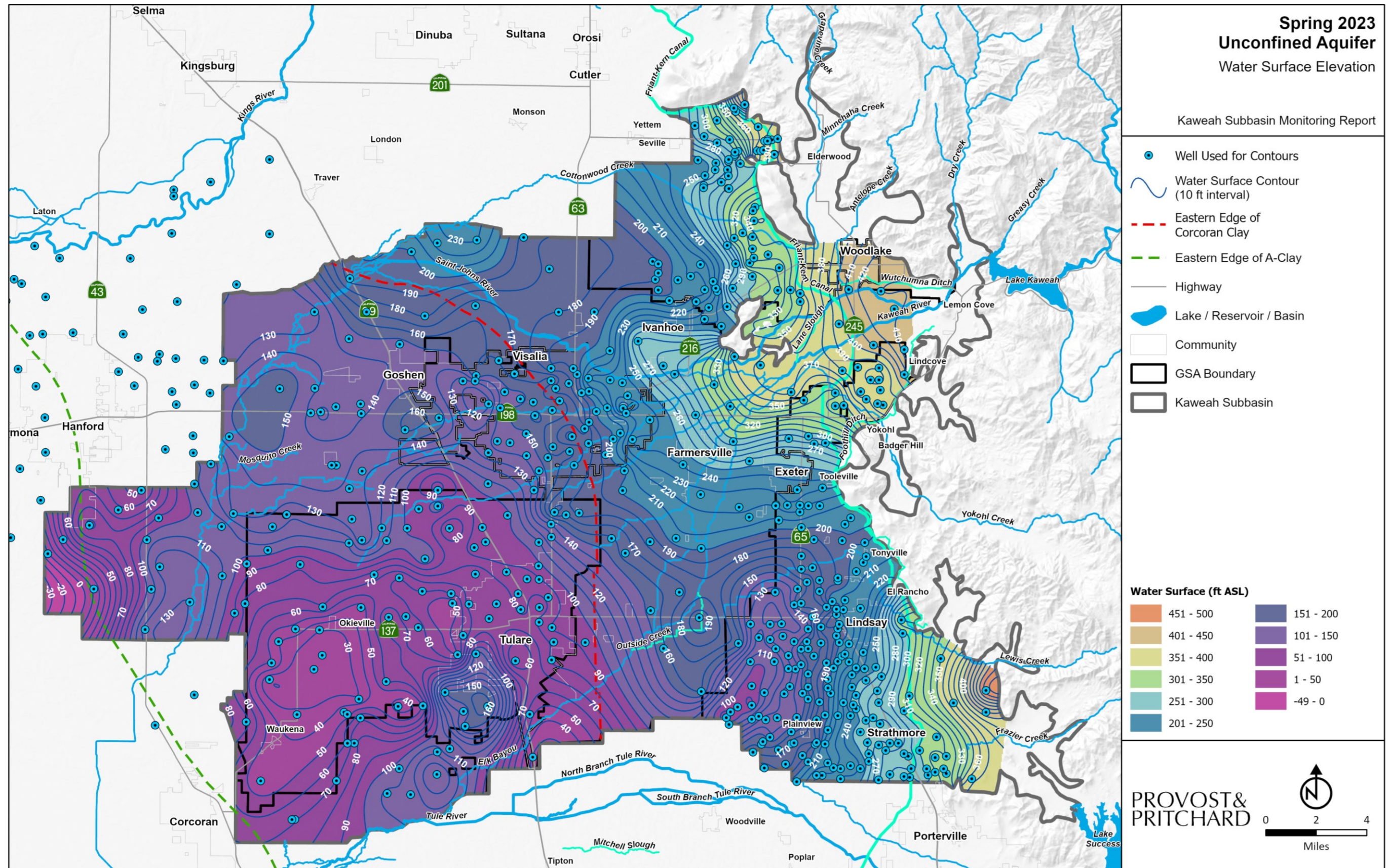
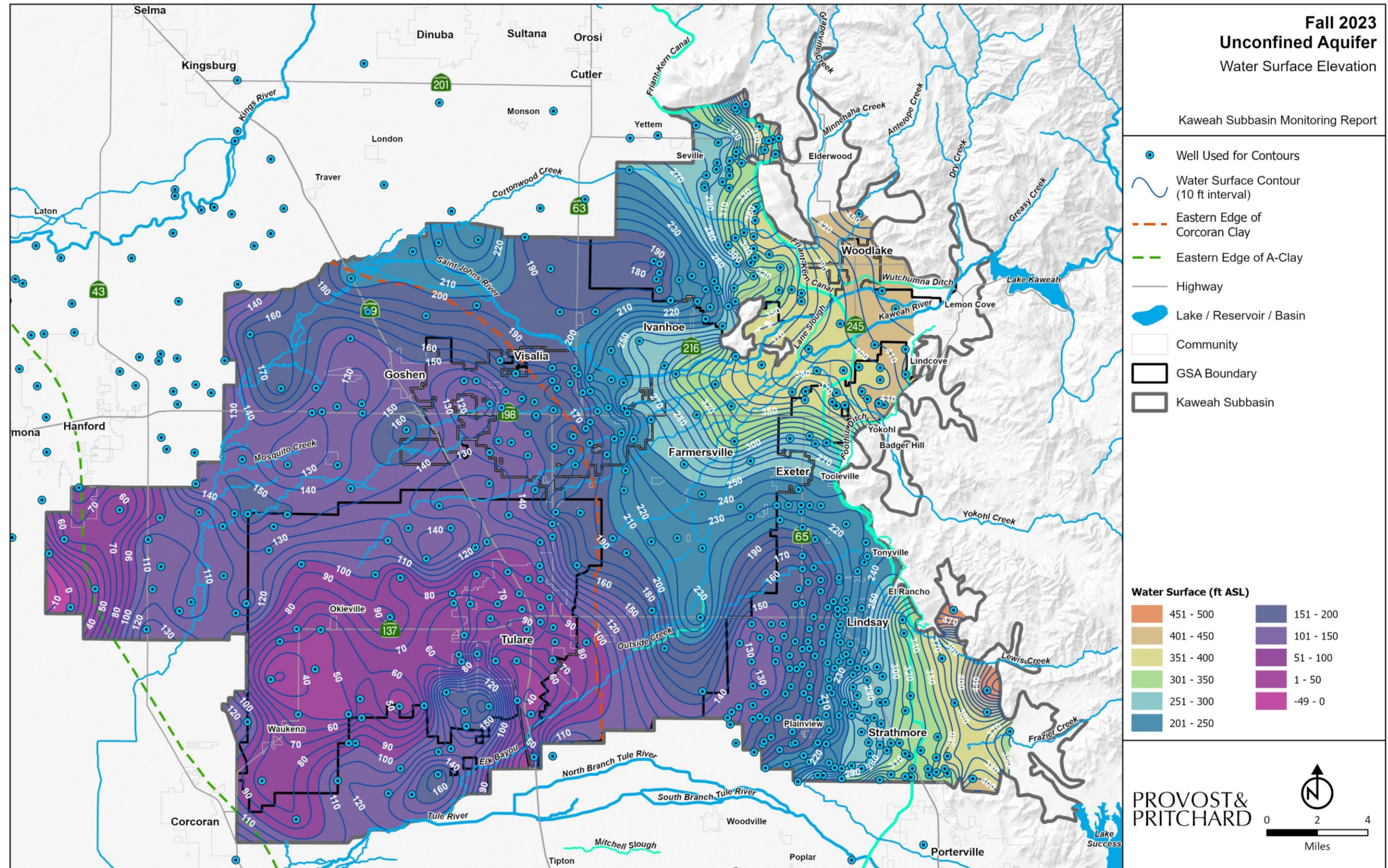


Figure 3-3. Long-Term Confined Aquifer Groundwater Level Trends in the MKGSA Plan Area





3.3.2 Land Subsidence

Land subsidence due to overpumping has occurred throughout San Joaquin Valley over the past 100 years. The Corcoran Clay, which is the primary regional confining layer, and other fine-grained units within the Kaweah Subbasin's aquifer systems are susceptible to subsidence. When long-term groundwater overpumping occurs, the aquifer system can become depressurized, and water originally deposited within the fine-grained clay units can be released. This depressurization allows for the permanent collapse and rearrangement of the structure, or matrix, of particles in fine-grained layers that results in permanent or inelastic land subsidence.

The greatest subsidence in the Subbasin occurs along the western and southern boundaries of the MKGSA area. Greater amounts of subsidence have occurred beyond the Kaweah Subbasin to the west and south. Based on historical land survey and radar technology supplemented with Interferometric Synthetic Aperture Radar (InSAR) data from 2015 on, it is estimated that since 1948, approximately 25 feet of total land subsidence has occurred in the southwestern corner of the MKGSA area. The amount of subsidence decreases from southwest to northeast across the MKGSA area and Subbasin. In northern Visalia, east of the Corcoran Clay, historical subsidence since 1949 is estimated to be around 6 feet. The distribution of Subbasin-wide land subsidence obtained from InSAR over the available period of record from June 13, 2015, to January 1, 2024, is shown on Figure 3-6. Over the period InSAR data are available, the annual rate of land subsidence across the Subbasin ranges from 6.3 feet at the southwest boundary with the Tule Subbasin to a land surface rise of 0.05 feet near Porterville. There has been no observable inelastic subsidence along the Friant-Kern Canal in the Kaweah Subbasin since SGMA was enacted in 2015. Areas of the Subbasin underlain with the Corcoran Clay without access to surface water have needed to deepen their wells to below the clay as the upper aquifer levels have declined. This in turn has led to greater stresses on the lower aquifer and thus contributed to subsidence.

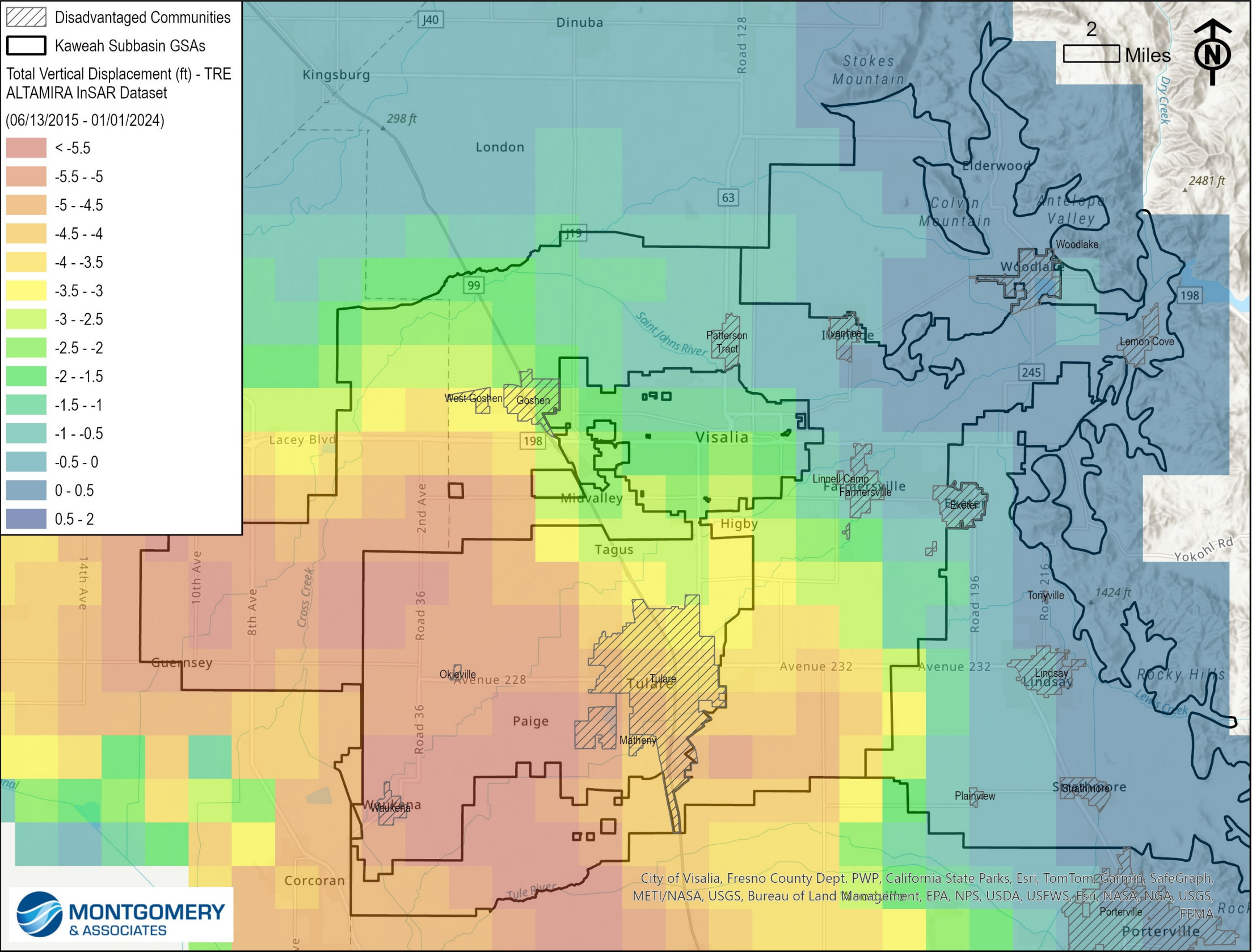


Figure 3-6. Kaweah Subbasin Total Land Subsidence from June 13, 2015, through January 1, 2024

3.3.3 Groundwater Quality

§354.16. Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

(d) Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.

The Kaweah Subbasin’s historical and current groundwater quality conditions have been analyzed using the best available data from the Groundwater Ambient Monitoring and Assessment (GAMA) Program (Section 4.2.3.2). The GAMA dataset provides a foundation for understanding baseline groundwater quality and identifying specific COCs. By leveraging the GAMA dataset, the historical presence and concentration of various COCs can be assessed, offering insight into the long-term trends and the current condition of groundwater quality.

Appendix 3B includes groundwater quality concentration and trend maps for pre-SGMA (2005-2015) and post-SGMA (2015-2024) conditions. The content available in Appendix 3B includes more current data and information than that documented in the Basin Setting in Appendix 3A. A summary table of the groundwater quality analyses is provided in Table 3-4 on page 3-34.

3.3.3.1 Bulletin 118 Overview

Groundwater in the oxidized older alluvium and younger alluvium is generally of the calcium bicarbonate type. In the unconsolidated deposits beneath the alluvial fans, groundwater is generally low in dissolved constituents. Where recharge is from the major streams, sodium constitutes less than 42% of the cations and TDS ranges from 100 to 270 milligrams per liter (mg/L). Sodium and bicarbonate are the principal ions in groundwater in the continental deposits and in reduced older alluvial deposits. Sodium accounts for more than 70% of the cations in the water from these deposits. TDS ranges from 100 to 500 mg/L. In the interfan areas, where recharge is from intermittent streams, dissolved constituents range from 270 to 650 mg/L and magnesium and chloride are major constituents (Croft & Gordon, 1968).

3.3.3.2 Data Sources

For the purpose of establishing minimum thresholds (MTs) and measurable objectives (MOs), hydrogeologic zones of similar characteristics are being delineated at the Subbasin level. The boundaries of these zones will likely be updated and modified regularly. These are presented in the Kaweah Subbasin Basin Setting document.

There is a total of 47 public water systems in the Subbasin with data available in SDWIS. These systems are generally representative of the Subbasin as they’re located throughout the area.

Between all 47 active public water systems, 174 wells were evaluated. In addition to SDWIS, GeoTracker GAMA was searched to identify contaminant plumes, and the SWRCB's Human Right to Water Portal was searched to identify contaminants that are commonly violating drinking water standards. A limited amount of data was available for private domestic wells within the Subbasin. The existing data sources and programs used to evaluate groundwater quality conditions and establish SMC are available in Section 4.2.

3.3.3.3 Constituents of Concern (COC)

There are both anthropogenic and natural sources of COCs in the Kaweah Subbasin. Anthropogenic sources that may contribute to the degradation of the current groundwater quality in the Subbasin include agricultural use of pesticides and fertilizers, salt accumulation resulting from agricultural irrigation practices, and household septic systems return flows. Also, point sources of constituents from industrial sites and other types of cleanup sites are identified by GeoTracker and Envirostor. Emerging COCs such as Per- and polyfluoroalkyl substances (PFAS) are also being evaluated as data becomes available. Natural sources of COCs in the Subbasin include the dissolution of rocks and minerals that comprise the aquifer matrix material. These naturally occurring COCs include silicate minerals which can contribute to arsenic; sodium and calcium borates, and borosilicate minerals which contribute to boron in groundwater; and sulfate minerals which can contribute to sulfate in groundwater, and evaporite and other minerals and salts which can dissolve and increase TDS concentration in groundwater.

The GAMA water quality dataset was used to identify specific constituents of concern. The primary metric for identifying URs related to groundwater quality within the Subbasin are exceedances of water quality objectives contained in the Water Quality Control Plan for the Tulare Lake Basin, which incorporates by reference the Primary Maximum Contaminant Levels (MCL) (Title 22 California Code of Regulations [CCR]), and the National Primary Drinking Water Regulations (EPA). These regulatory benchmarks apply to water that is delivered to the consumer, not to untreated groundwater. Exceedances of Primary MCLs in untreated groundwater indicate potential threats to human health and the potential need for additional treatment steps to make groundwater suitable for potable use. Current and historical untreated groundwater data was reviewed for COC concentrations exceeding applicable MCLs. Table 3-2 indicates well exceedances for COCs present in the Kaweah Subbasin and includes the date range of the data by each COC.

Table 3-2. Current and Historical Wells with Maximum Contaminant Level Exceedances for Constituents of Concern in Kaweah Subbasin

Constituent of Concern	MCL	MCL Units	Number of Wells with Data	Number of Wells with Exceedance	Percentage of Wells with Exceedance
California Primary MCL (Health-Based Standards)					
Nitrate as N	10	mg/L	1,214	340	28%
1,2,3-Trichloropropane (1,2,3 TCP)	0.005	µg/L ¹	339	64	19%
Gross Alpha	15	pCi/L ¹	314	29	9%
Uranium	20	pCi/L	305	25	8%
Arsenic	10	µg/L ¹	594	40	7%
1,2-Dibromo-3-chloropropane (DBCP)	0.2	µg/L ¹	531	30	6%
Perchlorate	6	µg/L ¹	391	16	4%
Tetrachloroethene (PCE)	5	µg/L ¹	670	20	3%
Chromium, Hexavalent (Cr6)	10	µg/L ¹	283	4	1%
California Secondary MCL (Aesthetic/Non-Health Based Standards)					
Total Dissolved Solids	1000	mg/L	968	52	5%
Specific Conductivity	1600	µS/cm	637	28	4%
Chloride	500	mg/L	1,228	36	3%
Sulfate	500	mg/L	1,109	10	1%
US EPA Secondary MCL (Aesthetic/Non-Health Based Standards)					
pH	8.5	-	1,047	122	12%
Agriculture Water Quality (AgWQ) Goal (Non-Health Based Standards)					
Sodium	69	mg/L	638	127	20%
Boron	0.7	mg/L	829	23	3%

¹Constituent units in µg/L or pCi/L units - in Attachment A: Title 22 Tables, the constituent units are in mg/L; MCL, maximum contaminant level; mg/L, milligram per liter; µg/L microgram per liter, pCi/L, picocuries per liter; µS/cm (microsiemens per centimeter; %, percent

3.3.3.4 Causes of Groundwater Quality Degradation

COCs identified in the Kaweah Subbasin are naturally occurring, anthropogenic, or a combination of sources. In some instances, especially in deeper parts of the Subbasin with older water that has been in contact with aquifer sediments over an extended period, there are naturally high concentrations of COCs. Therefore, naturally occurring COCs may be present regardless of human activity. It is recognized that pumping and resulting declines in groundwater levels can lead to increasing concentrations of naturally occurring COCs as flow to a well is focused deeper in the aquifer that has older water with elevated concentrations of naturally occurring COCs and/or poor-quality shallow groundwater migrates downward in the aquifer to the depth of deeper well screens (Levy *et al.*, 2021). Lower groundwater levels in combination with increased

use of imported water has also resulted in salt dissolution from native soil, which increases salt accumulation in groundwater (CV-SALTS 2024). Other COCs such as 1,2,3-TCP, 1,2-DBCP, nitrate, and PCE are primarily a result of human activity in the Kaweah Subbasin that groundwater pumping and groundwater recharge have the potential to mobilize. An initial analysis of groundwater quality data comparing Pre-SGMA and Post-SGMA concentrations and trends shows that degradation in the Kaweah Subbasin is predominantly due to legacy (pre-SGMA, pre-2015) groundwater conditions. A summary of the potential causation of degraded groundwater quality and elevated concentrations of the COCs in the Subbasin is provided in Table 3-3. A map depicting point-source contaminated sites in the Kaweah Subbasin and the clean-up status, sourced by GeoTracker and Envirostor databases is presented on Figure 3-7.

Appendix 3B includes maps showing the spatial distribution of pre-SGMA and post-SGMA maximum and median COC concentrations and trends in the Subbasin.

Table 3-3. Potential Causation of Historical Groundwater Quality Degradation

Constituent of Concern	Potential Causation of Historical Degradation of Groundwater Quality in the Kaweah Subbasin	Naturally Occurring	Anthropogenic
1,2,3-Trichloropropane (1,2,3 TCP)	Anthropogenic sources, widespread application of pesticides prior to the 1980's that included 1,2,3-TCP as an inactive ingredient (Burow <i>et al.</i> , 2019).		X
1,2-Dibromo-3-chloropropane (DBCP)	Anthropogenic sources, used as a soil fumigant (SWRCB, 2016) for the control of nematodes in over 40 different crops prior to 1979.		X
Arsenic	Both anthropogenic and naturally occurring sources. Naturally occurring sources primarily in deeper wells of the lower aquifer or valley trough (Haugen <i>et al.</i> , 2021, Belitz <i>et al.</i> , 2003). Anthropogenic sources of arsenic may increase due to pumping, lowering of groundwater levels and expelling of pore water from compacted clay layers due to subsidence (Smith <i>et al.</i> , 2018).	X	X
Gross Alpha	Primarily naturally occurring in the Subbasin. Natural radioactivity in groundwater is from the decay of isotopes that are present in rocks like granite and the fracture or breakdown of those rocks into minerals in sediments of aquifers. Decay releases a particle hazardous to human health and can damage cell DNA increasing the risk of cancer (Burton, 2008).	X	X
Chromium, Hexavalent (Cr6)	Primarily naturally occurring in the Subbasin. Anthropogenic point-sources include metal plating operations, and agriculture practices (ES&T, 2018).	X	X
Nitrate as N	Both anthropogenic and naturally occurring sources. Legacy loading from fertilization of irrigated land, animal waste (diaries), and septic return flows (Burow <i>et al.</i> , 2008). Natural sources of nitrate in soils are also recognized.	X	X

Constituent of Concern	Potential Causation of Historical Degradation of Groundwater Quality in the Kaweah Subbasin	Naturally Occurring	Anthropogenic
Perchlorate	Both anthropogenic and naturally occurring sources (Belitz and Landon, 2010; DTSC, 2005). Anthropogenic sources include rocket propellant, explosives, fireworks, road flares, airbag initiators, matches, electroplating operations and some disinfectants and herbicides. Perchlorate occurs naturally in arid states in the Southwest United States, in nitrate fertilizer deposits from Chile, and in potash ore. It also forms naturally in the atmosphere (EPA 2024).	X	X
Tetrachloroethene (PCE)	Anthropogenic point-source from uses such as dry cleaners, metal degreasing, and various industrial facilities (EPA, 2020).		X
Uranium	Naturally occurring sources leaching uranium from shallow sediments due to natural recharge and anthropogenic sources from agricultural or assisted recharge of high bicarbonate water (Jurgens <i>et al.</i> , 2010).	X	X
Chloride	Chloride is an ion of salt that accumulates as water evaporates and can build up in poorly drained soils. Chloride may be due to both anthropogenic and naturally occurring sources. Buildup of chloride salts due to agricultural, municipal and industrial activities increase chloride concentrations (CV-SALTS, 2024).	X	X
Specific Conductivity	Both anthropogenic and naturally occurring, high specific conductivity indicates elevated levels of dissolved salts (CV-SALTS, 2024). The causation of elevated specific conductivity in the Subbasin is the same as for TDS.	X	X
Sulfate	Sulfate is an ion that accumulates as water evaporates and can build-up in poorly drained soils. Sulfate may be due to both anthropogenic and naturally occurring sources (EPA, 2012). Buildup of sulfate salts due to agricultural, municipal and industrial activities increase sulfate concentrations.	X	X
Total Dissolved Solids	TDS concentrations are generally below 600 mg/L in the Subbasin; however localized elevated TDS may be due to both anthropogenic and naturally occurring sources. Buildup of salts due to agricultural, municipal and industrial activities increase TDS concentrations. Septic return flows are also a source of increase. Inverse geochemical modeling identified weathering of primary silicate minerals and evaporation as the main causes of TDS concentration increases (Hansen <i>et. al</i> 2018).	X	X
pH	Both anthropogenic and naturally occurring (EPA, 2024) pH levels have been altered due to geochemical processes such as weathering of primary silicate minerals to the formation of bicarbonate, a buffering agent. Fertilizers and chemicals used in farming and septic return flows can leach into the groundwater, altering pH levels.	X	X

Constituent of Concern	Potential Causation of Historical Degradation of Groundwater Quality in the Kaweah Subbasin	Naturally Occurring	Anthropogenic
Boron	Boron is generally below the agricultural water quality objective and California health-based notification level. Boron may be due to both anthropogenic and naturally occurring sources (Ayers & Westcot, 1985) and additional analysis is required to further evaluate causation in the Subbasin.	X	X
Sodium	Sodium is an ion of salt that accumulates as water evaporates and can build-up in poorly drained soils. Sodium may be due to both anthropogenic and naturally occurring sources (CV-SALTS, 2024). Buildup of salts due to agricultural, municipal and industrial activities increase sodium concentrations.	X	X

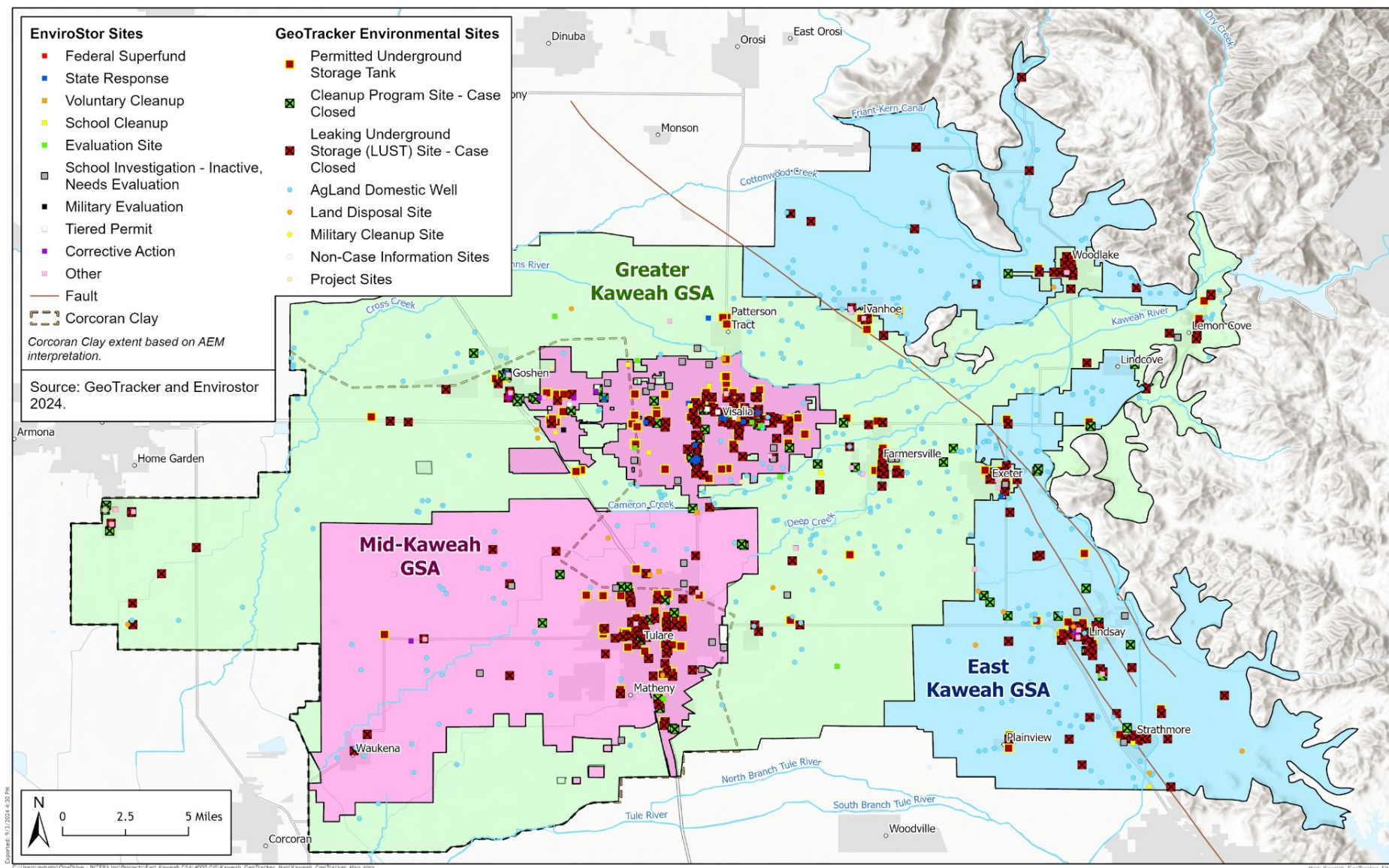


Figure 3-7. Point-Source Contaminated Sites in the Kaweah Subbasin Sourced by GeoTracker and Envirostor (2024)

3.3.3.5 COCs Exceeding the California Primary MCL (Health-Based Standards)

There are 9 COCs identified in the Kaweah Subbasin that exceeded their respective California Primary MCL. Below is a brief description of each COC as it relates to the drinking water standard, potential health effects, potential sources, and transport.

3.3.3.5.1 1,2,3-Trichloropropane (1,2,3-TCP)

1,2,3-TCP is a man-made, chlorinated hydrocarbon typically found at industrial or hazardous waste sites and has been used as an industrial solvent and as a cleaning and degreasing agent; it has also been found as an impurity resulting from the production of soil fumigants, distribution started in the 1950s by Shell and Dow. 1,2,3-TCP was removed from pesticides in the 1980s, however, due to its prevalent use; it has become a water quality concern for drinking water systems relying on groundwater in areas where it was applied. Its widespread use in the San Joaquin Valley has led to significantly high concentrations, with the highest concentrations of 1,2,3-TCP observed at point source cleanup sites in urban areas (Figure 3-7). Non-point source concentrations are prevalent in areas with young, shallow, oxic groundwater, especially beneath orchard and vineyard crops. These areas often have coarse-grained sediments that promote rapid recharge, which can facilitate the movement of 1,2,3-TCP into groundwater (Burow *et al.*, 2019). 1,2,3-TCP often co-occurs with other agriculture-related chemicals like 1,2-dibromo-3-chloropropane (DBCP) and 1,2-dichloropropane (1,2-DCP), indicating its persistence in the environment with minimal degradation. In 2017, the SWRCB established an MCL for 1,2,3-TCP of 0.005 µg/L or 5 parts per trillion (ppt).

3.3.3.5.2 1,2-Dibromo-3-Chloropropane (DBCP)

Prior to 1979, 1,2-DBCP was primarily used as a soil fumigant for the control of nematodes in over 40 different crops. Despite its use being banned in the late 1970's, DBCP persists in groundwater and often co-occurs with 1,2,3-TCP, sources and transport are similar as shown above on Figure 3-8. In 1989, SWRCB established an MCL for 1,2-DBCP of 0.2 (µg/L).

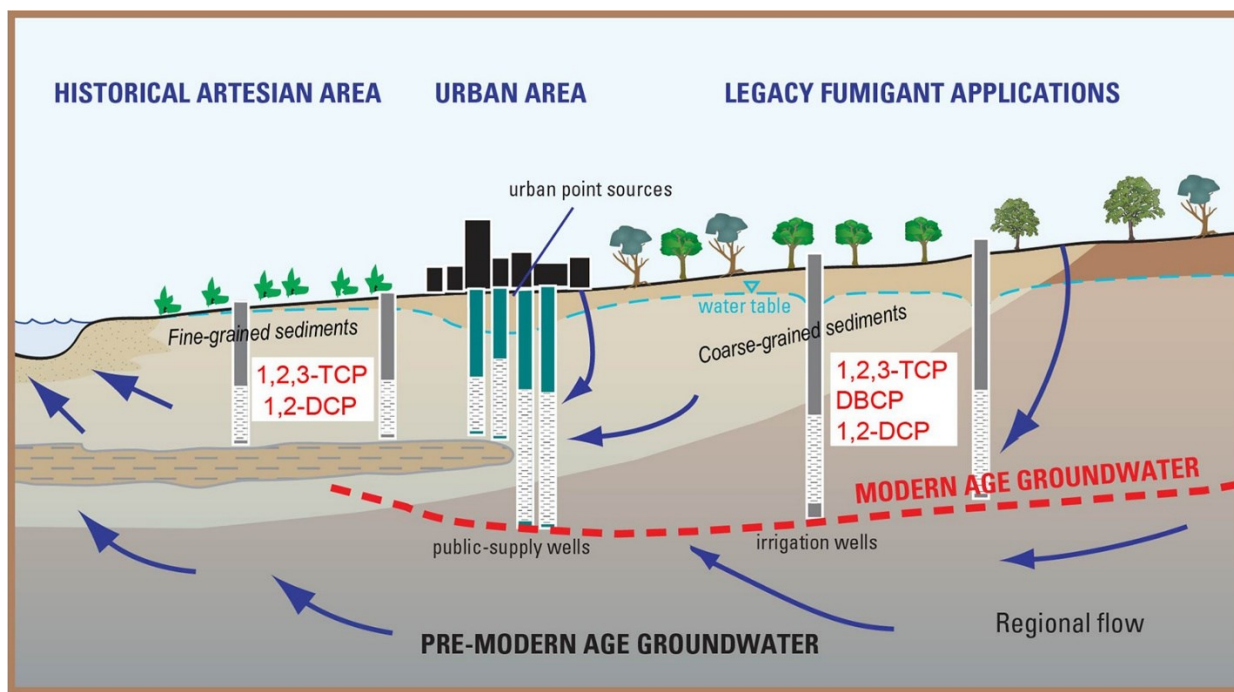


Figure 3-8. 1,2,3-TCP and DBCP Sources and Transport (Burow *et al.* 2019)

3.3.3.5.3 Arsenic

Arsenic is naturally occurring and concentrations of arsenic in California groundwater basins commonly exceed California's drinking water MCL. The California arsenic MCL is 0.010 milligrams per liter (mg/L) (equivalent to 10 µg/L) and became effective on November 28, 2008. Arsenic naturally sorbs onto oxide surfaces of mineral grains in sedimentary aquifer matrix material. Naturally occurring arsenic concentrations in groundwater are highly variable in semi-arid and arid groundwater basins of the western United States (Welch *et al.*, 2000). Because of low precipitation and long residence times, groundwater recharge is limited in these sedimentary basins. The long residence time of the groundwater in the Subbasin allows for interaction between groundwater and minerals that comprise the aquifer matrix material. With time, anoxic (low to no oxygen) conditions and high pH values, particularly above 8.0, arsenic desorbs from iron, manganese, and aluminum oxides on the surfaces of mineral grains of sediments and enters the groundwater (Izbicki *et al.*, 2008, Haugen *et al.*, 2021). Anoxic conditions also induce reductive dissolution of iron and manganese oxide coatings on mineral grains, releasing sorbed arsenic. Haugen *et al.*, 2021 identified increasing arsenic trends in wells located in deeper groundwater of the Central Valley trough where aquifer materials are more fine-grained and reducing conditions favor arsenic mobility. Haugen *et al.*, 2021 identified decreasing arsenic trends in oxic groundwaters, likely derived from agricultural recharge (Figure 3-9).

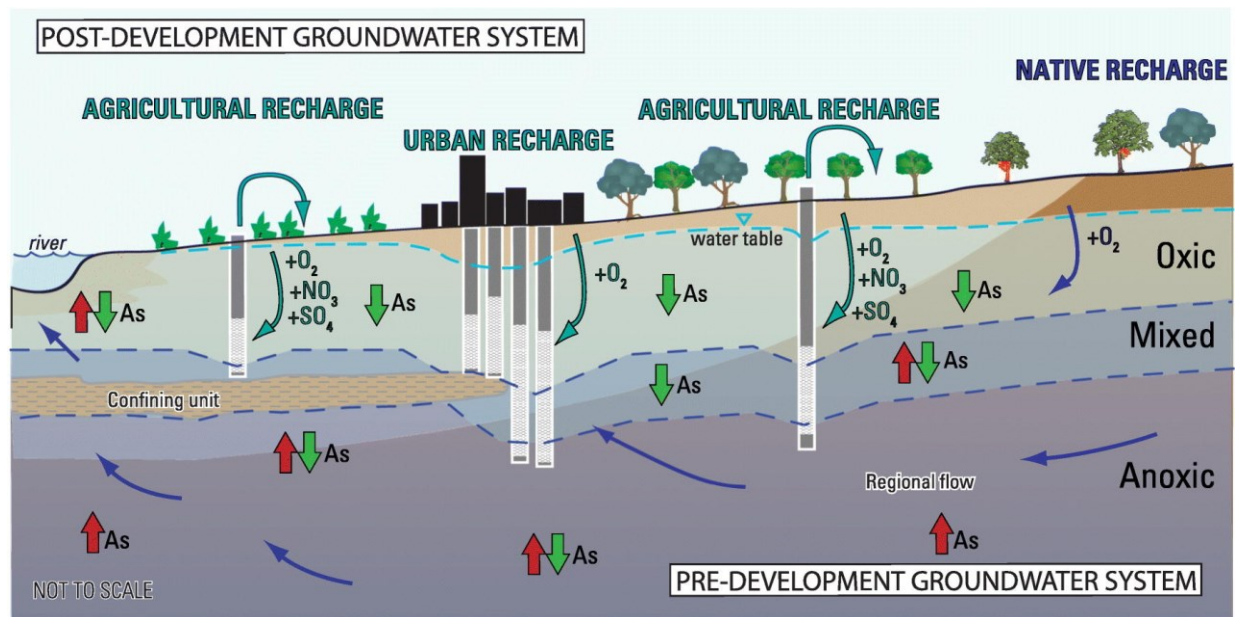


Figure 3-9. Pre- and Post-Development Groundwater System and Arsenic Concentration (Haugen *et al.*, 2021)

3.3.3.5.4 Gross Alpha

Natural radioactivity in groundwater is from the decay of isotopes present in rocks like granite and the fracture or breakdown of those rocks into minerals contained in sediments of aquifers. There are many other volcanic and geothermal rock types and mineral deposits widely distributed in California with radioactivity (Walker and Lovering, 1954). The isotopic decay process, simplified, releases particles hazardous to human health and can damage cell DNA increasing the risk of cancer; one of the particles released is a gross alpha particle (Burton, 2008). The presence of alpha particles in water usually indicates radium-226, U-235, and Rd-222 as the source. The distribution of uranium and gross alpha activities above MCL levels has been documented in California to be closely related (SWRCB, 2017a). Anthropogenic sources include paper mills and other industries, smoke detectors, and as byproducts of nuclear reactions (EPA, 2017).

3.3.3.5.5 Hexavalent Chromium (CrVI or Cr6)

Chromium is a heavy metal and the 21st most abundant element on the planet (Helmenstine, 2014). Chromium can be found in two anion forms, trivalent chromium Cr(III), and hexavalent chromium Cr(VI). Naturally occurring chromium is found in chromium-rich iron oxides, which are most abundant in mafic igneous rocks and older volcanic rocks (Ernst, 2012). Often, these rock formations are found along tectonically active areas such as California, which exposes these materials to weathering (Ernst 2012). Weathering of chromium-rich deposits leads to naturally high concentrations of chromium as both Cr(III) and Cr(VI) (Oze *et al.*, 2007). In the Central Valley, high Cr(VI) levels are linked to chromium-rich source rocks and soils and recharge

processes, including irrigation return, which can mobilize chromium from the unsaturated zone (Figure 3-10). Anthropogenic sources include discharges of dye and paint pigments, wood preservatives, chrome-plating liquid wastes, and leaching from hazardous waste sites (SWRCB, 2017b). In 2024, California adopted a hexavalent chromium MCL of 10 µg/L. Previously, the MCL was set at 50 µg/L for total chromium which was a summation of the 2 forms of chromium. Water systems have 2 to 4 years to comply with the regulations depending on the system size. Systems smaller than 1,000 connections have 4 years to comply while larger systems have 2 years.

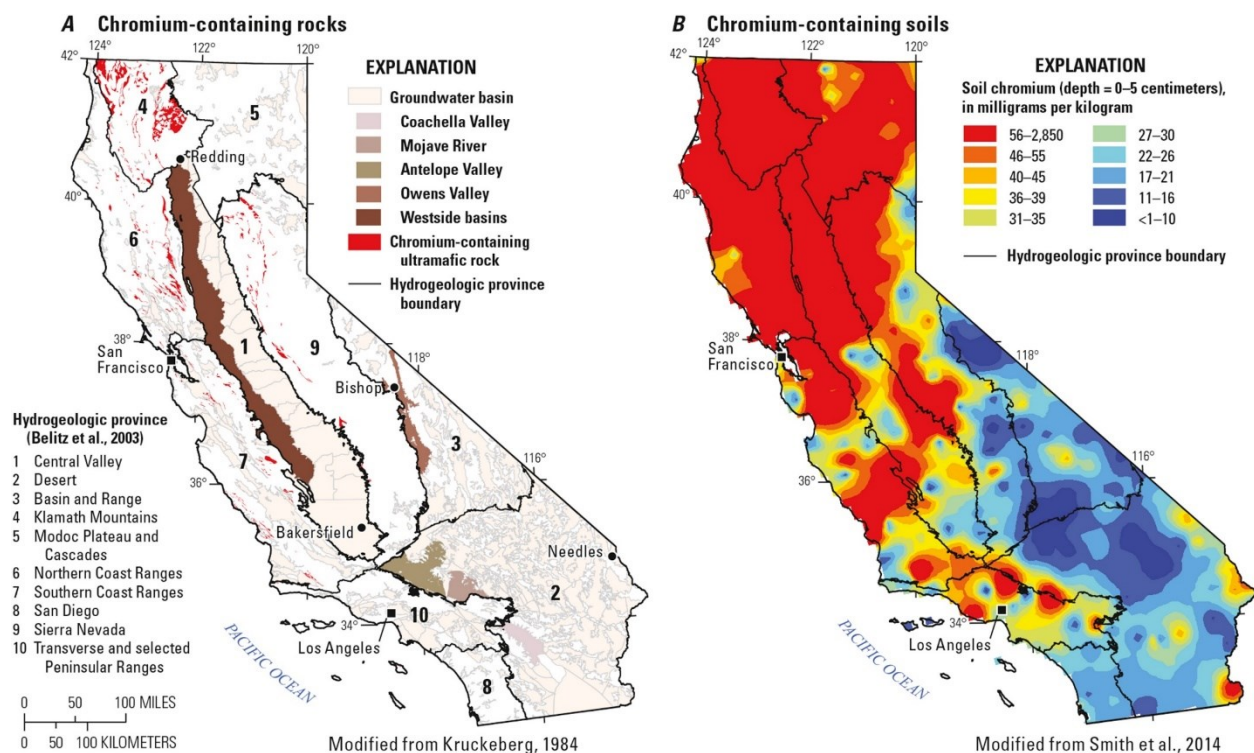


Figure 3-10. Chromium-Containing Rocks and Soils (Izbicki *et al.* 2015)

3.3.3.5.6 Nitrate

Sources of nitrate in groundwater are commonly associated with fertilizers, septic tanks, discharge from wastewater treatment plants and land application of treated wastewater; however, nitrate can also be naturally occurring. Spatial and temporal trends of nitrate are primarily controlled by water and nitrate fluxes of modern land use (Landon *et al.*, 2011). Previous studies of private wells in Tulare County found 40% of wells sampled for nitrate exceeded the drinking water MCL (SWRCB, 2016). This study identified dairy manure or septic effluent sources for the most heavily impacted wells based on nitrate isotopic analysis (Figure 3-11). In general, higher domestic well water nitrate concentrations are found in Central Valley wells below

400 feet surface elevation (Figure 3-12). In the Sierra Nevada foothills nitrate loading from orchards and septic systems may be a source of local high nitrate concentrations. The California drinking water MCL for nitrate as nitrogen (N), also known as nitrate-nitrogen (NO₃-N), is 10 mg/L.

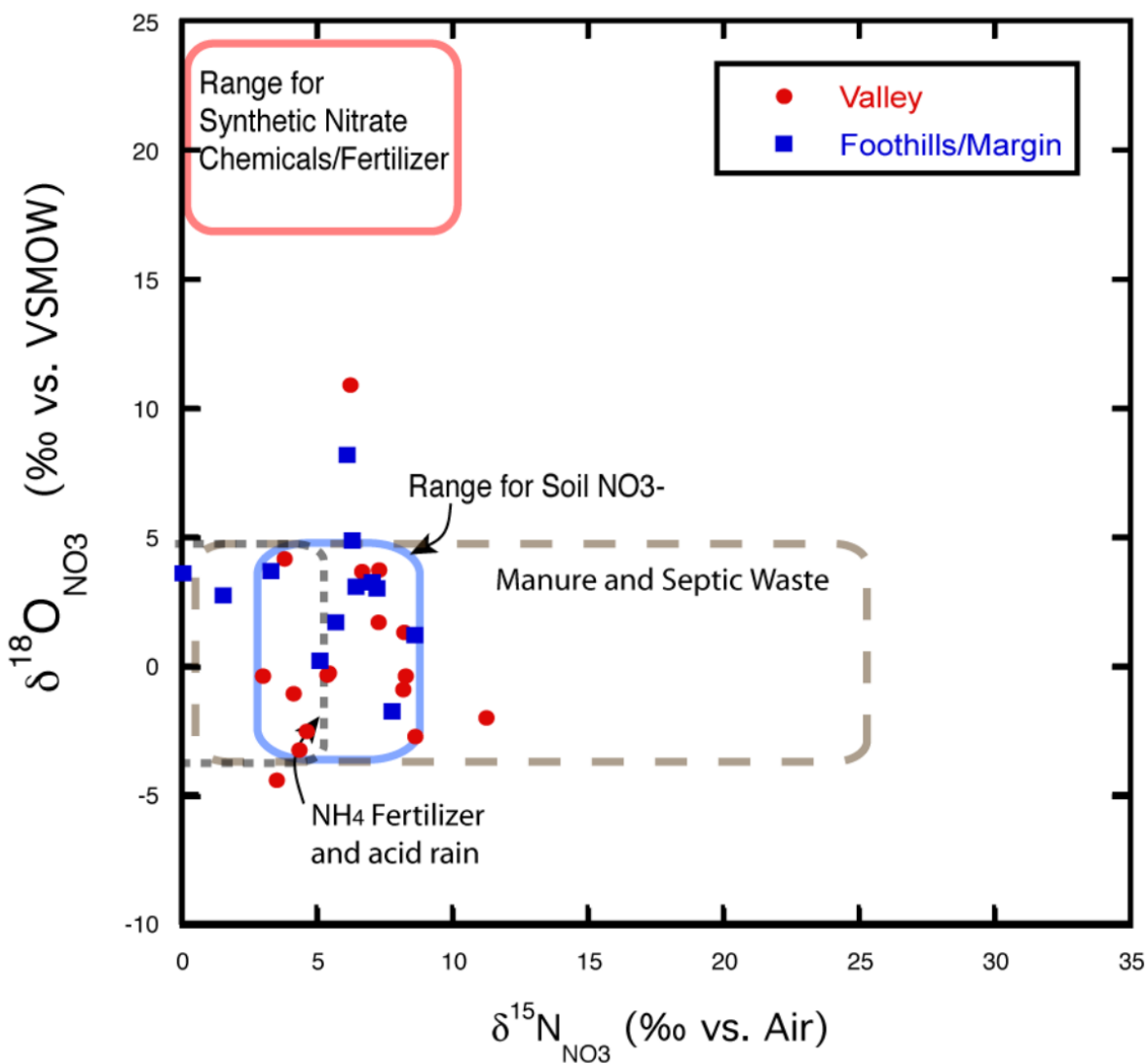


Figure 3-11. Nitrogen and Oxygen Isotope Compositions of Dissolved Nitrate in Tulare County Wells
(Singleton *et al.*, 2011)

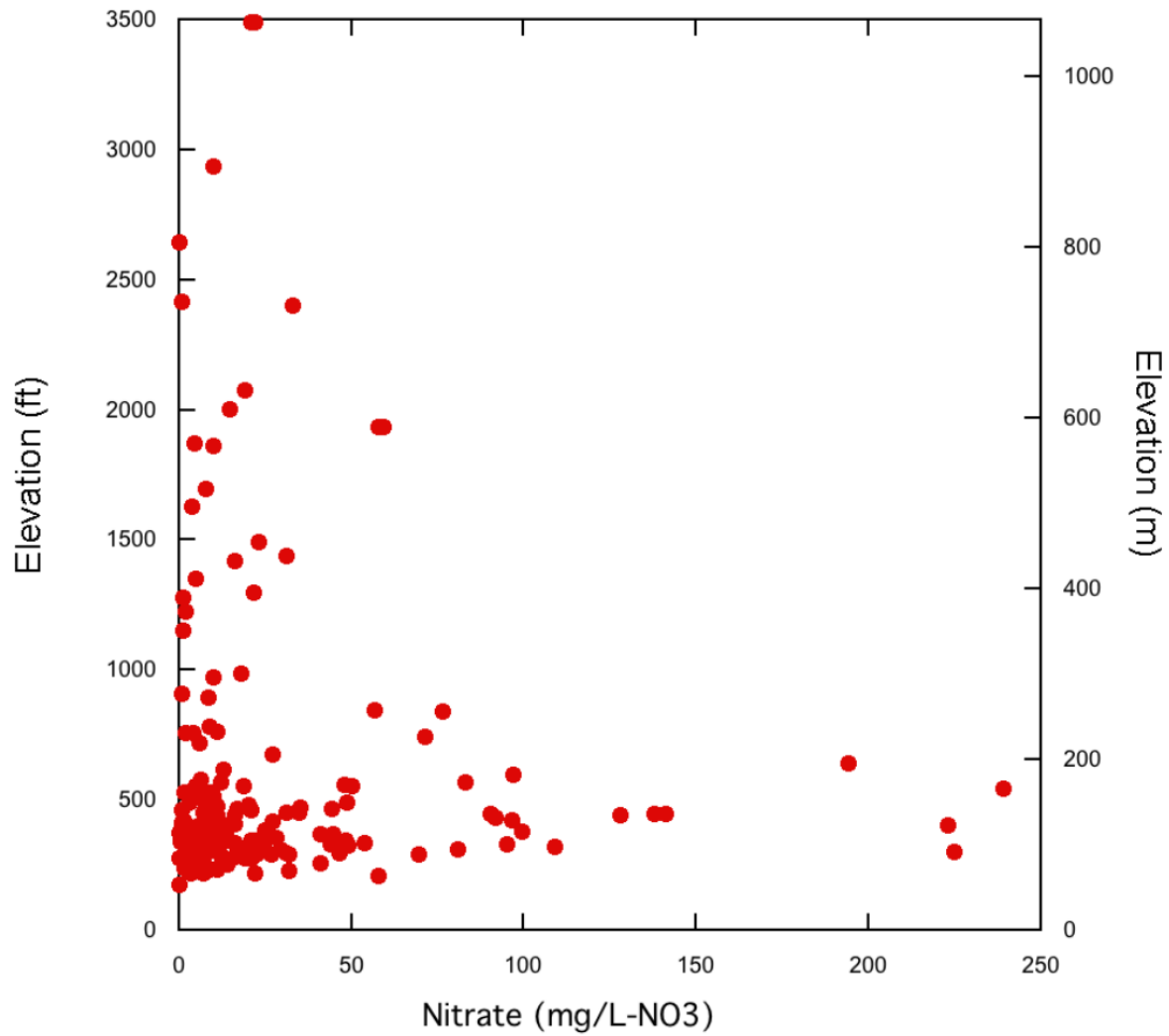


Figure 3-12. Nitrate by Elevation in Tulare County Wells (Singleton *et al.*, 2011)

3.3.3.5.7 Perchlorate

Perchlorate is a chemical that is both naturally occurring and manufactured. Perchlorate is commonly used in solid rocket propellants, munitions, and fireworks, and it can enter groundwater through industrial activities and improper disposal (Belitz and Landon, 2010). Ammonium perchlorate and sodium perchlorate are examples of manufactured salts. Perchlorate has also been found as an impurity in fertilizers made with natural minerals such as bloodmeal, fishmeal, hanksite (sulfate mineral), kelp, and potash (DTSC, 2005). Perchlorate is commonly found as an ionic salt and in a dissolved form it easily moves through and travels with the flow of water on or beneath the ground. California began to regulate perchlorate as a primary MCL in 2007. The California Department of Public Health (CDPH), which was responsible for drinking water regulation at the time, set the MCL for perchlorate at 6 µg/L. This regulation was established to address the health risks associated with perchlorate consumption in drinking water, particularly its impact on thyroid function.

3.3.3.5.8 Tetrachloroethene (PCE)

PCE is a volatile organic compound commonly used as a solvent in dry cleaning, metal degreasing, and various industrial processes (EPA, 2020). Due to its persistence in the environment and potential to contaminate groundwater, PCE is regulated under California's primary MCL for drinking water. California began regulating PCE in 1989, setting the MCL at 5 µg/L to protect public health. PCE is classified as a probable human carcinogen by the EPA and in addition to potential health effects has been linked to an increased risk of cancer, particularly liver and kidney cancer.

3.3.3.5.9 Uranium

Uranium is a radioactive substance that naturally occurs in groundwater and found in rocks, such as granites, and in sediments derived from crystalline rocks. Radiation released by the radioactive decay of uranium and its daughter products pose a risk to human health and the heavy metal characteristics of uranium pose additional and short-term health risks because of its toxic effects on the kidneys. Therefore, long-term exposure to elevated levels of uranium in drinking water can result in kidney damage and an increased risk of developing cancer (EPA, 2001). The California drinking water MCL for uranium is 20 picocuries per liter (pCi/L). This standard is designed to protect public health by limiting exposure to uranium, which can be harmful if consumed in large quantities over time. Uranium-238 is the most common of several natural isotopes and accounts for 99% of the mass of natural samples.

Because uranium is highly soluble in its oxidized forms but only slightly soluble in its reduced forms, its concentrations in groundwater depend on redox conditions, as well as on pH and on concentrations of bicarbonate. Extensive irrigation and groundwater pumping have altered the

chemistry and flow of groundwater and led to the leaching of uranium from shallow sediments especially if irrigation water is high in bicarbonate (Jurgens *et al.*, 2010).

3.3.3.6 COCs Exceeding the California Secondary (Upper) MCLs (Aesthetics-Based Standards)

There are 4 COCs identified in the Kaweah Subbasin that exceeded their respective California Secondary (upper) MCL (SMCL). Below is a brief description of each COC as it relates to the water quality objective based on SMCLs for drinking water and potential health effects. SMCLs are non-enforceable recommended thresholds intended to address aesthetic and cosmetic effects, such as taste, odor, and staining, rather than direct health risks. States and public water systems may establish higher or lower SMCL in consideration of local conditions.

3.3.3.6.1 Chloride

Chloride is a common ion found in groundwater and surface water, often resulting from natural sources, agricultural runoff, or industrial discharges. The Basin Plan includes a water quality objective for chloride through the incorporation of the SMCLs. When evaluating ambient groundwater conditions, long-term averaging periods are appropriate. The SMCL for chloride in California is set at 250 mg/L (low threshold), 500 mg/L (upper threshold) and 600 mg/L (short-term), in drinking water. While chloride itself is not typically harmful at concentrations found in drinking water, high levels can lead to a salty taste, corrosion of plumbing, and potential damage to crops when used for irrigation.

3.3.3.6.2 Specific Conductivity

Specific conductivity, also known as electrical conductivity (EC), is a measure of the water's ability to conduct electricity, which correlates with the concentration of dissolved salts or ions in the water. The Basin Plan includes a water quality objective for specific conductivity through the incorporation of the SMCLs. When evaluating ambient groundwater conditions, long-term averaging periods are appropriate. In California, specific conductivity is regulated under the state's SMCL, which like chloride is a guideline intended to address aesthetic effects rather than health risks. The SMCL for specific conductivity in California is set at 900 $\mu\text{S}/\text{cm}$ (microsiemens per centimeter), with an upper recommended level of 1,600 $\mu\text{S}/\text{cm}$ and a short-term limit of 2,200 $\mu\text{S}/\text{cm}$. High specific conductivity indicates elevated levels of dissolved salts, which can affect the taste of drinking water, contribute to the corrosion of pipes and pose challenges for water treatment processes. For agricultural uses, high conductivity levels can lead to soil salinity, negatively impacting crop growth and soil structure.

3.3.3.6.3 Sulfate

Sulfates are naturally in groundwater and present in rocks, minerals, soils, waters, and foods. Commercial uses include mining, metal works, waste treatment, leather processing, and in manufacturing chemicals such as dyes, glass, paper, soaps, fertilizers, and pesticides. Health concerns regarding sulfate in drinking water have been raised because of reports of unpleasant gastrointestinal episodes that may be associated with the ingestion of water containing high levels of sulfate. Sulfate in drinking water has a SMCL of 250 mg/L (recommended), 500 mg/L (upper). Total Dissolved Solids (TDS)

Total dissolved solids are suspended and settleable solids in surface water and groundwater. TDS in groundwater can naturally occur from mineral dissolution and soil erosion or occur from anthropogenic sources like wastewaters, fertilizers, and industrial discharge. High levels of TDS are associated with scaling on plumbing systems and unpleasant taste in drinking water. Levels of total solids that are too high or too low can also reduce the efficiency of wastewater treatment plants, as well as the operation of industrial processes that use raw water (EPA, 2012). Concentrations of dissolved solids in water can be so high that the water is unsuitable for drinking, irrigation, or other uses. The SMCL for TDS in drinking water is 500 mg/L (lower), 1,000 mg/L (upper) and 1,500 mg/L (short-term). State Water Board Resolution No. 88-63, Sources of Drinking Water Policy as described in Section 5.1 of the Basin Plan discusses the criteria for exceptions from MUN water supply, which is that if TDS concentrations exceed 3,000 mg/L – it is not reasonably expected that the groundwater would supply a public water system. Irrigation can increase concentrations of dissolved solids in groundwater in several ways, particularly in arid regions. When irrigation water evaporates or is taken up by plants, it leaves behind the dissolved salts it contained in the soil. Excess irrigation water can flush minerals that have accumulated over thousands of years in soils and the unsaturated zone down to the water table. TDS in groundwater has increased on average by about 100 mg/L in many parts of the San Joaquin Valley over the last 100 years (Hansen *et al.*, 2018) (Figure 3-13). Inverse geochemical modeling indicated that weathering of primary silicate minerals to bicarbonate accounted for most of the increase in TDS concentrations during the agricultural growing season. Contributing more than nitrate from fertilizers and sulfate from soil amendments combined. Increases in bicarbonate, nitrate, and sulfate in recharge were the main contributors to increased TDS (Hansen *et al.*, 2018).

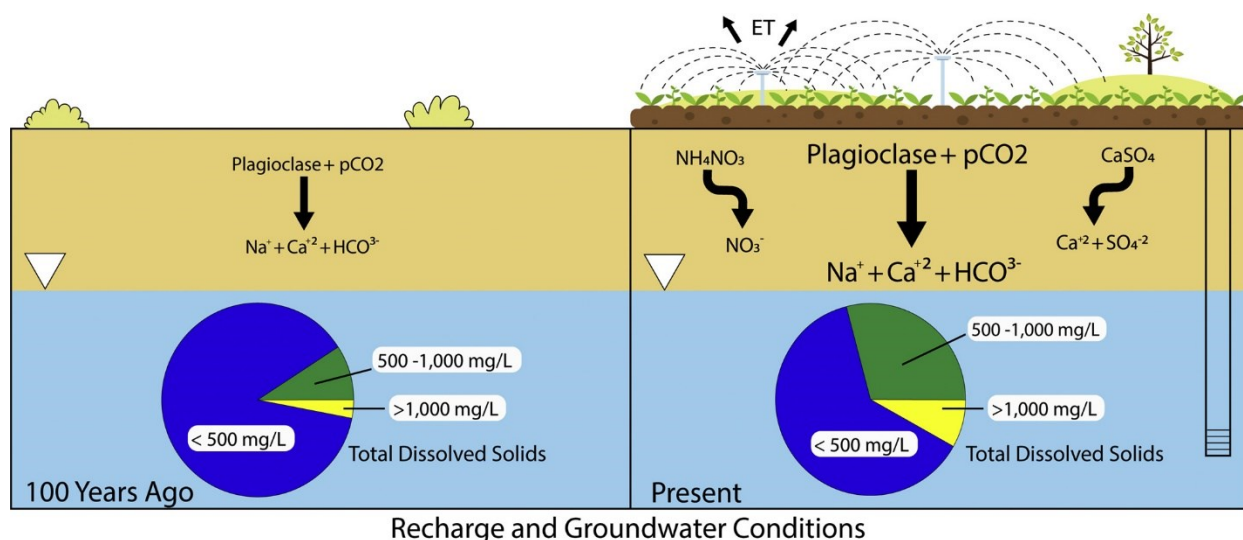


Figure 3-13. San Joaquin Valley Recharge and Groundwater Conditions Over 100 Years (Hansen *et al.*, 2018)

3.3.3.7 COC Exceeding the U.S. EPA Secondary MCL (Aesthetics-Based Standards)

pH is the one COC identified in the Subbasin that exceeded the U.S. EPA Secondary MCL. Below is a brief description of it as it relates to the drinking water standard and potential health effects.

pH is the measure of how acidic or basic (alkaline) water is, on a scale ranging from 0 to 14, with 7 being neutral (EPA, 2024). The EPA has established an SMCL for pH, recommending that drinking water have a pH between 6.5 and 8.5 to avoid problems such as pipe corrosion, scaling, and the ineffective disinfection of water. Like California's SMCLs, the EPA SMCLs are non-enforceable guidelines intended to manage aesthetic and operational issues rather than direct health risks. pH can change because of external inputs (anthropogenic or natural) and can cause mobilization, adsorption and desorption of constituents and radioactive decay of elements. The regulation of pH as a secondary water quality parameter has been included in the EPA guidelines since the establishment of the Safe Water Drinking Act in 1974.

3.3.3.8 COCs Above Recommended Agricultural Water Quality Goals

There are 2 COCs identified in the Kaweah Subbasin that are based on agricultural suitability standards and are referred to by the GSAs as Agricultural Water Quality (AgWQ) Goals. Below is a brief description of each COC as it relates to the water quality goal and health and health effects.

3.3.3.8.1 Boron

Boron is a naturally occurring element found in groundwater that can have implications for crops. In agriculture, boron is an essential micronutrient for plant growth, but its concentrations for sensitive crops concentrations above 0.2 mg/L can be harmful, with 1 to 2 mg/L being toxic (Ayers & Westcot, 1985). Consequently, water quality goals for agriculture often emphasize maintaining boron concentrations within a narrow range to avoid adverse crop effects. The Basin Plan includes a water quality goal for boron of 700 µg/L (0.7 mg/L). The GSA established the AgWQ threshold lower than the California notification level for boron at 1,000 µg/L (1 mg/L). When evaluating ambient groundwater conditions, long-term averaging periods are appropriate.

3.3.3.8.2 Sodium

Sodium is a naturally occurring element found in groundwater and plays a significant role in an agricultural context. Sodium levels in irrigation water are critical to monitor because excessive sodium can negatively impact soil structure, leading to reduced water infiltration and poor crop growth. Sodium toxicity includes leaf burn, scorch, and dead tissue along leaf edges, progressing inward from older leaves. Sodium toxicity primarily affects sensitive crops like deciduous fruits, nuts, citrus, avocados, and beans. The Basin Plan includes a water quality goal for sodium to emphasize maintaining low sodium levels prevent adverse effects to plant health, with a specific threshold value of 69 mg/L.

3.3.3.9 Historical Groundwater Quality Conditions (Pre-SGMA)

The baseline groundwater quality conditions for the Kaweah Subbasin, prior to the implementation of SGMA in 2015, were analyzed for the decade spanning 2005 to 2014. To depict these conditions, the maximum and median concentrations of various COCs were mapped for each well location in the GAMA dataset (Appendix 3B). The highest median concentrations of a COC reported is the median concentrations from each well with 4 or more samples. Additionally, the percentage of MCL exceedance by well was represented using proportional circles. The MCL exceedance percentage for a given well location and COC was calculated by dividing the number of samples exceeding the MCL by the total number of samples taken for that well location and COC.

The results and supporting maps are available in Appendix 3B and summarized in Table 3-4. The maps in Appendix 3B provide a visual representation of areas of concern, highlighting spatial patterns in groundwater quality and identifying specific locations where COCs may pose a significant risk to groundwater quality.

3.3.3.10 Historical Groundwater Quality Trend Analysis (Pre-SGMA)

Groundwater quality data spanning from 2005 to 2014, the decade prior to SGMA implementation, was evaluated to determine concentration trends for COCs present in the Subbasin using the Mann-Kendall test, an industry standard for non-parametric trend detection (Helsel, 2012; Helsel *et al.*, 2020). This test is advantageous because it does not require regularly spaced sampling intervals, is unaffected by missing time periods, avoids the need for data substitution when non-detects are present, and does not assume a specific data distribution. The Mann-Kendall test assesses whether a dataset exhibits a monotonic trend (increasing or decreasing) at a selected significance level. For this analysis, a significance level of 0.05 (i.e., a confidence level of 95%) was chosen.

Key statistics reported from the Mann-Kendall test include the p-value and the S statistic. The p-value indicates the statistical significance of the detected trend, with values less than 0.05 suggesting a significant trend and values greater than 0.05 indicating no statistical significance. The S statistic represents the difference between the number of increasing and decreasing data pairs: a positive S suggests an upward trend, a negative S indicates a downward trend, and an S close to zero implies no discernible trend. The results and supporting maps are available in Appendix 3B.

3.3.3.11 Current Groundwater Quality Conditions (Post-SGMA Enaction)

The groundwater quality conditions for the Kaweah Subbasin, following the implementation of SGMA in 2015, were analyzed for the decade spanning 2015 to 2024. The same process used for the pre-SGMA dataset was applied to depict these conditions: maximum and median concentrations of COCs were mapped spatially for each well location using the GAMA dataset. The highest median concentrations of a COC reported are not the median concentrations from all wells but are the median concentrations from each well with 4 or more samples. Additionally, the percentage of MCL exceedances was visualized through proportional circles, with the exceedance percentages calculated by dividing the number of samples exceeding the MCL by the total number of samples taken at each well location for the respective COC. The resulting maps for each COC are described in detail and supplemented with maps in Appendix 3B and summarized in Table 3-4.

3.3.3.12 Current Groundwater Quality Trend Analysis

Groundwater quality data spanning from 2015 to 2024 was evaluated to determine concentration trends for COCs present in the Subbasin using the Mann-Kendall test described above. The results for the post-SGMA dataset are described in detail and supplemented with maps in Appendix 3B.

Table 3-4. Summary of Groundwater Quality Conditions in the Kaweah Subbasin

Constituent	Naturally Occurring	Anthropogenic	Minimum Threshold ^{1,2}	Minimum Threshold Units	PRE-SGMA (2005-2015)						POST-SGMA (2015-2024)							
					Maximum Concentration Range		Median Concentration Range		Locations of Max Exceedances		Maximum Concentration Range		Median Concentration Range		Locations of Max Exceedances			
					Min	Max	Min	Max	EKGSa	MKGSa	GKGSa	Min	Max	Min	Max	EKGSa	MKGSa	GKGSa
1,2,3-TCP		X	0.005	mg/L	ND	0.8	ND	0.08	X	X	X	ND	0.28	ND	0.166	X	X	X
1,2-DBCP		X	0.2	mg/L	ND	1.01	ND	0.33	X	X	X	ND	0.29	ND	0.14		X	X
Arsenic	X	X	10	mg/L	0.11	100	0.6	23		X	X	0.25	100	1.15	88	X	X	X
Boron	X	X	0.7	mg/L	ND	48.4	0.0125	0.05005		X	X	ND	0.851	ND	ND		X	
Chloride		X	500	mg/L	ND	1600	2.3	700	X			0.982	1300	2.4	1050	X		X
Gross Alpha	X	X	15	pCi/L	0.25	58	0.4	37.25	X	X	X	0.513	39.8	0.856	26.45		X	X
Hexavalent Chromium	X	X	10	mg/L	ND	11	ND	2.2	X			ND	21	ND	12	X		X
Nitrate as N	X	X	10	mg/L	ND	510	0.1	59.5	X	X	X	ND	88	ND	58	X	X	X
Perchlorate	X	X	6	mg/L	ND	13	ND	11	X		X	ND	13	2	9.7	X		X
pH	X	X	8.5		6.26	9.9	6.8	9.4	X	X	X	6.9	12.7	7.2	9.1		X	X
Sodium	X	X	69	mg/L	2.96	500	4.725	220	X	X	X	5.46	390	8.9	320	X	X	X
Specific Conductivity	X	X	1600	mS/cm	2.38	5100	130	2500	X		X	109	4000	140	3650	X		X
Sulfate	X	X	500	mg/L	ND	4600	2.2	328			X	ND	190	1.1	160	-	-	-
Tetrachloroethene (PCE)		X	5	mg/L	0.017	270	ND	49	X	X	X	0.022	92	0.39	6.595		X	
Total Dissolved Solids (TDS)	X	X	1000	mg/L	5.52	3900	84.5	1500	X		X	72.9	2800	94	2500	X		X
Uranium	X	X	20	pCi/L	0.0459	56	0.501	37		X	X	0.0351	303	0.875	23		X	X

Notes:

¹Minimum threshold is equivalent to measurable objective and interim milestone. More details on this is available in Chapter 5.

² Sustainable Management Criteria (minimum threshold, measurable objective, and interim milestone) are based on drinking water standards (Title 22/Basin Plan), with the exception of boron and sodium based on the agricultural suitability goal

3.3.4 Interconnected Surface Water

Interconnected surface water (ISW) refers to 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 (Title 23 California Code of Regulations § 351[o]). Figure 3-14 shows a schematic of groundwater surface-water interactions under different surface water and groundwater conditions. Whether a river reach receives water from the aquifer (gaining reach) or loses water to the aquifer (losing reach) depends on the relationship between the water level in the stream and the groundwater level in the nearby aquifer. Surface water elevations in gaining reaches are below groundwater levels, allowing groundwater to discharge into the stream (top left diagram on Figure 3-14). Conversely, surface water levels in losing reaches are above the groundwater levels in the underlying aquifer; and, consequently, the water in the stream infiltrates into the aquifer, as shown in the top right and bottom diagrams of Figure 3-14. If a continuous unsaturated zone exists underneath the stream bottom (typically when the groundwater table is below the stream bottom), then the stream is *not* interconnected (i.e. the aquifer is hydraulically disconnected from the surface water). In disconnected sections of the stream infiltration rates from the stream to the groundwater system are *independent* of groundwater levels or pumping (bottom left diagram on Figure 3-14). The interconnection and corresponding depletions can be highly transient under dynamic flow and groundwater conditions. Hence, different stream sections can be interconnected or disconnected, and depletions vary over time.

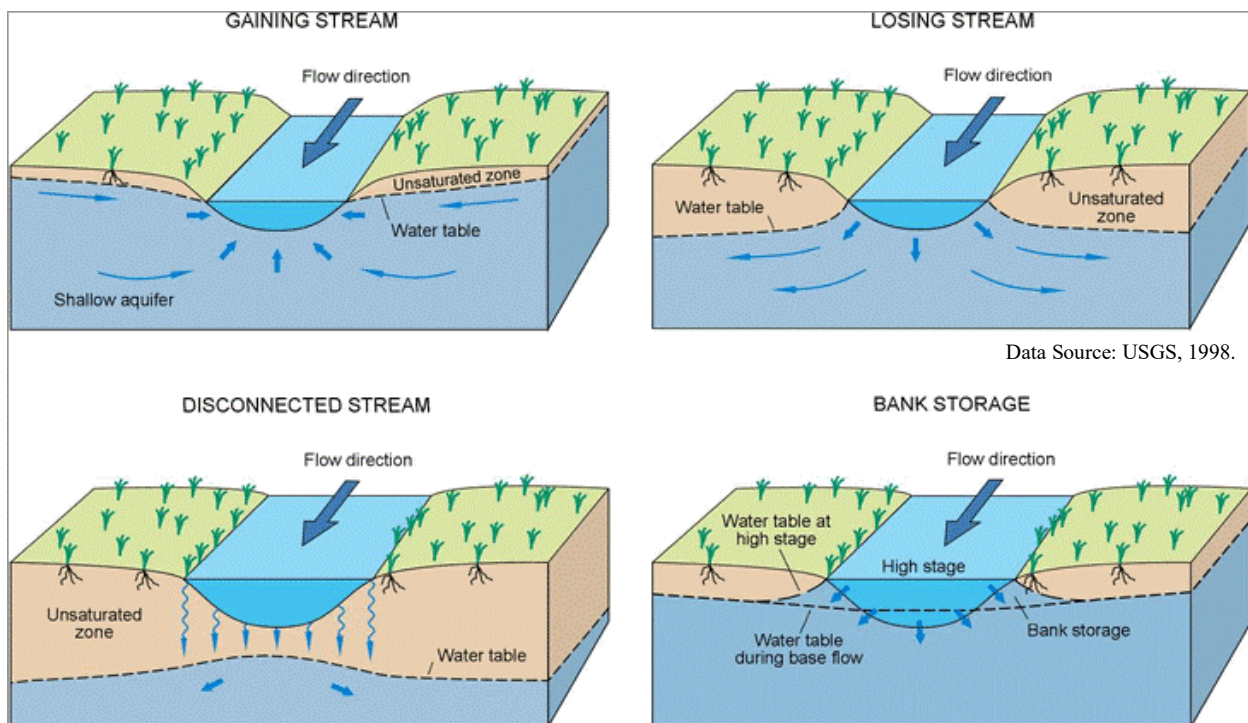


Figure 3-14. Schematic of Interconnected Surface Water Under Various Groundwater Conditions

The MKGSA jurisdictional area is located on the valley floor portion of the Subbasin, many miles west of the aquifer forebay area along the Sierra foothills. As such, all natural and man-made reaches of the Kaweah River, slough channels, and distributaries have been disconnected from the underlying water table for many decades as depicted in the bottom left diagram on Figure 3-14.

Figure 3-15 shows the depth to groundwater in the upper principal aquifer for the spring of 2017, which is both a relatively recent and very wet year. Depth to water in the upper principal aquifer is approximately 60-80 feet below ground north and northeast of the City of Visalia near the St. Johns River. Depth to groundwater is greatest in the southwest area of the MKGSA at 200 feet. Based on information provided on Figure 3-2 and Figure 3-15, the MKGSA does not have interconnected surface water (ISW). Since surface water is disconnected from groundwater, water in the unsaturated zone above the upper principal aquifer is due to recharge from precipitation and indirect recharge under streams and irrigation ditches in the MKGSA. Therefore, any species present along the surface water features in MKGSA do not require access to groundwater for survival, but instead are accessing surface water for their survival and the surface water is contingent upon surface water deliveries.

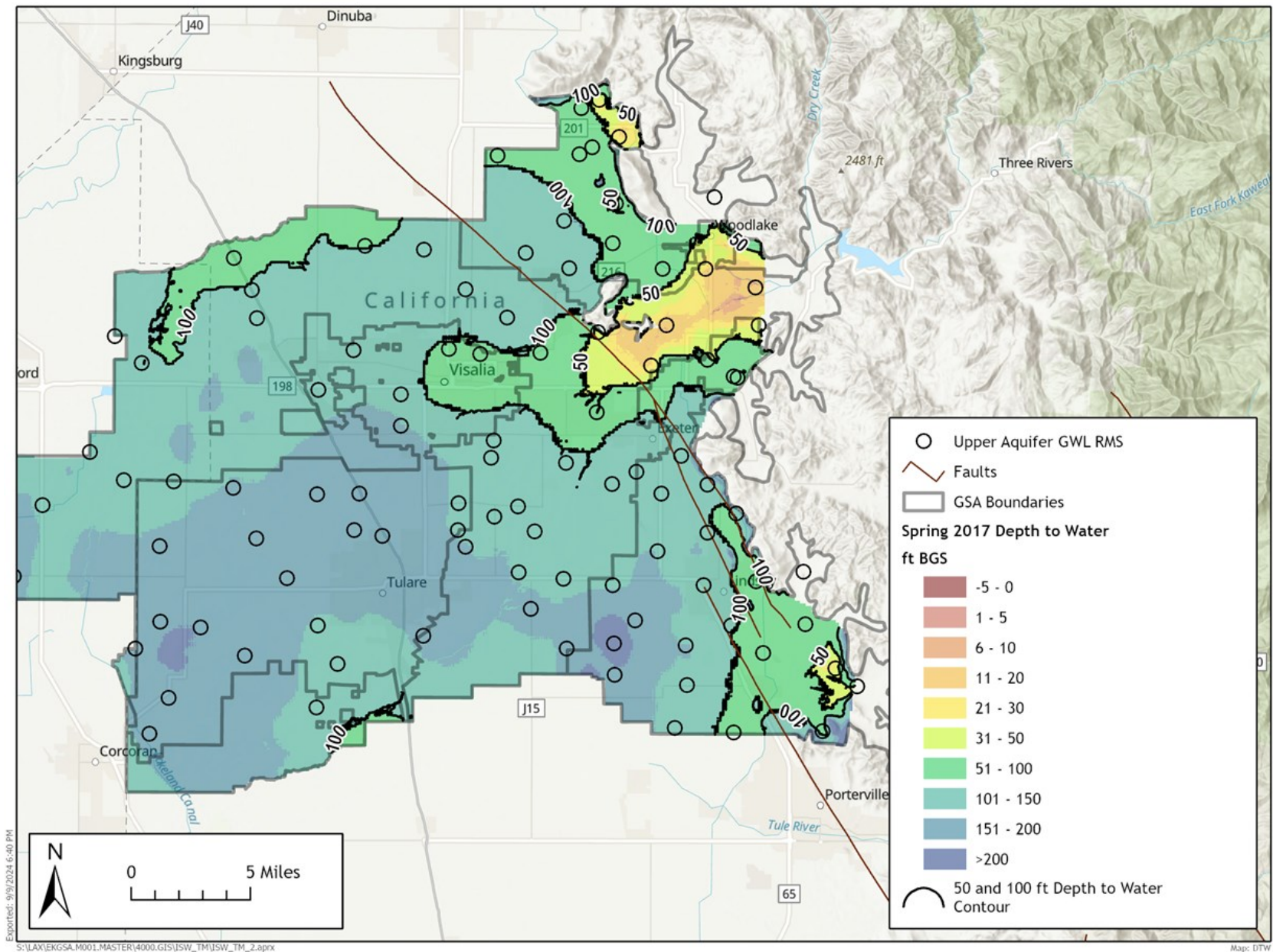


Figure 3-15: Spring 2017 Depth to Water in the Kaweah Subbasin

3.4 Water Budgets

§354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

- (a) One or more maps of the basin that depict the following, as applicable:
 - (1) The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.
 - (2) Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.

This section summarizes the estimated water budgets for the Subbasin, including information required by the GSP Regulations and other information supporting development of an effective sustainability plan. In accordance with the GSP Regulations §354.18, the water budget provides an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the Subbasin and the change in the volume of groundwater in storage, including under historical, current, and projected water budget conditions. Water budgets are reported in tabular formats, where applicable.

3.4.1 Overview of Water Budget Development

The GSP Regulations require the development of a subbasin-wide groundwater budget and a subbasin-wide surface water budget. In agricultural areas such as the Kaweah Subbasin, a land surface budget is an additional useful element to review to assess changes in water demands over time and evaluate the water demand versus water supply balance due to climatic variations and land use changes.

The water budget descriptions are divided into 3 subsections: (1) historical water budgets, (2) current water budgets, and (3) projected water budgets, with a groundwater budget and land surface budget presented within each. All subsections are described with a summary of key observations of trends over time and relative contribution to the water budget by different components, to emphasize what portions of the water budget have the most and least influence on the Subbasin's water resource conditions. A table summarizing the amount of water contributed by each component is provided on an annual basis. Each subsection follows the same format.

Water budgets are developed using the calibrated Kaweah Subbasin groundwater flow model constructed with version 2.3 of the MODFLOW-OWHM code (Boyce *et al.*, 2020). This code is a version of the USGS groundwater flow code MODFLOW that estimates agricultural supply and demand through the Farm Process. The model was developed in cooperation with Stanford University and includes best available data and science, such as AEM data collected across the Subbasin in 2018 and 2019. A report of model refinements implemented for this GSP revision is provided In Appendix 3C.

Before presenting the water budgets, a brief overview of the Subbasin's inflows and outflows is provided.

3.4.1.1 Water Budget Area and Components

The water budget is an inventory of surface water and groundwater flows into and out of the Subbasin. Some water budget components can be measured, such as streamflow at a gaging station or municipal groundwater pumping from a metered well. Other components of the water budget are simulated by the model such as recharge from precipitation, agricultural groundwater pumping which is unmetered, and change of groundwater in storage. The change of groundwater in storage is calculated by the model from simulated inflows minus outflows and is associated with a change in groundwater levels.

The Kaweah Subbasin is bounded on its northern, southern, and western extents by surrounding subbasins. The eastern extent is bounded by the base of the Sierra Nevada Mountain range near Sequoia National Park. The Subbasin's vertical boundary is defined by the bedrock or the bottom of the freshwater base.

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

- Lateral: The perimeter of the Kaweah Subbasin in addition to an approximately 3-mile buffer region that extends into nearby Tule, Tulare Lake, and Kings Subbasins
- Bottom: The base of the model
- Top: Above the ground surface, to the extent that surface water is included in the water budget

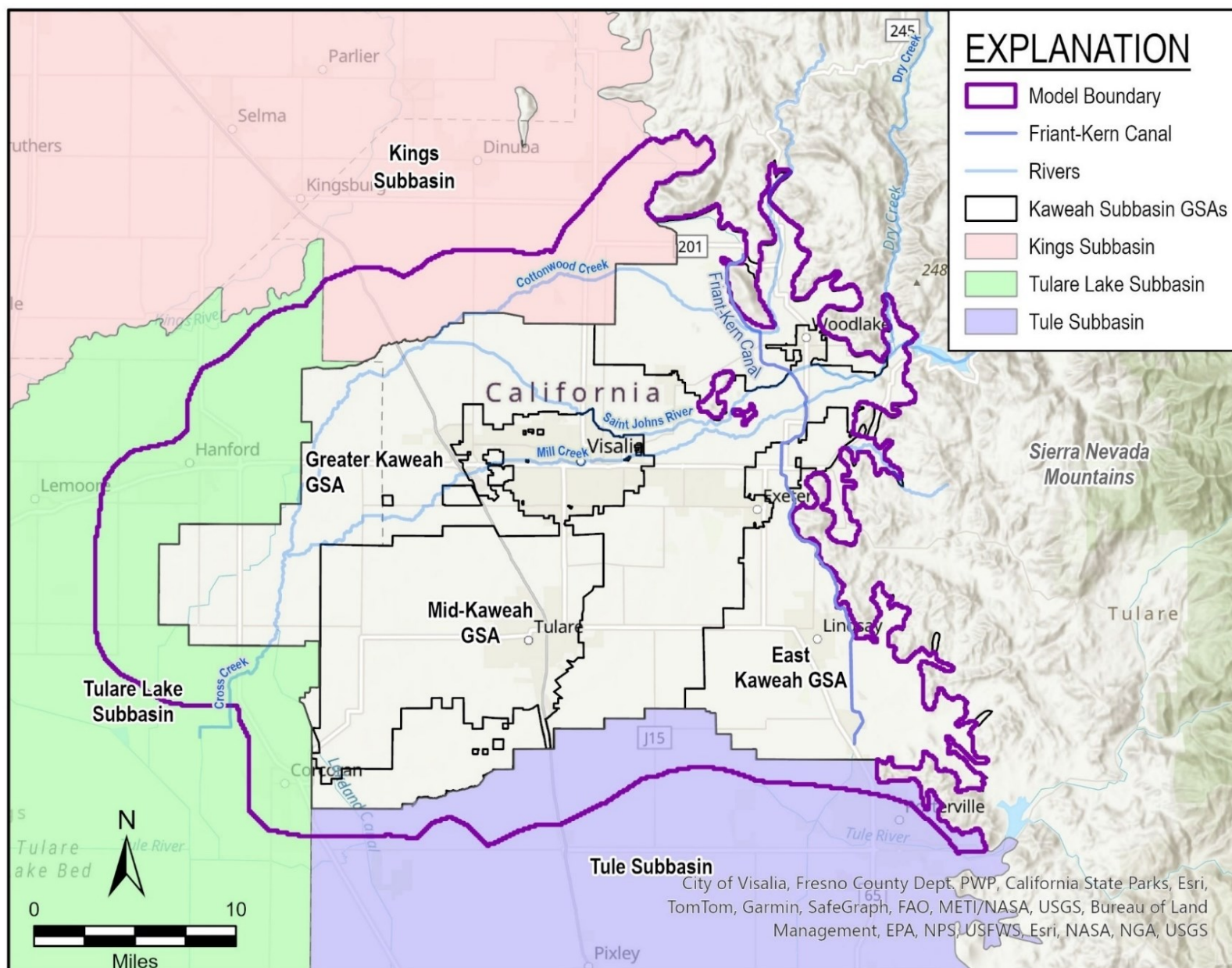
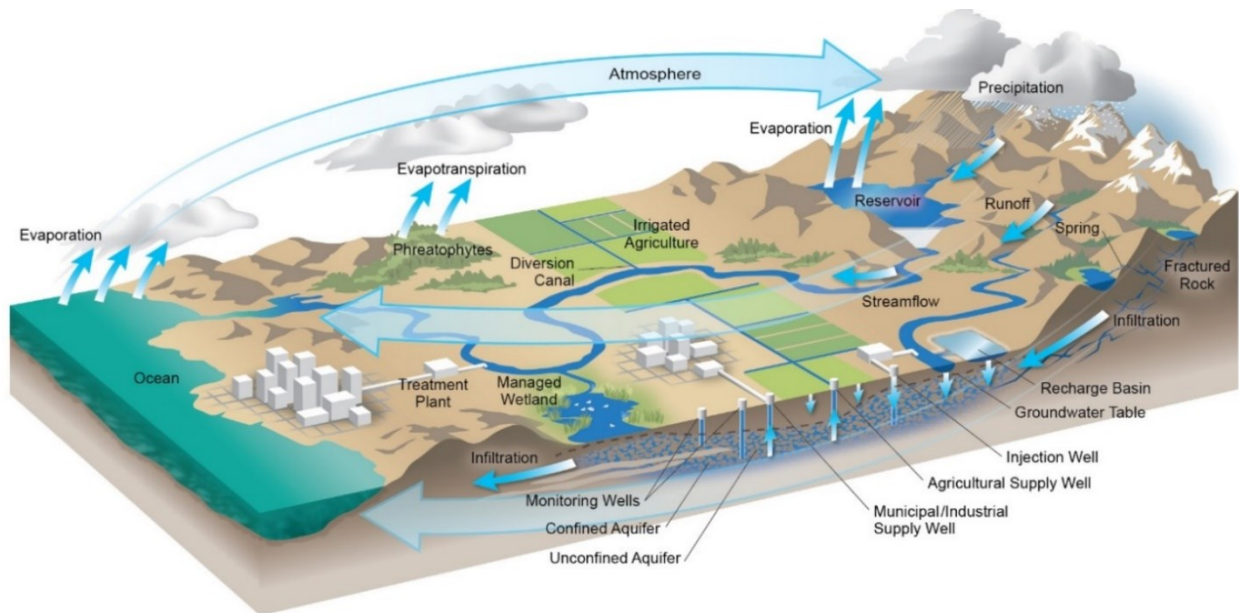


Figure 3-16. Kaweah Subbasin Water Budget Area

Figure 3-17 presents the general schematic diagram of the hydrologic cycle that is included in the water budget BMP (DWR, 2016c). Not all components represented in this graphic apply to the Kaweah Subbasin; specific components relevant to this GSP are presented in the subsections below.



(DWR, 2016c)

Figure 3-17. Schematic Hydrologic Cycle

The subsections below describe the Subbasin water budgets including the simulated inflow and outflow components.

3.4.1.1.1 Groundwater Budget Components

The groundwater budget represents the Subbasin's flow below the unsaturated zone and is developed by extracting groundwater budget components from the model over the Kaweah Subbasin zone budget area for the Kaweah Subbasin and each of the GSAs within the Subbasin (Figure 3-16). Evaluation of the groundwater budget provides an understanding of subbasin-wide trends in groundwater use, flows between subbasins, and groundwater-surface water connection.

Groundwater budget components applicable in the Subbasin are summarized below and illustrated on Figure 3-18.

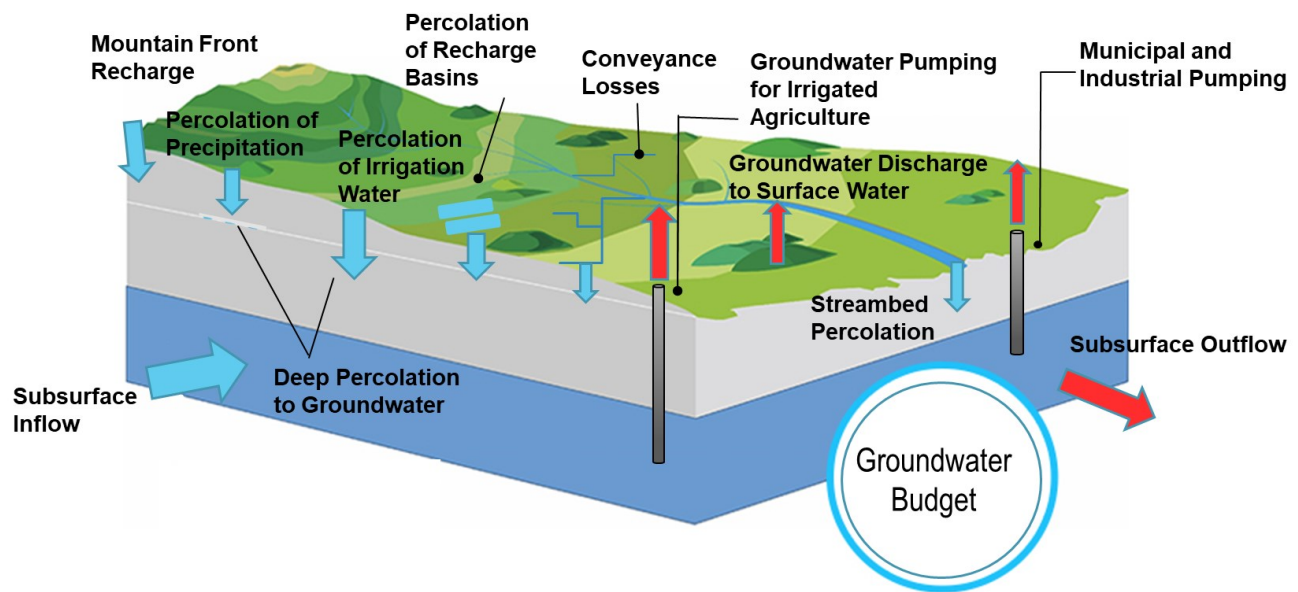


Figure 3-18. Illustration of Groundwater Budget Components

Groundwater Inflows:

- **Subsurface Inflow** – Subsurface inflow consists of inter-aquifer flow from neighboring Subbasins into the Kaweah Subbasin.
- **Streambed Percolation** – Streambed percolation consists of flow which percolates to groundwater from stream channels (natural channels). This is simulated in the model using the streamflow routing (SFR) package.
- **Conveyance Losses** – Conveyance losses consists of flow which percolates to groundwater from unlined canals and ditches (mainly manmade channels). Canal and ditch leakage is simulated as recharge to groundwater along unlined canals and ditches.
- **Mountain Front Recharge** – Mountain front recharge occurs on the eastern boundary from the Sierra Nevada Mountain range. The amount of mountain front recharge is based on estimates from other regional models and includes overland flow that becomes recharge as well as mountain block recharge from the crystalline bedrock into the shallow aquifer. Conveyance losses and mountain front recharge are grouped together in the water budget because they are simulated in the groundwater flow model's recharge package together.
- **Percolation of Recharge Basins** – Recharge basin percolation includes recharge from both surface water sources and wastewater treatment plant effluent.
- **Deep Percolation to Groundwater** – Deep percolation to groundwater includes percolation of irrigation water and percolation of precipitation, where:

- **Percolation of Irrigation Water** – Percolation of irrigation water includes recharge from irrigation water applied at surface that percolates to groundwater in the saturated zone. This also includes deep percolation from excess irrigation.
- **Percolation of Precipitation** – Percolation from precipitation consists of recharge from precipitation applied at surface that percolates to groundwater in the saturated zone.

Groundwater Outflows:

- **Subsurface Outflow** – Subsurface outflow consists of inter-aquifer flow from the Kaweah Subbasin to neighboring Subbasins
- **Municipal and Industrial Groundwater Pumping** – Pumping from municipal and industrial entities includes groundwater extracted from wells for urban use, small public water systems, dairies, nurseries, rural domestic, and golf courses.
- **Groundwater Pumping for Irrigated Agriculture** – This includes groundwater extracted from wells for use in agricultural irrigation.
- **Groundwater Discharge to Surface Water** – Groundwater discharge to surface water includes flow that discharges from groundwater into Kaweah River system channels.

The difference between groundwater inflows and outflows is equal to the change in storage. Total change in storage comprises the sum of aquifer and aquitard change in storage. Aquifer storage change is primarily referenced for comparison purposes in the text of this document, but both aquifer and aquitard storage are presented in associated tables.

3.4.1.1.2 Land Surface Budget Components

The land surface budget simulates the Subbasin's land surface system composed of the soil/land surface, root zone, and unsaturated zone. The land surface budget is developed by extracting land surface budget components from the historical model over the Kaweah Subbasin zone budget area for the Kaweah Subbasin and each of the GSAs within the Subbasin area (Figure 3-16). Evaluation of the land surface budget lends insight into trends in land and water use and the responsiveness of the surficial hydrologic system to inter-annual changes in precipitation.

Land surface budget components applicable in the Subbasin are summarized below and illustrated on Figure 3-19.

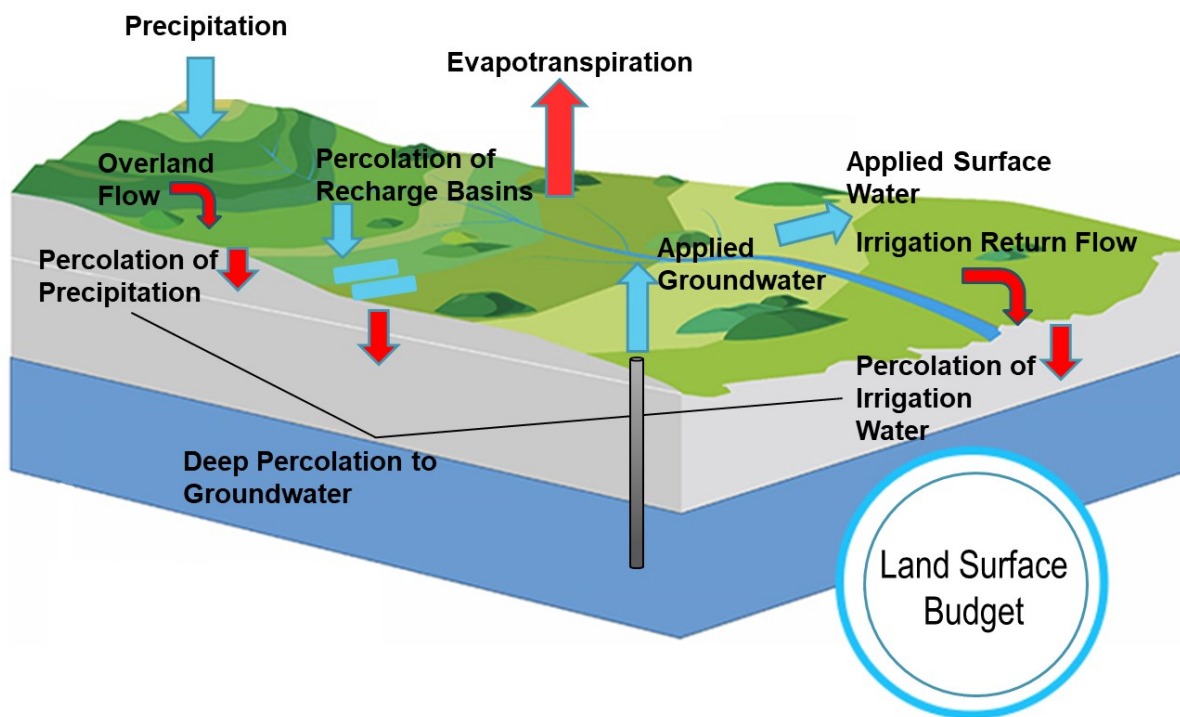


Figure 3-19. Illustration of Land Surface Budget Components

Land Surface Inflows:

- **Precipitation** - All precipitation that falls within the Subbasin
- **Applied Groundwater** - Water that is extracted from groundwater and applied to crops in the Subbasin
- **Applied Surface Water** - Water that is diverted from surface water bodies and canals (Kaweah River system and the Friant Kern Canal) and applied to crops in the Subbasin. This also includes treated wastewater from municipal Wastewater Treatment Plants (WWTPs) that is delivered for agricultural use.
- **Percolation of Recharge Basins** – Artificial recharge basins receive surface water, which percolates directly to groundwater. Surface water sources to recharge basins are from the Kaweah River diversions, the Friant Kern canal, and WWTP effluent diversions.

Land Surface Outflows:

- **Deep Percolation to Groundwater** – Deep percolation to groundwater includes percolation of irrigation water and percolation of precipitation.
- **Percolation of Irrigation Water** – Percolation of irrigation water is water recharged from applied surface water and applied groundwater that percolates to groundwater in the saturated zone. This also includes recharge from excess irrigation.
- **Percolation of Precipitation** – Percolation from precipitation consists of recharge from precipitation applied at surface that percolates to groundwater in the saturated zone.
- **Evapotranspiration** – Evapotranspiration includes water transpired by crops and native vegetation or evaporated into the atmosphere.
- **Percolation of Recharge Basins** - Artificial recharge basins receive surface water, which percolates directly to groundwater. Surface water sources to recharge basins are from the Kaweah River diversions, the Friant Kern Canal, and WWTP effluent diversions.
- **Overland Flow** – Overland flow includes precipitation runoff, which is assumed to recharge due to the low slope profile of the basin; therefore, this term is reported together with percolation from precipitation.
- **Irrigation Return Flow** - Applied agricultural water that runs off the land surface into surface water bodies; all tail water is assumed to recharge and therefore this is accounted for in the water budgets as percolation from irrigation water.

The difference between land surface inflows and outflows is equal to the change in storage.

3.4.1.1.3 Surface Water Budget Components

A Subbasin-wide surface water budget encompassing the surface water within the Subbasin is required in the GSP Regulations. The surface water budget is developed by extracting surface water budget components from model outputs for the Kaweah River System.

The Kaweah River splits at McKay Point, with the Upper Kaweah River upstream and the Lower Kaweah River and the St. Johns River splitting downstream. The St. Johns River converges with Cottonwood Creek and then feeds into Cross Creek. The Lower Kaweah River connects to Mill Creek and feeds into Cross Creek. Surface water diversions to agricultural lands occur along the Kaweah River System and only a small amount of water from the Kaweah River System leaves the Subbasin, usually during wet years. The Friant Kern Canal also brings in a substantial amount of imported surface water to the Subbasin which is diverted to the Kaweah River System and various agricultural districts in East Kaweah and Mid-Kaweah. Direct diversions off of the

Friant Kern Canal to irrigation districts, which are not conveyed through the Kaweah River System, are not included as part of the natural stream feature surface water budget.

Evaluation of the surface water budget increases understanding of Subbasin-wide trends in groundwater-surface water connection, surface water use from local water sources, and the responsiveness of the surface water system to historical climatic variation.

Surface water budget components applicable in the Subbasin are summarized below.

Surface Water Inflows:

- **Kaweah River Upstream Inflow** - Surface water inflow to Kaweah River from below Terminus Dam
- **Friant Kern Canal** - Surface water inflow from the Friant Kern Canal to the Kaweah River and St. Johns River
- **Small Tributaries** - Surface water inflow from minor streams outside of the Subbasin into the Subbasin's streams, which includes Dry Creek and Cottonwood Creek to the Kaweah River system. Other creeks such as Antelope Creek and Lewis Creek are not included due to flow data not being available, but there are plans to include them in the near future when the Model is updated to better simulate ISW.
- **Groundwater Discharge** - Flow that discharges from groundwater into the Kaweah River system and the component of groundwater-surface water interaction where groundwater enters a stream under gaining conditions. This occurs upstream of McKay Point where bedrock is shallow.

Surface Water Outflows:

- **Kaweah River Outflow** - Surface water outflow from the Subbasin to Tulare Lake Subbasin via Cross Creek
- **Surface Water Diversions** - Water that is diverted from surface water bodies and applied to crops in the Subbasin
- **Streambed Percolation** - Flow that percolates down to groundwater from stream channels, also known as seepage from streambed. The component of groundwater-surface water interaction where streamflow percolates down to groundwater under losing conditions.
- **Riparian Evapotranspiration** – Evapotranspiration of surface water by plants along riparian corridor. This component was not explicitly modeled and assumed to be minimal.

3.4.1.2 Model Assumptions and Limitations for Water Budget Development

Data sources and limitations for the water budget components described above are presented in Table 3-5. The level of accuracy and certainty varies between water budget components, depending largely on the quality of model input data or available calibration data. Water budget uncertainty may be reduced over time as GSP monitoring programs are implemented and the resulting data are used to check and improve the modeling tools and resulting water budgets. Incorporating locally refined water budget information may also increase model simulation accuracy.

3.4.1.3 Water Budget Timeframes

The GSP Regulations require water budgets for 3 timeframes representing historical conditions, current conditions, and projected conditions. Although significant seasonal variation is simulated by the model, which operates on a monthly timestep, the GSP does not consider seasonal water budgets. All water budgets are developed for complete water years (WY).

In accordance with the GSP Regulation 23 CCR §354.18(c), the GSP quantifies a current, historical, and projected water budget for the Subbasin, as follows:

- The historical water budget is intended to evaluate how past water supply availability has affected aquifer conditions and the ability of groundwater users to operate sustainably. GSP Regulations require that the historical water budget include at least the most recent 10 years of water budget information (depending on data availability).
- The current water budget is intended to allow the GSAs and DWR to understand the existing supply, demand, and change in storage under the most recently available population, land use, and hydrologic conditions.
- The projected water budgets are intended to quantify the estimated future baseline conditions without implementation of GSP projects and management actions. Since overdraft currently exists in the Subbasin, a projected water budget without implementation of GSP projects and management actions would clearly result in ongoing overdraft and worsening conditions. Demand management and managed aquifer recharge are key to halting overdraft and associated land subsidence. The projected water budget therefore includes projects and management actions to demonstrate what is needed to achieve sustainability. The projected water budgets estimate conditions concerning hydrology, water demand, and surface water supply over a 50-year planning and implementation horizon. Historical trends in hydrologic conditions are used to project 50 years forward while considering projected climate change assumptions and projects and management actions by the GSAs. Figure 3-20 summarizes the 3 timeframes for the water budgets developed for this GSP.

Table 3-5. Water Budget Components Data Sources and Limitations

Water Budget Component	Source of Model Input Data	Limitations
Land Surface Inflows		
Direct Precipitation	Historical precipitation data as provided by the AN81m/AN91m dataset from the PRISM	Precipitation is summarized over model element areas and may therefore not capture all variation over the element area.
Applied Groundwater	Simulated using land use water demands and surface water applications	Groundwater pumping is estimated from remaining crop water demand after natural sources and surface water deliveries are exhausted. Crop water demand estimates are developed at an model cell scale from estimated evapotranspiration data, irrigation methods, and soil type.
Applied Surface Water	Historical surface water diversion and delivery data	Derived from available historical records which are not always complete. Partitioning diversions to farm deliveries and losses is estimated.
Percolation of Recharge Basins	Historical recharge basin delivery data from surface water and WWTP effluent	Derived from available historical records which are not always complete.
Land Surface Outflows		
Percolation of Irrigation Water	Simulated by model	Estimated, limited data for calibration
Percolation of Precipitation	Simulated by model	Estimated, limited data for calibration
Evapotranspiration	Used estimated evapotranspiration arrays from Davids Engineering (simulated via soil water balance), or LandIQ in the Subbasin and OpenET (satellite-based) in the buffer area. Predictive simulations use LandIQ data.	Estimated evapotranspiration may be further limited by water supply in numerical model. Multiple datasets are necessary to cover model domain and simulation period. Inherent differences in estimated evapotranspiration between data sets were reconciled by applying scaling factors based on crop groups to better match the Davids Engineering and OpenET datasets with LandIQ. OWHM has the option to not meet the input ET arrays if it doesn't have enough water, therefore sometimes simulated ET could be less than actual ET.
Percolation of Recharge Basins	Historical recharge basin delivery data from surface water and WWTP effluent	Derived from available historical records which are not always complete.
Overland Flow	Simulated in model as percolation of precipitation	Limited data available
Irrigation Return Flow	Simulated in model as percolation of irrigation water	Limited data available
Surface Water Inflows		
Kaweah River Upstream Inflow	Simulated by model using historical streamflow measurements at stream headwaters	Subject to limitations in available streamflow measurements and estimates of stream inflows from and outflows to adjacent lands. These include diversions, precipitation, evaporation, runoff, return flows, gains from groundwater, and seepage to groundwater.
Friant Kern Canal	Simulated by model using historical gage data	Subject to limitations in available gage measurements.
Small Tributaries	Simulated by model using historical streamflow gage data	Estimated, from limited gauge data for inflows to the Kaweah River system from the ephemeral streams discharging from upstream watersheds bordering the model
Groundwater Discharge	Simulated by model	Estimated, limited data for calibration

Water Budget Component	Source of Model Input Data	Limitations
Surface Water Outflows		
Kaweah River Outflow	Simulated by model using historical streamflow measurements at stream headwaters and simulated surface water diversions and streambed percolation	Subject to limitations in available streamflow measurements and estimates of stream inflows from and outflows to adjacent lands. These include diversions, precipitation, evaporation, runoff, return flows, gains from groundwater, and seepage to groundwater
Surface Water Diversions	Historical surface water diversion and delivery data	Derived from available historical records which are not always complete
Streambed Percolation	Simulated by model	Estimated, limited data for calibration
Riparian Evapotranspiration	Not explicitly modeled	Assumed to be minimal; limited data available
Groundwater Inflows		
Subsurface Inflow	Simulated by model	Subject to uncertainty in simulated heads and aquifer hydraulic properties
Streambed Percolation	Simulated by model	Estimated, limited data for calibration
Conveyance Losses	Historical losses calculated as percentage of surface water diversion data	Subject to limitations of surface water diversions and gage measurements and assumptions of percentage of diversions applied as ditch and canal percolation
Mountain Front Recharge	Estimated based on review of regional models	Estimated, limited data for calibration
Percolation of Recharge Basins	Historical recharge basin data	Subject to limitations of diversion measurements or estimates provided
Percolation of Irrigation Water	Simulated by model	Estimated, limited data for calibration
Percolation of Precipitation	Simulated by model	Estimated, limited data for calibration
Groundwater Outflows		
Subsurface Outflow	Simulated by model	Subject to uncertainty in simulated heads and aquifer hydraulic properties
Municipal and Industrial Pumping	Used metered pumping where available and estimates based on population, service connections, etc. for historical period. Predictive period was simulated using projected urban water demands where available	Municipal pumping data was largely available, however small public water systems, rural domestic, and dairies were estimated. Predictive pumping assumes increased pumping as projected by Urban Water Management Plans, where available.
Groundwater Pumping for Irrigated Agriculture	Simulated using ETa, applied precipitation, and surface water deliveries	Groundwater pumping rates and depths are not derived from measured pumping data. They are estimated from crop acreages, crop water demand estimates and surface water delivery estimates
Groundwater Discharge to Surface Water	Simulated by model	Estimated, limited data for calibration

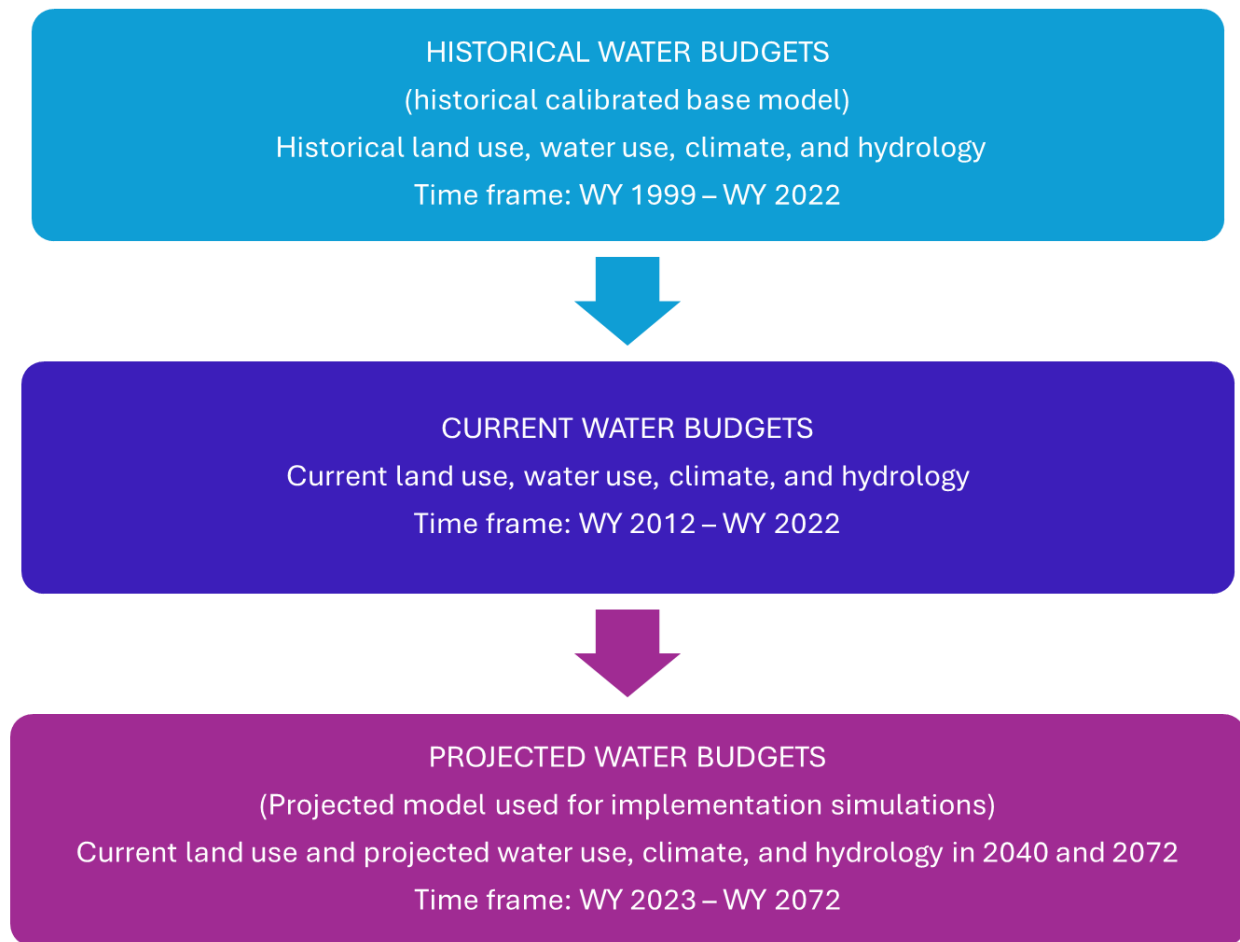


Figure 3-20. Summary of GSP-required Water Budget Time Frames

3.4.1.3.1 Historical Water Budgets

Historical conditions should go back to the most reliable historical data that are available for GSP development and water budget calculations. For this GSP, the historical timeframe is defined as WY 1999-2022 to align with the groundwater flow model period.

3.4.1.3.2 Current Water Budgets

The current water budget provides an understanding of the existing supply, demand, and change in storage under the most recent available population, land use, and hydrologic conditions. For this GSP, the current timeframe is defined as WY 2012-2022.

3.4.1.3.3 Future Projected Water Budgets

The projected water budget covers a 50-year time period from October 2022 through September 2072. Hydrologic conditions for the projected water budget are based on cycling the water year

sequence from the 24-year historical period twice beginning in WY 2024, with WY 2017 used as a proxy year for WY 2023 (both wet years), and WY 1999 used as a proxy year for WY 2072. Future precipitation, reference evapotranspiration, and inflows to Lake Kaweah are adjusted from the historical period based on the central tendency climate change factor dataset provided by DWR (DWR, 2018) for the 2070 (late future) period.

In addition to comparing groundwater conditions to SMCs, projected water budgets are useful to evaluate if sustainability will be maintained over the 50-year planning and implementation horizon. Projected future baseline conditions are supplemented with simulated projects and management actions to ensure URs to beneficial users and uses of groundwater do not occur.

3.4.1.4 Key Water Budget Findings

This GSP includes 2 types of water budgets (groundwater and land surface budgets) over 3 time periods: historical, current, and projected. Each water budget provides important information on the relative contribution of each component to the overall water budget. When comparing the results from each of the 3 time periods, potential trends in water budget gains and losses can be established for future Subbasin management.

Key findings of the detailed water budgets in the Subbasin can be summarized as follows:

- As simulated over the entire historical period, the Kaweah Subbasin has been subject to groundwater overdraft, demonstrated by a negative change of groundwater in storage due to groundwater outflows exceeding groundwater inflows.
- The historical water budget is not the most critical to review for GSP implementation; rather, it gives an understanding of past behavior and interactions of various flow components. Historical water budgets provide background information that is complementary to the Basin Setting.
- The groundwater budget provides key information such as total groundwater pumping and change in groundwater storage annually and cumulatively over the full simulation period. The land surface budget provides information on the total water demand and relative use of surface water versus groundwater. The surface water budget is primarily used to assess surface water for recharge availability operations but is also used to assess ISW conditions. In this Subbasin, the Kaweah River system is generally a losing stream except for the uppermost reaches where there is shallow bedrock.
- Cumulative and average annual loss of storage is greater in the current water budget compared to the historical water budget; therefore, if water management strategies do not change, the Subbasin will experience ongoing groundwater level and storage declines, land subsidence, and overall worsening conditions compared to historical conditions.

- Average annual agricultural pumping increased by about 58,800 AF from the historical (656,800 AF/year) to the current water budget (715,600 AF/year). The simulated historical average annual change in aquifer storage is -149,100 AF and for the current period the average annual change in aquifer storage is -230,700 AF.
- Due to large historical overdraft, the primary management action is demand reduction, which will be achieved through agricultural pumping allocations. Projected irrigation pumping in the GSP implementation scenario is expected to decrease to an annual average of 519,00 AF between WY 2023-2039 and 474,000 AF/year for WY 2040-2070. This results in an average annual change in aquifer storage to be 6,500 AF for WY 2023-2039 and 3,000 AF/year for WY 2040-2070.
- Groundwater conditions in neighboring subbasins impact projected water budgets and groundwater levels in the Kaweah Subbasin because they are hydraulically connected. Model assumptions, described in Appendix 3C, limit negative impacts to the Kaweah Subbasin from surrounding subbasins.
- Surface water inflows to the Kaweah River system decreases overall due to impacts from climate, however during exceptionally wet years, additional water is available for recharge.
- The current and projected water budgets display increasingly less groundwater discharge to streams and more streambed recharge to groundwater, indicating that progressively lowered groundwater elevations in the future may draw more water from the Subbasin's streams, and contribute less groundwater baseflow in return.
- Overall observations regarding historical, current, and future groundwater budgets:
 - Historical: The Subbasin is in overdraft.
 - Current: The Subbasin is in overdraft. Overall, a bit worse than historical.
 - Projected with projects and management actions accounting for climate change: the Subbasin's implementation of projects and pumping reductions results in a shift of 230,700AF/year of overdraft in the aquifer to a positive change in storage in the aquifer of 3,000 AF/year.
- The projected future water budget which incorporated changes in conditions as well as projects and management actions undertaken is what the GSP uses to evaluate SMC, and which helps define the sustainable yield of the Subbasin. This demonstrates that the Subbasin will operate sustainably during GSP implementation.

3.4.2 Historical and Current Groundwater Budgets

The historical and current annual groundwater budget for the Subbasin are summarized in Table 3-6. Historical and current annual groundwater budgets for the MKGSA area are summarized in Table 3-7.

3.4.2.1 Subbasin Historical Groundwater Budget

The historical groundwater budget is dominated by 6 primary components: percolation of irrigation water, percolation from precipitation, agricultural pumping, flow between groundwater and surface water, and inter-basin subsurface flow.

- Percolation from irrigation water and precipitation represents 51% of total groundwater inflow in an average year, though the total volume varies significantly with climate, ranging from 207,200 to 253,300 AF/year.
- Percolation from precipitation represents 6% of total groundwater inflow in an average year, though the total volume varies significantly with climate, ranging from 5,100 to 93,200 AF/year.
- Conveyance losses and mountain front recharge accounts for 13% of total groundwater inflow, with the total volume ranging from 24,300 to 283,800 AF/year.
- Mountain front recharge accounts for 4% of total groundwater inflow, with the total volume ranging from 11,600 to 46,300 AF/year.
- Percolation from recharge basins represents 10% of total groundwater inflow with total volumes ranging from 19,700 to 203,600 AF annually.
- Groundwater pumping constitutes 87% of groundwater outflow, 78% from agricultural pumping and 9% from municipal and industrial pumping. Agricultural pumping ranges from 412,900 to 930,900 AF/year with variation largely dependent on climate, land use, and surface water availability. Municipal and industrial pumping is less variable, ranging from 63,200 to 87,700 AF/year.
- Groundwater-surface water interaction occurs in both gaining and losing reaches across the Subbasin. Subbasin-wide streambed recharge comprises 13% of total groundwater inflows in an average year, while groundwater discharge to streams comprises 1% of total outflows in an average year. Subbasin-wide, an average of 82,500 AF of surface water percolates along the channels of the Kaweah River System and an average volume of 6,400 AF of groundwater discharges into the Subbasin's streams annually.
- Subsurface flows constitute 13% of total groundwater inflows and 12% of total groundwater outflows in an average year. On average there is annually more subsurface

outflows than inflows, for a net outflow of 16,166 AF. On a net basis, groundwater flows into the Subbasin from Kings and Lower Tule Subbasins and out of the Subbasin to the Tulare Lake Subbasin. The location of subsurface inflows and outflows are largely due to regional groundwater gradients that direct groundwater from northeast to southwest. Subsurface flows are also impacted by seasonal groundwater pumping occurring in agricultural areas.

Historical wet periods result in increased deep percolation to groundwater and reduced groundwater pumping due to associated increases in surface water use and reduced irrigation demands. Likewise, the Subbasin is highly responsive to extended dry periods largely driven by decreases in deep percolation to groundwater and increased reliance on groundwater extraction. The annual change of groundwater in storage fluctuates between a loss of 687,700 and a gain of 618,800 AF, with an annual average loss of 202,900 AF, which substantiates the Subbasin's historical overdraft. The Subbasin displays a cumulative groundwater storage loss of 4,870,000 AF over the historical water budget period.

3.4.2.2 Subbasin Current Groundwater Budget

The current groundwater budget is summarized in Table 3-6. Major differences between the historical groundwater budget and the current groundwater budget include the following:

- A 12,400 AF decrease in average annual percolation of irrigation water, and an average annual decrease of 8,100 AF of precipitation percolation
- A 15,700 AF decrease in average annual conveyance losses
- A 15,100 AF decrease in average annual streambed recharge, and a 136 AF average annual increase in groundwater discharge to streams
- A 58,800 AF increase in average annual agricultural pumping driven by decreased surface water applications
- A 102,800 AF decrease in average annual change of groundwater in storage; 81,600 AF from the change in storage in the aquifer and 21,200 AF from change in storage in the aquitard

These results suggest current land use and water use trends are unsustainable, even without considering climate change impacts.

3.4.2.3 MKGSA Historical Groundwater Budget

The historical groundwater budget for the Mid-Kaweah GSA is dominated by the same primary water budget components as the overall Subbasin but with different percentage distributions (Table 3-7).

- Percolation from irrigation water and precipitation represents 29% of total groundwater inflow in an average year, though the total volume varies significantly with climate, ranging from 39,600 to 91,600 AF/year.
- Conveyance losses accounts for 11% of total groundwater inflow, with the total volume ranging from 400 to 89,900 AF/year.
- Percolation from recharge basins represents 14% of total groundwater inflow with total volume ranging from 10,100 to 128,900 AF/year. The MKGSA contributes to 60% of the Subbasin's total percolation from recharge basins.
- Groundwater pumping constitutes 55% of groundwater outflow, 39% agricultural pumping and 15% municipal and industrial groundwater pumping. Agricultural pumping ranges from 48,800 to 215,200 AF/year with variation largely dependent on climate, land use, and surface water use. Municipal and industrial pumping is less variable, ranging from 44,200 to 57,900 AF/year. Irrigated agriculture in the MKGSA pumps 21% of Subbasin-wide irrigation pumping and 69% of Subbasin pumping for M&I.
- Streambed percolation within the MKGSA contributes 9% of total groundwater inflows in an average year; there are no gaining stream reaches within the MKGSA area and therefore there is no discharge to streams and thus no ISW.
- Subsurface flows constitute 44% of total groundwater inflows and 45% of total groundwater outflows in an average year. Overall, there is greater subsurface outflow than inflow.

The annual change of aquifer storage fluctuates between a loss of 179,800 and a gain of 215,900 AF with an annual average loss of 51,100 AF. MKGSA has a cumulative groundwater storage loss of 1,831,700 AF over the historical period (1999 – 2022).

3.4.2.4 MKGSA Current Groundwater Budget

The current groundwater budget for MKGSA is summarized in Table 3-7. The largest differences between the historical groundwater budget and the current groundwater budget include the following:

- A 2,900 AF decrease in average annual percolation of irrigation water and a 1,700 AF per year decrease in percolation of precipitation.
- A 4,900 AF decrease in average annual conveyance losses.
- A 18,800 AF increase in average annual agricultural pumping driven by decreased surface water applications.
- A 29,600 AF increase in average annual loss of groundwater in storage; 23,300 AF from the change in storage in the aquifer, and 6,300 AF from change in storage in the aquitard.

Table 3-6. Historical and Current Annual Groundwater Budget Summary for the Kaweah Subbasin (WY 1999 – WY 2022)

Values in 1,000s Acre-Feet

Water Year	Rainfall		Components of Inflow							Components of Outflow				Total Inflow	Total Outflow	Aquitard Storage Change	Aquifer Storage Change	Change in Storage	Cumulative Change in Storage
	Inches	% of Average	Subsurface Inflow	Streambed Percolation	Conveyance Losses (Canal and Ditch Recharge)	Mountain Front Recharge	Percolation of Recharge Basins	Percolation of Irrigation Water	Percolation of Precipitation (Crop and Non-Ag Land)	Groundwater Pumpage		Discharge to Surface Water	Subsurface Outflow						
										M & I GW Pumping	GW Pumping for Irrigated Agriculture								
1999	9.6	104%	107.2	83.4	92.5	11.6	74.1	237.4	39.4	67.8	534.5	3.6	53.0	645.6	659.0	18.3	-31.8	-13.4	-13.4
2000	10.9	118%	87.1	91.1	94.7	23.2	63.6	261.2	51.0	65.9	570.0	4.2	78.7	672.0	718.8	-5.4	-41.5	-46.8	-60.3
2001	9.3	101%	79.5	57.0	66.2	23.2	28.7	222.8	36.4	71.9	665.8	5.3	102.0	513.8	845.0	-34.8	-296.5	-331.2	-391.5
2002	8.9	96%	79.3	74.8	69.4	23.2	35.1	254.3	39.1	74.3	702.3	4.9	104.1	575.0	885.6	-45.6	-265.0	-310.6	-702.1
2003	9.4	101%	77.2	93.3	95.6	23.2	80.2	265.5	29.6	74.8	594.1	5.9	112.9	664.6	787.8	-37.1	-86.1	-123.2	-825.3
2004	7.5	81%	74.8	59.8	52.2	11.6	27.6	237.4	35.8	81.5	758.9	4.7	106.1	499.2	951.2	-65.9	-386.2	-452.0	-1,277.3
2005	14.2	153%	83.7	144.2	160.0	46.3	138.0	287.0	55.0	71.0	422.9	7.2	102.7	914.2	603.8	-18.2	328.6	310.4	-967.0
2006	14.6	158%	78.3	150.1	167.4	46.3	95.5	303.7	71.1	74.5	444.7	11.1	98.7	912.4	628.9	-4.2	287.7	283.5	-683.5
2007	5.2	57%	74.7	43.0	32.3	11.6	32.9	238.6	13.2	87.4	816.7	6.0	120.0	446.2	1,030.2	-55.7	-528.2	-583.9	-1,267.4
2008	7.8	85%	75.9	71.9	71.0	23.2	29.6	253.8	36.7	85.1	706.0	5.7	170.1	562.0	966.9	-76.0	-328.9	-404.9	-1,672.3
2009	6.8	74%	75.7	69.6	74.2	23.2	31.6	259.4	20.3	83.4	727.5	5.2	168.3	553.9	984.4	-86.4	-344.2	-430.5	-2,102.9
2010	11.4	123%	79.1	125.7	149.1	46.3	107.3	267.9	49.8	75.9	501.6	7.6	143.1	825.3	728.2	-47.5	144.5	97.1	-2,005.8
2011	17.1	184%	101.6	175.0	196.4	46.3	177.1	340.5	93.2	71.1	446.8	13.1	101.4	1,130.2	632.3	-8.1	506.0	497.9	-1,507.9
2012	7.9	85%	97.0	61.5	54.9	11.6	48.2	222.4	13.8	81.5	697.2	8.5	101.8	509.3	888.9	-37.7	-342.0	-379.6	-1,887.5
2013	5.5	59%	91.7	45.2	22.2	11.6	32.4	223.2	15.3	81.0	843.2	5.0	117.7	441.6	1,046.9	-75.7	-529.5	-605.2	-2,492.8
2014	4.4	48%	91.1	24.2	19.8	11.6	25.0	218.8	5.1	75.3	885.1	3.6	104.6	395.5	1,068.6	-109.1	-564.0	-673.1	-3,165.8
2015	7.2	78%	88.8	24.0	13.9	11.6	23.5	207.2	26.9	65.8	850.5	3.7	90.1	395.8	1,010.1	-125.2	-489.1	-614.3	-3,780.2
2016	11.6	126%	77.6	79.3	80.6	23.2	44.7	207.4	44.6	67.7	587.4	5.0	95.6	557.4	755.8	-102.9	-95.5	-198.4	-3,978.6
2017	14.3	154%	86.3	188.8	237.5	46.3	203.6	354.5	81.0	63.2	412.9	10.7	92.4	1,198.1	579.2	-40.7	659.6	618.8	-3,359.7
2018	6.1	66%	76.7	69.1	71.1	11.6	53.3	227.3	19.2	72.7	649.5	7.2	77.2	528.3	806.6	-51.5	-226.8	-278.3	-3,638.0
2019	12.0	129%	89.5	140.8	211.1	46.3	138.1	329.0	45.6	68.3	500.1	11.2	78.3	1,000.5	657.8	-29.2	371.9	342.7	-3,295.3
2020	8.5	92%	80.8	47.7	43.7	11.6	28.8	215.2	20.5	69.2	708.4	6.5	81.4	448.3	865.5	-53.1	-364.2	-417.3	-3,712.6
2021	4.5	48%	94.9	16.2	12.7	11.6	19.7	224.6	13.2	72.5	930.9	4.0	73.2	392.9	1,080.7	-94.9	-592.8	-687.7	-4,400.3
2022	7.5	81%	106.5	44.3	32.5	11.6	29.0	219.9	33.4	68.1	806.6	3.4	69.5	477.1	947.6	-105.6	-364.8	-470.5	-4,870.8
Maximum	17.1	184%	107.2	188.8	237.5	46.3	203.6	354.5	93.2	87.4	930.9	13.1	170.1	1,198.1	1,080.7	18.3	659.6	618.8	
Minimum	4.4	48%	74.7	16.2	12.7	11.6	19.7	207.2	5.1	63.2	412.9	3.4	53.0	392.9	579.2	-125.2	-592.8	-687.7	
Average	9.3	100%	85.6	82.5	88.4	23.7	65.3	253.3	37.1	73.7	656.8	6.4	101.8	635.8	838.7	-53.8	-149.1	-202.9	
% of Total			13%	13%	14%	4%	10%	40%	6%	9%	78%	1%	12%						
Maximum	14.3	154%	106.5	188.8	237.5	46.3	203.6	354.5	81.0	81.5	930.9	11.2	117.7	1,198.1	1,080.7	-29.2	659.6	618.8	
Minimum	4.4	48%	76.7	16.2	12.7	11.6	19.7	207.2	5.1	63.2	412.9	3.4	69.5	392.9	579.2	-125.2	-592.8	-687.7	
Average	8.1	88%	89.2	67.4	72.7	19.0	58.8	240.9	29.0	71.4	715.6	6.3	89.3	576.8	882.5	-75.1	-230.7	-305.7	
% of Total			15%	12%	13%	3%	10%	42%	5%	8%	81%	1%	10%						

Table 3-7. Historical and Current Annual Groundwater Budget Summary for the Mid-Kaweah Groundwater Sustainability Agency

Values in 1,000s Acre Feet

	Water Year	Rainfall		Components of Inflow						Components of Outflow				Total Inflow	Total Outflow	Aquitard Storage Change	Aquifer Storage Change	Change in Storage	Cumulative Change in Storage		
				Subsurface Inflow	Streambed Percolation	Conveyance Losses (Canal and Ditch Recharge)	Mountain Front Recharge	Percolation of Recharge Basins	Percolation of Irrigation Water	Percolation of Precipitation (Crop and Non-Ag Land)	Groundwater Pumpage		Discharge to Surface Water							Subsurface Outflow	
		M & I GW Pumping	GW Pumping for Irrigated Agriculture																		
Historical 1999-2022	1999	9.4	105%	98.1	18.8	35.6	0.0	39.3	52.9	7.7	49.1	88.4	0.0	137.8	252.4	275.3	-8.7	-14.2	-22.9	-22.9	
	2000	10.7	118%	101.6	24.4	31.4	0.0	34.6	50.5	9.8	44.2	99.1	0.0	143.3	252.3	286.6	-10.1	-24.2	-34.3	-57.2	
	2001	9.9	109%	105.5	16.5	14.3	0.0	15.7	46.0	7.8	46.6	153.0	0.0	141.4	205.7	340.9	-22.6	-112.6	-135.2	-192.4	
	2002	8.9	98%	109.6	20.0	19.2	0.0	19.7	53.8	7.8	50.1	162.8	0.0	142.3	230.2	355.1	-25.2	-99.7	-124.9	-317.4	
	2003	9.0	99%	115.2	26.2	30.5	0.0	42.9	50.4	5.1	51.2	121.0	0.0	149.2	270.2	321.4	-19.6	-31.6	-51.2	-368.6	
	2004	7.6	84%	113.0	16.7	14.2	0.0	15.4	50.7	7.2	55.8	180.9	0.0	142.3	217.1	379.0	-32.4	-129.5	-161.9	-530.5	
	2005	14.4	160%	123.6	41.3	59.6	0.0	74.4	59.4	11.4	52.2	68.8	0.0	159.4	369.6	280.3	-10.9	100.3	89.3	-441.1	
	2006	14.9	165%	136.4	41.9	54.7	0.0	53.2	58.3	14.2	55.1	74.5	0.0	158.0	358.5	287.6	-5.9	76.8	71.0	-370.2	
	2007	4.6	52%	131.7	12.3	10.4	0.0	18.6	59.9	2.1	57.6	199.3	0.0	159.3	235.0	416.2	-26.8	-154.4	-181.2	-551.4	
	2008	7.6	84%	127.2	21.8	17.6	0.0	16.8	48.6	6.5	56.3	165.6	0.0	177.9	238.4	399.7	-32.9	-128.4	-161.3	-712.7	
	2009	6.6	73%	125.8	20.0	22.6	0.0	17.6	50.8	3.5	57.1	152.8	0.0	182.2	240.3	392.1	-37.3	-114.5	-151.8	-864.5	
	2010	11.4	127%	120.3	39.1	65.8	0.0	75.0	60.4	9.6	53.5	75.9	0.0	193.4	370.2	322.8	-19.7	67.1	47.4	-817.1	
	2011	17.3	191%	138.6	54.4	68.6	0.0	109.7	67.2	18.6	51.8	64.8	0.0	190.6	457.2	307.2	-7.1	157.1	150.0	-667.1	
	2012	7.7	86%	140.2	18.7	15.3	0.0	32.2	44.9	2.6	53.6	167.8	0.0	170.1	253.8	391.4	-19.2	-118.4	-137.6	-804.7	
	2013	5.5	61%	130.3	12.5	3.7	0.0	20.8	45.7	3.0	54.2	201.9	0.0	164.0	216.0	420.0	-33.0	-171.0	-204.1	-1,008.8	
	2014	4.4	49%	120.2	5.4	0.8	0.0	14.3	45.7	1.4	52.0	206.2	0.0	147.2	187.7	405.4	-44.8	-172.8	-217.7	-1,226.5	
	2015	7.3	81%	108.7	5.1	0.4	0.0	13.5	41.9	5.8	44.2	188.4	0.0	134.5	175.4	367.2	-48.2	-143.6	-191.8	-1,418.3	
	2016	10.3	114%	100.8	20.6	26.1	0.0	33.1	38.2	7.0	44.7	127.9	0.0	139.0	225.9	311.6	-39.3	-46.4	-85.8	-1,504.0	
	2017	14.0	155%	119.3	53.9	89.9	0.0	128.9	73.0	15.4	45.8	48.8	0.0	187.4	480.4	281.9	-17.5	215.9	198.5	-1,305.6	
	2018	5.5	61%	121.2	21.0	25.3	0.0	38.0	49.0	3.4	49.2	142.1	0.0	159.1	257.9	350.4	-22.8	-69.8	-92.6	-1,398.1	
	2019	11.1	124%	126.1	44.6	88.9	0.0	85.5	68.6	8.2	48.4	81.4	0.0	180.6	422.0	310.4	-13.7	125.3	111.6	-1,286.6	
	2020	7.7	86%	129.4	12.3	13.3	0.0	18.3	42.2	3.7	49.0	173.2	0.0	151.6	219.2	373.8	-23.9	-130.7	-154.6	-1,441.2	
	2021	4.2	47%	118.4	0.6	3.2	0.0	10.1	47.1	2.9	51.4	215.2	0.0	136.0	182.3	402.6	-40.5	-179.8	-220.3	-1,661.5	
	2022	6.3	70%	109.6	9.5	9.8	0.0	17.1	45.2	5.7	49.0	189.0	0.0	129.1	196.9	367.1	-43.2	-127.0	-170.3	-1,831.7	
		Maximum	17.3	191%	140.2	54.4	89.9	0.0	128.9	73.0	18.6	57.6	215.2	0.0	193.4	480.4	420.0	-5.9	215.9	198.5	
		Minimum	4.2	47%	98.1	0.6	0.4	0.0	10.1	38.2	1.4	44.2	48.8	0.0	129.1	175.4	275.3	-48.2	-179.8	-220.3	
		Average	9.0	100%	119.6	23.2	30.0	0.0	39.4	52.1	7.1	50.9	139.5	0.0	157.3	271.4	347.8	-25.2	-51.1	-76.3	
	% of Total			44%	9%	11%	0%	14%	19%	3%	15%	40%	0%	45%							
Current 2012 - 2022	Maximum	14.0	155%	140.2	53.9	89.9	0.0	128.9	73.0	15.4	54.2	215.2	0.0	187.4	480.4	420.0	-13.7	215.9	198.5		
	Minimum	4.2	47%	100.8	0.6	0.4	0.0	10.1	38.2	1.4	44.2	48.8	0.0	129.1	175.4	281.9	-48.2	-179.8	-220.3		
	Average	7.6	85%	120.4	18.6	25.2	0.0	37.4	49.2	5.4	49.2	158.4	0.0	154.4	256.1	362.0	-31.5	-74.4	-105.9		
	% of Total			47%	7%	10%	0%	15%	19%	2%	14%	44%	0%	43%							

3.4.3 Historical and Current Land Surface Budgets for Kaweah Subbasin

The historical and current annual land surface budget for the Kaweah Subbasin is summarized in Table 3-8.

3.4.3.1 Subbasin Historical Land Surface Budget

Inflow to the land surface system is dominated by applied groundwater (51%) with applied surface water (23%), and precipitation (25%) having lesser inflows. Outflow from the land surface system is primarily from evapotranspiration from applied water (69%), evapotranspiration from precipitation (22%), and percolation of irrigation water (18%). The land surface system is highly dependent on annual precipitation, with total flow correlating strongly with climate classification. Applied groundwater increases in dry years and decreases in wet years, related to increased groundwater demand during dry years. Applied surface water and irrigation return flows to streams generally display the opposite trend, associated with surface water use increasing in wet years and decreasing in dry years.

3.4.3.2 Subbasin Current Land Surface Budget

Major differences between the historical land surface budget and the current land surface budget include the following:

- A 58,500 AF increase in applied groundwater
- A 77,100 AF decrease in applied surface water
- A 20,500 AF decrease in deep percolation to groundwater attributed to lower volumes of total applied water

Overall, the current land surface budget compared to historical reflects a system with increased applied groundwater and decreased surface water application which results in less overall applied water and decreased deep percolation to groundwater.

Table 3-8. Historical and Current Annual Land Surface Budget for the Kaweah Subbasin

Values in 1,000s Acre-Feet

	Water Year	Rainfall		Components of Inflow				Components of Outflow					Total Inflow	Total Outflow
		Inches	% of Average	Precipitation	Applied Groundwater	Applied Surface Water	Percolation of Recharge Basins	Percolation of Irrigation Water	Percolation of Precipitation (Crop and Non-Ag Land)	Evapotranspiration Applied Water	Evapotranspiration Precipitaion	Percolation of Recharge Basins		
Historical 1999-2022	1999	9.6	104%	352.2	534.5	348.8	74.1	237.4	39.4	645.9	312.8	74.1	1,309.7	1,309.7
	2000	10.9	118%	401.7	570.0	399.8	63.6	261.2	51.0	708.6	350.7	63.6	1,435.1	1,435.1
	2001	9.3	101%	342.7	665.8	276.2	28.7	222.8	36.4	719.1	306.3	28.7	1,313.4	1,313.4
	2002	8.9	96%	325.6	702.3	310.9	35.1	254.3	39.1	758.8	286.5	35.1	1,373.8	1,373.8
	2003	9.4	101%	344.6	594.1	385.2	80.2	265.5	29.6	713.8	314.9	80.2	1,404.1	1,404.1
	2004	7.5	81%	275.6	758.9	260.7	27.6	237.4	35.8	782.2	239.8	27.6	1,322.8	1,322.8
	2005	14.2	153%	521.4	422.9	516.9	138.0	287.0	55.0	652.8	466.5	138.0	1,599.2	1,599.2
	2006	14.6	158%	536.1	444.7	533.9	95.5	303.7	71.1	674.9	465.0	95.5	1,610.2	1,610.2
	2007	5.2	57%	192.6	816.7	175.8	32.9	238.6	13.2	753.9	179.3	32.9	1,218.0	1,218.0
	2008	7.8	85%	287.5	706.0	315.6	29.6	253.8	36.7	767.8	250.8	29.6	1,338.7	1,338.7
	2009	6.8	74%	251.4	727.5	313.9	31.6	259.4	20.3	782.0	231.2	31.6	1,324.5	1,324.5
	2010	11.4	123%	418.5	501.6	481.8	107.3	267.9	49.8	715.5	368.7	107.3	1,509.2	1,509.2
	2011	17.1	184%	627.2	446.8	589.4	177.1	340.5	93.2	695.7	533.9	177.1	1,840.5	1,840.5
	2012	7.9	85%	290.0	697.2	231.8	48.2	222.4	13.8	706.6	276.2	48.2	1,267.2	1,267.2
	2013	5.5	59%	200.5	843.2	134.1	32.4	223.2	15.3	754.0	185.2	32.4	1,210.1	1,210.1
	2014	4.4	48%	162.9	885.1	83.8	25.0	218.8	5.1	750.2	157.8	25.0	1,156.8	1,156.8
	2015	7.2	78%	265.2	850.5	67.4	23.5	207.2	26.9	710.7	238.3	23.5	1,206.6	1,206.6
	2016	11.6	126%	427.9	587.4	249.2	44.7	207.4	44.6	629.2	383.3	44.7	1,309.2	1,309.2
	2017	14.3	154%	524.9	412.9	612.9	203.6	354.5	81.0	671.4	443.9	203.6	1,754.4	1,754.4
	2018	6.1	66%	223.9	649.5	276.1	53.3	227.3	19.2	698.3	204.6	53.3	1,202.8	1,202.8
	2019	12.0	129%	439.9	500.1	531.6	138.1	329.0	45.6	702.7	394.3	138.1	1,609.7	1,609.7
	2020	8.5	92%	313.2	708.4	201.5	28.8	215.2	20.5	694.7	292.7	28.8	1,251.9	1,251.9
	2021	4.5	48%	164.1	930.9	69.3	19.7	224.6	13.2	775.6	150.9	19.7	1,184.0	1,184.0
	2022	7.5	81%	274.9	806.6	129.2	29.0	219.9	33.4	715.9	241.5	29.0	1,239.7	1,239.7
	Maximum	17.1	184%	627.2	930.9	612.9	203.6	354.5	93.2	782.2	533.9	203.6	1,840.5	1,840.5
Minimum	4.4	48%	162.9	412.9	67.4	19.7	207.2	5.1	629.2	150.9	19.7	1,156.8	1,156.8	
Average	9.26	100%	340.2	656.8	312.3	65.3	253.3	37.1	715.8	303.1	65.3	1,374.6	1,374.6	
% of Total				25%	48%	23%	5%	18%	3%	52%	22%	5%		
Current 2012 - 2022	Maximum	14.3	154%	524.9	930.9	612.9	203.6	354.5	81.0	775.6	443.9	203.6	1,754.4	1,754.4
	Minimum	4.4	48%	162.9	412.9	67.4	19.7	207.2	5.1	629.2	150.9	19.7	1,156.8	1,156.8
	Average	8.1	88%	298.9	715.6	235.2	58.8	240.9	29.0	709.9	269.9	58.8	1,308.4	1,308.4
	% of Total			23%	55%	18%	4%	18%	2%	54%	21%	4%		

3.4.4 Projected Water Budgets

Methodology and assumptions used to develop projected water budgets are discussed in the subsections below. A summary of the average annual current water budget along with the projected water budget for WY 2023-2039 and WY 2040-2070 are shown in Table 3-9. The projected annual groundwater budget for the Subbasin is summarized in Table 3-10. The projected annual groundwater budget for the MKGSA is summarized in Table 3-11. The projected water budget was developed based on predictive modeling with the calibrated Kaweah Subbasin groundwater flow model. Model assumptions are described in the model report contained in Appendix 3C.

3.4.4.1 Subbasin Projected Groundwater Budget

Major differences between the current groundwater budget and the projected groundwater budgets incorporating climate change include the following on an annual average basis:

- There is a projected average annual decrease of 196,500 AF in agricultural pumping for WY 2023-2039, and an average annual decrease of 241,600 AF for WY 2040-2070 from the current period. Agricultural pumping decreases are driven largely by simulated decreased evapotranspiration (ET) to account for planned management actions to reduce groundwater pumping. As surface water applications are constant across all scenarios, decreased ET reduces crop water demand and results in reduced groundwater extraction as part of the groundwater extraction allocation management action.
- For municipal and industrial pumping there is an average annual increase from the current period of 11,100 AF for WY 2023-2039 (116% of current) and an average annual increase of 18,800 AF for WY 2040-2070 (126% of current). This is largely due to increased urban demand projections in Urban Water Management Plans for the cities of Visalia and Tulare.
- As a result of decreased ET, the project groundwater budget has reduced percolation of irrigation water compared to the current budget; for WY 2040-2070 there is an annual average decrease of 19,000 AF.
- Table 3-9 reports overall changes in groundwater storage both within the permeable aquifer system and within clay interbeds. Projected average annual groundwater storage change in the aquifer is about +3,000 AFY over 2040-2070, meaning that a modest increase in overall groundwater storage is projected for the aquifer system over this time period.
- At the same time, the projected average annual groundwater storage change in the clay interbeds is about -14,700 AFY over WY 2040-2070 as a result of lagged depressurization within the clay interbeds. The persistence of groundwater storage changes in the clay interbeds is due to their low permeability and represents the effects of groundwater pumping from the lower aquifer that occurred prior to the GSP implementation period. As

such, it is reasonable to expect some continued loss of groundwater storage within the clay interbeds even with the demand management measures planned by all 3 GSAs.

3.4.4.2 MKGSA Projected Groundwater Budget

Major differences between the current groundwater budget and the projected groundwater budgets incorporating climate change include the following:

- There is a projected average annual decrease in irrigated agriculture pumping from the current period of 45,400 AF (29% reduction) for WY 2023-2039, and an average annual decrease of 43,700 AF (28 % reduction) for WY 2040-2070. Agricultural pumping decreases are driven largely by simulated decreased ET to account for planned management actions to reduce groundwater pumping. As surface water applications are constant across all scenarios, decreased ET reduces crop water demand, and results in reductions to groundwater extraction as part of the groundwater extraction allocation implementation management action.
- For municipal and industrial pumping there is an average annual increase from the current period of 10,700 AF for WY 2023-2039 (122% of current) and an average annual increase of 17,900 AF for WY 2040-2070 (136% of current). This is driven by Urban Water Management Plan projected water demands for the cities of Visalia and Tulare.
- As a result of decreased ET, there is reduced percolation of irrigation water of 1,600 AF (73% of current percolation) for both the WY 2023-2039 and WY 2040-2070 periods.

Table 3-9. Current and Projected Groundwater Budget Average Annual Summary and Comparison for the Kaweah Subbasin

Groundwater Budget Component	Values in 1,000s Acre Feet				
	Current Period	Projected Period		Comparison	
	2012-2022	2023-2039	2040-2070	2023-2039 Change from Current	2040-2070 Change from Current
Subsurface Inflow	89.2	93.1	107.6	3.9	18.4
Streambed Percolation	67.4	89.4	82.3	22.0	15.0
Conveyance Losses (Canal and Ditch Recharge)	72.7	80.3	74.7	7.5	2.0
Mountain Front Recharge	19.0	23.1	21.2	4.1	2.3
Percolation of Recharge Basins	58.8	63.8	63.5	5.0	4.7
Percolation of Irrigation Water	240.9	242.6	221.9	1.7	-19.0
Percolation of Precipitation (Crop and Non-Ag Land)	29.0	41.9	41.6	12.9	12.6
M & I GW Pumping	71.4	82.5	90.2	11.1	18.8
GW Pumping for Irrigated Agriculture	715.6	519.1	474.0	-196.5	-241.6
Discharge to Surface Water	6.3	10.6	10.1	4.3	3.8
Subsurface Outflow	89.3	64.8	50.1	-24.5	-39.1
Total Inflow	576.8	634.0	612.8	57.2	36.0
Total Outflow	882.5	677.0	624.5	-205.5	-258.0
Clay Interbed Storage Change	-75.1	-36.8	-14.7	38.2	60.4
Aquifer Storage Change	-230.7	-6.2	3.0	224.5	233.7
Change in Storage	-305.7	-43.0	-11.6	262.7	294.1

Table 3-10. Projected Groundwater Budgets Summary for the Kaweah Subbasin

Values in 1,000s Acre-Feet

	Water Year	Rainfall		Components of Inflow						Components of Outflow				Total Inflow	Total Outflow	Aquitard Storage Change	Aquifer Storage Change	Change in Storage	Cumulative Change in Storage	
				Subsurface Inflow	Streambed Percolation	Conveyance Losses (Canal and Ditch Recharge)	Mountain Front Recharge	Percolation of Recharge Basins	Percolation of Irrigation Water	Percolation of Precipitation (Crop and Non-Ag Land)	Groundwater Pumpage		Discharge to Surface Water							Subsurface Outflow
		M & I GW Pumping	GW Pumping for Irrigated Agriculture																	
2023-2039	2023	14.7	157%	115.2	213.2	264.4	44.2	280.4	453.0	84.6	75.1	354.0	26.4	92.1	1,455.1	547.6	-86.1	993.7	907.6	907.6
	2024	9.3	99%	82.0	89.4	49.0	13.4	23.1	205.6	37.4	76.1	557.9	8.2	79.1	499.8	721.2	-58.7	-162.8	-221.4	686.1
	2025	10.7	114%	83.2	98.0	79.2	21.6	33.7	262.8	50.9	76.8	549.8	7.2	70.4	629.3	704.2	-54.2	-20.6	-74.9	611.3
	2026	9.8	104%	84.7	55.4	51.4	12.7	20.7	198.2	41.5	77.4	595.4	7.5	70.6	464.5	750.9	-49.6	-236.8	-286.4	324.9
	2027	8.1	86%	88.7	62.8	45.4	16.6	20.3	209.0	37.3	78.0	628.9	6.4	61.7	480.0	775.1	-62.1	-232.9	-295.0	29.8
	2028	8.8	94%	92.8	79.9	71.5	20.8	31.2	230.0	24.6	78.7	518.6	6.3	58.7	550.7	662.3	-55.1	-56.5	-111.6	-81.8
	2029	7.4	79%	92.6	54.0	48.6	10.1	22.5	224.3	35.6	79.0	644.7	5.4	58.5	487.7	787.6	-51.5	-248.5	-300.0	-381.8
	2030	13.7	147%	93.4	121.1	121.4	37.6	113.4	333.2	58.9	79.7	367.6	8.4	62.1	879.0	517.8	-29.1	390.4	361.3	-20.5
	2031	14.3	152%	95.8	163.1	163.3	45.8	178.1	328.6	72.5	81.0	365.6	29.2	70.5	1,047.2	546.2	-3.7	504.6	501.0	480.5
	2032	5.4	57%	84.7	42.5	26.7	10.6	17.3	175.0	13.0	88.4	611.2	6.5	73.4	369.9	779.5	-15.3	-394.4	-409.6	70.8
	2033	7.8	83%	89.0	72.7	56.6	23.3	26.7	214.8	41.1	88.7	587.1	5.4	64.0	524.3	745.2	-25.1	-195.8	-220.9	-150.1
	2034	6.4	68%	93.5	56.8	42.0	20.9	22.8	208.2	24.2	89.0	599.6	5.7	57.8	468.4	752.1	-32.9	-250.8	-283.7	-433.8
	2035	11.4	122%	98.9	103.4	87.4	45.5	54.6	245.1	55.3	83.6	456.0	9.6	54.5	690.2	603.6	-27.9	114.5	86.6	-347.1
	2036	16.7	178%	103.3	167.6	166.3	36.5	179.2	312.8	97.1	85.0	325.9	29.5	60.8	1,062.8	501.2	-2.7	564.3	561.6	214.5
	2037	6.8	73%	90.1	67.2	42.2	9.9	24.2	186.8	15.4	88.5	501.0	8.7	62.1	436.0	660.4	-10.1	-214.3	-224.4	-9.9
	2038	5.1	54%	93.0	47.9	29.2	11.5	18.8	173.3	15.4	88.9	561.1	6.0	55.0	388.9	710.9	-23.4	-298.5	-321.9	-331.8
	2039	4.5	48%	101.7	24.3	19.8	11.0	17.2	163.3	6.8	89.0	601.0	3.7	49.7	344.2	743.3	-38.5	-360.7	-399.2	-731.0
	2040	6.8	72%	111.5	28.6	24.5	11.0	17.5	164.0	28.3	89.2	578.7	2.6	45.4	385.4	715.9	-52.7	-277.8	-330.5	-1,061.5
	2041	10.7	115%	116.9	50.0	48.2	16.6	22.8	185.1	51.7	88.7	495.2	3.8	43.1	491.2	630.7	-50.4	-89.1	-139.5	-1,201.0
	2042	14.7	157%	133.9	214.1	264.4	44.2	285.3	439.2	87.9	87.0	233.7	31.6	53.1	1,469.1	405.5	-2.9	1,066.6	1,063.6	-137.4
	2043	6.4	69%	94.4	72.2	61.6	9.9	30.0	200.4	28.2	95.7	497.2	7.4	57.7	496.8	657.9	-1.5	-159.6	-161.1	-298.5
	2044	11.6	124%	104.0	150.0	153.5	45.8	160.9	311.7	52.3	90.8	377.4	26.0	59.9	978.2	554.0	7.1	417.1	424.2	125.7
	2045	8.5	91%	91.1	51.5	27.3	10.8	19.4	155.3	30.7	91.4	542.2	6.2	60.4	386.2	700.3	-5.6	-308.5	-314.1	-188.5
	2046	5.2	56%	96.9	23.9	15.2	11.0	17.7	167.9	19.2	90.8	628.1	3.5	54.1	351.8	776.5	-21.9	-402.8	-424.7	-613.2
	2047	7.3	78%	105.4	45.9	27.1	11.5	19.8	176.9	34.0	90.0	584.3	2.6	49.6	420.6	726.6	-29.2	-276.8	-306.0	-919.2
	2048	9.3	99%	109.9	89.7	49.0	13.4	26.6	191.0	39.9	89.4	434.3	4.4	47.6	519.5	575.8	-28.7	-27.6	-56.3	-975.5
	2049	10.7	114%	109.1	99.5	79.2	21.6	37.0	237.9	53.7	88.7	432.0	5.6	47.5	638.0	573.8	-23.3	87.5	64.2	-911.3
	2050	9.8	104%	109.1	55.6	51.4	12.7	23.9	174.4	44.9	88.5	488.7	7.0	46.8	471.9	631.0	-23.9	-135.2	-159.1	-1,070.4
	2051	8.1	86%	111.4	63.2	45.4	16.6	23.3	184.3	39.6	87.7	522.3	6.2	44.8	483.8	661.0	-30.8	-146.4	-177.2	-1,247.6
	2052	8.8	94%	114.4	80.1	71.5	20.8	34.1	209.6	27.5	87.3	422.3	6.1	43.5	558.0	559.3	-28.9	27.6	-1.3	-1,248.9
	2053	7.4	79%	113.2	54.0	48.6	10.1	25.2	202.8	37.7	86.9	551.4	5.4	42.9	491.6	686.5	-30.9	-164.1	-194.9	-1,443.8
	2054	13.7	147%	112.2	121.7	121.4	37.6	115.9	320.1	62.9	87.2	299.8	8.4	45.8	891.8	441.1	-13.4	464.1	450.7	-993.2
	2055	14.3	152%	110.2	164.9	163.3	45.8	180.4	317.2	76.3	88.9	304.9	28.8	54.6	1,058.2	477.3	11.1	569.8	580.9	-412.3
	2056	5.4	57%	97.3	42.5	26.7	10.6	19.5	159.2	14.3	94.4	543.2	6.7	54.9	370.1	699.1	-4.2	-324.8	-328.9	-741.2
	2057	7.8	83%	100.8	72.7	56.6	23.3	28.7	202.1	42.5	93.8	528.2	5.5	49.4	526.6	676.9	-11.7	-138.6	-150.3	-891.5
	2058	6.4	68%	104.1	56.8	42.0	20.9	24.6	196.9	25.4	93.2	548.4	5.8	46.5	470.6	694.0	-17.7	-205.6	-223.3	-1,114.8
	2059	11.4	122%	108.3	103.5	87.4	45.5	56.1	237.9	56.6	88.4	417.8	9.7	45.7	695.4	561.6	-12.0	145.7	133.7	-981.1
	2060	16.7	178%	110.5	168.4	166.3	36.5	180.5	307.6	98.4	89.4	297.4	29.5	53.2	1,068.3	469.6	10.6	588.1	598.7	-382.4
	2061	6.8	73%	95.4	67.4	42.2	9.9	25.4	181.7	16.3	92.7	477.3	8.8	55.7	438.4	634.6	1.0	-197.2	-196.2	-578.6
	2062	5.1	54%	97.8	47.9	29.2	11.5	19.8	169.6	15.6	92.3	545.0	6.0	50.4	391.5	693.7	-12.1	-290.1	-302.3	-880.8
	2063	4.5	48%	106.1	24.3	19.8	11.0	18.0	161.3	7.0	91.4	592.4	3.7	46.5	347.5	733.9	-23.2	-363.3	-386.4	-1,267.3
	2064	6.8	72%	115.3	28.5	24.5	11.0	18.2	164.0	28.3	90.3	578.3	2.6	43.4	389.9	714.6	-34.6	-290.1	-324.7	-1,592.0
	2065	10.7	115%	120.5	50.0	48.2	16.6	23.3	185.1	51.7	88.9	494.8	3.8	41.4	495.4	628.9	-38.4	-95.1	-133.5	-1,725.5
	2066	14.7	157%	137.2	215.0	264.4	44.2	285.7	439.4	87.9	87.1	233.6	31.2	50.8	1,473.9	402.7	6.5	1,064.6	1,071.2	-654.3
	2067	6.4	69%	97.4	72.4	61.6	9.9	30.3	200.6	28.2	95.7	498.2	7.4	54.7	500.4	656.1	6.0	-161.6	-155.6	-809.9
2068	11.6	124%	107.1	158.9	153.5	45.8	161.1	311.8	52.3	90.5	377.4	26.4	56.6	990.4	550.8	14.5	425.1	439.6	-370.4	
2069	8.5	91%	94.0	54.2	27.3	10.8	19.4	155.3	30.7	90.7	542.2	6.4	57.0	391.7	696.3	1.1	-305.8	-304.7	-675.1	
2070	5.2	56%	100.0	24.9	15.2	11.0	17.7	167.9	19.2	90.1	628.1	3.7	50.8	355.9	772.6	-15.2	-401.5	-416.8	-1,091.8	
2071	7.3	78%	108.9	46.9	27.1	11.5	19.8	176.9	34.0	89.1	584.3	2.8	46.5	425.1	722.7	-21.1	-276.6	-297.6	-1,389.4	
2072	9.3	99%	114.3	91.9	49.0	13.4	26.6	179.1	39.9	88.2	441.8	4.5	44.6	514.3	579.2	-19.3	-45.5	-64.8	-1,454.2	
	Maximum	16.7	178%	115.2	213.2	264.4	45.8	280.4	453.0	97.1	89.0	644.7	29.5	92.1	1,455.1	787.6	-2.7	993.7	907.6	
	Minimum	4.5	48%	82.0	24.3	19.8	9.9	17.2	163.3	6.8	75.1	325.9	3.7	49.7	344.2	501.2	-86.1	-394.4	-409.6	
	Average	9.5	101%	93.1	89.4	80.3	23.1	63.8	242.6	41.9	82.5	519.1	10.6	64.8	634.0	677.0	-36.8	-6.2	-43.0	
	% of Total		15%	14%	13%	4%	10%	38%	7%	12%	77%	2%	10%		</					

Table 3-11. Projected Annual Groundwater Budget Summary for the Mid-Kaweah Groundwater Sustainability Agency

Values in 1,000s Acre Feet

Water Year	Rainfall		Components of Inflow							Components of Outflow				Total Inflow	Total Outflow	Aquitard Storage Change	Aquifer Storage Change	Change in Storage	Cumulative Change in Storage
	Inches	% of Average	Subsurface Inflow	Streambed Percolation	Conveyance Losses (Canal and Ditch Recharge)	Mountain Front Recharge	Percolation of Recharge Basins	Percolation of Irrigation Water	Percolation of Precipitation (Crop and Non-Ag Land)	Groundwater Pumpage		Discharge to Surface Water	Subsurface Outflow						
										M & I GW Pumping	GW Pumping for Irrigated Agriculture								
2023	13.2	157%	118.1	65.5	119.6	0.0	119.3	127.1	14.9	55.1	38.6	0.0	188.3	564.5	282.0	-57.3	339.8	282.5	282.5
2024	8.0	95%	121.6	23.9	16.2	0.0	11.5	34.7	6.2	55.6	132.3	0.0	148.5	214.1	336.4	-37.5	-84.9	-122.3	160.2
2025	9.2	110%	114.5	28.3	30.3	0.0	18.2	55.3	8.7	56.0	116.1	0.0	140.9	255.3	313.0	-31.6	-26.1	-57.6	102.6
2026	9.2	110%	112.2	15.4	10.8	0.0	10.0	33.0	7.8	56.6	131.2	0.0	126.5	189.2	314.3	-27.1	-98.0	-125.2	-22.6
2027	7.0	84%	111.1	15.4	13.7	0.0	11.1	36.8	6.4	57.2	145.6	0.0	119.0	194.5	321.8	-32.7	-94.6	-127.2	-149.8
2028	7.4	89%	109.8	21.8	24.4	0.0	15.7	45.7	3.3	57.8	110.2	0.0	116.9	220.7	285.0	-29.5	-34.8	-64.3	-214.1
2029	6.7	80%	106.7	13.1	18.7	0.0	13.1	38.4	6.5	58.1	151.7	0.0	107.7	196.6	317.5	-26.5	-94.5	-120.9	-335.0
2030	12.7	151%	111.0	36.5	62.9	0.0	69.2	71.5	10.5	58.7	66.1	0.0	123.4	361.7	248.2	-18.1	131.5	113.5	-221.6
2031	12.9	154%	125.2	53.2	79.0	0.0	80.4	65.2	11.5	59.9	57.3	0.0	148.6	414.5	265.9	-8.0	156.6	148.6	-73.0
2032	4.2	50%	113.2	11.5	7.8	0.0	10.3	32.0	1.8	60.9	132.6	0.0	124.3	176.6	317.8	-9.4	-131.9	-141.2	-214.2
2033	6.7	80%	108.0	19.8	18.0	0.0	13.6	43.8	6.3	61.4	127.6	0.0	115.0	209.5	304.0	-13.6	-80.9	-94.4	-308.7
2034	5.4	65%	109.8	13.1	14.4	0.0	12.5	36.5	4.0	61.8	144.9	0.0	105.2	190.3	311.9	-17.1	-104.6	-121.7	-430.3
2035	10.2	122%	116.9	31.6	33.1	0.0	30.7	45.8	9.2	62.3	107.6	0.0	107.8	267.4	277.7	-17.1	6.8	-10.3	-440.7
2036	15.2	182%	136.7	55.4	80.0	0.0	81.7	71.8	16.9	63.6	56.0	0.0	135.1	442.6	254.7	-7.9	195.8	187.9	-252.8
2037	6.1	73%	129.1	18.7	13.4	0.0	12.6	34.1	2.3	64.6	134.9	0.0	116.5	210.2	316.0	-8.5	-97.4	-105.8	-358.6
2038	4.6	55%	122.2	12.5	8.9	0.0	11.6	32.9	2.3	64.9	135.4	0.0	103.3	190.5	303.6	-13.0	-100.2	-113.2	-471.8
2039	4.0	47%	112.7	4.5	6.4	0.0	11.3	31.5	1.5	65.0	133.1	0.0	92.8	167.8	290.9	-19.3	-103.8	-123.1	-594.9
2040	6.2	74%	107.3	5.7	6.6	0.0	11.5	32.4	5.3	65.0	134.5	0.0	85.0	168.8	284.5	-25.4	-90.3	-115.7	-710.6
2041	8.9	107%	111.1	11.3	13.7	0.0	13.4	35.4	7.4	64.5	141.2	0.0	80.1	192.3	285.9	-26.5	-67.1	-93.6	-804.2
2042	13.2	157%	143.8	66.4	119.6	0.0	122.4	127.1	14.9	65.5	37.9	0.0	137.0	594.1	240.3	-10.0	363.8	353.8	-450.4
2043	5.9	71%	136.1	22.0	21.7	0.0	16.9	41.0	4.8	67.7	115.6	0.0	111.2	242.5	294.5	-5.4	-46.7	-52.0	-502.5
2044	11.0	131%	141.6	48.2	71.5	0.0	64.7	73.4	9.0	69.1	80.0	0.0	127.6	408.3	276.6	-2.2	133.9	131.7	-370.8
2045	7.9	94%	132.8	13.6	6.4	0.0	11.9	30.3	5.5	69.8	130.9	0.0	108.6	200.5	309.3	-5.2	-103.5	-108.7	-479.5
2046	5.0	60%	119.3	4.1	6.0	0.0	12.0	31.5	4.1	69.2	131.8	0.0	95.3	176.9	296.3	-10.1	-109.4	-119.4	-598.9
2047	6.1	73%	113.4	11.5	8.9	0.0	12.5	33.3	5.7	68.4	137.3	0.0	88.5	185.4	294.2	-13.4	-95.4	-108.8	-707.7
2048	8.0	95%	120.1	19.7	16.2	0.0	14.7	33.7	6.2	67.7	130.7	0.0	84.6	210.7	283.0	-15.6	-56.6	-72.3	-780.0
2049	9.2	110%	124.9	26.9	30.3	0.0	21.3	54.0	8.7	67.1	114.2	0.0	87.9	266.1	269.1	-14.8	11.8	-3.0	-783.0
2050	9.2	110%	128.9	14.9	10.8	0.0	12.9	32.5	7.7	66.9	132.4	0.0	82.9	207.7	282.2	-14.9	-59.6	-74.4	-857.5
2051	7.0	84%	129.4	15.2	13.7	0.0	13.9	36.1	6.4	66.1	145.2	0.0	80.2	214.6	291.5	-18.3	-58.5	-76.8	-934.3
2052	7.4	89%	130.2	21.6	24.4	0.0	18.3	44.9	3.3	65.6	108.7	0.0	82.9	242.7	257.3	-17.7	3.1	-14.6	-948.9
2053	6.7	80%	129.4	13.1	18.7	0.0	15.6	37.8	6.4	65.2	151.5	0.0	79.2	221.1	295.9	-18.0	-56.8	-74.8	-1,023.7
2054	12.7	151%	133.3	36.3	62.9	0.0	71.5	71.2	10.5	65.6	65.1	0.0	96.1	385.7	226.7	-11.6	170.6	159.0	-864.8
2055	12.9	154%	143.2	52.7	79.0	0.0	82.5	64.8	11.5	67.3	56.2	0.0	120.0	433.7	243.5	-1.3	191.6	190.3	-674.5
2056	4.2	50%	131.4	11.5	7.8	0.0	12.3	31.5	1.8	68.3	132.5	0.0	98.6	196.2	299.5	-4.5	-98.8	-103.3	-777.8
2057	6.7	80%	126.1	19.9	18.0	0.0	15.4	43.3	6.3	67.8	126.5	0.0	92.8	229.0	287.1	-7.2	-50.9	-58.1	-835.9
2058	5.4	65%	128.1	13.2	14.4	0.0	14.0	36.2	4.0	67.3	144.7	0.0	86.7	210.0	298.7	-9.4	-79.4	-88.7	-924.6
2059	10.2	122%	134.6	31.6	33.1	0.0	32.1	45.5	9.2	66.8	106.6	0.0	92.5	286.1	265.9	-8.5	28.8	20.3	-904.4
2060	15.2	182%	151.3	55.3	80.0	0.0	82.9	71.8	16.9	67.7	55.4	0.0	119.9	458.1	243.0	-0.5	215.7	215.1	-689.2
2061	6.1	73%	141.3	18.6	13.4	0.0	13.7	33.8	2.3	68.5	134.1	0.0	102.5	223.0	305.1	-2.2	-79.9	-82.1	-771.4
2062	4.6	55%	133.4	12.5	8.9	0.0	12.5	32.9	2.3	68.0	135.9	0.0	91.9	202.6	295.9	-6.2	-87.2	-93.3	-864.7
2063	4.0	47%	123.9	4.5	6.4	0.0	12.0	31.5	1.4	67.1	133.8	0.0	84.0	179.8	285.0	-9.7	-95.6	-105.3	-970.0
2064	6.2	74%	117.5	5.8	6.6	0.0	12.1	32.4	5.3	66.1	134.0	0.0	78.4	179.6	278.5	-14.5	-84.4	-98.9	-1,068.9
2065	8.9	107%	120.0	11.3	13.7	0.0	13.9	35.3	7.4	64.6	140.8	0.0	75.1	201.6	280.6	-18.5	-60.5	-78.9	-1,147.8
2066	13.2	157%	150.0	66.2	119.6	0.0	122.7	127.3	14.9	65.5	37.8	0.0	130.9	600.7	234.2	-3.6	370.1	366.5	-781.3
2067	5.9	71%	140.5	21.9	21.7	0.0	17.2	41.3	4.8	67.8	116.7	0.0	104.4	247.3	288.8	-0.2	-41.3	-41.5	-822.9
2068	11.0	131%	145.8	52.8	71.5	0.0	64.8	73.4	9.0	68.8	79.9	0.0	123.0	417.3	271.7	2.9	142.8	145.7	-677.2
2069	7.9	94%	136.0	15.1	6.4	0.0	11.9	30.3	5.5	69.0	130.9	0.0	104.0	205.2	304.0	-0.6	-98.2	-98.8	-776.0
2070	5.0	60%	122.6	3.7	6.0	0.0	12.0	31.5	4.1	68.4	131.8	0.0	91.2	179.8	291.5	-5.4	-106.2	-111.6	-887.6
2071	6.1	73%	117.5	11.9	8.9	0.0	12.5	33.3	5.7	67.5	137.3	0.0	85.5	189.8	290.3	-7.8	-92.7	-100.5	-988.1
2072	8.0	95%	122.9	20.1	16.2	0.0	14.7	33.7	6.2	66.6	129.4	0.0	82.7	213.8	278.6	-9.0	-55.8	-64.8	-1,052.8
2023-2039	Maximum	15.2	182%	136.7	65.5	119.6	0.0	119.3	127.1	65.0	151.7	0.0	188.3	564.5	336.4	-7.9	339.8	282.5	
	Minimum	4.0	47%	106.7	4.5	6.4	0.0	10.0	31.5	55.1	38.6	0.0	92.8	167.8	248.2	-57.3	-131.9	-141.2	
	Average	8.4	100%	116.4	25.9	32.8	0.0	31.4	49.2	60.0	113.0	0.0	124.7	262.7	297.7	-22.0	-13.0	-35.0	
% of Total			44%	10%	12%	0.0	12%	19%	3%	20%	38%	0%	42%						
2040-2070	Maximum	15.2	182%	151.3	66.4	119.6	0.0	122.7	127.3	69.8	151.5	0.0	137.0	600.7	309.3	2.9	370.1	366.5	
	Minimum	4.0	47%	107.3	3.7	6.0	0.0	11.5											

3.4.4.3 Subbasin Projected Land Surface Budgets

The projected land surface budgets are summarized in Table 3-12.

Major differences between the current land surface budget and the projected land surface budgets incorporating climate change include the following:

- Applied groundwater is projected to decrease by an average annual volume of 196,500 AF for WY 2023-2039, and 241,600 AF for WY 2040-2070.
- Evapotranspiration is projected to decrease by an average annual volume of 93,800 AF for WY 2023-2039 and 152,425 AF for WY 2040-2070.
- Percolation from precipitation is projected to increase from the current period by 47,200 AF for WY 2023-2039 and 4,200 AF for WY 2040-2070. It will decrease from the historical period by 8,100 AF for WY 2040-2070.
- Percolation from recharge basins is projected to increase by an average annual volume of 5,000 AF for WY 2023-2039 and 4,700 AF for WY 2040-2070.

Implementation of management actions to reduce groundwater pumping results in reduced ET, applied groundwater, and percolation of applied water. Implementation of additional recharge basin projects results in increased percolation to groundwater.

3.4.4.4 Uncertainties in Projected Water Budget Simulations

While significant uncertainty exists regarding the prediction of climatic conditions, the 2030 and 2070 central tendency scenarios provided by DWR are considered best available science at the time the GSP was developed and can be used to adequately describe likely future conditions for SGMA planning and implementation (DWR, 2018). As described by DWR, there is an approximately equal likelihood that actual future conditions will be more stressful or less stressful than those described by the recommended scenarios, therefore these conditions provide a solid middle ground on which to examine future groundwater sustainability with climate change. Further specifics regarding uncertainty in projected water budget simulations are described in the climate change guidance released by DWR (DWR, 2018). As climate change science improves and newer data becomes available, DWR will release revised projected climate change datasets to be used in future GSP updates.

Table 3-12. Projected Land Surface Budgets Summary for Kaweah Subbasin (WY 2023 – WY 2072)

Values in 1,000s Acre-Feet

Water Year	Rainfall		Components of Inflow				Components of Outflow					Total Inflow	Total Outflow
	Inches	% of Average	Precipitation	Applied Groundwater	Applied Surface Water	Percolation of Recharge Basins	Percolation of Irrigation Water	Percolation of Precipitation (Crop and Non-Ag Land)	Evapotranspiration Applied Water	Evapotranspiration Precipitaion	Percolation of Recharge Basins		
2023	14.7	157%	538.3	354.0	730.3	280.4	453.0	84.6	631.3	453.6	280.4	1,902.9	1,902.9
2024	9.3	99%	338.9	557.9	232.9	23.1	205.6	37.4	585.2	301.5	23.1	1,152.8	1,152.8
2025	10.7	114%	391.1	549.8	332.1	33.7	262.8	50.9	619.2	340.2	33.7	1,306.7	1,306.7
2026	9.8	104%	358.5	595.4	192.6	20.7	198.2	41.5	589.8	317.0	20.7	1,167.1	1,167.1
2027	8.1	86%	295.2	628.9	208.9	20.3	209.0	37.3	628.8	257.9	20.3	1,153.2	1,153.2
2028	8.8	94%	321.0	518.6	315.1	31.2	230.0	24.6	603.7	296.4	31.2	1,185.9	1,185.9
2029	7.4	79%	271.9	644.7	232.2	22.5	224.3	35.6	652.6	236.3	22.5	1,171.4	1,171.4
2030	13.7	147%	503.4	367.6	492.7	113.4	333.2	58.9	527.1	444.4	113.4	1,477.0	1,477.0
2031	14.3	152%	521.7	365.6	509.1	178.1	328.6	72.5	546.1	449.2	178.1	1,574.5	1,574.5
2032	5.4	57%	195.6	611.2	145.3	17.3	175.0	13.0	581.5	182.6	17.3	969.4	969.4
2033	7.8	83%	285.1	587.1	222.8	26.7	214.8	41.1	595.1	244.0	26.7	1,121.8	1,121.8
2034	6.4	68%	233.2	599.6	216.5	22.8	208.2	24.2	608.0	209.0	22.8	1,072.2	1,072.2
2035	11.4	122%	417.6	456.0	339.4	54.6	245.1	55.3	550.4	362.3	54.6	1,267.7	1,267.7
2036	16.7	178%	611.4	325.9	508.9	179.2	312.8	97.1	522.0	514.4	179.2	1,625.4	1,625.4
2037	6.8	73%	250.4	501.0	224.5	24.2	186.8	15.4	538.6	235.0	24.2	1,000.1	1,000.1
2038	5.1	54%	186.4	561.1	163.2	18.8	173.3	15.4	551.0	171.1	18.8	929.5	929.5
2039	4.5	48%	163.7	601.0	122.5	17.2	163.3	6.8	560.1	156.9	17.2	904.3	904.3
2040	6.8	72%	247.7	578.7	125.4	17.5	164.0	28.3	540.2	219.5	17.5	969.5	969.5
2041	10.7	115%	391.6	495.2	212.7	22.8	185.1	51.7	522.8	340.0	22.8	1,122.3	1,122.3
2042	14.7	157%	538.3	233.7	732.9	285.3	439.2	87.9	527.3	450.4	285.3	1,790.1	1,790.1
2043	6.4	69%	235.8	497.2	293.1	30.0	200.4	28.2	589.9	207.6	30.0	1,056.1	1,056.1
2044	11.6	124%	424.8	377.4	487.2	160.9	311.7	52.3	552.9	372.5	160.9	1,450.4	1,450.4
2045	8.5	91%	312.3	542.2	119.3	19.4	155.3	30.7	506.2	281.6	19.4	993.3	993.3
2046	5.2	56%	191.8	628.1	113.9	17.7	167.9	19.2	574.1	172.6	17.7	951.5	951.5
2047	7.3	78%	265.7	584.3	162.9	19.8	176.9	34.0	570.3	231.6	19.8	1,032.6	1,032.6
2048	9.3	99%	338.9	434.3	249.9	26.6	191.0	39.9	493.3	299.0	26.6	1,049.8	1,049.8
2049	10.7	114%	391.1	432.0	333.6	37.0	237.9	53.7	527.8	337.4	37.0	1,193.8	1,193.8
2050	9.8	104%	358.5	488.7	194.0	23.9	174.4	44.9	508.4	313.6	23.9	1,065.1	1,065.1
2051	8.1	86%	295.2	522.3	210.3	23.3	184.3	39.6	548.2	255.6	23.3	1,051.0	1,051.0
2052	8.8	94%	321.0	422.3	316.5	34.1	209.6	27.5	529.2	293.5	34.1	1,094.0	1,094.0
2053	7.4	79%	271.9	551.4	233.6	25.2	202.8	37.7	582.2	234.2	25.2	1,082.1	1,082.1
2054	13.7	147%	503.4	299.8	493.9	115.9	320.1	62.9	473.7	440.4	115.9	1,413.0	1,413.0
2055	14.3	152%	521.7	304.9	510.3	180.4	317.2	76.3	498.0	445.4	180.4	1,517.4	1,517.4
2056	5.4	57%	195.6	543.2	146.4	19.5	159.2	14.3	530.4	181.3	19.5	904.7	904.7
2057	7.8	83%	285.1	528.2	223.9	28.7	202.1	42.5	550.0	242.7	28.7	1,066.0	1,066.0
2058	6.4	68%	233.2	548.4	217.6	24.6	196.9	25.4	569.1	207.8	24.6	1,023.8	1,023.8
2059	11.4	122%	417.6	417.8	340.4	56.1	237.9	56.6	520.3	361.0	56.1	1,231.9	1,231.9
2060	16.7	178%	611.4	297.4	509.7	180.5	307.6	98.4	499.6	513.0	180.5	1,599.1	1,599.1
2061	6.8	73%	250.4	477.3	225.2	25.4	181.7	16.3	520.8	234.1	25.4	978.3	978.3
2062	5.1	54%	186.4	545.0	163.9	19.8	169.6	15.6	539.3	170.8	19.8	915.1	915.1
2063	4.5	48%	163.7	592.4	123.1	18.0	161.3	7.0	554.1	156.8	18.0	897.2	897.2
2064	6.8	72%	247.7	578.3	126.0	18.2	164.0	28.3	540.2	219.5	18.2	970.1	970.1
2065	10.7	115%	391.6	494.8	213.1	23.3	185.1	51.7	522.8	340.0	23.3	1,122.9	1,122.9
2066	14.7	157%	538.3	233.6	733.2	285.7	439.4	87.9	527.3	450.4	285.7	1,790.7	1,790.7
2067	6.4	69%	235.8	498.2	293.3	30.3	200.6	28.2	590.9	207.6	30.3	1,057.6	1,057.6
2068	11.6	124%	424.8	377.4	487.3	161.1	311.8	52.3	552.9	372.5	161.1	1,450.5	1,450.5
2069	8.5	91%	312.3	542.2	119.3	19.4	155.3	30.7	506.2	281.6	19.4	993.3	993.3
2070	5.2	56%	191.8	628.1	113.9	17.7	167.9	19.2	574.1	172.6	17.7	951.5	951.5
2071	7.3	78%	265.7	584.3	162.9	19.8	176.9	34.0	570.3	231.6	19.8	1,032.6	1,032.6
2072	9.3	99%	338.9	441.8	230.6	26.6	179.1	39.9	493.3	299.0	26.6	1,037.9	1,037.9
Maximum	16.7	178%	611.4	644.7	730.3	280.4	453.0	97.1	652.6	514.4	280.4	1,902.9	1,902.9
Minimum	4.5	48%	163.7	325.9	122.5	17.2	163.3	6.8	522.0	156.9	17.2	904.3	904.3
Average	9.5	101%	346.1	519.1	305.2	63.8	242.6	41.9	581.8	304.2	63.8	1,234.2	1,234.2
% of Total			28%	42%	25%	5%	20%	3%	47%	25%	5%		
Maximum	16.7	178%	611.4	628.1	733.2	285.7	439.4	98.4	590.9	513.0	285.7	1,790.7	1,790.7
Minimum	4.5	48%	163.7	233.6	113.9	17.5	155.3	7.0	473.7	156.8	17.5	897.2	897.2
Average	9.1	97%	332.1	474.0	284.7	63.5	221.9	41.6	536.9	290.5	63.5	1,154.3	1,154.3
% of Total			29%	41%	25%	5%	19%	4%	47%	25%	5%		

3.4.5 Water Budget Summary

The historical, current, and projected water budgets summarize overall groundwater conditions, and the benefits of groundwater management activities on groundwater sustainability in the Subbasin.

The current groundwater budget shows an average annual aquifer storage loss of 230,000 AFY. Recharge projects and demand management actions are already being implemented in the Subbasin and it is imperative they be expanded soon to achieve sustainable groundwater conditions and limit land subsidence during the GSP implementation period.

For the projected water budget, the Subbasin's implementation of projects and pumping reductions results in a modest, increase in groundwater storage in the aquifer of about 3,000 AF/year. The elimination of overdraft, along with avoiding URs, demonstrates that projects and management actions planned by all 3 GSAs are sufficient to achieve sustainability during the GSP implementation period. Projections are based on the assumed future hydrology, surface water availability and conditions in neighboring Subbasins.

3.4.6 Sustainable Yield

The sustainable yield of the Subbasin is an estimate of the quantity of groundwater that can be pumped on a long-term average annual basis without causing URs. Basin-wide pumping within the sustainable yield estimate is neither a measure of, nor proof of, sustainability. Sustainability under SGMA is only demonstrated by avoiding URs for the applicable sustainability indicators. However, estimates of sustainable yield using the current and projected simulations may prove useful in estimating the need for projects and management actions to help achieve and maintain sustainability.

The role of sustainable yield estimates in SGMA, as described in the Sustainable Management Criteria (SMC) BMP (DWR, 2017), are as follows:

"In general, the sustainable yield of a basin is the amount of groundwater that can be withdrawn annually without causing undesirable results. Sustainable yield is referenced in SGMA as part of the estimated basin-wide water budget and as the outcome of avoiding undesirable results.

Sustainable yield estimates are part of SGMA's required basin-wide water budget. Section 354.18(b)(7) of the GSP Regulations requires that an estimate of the basin's sustainable yield be provided in the GSP (or in the coordination agreement for basins with multiple GSPs). A single value of sustainable yield must be calculated basin-wide. This sustainable yield estimate can be helpful for estimating the projects and programs needed to achieve sustainability."

The Kaweah GSAs used results from the GSP implementation model scenario to estimate sustainable yield; using the projected average groundwater pumping between 2023 and 2070. This predictive groundwater model scenario incorporates planned projects and management actions that maintain groundwater elevations at levels that avoid URs for all applicable sustainability indicators. The projected groundwater levels fluctuate in response to climatic variation, but display no long-term rising or falling trends, indicating no significant change in aquifer storage between 2023 and 2070. Based on this approach, the sustainable yield for the Subbasin is 578,000 AFY: the volume of pumping projected between 2023 and 2070 that results in no long-term change in storage.

3.5 Management Areas

§ 354.20. Management Areas

- (a) Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin.
- (b) A basin that includes one or more management areas shall describe the following in the Plan:
 - (1) The reason for the creation of each management area.
 - (2) The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large.
 - (3) The level of monitoring and analysis appropriate for each management area.
 - (4) An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable.
- (c) If a Plan includes one or more management areas, the Plan shall include descriptions, maps, and other information required by this Subarticle sufficient to describe conditions in those areas.

MKGSA has established 3 management areas within the GSAs boundaries consisting of the respective jurisdictional areas of MKGSA's 3 Members: the City of Visalia, City of Tulare, and TID. They are depicted on Figure 3-21.

Reasons for the creation of the 3 management areas include the following:

- Each Member of the MKGSA is a separate public agency. The 2 incorporated municipalities are charter cities with the ability to enact laws distinct from those adopted by the State. The agricultural area is administered by an independent special district.
- As distinct public agencies, the GSA Members have differing means of raising funds to comply with SGMA and abilities to implement the projects and management actions described in Chapter 6 of this GSP.
- Water sources vary among Members. Visalia and Tulare rely exclusively on groundwater, whereas TID has local and imported surface water to supplement

groundwater uses of its landowners. TID also diverts its surface water supplies for groundwater recharge purposes, particularly in wet years. Furthermore, Visalia's water supply system is owned and operated by Cal Water Service, while Tulare's water supply system is under City ownership and operation.

- Financial contributions by each Member toward projects may depend on an evaluation of existing water management agreements among them and on the water accounting framework (Section 6.2) which will define the water budget components of each Member. These contributions may not be equal and would therefore vary depending on the management area.
- Management actions by each Member may differ due to varying water supply sources, participation in projects, and other available resources.
- Tulare and Visalia have exclusively urban demands including municipal, industrial, commercial, and residential uses, while TID serves exclusively irrigated agricultural demands and related uses. Small-system and domestic wells also exist within the TID service area, but these types of wells are not prevalent within the confines of the cities.
- Each Member has maintained an existing groundwater monitoring program for differing purposes and time periods. While these programs are incorporated into a common platform for DWR annual reporting purposes, these programs continue to be somewhat distinct.
- Visalia benefits from percolation from the St. Johns River branch of the Kaweah River flanking its northerly boundary, whereas Tulare and TID do not receive direct percolation from the larger natural water courses in the Subbasin.

Cal Water Service wells serving Visalia are generally tapping the unconfined aquifer system east of the Corcoran Clay, whereas Tulare's well field overlies this clay layer and pumps from the confined aquifer. Newer wells serving recently annexed portions of Visalia along its westerly boundary do produce from semi-confined/confined zones. Both systems pump on a year-round basis and static groundwater level conditions are rarely reached. A permanent cone of depression exists under Tulare due to year-round pumping. To avoid future subsidence URs in the confined lower aquifer, predictive groundwater model simulations indicate that the City of Tulare needs to transition its pumping from the lower to the upper aquifers above the Corcoran Clay.

The TID and City of Tulare management areas contain DACs, the presence of which may dictate unique management actions to address localized URs. The City of Tulare is classified as a DAC. A description of DACs within the MKGSA area is provided in Section 2.1. Should DAC's sustainability needs within TID dictate a more focused management effort, consideration may be given to designating additional management areas therein if warranted.

Methods for monitoring in Chapter 4 and establishing SMC in Chapter 5 for each management area are consistent across management areas.

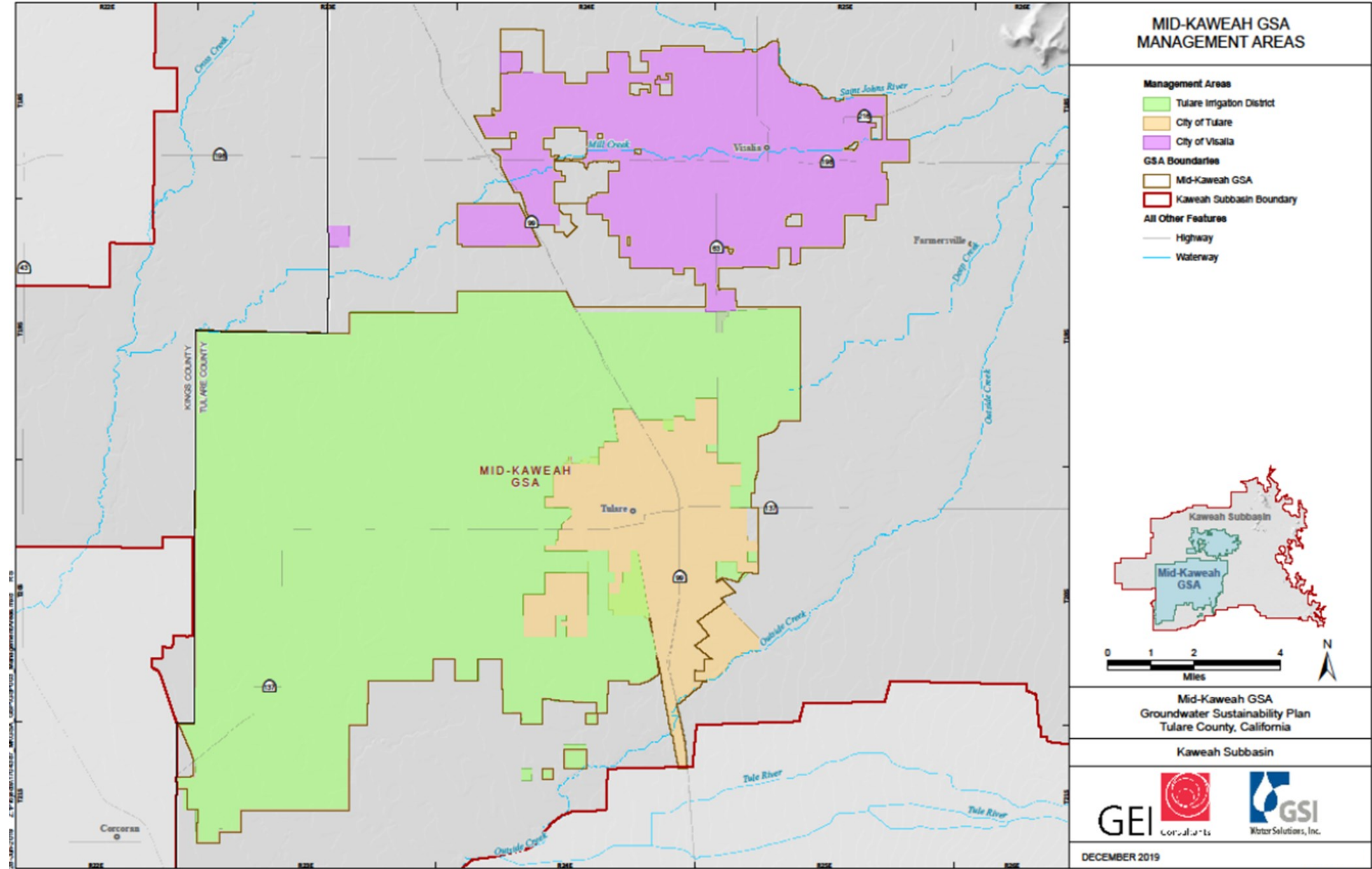


Figure 3-21. MKGSA Management Areas

4 MONITORING NETWORKS

§354.32 Introduction to Monitoring Networks. This Subarticle describes the monitoring network that shall be developed for each basin, including monitoring objectives, monitoring protocols, and data reporting requirements. The monitoring network shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.

Monitoring is a fundamental component of a groundwater management program. It is the method by which progress toward reaching MOs and the goal of groundwater sustainability is measured. Figure 4-1 includes the sustainability indicators required for compliance with SGMA monitoring and reporting requirements. This chapter discusses the current monitoring network(s) and will identify current data gaps and propose measures to address these gaps in areas where the current monitoring network does not meet SGMA objectives.

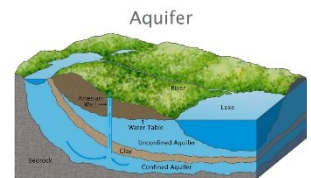
Groundwater Levels:

Monitoring of static groundwater levels each spring and fall



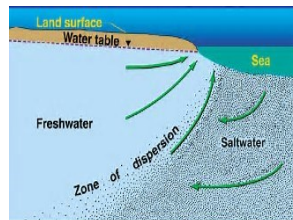
Groundwater Storage:

Estimated annual change in groundwater storage based on groundwater levels



Seawater Intrusion:

Intrusion of seawater into local aquifers. Not applicable to the MKGSA



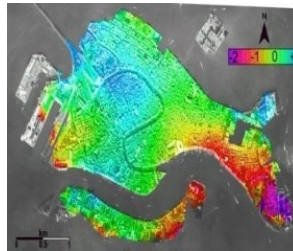
Water Quality:

Monitoring for water quality degradation that could impact available groundwater supplies.



Land Subsidence:

Surface land subsidence caused by groundwater withdrawals.



Depletion of Interconnected Surface Water:

Loss of permanent connections between surface water and groundwater. Not applicable to the MKGSA



Figure 4-1. Sustainable Indicator Monitoring

This chapter describes the existing and developing monitoring networks in the MKGSA that collect data to determine short-term, seasonal, and long-term trends in groundwater conditions and related surface conditions. The data collected from the monitoring networks provides necessary information to support the implementation of this GSP, evaluates its effectiveness, and serve as a guide for decisions made by MKGSA management.

4.1 Kaweah Subbasin Representative Monitoring Network

§354.34 Monitoring Network.

- (b) Each Plan shall include a description of the monitoring network objectives for the basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:
- (1) Demonstrate progress toward achieving measurable objectives described in the Plan.
 - (2) Monitor impacts to the beneficial uses or users of groundwater.
 - (3) Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.
 - (4) Quantify annual changes in water budget components.

4.1.1 Monitoring Network Objectives

The objectives of the various Subbasin-wide monitoring programs include the following:

1. Establish a baseline for future monitoring
2. Provide warning of potential future problems
3. Use data gathered to generate information for water resources evaluation
4. Help quantify annual changes in water budget components
5. Develop meaningful long-term trends in groundwater characteristics
6. Provide comparable data from various places in the MKGSA area
7. Demonstrate progress toward achieving MOs described in the GSP
8. Monitor changes in groundwater conditions relative to MTs
9. Monitor impacts to the beneficial uses or users of groundwater

The requirements for monitoring the groundwater levels will initially be fulfilled by utilizing existing monitoring programs and data from public wells. Throughout the Subbasin, there are several programs that currently monitor and report groundwater levels to DWR on a semiannual basis. The MKGSA will use these established monitoring points as the framework for the monitoring network and expand and improve upon it through the implementation of the GSP. Whenever possible, water quality will be monitored in conjunction with water level monitoring in an effort to develop a more robust groundwater quality data set. Where groundwater level monitoring is to occur in private wells, the MKGSA plans to seek landowner approval to use the wells in the monitoring network for water quality monitoring. The subsidence monitoring network will utilize available existing data sets and points in addition to adding several monitoring locations on key infrastructure within the MKGSA.

The following sections include descriptions of the monitoring networks within the MKGSA that will be utilized to meet the criteria for the 5 sustainability indicators present: groundwater levels, groundwater storage, water quality, land subsidence, and depletion of ISW. The adequacy of the monitoring network is discussed for each sustainability indicator, as well as the quantitative values for the MTs, MOs, and interim milestones. The sections also include a review of each monitoring network for site selection, monitoring frequency and density, identification of data gaps, and the current plans to fill data gaps. This information will be reviewed and evaluated during each 5-year assessment.

4.1.2 Adequacy of Monitoring Network

When evaluating the adequacy of the monitoring network, 3 general types of data gaps will be considered:

1. Temporal: A temporal data gap indicates that there is an insufficient frequency of monitoring. For instance, data may only be available for a well in the Fall since it is rarely idle in the Spring. In addition, a privately owned well may have sporadic access due to locked security fencing, roaming dogs, change in ownership, etc.
2. Spatial: Spatial data gaps occur when there is an insufficient number or density of monitoring sites in a specific area.
3. Quality: Data may be available but be of poor or questionable accuracy. Poor data can lead to incorrect assumptions or biases, creating more inaccuracies than if no data had been collected at all. The data may not appear consistent with other data in the area, or with past readings at the monitoring site. The monitoring site may not meet all the desired criteria to provide reliable data, such as having information on perforation depth, etc.

Improving the monitoring network(s) will aim to follow the Data Quality Objective (DQO) process that follows the EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006). The DQO process is also outlined in the DWR's Best Management Practices for Monitoring Networks (2016a) and Monitoring Protocols (2016b). Leaning on this DQO process intends to help facilitate a repeatable and robust approach to collecting data with a specific goal in mind.

The Subbasin has developed and will continue to maintain a Data Management System (DMS) for storing and reporting information for the implementation of this GSP. Specifically, the monitoring network data is collected and compiled into 1 central data system that can be easily referenced and displayed when needed. More information on the DMS is available in Section 7.3.

4.1.3 Representative Monitoring Network Maps

Maps of the Kaweah Subbasin Representative Monitoring Networks are provided on Figure 4-2 for groundwater levels, Figure 4-3 for land subsidence, Figure 4-4 for groundwater quality, and Figure 4-5 for ISW. Note that the RMS shown on Figure 4-5 for ISW are all outside of the MKGSA because there is no ISW in the MKGSA.

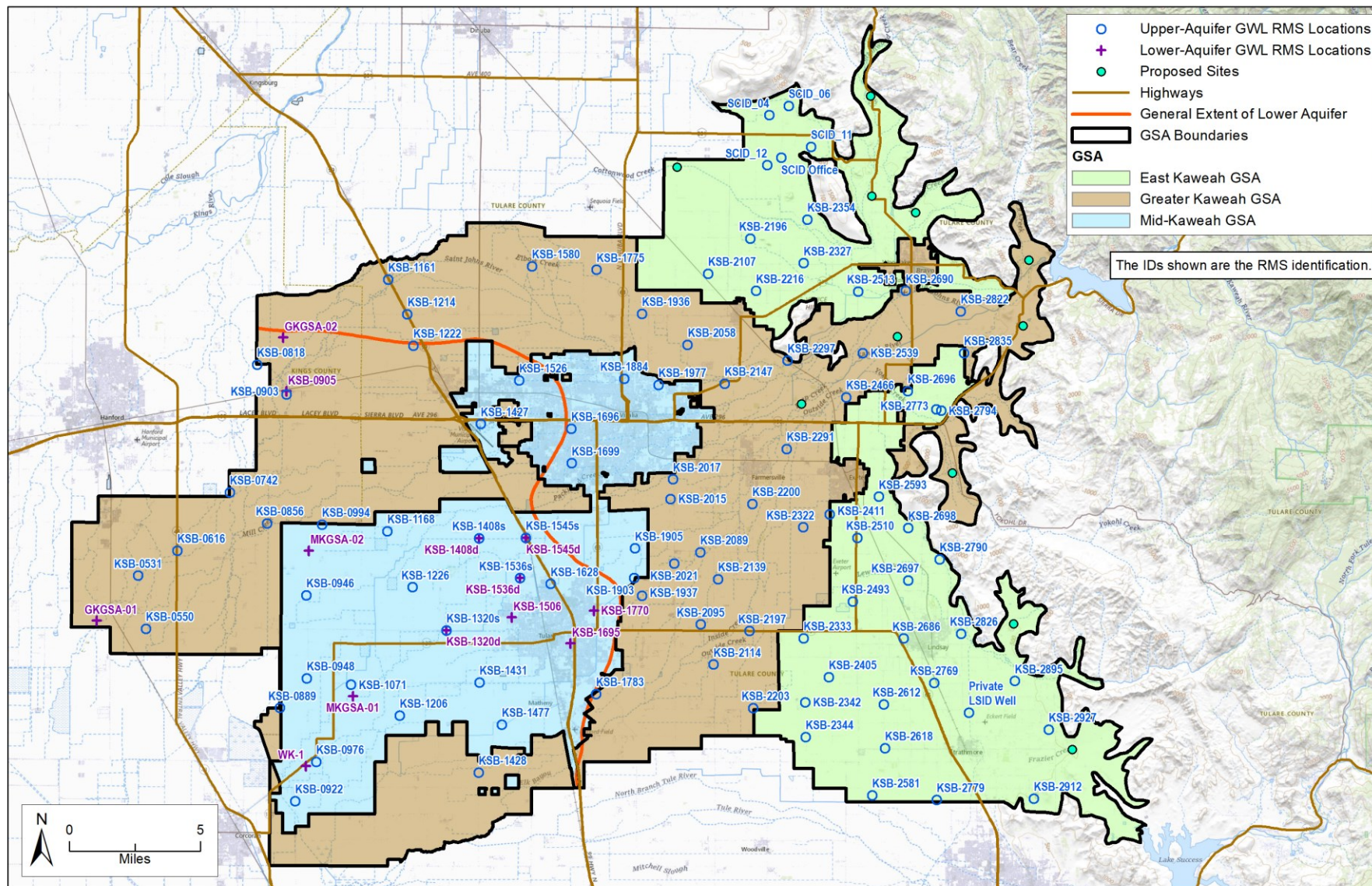


Figure 4-2 Kaweah Subbasin Groundwater Levels Representative Monitoring Network

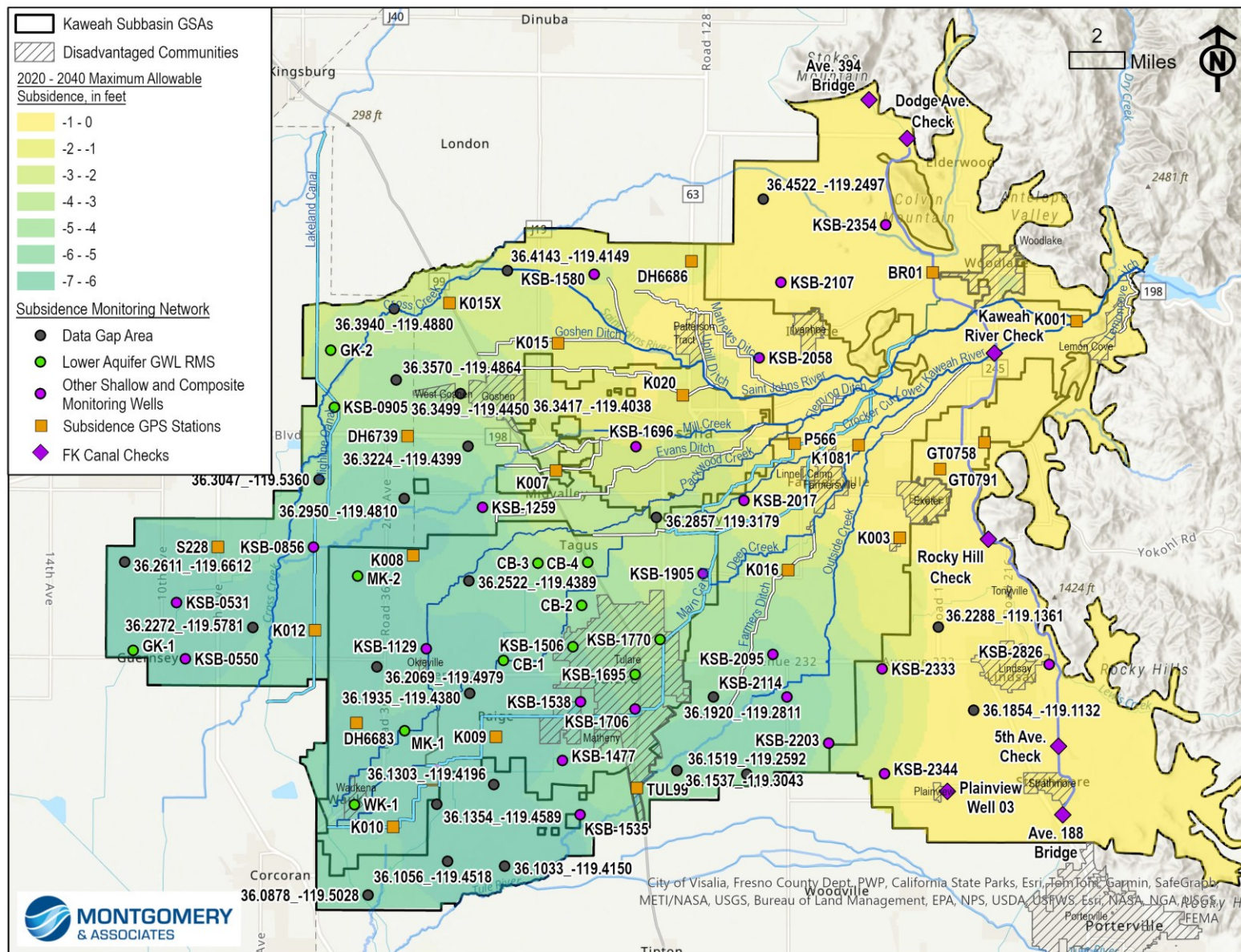


Figure 4-3. Kaweah Subbasin Land Subsidence Representative Monitoring Network

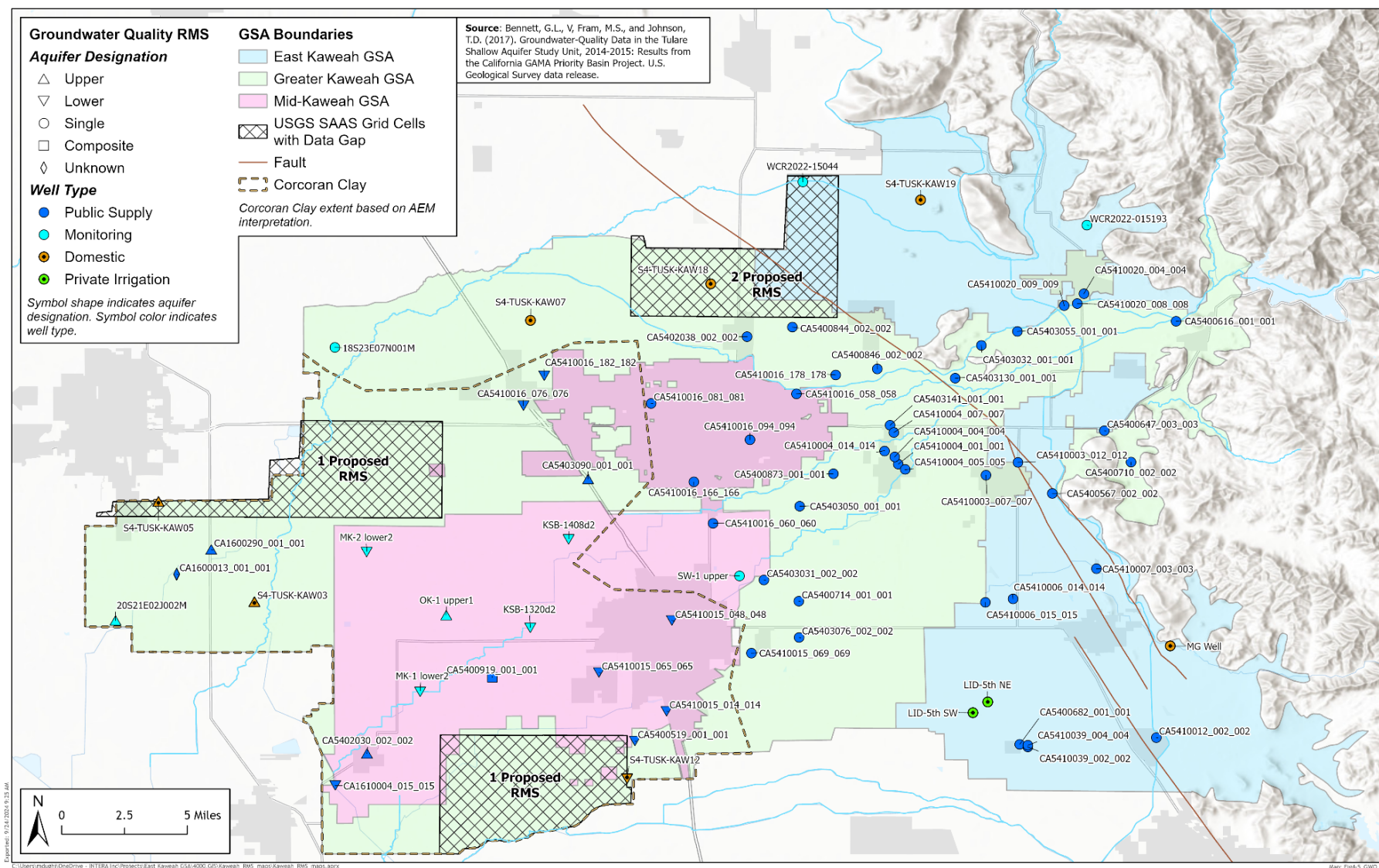


Figure 4-4 Kaweah Subbasin Groundwater Quality Representative Monitoring Network

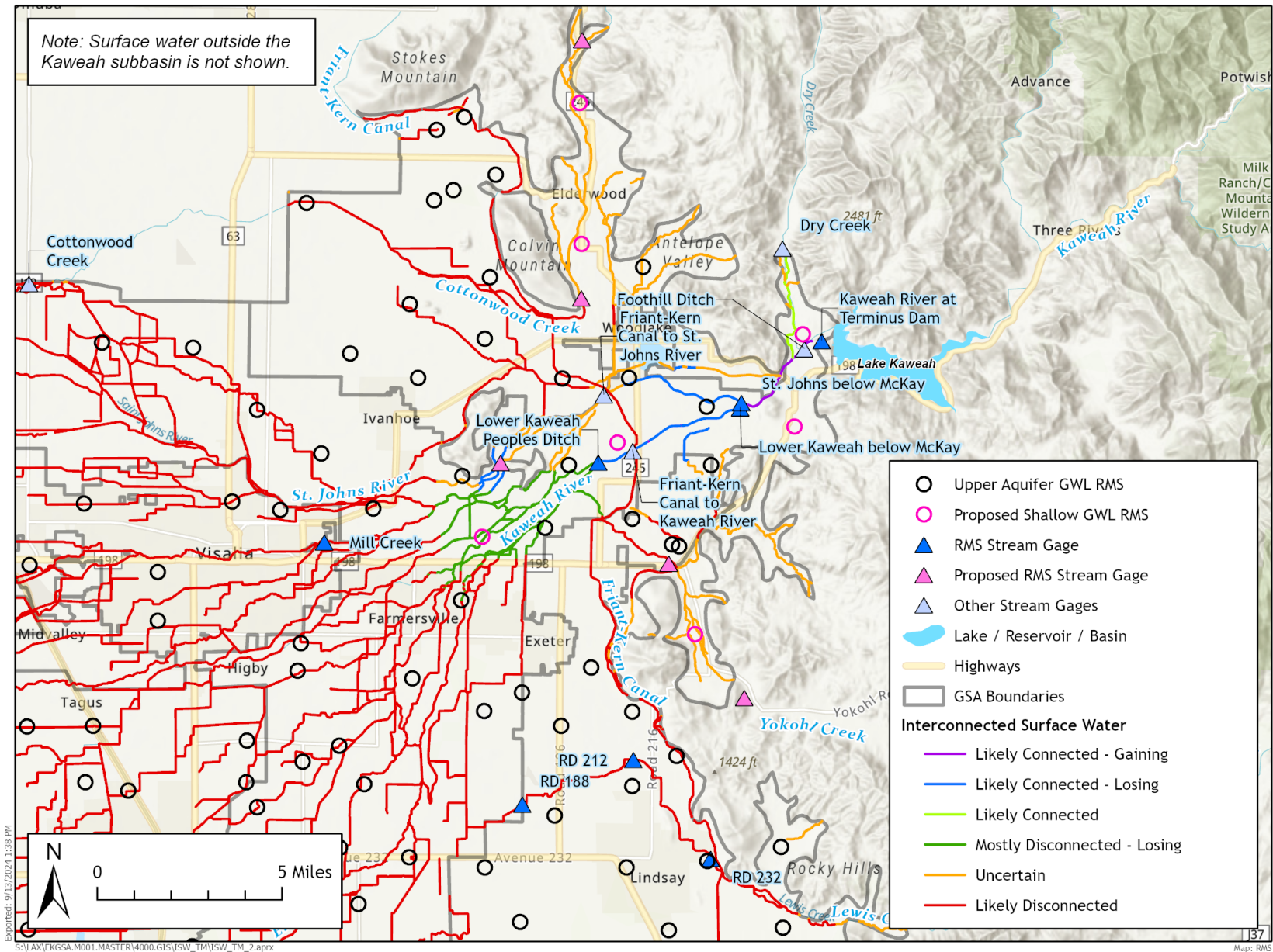


Figure 4-5. Interconnected Surface Water Representative Monitoring Network

4.1.4 Representative Monitoring Site Summary

A summary of the Subbasin’s RMS networks is provided in Table 4-1 for groundwater level, in Table 4-2 for land subsidence, and in Table 4-3 for groundwater quality.

Table 4-1 Summary of RMS in Kaweah Subbasin for Groundwater Levels

Representative Monitoring Site ID	GSA	Aquifer Designation
KSB-0922	Mid-Kaweah	Upper
KSB-0946	Mid-Kaweah	Upper
KSB-0948	Mid-Kaweah	Upper
KSB-0976	Mid-Kaweah	Upper
KSB-0994	Mid-Kaweah	Upper
KSB-1071	Mid-Kaweah	Upper
KSB-1168	Mid-Kaweah	Upper
KSB-1206	Mid-Kaweah	Upper
KSB-1226	Mid-Kaweah	Upper
KSB-1320d	Mid-Kaweah	Lower
KSB-1320s	Mid-Kaweah	Upper
KSB-1408d	Mid-Kaweah	Lower
KSB-1408s	Mid-Kaweah	Upper
KSB-1427	Mid-Kaweah	Upper
KSB-1431	Mid-Kaweah	Upper
KSB-1477	Mid-Kaweah	Upper
KSB-1506	Mid-Kaweah	Lower
KSB-1526	Mid-Kaweah	Upper
KSB-1536d	Mid-Kaweah	Lower
KSB-1536s	Mid-Kaweah	Upper
KSB-1545d	Mid-Kaweah	Lower
KSB-1545s	Mid-Kaweah	Upper
KSB-1628	Mid-Kaweah	Upper
KSB-1695	Mid-Kaweah	Lower
KSB-1696	Mid-Kaweah	Upper
KSB-1699	Mid-Kaweah	Upper
KSB-1770	Mid-Kaweah	Lower
KSB-1884	Mid-Kaweah	Single
KSB-1903	Mid-Kaweah	Upper
KSB-1905	Mid-Kaweah	Upper
KSB-1977	Mid-Kaweah	Single
MKGSA-01	Mid-Kaweah	Lower
MKGSA-02	Mid-Kaweah	Lower
WK-1	Mid-Kaweah	Lower

Representative Monitoring Site ID	GSA	Aquifer Designation
KSB-2107	East Kaweah	Single
KSB-2187	East Kaweah	Single
KSB-2196	East Kaweah	Single
KSB-2216	East Kaweah	Single
KSB-2226	East Kaweah	Single
KSB-2281	East Kaweah	Single
KSB-2327	East Kaweah	Single
KSB-2333	East Kaweah	Single
KSB-2342	East Kaweah	Single
KSB-2344	East Kaweah	Single
KSB-2354	East Kaweah	Single
KSB-2369	East Kaweah	Single
KSB-2405	East Kaweah	Single
KSB-2493	East Kaweah	Single
KSB-2510	East Kaweah	Single
KSB-2513	East Kaweah	Single
KSB-2581	East Kaweah	Single
KSB-2593	East Kaweah	Single
KSB-2612	East Kaweah	Single
KSB-2618	East Kaweah	Single
KSB-2686	East Kaweah	Single
KSB-2696	East Kaweah	Single
KSB-2697	East Kaweah	Single
KSB-2698	East Kaweah	Single
KSB-2769	East Kaweah	Single
KSB-2773	East Kaweah	Single
KSB-2779	East Kaweah	Single
KSB-2790	East Kaweah	Single
KSB-2794	East Kaweah	Single
KSB-2826	East Kaweah	Single
KSB-2835	East Kaweah	Single
KSB-2895	East Kaweah	Single
KSB-2912	East Kaweah	Single
KSB-2927	East Kaweah	Single
Private LSID Well	East Kaweah	Upper
SCID Office	East Kaweah	Single
GKGSA-01	Greater Kaweah	Lower
GKGSA-02	Greater Kaweah	Lower
KSB-0531	Greater Kaweah	Upper
KSB-0550	Greater Kaweah	Upper
KSB-0616	Greater Kaweah	Upper

Representative Monitoring Site ID	GSA	Aquifer Designation
KSB-0742	Greater Kaweah	Upper
KSB-0818	Greater Kaweah	Upper
KSB-0856	Greater Kaweah	Upper
KSB-0889	Greater Kaweah	Upper
KSB-0903	Greater Kaweah	Upper
KSB-0905	Greater Kaweah	Lower
KSB-1161	Greater Kaweah	Upper
KSB-1214	Greater Kaweah	Upper
KSB-1222	Greater Kaweah	Upper
KSB-1428	Greater Kaweah	Upper
KSB-1580	Greater Kaweah	Single
KSB-1775	Greater Kaweah	Single
KSB-1783	Greater Kaweah	Upper
KSB-1936	Greater Kaweah	Single
KSB-1937	Greater Kaweah	Upper
KSB-2015	Greater Kaweah	Single
KSB-2017	Greater Kaweah	Single
KSB-2021	Greater Kaweah	Single
KSB-2058	Greater Kaweah	Single
KSB-2089	Greater Kaweah	Single
KSB-2095	Greater Kaweah	Single
KSB-2114	Greater Kaweah	Single
KSB-2139	Greater Kaweah	Single
KSB-2147	Greater Kaweah	Single
KSB-2197	Greater Kaweah	Single
KSB-2200	Greater Kaweah	Single
KSB-2203	Greater Kaweah	Single
KSB-2291	Greater Kaweah	Single
KSB-2297	Greater Kaweah	Single
KSB-2322	Greater Kaweah	Single
KSB-2411	Greater Kaweah	Single
KSB-2466	Greater Kaweah	Single
KSB-2539	Greater Kaweah	Upper
KSB-2690	Greater Kaweah	Single
KSB-2822	Greater Kaweah	Single

Table 4-2 Summary of RMS in Kaweah Subbasin for Land Subsidence

Representative Monitoring Site ID	Groundwater Sustainability Agency
36.1935_-119.4380	Mid-Kaweah
36.2069_-119.4979	Mid-Kaweah
36.2522_-119.4389	Mid-Kaweah
36.2857_-119.3179	Mid-Kaweah
36.3417_-119.4038	Mid-Kaweah
KSB-1320d (CB-1)	Mid-Kaweah
KSB-1536d (CB-2)	Mid-Kaweah
KSB-1408d (CB-3)	Mid-Kaweah
KSB-1545d (CB-4)	Mid-Kaweah
DH6683	Mid-Kaweah
K007	Mid-Kaweah
K008	Mid-Kaweah
K009	Mid-Kaweah
K010	Mid-Kaweah
K020	Mid-Kaweah
KSB-1129	Mid-Kaweah
KSB-1477	Mid-Kaweah
KSB-1506	Mid-Kaweah
KSB-1538	Mid-Kaweah
KSB-1695	Mid-Kaweah
KSB-1696	Mid-Kaweah
KSB-1706	Mid-Kaweah
KSB-1770	Mid-Kaweah
KSB-1905	Mid-Kaweah
MKGSA-1 (MK-1)	Mid-Kaweah
MKGSA-2 (MK-2)	Mid-Kaweah
TUL99	Mid-Kaweah
WK-1	Mid-Kaweah
36.1854_-119.1132	East Kaweah
36.2288_-119.1361	East Kaweah
36.4522_-119.2497	East Kaweah
5th Ave. Check	East Kaweah
Ave. 188 Bridge	East Kaweah
Ave. 394 Bridge	East Kaweah
BR01	East Kaweah
Dodge Ave. Check	East Kaweah
GT0758	East Kaweah

Representative Monitoring Site ID	Groundwater Sustainability Agency
GT0791	East Kaweah
KSB-2107	East Kaweah
KSB-2333	East Kaweah
KSB-2344	East Kaweah
KSB-2354	East Kaweah
KSB-2826	East Kaweah
Plainview Well 03	East Kaweah
Rocky Hill Check	East Kaweah
36.0878_-119.5028	Greater Kaweah
36.1033_-119.4150	Greater Kaweah
36.1056_-119.4518	Greater Kaweah
36.1303_-119.4196	Greater Kaweah
36.1354_-119.4589	Greater Kaweah
36.1519_-119.2592	Greater Kaweah
36.1537_-119.3043	Greater Kaweah
36.1920_-119.2811	Greater Kaweah
36.2272_-119.5781	Greater Kaweah
36.2611_-119.6612	Greater Kaweah
36.2950_-119.4810	Greater Kaweah
36.3047_-119.5360	Greater Kaweah
36.3224_-119.4399	Greater Kaweah
36.3499_-119.4450	Greater Kaweah
36.3570_-119.4864	Greater Kaweah
36.3940_-119.4880	Greater Kaweah
36.4143_-119.4149	Greater Kaweah
DH6686	Greater Kaweah
DH6739	Greater Kaweah
GKGSA-1 (GK-1)	Greater Kaweah
GKGSA-2 (GK-2)	Greater Kaweah
K001	Greater Kaweah
K003	Greater Kaweah
K012	Greater Kaweah
K015	Greater Kaweah
K015X	Greater Kaweah
K016	Greater Kaweah
K1081	Greater Kaweah
Kaweah River Check	Greater Kaweah
KSB-0531	Greater Kaweah
KSB-0550	Greater Kaweah

Representative Monitoring Site ID	Groundwater Sustainability Agency
KSB-0856	Greater Kaweah
KSB-0905	Greater Kaweah
KSB-1259	Greater Kaweah
KSB-1535	Greater Kaweah
KSB-1580	Greater Kaweah
KSB-2017	Greater Kaweah
KSB-2058	Greater Kaweah
KSB-2095	Greater Kaweah
KSB-2114	Greater Kaweah
KSB-2203	Greater Kaweah
P566	Greater Kaweah
S228	Greater Kaweah

Table 4-3 Summary of Subbasin Representative Monitoring Wells for Groundwater Quality

Representative Monitoring Site ID	Other ID	Owner ID	USGS Grid Cell #	GSA	Well Use Type	Aquifer Designation	Well Depth (bgs)	Depth of Bottom Perforation (bgs)
CA5400919_001_001	5400919-001	WELL 01	11	MKGSA	Public Supply	Composite	220	-
CA5410015_014_014	5410015-014	WELL 14	13	MKGSA	Public Supply	Lower	700	300
CA5410015_048_048	5410015-048	WELL 34	14	MKGSA	Public Supply	Lower	652	450
CA5410015_065_065	5410015-065	WELL 42	11	MKGSA	Public Supply	Lower	-	-
CA5410016_058_058	5410016-058	WELL 50-01	17	MKGSA	Public Supply	Single	270	150
CA5410016_060_060	5410016-060	WELL 52-01	15	MKGSA	Public Supply	Single	310	180
CA5410016_081_081	5410016-081	WELL 64-01	17	MKGSA	Public Supply	Single	400	190
CA5410016_094_094	5410016-094	WELL 82-01	16	MKGSA	Public Supply	Single	580	280
CA5410016_166_166	5410016-166	WELL 55-02	16	MKGSA	Public Supply	Single	570	196
KSB-1408d2	-	KSB-1408d2	9	MKGSA	Monitoring	Lower	490	490
KSB-1320d2	-	KSB-1320d2	10	MKGSA	Monitoring	Lower	540	540
MK-1 lower2	-	MK-1 lower2	2	MKGSA	Monitoring	Lower	450	450
MK-2 lower2	-	MK-2 lower2	4	MKGSA	Monitoring	Lower	420	420
SW-1 upper	-	SW-1 upper	15	MKGSA	Monitoring	Single	250	250-
OK-1 upper1	-	OK-1 upper1	10	MKGSA	Monitoring	Upper	230	230
CA5402030_002_002	5402030-002	WELL 02	1	MKGSA	Public Supply	Upper	400	200
CA5400567_002_002	5400567-002	WELL 02 - MIDDLE - ALFRED ST.	28	EKGSA	Public Supply	Single	105	-
CA5400647_003_003	5400647-003	WELL 03 - SOUTH	28	EKGSA	Public Supply	Single	140	90
CA5400682_001_001	5400682-001	WELL 01	25	EKGSA	Public Supply	Single	320	220
CA5410006_014_014	5410006-014	WELL 14 (WALKER WELL) - RAW	23	EKGSA	Public Supply	Single	405	285
CA5410012_002_002	-	-	26	EKGSA	Public Supply	Single	323	125
CA5410039_002_002	5410039-002	SOUTH WELL - RAW	25	EKGSA	Public Supply	Single	448	240
CA5410039_004_004	5410039-004	WELL 03 - RAW	25	EKGSA	Public Supply	Single	560	245

Representative Monitoring Site ID	Other ID	Owner ID	USGS Grid Cell #	GSA	Well Use Type	Aquifer Designation	Well Depth (bgs)	Depth of Bottom Perforation (bgs)
CA5410007_003_003	5410007-003	NORTH LINDSAY HEIGHTS WELL - (NO3)	27	EKGSA	Public Supply	Single	-	226
MG Well	-	MG Well	27	EKGSA	Domestic	Single	-	-
WCR2022-015193	WCR2022-015193	NE Target 2	30	EKGSA	Monitoring	Single	75	75
WCR2022-15044	WCR2022-15044	Cottonwood Creek	18	EKGSA	Monitoring	Single	410	410
LID-5th NE	-	LID-5th NE	24	EKGSA	Private Irrigation	Single	-	-
LID-5th SW	-	LID-5th SW	24	EKGSA	Private Irrigation	Single	-	-
CA5410006_015_015	5410006-015	WELL 15 (CITY WELL)	23	EKGSA	Public Supply	Single	510	210
CA1600013_001_001	-	-	3	GKGSA	Public Supply	Unknown	-	-
CA1600290_001_001	-	-	4	GKGSA	Public Supply	Upper	290	-
CA5400519_001_001	5400519-001	WELL 01	13	GKGSA	Public Supply	Lower	300	150
CA5400616_001_001	5400616-001	WELL 01 - MCKAY'S POINT	29	GKGSA	Public Supply	Single	158	68
CA5400710_002_002	5400710-002	WELL 02 - SOUTH	28	GKGSA	Public Supply	Single	121	69
CA5400714_001_001	5403031-002	WELL 01	14	GKGSA	Public Supply	Single	400	320
CA5400844_002_002	5400844-002	WELL 02	17	GKGSA	Public Supply	Single	285	-
CA5400846_002_002	5400846-002	WELL 02	21	GKGSA	Public Supply	Single	220	-
CA5400873_001_001	5400873-001	WELL 01	16	GKGSA	Public Supply	Single	-	-
CA5402038_002_002	5402038-001	WELL 02 EAST	17	GKGSA	Public Supply	Single	-	-
CA5403031_002_002	5403031-001	WELL 02 - STANDBY	15	GKGSA	Public Supply	Single	360	180
CA5403032_001_001	5403032-001	WELL 8	20	GKGSA	Public Supply	Single	220	140
CA5403050_001_001	5402027-001	WELL 02	15	GKGSA	Public Supply	Single	130	-
CA5403055_001_001	5403055-001	WELL 01	20	GKGSA	Public Supply	Single	175	25
CA5403076_002_002	5403076-002	WELL 02	14	GKGSA	Public Supply	Single	400	200
CA5403090_001_001	5403090-001	WELL 01	9	GKGSA	Public Supply	Upper	275	175
CA5403130_001_001	5403130-001	WELL 01	21	GKGSA	Public Supply	Single	100	80
CA5403141_001_001	5403141-001	WELL 01	21	GKGSA	Public Supply	Single	300	-

Representative Monitoring Site ID	Other ID	Owner ID	USGS Grid Cell #	GSA	Well Use Type	Aquifer Designation	Well Depth (bgs)	Depth of Bottom Perforation (bgs)
CA5410003_007_007	5410003-007	WELL E11W	22	GKGSA	Public Supply	Single	405	150
CA5410003_012_012	5410003-012	WELL E12W	22	GKGSA	Public Supply	Single	600	320
CA5410004_001_001	5410004-001	WELL 01A	22	GKGSA	Public Supply	Single	219	192
CA5410004_004_004	5410004-004	WELL 04A	22	GKGSA	Public Supply	Single	235	150
CA5410004_005_005	5410004-005	WELL 05A	22	GKGSA	Public Supply	Single	300	156
CA5410004_007_007	5410004-007	WELL 07A	21	GKGSA	Public Supply	Single	300	150
CA5410004_014_014	5410004-014	WELL 08A	21	GKGSA	Public Supply	Single	670	310
CA5410015_069_069	5410015-069	WELL 044	14	GKGSA	Public Supply	Single	-	-
CA5410016_076_076	-	WELL 69-01	8	GKGSA	Public Supply	Lower	405	300
CA5410016_178_178	5410016-178	WELL 33-02 (OAKRCH)	17	GKGSA	Public Supply	Single	-	-
CA5410016_182_182	5410016-182	WELL 95-01	8	GKGSA	Public Supply	Lower	-	-
CA5410020_004_004	5410020-004	WELL 08	30	GKGSA	Public Supply	Single	175	100
CA5410020_008_008	5410020-008	WELL 12	29	GKGSA	Public Supply	Single	195	100
CA5410020_009_009	5410020-009	WELL 13	29	GKGSA	Public Supply	Single	-	-
18S23E07N001M	18S23E07N001M	GKGSA-02	6	GKGSA	Monitoring	Single	-	-
20S21E02J002M	20S21E02J002M	GKGSA-01	2	GKGSA	Monitoring	Upper	-	-
CA1610004_015_015	1610004-015	WELL 06A	1	GKGSA	Public Supply	Lower	1130	590
S4-TUSK-KAW03	361300119340001	S4-TUSK-KAW03	3	GKGSA	Domestic	Upper	260	260
S4-TUSK-KAW19	362700119110002	S4-TUSK-KAW19	19	GKGSA	Domestic	Single	183	-
S4-TUSK-KAW18	362400119180001	S4-TUSK-KAW18	18	GKGSA	Domestic	Single	220	220
S4-TUSK-KAW07	362300119240001	S4-TUSK-KAW07	7	GKGSA	Domestic	Single	370	370
S4-TUSK-KAW05	361700119370001	S4-TUSK-KAW05	5	GKGSA	Domestic	Upper	160	160
S4-TUSK-KAW12	360700119210001	S4-TUSK-KAW12	13	GKGSA	Domestic	Lower	300	300

4.1.5 Monitoring Frequency of Representative Monitoring Network

A summary of the monitoring frequency for each sustainability indicator is provided in Table 4-4.

Table 4-4. Representative Monitoring Frequency by Sustainability Indicator.

Sustainability Indicator	Monitoring Type	Monitoring Frequency	Frequency of Reporting to DWR	Note
Groundwater Levels	Groundwater Level Representative Monitoring Wells	Bi-Annually <i>Seasonal High (Spring - March)</i> <i>Seasonal Low (Fall – October)</i>	Bi-Annually	MKGSA Plans to improve data gaps through the Well Registration Program, a new management action.
Land Subsidence	Subsidence Representative Monitoring Sites & InSAR data	Annually	Annually	As new technologies, such as InSAR have become available, subsidence is no longer a data gap in the EKGSA.
Groundwater Quality	Groundwater Quality Representative Monitoring Well	Twice per year (or more frequently pending on the Exceedance Policy). See Figure 4-15	Annually	MKGSA Plans to improve data gaps through the Well Registration Program, a new management action.
Groundwater Storage Change	Groundwater Elevation Change Contours	Annually	Annually	Both cumulative and annual change in groundwater storage are evaluated. The monitoring data is sourced from the groundwater level representative monitoring network.
Interconnected Surface Water	Representative Monitoring Stream Gages	Monthly	Annually	The shallow groundwater level monitoring from the groundwater level RMS are used to supplement the analyses and monitoring for interconnected surface water

4.2 Existing Monitoring Networks and Programs

Monitoring programs—a fundamental component of groundwater management and also required for SGMA compliance—help measure progress toward groundwater sustainability. Monitoring programs are needed that monitor impacts to beneficial users and uses, such as groundwater level, land subsidence, and groundwater quality monitoring. Existing monitoring programs, included in this subsection, contain a description of their SGMA compliance and history and

adequacy for the MKGSA Monitoring Network. Additional information is also available in the Kaweah Subbasin Setting document in Appendix 3A. In general, groundwater levels have been monitored at least semi-annually and groundwater quality has been monitored annually. Where viable, these existing monitoring networks have been incorporated into the GSP monitoring networks to comply with monitoring network requirements for SGMA.

The MKGSA is actively working on expanding its monitoring network including adding new dedicated monitoring wells, installing low flow water sampling devices in the wells, and installing a benchmark system that is used to measure land subsidence.

4.2.1 Existing Groundwater Level Monitoring

Groundwater elevations are monitored by individual local agencies (e.g., water districts) and regional agencies. Table 4-5 presents a summary of the groundwater monitoring in the MKGSA. The data collected by these agencies and historical trends are described in the Kaweah Subbasin Basin Setting Report (Appendix 3A). Table 4-1 shows many of these monitoring programs have a long history. Groundwater levels within the MKGSA have historically mainly been monitored mainly by TID with records going back to 1945.

Table 4-5. Existing Groundwater Level Monitoring Summary

Agency	Frequency of Monitoring	Period of Record for Monitoring	Types of Wells Monitored	Number of Wells (Approx.)	Known Completion of Wells Monitored	Number of Multi-Completion Wells
Bureau of Reclamation	Monthly to bi-annually	1924 – 2008	Unknown	118	15	Unknown
Cal Water (City of Visalia)	Monthly	1971 – present	Municipal	104	None	Unknown
City of Tulare	Monthly to bi-annually	1992 – present	Municipal	30	11	None
Dept of Water Resources	Bi-annually	1930 – 2016	Various	182	7	Unknown
KDWCD	Monthly to bi-Annually	1919 – present	Agricultural	425	30	4
Kings County Water District	Bi-annually	2011 – present	Agricultural	6	3	Unknown
Lakeside ID	Bi-annually	2012 – present	Agricultural	33	2	Unknown
Tulare ID	Bi-annually	1945 – present	Agricultural	146	18	8

Many of the redundant and disjointed pre-SGMA groundwater level monitoring programs ceased when the SGMA groundwater monitoring program was developed and implemented by the GSAs in the Kaweah Subbasin.

4.2.2 Existing Land Subsidence Monitoring

The existing land subsidence monitoring network was established in the original *Groundwater Sustainability Plan: Mid-Kaweah Groundwater Sustainability Agency* (MKGSA, 2019). Most subsidence monitoring stations are part of the Kaweah Delta Water Conservation District (KDWCD) Land Surface Elevation monitoring network, which consists of 31 monitoring stations throughout the Kaweah Subbasin and the neighboring subbasins. Vertical measurement accuracy is within +/- 0.01 feet. A total of 9 stations are located within the MKGSA area and 4 stations are located just beyond the MKGSA boundary (< 0.5 mile). In addition, 2 continuous GPS stations are located on either side of the MKGSA area, including 1 on the east side within 0.5 mile of the boundary and 1 near the southwestern corner within 2 miles. These 2 GPS stations are located in proximity to 2 KDWCD stations (~1 mile or less). Another subsidence station is located at the office of TID and is being monitored by KDWCD and Caltrans and information from this station will be incorporated into MKGSAs annual reporting and 5-year Periodic Evaluation. Table 4-6 provides a summary of historical and recent land subsidence monitoring programs in the MKGSA and the Kaweah Subbasin.

TID has developed a Subsidence Monitoring Network consisting of 24 survey markers on key structures throughout the irrigation district where potential subsidence may be occurring. TID uses in-house, survey-grade equipment to annually monitor the survey markers for potential subsidence impacts to infrastructure, particularly irrigation district distribution facilities.

Table 4-6. Historical and Recent Subsidence Monitoring

Category	Monitoring Entity (Entities)	Period of Record
Historical Monitoring	National Geodetic Survey of benchmarks (repeat level surveys)	1926 to 1970
Recent Monitoring	National Geodetic Survey of benchmarks (repeat level surveys). Installation and measurement of Deer Creek extensometer (8.5 miles south of Kaweah Subbasin, in the Tule Subbasin)	1970 to present
	KDWCD Land Surface Elevation Monitoring (local benchmark monitoring network)	2016 to present
	UNAVCO and CVSRN CGPS stations: P056, P566, CRCN, LEMA, and RAPT	2006 to present (depending on station)
	NASA Jet Propulsion Laboratory (JPL) and USGS and others (InSAR and UAVSAR programs)	2007 to 2010 2015 to present
	TID Subsidence Monitoring Benchmarks	2022 to present

4.2.3 Existing Groundwater Quality Monitoring

Most of the wells in Kaweah are used for agricultural or domestic purposes. Agricultural wells are monitored by the well operators to ensure crop productivity. These monitoring records are typically kept private and are not public information. Water quality monitoring of drinking water sources has been performed by PWS under the California Safe Drinking Water Act and overseen by the Division of Drinking Water (DDW). PWS are defined by California Health & Safety Code § 116275(h) as systems that have either 15 or more service connections or serve at least 25 individuals daily at least 60 days out of the year. Private domestic wells serving 1 to 4 connections are not subject to any water quality regulation. Additional testing may be done if a site has specific constituents of concern that need to be monitored. Some limited data is available in smaller communities that include clusters of domestic wells.

Groundwater quality monitoring and reporting are currently conducted through numerous public agencies. The following subsections provide a summary of databases, programs, and agencies that actively collect groundwater data, provide information on where the data are stored, and how they were used in the development of the Basin Setting for the GSP, development of the Kaweah Subbasin Representative Groundwater Quality Monitoring Network, and the degradation of groundwater quality SMC.

The groundwater quality monitoring network is being enhanced by adding dedicated monitoring wells to track regional trends and to serve as a warning system for changes in groundwater quality. In the MKGSA, there are currently 8 new multi-completion monitoring well locations with 18 well completions; 2 more multi-completion monitoring locations will soon be added in Okieville, adding 4 more monitoring wells to the network. The dedicated monitoring wells are equipped with pneumatic bladder pumps to retrieve water quality samples.

A summary of these programs is provided in Table 4-7.

Table 4-7. Existing Groundwater Quality Monitoring Programs in the Kaweah Subbasin

Programs or Data Portals	Parameters	Frequency	Objectives	Notes
AB-3030 and SB-1938	Water levels are typically monitored annually An Ag Suitability analysis (limited suite of general minerals) monitoring frequency between annual to once every 3 years.	Semiannual to Annual		Monitoring is recommended as a part of groundwater management planning. Data availability is inconsistent between Districts.
ILRP	Annually: static water level, temperature, pH, electrical conductivity, nitrate as nitrogen, and dissolved oxygen. Once every 5 years, general minerals will be collected.	Annual Every 5 years	Monitor impacts of agricultural and fertilizer applications on first encountered groundwater	Sampling will begin in Fall 2018 with a limited number of wells sampled. The program will be expanded and may incorporate a shared sampling program with SGMA.
CV-SALTS	Sampling parameters required through WDR's: typically include monthly sodium, chloride, electrical conductivity, nitrogen species (N, NO ₂ , NO ₃ , NH ₃), pH and other constituents of concern identified in the Report of Waste Discharge. A limited suite of general minerals is required quarterly from the source and annual from the wastewater.	Most constituents sampled monthly, quarterly general minerals from source water and annual general minerals from waste discharge Kaweah is a Priority 1 Basin, meaning that management strategies will be initiated in 2019.	To monitor degradation potential from wastewaters discharged to land application areas.	Water quality monitoring required by CV-SALTS is consistent with the Regional Water Boards existing requirements through their Waste Discharge Requirements process. It is unlikely that additional monitoring will be required. The initial phases of the program are strongly focused on identifying sources of salinity and reducing salinity and nitrogen species in wastewaters discharged to land. By 2030, the program is expected to implement projects to aid with salt and nitrate management in the Central Valley.
SDWIS	Database for all public water system wells and historical sample results. Data available includes all Title 22 regulated constituents.	Title 22 General Minerals and Metals every 3 years; Nitrate as N annually, if ≥ 5 ppm, sampled quarterly; VOCs and SOCs sampled every 3 years; Uranium sampling depends on historical results, varies between 1 sample every 3 (when	Demonstrate compliance with Drinking Water Standards through monitoring and reporting water quality data.	An abundant source of data because of the required testing frequency and list of parameters.

Programs or Data Portals	Parameters	Frequency	Objectives	Notes
		≥ 10 pCi/L), 6 (when < 10 pCi/L) or 9 (no historical detection) years.		
GAMA. Collaboration with SWQCB, RWQCB, DWR, DPR, NWIS, LLNL	Constituents sampled vary by the Program Objectives. Typically, USGS is the technical lead in conducting the studies and reporting data.	The priority basin project performed baseline and trend assessments sampling over 2,900 public and domestic wells that represent 95% of the groundwater resources in CA. The Domestic Well Project sampled over 180 domestic wells in Tulare County: 29 Wells were within the Kaweah Subbasin.	Improve statewide comprehensive groundwater monitoring. Increase the availability to the general public of groundwater quality and contamination information.	USGS reports prepared for the Priority Basin Project were used to identify constituents of concern in the basin and confirm water quality trends prepared for groundwater characterization.
GeoTracker and DTSC EnviroStor	Many constituents of concern, organic and inorganic.	Depends on program. Monthly, Semiannually, Annually, etc.	Records database for cleanup program sites, permitted waste dischargers,	Records available on GeoTracker includes cleanup sites for Leaking Underground Storage Tank (LUST) Sites, Department of Defense Sites, and Cleanup Program Sites. Other records for various unregulated projects and permitted facilities includes Irrigated Lands, Oil and Gas production, operating Permitted Underground Storage Tanks (USTs), and Land Disposal Sites.
USGS California Water Science Center	Conducted Multiple Groundwater Quality Studies of the Kaweah Subbasin	Reports and fact sheet publications range from 1998 through 2017.	Special studies related to groundwater quality that provide comprehensive studies to characterize the basin.	Groundwater Quality in the Shallow Aquifer (2017). Status and Understanding (2012). Groundwater Quality in SESJ (2012). Groundwater Quality Data in the SESJ (2008). Environmental Setting (1998).

Programs or Data Portals	Parameters	Frequency	Objectives	Notes
Department of Pesticide Regulation	Pesticides	Annual	DPR samples groundwater to determine: (1) whether pesticides with the potential to pollute groundwater are present in groundwater (2) the extent and source of pesticide contamination (3) the effectiveness of regulatory mitigation measures	https://www.cdpr.ca.gov/docs/emon/grndwtr/index.htm

4.2.3.1 United States Geological Survey (USGS)

The USGS California Water Science Center (CWSC) provides California water data through data collection, processing, analysis, reporting, and archiving. Data includes surface water, groundwater, spring sites, and atmospheric sites, with data often available in real-time via satellite telemetry. The CWSC groundwater database consists of records of wells, springs, test holes, tunnels, drains, and excavations. Available information includes groundwater level data, well depth, aquifer parameters, and more. The following studies were used for evaluating groundwater conditions:

- Status and Understanding of Groundwater Quality in the Two Southern San Joaquin Valley Study Units, 2005-2006: California GAMA Priority. Scientific Investigations Report 2011-5218. 2012.
- Environmental Setting of the San Joaquin-Tulare Basins, California. Water Resources Investigations Report 97-4205. 1998.
- Groundwater Quality in the Shallow Aquifers of the Tulare, Kaweah, and Tule Groundwater Basins and Adjacent Highlands areas, Southern San Joaquin Valley, CA. USGS and SWRCB. Fact Sheet, 2017.
- Groundwater Quality in the Southeast San Joaquin Valley, California. USGS and SWRCB. June 2012.

- Groundwater Quality Data in the Southeast San Joaquin Valley, 2005-2006: Results from the California GAMA Program. Data Series 351. USGS and SWRCB. 2008.

4.2.3.2 Groundwater Ambient Monitoring & Assessment (GAMA) Program

The California State Water Resources Control Board developed the GAMA in 2000 and it was later expanded in response to Assembly Bill 599 – the Groundwater Quality Monitoring Act of 2001 (California Water Code Sections 10780-10782.3). AB 599 requires improvement in the statewide comprehensive groundwater monitoring and dissemination of groundwater quality information to the public. The GAMA Program is based on interagency collaboration with the State and Regional Water Boards, DWR, Department of Pesticide Regulations, U.S. Geological Survey, Lawrence Livermore National Laboratory, University of California and California State University, and cooperation with local water agencies and well owners.

From 2004 to 2012 the GAMA Program Priority Basin Project (PBP) operated a Phase 1 to characterize the groundwater quality used by public water supply systems on a statewide scale (Figure 4-6). In 2012 the GAMA focus shifted to a Phase 2 assessing of shallow aquifer groundwater quality used by domestic wells and small community supply systems (Figure 4-7). Both Phase 1 and 2 have a long-term monitoring component called Trends that resamples up to 20% of the GAMA wells to evaluate if and how groundwater quality is changing. All results of GAMA sampling are publicly available and accessible via the GAMA Online Tools:

https://www.waterboards.ca.gov/water_issues/programs/gama/online_tools.html

- GAMA Public Supply Study – The USGS identified 476 groundwater basins and subbasins in California and ranked them in order of sampling priority based on the number of public-supply wells, groundwater usage, and potential sources of groundwater quality issues. The GAMA Program combined the highest priority basins into 35 study units and within each study unit, 60 to 120 public-supply wells were selected to sample by an unbiased, spatially distributed grid-based method; each study was divided into equal-area Grid Cells (Scott, 1990), and GAMA worked to sample 1 well per Grid Cell. GAMA sampled a robust suite of constituents, at much lower detection limits, than applicable State requirements. A statistically consistent tiered analytical approach was established to balance spatial coverage with the number of constituents analyzed in each study unit. This sampling and reporting design was the basis for comparing water quality in different study units (Belitz *et al.*, 2003).
- GAMA Domestic Shallow Supply Study – In 2012, GAMA started the Shallow Aquifer Assessment (SSA) to evaluate water resources in shallow aquifers in California that provide water for domestic and small community supply wells. These wells are often drilled to shallower depths in the groundwater system than public supply wells and are important to characterize because shallow groundwater may respond more quickly and be

more susceptible to influence from human activities at the land surface, than the deeper aquifers (USGS, 2018). To prioritize shallow aquifers, California was divided into 938 groundwater units consisting of DWR Bulletin 118 groundwater basins and highland areas or Hydrologic Units from the Watershed Boundary Dataset (Johnson and Belitz, 2015). The groundwater units were prioritized for sampling based on the number and density of households relying on domestic wells, water use, and well location information compiled from well completion reports submitted to the DWR. The groundwater units were grouped into study units with Grid Cells to facilitate comparison of groundwater quality between the shallow aquifer systems and the deep aquifer systems assessed by GAMA from 2004 to 2012 (Shelton and Tejeda, 2024).

- GAMA Trends Study- The GAMA-PBP Trend Study was designed to resample 10% of the original PBP public supply wells every 3 years and to resample all of the PBP public supply wells every 10 years ([Belitz et al., 2003](#)). This network design is consistent with the USGS National Water Quality Assessment trends characterization system ([Lindsey and Rupert, 2012](#)) and upholds the research of step-trends over broad areas. This Trends Study plan was changed to resampling 20% of the public supply and the domestic well networks every 5-10 years. This change was due to the cost of resampling, the addition of the SSA, and the logistics of well availability. The step-trends calculations with the resample data require samples to be regrouped over spatially larger geographic areas than the previous PBP sampling. The Trend Study will work to describe groundwater quality in the shallow aquifers and how that impacts deeper aquifer public supply well water; what time scale, pumping, and flow conditions will such changes occur. The Trend Study also seeks to determine how such impacts apply from each well, each study unit basin, and across multiple California basins. This work can inform water managers from a domestic well owner to entire municipalities. The Trends Study seeks out local trend-monitoring programs, sampling, and data; the [Irrigated Lands Regulatory Program](#), [CV-Salts Surveillance and Monitoring Program](#), and evolving groundwater-quality monitoring by GSAs are included.

The wells sampled under the GAMA program within the Kaweah Subbasin are shown on Figure 4-7. Groundwater quality data collected for Phase 1 and 2 and Trends were reviewed to aid in identifying COCs of interest.

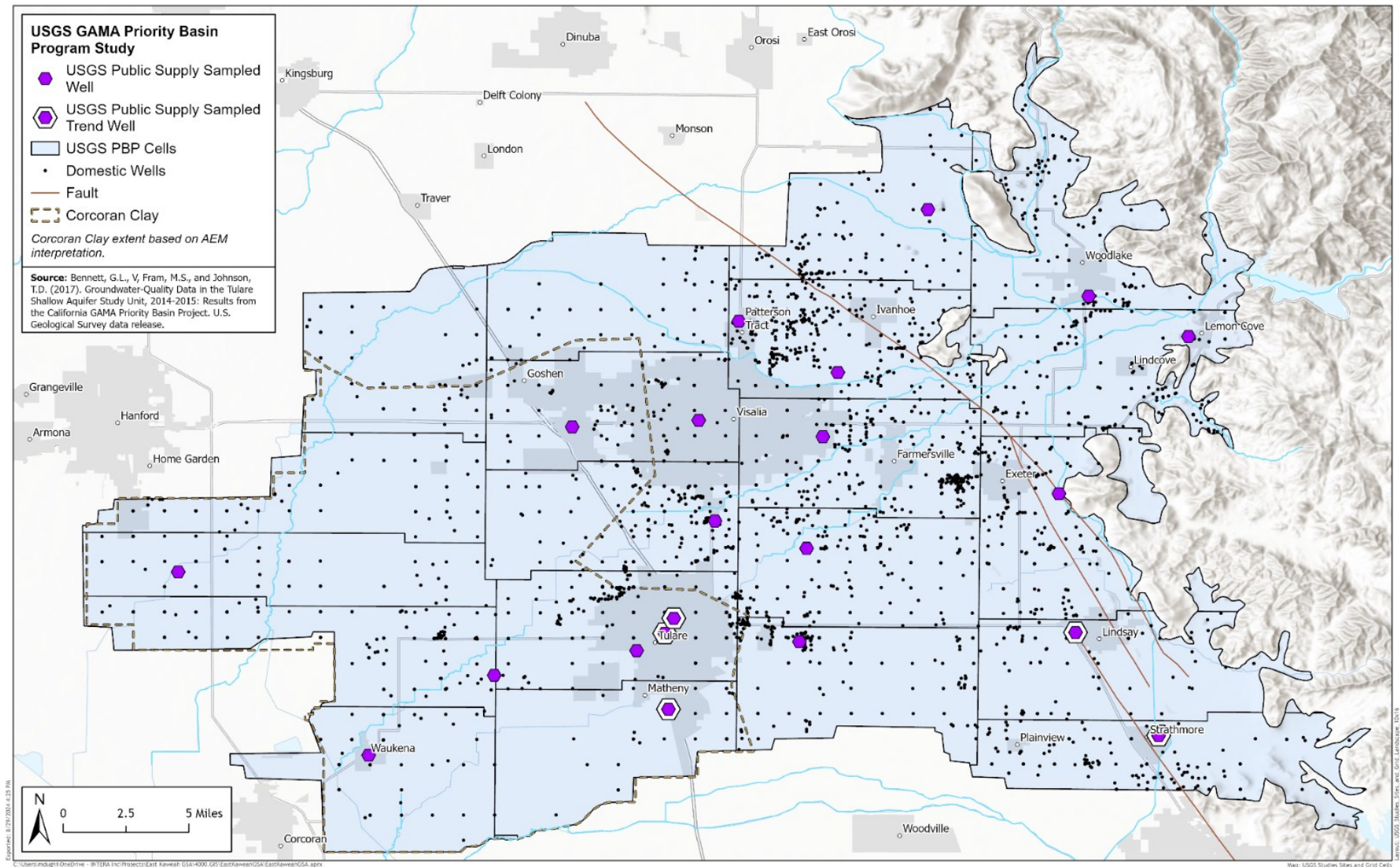


Figure 4-6. USGS GAMA Study Sites (Program Priority Basin Project – Phase 1)

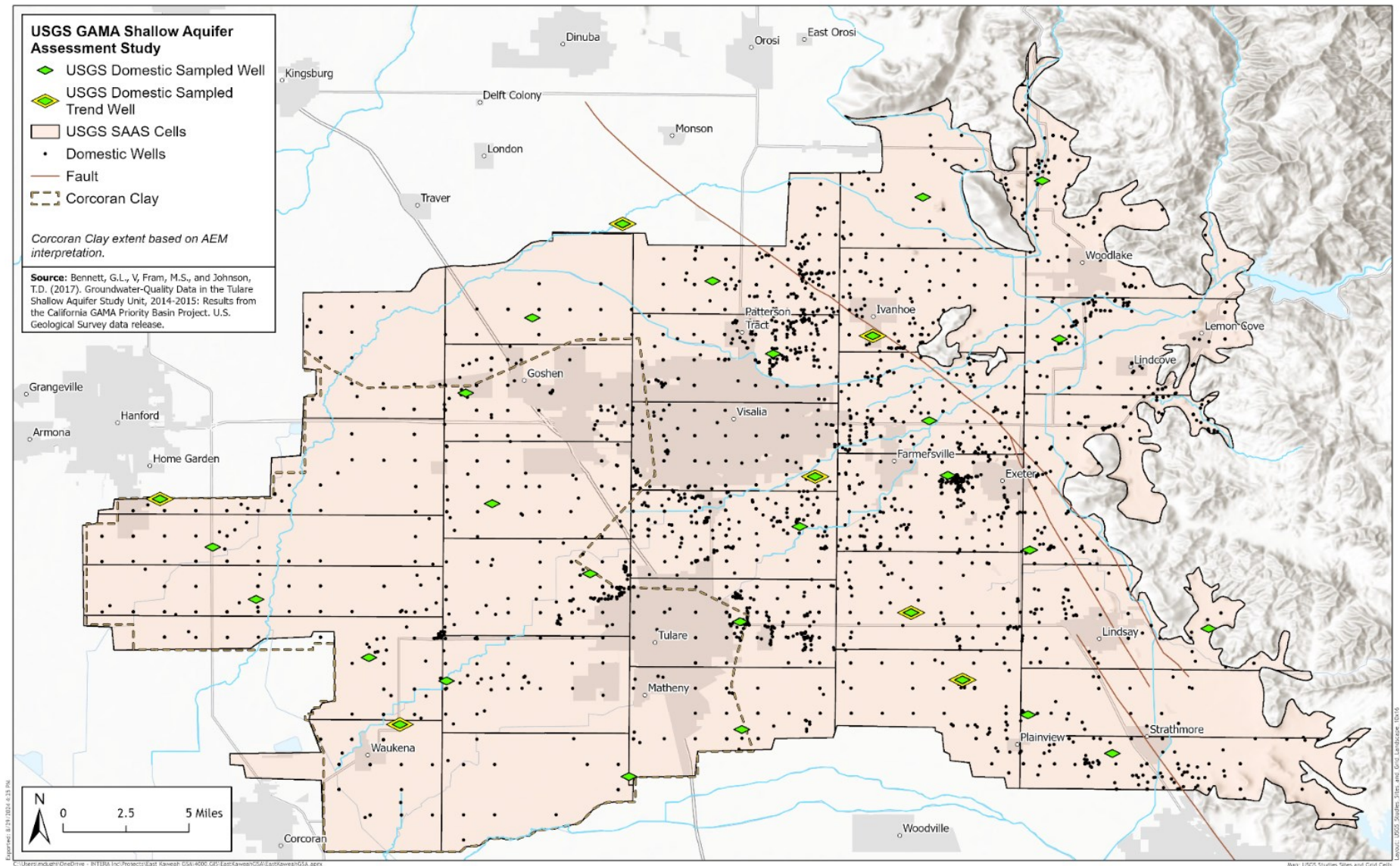


Figure 4-7. USGS GAMA Study Sites (Program Priority Basin Project – Phase 2: Shallow Aquifer Assessment Study)

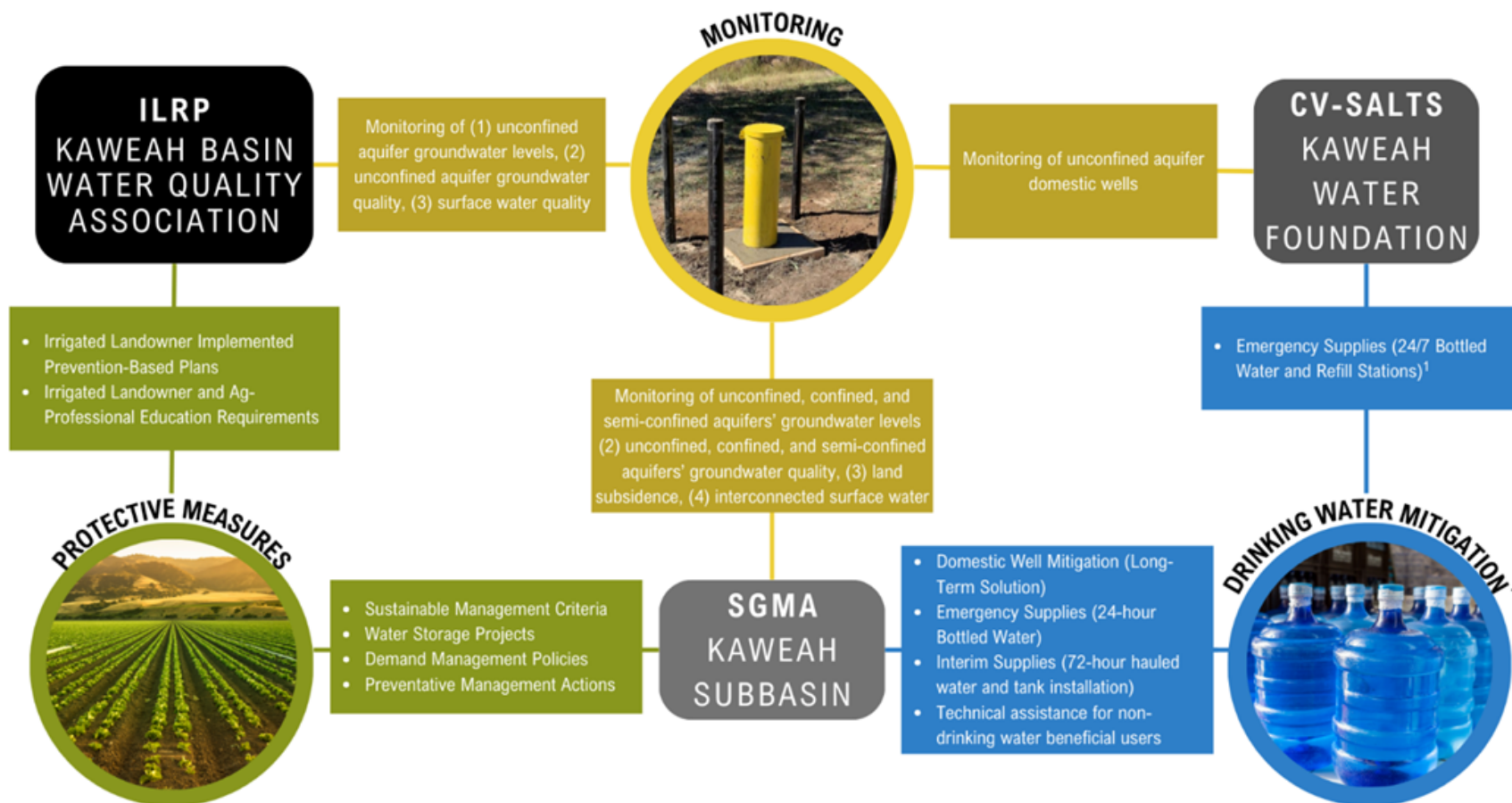
4.2.3.3 Irrigated Lands Regulatory Program

The ILRP addresses discharge of wastes (e.g., sediments, pesticides, nitrates) from commercial irrigated lands. The goal of the ILRP is to protect surface water and groundwater and reduce impacts of irrigated agricultural discharges to waters of the State. In 1999, the California Legislature passed Senate Bill 390, which eliminated a blanket waiver for agricultural waste discharges. The Bill required the Regional Water Quality Control Board (RWQCB) to develop a program to regulate agricultural lands under the Porter-Cologne Water Quality Control Act. In 2003, the Central Valley Water Board adopted a conditional Waiver of Waste Discharge Requirements (WDRs) to regulate agricultural discharges to surface waters. In September 2013, the RWQCB adopted the WDR governing the Tulare Lake Region, of which the Kaweah Subbasin is a part, that address discharges to both surface water and groundwater, thus requiring ILRP enrollment for all commercial irrigated agricultural operations. Figure 4-8 explains the relationship between MKGSA and ILRP.

Irrigated landowners can choose to comply with the WDRs individually or can join a coalition. Coalitions are governing agencies that assist members in complying with ILRP WDRs on a watershed level, thus potentially reducing/eliminating grower interaction with the RWQCB. Coalitions assess fees to cover their costs and RWQCB fees, prepare and implement mandatory regional water quality management and monitoring plans, and report the results of the monitoring efforts and the effectiveness of the plans.

A majority of the Kaweah Subbasin is within the Kaweah Basin Water Quality Association (KBWQA). One of the requirements under WDR was for the KBWQA to prepare a Groundwater Assessment Report (GAR), which is an analysis of the risks to groundwater from nitrates and pesticides as the primary COCs that may originate from irrigated agriculture within the coalition area. Both the vadose zone and aquifer have nitrates and pesticide in storage that are the result of past land use practices representing potential impacts that will continue to migrate over time.

Following results from the GAR, the KBWQA developed a Comprehensive Groundwater Quality Monitoring Plan (CGQMP) and Groundwater Trend Monitoring Plan (GTMP). These 2 work products will be the basis for the KBWQA's groundwater quality monitoring going forward. The KBWQA recently received conditional approval from the RWQCB for these products, therefore no data is available at this time. In 2018, the first round of groundwater quality trend monitoring occurred. The usefulness of the data collected through the ILRP to the needs of the MKGSA SGMA compliance will be evaluated as data becomes available. The KBWQA submits their data to the Groundwater Ambient Monitoring & Assessment (GAMA) program when available.



¹ Kaweah Basin Water Quality Association also contributes to drinking water mitigation by funding and administering the 24/7-accessible drinking water kiosks in the Kaweah Subbasin.

Figure 4-8. Relationship Between MKGSA and ILRP/CV-SALTS

4.2.3.4 GeoTracker and EnviroStor Databases

The SWRCB oversees the GeoTracker database. This database systems allows the SWRCB to house data related to sites that impact or have the potential to impact the groundwater. Records available on GeoTracker includes cleanup sites for Leaking Underground Storage Tank (LUST) Sites, Department of Defense Sites, and Cleanup Program Sites. Other records for various unregulated projects and permitted facilities includes Oil and Gas production, operating Permitted Underground Storage Tanks (USTs), and Land Disposal Sites.

GeoTracker is a public portal that can retrieve records and view data sets from multiple SWRCB programs and other agencies through Google maps GIS interface. This database is not only useful for the public, but also to help other agencies, such as the MKGSA, monitor the progress of cases. It also provides a web application tool for secure reporting of lab data, field measurement data, documents, and reports.

The California Department of Toxic Substances Control (DTSC) oversees the EnviroStor database. This DMS tracks cleanup, permitting, enforcement, and investigation efforts at hazardous waste facilities and sites with known contamination or where further investigation is warranted by the DTSC. This database only provides reports, inspection activities, and enforcement actions completed in or after 2009. Like the GeoTracker database, this is not only useful for the public, but other agencies may use it to monitor progress of ongoing cases. The primary difference between the 2 databases is that EnviroStor only houses case records for which DTSC is the lead regulatory agency, whereas the GeoTracker database houses case record from various agencies at the State and local levels. For the Basin Setting, both databases were searched to identify and report on any contamination sites that may have impacts to groundwater water quality.

4.2.3.5 California State Drinking Water Information System (SDWIS)

All public drinking water systems (defined as a system with 15 or more service connections or regularly serves 25 individuals daily at least 60 days of the year) are regulated by the DDW to demonstrate compliance with State and Federal drinking water standards through a rigorous monitoring and reporting program. Required monitoring for each well within each water system is uploaded to the DDW's database and subsequently available for the public through the SDWIS. In addition to providing compliance monitoring data for each regulated water system, other information such as monitoring frequency, basic facility descriptions, lead and copper sampling, violations and enforcement actions, and consumer confidence reports are also available.

All drinking water systems are required to collect samples, known as Title 22 constituents, on a given frequency depending on the constituent and regional groundwater vulnerability. PWS

provide the most abundant source of data since the testing requirements are fairly frequent intervals. It is important to understand that this characterization is not intended to represent water supplied by purveyors because they may provide wellhead treatment to remove or reduce contamination. The following is a summary of the minimum sampling frequency for a public water supply well:

- General minerals, metals and organics (Synthetic Organic Chemicals and Volatile Organic Compounds) sampling is required every 3 years. If any organics are detected, sampling frequency must be increased to quarterly.
- Nitrate sampling is required annually unless ≥ 5 ppm; then sampling is required quarterly.
- If arsenic is ≥ 5 ppb, sampling should be increased to quarterly but is not always done.
- Radiologicals (gross alpha and uranium) are sampled 1 every 3 years (when initial monitoring is $\geq \frac{1}{2}$ the MCL), 6 (when initial monitoring is $\leq \frac{1}{2}$ the MCL) or 9 (when initial monitoring is non-detect) years depending on historical results.

4.2.3.6 Department of Pesticide Regulation (DPR)

The DPR Ground Water Protection Program evaluates and samples for pesticides to determine if they may contaminate groundwater, identifies areas sensitive to pesticide contamination, and develops mitigation measures to prevent that movement. DPR obtains groundwater sampling data from other public agencies such as SDWIS, USGS, and GAMA, and through its own sampling program. Sampling locations and constituents are determined by pesticides used in a region and from a review of pesticide detections reported by other agencies. Because of their sample selection methodology, DPR typically only collects 1 sample per well and they do not confirm positive detections with repeat sampling. Rather, their focus is on validating contamination through their research and sampling program. These data are reported annually along with the actions taken by DPR and the SWRCB to protect groundwater from contamination by agricultural pesticides. Annual reports are reviewed and contaminant detections are identified in the groundwater quality characterization. In the Kaweah Subbasin, only legacy pesticides (DBCP and 1,2,3-TCP) are detected in the PWS wells. No pesticides currently in use were identified.

4.2.3.7 Central Valley-Salinity Alternatives for Long-term Sustainability (CV-SALTS)

CV-SALTS is a collaborative stakeholder driven and managed program to develop sustainable salinity and nitrate management planning for the Central Valley. The program objective is intended to facilitate the salt and nitrate implementation strategies recommended in the Salt and Nitrate Management Plan (SNMP) developed in 2017. They are designed to address both legacy and ongoing salt and nitrate accumulation issues in surface and groundwater. The overarching management goals and priorities of the control are 1) ensure safe drinking water supply;

2) achieve balanced salt and nitrate loading; and 3) implement long-term, managed restoration of impaired water bodies. The program is phased with the primary focus of early actions on nitrate impacts on groundwater drinking water supplies and established specific implementation activities. The Kaweah Subbasin is a Priority 1 basin for nitrate management. The nitrate control program schedule began in 2019, following the State Board's adoption of the Salt and Nitrate Control Program basin plan. In February 2023, the Central Valley Water Board accepted the Final Management Zone Proposal from the Kaweah Water Alliance (KWF), which officially established the Kaweah Management Zone for the implementation of the Nitrate Control Program.

A Kaweah Management Zone Implementation Plan (MZIP) was completed in September 2023 to comply with the Nitrate Control Plan, which has the following 3 main goals in the Central Valley: 1) ensure a safe drinking water supply; 2) reduce salt and nitrate loading so that ongoing discharges neither threaten to degrade high-quality waters absent appropriate findings by the Central Valley Water Board nor cause or contribute to exceedances of water quality objectives; and, 3) implement long-term, managed restoration of impaired water bodies (LSCE and GEI, 2023). While ILRP allows for compliance with their regulatory program through coalitions that cover a broad, non-contiguous area based on similar land use, SGMA and CV-SALTS will both require contiguous management areas/zones to be contiguous areas regardless of land use.

Both the ILRP and CV-SALTS programs involve permittees and local stakeholders working towards the state's water quality objectives. In this regard, collaborative efforts will likely be made to maximize each program's resources and provide a more integrated approach to developing local solutions for groundwater management. Figure 4-8 clarifies the relationship between SGMA, ILRP, and CV-SALTS.

4.2.4 Existing Surface Water Monitoring

Section 2.3.4 of the Basin Setting document provided as Appendix 3A describes all the surface water flow monitoring in the Kaweah Subbasin and Figure 21 of Appendix 3A shows the locations of flow monitoring stations. TID's main sources of surface water come from the San Joaquin and the Kaweah rivers. Surface water is provided from the San Joaquin River through a USBR contract that delivers water to TID from the Friant Dam via the Friant-Kern Canal. Kaweah River water is delivered to TID and is administered by the Kaweah & St. Johns River Association (KSJRA). TID can also obtain surface water from several small surface streams which pass through TID's service area. Figure 4-9 shows the surface water monitoring stations upstream and within MKGSA. Water from the Kaweah River is delivered via Pre-1914 water rights and administered by the KSJRA. Seasonal streams originating in the eastern portion of the Kaweah Subbasin that flow through the EKGSA and GKGSA also contribute to the surface water inflow to MKGSA but are not currently gauged.

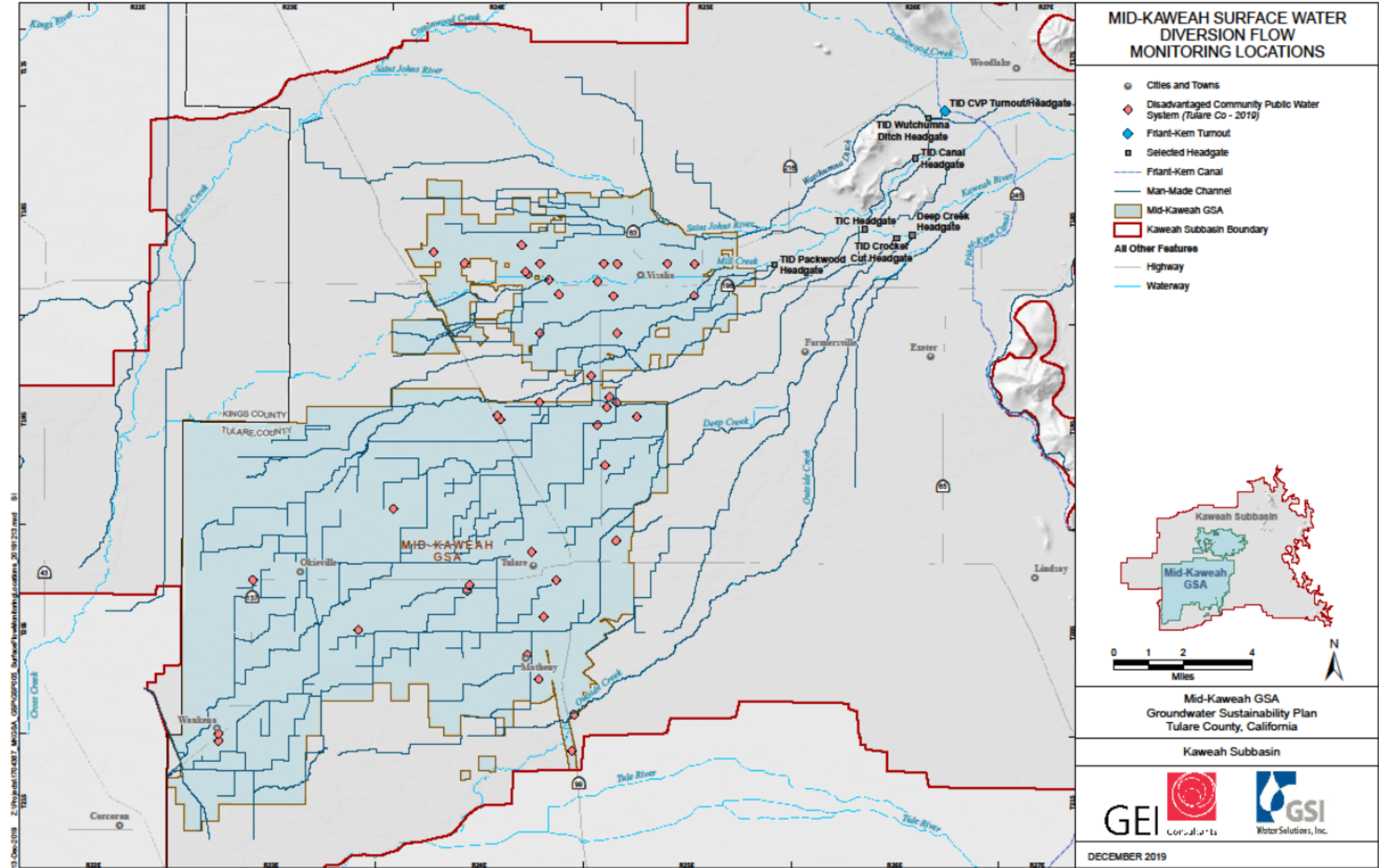


Figure 4-9. Surface Water Diversion Flow Monitoring Locations

4.2.5 Existing Weather and Precipitation Monitoring

For the Kaweah Subbasin, several weather stations are used for the measurement of precipitation. These stations, which are part of the California Irrigation Management Information System (CIMIS) network, are listed in Table 4-8.

Table 4-8. CIMIS Stations in Kaweah Subbasin

Station Number	Station Name
43747	Hanford *
42012	Corcoran *
49367	Visalia *
44957	Lindsay
44890	Lemon Cove
48917	Three Rivers Edison

* Located in close proximity to the MKGSA jurisdictional area

4.3 MKGSA Groundwater Level Monitoring Network

§ 354.34. Monitoring Network.

(a) Each Agency shall develop a monitoring network capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan implementation.

4.3.1 Groundwater Level Monitoring Management Areas

Monitoring requirements and activities are consistent across all management areas described in Section 3.5. The management area in which RMS are located are listed in Table 4-9.

4.3.2 Groundwater Level Monitoring Frequency

At a minimum, groundwater level monitoring occurs in the spring and fall each year. TID collects groundwater level measurements from agricultural extraction wells in January and October each year and continuously from dedicated monitoring wells equipped with pressure transducers. In coordination with its members, the MKGSA is increasing the number of dedicated monitoring wells that are equipped with pressure transducers and water quality sampling equipment. The cities collect groundwater level data more frequently (monthly or continuously). This frequency of monitoring is sufficient to demonstrate seasonal, short-term (1 to 5 years), and long-term (5 to 10 years) trends in groundwater and related surface conditions and yield representative information about groundwater conditions.

4.3.3 Groundwater Level Monitoring Network

Figure 4-10 provides the current distribution of monitoring wells throughout the Subbasin. Within the MKGSA, the full monitoring network includes production wells from the cities of Visalia and Tulare that measure groundwater levels monthly. Groundwater levels are collected under both static and pumping conditions. Although these wells are not included as RMS, groundwater level data collected are reviewed in preparing groundwater level contour maps for annual reporting. The City of Visalia also administers a groundwater monitoring program at their WWTP located in the southwest area of the City. A detailed groundwater monitoring report for the City of Visalia showing the well locations, well construction details, groundwater levels, and groundwater quality results is provided as Appendix 4A.

4.3.4 Groundwater Level Representative Monitoring Network

The MKGSA Representative Monitoring Network (RMN) of 34 wells is a subset of the full Subbasin monitoring network. Quantitative metrics to assess progress toward the sustainability goal are assigned at each RMS, which is explained in detail in Chapter 5. Supplemental data from the larger Monitoring Network (made up of sites from existing monitoring programs) are used to support technical analyses, such as groundwater elevation contours, cross-boundary relationships, and model development and interpretation. A map of the MKGSA's RMN is available on Figure 4-11.

The rationale for including an existing well or adding a new well into the groundwater level monitoring network includes the following:

- The monitoring point contributes to meeting the minimum density necessary within the MKGSA.
- The monitoring point contributes to the minimum density of wells in a township/range.
- The monitoring point has performed adequately to provide information for annual reporting, groundwater contour maps, and estimation of storage change. A prolonged period of record is important to compare interpretations of historical data to future interpretations.
- Construction information is known for the well, including total completed depth and the perforated interval(s).
- Access to the well is unrestricted, and/or permission to access the monitoring point can be obtained.
- Dedicated monitoring wells are preferable to production wells, where feasible.

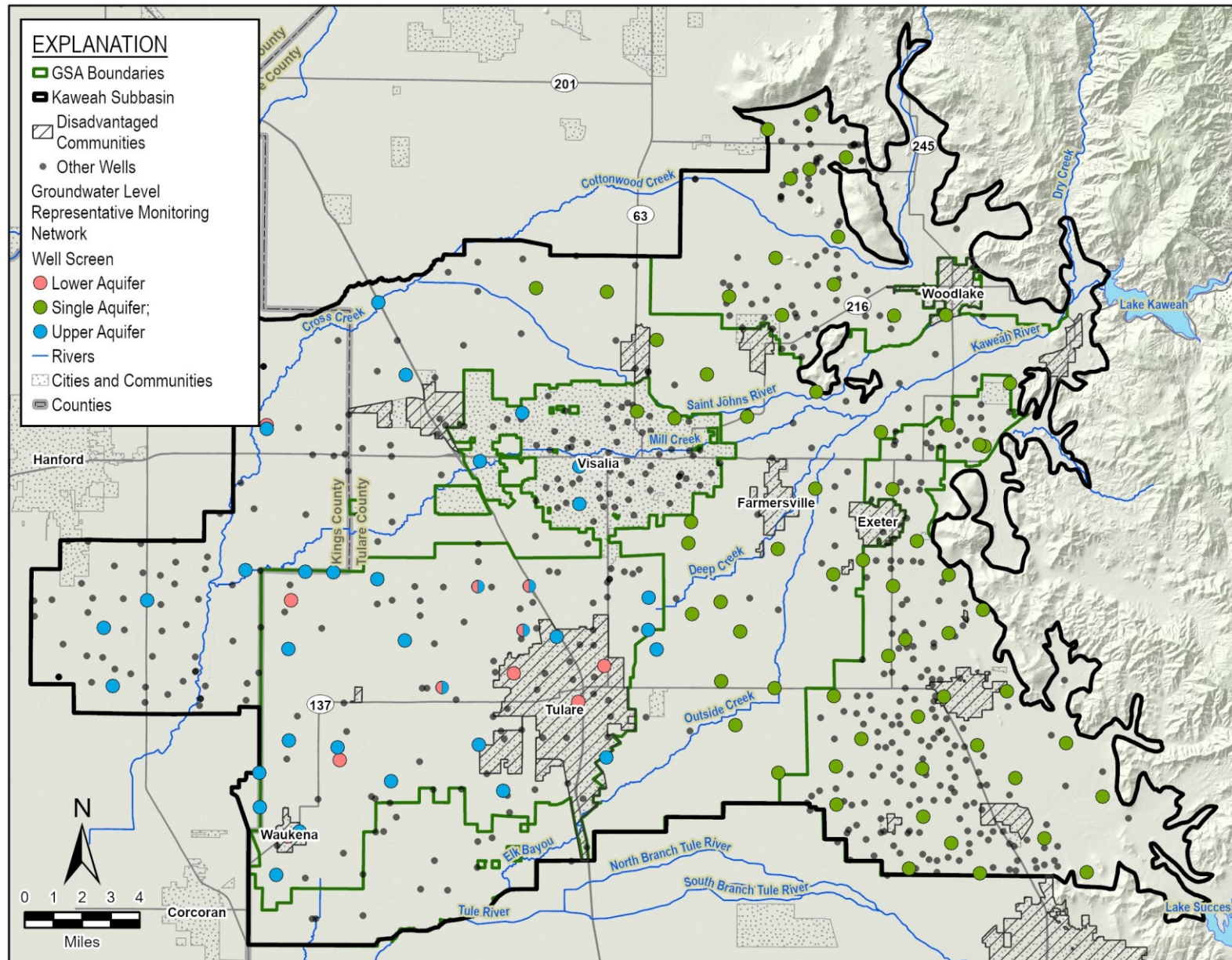


Figure 4-10. Kaweah Subbasin Current Groundwater Level Monitoring Network



Table 4-9 summarizes known well construction information and, unfortunately for many of these wells, construction information was not available (noted as NA). Table 4-9 also lists the management area/monitoring entity and the frequency at which groundwater level data are collected. Since submittal of the 2020 GSP where 42 RMS were identified, 9 wells have gone dry (well depths less than 125 feet) and 2 wells have spurious data. These wells have been removed from the network. An additional 3 lower aquifer dedicated monitoring wells have been added to the RMS network.

Based on the BMP for monitoring networks, the well density goal is 4 to 10 wells per 100 square miles. The MKGSA area is 163 square miles. Based on the BMP, the MKGSA monitoring network requires a minimum of 6 to 16 monitoring wells. Since there are 34 RMS, the monitoring density is more than sufficient and is well distributed through the GSA, as shown on Figure 4-11.

Groundwater level data for the RMS wells are available through the SGMA Monitoring Network Module (MNM) and Subbasin DMS described in Section 7.3.

Table 4-9. MKGSA Representative Monitoring Network for Groundwater Levels

Well Summary Well ID	Management Area/ Monitoring Entity	Aquifer Monitored	Total Depth (feet bgs)	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Monitoring Frequency
KSB-0922	Tulare Irrigation District	Upper	428	322	420	semi-annual
KSB-0946	Tulare Irrigation District	Upper	NA	NA	NA	semi-annual
KSB-0948	Tulare Irrigation District	Upper	NA	NA	NA	semi-annual
KSB-0976	Tulare Irrigation District	Upper	NA	NA	NA	semi-annual
KSB-0994	Tulare Irrigation District	Upper	NA	NA	NA	semi-annual
KSB-1071	Tulare Irrigation District	Upper	NA	NA	NA	semi-annual
KSB-1168	Tulare Irrigation District	Upper	331	178	190	semi-annual
KSB-1206	Tulare Irrigation District	Upper	NA	NA	NA	semi-annual
KSB-1226	Tulare Irrigation District	Upper	NA	NA	NA	semi-annual
KSB-1320s	Tulare Irrigation District	Upper	540	80	250	daily (transducer)
KSB-1320d	Tulare Irrigation District	Lower	540	330	540	daily (transducer)
KSB-1408s	Tulare Irrigation District	Upper	490	80	200	daily (transducer)
KSB-1408d	Tulare Irrigation District	Lower	490	230	490	daily (transducer)
KSB-1427	Kaweah Delta Water Conservation District	Upper	NA	NA	NA	semi-annual
KSB-1431	Tulare Irrigation District	Upper	229	170	210	semi-annual
KSB-1477	Tulare Irrigation District	Upper	NA	NA	NA	semi-annual
KSB-1506	Tulare Irrigation District	Lower	720	300	720	semi-annual

Well Summary Well ID	Management Area/ Monitoring Entity	Aquifer Monitored	Total Depth (feet bgs)	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Monitoring Frequency
KSB-1526	Kaweah Delta Water Conservation District	Upper	NA	NA	NA	semi-annual
KSB-1536s	Tulare Irrigation District	Upper	500	80	250	daily (transducer)
KSB-1536d	Tulare Irrigation District	Lower	500	350-420	500-540	daily (transducer)
KSB-1545s	Tulare Irrigation District	Upper	450	80	255	daily (transducer)
KSB-1545d	Tulare Irrigation District	Lower	450	340	450	daily (transducer)
KSB-1628	Tulare Irrigation District	Upper	720	320	720	semi-annual
KSB-1695	City of Tulare	Lower	774	348	756	monthly
KSB-1696	City of Visalia (Cal Water)	Upper	NA	NA	NA	semi-annual
KSB-1699	City of Visalia (Cal Water)	Upper	NA	NA	NA	monthly
KSB-1770	City of Tulare	Lower	715	300	700	monthly
KSB-1884	City of Visalia (Cal Water)	Single	NA	NA	NA	monthly
KSB-1903	City of Tulare	Upper	620	320	620	monthly
KSB-1905	Tulare Irrigation District	Upper	NA	NA	NA	semi-annual
KSB-1977	City of Visalia (Cal Water)	Single	NA	NA	NA	monthly
MKGSA-01	Tulare Irrigation District	Lower	950	900	950	daily (transducer)
MKGSA-02	Tulare Irrigation District	Lower	960	900	950	daily (transducer)
WK-1	Tulare Irrigation District	Lower	911	750	900	daily (transducer)

4.3.5 Groundwater Level Monitoring Protocols

As referenced in § 352.4 of the GSP Regulations, “monitoring protocols shall be developed according to best management practices. Monitoring protocols shall be reviewed at least every 5 years as part of the periodic evaluation of the Plan and modified as necessary.”

Per the DWR’s Monitoring Protocol BMP:

- All groundwater levels in a basin will be collected within as short a time as possible, preferably within a 1- to 2-week period.
- Depth to groundwater will be measured at an established Reference Point (RP) on the well casing. The RP will be identified with a permanent marker, paint spot, or a notch in the lip of the well casing. By convention, in open casing monitoring wells, the RP is located on the north side of the well casing. If no mark is apparent, the person performing the measurement should measure the depth to groundwater from the north side of the top of the well casing.

- The sampler will remove the appropriate cap, lid, or plug that covers the monitoring access point listening for pressure release. If a release is evident, the measurement will be delayed for a short period of time to allow the water level to equilibrate.
- Measurements of depth to groundwater and land surface will be measured and reported in feet to an accuracy of at least 0.1 foot relative to NAVD88, or another national standard that is convertible to NAVD88, and the method of measurement will be noted on the record (e.g. electric sounder, steel tape, transducer, acoustic sounder, or airline).
- The water level probe should be cleaned after measuring each well.
- To assure that the same well is being measured each time, the monitoring entity will create a Well Identification Sheet that will be used to track the monitoring at each well site. The following information will be recorded on the sheet: well number, date of survey, latitude and longitude, RP elevation and description, location description and map, well type and use, well completion type, and, if available, total depth, screened intervals, and well completion report number.
- The sampler will replace any well caps or plugs and lock any well buildings or covers.
- All data will be entered into the MKGSA DMS as soon as possible. Care will be taken to avoid data entry mistakes and the entries will be checked by a second person for accuracy.

TID follows a monitoring plan in collecting groundwater elevation data for local groundwater management and for reporting to DWR as required by the CASGEM program. A copy of TID's groundwater level monitoring plan is attached as Appendix 4B.

4.3.5.1 Pressure Transducers

Per the DWR *Monitoring Protocols* BMP, groundwater levels may be measured using pressure transducers installed in monitoring wells and recorded by dataloggers, along with calculated groundwater elevations. When relying on pressure transducers and dataloggers, manual measurements of groundwater levels will be taken during installation to synchronize the transducer system and, periodically (quarterly), to ensure monitoring equipment does not allow a “drift” in the actual values.

The following protocols will be followed when installing a pressure transducer in a monitoring well:

- The sampler will use an electronic sounder or chalked steel tape to measure the depth to groundwater level from the RP. The groundwater elevation will be calculated by subtracting the depth to groundwater from the RP elevation. These values will be used as references to synchronize the transducer system in the monitoring well.

- The sampler will record the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and other pertinent information in the log.
- The sampler will record whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Vented cables are preferred, but non-vented cables are acceptable if the transducer data are properly corrected for natural fluctuations in barometric pressure, which requires commensurate logging of barometric pressures.
- Transducers will be able to record groundwater levels with an accuracy of at least 0.1 feet. Various factors will be considered in the selection of the transducer system, including battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers.
- Follow manufacturer specifications for installation, calibration, battery life, correction procedure (for non-vented cables), and anticipated life expectancy to ensure optimal use of the equipment.
- Secure the cable to the wellhead with a well dock or another reliable method. Mark the cable at the elevation of the RP with tape or an indelible marker to allow estimates of future cable slippage.
- The transducer data will be checked periodically against hand-measured groundwater levels to monitor electronic drift or cable movement. This check will not occur during routine site visits, but at least annually.
- The data will be downloaded regularly to ensure data are not lost and entered the DMS following the QA/QC program established for the GSP. Data from non-vented cables will be corrected for atmospheric barometric pressure changes, as appropriate. After ensuring the transducer data have been downloaded and stored in the DMS, the data will be deleted from the datalogger to ensure that adequate datalogger memory remains for future measurements.

4.4 MKGSA Land Subsidence Monitoring Network

4.4.1 Land Subsidence Management Areas

This section details the land subsidence monitoring network in the MKGSA area. Monitoring requirements and activities are consistent across all management areas in the MKGSA. The MKGSA land subsidence monitoring network is part of an integrated and coordinated monitoring program as outlined in Appendix 5B.

4.4.2 Land Subsidence Monitoring Frequency

Land subsidence is monitored in the Subbasin using remote sensing (InSAR) and subsidence benchmark surveys. InSAR data are collected by DWR at a monthly frequency and reported quarterly. Subsidence station elevations are and will continue to be monitored annually by the GSAs and partner agencies to supplement InSAR data.

4.4.3 Land Subsidence Monitoring Network

To provide better coverage than the previous monitoring network, land subsidence is monitored using InSAR data provided as technical support by DWR. InSAR data covers the entire Subbasin on a roughly 302-foot by 302-foot grid. This subsidence dataset represents the best available science for the GSP area and is therefore used as the subsidence monitoring network. InSAR data will be confirmed as necessary using benchmark survey data collected by the Kaweah Delta Water Conservation District (KDWCD). KDWCD monitors 9 stations within the MKGSA area using GPS methods. TID monitors 24 stations on key infrastructure locations within TID. These data supplement InSAR data collected by DWR.

Subbasin-wide integrated land subsidence monitoring includes a plan for focused monitoring by the EKGSA and GKGSA around the Friant-Kern Canal. This plan is referred to as the Friant-Kern Canal Monitoring and Action Plan (FMAP). The Friant-Kern Canal is outside the MKGSA area, and therefore the FMAP is not part of MKGSA's land subsidence monitoring network. However, the MKGSA fully supports the FMAP because it is part of the Subbasin's commitment to avoiding unreasonable subsidence impacts. The FMAP is included as Appendix 4C.

4.4.4 Land Subsidence Representative Monitoring Network

The land subsidence representative monitoring network for the Subbasin (96 sites) and MKGSA area (28 sites) is shown on Figure 4-12 and Figure 4-13, respectively. The 28 MKGSA sites are listed in Table 4-10. InSAR data will be interpolated to each site in the representative monitoring network, and subsidence at each site will be tracked and compared to the subsidence SMC for that site.

The monitoring network locations are co-located with several existing benchmarks, GPS stations, and wells, with additional locations based on historical subsidence observations and locations of critical infrastructure. The following locations make up the RMS subsidence monitoring network in the MKGSA area:

- 10 lower aquifer groundwater level RMS

- 6 other shallow and composite (i.e. screened across Corcoran Clay) groundwater level RMS
- 7 existing KDCWD subsidence GPS stations
- 5 locations without prior monitoring where subsidence is observed in InSAR data between 2015 and 2022, areas along basin boundaries with no existing monitoring locations, or near critical infrastructure such as local conveyance systems

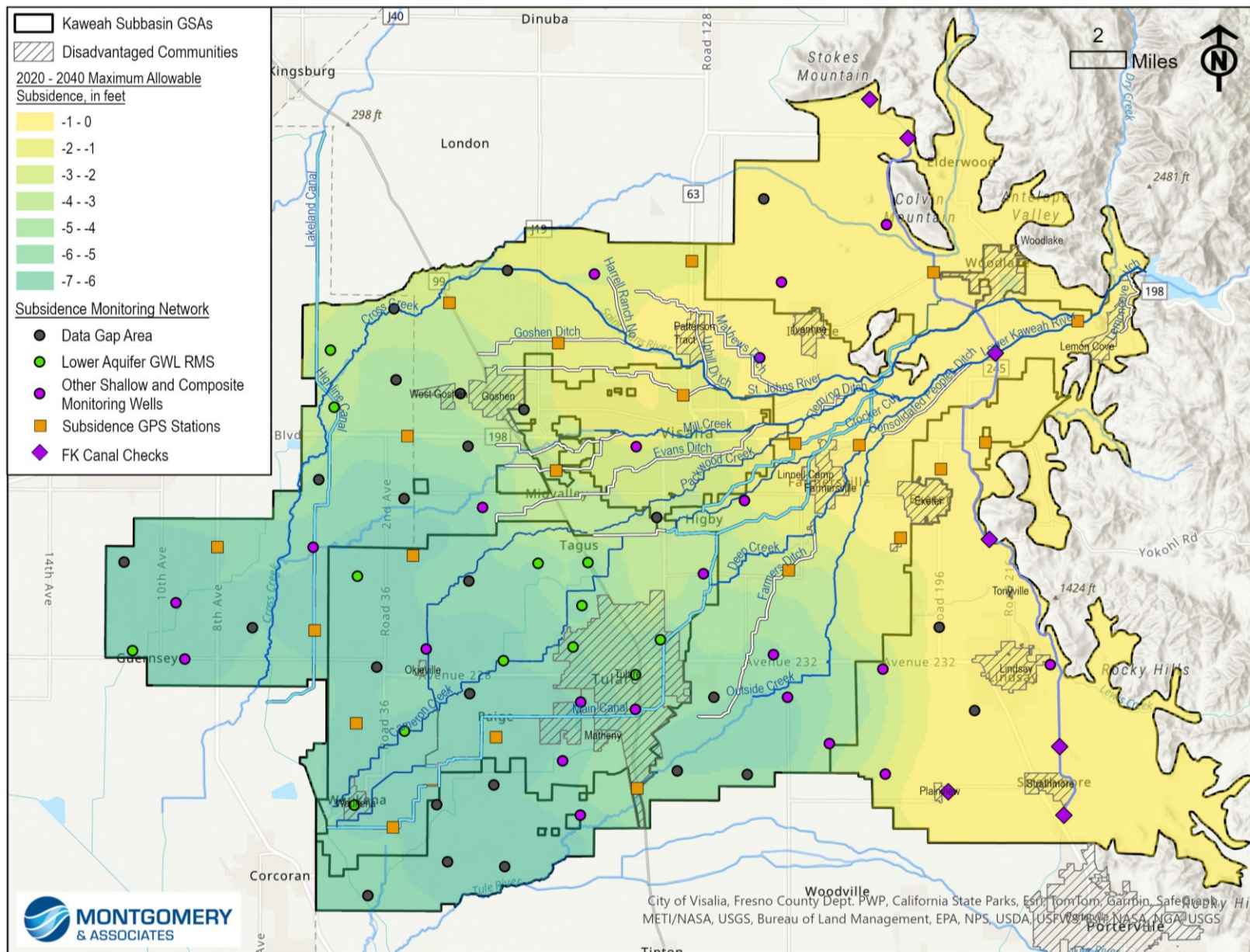


Figure 4-12. Kaweah Subbasin Subsidence Monitoring Network



Table 4-10. Summary of MKGSA Subsidence Monitoring Locations

Representative Monitoring Site	Network Category
36.2857_-119.3179	Data Gap Area
36.1935_-119.4380	Data Gap Area
36.2069_-119.4979	Data Gap Area
36.2522_-119.4389	Data Gap Area
36.3417_-119.4038	Data Gap Area
KSB-1320d (CB-1)	Lower Aquifer GWL RMS
KSB-1536d (CB-2)	Lower Aquifer GWL RMS
KSB-1408d (CB-3)	Lower Aquifer GWL RMS
KSB-1545d (CB-4)	Lower Aquifer GWL RMS
DH6683	Subsidence GPS Station
K007	Subsidence GPS Station
K008	Subsidence GPS Station
K009	Subsidence GPS Station
K010	Subsidence GPS Station
K020	Subsidence GPS Station
KSB-1129	Other shallow and composite monitoring wells
KSB-1477	Other shallow and composite monitoring wells
KSB-1506	Lower Aquifer GWL RMS
KSB-1538	Other shallow and composite monitoring wells
KSB-1695	Lower Aquifer GWL RMS
KSB-1696	Other shallow and composite monitoring wells
KSB-1706	Other shallow and composite monitoring wells
KSB-1770	Lower Aquifer GWL RMS
KSB-1905	Other shallow and composite monitoring wells
MKGSA-1 (MK-1)	Lower Aquifer GWL RMS
MKGSA-2 (MK-2)	Lower Aquifer GWL RMS
TUL99	Subsidence GPS Station
WK-1	Lower Aquifer GWL RMS

4.4.5 Land Subsidence Monitoring Protocols

Land subsidence InSAR monitoring protocols are the same protocols used by DWR, who adapted their methods to measure subsidence on hard surfaces only and interpolate between them. This minimizes the change in land surface elevation captures in soft surfaces that are likely not true subsidence. The cell size of the interpolated surface is 302 feet by 302 feet. The InSAR monitoring protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

According to the KDWCD Land Surface Elevation Monitoring Plan, the following protocols are used for data collection and processing.

4.4.5.1 Static Occupation Protocols for GPS Stations

The protocols listed below will be followed for collection of the land surface elevation data:

- Static occupation strategies may necessarily vary by point but will in every case remain consistent with National Geodetic Survey recommendations. The observer will use a dual-frequency (L1/L2) survey grade GPS receiver to continuously occupy each station for no fewer than 2.0 hours per measurement period. Lower root-mean square error (RMSE) correlates directly with longer duration of observation.
- The preferred outcome at each station is to acquire one 4.0+ hour autonomous dataset from 1 setup. The average of two 2.0+ hour autonomous datasets from 2 independent setups separated by not more than 24 hours is an acceptable alternative. Occasionally, one 2.0+ hour autonomous dataset may meet the Vertical RMSE (VRMSE) standard.
- Although L-band receivers are 24-hour, all-weather capable, operations will be limited to daylight hours. Modern receivers are resistant to moisture infiltration but will not be exposed to heavy or sustained precipitation. Fog, haze, overcast, clouds, light rain, and dust should not be problematic. Operations will cease in cases where environmental elements—such as high winds or blowing debris—or man-made conditions threaten observer safety, equipment functionality, or data integrity, and will begin again only when practicable for at least 2 hours.
- Prior to initiating each collection period, at 30-minute intervals during each period and at cessation, observers will complete a schedule of system checks in the station field notes. Logging will be enabled during instrument configuration; however, observers shall remain aware and engaged throughout each collection period and be ready to take appropriate action.

4.4.5.2 Data Processing Protocols for GPS Data

After the land surface elevation data are collected, the protocols listed below will be followed in the processing of the data:

- All original datasets will be preserved in a permanent standalone database. Copies of the datasets will be examined for coherence and continuity. Errors and deficiencies will be corrected additively or proportionally wherever possible. Unusable datasets will be set aside and stations with inadequate data will be occupied again. Further data will not be eliminated unless irreparable defects are revealed by subsequent analysis. Station coordinates will be computed from the quality-checked copies with rigorous relative and absolute adjustment strategies.
- Relative coordinate solutions will be computed by the Online Positioning User Service (OPUS), an NGS differential GPS (DGPS) internet application. OPUS solutions are the primary program deliverables. Primary solutions are given in terms of the computational reference frame on the observation epoch date and of the standard datum on the current standard epoch date.
- Absolute coordinate solutions will be computed by the Automatic Precise Positioning Service (APPS), a National Aeronautics and Space Administration (NASA) – Jet Propulsion Laboratory (JPL) – California Institute of Technology (CIT) precise point positioning (PPP) internet application. APPS solutions are secondary program deliverables. Secondary solutions are rendered in terms of the computational reference frame on the observation epoch date and may be transformed to the standard datum adjusted to the current standard epoch date.
- Uncertainty is associated with every observation. Every measurement contains some degree of error. GPS coordinates are characteristically less accurate in the vertical than in the horizontal. NGS and NASA employ sophisticated strategies to detect and correct systematic error. While many conventions are observed, no single comprehensive adjustment computation protocol exists.
- Corrections can be performed in office with local instrument software and continuously operating reference station (CORS) data obtained online from NGS, or absolutely with archived ephemerides and the Global Navigation Satellite System (GNSS)- Inferred Positioning System and Orbital Analysis Simulation Software (GIPSY-OASIS) site package. These options should be considered if OPUS and APPS become problematic.

4.5 MKGSA Groundwater Storage Monitoring Network

Change in groundwater storage is correlated with the change in groundwater levels. Therefore, the MKGSA uses groundwater levels as a proxy monitoring change in groundwater storage. Groundwater storage changes are calculated by evaluating the volumetric difference between changes in groundwater surfaces created based on groundwater level data collected in the spring of each year.

Because groundwater levels are used as a proxy for groundwater storage changes, the sub-level discussions such as management areas, monitoring frequency, spatial density, etc., are not deemed necessary, since this information is provided for groundwater level data collection above.

4.6 MKGSA Groundwater Quality Monitoring Network

The MKGSA Groundwater Quality Representative Monitoring Network is a subset of the Kaweah Subbasin Groundwater Quality Representative Monitoring Network depicted on Figure 4-4 and each MKGSA RMS well is listed in Table 4-11. The resources used to build the Kaweah Subbasin Groundwater Quality Representative Monitoring Network are summarized on Figure 4-14.

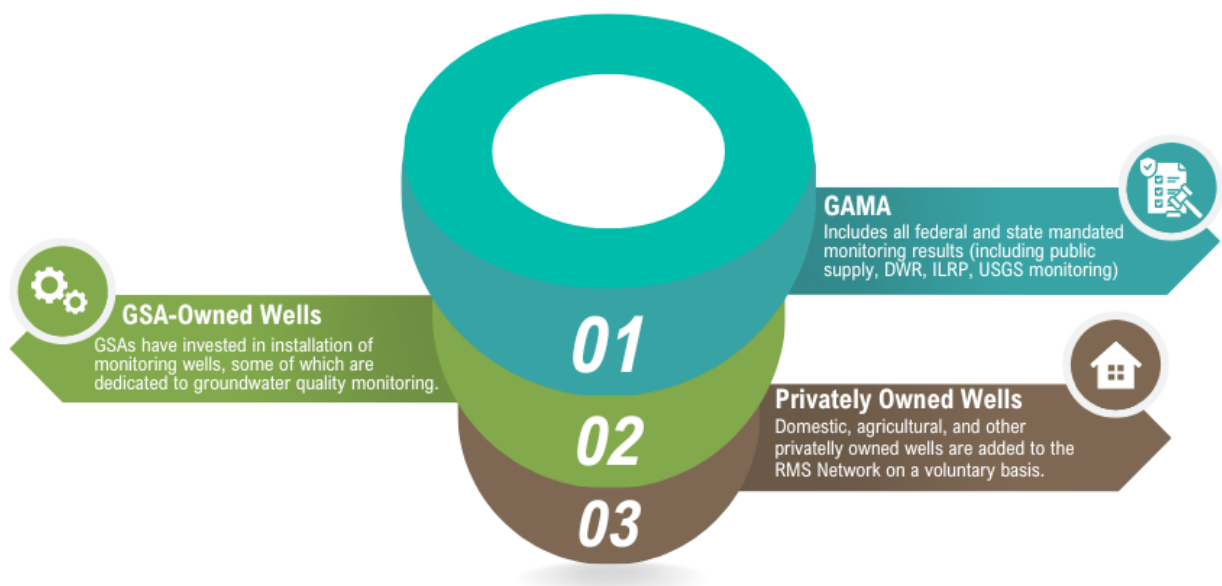


Figure 4-14. Data and Information Resources Used to Establish the Groundwater Quality RMS Network

Table 4-11. Mid-Kaweah Groundwater Sustainability Agency Groundwater Quality Representative Monitoring Network

RMS ID	Other ID	OWNER ID	USGS Grid Cell #	Well Use Type	Aquifer Designation	Well Depth (bgs)	Depth of Bottom Perforation (bgs)
CA5400919_001_001	5400919-001	WELL 01	11	Public Supply	Composite	220	-
CA5400919_001_001	5400919-001	WELL 01	11	Public Supply	Composite	220	-
CA5410015_014_014	5410015-014	WELL 14	13	Public Supply	Lower	700	300
CA5410015_048_048	5410015-048	WELL 34	14	Public Supply	Lower	652	450
CA5410015_065_065	5410015-065	WELL 42	11	Public Supply	Lower	-	-
CA5410016_058_058	5410016-058	WELL 50-01	17	Public Supply	Single	270	150
CA5410016_060_060	5410016-060	WELL 52-01	15	Public Supply	Single	310	180
CA5410016_081_081	5410016-081	WELL 64-01	17	Public Supply	Single	400	190
CA5410016_094_094	5410016-094	WELL 82-01	16	Public Supply	Single	580	280
CA5410016_166_166	5410016-166	WELL 55-02	16	Public Supply	Single	570	196
CA5402030_002_002	5402030-002	WELL 02	1	Public Supply	Upper	400	200
KSB-1408d2	-	KSB-1408d2	9	MKGSA Monitoring	Lower	490	490
KSB-1320d2	-	KSB-1320d2	10	MKGSA Monitoring	Lower	540	540
MK-1 lower2	-	MK-1 lower2	2	MKGSA Monitoring	Lower	450	450
MK-2 lower2	-	MK-2 lower2	4	MKGSA Monitoring	Lower	420	420
SW-1 upper	-	SW-1 upper	15	MKGSA Monitoring	Single	250	250-
OK-1 upper1	-	OK-1 upper1	10	MKGSA Monitoring	Upper	230	230

4.6.1 Groundwater Quality Management Areas

Monitoring requirements and activities are consistent across all MKGSA management areas. There are no unique criteria for monitoring or selection of monitoring sites associated with management areas in the Kaweah Subbasin.

4.6.2 Groundwater Quality Monitoring Frequency

The monitoring frequency for the Kaweah Subbasin groundwater quality representative monitoring network is described on Figure 4-15. For the first 2 years (2025 and 2026 water years), RMS wells will be sampled twice per year (seasonally) for each COC identified in Table 4-12. In the years following, the RMS wells will continue to be sampled seasonally (twice per year) for any COCs for which the well had exceeded in the 2 years prior and once every year for any COCs for which the well had met the standards detailed in Table 4-12. Additional monitoring is required per the Exceedance Policy described in Section 5.8.3.1.1 in instances where RMS wells experience exceedances of the MT.

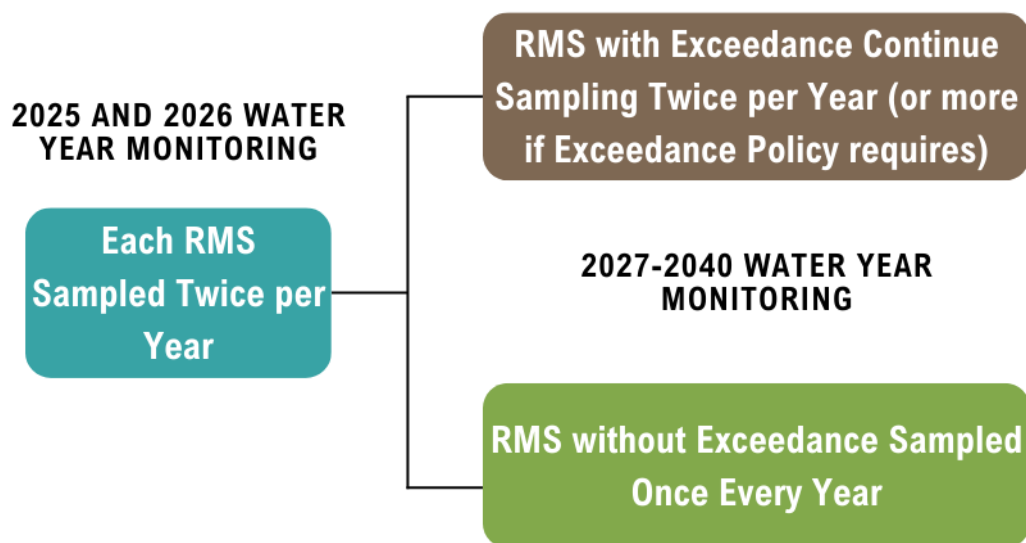


Figure 4-15. Representative Monitoring Frequency

Table 4-12. Constituents of Concern Monitored by the Kaweah Subbasin Representative Groundwater Quality Monitoring Network

Constituent	Groundwater Quality Standard	Measurement Unit
Drinking Water Quality Standards		
Nitrate as N	10	mg/L
1,2,3-Trichloropropane (1,2,3 TCP)	0.005	µg/L
Gross Alpha	15	pCi/L
Uranium	20	pCi/L
Arsenic	10	µg/L
1,2-Dibromo-3-chloropropane (DBCP)	0.2	µg/L
Perchlorate	6	µg/L
Tetrachloroethene (PCE)	5	µg/L
Chromium, Hexavalent (Cr6)	10	µg/L
Aesthetic (Non-Health Based) Standards		
Total Dissolved Solids	1,000	mg/L
Specific Conductivity	1,600	umhos/cm
Chloride	500	mg/L
Sulfate	500	mg/L
pH	8.5	-
Agriculture-Based Standards		
Sodium	69	mg/L
Boron	0.7	mg/L

Municipal wells are monitored according to a schedule determined by the Division of Drinking Water of the State Water Resources Control Board. Schedules are provided at <https://sdwis.waterboards.ca.gov/PDWW/>

Groundwater from the TID and MKGSA non-RMS multi-level monitoring wells is analyzed annually for all COCs.

4.6.3 Groundwater Quality Monitoring Network

The existing monitoring activities described in Section 4.2.3 are considered a supplemental component of the Kaweah Subbasin Groundwater Quality Monitoring Network to the Subbasin's Representative Groundwater Quality Monitoring Network. The Subbasin will review results from the RMS well monitoring as well as the supplemental monitoring activities within and near the Subbasin to make informed decisions about overall groundwater quality conditions and progress toward implementation. GSAs will take appropriate action in the event conditions are trending toward significant and unreasonable degraded groundwater quality and fill groundwater quality data gaps.

Figure 4-16 shows the location of public drinking water system wells and dedicated monitoring wells currently used to monitor groundwater quality, categorized by aquifer where screen information is available. Table 4-11 provides a list of the wells, the PWS associated with the well, location, construction information, principal aquifer monitored, and type (PWS or monitoring well). As the largest PWSs in the MKGSA, the City of Visalia and City of Tulare monitor groundwater quality for compliance with Title 22 for municipal and industrial uses. Figure 4-16 and Table 4-13 contains multi-completion monitoring wells located within the TID service area, some of which are also RMS wells listed in Table 4-11. These monitoring wells have been installed to fill data gaps identified in the 2020 GSP. The non-RMS wells are monitored annually and reported to DWR in the Kaweah Subbasin annual report. MKGSA dedicated monitoring wells installed in 2022 are equipped with low flow sampling equipment.

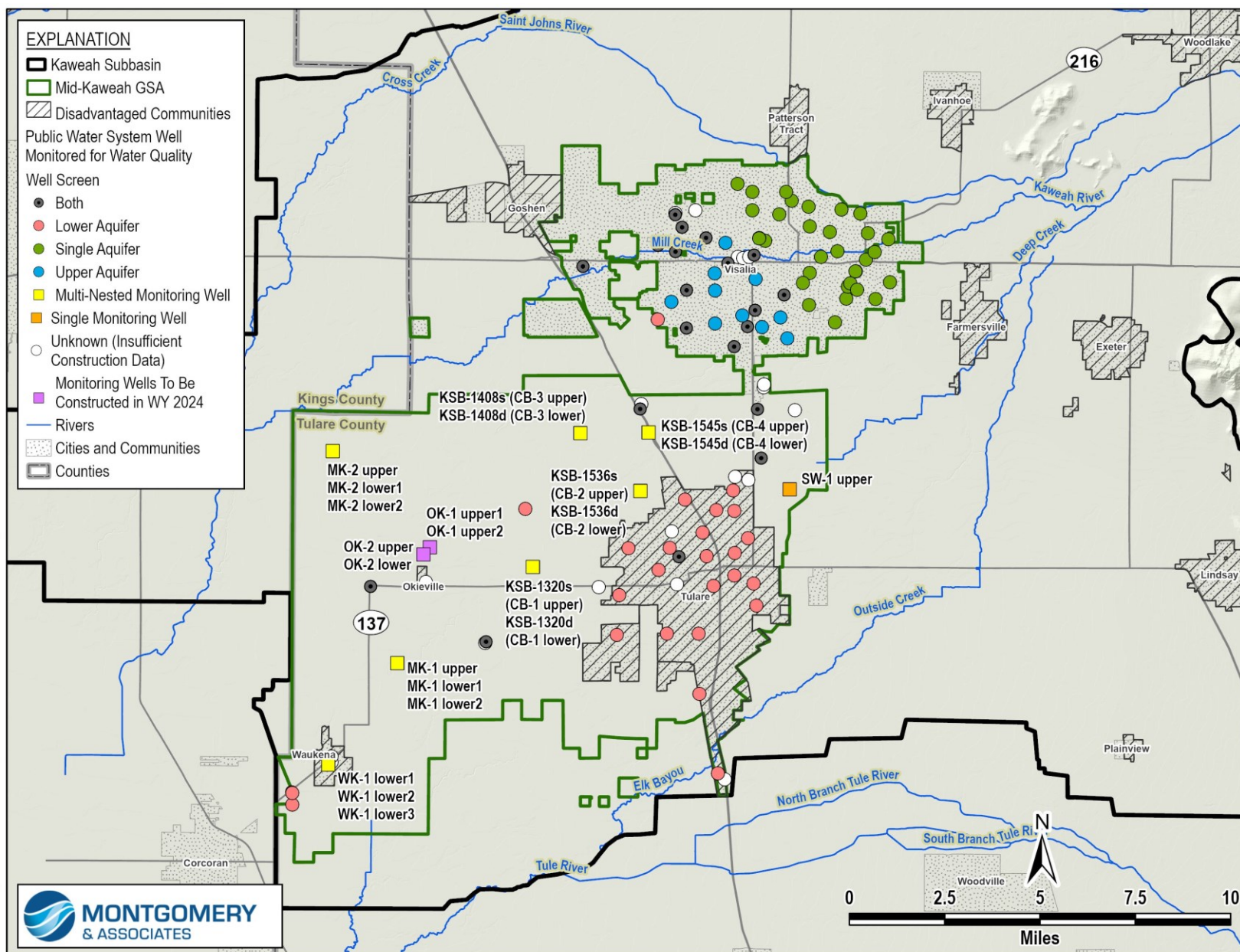


Figure 4-16. Mid-Kaweah Groundwater Sustainability Agency Public Water System and Dedicated Monitoring Well Water Quality Monitoring Network

Table 4-13. Mid-Kaweah Groundwater Sustainability Agency Groundwater Quality Monitoring Network

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System
5400679-001	Public Drinking Water	99 Palms Inn and Suites	WELL 01	36.2709	-119.36636	175	300	Both
5400538-001	Public Drinking Water	Accelerated Charter High School	WELL 01	36.25236	-119.30941	168	320	Both
5400816-002	Public Drinking Water	Bedel Mutual Water Co	WELL 02	36.32347	-119.26517	NA	NA	Single
5400816-003	Public Drinking Water	Bedel Mutual Water Co	WELL 03	36.32349	-119.26528	NA	NA	Single
5400919-001	Public Drinking Water	Buena Vista School	WELL 01	36.18212	-119.43825	240	350	Both
5400919-002	Public Drinking Water	Buena Vista School	WELL 02	36.18167	-119.43857	NA	NA	Unknown
1610004-003	Public Drinking Water	Corcoran, City Of	WELL 03A	36.12465	-119.52906	250	470	Both
1610004-015	Public Drinking Water	Corcoran, City Of	WELL 06A	36.11987	-119.5287	590	1130	Lower
1610004-016	Public Drinking Water	Corcoran, City Of	WELL 07A	36.12425	-119.52878	515	1000	Lower
5410016-010	Public Drinking Water	CWS – Visalia	WELL 07-01	36.32889	-119.28169	175	270	Single
5410016-014	Public Drinking Water	CWS – Visalia	WELL 11-02	36.32281	-119.28684	310	440	Single
5410016-015	Public Drinking Water	CWS – Visalia	WELL 12-01	36.34049	-119.28692	186	246	Single
5410016-016	Public Drinking Water	CWS – Visalia	WELL 13-01	36.32044	-119.31236	214	265	Upper
5410016-017	Public Drinking Water	CWS – Visalia	WELL 14-01	36.335	-119.30782	222	280	Single
5410016-018	Public Drinking Water	CWS – Visalia	WELL 15-01	36.32802	-119.26052	280	334	Single
5410016-023	Public Drinking Water	CWS – Visalia	WELL 19-01	36.31061	-119.28716	192	225	Single
5410016-024	Public Drinking Water	CWS – Visalia	WELL 20-01	36.34502	-119.30138	245	257	Single
5410016-026	Public Drinking Water	CWS – Visalia	WELL 22-01	36.33086	-119.25627	78	300	Single
5410016-027	Public Drinking Water	CWS – Visalia	WELL 23-01	36.30859	-119.31249	196	304	Both
5410016-028	Public Drinking Water	CWS – Visalia	WELL 24-01	36.33842	-119.27757	198	275	Single
5410016-029	Public Drinking Water	CWS – Visalia	WELL 25-01	36.32263	-119.33147	274	282	Upper
5410016-030	Public Drinking Water	CWS – Visalia	WELL 26-01	36.32649	-119.32533	269	373	Both
5410016-031	Public Drinking Water	CWS – Visalia	WELL 27-01	36.31444	-119.29889	175	328	Both
5410016-035	Public Drinking Water	CWS – Visalia	WELL 30-01	36.33112	-119.27397	130	330	Single

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System
5410016-036	Public Drinking Water	CWS – Visalia	WELL 31-01	36.30212	-119.30928	208	245	Upper
5410016-037	Public Drinking Water	CWS – Visalia	WELL 32-01	36.30652	-119.31853	119	257	Upper
5410016-040	Public Drinking Water	CWS – Visalia	WELL 34-01	36.29796	-119.29742	120	250	Upper
5410016-043	Public Drinking Water	CWS – Visalia	WELL 36-01	36.35028	-119.29544	120	282	Single
5410016-044	Public Drinking Water	CWS – Visalia	WELL 37-01	36.33424	-119.32651	150	290	Upper
5410016-045	Public Drinking Water	CWS – Visalia	WELL 38-01	36.33076	-119.35002	175	295	Both
5410016-046	Public Drinking Water	CWS – Visalia	WELL 39-01	36.31612	-119.34474	190	310	Both
5410016-047	Public Drinking Water	CWS – Visalia	WELL 40-01	36.31607	-119.33142	96	192	Upper
5410016-048	Public Drinking Water	CWS – Visalia	WELL 41-01	36.30235	-119.31605	148	296	Both
5410016-053	Public Drinking Water	CWS – Visalia	WELL 45-01	36.30588	-119.3006	150	280	Upper
5410016-054	Public Drinking Water	CWS – Visalia	WELL 46-01	36.33605	-119.33569	170	300	Both
5410016-055	Public Drinking Water	CWS – Visalia	WELL 47-01	36.30344	-119.33124	168	292	Upper
5410016-056	Public Drinking Water	CWS – Visalia	WELL 48-01	36.34657	-119.31396	200	330	Single
5410016-057	Public Drinking Water	CWS – Visalia	WELL 49-01	36.31316	-119.26975	160	290	Single
5410016-058	Public Drinking Water	CWS – Visalia	WELL 50-01	36.3455	-119.26326	150	270	Single
5410016-059	Public Drinking Water	CWS – Visalia	WELL 51-01	36.31173	-119.35196	160	286	Upper
5410016-060	Public Drinking Water	CWS – Visalia	WELL 52-01	36.27095	-119.31122	180	300	Both
5410016-061	Public Drinking Water	CWS – Visalia	WELL 53-01	36.34706	-119.27199	190	300	Single
5410016-064	Public Drinking Water	CWS – Visalia	WELL 56-01	36.34804	-119.28745	280	420	Single
5410016-065	Public Drinking Water	CWS – Visalia	WELL 57-01	36.31764	-119.26898	292	350	Single
5410016-066	Public Drinking Water	CWS – Visalia	WELL 57-02	36.31771	-119.26898	252	265	Single
5410016-067	Public Drinking Water	CWS – Visalia	WELL 58-01	36.31889	-119.26785	272	290	Single
5410016-069	Public Drinking Water	CWS – Visalia	WELL 61-01	36.30172	-119.34474	220	440	Both
5410016-070	Public Drinking Water	CWS – Visalia	WELL 62-01	36.31654	-119.26465	200	460	Single
5410016-080	Public Drinking Water	CWS – Visalia	WELL 70-01	36.33315	-119.35828	220	400	Both
5410016-081	Public Drinking Water	CWS – Visalia	WELL 64-01	36.34004	-119.34695	190	400	Both

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System
5410016-087	Public Drinking Water	CWS – Visalia	WELL 77-01	36.32501	-119.39351	175	355	Both
5410016-089	Public Drinking Water	CWS – Visalia	WELL 72-01	36.33809	-119.25954	280	450	Single
5410016-090	Public Drinking Water	CWS – Visalia	WELL 78-01	36.31296	-119.256	220	250	Single
5410016-091	Public Drinking Water	CWS – Visalia	WELL 79-01	36.35366	-119.31398	180	290	Single
5410016-092	Public Drinking Water	CWS – Visalia	WELL 80-01	36.30502	-119.35831	290	555	Lower
5410016-093	Public Drinking Water	CWS – Visalia	WELL 81-01	36.31938	-119.24915	245	620	Single
5410016-094	Public Drinking Water	CWS – Visalia	WELL 82-01	36.31902	-119.29002	280	450	Single
5410016-098	Public Drinking Water	CWS – Visalia	WELL 91-01	36.35365	-119.2982	180	390	Single
5410016-154	Public Drinking Water	CWS – Visalia	WELL 16-02	36.32956	-119.31309	260	480	Both
5410016-156	Public Drinking Water	CWS – Visalia	WELL 83-01	36.30411	-119.27493	370	680	Single
5410016-158	Public Drinking Water	CWS – Visalia	WELL 93-01	36.34649	-119.34068	NA	NA	Unknown
5410016-159	Public Drinking Water	CWS – Visalia	WELL 60-01	36.27059	-119.2937	NA	NA	Unknown
5410016-166	Public Drinking Water	CWS – Visalia	WELL 55-02	36.29472	-119.32229	196	570	Both
5410016-167	Public Drinking Water	CWS – Visalia	WELL 94-01	36.3567	-119.32098	230	590	Single
5410016-185	Public Drinking Water	CWS – Visalia	WELL 97-01	36.33575	-119.24997	NA	NA	Single
5401033-001	Public Drinking Water	Horizon Nut LLC	WELL 01	36.27279	-119.36578	NA	NA	Unknown
5403074-002	Public Drinking Water	Kraft Heinz Foods Co	WELL 01	36.13242	-119.32923	360	700	Lower
5403074-004	Public Drinking Water	Kraft Heinz Foods Co	WELL 01	36.13016	-119.32604	NA	NA	Unknown
5403146-001	Public Drinking Water	Liberty Elementary School	WELL 01	36.24517	-119.3216	NA	NA	Unknown
5402050-001	Public Drinking Water	Milk Specialties Global	WELL 01	36.33601	-119.31067	NA	NA	Single
5402050-002	Public Drinking Water	Milk Specialties Global	WELL 01	36.33594	-119.31071	NA	NA	Single
5400951-003	Public Drinking Water	Mooney Grove Park	WELL 01	36.27932	-119.30842	NA	NA	Unknown
5400951-004	Public Drinking Water	Mooney Grove Park	WELL 01	36.28044	-119.30818	NA	NA	Unknown
5400713-001	Public Drinking Water	Oak Valley School	WELL 01	36.23272	-119.4201	610	660	Lower
5403217-001	Public Drinking Water	Okieville Highland Acres Mwc	WELL 01	36.2047	-119.4666	NA	NA	Unknown
5402031-001	Public Drinking Water	Preet Market	WELL 01	36.20295	-119.49257	260	300	Both

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System
5403118-001	Public Drinking Water	Saputo Dairy Food USA	WELL 01	36.21476	-119.34787	240	440	Both
5403208-002	Public Drinking Water	Soult's Pump & Equipment Co	WELL 02	36.20312	-119.38544	NA	NA	Unknown
5400880-001	Public Drinking Water	The Lakes Association	WELL 01	36.34482	-119.35018	180	360	Both
5400880-002	Public Drinking Water	The Lakes Association	WELL 02 – South	36.34543	-119.35014	NA	NA	Unknown
5401039-001	Public Drinking Water	Tulare County Civic Center	WELL 01 – AG Bldg.	36.3289	-119.3206	NA	NA	Unknown
5401039-002	Public Drinking Water	Tulare County Civic Center	WELL 02 – Motorpool	36.32847	-119.31827	NA	NA	Unknown
5401039-003	Public Drinking Water	Tulare County Civic Center	WELL 03 – Courthouse	36.32887	-119.31528	NA	NA	Unknown
5410015-001	Public Drinking Water	Tulare, City Of	WELL 01	36.20966	-119.35737	382	520	Lower
5410015-011	Public Drinking Water	Tulare, City Of	WELL 11	36.20363	-119.33155	348	756	Lower
5410015-012	Public Drinking Water	Tulare, City Of	WELL 12	36.21816	-119.35218	312	708	Lower
5410015-013	Public Drinking Water	Tulare, City Of	WELL 13	36.2077	-119.32192	300	700	Lower
5410015-014	Public Drinking Water	Tulare, City Of	WELL 14	36.16261	-119.33796	300	700	Lower
5410015-015	Public Drinking Water	Tulare, City Of	WELL 15	36.22191	-119.31546	300	700	Lower
5410015-017	Public Drinking Water	Tulare, City Of	WELL 17	36.18549	-119.33858	300	396	Lower
5410015-021	Public Drinking Water	Tulare, City Of	WELL 22	36.22403	-119.33683	300	702	Lower
5410015-025	Public Drinking Water	Tulare, City Of	WELL 26	36.21799	-119.37162	300	720	Lower
5410015-026	Public Drinking Water	Tulare, City Of	WELL 27	36.23654	-119.34513	320	720	Lower
5410015-033	Public Drinking Water	Tulare, City Of	WELL 31	36.23258	-119.33051	400	700	Lower
5410015-047	Public Drinking Water	Tulare, City Of	WELL 33	36.20002	-119.37576	321	764	Lower
5410015-048	Public Drinking Water	Tulare, City Of	WELL 34	36.21494	-119.33492	450	663	Lower
5410015-051	Public Drinking Water	Tulare, City Of	WELL 35	36.19635	-119.31145	390	760	Lower
5410015-052	Public Drinking Water	Tulare, City Of	WELL 36	36.24002	-119.32245	320	600	Lower
5410015-055	Public Drinking Water	Tulare, City Of	WELL 37	36.2047	-119.31274	320	680	Lower
5410015-056	Public Drinking Water	Tulare, City Of	WELL 38	36.21622	-119.32173	280	620	Lower

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System
5410015-057	Public Drinking Water	Tulare, City Of	WELL 39	36.23227	-119.32199	320	590	Lower
5410015-061	Public Drinking Water	Tulare, City Of	WELL 40	36.18542	-119.35347	380	725	Lower
5410015-065	Public Drinking Water	Tulare, City Of	WELL 42	36.18491	-119.3769	310	690	Lower
5410015-073	Public Drinking Water	Tulare, City Of	WELL 45	36.20433	-119.34884	NA	NA	Unknown
5410015-075	Public Drinking Water	Tulare, City Of	WELL 46	36.22436	-119.35128	NA	NA	Unknown
5410015-077	Public Drinking Water	Tulare, City Of	WELL 47	36.24399	-119.31532	NA	NA	Unknown
5400795-001	Public Drinking Water	Waukena Elementary School	WELL 01	36.13611	-119.5104	NA	NA	Unknown
5402030-002	Public Drinking Water	Waukena Market	WELL 02	36.13826	-119.51044	NA	NA	Unknown
NA	Monitoring	Tulare Irrigation District	KSB-1408s ¹ (CB-3 upper)	36.261639	-119.39439	80	200	Upper
NA	Monitoring	Tulare Irrigation District	KSB-1408d ² (CB-3 lower)	36.261639	-119.39439	230	490	Lower
NA	Monitoring	Tulare Irrigation District	KSB-1545s ¹ (CB-4 upper)	36.262009	-119.36238	80	255	Upper
NA	Monitoring	Tulare Irrigation District	KSB-1545d ² (CB-4 lower)	36.262009	-119.36238	340	450	Lower
NA	Monitoring	Tulare Irrigation District	KSB-1536s ¹ (CB-2 upper)	36.239729	-119.36607	80	250	Upper
NA	Monitoring	Tulare Irrigation District	KSB-1536d ² (CB-2 lower)	36.239729	-119.36607	350-420	500-540	Lower
NA	Monitoring	Tulare Irrigation District	KSB-1320s ¹ (CB-1 upper)	36.210657	-119.41643	80	250	Upper
NA	Monitoring	Tulare Irrigation District	KSB-1320d ² (CB-1 lower)	36.210657	-119.41643	330	540	Lower
NA	Monitoring	Tulare Irrigation District	MK-1 upper	36.173829	-119.47983	260	310	Upper
NA	Monitoring	Tulare Irrigation District	MK-1 lower1	36.173829	-119.47983	390	450	Lower
NA	Monitoring	Tulare Irrigation District	MK-1 lower2	36.173829	-119.47983	900	950	Lower
NA	Monitoring	Tulare Irrigation District	MK-2 upper	36.25434	-119.51064	250	300	Upper

Well ID	Well Type	System Name	Well Name	Latitude	Longitude	Top of Screen (feet bgs)	Bottom of Screen (feet bgs)	Aquifer System
NA	Monitoring	Tulare Irrigation District	MK-2 lower1	36.25434	-119.51064	380	420	Lower
NA	Monitoring	Tulare Irrigation District	MK-2 lower2	36.25434	-119.51064	900	950	Lower
NA	Monitoring	Tulare Irrigation District	SW-1 upper	36.240535	-119.29599	150	250	Single
NA	Monitoring	Tulare Irrigation District	WK-1 lower1	36.135090	-119.51197	480	540	Lower
NA	Monitoring	Tulare Irrigation District	WK-1 lower2	36.135090	-119.51197	625	685	Lower
NA	Monitoring	Tulare Irrigation District	WK-1 lower3	36.135090	-119.51197	750	900	Lower
NA	<i>Monitoring</i>	<i>Tulare Irrigation District</i>	<i>OK-1 upper1</i>	<i>36.217968</i>	<i>-119.46481</i>	<i>135</i>	<i>230</i>	<i>Upper</i>
NA	<i>Monitoring</i>	<i>Tulare Irrigation District</i>	<i>OK-1 upper2</i>	<i>36.217968</i>	<i>-119.46481</i>	<i>240</i>	<i>330</i>	<i>Upper</i>
NA	<i>Monitoring</i>	<i>Tulare Irrigation District</i>	<i>OK-2 upper</i>	<i>36.215237</i>	<i>-119.46783</i>	<i>200</i>	<i>300</i>	<i>Upper</i>
NA	<i>Monitoring</i>	<i>Tulare Irrigation District</i>	<i>OK-2 lower</i>	<i>36.215237</i>	<i>-119.46783</i>	<i>375</i>	<i>475</i>	<i>Lower</i>

Monitoring wells in italics are to be completed in WY 2024

4.6.4 Groundwater Quality Representative Monitoring Network

4.6.4.1 Considerations in Establishing Representative Monitoring Sites

The RMS sites were selected based on a combination of factors including the well's geographic location, the screen interval relative to the principal aquifers (upper, lower, single, hardrock), accessibility, well condition and remaining useful life, continuity of historical data, and the site's ability to be representative of all beneficial uses and users of groundwater.

On the eastern portion of the Kaweah Subbasin, the depth to bedrock limits the saturated thickness of the aquifer. In these areas adjacent to the foothills, the depth of domestic wells, agricultural wells, and public supply wells are generally comparable because of depth limitations. West of the fault that delineates the limited saturated thickness zone from the rest of the Subbasin, the depth of domestic wells tends to be more shallow than agricultural and public supply wells. In the western third of the Subbasin, the aquifer is split into an unconfined zone and a confined zone by the Corcoran Clay. The hydrogeologic zones are described in the HCM (Section 3.2). The hydrogeologic features play a role in determining what characteristics are deemed representative of nearby beneficial users when assigning RMS wells. More specifically, public supply wells are representative of all beneficial users on the eastern-most portion of the Subbasin, where designated monitoring in the upper aquifer has been implemented on the western portion of the Subbasin to improve monitoring of shallow aquifers often tapped by domestic wells.

As the monitoring program evolves, the groundwater quality monitoring network is expected to be further refined as access is gained to additional wells or new wells are drilled. For more information on data gaps and the plan to fill them, see Section 4.9.3.

4.6.4.2 Spatial Density of Representative Monitoring Network

The USGS GAMA Project developed a statistically consistent analytical approach using spatially distributed equal areas called Grid Cells to validate the representative nature of groundwater sampling across California. The Grid Cell study design utility allows for GAMA study unit groundwater quality results to be analyzed separately or in combination.

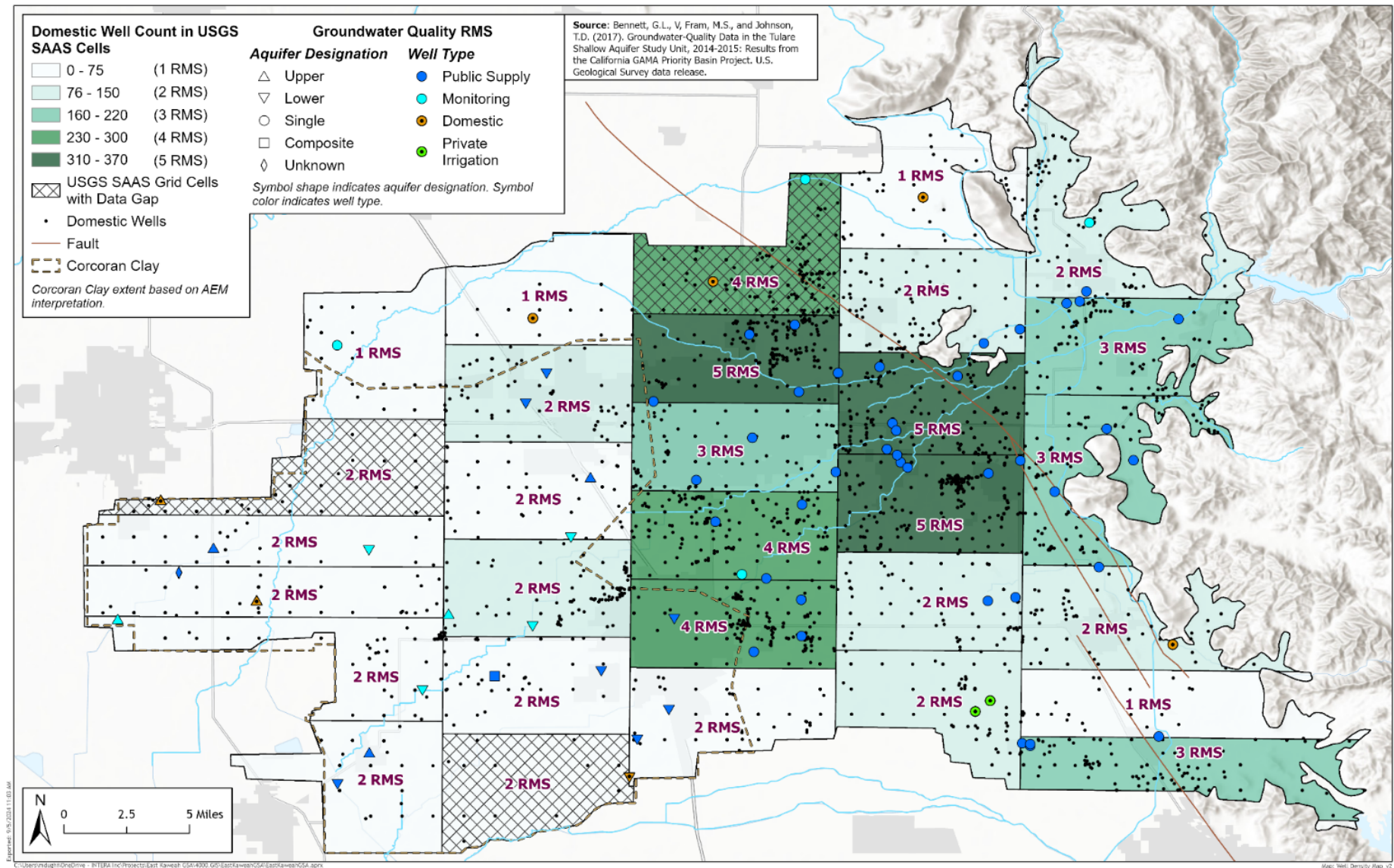
The spatial density of the representative monitoring network for the Kaweah Subbasin is developed using an approach informed by the USGS GAMA project, which employs the statistically consistent analytical approach described above, using spatially distributed equal area Grids Cells to validate the representativeness of groundwater sampling across California. The resulting Grid Cells were adopted to evaluate the distribution and density of public supply and domestic wells, identified as critical for assessing potential exposure to groundwater quality issues within the Subbasin.

For each Grid Cell, the count of domestic wells is calculated. These Grid Cells are then classified based on the number of domestic wells using the Equal Interval classification in ArcGIS. This method divides the data range into equal class widths, resulting in varying frequencies of observations per class, thereby implementing a consistent classification of well density. Figure 4-17 depicts the resulting Grid Cells count of recommended RMS wells per Grid Cell.

The classification system established 5 classes to represent the range of domestic well densities within the Grid Cells. The class with the fewest domestic wells was assigned 1 RMS, while the class with the highest number of domestic wells was assigned 5 RMS. Intermediate classes were assigned 2, 3, or 4 RMS, based on the number of wells in each Grid Cell (Figure 4-17) This approach allocates proportionally more monitoring sites to areas with higher domestic well densities, thereby enhancing the representativeness of the monitoring network.

Additionally, within the extent of the Corcoran Clay, Grid Cells designated with 1 RMS are increased to 2 RMS to provide adequate representation for both the lower and upper aquifer systems. For each proposed RMS, considerations were made regarding outreach to municipal and domestic well owners to address site access, well depth, and longevity. These factors are taken into account to maintain the viability of the wells included in the RMS throughout the 20-year period necessary to achieve sustainability.

The base RMS for the network includes all public supply wells with available data, as well as GSA-specific monitoring wells. From this base, proposed RMS were selected according to the number required within each Grid Cell, resulting in a robust and spatially distributed monitoring network that accurately reflects the vulnerability of domestic wells in the Subbasin and supports long-term groundwater sustainability efforts.



4.6.5 Groundwater Quality Monitoring Protocols

Both Visalia and Tulare have protocols they follow for the collection, handling, transport, and analysis of groundwater samples. These protocols are included in Appendix 4A.

For other wells monitored, groundwater quality will generally follow the protocols identified in the *Monitoring Protocols, Standards, and Sites BMP*. This BMP largely leans on the U.S. EPA's DQO process.

The following comments and exceptions to the BMP should be noted:

- If used in a well suspected of contamination or if there are obvious signs of contamination (such as oil), well sounding equipment will be decontaminated after use.
- Unique well identifiers will be labeled on all public wells, and on private wells if permission is granted.
- For water quality monitoring, field parameters for pH, electrical conductivity, and temperature will only be collected when required for the parameter being monitored. Calculating a run time before sampling may be used to determine if a well has been purged adequately.

4.7 MKGSA Interconnected Surface Water Monitoring Network

§ 354.34. Monitoring Network.

(j) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.

In the MKGSA, the connection of surface water and groundwater was disconnected many decades ago. Therefore, a monitoring network and monitoring is not required for the MKGSA.

4.8 Seawater Intrusion Monitoring

§ 354.34. Monitoring Network.

(j) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.

The Kaweah Subbasin being in the interior part of the state is far removed from any seawater body. Furthermore, deep connate water exhibiting high TDS is beyond the reach of producing wells in the Subbasin and is considered isolated from the freshwater aquifers above. The

Subbasin GSAs have determined that seawater intrusion is not present and is not likely to physically occur. No monitoring for seawater intrusion is conducted by Subbasin GSAs.

4.9 Monitoring Data Gaps

§354.38 Assessment and Improvement of Monitoring Network.

- (a) Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.
- (b) Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.
- (c) If the monitoring network contains data gaps, the Plan shall include a description of the following:
 - (1) The location and reason for data gaps in the monitoring network.
 - (2) Local issues and circumstances that limit or prevent monitoring.
- (d) Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.
- (e) Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:
 - (1) Minimum threshold exceedances.
 - (2) Highly variable spatial or temporal conditions.
 - (3) Adverse impacts to beneficial uses and users of groundwater.
 - (4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.

§354.40 Reporting Monitoring Data to the Department. Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.

The following section describes data gaps for groundwater elevations and storage, groundwater quality, and land subsidence and the plan to address them.

Data gaps identified through the development of the GSP are discussed in the subsection below. As these data gaps are filled and new data collected, additional data gaps may become evident and will be included in future Periodic Evaluations. in progress. The principal data gaps listed below are subject to revision during completion of this GSP. The MKGSA is intending to fill these gaps during the next 5 years.

4.9.1 Groundwater Level and Storage Monitoring Data Gaps

As referenced in Regulation §352.4, “If an Agency relies on wells that lack casing perforations, borehole depth, or total well depth information to monitor groundwater conditions as part of a Plan, the Agency shall describe a schedule for acquiring monitoring wells with the necessary information or demonstrate to the Department that such information is not necessary to understand and manage groundwater in the basin.”

Improved well classification and construction details need to be determined to improve the monitoring network. Downhole well surveys and desktop surveys may be utilized for existing wells to fill in the well construction details gap. Preference will be given to new dedicated monitoring wells and converted production wells to improve the monitoring network spatial extent and density. Some of these improvements have taken place in the past few years, but a complete reevaluation will occur with the first Periodic Evaluation.

A Subbasin-wide Well Registration Program is included as a management action in Section 6.7.6. The purpose of voluntary registration of wells is to create a baseline record for each groundwater well in the event of a future claim and to have the necessary information on file to identify at-risk domestic wells for notification and advance mitigation purposes. Additionally, the Well Registration Program is designed to gather as much data on well construction, location, ownership, use, groundwater levels, and groundwater quality for all well types to help fill data gaps.

4.9.2 Land Subsidence Monitoring Data Gaps

With the addition of survey points to TID's critical infrastructure and availability of InSAR data, the current subsidence monitoring network is believed to sufficiently cover the MKGSA.

Most subsidence occurs below the Corcoran Clay. Impacts due to subsidence have been difficult to observe because regular maintenance of infrastructure can address the impacts of subsidence incrementally. This includes not tracking subsidence-related well collapse because it is not included in the well permitting process nor is it often identified as it may only be 1 of many well casing related issues.

The MKGSA has identified several infrastructure categories that could potentially be impacted by subsidence as discussed in Section 5.6.1, but there are limited data about any historical subsidence impacts. The MKGSA will modify its subsidence monitoring program as more information is collected about subsidence impacts on infrastructure.

4.9.3 Groundwater Quality Monitoring Data Gaps

The data gaps hinder groundwater condition interpretations, water management decisions, and reaction time to mitigate or avoid impacts induced by groundwater contamination. The Kaweah Subbasin has several data gaps (as seen as hatched areas on Figure 4-17); however, for the purposes of this technical memorandum, the focus is on groundwater quality data gaps. These data gaps include the following:

- Establish groundwater quality RMS sites in the hatched areas designated as data gaps on Figure 4-4. In areas overlaying the Corcoran Clay, it is preferred to add RMS wells in both the upper and lower aquifers
- Monitor groundwater quality data at various depths (in or near the same location)
- Determine the relationship between groundwater recharge activities and groundwater quality
- Determine if groundwater pumping is altering hydraulic gradients resulting in the movement of existing contaminant plumes into uncontaminated areas
- Determine if land subsidence is causing contaminants adsorbed in Corcoran Clay to be released

Information on the plan to address these data gaps is provided in Section 4.9.5.

4.9.4 Surface Water Monitoring Data Gaps

There is ongoing uncertainty in the amount of ditch losses throughout TID's water delivery system which effectively are a source of recharge to the unconfined aquifers. More gauging between long reaches with limited turnout and at check structures will provide data to determine losses between gauging locations. Shallow monitoring wells adjacent to ditches may provide information on how losses change over time, where losses start off high, and asymptotically approach a more constant loss as the shallow sediments become saturated.

4.9.5 Plan to Fill Data Gaps

MKGSA is in the process of filling data gaps and is embracing new technologies to improve the Kaweah Subbasin's understanding of groundwater conditions affecting beneficial users, uses, and property interests. Improving certainty results in better groundwater management planning; therefore, filling data gaps is considered a top priority for MKGSA. New management actions have been added with the aim of improving data gaps and community trust building to access private, currently inaccessible data and information.

Plan to Fill Groundwater Level Data Gaps The MKGSA will oversee the groundwater level monitoring network, including filling areas with data gaps. This will be especially useful for the regions that are not currently monitored, such as outside irrigation district boundaries. The MKGSA will need to locate accessible private wells or drill new wells in the 7 locations shown. Over time, the MKGSA will transition to utilizing dedicated monitoring wells in its monitoring network.

To address data quality gaps related to unknown construction information, the MKGSA will employ the following options:

- **Collect well completion reports.** Accurate well Completion Reports (WCRs) can potentially provide missing well construction and completion information. These records could be collected from landowners or DWR. Because of the way data are collected and dispersed, it is often difficult to correlate WCRs with actual wells. Locations of wells as reported on WCRs are often subjective, as they are based on the drillers' ability to convey spatial location. In some cases, wells have been destroyed or lost without documentation. Obtaining well logs directly from owners bypasses this confusion, though this is not a perfect solution. Private well owners may be unable or unwilling to provide logs for their wells. Acquiring this information will be pursued through the MKGSA Well Registration management action discussed in Section 6.7.6.
- **Perform a video inspection of each well to obtain construction information.** In the absence of verified well logs a video inspection can be performed on wells to determine the total completed depth and perforated interval(s). Each video inspection currently ranges in costs between \$2,500 and as much as \$15,000 if required to lift and re-install a pump to obtain access in production wells. There would also be additional costs for administration and outreach to landowners. The MKGSA would need to enter into private agreements with individual well owners for the use of these wells; as an incentive for participation the MKGSA would cover the cost of the well video assessment.
- **Abandoned Wells.** The MKGSA will assess the likelihood of monitoring former wells that have been abandoned. Use of these wells will potentially bolster the density of the monitoring network in areas with minimal coverage, likely involve less stringent access requirements, and they are cheaper than drilling new wells. Additionally, since these wells are no longer in production, the monitoring of abandoned wells allows for better potential in gaining a static groundwater level reading.
- **Replace monitoring point with a dedicated monitoring well.** Dedicated monitoring wells could be installed and used in place of private wells. The construction information would be known and since the MKGSA would locate these wells, access issues would not be an issue. Dedicated monitoring wells are expensive to construct, and their installation will depend on available funding.
- **Replace monitoring point with another private well.** Private wells without documented construction information may potentially be replaced with other private wells that have verified well completion information. This option may be simpler and less costly than using video inspection and would be substantially less expensive than drilling new dedicated monitoring wells. This method of network repair would sidestep the

expense of drilling new wells but would still be subject to availability and limitations arising from the missing historical record.

- **Implement a Well Registration Program.** Construction, groundwater level, and groundwater quality data from wells not currently in the MKGSA database are expected to be better understood through this management action. This management action fills data gaps by accessing existing and future data from domestic, small community, and agricultural wells. More information on this management action is available in Section 6.7.6.
- **Implement a Well Mitigation Program.** Through the mitigation program, groundwater level and quality data is to be better understood at impacted domestic well sites across the Subbasin. Following completion of long-term mitigation services, the GSA will request these landowners consider allowing the GSA access to the well for future monitoring and inclusion in the representative monitoring networks for groundwater quality and groundwater levels. More information on this management action is available in Section 6.9.7.

Plan to Fill Subsidence Data Gaps With the addition of survey points to critical infrastructure, and utilizing the InSAR data, the current subsidence monitoring network is believed to sufficiently cover the MKGSA.

Plan to Fill Groundwater Storage Data Gaps Storage data gaps will be filled by the same methods used to address data gaps in the groundwater level network, as spatial data coverage is a critical component in the change in storage calculations. Aquifer evaluation at a Subbasin scale was performed through AEM, the findings of which have been incorporated into the Kaweah Subbasin Groundwater Flow Model Update (see Appendix 3C) for use in planning groundwater management into the future and for annual reporting and Periodic Evaluations.

Plan to Fill Groundwater Quality Data Gaps MKGSA recognizes the addition of private domestic wells in the representative monitoring network would be helpful; however, there is generally hesitation among private landowners with sharing their data with a public agency. Two new management actions have been added, which are anticipated to improve the understanding of domestic groundwater quality in MKGSA and the Kaweah Subbasin:

- **Well Registration Program.** Construction, groundwater level, and groundwater quality data from wells not currently in the MKGSA database are expected to be better understood through this management action. By enrolling in the Well Registration Program (and participating in the representative monitoring network), the GSAs would receive the information necessary to notify the owners of wells at risk of groundwater quality, level, or subsidence impacts. This management action fills data gaps by accessing existing and future data from domestic and small

community wells. More information on this management action is available in Section 6.7.6.

- **Mitigation Program.** The Subbasin Mitigation Program will help us better understand groundwater level and quality data at impacted domestic well sites across the Subbasin. Following completion of long-term mitigation services, the GSA will request these landowners consider allowing the GSA access to the well for future monitoring and inclusion in the representative monitoring networks for groundwater quality and groundwater levels. More information on this management action is available in Section 6.7.4.

In addition to the new Well Registration Program and Mitigation Program, several new recharge facilities include groundwater quality monitoring to assess the relationship between the recharged water and the underlying groundwater quality. More information on these recharge basins and the Well Registration Program is available in Section 6.

The MKGSA's commitment to monitor constituents of concern across the groundwater level monitoring network intends to fill some of the significant data gaps with respect to groundwater quality data. Monitoring over the first 5 years of implementation should provide more insight on groundwater quality (location, trends, etc.) in the MKGSA. The MKGSA will also collaborate, where appropriate and feasible, with other agencies tasked with tracking and/or improving groundwater quality for additional assistance with data gaps.

5 SUSTAINABLE MANAGEMENT CRITERIA

This chapter provides location-specific SMC for the 5 applicable sustainability indicators, including the definition of URs, MTs, interim milestones (IMs), and MOs (MOs). This section builds from the Kaweah Subbasin’s sustainability goal described in Section 5.2 and is consistent with Appendix 6 of the Coordination Agreement (Appendix 1A).

The overall goal of SGMA is to achieve sustainable management of groundwater basins. To meet this goal, the Kaweah Subbasin GSAs have established SMC to reach sustainability by 2040. Demonstration of the absence of URs supports a determination that the Subbasin is operating within its sustainable yield and, thus, that the sustainability goal has been achieved. However, the occurrence of 1 or more URs within the initial 20-year implementation period does not, by itself, indicate that the Subbasin is not being managed sustainably.

The Kaweah Subbasin’s strategy is to manage the MO through implementation of management actions and projects to achieve the sustainability goal. More information on this strategy and confidence in achieving it is the specific demand management policies, projects, and other proactive measures are available in Chapter 6.

5.1 Introduction

§354.22 Introduction to Sustainable Management Criteria. This Subarticle describes criteria by which an Agency defines conditions in its Plan that constitute sustainable groundwater management for the basin, including the process by which the Agency shall characterize undesirable results, and establish minimum thresholds and measurable objectives for each applicable sustainability indicator.

Sustainable groundwater management is defined by SGMA as the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing URs. Thus, the avoidance of URs, defined later in this chapter, is vital to the success of this GSP. The purpose of this section is to define various SMCs by stating the sustainability goal for the Kaweah Subbasin, defining URs, and establishing the MTs, IMs, and MOs for each applicable sustainability indicator. A thorough understanding of the historical, current, and future groundwater conditions of the Subbasin is necessary to properly define SMC. Therefore, the development of the criteria is dependent on basin information presented in the HCM, groundwater conditions, and water budget sections (Chapter 3).

The SMC methodology and approach are shown on Figure 5-1, and a summary of the definitions and qualitative and quantitative functions of the SMC are available on Figure 5-2.

Appendices 5A, 5B, 5D, and 5F contain supplemental information on the process, analyses, and results that informed the revisions to the SMC for chronic lowering of groundwater levels and

land subsidence. Appendices 5C and 5E contain hydrographs. Appendix 3B contains the technical analysis to establish SMC for quality. The following appendices are all considered extensions of Chapter 5:

Appendix 3B - Technical Analysis to Support the Establishment of Sustainable Management Criteria for Degraded Groundwater Quality Sustainability Indicator

Appendix 5A – Technical Analysis to Support Establishment of SMC for Chronic Lowering of Groundwater Levels & Reduction of Groundwater Storage Sustainability Indicators

Appendix 5B – Land Subsidence and Lower Aquifer Chronic Lowering of Groundwater Level Sustainable Management Criteria Development Process for the Kaweah Subbasin

Appendix 5C – Technical Support for Land Subsidence Sustainable Management Criteria in the Kaweah Subbasin

Appendix 5D – Groundwater Level Sustainable Management Criteria Hydrographs

Appendix 5E – Development and Use of a 1-Dimensional Land Subsidence Model for the Kaweah Subbasin

Appendix 5F - Projected Representative Monitoring Site Hydrographs

Appendix 5G - Development of the Relationship Between Modeled Aquifer Storage and Regional Groundwater Elevations Technical Memorandum

The process and analyses vary for each sustainability indicator's SMC development; however, the general methodology remains consistent with the goal of avoiding significant and unreasonable effects on beneficial uses and users of groundwater in the Subbasin (Figure 5-1).

Sustainable Management Criteria Methodology

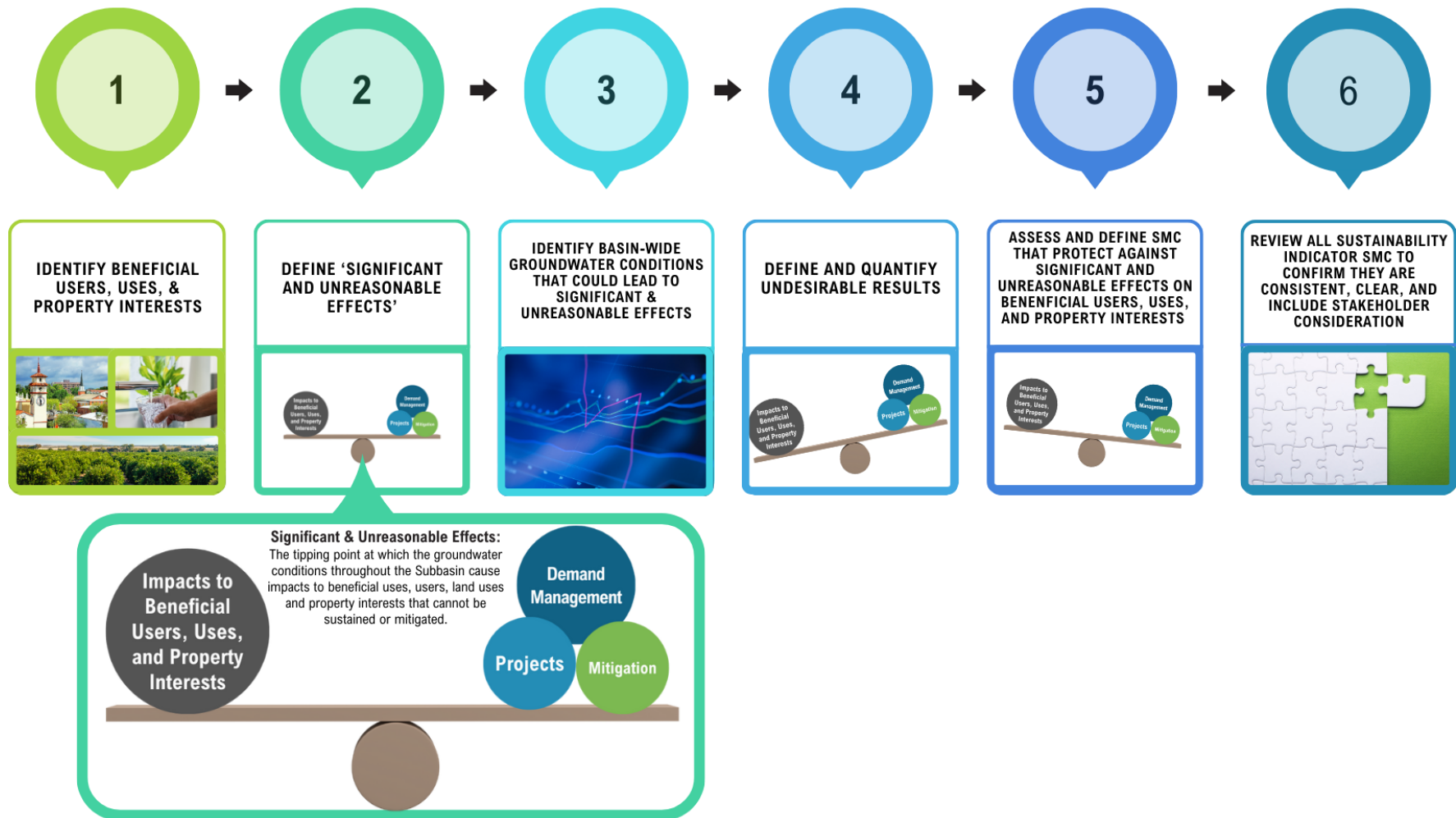


Figure 5-1. Sustainable Management Criteria Methodology and Approach

5.1.1 General Description of Undesirable Result

§354.26 Undesirable Results.

- (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.
- (b) The description of undesirable results shall include the following:
 - (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to 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.

The Kaweah Subbasin carefully considered and determined the groundwater conditions at which each of the 5 applicable sustainability indicators exhibit significant and unreasonable effects. URs are considered to occur when any of the 5 applicable sustainability indicators exceed a combination of MTs. All UR descriptions presented in this chapter are consistent with those presented within the Kaweah Subbasin Coordination Agreement (Appendix 1A). Further subsections describe the data and rationale used as justification for determining significant and unreasonable conditions that lead to URs for each specific sustainability indicator and provide the following rationales, as required by §354.26:

- Investigation of the cause of groundwater conditions that will lead, or has led to, URs impacting beneficial uses and users in the Subbasin
- Criteria used to define when and where the effects of groundwater conditions cause URs
- Quantification of URs via localized MT exceedances
- Description of the potential effects of the UR on beneficial uses or users

5.1.2 General Description of Minimum Thresholds

§354.28 Minimum Thresholds.

- (b) The of minimum thresholds shall include the following:
- (1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold 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 the basin setting.
 - (2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.
 - (3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.
 - (4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

In addition to a qualitative description, each UR must also be substantiated using a quantitative combination of MT exceedances. An MT is a quantitative value that represents the groundwater conditions at an RMS that, when exceeded individually or in combination with MTs at other RMS, may cause UR(s) in the Subbasin. When setting the MT for each sustainability indicator, potential impacts to the relevant beneficial uses and users of groundwater were considered. In addition, the Kaweah Subbasin MTs were set at levels that do not impede adjacent GSAs or subbasins from avoiding their MTs or achieving their sustainability goals.

The following components are presented in each sustainability indicator's relevant MT section:

- The information and criteria relied upon to establish and justify the MTs 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 the Basin Setting.
- The relationship between the MTs for each sustainability indicator, including an explanation of how the Kaweah Subbasin has determined that conditions for levels at each MT will avoid URs.
- How MTs have been selected to avoid causing URs in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.
- How MTs may potentially impact beneficial uses and users of groundwater or land uses and property interests.
- How state, federal, or local standards relate to the relevant sustainability indicator. If an MT differs from other regulatory standards, the Kaweah Subbasin GSAs will explain the nature and basis for the difference.

- How each MT will be quantitatively measured, consistent with monitoring network requirements.
- How SMC for 1 sustainability indicator may be used as a proxy for another sustainability indicator.
- Each of the sustainability indicators must be monitored for MT exceedances. However, based on the close relationship between groundwater levels and changes in aquifer storage (Appendix 5G) and land subsidence (Lees *et al.*, 2022, the limiting MT for groundwater conditions is whichever indicator is the most sensitive to groundwater level declines. Given the specific hydrogeology of the MKGSA, groundwater levels are determined at this time to be the most sensitive to potential MT exceedances and, therefore, are the primary metric for determining URs within the Subbasin. In general, based on currently known information, groundwater level MT exceedances would be triggered prior to URs being experienced from aquifer storage reductions or land subsidence. Nonetheless, in addition to monitoring groundwater levels, the groundwater quality, potential ISW depletion rates, and land subsidence sustainability indicators will also be monitored separately.

5.1.3 General Description of Measurable Objectives

§354.30 Measurable Objectives.

- (a) Each Agency shall establish measurable objectives, including interim milestones 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.
- (b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.
- (c) 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.
- (d) 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.
- (e) 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 interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.
- (f) Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.
- (g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

MOs are quantitative goals that reflect the desired groundwater conditions and allow the Kaweah Subbasin to achieve the sustainability goal within 20 years. MOs are set to allow for a reasonable margin of operational flexibility relative to the MT that provides accommodation for extended droughts, climate change factors, conjunctive use operations, and other groundwater management activities. The Kaweah Subbasin and MKGSA have developed a set of management actions and projects outlined in Chapter 6 that are intended to achieve sustainability in 2040 at the MO. Adjustments to the management actions and projects will be made accordingly during the implementation period to achieve sustainability in 2040 at the MO.

5.1.4 General Description of Interim Milestones

Five-year IMs for the MKGSA implementation timeline are designed to allow the MKGSA to track progress over time toward the sustainability goal and are presented for each sustainability indicator. Consistent with the Coordination Agreement (Appendix 1A), a summary of the URs, MTs, MOs, and IMs for each sustainability indicator is available in the subsections that follow.

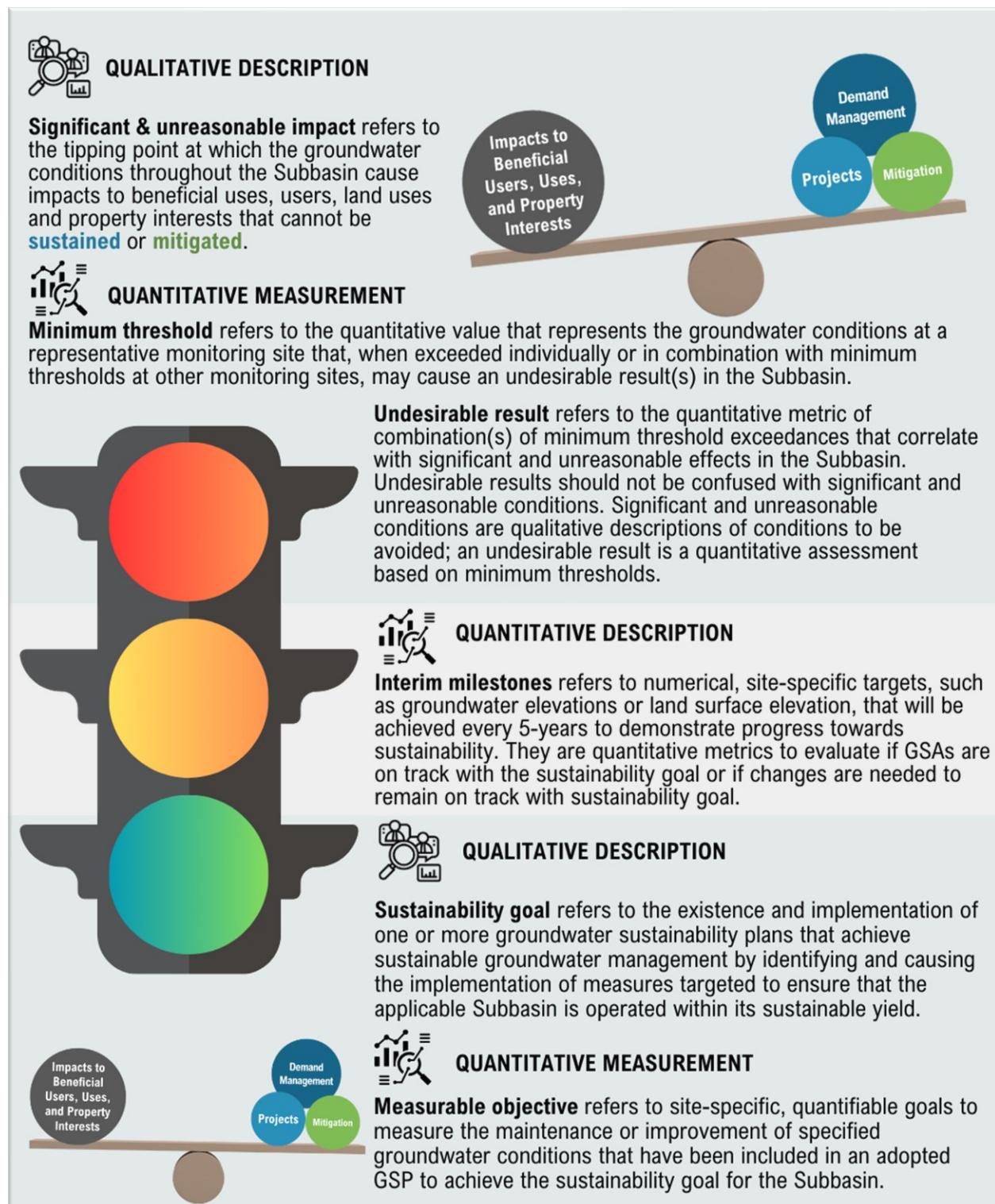


Figure 5-2. Sustainable Management Criteria Definitions and Functions

5.1.5 Sustainability Indicators Applicable in the Kaweah Subbasin

The applicability of sustainability indicators is described in Section 4 – Monitoring Network and summarized on Figure 5-3.

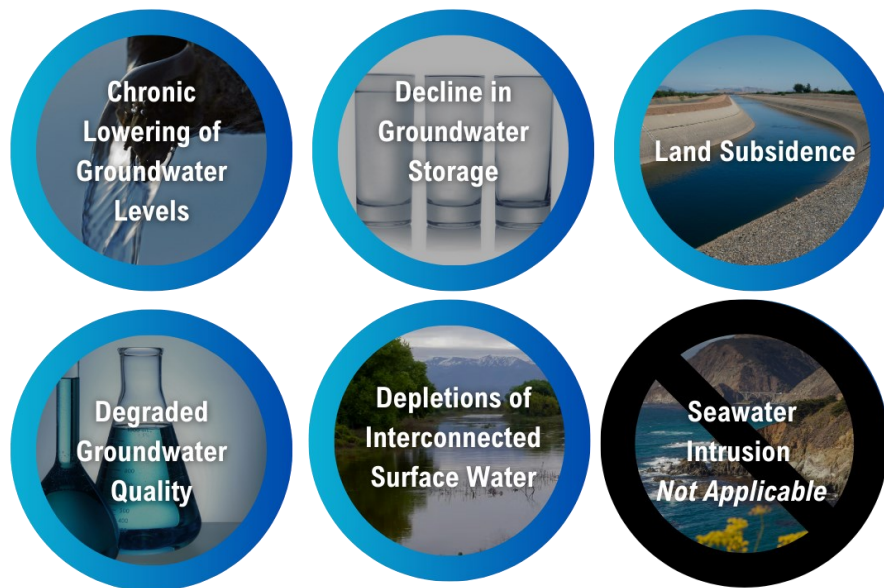


Figure 5-3. SGMA Sustainability Indicators

5.1.6 Potential Effects on Beneficial Users, Uses, and Property Interests by Sustainability Indicator

Figure 5-4 summarizes potential effects on beneficial uses, users, and property interests that are considered when establishing SMCs for the 5 applicable sustainability indicators.

5.1.7 Management Areas

Descriptions of each MKGSA Management Area and the rationale for their formation are available in Section 3.5. Management Areas in the Kaweah Subbasin do not have different SMC approaches and will not be operated to different MTs and MOs objectives than the Subbasin at large. Additionally, URs are defined consistently throughout the Subbasin.



Figure 5-4. Potential Effects on Beneficial Users, Uses, and Property Interests in the Kaweah Subbasin by Sustainability Indicator

5.2 Sustainability Goal

§354.24 Sustainability Goal. Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.

SGMA requires GSAs to establish within their GSP a sustainability goal applicable for the entire Subbasin that culminates in the sustainable management of groundwater resources through the absence of URs within 20 years. The sustainability goal and bases for SMC were coordinated across the Kaweah Subbasin GSAs. Consistent with the Coordination Agreement (Appendix 1A), and compliant with §354.24 of the Regulations and broadly stated sustainability goal for the Kaweah Subbasin is:

For each GSA to manage groundwater resources to preserve the viability of existing agricultural enterprises of the region, domestic wells, and the smaller communities that provide much of their job base in the Subbasin, including the school districts serving these communities. The goal will also strive to fulfill the water needs of existing and amended county and city general plans that commit to continued economic and population growth within [the Kaweah Subbasin area within] Tulare County and within portions of Kings County.

The sustainability goal will be achieved by:

- The implementation of the EKGSA, GKGSA and MKGSA GSPs, which are designed to identify phased measures (projects and management actions) targeted to ensure that the groundwater resources of the Kaweah Subbasin are managed to avoid URs and achieve MOs by 2040.
- Collaboration with other agencies and entities to prevent chronic lowering of groundwater levels and the reduction of groundwater storage, minimize land subsidence, and address the degradation of water quality to protect the local beneficial uses and users of groundwater.
- Assessments of progress toward implementation via evaluation of IMs and benefits from implemented projects and management actions during annual reporting and each 5-year GSP update pursuant to SGMA.
- Continued implementation of projects and management actions by the 3 GSAs as appropriate through the planning and implementation horizon.

To achieve the sustainability goal, a combination of projects and management actions will be implemented over the course of the next 16 years of the implementation period. Understanding that projects require funding and time to construct, interim assessments at 5, 10, and 15 years were set to evaluate progress on the path for reaching the sustainability goal by 2040. As much of the overdraft as possible will be avoided by demand management derived from allocation policies as well as increased supply via projects. Any impacts to beneficial uses and users of groundwater that may occur on the path toward the sustainability goal are addressed via the Kaweah Subbasin Mitigation Program and MKGSA Mitigation Plan (see Section 6.7.4). MKGSA is managing to achieve the sustainability goal, as evidenced by the Water Accounting Framework (Section 6.2), pre-emptive management actions, and significant investments in groundwater sustainability and resiliency infrastructure (see Chapter 7, Table 7-1).

The key factor for the Kaweah Subbasin to meet the sustainability goal is to avoid URs. Significant and unreasonable effects that lead to URs are further discussed in the next section. Within the MKGSA, the notable correlation has been developed between the chronic lowering of groundwater levels and the significant and unreasonable effects of reduction of groundwater in storage and land subsidence sustainability indicators. Therefore, maintaining groundwater levels at the defined SMC is the primary mechanism to avoid URs, and sustainability will be achieved by eliminating overdraft through pumping restrictions (i.e., allocations), storing more groundwater (via managed recharge projects), and establishing new water banking facilities.

5.3 General Process for Establishing Sustainable Management Criteria

5.3.1 SMC Revision Priorities

The SMC presented in this GSP have been revised from previous GSP versions to meet regulatory requirements under SGMA. Priorities for establishing revised SMC and general process to establish revised SMC are summarized on Figure 5-5 and Figure 5-1, respectively.

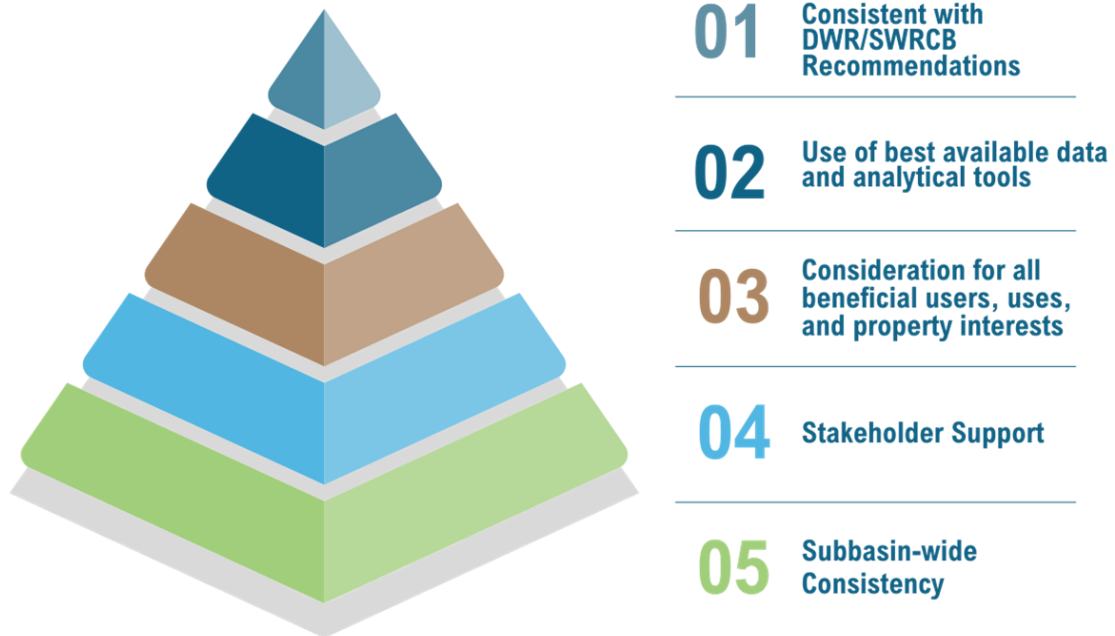


Figure 5-5. Kaweah Subbasin SMC Revision Priority Considerations

5.3.2 Stakeholder Feedback Process

In general, SMC for each sustainability indicator is determined using a data-informed, Subbasin-wide coordinated, and stakeholder-inclusive process. Specifically, the MKGSA Advisory Committee (AC), Kaweah Subbasin Technical Team, Core Teams focused on specific sustainability indicators and Board of Directors (Board) carefully considered when the 4 sustainability indicators applicable to the MKGSA would reach levels that were “significant and unreasonable” conditions and what conditions would be sustainable based upon the quantitative data presented in the investigative analyses on impacts to beneficial users and uses. Figure 5-6 includes a chart summarizing the stakeholder and technical process relationship.

The MKGSA Board, in combination with stakeholder input, AC, and Core Team expertise, ultimately determined the definition of URs based on relative levels that would have a significant and unreasonable negative impact on communities within the Kaweah Subbasin, severely threaten regional agricultural economy, and/or impact the world’s food chain supply.

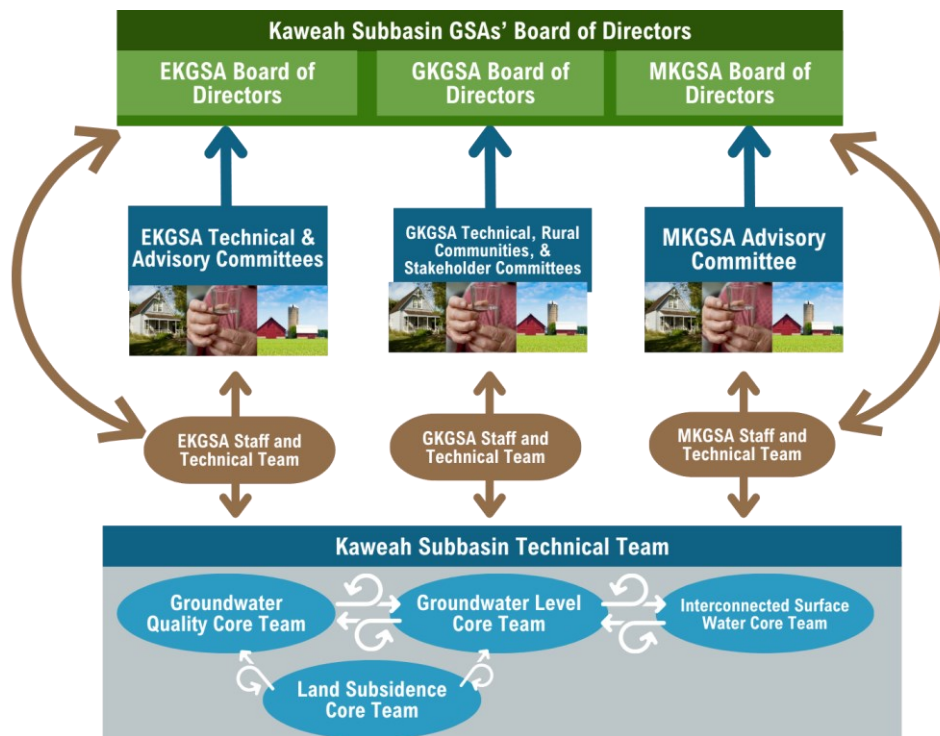


Figure 5-6. Kaweah Subbasin Stakeholder and Technical Feedback to Revise SMC

5.4 Sustainable Management Criteria Summary

Table 5-1 provides a summary of the SMC for each of the applicable sustainability indicators. This GSP is designed to avoid URs by achieving the sustainability goal within 20 years and progressing toward reaching IMs every 5 years. Management actions and projects provide sufficient options for reaching MOs within 20 years and maintaining those conditions for 30 years for all applicable sustainability indicators. The rationale and background for developing these criteria are provided in detail in the following sections.

The SMC presented in Table 5-1 are part of the Kaweah Subbasin's 50-year planning horizon: SGMA allows for 20 years to reach sustainability and requires the Subbasin to have no URs for the subsequent 30 years. The SMC presented in this GSP has been developed using the best available data and science and may require revision in the future as more data are collected and the Kaweah Subbasin Groundwater Flow Model is further used to improve the understanding of the groundwater conditions under different climate scenarios and operational conditions.

Use of Proxy SMC [§354.28(d)]

- There is a significant correlation between groundwater levels and aquifer storage. The Kaweah Subbasin is utilizing groundwater levels as a proxy metric for aquifer storage (Appendix 5G).
- For land subsidence, the Kaweah Subbasin is using a rate of land subsidence that avoids impacts on critical infrastructure. Lower aquifer groundwater management is directly correlated with land subsidence; therefore, lower aquifer SMC is established as the groundwater elevation that is consistent with SMC for land subsidence.

Table 5-1. Kaweah Subbasin Sustainable Management Criteria Summary

Chronic Lowering of Groundwater Levels		Reduction in Groundwater Storage	Degraded Groundwater Quality	Land Subsidence	Depletions of Interconnected Surface Water
Measure-ment	Groundwater elevations derived from measured depth to groundwater at RMS	Groundwater levels are used as a proxy for the reduction in groundwater storage.	Groundwater quality analysis from samples collected by the GSA or other public agencies	Total subsidence measured at RMS using DWR provided InSAR data	Groundwater elevations from measured depth, available surface water presence and flow data, aerial imagery. *Interconnected surface water monitoring remains a data gap, see more information on the Interconnected Surface Water Data Gap Workplan in Chapter 6
Undesirable Results	Upper Aquifer: 1. If more than 17 RMS wells in the Kaweah Subbasin exceed their minimum threshold in any given water year; AND 2. More than 30 domestic wells in the Kaweah Subbasin are impacted due to overdraft and require mitigation in any given water year. If 30 wells require mitigation for multiple years, no more than 350 wells shall be impacted cumulatively by 2040;. OR 3. If a GSA is unable to meet mitigation needs.	Since groundwater levels are used as a proxy for storage, the URs for Reduction in Groundwater Storage match those for Chronic Lowering of Groundwater Levels	1. Ten separate RMS wells with minimum threshold exceedances due to groundwater activities that occurred after January 1, 2015 (as determined by the Exceedance Policy) in a single water year for any single or combination of COCs. OR 2. The GSAs cannot meet mitigation demand for domestic wells impacted by groundwater quality degradation associated with groundwater activities after January 1, 2015.	When the cumulative subsidence MT is exceeded at any single RMS location.	The data and information gaps are too significant to establish URs at this time. URs will be established after the availability of the DWR Guidance Document and the completion of the Interconnected Surface Water Data Gap Workplan (Appendix 5H, Attachment A)
	Lower Aquifer: A single groundwater level MT is exceeded AND The corresponding subsidence MT (cumulative OR rate) is exceeded at any RMS in the Kaweah Subbasin				
Minimum Threshold	Upper Aquifer: MTs are set at a groundwater elevation at each RMS that is based on the GSAs collective ability to maintain groundwater supplies either through protective local supplies or through interim mitigation measures (when necessary) during the implementation period	Groundwater levels are used as a proxy for groundwater storage MTs	MTs are established at drinking water standards for most Constituents of Concern based on the California Primary MCL, California Secondary MCL, U.S. EPA Secondary MCL, whichever is applicable. For sodium and boron, the MT is established at Agricultural Water Quality Goal. The MTs are consistent with Title 22 and the Basin Plan	Maximum subsidence limited to 7 feet, Average subsidence = 3.1 feet to be protective of beneficial users, uses, and land uses (varies by RMS location)	MTs are preliminarily established as depletions that would lead to flows lower than WY 2022 low flows for the 2 existing stream gage RMS which overlay likely connected surface waterbodies. This is considered an interim measure until the DWR Guidance document is available for consideration and until the Interconnected Surface Water Data Gap Workplan (Appendix 5H, Attachment A) is completed
	Lower Aquifer: MTs are based on the groundwater elevation that correlates with the subsidence MT at each specific RMS. These MTs are also protective of groundwater supplies in the lower aquifer				
Measurable Objective	Upper Aquifer: Established to allow reasonable operational flexibility and to be consistent with groundwater conditions necessary to achieve the conditions described in the Kaweah Subbasin’s sustainability goal. In areas with limited saturated thickness due to shallow bedrock (against the mountain front), the MOs were set at Spring 2017 groundwater levels. The groundwater levels west of this region were set at half the decline rate used for the basis of the minimum threshold. Between these areas, a multi-mile transitional area is included to smooth the gradient between the 2 water level criteria to provide hydrogeological plausible gradients from east to west. This is expected to be updated with the Subbasin Groundwater Flow Model.	Groundwater levels are used as a proxy for groundwater storage MOs	MOs and IMs are the same as MTs	0 feet per year of subsidence.	MOs and IMs are the same as MTs.
	Lower Aquifer: MOs are based on pre-SGMA Fall 2012 lower aquifer groundwater levels.				

5.5 Chronic Lowering of Groundwater Levels SMC

§354.28 Minimum Thresholds.

- (c) Minimum thresholds for each sustainability indicator shall be defined as follows:
- (1) Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:
 - (A) The rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin.
 - (B) Potential effects on other sustainability indicators.
 - (2) Reduction of Groundwater Storage. The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.

Revised chronic lowering of groundwater levels SMC are developed based on the best available science, input collected during the stakeholder process (Figure 5-6), coordination amongst the 3 GSAs' technical experts, and discussions with SWRCB Staff.

The revised SMC methodology began by identifying all beneficial users and uses of groundwater in the Kaweah Subbasin, and then the risk of potentially impacting these users via a Dry Well Susceptibility Analysis (DWSA) was evaluated. The DWSA evaluated the potential risk of impairing domestic wells, agricultural wells, small community wells, and municipal wells' function under various groundwater level scenarios. More information on the DWSA, SMC methodology, and rationale for SMC are available in the subsections below and Table 5-2.

Table 5-2. Groundwater Level and Storage SMC Appendices

Appendix 5A	Chronic Lowering of Groundwater Levels and Reduction of Groundwater Storage SMC Technical Memorandum	Describes the considerations, approach, analyses, and results involved in the establishment of upper aquifer SMC for the chronic lowering of groundwater level and reduction of groundwater storage sustainability indicators
Appendix 5B	Land Subsidence and Lower Aquifer Chronic Lowering of Groundwater Level SMC Development Process for the Kaweah Subbasin	Describes the land subsidence critical infrastructure impact analysis and correlated groundwater levels that are the basis of the lower aquifer SMC for the chronic lowering of groundwater level and reduction of groundwater storage sustainability indicators
Appendix 5D	Groundwater Level SMC Hydrographs	Includes annotated hydrographs for all groundwater level RMS with the MTs, MOs and IMs
Appendix 5E	Development and Use of A 1-D Land Subsidence Model for the Kaweah Subbasin	Describes the land subsidence critical infrastructure impact analysis used to inform the land subsidence SMC
Appendix 5F	Projected Hydrographs	Includes annotated hydrographs for all RMS projected through 2070

Appendix 5G	Development of the Relationship Between Modeled Aquifer Storage and Regional Groundwater Elevations	Presents an analysis of groundwater levels with modeled basin groundwater storage for the unconfined aquifer to help understand the range of the relationship between groundwater storage and average water levels
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5.5.1 Groundwater Beneficial Uses and Users

The first step of the SMC approach (Figure 5-1) is to identify beneficial users, uses, and property interests, which is done in Section 2.7.1. Potential effects on beneficial uses induced by chronic lowering of groundwater levels are summarized on Figure 5-4. MKGSA is managing to avoid these potential effects through significant changes in groundwater management, including allocations (groundwater pumping restrictions) limited to native yield and recharge activities (described in Chapter 6).

In evaluating the potential effects of impacts related to the chronic lowering of groundwater levels, it was determined that domestic drinking water wells are the most vulnerable beneficial users in the upper aquifer and single aquifer. The single aquifer area is defined as the area in which there is no aquifer separation by the Corcoran Clay. For simplification purposes, both the single aquifer and upper aquifer are referred to as “upper aquifer” in this section. Based upon the determination of domestic wells being the most vulnerable beneficial user in the upper aquifer, the Kaweah Subbasin Technical Team and the WLCT developed a dry well susceptibility analysis (DWSA), which formed the basis for defining upper aquifer groundwater level MTs.

During SMC development, it was identified that the lower aquifer would need to be evaluated independently of the upper aquifer in the Kaweah Subbasin. The lower aquifer MTs, which are based on land subsidence MTs, were also evaluated to ensure there were no potential impacts to domestic wells. The beneficial users, uses, and property interests most vulnerable to the chronic lowering of groundwater levels include that critical infrastructure and their users listed for land subsidence under Section 5.6.1.

5.5.1 Chronic Lowering of Groundwater Levels Undesirable Results

§354.26 Undesirable Results.

- (b) The description of undesirable results shall include the following:
- (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to 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.

As depicted on Figure 5-1, defining beneficial users, significant and unreasonable effects, and URs are critical first steps to establishing effective SMC.

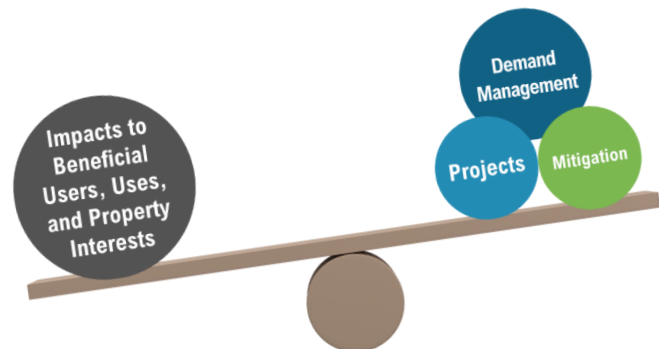
5.5.1.1 Subbasin Defined Significant and Unreasonable Chronic Decline in Groundwater Levels

To locally define significant and unreasonable effects due to the chronic lowering of groundwater levels sustainability indicator, transparency with and involvement of stakeholders was critical in the development of the methodology and multiple iterations of the technical analyses involved (Figure 5-6).

It is important to distinguish the role of SGMA in evaluating subbasin-wide challenges. Subbasins and their GSAs are asked to evaluate impacts on a subbasin-wide level to determine what constitutes significant and unreasonable effects that could lead to URs. The Kaweah Subbasin GSAs recognize the importance of also addressing localized, individual impacts that may occur as the Subbasin works toward achieving and maintaining sustainability. The Kaweah Subbasin developed a Mitigation Program and GSA-specific Mitigation Plans that are intended to address these individual impacts on the path to achieving sustainability.

The UR is a quantitative reflection of significant and unreasonable effects occurring subbasin-wide. The Kaweah Subbasin has defined significant and unreasonable effects as:

The tipping point at which groundwater conditions across the Kaweah Subbasin cause impacts to beneficial users, uses, and property interests that cannot be sustained or mitigated.



In the case of chronic lowering of groundwater levels, this may include the number of domestic wells impacted which exceeds the GSAs' mitigation budgets, community water systems unable to meet their supplies, or supply wells in areas of limited saturated thickness that are unable to meet demands or cannot drill deeper with technical assistance awarded via the GSA's Mitigation Plan. As stated, the Kaweah Subbasin's revised SMC in this GSP and recent changes in demand management policies are designed to achieve the sustainability goal and avoid URs. The prevention of significant and unreasonable effects is a correlated outcome of this strategy.

5.5.1.2 Significant and Unreasonable Impacts on the Most Sensitive Beneficial Uses and Users

The Kaweah Subbasin’s beneficial uses, users, and property interests are listed in Section 2.7.1. The vulnerability of these groups to the potential impacts of chronic lowering of groundwater levels varies based on the depths at which the wells are constructed. In the Kaweah Subbasin, domestic wells are often drilled to more shallow depths than agricultural wells. Therefore, as groundwater levels are lowered, the first wells to be impacted are the shallower domestic wells. MKGSA will continue to closely monitor the potential risks of impacts to shallow domestic wells and is committed to improving the capabilities of appropriately notifying landowners of well impacts through the Well Registration Program. This Program is intended to gather well-construction information and contact information needed to meaningfully evaluate well-specific risks and notify the landowner when appropriate (see description in Chapter 6). In addition to supporting early notification, all the gathered information on domestic wells and their potential risks will be evaluated by the MKGSA to annually reassess the SMC, demand management policies, and available options to avoid localized, individual impacts. The GSAs have an ethical and financial interest in this reassessment protocol – it is more affordable for the GSA to be proactive and avoid the need for mitigation than to retroactively mitigate. Significant and unreasonable effects on the beneficial uses, users, and property interests include:

- Individual Impact: any domestic well unable to supply safe drinking water to a household due to lowering of groundwater levels.

Significant and Unreasonable Effect: the number of impacted domestic wells exceeds the GSA’s mitigation budget’s capacity.

Individual Impact refers to a singular impact that can be induced by groundwater conditions associated with sustainability indicators.



A specific count or combination of individual impacts are what constitutes “significant and unreasonable effects”



Significant and Unreasonable Effects refers to the tipping point at which the groundwater conditions throughout the Subbasin cause impacts to beneficial uses, users, land uses and property interests that cannot be sustained or mitigated.

- **Individual Impact:** A small community groundwater production system is unable to supply safe drinking water to connected households due to the lowering of groundwater levels.

Significant and Unreasonable Effect: the proactive measures, technical assistance, and groundwater management policies initiated by the GSA in accordance with the Mitigation Program are not sufficient to avoid impairments in production for small community systems.

5.5.1.3 Significant and Unreasonable Impacts on Other Beneficial Uses and Users

In the case of other beneficial users, uses, and property interests, including agricultural, industrial, municipal, commercial, and other production well types, these wells are generally drilled deeper than domestic and small community wells in the Kaweah Subbasin. Therefore, they are less vulnerable to impacts from the lowering of groundwater levels than those discussed in Section 5.5.1.2. Significant and unreasonable effects on these beneficial uses, users, and property interests include:

- **Individual Impact:** An agricultural well is unable to meet intended demand due to the lowering of groundwater levels.

Significant and Unreasonable Effect: The number of impacted agricultural wells exceeds the capacity of the GSA Mitigation Plan's technical assistance budget.

- **Individual Impact:** A municipal or commercial well is unable to supply drinking water to connected households due to the lowering of groundwater levels and cannot use its backup well(s) to supply drinking water.

Significant and Unreasonable Effect: the proactive measures, technical assistance, and groundwater management policies initiated by the GSA in accordance with the Mitigation Program are not sufficient to avoid or mitigate impairments in production for municipal/commercial supplies.

- **Individual Impact:** An industrial well is unable to meet the intended demand due to the lowering of groundwater levels.

Significant and Unreasonable Effect: The number of impacted industrial wells exceeds the capacity of the GSA Mitigation Plan's technical assistance budget.

It is important to note that if these agricultural, industrial, municipal, or commercial wells are pumping more than their pro rata share of the native yield, then they are contributing to overdraft and will not qualify for mitigation support. Each GSA may evaluate extending mitigation support and/or technical assistance for non-qualifying claims on a case-by-case basis. The reason for this distinction is to avoid the need to drill deeper and/or reward unsustainable groundwater use.

5.5.1.4 Significant and Unreasonable Impacts on Neighboring Subbasins

The Kaweah Subbasin has coordinated with neighboring subbasins' draft revised SMC to avoid inconsistencies and inter-basin groundwater management challenges. Significant and unreasonable effects induced by Kaweah Subbasin groundwater management on neighboring subbasins include:

- Individual Impact: any drinking water well in a neighboring subbasin unable to supply safe drinking water to a household due to the lowering of groundwater levels induced by Kaweah Subbasin groundwater management.

Significant and Unreasonable Effect: the number of drinking water wells in an adjacent subbasin impacted by Kaweah Subbasin groundwater management exceeds the neighboring subbasins mitigation budget's capacity.

5.5.1.5 Summary of Significant and Unreasonable Effects

The individual impacts and significant and unreasonable effects by beneficial users are summarized in Table 5-3.

Table 5-3. Summary of Individual Impacts and Significant and Unreasonable Chronic Lowering of Groundwater Level Impacts

Beneficial User	Individual Impact	Significant & Unreasonable Impact
Domestic Wells	Any domestic unable to supply safe drinking water to a household due to the lowering of groundwater levels.	The number of impacted domestic wells exceeds the GSA's mitigation budget's capacity.
Small Community Wells	Small community groundwater production system unable to supply safe drinking water to connected households due to the lowering of groundwater levels.	The proactive measures, technical assistance, and groundwater management policies initiated by the GSA in accordance with the Mitigation Program are not sufficient to avoid or mitigate impairments in production for a small community system.
Agricultural Wells	An agricultural well is unable to meet the intended demand due to the lowering of groundwater levels.	The number of impacted agricultural wells exceeds the GSA Mitigation Plan's technical assistance budget's capacity.
Industrial	An industrial well is unable to meet the intended demand due to the lowering of groundwater levels.	the number of impacted industrial wells exceeds the GSA Mitigation Plan's technical assistance budget's capacity.
Municipal/ Commercial Wells	A municipal or commercial well is unable to supply drinking water to connected households due to the lowering of groundwater levels and is unable to use their backup well(s) to supply drinking water.	The proactive measures, technical assistance, and groundwater management policies initiated by the GSA in accordance with the Mitigation Program are not sufficient to avoid impairments in production for municipal/commercial supplies.

5.5.1.6 Criteria for Defining Chronic Lowering of Groundwater Levels Undesirable Results

By regulation, the UR for chronic lowering of groundwater levels is a quantitative combination of groundwater level MT exceedances. As per California Water Code §354.26(c), multiple combinations of potential MTs were evaluated to assess whether URs would occur based on different groundwater conditions. Appendix 5A describes in detail the methodology, analysis, and results associated with MT determinations. The primary criteria and metric to determine if URs occur in the Subbasin is if the count of impacted domestic wells exceeds the GSAs' ability to mitigate those impacts. Domestic wells are the most vulnerable to groundwater level impacts because they are generally drilled shallower than other well types in the Kaweah Subbasin. Also, the loss of water in domestic wells results in homes that do not have potable water leaving homeowners without reliable water supplies. Therefore, by defining URs to be protective of impacts on domestic wells, other beneficial users, uses, and property interests are also protected. An UR in the Kaweah Subbasin's upper aquifer has been defined to be multi-layers to ensure the protection of the most vulnerable groundwater users:

UR#1. If more than 17 upper aquifer RMS wells in the Kaweah Subbasin exceed their minimum threshold in any given water year;

AND

UR#2. More than 30 domestic wells in the Kaweah Subbasin are impacted due to overdraft and require mitigation in any given water year. If 30 wells require mitigation for multiple years, no more than 350 wells shall be impacted cumulatively by 2040;

OR

UR#3. If a GSA is unable to meet mitigation needs.

For **UR #1** above, the first metric of 17 RMS wells exceeding the MT spatially correlates on average to the number of potentially impacted domestic wells that a GSA can afford to mitigate in a single water year (i.e., approximately 60, based on the DWSA estimate of mitigation costs). The number of potentially impacted domestic wells per RMS is approximately 3—if groundwater levels are at the MT—based on the spatial distribution of wells with available depth information (i.e., there are 102 RMS within the Subbasin that have been designated for the upper aquifer, and the DWSA determined that there are 350 potentially impacted domestic wells if groundwater levels reach the MT; hence, $350 \div 102 = 3.4$); therefore, 60 potentially impacted domestic wells divided by 3.4 wells per RMS equals 17.6 RMS (i.e., greater than 17).

For **UR #2** above, the annual number of impacted domestic wells able to be mitigated is approximately 60; however, coordination of the GSAs and technical teams determined that a 50% safety factor should be applied for domestic impacts for an added level of security;

therefore, 30 (50% of 60) impacted domestic wells were selected as a second quantitative measure for URs. In summary, if both metrics in #1 are exceeded, it would indicate that sustainability planning and implementation is not sufficient and, therefore, is a UR.

Alternatively, more than 17 RMS MT exceedances could also result in very few domestic well impacts, so the additional metric of 30 impacted domestic wells was included. A cumulative limit of 350 domestic well impacts during the plan implementation period (2024-2040) is included to ensure no more than 10% of the total domestic wells identified within the Subbasin (3,543) are impacted. UR #2 was included to override #1 in the event that the available mitigation costs are exceeded if #1 does not occur.

UR #3 was included to further protect the beneficial users by requiring the UR to reflect a clear condition of significant and unreasonable effects in the Kaweah Subbasin. This UR #3 was specifically included to serve as a protective measure in the event data uncertainty results in the projected potential impacts being undercounted. This circumstance is expected to be avoided via several protective assumptions built into the mitigation cost estimate, such as assuming maximum mitigation award for all claims and assuming all potentially impacted wells are/will be indeed impacted.

The definition of URs—and all other SMCs—may be revised in the future as lessons are learned through the implementation of this GSP and the Mitigation Program.

5.5.1.7 Potential Causes of Undesirable Results

Potential causes of URs related to the chronic lowering of groundwater levels include the following:

- Prolonged periods of groundwater extraction in excess of the sustainable yield can lead to regional declines in groundwater levels in the Subbasin.
- Localized over-pumping of groundwater can lead to declining groundwater levels in a subarea of the Subbasin, even if regional pumping is maintained within the sustainable yield. For example, a cluster (or pumping center) of high-capacity wells may cause excessive localized drawdown, leading to significant and unreasonable effects on neighboring wells.
- Extreme drought—such as the 2012-2016 and 2020 to 2022 droughts and associated impacts on groundwater conditions due to a) curtailments of imported surface water supplies, b) reduction in natural recharge, and c) increased pumping to meet demands—can lead to excessively low groundwater elevations and URs. This becomes especially significant if groundwater levels do not rebound after the drought period is over or excessive subsidence occurs.

- Unsustainable groundwater management by neighboring subbasins leads to excessive underflow losses.

5.5.1.8 Effects on Beneficial Users and Land Uses

Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the Subbasin. The primary significant and unreasonable effects related to the chronic lowering of groundwater levels on beneficial users include significant loss of well capacity, increased costs due to higher pumping lifts, lack of groundwater extraction due to the groundwater levels declining below the pump setting depth or the bottom of the well, drying of domestic wells, or subsidence impacts on well structures and above ground critical infrastructure (in the case of lower aquifer groundwater level decline).

5.5.2 Chronic Lowering of Groundwater Levels Minimum Thresholds

§354.28 Minimum Thresholds.

- (c) Minimum thresholds for each sustainability indicator shall be defined as follows:
- (1) Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:
 - (A) The rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin.
 - (B) Potential effects on other sustainability indicators.

MTs for the chronic lowering of groundwater level sustainability indicator are quantified as groundwater elevations at each RMS well. Table 5-4 summarizes the SMC at each RMS well. Figure 5-7 and Figure 5-8 are maps showing MTs at each RMS for the upper and lower aquifers, respectively.

The function of MTs is to provide a quantitative metric representative of significant and unreasonable effects that can be used by the GSAs to evaluate the potential for URs. The Kaweah Subbasin GSAs have established management policies that aim for groundwater levels to recover to the MO; however, the GSAs are prepared to mitigate impacts in the event they occur during prolonged drought conditions (which are reflected in the exceedance of MT(s)). Appendix 5A details the process used to develop the SMC for the upper aquifer and Appendix 5B provides details on the process used to develop SMC for the land subsidence sustainability indicator, which is the basis for the lower aquifer SMC. Hydrographs for each RMS and their respective SMC are provided in Appendix 5D.

Table 5-4. MKGSA Chronic Lowering of Groundwater Level Sustainable Management Criteria

Representative Monitoring Site	Aquifer	Minimum Threshold	Measurable Objective	Operational Flexibility (feet)	2025 Interim Milestone	20230 Interim Milestone	2035 Interim Milestone
Groundwater Elevation in feet above mean sea level, unless otherwise indicated							
Monitored by MKGSA							
KSB-1320d	Lower	50	95	45	50	80	90
KSB-1320s	Upper	30	32	2	69	44	36
KSB-1408d	Lower	45	145	76	69	120	137
KSB-1408s	Upper	52	71	19	87	76	73
KSB-1536d	Lower	43	132	78	54	106	123
KSB-1536s	Upper	31	55	24	55	55	55
KSB-1545d	Lower	58	155	80	75	128	146
KSB-1545s	Upper	42	57	15	69	61	59
MKGSA-01	Lower	20	30	10	20	27	29
MKGSA-02	Lower	30	39	9	30	36	38
WK-1	Lower	-70	-26	44	-70	-41	-31
Monitored by Others							
KSB-0922	Upper	-15	11	26	23	15	13
KSB-0946	Upper	55	70	14	76	72	70
KSB-0948	Upper	-9	8	17	49	22	13
KSB-0976	Upper	-20	5	25	32	14	8
KSB-0994	Upper	93	104	11	94	101	103
KSB-1071	Upper	-10	10	20	51	24	15
KSB-1168	Upper	100	123	23	100	116	121
KSB-1206	Upper	-35	-4	30	48	13	1
KSB-1226	Upper	32	53	21	85	64	57
KSB-1427	Upper	87	101	14	110	104	102
KSB-1431	Upper	51	75	24	97	82	77
KSB-1477	Upper	72	105	32	72	94	101
KSB-1506	Lower	48	109	61	48	89	102
KSB-1526	Upper	88	112	24	123	115	113
KSB-1628	Upper	7	33	27	47	38	35
KSB-1695	Lower	48	112	58	54	93	106
KSB-1696	Upper	79	94	15	94	94	94
KSB-1699	Upper	91	110	19	119	113	111
KSB-1770	Lower	50	155	87	68	126	145
KSB-1884	Single	146	175	29	183	178	176
KSB-1903	Upper	101	129	27	106	121	126
KSB-1905	Upper	96	125	29	123	124	125
KSB-1977	Single	167	183	16	205	190	185



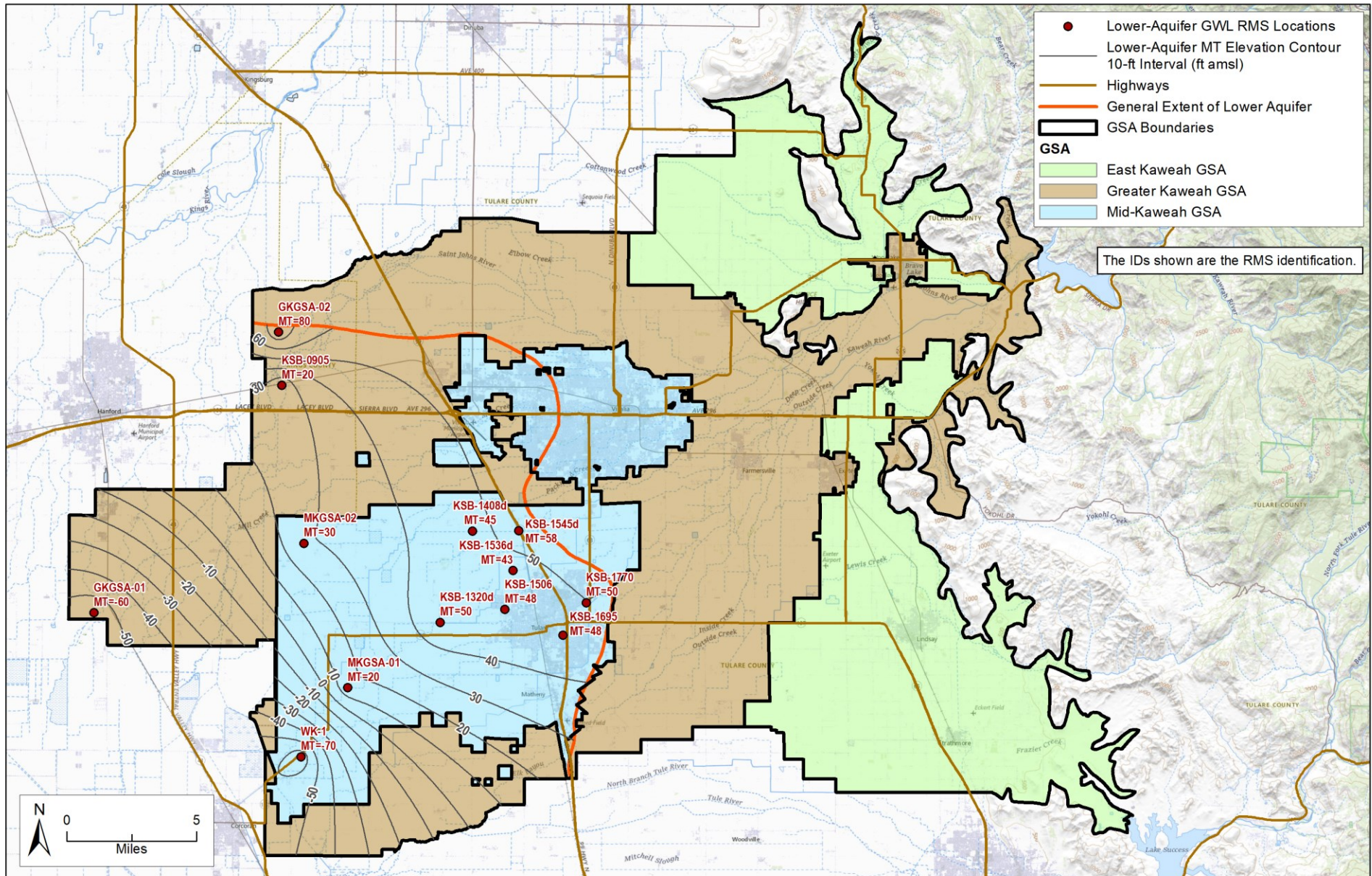


Figure 5-8. Kaweah Subbasin Lower Aquifer Groundwater Level Minimum Thresholds

5.5.2.1 Information and Methodology Used to Establish Minimum Thresholds

The methodology to establish MT for groundwater levels (and all other SMC) is depicted on Figure 5-1. A more granular summary of analyses and methodologies is available in Appendices 5A, 5B, and 5D.

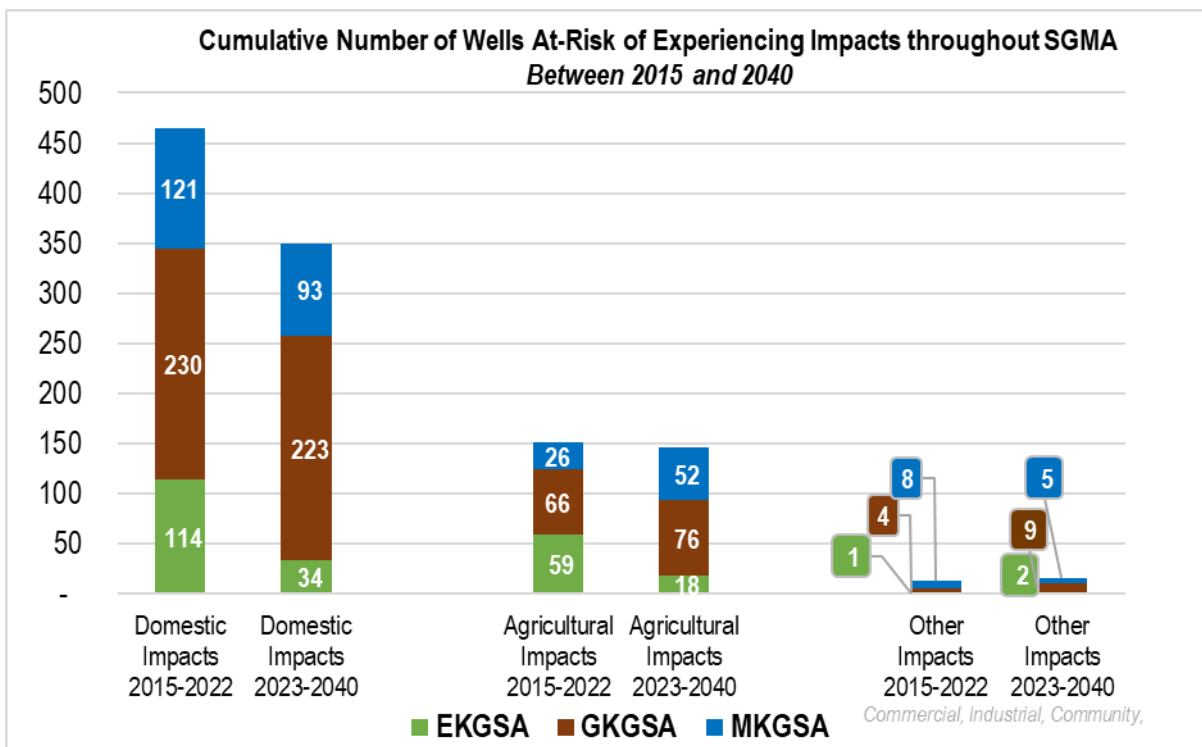
In the case of groundwater level SMC development, over 100 stakeholder engagement meetings (Table 5-5) were held to refine the methodology, assumptions, datasets, and logistics to determine which groundwater level conditions under the projected declines were considered significant and unreasonable with MTs proposed and reviewed iteratively until agreement and coordination between the GSAs was reached. Ultimately, the ability of each GSA to sustain groundwater levels and/or mitigate potential impacts to domestic wells under projected dry conditions was the primary determining factor for selecting the final groundwater elevations to assign as MTs for the upper aquifer RMS (Appendix 5A). The lower aquifer MTs are based on avoiding significant and unreasonable land subsidence (Appendix 5B and 5D) and are listed along with the upper aquifer RMS locations in Table 5-8 and shown on Figure 5-8. As an additional check, lower aquifer SMC were evaluated using the DWSA to ensure there are no potential impacts to domestic wells.

Ultimately, the ability of each GSA to sustain groundwater levels and/or mitigate potential impacts to domestic wells under projected dry conditions was the primary determining factor in selecting the upper aquifer groundwater level MT. A summary of the number of potential impacts generated from the DWSA is shown on Figure 5-9 and explained in more detail in Appendix 5A. The annual mitigation cost estimates, which include both the costs to physically mitigate and the costs to administer the program, sample for groundwater quality, and technically evaluate claims, are summarized by GSA on Figure 5-10.

Table 5-5. Second Amended GSP Stakeholder Coordination Meetings Addressing Groundwater Level SMC Revisions
(as of May 15, 2024)

Stakeholder Meeting Type	Count of Meetings ¹	Stakeholder Groups Represented/Present
EKGSA Technical Advisory Committee	16	Drinking Water Advocacy Groups (NGO), Environmental/Conservation Groups, Groundwater-Dependent Growers, Conjunctive Use Growers, Small Family Farmers, Tulare County, Local Community & City Representatives
EKGSA Advisory Committee	9	
EKGSA Board of Directors	11	
GKGSA Advisory Committee	6	
GKGSA Board of Directors	13	
GKGSA Stakeholder & Rural Communities Committee	9	
GKGSA Outreach Events	7	
MKGSA Advisory Committee	16	Drinking Water Advocacy Groups (NGO) Groundwater-Dependent Growers
MKGSA Board of Directors	14	GSA Staff & Technical Support
MKGSA Mitigation Workshop	1	
Community Well Mitigation Workshop with SHE	1	Self-Help Enterprises (SHE)
Dry Well Susceptibility Analysis Workshop	3	Drinking Water Advocacy Groups (NGO) Groundwater-Dependent Growers
Total	106	

¹ Meetings listed include only those in which revisions to groundwater level SMC updates (for the Second Amended GSPs) were presented and discussed.



Note: this count of wells assumes all minimum thresholds are exceeded across the Kaweah Subbasin, which theoretically cannot happen due to our definition of URs. This is considered highly unlikely, and the Kaweah Subbasin is committed to demand management, recharge, water banking, and other projects to manage to the sustainability goal and Measurable Objective.

Figure 5-9. Count of Potentially Impacted Wells Based on Minimum Threshold Scenario

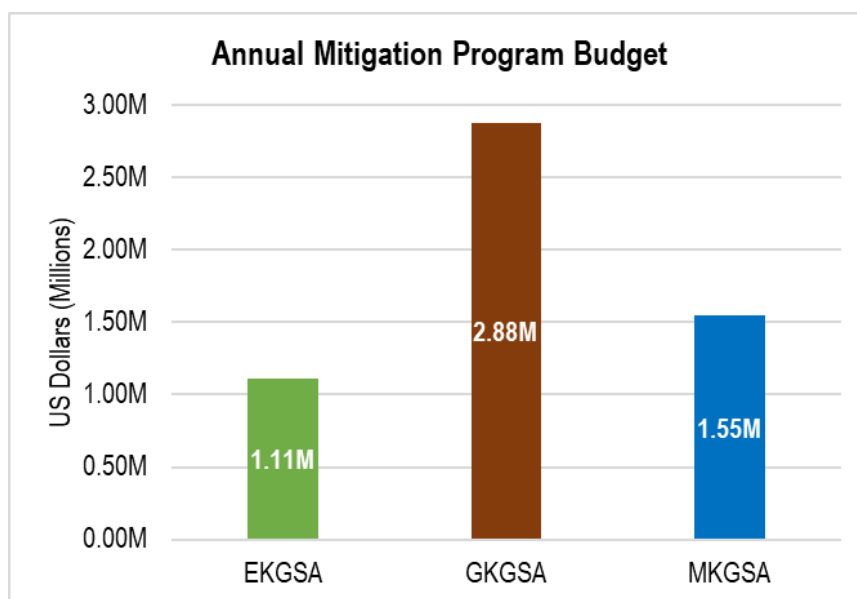


Figure 5-10. Annual Estimated Cost to Implement the Kaweah Subbasin Mitigation Program

5.5.2.2 Minimum Threshold Extent

The lateral extent of MTs for the upper aquifer covers the entire Subbasin. The presence of the aquitard between the upper and lower aquifers (i.e., the Corcoran Clay) is limited to the western half of the Subbasin, which delineates the extent of the lower aquifer.

The vertical extent also varies across the Subbasin for both upper and lower aquifers, as reflected in the MTs at each RMS on Figure 5-7 and Figure 5-8.

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

The upper aquifer groundwater level MTs were developed using current and historical groundwater level measurements across the Subbasin based on the best available data and science. The groundwater level data were evaluated to ensure hydrogeologic plausibility and reasonable continuity of MT values between RMS locations for other sustainability indicators. For the lower aquifer, the subsidence analysis was used to inform MTs.

- **Land subsidence.** The MTs for the land subsidence sustainability indicator were used to define the lower aquifer MTs (Appendix 5B and 5D). Therefore, the land subsidence and lower aquifer groundwater level MTs are aligned, and there is no impact on each other.

Further geologic investigation may demonstrate that there is gradually increasing aquifer confinement with depth in parts of the single aquifer system (i.e., east of the Corcoran Clay). In this case, the deeper portion of the single aquifer may exhibit different groundwater levels than the shallower portion. A recent nested monitoring well installation in the Tule Subbasin suggests this might be the case in the southern portion of the Kaweah Subbasin. See GKGSA's recent management action regarding the installation of new dual nested monitoring wells in this area to fill this data gap in Chapter 6 of the GKGSA GSP. If future investigations suggest the delineation of upper and lower aquifers within areas of the aquifer currently characterized as a single aquifer system, limits on the deeper aquifer groundwater levels may be necessary to avoid URs from land subsidence.
- **Reduction in groundwater storage.** The reduction of groundwater storage sustainability indicator MTs are identical to those developed for the chronic lowering of groundwater levels sustainability indicator, since groundwater levels are used as a proxy for the reduction of groundwater storage SMC (Section 5.7 and Appendix 5G). Groundwater storage is the measure of the volume of groundwater stored within the aquifer. Therefore, more groundwater is available in the aquifer during periods with higher groundwater levels and vice versa. Although a significant relationship between groundwater levels and storage within the unconfined aquifer has been established, the strength of this relationship may vary according to the depth to the base of the aquifer (i.e., saturated

thickness). An equal volume of groundwater lost due to the lowering of groundwater levels in an area with a very shallow depth to the base of the aquifer will have vastly different consequences for beneficial users than an area with a much deeper base of the aquifer. The remaining amount of storage within the aquifer was a limiting factor for defining MTs in areas of the Subbasin with shallower depth to bedrock and thinner aquifers. Acknowledgement of this limitation was factored into establishing groundwater level MTs in the easternmost portion of the Subbasin.

- **Degraded water quality.** Legacy and natural groundwater quality issues are present in the Kaweah Subbasin. SGMA requires GSAs to account for the degradation of groundwater quality induced by a GSA's management of groundwater. This may include degradation of groundwater quality or migration of contaminant plumes caused by recharge activities or changes in groundwater levels and flow directions induced by overdraft pumping. Existing programs require changes in fertilizer use, reporting, and water quality impact avoidance planning to limit or avoid additional groundwater quality impacts related to agricultural activities (see Section 4.2.3). At this time, there are no instances of degradation of groundwater quality induced by groundwater management activities since SGMA was enacted; however, the Kaweah Subbasin GSAs are committed to expanding the groundwater quality monitoring network, especially near areas with domestic wells, community groundwater supply systems, and adjacent to groundwater recharge facilities. The Kaweah Subbasin GSAs have also included new management actions that may aid in filling data gaps related to groundwater quality (particularly pertaining to domestic wells) throughout the Subbasin. See Section 4.9 for more information.
- **Depletion of interconnected surface water.** There is no ISW in the MKGSA area. See Section 3.3.4.

5.5.2.4 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The following 3 subbasins of the San Joaquin Valley Basin adjoin the Kaweah Subbasin:

- Kings Subbasin, to the north
- Tule Subbasin, to the south
- Tulare Lake Subbasin, to the west

The Kaweah Subbasin GSAs have coordinated with neighboring subbasins to compare the revised MTs for water levels and land subsidence and are generally consistent across GSA boundaries. In the Kaweah Subbasin, the upper aquifer groundwater level MTs and MOs appear generally higher than neighboring subbasins in the eastern region of the Kaweah Subbasin. The regular monitoring and analysis of groundwater conditions as part of annual reporting will

provide more information on whether inter-basin policies are needed to avoid impacts on beneficial uses and users of groundwater. Because land subsidence SMC is the limiting factor for assigning lower aquifer groundwater level SMC, it is expected that the lower aquifer MTs will be at or above the lower aquifer MTs in neighboring GSAs (more on this in Section 5.6.3).

5.5.2.5 Effects on Beneficial Users and Land Uses

Potential effects on beneficial users, uses, and property interests are depicted on Figure 5-4. The beneficial users identified generally occur throughout the Subbasin, with domestic wells primarily drilled in the upper aquifer and irrigation wells drilled in both aquifer systems. Sections 0 and 0 provide information on effects to beneficial users, uses, and property interests. The MTs for the chronic lowering of groundwater level seek to prevent significant and unreasonable effects on groundwater supply wells. The GSAs will monitor to ensure the Subbasin is trending toward sustainability as planned, or if further projects and management actions are needed in areas where groundwater level trends are toward the MTs. The key to sustainability in the Kaweah Subbasin is the reduction of extraction through groundwater allocation. GSAs intend to actively monitor and allocate groundwater based on achieving sustainability. Although the Subbasin GSAs' strategy involves groundwater pumping restrictions and elevated SMC, individual well impacts may still occur during prolonged drought periods. In addition, individual impacts to beneficial users, uses, and property interests could occur in areas where groundwater levels are within the range of operational flexibility. These individual impacts are addressed via the Kaweah Subbasin Mitigation Program and GSA-specific Mitigation Plans.

5.5.2.6 Relevant Federal, State, or Local Standards

There are no federal, state, or local regulations related to groundwater levels outside of SGMA.

5.5.2.7 Method for Quantitative Measurement of Minimum Thresholds

Groundwater levels will be assessed annually using the monitoring network described in Chapter 4 and compared against MTs. Groundwater level monitoring will be conducted in accordance with the monitoring plan outlined in Chapter 4. The dense network of RMS wells spans the various Subbasin's aquifer systems. Groundwater level data will be collected at RMS at least bi-annually to capture the seasonal high (spring) and seasonal low (fall) water table conditions. These data are reported to DWR by July 1 and January 1 through the SGMA Data Portal and reported in Annual Reports. During Annual Report preparation, the GSAs and their respective stakeholder committees review monitoring results and consider if management and policy changes are needed to steer the Subbasin on the sustainability track or if progress is trending as expected.

5.5.3 Chronic Lowering of Groundwater Levels Measurable Objectives and Interim Milestones

§354.30 Measurable Objectives.

- (a) Each Agency shall establish measurable objectives, including interim milestones 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.
- (b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.
- (c) 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.
- (d) 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.
- (e) 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 interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.
- (f) Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.
- (g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

The MO for the chronic lowering of groundwater level sustainability indicator represents a target groundwater surface elevation that acts as a quantitative measure of the sustainability goal. MOs were developed by applying the concept of providing a reasonable margin of operational flexibility under adverse conditions (GSP Emergency Regulations §354.30(c)). IMs were developed to present a reasonable path to achieve the sustainability goal for the Subbasin within 20 years of Plan implementation.

5.5.3.1 Methodology for Setting Measurable Objectives and Interim Milestones

The MOs for the upper aquifer RMS were developed after establishing MTs. The MO methodology utilized the same Annual Allowable Rate of Decline (AARD) surface that was evaluated for establishing MTs. This methodology is described in more detail in Appendix 5A. Several technical meetings with the stakeholders, GSA staff, and SMC Core Teams were held to coordinate an agreed-upon approach for establishing MOs. The MO for the Subbasin upper aquifer was established to maintain sufficient operational flexibility and sustain sufficient saturated thickness in the areas with shallow depth to bedrock along the mountain front of the Sierra Nevada foothills. The MO was determined to be representative of the Subbasin sustainability goal and reasonable to achieve through demand management policies and project benefits. The easternmost area required a reduced margin of operational flexibility due to the reduced thickness of the aquifer, where the depth to bedrock is much shallower. Therefore, a

different rationale was established for the easternmost area of the Subbasin with shallow depth to bedrock as compared to the area west of this region.

For the easternmost area (where shallow depth to bedrock occurs), spring 2017 groundwater levels were selected as the MOs based on stakeholder feedback and to allow sufficient storage for future drought resiliency. West of this region, the MOs are informed by the projected AARD scenarios from the DWSA. The rate of decline is 50% of the difference between the Fall 2022 and MT groundwater level elevations. This was deemed representative of required operational flexibility and minimizes dry well impacts aligned with the qualitative definition of MO and the sustainability goal.

Because spring 2017 groundwater levels are much higher than the MO of the easternmost region, a transition between the surfaces was required for the hydrogeologic plausibility of the MO groundwater level surface. The gradient of the transition between the east and west portions of the Subbasin was compared to observed historical gradients in past groundwater level datasets to ensure it did not unreasonably exceed gradients that have been measured historically in the area. A transition zone with too steep of a gradient could potentially induce more flow toward the west, lowering groundwater levels and reducing storage for the areas where the aquifer thickness is limited and hindering the ability to maintain groundwater levels at the MO.

The Subbasin groundwater model described in Appendix 3C was used to verify the analyses to ensure the groundwater conditions evaluated to develop the SMC are hydrogeologically plausible. The MOs for the upper aquifer are shown for each of the RMS in Table 5-4 and on Figure 5-11. The lower aquifer MOs are established based on the land subsidence SMC methodology, described in Appendix 5B, and are also presented in Table 5-4 and on Figure 5-12.

Interim milestones (IMs) represent target groundwater levels at the RMS to demonstrate progress toward the MOs and are based on incrementally (net) decreasing groundwater level changes over time based on the following:

- 2025 IM– for the upper aquifer, extend the 2014-2022 rate of groundwater level decline (see Appendix 5A) to 2025. For the lower aquifer, extend the 2012-2019 rate of groundwater level decline (based on the groundwater levels evaluated for the land subsidence SMC methodology, described in Appendix 5B) to 2025. If either extension results in a 2025 IM below the MT, the 2025 IM is set to be equal to the MT.
- 2030 IM –elevation at two-thirds of the elevation difference between the 2025 interim milestone and the MO
- 2035 IM – elevation at two-thirds of the elevation difference between the 2030 interim milestone and the MO

The method for setting IMs is also illustrated on Figure 5-13. Groundwater elevations representing MOs for each of the RMS are shown in Table 5-4. Figure 5-14 through

Figure 5-16 include an example of projected groundwater level hydrographs with the RMS well's SMC for each respective GSA.

Projected hydrographs are available in Appendix 5F to demonstrate the effectiveness of the projects and management actions included in Chapter 6 to avoid MTs and approach MOs.

More detail on the methodology, analyses, and considerations that informed the MOs are available in Appendix 5A for upper aquifer groundwater levels and Appendix 5B for lower aquifer groundwater levels.





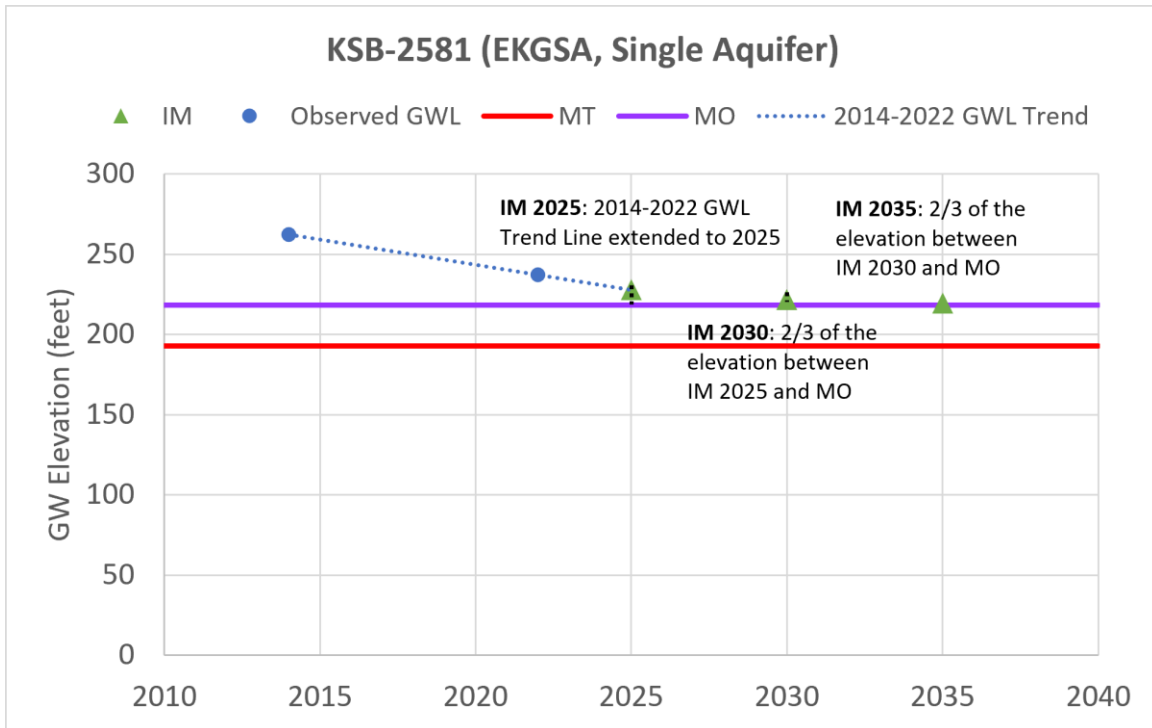


Figure 5-13 Example of Interim Milestone Methodology for Chronic Lowering of Groundwater Levels

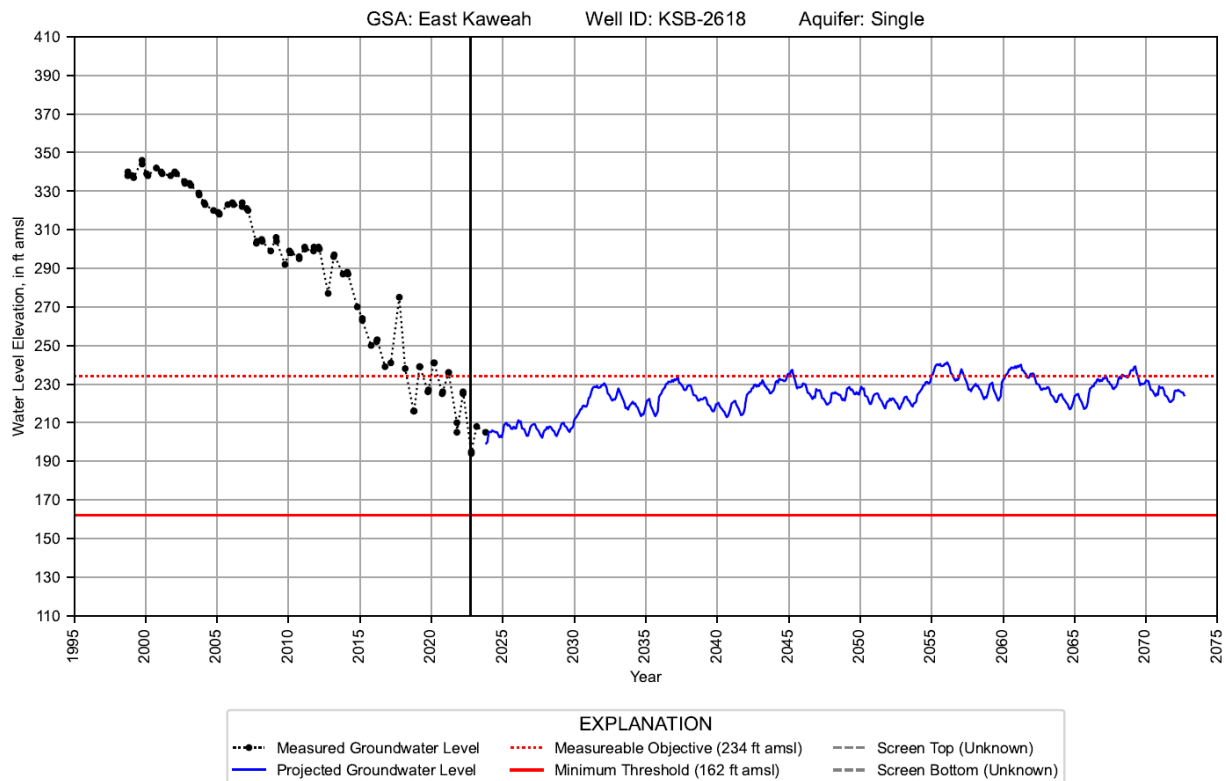


Figure 5-14. Projected RMS Hydrograph with MT and MO (EKGSA)

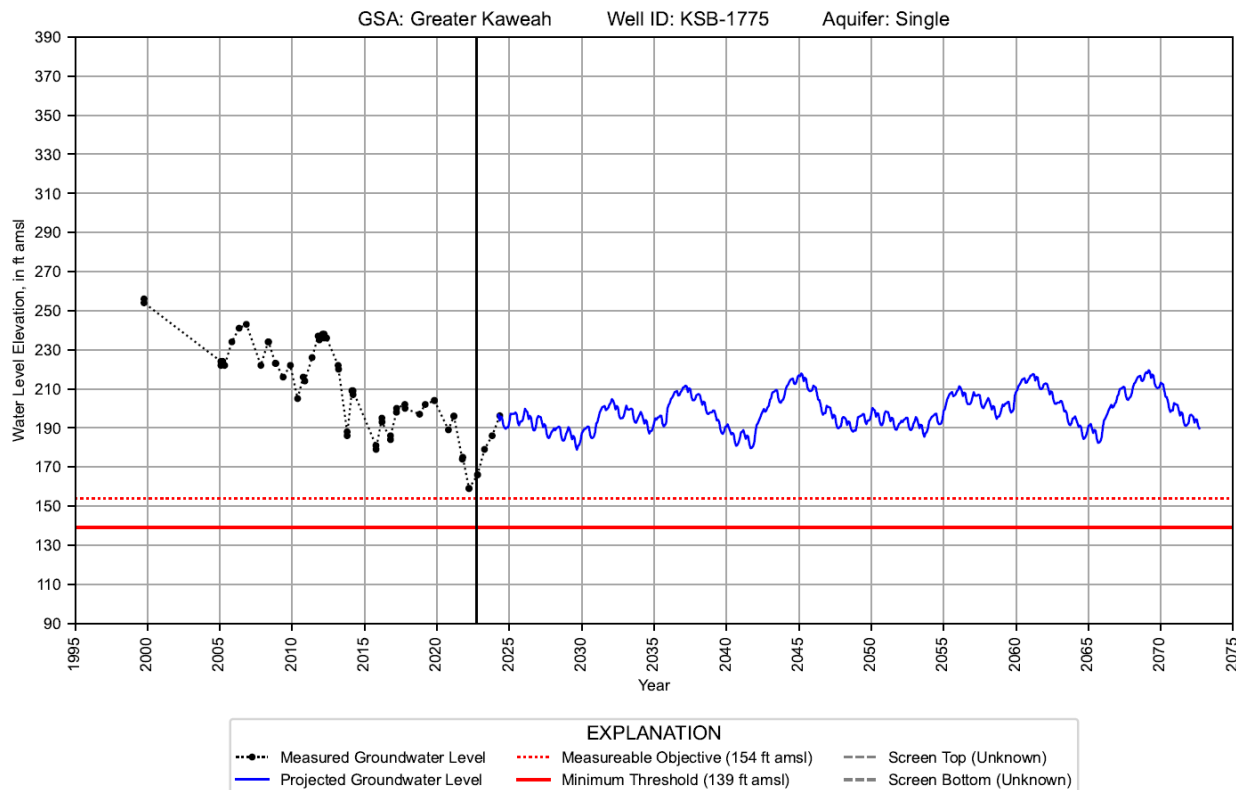


Figure 5-15. Projected RMS Hydrograph with MT and MO (GKGSA)

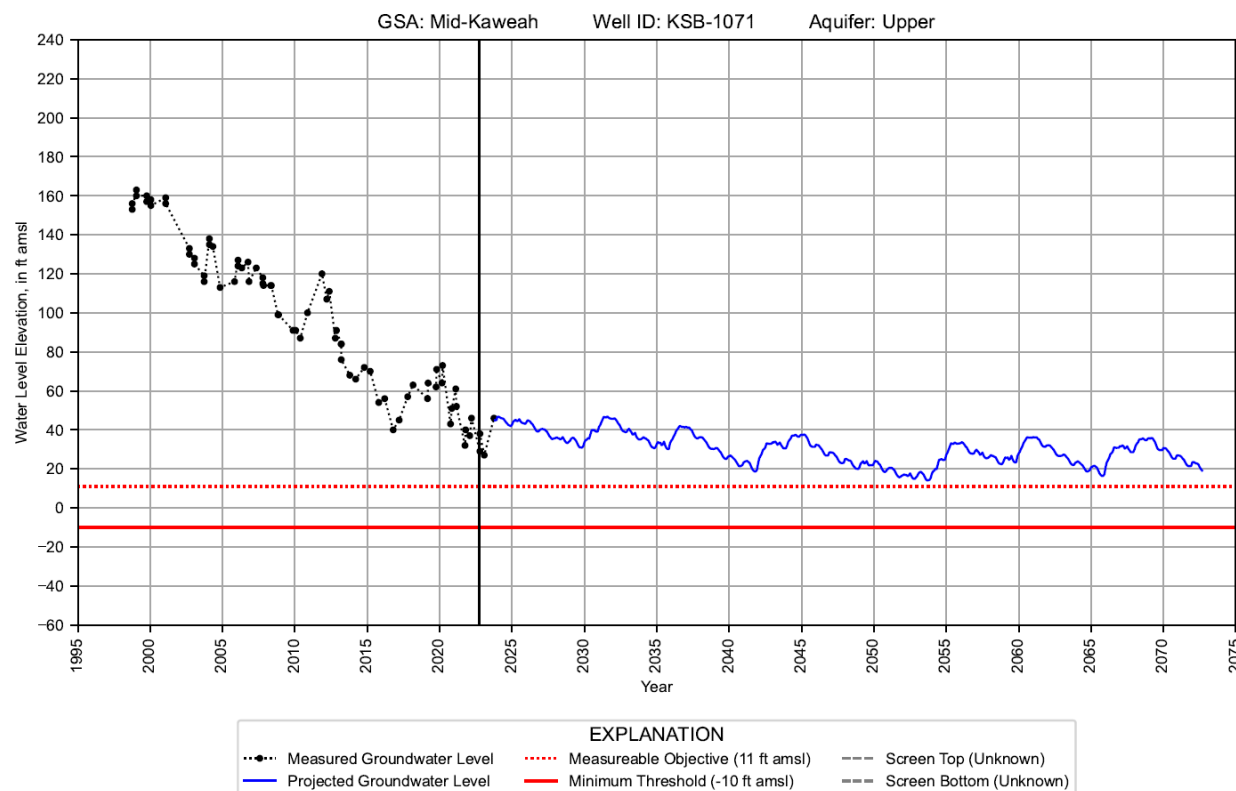


Figure 5-16. Projected RMS Hydrograph with MT and MO (MKGSA)

5.5.3.2 Operational Flexibility

Operational flexibility is defined as the water level difference between MTs and MOs. In general, areas with a higher projected rate of decline have more operational flexibility. Table 5-4 lists the operational flexibility at each MKGSA RMS.

5.5.4 Future Adjustments to Sustainable Management Criteria

The SMC established herein is developed using the best available data, information, and science. Data gaps and uncertainties, along with strategies to fill them, are summarized in Section 4.9. At this time, the revision of SMC for the GSP has been prioritized to address DWR-identified deficiencies. The potential to meet SMC has been informed through a preliminary analysis using an updated and recalibrated Subbasin groundwater flow model. The groundwater flow model has served as a useful tool in updating groundwater budgets and assessing the ability to achieve sustainability in the future with climatic influences and different operational conditions. Analysis using the model has shown that the projects and management actions identified in Chapter 6 will enable the GSAs to meet their sustainability goals. As new data are collected and analysed, it may be necessary or appropriate to adjust projects and management actions or SMC to better reflect conditions.

In the future, the model will also serve as a useful tool in reassessing and verifying projects and management actions to meet SMC, impact attribution analyses, and supplemental impact risk assessments.

5.6 Land Subsidence SMC

§354.28 Minimum Thresholds.

- (c) Minimum thresholds for each sustainability indicator shall be defined as follows:
 - (5) Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with the surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:
 - (A) Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects.
 - (B) Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.

The land subsidence SMC—based on input collected during stakeholder and Advisory Committee meetings and discussions with SWRCB and GSA staff—addresses total cumulative subsidence, differential subsidence, and an annual subsidence rate. The land subsidence SMC methodology is as follows:

1. Identify infrastructure potentially impacted by subsidence

2. Identify the total amount of subsidence that is acceptable without causing significant and unreasonable impacts to the infrastructure identified in Step 1
3. Compare acceptable subsidence to current subsidence rates and adjust them as needed
4. Estimate groundwater levels that avoid unacceptable subsidence, and assign groundwater level MTs protective of unacceptable subsidence

The land subsidence SMC of all 3 of the Subbasin's GSPs are coordinated and based on the unified analysis in Appendix 5B. While Appendix 5B presents an assessment and analysis of land subsidence impacts and SMC for the entire Kaweah Subbasin, this section presents only the subset of the analysis and SMC relevant to the area covered by this GSP.

5.6.1 Land Surface Beneficial Uses and Users

The Kaweah Subbasin GSAs reviewed all critical infrastructure that could be impacted by subsidence. The assessment of significant and unreasonable impacts was informed by outreach to agencies or stakeholders that manage critical infrastructure in the Kaweah Subbasin. The review is discussed in Appendix 5B.

Table 5-6 summarizes the beneficial land surface uses that are found in the GSP area, along with an assessment of whether data exist to quantify significant and unreasonable impacts from subsidence. Table 5-6 does not imply that subsidence impacts to infrastructure lacking historical data on impacts will not be addressed or mitigated by the GSA. The GSA will monitor subsidence impacts on all infrastructure listed in Table 5-6 and address mitigation of critical infrastructure as outlined in the mitigation program.

This analysis acknowledges that the relationship between subsidence and infrastructure impacts is incomplete. Future data may offer an updated understanding of infrastructure impacts, allowing subsequent GSP updates to better quantify subsidence impacts on all infrastructure.

Table 5-6. Summary of Beneficial Uses and Users (Critical Infrastructure) Potentially Impacted by Land Subsidence

Infrastructure / Beneficial Use	Significant & Unreasonable Impact	Quantifiable Impacts?	Agency or Group Contacted Regarding Historical Subsidence Impacts
Flood Control	Capacity loss in stream channels from reduced land slope, or reduced land drainage from reduced land slope leading to increased risk of flooding	No historical quantifiable impacts.	Tulare County Flood Control District Kaweah Delta WCD Tulare Irrigation District
Local Canals	Capacity loss from reduced canal slope and cracks	Possible based on historical impacts to beneficial users	Tulare Irrigation District Kaweah Delta WCD Other local private ditch companies
Supply Wells	Collapse of deep wells that prevents use and requires repair or replacement	Based on well design. Not enough historical information to correlate collapse with subsidence	Self-Help Enterprise Local drillers Local landowners with wells
Roads and Bridges	Uneven settlement that requires repairs or replacement	No historical quantifiable impacts	Tulare County Resources Management Agency – Road Department
Electrical Power Lines	Stretch or harm	No historical quantifiable impacts	-
Sanitary Sewers	Cracks or loss of capacity	No historical quantifiable impacts	-
Gas and Water Pipelines	Cracks or loss of capacity	No historical quantifiable impacts	-
Railroad Tracks	Uneven settlement that requires repairs or replacement	No historical quantifiable impacts	California High Speed Rail Authority

5.6.2 Subsidence Undesirable Results

As depicted on Figure 5-1, establishing URs are a critical first steps to establishing effective SMC.

5.6.2.1 Subbasin Defined Significant and Unreasonable Land Subsidence

Based on the review of existing data summarized in Table 5-6, impacts were quantified for the infrastructure that had adequate, quantifiable information. Details of the quantification are in Appendix 5B.

5.6.2.1.1 Significant and Unreasonable Impacts on Local Canals

Differential subsidence that reduces the slope of a canal by 1 foot over 1.5 miles is significant and unreasonable.

The differential subsidence that results in significant and unreasonable impacts was established by reviewing historical impacts on local canals and the mitigation required to deliver surface water to growers. An inability to deliver adequate surface water could result in increased groundwater pumping to make up for reduced surface water deliveries. Appendix 5B includes an analysis of data that substantiates the 1 foot over 1.5 miles criterion.

5.6.2.1.2 Significant and Unreasonable Impacts on Water Supply Wells

Subsidence of greater than 9 feet may result in significant and unreasonable harm to deep water supply wells.

The analysis included in Appendix 5B shows that deep irrigation wells can be designed to absorb between 9 and 14 feet of subsidence when installed with mechanical compression sleeves. The Kaweah Subbasin GSAs adopted the more conservative 9 feet of subsidence as the maximum allowable to protect deep water supply wells in the 2022 Amended GSPs.

5.6.2.1.3 Significant and Unreasonable Impacts on Flood Control

Subsidence of greater than 7 feet may result in significant and unreasonable flood impacts due to flattening of land slopes and associated drainage complications .

Flattening land slope from subsidence could reduce the ability to drain flood waters, increasing impacts from flooding. An analysis of subsidence impacts on land slope is included in Appendix 5C and summarized in Appendix 5B. This analysis demonstrates that maintaining a reasonable subsidence distribution that does not exceed 7 feet in the southwestern portion of the Subbasin will result in only minor land flattening. Because the 7 feet of subsidence occurs in only limited places in the Subbasin, the average subsidence across the Subbasin is 3.1 feet in this analysis.

5.6.2.1.4 Summary of Significant and Unreasonable Impacts

The significant and unreasonable subsidence impacts relevant to the area covered by this GSP are summarized in Table 5-7. Other critical infrastructure not listed in Table 5-7 that might be impacted by subsidence are eligible for mitigation funds under the GSP Mitigation Program. However, these other critical infrastructures lack data required to quantify levels of significance and establish numerical SMC.

Table 5-7. Summary of Significant and Unreasonable Subsidence Impacts

Critical Infrastructure	Absolute Subsidence Impact?	Differential Subsidence Impact?	Value
Domestic and Small System Wells	X		Any collapse
Local Canals		X	1 foot of subsidence over 1.5 miles
Water Supply Wells (non-drinking water)	X		9 feet of subsidence
Flood Control	X	X	7 feet of subsidence

5.6.2.1.5 Significant and Unreasonable Impacts on the Most Sensitive Beneficial Uses and Users

Any domestic or small water system well collapse due to subsidence is significant and unreasonable.

Domestic well owners and small water systems could suffer significant hardships if wells collapse due to subsidence.

5.6.2.2 Criteria for Defining Land Subsidence Undesirable Results

By regulation, the land surface subsidence UR is a quantitative combination of subsidence MT exceedances. The primary criteria and metric to determine if land subsidence URs are occurring in the Subbasin will be the cumulative subsidence at each RMS. Reflecting the GSA's commitment to minimizing subsidence, any single MT exceedance is undesirable. The statement of URs is:

An Undesirable Result will occur in the Subbasin if the cumulative subsidence minimum threshold is exceeded at any single RMS location.

An UR does not occur if the subsidence MT rate is exceeded since the rate is not tied to significant and unreasonable impacts. If the subsidence MT rate is exceeded at any location, the GSA will expedite management actions before subsidence URs occur.

5.6.2.3 Potential Causes of Undesirable Results

Undesirable results associated with subsidence are caused by overpumping or reduced groundwater recharge during drought periods and may occur due to groundwater levels falling below previous lows in the confined aquifers. Overpumping and lack of recharge is area specific, and some areas have historically experienced greater subsidence than others despite similar groundwater level trends. Subsidence impacts may occur in the Subbasin even if groundwater levels stabilize, as residual subsidence from past overdraft can continue for many years after groundwater level decline slows or stops (Lees *et al.*, 2022). Subsidence impacts may also occur due to continued pumping in neighboring subbasins, outside the jurisdiction of the MKGSA. The MKGSA intends to pursue a regional subsidence coordination effort as described in Management Action 8: Collaboration with Other Agencies and Inter-Basin Coordination (Section 6.7.8).

5.6.2.4 Effects on Beneficial Users and Land Uses

Subsidence URs may impact water conveyance, flood control, domestic wells, municipal wells, or potentially other infrastructure. The Kaweah Subbasin GSAs have established a Mitigation Program to alleviate subsidence impacts to domestic and small community water system wells as well as critical infrastructure. The MKGSA Well Mitigation Plan Version 1.0, included in Appendix 6D, provides mitigation for qualifying drinking water well applicants. In June 2025, the plan will be updated and expanded as version 2.0 to include mitigation in the form of technical assistance for non-drinking water wells and land subsidence impacts to critical infrastructure claims. The GSAs will perform outreach with local utility and infrastructure agencies to raise awareness of the Mitigation Plan and to explain its benefits and how to apply. During GSP implementation, the GSAs will also set up channels to routinely inquire about any infrastructure damage that may occur from land subsidence.

5.6.3 Subsidence Minimum Thresholds

The MT for land subsidence is both a rate and extent of total subsidence, which is defined as the sum of active subsidence caused by future lowering of groundwater levels and any residual subsidence from previous years. The horizontal extent of MT coverage is the entire MKGSA GSP area. The vertical extent of total subsidence is discussed below.

MTs are set at the 28 RMS shown on Figure 5-17. Cumulative MT subsidence values for each of the 28 MKGSA RMS are listed in Table 5-8. These MTs are a subset of the Subbasin-wide MTs developed in Appendix 5B. As explained in Section 5.6.3.3, the MT subsidence rate is 1.25-times the annual average rate that would achieve the cumulative subsidence MT for all RMS.

The GSAs have elected to establish subsidence action levels that will trigger projects and management actions to address subsidence before a MT exceedance. The action levels are 75%

of the MTs shown in Table 5-8. Action levels will give the GSAs the warning and opportunity to implement changes in the Subbasin before subsidence URs occur.

Table 5-8. MKGSA Subsidence Minimum Thresholds

Representative Monitoring Site	Subsidence Minimum Threshold		
	Total (feet)	Action Level (feet)	Rate (feet/year)
36.1935_-119.4380	-7.00	-5.25	-0.44
36.2069_-119.4979	-7.00	-5.25	-0.44
36.2522_-119.4389	-6.50	-4.88	-0.41
36.2857_-119.3179	-3.15	-2.36	-0.20
36.3417_-119.4038	-2.80	-2.10	-0.18
KSB-1320d (CB-1)	-7.00	-5.25	-0.44
KSB-1536d (CB-2)	-6.40	-4.80	-0.40
KSB-1408d (CB-3)	-6.30	-4.72	-0.39
KSB-1545d (CB-4)	-5.80	-4.35	-0.36
DH6683	-7.00	-5.25	-0.44
K007	-3.08	-2.31	-0.19
K008	-7.00	-5.25	-0.44
K009	-7.00	-5.25	-0.44
K010	-7.00	-5.25	-0.44
K020	-1.30	-0.98	-0.13
KSB-1129	-7.00	-5.25	-0.44
KSB-1477	-6.69	-5.02	-0.42
KSB-1506	-6.15	-4.61	-0.38
KSB-1538	-6.82	-5.12	-0.43
KSB-1695	-5.60	-4.20	-0.35
KSB-1696	-1.98	-1.49	-0.13
KSB-1706	-5.80	-4.35	-0.36
KSB-1770	-7.00	-5.25	-0.44
KSB-1905	-4.02	-3.02	-0.25
MKGSA-1 (MK-1)	-7.00	-5.25	-0.44
MKGSA-2 (MK-2)	-7.00	-5.25	-0.44
TUL99	-5.54	-4.16	-0.35
WK-1	-7.00	-5.25	-0.44



5.6.3.1 Information and Methodology Used to Establish Minimum Thresholds

The general process to develop the subsidence SMC is shown on Figure 5-18. The various steps on Figure 5-18 are described in more detail in Appendix 5B.

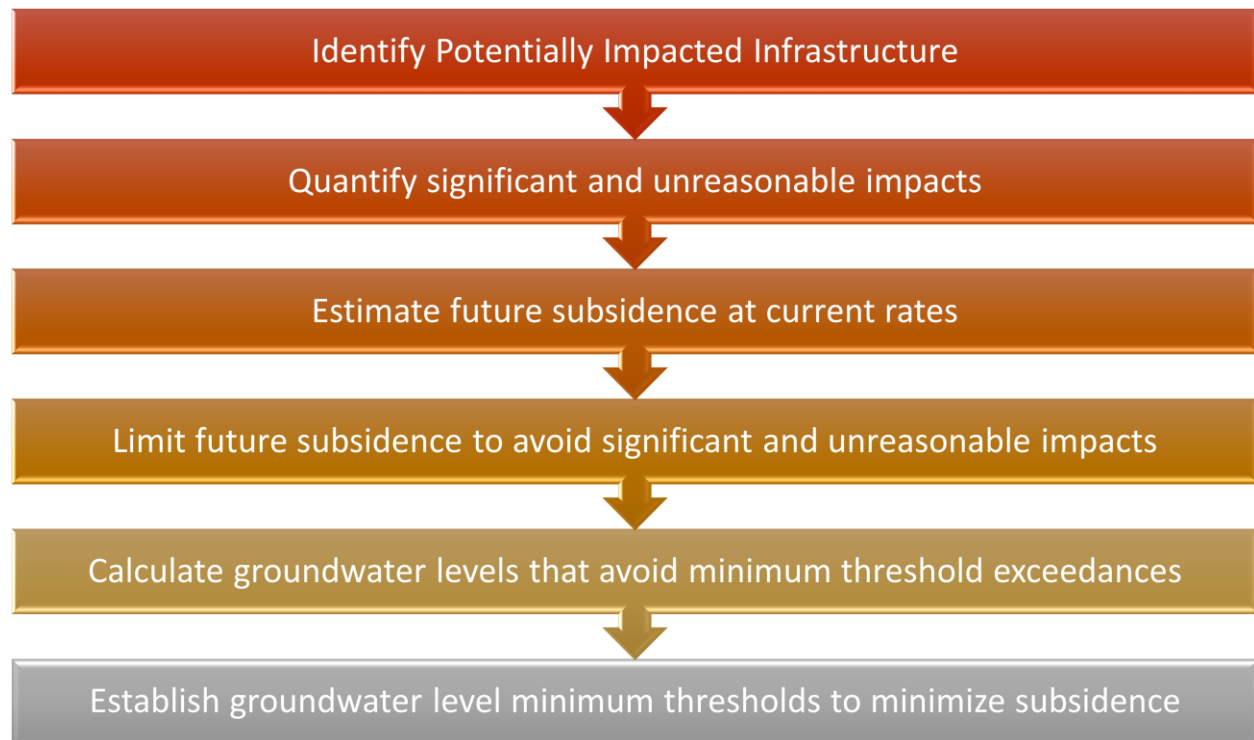


Figure 5-18. Process for Developing Land Subsidence SMC

5.6.3.2 Subsidence Minimum Threshold Extent

The spatial extent of MTs covers the entire GSP area. Subsidence MTs must address potential impacts to critical infrastructure from both total subsidence and differential subsidence. The process detailed in steps 3 and 4 in Appendix 5B shows how both total and differential subsidence are accounted for in the MTs.

Figure 5-19 shows the maximum allowable land subsidence in the MKGSA area on which the RMS subsidence MTs are based and includes a histogram showing MT distribution across the GSP area. While the average subsidence MT is 3.1 feet across the entire Subbasin, the average subsidence MT in the MKGSA area is 5.31 feet because the MKGSA covers some of the higher subsidence portions of the Subbasin. Subsidence MTs are different at every point in the GSP area and never exceed the significant and unreasonable levels for infrastructure discussed in Section 5.6.2.1.1.

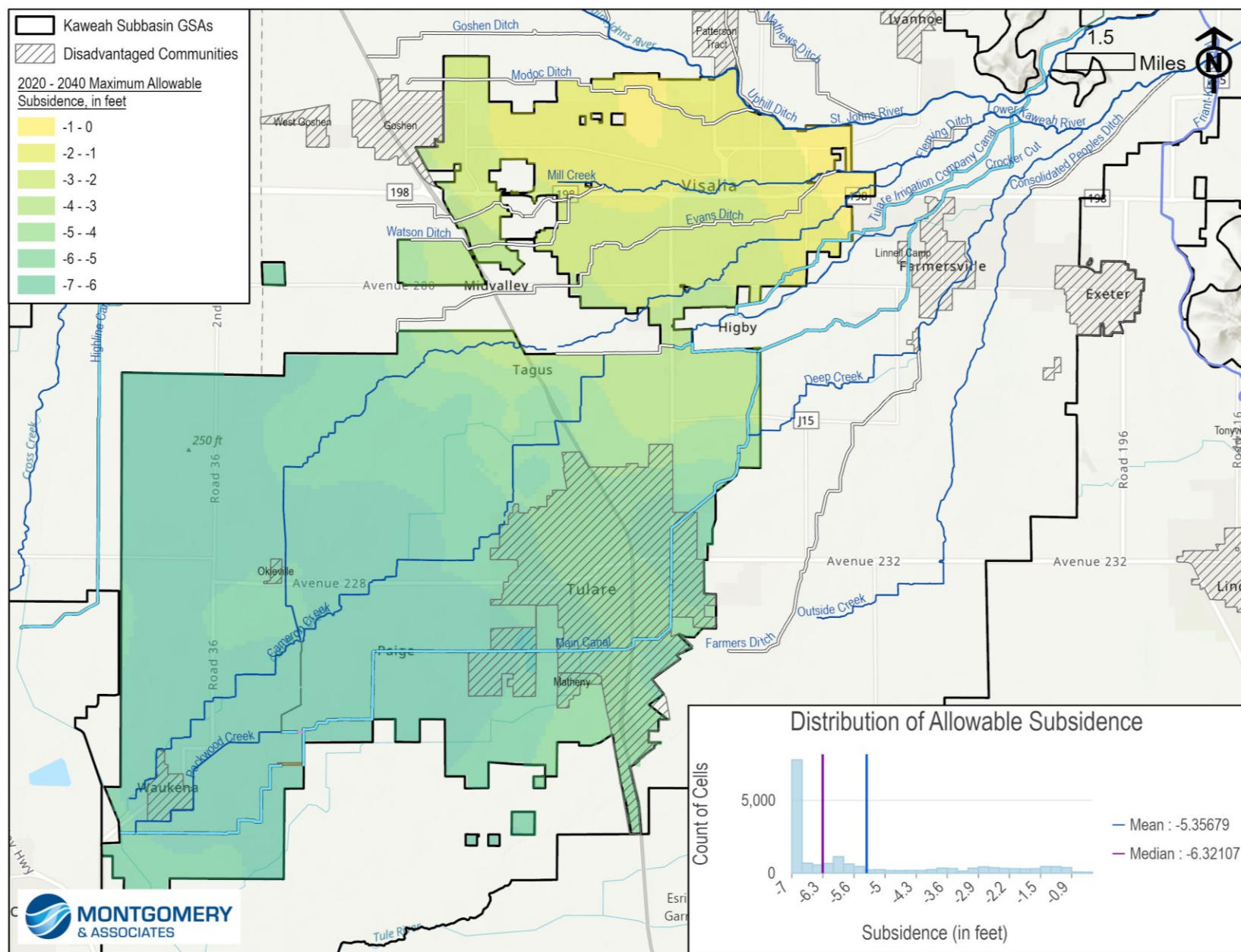


Figure 5-19. MKGSA Subsidence Minimum Threshold (Maximum Allowable Subsidence) and Histogram

5.6.3.3 Subsidence Minimum Threshold Rate

An annual subsidence MT rate is established at each monitoring site to complement the cumulative subsidence MT and help the MKGSA review annual subsidence measurements relative to long-term goals. First, the annual average subsidence rate to achieve the cumulative MT is calculated by dividing the cumulative value by the total number of years during the GSP implementation period (20). The subsidence MT rates range between 0.13 and 0.44 feet/year, which because of the downscaling steps performed to establish the cumulative MT, are less than average subsidence rates observed between 2015 and 2022. To account for downscaling effects, the subsidence MT rate is the downscaled annual average rate at each monitoring location multiplied by 1.25.

Both the rate and the extent criteria of MTs must be satisfied to avoid URs. Therefore, subsidence will not continue unabated. If subsidence continues at the MT rate, it will eventually exceed the MT extent, producing an UR.

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

The Kaweah Subbasin GSAs developed land subsidence MTs using smooth and continuous estimates of subsidence across the Subbasin, as discussed in Appendix 5B, based on best available data and tools. Therefore, there are no discontinuities in subsidence MTs and no conflict between MTs at individual RMS across the Kaweah Subbasin or within the jurisdictional boundaries of the MKGSA.

As described below, the subsidence MT has little or no impact on other MTs.

- **Chronic lowering of groundwater levels.** The lower aquifer groundwater level MTs are based on avoiding significant and unreasonable subsidence, as discussed in Appendix 5B. Therefore, the subsidence MTs and lower aquifer groundwater level MTs are aligned, and there is no negative impact of one on the other.

Further geologic investigation may demonstrate that there is gradually increasing aquifer confinement with depth in parts of the single-aquifer system. In this case, the lower portion of the single aquifer may display a different groundwater level than the upper portion. A recent nested monitoring well installation in the Tule Subbasin suggests this might be the case in the southern portion of the Kaweah Subbasin (northern portion of the Tule Subbasin). If future investigations suggest a multi-zone system in the single-aquifer system, limits on lower zone groundwater levels in the single aquifer may be necessary to avoid undesirable subsidence.

- **Reduction in groundwater storage.** The groundwater storage MTs are based on the chronic lowering of groundwater level MTs. Because the subsidence MTs do not impact

the chronic lowering of groundwater level MTs, they will similarly not impact the allowable reduction in groundwater storage MT.

- **Degraded water quality.** A relationship between the land subsidence MT and water quality MTs has not been established. The GSAs anticipate that land subsidence will not result in significant and unreasonable degradation of water quality. However, the Kaweah Subbasin GSAs are coordinating with other local agencies, non-profit organizations, and landowners to monitor for any potential degradation of water quality due to subsidence.
- **Depletion of interconnected surface water.** Subsidence may change the slope of interconnected streams, but this likely has a marginal impact on depletion of ISW.

5.6.3.5 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The following 3 subbasins of the San Joaquin Valley Basin adjoin the Kaweah Subbasin:

- Kings Subbasin to the north
- Tule Subbasin to the south
- Tulare Lake Subbasin to the west

Land subsidence throughout the San Joaquin Valley is driven by lowered groundwater levels, particularly in the deeper aquifers. Neighboring subbasins are facing similar challenges with subsidence, and the neighboring subbasin GSPs include the subsidence MTs in Table 5-9.

Table 5-9. Neighboring Subbasin Subsidence Minimum Thresholds

Groundwater Sustainability Agency	Subbasin	Maximum Subsidence Rate	Maximum Cumulative Subsidence
Kings River East	Kings	8 inches/year over 36 square miles	4 feet from 2020 elevations
East Tule	Tule	N/A	4 feet (E0048_B_RMS)
Lower Tule River ID	Tule	N/A	7 feet from 2020 elevations
Mid-Kings River & El Rico	Tulare Lake	N/A	6 feet from 2023 elevations (approximately 8 feet from 2020 elevations)

Figure 5-20 compares the Kaweah Subbasin MTs with those of surrounding subbasins and GSAs. On this figure, darker green colors indicate more allowable subsidence. Figure 5-20 shows that the allowable subsidence in surrounding subbasins is greater than or equal to the subsidence in the Kaweah Subbasin, and there are no anticipated impacts on neighboring subbasins. The Kaweah Subbasin GSAs will formalize collaboration with neighboring subbasins during GSP implementation with development of a Regional Subsidence Monitoring and Action Plan (RSMAP) described as a management action in Section 6.7.8 to coordinate strategies for minimizing subsidence and associated impacts in the region.



5.6.3.6 Effects on Beneficial Users and Land Uses

The subsidence MTs were explicitly set to have less than significant impacts on critical infrastructure. The GSAs will monitor land uses and users for which there is no existing quantitative data on subsidence impacts to ensure that any future subsidence does not result in an UR. The GSAs have a unified Mitigation Program—included here as Appendix 6C—and each GSA is developing individual plans to address and mitigate any subsidence impacts to critical infrastructure.

5.6.3.7 Relevant Federal, State, or Local Standards

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

5.6.3.8 Method for Quantitative Measurement of Minimum Thresholds

The MKGSA will assess subsidence annually using the subsidence monitoring network shown on Figure 5-17 and listed in Table 5-8. The MKGSA network includes 28 subsidence monitoring sites from the Subbasin wide monitoring network of 88 sites. Land surface elevation monitoring data will be compiled from DWR's InSAR dataset at least annually in the fall and annual subsidence at each monitoring point will be compared to the MT.

Each RMS shown on Figure 5-17 is assigned both a maximum total subsidence, which is the vertical extent of subsidence, and a maximum subsidence rate. MT subsidence values for each of the 28 RMS are listed in Table 5-8.

5.6.4 Subsidence Measurable Objectives and Interim Milestones

The MO for land subsidence represents a target annual subsidence rate in the Subbasin. In accordance with GSA's commitment to avoid or minimize subsidence, the MO is set to a rate of zero inelastic subsidence.

The GSA understands that this goal may not be achievable and has discussed this with DWR and SWRCB representatives. A recent study by Stanford University researchers found that even if groundwater levels stabilize immediately, ongoing subsidence could continue for decades, and result in as much as 10 feet of additional subsidence in some areas of the Subbasin (Lees *et al.*, 2022). The same study showed that in the 1960s to 1980s when groundwater levels rose basin-wide because of increased use of surface water, subsidence continued at rates between 0.03 and 0.3 foot per year. Recent studies and historical observations suggest that some subsidence may occur after 2040 regardless of the projects and management actions implemented by the GSAs, making it difficult to achieve the objective of zero subsidence.

By setting the MO to a rate of zero subsidence, GSAs are committing to minimizing subsidence and limiting impacts on land surface uses and users. The MKGSA is implementing projects and

management actions on an accelerated basis to reduce the subsidence rate and achieve the MOs (see Chapter 6).

5.6.4.1 Methodology for Setting Measurable Objectives and Interim Milestones

The MO was set to the best possible outcome: a rate of zero inelastic subsidence. This MO was chosen to minimize impacts on land surface uses and users.

A subsidence rate IM is established at 5-year intervals from 2025 through 2040. The IM rate is reduced over time to help the Subbasin achieve the MO of zero subsidence after 2040. The rates are calculated at each monitoring location using the following approach:

- **2025 IM** is equal to the MT rate
- **2030 IM** is the average annual subsidence rate that achieves the subsidence MT
- **2040 IM** is one-half the average annual subsidence rate that achieves the subsidence MT

5.6.4.2 Measurable Objectives

MOs for each of the 28 subsidence RMS are set to zero.

5.6.4.3 Interim Milestones

IMs for all 28 subsidence RMS are listed in Table 5-10.

Table 5-10. MKGSA Subsidence Interim Milestones

Representative Monitoring Site	Interim Milestone Subsidence Rate (feet/year)		
	IM 2025	IM 2030	IM 2035
36.1935_-119.4380	-0.44	-0.35	-0.18
36.2069_-119.4979	-0.44	-0.35	-0.18
36.2522_-119.4389	-0.41	-0.33	-0.16
36.2857_-119.3179	-0.20	-0.16	-0.10
36.3417_-119.4038	-0.18	-0.14	-0.10
KSB-1320d (CB-1)	-0.44	-0.35	-0.18
KSB-1536d (CB-2)	-0.40	-0.32	-0.16
KSB-1408d (CB-3)	-0.39	-0.32	-0.16
KSB-1545d (CB-4)	-0.36	-0.29	-0.15
DH6683	-0.44	-0.35	-0.18
K007	-0.19	-0.15	-0.10
K008	-0.44	-0.35	-0.18
K009	-0.44	-0.35	-0.18
K010	-0.44	-0.35	-0.18
K020	-0.13	-0.10	-0.10
KSB-1129	-0.44	-0.35	-0.18
KSB-1477	-0.42	-0.33	-0.17
KSB-1506	-0.38	-0.31	-0.15
KSB-1538	-0.43	-0.34	-0.17
KSB-1695	-0.35	-0.28	-0.14
KSB-1696	-0.13	-0.10	-0.10
KSB-1706	-0.36	-0.29	-0.15
KSB-1770	-0.44	-0.35	-0.18
KSB-1905	-0.25	-0.20	-0.10
MKGSA-1 (MK-1)	-0.44	-0.35	-0.18
MKGSA-2 (MK-2)	-0.44	-0.35	-0.18
TUL99	-0.35	-0.28	-0.14
WK-1	-0.44	-0.35	-0.18

5.7 Reduction in Groundwater Storage SMC

The SMC for the reduction of groundwater storage focuses on avoiding potential URs related to groundwater extraction during periods of drought. Because groundwater storage is closely related to groundwater levels, the reduction of groundwater storage SMC are identical to those developed for the chronic lowering of groundwater levels sustainability indicator.

5.7.1 Reduction of Groundwater Storage Undesirable Results

§ 354.26. Undesirable Results.

- (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.
- (b) The description of undesirable results shall include the following:
 - (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to 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 signed 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.

The overall process relied upon to define URs for the reduction of groundwater storage sustainability indicator is the same as the chronic lowering of groundwater level sustainability indicator and is described in Sections 5.3, 5.4, and 5.5.

The evaluation of potential effects on beneficial uses and users, land uses, and property interests for the reduction of groundwater storage sustainability indicator is the same as for chronic lowering of groundwater levels. The effects of decreasing groundwater storage manifest as effects for other sustainability indicators (i.e., reduction of groundwater storage is associated with chronic lowering of groundwater levels). The qualitative description of URs is reduction of groundwater storage that will likely cause other sustainability indicators to have URs.

The criteria used to define URs for the reduction of groundwater storage are based on the qualitative description of URs, which causes other sustainability indicators to have URs. As explained in Section 5.4, groundwater levels are used as a proxy for the reduction of groundwater storage sustainability MTs. Based on this premise, the combination of MT exceedances that are deemed to cause significant and unreasonable effects leading to URs in the Subbasin for the reduction of groundwater storage are the same combination deemed to cause URs for the chronic lowering of groundwater levels (Table 5-4).

5.7.2 Reduction of Groundwater Storage Minimum Thresholds

§ 354.28. Minimum Thresholds.

- (d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence

Pursuant to GSP Emergency Regulations §354.28(d), groundwater levels may be used as a proxy for other sustainability indicators if a significant correlation between groundwater levels and the other sustainability indicators can be demonstrated. Groundwater levels are correlated to groundwater storage (i.e., rising groundwater levels indicate an increase in groundwater storage and vice versa). Groundwater storage cannot be directly measured and can only be estimated using measured or modeled groundwater levels and knowledge of the basin geometry and subsurface hydraulic properties; therefore, the calibrated numerical groundwater flow model is used to estimate groundwater in storage for the Subbasin (as described in Appendix 5G). Furthermore, groundwater levels are a more direct and reliable measure of sustainability as compared to estimated storage changes. For these reasons, the SMC for the chronic lowering of groundwater levels (Table 5-4) are used as a proxy for the reduction of groundwater storage sustainability indicator.

Because of the correlation between the reduction of groundwater storage and chronic lowering of groundwater level sustainability indicators, SMC for reduction of groundwater storage are described in the chronic lowering of groundwater levels SMC section (Section 5.5).

5.8 Degraded Groundwater Quality SMC

§354.28 Minimum Thresholds.

- (c) Minimum thresholds for each sustainability indicator shall be defined as follows:
 - (5) Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with the surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:
 - (C) Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects.
 - (D) Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.

The Kaweah Subbasin's strategy is to manage groundwater quality to the MOs through the implementation of management actions and projects to achieve the sustainability goal. The priorities to establish the SMC in the Kaweah Subbasin are shown on Figure 5-5. More information on this strategy and the confidence in achieving it is available in Chapter 6.

To comply with the SGMA requirements, the Kaweah Subbasin GSAs support the protection of groundwater quality by coordinating with agencies and programs such as those listed above that

are already established to maintain and improve the groundwater quality in the Kaweah Subbasin. All future projects and management actions implemented by the Kaweah Subbasin GSAs will be designed to avoid or mitigate any further degradation of groundwater quality caused by the management of groundwater. Under SGMA the prevention of groundwater quality degradation will be supported by groundwater sampling and reporting to document the existing conditions pre-SGMA and any changes in groundwater quality conditions and trends that occur through the implementation period.

The Kaweah Subbasin GSAs will continue to coordinate with the entities responsible for complying with existing groundwater quality regulatory programs such as the CV-SALTS, Dairy Program, and ILRP. The Kaweah GSAs are working with CV-Salts and ILRP to establish roles, responsibilities, and collaboration under a memorandum of understanding or a memorandum of agreement.

5.8.1 Beneficial Users Affected by Degraded Groundwater Quality

§354.26 Undesirable Results.

- (b) The description of undesirable results shall include the following:
- (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.

The first step of the SMC approach (Figure 5-1) is to identify beneficial users, uses, and property interests, which are listed in Table 5-11.

Table 5-11. Beneficial Users and Uses Affected to Degraded Groundwater Quality in the Kaweah Subbasin

Beneficial Use	Beneficial User
Drinking Water Use	Domestic Well Users
	Small Community Well Users and Service Providers
	Municipal Well Users and Service Providers
	Commercial and Industrial Users
Agricultural Use	Conjunctive Use Growers (Irrigation)
	Groundwater-Dependent Growers (Irrigation)
	Small Family Farmers (Irrigation)
	Produce Packing Facilities (Ag-Industrial Use)
	Livestock Facilities (Ag-Industrial Use)
Property Interest & Economic Potential	Commercial and Industrial Property Values
	Agricultural Property Values
	House Property Values

¹Property interest and economic potential are not recognized as beneficial uses under the Basin Plan; however, SGMA requires GSAs to protect against significant and unreasonable “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.” (23 CCR § 354.26 (b)(3))

5.8.2 Undesirable Results

§ 354.26. Undesirable Results.

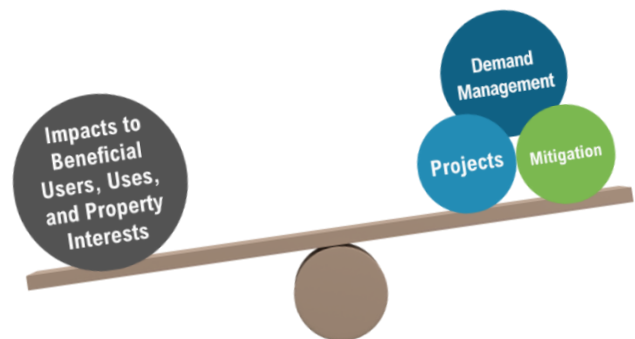
- (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.
- (b) The description of undesirable results shall include the following:
 - (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to 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 signed 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.

The UR is a quantitative reflection of significant and unreasonable effects occurring subbasin-wide. The components of the UR definitions are expanded on below.

5.8.2.1 Subbasin Defined Significant and Unreasonable Conditions

The Kaweah Subbasin has defined significant and unreasonable effects as:

The tipping point at which groundwater conditions across the Kaweah Subbasin cause impacts to beneficial users, uses, and property interests that cannot be sustained or mitigated.



Consistent with the Coordination Agreement, significant and unreasonable effects may lead to URs if groundwater quality is adversely impacted by groundwater pumping and recharge projects and these impacts result in groundwater no longer being generally suitable for designated beneficial uses as defined in the Water Quality Control Plan for the Tulare Lake Basin (Basin Plan) including agricultural irrigation and/or domestic use.

Significant and unreasonable impacts include degraded water quality from migrating plumes or other induced effects of GSA actions, including those upon municipal, small community, and domestic well sites rendered unsuitable for potable supplies and associated uses, and/or the costs associated with treatment of groundwater supplies at the wellhead or point of use and/or point of connection so that they are compliant with state and federal regulations. Significant and unreasonable degraded groundwater quality can also include impacts to irrigated agricultural industries, as certain mineral constituents and salt build-up can impact field productivity and crop yields. These conditions must not be localized, but a regional problem to be considered

significant and unreasonable, per SGMA definition of UR: “Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin” (23 CCR § 354.26 (a)).

Groundwater quality degradation is considered significant and unreasonable if the Kaweah Subbasin is unable to (1) meet the mitigation demand due to impacts induced by groundwater activities that occurred after January 1, 2015, or (2) manage against degraded groundwater quality induced by groundwater activities that occurred after January 1, 2015.

The UR establishes metrics to evaluate significant and unreasonable conditions in the Kaweah Subbasin through a combination of tracking MT exceedances and meeting mitigation demands. The UR has been defined to ensure the protection of the most sensitive beneficial uses and users of groundwater by addressing all potential COCs that could contribute to degradation of groundwater quality. The combination of MT exceedances and mitigation demands is defined as follows:

UR#1 –Ten separate RMS wells with minimum threshold exceedances due to groundwater activities that occurred after January 1, 2015 (as determined by the Exceedance Policy), in a single water year for any single or combination of COCs.

OR

UR#2 –The GSAs cannot meet mitigation demand for domestic wells impacted⁴ by groundwater quality degradation associated with groundwater activities after January 1, 2015.

5.8.2.2 Criteria for Defining Groundwater Quality Undesirable Results

Basis for Criteria UR#1: Ten RMS wells experiencing a MT exceedance equates to the GSA’s mitigation budget for groundwater quality impacts induced by groundwater activities that occurred after January 1, 2015. A summary of the Kaweah Subbasin Mitigation Cost Estimate and how it informed Criteria #1 is provided in Table 5-12.

⁴ Impacted” means the domestic well is experiencing a point-of-use primary MCL (health-based standard) exceedance induced by groundwater activities after January 1, 2015.

Table 5-12. Basis for Groundwater Quality Undesirable Result #1

\$5,800,000	Subbasin-Wide Annual Budget Included in GSP
\$288,000	Annual Administrative Cost Estimate
\$2,100,000	Annual Dry Well Mitigation Cost Estimate
\$1,500,000	Annual Fixed Land Subsidence Mitigation
\$500,000	Annual Uncertainty Reserve (Buffer Funding for Uncertainty in the Analysis)
\$1,412,000	Remaining Annual Budget for GWQ Mitigation
\$2,500	Avg Per Well Cost of GWQ Mitigation (Includes \$500 uncertainty buffer, \$250 for emergency supplies for >1 month, and \$500 to account for inflation).
565	Wells Affordably Mitigated in a Single Year
14%	Percentage of Domestic Wells in KSB Covered by Mitigation Budget
75	Count of Currently Active GWQ RMS in the KSB
10	Count of GWQ RMS that Equate to Percentage of Domestic Wells Feasibly Mitigated Annually

The above remaining annual budget for GWQ mitigation (\$1,412,000) protects the beneficial uses or users of groundwater that may be impacted by elevated concentrations of COCs exceeding regulatory standards associated with any combination of 10 RMS MT exceedances. UR#2 is meant to cover the event where mitigation demands exceed the available budget before 10 RMS MT exceedances occur.

Basis for Criteria UR#2: The Kaweah Subbasin Mitigation Program includes coverage for domestic wells impacted by groundwater quality impacts induced by groundwater activities after January 1, 2015. Criteria #1 is based on the existing mitigation budget of \$1.4M. This budget includes a \$500,000 annual uncertainty reserve as a buffer to account for uncertainty due to data gaps and future economic unknowns, as well as other cost assumptions: point of use Reverse Osmosis (RO) system (\$1,250), 1 month of emergency water supplies (\$250), inflation budget (\$500) and uncertainty buffer (\$500) for the average cost per well for groundwater quality mitigation. However, if groundwater quality is degraded beyond the GSAs' ability to meet the mitigation demand, then this would be deemed a significant and unreasonable impact which could lead to URs.

Significant and unreasonable effects for the degradation of groundwater quality in the Kaweah Subbasin are tied to the inability of the GSAs to meet mitigation demands for impacts related to GSA groundwater activities; therefore, the UR metrics described above prevent the significant and unreasonable effects and provide the necessary protection for all beneficial uses and users of groundwater within the Subbasin.

It is important to clarify that the UR definition is specific to domestic wells. This is because small public supply wells supplying disadvantaged communities are automatically enrolled into

the Subbasin's Small Community Proactive and Protective Action Plan. This management action is detailed in Section 6.7.5. Because location, construction information, historical groundwater levels and quality data are available for these wells, the GSAs will engage with these community well operators to assess long-term planning needs and evaluate if site-specific GSA management changes are needed to protect against impacts to these wells. Domestic well locations, construction information, and historic data are not available for all domestic wells; therefore, the same protective action is not possible for them and domestic well owners are invited to enroll in the Well Registration Program and are candidates for the Subbasin's Well Mitigation Program.

5.8.2.3 Potential Causes of Undesirable Results

Undesirable results associated with groundwater quality degradation can be caused by several factors related to changes in the groundwater flow system of the principal aquifers due to GSA groundwater management activities. For example, recharge projects may have short-term movement of legacy contamination out of the vadose zone and into the ambient groundwater aquifers. Additionally, the drawdown of shallow contaminated groundwater into the upper portion of a pumping well screen and changes in groundwater flow gradients and flow directions, such that known plumes and COC migration could threaten production well quality. Well production depths may also draw out impaired groundwater from aquifer and/or aquitard layers, both from naturally occurring (e.g., high concentrations of arsenic in saturated clays) and human-caused (e.g., dense-phase liquids concentrated above clay layers) impacts, which, if MCLs are exceeded, may cause URs. Declining groundwater levels may or may not be a cause, depending on location. In areas where shallow groundwater can threaten the health of certain agricultural crops, rising groundwater levels may be of concern as well.

5.8.2.4 Effects on Beneficial Users and Land Uses

The potential effects of degraded groundwater quality from migrating contaminant plumes, mobilized COCs, or other induced effects of GSA actions include those upon the municipal, small community, and domestic beneficial users whose well sites are rendered unfit for potable supplies and associated uses (i.e., regulatory water quality standards are not met) and/or the costs to treat groundwater supplies at the wellhead or point of use to be compliant with state and federal regulations cannot be covered. Potential effects also include those upon the beneficial users of irrigated agricultural industries, as certain mineral constituents and salt build-up can impact field productivity and crop yields.

5.8.3 Minimum Thresholds

§354.28 Minimum Thresholds.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

- (4) Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.

The approach to developing MTs for the Kaweah Subbasin is based on existing programs and regulations that acknowledge and incorporate the designated beneficial uses listed in the Basin Plan and subsequent adopted amendments. The MTs established by the Kaweah Subbasin are listed in Table 5-13. In addition, for groundwater designated for domestic and municipal supply (MUN), MTs shall be set at the MCLs specified in the following provisions of Title 22 of the California Code of Regulations (Title 22), which are incorporated by reference into the Basin Plan and therefore the Subbasin GSPs as well: Table 64442 (Radionuclide) of section 64442, Tables 64431-A (Inorganic Chemicals) of section 64431, and Table 64444-A (Organic Chemicals) of section 64444, and Tables 64449-A (Secondary Maximum Contaminant levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) and of Section 64449 (Attachment A of Appendix 3B). The incorporation-by-reference of the Basin Plan and Title 22 is prospective, including future changes to the incorporated provisions as the changes take effect. The Kaweah Subbasin GSAs recognizes that science and health risks associated with COCs can change over time, therefore the GSAs intend to incorporate those changes as they become available via the Basin Plan.

For irrigation wells, water quality should generally be suitable for agricultural use. Based on review of the historical groundwater quality data, provisional agricultural suitability standards have been established for boron and sodium based on a literature review and outreach to agricultural experts in the Subbasin⁵. However, there are no adopted numeric water quality objectives for these constituents in the Basin Plan and the application of narrative water quality objectives may make such standards vary depending on site specific circumstances such as the type of dominant crops grown in the area. Total dissolved solids and specifically chloride will be monitored and are also appropriate constituents to evaluate for agricultural use suitability. Ongoing work by the CV-SALTS program will be monitored to determine if numeric water quality objectives for the protection of the AGR use may be adopted in the future.

⁵ Sources to assess suitability for Boron and Sodium: Western Fertilizer handbook 7th edition 1985
FAO # 29 report "Water Quality for Agriculture" 1985
Diagnosis and Improvement of Saline and Alkali Soils, USDA 1954
Citrus Production Manual, University of California, 2014

The degraded groundwater quality MTs for each COC identified for the Subbasin are listed in Table 5-13. The MTs are protective of beneficial uses and users of groundwater because they are consistent with the groundwater quality standards that are in accordance with the regulations for the San Joaquin Valley region and agricultural needs.

Important Acknowledgement: The presence of (an) exceedance(s) does not indicate that significant and unreasonable impacts are occurring within the scope of GSAs' responsibility under SGMA. To evaluate if the exceedance is caused by groundwater activities that occurred after January 1, 2015, and therefore within the scope of GSA responsibility, an Exceedance Policy has been established and is considered an integral component of the definition of MTs and URs for groundwater quality in the Subbasin. For more information on the Exceedance Policy, see Section 5.8.3.1.1.

Table 5-13. Sustainable Management Criteria for Groundwater Quality

Constituent of Concern	MT, MO, and IM	MCL Units
California Primary MCL (Health Based Standard)		
1,2,3-Trichloropropane (1,2,3 TCP)	0.005	µg/L ¹
1,2-Dibromo-3-chloropropane (DBCP)	0.2	µg/L ¹
Arsenic	10	µg/L ¹
Goss Alpha	15	pCi/L ¹
Chromium, Hexavalent (Cr6 or CrVI)	10	µg/L ¹
Nitrate as N	10	mg/L
Perchlorate	6	µg/L ¹
Uranium	20	pCi/L ¹
Tetrachloroethene (PCE)	5	µg/L ¹
California Secondary MCL (Aesthetics Based Standard)		
Chloride	500	mg/L
Specific Conductivity	1600	µS/cm /cm
Sulfate	500	mg/L
Total Dissolved Solids	1000	mg/L
US EPA Secondary MCL (Aesthetics Based Standard)		
pH	8.5	-
Agriculture Water Quality (AgWQ) Goal (Non-Health Based Standards)		
Boron	0.7	mg/L
Sodium	69	mg/L

¹Constituent units in µg/L or pCi/L- in Attachment A: Title 22 Tables the constituent units are in mg/L, all constituents in this tables are in order of high to low percentage of wells with exceedances per Table 2-2; MT, minimum threshold; MO, measurable objective; IM, interim milestones; MCL, maximum contaminant level; mg/L, milligram per liter; µg/L microgram per liter; pCi/L, picocuries per liter; µS/cm, microsiemens per centimeter

5.8.3.1.1 Minimum Threshold Exceedance Policy

The MT Exceedance Policy is designed as an Exceedance Investigation Plan that will be implemented if sampling results indicate that a COC is detected in an RMS at a concentration equal to or greater than its respective MT (i.e. regulatory standards and agricultural suitability standards). Following an exceedance of COC regulatory standard, a confirmation sample will be collected for any COC with a Primary MCL (health-based standard) within 1 month and within 3 months for any COC with a Secondary COC (aesthetic [non-health]-based standard). Exceedances of an agricultural suitability standard (boron and sodium) will be confirmed within 6 months or at the time of the next regular sampling occurrence, whichever comes first. If the confirmation sample confirms the exceedance, then an Exceedance Investigation (consisting of a desktop study and field investigation) will begin. The desktop study described below will review historical data within an approximate 1.5 mile-radius⁶ of the RMS to document historical concentrations and trends. This may include review of data for other COC; for example, nitrate data in the vicinity of a TDS exceedance may be evaluated as it may elucidate the potential source(s) or migration pathway of the COC of interest. Historical data will also be reviewed to determine if the exceedance is likely attributable to post-2015 activities or if the COC likely was present at the same or greater concentration (legacy contamination) prior to the adoption of SGMA (i.e., pre-2015). In addition, the desktop study will perform a preliminary evaluation as to whether GSA activities (e.g., recharge operations and/or pumping) have induced further degradation of groundwater quality.

In the event the cause of the exceedance is unrelated to groundwater activities after January 1, 2015 (as determined by the Exceedance Policy), then the GSAs will work with the most relevant or responsible entities for mitigation of the degradation. This is expected to include coordination with CV-SALTs, ILRP, and other programs.

The Exceedance Policy is further explained in a process diagram on Figure 5-21.

⁶ The investigation distance is a preliminary estimate based on the current spatial density of RMS locations and professional judgment will be used to evaluate whether the investigation area requires expansion on a case-by-case basis.

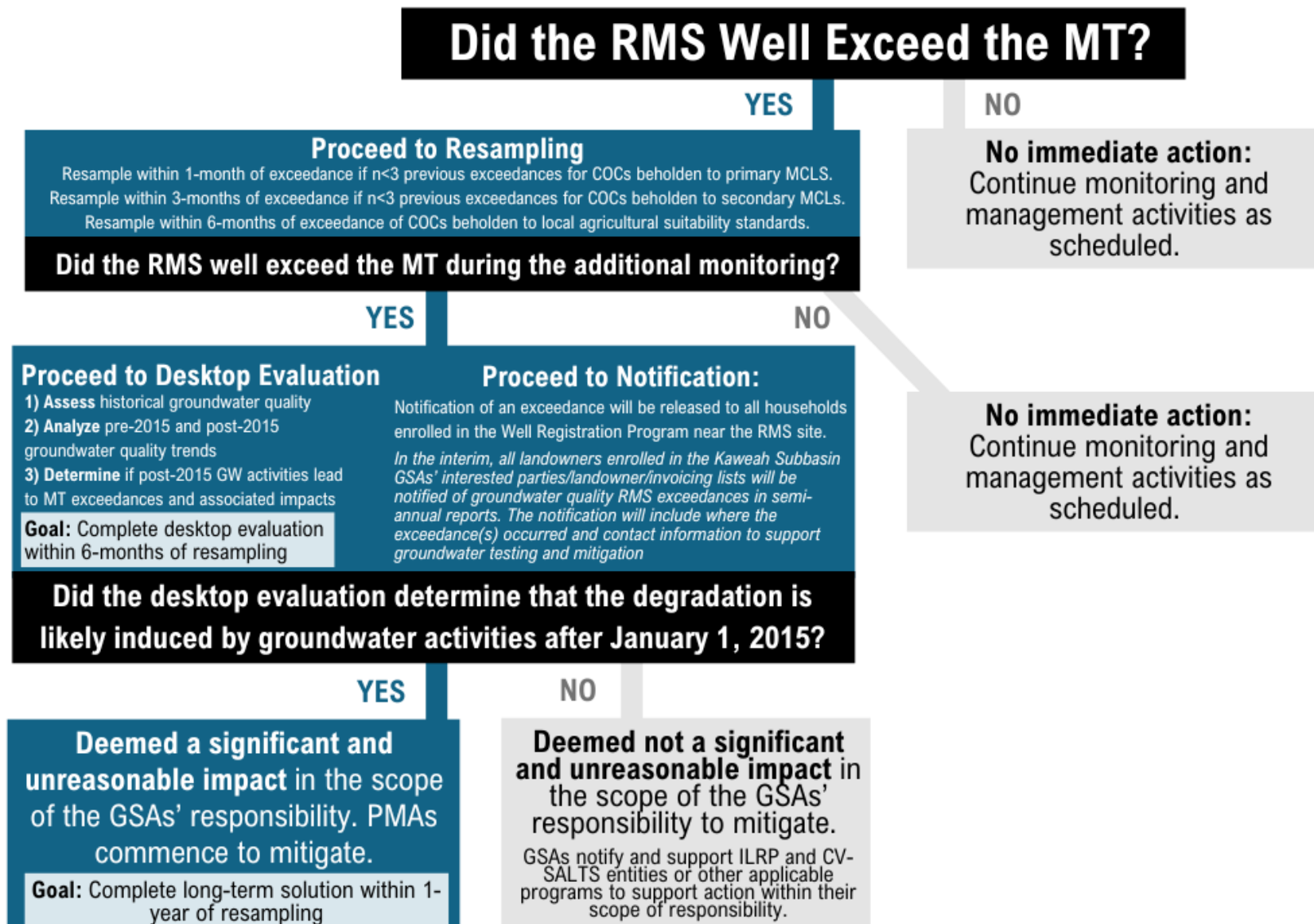


Figure 5-21. Groundwater Quality Exceedance Policy

Desktop Evaluation for COC Exceedance

Following a confirmation sample exceedance, the GSAs will proceed to a desktop evaluation to assess if the degradation is likely induced by groundwater management activities (i.e., pumping and/or recharge) after January 1, 2015, and the following steps are taken. The desktop evaluation shall be conducted by a licensed geologist or engineer with relevant experience in groundwater resources and quality.

Step 1. Evaluate Conceptual Site Model

A conceptual site model will be developed that identifies the following:

- Beneficial uses and users, land use, and property interests
- COC and migration source(s), migration pathways, and transport
- Associated COC
- Historical groundwater quality data
- Previous investigations/studies, if any
- Well construction information (depth, screened interval, etc.) for wells within 1.5 miles
- Well log and age
- Principal aquifers screened (i.e., upper, lower, composite or unknown)
- Historical and current water levels for well within approximately 1.5 miles
- Well pumping capacity and historical groundwater extractions
- Historical and current land uses from LandIQ or DWR data
- Consumptive water use from Land IQ in within a minimum 0.5 miles radius of the well
- Aquifer properties as represented in the latest numerical model for the Subbasin or derived from available pumping test analysis data
- Cross section of the local stratigraphy based on best available data such as Leapfrog® 3D visual model of compiled Airborne Electromagnetic (AEM) surveys
- Historical and current land use and land management practices

- Groundwater management actions or projects conducted in the area of concern
- Envirostor and GeoTracker reporting of nearby environmental contamination sites

This step may entail expanding from the desktop evaluation to include a field investigation conducted by a qualified technician. An example schematic of a site conceptual model for nitrate indicating common sources is provided on Figure 3-7 of Appendix 3B.

Step 2. Groundwater Quality Data Analysis

RMS well historical data will be graphed in a time series with time on the x-axis and concentration on the y-axis. The graph will include the Mann-Kendall trend analysis—with a comparison of the historical data to relative concentration of the COC—to assess if water quality degradation has an increasing trend after January 1, 2015.

The Mann-Kendall test is an industry standard for non-parametric trend detection and will continue to be applied to assess trends in groundwater quality in the Kaweah Subbasin (Helsel, 2012; Helsel *et al.*, 2020). The Mann-Kendall test does not require regularly spaced sample intervals, is unaffected by missing time periods, avoids substitution for data that contain non-detects, and does not assume a pre-determined data distribution. The Mann-Kendall test assesses whether or not a dataset exhibits a monotonic trend (increasing, decreasing, or stable) within a selected statistical significance level. A significant level of 0.05 (i.e., a confidence level of 95%) is selected for this analysis.

Step 3. Consideration of Driving Mechanisms

COC concentrations in groundwater are dependent on physical and chemical influences. Examples of physical influences include changes in groundwater levels, gradients, pumping, source water recharge volumes, and quality of recharge water. Examples of chemical influences include reduction/oxidation (redox) conditions of groundwater (which can cause mobilization, mineralization, or adsorption of constituents) and radioactive decay of elements (Jurgens, *et al.*, 2009).

Many studies suggest that groundwater level decline and subsidence may increase constituent concentrations by changing the physical and chemical influences on constituent concentrations (Levy *et al.*, 2021; Haugen *et al.*, 2021; Smith *et al.*, 2018).

For example:

- Shallow constituents, which typically exist in the top of the unconfined aquifer, may migrate downward with the water table resulting in those constituents being pulled downward into well screens at deeper depths.

- Continued groundwater level decline at different rates may alter groundwater elevation gradients which may cause constituents to migrate along new flow paths.
- Well users may encounter new constituents as wells are drilled deeper into the aquifer where there are often higher concentrations of arsenic, uranium, and TDS.
- Artificial recharge or changes in groundwater levels that alter redox conditions may cause the mobilization of constituents (Haugen *et al.*, 2021).
- Groundwater pumping overdraft and resulting subsidence may expel pore water from compacted clay layers, increasing arsenic concentrations (Smith *et al.*, 2018; Underhill, 2023; Erban *et al.*, 2013). Arsenic can pose a significant threat to human health for people who depend on groundwater for drinking purposes (U.S. Environmental Protection Agency, 2023).
- Improperly constructed or sealed wells or improperly abandoned wells may act as conduits for COC into confined and unconfined aquifers (California Department of Water Resources 1991).

Step 4. Data Evaluation & Determination

All results from the steps above will be evaluated by a qualified professional to assess if the exceedance is likely induced by groundwater activities that occurred after January 1, 2015.

If the results of the data evaluation conclude that the cause of the exceedance was induced by groundwater activities that occurred after January 1, 2015, as per the desktop evaluation and review by the GSAs technical advisory or advisory committees, the GSA then proceeds to implement corrective measures to avoid further degradation from groundwater activities. The applicable measure will be evaluated on a case-by-case basis.

Landowner Notification Protocol & Reporting

Concurrent with the desktop evaluation and following the confirmation sample confirming an exceedance, the Kaweah Subbasin GSAs will report confirmation sample exceedances in semi-annual reports that will be distributed to all recipients on the GSAs' interested parties, landowner, and invoicing lists.

The reports will include, at a minimum, a map of where the confirmation exceedance occurred, information on groundwater quality testing resources available to landowners, and information on the Kaweah Subbasin's Mitigation Program, which includes mitigation for groundwater quality.

In the future, the notification protocol will be improved through implementation of the Kaweah Subbasin Well Registration Program. This program is intended to improve documentation and fill data gaps where domestic wells are located, their construction information, and the landowner's contact information to improve notification, future analyses, and data management.

In addition to the semi-annual groundwater quality reports, the Kaweah Subbasin GSAs will continue reporting groundwater quality monitoring results in the Annual Reports, submitted to the Department of Water Resources and made publicly available every year by April 1.

Implemented Corrective Measures (If Applicable)

In the event an exceedance is determined to have been induced by groundwater activities after January 1, 2015, the GSAs have 1-year from the resampling event to take measures to prevent further degradation induced by groundwater activities. The appropriate corrective measures will be determined on a case-by-case basis, with recommendations coming from each GSA's technical advisory or advisory committees and final approval for action being taken by the respective GSA board.

The corrective actions may include the following:

- Halting recharge activities at a site in instances in which recharge activities are determined to be mobilizing contamination.
- Authorizing agricultural landowners to extract groundwater above their pro-rata allocated volume at specific locations. This practice is being piloted at the Okieville Recharge Basin project, in which the recharge activities risked migrating nitrate loading. The nearby landowners may be asked to pump additional groundwater within the groundwater flow path to the community of Okieville until groundwater quality conditions are improved from the recharge of good-quality Friant-Kern Canal supplied surface water.
- Initiating pumping restrictions in localized areas where pumping may be altering the groundwater chemistry.
- Lower aquifer pumping may be causing subsidence and releasing COCs such as arsenic from the compressed clays.
- Pumping may be altering gradients more than historical conditions, inducing mobilization or exposure of COCs.
- Providing water treatment systems for mitigation.

5.8.3.2 Information and Methodology Used to Establish Minimum Thresholds

The approach to developing MTs for the Kaweah Subbasin is based on existing programs and regulations that acknowledge and incorporate the designated beneficial uses listed in the Basin Plan and adopted amendments. Table 5-13 lists the MTs for the COCs. In addition, for groundwater designated for domestic and municipal supply (MUN), MTs are set at the MCLs specified in the following provisions of Title 22 of the California Code of Regulations (Title 22), which are incorporated by reference into this GSP: Table 64442 (Radionuclide) of section 64442, Tables 64431-A (Inorganic Chemicals) of section 64431, and Table 64444-A (Organic Chemicals) of section 64444, and Tables 64449-A (Secondary Maximum Contaminant levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) and of Section 64449 (Attachment A of Appendix 3B). The incorporation-by-reference of the Basin Plan and Title 22 is prospective, including future changes to the incorporated provisions as the changes take effect.

For irrigation wells, water quality should generally be suitable for agricultural use. Based on review of the historical groundwater quality data, provisional agricultural suitability standards have been established for boron and sodium based on a literature review and outreach to agricultural experts in the Kaweah Subbasin. Total dissolved solids and specifically chloride will be monitored and are also appropriate constituents to evaluate for agricultural use suitability. Ongoing work by the CV-SALTS program will be evaluated to determine if an agricultural suitability standard for chloride below the drinking water MCL of 500 mg/L will be considered.

The degraded groundwater quality MTs for each COC identified for the Kaweah Subbasin are listed in Table 5-13. The MTs are protective of beneficial uses and users of groundwater because they match the groundwater quality standards that are in accordance with the regulations for the San Joaquin Valley region and agricultural needs.

5.8.3.3 Relationship between Sustainability Indicators

Degraded water quality is related to the sustainability indicators: chronic lowering of groundwater levels, reduction in groundwater storage, and land subsidence. As groundwater levels decline and storage decreases, the potential exists for increased concentrations of COC due to poorer water associated with irrigation return flow and septic recharge that has percolated to the aquifer and has the potential to migrate laterally as a result of pumping. Some COC may also exist in elevated concentrations in deeper aquifer zones and an increasing trend in COC concentration may be correlated with focused pumping deeper in aquifer as groundwater levels decline. In addition, lower groundwater levels may induce subsidence in areas where clay layers are present in the subsurface, expelling pore water that could contain elevated naturally occurring constituents such as arsenic. Conversely, rising water levels, which relate directly to an increase in groundwater storage, can also lead to increased concentrations of some COC that may reside

in unsaturated soils at shallower depths. Degraded water quality is not a predictor of other sustainability indicators. Rather, it is a potential response. As such, it is sufficient to establish the MT for degraded water quality in isolation from the other sustainability indicators.

5.8.3.4 Selection of Minimum Thresholds to Avoid Undesirable Results

The degraded groundwater quality MTs for each COC identified for the Kaweah Subbasin are listed on Table 5-13. The MTs are protective of beneficial uses and users of groundwater because they match the groundwater quality standards that are in accordance with the regulations for the San Joaquin Valley region and agricultural needs.

5.8.3.5 Impact of Minimum Thresholds on Water Uses and Users

The MTs have been set consistent with existing water quality standards from Title 22 and the Basin Plan with respect to the water uses and users of groundwater in the locale. Therefore, these SMCs are designed to be protective and acknowledge existing drinking water regulatory programs and standards. Minimum thresholds for drinking water supply wells lean on the recognized standards that are intended to be protective of human and animal health as well as agricultural users.

5.8.3.6 Measurement of Minimum Thresholds

Measurement of groundwater quality for evaluation against MTs is described in Section 4.6.5.

5.8.4 Measurable Objectives and Interim Milestones

§354.30 Measurable Objectives.

- (a) Each Agency shall establish measurable objectives, including interim milestones 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.
- (b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.
- (c) 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.
- (d) 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.
- (e) 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 interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.
- (f) Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.
- (g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

The MOs and IMs are consistent with the MTs (Table 5-13). The rationale for this consistency is to honor existing groundwater quality standards in the Basin Plan and not create competing regulatory standards that deviate from programs that are comprehensively dedicated to groundwater quality monitoring and standards, such as Title 22 and the programs complementary to the Basin Plan (like ILRP and CV-SALTS).

The role of the Subbasin GSAs is to partner and support these complementary programs while relying on their groundwater quality expertise to guide establishing groundwater quality standards.

5.9 Depletion of Interconnected Surface Water SMC

The MKGSA jurisdictional area is located on the valley floor portion of the Subbasin, many miles west of the aquifer forebay area along the Sierra foothills. As such, all reaches of the Kaweah River, slough channels, and distributaries, both natural and man-made, have been disconnected from the underlying water table for many decades and current depth to groundwater in the upper principal aquifer is 60 to 220 feet bgs in the MKGSA as described in Section 3.3.4 of this GSP. For this reason, there are no ISW in the MKGSA area and such interconnection is not likely to occur in the future. Because there is no ISW, MKGSA does not monitor ISW or include SMC for depletion of ISW. The Subbasin GSAs that do have ISW, EKGSA and GKGSA, have included monitoring and SMC in their respective amended GSPs.

In coordination with GKGSA and EKGSA, this amended GSP includes a description of Subbasin beneficial users, uses, and property interested related to ISW identified and a list of stakeholder meetings conducted to provide feedback on the SMC approach.

5.9.1 Identification of Beneficial Users, Uses, and Property Interests

§354.26 Undesirable Results.

- (b) The description of undesirable results shall include the following:
 - (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.

The first step of the SMC approach (Figure 5-1) is to identify beneficial users, uses, and property interests. All beneficial use/users for ISW are listed in Table 5-14. These include in-stream and riparian habitat as well as existing surface water right holders that divert water from the various natural and man-made surface water bodies in the Kaweah Subbasin. There can be overlap between groundwater dependent ecosystems (GDEs) and riparian phreatophytes that depend on recharge from surface water to the shallow subsurface. The Subbasin GSAs have used best available data and tools to identify and characterize all relevant Subbasin-wide beneficial uses and users as described in the following sections.

Table 5-14. Beneficial Users and Uses Pertaining to Interconnected Surface Water in the Kaweah Subbasin

Interconnected Surface Water Dependent Beneficial Users	Groundwater Beneficial Users
In-Stream Habitat & Ecosystems <i>*This includes Phreatophytes within in-stream habitats</i>	Groundwater Dependent Ecosystems (GDE)
Riparian Habitat & Ecosystems <i>*This includes Phreatophytes within riparian habitats</i>	Groundwater Well Users <i>*This includes domestic/small-community, agricultural, municipal, industrial/commercial,</i>
Surface Water Rights Holders	
Recreational Users ¹	

¹Although the Tulare Lake Basin Plan (which covers the Kaweah Subbasin) notes recreation as a beneficial use, there are no known authorized or designated in-stream recreational activities within the Kaweah Subbasin. All known and allowed and designated recreational activities occur upstream of the Subbasin at Lake Kaweah and upstream on the Kaweah River.

5.9.1.1 In-Stream and Riparian Habitat Beneficial Use/Users

The Nature Conservancy’s (TNC) Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (DWR, 2024) was the starting basis for defining in-stream habitat and ecosystems. These wetlands features are a compilation of underlying publicly available state and federal datasets that represent the areas of potential surface expression of groundwater under natural conditions. Figure 3-3 of Appendix 5H shows the distribution of NCCAG in the Subbasin that primarily coincides with surface water features, indicating potential in-stream habitat subject to ISW beneficial use. The densest concentration of these areas of potential ISW-dependent beneficial use lies along the Kaweah and St. Johns Rivers. Several areas with potential in-stream beneficial users are in areas with depth to water data gaps (such as Dry Creek and Cottonwood Creek) and were *not* screened out of the analysis but remain as areas of uncertainty.

There are instances of anomalies in the NCCAG dataset that are confirmed to not be GDEs but rather forms of infrastructure, such as the basin near Strathmore that is incorrectly shown as a GDE. Figure 3-4 of Appendix 5H includes a screenshot of this TNC-identified potential GDE being a recharge basin. The Kaweah Subbasin is working to refine the NCCAG dataset to correct for such anomalies and develop a more accurate representation of in-stream and riparian habitat beneficial use/users. For the time being, the entire NCCAG coverage provided by TNC is used as the basis for the in-stream and habitat beneficial use/user evaluation.

NCCAG within 50 foot depth to water is considered a primary ISW beneficial user. Vegetation in the 50 – 100 feet depth to water are considered a secondary ISW beneficial user. While this riparian vegetation is not in areas with ISW, it is downstream and proximal to the ISW segments and hence, may be impacted by reductions in flows due to pumping-driven depletions from ISW. However, given the other hydrologic and anthropogenic factors that influence surface flows in

the Kaweah Subbasin (Figure 2-2 and 2-5 of Appendix 3H) it would be very challenging to assess depletion impacts on this vegetation.

NCCAG in the western areas, such as in MKGSA, with Spring 2017 depth to water deeper than 100 feet represent areas where a) the vegetation is likely not groundwater dependent due to the deep-water table, and b) surface water is disconnected from groundwater, due to the deep water table in the area. Vegetation along the stream channel in these areas primarily depends on surface-flows in disconnected segments of the surface water bodies. Depletions from ISW upstream of these areas may lead to impacts on this vegetation; however, given the highly managed nature of surface flows (Figure 2-2 and 2-5 of Appendix 3H), depletions from upstream ISW are likely to have minimal impacts on these habitats. As such, NCCAG in areas with greater than 100 feet depth to water were not considered as ISW beneficial users.

Multiple data sources are used to identify in-stream and riparian habitat and species that may be ISW-dependent beneficial users, including the NCCAG vegetation data layer, the VegCamp database (CDFW, 2024b), TNC's rooting depth database, the U.S. Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) web tool, and the California Department of Fish and Wildlife's (CDFW, 2024a) California Natural Diversity Database (CNDDB).

The NCCAG vegetation and VegCamp data layers are shown on Figures 3-5 and 3-6 of Appendix 5H, respectively. The polygons in both figures are grouped by the constituent dominant species. There is significant similarity between the two datasets, which is to be expected since NCCAG is in partly constructed from VegCamp data along with other sources. These two figures rank the species by commonality in the Subbasin, as measured by the number of polygons with the given dominant species, which is indicated in the legend. Dominant species with a single occurrence were combined into a single group. Valley oak, blue oak, Goodding's willow, and Fremont cottonwood comprise the most common species. The presence of valley oak is predominantly along stream channels in the valley floor, occurring both in areas of potential ISW and areas without ISW. Significant stands of valley oak are located in the Kaweah Oaks Preserve and surrounding areas along the St. Johns and Kaweah Rivers, and nearby irrigation ditches exist. Blue oak, Goodding's willow, and Fremont cottonwood are primarily identified in the foothill valleys on the eastern edge of the Subbasin, often in the data gap areas. An area of California Sycamore trees in the Dry Creek area was previously identified as a Sycamore Alluvial Woodland habitat which is rare in California. Of these most common species, the valley oak and blue oak were indicated to have maximum rooting depths typically greater than 50 feet but less than 100 feet in TNC's rooting depth database.

The results from USFWS IPaC shown in Table 3-2 of Appendix 5H indicate species that “...are potentially affected by activities in this location” (USFWS, 2024). The area of interest (AOI) submitted to IPaC was a bounding polygon containing the entire Kaweah Subbasin. The resulting species are constituted by a range of protected statuses from proposed threatened to endangered, and a range of habitat statuses from no designated critical habitat to designated critical habitat that overlaps with the submitted location. Six species highlighted in Table 3-2 of Appendix 5H have designated critical habitat that overlaps the AOI, as shown on Figure 3-6 of Appendix 5H. In the north- and southwest of the Subbasin, these habitat areas coincide with areas of deep groundwater without the potential for ISW, however some critical habitat overlaps a small area of potential ISW in the north of the Subbasin. Critical habitat also overlaps areas of depth to water data gaps in the eastern foothills including Cottonwood Creek, Dry Creek, Yokohl Creek, and parts of Lewis Creek.

CDFW’s CNDDDB dataset contains siting locations and dates of protected plant and species, termed “elements” in the database. Figures 3-8 and 3-9 of Appendix 5H show the sighting locations for 2011 – 2015 (pre-SGMA) and 2016 – present (post-SGMA), respectively, classified by plant and animal element type and location specificity. The most recent date of element sighting is 2018. The location distribution is similar to the IPaC habitat locations: most sightings for both time periods are either in areas without the potential for ISW or are located in data gap areas. The sightings in the upper Cottonwood Creek data gap area do not coincide with the stream channel, though there is an element in the data gap area near the Dry Creek channel. Figures 3-10 and 3-11 of Appendix 5H, and Figures 3-12 and 3-13 of Appendix 5H show the same locations and time periods as Figure 3-8 and 3-9 of Appendix 5H, classified by California and federal protected status. Based on the CDFW CNDDDB dataset, most sighting occurrences of endangered, threatened, or rare species are not in areas with potential ISW within the Subbasin, but such species may exist without having reported sightings.

5.9.1.2 Location of Culturally Significant Ecological Areas Near Potentially Interconnected Surface Waters

The Wukchumni people are the original inhabitants of the area now known as the Kaweah Subbasin throughout Tulare County. The Wukchumni were created here as taught through oral historic creation stories and pictographs. Acorns from the native oak trees were a significant food source for the Wukchumni people. Native oaks and other California Native riparian plants remain culturally significant to the Wukchumni people for food, medicines, basketry materials, and ceremonial materials. Today, the Kaweah Oaks Preserve, located in Greater Kaweah GSA and near the Kaweah River and its tributaries, is a dedicated area of cultural significance for the Wukchumni. You can find Oak trees, as well as many other native foods and culturally significant plants along the Kaweah waterways.

Located alongside the Kaweah Oaks Preserve is the Quaker Oaks Farm, an environmental and education center that focuses on conservation, agroecology, and the interconnections of the people, land, animals, and plants on the local land. The Quaker Oaks Farm is operated in partnership with the Wukchumni Tribe.

5.9.1.3 Surface Water Diversions Beneficial Use/Users

Surface water diversion points within the Kaweah Subbasin occur off of the irrigation ditches, the Friant-Kern Canal, and networks of pipelines and canals operated by the various irrigation districts within the Kaweah Subbasin. These are mapped on Figure 5-22. Riparian water rights are also present; however, these are not as publicly well-documented and therefore most are not present on the map. The Kaweah Subbasin GSAs are collecting additional information on Riparian diversions, and this will be included in subsequent revisions to the ISW evaluation.

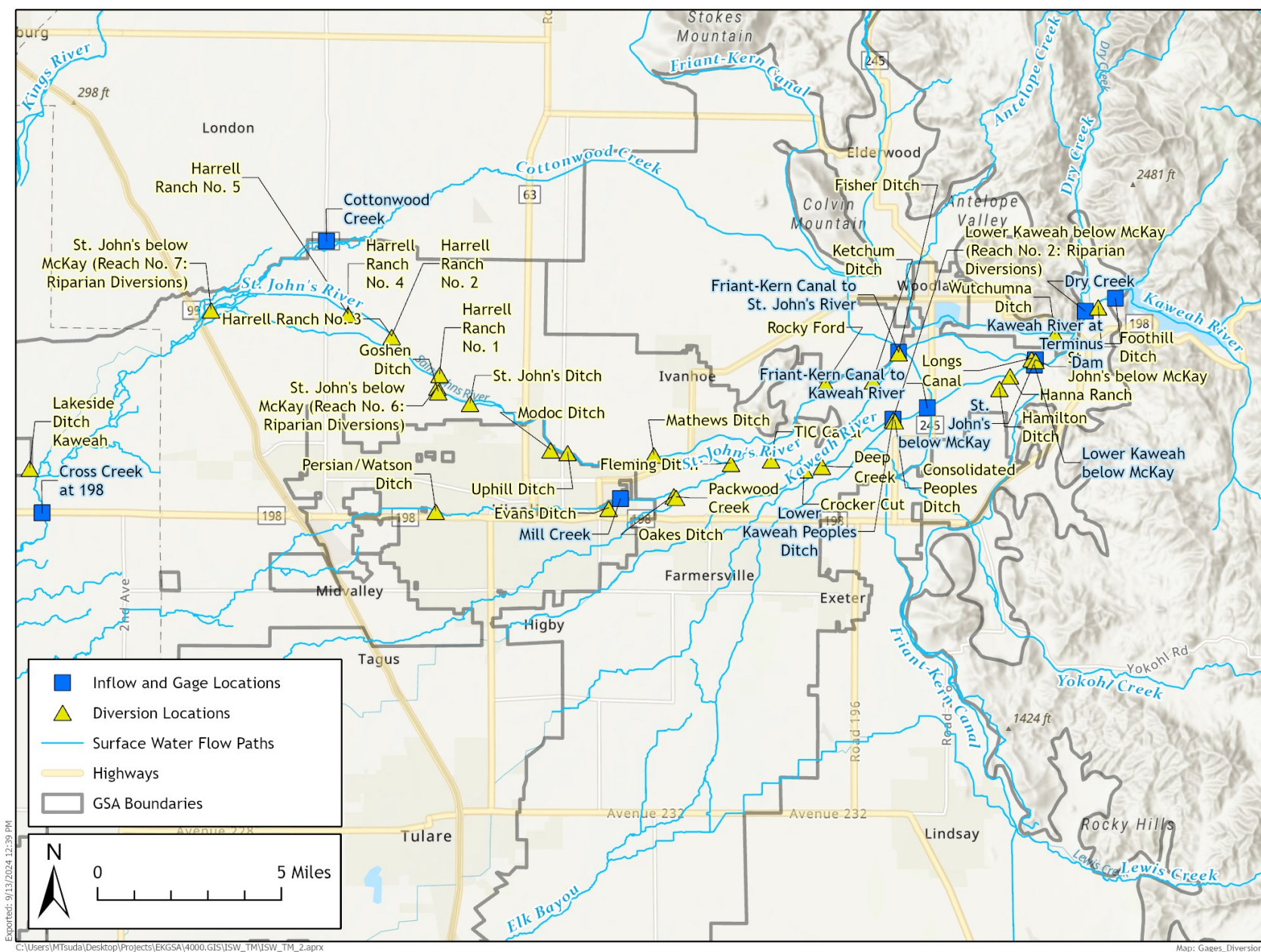


Figure 5-22. Beneficial Users of ISW: Surface Water Rights Holders

5.9.2 Stakeholder Engagement

The stakeholders associated with the beneficial uses of ISW were engaged in meetings documented in MKGSA staff and/or consultants participated in most of these meetings.

Table 5-15. This engagement and subsequent feedback is a critical element to the SMC establishment process. MKGSA staff and/or consultants participated in most of these meetings.

Table 5-15. Stakeholder Engagement Meetings Covering Interconnected Surface Water

Meeting or Workshop	Date	Attendees
GKGSA Board of Directors Meeting	July 8, 2024	Interested Public
MKGSA Board of Directors Meeting	July 9, 2024	Interested Public
EKGSA TAC Meeting	July 12, 2024	Committees are Composed of Representatives from Domestic Well, Grower, Surface Water Rights Holder, Small Family Farm, and Environmental Interests
EKGSA AC Meeting	July 15, 2024	
GKGSA TAC Meeting	July 18, 2024	
EKGSA TAC Meeting	July 19, 2024	
EKGSA Board of Directors Meeting	July 22, 2024	Interested Public
ISW Workshop #1	July 22, 2024	TNC, Sequoia Riverlands Trust, California Fish and Wildlife, Kaweah Delta Water Conservation District
GKGSA Combined Meeting	July 22, 2024	Committee is Composed of Representatives from Rural Communities, Domestic, Grower, and Environmental Interests
MKGSA AC Meeting	July 29, 2024	Committee is Composed of Representatives from Domestic Well, Grower, Surface Water Rights Holder, Small Family Farm, and Environmental Interests
EKGSA Board of Directors Meeting	August 1, 2024	Interested Public
MKGSA AC Meeting	August 6, 2024	Committees are Composed of Representatives from Domestic Well, Grower, Surface Water Rights Holder, Small Family Farm, and Environmental Interests
EKGSA TAC Meeting	August 9, 2024	
GKGSA Board of Directors Meeting	August 12, 2024	Interested Public
MKGSA Board of Directors Meeting	August 13, 2024	
GKGSA TAC Meeting	August 15, 2024	Committees are Composed of Representatives from Domestic Well, Grower, Surface Water Rights Holder, Small Family Farm, and Environmental Interests
Meeting with TNC	August 16, 2024	The Nature Conservancy (TNC)
EKGSA AC Meeting	August 19, 2024	Committees are Composed of Representatives from Domestic Well, Grower, Surface Water Rights Holder, Small Family Farm, and Environmental Interests
MKGSA AC Meeting	August 20, 2024	
EKGSA TAC Meeting	August 23, 2024	
GKGSA Combined Meeting	August 26, 2024	Committee is Composed of Representatives from Rural Communities, Domestic, Grower, and Environmental Interests

Meeting or Workshop	Date	Attendees
GKGSA TAC Meeting	August 27, 2024	Committee is Composed of Representatives from Domestic Well, Grower, Surface Water Rights Holder, Small Family Farm, and Environmental Interests
Meeting with Rivers Association	September 4, 2024	Kaweah Rivers Association
ISW Workshop #2	September 5, 2024	Wukchumni Tribe, TNC, Sequoia Riverlands Trust, California Fish and Wildlife, Kaweah Delta Water Conservation District, Audubon California, NRCS, Community Water Center, Leadership Council for Accountability and Justice
Meeting with Sequoia Riverlands Trust	September 8, 2024	Sequoia Riverlands Trust
GKGSA Board of Directors Meeting	September 9, 2024	Interested Public
EKGSA AC Meeting	September 16, 2024	Committees are Composed of Representatives from Domestic Well, Grower, Surface Water Rights Holder, Small Family Farm, and Environmental Interests
EKGSA TAC Meeting	September 13, 2024	
GKGSA TAC Meeting	September 19, 2024	
GKGSA Combined Meeting	September 23, 2024	Committee is Composed of Representatives from Rural Communities, Domestic, Grower, and Environmental Interests
EKGSA Board of Directors Meeting	October 2, 2024	Interested Public

AC = Advisory Committee; TAC = Technical Advisory

6 PROJECTS AND MANAGEMENT ACTIONS

§ 354.44. Projects and Management Actions

- (a) Each Plan shall include a description of the projects and management actions the Agency 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 Section 354.18, 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 time-table 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 be included.
 - (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.

6.1 Introduction

This chapter discusses water supply availability for projects (Section 6.5), describes each project (Section 6.6), describes management actions (Section 6.7), and summarizes the analyses of water supply benefits afforded by each applicable project (Section 6.8). Chapter 7 discusses the MKGSA's implementation plan.

The MKGSA has approached groundwater sustainability by setting SMC in Chapter 5 and implementing projects and management actions that achieve sustainability by 2040 through avoiding URs included in Chapter 5. The MKGSA has developed a portfolio of projects and management actions that increase groundwater supplies or limit groundwater pumping to achieve MOs by 2040. Projects and management actions have been selected to address one or a combination of the various SGMA-identified URs. Lastly, the MKGSA recognizes priority projects and management actions need to be implemented earlier to achieve sustainability by 2040. This is referred to as the Priority Track with early implementation of demand reduction management actions supplemented by projects. The Secondary Track includes projects and management actions that support the Priority Track.

6.2 Water Supply Accounting

A Water Accounting Framework (WAF) was developed by the 3 Kaweah Subbasin GSAs to direct development of projects and management actions and to track benefits accrued by each project and management action. The following subsections describe the WAF and how it informs the Subbasin allocation strategy.

It should be noted that the WAF has not been updated since 2020 because the GSAs' focus has been on addressing DWR deficiencies, including an intensive update of the numerical groundwater model in the Kaweah Subbasin that is used to establish an updated water budget (Section 3.4). Once the Amended GSPs have been submitted to the SWRCB, the WAF will be updated to reflect projected native, foreign, and salvaged water for each GSA and the Subbasin. Updating the WAF is a high priority for the GSAs to assist with WY 2026 allocations to be set in July 2025.

6.2.1 Application of Basin Setting Water Budget

Table 32 of the Kaweah Basin Setting (Appendix 3A) contains the Subbasin hydrogeologic water budget for the current period 1997-2017, showing all components of inflow and outflow. The water budget, however, does not account for who contributed to the GSA-managed inflows to the groundwater system within the Kaweah Subbasin or the MKGSA. The updated groundwater water budgets are derived from the Subbasin groundwater flow model, which was also used to develop both Subbasin-wide and GSA-specific projected water budgets incorporating groundwater pumping projections/cutbacks and planned projects and management

actions of each GSA. Updated water budgets will be used to update the WAF in the final version of this GSP.

6.2.2 Water Accounting Framework Allocation (based on 2020 GSP Water Budget)

The Subbasin GSAs have discussed water budgets in the context of groundwater law and case law and have developed a means to account for various components of the water budget and ownership of said water, consistent with commonly accepted rules regarding surface and groundwater rights. These discussions also included recognition of water storage and conveyance infrastructure within the Subbasin as owned/operated by various water management entities within each GSA.

These discussions and common understanding are reflected in the Kaweah Subbasin Coordination Agreement and culminated in an agreed-to methodology to assign groundwater inflow components to each GSA consistent with categories that recognize a native, foreign, and salvaged portion of all such components. In general, this methodology defines:

- The native portion of groundwater inflows to consist of those inflows which all well owners have access to on a pro-rata basis;
- The foreign portion to consist of all imported water entering the Subbasin from non-local sources under contract by local agencies or by purchase/exchange arrangements (the largest foreign supply is imported surface water from the Friant Division of the Central Valley Project);
- The salvaged portion to consist of all local surface and groundwater supplies stored, treated, and otherwise managed by an appropriator/owner of the supply and associated water infrastructure systems (e.g., storm water disposal systems and waste water treatment plants), however the largest salvaged water supply comes from Kaweah River water rights that are either directly or indirectly recharged to the Kaweah Subbasin groundwater system).

The methodology and apportionment of groundwater inflow components is shown in Table 6-1.

Table 6-1. Groundwater Inflow Components

Components of Groundwater Inflow (*)
Native – Inflows which all well owners have access to on a pro-rata basis
Percolation from rainfall
Streambed percolation (natural channels) from Kaweah River watershed sources
Agricultural land irrigation returns from pumped groundwater
Mountain front recharge
Foreign – All imported water entering the Subbasin from non-local sources under contract by local agencies or by purchase/exchange agreements
Streambed percolation from imported sources
Basin recharge from imported sources
Ditch percolation from imported sources
Agricultural land irrigation returns from imported sources
Salvaged – All local surface and groundwater supplies stored, treated, and otherwise managed by an appropriator/owner of the supply and associated water infrastructure systems
Ditch percolation from previously appropriated Kaweah River sources
Additional ditch/field recharge from over-irrigation
Captured storm water returns
Wastewater treatment plant returns
Basin percolation from previously stored Kaweah River sources
Agricultural land irrigation returns from Kaweah River watershed sources

(*) Except for mountain-front recharge, sub-surface inflows in and out of the Subbasin are excluded from this apportionment and no ownership claims are asserted nor disavowed per this apportionment.

Applying the categorical apportionment in Table 6-1 to each GSA and their member entities that hold appropriative and contract water rights and/or salvaged water infrastructure systems results in the following apportionment to each GSA, shown in Table 6-2. Note that Table 6-2 has not been updated since 2020 but will be updated for the final version of this GSP.

Table 6-2. GSA Apportionment (based on 2020 GSP Water Budget)

	Native Water			
	East	Greater	Mid	Total
Percolation of Precipitation. (Ag and 'Native' non-Ag land)	23,666	44,213	20,974	88,854
Streambed Percolation from Kaweah River Sources	16,767	31,324	14,860	62,952
Irrigation Return from Pumped GW	41,484	77,501	36,766	155,752
Mountain Front Recharge	14,976	27,978	13,273	56,227
Total Native	96,894	181,017	85,874	363,784
GSA% of Total Native	27%	50%	24%	100%

	Foreign Water			
	East	Greater	Mid	Total
Streambed Percolation from Imported Sources	0	11,730	2,523	14,253
Ditch Percolation from Imported Sources	0	1,204	21,745	22,949
Basin Percolation from Imported Sources	0	1,050	14,305	15,355
Irrigation Returns from Imported Sources	12,073	1,241	7,140	20,453
Total Foreign	12,073	15,225	45,713	73,010
GSA% of Total Foreign	17%	21%	63%	100%

	Salvaged Water			
	East	Greater	Mid	Total
Ditch Percolation from Kaweah River Sources	8,835	49,771	34,880	93,486
Additional Storage	226	6,892	5,697	12,815
Stormwater Return Flows	508	2,370	8,491	11,368
WWTP Return Flows	1,470	3,129	13,878	18,477
Basin Percolation from Kaweah River Sources	0	16,005	23,479	39,484
Irrigation Returns from Kaweah River Sources	4,555	31,039	11,981	47,574
Total Salvaged	15,593	109,205	98,406	223,205
GSA% of Total	7%	49%	44%	100%

	East	Greater	Mid	Total *
Grand Total	124,560	305,447	229,992	659,999**
GSA% of Total	19%	46%	35%	100%

Table values in acre-feet

*Excludes net sub-surface inflow of ≈ 60 TAF/year

** Sustainable Yield for the Kaweah Subbasin

Note: Data are based on water budget for the period WY 1997 to 2017 for the Kaweah Subbasin

In the 2020 GSP, the WAF included a comparison of groundwater inflow assignments into MKGSA to annual groundwater pumping for the same period (1997-2017). The difference between the numbers results in an imputed water balance surplus for MKGSA. The imputed water balance will be updated with the updated water budget in the final version of the GSP.

As stipulated in the Coordination Agreement, Subbasin GSAs will continue discussions on water budgets and groundwater conditions during GSP implementation and, in so doing, manage the location, extent, and financial contributions to projects and management actions of each. The groundwater net inflow balances and hydrogeologic water budgets of each GSA region will be given due consideration in these future discussions. The Subbasin GSA groundwater inflow water balances are preliminary and a starting point from which to establish a future framework to assess GSA responsibilities in achieving the Subbasin sustainability goal and eliminating URs by 2040.

As additional data becomes available and water budget components are refined, the Subbasin water budget will be periodically reevaluated, no less frequent than the 5-year Periodic Evaluations. Likewise, the individual GSA water balances will also be reviewed as this re-evaluation occurs at the Subbasin level.

6.2.3 Water Budget Reconciliation (based on 2020 GSP Water Budget)

The shared/owner water budget may be reconciled against the hydrogeologic water budget set forth in Section 3.4, as both methods of quantifying the groundwater inflow components necessarily arrive at the same volume in acre-feet. The reconciliation for the Kaweah Subbasin (based on the 2020 GSP water budget) is shown as follows:

Groundwater inflow budget (avg. of 1997-2017):

- Total inflow = 814 taf
- Mountain front recharge = 56 taf
- Sub-surface inflow = 209 taf

The shared/owner balance excludes the subsurface inflow from other adjacent subbasins, as this estimated quantity and accounting therefore awaits further discussions with the relevant GSAs within these adjacent subbasins. With this assumption, the reconciliation of the Subbasin groundwater budget to the GSAs' shared/owner water balance is:

$$814 \text{ taf} - (209 \text{ taf} + 56 \text{ taf}) \approx 660 \text{ taf}$$

Adding back in the mountain front recharge results in:

$$660 \text{ taf} + 56 \text{ taf} \approx 720 \text{ taf, i.e., the safe yield of the Subbasin as discussed in Appendix 3A.}$$

6.2.4 GSA Member Allocation Strategy

MKGSA Members (City of Visalia, City of Tulare and TID) recognize that the GSA water budget may be further apportioned across the 3 management areas as established in Section 3.5

of this Plan. This segregation will take into consideration the existing water management and associated facility ownership agreements among the MKGSA Members as they relate to groundwater recharge activities. This apportionment will aid in determining Member participation in the various projects as well as shape the extent of management actions such as pumping restrictions, all as outlined in Section 6.7.1. Any allocation strategy will give due consideration to the Sustainability Plan Cooperative Statement adopted by the MKGSA Board as stated in Section 6.6.20.

6.3 General Process for Developing Projects and Management Actions

In early 2021, DWR provided guidance to GSAs regarding how to incorporate projects and management actions developed after the submission of the 2020 GSPs. The MKGSA Board of Directors approved a process to evaluate new projects and management actions and approve them for a current list of approved GSP projects and management actions. A project proponent is required to submit a MKGSA Request for Proposal application (Application), which can be found at: https://www.midkaweah.org/files/MKGSA_PMA.s. Upon receipt of the Application, it is reviewed by the MKGSA Advisory Committee for consideration and approval to move to the MKGSA Board of Directors for consideration. Upon approval from the MKGSA Board of Directors, the project or management action is added to the List of Projects from the MKGSA GSP, which is kept updated on the MKGSA website at: https://www.midkaweah.org/files/ugd/55be79_df7c43a7e6b14de6bab3fcd38692b4e7.pdf.

6.4 Overview of Projects and Management Actions

In the 2020 GSP, the MKGSA included projects and management actions that focus on a 2-track system, which was commonly referred to as the Plan A and Plan B tracks. In 2020, Plan A included groundwater recharge projects, surface water projects, and exchange programs, all of which relied upon excess wet year surface water to be imported into the MKGSA and actively recharged into the groundwater system. This Plan A was often referred to as the groundwater supply enhancement track. In 2020, the Plan B track was to move forward with management actions that would limit the amount of groundwater pumped via an allocation system, establish a water market, pursue further data and understanding of the Subbasin, and comply with various water management planning requirements. Plan B was commonly called the demand management track and was meant to manage and reduce groundwater pumping deficits that could not be met with the Plan A groundwater supply enhancement track.

In 2021, following the 2020 dry conditions, landowners in the MKGSA, mainly agricultural growers, realized drought conditions may continue, and some action was needed to arrest or halt the continued decline in groundwater levels. A discussion amongst landowners, growers, MKGSA staff, the MKGSA Advisory Committee, and the MKGSA Board of Directors took

place in the Summer of 2021, and the conclusion and direction of the MKGSA Board of Directors was to pursue a demand management action to be developed and implemented by Summer 2022. The direction set in motion the reversal of the original Plan A / Plan B approach established in 2020. The MKGSA is no longer leading with Plan A – groundwater supply enhancement projects and following with Plan B – demand management. The MKGSA’s current strategy is to lead with a Priority Track (previously Plan B) – demand management and immediate priority projects that is supported by the Secondary Track (previously Plan A) – groundwater supply enhancement projects. This was a significant shift in MKGSA’s approach to achieving sustainability, and since 2022, MKGSA has seen the benefits of that shift and believes that groundwater sustainability is achievable by 2040.

As the MKGSA began the redevelopment of SMCs for subsidence, the Kaweah Subbasin GSAs recognized the need to move specific projects and management actions forward to address ongoing subsidence. Specific projects and management actions were deemed necessary to be implemented in the Priority Track, while others were put into the Secondary Track. The goal of implementing projects to address subsidence on an accelerated path under the Priority Track affords the MKGSA the opportunity to not induce any new subsidence and to strive to reduce ongoing residual subsidence to zero.

In developing the Priority Track, the MKGSA has included the following management actions and projects that are represented in order of priority:

Management Actions:

- MA1: Groundwater Extraction Allocation Implementation (Emergency Ordinance to Establish an Extraction Limitation for the Mid-Kaweah Groundwater Sustainability Agency)
- MA2: Water Accounting Dashboard
- MA3: Water Marketing Strategy (MKGSA Version 1.0 Kaweah Water Market Pilot)
- MA4: Kaweah Subbasin Well Mitigation Program and the MKGSA Well Mitigation Plan
- MA5: Small Community Well Proactive & Protective Action Plan
- MA6: Well Registration Program
- MA7: Well Permit Application Review and Technical Support
- MA8: Collaboration with Other Agencies & Inter-Basin Coordination (Regional Subsidence)
- MA9: Subsidence Mitigation Surface Water Allocation System
- MA10: Lower Aquifer Groundwater Allocations

Projects:

- P1: Cordeniz Basin
- P2: Okieville Recharge Basin
- P3: KDWCD/Visalia/Tulare ID Packwood Creek Linear Recharge Project
- P4: On-Farm Recharge Program
- P5: Visalia/Tulare ID Exchange Project
- P6: MKGSA Groundwater Banking Operations
- P7: Okieville Well#2 Resiliency Project
- P8: Visalia/Tulare ID Cameron Creek Linear Recharge Project

Secondary Track projects and management actions are designed to support those actions in the Priority Track and have a different schedule and priority than the Priority Track. The MKGSA has included the following projects and management actions in the Secondary Track, presented in order of priority:

Projects:

- P9: Visalia Eastside Regional Park & Groundwater Recharge
- P10: Sun World International/TID Exchange Program
- P11: Groundwater Recharge Assessment Tools
- P12: TID Existing Recharge Capacity Evaluation
- P13: Tulare ID/City of Tulare Catron Basin
- P14: McKay Point Reservoir
- P15: Seaborn Reservoir
- P16: Vadose Zone Well Battery Project
- P17: Kaweah Subbasin Multi Benefit Recharge Facility
- P18: TID/GSA Multi Benefit Land Repurposing Recharge Basin
- P19: TID/Friant Leveraged Exchange Programs
- P20: MKGSA Deep Well Injection Project

Management Actions:

- MA11: Subbasin Geophysical Data Survey Project
- MA12: Urban Water Conservation
- MA13: Agricultural Water Conservation and Management
- MA14: Replenishment Supply Allocation Program

The various projects and management actions being pursued to achieve groundwater sustainability by 2040 are described in this section. Table 6-3 lists the projects and management actions by track along with identifying sustainability indicators benefited and current project status.

Table 6-3: MKGSA Project and Management Action Benefits and Status

Project/Management Action	Sustainability Indicator Benefited				Status
	Ground-water Levels	Reduction in Storage	Ground-water Quality	Land Subsidence	
Priority Management Action & Projects Track					
Management Actions					
MA1: Groundwater Extraction Allocation Implementation (Emergency Ordinance to Establish an Extraction Limitation for the Mid-Kaweah Groundwater Sustainability Agency)	✓	✓	✓	✓	Completed; Implemented May 2022
MA2: Water Accounting Dashboard	Not Applicable				Completed May 2022
MA3: Water Marketing Strategy (MKGSA Version 1.0 Kaweah Water Market Pilot)	✓	✓	✓	✓	Pilot Completed June 2024 and Implementation Anticipated in Spring 2025
MA4: Kaweah Subbasin Well Mitigation Program and the MKGSA Well Mitigation Plan	✓		✓	✓	Adopted June 2024 (Complete)
MA5: Small Community Well Proactive & Protective Action Plan (PPAP) <i>*new</i>	Not Applicable				Program Development starts June 2024 Implement in June 2025; P7 Okieville Well #2 Resiliency Project (see below in this table) is the first MKGSA project under the PPAP
MA6: Well Registration Program <i>*new</i>	Not Applicable				Begin Fall 2024
MA7: Well Permit Application Review and Technical Support <i>*new</i>	Not Applicable				Implemented
MA8: Collaboration with Other Agencies & Inter-Basin Coordination (Regional Subsidence)	✓	✓	✓	✓	Begin Summer 2024
MA9: Subsidence Mitigation Surface Water Allocation System <i>*new</i>	✓	✓		✓	Develop Summer 2024 Implement Summer 2025
MA10: Lower Aquifer Groundwater Allocation	✓	✓		✓	Develop Fall 2024
MA14: Replenishment Supply Allocation Program <i>*new</i>	✓	✓		✓	Develop Summer 2024 Implement WY 2025

Project/Management Action	Sustainability Indicator Benefited				Status
	Ground-water Levels	Reduction in Storage	Ground-water Quality	Land Subsidence	
Projects					
P1: Cordeniz Basin	✓	✓	✓	✓	Completed Summer 2020
P2: Okieville Recharge Basin	✓	✓	✓	✓	Completed May 2024
P3: KDWCD/Visalia/Tulare ID Packwood Creek Linear Recharge Project	✓	✓	✓		Completed
P4: On-Farm Recharge Program	✓	✓	✓	✓	Implemented; started 2017
P5: City of Visalia/TID Exchange Program	✓	✓	✓	✓	Completed
P6: MKGSA Groundwater Banking Operations	✓	✓	✓	✓	Begin Developing Summer 2024 Construction 2026
P7: Okieville Well #2 Resiliency Project	✓		✓		Preliminary Site Plan Finished and Grant Funds Pursued; Completion in June 2027
P8: Visalia/Tulare ID Cameron Creek Linear Recharge Project	✓	✓	✓		Under Design; Construction 2025
Secondary Projects & Management Action Track					
Projects					
P9: Visalia Eastside Regional Park/Groundwater Recharge Project	✓	✓	✓		Phase 1- Basin G Completed
P10: Sun World International / TID Exchange	✓	✓	✓	✓	Completed
P11: Groundwater Resources Assessment Tool	Not Applicable				Complete
P12: TID Existing Recharge Capacity Evaluation	Not Applicable				Complete
P13: Tulare ID/City of Tulare Catron Basin	✓	✓	✓	✓	Preliminary Design; awaiting funding
P14: McKay Point Reservoir	✓	✓	✓		EIR Completed; Begin Fall 2024
P15: Seaborn Reservoir	✓	✓	✓	✓	Federal Funded Feasibility Report and Environmental Review Underway

Project/Management Action	Sustainability Indicator Benefited				Status
	Ground-water Levels	Reduction in Storage	Ground-water Quality	Land Subsidence	
P16: Vadose Zone Well Battery Project	✓	✓	✓		Grant Received to Pilot - Construction Anticipated Winter 2025
P17: Kaweah Subbasin Multi-Benefit Recharge Facility	✓	✓	✓		Seeking Property
P18: TID/GSA Multi-Benefit Land Repurposing Recharge Basin	✓	✓	✓		Seeking Property
P19: TID/Friant Leveraged Exchange Program	✓	✓	✓	✓	Ongoing
P20: MKGSA Deep Well Injection Project	✓	✓		✓	Early Development
Management Actions					
MA11: Geophysical Data Survey Project	Not Applicable				Complete
MA12: Urban Water Conservation	Not Applicable				Ongoing
MA13: Agricultural Water Conservation and Management Program	Not Applicable				Ongoing

Where applicable, the locations of projects are depicted on Figure 6-1 .



6.5 Water Supply Considerations

Most of the projects and management actions listed in Section 6.6 will provide added water supply benefits, either in the form of groundwater storage or regulation of surface flows that would otherwise leave the Kaweah Subbasin. An assessment of the water supply availability is required to appropriately analyze the projects and management actions and their respective capabilities, particularly in a region subject to critical overdraft and considered as having limited surface water supplies exhibiting a high degree of variability from year to year. A water supply assessment is included in Section 6.8.

For the groundwater recharge projects, an analysis of available surplus water supplies to the MKGSA Members, coupled with estimated capacities of each project, has been conducted to determine the associated benefits. This analysis is further described in Section 6.8. For the surface water storage projects, an analysis of local or regional flood flows otherwise leaving the Subbasin that would be diverted into storage for later in-lieu deliveries has been conducted as summarized in Section 6.8.2. For the applicable exchange programs, the Friant supplies available to TID coupled with local supplies of the exchanging entities are analyzed to determine the additional exchange water to be delivered into the GSA region, the results of which are shown in Section 6.8.3. For the Packwood Creek recharge facilities now in operation, an estimation of groundwater benefits is presented in Section 6.8.4. These analyses are used to determine the projected water supply benefits (in terms of added groundwater storage) for a number of the projects proposed in this GSP.

Most of the water relied upon for the MKGSA projects and management actions will be sourced from TID. TID has pre-1914 water rights on the Kaweah River and a contract with USBR for 30,000 AF of Class 1 water and 141,000 AF of Class 2 (Contract No. I75r-2485D) from the Friant Division of the Central Valley Project. The USBR contract also affords TID access to water supplies generated from the San Joaquin River Restoration Program Water Management Goal (Recaptured Water, Unreleased Restoration Flows, and Recovered Water Account) and wet year Section 215 water. TID also negotiates exchange programs with other statewide entities to import water supplies when available.

6.6 Projects

The projects described below are arranged by those already completed and then in order of priority. The project description, its implementation circumstances and status, public noticing, permitting and regulatory compliance, water sources and legal authority, and project costs are all discussed for each project individually and address §354.44(a) and (b)(1)-(8) of the Regulations.

Anticipated benefits of the recharge facilities/programs are discussed both individually herein and in the aggregate in Section 7.2 using the methodology set forth in Section 6.8; benefits of other projects/programs are discussed individually herein and, in the case of the local reservoir storage projects, with application of the methodology set forth in Section 6.8.2. Similarly, benefits of the exchange programs are articulated in Section 6.8.3, and for the Packwood Creek channel recharge project, in Section 6.8.4.

6.6.1 P1: Cordeniz Recharge Basin

6.6.1.1 Description

The Cordeniz Basin is a 60-acre groundwater recharge facility completed in March 2020 on the northwest corner of Road 84 and Avenue 248 within the TID service area (Figure 6-2). The Cordeniz Basin was sited to provide groundwater recharge in an area upgradient of a region that historically had lower groundwater levels. The project involved the construction of a 5-foot-deep basin, which is served by the Serpa Ditch. The project will add an estimated additional recharge infiltration capacity of approximately 25 AF per day based on borehole soil samples collected during the pre-construction phase. Four groundwater monitoring wells adjacent to the facility are included in the project to monitor groundwater levels in the region. These monitoring wells have been added to the Representative Monitoring Network and are sampled for groundwater levels and groundwater quality.



Figure 6-2. Cordeniz Basin 2023 Recharge Operations

6.6.1.2 Status of Implementation

Construction began in the fall of 2013, and the project was completed and operational by March 2020. TID constructed the basin utilizing in-house staff and equipment. The project took approximately 7 years to complete—longer than anticipated—because ongoing drought conditions caused budget concerns and severe wet years caused staff to pass water through the system. The basin was used in 2021 for a brief recharge event; however, in 2023, the Cordeniz Basin was used for almost 8 months of recharge, with groundwater levels in the region significantly increasing (Figure 6-2).

6.6.1.3 Permitting and Regulatory Compliance

The project's design and approval complied with NEPA—a Finding of No Significant Impact (FONSI) was determined—and CEQA Mitigated Negative Declaration was submitted. All public noticing requirements were satisfied as part of this compliance process.

6.6.1.4 Water Sources and Legal Authority

All water re-diverted into the facility from the Serpa Ditch stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit of the Central Valley Project. Water supplies to this basin have no impacts on third parties as supplies used are from existing water rights and contracted supplies. The projected allotments available from these sources, which vary from year to year, are described in Section 6.8. In addition, surplus water from Kaweah or CVP sources has historically been available for purchase, and TID or other GSA Members will continue to purchase supplies, as they have in the past, as a source for this new project. These supplies are not, however, quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has the authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, they too, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1.4, have legal authority to participate in the project insofar as its benefits are concerned.

6.6.1.5 Project Costs and Funding

The Cordeniz Basin project's capital cost was \$3.38 million, and its annual maintenance cost is estimated to be \$10,000. Federal funding was provided under Part III of the San Joaquin River Restoration Settlement for approximately 50% of the project design, permitting, and construction. The remainder of the funds for the project came from TID. Ongoing maintenance costs are covered by TID in their annual operations and maintenance budget.

6.6.1.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 6.5 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year planning and implementation horizon are estimated at 80,500 AF with average annual benefits at 1,610 AF/year. Maximum recharge in wet years is estimated to be 3,600 AF. The MOs (see Chapter 5 of this GSP) to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Slowing of water quality degradation is also anticipated, as it is generally accepted that high quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) provides improvements to groundwater quality and has historically had a dilution effect to both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin groundwater flow model has been used to simulate the groundwater level rise afforded by a representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing groundwater level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not an SGMA-defined MO, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water in the basin would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter. Side slopes on the basin were graded to provide varying depths of water for waterfowl habitat.

6.6.2 P2: Okieville Recharge Basin

6.6.2.1 Description

The Okieville Recharge Basin involves the construction of a 20-acre recharge facility and supporting infrastructure adjacent and upgradient to the disadvantaged community (DAC) of Okieville. The project's purpose is twofold: to increase the availability of wet-year recharge capacity upgradient of a DAC community well and to provide water quality benefits to the residents of Okieville. The project is supplied recharge water by an irrigation canal known as Packwood Creek and will add an additional recharge infiltration capacity of approximately 10 AF per day. Application of high-quality Sierra watershed surface supplies dedicated to recharge upgradient of the community should improve the quality of local groundwater pumped by the Okieville-Highland Acres Mutual Water Company well and delivery system that serves the small community of approximately 100 homes. The District also intends to implement a monitoring program including monitoring wells to determine the empirical benefits of groundwater recharge on the quantity and quality of groundwater available to the community.

6.6.2.2 Status of Implementation

After TID received a DWR SGMA Implementation grant in 2021 to provide funding for the project, they quickly completed its environmental review, design, and permitting in 2023. The project was bid in 2023, and construction began in fall of that year. Key facilities of the project were completed in April 2024 and it is receiving recharge water from TID. Some elements of the project are still to be completed, and full completion of the project is anticipated by summer 2024.

6.6.2.3 Permitting and Regulatory Compliance

The project's design and approval complied with CEQA, and A Mitigated Negative Declaration was submitted. All public noticing requirements were satisfied as part of this compliance process. TID also applied for, and successfully secured, all construction and environmental review permits necessary to construct the basin.

6.6.2.4 Water Sources and Legal Authority

All water re-diverted into the facility from Packwood Creek stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit thereof and, as such, does not impose impacts on third parties. The projected allotments available from these sources, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new project. These additional supplies are not being quantified nor are they assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, they too, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1.4, have legal authority to participate in the project insofar as its benefits are concerned.

6.6.2.5 Project Costs and Funding

The Okieville Recharge Basin Project's capital cost, including its appurtenant facilities and monitoring wells, is estimated at \$2.5 million, and its annual maintenance cost is estimated to be \$10,000. Ongoing maintenance costs are covered by TID in their annual operations and maintenance budget. Construction funding was in part provided by the approximately \$1.9 million SGMA Implementation Grant awarded to the Kaweah Subbasin in 2021 by DWR. The remainder of the costs to complete the project were provided by TID through reserve funds and represent a 24% cost share.

6.6.2.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 6.5 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year planning and implementation horizon are estimated at 31,500 AF, with average annual benefits at 630 AF/year. Maximum recharge in wet years is estimated to be 1,400 AF. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Slowing of water quality degradation is anticipated as well, as it is generally accepted that high quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin groundwater flow model has been used to simulate the groundwater level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing groundwater level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not an SGMA-defined MO, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

6.6.3 P3: KDWCD/Visalia/Tulare ID Packwood Creek Linear Recharge Project

6.6.3.1 Description

This project, a joint effort of the City of Visalia, TID, and the KDWCD, consists of improvements to the existing Oakes Basin for habitat enhancement and the placement of 4 automated check structures within Packwood Creek northeasterly of Visalia (Figure 6-3). Supervisory Control and Data Acquisition (SCADA) retrofits to an existing check structure are also part of this project. The creek can be fed with flows re-diverted from the Lower Kaweah River and from the Friant-Kern Canal further upstream into the river system. The check structures operate to maintain a designated flow while keeping upstream water levels higher to maximize streambed and bank pools' recharge surface area between structures.



Figure 6-3. New Automated Check Structure in Packwood Creek

6.6.3.2 Status of Implementation

The project was completed in 2015 and has been used for recharge purposes since that time, with significant recharge events in 2017, 2019, and 2023. The project has also been used during other drier periods when flood flows earlier in the year are available for groundwater recharge and during opportunities when TID and the City of Visalia were able to secure surface water on the open market.

6.6.3.3 Permitting and Regulatory Compliance

All environmental permits and other necessary compliance actions have been completed. For CEQA purposes, the project was approved under a Mitigated Negative Declaration; for NEPA purposes under a FONSI.

6.6.3.4 Water Sources and Legal Authority

The project proponent KDWCD, as a water conservation district in California, has the authority to pursue projects for groundwater management purposes. Water re-diverted into the Packwood Creek stems from either the Kaweah River system or the Friant Unit of the CVP. Both KDWCD and TID possess appropriative rights to Kaweah River water and contract entitlements to CVP water. Visalia can, and has occasionally, purchased local Kaweah River water and CVP water for recharge purposes. TID possesses the rights-of-way for the Packwood Creek channel, and KDWCD and the city maintain the various reaches of the creek channel along its upper reaches.

When not in use by the city for recharge purposes, KDWCD, a member of a neighboring GSA, may also use the channel and appurtenant facilities for groundwater recharge.

6.6.3.5 Project Costs and Funding

The entire project cost \$1.6 million, including the habitat improvements to the Oakes Basin and all SCADA equipment and appurtenances. Of this total, \$800,000 was provided by a USBR WaterSMART grant and the balance from Visalia/KDWCD/TID funding sources. Ongoing O&M costs are approximately \$5,000 per year and have been incorporated in the budget for TID for SCADA system maintenance.

6.6.3.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 6.5 and its intake capacity, the project's total accrued benefits (via increased groundwater in storage) through the 50-year Planning and implementation horizon are estimated at 73,250 AF, with average annual benefits at 1,465 AF/year. It is assumed that half of these benefits are commingled with the benefits being achieved under the Visalia/TID exchange described in Section 6.6.5, thus the net benefits of this project would amount to 36,620 AF over the Planning and implementation horizon and 730 AF/year. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, since it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on the unconfined aquifer layer over which the creek generally traverses.

As described in the Coordination Agreement, the Kaweah Subbasin groundwater flow model has been used to simulate the groundwater level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing groundwater level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

6.6.4 P4: On-Farm Recharge Programs

6.6.4.1 Description

On-farm recharge in surplus flow seasons has historically been informally practiced within TID and other areas in the San Joaquin Valley. Nominal incentives existed in the past, with most growers avoiding interference to cropping plans and possible yield impacts. Now, with SGMA mandates, a shift in grower receptivity to these types of programs is occurring. By incorporating targeted incentives to growers and landowners, this historical and informal practice can be

formalized and greatly expanded as part of the GSP. For example, in 2017—when Kaweah watershed runoff was 193% of average—TID achieved participation by 12 farmers to over-irrigate 540 acres and fill on-site regulation ponds. As a result, about 6,900 AF was ultimately infiltrated into groundwater storage in addition to TID’s routine recharge operations.

Four types of on-farm programs are being designed, partly in response to the 2017 pilot program. These are (a) a crop buy-out program where planted fields are flooded and associated growers are compensated for crop damages; (b) a shallow-basin program where parcels are deepened for optimum recharge and associated growers may continue planting forage crops and can receive monetary compensation in the event of flooding; (c) an over-irrigation program where growers take delivery of water for over-irrigation of permanent plantings or open-ground crops on a voluntary basis with reduced water costs, and (d) a mandatory program where landowners may ultimately be required to dedicate a designated percentage of their lands for winter/spring recharge in surplus supply years.

The combined 4 approaches are being designed to achieve the optimal amount of participating lands in the overall program. As many as 600 acres of participating parcels may be enrolled in the voluntary programs depending on the level of need determined by TID and as dictated by surplus flow availability.

6.6.4.2 Status of Implementation

With the implementation of the Emergency Ordinance in May 2022 (Appendix 6B) to establish an Extraction Limit for the Mid-Kaweah Groundwater Sustainability Agency Service Area, the MKGSA is allocating groundwater, restricting groundwater pumping to a maximum level, and tracking groundwater usage. With this system in place, growers receive groundwater credits for over application of surface water as on-farm recharge. The on-farm recharge practice during winter months in wet years has now become an extension of their irrigation practices. In the winter of 2023, growers took advantage of wet conditions and TID was able to deliver approximately 750 cfs to recharge operations in recharge basins and fields during the winter period when there were no agricultural demands. This amount is double the average winter recharge rate that TID typically experiences during winter.. Most of this water was diverted to irrigation turnouts. During pre-2023 winter months, TID typically served approximately 12 turnouts; however, in 2023, the District was running 80-100 turnouts. Growers realized that with the implementation of the Emergency Ordinance and MKGSA tracking of water that returns to the groundwater system as a credit, winter irrigation or on-farm recharge would help them build a groundwater supply to use during droughts.

6.6.4.3 Permitting and Regulatory Compliance

Concerning the pilot on-farm programs implemented thus far, TID concluded that legally no permitting or CEQA compliance needs to be pursued. The delivery of water—allotted to the

District under its appropriative and contract water rights—to parcels within its service area has long been practiced. Should it be concluded differently for any of the formalized programs in the future, CEQA will be pursued and complied with, likely in the form of a Negative Declaration.

6.6.4.4 Water Sources and Legal Authority

All water re-diverted to parcels within TID stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and as such does not impose impacts on third parties. The projected allotments available from these sources, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new program. However, they are not being quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this program will accrue to other GSA Members, they too, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, have legal authority to participate in the program insofar as its recharge benefits are concerned.

6.6.4.5 Project Costs

On-farm programs primarily involve the delivery of TID water to farm fields; associated operational and maintenance costs are anticipated to be similar to what the district has historically experienced. Some nominal operational costs may increase with additional canal deliveries. Any financial incentives offered to growers to accept water on their properties will become a cost component as well.

6.6.4.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the intake capacity and frequency of surplus flow conditions as referenced in Section 6.5, the project's accrued benefits (via increased groundwater in storage) through the 50-year planning and implementation horizon are estimated at 180,000 AF, with average annual benefits at 3,610 AF/year. Maximum recharge in wet years is estimated to be 8,900 AF. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

There are concerns that on-farm recharge efforts may accelerate the downward movement of nitrates accumulating below the root zone in agricultural fields through the vadose zone into the aquifer and degrade water quality, particularly for potable uses by domestic well owners. Researchers at UC Davis and others have been looking at this issue and preliminary conclusions are that initially there can be a spike in nitrate concentrations at the water table; however, repeated recharge will have a flushing effect and nitrate concentrations will be lowered. It has been preliminarily recommended that an on-farm program make use of the same land parcels over an extended period of time to ensure the benefits of this flushing effect.

As described in the Coordination Agreement, the Kaweah Subbasin groundwater flow model has been used to simulate the groundwater level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing groundwater level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

6.6.5 P5: City of Visalia/TID Exchange Program

6.6.5.1 Description

Under an agreement executed in 2013, the City of Visalia delivers tertiary-treated wastewater to TID in exchange for excess surface water in wet years diverted by TID to specific recharge locations that benefit the groundwater pumping system serving the City of Visalia (Visalia). This leveraged exchange provides for 1 AF of surplus water to be returned to Visalia on average for every 2 AF of wastewater effluent delivered to TID. Per the agreement, Visalia commits to provide at least 11,000 AF of treated water annually for delivery to TID's canal system for groundwater recharge on an in-lieu basis by virtue of the supply to growers.

6.6.5.2 Status of Implementation

Visalia's \$132 million in upgrades to its existing wastewater treatment plant (WWTP) were completed in the fall of 2018. These improvements have allowed Visalia to deliver Title 22 compliant tertiary-treated wastewater permitted to be used on any agricultural crop to growers within TID. Deliveries of tertiary-treated wastewater to TID began in 2019 with growers using it to meet crop demand. Water not applied to crops is considered a loss in transit to irrigation and is considered to have percolated into the groundwater system. TID also started delivering recharge water to Visalia in 2017 via numerous different recharge facilities located upgradient of Visalia's groundwater well fields.

6.6.5.3 Permitting and Regulatory Compliance

The City Council adopted an Environmental Impact Report (EIR) and Notice of Determination for the plant upgrades in February 2013. All other permits related to the water exchange with the RWQCB have been obtained by the City. To address the delivery of treated wastewater into the canal system and then to growers, TID sought agreements with landowners wanting to take delivery of the water. Visalia subsequently submitted all requisite delivery and other operational information to the RWQCB on an annual basis. TID also obtained NEPA compliance with USBR for the exchange, acknowledging the delivery of CVP water for groundwater recharge purposes for Visalia's benefit. In summary, the program is fully permitted and is now in full operation.

6.6.5.4 Water Sources and Legal Authority

All water delivered to Visalia's recharge locations is supported by TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit, and as such does not impose impacts on third parties. TID complied with NEPA by developing an Environmental Assessment and the USBR adopted a FONSI in 2014 for the devotion of CVP water toward this exchange program. Considered legally as "salvaged" water, Visalia's WWTP effluent conveyed to the TID canal system is under their ownership and also poses no issues with third parties.

6.6.5.5 Project Costs and Funding

Aside from the capital cost already incurred for Visalia's upgrades to its WWTP and various costs for permitting and environmental compliance, there are no costs associated with this exchange.

6.6.5.6 Expected Benefits and Targeted Measurable Objectives

Because the city effectively provides for additional recharge capacity not previously accessible by TID, half of the average annual delivery to TID (i.e., 5,500 AF) will be included as additional recharge within the MKGSA area. This supply will consist primarily of imported water from the CVP into the Kaweah Subbasin. The WWTP effluent deliveries to TID do not amount to new water since this source of groundwater recharge currently occurs within the GSA area. A projected operation of this exchange over a 90-year hydrologic record is as shown in Section 6.8.3.

There are, however, water quality benefits associated with the upgrades to the city's WWTP to tertiary levels. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers)

improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin groundwater flow model has been used to simulate the groundwater level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing groundwater level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

6.6.6 P6: MKGSA Groundwater Banking Operations

6.6.6.1 Description

The MKGSA is developing several groundwater banking operations along main canals located outside areas subject to subsidence. Currently the MKGSA, in coordination with TID, is investigating properties along the Main Intake Canal northeast of TID. The Main Intake Canal carries most of the surface water supplies afforded to TID. TID intends to develop groundwater recharge facilities on these properties along with groundwater recovery wells that would place recovered groundwater back into the Main Intake Canal for delivery within its service area, specifically to areas that are subject to unsustainable amounts of subsidence. This project has been given a high priority to avoid pumping within TID areas subject to subsidence and to use the recovered water to meet irrigation demands rather than groundwater from the lower aquifer that would induce subsidence.

TID is pursuing approximately 160 acres of recharge basin along the Main Intake Canal. TID will utilize existing excess wet year supplies to recharge the groundwater aquifers under the recharge basins. The area around the Main Intake Canal has typically been more permeable, and TID anticipates high recharge rates. All groundwater recharged would be accounted for, and monitoring wells established in the area will track groundwater levels. Once groundwater levels and accounting have demonstrated aquifer recharge—or in terms of this project, banked water—TID will exercise recovery wells to pump water back into the Main Intake Canal for delivery to agricultural users in areas subject to subsidence within the TID service area. TID will be monitoring groundwater levels and will work with neighboring landowners and the GKGSA to ensure they are not impacted.

6.6.6.2 Status of Implementation

TID is currently working with local landowners to locate suitable properties for potential participation in the banking operations. There are currently 3 potential sites for which TID is performing evaluations to determine if the properties are suitable for recharge. Using TowTEM, TID will obtain hydrogeologic properties to estimate potential permeability rates. After site

selection, TID will work with a local engineering firm to begin the design and permitting process. TID anticipates having the banking projects online by 2026.

Due to the current commitments to avoid any new subsidence and limit residual subsidence, the MKGSA has placed a high priority on this project. MKGSA staff and consultants will concentrate all efforts on completing this project in 2026 in order to immediately begin banking water supplies to offset lower aquifer pumping.

6.6.6.3 Permitting and Regulatory Compliance

Project planning will include compliance with CEQA, an Air Quality Impact Assessment, and Dust Control Plan as required by the San Joaquin Air Pollution Control District, and a Storm Water Pollution permit as called for by the SWRCB. If federal funds are used for development of this project, compliance with NEPA will also be pursued.

6.6.6.4 Water Sources and Legal Authority

All water re-diverted into the facility from the TID canal system stems from TID's appropriate rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties. The projected allotments available from these sources, which vary from year to year, are as determined in Section 6.8. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new project. These supplies are not quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. If any recharge benefits from this project accrue to other GSA Members, they too, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement (Appendix 1B), have legal authority to participate in the project insofar as its benefits are concerned.

6.6.6.5 Project Costs

Based on recent costs in acquiring land and constructing recharge basins, an estimated cost per acre is \$40,000. However, because this project includes installing recovery wells, monitoring wells, and a greater amount of design, permitting, and construction, TID estimates that the project costs would be more than of \$80,000 per acre, which amounts to \$12.8 million for a 160-acre banking facility. It is estimated that similar to other recharge basins under TID's control, annual maintenance costs are expected to be approximately \$20,000 per year.

6.6.6.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 6.5 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year planning and implementation horizon are estimated at 255,000 AF, with average annual benefits at 5,090 AF/year. Maximum recharge in wet years is estimated to be 11,400 AF. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Slowing of water quality degradation is anticipated as well, since it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

For subsidence benefits, a portion of the water supply recharged in the basins will be extracted annually and delivered to areas within TID that are experiencing the highest rates of subsidence. If we assume that 65% of the water recharge could be recovered, that means on an average annual basis 3,300 AF could be recovered. If the average need for growers in TID for groundwater to supplement surface water is estimated to be approximately 1.2 AF/acre, this project could eliminate pumping over approximately 2,800 acres of cropping. Realistically this project will accumulate groundwater supplies in wet years and recover water in dry years to reduce or eliminate groundwater pumping subsidence prone areas. Estimates of recovery and reduction in subsidence will be determined as projects are developed.

The Kaweah Subbasin groundwater flow model has been used to simulate the groundwater level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will help assess the project's groundwater level benefits, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not an SGMA-defined MO, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

6.6.7 P7: Okieville Well #2 Resiliency Project

6.6.7.1 Description

In 2019, a new well and water system were constructed to serve the DAC of Okieville Highland Acres (Okieville) with DWR funds. The new water system is served by the Okieville Highland Acres Mutual Water Company (OHAMWC). This project alleviated 80 residences that

6.6.7.2 Status of Implementation

TID, the Kaweah Delta Water Conservation District (KDWCD), and OHAMWC have collaborated on this project and started the initial design and permitting phases in preparation for seeking grant funds. In November 2023, TID applied for a USBR WaterSMART Drought Resiliency Grant Application. In Spring 2024, TID was notified by the USBR that the project was not funded. While the project scored strongly in most areas, it was because the community

had not suffered an outage or impact to their well, the project was not awarded funds. TID is currently working on securing other grant funds.

6.6.7.3 Permitting and Regulatory Compliance

The MKGSA anticipates that this project will pursue compliance under CEQA and NEPA (assuming a grant award from the Bureau of Reclamation). Other permits anticipated include compliance with the San Joaquin Valley Air Pollution Control District Dust Control Plan requirements, State Water Resources Control Board Storm Water Pollution Prevention Plan requirements, and with the U.S. Fish and Wildlife and California Department of Fish and Wildlife.

6.6.7.4 Water Sources and Legal Authority

All water accessed and pumped by the new well will be via the appropriative groundwater rights afforded to the community of Okieville.

6.6.7.5 Project Costs

The initial Engineering Estimate for the project is \$7.68 million. The USBR grant had requested \$7.3 million in grant funding and the remainder of funds—\$0.38 million—will be from TID in the form of cost-share.

6.6.7.6 Expected Benefits and Targeted Measurable Objectives

This project's goal is to provide resiliency with a reliable and potable water supply for the community of Okieville. As such, the project will access groundwater under the footprint of an existing recharge basin which provides a more stable groundwater level along with better water quality.

6.6.8 P8: City of Visalia/TID Cameron Creek Recharge Project

6.6.8.1 Description

This project is based upon the nearby Packwood Creek recharge system completed in 2016 as a partnership between the City of Visalia and TID. It involves the development of check structures and automated gates to create a linear recharge facility within the Cameron Creek system. Several structures would be built to hold upstream water levels in the creek and create large pools of water to take full advantage of the high infiltration characteristics of the channel. The initial reach of Cameron Creek is located just east of Visalia at its diversion structure off of TID's Main Intake Canal and travels along the southern boundary of the City of Visalia.

6.6.8.2 Status of Implementation

In 2001, Visalia and TID agreed to provide—among other things—the development of recharge facilities and placement of structures within Cameron Creek to enhance recharge for the benefit of both parties. This project is in furtherance of this agreement. Over the intervening time, temporary earthen berms were placed in the creek to enhance recharge in wet seasons. Reconnaissance-level field surveys were conducted to identify suitable locations for permanent check structures, and preliminary design work using the Packwood Creek Project (see Section 6.6.3) has been completed. In 2022, the Kaweah Subbasin received an SGMA implementation grant from DWR, which included the Cameron Creek Linear Recharge Project. Visalia has contracted with a local civil engineering firm that also designed the Packwood Creek Linear Project (Section 6.6.3), and designs are underway. Design and permitting are anticipated to be done by 2025, then construction will begin. Initial estimates are that the project will be completed by 2026.

6.6.8.3 Permitting and Regulatory Compliance

Cameron Creek is a man-made channel with easements under the ownership of TID. As such, no streambed alteration permits or dredge/fill permits will be needed from state and federal agencies. CEQA will be complied with, likely under a Negative Declaration.

6.6.8.4 Water Sources and Legal Authority

All water diverted into the channel from the TID’s Main Intake Canal is supported by TID’s appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit, so does not impose impacts on third parties. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new project. These supplies are neither quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has the authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1.4, they too have legal authority to participate in the project insofar as its benefits are concerned.

6.6.8.5 Project Costs

The project will be similar in its key features and operations to the Packwood Creek Project described in Section 6.6.3. The project is estimated to cost \$2.2 million, of which approximately \$1.1 million will be funded by the SGMA grant secured in 2022. The remainder of the cost share funds shall be provided by the City of Visalia.

6.6.8.6 Expected Benefits and Targeted Measurable Objectives

Based on TID's operational records of historical diversions into Cameron Creek, conveyance losses (seepage infiltration) of more than 25% have been recorded. With the presence of check structures and more frequent use of the channel for recharge purposes, higher seepage rates and resulting groundwater recharge can be anticipated. As design and operations analyses become more refined, project benefits can be better estimated. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on the unconfined aquifer layer over which Cameron Creek traverses.

6.6.9 P9: Visalia Eastside Regional Park & Groundwater Recharge

6.6.9.1 Description

This project to be built by the City of Visalia (Visalia) consists of a 250-acre park featuring diverse recreational opportunities, native plants, wildlife habitat, and integrated groundwater recharge and storm water retention facilities. The dedicated groundwater recharge element is planned to encompass upwards of 100 acres. The park is sited in the northeast region of Visalia and is traversed by several ditches and channels that will feed the recharge element of the facility. A groundwater education center is also planned for the park.

6.6.9.2 Status of Implementation

A park master plan has been developed through the input of a task force of a diverse group of stakeholders. Visalia utilized the master plan to complete park designs, which incorporate outdoor recreation and groundwater recharge facilities. With the completion of designs, which incorporated phases, Visalia began securing funding to complete various phases of the project. It was able to secure funds to begin construction of the basin components of the project and is within months of completing the first phase of the project, which includes the installation of 20 acres of recharge basin and a battery of vadose zone injection wells.

6.6.9.3 Permitting and Regulatory Compliance

Visalia will pursue all permits and compliance with CEQA needed for a functioning park and recharge facility.

6.6.9.4 Water Sources and Legal Authority

As an irrigation district under Division 11 of the California Water Code, TID has the authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSAs,

by virtue of the authorities granted to them as public entities, they too have legal authority to participate in the project. The water to be devoted to the park's recharge facility will come from both the exchange return flows from TID's CVP supplies (see Section 7.3.9) as well as Kaweah River sources acquired annually by the city. As a chartered city, Visalia has all the necessary authorities to construct the park facility and acquire water for recharge purposes.

All water re-diverted into the facility from the TID canal system stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties. Other project participants may also possess their own water rights for re-diversion into the facility. The projected allotments available from these sources for TID, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSAs may continue to purchase supplies as a source for this new project. These supplies are neither quantified nor assumed herein due to their uncertainty.

6.6.9.5 Project Costs and Funding

Phase 1 of the project was estimated to cost \$1.74 million, with \$1.57 million awarded to Visalia from the Watershed and Urban Rivers allocation from Prop 1 and the balance from the City of Visalia. Additional funding may also come from the state's Land and Water Conservation Fund administered by California State Parks. Visalia is currently seeking grant funds for future phases of the recharge basins and other park components.

6.6.9.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 6.5 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year Planning and implementation horizon are estimated at 95,000 AF, with average annual benefits at 1,910 AF/year. It is assumed that half of these benefits are combined with benefits being achieved under the Visalia/TID exchange described in Section 7.3.9, and thus the net benefits of this project would amount to 47,500 AF over the planning and implementation horizon and 950 AF/year. Maximum recharge capability in wet years is estimated to be 4,300 AF. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on the unconfined aquifer layer over which the park resides.

As described in the Coordination Agreement, the Kaweah Subbasin groundwater flow model has been used to simulate the groundwater level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing

groundwater level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not an SGMA-defined MO, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

6.6.10 P10: Sun World International/TID Exchange Program

6.6.10.1 Description

In 2014, TID executed an exchange agreement with Sun World International, which calls for an exchange of Sun World's local Kaweah River supply for TID's CVP Friant supply. Sun World is a company with landholdings in the San Joaquin Valley and elsewhere in California, but none are currently within the Kaweah Subbasin. The company does, however, possess a contractual right to Kaweah River water via one of the local ditch companies. Sun World's local supply, which would have otherwise been transferred directly or indirectly out of the Subbasin, is now committed for diversion into TID, who owes back water on a leveraged basis ranging from 2:1 to 3.5:1 depending on year type, i.e., 2 to 3.5 AF to TID for every 1 AF provided to Sun World.

6.6.10.2 Status of Implementation

The exchange is underway and TID is tracking the delivery balances to each entity.

6.6.10.3 Permitting and Regulatory Compliance

The delivery of additional Kaweah River water to TID requires no additional approvals from the local river Watermaster, as TID is already an appropriator on the river. TID's exchange water from the CVP is being directed by Sun World to the Lower Tule River Irrigation District within which it has land holdings and the district is a fellow Friant contractor. Annual exchange notices are required by USBR to document these deliveries as among Friant contractors, and TID complies with this long-standing protocol.

6.6.10.4 Water Sources and Legal Authority

All water re-diverted into TID's canal system for in-lieu or direct recharge stems from Sun World's contractual rights to Kaweah River water and, as such, does not impose impacts on third parties. TID's transfers of its CVP water to another Friant Unit contractor as allowed for under its USBR contract also poses no impacts to third parties.

6.6.10.5 Project Costs

Aside from costs to construct the exchange agreement by the parties, there are no additional costs to TID to effectuate the exchange from year to year. Sun World continues to pay the charges associated with its Kaweah contract supply; TID receives remuneration from Sun World by way of exchange fees and water cost reimbursements, all of which are intended to assist in the purchase of surplus water in wetter years.

6.6.10.6 Expected Benefits and Targeted Measurable Objectives

Based on a 90-year analysis of the exchange using historical Kaweah River hydrology depicting Sun World's average annual supply and resulting exchange supplies inuring to TID, the exchange arrangement is projected to supply new yield (net exchange amount) of approximately 3,400 AF annually and, over the 50-year Planning and implementation horizon, would accrue to 170,000 AF. This analysis is shown in Section 6.8.3. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect to both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin groundwater flow model was used to simulate the groundwater level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing groundwater level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

6.6.11 P11: Groundwater Recharge Assessment Tool

6.6.11.1 Description

Since 2016, TID, along with Madera ID, has been working with Sustainable Conservation in the development of its online groundwater recharge assessment tool (GRAT) that helps assess the potential for various recharge activities and locations within an area of study. The tool allows for assessment of on-farm recharge, fallowing, and recharge basin development based on various criteria such as access to conveyance facilities, soil types, recharge potential, and retention for continued usage. TID intends to use this tool to enhance the capabilities of the various projects and programs for groundwater recharge, irrigation demand reduction, and SGMA compliance. Shown on Figure 6-5 is the home screen of the GRAT application.

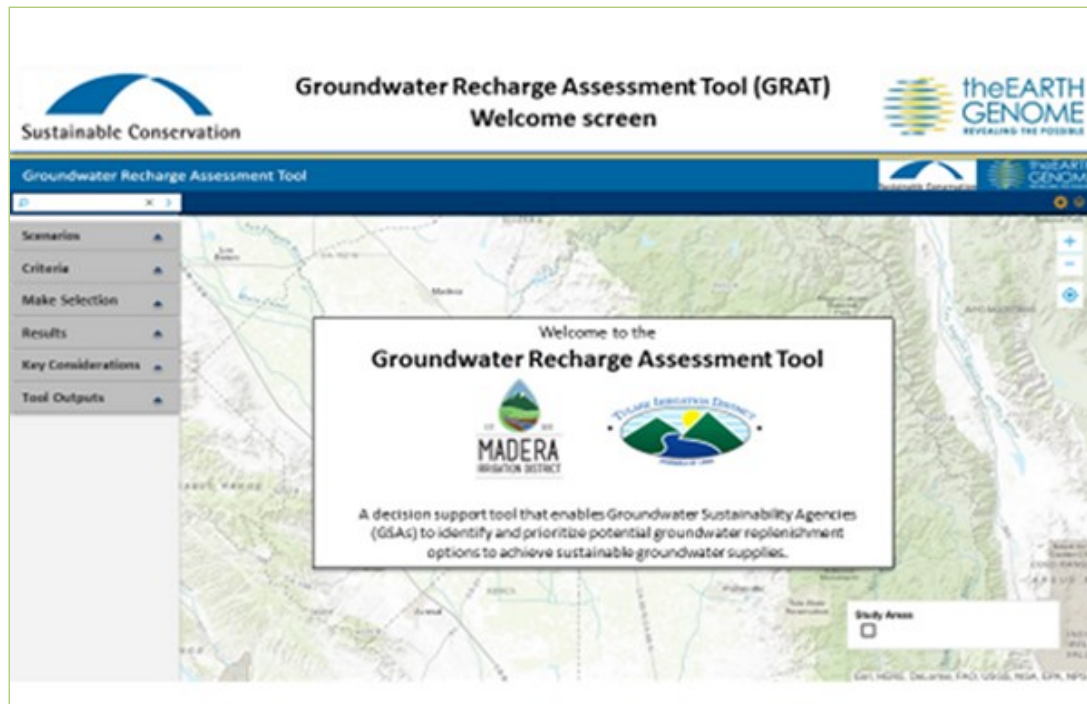


Figure 6-5. Groundwater Recharge Assessment Tool

6.6.11.2 Status of Implementation

GRAT is complete, with periodic updates to add additional features being considered by Sustainable Conservation.

6.6.11.3 Permitting and Regulatory Compliance

No permits or other regulatory considerations are necessary for application of GRAT, since it is an aid for reconnaissance purposes only.

6.6.11.4 Water Sources and Legal Authority

GRAT does not involve the commitment or diversion of water.

6.6.11.5 Project Costs

As a pilot project, no fees have been incurred to date. However, an annual subscription fee approximately more than \$10,000 may be required in the future as Sustainable Conservation continues to expand upon and refine GRAT.

6.6.11.6 Expected Benefits and Targeted Measurable Objectives

Use of GRAT in the identification, prioritization, and optimization of numerous on-farm participants and potential recharge basins is expected to identify those locations that offer

maximum delivery conveyance capacity and optimal infiltration characteristics. The individual projects selected using GRAT will determine the estimated benefits to be provided, along with the associated MOs to be met with their implementation.

6.6.12 P12: TID Existing Recharge Capacity Evaluation

6.6.12.1 Description

TID has occasionally considered alternative maintenance practices for its sinking basins used throughout the district for canal flow regulation and groundwater recharge. A total of 15 basins encompassing approximately 1,350 acres represent the extent of these facilities. A series of reports have been compiled in the recent past by the district to more formally address ways by which recharge in these existing facilities may be increased and optimal infiltration rates be sustained over time.

With the passage of SGMA, a more robust analysis of this valuable recharge capacity within the district was completed and addressed in the February 2018 report, “Groundwater Recharge Capacity Evaluation Phase III: Hydrogeologic Investigations to Maximize Recharge Capacity,” (Report), included herein as Appendix 6A. In addition to recharge basins, the Report considered optimizing the district’s extensive system of unlined conveyance facilities and on-farm programs to increase aquifer recharge in wet seasons.

6.6.12.2 Status of Implementation

TID is evaluating the extensive recommendations of the subject Report and addressing the timing and funding needs to proceed with implementing some or all of the recommendations. Given this situation, the implementation of chosen system improvements will be identified during the GSP 5-year Periodic Evaluation and annual update periods where appropriate.

6.6.12.3 Permitting and Regulatory Compliance

Most of the recommendations contained in the Report deal with maintenance efforts and operational actions for existing facilities. TID routinely undertakes O&M practices on a regular basis on all its facilities, and it has concluded that no additional permits or regulatory compliance are necessary. For any basin expansions or extensions to such facilities, any necessary construction permits and CEQA compliance will be pursued prior to construction.

6.6.12.4 Water Sources and Legal Authority

Like other projects described in Section 7.3, all water diverted into existing facilities stems from TID’s appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties.

6.6.12.5 Project Costs and Funding

As specific maintenance practices or facility improvements are identified, the associated costs will be estimated as well, and a determination will be made as to whether they can be absorbed as part of the District's ongoing annual O&M budget funding practices or whether capital funding is necessary.

6.6.12.6 Expected Benefits and Targeted Measurable Objectives

As specific O&M recommendations are selected and ready for implementation, estimates will be made of any resulting additional groundwater recharge. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, since it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

6.6.13 P13: City of Tulare/TID Catron Basin

6.6.13.1 Description

The City of Tulare currently owns a 100-acre agricultural parcel surrounding its WWTP. This project proposes to turn the property into a storm water detention / groundwater recharge basin. Tulare currently distributes a majority of their storm water through TID's canal system that runs adjacent to the property. During large storm events, TID's canal system can become overwhelmed with storm water, and flooding events have occurred in the area just upstream of the proposed project site. The project would be designed to pump storm water into the proposed basin for subsequent infiltration or release it back to the canal system as capacity is made available when the storm passes. The project would also be used to accept surface water that TID can make available for recharge purposes. The site is anticipated to accept and infiltrate up to 50 AF per day. The use of higher-quality TID surface water should help the current nitrate concentration residing under the WWTP holding ponds near the proposed project site.

6.6.13.2 Status of Implementation

The project is in its early planning and design stages; however, the proposed site has been secured for this purpose. It is anticipated that the project will be completed and operational by 2026, based on available funding.

6.6.13.3 Permitting and Regulatory Compliance

Project planning will include compliance with CEQA, an Air Quality Impact Assessment and Dust Control Plan as required by Tulare County, and a Storm Water Pollution permit as called

for by the RWQCB. In the event federal funds are secured, the project will need to comply with the National Environmental Policy Act (NEPA).

6.6.13.4 Water Sources and Legal Authority

Storm water diverted into the site from Tulare’s storm sewer system is considered salvaged water from a legal standpoint, and the city has the right to utilize this water as owner/operator of the storm water collection system. Recaptured storm water supplies are abandoned flows that if not recaptured and treated, would not be usable water supplies. For these reasons, the recapture does not impose impacts on third parties. All water re-diverted into the site from the TID canal system stems from TID’s appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties. The projected allotments available from these sources, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members, will continue to purchase supplies as a source for this new project. These supplies are not, however, being quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has the authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, such as the City of Tulare, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, they too have legal authority to participate in the project insofar as its benefits are concerned.

6.6.13.5 Project Costs

Based on recent experiences of TID in constructing recharge basins, an estimated cost per acre is at least \$15,000, which amounts to \$1.5 million for a 100-acre facility. As with other recharge basins under its control, annual maintenance costs are expected to be approximately \$10,000.

6.6.13.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 6.5 and its intake capacity, the project’s accrued benefits (via increased groundwater in storage) through the 50-year Planning and implementation horizon are estimated at 80,000 AF with average annual benefits at 1,600 AF/year. Maximum recharge in wet years is estimated to be 3,500 AF. Recharge estimates exclude water diverted into the facility for detention purposes, assumed to be half of all water diverted. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San

Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin groundwater flow model has been used to simulate the groundwater level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing groundwater level benefits of this project, both locally and regionally within the GSA. Model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not an SGMA-defined MO, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

6.6.14 P14: McKay Point Reservoir

6.6.14.1 Description

McKay Point Reservoir is a partnership between the TID, Visalia & Kaweah Water Co., and the Consolidated Peoples Ditch Co. (collectively called the Owners) to construct a 4,000 acre-foot off-stream storage reservoir adjacent to the St. Johns River at McKay Point (Figure 6-6). TID will have access to at least 1/3 of the available storage space, i.e., about 1,500 AF, based on its joint ownership of the property and project along with the other Owners. The reservoir would be utilized to manage and regulate Kaweah River water otherwise lost in flood release operations to meet irrigation needs and groundwater recharge operations, under appropriation by the Owners. For TID, the Reservoir also allows flood water to be captured at the McKay Point Reservoir while imported supplies from the Friant-Kern Canal can be diverted into the District for groundwater recharge. Once the McKay Point Reservoir is at capacity, imported Friant supply diversions would be reduced or eliminated and releases from the reservoir would convey water into recharge facilities within TID.

Adjacent to the McKay Point Reservoir site are existing mining pits from which a majority, if not all, extractable aggregates have been removed in past years. TID may be able to utilize these pits to expand the storage available for the reservoir project; however, this will require additional planning and CEQA compliance.

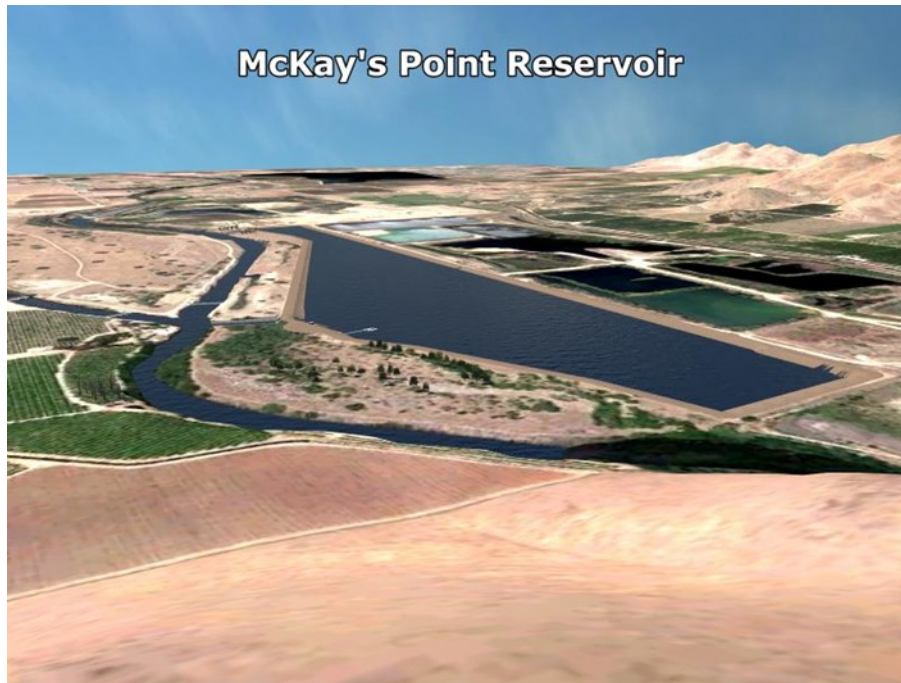


Figure 6-6. Artist Rendering of McKay Point Reservoir

6.6.14.2 Status of Implementation

Site excavation and facility construction are anticipated to begin in early 2025 and be finished by early 2035. Agreements have been executed with an aggregate processing contractor, West Coast Sand and Gravel, Inc., to excavate the site to reservoir design specifications. TID released an EIR in March 2024 for public review and approved the project and the EIR in August 2024.

6.6.14.3 Permitting and Regulatory Compliance

Environmental review, under CEQA has been completed. Tulare County is providing a conditional use permit in the form of a Surface Mining and Reclamation Act (SMARA) permit, which will include a separate public hearing process to be conducted in October 2024. The project will also require an Air Quality Impact Assessment and Dust Control Plan as required by the San Joaquin Air Pollution Control District, and a Storm Water Pollution permit as called for by the SWRCB. If federal funds are used for the development of this project, compliance with NEPA will also be pursued.

6.6.14.4 Water Sources and Legal Authority

All water re-diverted into the reservoir from the St. Johns branch of the river stems from the Owners' appropriative rights to Kaweah River water and, as such, does not impose impacts on third parties. The projected allotments available from this source, which vary from year to year, are as determined in Section 7.6.2. In addition, water for purchase belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as

a source for this new project. These supplies are not quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1.4, they too have legal authority to participate in the project insofar as its benefits are concerned.

6.6.14.5 Project Costs and Funding

The total project cost including reservoir excavation, appurtenant facilities, perimeter cut-off walls, and inlet/outlet structures is estimated at \$12 to \$14 million, and TID's share thereof would be 1/3, or about \$4.5 million. Much of this cost will be offset by payments from the excavation contractor for its access to aggregate materials to be processed and sold to the local construction industry.

6.6.14.6 Expected Benefits and Targeted Measurable Objectives

As described in above, TID's share of the project's storage capacity is about 1,500 AF. Using the methodology referenced in Section 6.5 and overlaying this storage capacity against the historical hydrologic period, the facility would retain (new yield) about 730 AF per year on average to be devoted to summer re-diversions into the TID/MKGSA delivery system for downstream recharge or to offset groundwater pumping, i.e., in-lieu recharge. By similar analysis, the reservoir expansion project is expected to add another 480 AF of yield on average. These estimates assume only 1 fill of the off-stream reservoirs per year; however, in many years Terminus Dam on the Kaweah River must enter into a short-duration flood space evacuation several times, so the yield estimates are conservative.

As described in Section 7.6.2, the project is anticipated to provide about 730 AF of new stored water to be devoted to in-lieu or direct recharge within the TID service area. Projected over the 50-year SGMA Planning and implementation horizon, this would amount to 36,500 AF on an accrual basis. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

While not an SGMA-defined MO, this project will also provide new habitat associated with surface water periodically stored in the reservoir. Water would typically be present during the

winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

6.6.15 P15: Seaborn Reservoir

6.6.15.1 Description

The initial designs of the Seaborn Reservoir include the construction of an 7,000 AF reservoir with an inlet located at the bifurcation of the Lower Kaweah River and the St. Johns River (called McKay Point), which is just upstream of the site. A pump station will be installed in the southeast corner of the basin, nearest the St. Johns River, to allow water to be pumped back into the St. Johns River for diversion at the TID headgate downstream (Figure 6-7).

The reservoir—under appropriation by the Owners—would be used to manage and regulate Kaweah River water otherwise lost in flood release operations to meet irrigation needs and groundwater recharge operations. For TID, the Reservoir also allows flood water to be captured at the Seaborn Reservoir while imported supplies from the Friant-Kern Canal can be diverted into the District for groundwater recharge. Once the Seaborn Reservoir is at capacity, imported Friant supply diversions would be reduced or eliminated and releases from the reservoir would convey water into recharge facilities within TID.

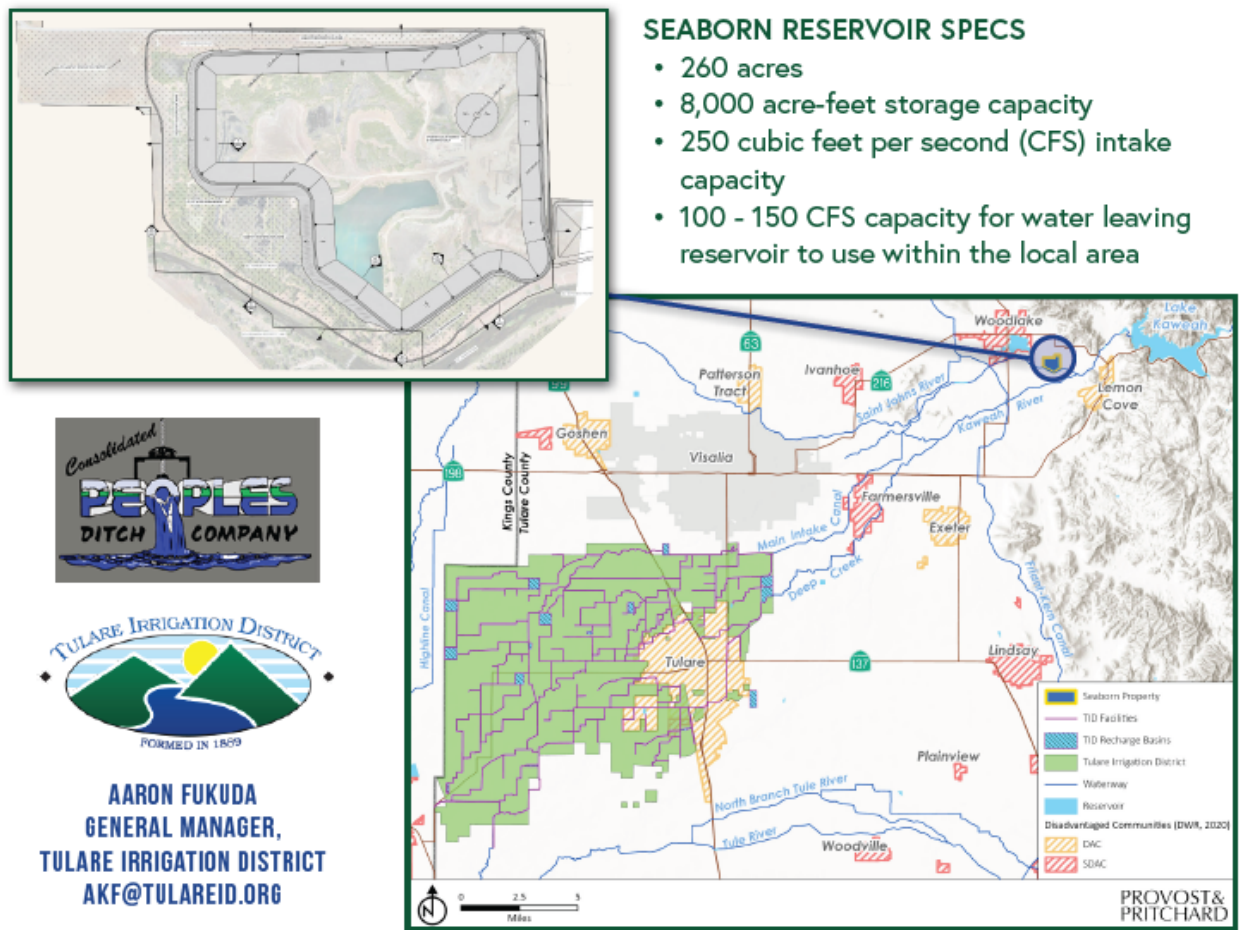


Figure 6-7. Seaborn Reservoir Project

6.6.15.2 Status of Implementation

Preliminary designs and permitting have started. TID and CPDC have received funding from Congressman David Valadao, Congressman Jim Costa, and Senator Alex Padilla through a Community Funding Project award in 2024. Local consulting firm Provost & Pritchard has been hired to complete a feasibility study for an application in fall 2023 to the U.S. Bureau of Reclamation Small Water Storage grant program. TID and CPDC hope to have the design, permitting, and funding available to begin construction in 2027 and have an operational reservoir by 2029.

6.6.15.3 Permitting and Regulatory Compliance

Provost & Pritchard is currently working on a feasibility study. The project will comply with CEQA and NEPA based on funding sources. During the feasibility study the project partners will also determine any other permits that will be required.

6.6.15.4 Water Sources and Legal Authority

All water re-diverted into the reservoir from the St. Johns branch of the river stems from the Owners' appropriative rights to Kaweah River water and as such, does not impose impacts on third parties. The projected allotments available from this source, which vary from year to year, are as determined in Section 6.8.2. In addition, water for purchase belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new project. These supplies are neither quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement, they too have legal authority to participate in the project insofar as its benefits are concerned.

6.6.15.5 Project Costs and Funding

The estimated total project cost, reservoir construction, habitat restoration, and facilities to divert and pump water, is approximately \$35 million. TID is currently seeking grant funds through USBR, and any funds not secured through grant funds will be shared between TID and CPDC equally.

6.6.15.6 Expected Benefits and Targeted Measurable Objectives

As described in Section 6.6.14, TID's share of the project's storage capacity is approximately 7,000 AF. Using the methodology referenced in Section 6.5 and overlaying this storage capacity against the historical hydrologic period, the facility would retain (new yield) about 1,950 AF per year on average to be devoted to summer re-diversions into the TID/MKGSA delivery system for downstream recharge or to offset groundwater pumping, i.e., in-lieu recharge.

As described in Section 6.8.2, the project is anticipated to provide about 1,950 AF of new stored water to be devoted to in-lieu or direct recharge within the TID service area. Projected over the 50-year SGMA planning and implementation horizon, this would amount to 97,500 AF on an accrual basis. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

While not an SGMA-defined MO, this project will also provide new habitat associated with surface water periodically stored in the reservoir. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

6.6.16 P16: Vadose Zone Injection Well Battery

6.6.16.1 Description

This project would consist of shallow injection wells that extend a sufficient distance below grade into the vadose zone to ensure that water quality from injected recharge water is not a concern. These wells may also aid in bypassing restricting clay layers near the surface. Small wells would be drilled and a perforated casing inserted to allow for water to flow into the pore spaces of soil under gravity head pressure. Similar systems have been widely used in the storm water capture and recharge industry and TID has investigated utilizing these recharge systems along TID canals and ditches to access canal water for recharge purposes. They would be placed within the right-of-way to depths that vary from 35 to 50 feet below ground surface. In surplus years, water would be delivered to these injection wells for groundwater recharge. The injection recharge flow rate is not presently known; however, the District anticipates the recharge rates to be in the range of 300 to 500 gallons per minute. Over time these systems may clog due to water quality, so the system would require increased maintenance and replacement costs.

6.6.16.2 Status of Implementation

The MKGSA received grant funds from DWR to conduct a water quality test using a Vadose Zone injection well. MKGSA has also partnered with the United State Department of Agriculture (USDA) Sustainable Agriculture Water Systems Unit (SAWS) to secure a vadose zone injection well site and conduct a pilot study to determine the effectiveness of vadose zone injection. MKGSA anticipates the project to begin in early 2025 upon securing a shallow well.

6.6.17 P17: Kaweah Subbasin Multi-Benefit Recharge Facility

6.6.17.1 Description

This project consists of the acquisition and development of new groundwater recharge facilities within the Kaweah Subbasin and is intended to be a partnership with other adjacent GSAs or other public agencies to facilitate additional groundwater recharge capabilities within the Subbasin. At least 160 acres are to be acquired in a location exhibiting good infiltration capacity and nearby a TID-operated feeder canal for re-diversion of Kaweah River supplies in surplus years. The TID/MKGSA share of the project is assumed to be 25% and the recharge accomplished by the facility would be credited to TID and its parent GSA in like percentage. The project, targeted for that portion of the Subbasin immediately upgradient of the GSA, would also

help to raise groundwater levels for groundwater users within the MKGSA area. This basin would also be combined with other potential project benefits such as habitat restoration or disadvantaged community drinking water benefits. Status of Implementation Discussions are ongoing between TID and the 2 other Subbasin GSAs regarding participation, location, and funding options for the project. Once identified, more specific planning and CEQA compliance will begin. At this time, it is projected that suitable land identification, planning, and construction will be completed by 2030.

6.6.17.2 Permitting and Regulatory Compliance

Project planning will include compliance with CEQA, an Air Quality Impact Assessment and Dust Control Plan as required by Tulare County, and a Storm Water Pollution Permit as called for by the RWQCB.

6.6.17.3 Water Sources and Legal Authority

All water re-diverted into the facility from the TID canal system stems from TID's appropriate rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose impacts on third parties. Likewise, other project participants may possess their own water rights for re-diversion into the facility. The projected allotments available from these sources for TID, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSAs may continue to purchase supplies as a source for this new project. These supplies are not quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has the authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSAs, by virtue of the authorities granted to them as public entities, they too have legal authority to participate in the project.

6.6.17.4 Project Costs

Based on recent experiences of TID in acquiring land and constructing recharge basins, an estimated cost per acre is \$40,000, which amounts to \$6.4 million for a 160-acre facility. As with other recharge basins under its control, annual maintenance costs are expected to be approximately \$10,000. TID/MKGSA's share would be 25% of these costs based on the shared percentage assumed herein.

6.6.17.5 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 6.5 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the

SGMA 50-year planning and implementation horizon are estimated at 381,500 AF, with average annual benefits at 7,630 AF/year. Maximum recharge in wet years is estimated to be 17,100 AF. TID/MKGSA's share at 25% would thus be an annual recharge benefit of 1,910 AF, accruing to 95,500 AF during the 50-year Planning and implementation horizon. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, as it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin groundwater flow model has been used to simulate the groundwater level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing groundwater level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not an SGMA-defined MO, this project will also provide a new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

6.6.18 P18: TID/MKGSA Multi-Benefit Land Repurposing Recharge Basin

6.6.18.1 Description

TID currently owns and/or operates some 1,350 acres of "sinking" (recharge) basins for canal flow regulation and groundwater recharge purposes. These basins are kept full in surplus water seasons and, based on historical operations and the analysis described in Section 6.8, it is known that more basin capacity could be utilized in the wet years. As a function of agricultural land for sale exhibiting optimal infiltration characteristics and proximity to district conveyance facilities, as much as another 160 acres may be acquired for GSA Members, removed from agricultural use, and converted to a recharge basin. This basin would also be combined with other potential project benefits such as habitat restoration or disadvantaged community drinking water benefits.

6.6.18.2 Status of Implementation

Using GRAT—described in Section 6.6.11—TID will continue to pursue suitable parcels for acquisition and to the degree compatible with its on-farm programs. Due to high capital costs, the development of new basins is currently considered less desirable than on-farm programs, and only with very nominal landowner participation would TID aggressively pursue additional

sinking basins. With the on-farm program fully functional, any new recharge basin project would be identified and pursued for operational capability by 2030.

6.6.18.3 Permitting and Regulatory Compliance

Project planning will include compliance with CEQA, an Air Quality Impact Assessment and Dust Control Plan as required by the San Joaquin Air Pollution Control District, and a Storm Water Pollution permit as called for by the SWRCB. If federal funds are used for the development of this project, compliance with NEPA will also be pursued.

6.6.18.4 Water Sources and Legal Authority

All water re-diverted into the facility from the TID canal system stems from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and as such, does not impose impacts on third parties. The projected allotments available from these sources, which vary from year to year, are as determined in Section 7.6.1. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new project. However, these supplies are not quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, they too, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, have legal authority to participate in the project insofar as its benefits are concerned.

6.6.18.5 Project Costs

Based on recent experiences of TID in acquiring land and constructing recharge basins, an estimated cost per acre is \$40,000, which amounts to \$6.4 million for a 160-acre facility. As with other recharge basins under its control, annual maintenance costs are expected to be approximately \$10,000.

6.6.18.6 Expected Benefits and Targeted Measurable Objectives

Constrained only by the frequency of surplus flow conditions as referenced in Section 6.5 and its intake capacity, the project's accrued benefits (via increased groundwater in storage) through the 50-year planning and implementation horizon are estimated at 255,000 AF, with average annual benefits at 5,090 AF/year. Maximum recharge in wet years is estimated to be 11,400 AF. The MOs to be partially met with this project include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Slowing of water quality degradation is anticipated as well, since it is generally accepted that high-quality,

low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

As described in the Coordination Agreement, the Kaweah Subbasin groundwater flow model has been used to simulate the groundwater level rise afforded by a generic representation of projects and management actions of the Subbasin GSAs. Future simulations will aid with assessing groundwater level benefits of this project, both locally and regionally within the GSA. These model simulations may be done in conjunction with other planned projects and management actions to better ascertain benefits in the aggregate.

While not an SGMA-defined MO, this project will also provide new habitat associated with surface water periodically ponded in the recharge facility. Water would typically be present during the winter and early spring months, and presumably during times when both migrating and local waterfowl would benefit from the water and vegetative habitat around the facility's perimeter.

6.6.19 P19: TID/Friant Leveraged Exchange Programs

6.6.19.1 Description

Similar to the exchange agreement with Sun World, TID continues to evaluate other exchange arrangements with entities within the CVP Place of Use. The fundamental concept applied in such evaluations is for TID to provide some degree of firm dry-year water supply to entities with permanent crops in exchange for a larger volume of return water. In this way, TID adds new water into the GSA region for either direct or in-lieu groundwater recharge. Exchanges of this nature could be year-to-year or over a specified period of years. TID has a long practice of engaging in such exchange arrangements.

6.6.19.2 Status of Implementation

New exchange opportunities may arise from time to time, but their specific implementation and duration cannot be projected at this stage. Therefore, any water balance benefits from such future programs are not included or counted in the benefits accomplishments identified in Section 7.2. Given this limited information, further details concerning future exchange opportunities are omitted in this section; however, those that materialize in the future will be identified during GSP 5-year Periodic Evaluations.

6.6.20 Future Project Funding by Members

According to policy, the MKGSA Members have agreed to pay for administration and planning activities on a 1/3 cost share basis. During GSP implementation, and in recognition of MKGSA's

water budget role and its segregation into the respective Member Management Areas as described in Section 2.5 of this Plan, the GSA Board adopted the following “Sustainability Plan Cooperative Statement” at its August 2018 regular meeting:

“Objectives: In compliance with SGMA, the MKGSA Members will strive to (a) identify strategies to avoid agricultural land retirement, (b) create opportunities for city Members to satisfy water demands in UWMPs and in General Plan/RHNA obligations, (c) preserve adequate groundwater supplies for unincorporated communities and schools and (d) define responsibilities for Projects & Management Actions in their GSP.

In furtherance of these Objectives, the Members will support a Kaweah Sub-Basin and internal Management Area water budget apportionment, as well as sustainable management criteria and associated projects and management actions for its GSP, to provide the most opportune ability to both realize the urban General Plan growth projections of the cities of Visalia and Tulare and ensure the sustainability of agricultural production acreage and supporting communities within the Tulare Irrigation District. Notwithstanding their differing water rights, supplies and apportionment of the Kaweah Sub-Basin water budget as among the East, Greater and MKGSAs, the Members are committed to shape and distribute this water budget in a fashion to achieve these Objectives.”

Section 3.5 delineates the Member jurisdictional areas identified as Management Areas. The Members have negotiated the role of the various water management agreements among them—all executed prior to the passage of SGMA and identified in Section 1.3—that affect apportionment of funding. The Members have agreed that the funding necessary to provide administration of the GSA and the GSP has be according to the following cost share distribution:

Tulare ID	33.3%
City of Tulare	33.3%
City of Visalia	33.3%

The participation and funding for the projects listed in Section 7.5 are as identified in the project descriptions if the project has been completed and estimated if the project is still pending. Each Member will be responsible for the capital funding needs for their assigned level of need for each project. Furthermore, each Member will pursue their own process necessary to secure the funding, including, but not limited to legal processes to secure funding such as Proposition 26 and Proposition 218.

In addition to local Member financial contributions to projects, additional grant funds may be forthcoming. Both cities and TID remain attentive to upcoming state and federal grant funding opportunities. TID has had success in the past in garnering federal grant funding for water

management projects, and USBR's WaterSMART program continues to be available to federal contractors for groundwater recharge and other water management/efficiency projects. Other grant funding sources include USBR's Part III Investment Strategy Program as part of the Water Management Goal of the San Joaquin River Restoration Program and state funding to be made available in the future from the IRWM and possibly Flood-MAR programs.

6.6.21 Conceptual Projects

Below is a project that is at the conceptual stage of development.

6.6.21.1 MKGSA Deep Well Injection Project

6.6.21.1.1 Description

The MKGSA investigating methods to provide a more immediate placement of water into the Lower Aquifer to hold up groundwater levels to minimize subsidence as technical work within the Subbasin has identified subsidence is correlated with declines in confined Lower Aquifer groundwater levels. The MKGSA intends to raise groundwater levels higher than the historical low levels experienced in 2022. By injecting surface water sourced from Kaweah River or Friant supplies from the CVP, the MKGSA expects groundwater levels within the confined aquifer to be increased and/or maintained. Wells would be drilled below the Corcoran Clay and perforated screens within the confined aquifer would allow water to be pushed into the confined aquifer. The wells would have blank casing from the top of the confined aquifer to the surface.

6.6.21.1.2 Status of Implementation

The MKGSA intends to begin investigating the feasibility of injection wells in the fourth quarter of 2025. MKGSA staff has reached out to agencies within California that have installed and are operating similar injection wells. MKGSA staff will be developing an Injection Well Technology Report by December 2024, to be delivered to the MKGSA Board of Directors. Based on the Injection Well Technology Report, the MKGSA will determine the next steps of the potential consideration of injection wells.

6.6.21.1.3 Permitting and Regulatory Compliance

Project permitting for this injection well is currently unknown and shall be determined as a part of the feasibility analysis. However, the MKGSA anticipates compliance with CEQA and NEPA if federal funds are utilized and anticipates securing a well permit from Tulare County.

6.6.21.1.4 Water Sources and Legal Authority

All water used for an injection well would be from TID's appropriative rights to Kaweah River water and contract rights to CVP water from the Friant Unit and, as such, does not impose

impacts on third parties. The projected allotments available from these sources, which vary from year to year, are as determined in Section 6.8. In addition, water for purchase from Kaweah or CVP sources belonging to others has historically been available, and TID or other GSA Members will continue to purchase supplies as a source for this new project. These supplies are neither quantified nor assumed herein due to their uncertainty.

As an irrigation district under Division 11 of the California Water Code, TID has authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its landowners. To the degree that any recharge benefits from this project will accrue to other GSA Members, they too, by virtue of the authorities granted to a GSA and by extension to the Members in accordance with the JPA Agreement referenced in Section 1, have legal authority to participate in the project insofar as its benefits are concerned.

6.6.21.1.5 Project Costs

The costs of this project have not been determined and shall be estimated during the development of the feasibility study in the last quarter of 2024.

6.6.21.1.6 Expected Benefits and Targeted Measurable Objectives

During the development of the feasibility study on injection wells, the exact benefits of such a project shall be determined. However, MKGSA staff estimate that injection of water into the lower aquifer can provide benefits to the lower confined aquifer levels and, subsequently, due to the work that the Kaweah Subbasin GSAs have done to analyze subsidence, can safely assume that those increased groundwater levels will reduce the chances of new subsidence and reduce ongoing residual subsidence.

6.7 Management Actions

The management actions as described below are arranged in the following order: extraction allocation, water marketing strategy; Subbasin Mitigation Program and MKGSA Mitigation Plan; small community well proactive and protective action plan; well registration; well permit application review; land subsidence and lower aquifer strategic management; lower aquifer groundwater allocations geophysical survey project; and urban and agricultural conservation programs. The description, its implementation circumstances and status, public noticing, permitting and regulatory compliance, water sources and legal authority, program costs and funding, and benefits are all discussed for each management action individually.

6.7.1 MA1: Groundwater Extraction Allocation Implementation

6.7.1.1 Description

In accordance with SGMA §10726.4, a GSA has the authority to regulate groundwater extractions and impose an allocation mechanism. In the absence of sufficient surface water to support local water needs, beneficial users and uses within the MKGSA must turn to groundwater. In response to groundwater level declines, in 2020 the MKGSA intended to develop groundwater allocations that promote reduced groundwater use and help meet its MOs by 2040. However, by the spring of 2021, landowners—mainly agricultural users—recognized that in the second prolonged drought period in 10 years, groundwater levels were declining at an alarming rate. Growers discussed with MKGSA staff the need to halt the groundwater declines and accepted the need to move to an allocation system as the primary groundwater sustainability tool rather than the backup plan or what we have referred to as the Plan B track (described in Section 6.4). The MKGSA worked with the MKGSA Advisory Committee, a local agricultural committee called the “coffee shop committee,” individual landowners, and the other Kaweah Subbasin GSAs to establish a groundwater allocation system that includes groundwater usage limits to avoid declines in future groundwater levels. The MKGSA developed and adopted the Emergency Ordinance to establish an Extraction Limit for the Mid-Kaweah Groundwater Sustainability Agency Service Area (Emergency Ordinance) on May 1, 2022. The Emergency Ordinance was further amended in May 2024. Both the Emergency Ordinance and amendments are included in Appendix 6B.

The Emergency Ordinance allocated groundwater pumping—measured as ET—and applied it to agricultural extractors with irrigation on more than 4 acres. Initial allocations were based on estimates of how much groundwater the MKGSA historically put into the groundwater system according to the Water Accounting Frameworks (see Coordination Agreement in Appendix 1A). The initial allocation in Water Year 2022 was 2.5 AF/acre of groundwater, measured as ET. Utilizing historical Land IQ data for WY 2021, the MKGSA understood that a majority of landowners in the MKGSA utilized more than 3.0 AF/acre in water to meet their crop demands. The Emergency Ordinance also charges fees for groundwater use, measured as ET. There is an administrative fee of \$10 per AF on all groundwater utilized within the MKGSA to pay for the ongoing administration of the Emergency Ordinance and for compliance measures outlined in the GSP to comply with SGMA. Growers in areas with no access to surface water also paid rates for the water to recognize water pumped would need to be replaced. Costs for that groundwater ranged from \$150 to \$200 per AF. Allocations and rates are re-evaluated annually in July of each year. Under the Emergency Ordinance, the MKGSA also developed an online tool called the

Water Dashboard⁷. The Water Dashboard allows landowners and groundwater users to see their allocations and monthly usage of water to meet their ET demands.

In WY 2023, the MKGSA followed what was done in 2022 and allocated another 2.5 AF/acre. However, in the wet year of 2023, with the Water Dashboard online and being used, TID was able to continue to use the tool to also include surface water usage, and excess surface water usage above ET which was seen as a groundwater credit. A groundwater credit is a small portion 10% to 25% of each AF, which is dependent on the timing of when the groundwater credit was deducted to account for water accruing to the sustainable yield and to account for unknowns in the groundwater system. In October 2023, the MKGSA made WY 2024 groundwater allocations and reduced the allocation from 2.5 AF/acre to 1.83 AF/acre. Above the sustainable yield of 0.83 AF/acre, the MKGSA in coordination with the landowners, agreed that only water put into the groundwater system could be allocated into the future and the allocation was based on water recharged by TID in WY 2023. This new methodology for allocation has been widely promoted by the MKGSA and is considered “what you put into the groundwater system is what you get to take out or allocate.” The outcome of this approach is to only allocate the sustainable yield plus any additional measured groundwater recharge.

It is important to acknowledge that MKGSA’s allocation system is not reliant on overdraft pumping but relies upon recharged groundwater supplies. MKGSA allocates only sustainable yield; therefore, the GSA does not have an “allowable overdraft” policy in its current allocation program. Demand management is MKGSA’s priority to achieving sustainability and avoiding the need for mitigation. Additional projects and water supplies simply make the allocation system resilient in the future.

6.7.1.2 Status of Implementation

Upon submission of the 2020 GSP, the State of California experienced another prolonged drought. In spring 2021, landowners within the Kaweah Subbasin, including within the MKGSA began noticing increased groundwater level declines. Based on groundwater level declines, impacts to groundwater wells, and drying of rural and disadvantaged community wells, the MKGSA began looking into immediate actions that could be taken to address the emergency drought conditions and subsequent declines in groundwater levels. The MKGSA worked for approximately 10 months in coordination with the MKGSA Advisory Committee, the public, and interested parties to develop and approve the Emergency Ordinance to Establish an Extraction Limitation for the Mid-Kaweah Groundwater Sustainability Agency Service Area (Emergency Ordinance). The Emergency Ordinance, approved in May 2022 and subsequently amended in May 2024, is included as Appendix 6B.

⁷ <https://gsawd.com/>

The Emergency Ordinance establishes a groundwater pumping cap, which is measured and tracked as ET. Due to the inability to implement GSA-wide metering in time to initiate the Emergency Ordinance, the MKGSA contracted with Land IQ to track field-level ET using satellite images and ground sensors for calibration. Each year in July, growers receive an allocation of groundwater pumping (measured as ET) for the next water year (October through September). Invoices for allocations are sent at the beginning of each water year to reserve the allocation, and a second invoice is sent at the end of the water year (September of the following year) to indicate any credits or groundwater usage above the groundwater pumping cap. With this system in place, the MKGSA is seeing tremendous benefits. In Water Year 2022, the MKGSA saw a decline in ET of 13%, which is approximately 20,000 AF, and in Water Year 2023, the MKGSA saw record-breaking diversions to growers for groundwater recharge and substantial groundwater level increases.

The Emergency Ordinance is now in its third year of implementation and has successfully reduced groundwater demands during dry periods and increased groundwater recharge during wet years. While the program has been a success, the MKGSA continues to make strides in improving and adopting the program to changing conditions and new concepts.

6.7.1.3 Permitting and Regulatory Compliance

The MKGSA is a lawfully formed GSA pursuant to SGMA and has the powers and authorities provided to GSAs through the legislative enactment of SGMA and amendment to the Water Code. Water Code section 10725.2 states: “A groundwater sustainability agency may adopt rules, regulations, ordinances, and resolutions for the purpose of this part, in compliance with any procedural requirements applicable to the adoption of a rule, regulation, ordinance, or resolution by the groundwater sustainability agency.”

Pursuant to Water Code section 10725, a GSA may exercise the powers provided the GSA adopts and submits a GSP to the DWR. The Emergency Ordinance is designed to implement the provisions of the Agency GSP and may be amended at any time if necessary to achieve consistency with the GSP and any steps needed to achieve sustainability.

The Emergency Ordinance is exempt from CEQA pursuant to Water Code section 10728.6 and CEQA Guidelines sections 15061(b)(3), 15307 and 15308.

6.7.1.4 Water Sources and Legal Authority

Legal authority for a groundwater allocation or pumping restriction program is grounded in SGMA §10726.4 and further articulated in §354.44(b)(2) of the Regulations.

6.7.1.5 Program Costs and Funding

Costs to implement, maintain, and provide administration of the Emergency Ordinance are covered by fees collected on the amount of water consumed as ET. For every acre-foot of evapotranspired water, a fee of \$10 is collected for Emergency Ordinance funding. Those fees were established by providing a summary of the services and fees required to create and operate the Emergency Ordinance, including implementing management actions and spreading those costs over time over an estimated allocation of ET.

6.7.1.6 Expected Benefits and Targeted Measurable Objectives

The primary benefit of this program will be the achievement of sustainable yield by 2040, thereby eliminating all URs by that time. The MOs to be fully met with this allocation program, along with the projects identified in Section 6.6, include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduction in land subsidence rates. Reduced water quality degradation is anticipated as well, since it is generally accepted that high-quality, low-TDS runoff from the Sierra Nevada sources (Kaweah and San Joaquin Rivers) improves groundwater quality and has historically had a dilution effect on both the unconfined and semi-confined aquifer layers.

6.7.2 MA2: Water Accounting Dashboard

During the development of the Emergency Ordinance in the Fall of 2021, the MKGSA, in discussions with local landowners, growers, the MKGSA Advisory Committee, and the MKGSA Coffee Shop Committee, began to develop the Water Dashboard (<https://gsawd.com/>). The Water Dashboard is an online tool for growers that is part of the Emergency Ordinance to manage grower groundwater allocations measured as ET and as a platform for growers to monitor field-level ET data produced by Land IQ (see Figure 6-8 for an example of a water account summary). The MKGSA collaborates with TID to report surface water deliveries applied to meet crop ET. The Water Dashboard implements an algorithm that nets groundwater used to meet ET by applying precipitation and surface water to meet ET first with any unmet ET in any given month met by groundwater supplies.

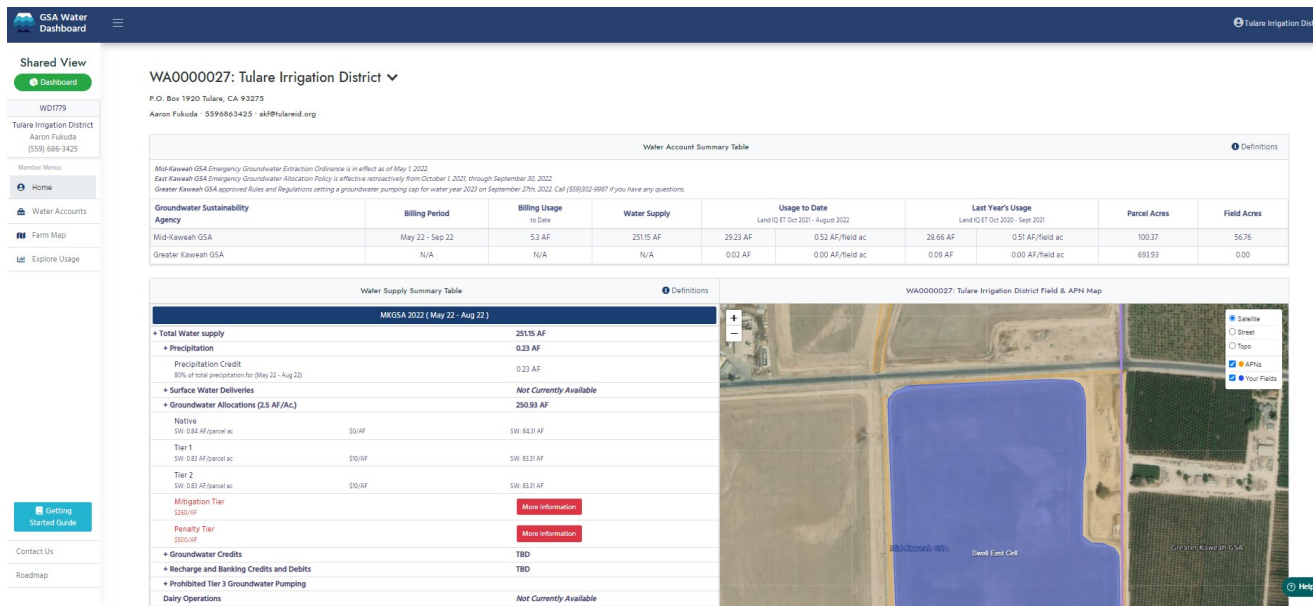


Figure 6-8. Kaweah Subbasin Water Dashboard Example Water Account Summary

Each water year, the MKGSA allocates groundwater measured as ET consumption and growers can view their allocations on the Water Dashboard. If growers exceed the maximum groundwater pumping cap, penalties are applied. If growers have remaining groundwater at the end of a water year, it is rolled into a future year as a groundwater credit.

Lastly, the Water Dashboard manages invoicing to growers for allocated groundwater. At the beginning of each water year, growers are allocated water and upon the allocation are sent a Reservation Invoice. If the landowner pays for the Reservation Invoice, the allocation of groundwater is added to their Water Dashboard account to the unique parcel/field. At the end of the year, a True-Up invoice is sent indicating Penalty Fees or Groundwater Credits. Upon payment of the True-Up fees, Penalties are applied, or groundwater credits are indicated on the Water Dashboard.

6.7.2.1 Status of Implementation

The Water Dashboard was brought online in May 2022. Numerous grower workshops and one-on-one sessions were held to register growers. At this time, the MKGSA currently has approximately 350+ unique accounts in the Water Dashboard; many of those growers use the Water Dashboard as intended. In Water Year 2023, the Water Dashboard provided incentives to growers to increase individual field applications of excess surface water to avoid downstream flooding concerns and increase groundwater recharge. Any over-irrigation to a field was reflected on the Water Dashboard as a groundwater credit.

6.7.2.2 Permitting and Regulatory Compliance

No permitting or regulatory processes are expected to be needed to implement this management action.

6.7.2.3 Water Sources and Legal Authority

California Water Code Section 10725.2 provides the GSA has the powers and authorities “perform any act necessary or proper” to implement SGMA regulations and allows the GSA to adopt rules, regulations, ordinances, and resolutions necessary for SGMA implementation. (23 CCR §355.4(b)(6).)

6.7.2.4 Program Costs and Funding

The MKGSA has contracted with United Tracking Systems, a local agricultural programming firm, to develop the Water Dashboard. As of March 2024, the MKGSA has expended approximately \$165,000 on the development of the Water Dashboard. Fees collected via the Emergency Ordinance have covered development costs. The Water Dashboard is still undergoing development and improvements. The MKGSA anticipates spending another \$75,000 to develop the program with annual maintenance costs estimated to be approximately \$10,000 per year.

6.7.2.5 Expected Benefits and Targeted Measurable Objectives

The Water Dashboard allows growers and landowners to participate in the Emergency Ordinance to track their water usage (as ET) and manage their groundwater usage. Because the MKGSA is only allocating the sustainable yield, plus any groundwater measured and recharged, the ability to measure, track, and manage afforded by the Water Dashboard allows the MKGSA and the landowner to operate within the available groundwater within the system, rather than pumping in overdraft. By managing water usage to eliminate overdraft, the MKGSA anticipates avoiding chronic lowering of groundwater URs, which in turn avoids URs for other applicable indicators such as reduced groundwater storage, degraded groundwater quality, and land subsidence.

6.7.3 MA3: Water Marketing Strategy

With operational groundwater management tools such as an allocation system, a platform and methodology for tracking groundwater usage and credits, and a suite of projects and management actions, the MKGSA has the ability to allow landowners to buy and sell groundwater credits. Having the ability to buy excess credits from landowners or agencies that are unable to use saved groundwater credits, which represent real water in the groundwater system, the MKGSA hopes to reduce reliance on excess overdraft pumping, allow for shared resources, and incentivize growers to save groundwater for drought periods.

6.7.3.1 Status of Implementation

In 2019 TID received a WaterSMART grant from the USBR to develop a Groundwater Marketing Strategy. The Water Marketing Strategy (Strategy) project goal is to develop a water marketing strategy in the Kaweah Subbasin that each GSA can consider implementing within their jurisdictional area. TID retained Stantec, a consultant with experience in facilitation and water markets, to guide the development of the Water Marketing Strategy, with support from Dr. Matthew Feinup.

An 11-member committee was established to represent all of the beneficial users and uses of groundwater in the Kaweah Subbasin, and this Water Marketing Strategy Committee (Committee) is tasked with developing the Strategy. The Strategy is a document that will establish the elements that best represent the beneficial users and uses of the Subbasin and help achieve groundwater sustainability. Elements such as who can participate, how far groundwater can be bought or sold, how formal the purchases are, and how to monitor the trades are sample elements of what will be established in the Strategy by the Committee.

The Committee has been meeting since Mid-2021 and has established a list of Guiding Principles that will guide development of the Strategy. The Committee investigated groundwater rights and has completed a study of the existing water markets in California and across the world.

The Committee has established the initial elements of the Strategy. The Final Strategy will be informed by the completed pilot market. Two Pilot Market auctions took place in May and June 2024. During the Pilot Market, the MKGSA has incorporated an automated trading platform into the Water Dashboard, allowing growers to seamlessly use the tool that has been developed for tracking and monitoring their individual water use. During the Pilot Market, growers were limited to a small amount of water to trade to test the market. All results have been shared with the public, with landowner's names removed from the trades. Upon completion of the MKGSA Pilot Market and the Strategy, each Kaweah Subbasin GSA including the MKGSA will consider approving the Strategy and implementing a groundwater market as a permanent program.

6.7.3.2 Permitting and Regulatory Compliance

Any permitting or other regulatory compliance needs deemed necessary to implement and administer a marketing/transfer program, all in furtherance of SGMA §10726.4, will be identified and pursued during the first 5 years of GSP implementation. Because the current program being implemented is a pilot program it is not subject to CEQA.

6.7.3.3 Water Sources and Legal Authority

Legal authority for a groundwater marketing and transfer program is grounded in SGMA §10726.4. The water source will be limited to groundwater allocations as assigned on an annual or permanent share basis.

6.7.3.4 Program Costs and Funding

The development of the Kaweah Subbasin Water Marketing Strategy is being partially funded by USBR via a WaterSMART grant. The grant covers approximately 50% of the project costs, estimated to be approximately \$800,000. The other costs are being covered by TID and the Kaweah Subbasin GSAs.

6.7.3.5 Expected Benefits and Targeted Measurable Objectives

The primary benefit of this program will be to provide groundwater rights holders options in the management of their groundwater assets. With the ultimate cessation of unlimited access to groundwater for beneficial uses (notwithstanding quality or depth considerations), these water rights holders may find that alternatives allowing for the transfer of limited allocations may prove attractive in a robust and properly functioning market. While such a program will not add to the GSA's overall groundwater balance/budget, it may encourage the distribution of allocations in the most economically efficient manner. Adding no new supply or additional pumping restrictions within the GSA as a whole, it is assumed that this program will not measurably improve groundwater levels but will reduce chronic declines. Reduction in groundwater level declines will contribute to achieving MOs for groundwater storage, groundwater quality and land subsidence.

6.7.4 MA4: Kaweah Subbasin Mitigation Program and MKGSA Mitigation Plan

The Kaweah Subbasin Mitigation Program (Mitigation Program) establishes requirements for the mitigation of wells and critical infrastructure demonstrated to have been adversely affected by declining groundwater levels, land subsidence, and groundwater quality degradation associated with groundwater overdraft. Each GSA has the discretion to expand beyond the requirements detailed in the Mitigation Program in their own respective Mitigation Plans (Figure 6-9). Figure 6-10 describes the Mitigation Program and MKGSA Plan.

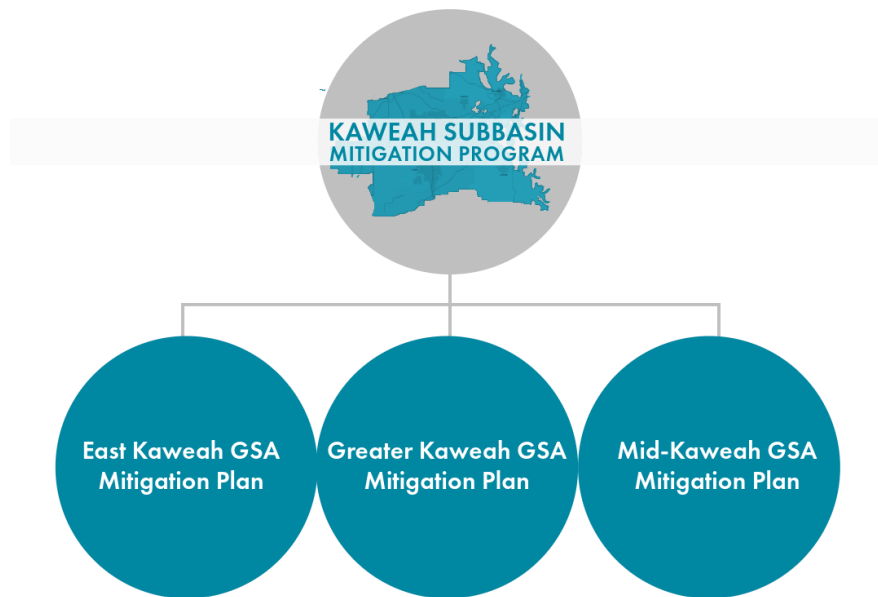
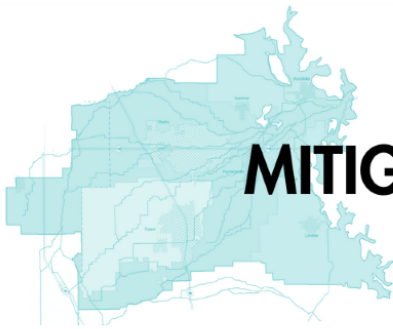


Figure 6-9. Relationship between Kaweah Subbasin Mitigation Program and GSA Mitigation Plans

The Kaweah Subbasin Mitigation Program offers 2 tracks for assistance, Drinking Water Well Mitigation and Technical Assistance for non-drinking water wells and critical infrastructure. The MKGSA Mitigation Plan only includes the Drinking Water Well Mitigation Track for the first year of implementation; it will offer the Technical Assistance Track starting in June 2025. Important distinctions between the tracks are described on Figure 6-10.

The Mitigation Program directly addresses the impacts of chronic lowering of groundwater levels, reduced groundwater in storage, groundwater quality, and land subsidence caused by lowered groundwater levels by providing funding for replacement wells, well modifications, alternative water supplies, or critical infrastructure (if applicable) improvements to eligible landowners. In addition, the Mitigation Program will directly support water system consolidation, well replacement or modifications, and/or well treatment for qualifying wells that experience groundwater quality due to groundwater conditions induced by the GSAs' allowable overdraft.



Kaweah Subbasin

MITIGATION PROGRAM

VERSION 1.0
JUNE 2024

What is the Kaweah Subbasin Mitigation Program?

The Kaweah Subbasin Mitigation Program (Version 1.0) is a subbasin-wide program intended to provide mitigation services and technical assistance for those impacted by groundwater overdraft conditions, such as: chronic lowering of groundwater levels, land subsidence, and groundwater quality induced by pumping-related changes in groundwater levels. The Mitigation Program includes two tracks (described in the following two pages).

ATTENTION



If your household has lost access to drinking water, please call Self-Help Enterprises at your earliest convenience to arrange emergency bottled water supplies within 24-hours and an interim measure (such as a water tank) within 72-hours. Tenants or well owners may call to arrange.



(559) 802-1685

www.selfhelpenterprises.org

8445 W Elowin Ct
Visalia CA



Drinking Water Well Track
Technical Assistance Track

domestic (house) wells



multi-use drinking water wells



small community wells



agricultural wells



critical infrastructure (pipelines, canals, etc)



non-potable industrial wells (non-drinking water)



other wells not used for drinking water purposes



For questions regarding the Mitigation Program, contact your GSA

EAST KAWEAH GSA	GREATER KAWEAH GSA	MID-KAWEAH GSA
 (559) 697-6095  www.ekgsa.org  315 E Lindmore Ave, Lindsay, CA	 (559) 302-9987  www.greaterkaweahgsa.org  2975 Farmersville Rd, Farmersville, CA	 (559) 686-3425  www.midkaweah.org  6826 Ave 240, Tulare, CA

page 1

Figure 6-10. Kaweah Subbasin Mitigation Program Flyer (page 1 of 3)

KAWEAH SUBBASIN MITIGATION PROGRAM VERSION 1.0

Available
June 2024

DRINKING WATER WELL MITIGATION TRACK

The Kaweah Subbasin Mitigation Program's Drinking Water Well Mitigation Track is intended to provide emergency and interim drinking water supplies and long-term mitigation for those experiencing a loss of access to drinking water due to groundwater overdraft conditions such as chronic lowering of groundwater levels, subsidence, and/or water quality induced by groundwater management in the Kaweah Subbasin. If translation services are needed, please contact Self-Help Enterprises to arrange.

If your household has lost access to drinking water, please call Self-Help Enterprises at your earliest convenience to arrange emergency bottled water supplies within 24-hours and an interim measure (such as a water tank) within 72-hours. Tenants or well owners may call to arrange access to emergency and interim supplies; however, well owners are required to submit claims to receive long-term solutions.



(559) 802-1685



www.selfhelpenterprises.org



8445 W Elowin Ct, Visalia CA



WHO CAN SUBMIT A CLAIM?



CRITERIA FOR A CLAIM TO QUALIFY

- 1** The well was impacted after January 1, 2015, and has undergone the on-site assessment via the Kaweah Subbasin Mitigation Program claims process.
- 2** The well or critical infrastructure impact was induced by overdraft conditions associated with the GSA's groundwater management.
- 3** The well or system of wells shall not have contributed to overdraft by pumping in excess of their individual prorata share of the sustainable yield for the GSA or contributed to other undesirable results. **This criterion does not apply to domestic (house) wells*

CLAIMS PROCESS

- Well user (owner or tenant) contacts Self-Help Enterprises (SHE) upon loss of drinking water supplies to receive emergency bottled water within 24 hours and interim supplies system within 72 hours.
- The well owner then fills out an online intake form or calls SHE for assistance
<https://www.selfhelpenterprises.org/programs/emergency-services/water-sustainability/>
- SHE staff perform site assessment and gather information from well owner.
- SHE, GSA staff, and technical committee(s) evaluate the likely causation of well failure to determine if the claim qualifies for funding via the Mitigation Program or an alternative program.
- If the claim qualifies for any program that SHE administers, then SHE will arrange for long-term a solution and serve as the lender.
- If the claim qualifies for the Mitigation Program, then the GSA will reimburse SHE for all materials and administrative, technical, and mitigation services associated with the claim.

page 2

Figure 6-10. Kaweah Subbasin Mitigation Program Flyer (page 2 of 3)

KAWEAH SUBBASIN MITIGATION PROGRAM VERSION 1.0 TECHNICAL ASSISTANCE TRACK

Available
June 2024 for
EKGSA

Available
June 2025 for
MKGSA & GKSGA
Contact MKGSA or GKSGA to
arrange interim technical support
before June 2025.

The Kaweah Subbasin Mitigation Program's Technical Assistance Track is intended to provide GSA funding and/or technical resources to identify meaningful solutions to non-drinking water well and/or critical infrastructure (pipelines, canals, etc) that are impacted by overdraft conditions within the Kaweah Subbasin.

EAST KAWEAH GSA

(559) 697-6095

www.ekgsa.org

315 E Lindmore Ave, Lindsay, CA

GREATER KAWEAH GSA

(559) 302-9987

www.greaterkaweahgsa.org

2975 Farmersville Rd, Farmersville, CA

MID-KAWEAH GSA

(559) 686-3425

www.midkaweah.org

6826 Ave 240, Tulare, CA

WHO CAN SUBMIT A CLAIM?



CRITERIA FOR A CLAIM TO QUALIFY

- 1 The well or critical infrastructure was impacted after January 1, 2015, and has undergone the on-site assessment via the Kaweah Subbasin Mitigation Program claims process.
- 2 The well or critical infrastructure impact was induced by overdraft conditions associated with the GSA's groundwater management.
- 3 The well or system of wells shall not have contributed to overdraft by pumping in excess of their individual prorata share of the sustainable yield for the GSA or contributed to other undesirable results.
**This criterion does not apply to claims for critical infrastructure*

CLAIMS PROCESS

- Well or critical infrastructure owner contacts their respective GSA staff to set up a meeting to fill out the claim application together and discuss the program.
- Following the initial meeting, GSA staff and/or a technical contractor will perform a site assessment and analyses to determine the likely causation of well or infrastructure impacts.
- GSA staff and technical committee review findings of assessment and determine if the claim qualifies for technical assistance funding via the Mitigation Program.
- If the claim qualifies via the Mitigation Program, the GSA and Claimant (well/infrastructure owner) will enter an agreement and the GSA will fund technical assistance to support long-term solution(s) to the impacted well or critical infrastructure.

page 3

Figure 6-10. Kaweah Subbasin Mitigation Program Flyer (page 3 of 3)

6.7.4.1 Status of Implementation

This is a high-priority Mitigation Program needed to maintain access to a water supply that meets basic health and safety needs by mitigating impacts of declining water levels, land subsidence, and groundwater quality induced by pumping-influenced groundwater level changes. Therefore, the Kaweah Subbasin GSAs are committed to mitigating such impacts by committing to implementing this Program. Funding is available for the Program through GSAs implementation of assessments, fees, charges, and penalties. The Kaweah Subbasin GSAs understand that SAFER funding is unavailable for Mitigation Program implementation.

The MKGSA has collaborated with the EKGSA and GKGSA to establish the Kaweah Subbasin Mitigation Program v1.0 (Mitigation Program). Appendix 6D contains the Subbasin Mitigation Program. The Mitigation Program establishes a commitment to provide emergency drinking water supplies within 24 hours, interim water supplies within 72 hours, a permanent solution (well and water quality), homeowner well education, and administration to provide safe drinking water to homes within the Kaweah Subbasin that are impacted by declining groundwater levels.

The MKGSA Mitigation Plan (Appendix 6D) is based on the Mitigation Program and incorporates the commitments and processes outlined for an applicant to receive mitigation within the MKGSA. The MKGSA Mitigation Plan includes a funding plan to ensure that mitigation funds are available to qualifying homeowners.

During development, the public and relevant entities were given opportunities to provide comments on the Program and Plan. The MKGSA engaged with its Advisory Committee and stakeholders, as detailed in the Stakeholder Outreach phase of the Mitigation Plan process. As outlined in the Outreach Section of the Mitigation Plan, each GSA and the Kaweah Subbasin have adopted aggressive and broad outreach programs to inform groundwater users of the Subbasin Mitigation Program and GSA-specific Mitigation Plans.

The Mitigation Program and MKGSA Mitigation Plan were approved by the MKGSA Board in June 2024. The Subbasin GSAs have a signed agreement with Self-Help Enterprises (SHE) to reimburse SHE for costs associated with mitigation program administration, groundwater quality sampling, interim drinking water supplies, and long-term mitigation measures for all drinking water well claims that qualify for Kaweah Subbasin mitigation. Figure 6-11 summarizes the schedule and status of the Mitigation Program and MKGSA Mitigation Plan.

June 2024

Upon adoption of Mitigation Program Version 1.0

- Drinking Water Well Mitigation Track initiated
- Emergency drinking water supplies available (within 24-hours of request)
- Interim drinking water supplies available (within 72-hours of request)
- Long-term physical mitigation available for qualifying drinking water well claims
- Continued demand management and implementation of projects to reduce future mitigation circumstances

June 2025

Upon adoption of Mitigation Program Version 2.0

- Technical Assistance Track added to the Mitigation Program
- Technical assistance funding available for qualifying non-drinking water wells claims
- Technical assistance funding available for qualifying critical infrastructure claims
- Well Registration Program near completion (full roll-out in Summer 2025)
- Improved claims dispute process added to the Mitigation Program
- Phases 1-4 of the Small Community Well Proactive & Protective Action Program complete (see Attachment A)

June 2026

- Well Registration Program active and available for all well users within the Kaweah Subbasin to voluntarily participate in. Phase 2 and 3 completed (usable database and active notification protocol).
- Phase 5 of the Small Community Well Proactive & Protective Action Program (Attachment A) completed/ongoing

Figure 6-11. Kaweah Subbasin Mitigation Program and MKGSA Mitigation Plan Schedule

6.7.4.2 Permitting and Regulatory Compliance

The GSA will confirm with the Claimant that any mitigation efforts that are non-exempt from CEQA and NEPA requirements will comply with CEQA and NEPA prior to approval and issuance of mitigation assistance. Non-exempt critical infrastructure mitigation projects may have various permits in conjunction with the environmental planning process. New wells must comply with the Tulare County well permitting process.

6.7.4.3 Legal Authority

California Water Code Section 10725.2 provides the GSA has the powers and authorities to “perform any act necessary or proper” to implement SGMA regulations and allows the GSA to adopt rules, regulations, ordinances, and resolutions necessary for SGMA implementation. Because the DWR is required to evaluate whether the GSP provides a reasonable means to mitigate for continued overdraft, a mitigation program is a necessary or proper act to implement SGMA. (23 CCR §355.4(b)(6).)

Legal authority to implement any of the aforementioned assistance measures resides with the GSAs' and the member agencies' ability to implement such actions deemed necessary to achieve its specific and limited purposes as stated in the Joint Powers Agreement referenced in Section 1.4 of this Plan.

6.7.4.4 Program Costs and Funding

MKGSA, along with the other GSAs, underwent significant financial analyses to estimate an annual and cumulative mitigation budget that is directly in alignment with SMC in Section 5.5. MKGSA will fund its mitigation efforts from the Emergency Ordinance including a new Reserve Fund Policy. A summary of the annual mitigation cost estimates that were used to develop the budgets is available Figure 6-12.

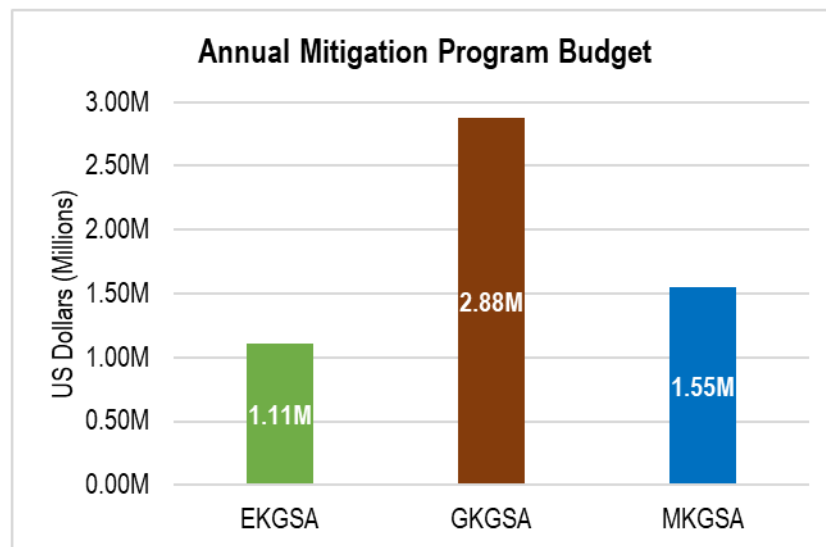


Figure 6-12. Annual Mitigation Cost Estimates and GSA Mitigation Budgets

MKGSA's funding mechanism for mitigation is not reliant on fees from overdraft pumping, however fees from pumping recharged supplies in the groundwater system and from fees assessed to municipalities that may be causing impacts due to ongoing pumping and the subsequent cones of depressions that are created. MKGSA allocates only sustainable yield; therefore, the GSA does not have an 'allowable overdraft' policy within its current allocation program. Demand management is MKGSA's priority to achieving sustainability and avoiding the need for mitigation.

The Kaweah Subbasin Technical Team performed a Dry Well Susceptibility Analysis (described in Chapter 5— Sustainable Management Criteria) which provided a conservative mitigation cost estimate under different drought scenarios with intentional protective funding buffers built into account for uncertainties. The mitigation cost estimates include costs to physically mitigate wells, emergency and interim supplies, water quality laboratory fees and treatment equipment,

Self-Help Enterprises' (SHE) administration of the program, GSAs' administration of the program, and contractor assistance during the assessment phase. The Kaweah Subbasin GSAs' mitigation budget estimates are designed to be sufficient to address mitigation needs, independent of the positive effects that projects and demand management changes that have taken place since the initial GSP was submitted in 2020.

In the event the costs to implement the Mitigation Program require revisions, the Kaweah Subbasin GSAs shall revisit their funding mechanisms and mitigation budgets to meet the mitigation commitments established in the Mitigation Program and respective Mitigation Plans. Alternatives may include raising groundwater extraction fees and/or a property-based tax.

The GSAs will also explore grant funding at the state and federal levels as they may become available. The state has many existing grant programs for community water systems and well construction funding; however, the state's SAFER funding is not permitted to be used for Mitigation Program implementation. County, state, and federal assistance may be needed to best maximize the Mitigation Program in conjunction with similar programs that sprout up from similar regulatory requirements to SGMA, like CV-SALTS and ILRP. The GSAs will also work with local non-governmental organizations that may be able to aid or seek grant monies to assist Mitigation Program implementation.

MKGSA places a significant emphasis on the ability to mitigate domestic wells impacted due to declining groundwater levels. The Subbasin's definition of URs reinforces this emphasis by ensuring that if funding is not available for the mitigation of a domestic well, an UR has occurred.

6.7.4.5 Expected Benefits and Targeted Measurable Objectives

The Mitigation Program and MKGSA Mitigation Plan address impacts due to the following:

- reduction in groundwater storage¹
- chronic lowering of groundwater levels¹
- land subsidence¹
- degraded water quality¹

¹induced by chronic lowering of groundwater levels (allowable overdraft during GSP implementation)

The Subbasin Mitigation Program and MKGSA Mitigation Plan provide direct assistance to beneficial users in the GSA who have had their well or infrastructure adversely impacted because of continued overdraft conditions while the GSA implements other projects and management actions to achieve sustainability. The metric for measuring Mitigation Program and Plan benefits will be the number of wells adversely impacted and mitigated, and the Subbasin's ability to manage groundwater levels to the MOs, avoiding the need for mitigation. The Kaweah Subbasin

GSAs will provide an annual accounting of the number of wells and other impacts identified and mitigated in the Kaweah Subbasin Annual Report, provided to the DWR in April of each year.

6.7.5 MA5: Small Community Well Proactive & Protective Action Plan (PPAP) *new

Small community wells/systems identified as being at-risk by the State Water Resources Control Board's metrics for small community wells will receive proactive mitigation via the Small Community Well Proactive & Protective Action Program (PPAP).

The GSAs have an ethical and financial interest in avoiding impacts to these small community wells and after consultations with local community well mitigation providers, it was determined the most effective and helpful mitigation for small community wells is to avoid the need for mitigation altogether. That said, the GSAs intend to avoid impacts to these community wells through a series of site-specific proactive measures, which may include but are not limited to the options listed below. The proactive measure(s) implemented will vary on a case-by-case basis.

1. Assess what next steps are needed to avoid or mitigate impacts to support Contingency Plan development and/or improvement.
2. Develop or support development of Preliminary Engineer Reports for small community wells that have been stuck with lack of funding or resources to take the next steps in their own contingency plans.
3. Implement groundwater pumping restriction policies near at-risk community wells.
4. Host Financial Empowerment Workshops to map out long-term planning for resiliency and maintenance, with a focus on prioritizing future access to affordable drinking water.
5. Support grant writing and cost-share when funding and opportunities allow.
6. Consider additional technical assistance that meets the unique needs of the at-risk small community well.

Although the claims process in the Subbasin Mitigation Program and GSA Mitigation Plans is designed more for private domestic and multi-use drinking water well owners, community well owners may still notify SHE in the event of potential impacts to their well.

This process will establish continued trust-building with the leaders within these at-risk communities. Before proactive technical assistance/mitigation is underway, the GSAs are committed to meeting with community leaders to understand their unique challenges to map out the best strategy for contingency plans and supplemental assistance.

The GSAs are committed to this management action component of the Kaweah Subbasin Mitigation Program. As this management action will be the first of its kind in the region, there is considerable uncertainty associated with budget, schedule, and available data and information. The GSAs have experience developing methods of navigating uncertainty, such as sensitivity analyses and adapting schedules and budget priorities to achieve sustainability initiatives. The schedule and budget are subject to change as additional information and experience are gained through development and implementation.

More information on the current schedule and approach of the PPAP is shown on Figure 6-13.



Figure 6-13. Small Community Well Proactive & Protective Action Program (PPAP) Approach and Schedule

This is a high-priority management action needed to maintain access to a water supply that meets basic health and safety needs by mitigating impacts of declining water levels, land subsidence, and groundwater quality induced by pumping-influenced water level changes. Declining groundwater levels created by allowable overdraft during the implementation phase of the GSPs may induce unintended groundwater quality impacts. Therefore, the Kaweah Subbasin GSAs are committed to taking protective and proactive measures to avoid the need for mitigation of the small community water systems.

6.7.5.1 Status of Implementation

The schedule for the PPAP is available on Figure 6-13. Public and relevant entities must be given the opportunity and time to comment on the Program prior to adoption by the GSA.

Opportunities to comment will be made available at stakeholder advisory committee meetings, Amended GSP public comment period, and at GSA Board Meetings.

The Okieville Well #2 Resiliency Project represents a good example of how this management action will work. The MKGSA and TID, in working with the Okieville Community on the Okieville Recharge Basin, recognized that the community was reliant on a single community well. In discussion, it was determined that if their well had any failure, which could be mechanical, structural, or loss of water, the entire community would be without water. Based on that identification of potential risk, TID, the KDWCD, SHE, and the Community of Okieville developed the Okieville Well #2 Resiliency Project, which provides for a backup well, water storage tank, and generator system to provide redundancy and reliability to the community's drinking water needs.

6.7.5.2 Permitting and Regulatory Compliance

The GSA will confirm with the Claimant that any mitigation efforts that are non-exempt from CEQA and NEPA requirements will comply with CEQA and NEPA prior to approval and issuance of mitigation assistance. New wells must comply with the Tulare County well permitting process.

6.7.5.3 Legal Authority

California Water Code Section 10725.2 provides the GSA has the powers and authorities “perform any act necessary or proper” to implement SGMA regulations and allows the GSA to adopt rules, regulations, ordinances, and resolutions necessary for SGMA implementation. (23 CCR §355.4(b)(6).)

6.7.5.4 Project Costs and Funding

The costs to develop and implement the PPAP are unknown at this time as the PPAP is undergoing initial planning and development. It may cost approximately \$100,000 per year; however, opportunities to cost-share with other Kaweah Subbasin GSAs may reduce that estimate. The primary source of funding for the PPAP is through GSA fees. MKGSA will fund its mitigation efforts from the Emergency Ordinance including a new Reserve Fund Policy.

6.7.5.5 Expected Benefits and Targeted Measurable Objectives

This management action will directly address the impacts of chronic lowering of groundwater levels, reduced groundwater in storage, groundwater quality, and land subsidence caused by lowered groundwater levels by providing strategies to avoid impacts to small community wells and identify next steps to confirm their sustainability and resiliency.

This management action is designed to provide the following benefits for small community water systems:

1. Improved risk management and planning
2. Reduced risk of experiencing impacts related to:
 - a. reduction in groundwater storage¹
 - b. chronic lowering of groundwater levels¹
 - c. land subsidence¹
 - d. degraded water quality¹

¹*induced by groundwater management activities.*

SGMA required annual reporting provides the GSAs the opportunity to review progress on this management action and regularly assess if the risk status of the Subbasin's small community wells' changes.

6.7.6 MA6: Well Registration Program **new*

The Kaweah Subbasin GSAs have committed to developing a Well Registration Program to be completed in phases and available for full implementation in summer 2025. The purpose of voluntary registration of wells is to create a baseline record for each groundwater well in the event of a future claim and to have the necessary information on file to identify at-risk domestic wells for notification and advance mitigation purposes. The Well Registration Program is designed to gather as much data on well construction, location, ownership, use, groundwater levels, and groundwater quality for all well types.

This can be particularly beneficial for drinking water wells, as many of these wells' construction, maintenance, exact location, site-specific groundwater levels, and quality are considered a data gap. SGMA noted wells that extract less than 2 acre-feet per year were deemed De Minimis, and not required to participate in the GSP process. Existing domestic well records through the DWR include inactive and abandoned wells and documentation errors. The exact locations of most domestic wells are not well understood. The registration will require the well owner to provide information on well location, construction, water quality, and well maintenance history. Having a well registered will not be a prerequisite for Mitigation Plan qualification, but it should speed up the GSAs' assessment of claims should it arise, because there is already background information on the well. Additionally, if a well is registered it may be possible to apply for mitigation before the well goes dry since proactive measures avoid impacts and save the costs of providing emergency and temporary water supplies. Although there is an emphasis on domestic wells, all well types will be asked to voluntarily enroll in the program, as the more data and information available can improve water management, planning, and proactive efforts.

This management action requires considerable time and resource commitments to make usable. The upfront effort is for the GSAs to continue efforts to build trust in the local communities and communicate the benefits that well users will receive if enrolling (early notification and early processing). The GSAs are expecting there to be initial hesitation out of concern for the landowners' private data to become public and impact property values and future economic opportunities. That said, the Well Registration Program entails 3 primary phases listed below. Additional phases may be added as the program is being developed and implemented.

Phase 1 (Spring 2025): Initial outreach and development of data and information forms (consider online submittal options). The initial outreach phase will require several months to continue trust building as there is expected to be an initial hesitance with landowners sharing their private data and information with a public agency. The outreach campaign will highlight the benefits of voluntarily enrolling, such as early risk notifications, reduced risk as GSAs use this information to adapt management policies, and improvements in the GSAs' groundwater level and quality analyses which inform sustainability planning. Ongoing outreach is not clarified as a specific phase; however, it is a critical component of a successful Well Registration Program.

Phase 2 (Fall 2025): The well registration database is structured to receive registrants' data and information and beta tested. This may include incorporation of this database into the existing Kaweah Subbasin Data Management System (see Section 7.3).

Phase 3 (Spring 2026): Voluntary well registration active and available for all well owners in the Kaweah Subbasin and risk notification and consideration of management changes proceeds for all at-risk wells.

This management action will be accomplished through coordination across all stakeholder groups, GSA funding, exhaustive outreach efforts, and data management and notification system development. The GSAs recognize the need to invest in outreach specialists and technical support to develop databases and usable information forms. The GSAs have the capacity to complete this management action in-house, but would prefer partnering with local community leaders and agencies to build trust, offer translation services, and reach domestic well owners who may not be aware of GSA efforts. The strategy by the GSAs is to emphasize the benefits of enrolling, such as early notification of risks, the GSAs having the information necessary to avoid impacts to shallow wells, and expedited processing of mitigation claims. In addition, it is important that the GSAs remain transparent about the use of private information, the risks of sharing private data with public agencies, and what the GSA can do to protect private information. The success of this program is contingent on the trust the community has in the GSA – therefore, the initial phase (outreach and engagement) is the most critical and resource intensive.

An important element of the partnership between the Kaweah Subbasin GSAs and SHE for the Mitigation Program is the data, information, and resource sharing across the agencies. This includes the opportunity for existing and future participants of SHE’s emergency services to be educated on the importance of SGMA, data sharing, and existing GSA programs.

This management action is still in the early phases and more information on the approach will be made available at GSA public meetings in early 2025.

6.7.6.1 Status of Implementation

The project is currently in the early stages of planning and development. Implementation is broken down into 3 phases as described above in Section 6.7.6.

6.7.6.2 Permitting and Regulatory Compliance

No permitting or regulatory processes are expected to be needed to implement this management action.

6.7.6.3 Legal Authority

California Water Code Section 10725.2 provides the GSA has the powers and authorities “perform any act necessary or proper” to implement SGMA regulations and allows the GSA to adopt rules, regulations, ordinances, and resolutions necessary for SGMA implementation. (23 CCR §355.4(b)(6).)

6.7.6.4 Project Costs and Funding

For a Subbasin-wide program, phases 1 and 2 will cost approximately \$75,000 is needed for and \$10,000 per year to maintain phase 3 through the implementation period. Monthly maintenance and quality control of data is estimated to cost \$6,000 per month. There may be opportunities for cost-sharing between all 3 GSAs to lower costs.

6.7.6.5 Expected Benefits and Targeted Measurable Objectives

Expected benefits from this project include improved understanding of groundwater production from wells within the GSA and associated aquifer responses to groundwater extraction operations. Overall, improvements in the characterization of principal aquifers and aquitards are expected once we are able to tie specific wells and their water level and water quality information with specific aquifers. MOs are anticipated to be better met by virtue of this improved knowledge and incorporation into the Subbasin numeric model would include groundwater level stabilization and, by proxy, groundwater storage stabilization and reduced water quality degradation.

6.7.7 MA7: Well Permit Application Review and Technical Support ***new**

The Kaweah Subbasin GSAs have coordinated with Tulare County to receive all domestic and agricultural well permit applications, which provides the GSAs the information necessary to reach out to the landowner if the proposed well appears to be at-risk of experiencing impacts or if the well may induce impacts. In either case, the GSA will also provide recommendations on well depth, location, opportunities to connect to a municipal or small community well/system, etc., to support the applicant's groundwater access while avoiding unintended impacts as a result of new wells drilled without GSA consultation.

Well permit application review by the GSAs will use both the permit application and available data and resources to review the consider the following:

- The proposed location of the new well
- The planned depth and perforated interval of the new well; GSA will determine from which aquifer (Upper, Lower, or Single) the well is planned to extract
- The planned use of the water from the well (domestic supply, agricultural irrigation, etc.)
- Identifying the closest RMS to the proposed well to determine MTs for groundwater levels, groundwater quality and subsidence
- Identifying existing domestic wells and critical infrastructure in the area
- Estimating current groundwater levels around the proposed well

As new wells are being installed, the GSA is concerned that new wells may be installed at locations and depths that may not be in alignment with the sustainability mission. Additionally, new wells can also be drilled in locations and depths that elevate the risk of impacts. The GSAs are in a unique position to support landowners who are installing new wells with data and information to inform their decision to minimize impacts and maximize sustainability for the landowner and the surrounding beneficial uses, users, and property interests.

The GSAs will include information on this management action through protocols identified in Section 2.7. In addition, the GSAs will contact local drillers and water haulers and build the relationship in which the driller or hauler is encouraged to share information about this management action and information on the Kaweah Subbasin Mitigation Program and MKGSA Mitigation Plans with the landowner.

6.7.7.1 Status of Implementation

This management action is currently active. GSAs are receiving well permit applications for all domestic and agricultural wells within their respective jurisdiction from Tulare County.

6.7.7.2 Permitting and Regulatory Compliance

The Kaweah Subbasin GSAs will abide by the existing Tulare County permitting code and requirements. The GSAs do not have the authority to authorize or reject well permit applications. The role of the GSA is to provide information which may encourage long-term sustainability for the applicant.

6.7.7.3 Legal Authority

California Water Code Section 10725.2 provides the GSA has the powers and authorities “perform any act necessary or proper” to implement SGMA regulations and allows the GSA to adopt rules, regulations, ordinances, and resolutions necessary for SGMA implementation. (23 CCR §355.4(b)(6).)

6.7.7.4 Project Costs and Funding

The cost to implement this management action is minimal. This proactive measure is more affordable than the costs to mitigate or initiate new projects and management actions that may arise as a result of not engaging in Well Permit Review and Technical Support. Because GSA staff and/or their technical teams have data and information readily available on current and future groundwater conditions, locations of nearby critical infrastructure and wells as a result of SGMA implementation and aerial photography, this management action is expected to cost the GSA an estimated \$5,000 per year. This cost is expected to fluctuate over time.

6.7.7.5 Expected Benefits and Targeted Measurable Objectives

It is challenging to quantify the benefit of this measure as there are many variables and the activities are proactive, in an effort to avoid future unknowable impacts.

6.7.8 MA8: Collaboration with Other Agencies & Inter-Basin Coordination

The MKGSA's priority is to engage with the other Kaweah Subbasin GSAs, the Tule Subbasin, and the Tulare Lake Subbasin, toward a coordinated Subsidence program. The goal would be to coordinate with neighboring GSAs to understand the underlying activities contributing to active and historical subsidence, to understand the impacts of subsidence on critical infrastructure, to establish a monitoring and action plan to avoid the MTs established by GSAs, and to achieve sustainability by 2040. Given the increased subsidence experienced in recent years, time is of the essence, and the goal would be to meet with local representatives by October 31, 2024, and draft a Regional Subsidence Monitoring and Action Plan (RSMAP) by December 31, 2025. Appendix 6E provides an RSMAP development strategy that includes forming a RSMAP Committee and developing a coordinated RSMAP that outlines a regional strategy for monitoring subsidence and collaborating on the monitoring such that a common monitoring strategy is used in each

subbasin. Each subbasin will be responsible for implementing the strategy within its own boundaries.

GSA collaboration and coordination with Water Quality Agencies and Coalitions involves:

- Participate in meetings (salinity prioritization & optimization study, management zones) as a contributor of information, but also seeking information
- Exchange/share groundwater quality data and information between GSAs and other groundwater quality leads
- Request information to better inform 5-year GSP Periodic Evaluations, include data in DMS
- Identify, pursue, and administer grants in partnership with Water Quality focused agencies

Other forms of collaboration are underway, including that with NASA's Airborne Snow Observatory (ASO). Information from the ASO program centered on the Kaweah and San Joaquin River watersheds will aid in surface water management by establishing ways to optimize reservoir releases for irrigation demand and groundwater recharge. Having greatly improved data regarding snowpack and water content will assist surface water managers with avoiding untimely reservoir releases and spills out of the Subbasin and Tulare Lake regional watershed and subsequent loss of water otherwise available for recharge.

6.7.9 MA9: Land Subsidence and Lower Aquifer Strategic Management Plan

To curb pumping from the confined aquifer below the Corcoran Clay formation, TID will be developing a program to allocate increased surface water available to TID into areas highly susceptible to subsidence. During the annual allocations of surface water to landowners within TID, the MKGSA shall assist TID in evaluating areas that are subsiding at rates that are unsustainable. TID shall take the annual supply of surface water entitled and contracted to TID via the Kaweah River system and the Friant Division of the CVP, respectively, and disproportionately allocate higher amounts of surface water to landowners in the identified highly susceptible to subsidence. For example, TID has an annual supply of 65,000 AF to meet irrigation demand and an area that is susceptible to subsidence of approximately 15,000 acres of the total 65,000 acres in TID. TID would look to deliver 30,000 AF into the 15,000 acres of subsidence susceptible lands, equaling about 2.0 AF/acre to meet irrigation demands, and the remainder of water supply, which is 35,000 AF would go to the remaining 50,000 acres of irrigated agricultural not subject to subsidence and would be approximately 0.70 AF/acre. The areas receiving disproportionately less surface water would also likely receive higher allocations of groundwater pumping at less costs or with mitigation dollars to offset the increased groundwater pumping.

6.7.9.1 Status of Implementation

TID has started to discuss this management action with the TID Board of Directors. TID will be coordinating with MKGSA to define the area susceptible to subsidence and establish a workgroup to help develop a TID Subsidence Mitigation Surface Water Allocation System. The goal is to have the system designed and ready for implementation by the 2026 summer irrigation season.

6.7.9.2 Permitting and Regulatory Compliance

Any permitting or other regulatory compliance needs deemed necessary to implement and administer a TID Subsidence Mitigation Surface Water Allocation System, all in furtherance of SGMA §10726.4, will be identified during the development of the TID Subsidence Mitigation Surface Water Allocation System.

6.7.9.3 Water Sources and Legal Authority

Legal authority for TID Subsidence Mitigation Surface Water Allocation System is grounded in SGMA §10726.4.

6.7.9.4 Program Costs and Funding

The development and implementation of the TID Subsidence Mitigation Surface Water Allocation System will be covered by TID as a part of their ongoing operational costs.

6.7.9.5 Expected Benefits and Targeted Measurable Objectives

The primary benefit of this program will be to immediately reduce the pumping in the confined aquifer and therefore reduce the ongoing subsidence.

6.7.10 MA 10: Lower Aquifer Groundwater Allocations

The Kaweah Subbasin GSAs have been working to analyze and understand the ongoing subsidence in the Kaweah Subbasin, including the MKGSA. Current analysis show regions within the MKGSA experiencing subsidence. Chapter 5 sets the SMCs for subsidence and groundwater levels. During the analysis of subsidence, initial findings have shown that declining groundwater levels in the confined aquifer below the Corcoran Clay seem to be causing subsidence. The MKGSA is preparing data and analysis to set an allocation of groundwater pumping to keep water levels above the historical lows that were experienced to avoid new subsidence and minimize residual subsidence.

Upon completion of the 2024 Second Amended GSP, the MKGSA intends to immediately begin evaluation and development of a MKGSA Lower Aquifer Groundwater Allocation Program

(Lower Aquifer Program). The MKGSA commits to working with the Kaweah Subbasin GSAs on a Lower Aquifer Program by summer 2025.

6.7.10.1 Status of Implementation

The MKGSA as a member of the Kaweah Subbasin GSAs that are working on revisions to the 2022 GSPs. During the revisions to the GSP the MKGSA was made aware of new data showing declining groundwater levels causing subsidence in areas within the MKGSA. In response to this ongoing impact, the MKGSA has begun the evaluation of a program to allocate lower confined aquifer pumping to avoid new subsidence and limit ongoing residual subsidence. The MKGSA, in collaboration with the GKGSA and the EKGSA, will develop a Lower Aquifer Allocation Program by summer 2025. The goal is to reduce the residual subsidence in the MKGSA and eliminate any new subsidence.

6.7.10.2 Permitting and Regulatory Compliance

Any permitting or other regulatory compliance needs deemed necessary to implement and administer the MKGSA Lower Aquifer Allocation Program, all in furtherance of SGMA §10726.4, will be identified during developing the MKGSA Lower Aquifer Allocation Program. Currently the MKGSA does believe that there exists the authority under SGMA for the MKGSA to make allocations for groundwater pumping from the lower aquifer.

6.7.10.3 Water Sources and Legal Authority

Legal authority for the MKGSA Lower Aquifer Allocation Program is grounded in SGMA §10726.4.

6.7.10.4 Program Costs and Funding

The development and implementation of the MKGSA Lower Aquifer Allocation Program will be covered by MKGSA via the ongoing general administration costs incurred by the MKGSA.

6.7.10.5 Expected Benefits and Targeted Measurable Objectives

The primary benefit of this program will be to immediately reduce the pumping in the confined aquifer and therefore reduce the ongoing subsidence.

6.7.11 MA11: Subbasin Geophysical Data Survey Project

In fall 2015, TID served as a pilot program for hydrogeological subsurface data collection using electromagnetic geophysical methods conducted by a company called SkyTEM. This innovative airborne survey method acquires deep aquifer resistivity data to better ascertain its characteristics and geology. The work was arranged and funded by Stanford University with some administrative oversight by TID staff. The data collection was done by means of helicopter fly-

overs along pre-selected flight lines within TID, a process known as airborne electromagnetic surveying (AEM). Work products from this research and data analysis have been presented locally and statewide, and interest in furthering this means of sub-surface data collection has developed. The instrumentation used in the fly-over transects is depicted on Figure 6-14.

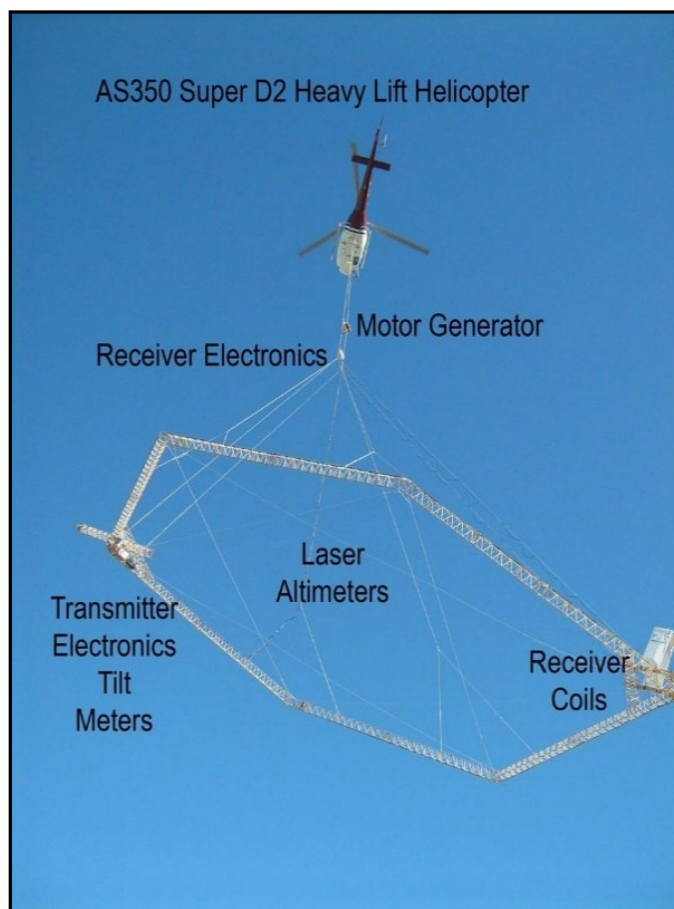


Figure 6-14. Airborne Survey Instrumentation

Stanford obtained a grant from National Academy of Sciences to integrate InSAR ground displacement data with AEM techniques to improve groundwater modeling tools for the Kaweah Subbasin.

TID and Stanford University have also collaborated on the acquisition of a towable electromagnetic imaging system called TowTEM that measures the resistivity of soils at shallow depths of 100 feet or less. The resistivity information that is gathered is correlated to soil types and the output is a 3D model of sediment textures.

TID is planning on using this information, in partnership with Stanford University, to determine areas that are best suited for groundwater recharge activities. This would take the form of identifying areas where potential recharge basins could be constructed or where on-farm

recharge programs would yield the highest infiltration rates. With the TowTEM system available to TID, several field acquisitions of electromagnetic data have taken place since the purchase of the equipment in 2022. Landowner fields are profiled to determine relative permeability (i.e., sands and clays), allowing landowners to make decisions on groundwater recharge activities. This has been useful to several landowners seeking assistance in determining future use of their fields.

In many cases, landowners questioned if they should put a permanent crop on the field or leave it open for annual crops which would allow for groundwater recharge in wet years. In the case of 1 local grower, his trees had reached an age during production when they were no longer producing efficiently, and a windstorm knocked down a good percentage of his field. This was during the 2020-2022 drought when he removed his almonds. The removal was a water savings measure as the almonds were not efficient and used a lot of water for evapotranspiration. TID was able to use the TowTEM system to produce an image of his field, and based on the highly sandy soils, the landowner decided not to replant the field in almonds and instead left it open for annual crops. This was a key decision because in 2023 during the winter floods, the landowner was able to put a lot of water out on the field and recharge the groundwater system thereby building groundwater credits on his Water Dashboard.

Additional data collection has now been completed (November 2018) for the Kaweah Subbasin under a new pilot program, 1 of 4 in the state proposed by Stanford University. As with the 2015 effort, data processing is being undertaken by Aqua Geo Frameworks in partnership with SkyTEM.

It is recognized that this additional data collected will enhance the understanding of the Kaweah Subbasin and its underlying aquifer characteristics, assist with the Basin Setting and Hydrogeologic Conceptual Model as necessary elements of GSPs, and provide new calibration parameters for the Subbasin numerical simulation model. The project will also provide direct benefits to the GSAs and landowners that overlie the proposed new flight lines, providing detailed subsurface information not previously available to those areas and landowners.

6.7.11.1 Status of Implementation

The fly-over data collection effort has been completed. Post-processing of the electromagnetic data into depictions of aquifer layers and geology is now underway, and the *Hydrogeologic Framework of Selected Areas of the Kaweah Sub-Basin Region in Tulare and Kings Counties, California* report, compiling all data and mapping, is included as Appendix 6F. Stanford integrated the new data in the Kaweah Subbasin MODFLOW model and delivered that model to the Kaweah Subbasin GSAs. The GSAs have updated the model through 2022 and recalibrated it. The calibrated Kaweah Subbasin MODFLOW model is being used by the Kaweah Subbasin GSAs in developing this GSP.

6.7.11.2 Permitting and Regulatory Compliance

All necessary permits for the project, including an FCC license due to electromagnetic wave signals, were acquired by SkyTEM. No permits are required for TowTEM.

6.7.11.3 Water Sources and Legal Authority

Not applicable.

6.7.11.4 Project Costs and Funding

The costs for the project are being paid as follows:

- \$300,000 from Stanford University for data collection costs
- \$160,000 from Subbasin GSAs for data collection costs
- \$25,000 from Subbasin GSAs for data management by consultant(s)

6.7.11.5 Expected Benefits and Targeted Measurable Objectives

The anticipated benefits of this project include enhanced knowledge of the Subbasin's geology and a more robust hydrogeologic conceptual model (HCM) description as a result. It is further anticipated that the data and resultant 3D mapping will aid with the Subbasin numerical model's predictive accuracy and in siting recharge projects and dedicated monitoring wells across the region for optimal and targeted recharge benefits. These benefits are expected to be realized and documented in the first 5-year GSP Periodic Evaluation to be conducted by each Subbasin GSA and submitted to DWR. MOs anticipated to be better met by virtue of this improved knowledge and resulting project planning would include groundwater level stabilization and, by proxy, groundwater storage stabilization and reductions in land subsidence rates; reduced water quality degradation may result as well.

6.7.12 MA12: Urban Water Conservation

As referenced in Section 2.5.1.4 of the Subbasin Basin Setting document (Appendix 3A), urban water usage in the future is expected to comply with the conservation mandates contained in SB 606 and AB 1668, both bills signed into law in May 2018. Based on that legislation, indoor residential use is to be capped at 55 gallons per capita per day (gpcd) in 2019 and ramped down to 50 gpcd by 2030, and outdoor residential use is to be capped in the future based on local climate and size of landscaped areas. Standards for outdoor usage are to be defined in a SWRCB rule-making process to be completed by June 2022.

6.7.12.1 Status of Implementation

The cities of Tulare and Visalia are currently evaluating their respective compliance measures for indoor use and are awaiting additional information and guidelines concerning regional outdoor and landscape compliance measures. The 2 cities are now complying with the 20X2020 mandates contained in SB 7X-7 and as embodied in their respective Urban Water Management Plans (UWMPs). As the SWRCB establishes its compliance deadlines for both indoor and outdoor usage, anticipated to occur by 2025, the 2 city GSA Members will have a clearer picture of an implementation schedule.

6.7.12.2 Permitting and Regulatory Compliance

Urban water conservation compliance currently derives from SB7X-7 passed in 2009 (Water Conservation Act of 2009), and the UWMPs of both Tulare and Visalia, along with associated ordinances, reflect that Act's mandates of a 20% reduction in urban per capita water usage by 2020. Future achievements in urban conservation will be as derived from the passage of AB 1668 and SB 606 in 2018. Future amendments to UWMPs and modified ordinances of both cities will eventually embody these recent laws.

6.7.12.3 Water Sources and Legal Authority

As stated in Section 6.7.13.2, legal authorities for any additional urban water conservation will be as derived from the passage of AB 1668 and SB 606.

6.7.12.4 Program Costs and Funding

Costs to implement recent urban water conservation objectives are not known at this time. Funding would be as provided by each urban Member for their respective programs.

6.7.12.5 Expected Benefits and Targeted Measurable Objectives

Given the early implementation stages of AB 1668 and SB 606, its benefits in terms of reduced groundwater pumping by Tulare and Visalia can only be roughly approximated. The Pacific Institute, in its 2014 report "Urban Water Conservation and Efficiency Potential in California," estimated that indoor usage could be reduced by 33 to 40 gpcd, and that outdoor/landscape usage could be reduced by 20 to 50 gpcd. These values are on a statewide basis and likely unrealistic in some regions; however, the report suggests that total urban water usage could be reduced by as much as 30 to 60%. Savings of this magnitude would represent a significant reduction in groundwater pumping by both cities. The MOs to be partially met with additional urban conservation include groundwater level stabilization and, by proxy, groundwater storage stabilization.

6.7.13 MA13: Agricultural Water Conservation and Management

TID, as the single member of the GSA providing agricultural water service, complies with all provisions of SB 7 (amending Division 6, Part 2.55 of the Water Code) passed into law in November 2009 regarding agricultural water conservation and management. Efficient management practices in the law related to SGMA objectives include volumetric water pricing, incentives for conjunctive use and increased groundwater recharge, and development of an overall water budget. AB 1668 and SB 606, passed in 2018, did not materially add to these objectives, save for those districts serving between 10,000 and 25,000 acres who must now prepare water management plans under the newer laws.

While these new laws do not require water use objectives or savings thresholds, they do encourage more efficient use of water by the agricultural sector and its suppliers.

6.7.13.1 Status of Implementation

Most provisions of the conservation laws are being complied with by TID. Water management plans, as originally required by USBR with the passage of the Central Valley Project Improvement Act (CVPIA) in 1992, are being regularly prepared by the district for submittal to DWR. The District is in conformity with accuracy limits as established by the state based on a measurement verification program conducted by the Irrigation Training & Research Center (ITRC) at Cal Poly San Luis Obispo.

6.7.13.2 Permitting and Regulatory Compliance

Regulatory compliance resides with those provisions of SB7, AB 1668, and SB 606 now codified into state law.

6.7.13.3 Water Sources and Legal Authority

As an irrigation district per Division 11 of the California Water Code, TID is empowered with ensuring the beneficial use of all water thereby furnished.

6.7.13.4 Program Costs and Funding

Costs for water management plan report preparation and submittals are ongoing for TID, and any future costs related to surface water measurement compliance and associated funding would be borne by that district.

6.7.13.5 Expected Benefits and Targeted Measurable Objectives

There are no direct benefits to be derived and quantified from compliance with the aforementioned agricultural conservation laws at the present time. TID will continue to divert for beneficial use all local and imported water supplies to which it is entitled. Should agricultural

demands for irrigation water diminish as a result of some of the conservation provisions, a larger portion of diverted supplies by TID will be devoted to groundwater recharge in the future.

6.7.14 Conceptual Management Action

6.7.14.1 MA14: Replenishment Supply Allocation Program

6.7.14.1.1 Description

The Kaweah Subbasin GSAs recognize that management of the Subbasin according to the Water Accounting Framework (WAF) provided in the Coordination Agreement (Appendix 1A and summarized in Section 6.2) assigns components of groundwater inflow to each GSA. The WAF identifies 3 inflows to the groundwater system: 1) Native (common supply), 2) Foreign (imported supply), and 3) Salvaged (water supplies afforded to entities that invest in the water) water supplies (Figure 6-15). To achieve sustainability, the Kaweah Subbasin GSAs have agreed that any groundwater pumping allocation beyond these water categories is assumed to be considered groundwater overdraft. Generally, the pumping of groundwater overdraft causes the lowering of groundwater levels that, without mitigation, can cause impacts to beneficial users and uses of groundwater.

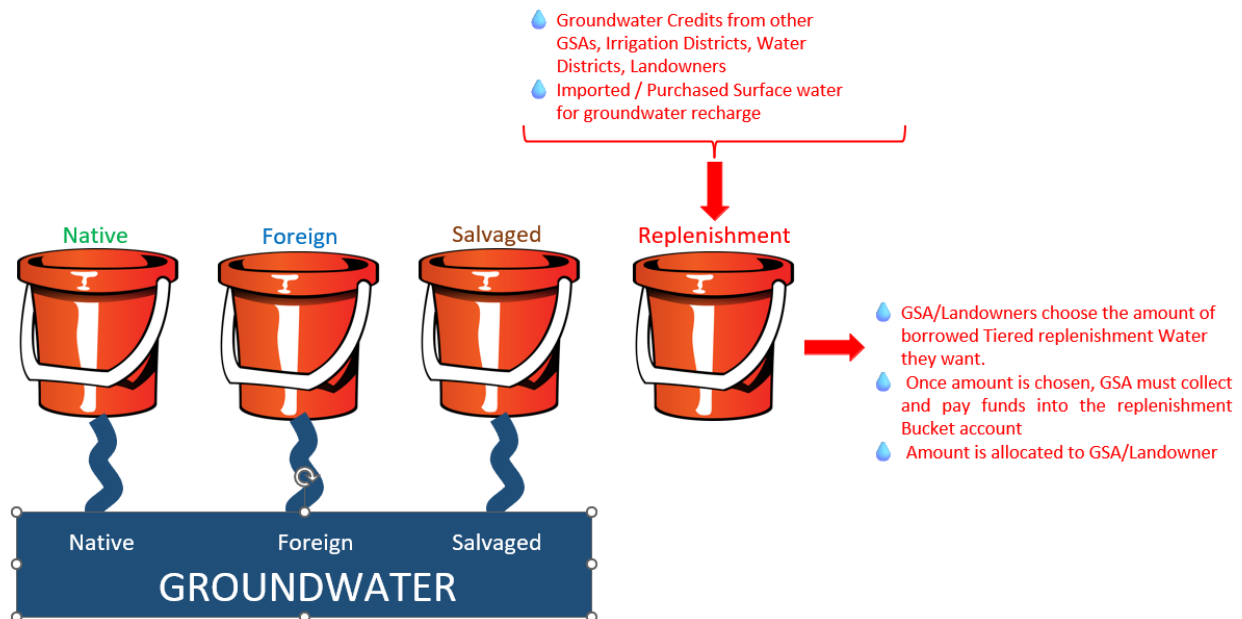


Figure 6-15. Water Accounting Framework with Replenishment Bucket

With that understanding, the Kaweah Subbasin GSAs have developed a fourth category of groundwater that can be allocated, which is called the Replenishment Supply. The Replenishment Supply is a recognized volume of water utilized by each GSA beyond the water

identified in the WAF, but it must be replenished in the groundwater system to avoid long-term overdraft.

The Kaweah Subbasin GSAs intend to establish a maximum Replenishment Supply available to the Subbasin and each GSA. The maximum Replenishment Supply available will be associated with determining the amount of water supply available that will not reduce groundwater levels below MTs. The calculation will consider current groundwater levels, current allocations of groundwater pumping (measured at ET), and any carryover credits afforded to GSAs through existing allocations that have taken place.

Each GSA that utilizes water within the Replenishment Supply must replace the water used via groundwater allocations under specific guidelines and rules currently being developed. Fees will be charged to use the Replenishment Supply, and the fees will be based upon the costs to replenish the water supply. Initial discussions of the fees charged included replacement water and project dollars to create the needed infrastructure to replace the utilized groundwater.

Continued overdraft of groundwater in the Kaweah Subbasin subjects all beneficial groundwater users to URs. The Kaweah Subbasin has recognized that the furtherance of overdraft without limits and replenishment will lead to consequences of lowered groundwater levels. Because the Kaweah Subbasin has established the WAF, which assigns inflow into the groundwater system sources mainly from surface water, the GSAs have determined that an assigned, limited, and replenishable amount of overdraft could be established at a subbasin level.

6.7.14.1.2 Status of Implementation

The Kaweah Subbasin GSAs have begun meeting to discuss the Replenishment Supply Allocation Program. A small committee of interested parties, including Kaweah Subbasin GSA representatives, has met and started to draft a program document. The goal is to establish a committee and process by summer 2024 for GSAs to discuss and consider. It is anticipated to have agreement on this program by the Water Year 2025 groundwater allocations.

Public and relevant entities must be given the opportunity and time to comment on the Replenishment Supply Allocation Program before adoption by the GSAs. Opportunities will be provided for comment at various GSA stakeholder and advisory committee meetings and special workshops held to discuss the program.

6.7.14.1.3 Permitting and Regulatory Process

No permitting or regulatory processes are expected to be needed to implement this management action.

6.7.14.1.4 Legal Authority

California Water Code Section 10725.2 provides the GSA has the powers and authorities “perform any act necessary or proper” to implement SGMA regulations and allows the GSA to adopt rules, regulations, ordinances, and resolutions necessary for SGMA implementation. (23 CCR §355.4(b)(6).)

6.7.14.1.5 Program Costs and Funding

The costs of developing the Replenishment Supply Allocation Program are currently unknown. Volunteers from each GSA and other interested parties are meeting to develop the initial program and committee. The primary source of funding for the replenishment of water for the program will come from fees charged by each GSA. Each GSA will determine the method for collecting and providing fees to replenish groundwater.

6.7.14.1.6 Expected Benefits and Targeted Measurable Objectives

This program will limit the amount of groundwater allocated, thereby limit declining groundwater levels. By proxy, this also limits reductions of groundwater storage and land subsidence.

6.7.14.1.7 How this Management Action Will be Accomplished

The Replenishment Supply Allocation will be accomplished by coordination between the Kaweah Subbasin GSAs and other interested parties in the Subbasin. Once a Replenishment Supply Committee is established and a program developed, the program will be shared with each GSA for consideration and adoption.

6.8 Benefits Analyses

The analysis conducted for Sections 6.8.1 through 6.8.4 was developed for the MKGSA 2020 GSP, and the potential for water supply for projects and management actions. The analysis is valid and useful for determining the total water supply availability in the future and potential for project benefits to achieve sustainability, it does not provide an analysis of benefits using the Subbasin groundwater model approach to determining sustainability. As a part of this 2024 Amended GSP, the Subbasin GSAs incorporated the proposed projects and managements, including a schedule of implementation, into a groundwater model to determine sustainability (see Appendix 3C for the model report). Section 7.2 provides an analysis using the predictive groundwater modeling to show benefits of projects and management actions under an implementation schedule and a climate change scenario.

6.8.1 Surplus Water Recharge Analysis

Chapter 2 of this Plan describes how TID conjunctive-use operations have benefited the MKGSA region from historical practices of groundwater recharge. There are, however, wet seasons and years during which local Kaweah River flows and surplus entitlements from the Friant Unit are not imported into the area because all such facilities are at capacity. TID's allotments from these sources increase significantly in wet seasons and, as such, are ideally suited for groundwater recharge projects and programs. Through historical operations, records, and communications with water facility managers, Table 6-4 has been utilized both by TID and the MKGSA to assess the future availability of CVP/Friant and Kaweah River surplus sources.

Table 6-4. Surplus CVP Availability

Uncontrolled Season Months ¹								
Year Type	Jan	Feb	Mar	Apr	May	Jun	Total	Frequency of Occurrence
I				0			0	0.35
II		0	4	25	7		36	0.15
II		0	9	16	7		32	0.2
IV		10	15	30	31	0	86	0.15
V	5	10	20	30	31	15	111	0.15
Wt. Avg.							41	
¹ The numerical entry denotes # days in months during which Uncontrolled Season Class 2 supplies are assumed to be available under climate change scenarios as projected by Friant WA's Technical Memorandum Dec. 2018								
Surplus Kaweah River Availability ²								
Year Type	Jan	Feb	Mar	Apr	May	Jun	Total	Frequency of Occurrence
I	0	0	0	0	0	0	0	0.35
II	0	0	0	0	0	0	0	0.15
II	2	2	2	2	4	4	16	0.2
IV	4	6	10	11	9	9	49	0.15
V	10	9	6	10	6	8	49	0.16
Wt. Avg.							18	
² The numerical entry denotes # days of spill to Tulare Lake Bed from Lower Kaweah and St. Johns channels under climate change projections for 2030 and 2070								
Combined SVP Surplus + Terminus Flood Release Months								
Year Type	Jan	Feb	Mar	Apr	May	Jun	Total	Frequency of Occurrence
I	0	0	0	0	0	0	0	0.35
II	0	0	4	25	7	0	36	0.15
II	2	2	11	18	11	4	48	0.2
IV	4	16	25	30	31	9	115	0.15
V	15	19	26	30	31	23	144	0.16
Wt. Avg.							54	

As indicated in Table 6-4, between the 2 sources, there exist about 54 days on average during which surplus flows are available for diversion and recharge. The number of days from each source individually are not additive, as there occur overlapping days within certain months, particularly in the wetter year types. That some of these surplus diversion capacity estimates during the months of January to June may be taken up with limited irrigation demands may be

the case; however, it is beyond the scope of this analysis to assume future irrigation patterns as they relate to surplus flow availability. For the on-farm programs described in Section 6.6.4, only the months of January to March were assumed for delivery of surplus flows to participating grower lands, bringing the average number of surplus flow days down to about 20 on average.

In 2011, under the auspices of USBR, TID conducted a System Optimization Review (Appendix 6G) and estimated surplus flows from the Kaweah River. This analysis (shown in Table 6-5) indicated 70 such days on average but acknowledged that the 1996 to 2006 period of analysis was wetter than average and was determined on a watershed basis, not just for TID’s particular service area. The analysis nevertheless corroborated the use of a conservative count of 19 days of Kaweah surplus flows, on average accessible by TID which, unlike the empirical analysis, is based on operational history. Furthermore, it may be assumed that other water rights holders along the Kaweah River system and members of other Kaweah Subbasin GSAs may, for purposes of SGMA compliance, incorporate projects to take advantage of flood release flows to which they are entitled (the Kaweah River is designated as a “fully appropriated stream system” by the SWRCB) but have historically allowed to be reallocated to others, including TID, by policy of the KSJRA Watermaster. Thus, the use of a more conservative estimate of surplus flows accessible to TID is warranted for this analysis and the projected water budget.

Table 6-5: Estimated Surplus Flow from the Kaweah River

Surplus Flow Analysis for Kaweah River						
CY	Dates		Duration (days)	Volumes (AF)	Avg. Rate (AF/Day)	Annual Total (AF)
1996	1/18	4/11	84	-	-	-
1997	2/15	3/22	35	384,000	10,970	
	11/16	11/22	6	2,000	333	
	12/12	12/19	7	12,000	1,710	398,000
1998	1/16	7/19	184	663,000	3,600	
	11/15	11/16	11	19,000	1,730	
	12/9	12/17	8	9,800	1,230	691,800
1999	1/21	3/1	39	39,000	1,000	39,000
2000	2/15	3/22	36	68,000	1,890	
	11/16	11/22	6	7,000	1,170	
	12/12	12/19	7	8,000	1,140	83,000
2001	3/1	3/9	8	9,600	1,200	
	5/19	5/26	7	26,000	3,710	
	12/6	12/16	10	13,000	1,300	48,600
2002	12/31	1/11	11	25,600	2,330	
	2/11	2/25	14	20,378	1,460	

Surplus Flow Analysis for Kaweah River						
CY	Dates		Duration (days)	Volumes (AF)	Avg. Rate (AF/Day)	Annual Total (AF)
2003	11/10	11/22	12	49,000	4,080	109,978
	12/10	12/22	12	15,000	1,250	
	1/9	1/18	9	16,000	1,780	141,800
	2/10	2/23	13	22,500	1,730	
	5/19	6/6	18	96,000	5,330	
2004	12/15	12/22	7	7,300	1,040	49,100
	1/6	1/13	7	15,000	2,140	
	3/29	4/6	8	18,000	2,250	390,600
	11/16	11/23	7	8,300	1,190	
	12/15	12/21	6	7,800	1,300	
2005	1/5	2/1	27	56,600	2,100	390,600
	3/28	4/25	28	55,000	1,960	
	5/16	6/2	17	92,300	5,430	390,600
	12/12	12/22	10	15,600	1,560	
	1/3	1/21	18	51,600	2,870	
2006	2/14	2/24	10	19,000	1,900	390,600
	3/21	6/14	85	320,000	3,760	
	Avg.		69.7			

Utilization of these flows by TID/MKGSA is entirely within the water rights hierarchy as administrated by the local Watermaster and CVP contract entitlement allotments made by the USBR. Surplus CVP availabilities as indicated in Table 6-5 are derived from application of the Technical Memorandum (TM) “Estimate of Future Friant Division Supplies for use in Groundwater Sustainability Plans,” Friant Water Authority, December 2018, included as an appendix to the Basin Setting report (Appendix 3A). The TM reflects an assumed climate change scenario for the San Joaquin River Watershed. Kaweah River flood month data are as adjusted by the climate change treatise contained in that report (the appendix to Appendix 3A). Peak flows are projected to decrease by about 5% and shift in occurrence from May back to March. TID’s historical data summarizing surplus flow days by month were adjusted accordingly.

Figure 6-16 is a graphical depiction of Table 6-5, where the colored bars indicate the number of surplus days in January to June for dry, average, and wet year types.

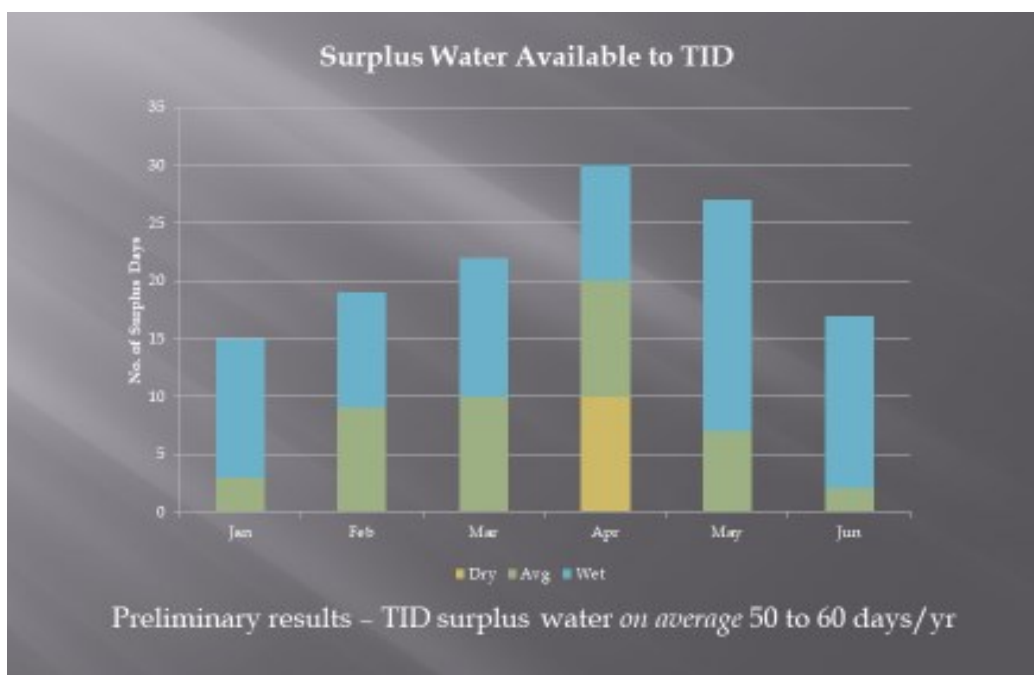


Figure 6-16. Surplus Water for Tulare Irrigation District Recharge

The data in Table 6-5 are overlain against a 90-year historical period of record to determine, by year type I – V, the number of days in each year during which additional recharge may be conducted assuming the presence of new projects/programs.

For the new groundwater recharge projects listed in Section 6.6, an assumed infiltration rate of 0.5 foot per day has been assumed in this analysis, which is representative of an average across soil types found in the MKGSA region. For a few of the projects, specific soils information is available and other rates are utilized. Soil borings and other data collected during the detailed planning and permitting stages of these projects will help refine the anticipated recharge benefits. The on-farm programs assume a lesser infiltration rate of 0.25 feet per day given canal turnout and field capacity limitations. For the joint-participation facility within the Greater Kaweah GSA, an infiltration rate of 0.75 feet per day is assumed due to differing soil types in that easterly region of the Subbasin.

Diversion capacity in existing conveyance facilities serving TID and city recharge locations is generally under-utilized in the months of January through June. TID operators indicate that 200 to 300 cfs of unused intake capacity is available during these months and at times more, even in wet years when irrigation demands are low. More is expected to be available with construction of the St. Johns and Lower Kaweah River Siphon improvement projects which are not included as GSP projects, but are part of the Capital Improvement Plan being pursued by TID to replace old infrastructure. The 2 siphon replacements will provide delivery resilience and improvements.

The recharge analysis combines the assumed surplus water availability data in Table 6-5, infiltration rates, and total acreage of the groundwater recharge projects included in Section 6.6 to produce an average annual recharge benefit for these projects in the aggregate. Based on relative acreage of each, individual recharge benefits are determined as well. For an assumed diversion rate of 200 cfs dedicated to new projects, the graph shown on Figure 6-17 depicts the relationship between maximum recharge capacities needed vs. average annual recharge achievements.

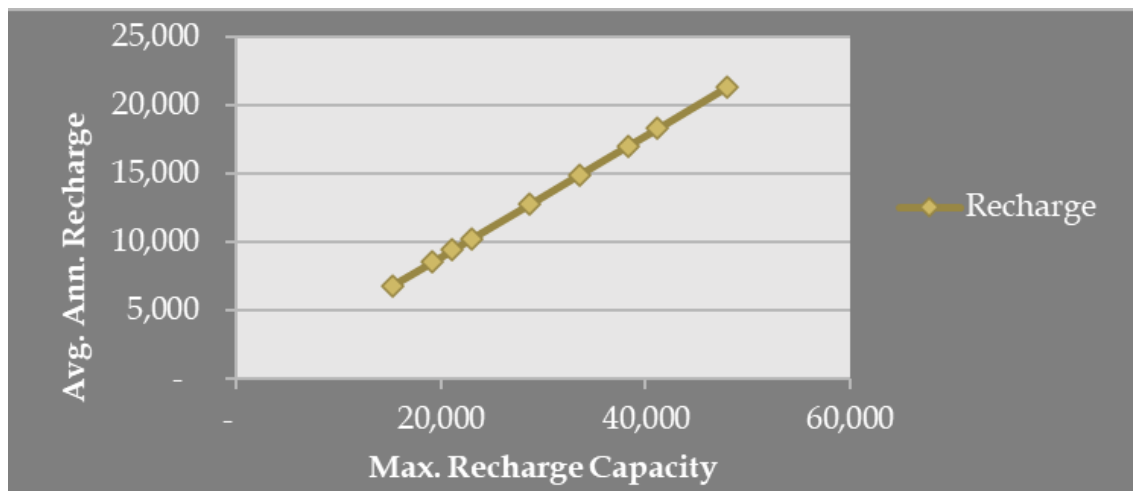


Figure 6-17. Recharge Capacities and Achievements
(values in acre-feet)

The full spreadsheet analysis from which the graph is derived is included for each project in Appendix 6H. The spreadsheets contained therein depict, on a yearly time step, the operation of the several recharge projects and their capture of wet-year surplus flows for added water budget benefits to the GSA area.

6.8.2 Flood Flow Capture Analysis

For new local surface storage projects, an approach similar to that applied in Section 6.8.1 was utilized, and Table 6-5 data for the Kaweah River system indicates 19 days (as adjusted by assumed climate change on Kaweah River runoff) on a weighted average basis during which surplus flows may be diverted into new surface storage. This surplus flow availability is overlaid against the historical hydrologic period to determine the frequency and storage volumes achievable for an assumed reservoir capacity. The full analysis over the aforementioned historical period of record is as depicted in Appendix 6H. The spreadsheets contained therein depict, on a yearly time step, the operation of the storage facility and its capture of flood waters over time to then be regulated for delivery into the GSA area.

6.8.3 Water Exchange Analyses

Similar to the determination of surplus water availability applied for recharge projects and as described in Section 6.8, this same methodology using TID’s projected surplus CVP sources was coupled with the exchanging entity’s projected local supply (WWTP treated effluent in the case of Visalia; local Kaweah water in the case of Sun World) to determine the net gains in water diverted into the GSA region and additive to its water budget over time. The full analysis over the aforementioned historical period of record for each of these exchange programs is depicted in Appendix 6E. The spreadsheets contained therein depict, on a yearly time step, the operation of the 2-way exchanges providing additional water to the GSA area.

6.8.4 Other Analyses

One in-channel recharge project, i.e., the Packwood Creek Water Conservation Project, has an associated calculation of average annual recharge quantities determined as part of a USBR WaterSMART grant application submitted by the KDWCD. That calculation is included in Appendix 6E.

7 GROUNDWATER SUSTAINABILITY PLAN IMPLEMENTATION

7.1 Schedule and Estimated Cost

§354.6 Agency Information. *When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:*

(e) An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.

Table 7-1 provides GSP implementation costs by activity and project and management action for 5-year periods. The 2020-2025 period includes actual costs through 2023. The project and management action schedule is indicated by the capital and O&M costs for each project and management action.

As described in Section 6.4, MKGSA's current strategy for GSP implementation is to lead with a Priority Track focused on demand management and immediate priority projects that are supported by the Secondary Track focused on groundwater supply enhancement projects. It is the intent of the Members to pursue all projects described in Section 6.6 with the understanding that each will exhibit specific and targeted benefits to individual Members as well as generalized added water benefits to the GSA region. Currently, reducing Subbasin groundwater pumping and limiting pumping from the lower aquifers are the priorities for the GSAs.

During implementation of this Plan and described in annual reporting and in Periodic Evaluations be provided to DWR (per §356.2(c) and 356.4 of the Regulations, respectively), assumptions regarding projects and management actions and associated objectives will be re-evaluated. Should some projects not be online and/or future hydrology prove inadequate to provide needed recharge supplies, the MO and IM triggers defined in Chapter 5 of the Plan will dictate more aggressive implementation of a groundwater allocation program as summarized in Section 6.7.1, in accordance with §354.44(b)(1)(A) of the Regulations.

As planning and permitting for applicable projects and management actions proceeds, the GSA shall use its Advisory Committee input, Communications and Engagement Plan, and existing stakeholder outreach efforts (all as summarized in Section 2.7 of this Plan) to inform the general public and stakeholders of the intent to pursue said projects and management actions. Similar public notification processes will be adhered to as required for CEQA and NEPA compliance where applicable for projects. The public notification process is to address §354.44(b)(1)(B) of the Regulations.

Table 7-1. Mid-Kaweah GSA Groundwater Sustainability Plan Implementation Costs and Schedule

	2020-2025			2025-2030		2030-2035		2035-2040	
	Capital Cost		Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost
	MKGSA Funded	Grant Funded							
1. Regular/Ongoing SGMA Compliance Activities									
GSA Administration	\$0	\$0	\$1,560,000	\$0	\$1,610,000	\$0	\$1,660,000	\$0	\$1,710,000
Outreach and Engagement (Included in GSA Admin)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Database Management System	\$13,230	\$0	\$18,000	\$0	\$6,180	\$0	\$6,400	\$0	\$6,600
Annual Reporting	\$0	\$0	\$199,750	\$0	\$128,750	\$0	\$132,600	\$0	\$136,600
GSP & Allocation Enforcement	-	-	-	-	-	-	-	-	-
Regular/Ongoing SGMA Compliance Activities Subtotal	\$13,230	\$0	\$1,777,750	\$0	\$1,744,930	\$0	\$1,799,000	\$0	\$1,853,200
2. GSP Amendments (Deficiency Amendments & Periodic Evaluations)									
Technical Consultant(s)	-	-	\$1,380,000	-	\$500,000	-	\$500,000	-	\$500,000
3. Plans to Fill Data Gaps									
Coordination and Implementation	-	-	\$210,000	-	\$250,000	-	\$250,000	-	\$250,000
4. Priority Projects (projects completed or in-process)									
P1: Cordeniz Basin	\$1,480,000	\$1,900,000	\$50,000	-	\$50,000	-	\$50,000	-	\$50,000
P2: Okieville Recharge Basin	\$600,000	\$1,900,000	\$20,000	-	\$50,000	-	\$50,000	-	\$50,000
P3: KDWCD/Visalia/Tulare ID Packwood Creek Linear Recharge Project	-	-	\$25,000	-	\$25,000	-	\$25,000	-	\$25,000
P4: On-Farm Recharge Program	-	-	-	-	-	-	-	-	-
P5: City of Visalia/TID Exchange Program	-	-	-	-	-	-	-	-	-
P6: MKGSA Groundwater Banking Operations	\$12,800,000	-	-	-	\$100,000	-	\$100,000	-	\$100,000
P7: Okieville Well #2 Resiliency Project	\$380,000	\$7,300,000	-	-	-	-	-	-	-
P8: Visalia/Tulare ID Cameron Creek Linear Recharge Project	-	-	-	\$2,200,000	\$25,000	-	\$25,000	-	\$25,000
P9: Visalia Eastside Regional Park/Groundwater Recharge Project	\$170,000	\$1,750,000	\$10,000	-	\$50,000	-	\$50,000	-	\$50,000
P10: Sun World International/TID Exchange Program	\$0	\$0	\$0	-	\$0	-	\$0	-	\$0
P11: Groundwater Resources Assessment Tools	-	-	\$50,000	-	\$50,000	-	\$50,000	-	\$50,000
P12: TID Existing Recharge Capacity Evaluations	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
P13: City of Tulare/TID Catron Basin	-	-	-	\$1,500,000	\$50,000	-	\$50,000	-	\$50,000
P14: McKay Point Reservoir	-	-	-	-	-	-	-	\$4,500,000	\$50,000
P15: Seaborn Reservoir	-	\$1,000,000	-	\$35,000,000	\$50,000	-	\$50,000	-	\$50,000
P16: Vadose Zone Well Battery Project	-	-	-	\$250,000	\$25,000	-	\$25,000	-	\$25,000
P17: Kaweah Subbasin Multi-Benefit Recharge Project	-	-	-	\$6,400,000	\$50,000	-	\$50,000	-	\$50,000
P18: TID/GSA Multi-Benefit Land Repurposing Recharge Basin	-	-	-	\$6,400,000	\$50,000	-	\$50,000	-	\$50,000
P19: TID/Friant Leveraged Exchange Program	-	-	-	\$0	\$0	\$0	\$0	\$0	\$0
Priority Projects Subtotal	\$15,430,000	\$13,850,000	\$155,000	\$51,750,000	\$575,000	\$0	\$575,000	\$4,500,000	\$625,000

	2020-2025			2025-2030		2030-2035		2035-2040	
	Capital Cost		Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost	Capital Cost	Annual O&M Cost
	MKGSA Funded	Grant Funded							
5. Priority Management Actions (management actions completed or in-process)									
MA1: Groundwater Extraction Allocation	\$150,000	-	\$150,000	-	\$375,000	-	\$375,000	-	\$375,000
MA2: Water Accounting Dashboard	\$250,000	-	\$50,000	-	\$500,000	-	\$500,000	-	\$500,000
MA3: Water Marketing Strategy	\$400,000	\$400,000	-	-	TBD	-	TBD	-	TBD
MA4: Kaweah Subbasin Mitigation Program and MKGSA Mitigation Plan	\$3,100,000	-	-	\$7,750,000	-	\$7,750,000	\$0	\$7,750,000	\$0
MA5: Small Community Well Proactive and Protective Action Plan	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
MA6: Well Registration Program	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
MA7: Well Permit Application Review and Technical Support	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
MA8: Collaboration with Other Agencies and inter-Basin Coordination (Regional Subsidence)	-	-	-	-	-	-	-	-	-
MA9: Subsidence Mitigation Surface Water Allocation System	-	-	-	-	-	-	-	-	-
MA10: Lower Aquifer Groundwater Allocation	-	-	-	-	-	-	-	-	-
MA11: Geophysical Data Survey Project	\$265,000	\$300,000	-	-	-	-	-	-	-
MA12: Urban Water Conservation	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
MA13: Ag Water Conservation and Management Program	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Priority Management Actions Subtotal	\$4,165,000	\$700,000	\$200,000	\$7,750,000	\$875,000	\$7,750,000	\$875,000	\$7,750,000	\$875,000
6. Optional Projects (projects to be considered if funding and stakeholder buy-in allows)									
P20: MKGSA Deep Well Injection Project	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
7. Optional Management Actions (management actions to be considered if funding and stakeholder buy-in allow)									
MA14: Replenishment Supply Allocation Program	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Totals	\$19,608,230	\$14,550,000	\$3,722,750	\$59,500,000	\$3,944,930	\$7,750,000	\$3,999,000	\$12,250,000	\$4,103,200
Five-Year Grand Totals	\$37,880,980			\$63,222,750		\$11,749,000		\$16,353,200	

7.2 Cumulative Accomplishments

The Subbasin's sustainability path has evolved since the inception of SGMA. During the development of the 2020 GSPs, the GSAs pursued water supply projects that could increase groundwater recharge activities to recover groundwater levels and avoid URs. Historically, this was the approach to solve groundwater problems. During the 2020-2022 drought period, however, it became apparent that relying on groundwater recharge projects would only be successful if there was a guarantee of enough wet years with excess water to recharge in developed recharge projects. Amid a drought and declining groundwater levels, the GSAs understood that demand management implemented through an allocation system was a priority to halt declining groundwater levels and continued overdraft. Achieving the Subbasin's sustainability goal relies on the GSAs' allocation systems to reduce groundwater extractions to within the sustainable yield.

Groundwater benefits from projects and management actions are a reduction of groundwater overdraft to stop the chronic lowering of groundwater levels and land subsidence. With increasing groundwater levels, benefits will also be realized for groundwater quality. The Kaweah Subbasin groundwater model provides a tool by which these benefits can be quantified. The model allows for the evaluation of individual project and management action benefits and cumulative benefits for individual GSAs and the Subbasin. As part of developing this amended GSP, a GSP Implementation scenario was used to determine the management actions and projects needed to avoid MTs and achieve MOs. Sections 6.6 and 6.7 describe the projects and management actions in the MKGSA area, respectively. Appendix 5F includes projected hydrographs for RMS to demonstrate avoidance of URs.

A difference between model-simulated annual groundwater extractions and the sustainable yield of 578,000 AFY (Section 3.4.6) approximates annual overdraft. Based on an implementation schedule of each GSA's projects and management actions, a 33% increase in managed aquifer recharge, and projected groundwater extractions that include a 34% reduction in irrigated agriculture pumping over current extractions, the graph on Figure 7-1 demonstrates the elimination of annual overdraft by 2040, which is sustained through the remainder of the planning horizon.

There is no 1 project or management action that can achieve sustainability in the Kaweah Subbasin. It will take coordinated effort by the 3 GSAs to reduce groundwater extractions and to maximize groundwater recharge.

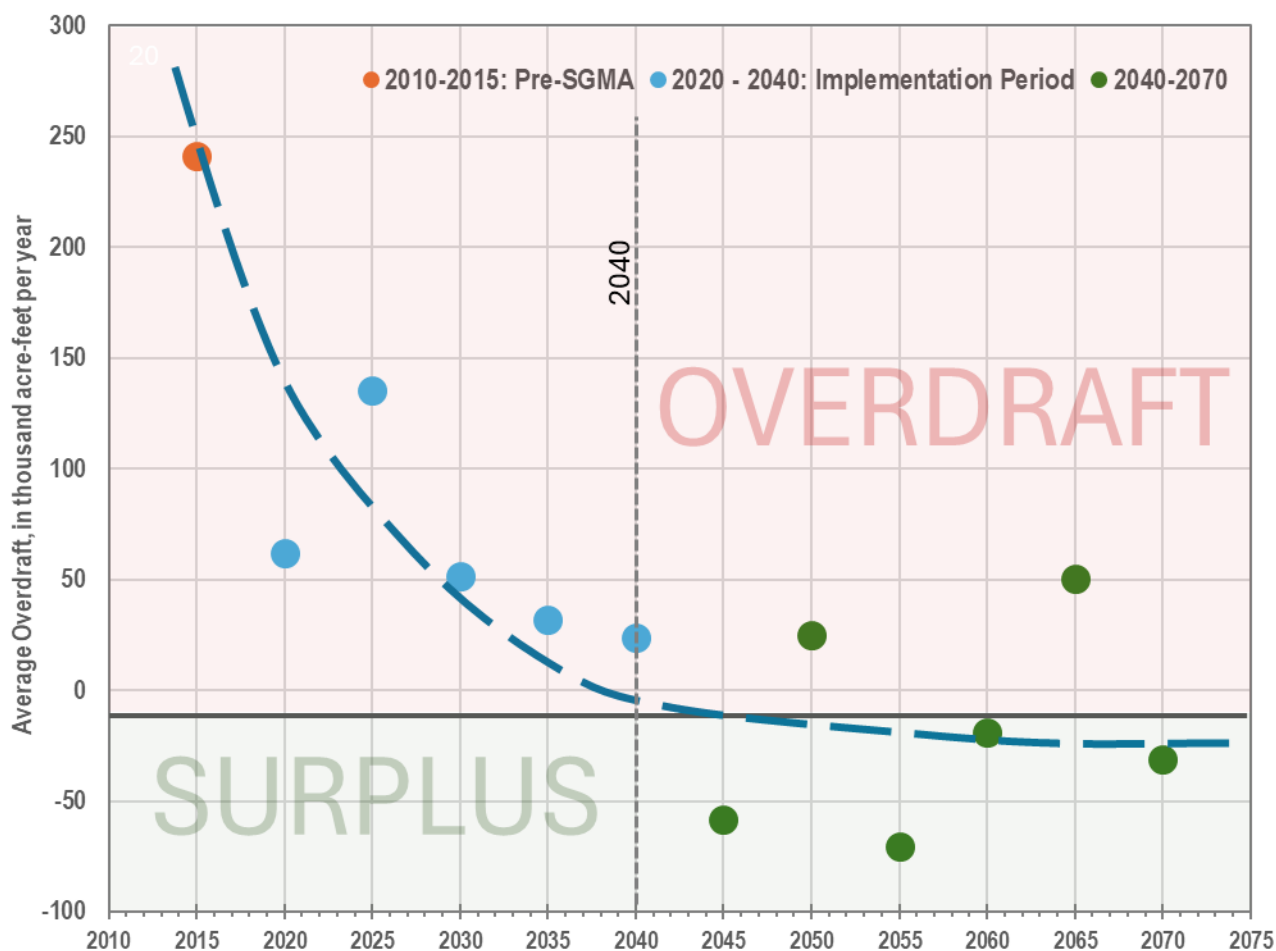


Figure 7-1. Kaweah Subbasin Overdraft Reduction Starting Pre-SGMA through 50-Year Planning Horizon

7.3 Data Management System

§ 352.6. Data Management System. Each Agency shall develop and maintain a data management system that is capable of storing and reporting information relevant to the development or implementation of the Plan and monitoring of the basin.

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

The Kaweah Subbasin DMS consists of 2 custom SQL databases. The HydroSQL database stores information about each monitoring site (well or surveying/benchmark site) in a stations table, and includes the following:

- Site Name (Local Site Name, State Well Number, Site Code)

- Site Location (X and Y Coordinates, Ground Surface Elevation and Reference Point Elevation, and Location and Elevation Accuracy and Source)
- Site Status
- Well Depth and Perforation Intervals
- Well Type and Use
- SMC (Suitability Indicators, MT/MO, and IM) for RMS

The HydroSQL database also stores related groundwater level and subsidence timeseries data. The timeseries data for groundwater levels include the following fields:

- Site Name
- Measure Date/Time
- Water Level Elevation (feet, NAVD88)
- Depth to Water (feet. bgs)
- Measurement Method and Accuracy
- Collecting Agency

The timeseries data for subsidence include the following fields:

- Site Name
- Sample Date/Time
- Cumulative Vertical Displacement (in feet) from a specified start date
- Land Surface Elevation (feet above sea level. NAVD88)

Water quality data are stored in the EnviroSQL database, which utilizes Enviro Data and is linked to HydroSQL for data management purposes. EnviroSQL contains water quality timeseries data, including the following fields:

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

Data used to populate the Kaweah Subbasin DMS are listed in Table ES- 6. Categories marked with an X indicate datasets that were used in populating the DMS, including data that are publicly accessible. Additional datasets will be added in the future as appropriate, such as recharge or diversion data.

Table ES- 6. Datasets Available for Use in Populating the DMS

Data Sets	Well and Site Information	Groundwater Level	Subsidence	Groundwater Quality
DWR (SGMA Data Viewer)	X	X	X	
CA Water Boards (GAMA Groundwater Information System)	X			X
DMS Provided by GEI			X	

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

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

The DMS also includes a publicly accessible web portal linked on each GSA’s website. The link via the MKGSA’s website is <https://portal.elmontgomery.com/?42>. The web portal provides stakeholders and the general public access to a web map that includes non-confidential hydrogeologic information used in the development of the GSP and annual reports. In the web map, users can view monitoring sites and attributes and create timeseries charts of groundwater level, groundwater quality, and subsidence timeseries data. Users can customize these timeseries charts, e.g., plot data for multiple sites, plot multiple timeseries, and display MT/MO threshold lines. In the web map, users can also turn on and off various geospatial layers compiled from public data sources, including the following:

- Land Use/Crops
- Streams and Canals/Ditches
- Recharge Basins
- Water Surface Elevation Contours
- Well Completion Reports and Household Water Supply Shortage Reports
- Parcels

- GSA Boundaries
- Groundwater Subbasin Boundaries
- Water District Boundaries
- Municipal Boundaries
- AEM Survey Lines
- Corcoran Clay Extent
- TRE ALTAMIRA InSAR Subsidence Data (Annual Vertical Displacement and Total Vertical Displacement rasters)

In addition, the web map provides functionalities for users to search for specific monitoring sites in the database, label, and mark sites, change base maps, draw and measure, and locate themselves on the map. The DMS and web map will be regularly updated as new information is made available to the Subbasin GSAs.

7.4 Reporting

§354.4 Reporting. Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.

The MKGSA together with the other 2 GSA will continue to develop and submit a Subbasin annual report by April 1 of each year. The annual reports will follow the guidelines set forth in §356.2 of the SGMA legislation. Per the guidelines, there will be 3 key sections in the report as shown in the outline below.

1. General Information
 - a. Executive Summary for the annual report
 - b. Location map of the region covered by the annual report
2. Basin Conditions
 - a. Groundwater elevation monitoring data, including contour maps and hydrographs
 - b. Groundwater extraction data
 - c. Surface water supply data
 - d. Total water use data
 - e. Change in groundwater storage, including maps and comparison to January 1, 2015
3. Progress of GSP implementation.
 - a. Progress on GSP implementation

b. Progress toward achieving sustainability

Additionally, MKGSA will re-evaluate and, if needed, amend its GSP at least every 5 years as prescribed in the SGMA Legislation. Periodic evaluations will include the result of Basin operations and progress in achieving sustainability. When a Periodic Evaluation is required, it will contain the information contained in DWR's *A Guide to Annual Reports, Periodic Evaluations, & Plan Amendments*⁸. Periodic evaluations track progress using current groundwater conditions, status of projects or management actions, evaluation of URs relating to MOs and MTs, changes in the monitoring network, summary of enforcement or legal actions, and agency coordination efforts. This is in accordance with SGMA law §356.4. Periodic Evaluation by Agency.

Certain components of the GSP may be re-evaluated more frequently than every 5 years, if deemed necessary. For example, this may occur if sustainability goals are not being met, additional data are acquired that change understanding of the Subbasin or operations, or priorities change. While the MKGSA is evaluating key components of the GSP, such as SMC, it will seek feedback from stakeholders through a public process utilizing adequate and appropriate materials. Decisions will be made at public board meetings and coordinated at the Subbasin level. Results from these processes and any changes will be incorporated into the GSP when it is resubmitted to DWR at least every 5 years.

⁸ <https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/GSP-Implementation-Guidance-Report.pdf>

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