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4CREEKS

GREATER KAWEAH
GROUNDWATER
SUSTAINABILITY
AGENCY

GROUNDWATER SUSTAINABILITY PLAN

2ND AMENDED
OCTOBER 2024

PUBLIC REVIEW DRAFT

OCTOBER 2024 VERSION



PUBLIC REVIEW DRAFT

2024 Second Amended Groundwater Sustainability Plan

Greater Kaweah Groundwater Sustainability Agency

October 2024

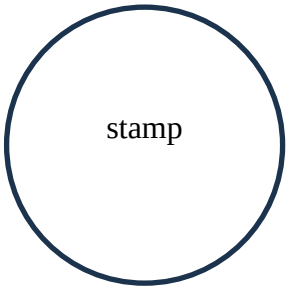
Prepared under the Kaweah Subbasin Coordination Agreement with Mid-Kaweah GSA and East Kaweah GSA

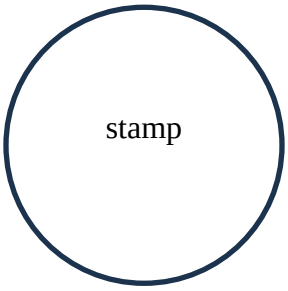
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Appendices

Appendices correspond with GSP Section. Note that there is no Appendix to Chapters 7 or 8.

Appendix 1

1A Letter of Intent to form GSAs

1B 2022 First Amended Kaweah Subbasin Coordination Agreement

Appendix 2

2A Greater Kaweah GSA Joint Powers Agreement and Bylaws

2B Greater Kaweah GSA Communication and Engagement Plan

2C DWR Stakeholder Communication and Engagement Guidance Document

2D Public Comment Summary

Appendix 3

3A Kaweah Subbasin, Basin Setting Components

3B Technical Analysis to Support the Establishment of Sustainable Management Criteria for Degraded Groundwater Quality Sustainability Indicator3C Kaweah Subbasin Groundwater Modeling Report

3D Interconnected Surface Water Analysis and Sustainable Management Criteria Technical Memorandum

Appendix 4

4A KDWCD Groundwater Management Plan

4B KBWQA Groundwater Trend Monitoring Workplan

Appendix 5

5A Chronic Lowering of Groundwater Levels and Reduction of Groundwater Storage SMC Technical Memorandum

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 SMC Hydrographs

5E Development and Use of a One-Dimensional Model for Land Subsidence in the Kaweah Subbasin Technical Memorandum

5F Projected Representative Monitoring Site Hydrographs

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

Appendix 6

6A Kaweah Subbasin Mitigation Program

6B Greater Kaweah Groundwater Sustainability Agency Mitigation Plan

6C Friant-Kern Canal Monitoring and Action Plan (FMAP) Technical Memorandum

6D Regional Subsidence Monitoring and Action Plan (RSMAP) Development Strategy

ACRONYMS & ABBREVIATIONS

1,2,3-trichloropropane……TCP
AEM.....Airborne Electromagnetic Surveying
AF .....acre-feet
APPS.....Automatic Precise Positioning Service
ASO.....NASA's Airborne Snow Observatory
BMP .....Best Management Practice
Board.....State Water Resources Control Board
C&E .....Communications and Engagement
Cal OES .....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
CIT .....California Institute of Technology
CORS .....continuously operating reference station
CVP.....Central Valley Project
CVPIA.....Central Valley Project Improvement Act
CWSC .....California Water Service Company
DGPS .....Differential GPS
DMS.....Data Management System
DWR .....California Department of Water Resources
EKGSA .....East Kaweah Groundwater Sustainability Agency
FEMA .....Federal Emergency Management Agency
gpcd.....gallons per capita per day
GEI.....GEI Consultants, Inc.
GKGSA.....Greater Kaweah Groundwater Sustainability Agency
GIPSY-OASIS .....Inferred Positioning System and Orbital Analysis Simulation Software
GNSS .....Global Navigation Satellite System
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
ITRC .....Irrigation Training & Research Center
JPA.....Joint Powers Authority
JPL .....Jet Propulsion Laboratory

KDWCD .....Kaweah Delta Water Conservation District
KSHM.....Kaweah Subbasin Hydrologic Model
KSJRA .....Kaweah and St. Johns River Association
MA .....Management Area
MAF.....Million Acre Feet
MCL.....Maximum Contaminant Level
MKGSA .....Mid-Kaweah Groundwater Sustainability Agency
MO .....Measurable Objective
MSL .....Mean Sea Level
MT.....Minimum Threshold
NASA.....National Aeronautics and Space Administration
NAVD88 .....North American Vertical Datum of 1988
NDVI.....Normalized Difference Vegetation Index
NEPA .....National Environmental Policy Act
NGO.....Non-Governmental Agency
OPUS .....Online Positioning User Service
PPP.....Precise point positioning
RO.....Reverse Osmosis
RP.....Reference Point
SCADA.....Supervisory Control and Data Acquisition
SGMA.....Sustainable Groundwater Management Act
SJRRP .....San Joaquin River Restoration Project
SMARA .....Surface Mining and Reclamation Act
SMC.....Sustainable Management Criteria
SOP .....Standard Operating Procedure
SOR.....System Optimization Review
SWRCB.....State Water Resources Control Board
TAF.....Thousand acre-feet
TDS.....Total Dissolved Solids
TID.....Tulare Irrigation District
UWMPs.....Urban Water Management Plans
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 Greater Kaweah Groundwater Sustainability Agency's GSP.

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.
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 et seq.
Annual report	The report required by Water Code Section 10728.
Areal Electro Magnetics – SKYTEM	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.
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 et seq., or as amended.
Coordination agreement	A legal agreement adopted between two 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 GKGSA, "current water budget" refers to the period between water years 1999 and 2022. For the Kaweah basin this was the period over which the best data and information were available to calculating a water budget. Because this period has the lowest degree of uncertainty in terms of quantification of each water budget component, it was this period that was used for calibrating and verifying the numerical groundwater budget during the development of the 2020 GSP. This period is distinguished from the Historical Water Budget (1999-2022) and the projected future water budget (2023-2072).
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.
De minimis 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 GKGSA 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 (commencing 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 GKGSA "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 budget (be prepared) starting with the most recently available information (2022 in the case of Kaweah 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 five 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.
Key Well	Wells preliminarily selected for the Kaweah Subbasin to establish a consistent, long-term source of data to monitor water levels in various aquifers over the long-term.
Land surface subsidence	The inelastic compaction that typically occurs in the fine-grained beds of the aquifers and in the aquitards due to the one-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 parameter such as hydraulic conductivity of aquifer storativity to improve the match between simulated and empirical data. During the development of the Kaweah GSPs only limited calibration us performed including adjusting only hydraulic conductivity of all three model layers between verifications runs in order to improve the match of simulated and empirical data. Calibration can be very time consuming and

	expensive, so the consulting team was only able to complete limited calibration give the time and budget constraints that existing during development of the 2020 GSPs. Calibration recommendations have been provided completion in the future as funding becomes available.
Model verification	Groundwater model runs performed for the purpose of checking or verifying how well the model generated heads match empirical values at key wells.
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	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 water levels were to decline below, the well is assumed to experience operational impacts. 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 water table 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 one 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 one 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 five 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.
Undesirable result	A combination of minimum threshold exceedances that that quantitatively reflect the presence of significant and unreasonable effects. Undesirable result is not defined in the Regulations. However, the description of undesirable result states that it should be a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the subbasin. 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 et seq.
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(A)]

§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 resources management. SGMA provides a statewide framework for groundwater management by locally formed Groundwater Sustainability Agencies (GSAs). The Greater Kaweah Groundwater Sustainability Agency (GKGSA) was formed in 2015 to satisfy the requirement for a GSA to cover a portion of the Kaweah Subbasin, alongside 2 additional GSAs of the Kaweah Subbasin: East Kaweah GSA (EKGSA) and Mid-Kaweah GSA (MKGSA) (Figure ES-1). The Kaweah Subbasin is surrounded by the Kings Basin to the north, Tulare Lake Subbasin to the west, and Tule Subbasin to the south (Figure ES-2).

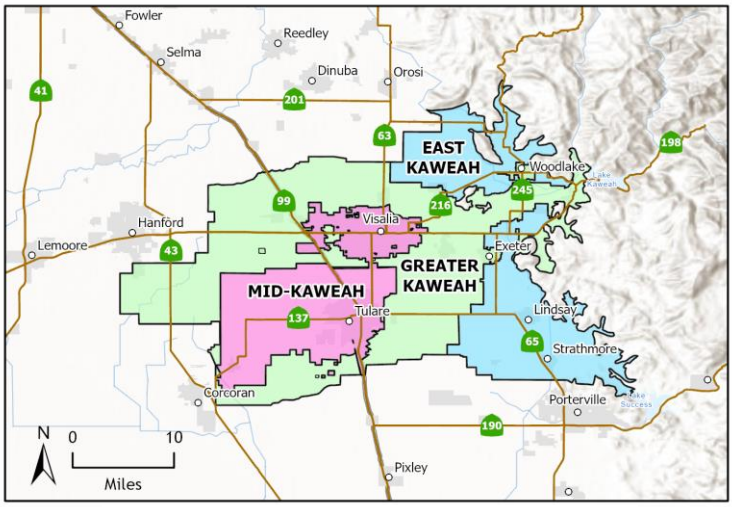


Figure ES-1. Kaweah Subbasin Groundwater Sustainability Agencies

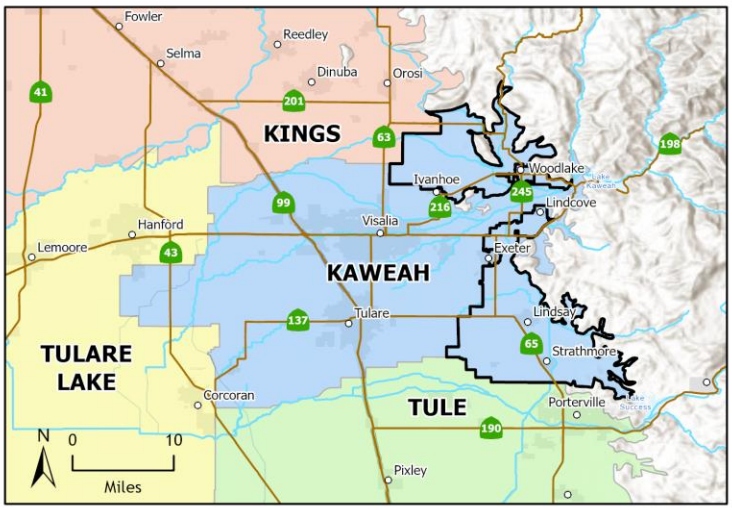


Figure ES-2. Neighboring Subbasins

Following submittal of an initial notification in 2017, GKGSA began development of the initial Groundwater Sustainability Plan (GSP) to comply with SGMA's statutory and regulatory requirements and initiated planning by engaging with stakeholders and holding public meetings. This GSP is the second amended GSP, following a first amended GSP adopted in 2022 to address comments and plan deficiencies identified by the California Department of Water Resources (DWR). This GSP includes greater protections for the most vulnerable beneficial users, uses and property interests through revised sustainable management criteria, coordinated methodology between GSAs and surrounding Subbasins, consistency between different sustainability indicators'

sustainable management criteria, and a clarified sustainability path with 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 GKGSA 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 pursuant to the SGMA, while establishing long-term reliability no later than 20 years from GSP adoption.

The content of the GSP includes administrative information, description of the basin setting, development of quantitative sustainable management criteria that consider the interests of all beneficial uses and users of groundwater, identification of projects and management actions and monitoring networks that will ensure the Basin is demonstrably managed in a sustainable manner no later than the 20-year sustainability timeframe and for the duration of the entire 50-year planning and implementation horizon.

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

ES-2. Plan Area

The GKGSA jurisdictional area is approximately 340 square miles (50% of the subbasin) and is situation across the subbasin, from an apex on the eastern side where the Kaweah River enters the subbasin to the western side. The East Kaweah GSA area is located on the eastern flank of the subbasin and is bisected by GKGSA. The Mid-Kaweah GSA area is located within the central to western side of the subbasin and is surrounded by GKGSA, except for a portion of its western boundary.

KDWCD is the primary local agency that measures groundwater levels at numerous wells within the GKGSA area along with DWR for the California Statewide Groundwater Elevation

Monitoring (CASGEM) program. KDWCD has also established land subsidence monitoring stations throughout the subbasin.

General plans have been prepared by Tulare and Kings Counties and by the Cities of Exeter, Farmersville, and Woodlake. These plans promote the conservation of water and the protection of the quantity and quality of groundwater in their respective areas. The GKGSA will support these polices and work for improvements, as necessary, during the implementation of the GSP. Public outreach was included in the development of the GSP to address the interests of beneficial uses and users of groundwater. GKGSA conducted a voluntary online survey of users and held focused meetings with various organizations during 2019 as well as conducting regular meetings of the Board of Directors, the Technical Advisory Committee, the Rural Communities Committee, and the Stakeholders Committee.

ES-3. Basin Setting

Chapter 3 provides summary information for the GKGSA portion of the basin setting, which was developed for the entire subbasin and presented in **Appendix 3A**. 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 comprises the southern portion of the Great Central Valley of California. The Sierra Nevada rise along its eastern boundary, the coast ranges hem the valley into the west, and the Tehachapi Mountains rise to the south. Continental deposits shed from the mountains form an alluvial wedge that thickens from the valley edges toward the axis of the structural trough. This process, in addition to periodic inundation by the Pacific Ocean, has resulted in an accumulation of sediments up to 32,000 feet thick

The basin setting is comprised of a hydrogeologic conceptual model, groundwater conditions, and a water budget.

Groundwater Conditions

Sustainability indicators are the effects caused by groundwater conditions that are occurring within a basin that, when significant and unreasonable, become undesirable results. To effectively plan to mitigate against and avoid undesirable results, it is important to establish the historical and current groundwater conditions for each sustainability indicator. These sustainability indicators include:

1. Chronic lowering of groundwater levels
2. Land Subsidence
3. Reduction in groundwater storage
4. Degraded groundwater quality
5. Depletions of interconnected surface water
6. Seawater intrusion (not applicable to the Kaweah Subbasin)

The sustainability indicators and their respective historical and current groundwater conditions are summarized below.

In general, groundwater flows across the GKGSA in a southwesterly direction and to local cones of depression during the irrigation season. A single aquifer is present in the eastern half of the subbasin but is split into two aquifers by the Corcoran Clay in the western half. The vertical flow gradient is from shallow to deep conditions.

Groundwater elevations naturally experience periods of drawdown and recovery due to seasonal fluctuations, variations in precipitation patterns, and changes in surface water availability. This natural variability is impacted by anthropogenic causes, including groundwater pumping and the diversion of natural surface water features. The impacts of human activity on the groundwater supply of the GKGSA are evident from some of the earliest historical records

Land Subsidence

Land subsidence due to overpumping has occurred throughout the San Joaquin Valley during the last 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. 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. Groundwater levels throughout the majority of the Kaweah Subbasin do not appear to support Interconnected Surface Waters or Groundwater Dependent Ecosystems (GDEs). However, data availability are limited at this time and additional work is proposed under a new work plan included in the Management Actions Section 6.7 to better understand interconnected surface water presence and nexus of depletions due to groundwater pumping, if any.

Groundwater Quality

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. The GAMA dataset provides a foundation for understanding baseline groundwater quality and identifying specific Constituents of Concern (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).

The COCs in the Kaweah Subbasin include:

Nitrate as N
1,2,3-Trichloropropane (1,2,3 TCP)
Gross Alpha
Uranium

Arsenic	Specific Conductivity
1,2-Dibromo-3-chloropropane (DBCP)	Chloride
Perchlorate	Sulfate
Tetrachloroethene (PCE)	pH
Chromium, Hexavalent (Cr6)	Sodium
Total dissolved Solids	Boron

Interconnected Surface Water

Interconnected Surface Water 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]). 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.

The Kaweah Subbasin recognizes the limitations that data gaps present for establishing SMC for depletions of ISW. Until these data gaps are resolved via the Interconnected Surface Water Data Gap Workplan (section 6. 7. 12), the best data, information, will continue to be used to evaluate depletions of interconnected surface water. In the interim, the surface waterbodies with potential interconnected are shown in Figure ES-3. See Appendix 3D for a comprehensive evaluation of the best available data, tools, and information on interconnected surface water in the Kaweah Subbasin as well as a discussion on the data gaps and plan to fill them.

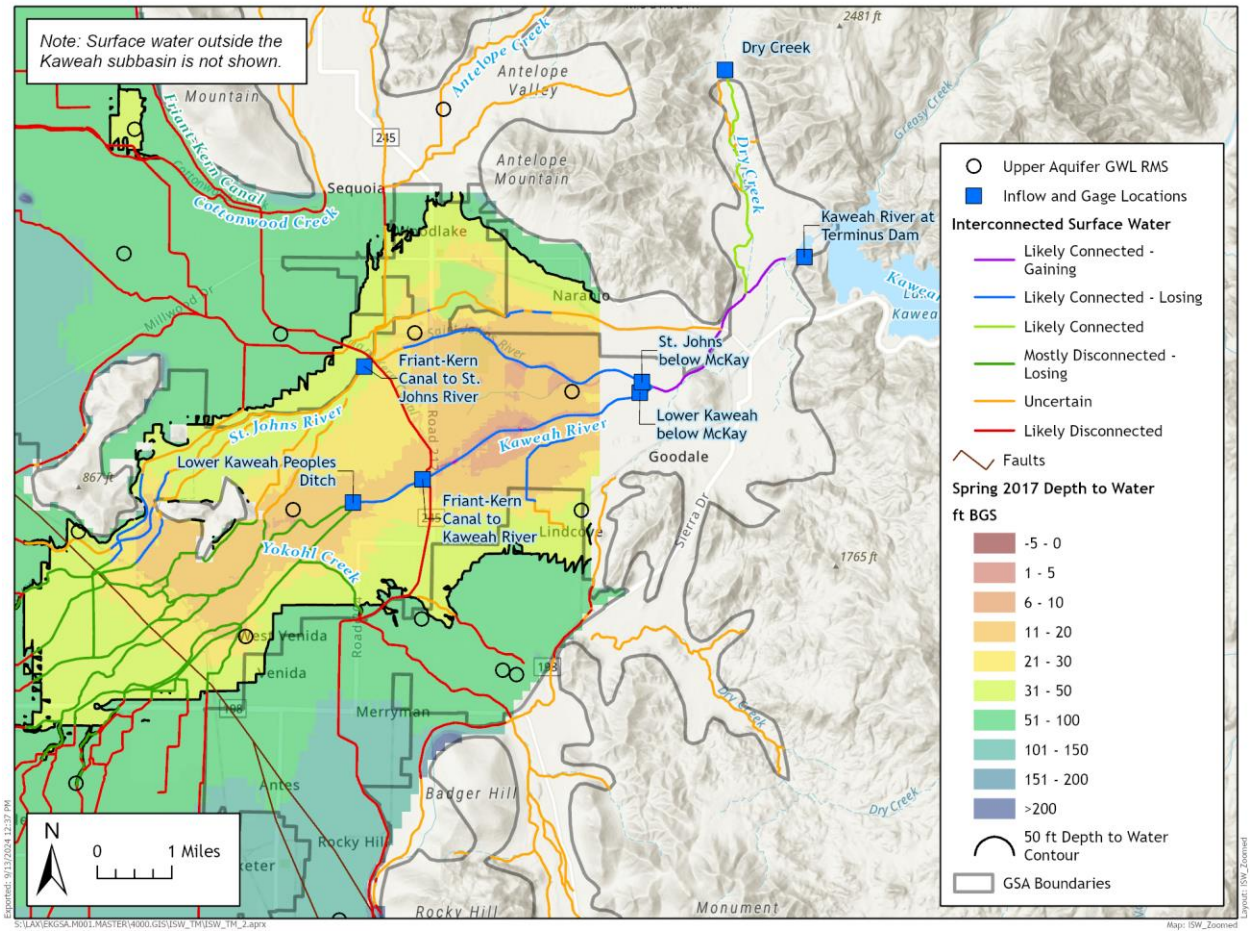


Figure ES-3. Potentially Interconnected Surface Water in the Kaweah Subbasin

Seawater Intrusion

Seawater intrusion is not an issue in the GKGSA or the Kaweah Subbasin as a whole because of the significant distance from coastal conditions.

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, which combined, serve as the 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. A diagram of the groundwater budget inflow and outflow components is available in Figure ES-4 and a diagram of the land surface budget inflow and outflow components are available on Figure ES-5.

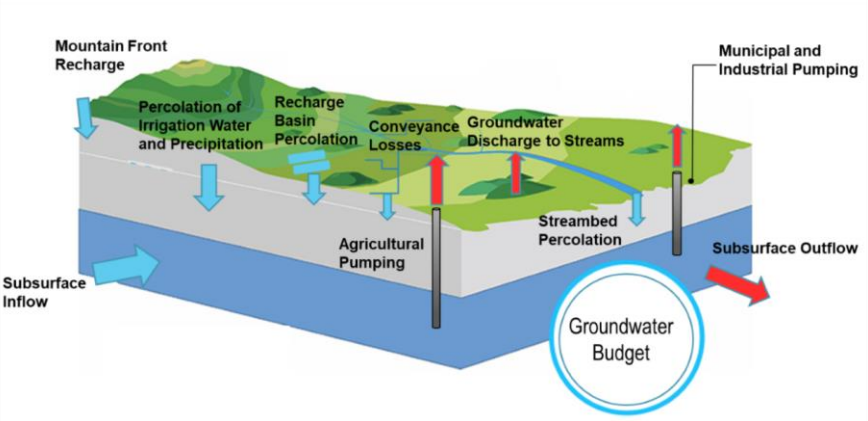


Figure ES-4. Diagram of Groundwater Budget Components

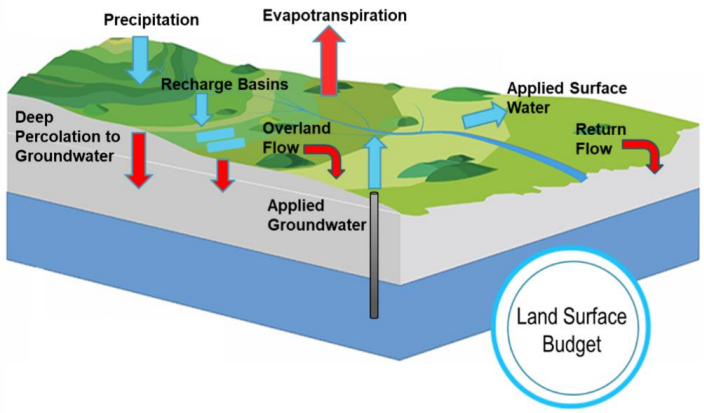


Figure ES-5. Diagram of Land Surface Budget Components

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 approximately 230,700 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 undesirable results, 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.

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 undesirable results 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 undesirable results 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.

ES-4. Monitoring Networks

Monitoring is the method by which progress towards reaching and maintaining the sustainability goal is ascertained. The Kaweah Subbasin and GKGSA representative monitoring network includes monitoring sites from existing programs and newly installed sites dedicated to monitoring for SGMA and other purposes. The representative monitoring network is organized in four parts: (1) groundwater level representative monitoring network, (2) groundwater quality representative monitoring network, (3) land subsidence monitoring network, and (4) interconnected surface water representative monitoring network.

ES-5. Sustainable Management Criteria

Sustainable Management Criteria (SMC) were developed using the best available science and information for the Subbasin, involved the stakeholder engagement process , and were developed in coordination with all three GSAs and their respective technical teams and stakeholder committees.

Establishing limits to avoid undesirable results through minimum thresholds is equally important to establishing the sustainability goal to design measurable objectives, policies, projects and management actions, and adaptive strategies to achieve sustainable conditions by 2040. The sustainability goal for the Kaweah Subbasin is as follows.

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.

GKGSA, along with the other two GSAs, characterized undesirable results and established minimum thresholds, measurable objectives, and interim milestones 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).
5. Depletion of Interconnected Surface Water (Section 5.9).

The seawater intrusion sustainability indicator is not applicable in the Subbasin because of the significant vertical and horizontal separation between the Subbasin and the Pacific Ocean.

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

1. First, potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other effects were evaluated and described qualitatively.

2. The qualitative statement on potential effects was then translated and quantified into minimum thresholds at specific monitoring network sites.

3. Lastly, a combination of minimum threshold exceedances representing undesirable results in the Basin was established.

The Kaweah Subbasin's priorities in revising SMC for this 2nd Amended GSP are summarized in Figure ES-5.

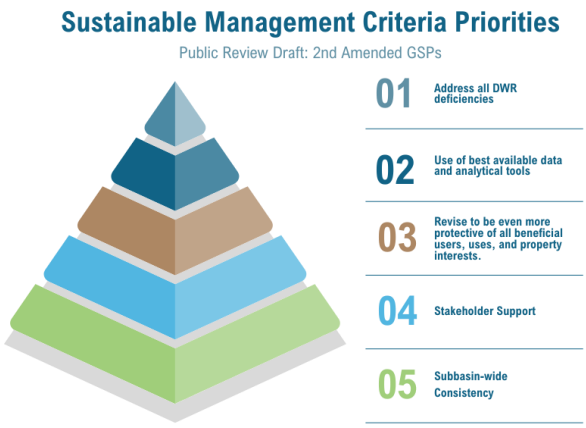


Figure ES-5. Sutainable Management Criteria Process Priorities

ES-6. Projects and Management Actions

Two primary tools for sustainable groundwater management are project development for water supply augmentation and management actions for data collection and demand reduction. The goal of the GKGSA was to first develop projects to augment and/or better use the surface water supply to overcome groundwater overdraft, however, since it is now understood that project development alone is unable to achieve the desired goals (i.e., avoiding Undesirable Results and achieving Measurable Objectives), therefore, management actions and programs have been employed in addition to construction and operation of new projects.

Chapter 6 provides a description of 16 projects and 18 management actions to enable the GKGSA to succeed at the sustainable management of its groundwater resources. The options include improvements to existing recharge basins, new recharge and storage facilities, changes in operations to gain access to wet-year flows that would previously pass through the subbasin, agricultural and urban conservation, and fallowing as well as further study of wells and the subbasin plus assistance with impaired wells. In addition, the potential use of flow meters would facilitate the application of several management programs, including fees and incentives, a groundwater market, and groundwater allocations.

A key component of this 2nd amended GSP is the establishment of a Subbasin Mitigation Program and GSA-specific Mitigation Plans that establishes requirements 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 by providing funding for replacement wells, well modifications, alternative water supplies, or critical infrastructure (if applicable) improvements to eligible landowners.

ES-7. GSP Implementation

Implementation of the GKGSA 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 DWR and State Water Resources Control Board (SWRCB) comments

1 INTRODUCTION TO THE KAWEAH SUBBASIN SECOND GROUNDWATER SUSTAINABILITY PLAN AMENDMENT

1.1 Introduction[§354]

§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.

This second amended Groundwater Sustainability Plan (GSP) covers the Greater Kaweah Groundwater Sustainability Agency's (GKGSA'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 California Department of Water Resources (DWR) Bulletin 118] (DWR, 2003, 2016), occupying some 700 sq. miles within the larger San Joaquin Valley Basin, is situated primarily within Tulare County, California. 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 consist of the local Kaweah River system, as well as the 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 agricultural lands possess a mix of surface supplies as well as groundwater, depending on location. The Subbasin is considered to be in critical overdraft, estimated to average 104,000 acre-feet (AF) per year. Land subsidence caused by historical groundwater overdraft is an issue also faced by the Subbasin. Groundwater quality concerns related 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.

Purpose [§354]On September 16, 2014, Governor Jerry Brown signed into law a three-bill legislative package, composed of AB 1739 (Dickinson), SB 1168 (Pavley), and SB 1319 (Pavley), collectively known as the Sustainable Groundwater Management Act (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.

SGMA requires governments and water agencies of high and medium priority basins to achieve sustainability by avoiding undesirable results. 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 Greater Kaweah Groundwater Sustainability Agency (GKGSA) 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 determination[1] was made because actions taken to correct identified deficiencies were not sufficient. Two of the 3 deficiencies apply to the GKGSA 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 sustainable management criteria 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 GKGSA GSP addresses SGMA compliance aspects in a coordinated fashion with the 2 other Subbasin GSAs (EKGSA and MKGSA). The 8 chapters of this Plan, which in general introduce the GKGSA, describe the basin setting, monitoring networks, Subbasin sustainability goals, and sustainable management criteria (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 GKGSA boundaries. In order to comply with the requirements of SGMA, GKGSA and the 2 other Kaweah GSAs contracted with GEI Consultants, Inc. (GEI) for development of the basin setting 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.

[1] https://sgma.water.ca.gov/portal/service/gspdocument/download/9589

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 GKGSA and the Kaweah Subbasin.

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

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

Identify and describe the Undesirable Results for applicable sustainability indicators, as they pertain to the GKGSA.

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

Chapter 6: Define and describe Projects and Management Actions proposed by GKGSA 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

1.2 Agency Information [§354.2 and §354.6(a),(b),(c)]

§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 Name:	Greater Kaweah GSA
Agency Address:	2975 Farmersville Rd, Farmersville, CA
Agency Phone Number:	(559) 747-5601

Agency Fax Number:	(559) 747-1989
Agency Website:	greaterkaweahgsa.org
Contact Person:	Mark Larsen
Contact Person Title:	General Manager

Letter of Intent to Form GSAs: See Appendix 1A

The GKGSA is a joint powers authority formed by five member agencies. The board of directors is comprised of one representative from each member agency, except the Kaweah Delta Water Conservation District (KDWCD), which is allotted two representatives. In addition, the board of directors includes one representative from the Rural Communities Committee, one representative from the Stakeholder Committee, and one representative from California Water Service Company. The total number of directors is nine.

Currently, the only staff of the GKGSA is a General Manager and one technical support staff, whose services are contracted through KDWCD, a member agency of the GKGSA. Staff from KDWCD is available to assist the General Manager as needed. The General Manager of the GKGSA, at the direction of the GKGSA board of directors, is the person with management authority for implementation of the Plan.

As agreed to in the Coordination Agreement, attached hereto and incorporated by reference as Appendix 1B, the Plan Manager for the Kaweah Subbasin is the General Manager for the GKGSA, currently Mark Larsen, whose contact information is located above.

1.3 Legal Authority [§354.6(d)]

§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.

On August 23, 2016, the Kaweah Delta Water Conservation District (KDWCD), the Kings County Water District, the Lakeside Irrigation Water District, St. John's Water District, and the Tulare County entered into a Joint Powers Authority (JPA) Agreement to form the Greater Kaweah Groundwater Sustainability Agency (GKGSA). Under this JPA Agreement, the GKGSA was granted the Authority to complete all acts necessary for the exercise of all powers authorized under SGMA and necessary to satisfy the requirements of SGMA. This JPA Agreement is included in **Appendix 2A**.

1.4 GSP Implementation Costs [§354.6(e)]

§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 GKGSA, on behalf of its member agencies, will incur costs to implement its GSP and maintain the plan via annual reports and 5-year updates. These costs and sources of funding are described below.

Table 1-1 presents an estimate of the costs associated with the implementation of the GKGSA GSP and measures associated with SGMA compliance.

Table 1-1: Estimated Costs for GSP Implementation

Item	Description	Estimated Cost
Annual Monitoring	Equipment, vehicles, SCADA, software	$100,000
Projects	Projects with estimated capital or startup costs per Section 7	$43,000,000
Management Actions	Management Actions with estimated annual costs per Section 7	$7,000,000
Annual Report	Compilation per DWR Regulations	$25,000
5-Year GSP Update and Report	Compilation per DWR Regulations, Assessment Report	$250,000
GSA / GSP Administration	Administration, Legal, Data management, Enforcement, other	$500,000

1.5 Agency Coordination [§354.8(c)]

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

(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.

The three Kaweah Subbasin GSAs worked to coordinate the Subbasin-wide sustainability goal,

undesirable results, and SMC, among many other items pertaining to this GSP. The Coordination Agreement submitted with this GSP is included as Appendix 1B.

2 PLAN AREA [§354.8]

The GKGSA 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 Subbasin to the south, and the Sierra Nevada Mountains to the east. The Kaweah and St. Johns Rivers and Cottonwood and Mill Creeks flow through the northern portion of the GKGSA jurisdictional area, from the Sierra Nevada Mountains, turning southwest and draining toward the Tulare Lake Basin. The GKGSA is roughly bisected by California State Highway 99 and the Mid-Kaweah GSA is located within the west-central portion of the GKGSA. The following section describes the area covered by the GKGSA GSP.

2.1 Geographic Area Covered [§354.8 (a)(1),(2)]

§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.

As shown in **Figures 2-1 and 2-2**, the GKGSA's jurisdictional area (343 square miles) represents nearly half (49%) of the area within the Kaweah Subbasin (696 square miles), with boundaries coincidental to the boundaries of the Mid-Kaweah GSA, the East Kaweah GSA, and the perimeter of the Kaweah Subbasin. The GKGSA is adjacent to the Kings River Subbasin to the north, Tule Subbasin to the south, the Tulare Lake Subbasin to the west, and the foothills to the Sierra Nevada Mountains to the east. The Mid-Kaweah GSA is located within the west-central portion of the GKGSA area in the vicinity of Visalia and Tulare and west of Tulare.

2.2 Plan Area Setting [§354.8(a)(4)]

§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.

The GKGSA 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 (see **Figure 2-1**). The Kaweah Subbasin is bounded by the Kings River Subbasin to the north, the Tulare Lake Subbasin to the west, the Tule Subbasin to the south, and the Sierra Nevada Mountains to the east. The Kaweah and St. Johns Rivers and Cottonwood and Mill Creeks flow through the northern portion of the GKGSA jurisdictional area, from the Sierra Nevada Mountains, turning southwest and draining toward the Tulare Lake Basin. The GKGSA is roughly bisected by

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Land use within the GKGSA consists mainly of field crops, grain and hay crops, or pasture west of California State Highway 99, as shown in **Figure 2-7**. The eastern portion of GKGSA, outside of the City of Visalia, is mostly deciduous fruit and nut trees with grain and hay crops in the southeastern portion of the GKGSA area. The areas within the limits of the GKGSA include the cities of Exeter, Farmersville, and Woodlake are classified as urban, as are the service areas for Ivanhoe Public Utility District, Patterson Tract Community Service District, and Tract 92 Community Service District.

GKGSA has, and may still, consider establishing Management Areas (MAs) within the GSA boundaries, as appropriate to facilitate the compliance with sustainability goals. New MAs will be included in future revisions of the GSP. This section addresses §354.20(b) and (c) of the GSP Regulations for MAs.

2.3 Jurisdictional Boundaries within Plan Area [§354.8(a)(1),(2),(3)]

§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.

Within the GKGSA jurisdictional area, population centers include three incorporated cities and several unincorporated communities. The City of Exeter, the City of Farmersville, and the City of Woodlake are completely located within the GKGSA. A portion of the City of Hanford is also located in the western portion of the GKGSA. Unincorporated communities within the GKGSA area include Goshen, Ivanhoe, Tract 92, and Patterson Tract, as shown on **Figure 2-2**. In addition, **Figure 2-1** shows various water conveyance systems within the Kaweah Subbasin while **Figure 2-2** shows the jurisdictional areas of the KDWCD, Kings County Water District (KCWD), St. Johns Water District, and Lakeside Irrigation Water District within the GKGSA

area. Other groundwater users include numerous *de minimus* domestic wells and multi-parcel water systems within the GKGSA, which will be covered by this GSP.

2.3.1 Local Agencies within Plan Area [§354.8(a)(1)]

The lands located within the service areas of KCWD, KDWCD, Lakeside Irrigation District, and St. Johns Water District may have access to both surface water supply and groundwater supply. The incorporated communities, community service districts (CSDs), public utility districts (PUDs), and undistricted lands within the GKGSA area are supplied by groundwater only. Refer to **Figure 1-2** for the locations of these areas within the GKGSA.

Each of the three incorporated cities in GKGSA'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 elements are to be considered in this GSP.

2.3.2 State and Federal Agencies within Plan Area [§354.8(a)(3)]

The member agencies of the GKGSA have existing relationships with state and federal regulatory agencies. Local supplies are impounded by the Terminus Dam, which is owned and operated by the US Army Corps of Engineers (ACOE). The Kaweah and St. Johns River Association, managed by KDWCD staff, works closely with the ACOE on both water supply and flood control for local supplies. In addition, KDWCD is a CVP, Friant Division Contractor with the US Bureau of Reclamation and remains in close communication regarding importation of CVP water.

2.3.3 Tribal Lands within Plan Area [§354.8(a)(3)]

There are no tribes with designated tribal lands within the GKGSA's boundaries. Per the Native American Heritage Commission (NAHC's) letter response, the record search of the NAHC's Sacred Lands File identified that the Wuksache Indian Tribe/Eshom Valley Band has a sacred land in the area known as Rocky Hill. The Rocky Hill area is in the foothills east of the City of Exeter and is presumed to be outside both the boundaries of the GKGSA and Kaweah Subbasin. Section 2.7.19 further describes a list of several California Native American Tribes, their status and contact information.

2.3.4 Absence of Adjudicated Areas or Areas Covered by Alternative Plans [§354.8(a)(2)]

There are no adjudicated areas or areas covered by Alternative Plans within the Kaweah Subbasin.

2.4 Water Use by Service Sector within Plan Area [§354.8(a)(4)]

§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 2-3 shows the various water sources and water use sectors in the GKGSA. The majority of the GKGSA uses a combination of surface water and groundwater for mostly agricultural uses, followed by commercial/industrial uses. The southwestern corner of the area relies on groundwater for mostly agricultural uses and the urban areas within GKGSA also rely solely on groundwater.

2.4.1 Surface Water and Conjunctive Use [§354.8(e)]

§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.

Kaweah Delta Water Conservation District, various private ditch companies, and Lakeside Irrigation District have, for many decades, supported the conjunctive use of surface water and groundwater and the recharge of the groundwater system with surface water. The GKGSA will facilitate these ongoing efforts by these various surface water entities.

2.4.2 Groundwater-Dependent Use [§354.8(g)]

§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.

Groundwater dependent ecosystems are also referred to as natural communities commonly associated with groundwater. All the communities in the GKGSA area are dependent on groundwater, including three incorporated cities (Exeter, Farmersville, Woodlake), several unincorporated communities, and the small community systems owned and operated by California Water Service Company (**Figure 2-2**), as well as the numerous domestic water users (*de minimus*) and multi-parcel water systems..

2.4.3 Well Density within Plan Area [§354.8(a)(5)]

§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.

Figures 2-4, 2-5, and 2-6 are well density maps and show the overall distribution of domestic, production, and public supply wells within the GKGSA, respectively. These maps are based on information from the DWR's Online System of Well Completion reports (OSWCR). The SGMA regulation [§ 354.8(a)(5)] requires the mapping of agricultural, industrial, and domestic wells based on DWR data; and these figures are provided for that requirement. The DWR data appears to have combined agricultural and industrial wells into the production well category although the majority of production wells in the GKGSA are likely agricultural wells. The status of these wells (active, inactive, abandoned, destroyed) is not yet known and confirming the status is beyond the scope of this version of the GSP.

GKGSA conducted a preliminary reconnaissance-level survey of all wells in the Agency area in the Summer of 2019 using remote sensing and GIS tools. This survey was intended to create a foundation for an immediate well registration process following implementation of the Plan. The survey identified potential well locations, classified wells according to use and probability of current activity (active, possibly active and inactive). In conjunction with parcel ownership data, this information will be used to develop a targeted outreach distribution list for the purposes of well registration to gain a more precise and current understanding of wells in the region.

The figures show the 'square-mile' sections that are covered in whole, or in part, of the GKGSA area. This GSP was not intended to produce any finer resolution than provided by the DWR map application.

Table 2-1 summarizes the well completion report density information for wells that are classified as new construction from 01/01/2002 to 03\01\2022 as available from the DWR OSWCR. Only wells with intended use for domestic, agricultural, or public purposes are included. Well completion report data was summarized by section and assigned to GKGSA if the centroid of the section fell within the GSA boundary. Data from the remaining section centroids outside of GKGSA but within the subbasin are also included.

Table 2-1: Summary of Well Information

Location of Section Centroid			Total	Domestic	Agricultural	Public
Number of Wells		Within GKGSA	1,468	618	784	66
		Outside GKGSA	1,533	537	944	52
		Total	3,001	1,155	1,728	118
Well Density	Max	Within GKGSA	39	24	13	2
		Outside GKGSA	41	20	18	3
	Mean	Within GKGSA	8	4	3	1
		Outside GKGSA	7	3	3	1

Overall, a total of 3,001 well completion reports met the above criteria within the entire subbasin. Of those, 1,468 were assigned to GKGSA based on the section centroid method. Approximately 42% (618) were classified as domestic, 53% (784) as agricultural, and 5% (66) as public. Maximum density of wells per section was similar within and outside of GKGSA at 39 and 41 respectively. The mean densities for overall and each category were also almost identical within and outside of GKGSA.

The higher density domestic well sections within the GKGSA are generally located around population centers in the northeastern portions of the GKGSA area, east of Tulare, around Visalia, between Exeter and Farmersville, and in the vicinity of Woodlake. Production wells show lesser densities but are generally more evenly distributed across the GKGSA area. The distribution of public wells is quite low, with the highest density around Visalia and Farmersville.

2.5 Land Use Planning in Plan Area [§354.8(b),(c),(f)]

§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.

Land use within the GKGSA consists mainly of field crops, grain and hay crops, or pasture west of California State Highway 99, as shown in **Figure 2-7**. The eastern portion of GKGSA, outside of the City of Visalia, is mostly deciduous fruit and nut trees with grain and hay crops in the southeastern portion of the GKGSA area. The areas within the limits of the cities of Exeter, Farmersville, and Woodlake are classified as urban, as are the service areas for Ivanhoe Public Utility District, Patterson Tract Community Service District, and Tract 92 Community Service District.

The GKGSA will track updates to the land use plans of Tulare County, Kings County, and the Cities of Exeter, Farmersville, and Woodlake to ensure sustainable groundwater management can be accomplished in the Kaweah Subbasin. Tulare County is itself a member agency of the GKGSA. In addition, the communities both have representation on the board as well as the Rural Communities Committee.

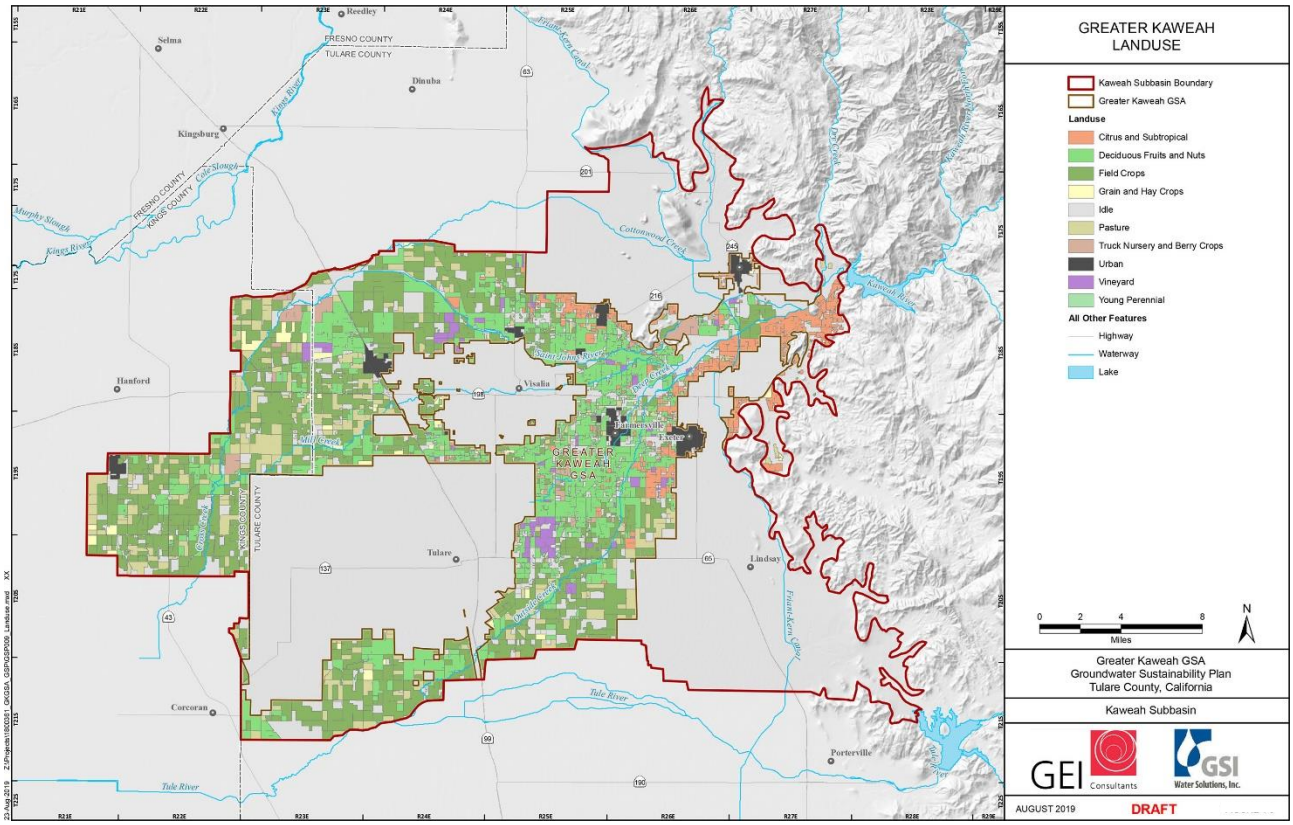


Figure 2-7: Greater Kaweah Land Use

The lands located within the service areas of KCWD, KDWCD, Lakeside Irrigation District, and St. Johns Water District may have access to both surface water supply and groundwater supply. The incorporated communities, community service districts (CSDs), public utility districts (PUDs), and undistricted lands within the GKGSA area are supplied by groundwater only. Refer to **Figure 2-7** for the locations of these areas within the GKGSA. Each of the three incorporated cities in GKGSA'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 elements are to be considered in this GSP.

2.5.1 Tulare County General Plan

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

1. Regulate the permanent extraction and exportation of groundwater from Tulare County.
2. 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.
3. Where feasible, the County shall participate in coordinated local, regional, and Statewide groundwater monitoring and planning programs.
4. Encourage active participation by local stakeholders and develop groundwater monitoring partnerships with local groundwater users and developers. Avoid the destruction of established recharge sites.
5. Work with federal, State, local, and regional agencies to improve local groundwater pollution detection and monitoring.
6. Encourage responsible agencies and organizations to install additional groundwater monitoring wells in areas where data gaps exist.
7. Research the development of an education program to inform homeowners regarding water quality concerns.
8. 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.
9. Identify and evaluate conditions within established watersheds which are causing deterioration of the water quality, water supply, or declining water yields.
10. Develop an education program to inform residents of water conservation techniques and the importance of water quality and adequate water supplies.
11. Protect groundwater recharge areas.
12. Amend County ordinances to include development standards which protect groundwater basins and surface water drainage areas and provide incentives for use of conservation techniques.
13. Establish development or design standards for the protection of groundwater recharge areas.
14. 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.

2.5.2 Kings County General Plan

The 2035 Kings County General Plan was adopted on January 26, 2010 addresses water in the objectives and policies of various elements, primarily in Resource Conservation (RC) and in Dairy, as listed below. The RC element recognizes that nearly one-third of its annual water use is derived from groundwater, which is replenished by precipitation, surface and subsurface flows, and imported water. The plan acknowledges that recharge to the aquifer beneath the Corcoran Clay occurs to the north and east of Kings County. The Air Quality element recognized improvements in agricultural practices that provide benefits to energy and air quality, including water well efficiency upgrades, conversion to electric motors to pump water versus the use of diesel engines, and the application of fertilizers and pesticides with irrigation water.

Element	Statement
Introduction	Protect water, natural lands, agriculture, prime soils, native plant and animal habitat, threatened and endangered species, fishing, energy, mineral, and archeological, cultural and historical resources throughout the County.
Land Use Objective A1.2	Protect natural waterways to ensure continued water delivery and recharge to surrounding agricultural uses and related homesites, while maintaining the natural aesthetic appeal of the Kings River and Cross Creek waterway channels.
RC Policy A1.1.1	Cooperate with water purveyors and water management agencies to manage groundwater resources within the County to assure an adequate, safe and reliable groundwater supply for existing and future water users.
RC Policy A1.1.2	Review new discretionary development proposals, including new or expanded uses within agricultural zone districts, to ensure that there are adequate water supplies to accommodate such uses. Projects should provide evidence of adequate and sustainable water availability prior to approval of a tentative map or other land use approval.
RC Policy A1.1.3	Discourage the net export of groundwater and surface water resources currently allocated to water users within Kings County.
RC Policy A1.1.5	Encourage and support regional groundwater management strategies such as an Integrated Regional Water Management Plan.
RC Policy A1.1.6	Support expansion of joint management of surface water and groundwater supplies that contributes to the protection, reliability and sustainability of local and regional water supplies.
RC Policy A1.2.1	Encourage and support the development of educational programs by water purveyors and public agencies, in order to increase public awareness of water conservation opportunities and the potential benefits of implementing water-saving measures and programs.

Element	Statement
RC Policy A1.2.3	Continue to support efforts and educational programs intended to reduce water consumption on agricultural lands and enhance groundwater recharge.
RC Objective A1.4	Protect the quality of surface water and groundwater resources in accordance with applicable federal, state and regional requirements and regulations.
RC Policy A1.4.1	Evaluate proposed land uses and development projects for their potential to create surface and groundwater contamination from point and non-point sources. Confer with other appropriate agencies, as necessary, to assure adequate water quality review to prevent soil erosion; direct discharge of potentially harmful substances; ground leaching from storage of raw materials, petroleum products or waste; floating debris; and runoff from the site.
RC Policy A1.4.2	Monitor and enforce provisions to control water pollution contained in the U.S. EPA National Pollutant Discharge Elimination System (NPDES) program as implemented by the California Water Quality Control Board, Central Valley Region (RWQCB).
RC Policy A1.4.3	Require the use of feasible and cost-effective Best Management Practices (BMPs) and other measures designed to protect surface water and groundwater from the adverse effects of construction activities and urban and agricultural runoff in coordination with the RWQCB.
RC Policy A1.4.4	Encourage and support the identification of degraded surface water and groundwater resources and promote restoration where appropriate.
RC Objective A1.5	Avoid the placement of potential pollution sources in areas that have the potential to foster groundwater recharge.
RC Policy A1.5.1	Cooperate with local agencies in the preservation and purchase of natural sloughs for use as water recharge and drainage basins.
RC Objective A1.6	Protect groundwater quality by applying development standards which seek to prevent pollution of surface or groundwater and net loss of natural water features.
RC Policy A1.6.2	Support measures to ensure that water users do not unreasonably use groundwater resources.
RC Policy A1.6.3	Protect groundwater by enforcing the requirements for installation of wells in conformity with the California Water Code, the Kings County Well Ordinance, and other pertinent state and local requirements.
Health and Safety Objective A3.1	Prepare for long term countywide drought conditions by encouraging water conservation measures among urban, rural, and agricultural users, and increase regional water storage capacity to enhance groundwater recharge and capture of floodwater.

Element	Statement
Dairy Policy 1.2d	High groundwater areas. New dairies, or the expansion of existing dairies, are prohibited in shallow or perched groundwater areas of the County unless the applicant can demonstrate that the minimum vertical distance between proposed lagoon bottoms/corral surfaces and highest anticipated groundwater levels is at least five feet. Highest groundwater levels shall be established based on available records and site-specific geotechnical investigation by qualified registered professional engineer or hydrogeologist.
Dairy Policy 1.2h	Separation of dairy facilities by ¼ mile. The minimum distance between a Dairy Facility and other Dairy Facilities or confined animal feeding operations shall be one-quarter (¼) mile. This restriction includes only the actual dairy facilities, i.e., corrals, milk barns, feed storage areas, manure storage areas, etc., but not cropland used to spread dairy process water and manure. These separations are required to avoid potential nuisance problems, potential inter-herd disease transmission, soil and groundwater contamination, and cumulative air quality degradation.
Dairy Policy 3.1.a	With each application for a new or expanded dairy, a technical report shall be prepared and shall address the following siting issues: A. Ground and surface water quality and quantity, ….
Dairy Policy 3.2.a	The *Technical Report* shall address water issues in the Groundwater Evaluation (see Component 1b of Appendix J), …. A. Minimum separation from bottom of all lagoons, manure and feed storage areas, and corrals and the groundwater level shall be at least five (5) feet at all times. B. The source of potable water for the Dairy Facility, and the safeguards to protect that water source must be identified.
Dairy Policy 3.2.c	Minimum Dairy Facility setbacks from water wells and water bodies shall be required: A. Manured and feed storage areas on dairy facilities shall be set back 150 feet from wells and water bodies as required by the RWQCB. B. Dairy Facilities shall be designed to ensure that no runoff into surface waters, including rivers, creeks, intermittent streams, canals, reservoirs, lakes, ponds, sloughs, stormwater basins, groundwater recharge basins, floodplains, floodways, etc., will occur. This can be done by constructing barriers or grading the facility away from such water bodies.
Dairy Policy 3.2.d	Dairy process water shall not be discharged into any surface water, including rivers, creeks, intermittent streams, canals, reservoirs, lakes, ponds, sloughs, stormwater basins, or groundwater recharge basins.
Element	**Statement**

Dairy Policy 3.2.h	*Hydrogeologic Sensitivity Assessment* (HSA): Whenever groundwater is being pumped from a hydrogeologic setting within one-half (½) mile of a proposed dairy site, or an expanding dairy, which is underlain by karst, fractured bedrock, or gravel, the applicants shall retain a qualified Certified Hydrogeologist or Professional Engineer to conduct a HSA. A. The HSA shall evaluate whether hydrogeologic setting would offer adequate barriers to pollutant migration to drinking water supplies. The evaluation shall be conducted in accordance with the principles contained in the EPA's Ground Water Rule.
Dairy Policy 3.2.i	All existing active and inactive domestic and irrigation water supply wells (including those located at the dairy site) at a proposed new dairy or proposed expansion of an existing dairy shall be inspected by a qualified professional to ensure that each well is properly sealed at the surface to prevent infiltration of waterborne contaminants into the well casing or surrounding gravel pack. If any of the wells are found not to comply with the California Well Standards or RWQCB Standards, the applicant or dairy operator shall retain a licensed well driller to install the required seal or functional equivalent certified by a licensed engineer or other qualified registered professional. Documentation of the inspections and seal installations, if any, shall be maintained on the dairy site and made available to the Code Compliance personnel upon their request. This policy applies to all wells located on the Dairy Facility or on any farmland controlled by the dairy and used for the application of dairy process water.
Dairy Policy 4.1a	*Manure Nutrient Management Plan* (MNMP) Components: The following components shall be addressed in the MNMP. *B. Manure Handling and Storage* – Manure must be handled and stored properly to prevent water pollution from dairies. Manure and dairy process water handling and storage practices shall consider odor and other environmental and public health problems. Handling and storage considerations shall include: 2. *Prevent leakage* – Construction and maintenance of buildings, collection systems, conveyance systems, and storage facilities shall prevent releases of organic matter, nutrients, and pathogens to ground or surface water by implementing the following measures: a. All manure separation pits and process water lagoons shall be constructed so that the bottoms of the pits and lagoons are at least five feet above the highest expected groundwater levels.

Element	Statement
Dairy Policy 4.1b	*Land Application of Manure* *B. Timing and methods of application* – Care must be taken when applying manure and process water to the land to prevent it from entering groundwater, streams, other water bodies, or environmentally sensitive areas. The timing and method of application shall prevent the loss of excess nutrients to groundwater or surface water.
Dairy Policy 4.1c	*Land Management* – Tillage, crop residue management, grazing management, and other conservation practices shall be utilized to minimize movement to surface water and groundwater of soil, organic materials, nutrients, and pathogens from lands where manure is applied.
Dairy Policy 4.1d	*Dead Animals Management Plan* – A Dead Animal Management Plan (see Component 5 of Appendix J) shall be prepared and implemented for the disposal of all dead animals in a way that does not adversely affect groundwater or surface water, create public health concerns, or cause nuisances due to odor or vectors.
Dairy Policy 4.4a	The County hereby adopts compliance with the water quality objectives of the Basin Plan as the threshold of significance for impacts to water quality from implementation of the Dairy Element. Therefore, dairy projects that 1) comply with the Basin Plan and 2) comply with the provisions in the Element allowing approval of a site plan review (SPR), do not create cumulatively significant environmental impacts on water quality.
Dairy Policy 6.2f	*Minimum standards for water quality monitoring program*: Water quality monitoring shall comply with all requirements and orders of the RWQCB. Copies of all reports that are required by, and submitted to, the RWQCB by any new or expanded dairy regulated under this Dairy Element shall also be provided a copy of those reports to the Kings County Zoning Administrator. A. Installation of groundwater monitoring wells at each dairy adequate to characterize the variations in depth to uppermost groundwater at the Dairy Facility and chemical quality of the uppermost groundwater zone. If noncontinuous perched groundwater zones underlie the facility, deeper aquifers may require monitoring. Vadose zone monitoring using lysimeters shall be required to monitor the quality of soil water, particularly in the vicinity of the lagoons. The design and installation of water quality monitoring system shall be performed under the direction of a Registered Geologist or a Professional Engineer in accordance with California Well Standards. B. Groundwater and soil water samples shall be analyzed, at minimum, for TDS, electrical conductivity, general mineral content, Nitrogen as nitrate and nitrite, phosphorus, and coliform or other appropriate indicator of biological contamination. This list of constituents to be analyzed may be modified at the request of the RWQCB. All samples should be analyzed by a State-certified analytical laboratory.

Element	Statement
Dairy Policy 6.2f (continued)	C. Sampling of all wells and/or lysimeters shall be conducted prior to dairy operation to establish background levels and thereafter on an annual basis. In addition, the depth to water in each well shall be measured to within an accuracy of 0.01 feet twice each year, once in the spring and once in the fall.
Dairy Policy 6.4.d	Each dairy operator shall retain a qualified professional (i.e., Professional Engineer or Certified Hydrogeologist) to compile and evaluate the water quality data required by Dairy Policy 6.2f. The Code Compliance personnel shall review the data to determine whether violations have occurred, or if corrective action is required. When considering response action for identified violations, the County shall consult with the RWQCB.

The GKGSA will address these issues with the adoption and implementation of its GSP in support of the Counties' efforts to address these objectives in their respective General Plans.

2.5.3 City of Farmersville General Plan

The 2025 General Plan Update for the City of Farmersville, adopted on November 6, 2002, has numerous objectives to promote its future, including the fifth objective which states: "Protect and preserve natural resources, such as farmland, air and water quality and native vegetation, while facilitating growth of the community." According to the General Plan, the City obtains its water supply from the underlying aquifer and the well system draws water from 240 to 400 feet below ground level. The water table is recharged by percolation from the Kaweah River and its distributary system and from irrigation waters.

In Chapter 4, which addresses the Conservation, Open Space, Parks, and Recreation Element of the General Plan, the City includes air and water quality as Issue Five and states that it "must provide for long-range community water needs and protect [ground]water quality and quantity." Moreover, its goal is to "protect air and water quality from negative impacts" and the Water Quality sub-section provides the following objectives and action plans:

15. Promote a community awareness program that will educate the community in water-saving methodologies at the home and the work place.

    a. The Public Works department will provide the community with information brochures containing water-saving techniques. Further the department should prepare a Water Conservation Ordinance for adoption by the City Council.

16. Promote the use of native and drought-tolerant new landscaping in existing and future parks.

    a. The City is planning to prepare a Water Conservation Ordinance which shall stress the use of native and drought-tolerant species.

17. Allow for adequate groundwater recharge by developing storm ponding and retention basins where feasible. In some areas these ponds or basins can be incorporated into a recreational area or used as wildlife habitat area.

    a. The Engineering Department shall implement the policies of this Element with regard to locations of future park/pond basins.

2.5.4 City of Exeter General Plan

The Exeter General Plan, 2000 - 2020 was adopted by the City Council on March 8, 2003 and addresses water supply and usage in the Resources section of the Land Use Element. Water is listed as a natural resource along with air, land, and native plants and animals. The Plan promotes the "wise use and management of these resources" and provides the following goals:

- Conserve natural resources, including native trees, agricultural land, and water.
- Promote groundwater recharge.
- Promote energy and water conservation.

The Plan promotes the continued improvement to its water system, including funding for new water wells, but does not provide specific actions to address these goals. The GKGSA GSP will address these goals directly, particularly groundwater recharge and water conservation.

2.5.5 City of Woodlake General Plan

The Woodlake General Plan, 2008 to 2028, was adopted during 2009 and is similar to the Plans by the Cities of Exeter and Farmersville. The Land Use Element of the Plan lists water as a natural resource along with air, land, and native plants and animals; promotes the "wise use and management of these resources"; and provides the following goals:

- Conserve natural resources, including native trees, agricultural land, and water.
- Promote ground water recharge
- Promote energy and water conservation

The Conservation Element of the Plan identified the following components, goals, objectives, and actions:

1. Conservation, development and utilization of natural resources, including water, forests, soils, rivers and other waters, wildlife, and other natural resources.

2. Reduce the possibility of water quality contamination from surface contaminants by drawing water from 240 to 400 feet below the ground's surface level. The City has abandoned wells due to high nitrate concentrations.

3. Aquifer recharge is derived from the St. Johns River and from irrigation water stored in Bravo Lake and conveyed by the Wutchumna Ditch.
4. Monitor activities of local canal and irrigation districts and promote the preservation of these established recharge sites and waterways.
5. Promote a community awareness program that will educate the community in water-saving methodologies at the home and the work place and prepare a water conservation ordinance for adoption by the City Council.
6. Allow for adequate groundwater recharge by developing storm ponding and retention basins where feasible and incorporate these features into recreation or wildlife habitat areas.
7. Promote the use of native and drought-tolerant species in private and public landscaping areas.

The GKGSA will address these issues with the adoption and implementation of its GSP in support of these cities' efforts to address the objectives in their respective General Plans.

2.6 Additional GSP Elements [§354.8(g)]

§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.

The GKGSA and Kaweah Subbasin agencies already have several protective practices for groundwater sustainability and protection. This section will describe some of those elements applicable to SGMA compliance that may not be further discussed in the GSP.

2.6.1 Wellhead Protection [§354.8(f)(4)]

Tulare County does not have a specific program for wellhead protection and recharge areas but the region (Kings and Tulare Counties) was identified in a 2-page fact sheet (January 2018) on wellhead protection via the Southern San Joaquin Valley Management Practices Evaluation Program (SSJVMPEP). which produced a 2-page fact sheet on wellhead protection in January 2018 along with a similar fact sheet on abandoned and inactive wells.

Kings County has established a wellhead protection program for the handling and application of certain pesticides, including offset distances from wells, dwellings, schools, and other designated areas; well site requirements to minimize runoff to the wellhead area plus requirements for applicator certification, permitting, notifications, and other limitations related to unlined

canals/ditches and to recharge basins. In 2004, Kings County designated a nominal 8-square mile area along Cross Creek, within the northwestern portion of the GKGSA area, as a runoff-type groundwater protection area (California Department of Pesticide Regulation, 2020).

2.6.2 Well Construction Policies

Tulare and Kings Counties have each adopted an ordinance for the construction of wells, based on California Well Standards as presented in DWR Bulletins 74-81 and 74-90. These requirements are administered by their respective environmental health departments. Details are available at the respective links: https://tularecountyeh.org/eh/index.cfm/our-services/water-wells/ https://tchhsa.org/eng/index.cfm/public-health/well-drilling/ and https://www.countyofkings.com/departments/health-welfare/environment-health-service/drinking-water/drinking-water-1.

2.6.3 Well Permitting Process [§354.8(f)(4)]

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 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 GKGSA 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 include the following information as of June 2022:

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

2.6.4 Well Abandonment and Well Destruction Programs

The Tulare County Environmental Health Services Division is responsible for the ordinance that regulates the disposition of wells according to Chapter 13, Part IV of the Ordinance Code of Tulare County. Article 1, Section 4-13-1005, defines "Abandoned Well" as a well which has been inactive for at least one year or is incapable of producing water, and "Destruction of Wells" as filling and sealing the well to prevent human and animal exposure to physical harm from an open well and to prevent surface water, waste, debris and contaminants from entering the well. Similarly, the Kings County Environmental Health Services Department addresses well abandonment and destruction via Ordinance 587 where abandoned wells are defined as wells "whose use has been permanently discontinued" and must be destroyed accordingly.

Both counties require a well permit and the destruction work must be completed by a licensed (C-57) contractor. The ordinances incorporates various requirements of the DWR bulletins related to well standards (74-81 and 74-90). Tulare County received grant monies to facilitate the identification and destruction of more than 80 abandoned wells.

2.6.5 Control of Saline Water Intrusion

Saline water intrusion is the induced migration of seawater into a freshwater aquifer system and is typically observed in coastal aquifers where over-pumping of the freshwater aquifer causes ocean water to encroach inland, degrading the freshwater aquifer. The GKGSA is located over 80 miles from the Pacific Ocean, which negates the possibility of saline water intrusion.

2.6.6 Migration of Contaminated Water

The GKGSA 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 GKGSA will encourage prompt and timely actions from responsible parties and these regulatory agencies to address/resolve the presence of contaminated groundwater and will not implement projects or management actions that exacerbate the condition. The GKGSA anticipates a point in the near future where water quality data can be assembled in a comprehensive package that will foster a program of proactive response to areas of concern, allowing for GKGSA to track contaminated issues and evaluate opportunities to pre-mitigate.

2.6.7 Measures Addressing Groundwater Contamination

The California Regional Water Quality Control Board, Central Valley Region (RWQCB) has implemented two long-term water quality programs to address wide-spread 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.

2.6.8 Groundwater Dependent Ecosystems

The Nature Conservancy (TNC) has identified potential groundwater dependent ecosystems (GDEs) in the Kaweah Subbasin and the vegetation and wetland areas associated with the relatively large surface water channels. Interconnected Surface Water is a sustainability indicator and is defined as "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." Interconnection between the surface water and groundwater could lead to GDEs and must be considered by the Plan. However, surface water channels are without flow in the GKGSA area for much of the year. Figure 19 of the Basin Setting Report (Appendix 3A) identified potential GDEs within the forebay area (east corner of the GKGSA) of the Subbasin and a small GKGSA area along the northern boundary of the subbasin (total area is over 9,000 acres) because depths to groundwater were within 50 feet of the ground surface during spring 2015. A review of the potential GDE map did not identify any vegetation or wetlands at the small area along the northern boundary. In the highlighted forebay area, approximately 850 acres support potential GDEs, including about 500 acres of tree vegetation, 220 acres of wetlands, and nearly 140 acres of a mixture of both categories. The tree vegetation only areas are dominated by Goodding's Willow (~40%) along with Valley Oak (~20%), and Fremont Cottonwood (~20%) while seven other species are present in the remainder. These trees are present in the mixed habitat area, and the Goodding's Willow is dominant (~60%) compared to the Valley Oak and Freemont Cottonwood (~30% together). The wetland areas are comprised of riverine (~70%) and palustrine (~30%) conditions and this proportion is reversed in the mixed habitat area where palustrine is dominant (~70%) compared to riverine (~30%). Given that groundwater is produced from aquifers more than 50 feet deep beneath the GSA, the vegetation and wetlands listed by TNC are believed to be surface water dependent. Further study will be taking place going forward through the Interconnected Surface Water Data Gap Work Plan included in the Management Action Section 7.7 of this GSP.

2.6.9 Groundwater Replenishment

Groundwater replenishment occurs naturally through deep percolation of rainfall, storm runoff via stream and river channels, and irrigation water via unlined channels and ditches and from irrigated fields. In addition, intentional replenishment occurs via deep percolation at recharge basins and wastewater effluent basins. KDWCD, as a water conservation district, engages in numerous groundwater replenishment activities. The primary sources of groundwater recharge are local supplies from the Kaweah River and imported water supplies from the CVP.

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.

2.6.10 Efficient Water Management Practices

The GKGSA supports the efforts of Tulare County and the Cities of Exeter, Farmersville, and Woodlake to implement efficient water management practices as well as encouraging its constituents to pursue such practices.

2.6.11 Existing Monitoring and Management Programs

Existing Monitoring and Management programs are detailed in **Section 4.1 Existing Monitoring Networks and Programs.**

2.7 Notice and Communication [§354.10(a)(b)(c)(d)]

§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:
  (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. California Code of Regulations §354.10 identifies the requirements for notice and communication information in a GSP.Below is the identification of beneficial users and uses of groundwater in the GKGSA, the description of participating agencies in the GKGSA, followed by a series of descriptions of notice and communication activities utilized by the GKGSA to reach out, connect, educate, and solicit comments from beneficial users and uses of groundwater for GKGSA implementation activities and GSP development.

2.7.1 Beneficial Users and Uses [§354.10(a)]

§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 GKGSA's jurisdiction primarily include agricultural, industrial, municipal and domestic water supply. GKGSA serves as GSA for the area comprising the collective jurisdictional area of its members. Beneficial users and uses of groundwater were identified and engaged by GKGSA based on the place and interest-based categories described in SGMA and codified in Water Code §10723.2. Beneficial uses and user of groundwater are codified in Water Code §10723.2 as:

(a.) Holders of overlying groundwater rights, including:

(1) Agricultural users, including farmers, ranchers, and dairy professionals

(2) Domestic well owners

(b.) Municipal Well Owners
(c.) Public water systems
(d.) Local land use planning agencies

(e.) Environmental users of groundwater

(f.) Surface water users, if there is a hydrologic connection between surface and groundwater bodies

(g.) The federal government, including, but not limited to, the military and managers of federal lands

(h.) California Native American

(i.) Disadvantaged communities, including, but not limited to, those served by private domestic wells or small community water systems

(j.) Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency Beneficial users and uses representing these categories and nature of consultation with these users are further described below.

2.7.1.1 Disadvantaged Communities

Data published by the U.S. Census Bureau (Bureau) in 2016 show ten areas within the jurisdiction of the GKGSA that meet the annual Median Household Income (MHI) criteria[2] to be

[2] A DAC is defined as a census geography community with an annual MHI that is less than 80 percent of the Statewide annual MHI (PRC Section 75005(g))]. A SDAC is a census geography community with an annual MHI that is less than 60 percent of the

considered a Disadvantaged Community (DAC) or severely disadvantaged community (SDAC). DACs in the region that meet the 2016 Bureau criteria for Census Designated Places—as well as the broader criteria for Census Tracts and Block Groups—are the City of Exeter and the communities of Lemon Cove and Patterson Tract. The cities of Farmersville and Woodlake, and the communities of Linnell Camp, Ivanhoe, and West Goshen have been identified as SDACs. Unincorporated communities that meet the Census Tract and Block Group criteria for DACs and SDACs, respectively, are the Cameron Creek Colony and Hypericum. While a DAC per Bureau data, a door-to-door survey conducted in 2014 by Self-Help Enterprises and California State University, Fresno, indicate that Cameron Creek Colony qualifies as a SDAC.

Consultation with these communities occurred primarily through the Rural Communities Committee, further described in Section 1.4.5. These committee meetings served as a collaborative forum for both community members and committee members to identify and resolve potential issues important for Plan development activities. In addition, the GKGSA followed best practices for engaging DAC and SDAC community members and eliminating potential access barriers these individuals may face. These practices included translating materials into Spanish and holding public workshops in coordination with the Community Water Center, Leadership Counsel for Justice and Accountability, and the Union of Concerned Scientists at locations convenient for the targeted community.

2.7.1.2 Agricultural Users

Agriculture and rangeland cover a broad area of the Kaweah Subbasin. Agricultural interests were represented in GSP during the Plan's development by water, conservation, and irrigation districts. Representatives from the agricultural community serve on both the GKGSA Board of Directors (Board) and the Stakeholder Committee, further described in Section 1.4.5. During the Plan's development, this included participation from the Consolidated Peoples Ditch Company, Farmers Ditch Company, Fleming Ditch Company, Foothill Ditch Company, Lemon Cove Ditch Company, Mathews Ditch Company, and the Wallace Ranch Water Company. As with the Rural Communities Committee, each Stakeholder Committee meeting is conducted as a collaborative forum where members and community members can discuss and resolve topics important for development of this Plan. Individual agricultural water users were also consulted and kept informed through existing communication channels of participating ditch companies, periodic electronic communication by the GKGSA and its sister GSAs in the Kaweah Subbasin.

2.7.1.3 Private Domestic Well Owners

Private domestic well operators within the GKGSA primarily include rural residents interspersed with active farmlands and rural schools. These domestic well water users are located in the unincorporated area of Tulare County and are represented on the Board by the Tulare County.

Statewide annual MHI. The statewide MHI for the U.S. Census Bureau American Community Survey 5-Year Data: 2012 – 2016 is $63,783. Therefore, the calculated DAC and SDAC thresholds are $51,026 and $38,270, respectively.

Domestic well owners had the opportunity to consult on the Plan during Board and Stakeholder Committee meetings, and review of this Plan.

2.7.1.4 Municipal Well Owners

Municipal and industrial (M&I) water supplies within the GKGSA are drawn exclusively from groundwater resources. Replenishment of this shared resource has been historically lead by the KDWCD in coordination with the local 27 irrigation districts and other regional partners. The M&I well operators include the cities of Exeter; Farmersville, Woodlake, and Hanford; Ivanhoe Public Utilities District; Patterson Tracy Community Services District; Tract 92 Community Services District, Lemon Cover Sanitary District; and California Water Service Company.

The M&I well operators are represented on both the Board and Rural Communities Committee. In addition, local M&I water providers in turn conducted outreach to and consulted with their customers through distribution of informational materials and postings on their websites and social media accounts, as available.

2.7.1.5 Public Water Systems

Public water systems within the GKGSA include the cities of Exeter, Farmersville, Woodlake; Lemon Cove Sanitary District; Patterson Tract Community Services District; Tract 92 Community Services District; Ivanhoe Public Utilities District; and the Tulare County. Each of these agencies is consulted through representation on the Rural Communities Committee. In addition, the Rural Communities Committee appoints one representative to serve on the Board. The Tulare County supports two County Service Areas, one of which serves the community of Wells Tract—a small community east of the City of Woodlake's sphere. Residents of Wells Tract receive drinking water and wastewater service from the City of Woodlake through an agreement with the Tulare County.

2.7.1.6 Surface Water Users

Given their connection to agricultural users, surface water users have been continually consulted regarding Plan development. Surface water supplies in the GKGSA region are diverted primarily from the Kaweah and St. John's Rivers, with supplemental supplies from the Friant Division of the Central Valley Project. The Kaweah River St. Johns Association manages distribution of surface water supplies from local supplies on behalf of surface water right holders. The KDCWD conducts groundwater recharge operations with surface water from the Kaweah River and the Friant Division. Surface water users within GKGSA primarily include farm, ranch, and dairy operations. These users were consulted through representation on the Stakeholder Committee, as well as regular communications through GKGSA member agencies' existing community platforms.

2.7.1.7 Federal Government

Water Code section 10723.2(g) codifies the federal government as a beneficial user of groundwater. No federal lands were identified in the GKGSA that are using groundwater.

2.7.1.8 Governmental and Land Use Planning Agencies

Governmental and land use planning agencies in the GKGSA include the planning commissions of the cities of Exeter, Farmersville, and Woodlake and counties of Tulare and Kings. The Tulare County is a member agency of the GKGSA and has one seat on the Board. The cities of Woodlake, Farmersville, and Exeter were consulted through their representation on the Rural Communities Committee. In addition, GKGSA representatives provided a presentation to the City of Woodlake and City of Farmersville Planning Commissions on February 25, 2019 and April 17, 2019, respectively. The presentations' content included an overview of SGMA, the status of development of the Plan, and government and land use planning agencies' obligations under SGMA in association to general plan updates. Other local planning commissions were also invited to provide comment on this Plan.

2.7.1.9 California Native American Tribes

As part of its 2016 formation notification to DWR, the GKGSA preliminarily identified five California Native American Tribes for potential engagement in the planning process. The GKGSA submitted a Sacred Lands File and Native American Contacts List Request to the Native American Heritage Commission (NAHC) on May 15, 2018. The GKGSA's request to the NAHC included a general description of the GKGSA and map identifying US Geological Survey quadrangles wholly or partially in the GKGSA's boundaries. The NAHC replied to the request on May 22, 2018 and identified five potentially affected California Native American Tribes in the area of potential effect. These tribes, and their status, is identified in **Table 2-2**.

There are no tribes with designated tribal lands within the GKGSA's boundaries. Per the NAHC's letter response, the record search of the NAHC's Sacred Lands File identified that the Wuksache Indian Tribe/Eshom Valley Band has a sacred land in the area known as Rocky Hill. The Rocky Hill area is in the foothills east of the City of Exeter and is presumed to be outside both the boundaries of the GKGSA and Kaweah Subbasin.

Table 2-2: Native American Tribes Identified in NAHCs Sacred Lands File and Native American Contacts List Request Response

Tribal Name	Contact	Title	Address	City/State/Zip	Sacred Lands File?
Kern Valley Indian Community	Robert Robinson	Chairperson	P.O. Box 1010	Lake Isabella, CA 93240	Yes
Santa Rosa Indian Community of the Santa Rosa Rancheria	Leo Sisco	Chairperson	P.O. Box 8	Lemoore, CA 93245	Yes
Tubatulabals of Kern Valley	Robert L. Gomez Jr.	Chairperson	12600 Mountain Mesa Road	Lake Isabella, CA 93240	Yes
Tule River Indian Tribe	Neil Peyron	Chairperson	P.O. Box 589	Porterville, CA 93258	Yes
Wuksache Indian Tribe/Eshom Valley Band	Kenneth Woodrow	Chairperson	1179 Rock Haven Court	Salinas, CA 93906	Yes

GKGSA staff began engaging tribes during GSA formation. In October 2016, GKGSA staff sent a letter to the Santa Rosa Indian Community of the Santa Rosa Rancheria informing them about potential formation of the GKGSA and inviting a representative of the tribe to serve on the Stakeholder Committee. No tribes in the region expressed interest in serving on the Stakeholder Committee. All tribes listed in **Table 2-2** above were notified of the availability of the draft Plan for public comment.

2.7.1.10 Environmental Users of Groundwater

Initially, GKGSA has not identified environmental users of groundwater within the region. Based on the ICONS Database, NC Dataset, and the GDE Pulse 2.2 Tool, the is a possibility that GDEs are an environmental user of groundwater in the GKGSA planning area. Those databases suggest the presence of GDEs in the east, and northeast portion of the planning area. GKGSA is also conducting biological field surveys to create a local dataset and verify whether GDEs exist in the planning area. The GKGSA consulted with organizations representing environmental interests, including the Tulare Basin Wildlife Partners and Sequoia Riverlands Trust, during development of this Plan. Representatives from these organizations served on the Stakeholder Committee and were consulted extensively on the topics of interconnected streams, ecosystem multi-benefit projects, and potential mitigation of groundwater dependent ecosystems. Members of these groups were kept up to date on GKGSA activities and development of this Plan through existing communication channels led by their representatives that serve on the Stakeholder Committee. More recently, the Sequoia Riverlands Trust has engaged with the GKGSA in regard to best defining interconnected surface water in the eastern areas of the Subbasin.

2.7.1.11 Groundwater Elevation Monitoring and Reporting Entities

Groundwater elevation monitoring and reporting in the GKGSA is primarily led by KDWCD, a member agency of GKGSA. Since 1995, the KDWCD led the Groundwater Management Plan

for the Kaweah Subbasin in accordance with the implementing provisions of AB3030, and managed a series of wells registered in the California Statewide Groundwater Elevation Monitoring Program (CASGEM).

2.7.1.12 Citizens Groups and General Public

Citizens groups and members of the general public, many of which are also beneficial users, were invited to engage in Board and Committee meetings, and other public meetings coordinated by GKGSA. In addition, outreach was conducted to civic organizations of the cities of Exeter, Woodlake, and Farmersville; and periodic presentations to the Tulare County Water Commission. These included presentations to the Woodlake Kiwanis Club, Rotary Club of Farmersville, Rotary Club of Woodlake, and the Exeter Kiwanis Club. **Table 2-4** lists all organizations that received presentations as parts of the GKGSA Speaker's Bureau Program, further described below.

2.7.2 Participating Agencies [§354.10(a)]

The GKGSA Joints Powers Agreement and Bylaws (attached hereto and incorporated by reference as **Appendix 2A**) describe in detail the GKGSA JPA's decision-making process.

The governing body of the GKGSA JPA consists of a nine-member Board of Directors (Board) that includes two seats held by the KDWCD; one seat for each founding agency; one seat held by California Water Service (Cal Water); and one seat each from a representative nominated by the Rural Communities Committee and Stakeholder Committee. The Cal Water representative on the Board is nominated by the utility and appointed by the Board. All decisions require a majority vote of the present and voting Board of Directors.

Cal Water is a privately held water utility regulated by the California Public Utilities Commission. Its participation on the Board was made possible through an amendment to Senate Bill 13 by Senator Fran Pavley and chaptered in California Water Code §10723.6(b)[3]. Cal Water's participates in the GKGSA's decision-making process through an agreement with the GKGSA JPA (See **Appendix 2A**). The agreement applies to Cal Water operations in East Tulare Villa (known as "Tulco"), West Goshen, Goshen and Oak Ranch. Cal Water service operations in the City of Visalia are within the jurisdictional boundary of the Mid-Kaweah GSA, a sister agency of GKGSA in the Kaweah Subbasin.

The decision-making structure of the GKGSA Board, shown in **Figure 2-8** below, is supported through a hierarchical structure that includes the GSA's Manager, Kaweah Subbasin Management Team, Technical Group, Rural Communities Committee, Stakeholder Committee, and Technical Advisory Committee. The Rural Communities Committee is comprised of local public agencies eligible to serve as a GSA pursuant to conditions described in California Water

[3] (b) A water corporation regulated by the Public Utilities Commission or a mutual water company may participate in a groundwater sustainability agency through a memorandum of agreement or other legal agreement. The authority provided by this subdivision does not confer any additional powers to a nongovernmental entity.

Code 10721(n)[4]. These communities include cities of Exeter, Farmersville and Woodlake, and the unincorporated communities of Ivanhoe, Lemon Cove, Patterson Track and Track 92. The Stakeholder Committee is comprised of private ditch companies, domestic well operators, growers, and non-profit organizations focused on ecosystem stewardship and enhancement. The Technical Advisory Committee is comprised of one technical person appointed by each Director. This group is led by a Director nominated by the full Board. To provide for a venue for consultation with community members, GKGSA and all of its committees, conduct and notice their respective meetings consistent to the Brown Act.

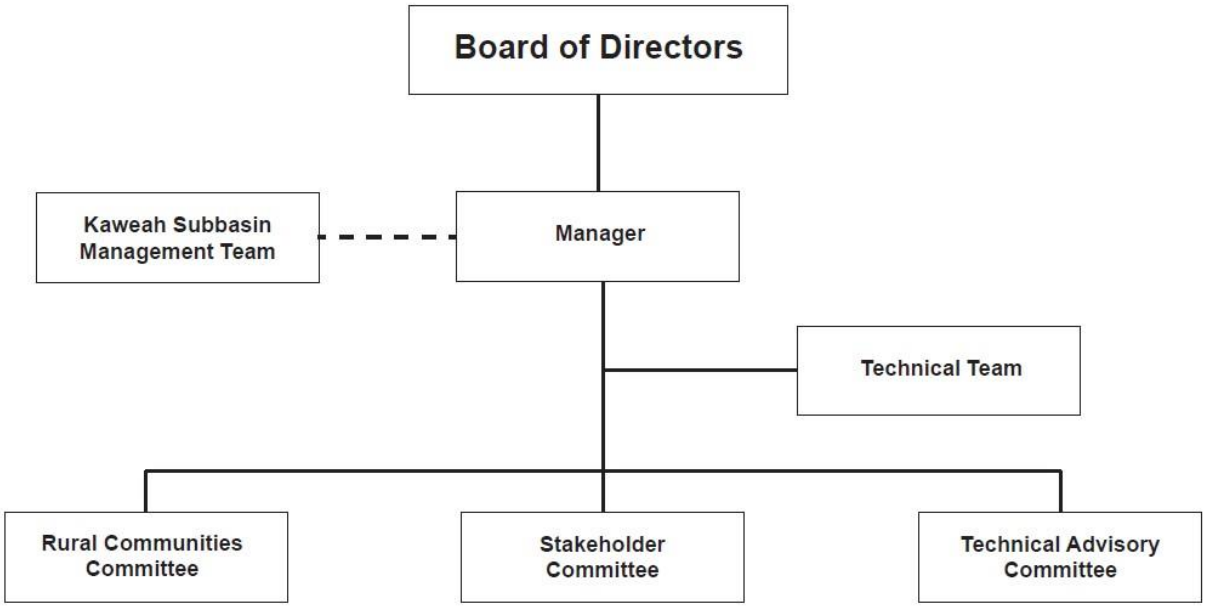


Figure 2-8: GKGSA Decision-Making Structure

2.7.3 Communication and Outreach Plan [§354.10]

§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.

[4] 10721(n) "Local agency" means a local public agency that has water supply, water management, or land use responsibilities within a groundwater basin.

Notification and communication activities for the development of this Plan were guided by the GKGSA Communications and Engagement Plan of November 2018 (attached hereto and incorporated by reference as **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 one of three "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 two-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 GKGSA.
>
> **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 GKGSA implemented to engage interested parties and stakeholder groups to participate in development of this Plan. Individuals and organizations were initially assigned one of the three groups by the GKGSA's Stakeholder Committee, with the anticipation that each stakeholder's involvement would change based on consultation with stakeholder and Plan 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 GKGSA, in coordination with its Kaweah Subbasin sister agencies – East Kaweah GSA and Mid-Kaweah GSA – established the Kaweah 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 GKGSA website (www.greaterkaweahgsa.org), 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, GKGSA member agencies, Board, 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 GKGSA Board, Stakeholder Committee, Rural Communities Committee, Technical Advisory Committee, and Kaweah Subbasin Management Team. The site is cross-linked to the Mid-Kaweah GSA and the East Kaweah GSA websites, the DWR SGMA information portal, and other related sites.

The primary opportunities for interested parties and members of the public to engage in development of this Plan included GKGSA Board and committee meetings, a public call for GSP projects and management actions, and the Plan public comment period. As described above, the GKGSA Board meets monthly and each of the three GKGSA committees meet, at a minimum, quarterly. All Board and committee meetings are open meetings pursuant to the Brown Act. Members of the public were notified of these meetings through notices sent to the interested parties database and postings on the GKGSA website. In addition, GKGSA representatives conducted a series of presentations to local organizations aimed at educating members of the general public about SGMA and encouraging participation at the Board and committee meetings. Each of these public engagement activities are further described below.

The GKGSA notified interested parties of the opportunity to provide input on the Public Review Draft Plan by posting on the GKGSA website, sending a notice to the interested parties database, and placing a notice in the local newspaper. Pursuant to SGMA, the GKGSA also sent a notice to cities and counties within the GKGSA's area of jurisdiction. Comments received from the public on the Public Review Draft Plan will be considered by the Board prior to Plan adoption. All comments received on the Public Review Draft Plan will be summarized in the Final GSP with a response from the GKGSA to each credible comment.

2.7.3.1 Stakeholder Surveys

To better understand and serve its community, the GKGSA gathered a large quantity of information on beneficial users within the boundaries of the Greater Kaweah subbasin by allowing stakeholders to participate in a voluntary water users survey. The survey was conducted online via a platform called Survey Monkey. The survey was five pages long and encompassed 85 questions that, among other questions, asked users which GSA they belonged to; what beliefs they had about groundwater and the environment; and what their knowledge of SGMA was; what they thought were the most pressing issues or challenges surrounding groundwater usage; and what ideas or suggestions they had regarding sustainability. The survey was made available to stakeholders in March of 2019. The survey has garnered a total of 138 responses as of July 2019. The GKGSA saw a positive completion rate of 86 percent by stakeholders with a general end time of four minutes and nine seconds.

2.7.3.2 Public Call for Projects and Management Actions

In 2018, the GKGSA began soliciting concept proposals for projects and management actions from stakeholders that are consistent with the region's groundwater sustainability objectives. In preparation for this Plan, the GKGSA created the proposal system by putting together a document that would allow not only stakeholders, but the public at large to submit their own ideas and suggestions for actionable sustainability projects that they believed should be brought to the GSA's attention.

2.7.4 Public Meetings [§354.10]

§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.

The GKGSA bylaws (**Appendix 2A**) require regular quarterly meetings of its Technical Advisory Committee, Rural Communities Committee, and Stakeholders Committee; and monthly meetings of its Board. These meetings are noticed and open to the public, in accordance with the Brown Act. In addition to these meetings, the GKGSA participates in a monthly Kaweah Subbasin Management Team meeting as signatory to the Kaweah Subbasin Coordinated MOU and Kaweah Subbasin Coordination Agreement (**Appendix 1B**), which includes representatives from the three GSAs in the Kaweah Subbasin.

The following agencies have participated in public outreach activities, as JPA members of the GKGSA:

- Kings County Water District
- Kaweah Delta Water Conservation District
- Lakeside Irrigation District
- St. John's Water District
- Tulare County

In addition to activities within its own jurisdictional area, the GKGSA has also participated in subbasin-wide SGMA outreach activities with the Mid-Kaweah GSA and East Kaweah GSA, with participation from the Tulare County Farm Bureau. Additional public outreach workshops were held for the GKGSA and are documented in **Appendix 2C** of this Plan.

2.7.4.1 Newsletter

Recognizing the establishment of SGMA, the GKGSA, and the GSP development were all new concepts for the beneficial users and uses of groundwater, in 2017 the GKGSA mailed the Greater Times newsletters out to landowners in the Subbasin to inform, educate and connect

them with the Subbasin activities. Table 2-3 provides a lists of this and other forms of outreach and notice, all as a part of the GKGSA's adaptive process in involving stakeholders and public.

2.7.4.2 Kaweah Subbasin Presentations

The GKGSA reached out to more than 10 community organizations, stakeholder groups and agencies as part of a Speaker's Bureau Program to raise awareness of the agency and encourage participation in development of this Plan at Board and 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 5 presentations and the distribution of GKGSA information to 11 organizations. Table 2-3 provides a lists of this and other forms of outreach and notice, all as a part of the GKGSA's adaptive process in involving stakeholders and public.

Table 2-3: Speaker's Bureau Program Presentations

Type	Group	Date Range	Number of Events	Attendees/ Audience	Participating GSA	Key Agenda Topics
Newsletter	Greater Kaweah GSA	October 2016 - Current	6 Editions	2000 + landowners	1	Update landowners on monthly activity and key decisions.
Outreach Events	Greater Kaweah GSA	October 2018- June 2023	8 Events	100+ Landowners	3	Communicate with Landowners to provide detailed information about SGMA and the GSAs.
Public Workshops	Greater Kaweah GSA	October 2018- June 2023	4 Workshops	1000+ Landowners	3	Review current activities, discuss policies with the public, review technical data, answer SGMA & GSA related questions
Speakers Bureau	Speakers Bureau	June 2019- 2024	5 Events	120 club members	1	Information about the agency and status of Plan development
Open House	Greater Kaweah GSA	January 2024- Current	5 Held	35+ landowners	1	Landowner Feedback, SGMA 101, Provide resources and tools to Landowners in the GKGSA

2.7.4.3 Board of Directors Meetings

Board meetings 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, committee members, and other interested parties 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 in development of the GSP and to track its progress. Information and notification of Board meetings was 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 interested parties on the Kaweah Groundwater Communication Portal (GCP), as described in Section 1.4.6.

The Board met monthly, unless otherwise publicly noticed in accordance with the Brown Act. Since August 23, 2016, the Board has held 88 meetings, with the majority of the meetings held at the offices of Kaweah Delta Water Conservation District, 2975 N. Farmersville, CA. Several Board meetings were also held off site in larger venues when the subject matter suggested a large attendance. The list of meetings is available on the agency website. 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 committee activities.

2.7.4.4 Committee Meetings

Publicly noticed Stakeholder, Rural Communities, and Technical Advisory Committee meetings are important venues for development of recommendations to the Board to key technical, policy, and outreach issues. Interested members of the public were encouraged to engage and consult in these discussions and assist committee members in their consideration of a preferred approach. These recommendations were later provided to the Board for their consideration. Written notification for each meeting were posted on the GKGSA website and sent via 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.

Each of the committees holds monthly, public meetings, unless otherwise noticed. The Rural Communities Committee and Stakeholder Committee frequently hold joint meetings to discuss Plan development topics applicable to their respective beneficial water users. During Plan development, the majority of the committees' meetings were held at the KDWCD office in Farmersville. Common agenda topics for the Rural Communities Committee and Stakeholder Committee included updates on GKGSA activities and Plan development, subbasin coordination activities, inter-basin coordination activities, and public and stakeholder communication and engagement. Technical Advisory Committee agenda topics typically covered key Plan elements, such as the basin setting, sustainable management criteria, groundwater monitoring network, and projects and management actions. Agenda's, minutes, and materials from each committee meeting is posted on the GKGSA website.

2.7.4.5 Open House

Monthly Open House events where held by GKGSA in their office site in 2023 and 2024 to provide a topic oriented venue for growers to hear about policy discussions and development, program assistance, and tools for managing their groundwater resources. The events were informal opportunities to ask questions and comment on GSP implementation and policy direction. Table 2-3 provides a lists of this and other forms of outreach and notice, all as a part of the GKGSA's adaptive process in involving stakeholders and public.

2.7.5 Public Comments [§354.10]

> §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.

The GKGSA has received and incorporated Stakeholder and public comment into this 2nd Amended Draft GSP throughout the preparation process. This Draft document will be circulated in a formal public comment process. Upon receipt of public comments, they will be incorporated

into the final document. The public comment summary is provided in Appendix 2D. The official comment letters are available upon request..

2.7.6 Interbasin Coordination [§354.10]

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 the development of the GSP, Kaweah Subbasin technical staff met with neighboring Subbasin technical staff to coordinate and share data for modeling boundary conditions and ensuring compatibility of sustainable management criteria.

Development of this Plan 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 three 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 on these topics. The schedule of KSMT and other intra-basin activities is provided in **Table 2-4**.

Inter-basin coordination activities included participation in events scheduled by other organizations, or events led by Kaweah Subbasin GSAs. These inter-basin activities focused on 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 these meetings is provided in **Table 2-4**.

Table 2-4: Inter-Basin, Intra-Basin Coordination Meetings

Type	Basin	Date Range	Number of Events	Attendees/ Audience	Participating GSA	Key Agenda Topics
South Valley SGMA	Inter Basin	July 2016 - 2024	6	30 + Landowners & Members	3	Subbasin updates, DWRs SGMA technical assistance, SkyTEM In the South Valley, headwaters coordination
Management Team Committee Meeting	Intra Basin	June 2018-2024	20	30 + Landowners & Members	3	GSA Updates and progress, coordination agreement, consultant presentations and recommendations
Farmer Rancher	Inter Basin	June 2019-2024	5	50+ Landowners	3	SGMA & GSP Development
Technical Group Meeting	Intra Basin	June 2019-2024	16	15+ Landowners & Members	3	SkyTEM proposal, technical memorandum discussing accounting framework, water budgets
The Community Water Center: Drinking Water Vulnerability Assesment Tool Kick Off	Inter Basin	June 2019-2024	1	100+ Landowners & Members	3	Development of an accessible, interactive and publicly available drinking water vulnerability assessment web tool, groundwater management needs of SDACs for GSPs

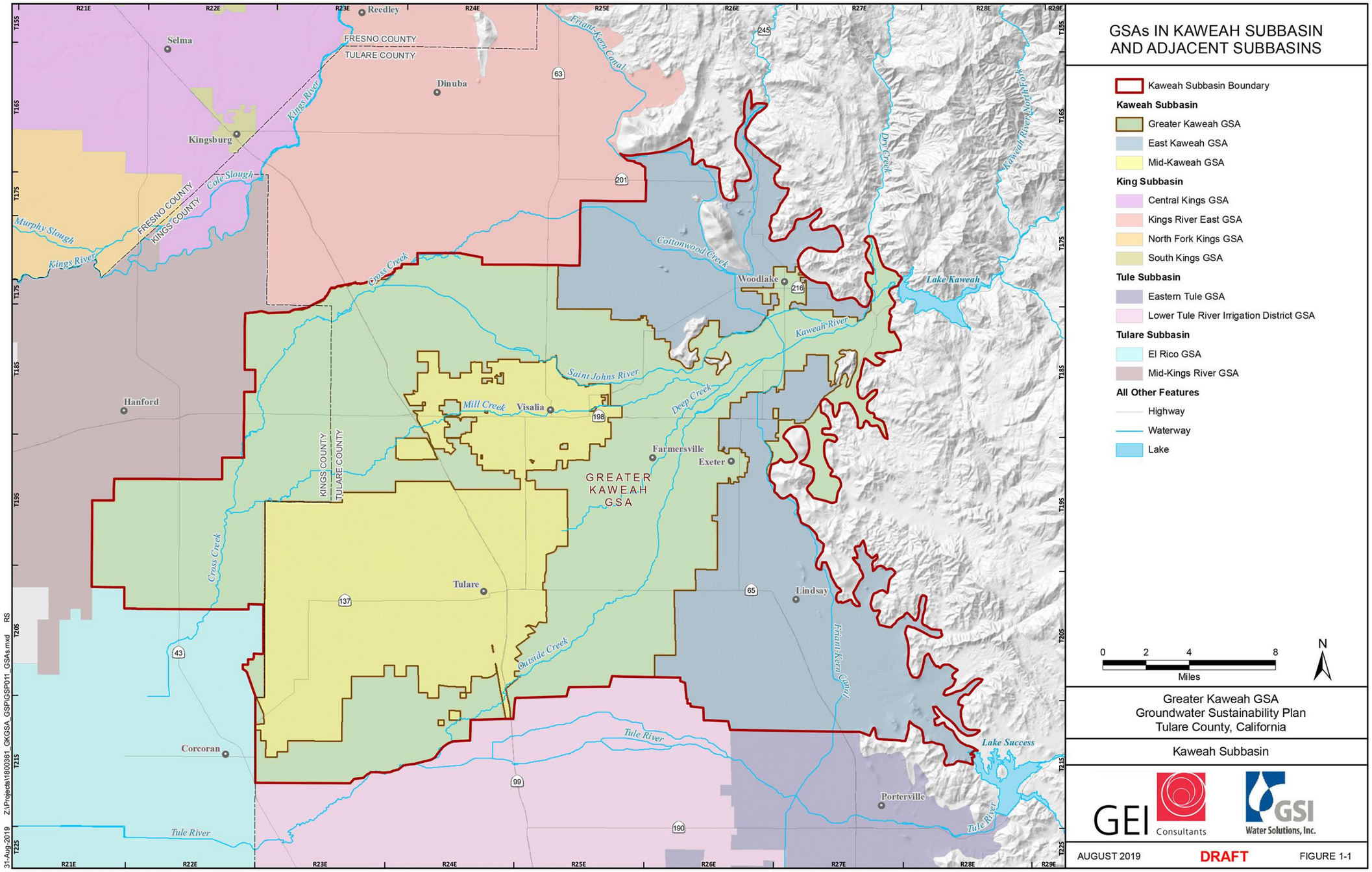


Figure 2-1: Greater Kaweah Jurisdictional Boundaries

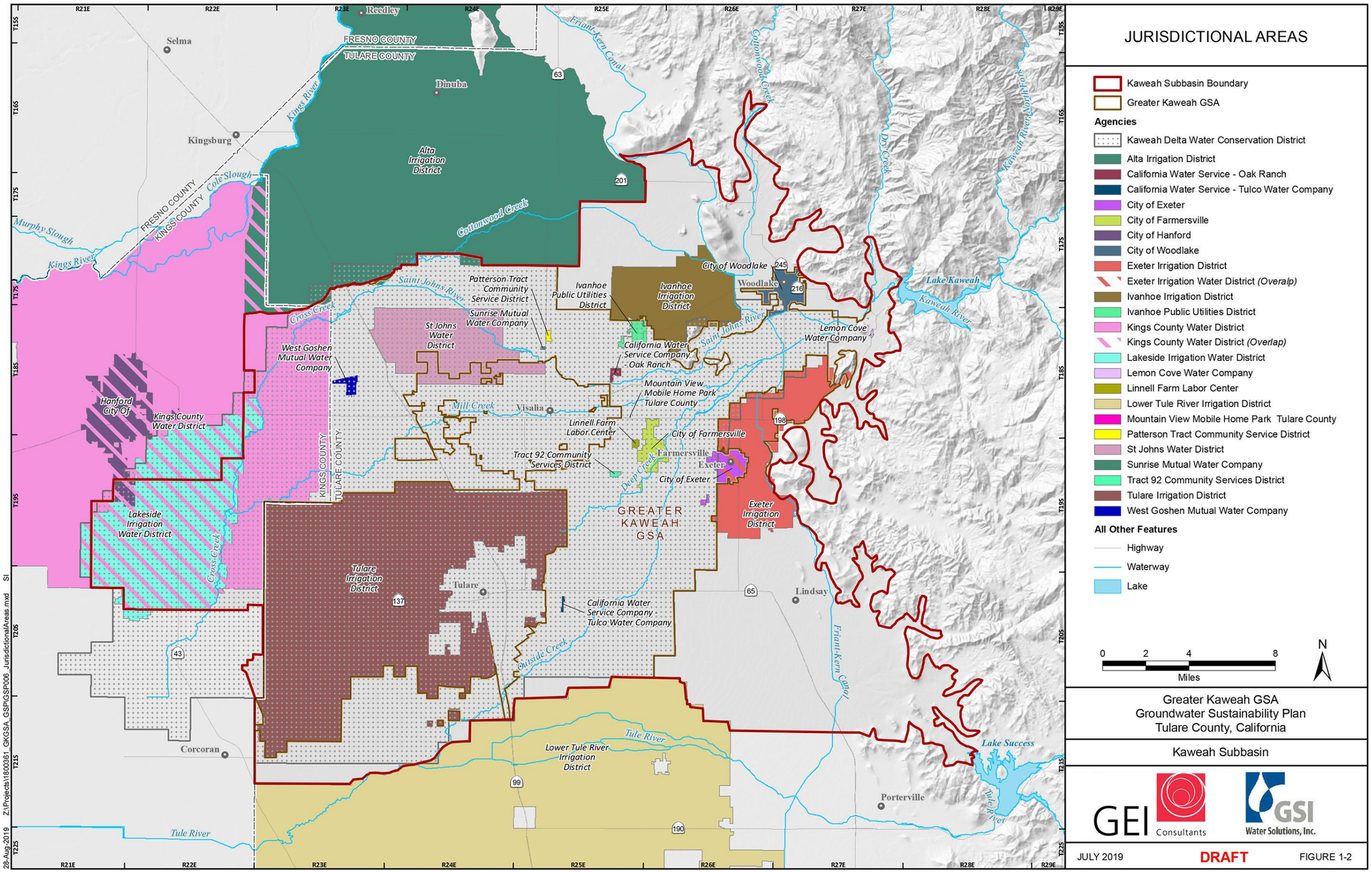


Figure 2-2: Jurisdictional Areas

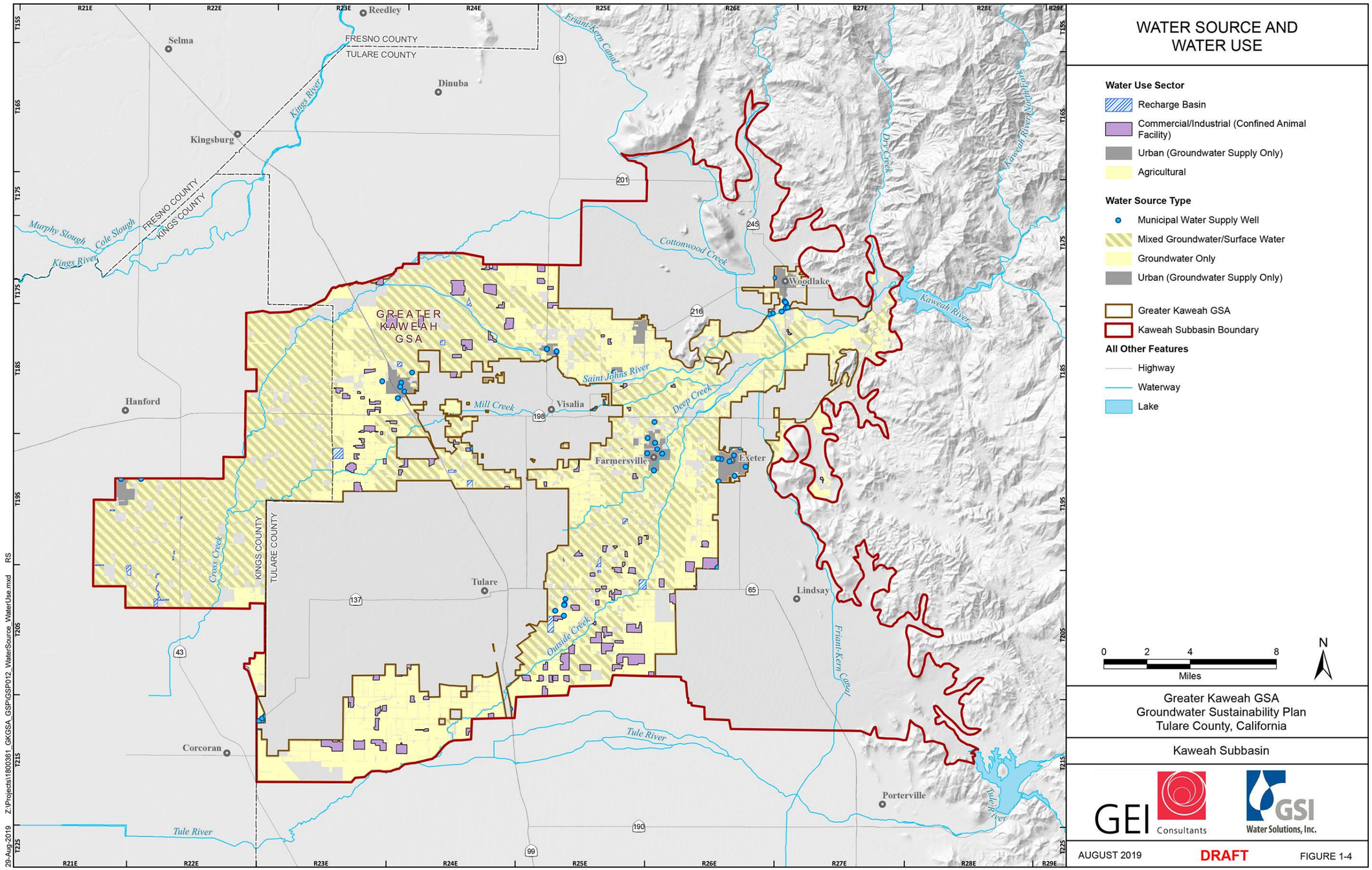


Figure 2-3: Water Source and Water Use

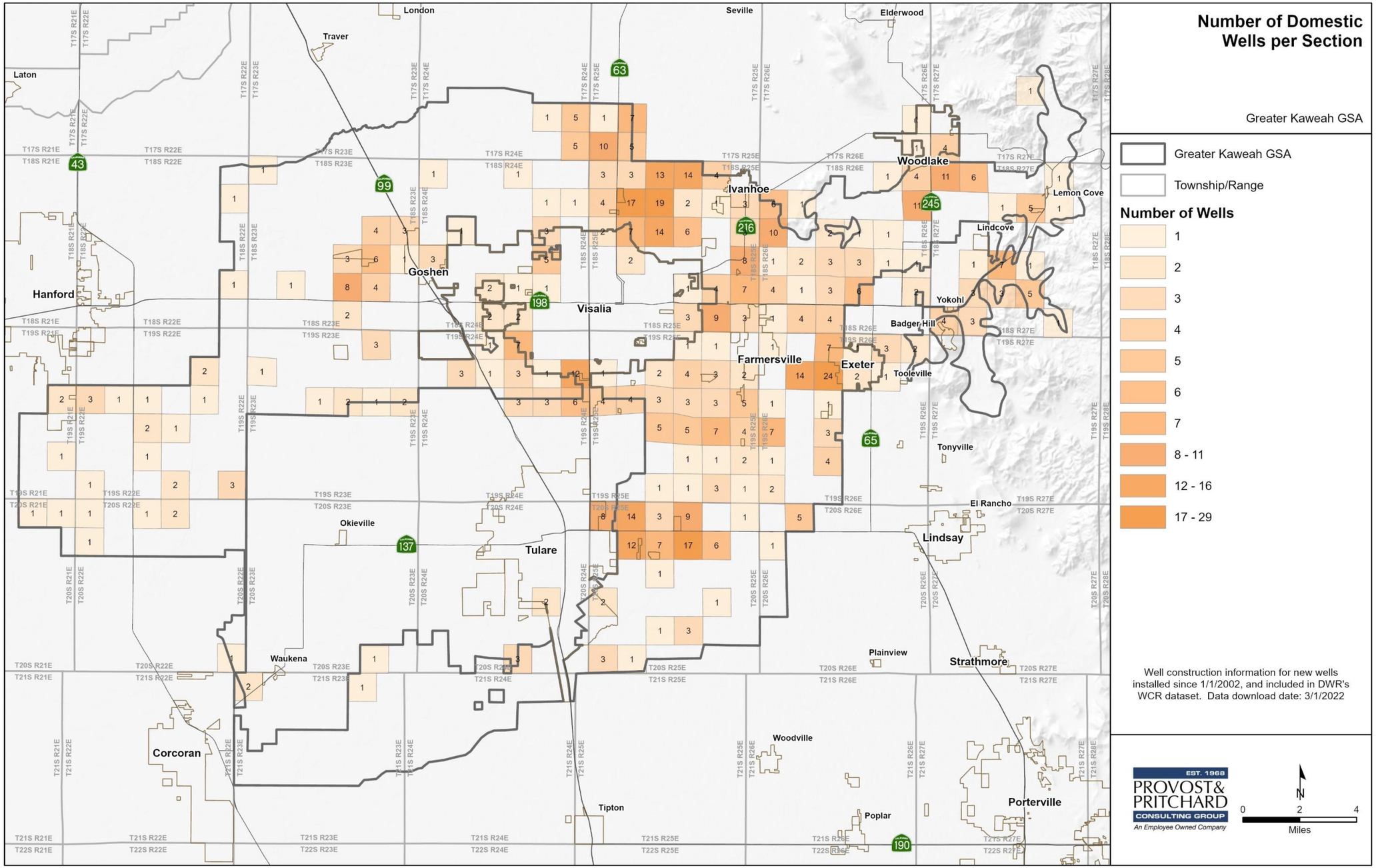


Figure 2-4: Well Density by Section (Domestic Wells)

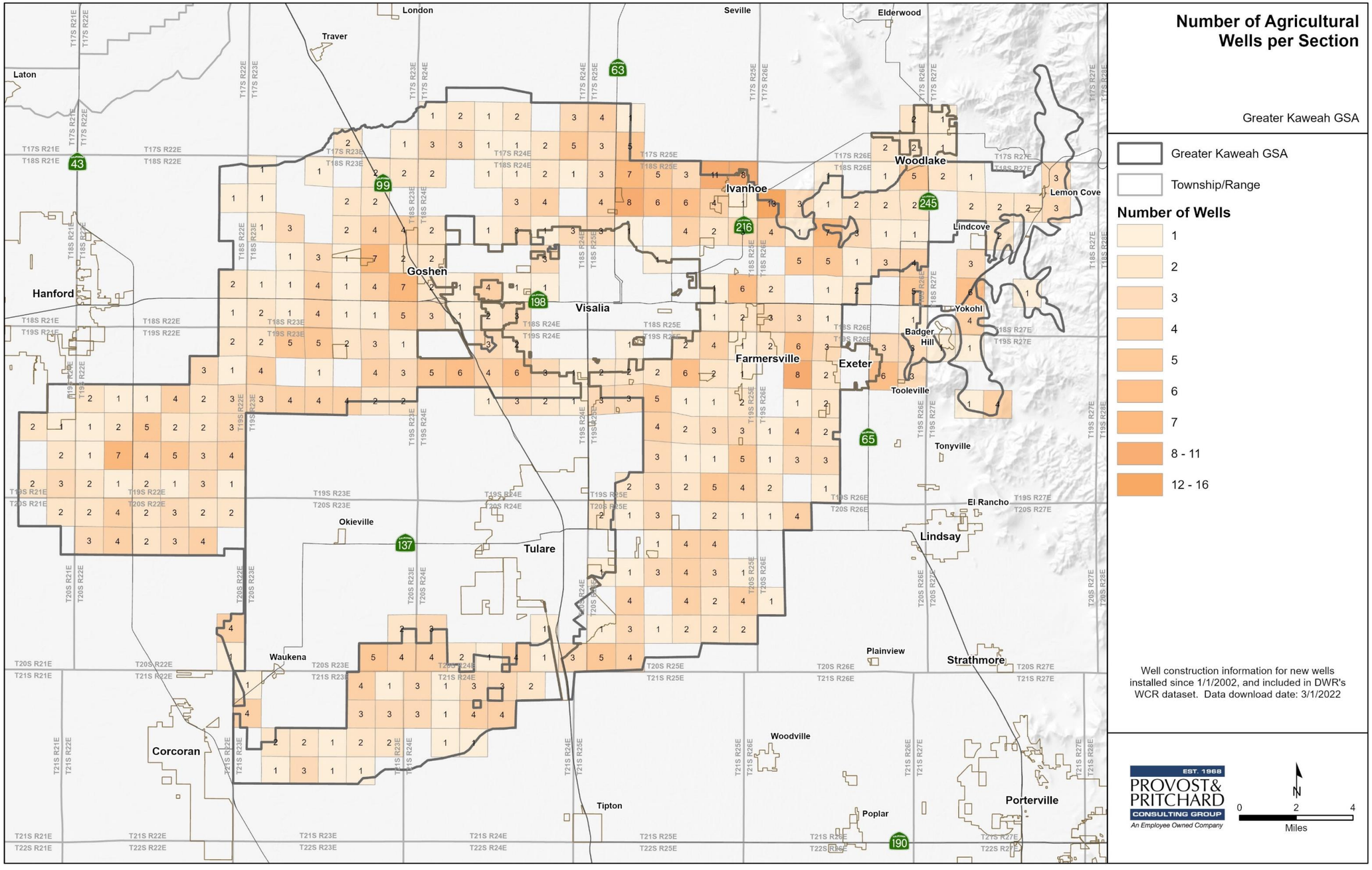


Figure 2-5: Well Density by Section (Production Wells)

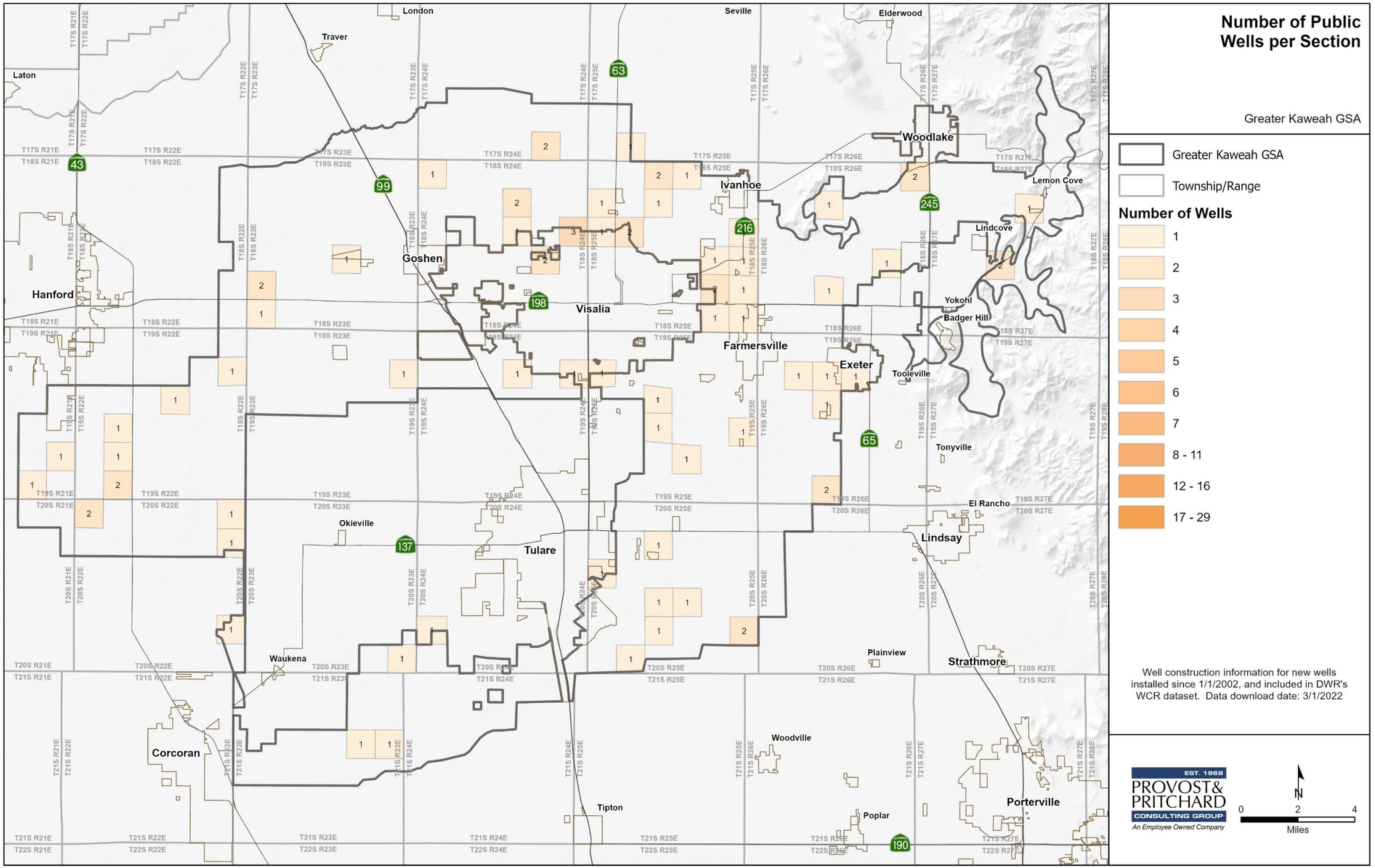


Figure 2-6. Well Density by Section (Public Wells)

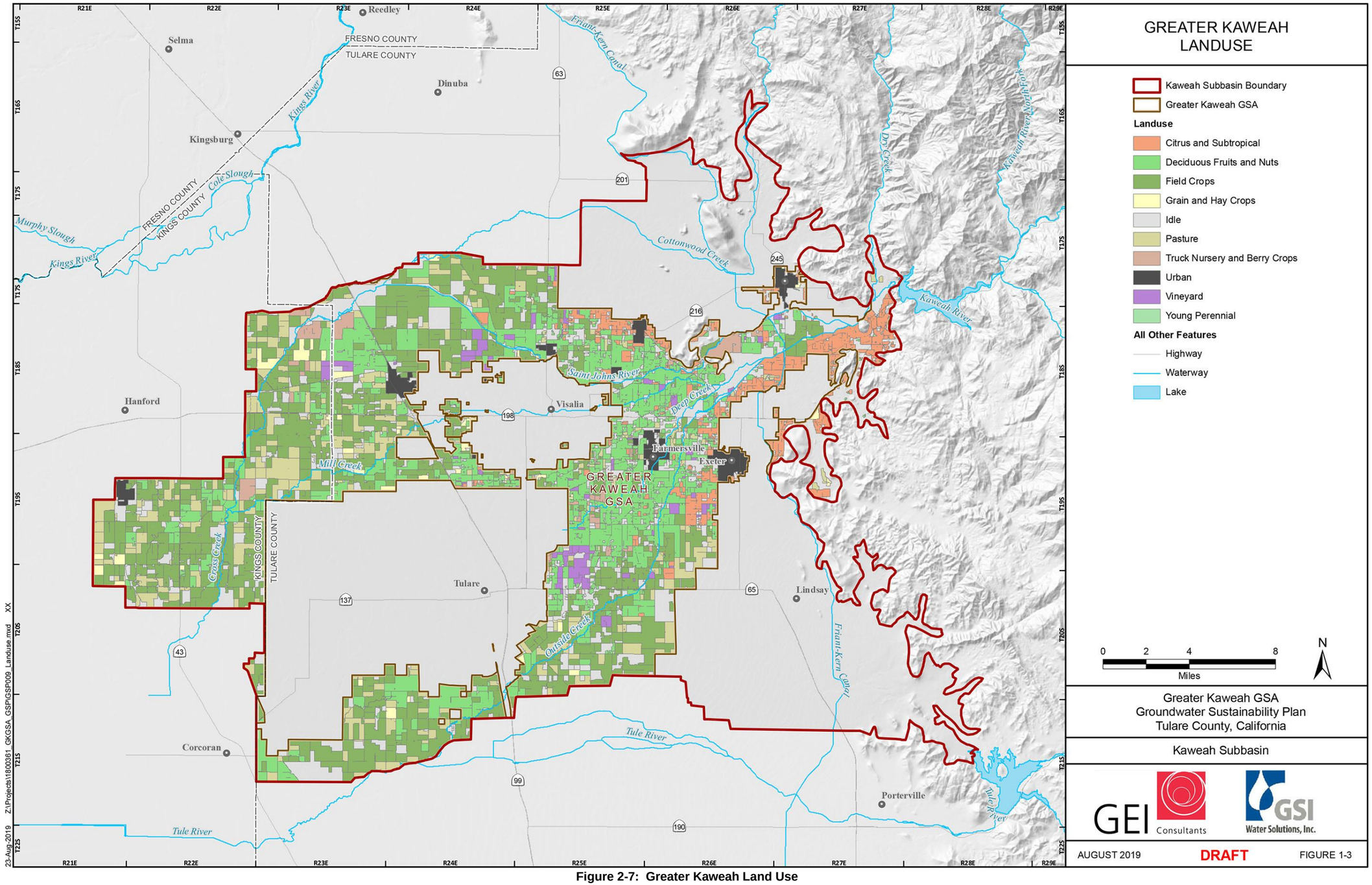


Figure 2-7: Greater Kaweah Land Use

3 BASIN SETTING [ARTICLE 5, SUBARTICLE 2]

3.1 Introduction to Basin Setting [§354.12]

§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.

The three Kaweah Subbasin GSAs (GKGSA, EKGSA, and MKGSA) jointly developed a Subbasin Basin Setting document through their coordinated efforts. The Kaweah Subbasin Basin Setting document is included with this GKGSA GSP in Appendix 3A. 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 Hydrogeologic Conceptual Model (HCM), which describes and depicts the 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 GKGSA, including:

- GKGSA Groundwater Level Trends
- GKGSA Land Subsidence
- GKGSA Interconnected Surface Water
- GKGSA Water Budget for Current Period

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

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 undesirable results 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 undesirable results.

Details regarding the hydrogeologic conditions in the GKGSA within the context of the entire Subbasin are provided in Appendix 3A.

3.2 Hydrogeologic Conceptual Model [§354.14]

§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 brief 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 Spring 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 GKGSA intends to fully update this basin setting section of the GSP as part of the next GSP amendment.

The GKGSA is located within Kaweah Subbasin, bordering the EKGSA and the mountain front to the east, the Kings River Subbasin to the north, the Tulare Lake Subbasin to the west, and Tule River Subbasin to the south. The MKGSA is located within the central-western portions of the Kaweah Subbasin and is surrounded by the GKGSA, except for portions of its western boundary. Roughly, the western half of the GSA is underlain by the Corcoran Clay, which creates an upper and a lower aquifer system, as shown by Sections A-A', B-B', C-C', D-D', and E-E' (Figures 4 through 8 of the Basin Setting Report). A single aquifer system is present beneath the eastern portion of the GSA, all the way to the eastern boundary of the subbasin. The thickness of the fresh groundwater system varies from about 900 feet on the northeastern side of GKGSA where the St. Johns River enters the broad valley to about 1,600 feet along the western side of the subbasin. The thickness probably thins substantially eastward, up the river to the mountain front.

In general, groundwater flows across the GKGSA in a southwesterly direction and to local cones of depression during the irrigation season. The vertical flow gradient is from shallow to deep conditions. The majority of the groundwater quality data comes from the northern and central portions of the GKGSA and within the MKGSA. Several COCs have been identified due to concentrations near Maximum Contaminant Levels (MCLs) or due to increasing trends in concentration: arsenic, nitrate, certain volatile organics, and 1,2,3-trichloropropane (1,2,3 TCP).

Land subsidence due to overpumping has occurred throughout much of the GKGSA area, and the Kaweah Subbasin in general, over the past 90 years, but data are limited in scale and frequency. The largest amounts of subsidence occurred along the western and southwestern portions of the GKGSA area. Greater amounts of subsidence are believed to have occurred beyond the Kaweah Subbasin to the west and south. According to the on-line DWR SGMA Data Viewer (2019), estimated subsidence between 1949 and 2005 has varied from about 1 foot or less to the north of Visalia to mostly 5 feet or less south of Farmersville and west of Visalia. Scattered areas of greater subsidence are present in these areas, between 5 and 10 feet. Along the southwestern corridor of GKGSA, the estimated subsidence mostly ranges between 10 and 15 feet with lesser areas ranging between 5 and 10 feet. In the westernmost GKGSA quadrangle, estimated subsidence ranges from 5 to 10 feet in the northwestern corner to between 15 and 20 feet in the southwestern corner. The pattern of these higher subsidence ranges is generally aligned in a northwest-southeast orientation. DWR did not provide subsidence estimates for the Farmersville, Ivanhoe, and areas further east. More recently, satellite radar technology (Interferometric Synthetic Aperture Radar or InSAR) has been used to identify subsidence for various time periods (January 2007 to December 2010, May 2015 to present), although this radar coverage is not complete across the basin. For the initial 4-year period, InSAR data are available for nine currently existing survey stations,

including three stations with positive values (no subsidence) between 0.4 and 4.4 inches along the St. Johns River and six stations with negative values (subsidence) between -0.2 and -18.1 inches. The least amount of subsidence reported by DWR occurred on the east side of the GKGSA, south of Farmersville, while the greatest amounts of subsidence (-14.5 and -18.1 inches) occurred on the western side of the GKGSA. For the most recent approximately 7-year InSAR period, subsidence data are available for 14 survey stations monitored by Kaweah Delta Water Conservation District in partnership with CalTrans and values have ranged between -1.6 to -17.1 inches. The least amount of subsidence (<3 inches) occurred in the seven stations on the northeast side of GKGSA while the highest value occurred on the western side.

While available date suggest the potential for groundwater dependent ecosystems along the upper reaches of the Kaweah River in the GKGSA, the data are limited at this time and additional work is necessary to determine the extent that groundwater sustains the plant communities and habitats and to what degree groundwater overdraft impacts them.

Within the GKGSA Plan area, the following data gaps in the HCM were identified:

- Accurate count of wells in GKGSA area, including well type (domestic, irrigation, etc.) and status (active, inactive, abandoned). A detailed reconnaissance survey is underway to verify location and operational status of wells within GKGSA's jurisdiction but was not yet complete to inform this plan).
- Construction details of wells, especially production/screen interval(s). This data gap is significant and limits a comprehensive understanding of depth-specific groundwater level and groundwater quality conditions.
- 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
- Groundwater extraction records from direct measurement and locally generated estimates of groundwater use in rural areas of the GKGSA. This information will improve the water budget.
- Lithologic composition of aquifer, including geophysical logs at strategic locations. This information could then help with the interpretation of Airborne Electromagnetic (AEM) data available for the Subbasin.
- Hydraulic parameters of principal aquifers based on pumping tests.
- Water quality data for small rural community, domestic and irrigation wells.
- Measurements of subsidence within the GKGSA. The historical record of measured subsidence is limited and further data on the impact of depth-specific aquifer pumping on subsidence is needed. The 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.

- Groundwater elevation monitoring in areas with shallower groundwater levels to confirm whether or not the potential interconnected surface water and/or GDEs are present.

The data gaps will be addressed as GKGSA 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

§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.

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 GKGSA 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.

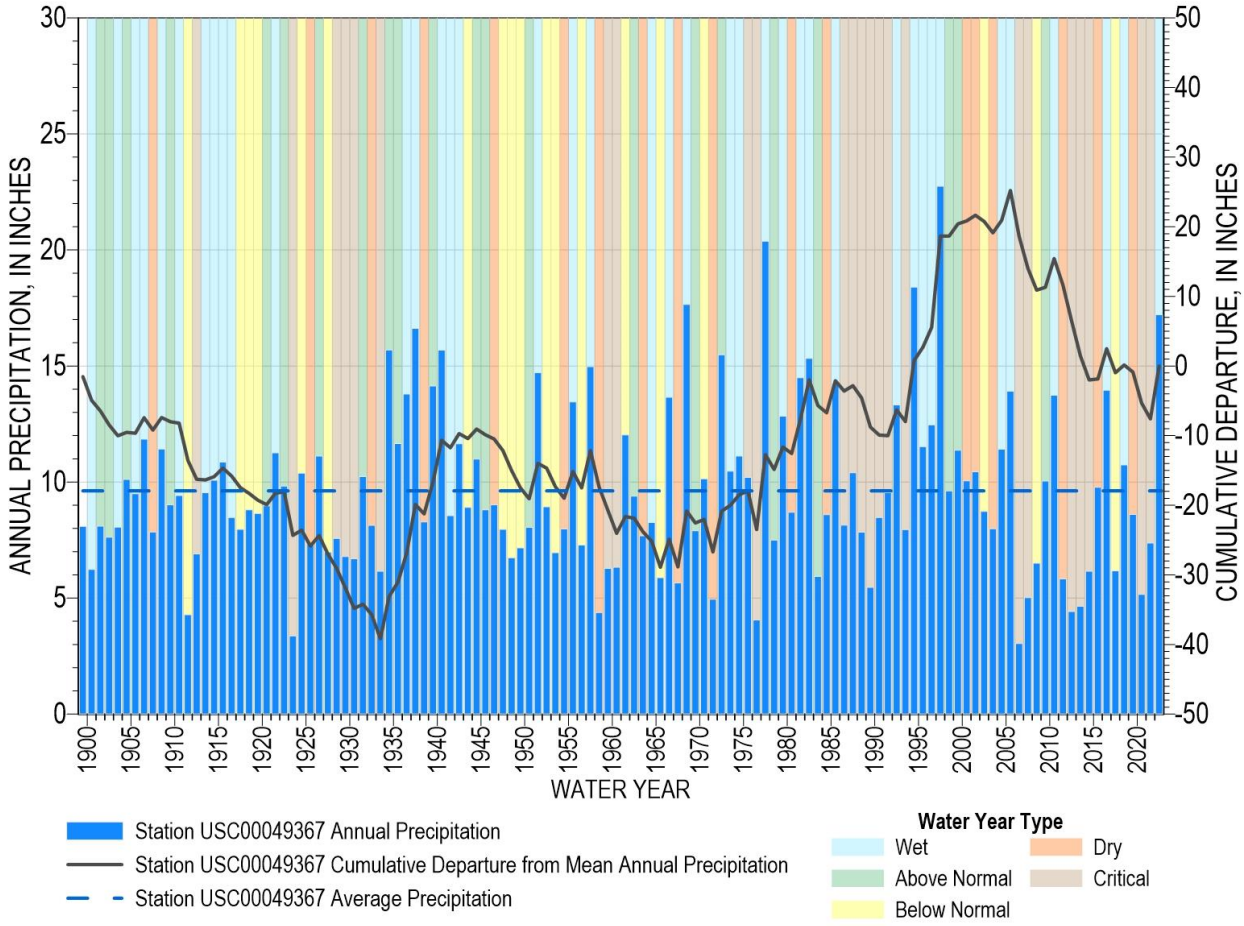


Figure 3-1. Cumulative Departure from Mean Annual Precipitation at the Visalia NOAA Station USC49367

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 climactic 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.

Error! Reference source not found. Figure 3-1 and Table 3-1 emphasize the highly variable c limatic 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

Period (Water Years)	Hydrologic Condition	Duration (No. of Years)	Precipitation Deviation (Inches)	Deviation Rate (Inches/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 levels for the deeper confined aquifers found below the Corcoran Clay have similar downwards trends to the unconfined aquifers. Depth to groundwater in wells screened in the confined aquifer is deeper than in the unconfined aquifers. Depth to groundwater can be greater than 300 feet below ground surface. Spring and Fall 2023 groundwater elevation contours for the Unconfined Aquifers are provided on Figure 3-2 and Figure 3-3, respectively. The contour maps both show a general groundwater gradient from the northeast to the southwest (Lake Kaweah towards 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 GKGSA area, pumping depressions are found in the southern GKGSA area east of Highway 99 and the western side of the GKGSA 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 western Kaweah-Tulare Lake Subbasins' boundary has more complexity due to the influence of multiple clay layers, surface water deliveries, and groundwater pumping. 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 three 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 (also known as Lower Aquifer) monitoring wells to the monitoring network.

It is important to note that while much of the Subbasin experienced widespread water level declines, there are areas where water level declines have been less pronounced. Generally, along the Kaweah River near the foothills in the eastern portion of the Subbasin, some wells have experienced very minimal seasonal fluctuations. These wells are presumed to be both relatively shallow and benefit from almost continual recharge from the flow of the Kaweah and St. Johns Rivers.

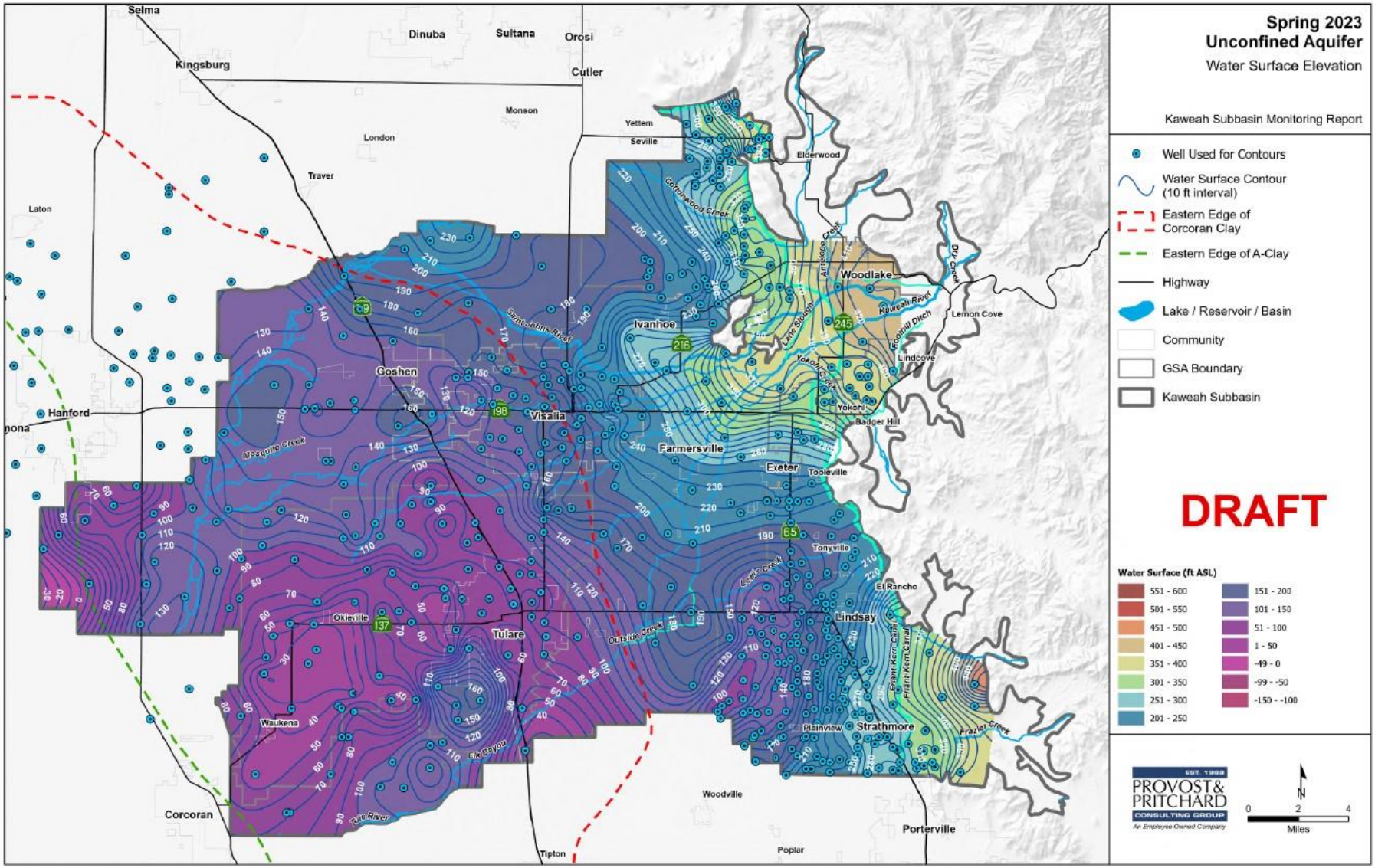


Figure 3-2. Spring 2023 Unconfined Aquifer Water Surface Elevation Map

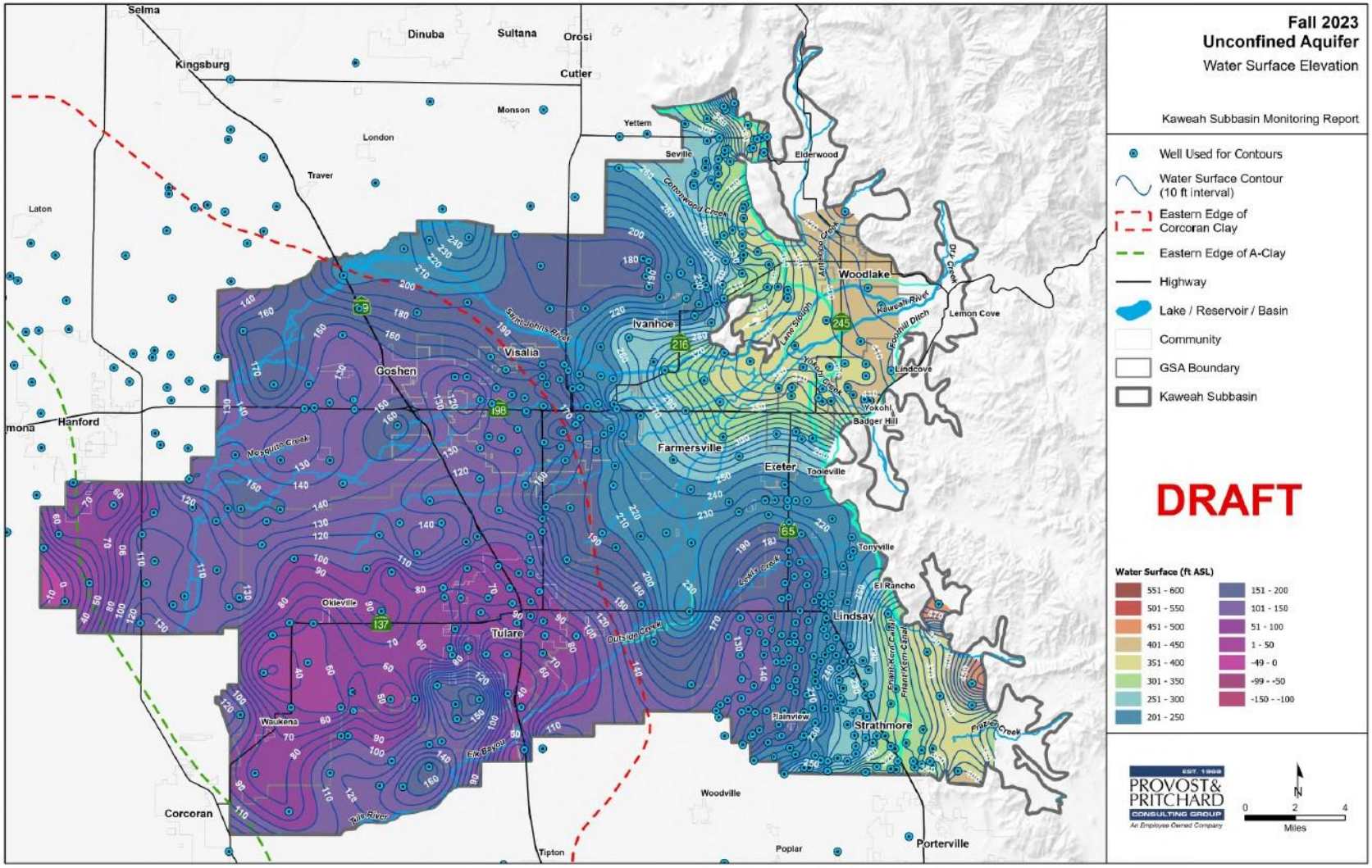


Figure 3-3. Fall 2023 Unconfined Aquifer Water Surface Elevation Map

3.3.2 Land Subsidence

Land subsidence due to overpumping has occurred throughout San Joaquin Valley over the past 90 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 GKGSA area. Based on historical land survey and radar technology supplemented with Interferometric Synthetic Aperture Radar (InSAR) data from 2015 onwards, it is estimated that since 1948, approximately 25 feet of total land subsidence has occurred in the southwestern part of the GKGSA area. The amount of subsidence decreases from southwest to northeast across the 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 3-4. 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.

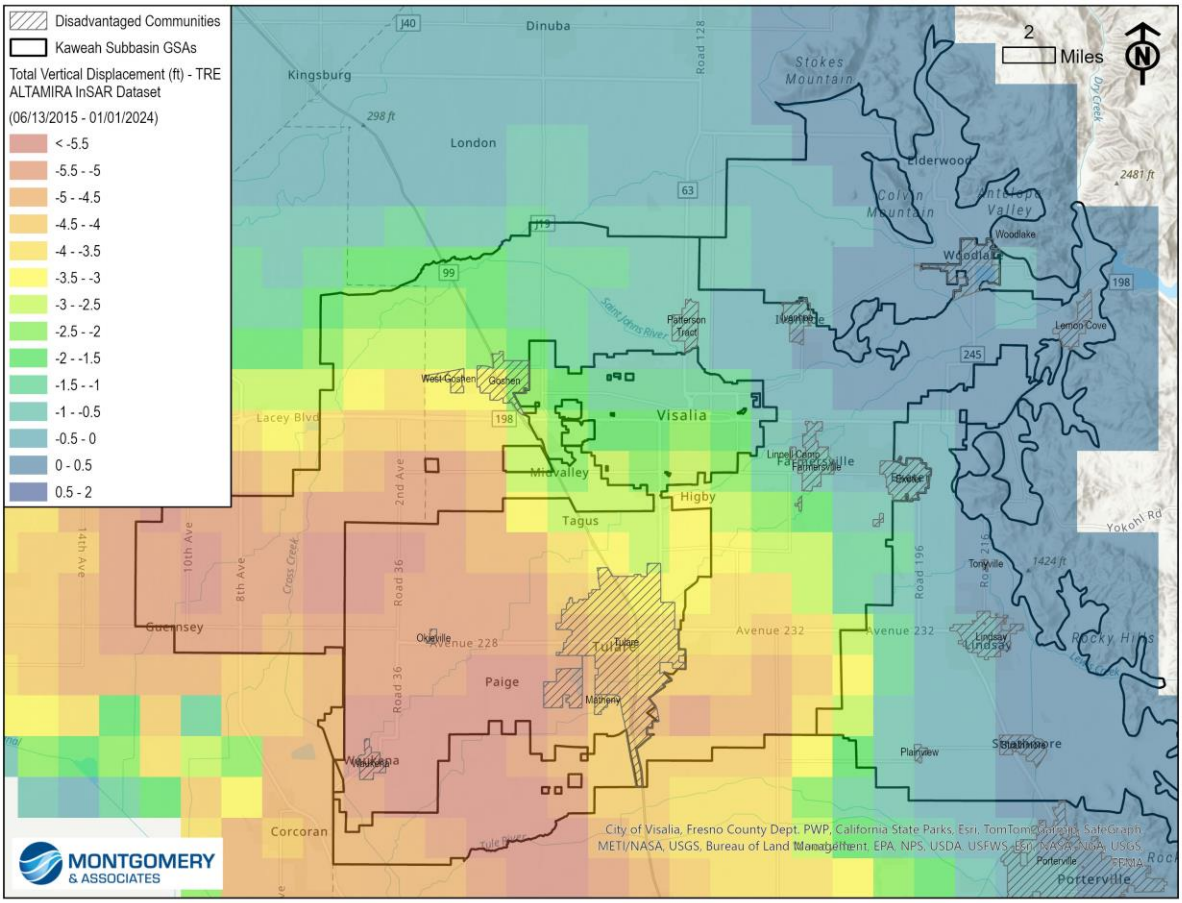


Figure 3-4. Kaweah Subbasin Total Land Subsidence from June 13, 2015 through January 1, 2024

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:

(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.

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 4.1.1). 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 at the end of this Section 3.3.3 as Table 3-3.

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 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 percent 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 and Zonal Delineation

For the purpose of establishing minimum thresholds and measurable objectives, 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 sustainable management criteria are available in Section 4.1.

3.3.3.3 Constituents of Concern

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 undesirable results 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 (US 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 MCL Exceedances for Constituents of Concern in Kaweah Subbasin

Constituent of Concern	MCL	MCL Units	Number 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	1214	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	1228	36	3%
Sulfate	500	mg/L	1109	10	1%
US EPA Secondary MCL (Aesthetic/Non-Health Based Standards)					
pH	8.5	-	1047	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%

[1]Constituent 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.

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 Kaweah Subbasin is detailed 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 in Figure 3-5.

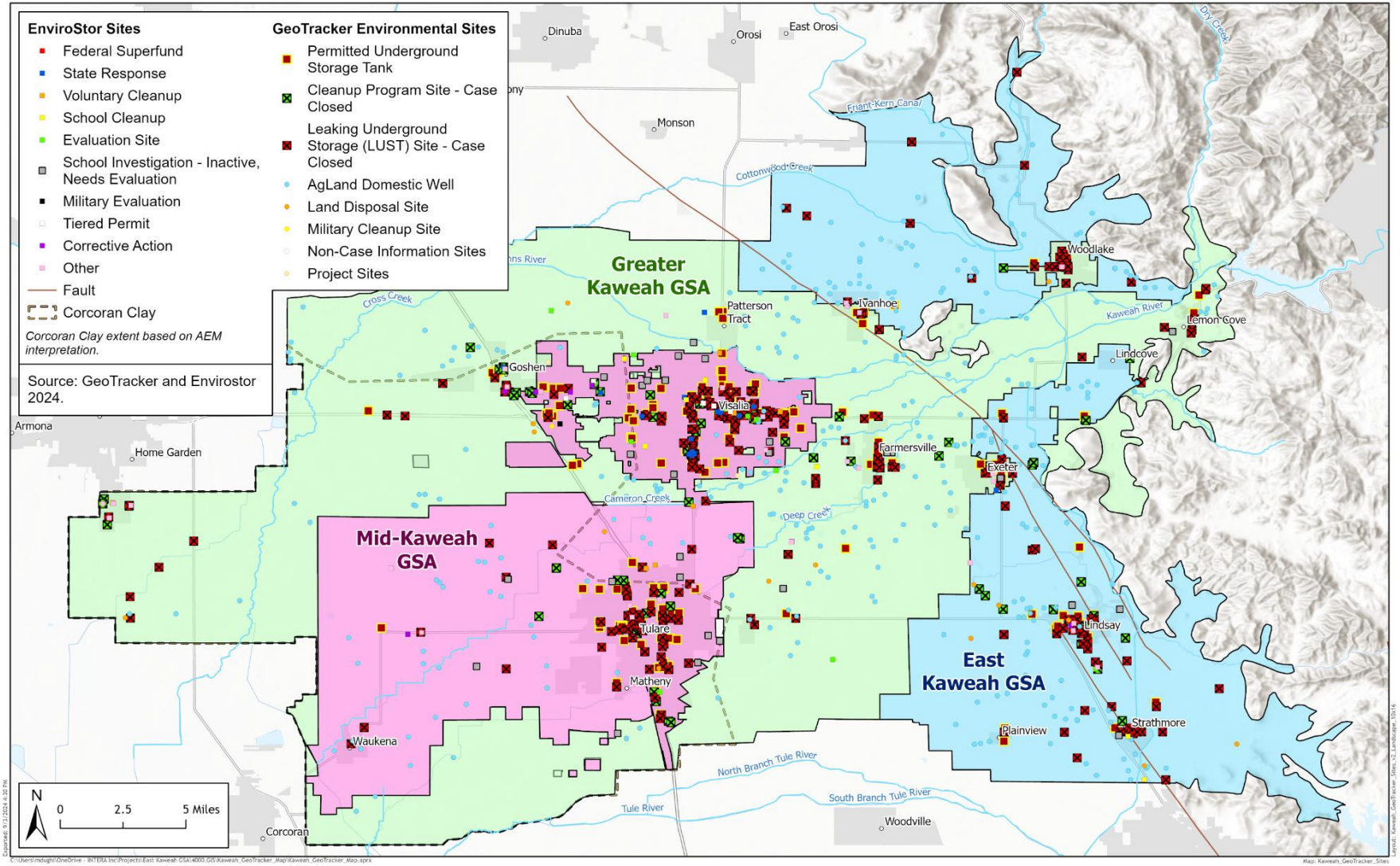


Figure 3-5: Point-Source Contaminated Sites in the Kaweah Subbasin Sourced by GeoTracker and Envirostor (2024)

Table 3-3: Potential Causation of Historical Groundwater Quality Degredation

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 et al. 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 et al. 2021, Belitz et al. 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 et. al 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 et. al 2008). Natural sources of nitrate in soils are also recognized.	X	X
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 et al. 2010).	X	X

Constituent of Concern	Potential Causation of Historical Degradation of Groundwater Quality in the Kaweah Subbasin	Naturally Occurring	Anthropogenic
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 et. al 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
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

See Appendix 3B for maps depicting the spatial distribution of pre-SGMA and post-SGMA maximum and median concentrations and concentration trends of these listed constituents in the Kaweah Subbasin.

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

There are nine 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.

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 3-5). 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).

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 in Figure 3-6. In 1989, SWRCB established an MCL for 1,2-DBCP of 0.2 (µg/L).

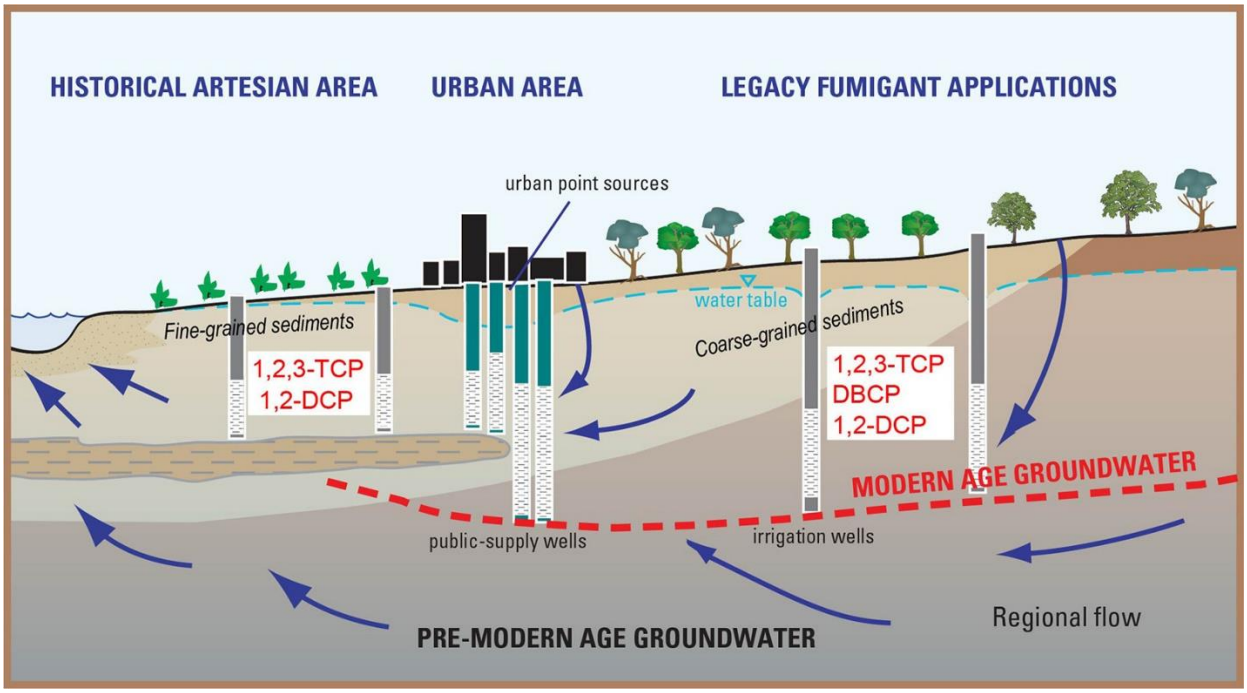


Figure 3-6: 1,2,3,-TCP and DBCP Sources and Transport (Burow et al., 2019)

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). In these sedimentary basins, groundwater recharge is limited due to low precipitation and the residence time of the groundwater in the basin is high. 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 (see Figure 3-7).

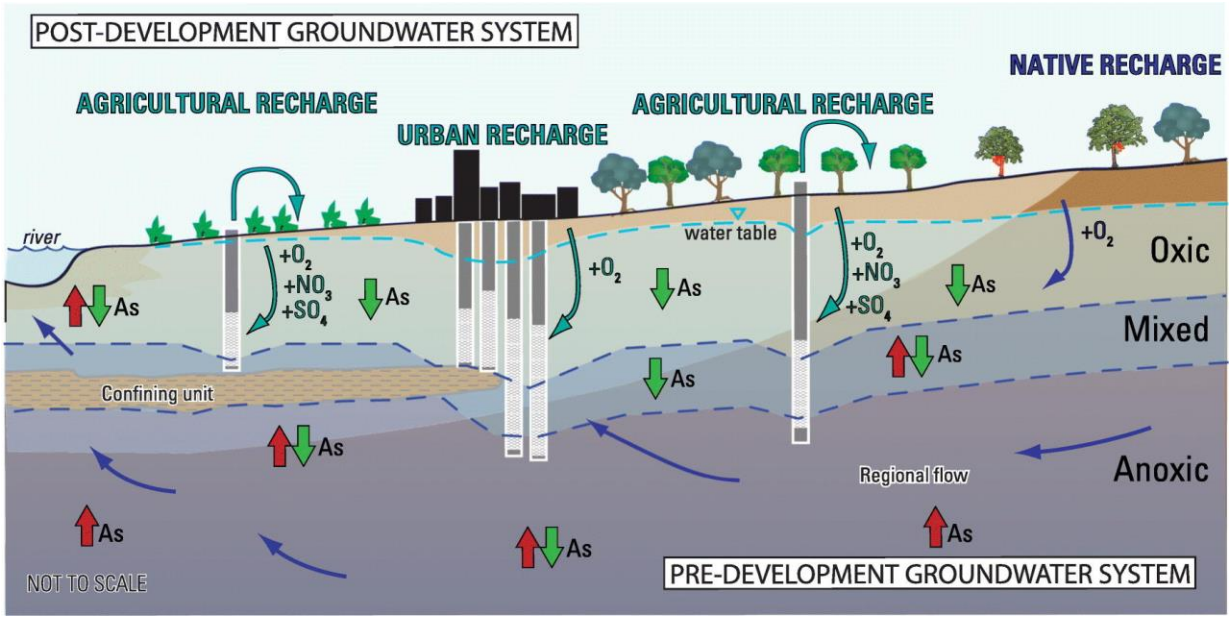


Figure 3-7: Pre- and Post-Development Groundwater System and Arsenic Concentration (Haugen et al., 2021)

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).

Hexavalent Chromium (CrVI)

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, 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 3-8). 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 two forms of chromium. Water systems have two to four years to comply with the regulations depending on the system size. Systems smaller than 1,000 connections have four years to comply while larger systems have two years.

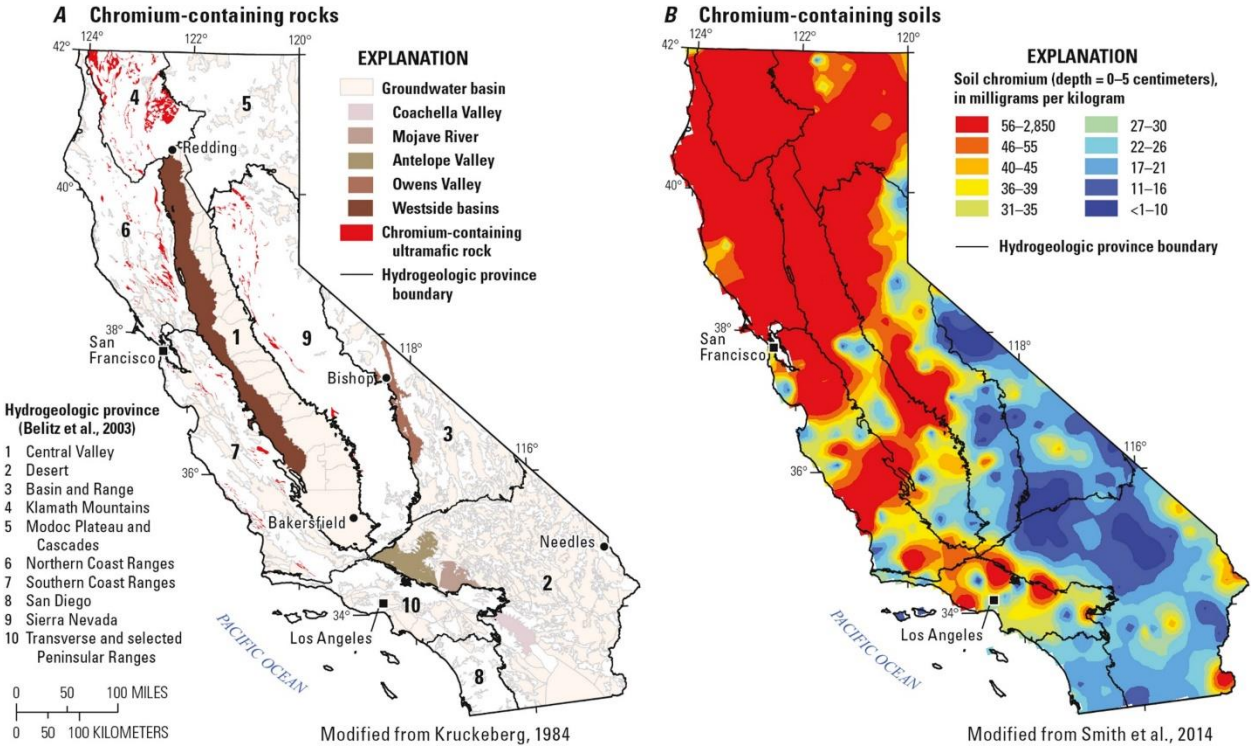


Figure 3-8: Chromium-Containing Rocks and Soils (Izbicki et al. 2015)

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 percent of wells sampled for nitrate exceeded the drinking water MCL (CSWRCB 2016). This study identified dairy manure or septic effluent sources for the most heavily impacted wells based on nitrate isotopic analysis (Figure 3-9). In general, higher domestic well water nitrate concentrations are found in Central Valley wells below 400 feet surface elevation (Figure 3-10). 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.

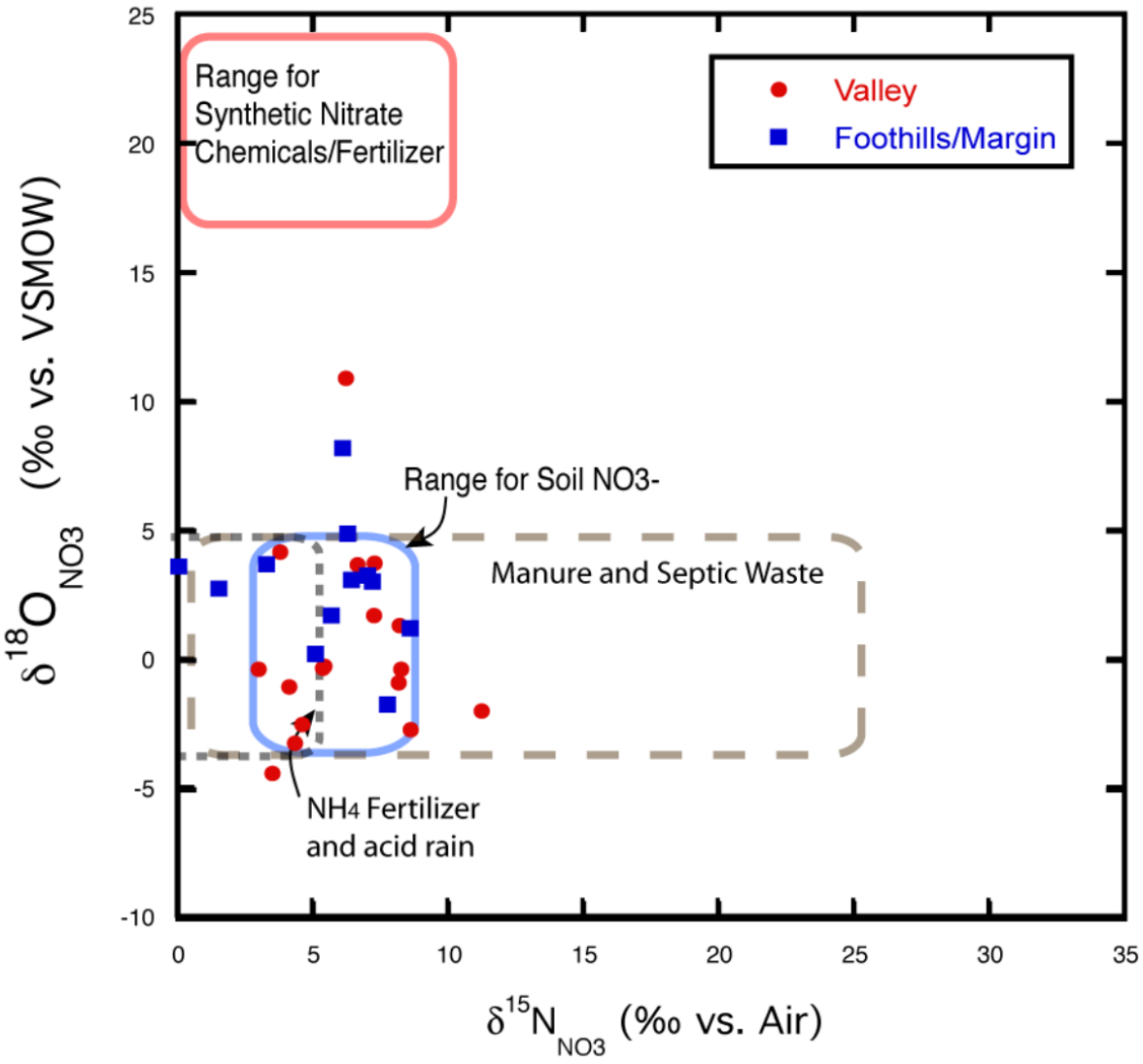


Figure 3-9: Nitrogen and Oxygen Isotope Compositions of Dissolved Nitrate in Tulare County Wells (Singleton et al.

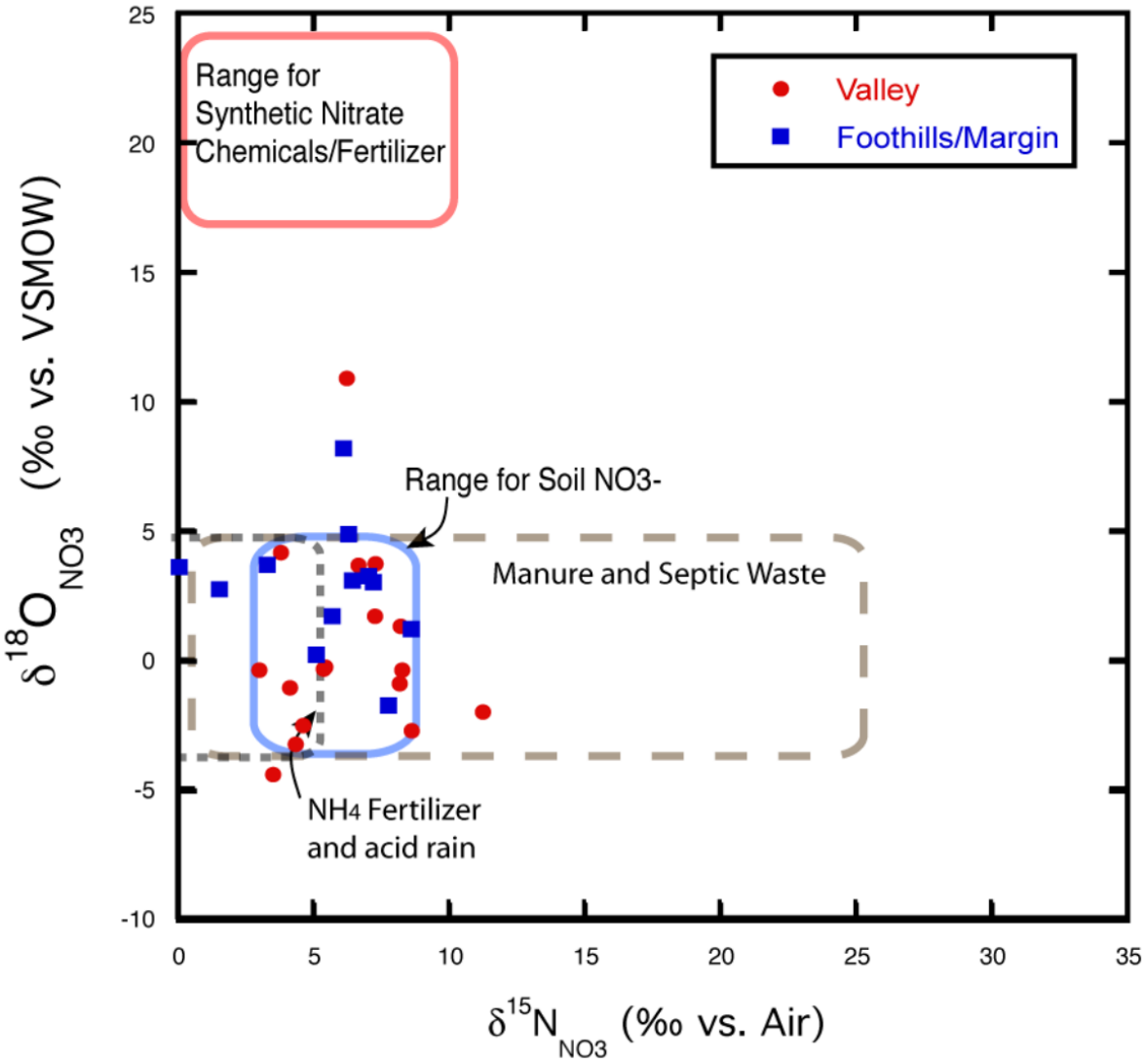


Figure 3-10: Nitrate by Elevation in Tulare County Wells (Singleton et al. 2011)

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.

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 US EPA and in addition to potential health effects has been linked to an increased risk of cancer, particularly liver and kidney cancer.

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 percent 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).

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

There are four 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.

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.

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 µS/cm (microsiemens per centimeter), with an upper recommended level of 1,600 µS/cm and a short-term limit of 2,200 µS/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.

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) and 600 mg/L (short-term), based on the aesthetic effects of taste and odor. The Basin Plan includes a water quality objective for sulfate through the incorporation of the SMCLs. When evaluating ambient groundwater conditions, long-term averaging periods are appropriate. The EPA estimates that about 3% of the public drinking water systems in the country may have sulfate levels of 250 mg/L or greater (EPA, 2012).

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) (see Figure 3-11). 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).

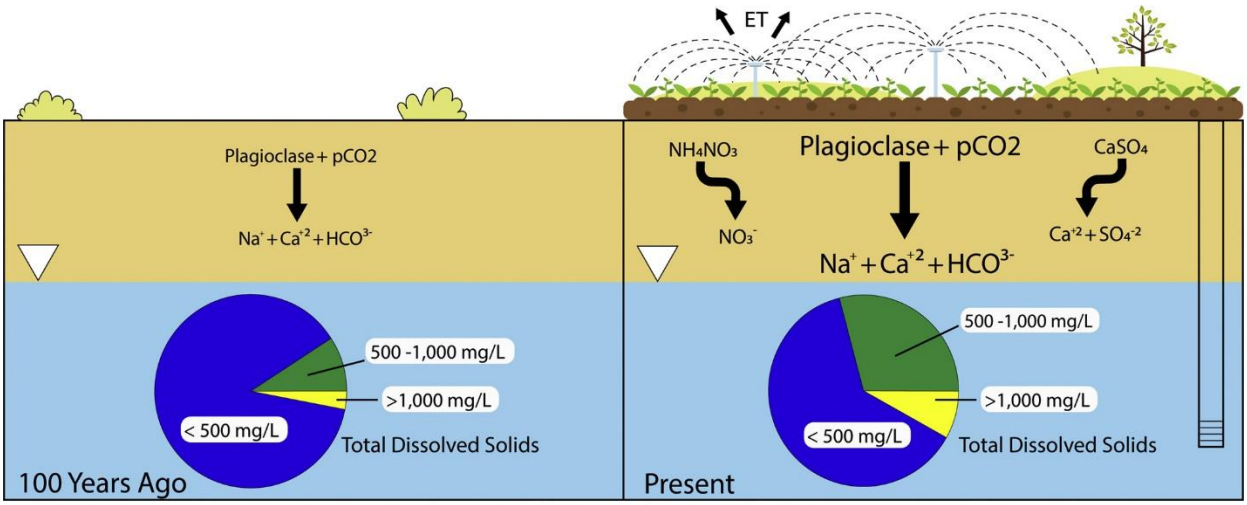


Figure 3-11: San Joaquin Valley Recharge and Groundwater Conditions Over 100 Years (Hansen et al. 2018)

pH

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. Similar to 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.

COCs Above Recommended Agricultural Water Quality Goals

There are two 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.

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 concentrations above 0.2 mg/L can be harmful for sensitive crops, 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 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.

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.

3.3.3.4 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 spatially for each well location in the GAMA dataset (Appendix 3B). The highest median concentrations of a COC reported is the median concentrations from each individual well with four 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.

Historical Groundwater Quality Trend Analysis

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.

3.3.3.5 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 individual 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.

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		Units	Locations of Max Exceedances			Maximum Concentration Range		Median Concentration Range		Units	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	mg/L	X	X	X	ND	0.28	ND	0.166	mg/L	X	X	X
1,2-DBCP		X	0.2	mg/L	ND	1.01	ND	0.33	mg/L	X	X	X	ND	0.29	ND	0.14	mg/L		X	X
Arsenic	X	X	10	mg/L	0.11	100	0.6	23	mg/L		X	X	0.25	100	1.15	88	mg/L	X	X	X
Boron	X	X	0.7	mg/L	ND	48.4	0.0125	0.05005	mg/L		X	X	ND	0.851	ND	ND	mg/L		X	
Chloride		X	500	mg/L	ND	1600	2.3	700	mg/L	X			0.982	1300	2.4	1050	mg/L	X		X
Gross Alpha	X	X	15	pCi/L	0.25	58	0.4	37.25	pCi/L	X	X	X	0.513	39.8	0.856	26.45	pCi/L		X	X
Hexavalent Chromium	X	X	10	mg/L	ND	11	ND	2.2	mg/L	X			ND	21	ND	12	mg/L	X		X
Nitrate as N	X	X	10	mg/L	ND	510	0.1	59.5	mg/L	X	X	X	ND	88	ND	58	mg/L	X	X	X
Perchlorate	X	X	6	mg/L	ND	13	ND	11	mg/L	X		X	ND	13	2	9.7	mg/L	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	mg/L	X	X	X	5.46	390	8.9	320	mg/L	X	X	X
Specific Conductivity	X	X	1600	mS/cm	2.38	5100	130	2500	mS/cm	X		X	109	4000	140	3650	mS/cm	X		X
Sulfate	X	X	500	mg/L	ND	4600	2.2	328	mg/L			X	ND	190	1.1	160	mg/L	-	-	-
Tetrachloroethene (PCE)		X	5	mg/L	0.017	270	ND	49	mg/L	X	X	X	0.022	92	0.39	6.595	mg/L		X	
Total Dissolved Solids (TDS)	X	X	1000	mg/L	5.52	3900	84.5	1500	mg/L	X		X	72.9	2800	94	2500	mg/L	X		X
Uranium	X	X	20	pCi/L	0.0459	56	0.501	37	pCi/L		X	X	0.0351	303	0.875	23	pCi/L		X	X

Notes:
[1]Minimum threshold is equivalent to measurable objective and interim milestone. More 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 Setting), with the exception of boron and sodium based on the agricultural suitability goal

3.3.4 Interconnected Surface Water

§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:

(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.

Interconnected surface water (ISW) refers to surface water that is hydrologically 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 3-12 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 3-12). 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 3-12. If the groundwater levels are below the stream (i.e. an unsaturated zone exists underneath the stream bottom), then the stream is *not* interconnected (i.e. the aquifer is hydrologically disconnected from the surface water) and infiltration rates from the stream to the groundwater system are independent of groundwater levels or pumping (bottom left diagram on Figure 3-12).

Groundwater pumping can cause (1) reduction of inflows to an ISW from groundwater or (2) an increase in outflow from an ISW to groundwater. The resulting reductions in the volume of surface water caused by groundwater pumping in both situations are called depletion of ISW. Note, depletions due to groundwater pumping can only occur in sections of the stream that are hydrologically connected with the aquifer. SGMA identifies that an undesirable result occurs if, among other reasons, groundwater use occurring in a basin causes reductions in surface flows from depletions of ISW that significantly and unreasonably impact beneficial uses of the surface water (CWC § 10721(x)(6)). Depletions of ISW under SGMA are only related to impacts caused by groundwater use.

Surface flows (and related beneficial uses) in the Kaweah Subbasin are dependent on climactic, anthropogenic, hydrologic, ecologic, and geologic factors as listed below:

Climactic Causes: Reductions in precipitation and snowpack, reduced window of snowmelt due to rising temperatures, forest fires altering mountain stream patterns, rising temperatures

increasing evaporation off of streams, rising temperatures increasing the consumptive use demand of vegetation in riparian corridors and in-stream.

Anthropogenic Causes: Reductions in dam releases, increased use of riparian water rights, increased use of other surface water rights, groundwater pumping

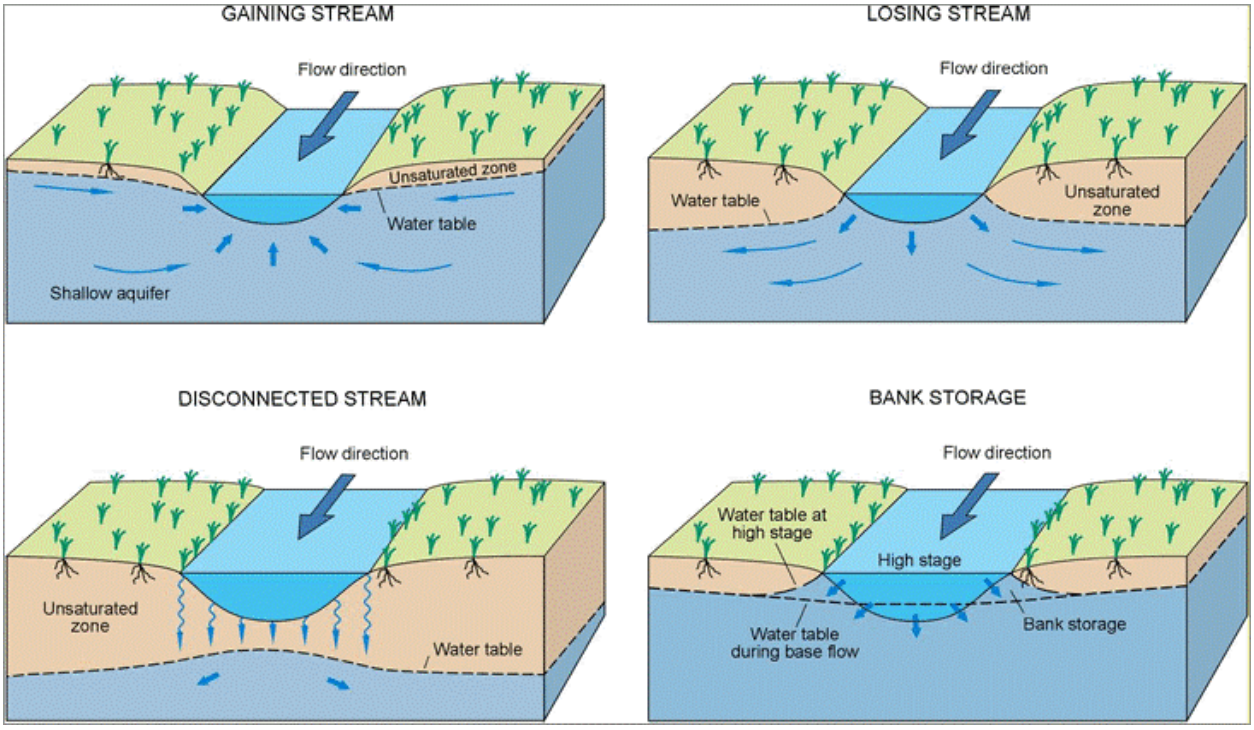
Hydrogeologic Causes: Reductions in mountain block recharge

Ecologic Causes: Increases in upstream and adjacent vegetative consumption of riparian and interconnected groundwater

Geologic Factors: Depth to bedrock influencing the saturated thickness (and likelihood of interconnection)

Figure 3-13 shows a schematic with the primary factors that influence surface water and groundwater in the Kaweah Subbasin. These include reservoir releases, precipitation, diversions, mountain front recharge, evapotranspiration, discharge/recharge from disconnected sections of the streams/rivers, and depletions from ISW. As can be seen, pumping-induced depletions from interconnected surface water are one of several factors that may alter surface flows.

Of these causes, the responsibility of the GSAs under SGMA is to protect beneficial uses and users from impacts induced by groundwater activities such as groundwater pumping, recharge, and other forms of groundwater management. Surface water delivery, dam releases, and other anthropogenic affects are outside of the jurisdiction of the GSAs and are not considered groundwater activities.



Data Source: USGS, 1998.

Figure 3-12: Schematic of Interconnected Surface Water Under Various Groundwater Conditions

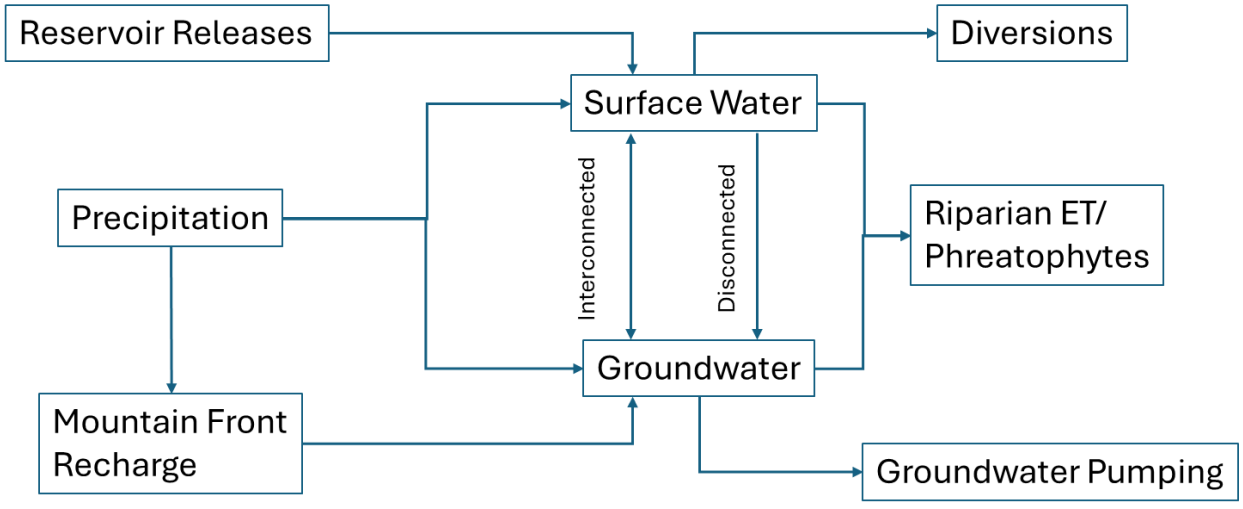


Figure 3-13: Factors Influencing Surface Flows and Groundwater in the Kaweah Subbasin

3.3.4.1 Surface Waterbodies in the Kaweah Subbasin

The surface waterbodies in the Kaweah Subbasin include natural and manmade surface water conveyance infrastructure. Natural streams and creeks enter the Kaweah Subbasin from the Sierra Nevada Foothills through alluvial fans and canyons. In addition to the natural waterways, irrigation lined and unlined ditches, lined and unlined canals, and pipelines designed to convey surface water are present across the Subbasin.

Figure 3-14 depicts the surface waterbodies in the Kaweah Subbasin. Figure 3-15 depicts the surface waterbodies in the eastside of the Subbasin.

Natural Channels

The Kaweah River rises in the Sierra Nevada at an elevation of over 12,000 feet and drains a watershed area of about 630 square miles above the foothill line. Terminus Dam, located about 3-1/2 miles east of the easterly Subbasin boundary, has a tributary drainage area of about 560 square miles, which produces about 95 percent of the total runoff of the watershed. The dam forms Lake Kaweah for flood control and irrigation water supply. Since completion of Terminus Dam in 1961, seasonal storage of Kaweah River flows has been provided, which assists in regulation to irrigation demand schedules. Other than maintenance of a minimum pool for recreation, no carryover storage is provided in the reservoir. The Kaweah River is fully appropriated, pre-1914 rights, and water is delivered via agreements with water rights holders of the Kaweah and St. Johns River Association (KSJRA). Releases from the dam form a significant part of flows in the Kaweah River and its distributaries and are made based on agricultural demand when flood control releases are not required. Water rights are administered through the Watermaster in accordance with historic agreements and associated measurement locations. Additionally, KDWCD and KSJRA works with the Army Corps of Engineers in the operation of Terminus Dam to coordinate flood releases as well as delivery to appropriators.

Dry Creek and Yokohl Creek are tributaries entering the Kaweah River below Terminus Reservoir and produce significant quantities of water only during flood periods. Runoff in Kaweah River is largely retained within the Subbasin and only in infrequent years of exceptionally large runoff is there escape to Tulare Lake bed. Seepage from the river contributes to recharge within the Subbasin.

At McKay Point, the Kaweah River divides into the St. Johns River and Lower Kaweah River branches. Water is diverted from the St. Johns and Lower Kaweah rivers and distributed through a complex system of natural channels and canals owned or operated by numerous agencies and entitlement holders within the subbasin, all of which have established rights to the use of water from the Kaweah River. The Lower Kaweah River, below McKay Point, conveys water to a series of distributary channels and canals throughout the central and southerly portions of the Subbasin. Outflow from the Subbasin occurs through Mill Creek to Cross Creek and from Elk Bayou to the Tule River in the southeasterly portion of the Subbasin. About 126,000 acres can receive irrigation water from the Lower Kaweah River system through the facilities of 10 entities. The principal diversions from the Lower Kaweah River below McKay.
Point in downstream order are listed below.

- Hamilton Ditch
- Hanna Ranch
- Consolidated Peoples Ditch
- Deep Creek
- Crocker Cut
- TIC Main Intake Canal
- Fleming Ditch
- Packwood Creek
- Oakes Ditch
- Evans Ditch

The St. Johns River, from McKay Point, flows northwesterly through the northern part of the Subbasin to a point approximately 2 miles east of SR 99 where it changes course and flows in a southwesterly direction and is joined by Cottonwood Creek. Prior to reaching SR 99 at the confluence of Cottonwood Creek, the St. Johns River becomes Cross Creek. River flows at this point are diverted into Lakeside Ditch for irrigation use by Lakeside Irrigation Water District and Lakeside Ditch Company. Corcoran Irrigation District and other Tulare Lake water users divert flows from Cross Creek into Lakelands Canal No. 2. During periods of flooding, river flows continue in the Cross Creek channel into Tulare Lake bed.

A total of about 180,000 acres can receive irrigation water from the St. Johns River through the facilities of 15 entities. It is estimated that on average about 142,000 AF/WY was diverted from the St. Johns River between 1981 and 1999. The principal diversion works from the St. Johns River in downstream order are as follows:

- Longs Canal
- Ketchum Ditch
- Tulare Irrigation District Main Intake Canal
- Mathews Ditch
- Uphill Ditch
- Modoc Ditch
- St. Johns Ditch
- Goshen Ditch
- Lakeside Ditch
- Lakelands Canal No. 2
- Persian and Watson

Lastly, the Tule River flows to the south of the Kaweah Subbasin. Seepage from the River can contribute to recharge within the Kaweah Subbasin in wetter periods (Water Supply Study of the Lindmore ID, 1948).

Man-made canals and ditches

The Friant-Kern Canal (FKC), managed by the U.S. Bureau of Reclamation (USBR), runs the length of the EKGSA, generally following the eastern border. East of the City of Lindsay it turns

south and runs through the interior of the EKGSA, skirting Strathmore and continuing to the south. The FKC is lined and is the primary source of imported surface water for the Kaweah Subbasin. Water is diverted from the Friant-Kern Canal to Tulare Irrigation District at a large Parshall flume and into the St. Johns River. Additionally, a turnout on the Friant-Kern Canal provides for releases directly into the Lower Kaweah River, and the Ketchum Ditch diverts water from the St. Johns River and discharges into the Lower Kaweah River.

Surface water is delivered from natural rivers and imported sources through a combination of pipes as well as man-made canals and ditches. Within the East Kaweah GSA, all surface water deliveries are conveyed through piped systems with the single exception of the Wutchumna Ditch, which is the principal water course supplying supplies water to the Ivanhoe Irrigation District. The ditch, which flows parallel to and slightly north of the St. Johns River, diverts water from the Kaweah River about 1.5 miles above McKay Point and is operated by the Wutchumna Water Company.

Within the remainder of the Kaweah Subbasin, principal man-made conveyance system is the Main Intake Canal of the TID, which delivers comingled Kaweah River and Central Valley Project (CVP) waters for use in the TID. TID also delivers water through the Cameron Creek and Packwood Creeks below the Tagus Evans Ditch. Within the Tulare Irrigation District, the largest entitlement holder within the Kaweah Subbasin, there are a total of approximately 300 miles of unlined canals and ditches, 30 miles of piped conveyances, and ¼ mile of lined canals (TID, 2012).

The headgates (diversions) from the Kaweah and St. Johns Rivers discussed in the previous section are conveyed from the headgate to the crops within the entitlement holder service areas by hundreds of miles of ditches.

Several ditch companies divert water from the Lower Kaweah River; the principal ones are listed below:

- Consolidated Peoples, Farmers, and Elk Bayou Ditch Companies
- Mathews
- Jennings
- Uphill
- Modoc
- Goshen
- Lakeside Ditch Companies

TID, Fleming, Oakes, Evans, Watson, and Persian Ditch Companies receive water from Lower Kaweah and St. Johns Rivers. A schematic diagram of the Kaweah system is presented in Figure 3-16. As can be seen, the Kaweah River system is highly managed with several anthropogenic inflows and diversions.

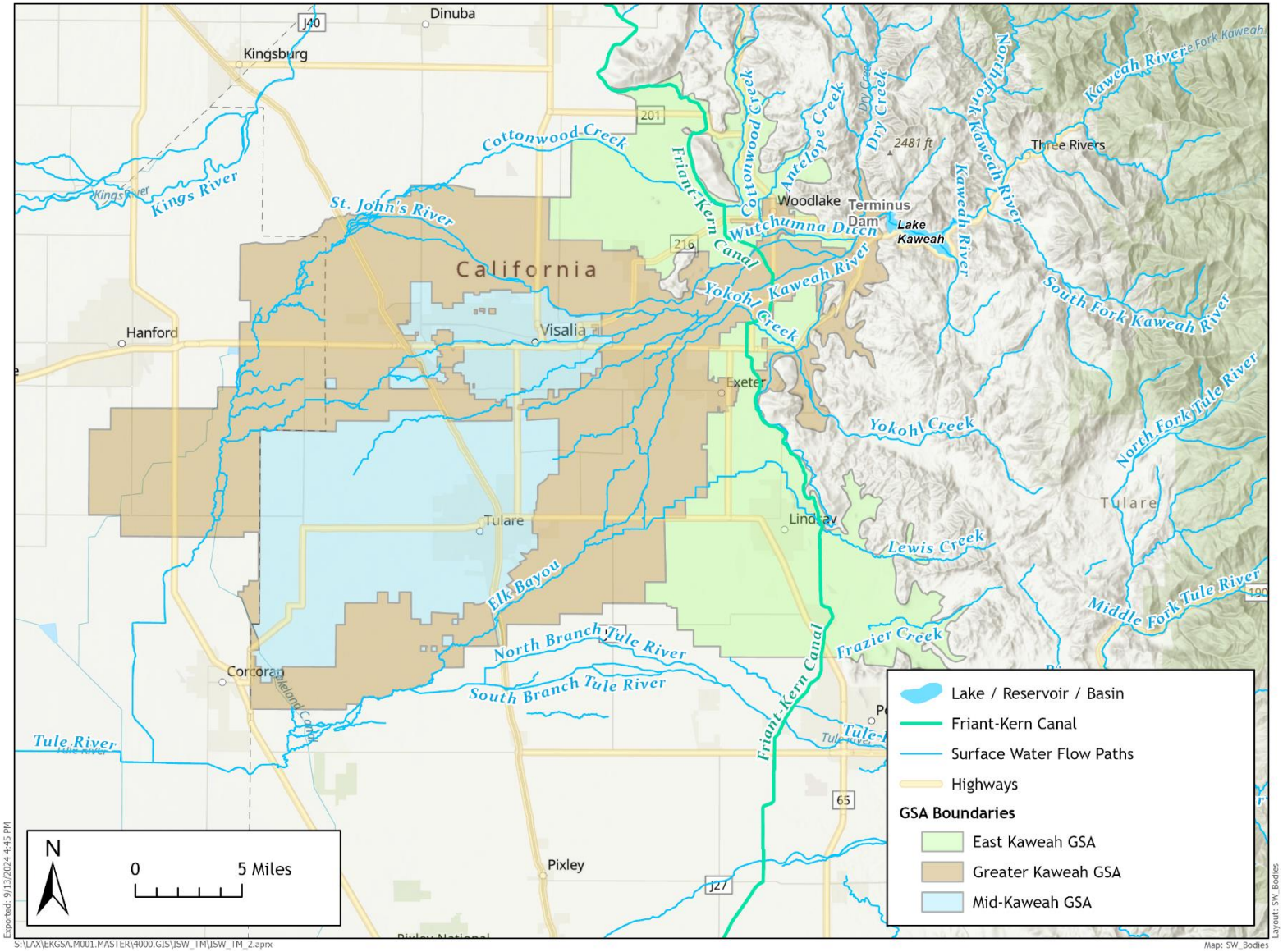


Figure 3-14: Surface Water Features in the Kaweah Subbasin

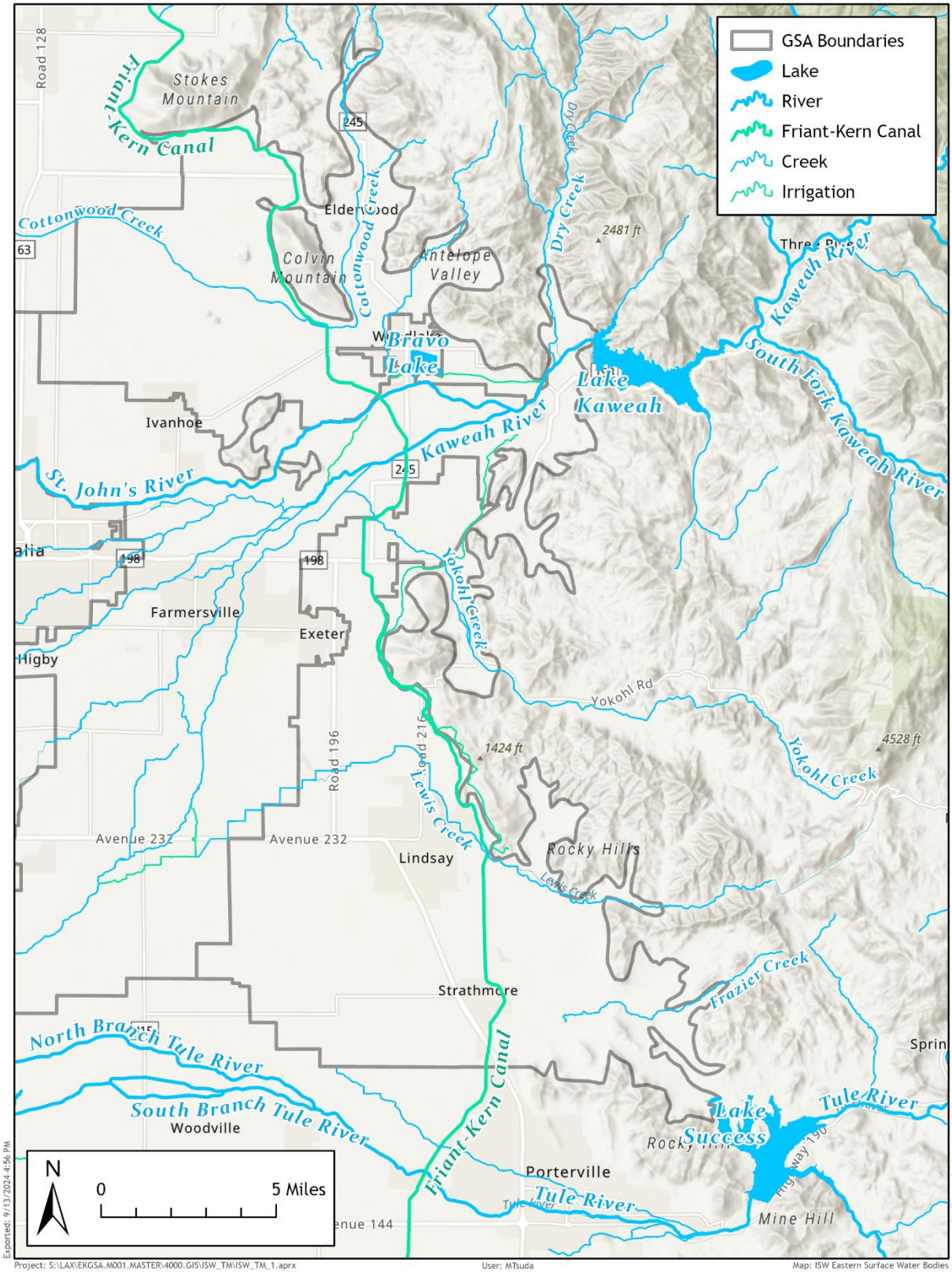


Figure 3-15: Surface Water Features on the Eastside of the Kaweah Subbasin

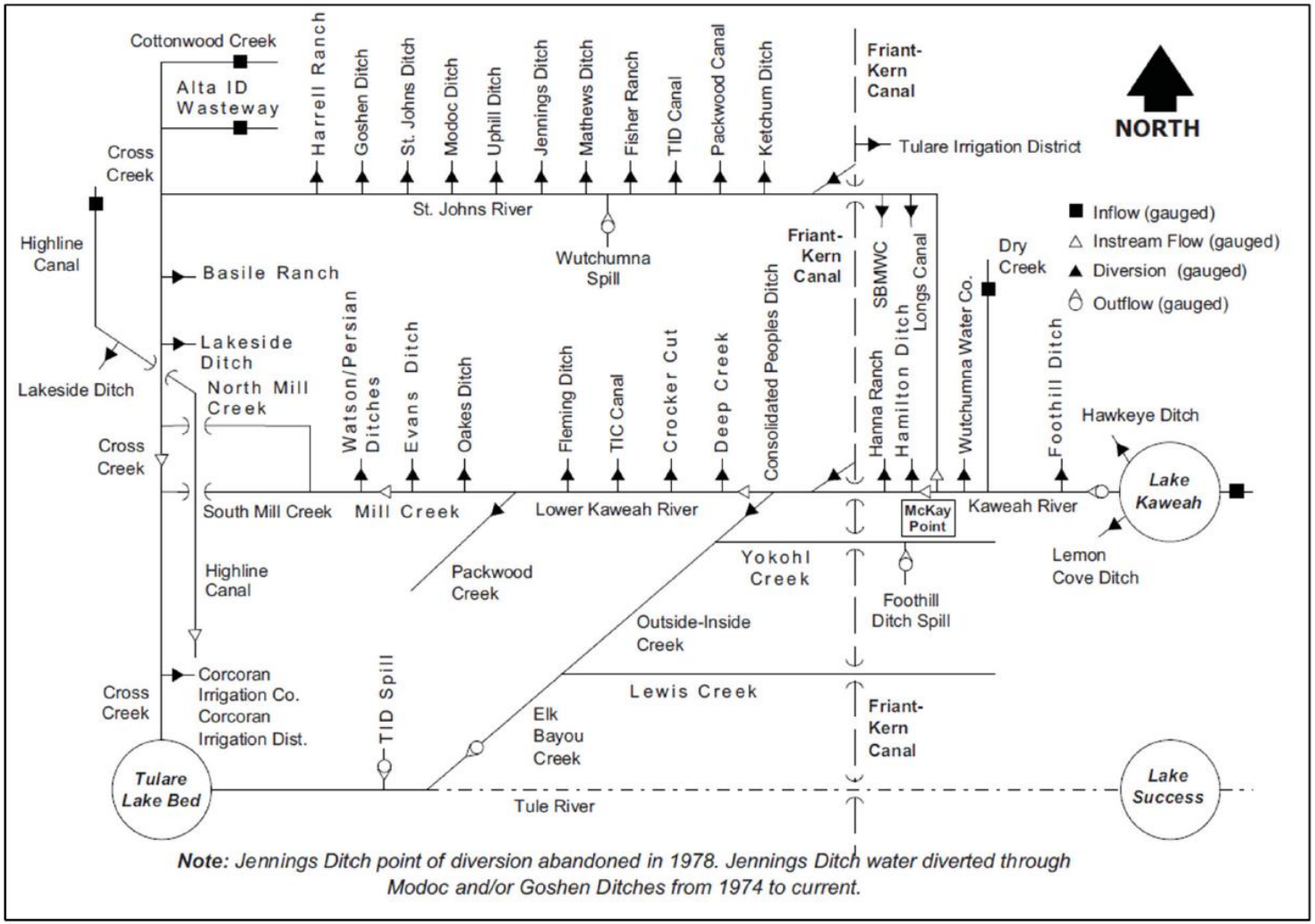


Figure 3-16: Schematic Diagram of the Kaweah River System

Available Flow Data and Information

Figure 3-17 shows the locations of surface water gages and diversions with data available in the Kaweah Subbasin. The surface water flow data were obtained from the Kaweah Delta Water Conservation District (KDWCD), and the diversion data were obtained from KDWCD. As can be seen there are several areas with no flow data. This includes the Cottonwood Creek, Antelope Creek, and Lewis Creek.

Figure 3-18 and 3-19 show all available surface water flow and diversion data along the Kaweah and St. John's Rivers from water year (WY) 2012 to 2022. In general, over the period of record the surface water flow and diversion volumes were highest in the wet years 2017 and 2019 and lowest in the dry years 2013, 2014, 2015, 2021, and 2022, with the 2022 volumes being higher than in the other dry years. For the surface water flows, the volumes were highest at the Terminus Dam and decreased downstream along the Kaweah River. The surface water flow data at the St. John's below McKay suggest that a significant portion of the flows from the Terminus Dam goes to the St. John's River; however, no downstream data are currently available along the St. John's River. The diversion volumes were highest at the Wutchumna Ditch, Consolidated Peoples Ditch, and Rocky Ford.



Figure 3-17: Points of Diversion and Stream Gage Locations in the Kaweah Subbasin

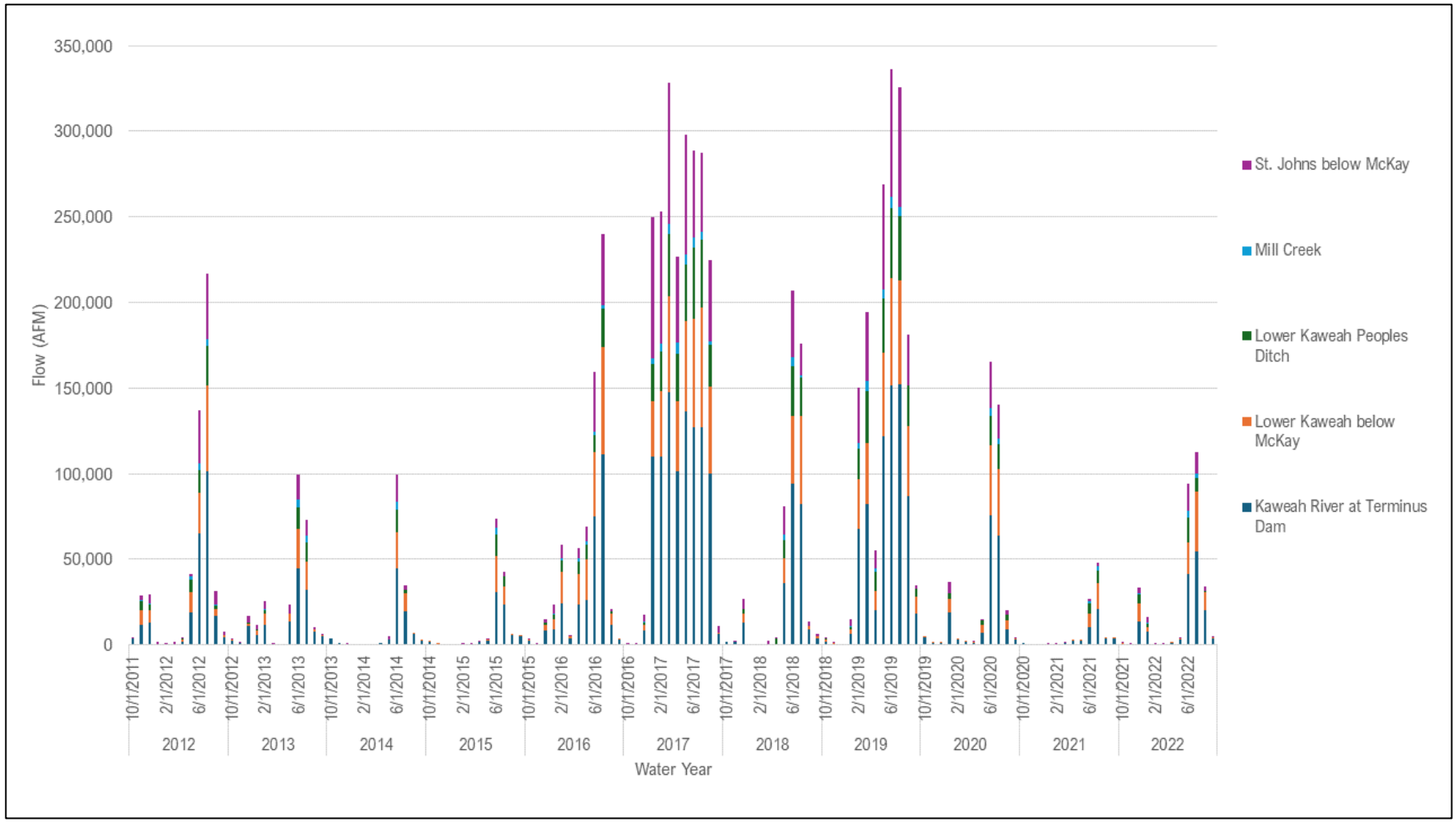


Figure 3-18: Surface Water Flows Along the Kaweah and St. John's Rivers for Water Years 2012-2022

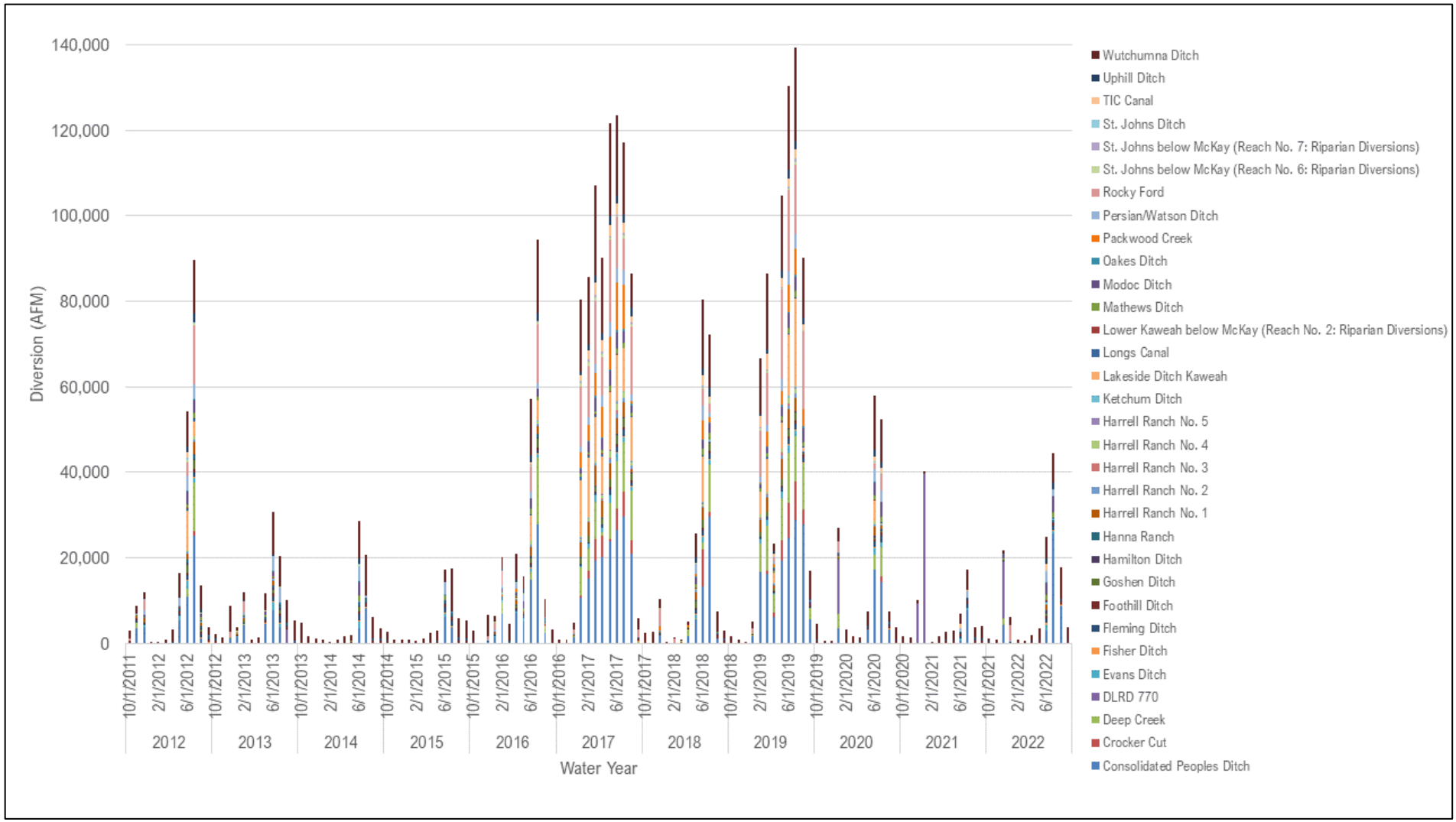


Figure 3-19: Surface Water Diversions from the Kaweah and St. John's Rivers for Water Years 2012-2022

3.3.4.2 Areas with Potential Interconnected Surface Water in the Kaweah Subbasin

ISWs exist where groundwater is hydrologically connected with surface water. This can only happen in areas with shallow groundwater. Hence, shallow groundwater level data is essential to defining the presence of ISW. Ideally the shallow groundwater level data should be taken from wells proximal to surface water bodies, as groundwater levels can change significantly as one moves away from the stream channel (Figure 3-12). In the absence of shallow groundwater elevations adjacent to streams uncertainty exists regarding the interconnectivity of surface water and groundwater. Groundwater elevations from shallow groundwater further away from stream channels can be used to assess potential interconnectivity of surface water, with the understanding that there may be mounding under losing reaches and groundwater lows under gaining sections of the stream network. ISWs can be dynamic in nature, with stream segments interconnected during high groundwater level conditions transitioning and disconnected during low groundwater level conditions.

Potential areas for ISW were assessed in the Kaweah Subbasin by evaluating available groundwater levels in areas with surface water bodies. The Spring 2017 groundwater elevations were used because these represented post-SGMA seasonal high groundwater levels during wet year conditions, giving conservative values for shallow groundwater levels. While 2023 was another wet year post-SGMA, the groundwater elevations from Spring 2023 were not used because it was an anomalously wet year, and Spring 2017 was more representative of the seasonal highs in a regular wet year. Observed Spring 2017 groundwater elevation data were interpolated and then subtracted from the 10-meter Digital Elevation Model (DEM) to obtain the Spring 2017 depth to water (DTW) raster. Figure 3-20 shows the Spring 2017 DTW in the Kaweah Subbasin. Note, there is sparse groundwater monitoring in the Cottonwood Creek, Antelope Creek, Dry Creek, Yokohl Creek, and Lewis Creek areas; hence, DTW could not be assessed in these areas. These areas have been identified as data gaps and DTW and potential ISWs will be assessed in the future, when groundwater level observations become available.

To assess the transient nature of ISWs, DTW were derived for Fall 2022 (a post-SGMA dry period) using a similar methodology. Figure 3-21 shows the Fall 2022 depths to water in the Kaweah Subbasin. The Spring 2017 and Fall 2022 depths to water were comparable, with the shallow groundwater zones being concentrated in the northeastern portion of the Subbasin along the Kaweah and St. John's Rivers.

Different ranges of depth to water are shown in the color flood (Figure 3-20). Owing to the uncertainty in the spatial distribution of groundwater levels, a conservative depth-to-water threshold of 50 ft below ground surface (bgs) was used to identify an area of interest with potential ISW. Figure 3-22 shows groundwater levels from RMS wells within the ISW area of interest. As can be seen, groundwater levels generally go down from east to west. Water levels at the eastern-most well (18S27E05J0001M) are the highest and fairly stable over time, without

showing much influence of hydrology. Water levels in the more westerly wells are lower with more inter-annual variability. In general, 2015 groundwater levels were the lowest and 2022 the second lowest groundwater levels observed over the 10-year period of record.

The Nature Conservancy's (TNC's) Interconnected Surface Water in the Central Valley (ICONS) uses DTW to identifying different likelihoods of ISWs (TNC, 2023). In the ICONS dataset, publicly available on TNC's website, the river and stream segments in the Central Valley are categorized based on the historical groundwater depth data as below (TNC, 2023):

- **Likely Connected – Gaining**: Depth to groundwater is less than or equal to zero feet below the ground surface. Groundwater is likely flowing into the surface water body.
- **Likely Connected – Losing**: Depth to groundwater is between 0 and 20 feet below the ground surface. Groundwater is likely receiving water from the surface water body.
- **Uncertain**: Depth to groundwater is between 20 and 50 feet below the ground surface. Groundwater may or may not be connected to the surface water body.
- **Likely Disconnected**: Depth to groundwater is greater than 50 feet below the ground surface. Groundwater is likely disconnected from the surface water body.

The broad ranges for the DTW account for uncertainty in the spatial distribution of DTW, especially near and underneath stream channels. Similar to the methodology used by TNC, the potential areas of interconnected surface water (ISW) in the Kaweah Subbasin were identified by categorizing the river and stream segments in the Subbasin based on the observed Spring 2017 groundwater depth data (Figure 3-20). The areas without the observed Spring 2017 groundwater depth data were classified as "Uncertain." After identifying the potential areas of ISW based on the groundwater depth data, which were mostly in the eastern portion of the Subbasin along the Kaweah and St. John's Rivers, the following refinements were made based on the stakeholder input and local knowledge:

- The segment of the Kaweah River between the Terminus Dam and McKay Point (point of bifurcation between the Kaweah and St. John's Rivers) was classified as "Likely Connected – Gaining." This was consistent with flow observations at surface flow gages at the Terminus Dam and McKay point, which indicated increasing flows from east to west.
- The stream segments to the west of the Lower Kaweah Peoples Ditch surface water gage and within the shallow groundwater zone (where the Spring 2017 depth to groundwater was less than or equal to 50 feet) were classified as "Mostly Disconnected – Losing." Shallow groundwater level observations adjacent to the river channel show consistent groundwater levels 10 ft or more below ground surface, even during wet conditions.
- Dry Creek flowing into the Kaweah River was classified as "Likely Connected."

While the methodology used for the Kaweah Subbasin ISW designations is consistent with TNC's ICONS dataset, the DTW surface and ISW designations are different due to the use of basin-specific groundwater level data, local stakeholder input, and hydrogeologic/hydrologic knowledge.

A map of the potential ISW underlaid by the Spring 2017 depth to groundwater is available in Figure 3-23. Based on this designation most of the ISW fall in the eastern portion of the GKGSA area along the Kaweah and St. John's River. GKGSA has several areas with groundwater level and surface-flow data gaps, which are currently being filled (via the Interconnected Surface Water Data Gap Work Plan – Section 6.7.12). DTW in the west are consistently greater than 50 ft bgs, and hence there is little to no likelihood of ISWs in the western portions of GKGSA and the entire MKGSA area.

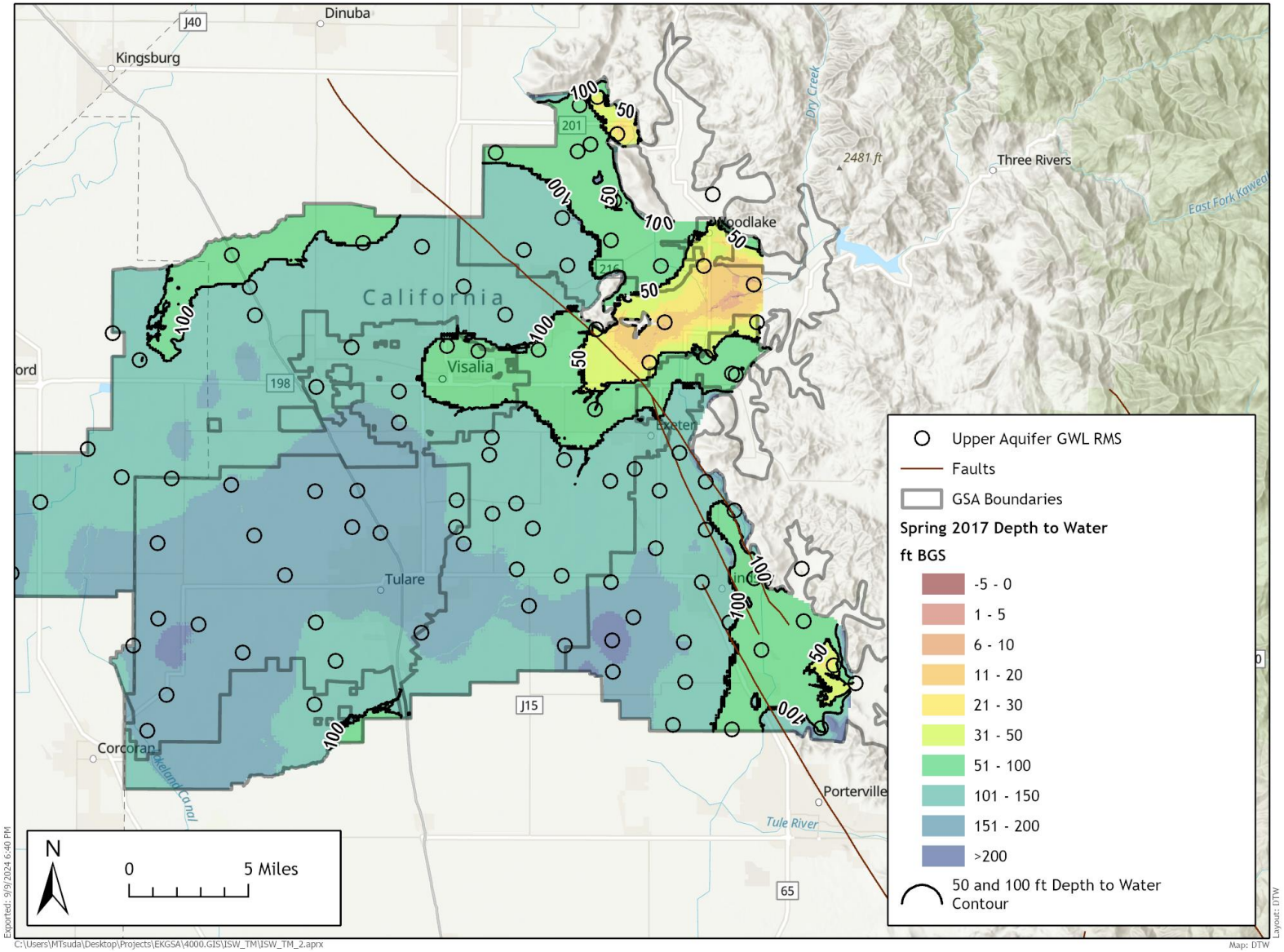


Figure 3-20: Spring 2017 Depth to Water in the Kaweah Subbasin

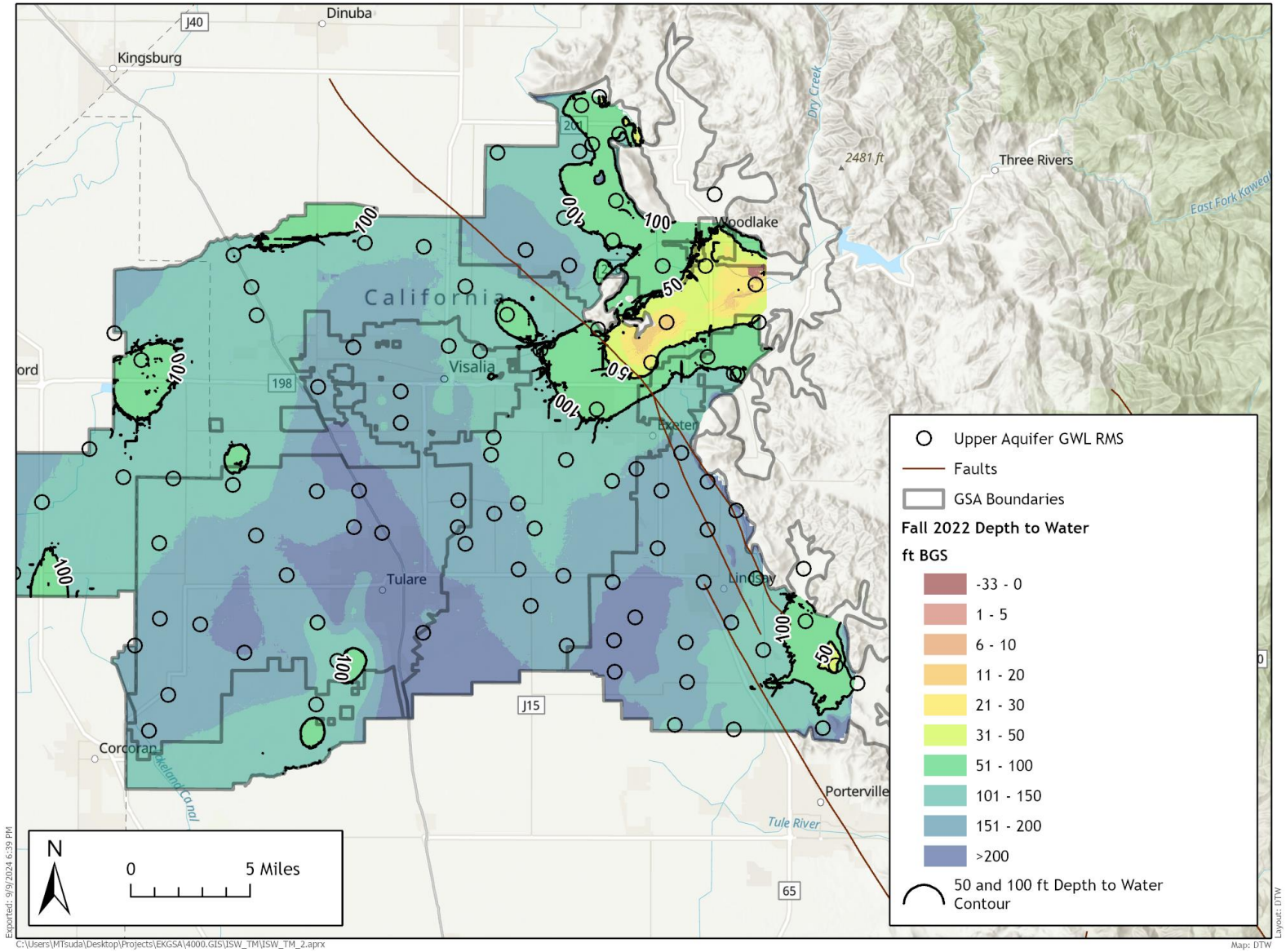


Figure 3-21: Fall 2022 Depth to Water in the Kaweah Subbasin

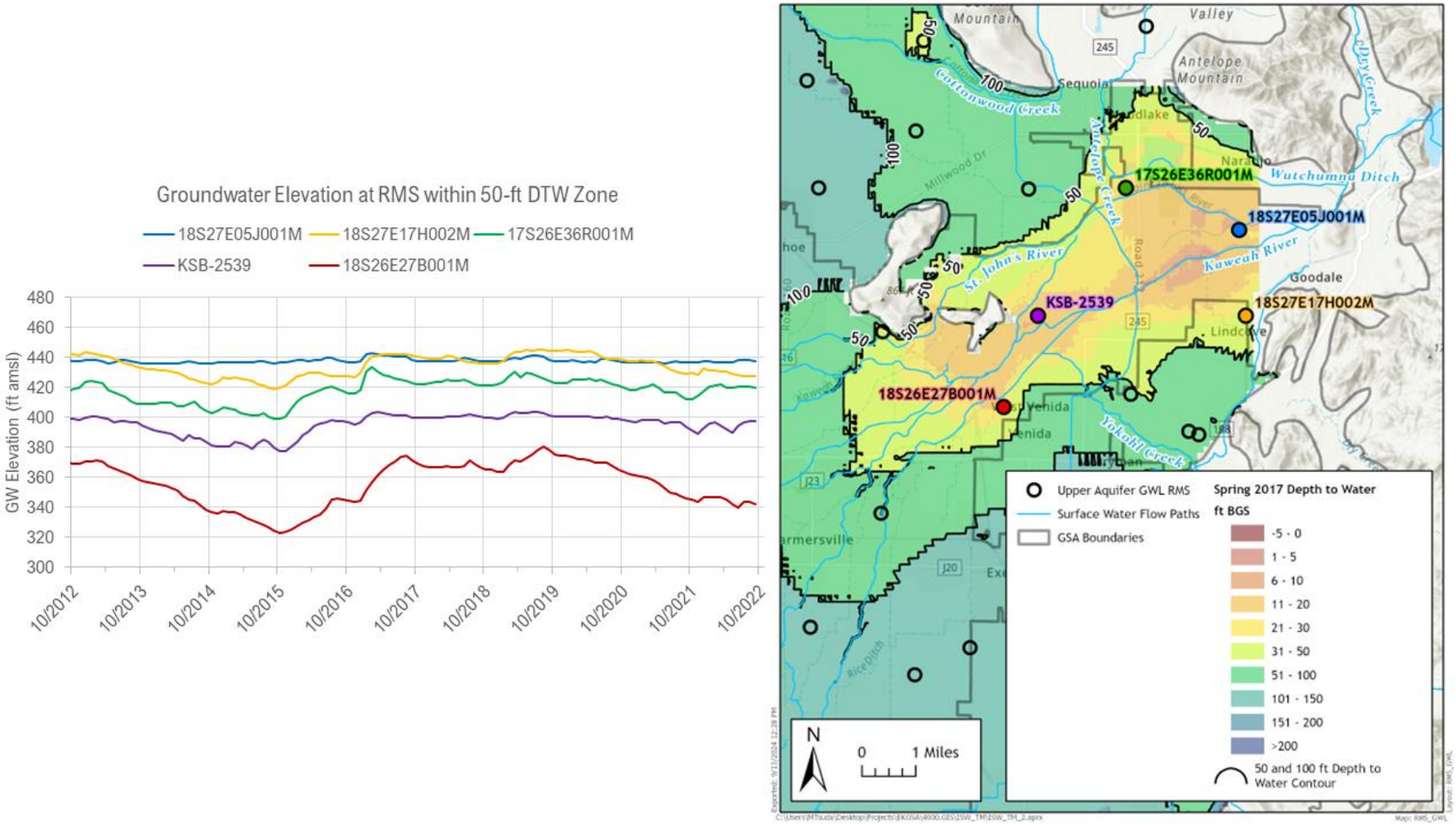


Figure 3-22: Water Level from RMS Wells from 50-ft Depth to Water (Spring 2017)

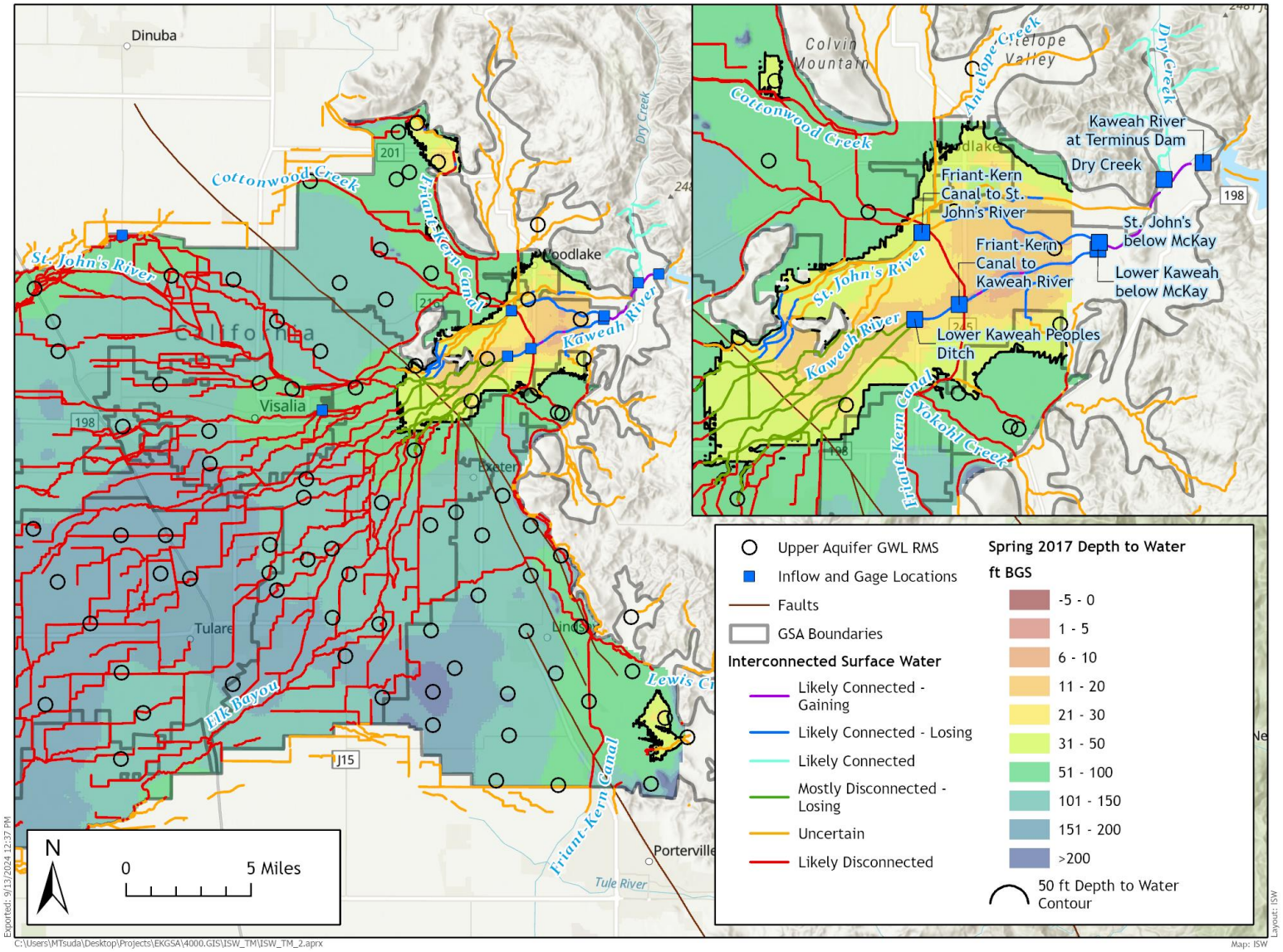


Figure 3-23: Potential Interconnected Surface Water in the Kaweah Subbasin

Uncertainty in ISW Designations

The current ISW classification is based on the available Spring 2017 groundwater depth data and is undefined in the areas with no observed groundwater level data from that period. While some of these data gap areas have been filled with the stakeholder input, there are still areas of uncertainty near the eastern edges of the Kaweah Subbasin. The existing surface water gage coverage is also insufficient for evaluating the ISW depletion, especially along the St. John's River and the Cottonwood Creek. Section 4.9 discusses these data gaps and the Kaweah Subbasin GSAs plans to fill these in the near future.

Due to these data gaps, the ISW designations are preliminary and may be refined once additional data is collected and analyzed. The refined groundwater model will also be used to assess dynamic interactions between surface water and groundwater and may also lead to changes to the ISW designations.

3.3.4.3 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are defined under SGMA as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (23 CCR § 351.(m)).

GDEs are beneficial users of groundwater. Some in-stream habitat and ecosystems and riparian habitat and ecosystems are also GDEs and this nexus makes those specific in-stream and riparian GDEs beneficial users of ISWs if the stream system in which the GDE is present is interconnected with the shallow aquifer below the streambed.

The Kaweah Subbasin evaluated potential GDEs using the Nature Conservancy's Natural Communities Commonly Associated with Groundwater dataset from the Natural Communities Dataset Viewer. Many of the GDEs identified in the NC Dataset Viewer (NC Dataset Viewer) are located in areas where the depth to groundwater is hundreds of feet and the likelihood of the species being reliant on groundwater is unlikely. These GDEs were screened out as unlikely to be GDEs. In addition, many of the GDEs identified in the NC Dataset Viewer also overlaid man-made structures such as wastewater treatment facilities, mining operations, recharge basins, lined canals, and other structures that are not consistent with the presence of potential GDEs. Figure 3-24 depicts an example of an incorrectly identified GDE. These incorrectly identified sites as well as the areas in which the depth to groundwater far exceed the conditions suitable for GDEs are not filtered out of the GDE map available in Figure 3-25.



Figure 3-24. Incorrect NCCAG GDE Characterization of a Basin near Strathmore, CA

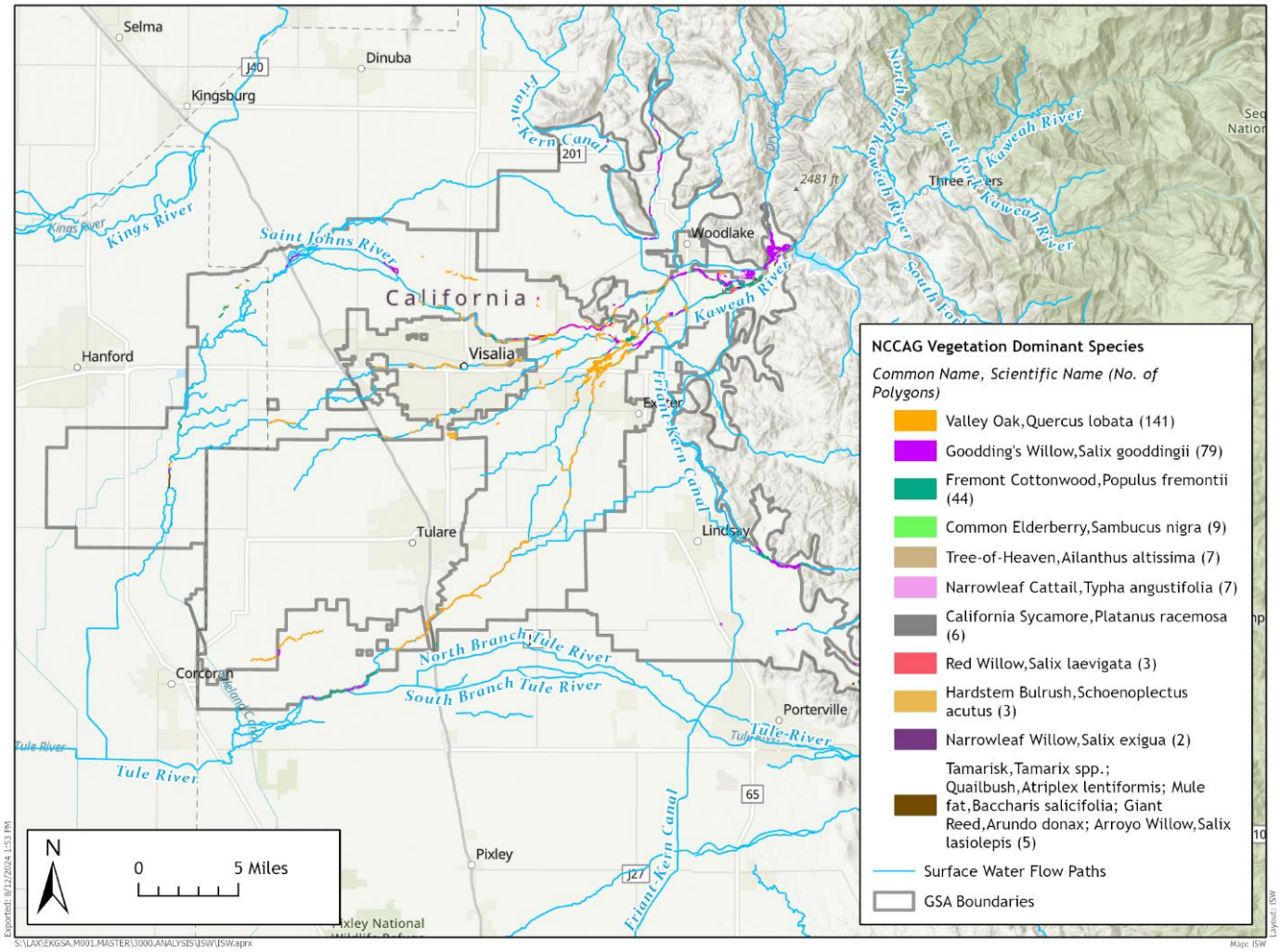


Figure 3-25. Potential GDEs in the Kaweah Subbasin (NCCAG)

3.3.5 Seawater Intrusion

§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:

(c) Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.

Seawater intrusion is not an issue in the GKGSA or the Kaweah Subbasin as a whole because there is no coastal boundary. However, in coastal basins, it may be induced by lowering the groundwater table, creating a landward gradient.

3.4 Water Budgets[§354.8]

§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.
and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.

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 specific to the GKGSA are also provided. 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 (see Figure 3-26). 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 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

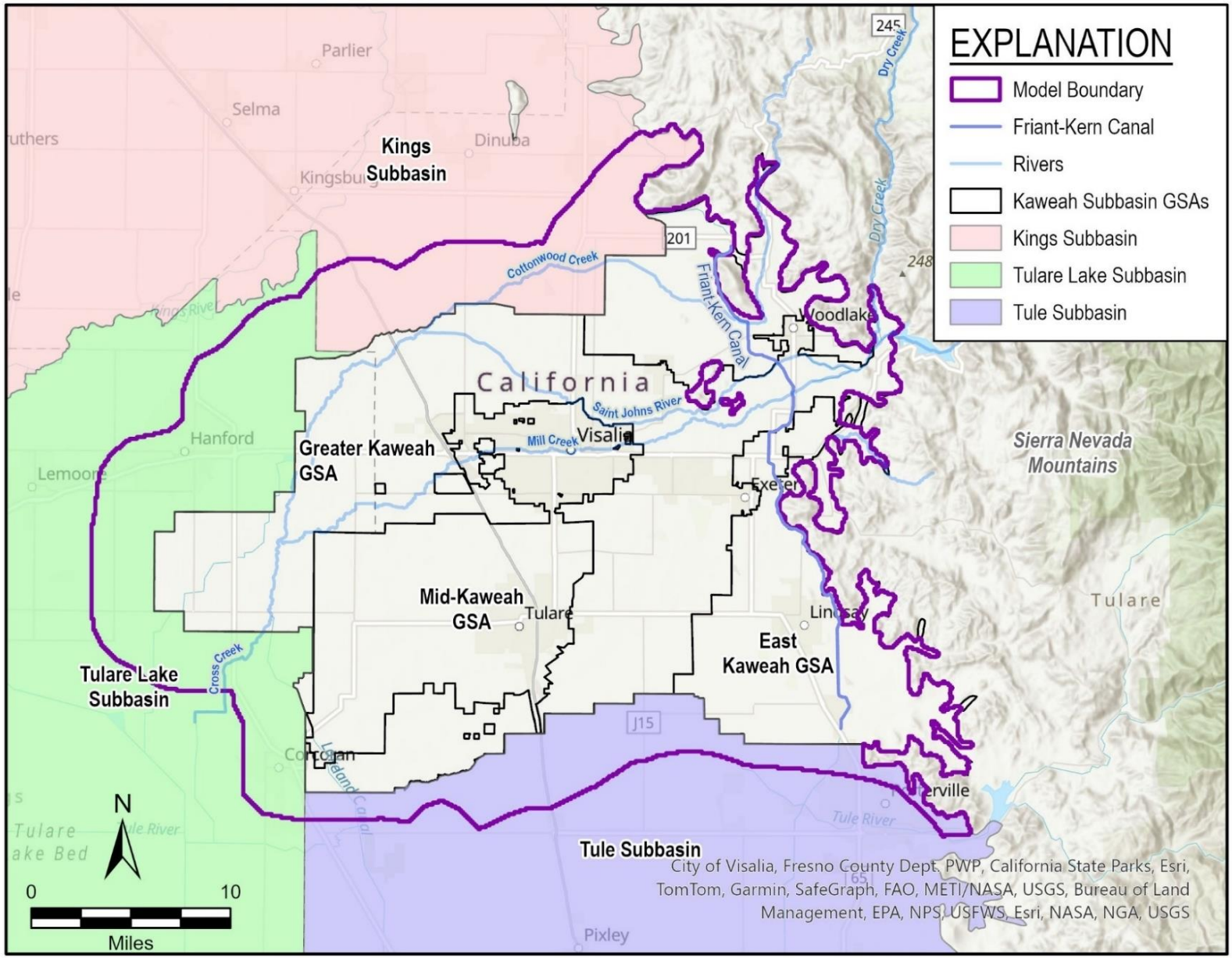
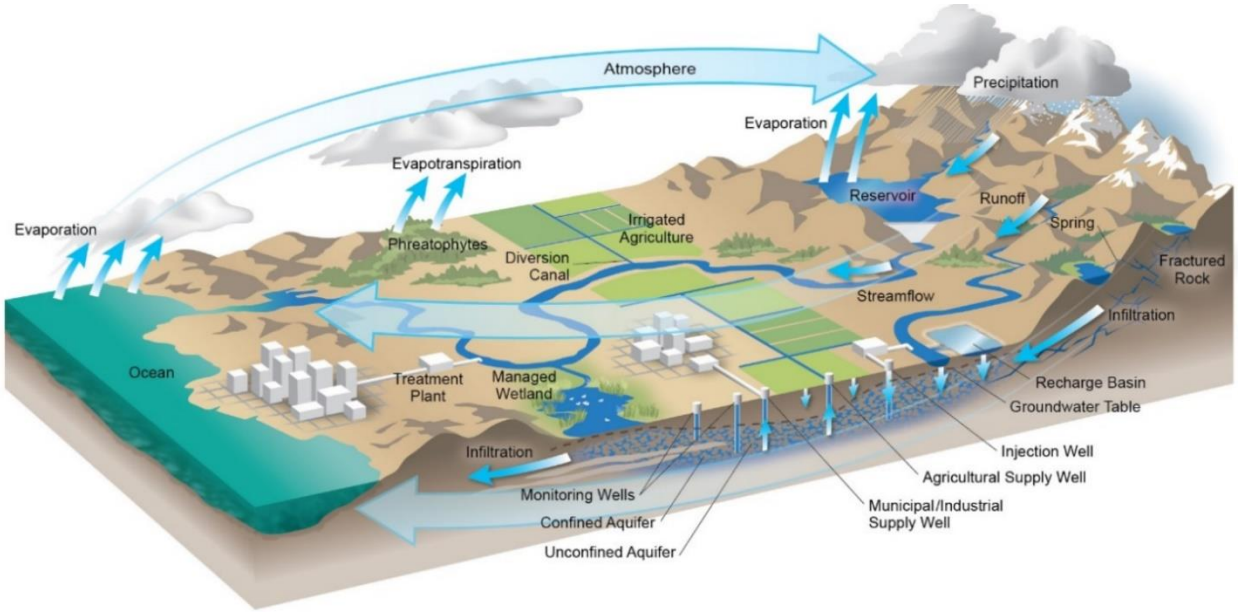


Figure 3-26. Kaweah Subbasin Water Budget Area

Figure 3-27 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 3-27. 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 3-26). 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 3-28.

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.
- **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. Aquitard storage change is related compression of aquitards and land subsidence. 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.

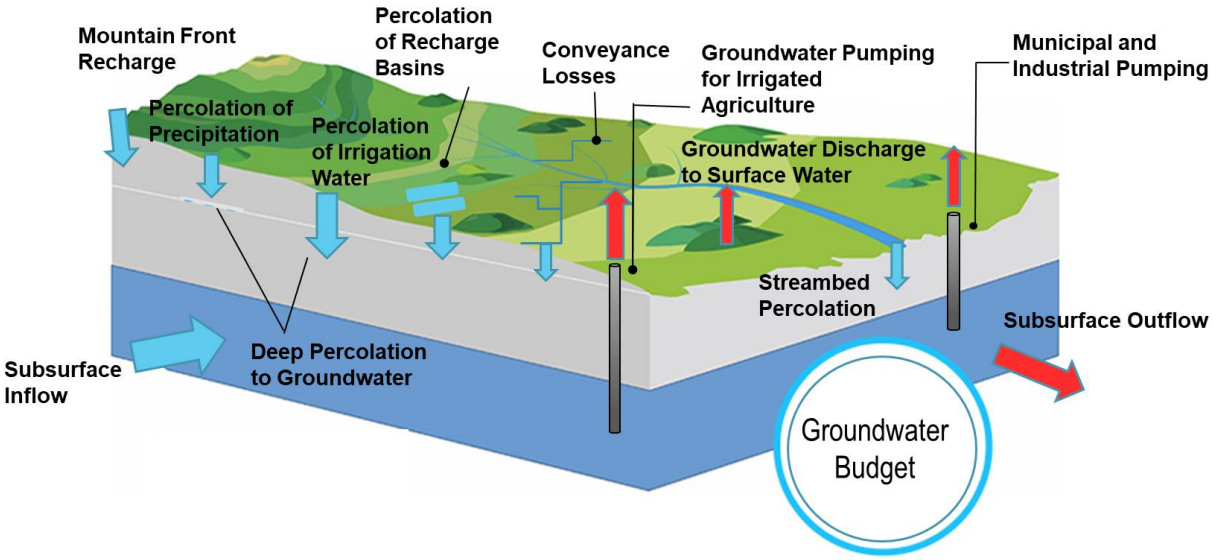


Figure 3-28. Illustration of Groundwater Budget Components

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 3-26). 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 3-29.

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 (e.g. 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.

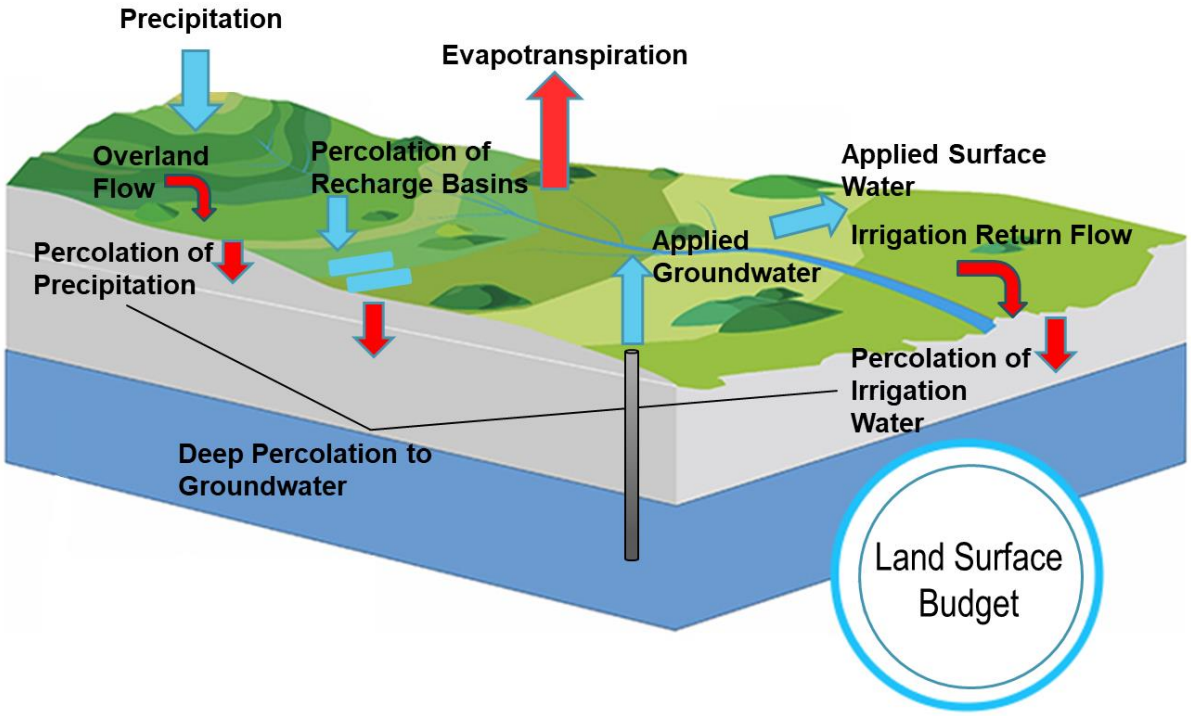


Figure 3-29. Illustration of Land Surface Budget Components

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 Saint Johns River splitting downstream. The Saint 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. However, because it is not a natural stream feature, it is not captured in the surface water budget where diversions come directly from the canal.

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 or Elk Bayou to the Tule Subbasin
- **Surface Water Diversions** - Water that is diverted from surface water bodies and applied to crops, directed to recharge basins, or percolated from canals/ditches as "losses" 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 is expected to 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 additional locally refined water budget information may also increase model simulation accuracy.

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	Subject to limitations in available streamflow measurements and estimates of stream inflows from and outflows to adjacent lands. These include diversions, precipitation, evaporation, runoff,

Water Budget Component	Source of Model Input Data	Limitations
	measurements at stream headwaters	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
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

3.4.1.3 Water Budget Timeframes

The GSP Regulations require water budgets for three timeframes representing historical conditions, current conditions, and projected conditions. It is noted that the model and water budgets are calculated on a monthly basis but summarized by water year herein. 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 3-30 summarizes the three timeframes for the water budgets developed for this GSP.

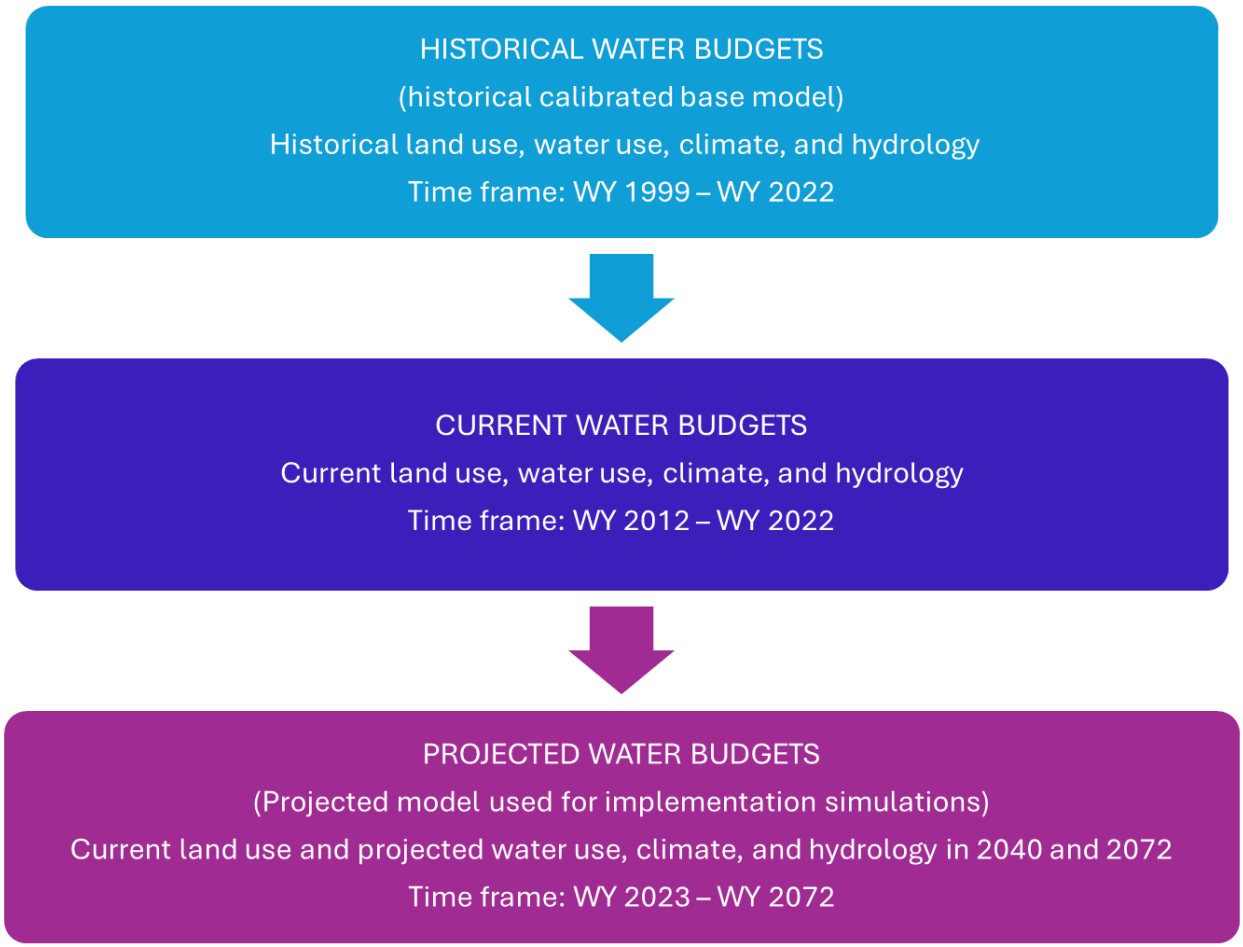


Figure 3-30. Summary of GSP-required Water Budget Time Frames

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 undesirable results to beneficial users and uses of groundwater do not occur.

3.4.1.4 Key Water Budget Findings

This GSP includes two types of water budgets (groundwater and land surface budgets) over three 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 three 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 interconnected surface water 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.

- In the Kaweah Subbasin, 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 -149,100AF and for the current period the average annual change in aquifer storage is -230,700AF.

- 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 from an annual average of 519,100 AF between WY 2023-2039 to an annual average of 474,000 AF/year for WY 2040-2070. This results in an average annual change in aquifer storage to be -6,200 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 GKGSA area are summarized in Table 3-7.

3.4.2.1 Subbasin Historical Groundwater Budget

The historical groundwater budget is dominated by eleven primary components: percolation of irrigation water, percolation from precipitation, conveyance losses, mountain front recharge, percolation in basins, streambed percolation, subsurface inflow, agricultural pumping, municipal pumping, flow between groundwater and surface water, and inter-basin subsurface inflow and outflow.

- Percolation from irrigation water represents 40% of the total groundwater inflow in an average year, though the total volume varies significantly year-to-year, ranging from 207,200 to 354,500 AF/year.
- Percolation from precipitation represents 6% of total groundwater inflow in an average year, though the total volume varies significantly year-to-year, ranging from 5,100 to 93,200 AF/year.
- Conveyance losses accounts for 14% of total groundwater inflow, with the annual volume ranging from 12,700 to 237,500 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 87,400 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 4,870,800 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; 81,500 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 GKGSA Historical Groundwater Budget

The historical groundwater budget for the GKGSA 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 represents 29% of total groundwater inflow in an average year, though the year-to-year volume varies significantly , ranging from 122,200 to 240,400 AF/year.
- Percolation from precipitation represents 3% of total groundwater inflow in an average year, though the total volume varies significantly year-to-year, ranging from 2,800 to 45,100 AF/year.
- Conveyance losses accounts for 8% of total groundwater inflow, with the total volume ranging from 4,800 to 126,200 AF/year.
- Mountain front recharge accounts for 1% of total groundwater inflow, with the total volume ranging from 3,600 to 14,200 AF/year.
- Percolation from recharge basins represents 4% of total groundwater inflow with total volume ranging from 8,300 to 73,400 AF/year.
- Streambed percolation represents 11% of total groundwater inflow with total volumes ranging from 15,200 to 134,200 AF/year.
- Groundwater pumping constitutes 64% of groundwater outflow, 61% agricultural pumping and 3% municipal and industrial groundwater pumping. Agricultural pumping ranges from 283,500 to 549,700 AF/year with variation largely dependent on climate, land use, and surface water use. Municipal and industrial pumping is less variable, ranging from 15,500 to 27,400 AF/year. Irrigated agriculture in the GKGSA pumps 62% of Subbasin-wide irrigation pumping and 28% of Subbasin pumping for M&I.
- Groundwater discharge to surface water in stream channels is approximately 1% of groundwater outflows with total volumes ranging from 2,700 to 11,100 AF/yr.
- Subsurface flows constitute 43% of total groundwater inflows and 35% of total groundwater outflows in an average year. Overall, there is greater subsurface inflow than outflow.

The annual change of aquifer storage fluctuates between a loss of 373,300 and a gain of 362,400 AF/year with an annual average loss of 106,700 AF/year. Annual aquitard storage change ranges from a gain of 8,200 to a loss of 68,100 AF/year with an average annual loss of 28,400 AF/year. GKGSA has a cumulative groundwater storage loss of 2,561,900 AF over the historical period (1999 – 2022).

3.4.2.4 GKGSA Current Groundwater Budget

The current groundwater budget for GKGSA is summarized at the bottom of Table 3-7. The largest differences between the historical groundwater budget and the current groundwater budget include the following:

- A 13,400 AF decrease in average annual deep percolation to groundwater caused primarily by decreases in percolation of precipitation.
- A 9,700 AF decrease in average annual conveyance losses.
- A 10,200 AF decrease in average annual streambed percolation.
- A 10,400 AF increase in average annual agricultural pumping driven by decreased surface water applications.
- A 54,900 AF increase in average annual loss of groundwater in storage; 43,600 AF from the change in storage in the aquifer, and 11,300 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
											Groundwater Pumpage									
		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)	M & I GW Pumping	GW Pumping for Irrigated Agriculture	Discharge to Surface Water	Subsurface Outflow						
	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*
Historical 1999-2022	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%						
Current 2012 - 2022	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 Greater Kaweah Groundwater Sustainability Agency (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
											Groundwater Pumpage									
		Inches	% of Average	Subsurface Inflow	Streambed Percolation	Conveyance Losses (Canal and Ditch Recharge) and MFR Recharge	Mountain Front Recharge	Percolation of Recharge Basins	Percolation of Irrigation Water	Percolation of Precipitation (Crop and Non-Ag Land)	M & I GW Pumping	GW Pumping for Irrigated Agriculture	Discharge to Surface Water	Subsurface Outflow						
	1999	8.9	102%	243.2	62.4	52.3	3.6	33.8	141.9	18.8	17.4	375.3	3.5	151.2	*555.9*	*547.4*	*8.2*	*0.3*	*8.5*	*8.5*
	2000	10.3	118%	228.1	65.9	51.3	7.1	28.0	164.7	25.2	20.3	381.4	3.7	177.9	*570.4*	*583.2*	*-2.8*	*-9.9*	*-12.8*	*-4.3*
	2001	9.0	103%	217.9	39.8	37.1	7.1	12.0	133.4	18.7	24.0	400.8	4.7	205.2	*466.0*	*634.7*	*-16.6*	*-152.1*	*-168.6*	*-172.9*
	2002	8.5	97%	220.1	53.9	37.9	7.1	14.3	155.6	19.9	22.9	428.4	4.2	211.4	*508.7*	*666.9*	*-22.5*	*-135.7*	*-158.2*	*-331.1*
	2003	8.7	99%	224.9	66.5	54.4	7.1	36.2	173.1	13.8	22.3	383.0	5.0	226.9	*575.9*	*637.2*	*-18.9*	*-42.4*	*-61.3*	*-392.4*
	2004	7.2	82%	217.0	42.4	29.3	3.6	11.1	143.0	18.3	23.7	461.8	3.9	218.0	*464.7*	*707.4*	*-33.7*	*-209.0*	*-242.7*	*-635.1*
	2005	13.6	155%	240.5	102.3	88.9	14.2	62.4	184.8	27.9	16.8	283.5	6.0	231.4	*721.1*	*537.8*	*-8.4*	*191.7*	*183.3*	*-451.8*
	2006	14.1	160%	231.5	107.9	89.9	14.2	41.2	206.0	35.4	17.0	289.3	9.2	249.0	*726.1*	*564.5*	*-0.7*	*162.2*	*161.6*	*-290.2*
	2007	4.8	55%	225.9	30.3	14.9	3.6	13.1	134.7	6.4	27.4	486.5	5.0	257.1	*428.8*	*776.0*	*-29.5*	*-317.7*	*-347.2*	*-637.5*
	2008	7.3	83%	244.7	49.7	43.0	7.1	11.5	162.0	17.8	27.0	421.9	4.7	298.6	*535.8*	*752.2*	*-42.5*	*-173.9*	*-216.4*	*-853.8*
	2009	6.4	73%	248.7	49.1	41.1	7.1	12.8	164.9	9.7	24.7	444.7	4.2	295.0	*533.4*	*768.6*	*-47.4*	*-187.8*	*-235.2*	*-1,089.0*
	2010	10.6	121%	264.7	86.1	66.0	14.2	31.0	164.9	23.7	20.8	334.0	6.1	267.6	*650.6*	*628.5*	*-27.1*	*49.2*	*22.1*	*-1,066.9*
	2011	16.1	183%	281.5	120.4	110.9	14.2	66.1	224.0	45.1	17.3	293.8	11.1	256.4	*862.3*	*578.6*	*-2.8*	*286.5*	*283.7*	*-783.2*
	2012	7.3	83%	253.2	42.5	30.1	3.6	14.7	133.5	6.0	25.7	408.0	7.1	253.3	*483.6*	*694.1*	*-19.4*	*-191.0*	*-210.5*	*-993.7*
	2013	5.1	58%	246.8	32.4	11.8	3.6	10.3	134.0	7.3	24.1	500.9	4.2	250.5	*446.1*	*779.6*	*-40.9*	*-292.6*	*-333.5*	*-1,327.2*
	2014	4.2	48%	237.9	18.4	6.7	3.6	9.5	127.8	2.8	20.9	506.6	2.7	224.1	*406.6*	*754.4*	*-58.5*	*-289.3*	*-347.8*	*-1,675.0*
	2015	6.8	77%	225.6	18.6	6.9	3.6	8.7	122.2	13.5	19.1	492.0	2.9	200.4	*399.0*	*714.4*	*-68.1*	*-247.3*	*-315.4*	*-1,990.4*
	2016	10.9	124%	221.6	57.7	39.6	7.1	10.2	133.0	21.3	20.9	358.6	3.9	200.2	*490.6*	*583.6*	*-55.9*	*-37.2*	*-93.0*	*-2,083.4*
	2017	13.6	155%	276.5	134.2	126.2	14.2	73.4	240.4	39.6	15.5	288.9	9.0	228.7	*904.5*	*542.1*	*-19.4*	*381.8*	*362.4*	*-1,721.0*
	2018	5.9	67%	231.6	47.5	36.8	3.6	14.0	134.7	9.8	21.8	409.8	6.1	214.4	*477.9*	*652.1*	*-26.3*	*-147.9*	*-174.1*	*-1,895.2*
	2019	11.5	131%	266.8	95.5	105.2	14.2	51.3	211.6	22.5	18.3	334.8	9.6	224.8	*767.1*	*587.5*	*-14.5*	*194.2*	*179.6*	*-1,715.5*
	2020	8.1	93%	227.9	34.9	23.9	3.6	9.2	126.6	10.3	18.6	421.7	5.4	227.6	*436.3*	*673.3*	*-28.1*	*-208.8*	*-236.9*	*-1,952.5*
	2021	4.4	51%	226.0	15.2	4.8	3.6	8.3	135.7	7.5	18.8	549.7	3.2	202.8	*401.1*	*774.4*	*-49.9*	*-323.4*	*-373.3*	*-2,325.8*
	2022	7.0	80%	228.5	33.8	17.6	3.6	10.5	130.3	16.7	17.3	467.9	2.7	189.1	*440.9*	*676.9*	*-55.8*	*-180.3*	*-236.1*	*-2,561.9*
Historical 1999-2022	Maximum	16.1	183%	281.5	134.2	126.2	14.2	73.4	240.4	45.1	27.4	549.7	11.1	298.6	904.5	779.6	8.2	381.8	362.4	
	Minimum	4.2	48%	217.0	15.2	4.8	3.6	8.3	122.2	2.8	15.5	283.5	2.7	151.2	399.0	537.8	-68.1	-323.4	-373.3	
	Average	**8.8**	**100%**	**238.8**	**58.6**	**46.9**	**7.2**	**24.7**	**157.6**	**18.3**	**20.9**	**405.1**	**5.3**	**227.6**	**552.2**	**659.0**	**-28.4**	**-78.4**	**-106.7**	
	% of Total			43%	11%	8%	1%	4%	29%	3%	3%	61%	1%	35%						
Current 2012 - 2022	Maximum	13.6	155%	276.5	134.2	126.2	14.2	73.4	240.4	39.6	25.7	549.7	9.6	253.3	904.5	779.6	-14.5	381.8	362.4	
	Minimum	4.2	48%	221.6	15.2	4.8	3.6	8.3	122.2	2.8	15.5	288.9	2.7	189.1	399.0	542.1	-68.1	-323.4	-373.3	
	Average	**7.7**	**88%**	**240.2**	**48.3**	**37.2**	**5.8**	**20.0**	**148.2**	**14.3**	**20.1**	**430.8**	**5.2**	**219.6**	**514.0**	**675.7**	**-39.7**	**-122.0**	**-161.7**	
	% of Total			47%	9%	7%	1%	4%	29%	3%	3%	64%	1%	33%						

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 (48%) with applied surface water (23%), and precipitation (25%) having lesser inflows. Outflow from the land surface system is primarily from evapotranspiration (74%) and deep percolation to groundwater from precipitation and percolation of irrigation water (21%). 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 58,800 AF increase in average annual applied groundwater
- A 77,100 AF decrease in average annual applied surface water
- A 20,500 AF decrease in average annual 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, decreased surface water application and 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		
	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*
Historical 1999-2022	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 GKGSA is summarized in Table 3-11.

3.4.4.1 Method and Assumptions Used to Develop Projected Water Budgets

The projected water budget was developed based on predictive modeling with the calibrated Kaweah Subbasin groundwater flow model. Predictive modeling was conducted with monthly stress periods, consistent with the historical and current period model.

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, 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.

3.4.4.2 Projected Surface Water Deliveries

Projected surface water diversions at each major point along the Kaweah River are calculated as a percentage of projected total annual inflow to Lake Kaweah, with the monthly diversion percentages derived based on historical data. Projected CVP water deliveries are assigned as estimated by the Friant Water Authority (FWA, 2018) based on the 2070.c scenario (central tendency climate change scenario with the full San Joaquin River Restoration Scenario and Full Access Water Management Goal). The 2070.c scenario was adjusted to include additional deliveries of CVP water during wet years based on the FWA January 2023 Reconnaissance Study (FWA, 2023) that evaluated the capacity of each Friant Contractor's managed aquifer recharge facilities to absorb additional spill deliveries during wet years.

3.4.4.3 Projected Groundwater Pumping

Projected municipal groundwater use by the City of Visalia and City of Tulare was developed based on each city's 2020 Urban Water Management Plan. The disposition of recycled water from each city as either deliveries to irrigators (in-lieu recharge) or deliveries to recharge basins was carried forward during the future period based on 2022-2023 recycled water management.

Projected groundwater pumping for irrigation was developed based on projected crop consumptive use. Projected crop consumptive use is established from 2022 cropping patterns and estimated evapotranspiration derived from LandIQ crop consumptive use analyses (LandIQ, 2022). To avoid chronic lowering of groundwater level undesirable results, the 2022 crop consumptive use was adjusted to account for future climate and reductions in crop consumptive use planned across all three GSAs in the Kaweah Subbasin. Projected groundwater extraction for irrigation was calculated by the groundwater flow model as the remaining crop irrigation requirement after accounting for effective precipitation and deliveries of surface water and recycled water to irrigators.

In addition to the reduction in overall groundwater pumping for irrigation, MKGSA and GKGSA plan to support landowners to transition their irrigation pumping from the lower aquifer to the upper aquifer. Predictive modeling for the future projected water budget assumes that the pumping transition will occur over a 12-year implementation period, with:

- 25% of lower aquifer pumping shifted to the upper aquifer during years 1-3 of GSP implementation
- 50% of lower aquifer pumping shifted to the upper aquifer during years 4-6 of GSP implementation
- 75% of lower aquifer pumping shifted to the upper aquifer during years 7-9 of GSP implementation
- 100% of lower aquifer pumping shifted to the upper aquifer during years 10-12 of GSP implementation

These measures do not impact projected volumes of irrigation pumping, but instead are planned in order to avoid undesirable results for land subsidence, which is due to unsustainable groundwater pumping from the lower aquifer.

3.4.4.3.1 Projects within MKGSA

In addition to existing recharge facilities within MKGSA that were operational during the current period (2012–2022), the projected water budget incorporates the following MKGSA projects that were either completed since 2022 or are in advanced stages of implementation or planning:

- Okieville Recharge Basin
- Linear Recharge Projects along Packwood Creek and Cameron Creek
- MKGSA Water Banking Operation

MKGSA projects are described in Chapter 6 of the MKGSA GSP.

3.4.4.3.2 Projects within GKGSA

The projected water budget incorporates the following GKGSA projects that were either completed since 2022 or are in advanced stages of implementation or planning:

- Paregien Basin Expansion and Paregien Basin Phase II
- Mathews Ditch Basin
- Ritchie Basin
- Peoples 1A Basin Expansion
- Kaweah Oaks Preserve Recharge Basin
- King Basin
- Johnson Slough Basin
- Kaweah Subbasin Multi-Benefit Recharge Facility (in association with MKGSA)

GKGSA projects are described in Chapter 6 of this GSP.

3.4.4.3.3 Projects within EKGSA

The projected water budget incorporates the following EKGSA projects that were either completed since 2022 or are in advanced stages of implementation or planning:

- Mariposa Basin
- 1st Avenue Basin
- 5th Avenue Basin
- Hirabayashi Recharge Basin
- Recharge of imported CVP water along Lower Lewis Creek

EKGSA projects are described in Chapter 7 of the EKGSA GSP.

3.4.4.3.4 Assumed Conditions within Neighboring Subbasins

Groundwater underflow between the Kaweah Subbasin and neighboring subbasins is dependent on groundwater conditions in both the Kaweah Subbasin and neighboring subbasins. For the purposes of the projected water budget, conditions in all 3 neighboring Subbasins – Kings, Tulare Lake, and Tule – are based on projected groundwater pumping and groundwater levels assumptions as assigned for the historical and current water budgets:

- Groundwater levels at the groundwater model boundary within each neighboring Subbasin are assigned based on:
    - 2022 conditions for model layer 1 (representing the upper aquifer in areas where the Corcoran Clay is present)

    - An assumed recovery of 25 feet from 2022 conditions in model layers 3 and 4 (representing the lower aquifer in areas where the Corcoran Clay is present)

- Irrigation pumping within the groundwater model domain and in neighboring subbasins outside of the Corcoran Irrigation District (CID) wellfield is projected using a similar methodology for irrigation pumping inside the Subbasin, based on projected crop demands and surface water availability. The following assumptions are made regarding future demand management in portions of the neighboring subbasins that fall within the domain of the Kaweah Subbasin groundwater model:
    - Alta Irrigation District: 15% reduction in crop consumptive use by 2040
    - Mid-Kings River GSA: 26% reduction in crop consumptive use by 2040
    - Lower Tule River Irrigation District: 31% reduction in crop consumptive use by 2040

  The assumed reductions in crop consumptive use as listed above are assigned based on the reduction in crop consumptive use—and therefore, irrigation pumping—within nearby areas of the Kaweah Subbasin. This assumes that neighboring subbasins would be undertaking groundwater demand management actions similar to those planned for the Kaweah Subbasin.

- Groundwater pumping in the portion of the CID wellfield that falls within the groundwater model domain is assigned as 50% of the 1999-2022 average pumping. This reflects an assumption that CID wellfield pumping will need to be curtailed in order to achieve sustainability within the El Rico GSA in the Tulare Lake Subbasin.

- Groundwater pumping for agricultural irrigation is shifted from the lower aquifer to the upper aquifer on the same schedule as detailed in Section 1.4.1.2.

Groundwater conditions in neighboring subbasins is a recognized source of uncertainty that has a material impact on the projected water budget in the Kaweah Subbasin. The approach used for the projected water budget in this GSP is neutral to slightly optimistic. These assumptions are adopted in the future projected water budgets based on the expectation that demand management in neighboring subbasins will be comparable in magnitude to the demand management measures planned within the Kaweah Subbasin, and included in the future projected water budget for this GSP.

Finally, it should be recognized that both the projected groundwater underflow from and to neighboring subbasins and the projected change in groundwater storage are intrinsically uncertain and dependent not only on assumptions within the Subbasin, but also upon assumed conditions in neighboring subbasins.

3.4.4.4 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 allocation and accounting program 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 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.

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

Values in 1,000s Acre Feet

Groundwater Budget Component	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

3.4.4.5 GKGSA Projected Groundwater Budget

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

- Average annual irrigated agricultural pumping is projected to decrease from 430,800 AF/year in the current period, to 318,000 AF/year between WY 2023 and 2039, and then to 265,500 AF/year for WY 2040 to 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.
- Average annual municipal and industrial pumping is projected to remain approximately the same, from 20,100 AF/year in the current period to 19,500 AF/year in the future period.
- As a result of decreased ET demand and applied water from irrigated agriculture, there is reduced percolation of irrigation water of 13,100 AF/year from the current period to WY 2023-2039 and a further reduction of 15,500 AF/year for the WY 2040-2070.

Table 3-10: Projected Groundwater Budgets Summary for the Kaweah Subbasin (WY2023 – WY2072)

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
										Groundwater Pumpage									
	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)	M & I GW Pumping	GW Pumping for Irrigated Agriculture	Discharge to Surface Water	Subsurface Outflow						
2023	14.7	157%	115.2	213.2	264.4	44.2	260.4	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	199.2	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	59.5	*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	179.1	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	265.3	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	*493.8*	*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	265.7	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	499.2	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*
2023-2039																			
Maximum	16.7	178%	115.2	213.2	264.4	45.8	260.4	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%						
2040-2070																			
Maximum	16.7	178%	137.2	215.0	264.4	45.8	265.7	439.4	98.4	95.7	628.1	31.6	60.4	1,473.9	776.5	14.5	1,066.6	1,071.2	
Minimum	4.5	48%	91.1	23.9	15.2	9.9	17.5	155.3	7.0	86.9	233.6	2.6	41.4	347.5	402.7	-52.7	-402.8	-424.7	
Average	**9.1**	**97%**	**107.6**	**82.3**	**74.7**	**21.2**	**63.5**	**221.9**	**41.6**	**90.2**	**474.0**	**10.1**	**50.1**	**612.8**	**624.5**	**-14.7**	**3.0**	**-11.6**	
% of Total			215%	164%	149%	42%	127%	443%	83%	180%	946%	20%	100%						

Table 3-11: Projected Annual Groundwater Budget Summary for the Greater Kaweah Groundwater Sustainability Agency (WY2023 – WY2072)

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
										Groundwater Pumpage									
	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)	M & I GW Pumping	GW Pumping for Irrigated Agriculture	Discharge to Surface Water	Subsurface Outflow						
2023	14.2	157%	299.2	147.2	137.4	13.6	158.8	223.7	42.7	17.7	257.0	25.0	229.9	*1,022.6*	*529.6*	*-46.9*	*541.6*	*492.9*	*492.9*
2024	8.8	97%	227.7	64.9	29.8	4.1	9.3	124.7	18.5	17.7	354.2	7.2	221.0	*479.1*	*600.0*	*-30.4*	*-90.6*	*-120.9*	*372.0*
2025	10.4	115%	223.5	69.0	43.6	6.6	13.2	142.6	26.1	17.6	349.9	6.1	202.7	*524.5*	*576.3*	*-26.0*	*-23.8*	*-51.8*	*320.2*
2026	9.7	107%	210.9	39.3	33.0	3.9	8.4	126.6	21.8	17.6	360.5	6.5	199.8	*444.0*	*584.4*	*-26.3*	*-115.2*	*-140.5*	*179.7*
2027	8.0	88%	209.3	46.6	26.2	5.1	6.9	133.3	20.3	17.7	389.6	5.5	187.8	*447.7*	*600.6*	*-31.0*	*-122.0*	*-153.0*	*26.8*
2028	8.4	92%	210.3	57.3	44.2	6.4	13.2	136.3	12.4	17.8	321.6	5.3	184.2	*460.0*	*528.8*	*-26.7*	*-22.1*	*-48.8*	*-22.0*
2029	7.3	81%	203.5	40.0	25.2	3.1	7.1	132.2	19.2	17.7	400.2	4.5	178.8	*430.2*	*601.3*	*-26.1*	*-144.9*	*-171.1*	*-193.1*
2030	13.5	149%	227.3	83.9	55.0	11.5	41.8	149.9	32.7	17.8	256.0	7.1	185.0	*602.2*	*465.9*	*-15.2*	*151.5*	*136.3*	*-56.8*
2031	14.1	155%	256.6	109.5	81.6	14.0	95.5	148.2	38.3	17.8	236.2	27.6	211.6	*743.7*	*493.2*	*-1.5*	*252.0*	*250.5*	*193.7*
2032	5.1	56%	219.1	30.3	17.3	3.3	4.7	110.1	6.5	24.2	371.8	5.7	200.4	*391.2*	*602.1*	*-8.7*	*-202.1*	*-210.8*	*-17.1*
2033	7.4	82%	210.9	52.1	36.2	7.1	10.8	137.0	20.8	24.1	341.4	4.6	186.4	*474.9*	*556.4*	*-12.6*	*-68.9*	*-81.5*	*-98.6*
2034	6.1	68%	203.8	42.8	25.7	6.4	8.0	128.2	13.2	23.9	355.5	4.9	182.1	*426.2*	*566.3*	*-16.1*	*-122.0*	*-138.1*	*-236.7*
2035	10.9	120%	211.0	71.2	51.7	14.0	21.5	148.6	28.2	18.0	246.5	8.1	190.7	*546.1*	*463.2*	*-11.5*	*94.4*	*82.9*	*-153.8*
2036	16.0	177%	243.3	111.8	82.2	11.2	95.1	144.6	51.1	18.0	214.7	27.8	218.1	*739.3*	*478.7*	*1.1*	*259.5*	*260.6*	*106.8*
2037	6.4	71%	213.6	47.9	27.2	3.1	9.3	106.5	8.1	20.6	278.8	7.6	208.4	*415.6*	*515.4*	*-4.4*	*-95.4*	*-99.8*	*7.0*
2038	4.9	54%	201.7	34.6	17.1	3.5	4.8	104.9	8.0	20.7	318.4	5.1	193.1	*374.7*	*537.2*	*-11.4*	*-151.1*	*-162.5*	*-155.4*
2039	4.4	48%	201.2	19.1	9.9	3.4	3.5	98.7	4.2	20.7	352.7	3.1	175.2	*340.0*	*551.7*	*-18.9*	*-192.8*	*-211.7*	*-367.1*
2040	6.6	72%	203.1	22.0	12.1	3.4	3.6	97.1	15.6	20.8	329.3	2.2	164.3	*356.8*	*516.6*	*-26.3*	*-133.5*	*-159.7*	*-526.6*
2041	10.2	112%	203.5	37.7	26.7	5.1	7.0	105.3	27.5	20.8	263.7	3.2	166.8	*412.7*	*454.5*	*-23.5*	*-18.2*	*-41.7*	*-568.6*
2042	14.2	157%	275.7	147.3	137.4	13.6	160.5	209.7	46.0	18.2	137.4	30.2	217.3	*990.1*	*403.1*	*4.2*	*582.8*	*587.0*	*18.5*
2043	6.3	70%	207.1	49.6	35.3	3.1	10.7	114.2	16.0	24.6	280.2	6.4	214.0	*436.0*	*525.2*	*1.6*	*-90.8*	*-89.2*	*-70.8*
2044	11.2	123%	233.5	101.4	78.8	14.0	93.9	141.6	28.9	18.3	215.2	24.8	223.3	*692.1*	*481.5*	*5.6*	*205.0*	*210.6*	*139.9*
2045	8.2	90%	203.6	37.2	18.8	3.3	5.1	94.7	16.2	18.3	293.6	5.5	212.0	*376.9*	*529.4*	*-2.4*	*-148.1*	*-150.5*	*-10.6*
2046	5.3	58%	197.0	19.2	7.9	3.4	3.3	104.4	10.9	18.3	380.7	3.1	187.8	*346.1*	*589.8*	*-11.8*	*-232.0*	*-243.8*	*-254.4*
2047	6.8	75%	199.2	33.4	16.2	3.5	4.8	108.9	17.2	18.3	337.6	2.3	175.5	*383.4*	*533.6*	*-14.9*	*-135.4*	*-150.3*	*-404.6*
2048	8.8	97%	198.5	69.0	29.8	4.1	9.5	111.1	21.0	18.3	232.3	3.9	181.7	*443.0*	*436.3*	*-12.8*	*19.5*	*6.7*	*-397.9*
2049	10.4	115%	201.6	71.8	43.6	6.6	13.3	119.2	28.9	18.3	234.1	4.7	187.8	*485.0*	*444.9*	*-9.2*	*49.3*	*40.1*	*-357.8*
2050	9.7	107%	196.2	39.9	33.0	3.9	8.6	103.5	25.3	18.3	252.6	6.1	192.8	*410.4*	*469.8*	*-9.3*	*-50.1*	*-59.4*	*-417.2*
2051	8.0	88%	196.6	47.2	26.2	5.1	7.0	109.6	22.5	18.3	283.4	5.3	190.5	*414.2*	*497.5*	*-12.3*	*-71.0*	*-83.3*	*-500.4*
2052	8.4	92%	200.3	57.8	44.2	6.4	13.3	116.9	15.3	18.3	226.9	5.1	190.9	*454.2*	*441.2*	*-11.0*	*24.0*	*13.0*	*-487.5*
2053	7.3	81%	197.8	40.0	25.2	3.1	7.2	111.5	21.3	18.3	307.2	4.6	188.0	*406.1*	*518.0*	*-13.0*	*-98.9*	*-111.9*	*-599.4*
2054	13.5	149%	221.3	84.7	55.0	11.5	41.9	137.2	36.7	18.3	189.3	7.1	193.1	*568.4*	*407.8*	*-5.2*	*165.8*	*160.6*	*-418.8*
2055	14.1	155%	244.4	111.7	81.6	14.0	95.6	137.3	42.2	18.3	176.7	27.2	215.5	*726.8*	*437.7*	*7.4*	*281.6*	*289.2*	*-129.6*
2056	5.1	56%	208.3	30.4	17.3	3.3	4.8	94.9	7.8	22.6	303.8	5.8	202.7	*366.7*	*535.1*	*-1.8*	*-166.6*	*-168.4*	*-298.0*
2057	7.4	82%	202.1	52.0	36.2	7.1	10.9	124.9	22.1	22.6	283.6	4.7	191.9	*455.4*	*502.8*	*-4.9*	*-42.6*	*-47.4*	*-345.4*
2058	6.1	68%	197.6	42.8	25.7	6.4	8.1	117.2	14.4	22.6	304.5	5.0	190.9	*412.2*	*522.9*	*-8.0*	*-102.7*	*-110.7*	*-456.1*
2059	10.9	120%	206.7	71.3	51.7	14.0	21.6	141.8	29.5	18.3	209.2	8.2	201.0	*536.6*	*436.7*	*-3.5*	*103.4*	*99.8*	*-356.3*
2060	16.0	177%	237.2	112.8	82.2	11.2	95.2	139.5	52.5	18.3	186.9	27.8	226.1	*730.6*	*459.1*	*7.7*	*263.7*	*271.5*	*-84.8*
2061	6.4	71%	207.0	48.2	27.2	3.1	9.3	101.7	9.0	20.9	255.9	7.8	214.9	*405.5*	*499.4*	*1.2*	*-95.1*	*-93.9*	*-178.7*
2062	4.9	54%	197.6	34.7	17.1	3.5	4.8	101.3	8.3	20.9	301.8	5.1	200.4	*367.3*	*528.2*	*-6.2*	*-154.6*	*-160.8*	*-339.5*
2063	4.4	48%	199.5	19.1	9.9	3.4	3.6	96.7	4.4	20.9	343.4	3.1	183.6	*336.5*	*551.0*	*-12.4*	*-202.1*	*-214.5*	*-554.0*
2064	6.6	72%	203.6	21.9	12.1	3.4	3.7	97.2	15.6	20.9	329.3	2.2	173.0	*357.5*	*525.3*	*-16.4*	*-149.5*	*-167.9*	*-721.9*
2065	10.2	112%	205.3	37.7	26.7	5.1	7.0	105.4	27.5	20.9	263.7	3.3	174.2	*414.7*	*462.0*	*-16.7*	*-26.6*	*-47.3*	*-769.2*
2066	14.2	157%	275.5	148.4	137.4	13.6	160.6	209.8	46.0	18.3	137.4	29.8	220.9	*991.2*	*406.4*	*8.0*	*576.8*	*584.8*	*-184.5*
2067	6.3	70%	205.4	49.8	35.3	3.1	10.7	114.3	16.0	24.6	280.2	6.4	215.1	*434.6*	*526.3*	*4.6*	*-96.3*	*-91.7*	*-276.2*
2068	11.2	123%	234.0	105.6	78.8	14.0	93.9	141.6	28.9	18.3	215.2	25.2	224.1	*696.8*	*482.8*	*6.6*	*205.4*	*214.0*	*-62.2*
2069	8.2	90%	203.6	38.4	18.8	3.3	5.1	94.7	16.2	18.3	293.6	5.7	212.1	*380.1*	*529.6*	*0.3*	*-149.8*	*-149.5*	*-211.7*
2070	5.3	58%	197.7	20.6	7.9	3.4	3.3	104.4	10.9	18.3	380.7	3.2	188.4	*346.1*	*590.6*	*-9.2*	*-233.3*	*-242.5*	*-454.1*
2071	6.8	75%	201.4	34.0	16.2	3.5	4.8	108.9	17.2	18.3	337.6	2.5	177.0	*386.1*	*535.3*	*-11.8*	*-137.4*	*-149.2*	*-603.4*
2072	8.8	97%	202.9	70.8	29.8	4.1	9.5	99.2	21.0	18.3	241.0	4.0	182.0	*437.4*	*445.3*	*-9.6*	*1.6*	*-7.9*	*-611.3*
2023-2039 Maximum	16.0	177%	299.2	147.2	137.4	14.0	158.8	223.7	51.1	24.2	400.2	27.8	229.9	1,022.6	602.1	1.1	541.8	492.9	
Minimum	4.4	48%	201.2	19.1	9.9	3.1	3.5	98.7	4.2	17.6	214.7	3.1	175.2	340.0	463.2	-48.9	-202.1	-211.7	
Average	**9.2**	**101%**	**221.9**	**62.8**	**43.7**	**7.1**	**30.1**	**135.1**	**21.9**	**19.4**	**317.9**	**9.5**	**197.4**	**522.6**	**544.2**	**-18.6**	**-3.0**	**-21.6**	
% of Total			42%	12%	8%	1%	6%	26%	4%	4%	58%	2%	36%						
2040-2070 Maximum	16.0	177%	275.7	148.4	137.4	14.0	160.6	209.8	52.5	24.6	380.7	30.2	226.1	991.2	590.6	8.6	582.8	587.0	
Minimum	4.4	48%	196.2	19.1	7.9	3.1	3.3	94.7	4.4	18.2	137.4	2.2	164.3	336.5	403.1	-26.3	-233.3	-243.8	
Average	**8.8**	**97%**	**211.6**	**58.2**	**40.5**	**6.5**	**29.9**	**119.6**	**22.6**	**19.7**	**265.5**	**9.2**	**197.4**	**489.0**	**491.8**	**-6.0**	**3.2**	**-2.8**	
% of Total			107%	29%	21%	3%	15%	61%	11%	10%	134%	5%	100%						

3.4.4.6 Projected Land Surface Budgets

The projected land surface budgets for the Kaweah Subbasin 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.

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*
2023-2039	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%		
2040-2070	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%		

3.4.4.7 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, 2018b). 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, 2018b). 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.

3.4.5 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 undesirable results 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."*

Groundwater elevations simulated in the projected GSP implementation model scenario through 2070 compared to MTs, indicate undesirable results are unlikely. Therefore, average annual pumping in the GSP implementation scenario can be used as an estimate of sustainable yield for the Subbasin. However, the projected groundwater budget indicates an average annual increase in groundwater storage of 6,600 AF. Accordingly, this number is added to average annual

projected pumping to arrive at a sustainable yield of 578,000 AF of groundwater pumping per year.

3.5 Management Areas

GKGSA has, and may still, consider establishing Management Areas (MAs) within the GSA boundaries, as appropriate to facilitate the compliance with sustainability goals. New MAs will be included in future revisions of the GSP.

4 MONITORING NETWORKS [§354.32 [ARTICLE 5, SUBARTICLE 4]]

§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 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.

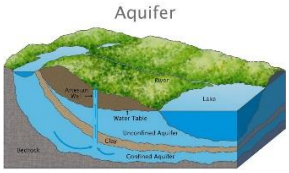
Groundwater Levels:

Monitoring of static groundwater levels each spring and fall



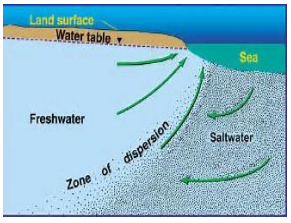
Groundwater Storage:

Estimated annual change in groundwater storage based on groundwater levels



Seawater Intrusion:

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



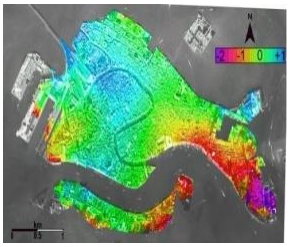
Water Quality:

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 GKGSA 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 GKGSA management.

4.1 Kaweah Subbasin Representative Monitoring Network[§354.34 (b)(1),(b)(2),(b)(3),(b)4)]

§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 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 to 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 GKGSA Area;
7. Demonstrate progress toward achieving measurable objectives described in the GSP;
8. Monitor changes in groundwater conditions relative to minimum thresholds;
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 GKGSA 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 GKGSA 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 GKGSA.

The following sections include descriptions of the monitoring networks within the GKGSA that will be utilized to meet the criteria for the five sustainability indicators present: groundwater levels, groundwater storage, water quality, land subsidence, and depletion of interconnected surface water. The adequacy of the monitoring network is discussed for each sustainability indicator, as well as the quantitative values for the minimum thresholds, measurable objectives, 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 five-year assessment.

4.1.2 Adequacy of Monitoring Network

When evaluating the adequacy of the monitoring network, three 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 U.S. 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.

Table 4-4 provides site-specific information representative of monitoring network sites in a tabular format. Each well contains data for the location, site type, monitoring frequency, and sustainability indicators monitored. At this time, GKGSA monitors 40 wells on a semi-annual or quarterly basis both inside and outside of the GKGSA boundary (Table 4-1). Forty-three

subsidence monitoring stations within the GKGSA boundary are surveyed annually to monitor land subsidence (Table 4-2). More information on the Representative Monitoring Network for each sustainability indicator is available in Sections 4.3 through 4.7.

The Kaweah Subbasin is improving the existing and will maintain a Data Management System (DMS) for storing and reporting information for the implementation of this GSP. Specifically, the monitoring network data will be collected and compiled into one central data system that can be easily referenced and displayed when needed. More information on the DMS is available in Section 7.

4.1.3 Representative Monitoring Network Maps

Maps of the Kaweah Subbasin Representative Monitoring Networks are available below.

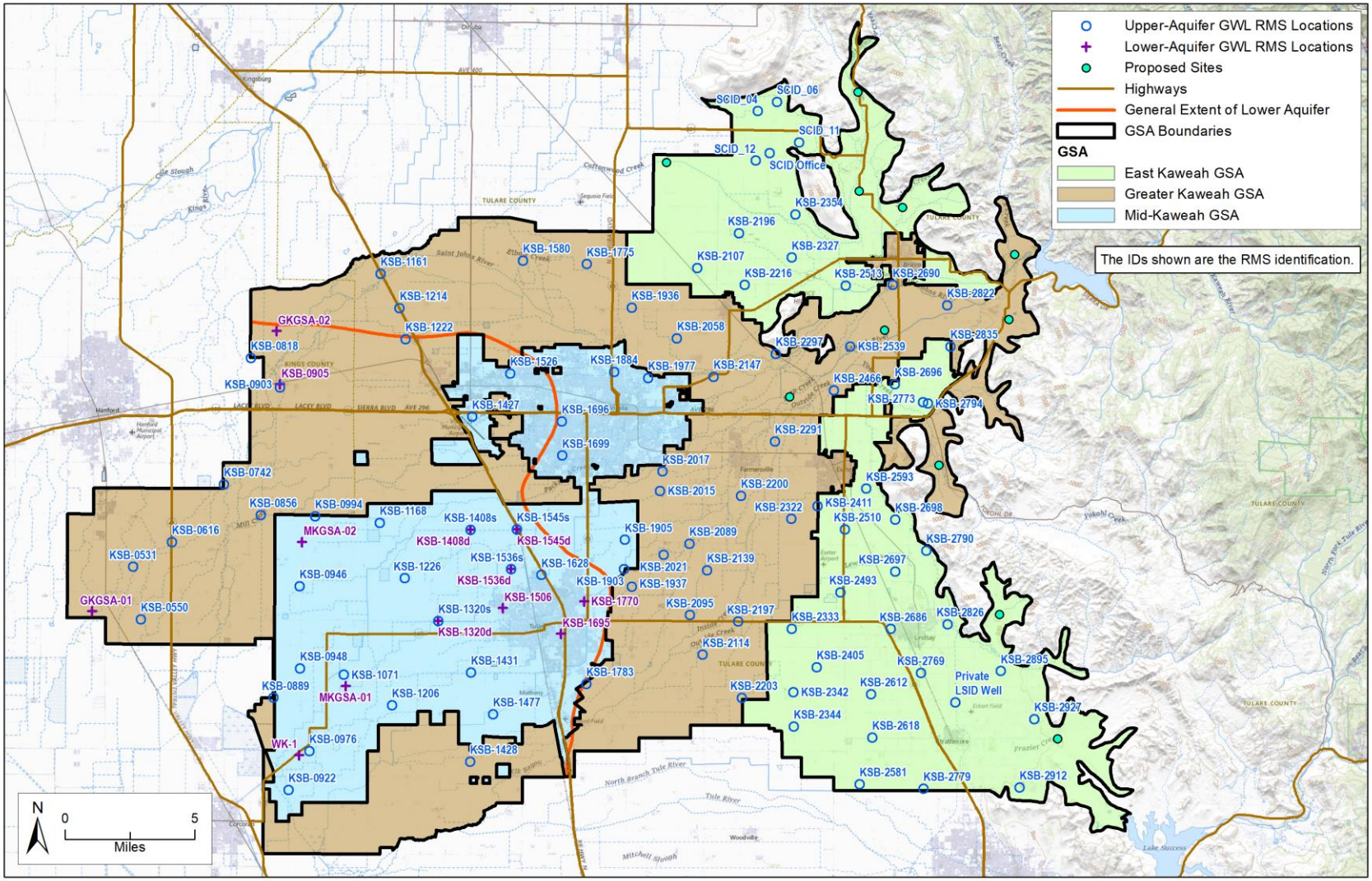


Figure 4-2. Groundwater Levels Representative Monitoring Network

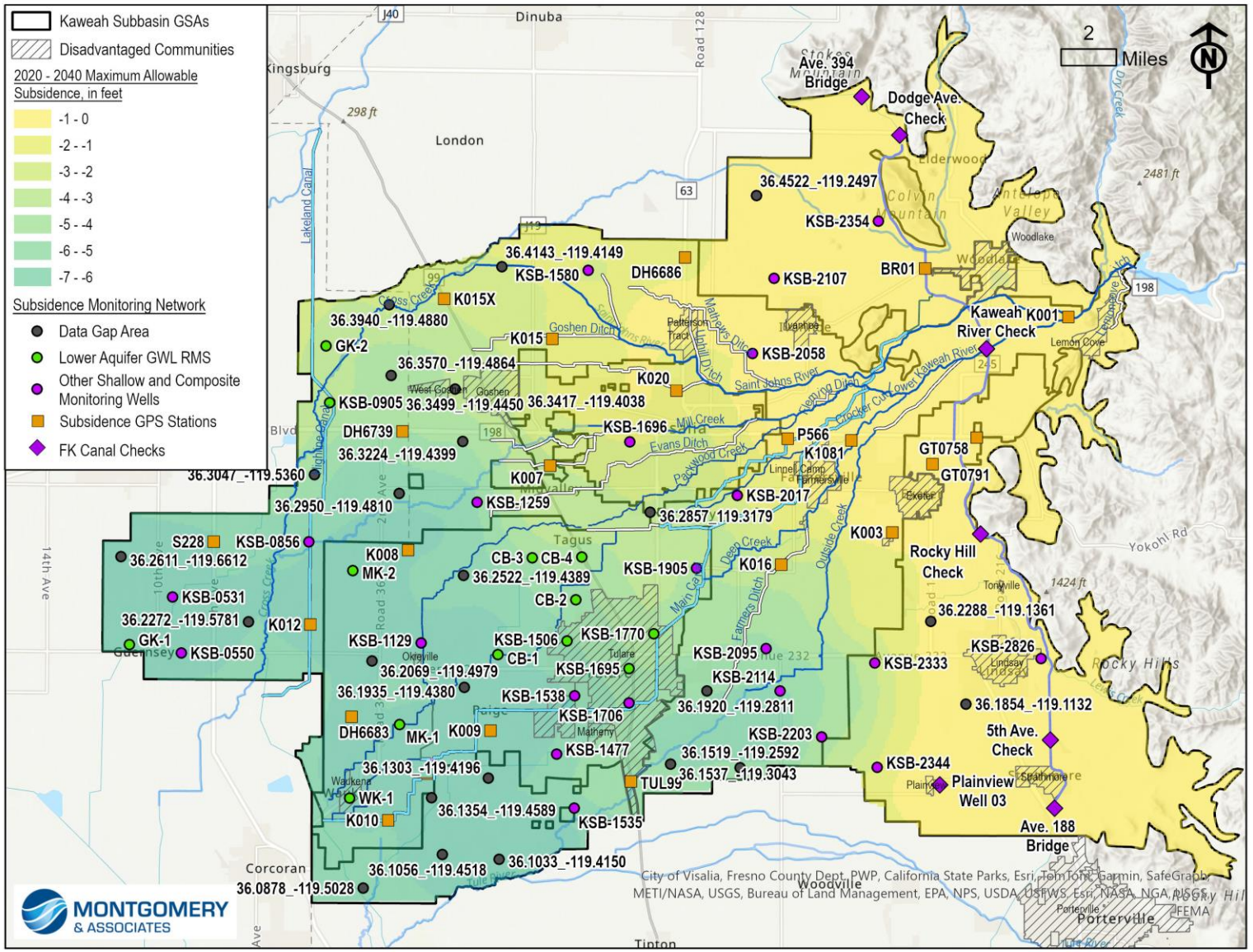


Figure 4-3. Land Subsidence Representative Monitoring Network

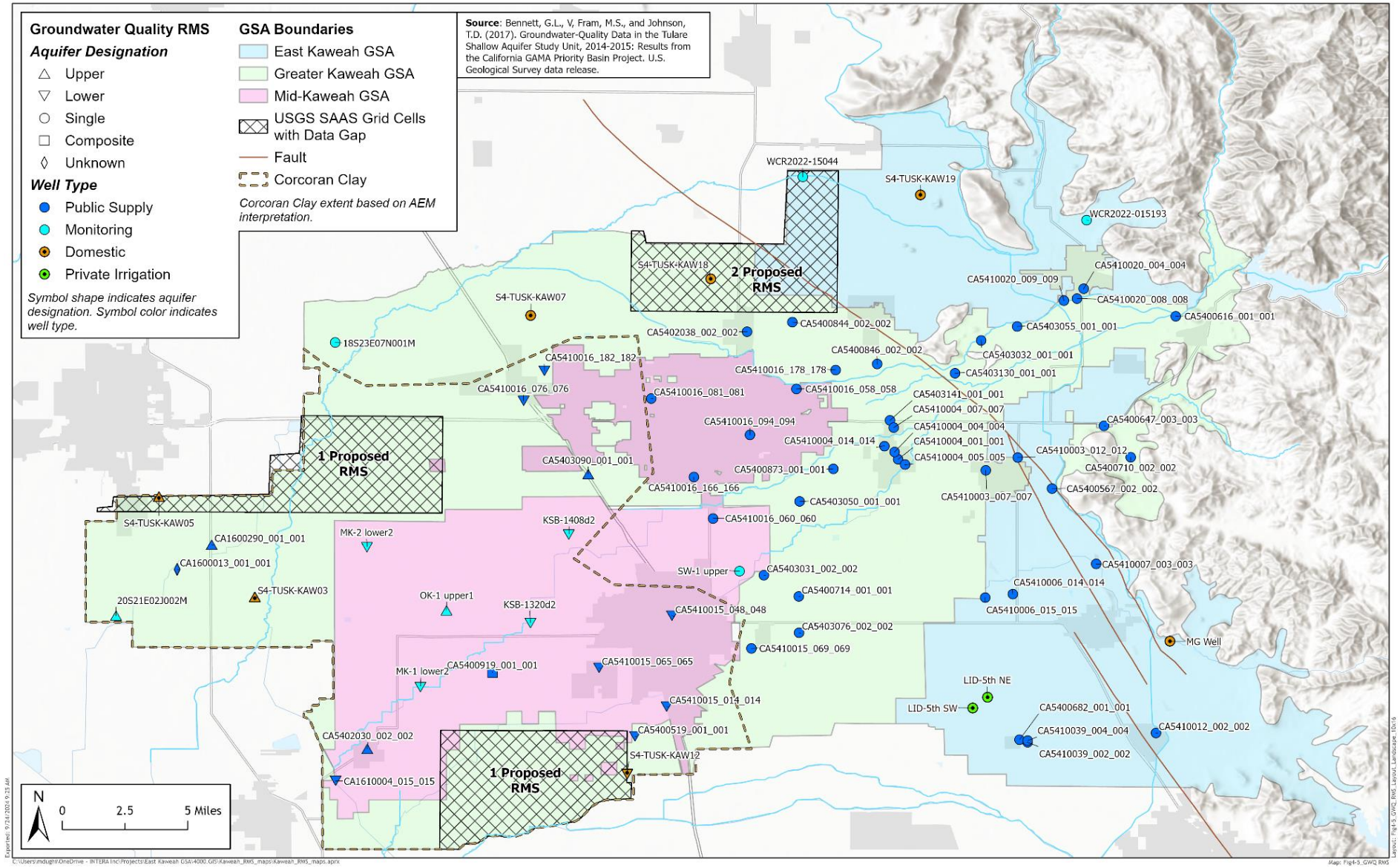


Figure 4-4. Groundwater Quality Representative Monitoring Network

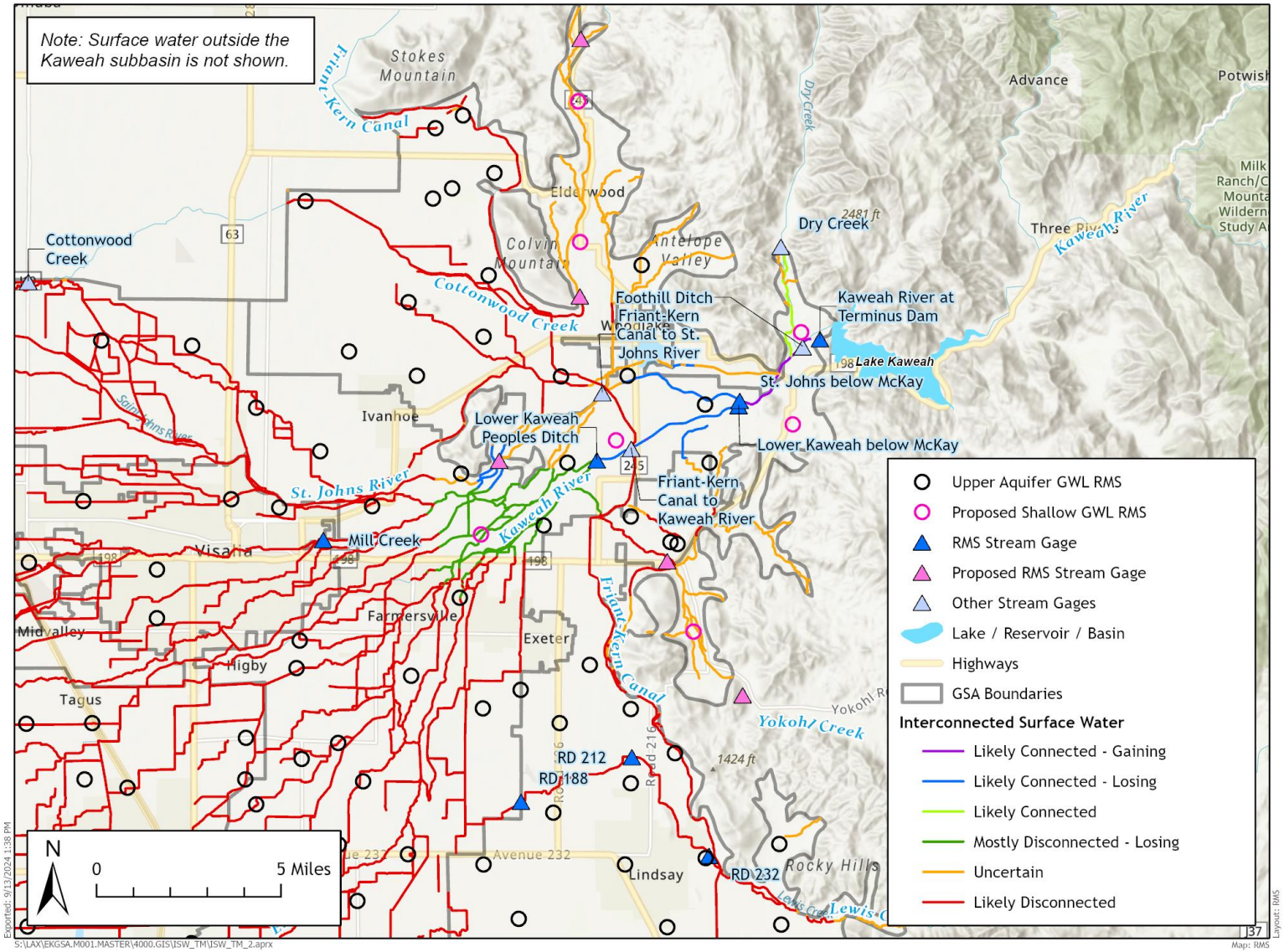


Figure 4-5. Interconnected Surface Water Representative Monitoring Network

4.1.4 Representative Monitoring Site Summary

A summary of the Kaweah Subbasin's entire RMS network for groundwater levels is in Table 4-1 and for groundwater quality in Table 4-3. A summary of RMS sites for land subsidence is available in Table 4-2.

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

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

Representative Monitoring Site ID	GSA	Aquifer Designation
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
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

Representative Monitoring Site ID	GSA	Aquifer Designation
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
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

Table 4-2: Summary of Kaweah Subbasin RMS For Land Subsidence

Representative Monitoring Site ID	GSA
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
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

Representative Monitoring Site ID	GSA
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
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
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

Representative Monitoring Site ID	GSA
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

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

RMS ID	Other ID	OWNER ID	USGS Grid Cell #	GSA	Well Use Type	Aquifer Designation	Well Depth (bgs)	Depth of Bottom Perforation (bgs)
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
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	-
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
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

4.1.5 Monitoring Frequency of Representative Monitoring Network

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

Table 4-4: Monitoring Frequency by Sustainability Indiactor

Sustainability Indicator	Monitoring Type	Monitoring Frequency	Frequency of Reporting to DWR	Note
Groundwater Levels	Groundwater Level Representative Monitoring Wells	Bi-Annually *Seasonal High (Spring - March)* *Seasonal Low (Fall – October)*	Bi-Annually	GKGSA 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 GKGSA.
Groundwater Quality	Groundwater Quality Representative Monitoring Well	Twice per year (or more frequently pending on the Exceedance Policy). (Figure 4-10)	Annually	GKGSA 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

The following section describes the monitoring networks that will be used to demonstrate short-term, seasonal and long-term trends in groundwater and related surface conditions. Monitoring

will be performed to measure progress toward groundwater sustainability. Monitoring programs needed to comply with SGMA track the sustainability indicators, and the most likely to have an impact on this subbasin are groundwater level monitoring, land subsidence monitoring, and groundwater quality monitoring. Existing monitoring programs as they relate to SGMA compliance, their history and adequacy for the GKGSA Monitoring Network are described in this section. Additional information is also available in the Kaweah Subbasin Setting document in Appendix 3A. In general, water levels and water quality have been monitored bi-annually and annually respectively and data are reported in the GSP annual report. Where viable, these existing monitoring networks will be incorporated into the defined monitoring networks for this GSP to be leveraged with monitoring network requirements for SGMA.

The GKGSA 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

Most member agencies maintain groundwater level records (Friant Contractors per requirements of CVP Contract). Many existing local water level monitoring networks were further developed by local water districts in part due to AB-3030 groundwater management planning. The most robust monitoring program where more than 300 wells are semiannually monitored in the Kaweah Delta Water Conservation District (KDWCD). Many of the redundant and disjointed groundwater level monitoring programs ceased when an approved groundwater monitoring program was developed and implemented by the GSAs in the Kaweah Subbasin, such as California Statewide Groundwater Elevation Monitoring (also known as CASGEM).

4.2.2 Existing Land Subsidence Monitoring

Benchmarks for the existing GKGSA land subsidence monitoring network were established in the original *Groundwater Sustainability Plan: Greater Kaweah Groundwater Sustainability Agency* (GKGSA, 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 14 stations are located within the GKGSA area, including 2 continuous GPS stations. These 2 GPS stations are located in proximity to 2 KDWCD stations (~1 mile or less). Table 4-5 provides a summary of historical and recent land subsidence monitoring programs in the MKGSA and the Kaweah Subbasin.

Table 4-5: Summary of Land Subsidence Monitoring in the Kaweah Subbasin

Category	Monitoring Entity (Entities)	Period of Record
Historical Monitoring	National Geodetic Survey of benchmarks (repeat level surveys)	1926 – 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 JPL, USGS, and others (InSAR and UAVSAR programs)	2007 – 2010 2015 to present

4.2.3 Existing Groundwater Quality Monitoring § 354.34 (a)

Most of the wells in the Kaweah Subbasin 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 public water systems 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 (1) 15 or more service connections or (2) 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.

A summary of these programs is provided in Table 4-6 at the end of the program descriptions.

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 include 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. Studies that were specifically used for the Basin Setting and groundwater characterization are:

- 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 later GAMA was 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 4-2). 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 4-3). Both Phase 1 and 2 have a long-term monitoring component called Trends that resamples up to 20 percent 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 ground-water basins and subbasins in California and ranked them in order of sampling priority based on the number of public-supply wells, ground-water usage, and potential sources of ground-water 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 one 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 and others, 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 re-sample 10 percent of the original PBP public supply wells every three years and to re-sample all of the PBP public supply wells every 10 years (Belitz and others, 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 re-sampling 20 percent of the public supply and the domestic well networks every 5-10 years. This change was due to the cost of re-sampling, the addition of the SSA, and the logistics of well availability. The step-trends calculations with the re-sample data require samples to be re-

grouped 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 Figures 4-6 and 4-7. Groundwater quality data collected for Phase 1 and 2 and Trends were reviewed to aid in identifying COCs of interest.

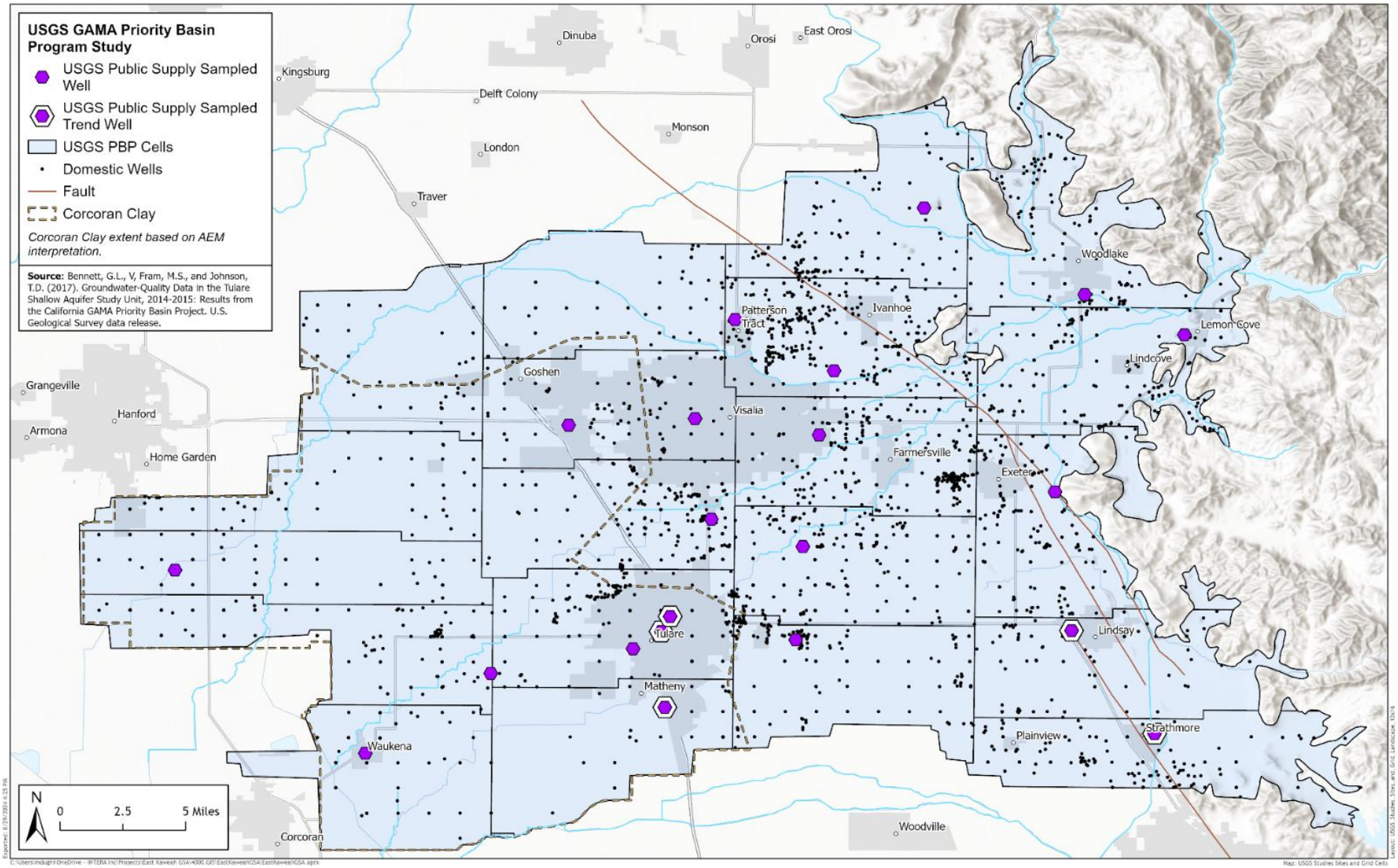


Figure 4-6. USGS GAMA Study Sites (Program Priority Basin Project – Phase 1)

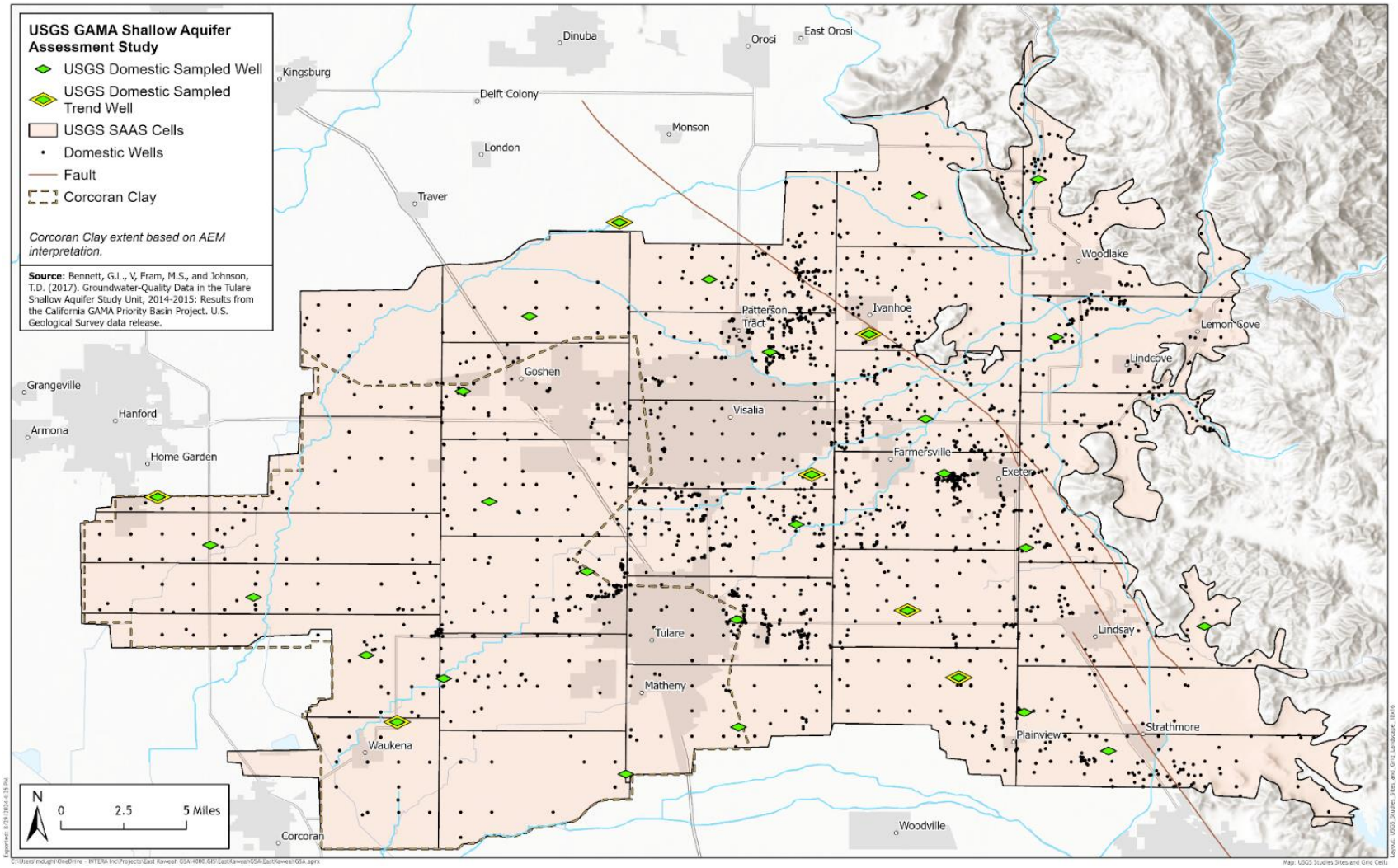


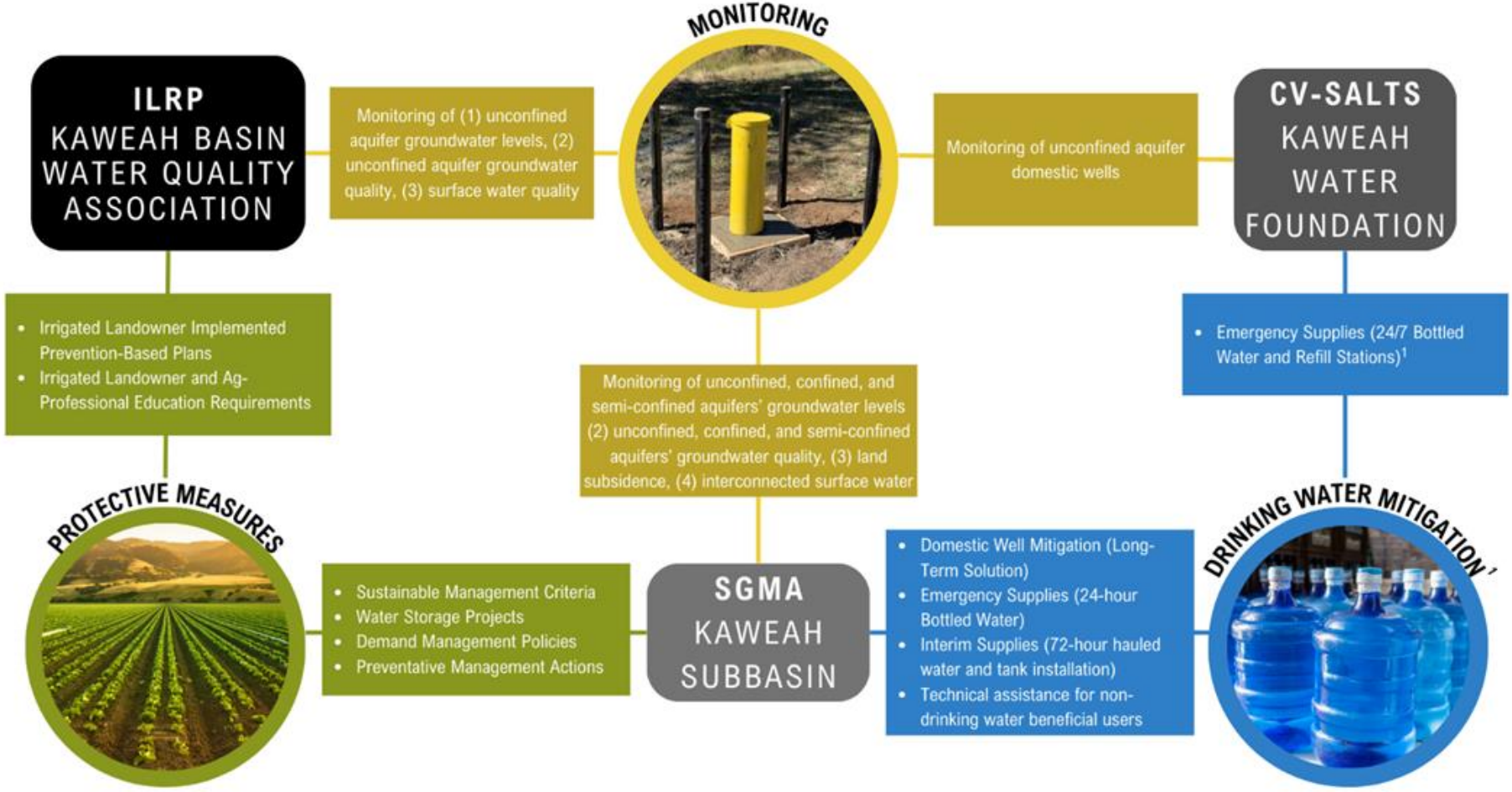
Figure 4-7. USGS GAMA Study Sites (Program Priority Basin Project – Phase 2: Shallow Aquifer Assessment Study)

4.2.3.3 Irrigated Lands Regulatory Program

The Irrigated Lands Regulatory Program (ILRP) addresses the 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 the impacts of irrigated agricultural discharges to the 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 addresses discharges to both surface water and groundwater, thus requiring ILRP enrollment for all commercial irrigated agricultural operations. Figure 4-8 explains the relationship between SGMA and ILRP.

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. The vadose zone and aquifer have nitrates and pesticides 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 two 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 are available currently. The usefulness of the data collected through the ILRP to the needs of the Kaweah Subbasin GSAs' SGMA compliance will continue to be evaluated as data becomes available. The KBWQA submits their data to the GAMA GeoTracker program at regular intervals. The GSAs can gain access to this data when the data are available in GeoTracker.



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

Figure 4-8: Relationship Between SGMA and ILRP/CV SALTS

4.2.3.4 Geotracker and EnviroStor Database

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 GKGSA, to 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 data management system tracks cleanup, permitting, enforcement, and investigation efforts at hazardous waste facilities and sites with known contamination or sites where further investigation is warranted by the DTSC. This database only provides reports, inspection activities and enforcement actions completed on 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 two databases is that EnviroStor only houses records for cases that DTSC is the lead regulatory agency, whereas the GeoTracker database houses records to cases 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 that has 15 or more service connections or regularly serves 25 individuals daily at least 60 days out 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. Public

water systems (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 ≥ ½ the MCL), 6 (when initial monitoring is ≤ ½ 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 ground water 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 review of pesticide detections reported by other agencies. Because of their sample selection methodology, DPR typically only collects one sample per well, 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 (dibromochloropropane and 1,2,3-trichloropropane) are detected in the public water system 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 to 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 State Board adoption of the Salt and Nitrate Control Program basin plan. **Figure 4-8** explains the relationship between GKGSA and ILRP.

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.

Figure 4-8 clarifies the relationship between SGMA, ILRP, and CV-SALTS.

Table 4-6. 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 five 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	Nitrate concentrations in groundwater via the Salt	Annually, with five-year reporting	Compliance with nitrate water quality objectives, provide safe drinking water,	The Kaweah Water Foundation governs the implementation of the Nitrate Control Program in the

Programs or Data Portals	Parameters	Frequency	Objectives	Notes
	and Nitrate Control Program	cycles for trend analysis.	and reduce salt and nitrate loading over time.	Kaweah Management Zone. Monitoring is conducted through established well networks, including public and domestic wells, with continued implementation of early action plans to provide safe drinking water to affected residents. Exceptions to meeting nitrate objectives may be requested, with compliance deadlines up to 35 years.
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 ≥ 10 pCi/L), 6 (when < 10 pCi/L) or 9 (no historical detection) years.	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.
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	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.

Programs or Data Portals	Parameters	Frequency	Objectives	Notes
		wells in Tulare County: 29 Wells were within the Kaweah Subbasin.		
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).
Department of Pesticide Regulation	Pesticides	Annual	DPR samples ground water to determine (1) whether pesticides with the potential to pollute ground water are present in ground water, (2) the extent and source of pesticide contamination, and (3) the effectiveness of regulatory	https://www.cdpr.ca.gov/docs/emon/grndwtr/index.htm

Programs or Data Portals	Parameters	Frequency	Objectives	Notes
			mitigation measures.	

4.2.4 Existing Interconnected Surface Water Monitoring § 354.34 (a) and § 354.38 (d)

§354.38 Assessment and Improvement of Monitoring Network.

(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.

Existing monitoring is limited for stream flow in the Kaweah Subbasin. However, several streams do have flow data and additional sites are proposed.

Existing Streamflow Monitoring: The surface waterbodies regularly monitored are the Kaweah River and St. Johns River. Yokohl Creek's stream gages were destroyed by recent fires and in their place, the Kaweah Subbasin is proposing new RMS sites (see Figure 4-5).

Existing Shallow Groundwater Level Monitoring: Existing shallow groundwater monitoring was previously limited to public supply systems in areas of shallow depth to bedrock on the eastern-most portion of the Subbasin. These areas also overlap where the potential for interconnection is present. Since this has been a data gap, almost all shallow monitoring currently is arranged by the GSAs.

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 CIMIS and NOAA networks, are listed in Table 4-7 below.

Table 4-7: CIMIS Stations in and around Kaweah Subbasin

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

Source	Station Number	Station Name
NOAA	04-0204	Angiola
NOAA	04-2012	Corcoran Irrigation District
NOAA	04-2922	Exeter Fauver Ranch
NOAA	04-3747	Hanford 1 S
NOAA	72-0040	Lake Kaweah Weather
NOAA	04-4890	Lemon Cove
NOAA	04-4957	Lindsay
NOAA	04-7077	Porterville
NOAA	04-9367	Visalia

4.3 GKGSA Groundwater Level Monitoring Network [§354.34 and §354.36]

§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.
(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.
(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:
(1) Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods:
(A) A sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.
(B) Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.
(2) Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.
(d) The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.
(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.
(f) The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:
(1) Amount of current and projected groundwater use.
(2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.
(3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.
(4) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.
(g) Each Plan shall describe the following information about the monitoring network:
(1) Scientific rationale for the monitoring site selection process.
(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.
(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.
(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.
(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.
(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.
§354.36 Representative Monitoring. Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:
(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.

4.3.1 Groundwater Level Monitoring Management Areas

A Management Area (MA) refers to an area within the subbasin or GSA for which a GSP has identified different Minimum Thresholds, Measurable Objectives, monitoring, or Projects and

Management Actions, based on unique local conditions for water use, water source, geology, aquifer characteristics, or other factors. MAs serve to preserve groundwater management practices and implement additional requirements set forth in this GSP. The GKGSA has not designated any MAs at this time but may elect to establish MAs in future updates to address different conditions (e.g. surface-water lands versus groundwater-only lands).

4.3.2 Groundwater Level Monitoring Frequency

Groundwater levels will be monitored at a minimum of twice each year in the Spring (likely March) and Fall (likely October). Spring measurements generally capture the recovery of the groundwater levels after an extended period of minimal agricultural irrigation demand, assuming normal rainfall. Fall measurements show a period after peak irrigation and other summertime urban demands have ceased, thereby yielding the cumulative impacts on the groundwater basin before any natural recovery has taken place. Monitoring frequency requirements for the coordinated Kaweah Subbasin representative monitoring protocols for all sustainability indicators are listed in Table 4-4.

4.3.3 Groundwater Level Monitoring Network

Figure 4-2 provides the current distribution of wells with available data throughout the GKGSA portion of the Kaweah Subbasin, including data from CASGEM, local and regional agencies, and MAs. Figure 4-2 shows the groundwater wells in the GKGSA that will be used for monitoring of groundwater levels and water quality. Most of these wells are upper or single aquifer wells. Based on the BMP for monitoring networks, the well density goal is 4 to 10 wells per 100 square miles (DWR, 2017). The GKGSA area is approximately 340 square miles. Based on the BMP, the GKGSA monitoring network will require between 14 and 34 monitoring wells.

4.3.4 Groundwater Level Representative Monitoring Network

§354.36 Representative Monitoring
Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:
(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.
(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:
(1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.
(2) Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.
(c) The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.

Figure 4-2 shows the current distribution of RMS wells within the Kaweah Subbasin. Most of these wells are upper or single aquifer wells. The GKGSA Representative Monitoring Network is a subset of the Monitoring Network which is made up of monitoring sites deemed representative of nearby conditions in which they are dedicated to monitoring. Quantitative metrics to assess progress towards the sustainability goal are assigned at each representative monitoring site, 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.

Representative Monitoring Network Site Selection

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 GKGSA.
- 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.

4.3.5 Groundwater Level Monitoring Protocols

The Kaweah Subbasin GSAs are required to monitor seasonal high (spring) and seasonal low (fall) upper aquifer groundwater levels and report results to DWR through their SGMA Data Portal on a bi-annual basis. The groundwater levels are monitored following industry standards, and the results are reported publicly through the Annual Reports submitted every April 1st from 2020 through the implementation period (2040).

Groundwater level, groundwater quality, and land subsidence monitoring will generally follow the protocols identified in the *Monitoring Protocols, Standards, and Sites BMP* (DWR, December 2016b). This BMP largely leans on the U.S. EPA's DQO process. The GKGSA may develop standard monitoring forms in the future.

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

1. SGMA regulations require groundwater levels to be measured to the nearest 0.1 feet. The BMP suggests measurements to the nearest 0.01 feet; however, this is not practical for many measurement methods. In addition, this level of accuracy would have little value since groundwater contour maps typically have 10 or 20-foot intervals, and storage calculations are based on groundwater levels rounded to the nearest foot. The accuracy of groundwater level measurements will vary based on the well type and condition. For instance, if significant oil is found in an agricultural well, then readings to the nearest foot are the best one can achieve.
2. 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.
3. Wells will be surveyed to a horizontal accuracy of 0.5 feet.
4. Unique well identifiers will be labeled on all public wells, and on private wells if permission is granted.
5. The BMP states that measurements each Spring and Fall should be taken 'preferably within a 1 to 2-week period'. This is likely not feasible due to the large number of wells in the GSA, and a 4-week period is requested for bi-annual monitoring and potentially be suggested to be taken in the Spring to capture peak groundwater levels.
6. If a vacuum or pressure release is observed, then water level measurements will be remeasured every 5 minutes until they stabilize.
7. In the field, water level measurements will be compared to previous records; if there is a significant difference, then the measurement will be verified.

The GKGSA relies on the monitoring plan implemented by the KDWCD in collecting groundwater elevation data for local groundwater management and for reporting to DWR as required by SGMA. A copy of KDWCD's groundwater level monitoring plan is attached as Appendix 4A.

Review and Evaluation of Monitoring Network

The monitoring network will be assessed and reviewed for adherence to SGMA requirements at the end of each five-year period, with the first period beginning in 2020 and concluding in 2025 or more as needed. As the representative monitoring network currently stands, there are a few data gaps that may affect the interim monitoring of the Subbasin's overall sustainability goal; however, these are being addressed through activities described in Section 4.9.

Quantitative Evaluations of Monitoring Results

Sustainable management criteria are presented and discussed in Chapter 5. This includes details surrounding minimum threshold, measurable objectives, and interim milestones. These criteria establish what the monitoring results are compared to in the assessment of progress towards the sustainability goal and if projects, management actions (including demand management policy changes), and mitigation budget changes are needed to avoid undesirable results. Both the sustainability goal and undesirable result are explained both quantitatively and qualitatively in Chapter 5.

4.4 GKGSA Land Subsidence Monitoring Network [§354.34 and §354.36]

§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.
(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.
(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:
(5) Land Subsidence. Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method.
(d) The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.
(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.
(f) The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:
(1) Amount of current and projected groundwater use.
(2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.
(3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.
(4) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.
(g) Each Plan shall describe the following information about the monitoring network:
(1) Scientific rationale for the monitoring site selection process.
(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.
(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.
(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.
(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.
(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.
§354.36 Representative Monitoring. Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:
(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.
(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:
(1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.
(2) Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.
(c) The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.

4.4.1 Land Subsidence Management Areas

Although the GKGSA has not established Management Areas for subsidence as of this GSP version, MA-18 (see Section 6.7.18) includes the development of management areas for

subsidence as part of a GKGSA Land Subsidence Management Plan (LSMP). The LSMP is planned to be developed from Fall 2024 to Spring 2025.

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.

The proposed FKC and Plainview monitoring points are monitored annually in March to evaluate subsidence impacts. The combination of monitoring points and additional spatial coverage from InSAR provides the appropriate density for monitoring. The InSAR data set is also available annually. The specific points surveyed by the GKGSA can be compared to the InSAR data.

Monitoring frequency requirements for the coordinated Kaweah Subbasin representative monitoring protocols for all sustainability indicators are listed in Table 4-5.

4.4.3 Land Subsidence Monitoring Network

Multiple agencies have performed land subsidence monitoring in the past. However, coverage over the GKGSA region was sparse until Interferometric Synthetic Aperture Radar (InSAR) was introduced in 2015 to monitor subsidence in the region through satellite imagery analysis. To supplement 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 used in addition to survey data collected by the KDWCD, Friant Water Authority, and other subsidence monitoring sources.

Agencies currently monitoring subsidence in the area include:

USGS Monitoring Network. A subsidence monitoring network consisting of 31 extensometers was installed in the 1950s to quantify the subsidence occurring in the San Joaquin Valley. By the 1980's, the land subsidence monitoring efforts decreased. Since then, a new monitoring network has been developed. The new network includes refurbished extensometers from the old network, continuous Global Positioning System (CGPS) stations, and the use of InSAR. More information can be found on the USGS website:

https://ca.water.usgs.gov/land_subsidence/california-subsidence-measuring.html.

NASA Monitoring Network. NASA obtains subsidence data by comparing satellite images of Earth's surface over time. For the last few years, subsidence maps have been produced using InSAR observations from satellite and aircraft imaging. More information can be found on their website: https://www.nasa.gov/jpl/nasa-california-drought-causing-valley-land-to-sink.

Kaweah Delta Water Conservation District: In 2016, KDWCD started a new monitoring network and placed extensometers throughout the Kaweah Subbasin to expand upon the long-standing USGS network of extensometers and establish an adequate number of subsidence monitoring stations to adequately monitor land elevation changes at areas most effected by subsidence in the Subbasin. The goal is to monitor the inelastic land subsidence resulting from groundwater pumping. KDWCD monitors 14 stations within the GKGSA area using GPS methods.

4.4.4 Land Subsidence Representative Monitoring Network §354.36(a),(b)(1),(b)(2),(c)

§354.34 Representative Monitoring

(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.

(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:

(1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.

(2) Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.

(c) The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.

A map of the GKGSA Representative Monitoring Network for land subsidence is available in Figure 4-3. In addition to the sites on the map, the InSAR data serves as a priority data source for the representative monitoring across the Kaweah Subbasin. InSAR utilizes satellite evaluations of land surface elevation change on a gride across a large region; therefore, the Figure does not include specific monitoring sites for InSAR.

The land subsidence representative monitoring network for the Subbasin (96 sites) and GKGSA area (44 sites) is shown on Figure 4-3 and in Table 4-8. 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.

Table 4-8: Summary of GKGSA Land Subsidence Monitoring Locations

Representative Monitoring Site	Network Category
36.1056_-119.4518	Data Gap Area
36.1033_-119.4150	Data Gap Area
36.1354_-119.4589	Data Gap Area
36.3224_-119.4399	Data Gap Area
36.0878_-119.5028	Data Gap Area
36.2950_-119.4810	Data Gap Area
36.1519_-119.2592	Data Gap Area
36.1920_-119.2811	Data Gap Area
36.4143_-119.4149	Data Gap Area
36.3499_-119.4450	Data Gap Area
36.3047_-119.5360	Data Gap Area
36.2611_-119.6612	Data Gap Area
36.2272_-119.5781	Data Gap Area
36.1537_-119.3043	Data Gap Area
36.1303_-119.4196	Data Gap Area
36.3940_-119.4880	Data Gap Area
36.3570_-119.4864	Data Gap Area
Kaweah River Check	FKC Check
KSB-0905	Lower Aquifer GWL RMS
GK-1	Lower Aquifer GWL RMS
GK-2	Lower Aquifer GWL RMS
KSB-1535	Other shallow and composite monitoring wells
KSB-1259	Other shallow and composite monitoring wells
KSB-2114	Other shallow and composite monitoring wells
KSB-0550	Other shallow and composite monitoring wells
KSB-2203	Other shallow and composite monitoring wells
KSB-0531	Other shallow and composite monitoring wells
KSB-0856	Other shallow and composite monitoring wells
KSB-2058	Other shallow and composite monitoring wells
KSB-1580	Other shallow and composite monitoring wells
KSB-2095	Other shallow and composite monitoring wells
KSB-2017	Other shallow and composite monitoring wells
K001	Subsidence GPS Station
K003	Subsidence GPS Station
DH6686	Subsidence GPS Station
DH6739	Subsidence GPS Station
K012	Subsidence GPS Station
K015	Subsidence GPS Station

Representative Monitoring Site	Network Category
K015X	Subsidence GPS Station
K016	Subsidence GPS Station
K1081	Subsidence GPS Station
S228	Subsidence GPS Station
P566	Subsidence GPS Station
K02A1	Subsidence GPS Station

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 stand-alone 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 GKGSA Groundwater Storage Monitoring Network [§354.36 (b)(1)]

§354.36 Representative Monitoring

(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:

(1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.

Change in groundwater storage is correlated with the change in groundwater levels. Therefore, the GKGSA will use groundwater levels as a proxy for the change in groundwater storage. Groundwater storage changes will be 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 will be 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 GKGSA Groundwater Quality 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.
(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.
(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:
(6) Depletions of Interconnected Surface Water. Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions. The monitoring network shall be able to characterize the following:
(A) Flow conditions including surface water discharge, surface water head, and baseflow contribution.
(B) Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.
(C) Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.
(D) Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.
(d) The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.
(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.
(f) The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:
(1) Amount of current and projected groundwater use.
(2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.
(3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.
(4) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.
(g) Each Plan shall describe the following information about the monitoring network:
(1) Scientific rationale for the monitoring site selection process.
(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.
(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.
(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.
(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.
(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.
§354.36 Representative Monitoring. Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:
(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.

The Kaweah Subbasin Representative Monitoring Network is designed to monitor groundwater conditions at representative monitoring sites across the Subbasin, compare the results against the sustainable management criteria, and assess if progress towards the Groundwater Sustainability

Plan is on track or if adaptive measures are needed. The Representative Monitoring Network is comprised of four monitoring networks:

- Groundwater level representative monitoring network
- Land subsidence representative monitoring network
- Groundwater quality representative monitoring network
- Interconnected surface water representative monitoring network

For the purposes of this technical memorandum, this section focuses on the groundwater quality representative monitoring network.

The Kaweah Subbasin Groundwater Quality Representative Monitoring Network is depicted on the map in Figure 4-4 and each RMS Well is listed in Table 4-3.

The resources that were used to build the Kaweah Subbasin Groundwater Quality Representative Monitoring Network is summarized in Figure 4-9.

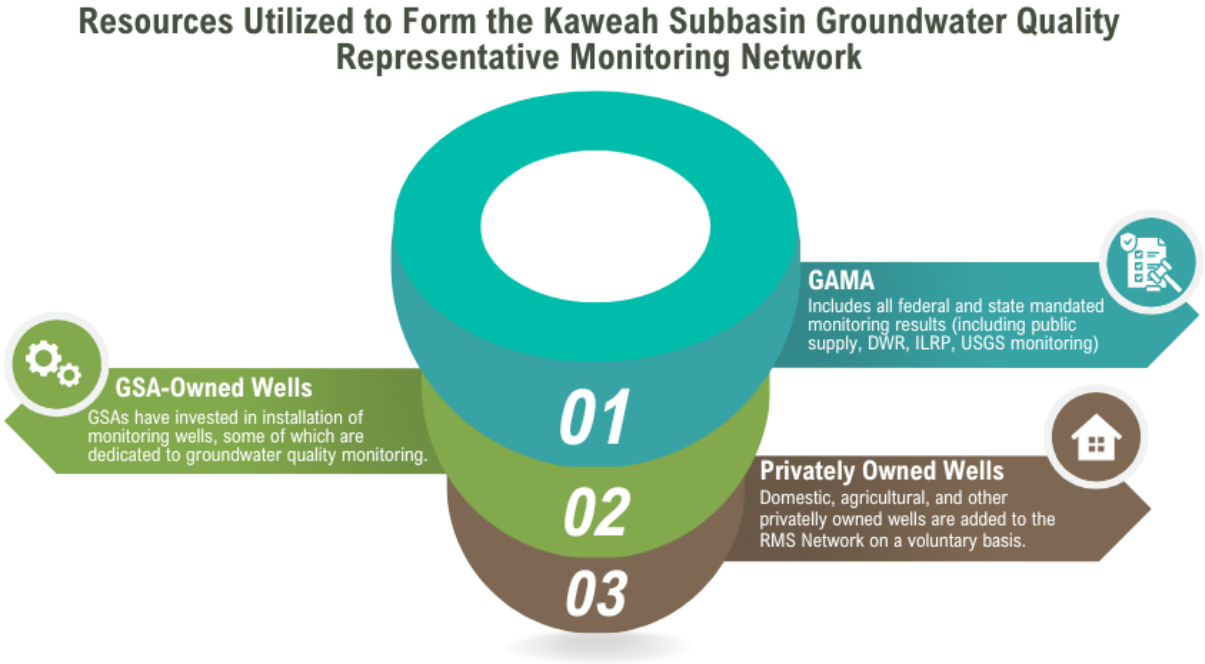


Figure 4-9. Data and Information Resources Utilized to Establish the Groundwater Quality RMS Network

4.6.1 Groundwater Quality Management Areas

Monitoring requirements and activities are consistent across all management areas. There are no unique criteria for monitoring or selection of monitoring sites associated with specific 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 in Figure 4-3. For the first two years (2025 and 2026 water years), each RMS well will be sampled twice per year (seasonally) for each COC identified in Table 4-9. In the years following, the RMS well will continue to be sampled seasonally (twice per year) for any COCs for which the well had exceeded in the two years prior and once every year for any COCs for which the well had met the standards detailed in Table 4-3. It is important to note that additional monitoring is required via the Exceedance Policy (Section 5.8.2) in instances in which the RMS well experiences exceedances of the minimum threshold.

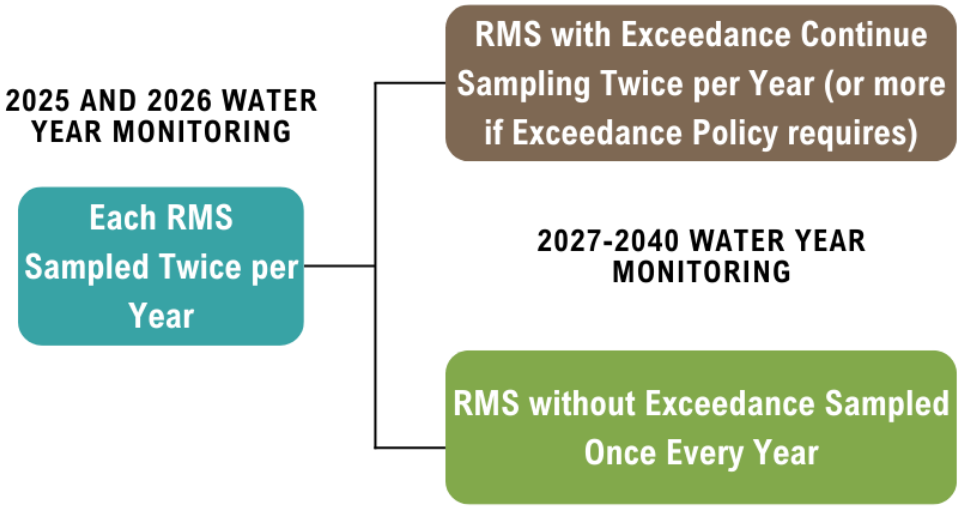


Figure 4-10. Representative Monitoring Frequency

Table 4-9. COCs Monitored by the Kaweah Subbasin Representative Groundwater Quality Monitoring Program

Constituent	Groundwater Quality Standard	MCL Units
Drinking Water Quality Standards (Primary MCL)		
Nitrate as N	10	MG/L
1,2,3-Trichloropropane (1,2,3 TCP)	0.005	UG/L
Gross Alpha	15	pCi/L
Uranium	20	pCi/L
Arsenic	10	UG/L
1,2-Dibromo-3-chloropropane (DBCP)	0.2	UG/L
Perchlorate	6	UG/L
Tetrachloroethene (PCE)	5	UG/L
Chromium, Hexavalent (Cr6)	10	ug/L
Aesthetic (Non-Health Based) Standards (Secondary MCL)		
Total Dissolved Solids	1000	mg/L
Specific Conductivity	1600	umhos/cm
Chloride	500	mg/L
Sulfate	500	mg/L
pH	8.5	-
Agriculturally-Based Standards		
Sodium	69	mg/L
Boron	0.7	mg/L

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 progress towards implementation, appropriate action in the event conditions are trending towards significant and unreasonable, and filling data gaps associated with groundwater quality.

4.6.4 Representative Groundwater Quality Monitoring Network

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, 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. Chapter 3 includes west-east cross-section through the Kaweah Subbasin to depict these unique hydrogeologic zones. These 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

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.

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 was developed using an approach informed by the USGS GAMA project, which employs the statistically-consistent analytical approach described above, utilizing 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 was calculated. These Grid Cells were then classified based on the number of domestic wells using the Equal Interval classification method 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 4-11 depicts the resulting Grid Cells and the count of recommended RMS wells per Grid Cell.

The classification system established five classes to represent the range of domestic well densities within the Grid Cells. The class with the fewest domestic wells was assigned one RMS, while the class with the highest number of domestic wells was assigned five RMS. Intermediate classes were assigned two, three, or four RMS, based on the number of wells in each Grid Cell (Figure 4-11). 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 one RMS were increased to two 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 were 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, the 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.

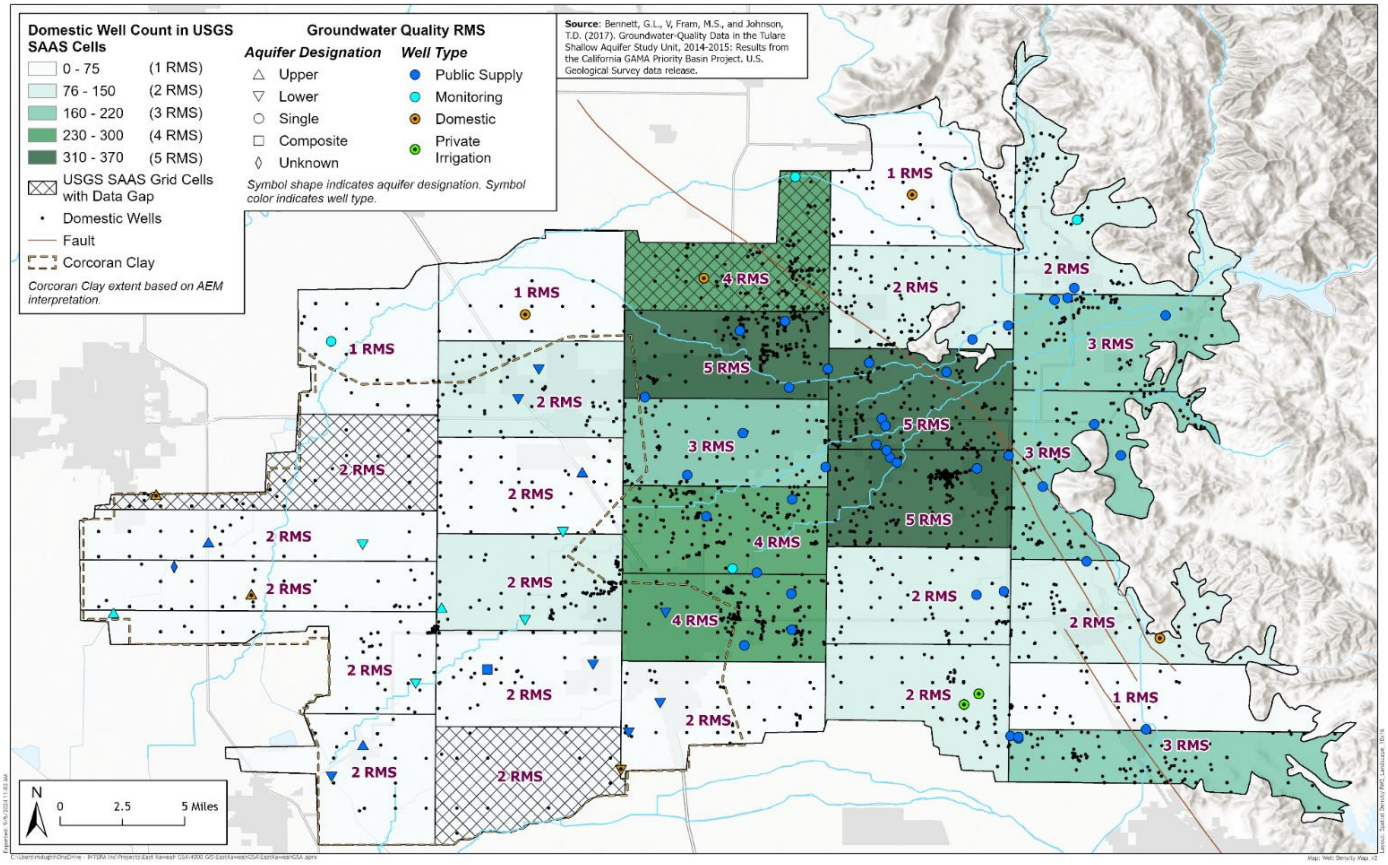


Figure 4-11. Spatial Dentisty Distribution Methodology and Supplemental Data Resources for Groundwater Quality RMS Network

4.6.5 Groundwater Quality Monitoring Protocols

Groundwater level, groundwater quality, and land subsidence monitoring 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.

Review and Evaluation of Monitoring Network

MCLs for COCs are presented in Section 5.8. These values use MCL and prevalence data to provide minimum thresholds, measurable objectives, and interim milestones for each COC.

Quantitative Evaluations of Monitoring Results

Appendix 3B includes historic and recent groundwater quality conditions for each of the COCs. The Kaweah Subbasin GSAs will continue to evaluate groundwater quality monitoring results from the representative monitoring network and supplemental sources on an annual basis in preparation for annual reporting requirements; however, may monitor more frequently if groundwater quality trends indicate contamination that may be related to groundwater management, such as groundwater pumping or recharge activities.

4.7 GKGSA Interconnected Surface Water Monitoring Network [§ 354.34 and §354.36]

§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.
(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.
(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:
(4) Degraded Water Quality. Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.
(d) The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.
(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.
(f) The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:
(1) Amount of current and projected groundwater use.
(2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.
(3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.
(4) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.
(g) Each Plan shall describe the following information about the monitoring network:
(1) Scientific rationale for the monitoring site selection process.
(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.
(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.
(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.
(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.
(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.
§354.36 Representative Monitoring. Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:
(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.
(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:
(1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.
(2) Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.
(c) The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.

The Kaweah Subbasin has established a Representative Monitoring Network designed to monitor groundwater levels and surface flows across the Subbasin and identify if adaptive measures are necessary to avoid significant and unreasonable depletions of interconnected surface water.

4.7.1 Interconnected Surface Water Management Areas

The GKGSA has not designated any MAs at this time but may elect to establish MAs in future updates to address interconnected surface water conditions.

4.7.2 Interconnected Surface Water Monitoring Frequency

The monitoring and evaluation of monitoring data from the stream gages RMS and the shallow RMS wells are different.

The RMS stream gages are monitored by the minute. The flow data is then aggregated to daily, monthly, and annual periods for analysis. Annual flows are compared to average annual flows for the SMC described in Sections 3.3 and 3.4 of Appendix 3D.

Shallow groundwater monitoring is consistent with the Subbasin-wide groundwater level representative monitoring networks' frequency. This includes seasonal high and low monitoring in spring (February – March) and fall (September – October). The results are evaluated and reported on a bi-annual basis and also documented in the Annual Reports. The Kaweah Subbasin GSAs are considering installing transducers in dedicated monitoring wells to better monitor and characterize dynamic flow and groundwater level conditions.

4.7.3 Interconnected Surface Water Representative Monitoring Network

§354.36 Representative Monitoring
Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:
(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.
(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:
(1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.
(2) Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.
(c) The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.

The Kaweah Subbasin Representative Monitoring Network is composed of RMS wells or stream gages that are part of existing monitoring programs, GSA-owned dedicated monitoring wells, and private wells in which the landowners have volunteered the GSA access to their site for regular monitoring (Figure 4-5).

There are significant data and information gaps regarding shallow aquifer levels, streamflows, riparian surface water diversion, and the well-specific groundwater pumping. Therefore, the Representative Monitoring Network for interconnected surface water includes proposed shallow aquifer level monitoring and proposed stream gages to better address the data gaps. More information on data gaps and the plan to fill them are available in Section 4.9, Section 6.7.12 and Attachment A of Appendix 3D.

4.7.3.1 Representative Monitoring Site Selection

The selection of ISW RMS was limited to existing stream gages and wells. Many of the stream gage RMS and shallow aquifer RMS wells on the monitoring network map (Figure 4-5) are proposed future improvements. Considerations for establishing RMS with the available data and information at this time was based on the following questions:

Stream Gage RMS Considerations:

- Is the stream gage still active?
- Is the stream gage located on a potentially interconnected reach of a river or stream within the Kaweah Subbasin?
- Is historical data and information available for the stream gage?
- Can the GSAs obtain site access?

Shallow Aquifer RMS Well Considerations:

- Is the well drilled in the upper aquifer with the screen at an appropriate depth?
- Is the well located near a potentially interconnected reach of a river or stream within the Kaweah Subbasin?
- Is historical data and information available for the well?
- Can the GSAs obtain site access?
- Can the well be monitored within the schedule and frequency established for the Groundwater Level Representative Monitoring Network?

The spatial density of the existing representation monitoring network is based on where data are currently available. The Kaweah Subbasin has identified stream gage and shallow aquifer well data as a data gap, particularly on the eastside of the Subbasin where potential ISW conditions are present.

Figure 4-5 shows the spatial density of the existing ISW representative monitoring network as well as proposed stream gage RMS and shallow aquifer RMS well locations. The strategy to fill these data gaps is further outlined in Section 6.7.12.

4.7.3.2 Quantitative Values

Information on SMC for depletions of interconnected surface water and rationale are available in Section 5.9.

4.7.3.3 Review and Evaluation of Monitoring Network

Bi-annual monitoring of groundwater levels (consistent with the groundwater level RMS network) is required to be reported to DWR. Stream gage data will be evaluated monthly and reported in the Kaweah Subbasin GSAs' annual report(s).

4.7.4 Interconnected Surface Water Monitoring Protocols

The monitoring protocols for interconnected surface water are consistent with the monitoring protocols for groundwater level monitoring. See Section 4.3.5 for more information on those protocols.

The monitoring protocols for RMS stream gage is to obtain the data from the organizations that own the stream gages on an annual-basis (or more frequently, if necessary).

4.8 Seawater Intrusion Monitoring [§354.34(j)]

§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 and §354.40]

§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, groundwater quality, and land subsidence.

4.9.1 Groundwater Level Monitoring Data Gaps

Existing groundwater-level monitoring has provided data to prepare groundwater contour maps and identify groundwater level trends over the decades. The existing monitoring system relies heavily on the member irrigation districts, but this only provides data for a portion of the GKGSA. To better represent hydraulic gradient and flow direction within the GKGSA, about seven wells are planned to be strategically placed for regular monitoring in the GKGSA. The GKGSA is making efforts to fill these locations either through conversations encouraging the use of agreements with private landowners or by identifying the use of future funds for drilling new dedicated monitoring wells.

Other data gaps exist in the fact that most of the proposed monitoring network wells are privately owned production wells that are used for monitoring. Specific well construction information, including depth and perforated interval, are not known for many of the wells. Also, depending on how and when the data was collected, data points in some (or all) years may be skewed. Utilizing a production well as a monitoring well runs the risk of potential influence from recent pumping that may affect the ‘static’ reading aimed to be captured. Much of the recorded well data within

the GKGSA is credible. However, the GKGSA will continue to improve this data set going forward.

GKGSA has added two new management actions, which are anticipated to provide opportunities to add more domestic wells to both the groundwater quality and groundwater level representative monitoring networks. These include the Well Registration Program and the Mitigation Program, described in more detail in Chapter 6.

4.9.2 Groundwater Storage Data Gaps

Gaps in current groundwater level monitoring networks have created corresponding inadequacies in calculating storage change. Data gaps associated with aquifer characteristics, such as specific yield values used for storage estimates, are anticipated to be improved through the completion of different projects and studies undertaken by the Kaweah Subbasin and the GKGSA (i.e. SkyTEM).

4.9.3 Land Subsidence Monitoring Data Gaps

With the addition of survey points to critical infrastructure and the utilization of the InSAR data set as a backstop, the current subsidence monitoring network is believed to sufficiently cover the GKGSA.

4.9.4 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 in Figure 4-4; however, for the purposes of this technical memorandum, the focus is on groundwater quality data gaps. These data gaps include:

- Groundwater quality RMS sites in the hatched areas designated as data gaps in Figure 4-4. In areas overlaying the Corcoran Clay, it is preferred to add RMS wells in the upper aquifer and lower aquifer.
- Groundwater quality data at various depths (in or near the same location)
- Relationship between groundwater recharge activities and groundwater quality

4.9.5 Interconnected Surface Water Monitoring Data Gaps

The first step in monitoring data gaps is to identify them. The principal data gaps associated with ISW and the plan to fill the data gaps are listed below. The strategy to fill the data gaps are

expanded in more detail in the Interconnected Surface Water Data Gap Workplan (Section 6.7.12) and Attachment D of Appendix 3D.

Interconnected Surface Water Data Gaps:

- Stream gage data (locations of interest clarified as proposed stream gage RMS in Figure 4-5.
- Shallow monitoring data (locations of interest clarified as proposed shallow RMS wells in Figure 4-5.
- Well-specific pumping data (e.g. location, depth, and monthly volume)
- Numerical surface and groundwater model capable of assessing ISW depletions
- Riparian diversion locations and diversion data
- Field validation of GDEs, habitats, and species identified via public data sources
- Refined estimate of mountain front and mountain block recharge
- Refined depth to groundwater adjacent to streams
- Refined depth to bedrock on east-side of the Subbasin (to improve estimations of Hardrock well count and saturated thickness

4.9.6 Plan to Fill Data Gaps

Plan to Fill Groundwater Level Data Gaps

The GKGSA 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 GKGSA will need to locate accessible private wells or drill new wells in the seven locations shown. Over time the GKGSA will transition to utilizing dedicated monitoring wells in its monitoring network.

To address data quality gaps related to unknown construction information, the GKGSA will utilize 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. Due to the way that data is 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. Multiple wells may exist within the area a well's log leads to. 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.
- **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 cost between $2,500 and as much as $15,000 if required to lift and reinstall a pump to obtain access to production wells. There would also be additional costs for administration and outreach to landowners. The GKGSA would need to enter into private agreements with individual well owners for the use of these wells; as an incentive for participation, the GKGSA would cover the cost of the well video assessment.

- **Abandoned Wells.** The GKGSA will assess the likelihood of monitoring former wells that have been abandoned. The 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 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 water level reading and better fulfilling the requirements of Sub-Article 4.
- **Replace the 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 GKGSA 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 the 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 side-step the expense of drilling new wells but would still be subject to availability and limitations arising from the missing historical record.
- **Implementation of the Well Registration Program.** Construction, groundwater level, and groundwater quality data from wells not currently in the GKGSA 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 and small community wells. More information on this management action is available in Section 6.7.13.

Plan to Fill Subsidence Data Gaps

With the addition of survey points to critical infrastructure and the utilization of the InSAR data set as a backstop, the current subsidence monitoring network is believed to sufficiently cover the GKGSA.

Plan to Fill Groundwater Storage Data Gaps

Significant data gaps will be filled using 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 a SkyTEM

electromagnetic analysis. The results from this analysis were not ready in time for this 2nd Amended GSP but are being incorporated into the Kaweah Subbasin Groundwater Flow Model Update that will be available for use later in 2024 and for use in future annual reporting and GSPs.

Plan to Fill Groundwater Quality Data Gaps

The Kaweah Subbasin recognizes the addition of private domestic wells in the representative monitoring network would be helpful; however, there is generally hesitation among private landowners to share 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 the Kaweah Subbasin:

- **Mitigation Program.** Through the mitigation program, groundwater level and quality at impacted domestic well sites across the Subbasin will be better understood. Following the completion of long-term mitigation , the GSA will request these landowners consider allowing the GSA access to the well for future monitoring and potentially inclusion in the representative monitoring networks for groundwater quality and groundwater levels. More information on this management action is available in Chapter 6 of the 2nd Amended GSPs.
- **Well Registration Program.** Through the registration program, well construction, groundwater level, and groundwater quality data from wells not currently in the Subbasin GSAs' well database are expected to improve understanding of groundwater conditions across the Subbasin. 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 Chapter 6 of the 2nd Amended GSPs.

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 is available in Chapter 6.

The Kaweah Subbasin proposal to monitor COCs across the groundwater quality monitoring network intends to fill some of the significant data gaps regarding groundwater quality data. Monitoring over the first five years of implementation should provide more insight into groundwater quality (location, trends, etc.) in the Kaweah Subbasin. The Kaweah Subbasin will also continue to collaborate, where appropriate and feasible, with other agencies tasked with tracking and/or improving groundwater quality for additional assistance with data gaps, such as the local ILRP, CV-SALTS organizations and the GSAs' mitigation partner, Self-Help Enterprises. The plan to fill data gaps pertaining to groundwater quality are summarized in Table 4-10.

Table 4-10. Groundwater Quality Data Gaps and Plan to Fill Them

Data Gap	Plan to Fill this Data Gap	Progress to Date
Shallow (upper aquifer) groundwater quality data (especially in the areas west of the Cities of Tulare and Visalia)	• Mitigation Program. Through the mitigation program, groundwater level and quality data are to be better understood at impacted domestic well sites across the Subbasin. Following the 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 of the 2nd Amended GSPs. • Well Registration Program. Construction, groundwater level, and groundwater quality data from wells not currently in the Subbasin well 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 Chapter 6 of the 2nd Amended GSPs.	• MKGSA has installed 12 new RMS wells. 4 of which are currently outfitted for groundwater quality monitoring. The remaining wells will be outfitted for groundwater quality monitoring as resources are available. • EKGSA has added three new private RMS wells via solicitation from members of the Technical Advisory Committee.
Groundwater quality data at various depths (in or near the same location)	GKGSA has identified a priority data gap area in the south east region of the GKGSA border for groundwater levels. As resources allow, GKGSA is in process to install multiple nested or multi-completion wells for groundwater level monitoring. These wells may be outfitted for groundwater quality monitoring, pending funding and resource restrictions.	• MKGSA's new RMS wells include nested/multi-completion wells and water quality testing equipment
Relationship between groundwater recharge activities and groundwater quality	• Installation of groundwater quality monitoring sites as part of recharge basin construction, where funding and resources allow • Solicit well owners located nearby a recharge basin to enroll in the Well Registration Program and volunteer for GSA-organized groundwater quality monitoring	• New groundwater recharge facilities in EKGSA (such as the City of Lindsay recharge facility) and MKGSA's Okieville recharge basin include groundwater quality monitoring at the community wells and designated monitoring wells.

Plan to Fill Interconnected Surface Water Data Gaps

Plan Fill Data Gaps in the Next 5 Years:

- Installation of new stream gages (proposed locations identified in Figure 4-5.
- Installation of new shallow monitoring wells or inclusion of existing private shallow monitoring wells that were previously unknown (proposed locations identified in Figure 4-5).
- Numerical surface and groundwater model capable of assessing ISW depletions (Attachment D of Appendix 3D).
- Biological expert field studies of the vegetative and animal beneficial users in the Subbasin
- Continued engagement with local surface water and environmental experts

5 SUSTAINABLE MANAGEMENT CRITERIA

§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.

This section provides location-specific sustainable management criteria (SMC) for the five applicable sustainability indicators, including the definition of undesirable results (URs), minimum thresholds (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 1B**).

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 one 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, through the implementation of management actions and projects, to the MO 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]

§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 SMC 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, development of the criteria is dependent on basin information presented in the

hydrogeologic conceptual model, groundwater conditions, and water budget sections of the GKGSA GSP (**CHAPTER 3**).

The SMC methodology and approach are shown in **FIGURE 5-1,** and a summary of the definitions and qualitative and quantitative functions of the SMC is available in **FIGURE 5-2**.

Seven appendices 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 for this 2nd Amended GSP. These appendices are considered extensions of **CHAPTER 5:**

1. **Appendix 5A** – Chronic Lowering of Groundwater Levels and Reduction of Groundwater Storage SMC Technical Memorandum
2. **Appendix 5B** – Land Subsidence and Lower Aquifer Chronic Lowering of Groundwater Level SMC Development Process for the Kaweah Subbasin
3. **Appendix 5C** – Technical Support for Land Subsidence Sustainable Management Criteria in the Kaweah Subbasin
4. **Appendix 5D** – Groundwater Level SMC Hydrographs
5. **Appendix 5E** - Development and Use of A One-Dimensional Land Subsidence Model for the Kaweah Subbasin Technical Memorandum
6. **Appendix 5F** – Projected Conditions Hydrographs
7. **Appendix 5G** – Development of the Relationship Between Modeled Aquifer Storage and Regional Groundwater Elevations Technical Memorandum
8. **Appendix 3B** – Groundwater Quality SMC Development Technical Memorandum
9. **Appendix 3D** – Interconnected Surface Water SMC Development 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 to beneficial uses and users of groundwater in the subbasin (**FIGURE 5-1**.

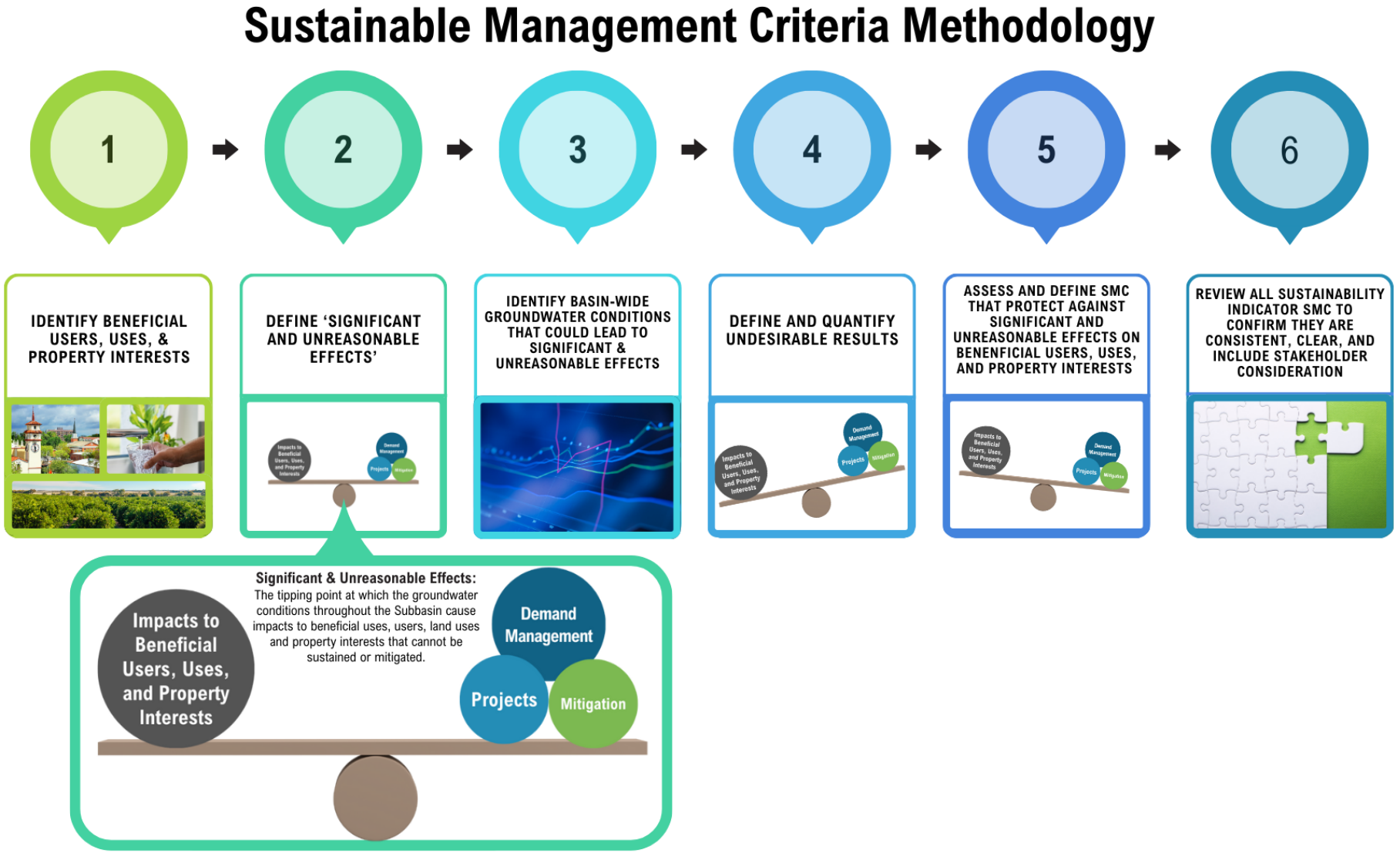


Figure 5-1 SMC Methodology and Approach

5.1.1 General Description of Undesirable Result

The Kaweah Subbasin carefully considered and determined the groundwater conditions at which each of the five applicable sustainability indicators exhibit significant and unreasonable effects. URs are considered to occur when any of the five 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 which 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; and,
- Description of the potential effects of the UR on beneficial uses or users.

5.1.2 General Description of Minimum Thresholds [§354.28]

§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.

In addition to a qualitative description, each UR must also be substantiated using a quantitative combination of MT exceedances. A MT is a quantitative value that represents the groundwater conditions at a 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 indicators' relevant MT section:

(1) 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.
(2) 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.
(3) How MTs have been selected to avoid causing URs in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.
(4) How MTs may potentially impact beneficial uses and users of groundwater or land uses and property interests.
(5) How state, federal, or local standards relate to the relevant sustainability indicator. If a MT differs from other regulatory standards, the Kaweah Subbasin GSAs will explain the nature and basis for the difference.
(6) How each MT will be quantitatively measured, consistent with monitoring network requirements.
(7) How SMC for one sustainability indicator may be used as a proxy for another sustainability indicator.
(8) Each of the sustainability indicators must be monitored for MT exceedances. However, based on the strong relationship between groundwater levels and changes in aquifer storage (i.e., rising groundwater levels indicate an increase in groundwater storage and vice versa), land subsidence (Lees et al., 2022)[5], and potentially, depletions of interconnected surface water, whichever indicator is the most sensitive to groundwater level reduction will be the limiting MT for groundwater conditions in that threshold region. Given the specific hydrogeology of the GKGSA and limited data for interconnected surface water depletions, 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 surface water depletions, aquifer storage reductions, or land subsidence. Nonetheless, in addition to monitoring groundwater levels, the groundwater quality, potential interconnected surface water depletion rates, and land subsidence sustainability indicators will also be monitored separately.

[5] Lees, M., Knight, R., Smith, R. (2022). Development and Application of a 1D Compaction Model to Understand 65 Years of Subsidence in the San Joaquin Valley. Water Resources Research. e2021WR031390. https://doi.org/10.1029/2021WR031390

5.1.3 General Description of Measurable Objectives

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 GKGSA has developed a set of management actions and projects outlined in Chapter 6 that are intended to achieve sustainability in 2040 at the MO. Adjustment 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 GKGSA implementation timeline were designed to allow the GKGSA 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 below subsections.

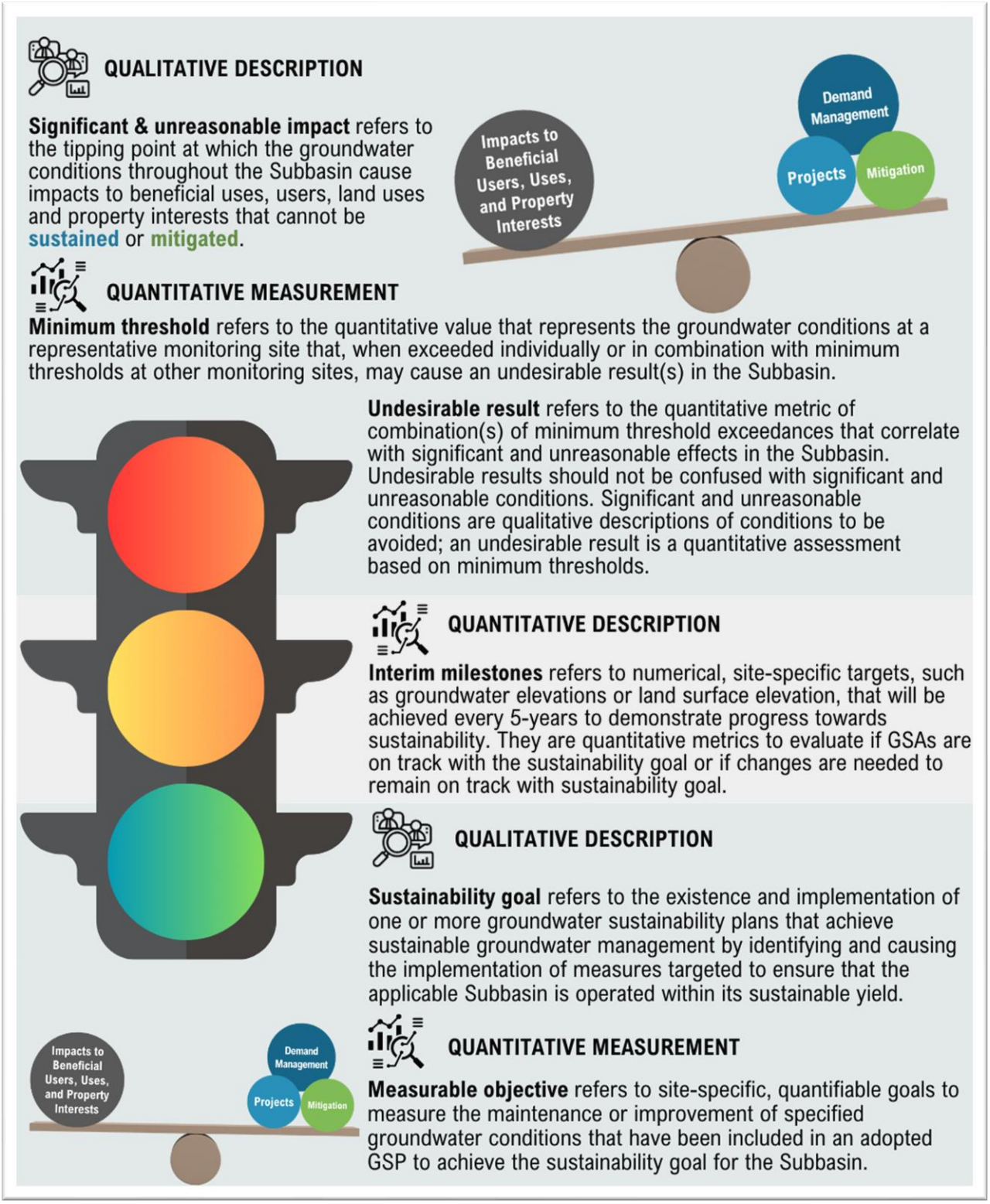


Figure 5-2 SMC Definitions & Functions

5.1.5 Sustainability Indicators Applicable in the Kaweah Subbasin

The applicability of sustainability indicators is described in Chapter 4 and summarized in 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 five applicable sustainability indicators.

5.1.7 Management Areas

Descriptions of each Management Area and their rationale for their formation are available in Section 3.5. The 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

5.2 Sustainability Goal [§354.24]

§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 SMCs were coordinated across the Kaweah Subbasin GSAs. Consistent with the Coordination Agreement (Appendix 1B), 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 reduction of groundwater storage, minimize land subsidence where significant and unreasonable, and address the degradation of water quality to protect the local beneficial uses and users of groundwater.
- Assessments of progress towards 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 three GSAs as appropriate through the planning and implementation horizon.

In order to achieve the sustainability goal, a combination of projects and management actions will be implemented over the course of the next 20 years. Understanding that projects take time

and funding 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 towards the sustainability goal are addressed via the Kaweah Subbasin Mitigation Program and GKGSA Mitigation Plan (see Chapter 6). GKGSA is managing to achieve the sustainability goal, as evidenced by the Water Accounting Framework (**SECTION 6.7**), 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 GKGSA, notable correlation has been developed between the chronic lowering of groundwater levels and the significant and unreasonable effects from 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 [§354.26(a)]

§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.

5.3.1 SMC Revision Priorities

The SMC presented in this GSP has been revised from previous versions to meet regulatory requirements under SGMA.



Figure 5-5 Kaweah Subbasin SMC Revision Priority Considerations

5.3.2 Stakeholder Feedback Process

In general, SMC for each sustainability indicator are determined using a data-informed, Subbasin-wide coordinated, and stakeholder-inclusive progress. Specifically, the GKGSA Technical Advisory Committee (TAC), Kaweah Subbasin Technical Team, "Core Teams", and Board of Directors (Board) carefully considered when the five sustainability indicators applicable to the GKGSA 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 that summarizes the stakeholder and technical process nexus.

The GSA Board, in combination with stakeholder input, TAC, Advisory Committee, and Core Team expertise ultimately determined the definition of URs based upon the relative levels that would have a significant and unreasonable negative impact to communities with the Kaweah Subbasin, historical and biological quality of life, and that would also severely threaten regional agricultural economy and impact the world's food chain supply.

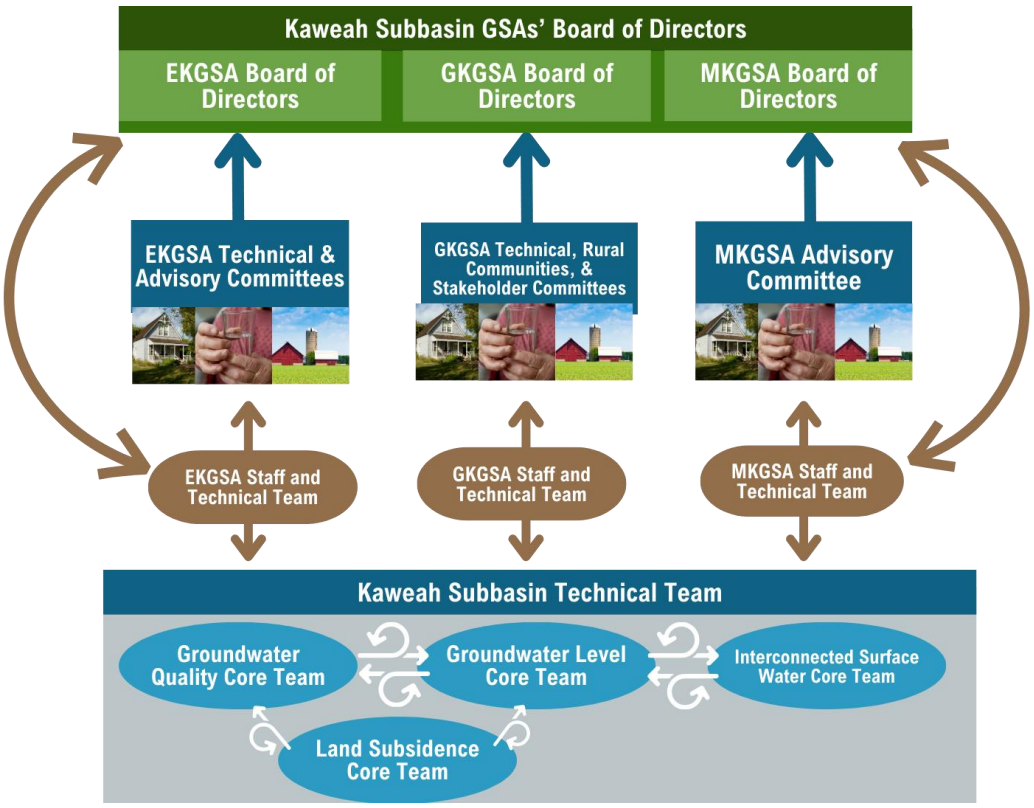


Figure 5-6 Kaweah Subbasin Stakeholder & Technical Feedback to Revise SMC

5.4 Sustainable Management Criteria Summary [§354.26(b)(1),(2),(3)]

§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.

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, along with progress 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 management plan: SGMA allows for 20 years to reach sustainability and requires the Subbasin have no URs for the subsequent 30 years. Note, the SMC presented in this GSP have 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 can be used to improve the understanding of the groundwater conditions under different climate scenarios and operational conditions (see Section 5.5.5).

Use of Proxy SMC

- There is a significant correlation between groundwater levels and aquifer storage for the unconfined aquifer; therefore, the Kaweah Subbasin is utilizing groundwater levels as a proxy metric for the reduction in aquifer storage sustainability indicator.

- For land subsidence, the Kaweah Subbasin is using a rate of land subsidence that avoids impacts to critical infrastructure. Lower aquifer groundwater management is directly correlated with land subsidence; therefore, lower aquifer SMC are established as the groundwater elevation that is consistent with SMC for land subsidence.

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Table 5-1: Kaweah Subbasin SMC General Summary

	Chronic Lowering of Groundwater Levels	Reduction in Groundwater Storage	Degraded Groundwater Quality	Land Subsidence	Depletions of Interconnected Surface Water
Measurement	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 Section 6.
UR	**Upper Aquifer:** 1. If more than 20 RMS wells in the Kaweah Subbasin exceed their minimum threshold in any given year; AND 2. More than 30 domestic wells in the Kaweah Subbasin are impacted by overdraft and require mitigation in any given year. OR 3. If a GSA is unable to meet mitigation needs. **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	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 (Section 6.7.12).
MT	**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	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	Maximum subsidence limited to 7 feet, Average subsidence = 3.1 feet to be	MTs are preliminarily established as depletions that would lead to flows lower than WY 2022 low flows[6] for the two existing stream gage RMS which overlay likely connected surface waterbodies.

[6]Low flows are defined as six months with the lowest flows over a twelve month period, not including months with no flows (when depletions are zero).

	Chronic Lowering of Groundwater Levels	Reduction in Groundwater Storage	Degraded Groundwater Quality	Land Subsidence	Depletions of Interconnected Surface Water
	(when necessary) during the implementation period. **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.		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	protective of beneficial users, uses, and land uses (varies by RMS location)	This is considered an interim measure until the DWR Guidance document is available for consideration and until the Interconnected Surface Water Data Gap Workplan (Section 6.7.12) is completed.
MO	**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 two water level criteria to provide hydrogeological plausible gradients from east to west. This is expected to be updated with the Groundwater Flow Model, when available. **Lower Aquifer:** MOs are based on pre-SGMA Fall 2012 lower aquifer groundwater levels.	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.

5.5 Chronic Lowering of Groundwater Levels SMC [§354.28(c)(1)(A), (c)(1)(B),(C)(2)]

§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 are developed based on the best available science, input collected during the stakeholder process (**FIGURE 5-6**), coordination amongst the three GSAs' technical experts, and discussions with the SWRCB Staff.

The revised SMC methodology began by identifying all beneficial users, uses, and property interests of groundwater in the Kaweah Subbasin, 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 in **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

5.5.1 Groundwater Beneficial Uses and Users [§354.26(b)(3)]

The first step of the SMC approach (Figure 5-1) is to identify beneficial users, uses, and property interests. Beneficial uses, users, and property interests are identified in Section 2.7.1. Potential effects on beneficial uses induced by chronic lowering of groundwater levels and reduction in groundwater storage are summarized in Figure 5-5. GKGSA 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 more in Chapter 6).

In evaluating the potential effects of impacts related to chronic lowering of groundwater levels, it was determined that domestic drinking water wells are the most vulnerable beneficial user 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” herein 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 ongoing work, it was also identified that the lower aquifer in the Kaweah Subbasin 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 those critical infrastructure and their users listed for land subsidence under Section 5.6.1.

5.5.2 Chronic Lowering of Groundwater Level and Reduction of Groundwater Storage Undesirable Results [§354.28(c)(2)]

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

5.5.2.1 Subbasin Defined Significant and Unreasonable Chronic Decline in Groundwater Levels [§354.26(b)(2)]

To locally define significant and unreasonable effects due to the chronic lowering of groundwater level sustainability indicator, transparency with and involvement of stakeholders is critical to the development of the methodology and multiple iterations of the technical analyses involved (see 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 is working towards achieving and maintaining sustainability. The Kaweah Subbasin Mitigation Program and GSA-specific Mitigation Plans address these individual impacts on the path to achieving sustainability. Where undesirable results occur within the GKGSA planning area during the path toward achieving sustainability, the Mitigation Plan provides a safety net.

The undesirable result 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 occurring across the Kaweah Subbasin, cause an impact or impacts to beneficial users, uses, and property interests, that cannot be sustained or mitigated.

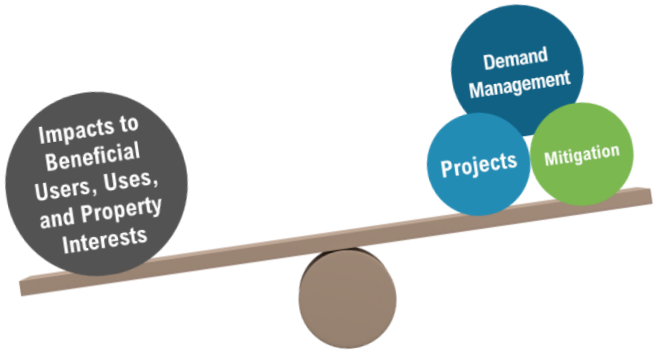


Figure 5-7 Analogy Diagram of Significant and Unreasonable Effects

In the case of chronic lowering of groundwater levels and reduction in storage, an undesirable result – ie., an undesirable cumulative significant and unreasonable effects - may include the number of domestic wells impacted that 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, or the diminishing of the occurrence of the GDEs[7]. As stated, the Kaweah Subbasin's revised SMC in this 2nd Amended 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.

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

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 from chronic lowering of groundwater levels and reduction in groundwater storage 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 typically shallow domestic wells. GKGSA 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.

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



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.

The Well Registration Program gathers well construction information and contact information necessary to meaningfully evaluate well-specific risks and notify the landowner when appropriate (see description in Chapter 6). In addition to supporting early notification, the GSA will evaluate the domestic well and well construction information annually reassess the SMC, demand management policies, and available sustainable management strategies to avoid localized, individual impacts. The GSAs have an

[7] Undesirable results for GDEs are the focus of the SMC for ISW.

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. include:

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

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

- 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/reduction in groundwater storage.

    - Significant and Unreasonable Effect: the Mitigation Program's proactive measures, technical assistance, and groundwater management policies are insufficient to avoid impairments in production for a small community systems.

5.5.2.3 Significant and Unreasonable Impacts on Other Beneficial Uses and Users

Less sensitive beneficial users, uses, and property interests, e.g., agricultural, industrial, municipal, commercial, and other production well types, generally drill deeper wells than domestic and small community users in the Kaweah Subbasin. Therefore, they are less vulnerable to impacts from the lowering of groundwater levels than those discussed in Section 5.5.2.1. 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/reduction in groundwater storage.

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

- Individual Impact: A municipal or commercial well is unable to supply drinking water to connected households due to the lowering of groundwater levels/reduction in groundwater storage and is unable to use their backup well(s) to supply drinking water.

    - Significant and Unreasonable Effect: the Mitigation Program's proactive measures, technical assistance, and groundwater management policies are insufficient to avoid or mitigate impairments in production for municipal/commercial supplies.

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

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

Importantly, if a beneficial user with an agricultural, industrial, municipal, or commercial well is pumping more than their pro rata share of the native yield, then that beneficial user is 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.

5.5.2.4 Significant and Unreasonable Impacts on Neighboring Subbasins

The Kaweah Subbasin has coordinated with neighboring subbasins' draft revised SMC to avoid inconsistencies and interbasin 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/reduction in groundwater storage 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.

5.5.2.5 Summary of Significant and Unreasonable Effects

Table 5-3 summarizes individual impacts and significant and unreasonable effects for beneficial users in the subbasin.

Table 5-3: Summary of Individual Impacts vs. 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/reduction in groundwater storage.	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/reduction in groundwater storage.	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/reduction in groundwater storage.	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/reduction in groundwater storage.	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/reduction in groundwater storage 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.

5.5.2.6 Criteria for Defining Chronic Lowering of Groundwater Levels Undesirable Results

By regulation, the undesirable result for the 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 undesirable results would occur based on different groundwater conditions. See the MTs subsection of this memorandum that details the methodology, analysis, and results associated with MT determinations. The primary criteria and metric to determine if undesirable results occur in the Subbasin is if the count of impacted domestic wells exceeds the GSAs' ability to mitigate those impac14ts. 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 undesirable results to be protective of impacts on domestic wells, other beneficial users, uses, and property interests are also protected. An undesirable result 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 costing). The number of potentially impacted domestic wells per RMS, if groundwater levels are at the MT, is approximately 3, based on the spatial distribution of wells with available depth information (i.e., there are 102 RMS wells that have been designated for the upper aquifer (Table 5-1), and the DWSA determined that there are 350 potentially impacted domestic wells if groundwater levels reach the MT; hence, 350÷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). At the time of developing this technical memorandum, 17 upper aquifer RMS wells equate to 17 percent of RMS wells in the Kaweah Subbasin's upper aquifer groundwater level representative monitoring network.

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 was selected as a second quantitative measure for undesirable results. 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; hence, 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. Undesirable result #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 undesirable result #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 metrics for undesirable results are intended to become more stringent over time since after 2040, when the sustainability goal is reached, the need for mitigation is projected to be reduced to zero.

The definition of undesirable results, and all other SMCs, may be revised in the future as lessons are learned through the implementation of this 2nd Amended GSP and the Mitigation Program.

5.5.2.7 Potential Causes of Undesirable Results

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

- Prolonged periods of extracting groundwater 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 to neighboring wells.
- Extreme drought (such as the 5-year drought observed in 2012-2016) 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 undesirable results. This becomes especially significant if groundwater levels do not rebound after the drought period is over or excessive subsidence occurs.
- Unsustainable groundwater management from neighboring subbasins leading to excessive underflow losses.

5.5.2.8 Effects on Beneficial Users and Uses

URs 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 chronic lowering of groundwater levels on beneficial users includes 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, significant reductions in GDEs as a result of declines in interconnected surface water due to nearby pumping, or subsidence impacts on well structures and above ground infrastructure (in the case of lower aquifer groundwater level decline). A breakdown of potential effects to beneficial uses and users in the Kaweah Subbasin by sustainability indicator is available in Figure 5-5.

5.5.3 Chronic Lowering of Groundwater Level MTs [§354.28(c)(1)(A)]

The MTs for the chronic lowering of groundwater level sustainability indicator are quantified as groundwater elevations at each RMS well dedicated to groundwater level monitoring (Chapter 4). Table 5-4 lists the SMC at each RMS well. Figures 5-8 and 5-10 provide maps showing MTs at each representative monitoring site for the upper and lower aquifers, respectively.

The function of MTs is to provide a quantitative metric representative of significant and unreasonable effects that GKGSA will use 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 have a plan to mitigate impacts in the event they occur during prolonged drought conditions (which are reflected in the exceedance of MT(s). See Appendix 5A for more details on the process used to develop the SMC for the upper aquifer. 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 their respective SMC are provided in Appendix 5D.

Table 5-4: Chronic Lowering of Groundwater Levels MTs, MOs, and IMs

Representative Monitoring Site ID	GSA	Aquifer Designation	MT (WSE in feet)	MO (WSE in feet)	Operational Flexibility (feet)	IM 2025 (WSE in feet)	IM 2030 (WSE in feet)	IM 2035 (WSE in feet)
KSB-2107	East Kaweah	Single	159	212	53	165	197	207
KSB-2187	East Kaweah	Single	258	291	33	265	282	288
KSB-2196	East Kaweah	Single	222	255	33	229	246	252
KSB-2216	East Kaweah	Single	191	255	64	191	234	248
KSB-2226	East Kaweah	Single	214	285	71	264	278	282
KSB-2281	East Kaweah	Single	325	362	37	325	349	358
KSB-2327	East Kaweah	Single	274	326	53	309	321	325
KSB-2333	East Kaweah	Single	80	168	88	108	148	161
KSB-2342	East Kaweah	Single	69	173	104	101	149	165

Representative Monitoring Site ID	GSA	Aquifer Designation	MT (WSE in feet)	MO (WSE in feet)	Operational Flexibility (feet)	IM 2025 (WSE in feet)	IM 2030 (WSE in feet)	IM 2035 (WSE in feet)
KSB-2344	East Kaweah	Single	54	156	102	92	135	149
KSB-2354	East Kaweah	Single	321	348	27	321	339	345
KSB-2369	East Kaweah	Single	316	387	71	316	363	379
KSB-2405	East Kaweah	Single	77	187	110	120	165	179
KSB-2493	East Kaweah	Single	112	199	87	139	179	192
KSB-2510	East Kaweah	Single	162	201	38	174	192	198
KSB-2513	East Kaweah	Single	338	350	12	338	346	349
KSB-2581	East Kaweah	Single	193	218	26	228	222	220
KSB-2593	East Kaweah	Single	219	246	27	219	237	243
KSB-2612	East Kaweah	Single	147	246	99	165	219	237
KSB-2618	East Kaweah	Single	162	232	71	171	212	226
KSB-2686	East Kaweah	Single	159	250	90	173	224	241
KSB-2696	East Kaweah	Single	336	374	38	348	365	371
KSB-2697	East Kaweah	Single	170	241	71	170	217	233
KSB-2769	East Kaweah	Single	211	290	79	211	264	281
KSB-2773	East Kaweah	Single	336	379	42	358	372	376
KSB-2779	East Kaweah	Single	235	265	30	263	264	264
KSB-2790	East Kaweah	Single	183	276	93	189	247	267
KSB-2794	East Kaweah	Single	341	383	42	366	378	381
KSB-2826	East Kaweah	Single	246	336	90	246	306	326
KSB-2835	East Kaweah	Single	396	420	24	396	412	417
KSB-2895	East Kaweah	Single	363	396	33	363	385	392
KSB-2912	East Kaweah	Single	346	400	55	346	382	394
KSB-2927	East Kaweah	Single	427	444	17	427	438	442
Private LSID Well	East Kaweah	Upper	277	335	57	277	316	329
SCID Office	East Kaweah	Single	250	298	48	269	289	295
GKGSA-01	Greater Kaweah	Lower	-60	-50	10	-60	-53	-51
GKGSA-02	Greater Kaweah	Lower	80	116	36	80	104	112
KSB-0531	Greater Kaweah	Upper	-39	-12	27	78	18	-2
KSB-0550	Greater Kaweah	Upper	-19	16	36	66	33	22
KSB-0616	Greater Kaweah	Upper	39	76	37	86	79	77
KSB-0742	Greater Kaweah	Upper	60	81	21	94	86	83
KSB-0818	Greater Kaweah	Upper	77	92	15	103	96	93
KSB-0856	Greater Kaweah	Upper	81	100	19	90	97	99
KSB-0889	Greater Kaweah	Upper	-4	16	20	37	23	18
KSB-0903	Greater Kaweah	Upper	126	140	14	126	135	138
KSB-0905	Greater Kaweah	Lower	20	58	38	20	45	54
KSB-1161	Greater Kaweah	Upper	129	144	15	149	146	144
KSB-1214	Greater Kaweah	Upper	135	154	18	140	149	152
KSB-1222	Greater Kaweah	Upper	116	131	15	134	132	131
KSB-1428	Greater Kaweah	Upper	45	75	31	65	72	74
KSB-1580	Greater Kaweah	Single	150	158	8	151	156	157
KSB-1775	Greater Kaweah	Single	139	155	17	148	153	155
KSB-1783	Greater Kaweah	Upper	1	25	24	54	35	29

Representative Monitoring Site ID	GSA	Aquifer Designation	MT (WSE in feet)	MO (WSE in feet)	Operational Flexibility (feet)	IM 2025 (WSE in feet)	IM 2030 (WSE in feet)	IM 2035 (WSE in feet)
KSB-1936	Greater Kaweah	Single	155	174	19	163	170	173
KSB-1937	Greater Kaweah	Upper	92	115	23	101	110	113
KSB-2015	Greater Kaweah	Single	133	164	31	172	166	165
KSB-2017	Greater Kaweah	Single	140	168	28	186	174	170
KSB-2021	Greater Kaweah	Single	112	134	22	144	137	135
KSB-2058	Greater Kaweah	Single	228	243	15	228	238	242
KSB-2089	Greater Kaweah	Single	131	156	26	156	156	156
KSB-2095	Greater Kaweah	Single	86	111	25	115	112	111
KSB-2114	Greater Kaweah	Single	80	104	24	106	105	104
KSB-2139	Greater Kaweah	Single	124	150	25	143	148	149
KSB-2147	Greater Kaweah	Single	233	248	15	233	243	246
KSB-2197	Greater Kaweah	Single	113	133	21	121	129	132
KSB-2200	Greater Kaweah	Single	179	199	21	211	203	201
KSB-2203	Greater Kaweah	Single	103	124	21	129	126	125
KSB-2291	Greater Kaweah	Single	244	270	26	244	261	267
KSB-2322	Greater Kaweah	Single	162	181	19	188	184	182
KSB-2411	Greater Kaweah	Single	174	201	27	193	199	200
KSB-2466	Greater Kaweah	Single	356	373	17	356	367	371
KSB-2539	Greater Kaweah	Upper	375	389	13	375	384	387
KSB-2690	Greater Kaweah	Single	381	406	25	381	398	404
KSB-2822	Greater Kaweah	Single	419	435	16	419	429	433
KSB-0922	Mid-Kaweah	Upper	-15	11	26	23	15	13
KSB-0946	Mid-Kaweah	Upper	55	70	14	76	72	70
KSB-0948	Mid-Kaweah	Upper	-9	8	17	49	22	13
KSB-0976	Mid-Kaweah	Upper	-20	5	25	32	14	8
KSB-0994	Mid-Kaweah	Upper	93	104	11	94	101	103
KSB-1071	Mid-Kaweah	Upper	-10	10	20	51	24	15
KSB-1168	Mid-Kaweah	Upper	100	123	23	100	116	121
KSB-1206	Mid-Kaweah	Upper	-35	-4	30	48	13	1
KSB-1226	Mid-Kaweah	Upper	32	53	21	85	64	57
KSB-1320d	Mid-Kaweah	Lower	50	95	45	50	80	90
KSB-1320s	Mid-Kaweah	Upper	30	32	2	69	44	36
KSB-1408d	Mid-Kaweah	Lower	45	145	76	69	120	137
KSB-1408s	Mid-Kaweah	Upper	52	71	19	87	76	73
KSB-1427	Mid-Kaweah	Upper	87	101	14	110	104	102
KSB-1431	Mid-Kaweah	Upper	51	75	24	97	82	77
KSB-1477	Mid-Kaweah	Upper	72	105	32	72	94	101
KSB-1506	Mid-Kaweah	Lower	48	109	61	48	89	102
KSB-1526	Mid-Kaweah	Upper	88	112	24	123	115	113
KSB-1536d	Mid-Kaweah	Lower	43	132	78	54	106	123
KSB-1536s	Mid-Kaweah	Upper	31	55	24	55	55	55
KSB-1545d	Mid-Kaweah	Lower	58	155	80	75	128	146
KSB-1545s	Mid-Kaweah	Upper	42	57	15	69	61	59
KSB-1628	Mid-Kaweah	Upper	7	33	27	47	38	35

Representative Monitoring Site ID	GSA	Aquifer Designation	MT (WSE in feet)	MO (WSE in feet)	Operational Flexibility (feet)	IM 2025 (WSE in feet)	IM 2030 (WSE in feet)	IM 2035 (WSE in feet)
KSB-1695	Mid-Kaweah	Lower	48	112	58	54	93	106
KSB-1696	Mid-Kaweah	Upper	79	94	15	94	94	94
KSB-1699	Mid-Kaweah	Upper	91	110	19	119	113	111
KSB-1770	Mid-Kaweah	Lower	50	155	87	68	126	145
KSB-1884	Mid-Kaweah	Single	146	175	29	183	178	176
KSB-1903	Mid-Kaweah	Upper	101	129	27	106	121	126
KSB-1905	Mid-Kaweah	Upper	96	125	29	123	124	125
KSB-1977	Mid-Kaweah	Single	167	183	16	205	190	185
MKGSA-01	Mid-Kaweah	Lower	20	30	10	20	27	29
MKGSA-02	Mid-Kaweah	Lower	30	39	9	30	36	38
WK-1	Mid-Kaweah	Lower	-70	-26	44	-70	-41	-31

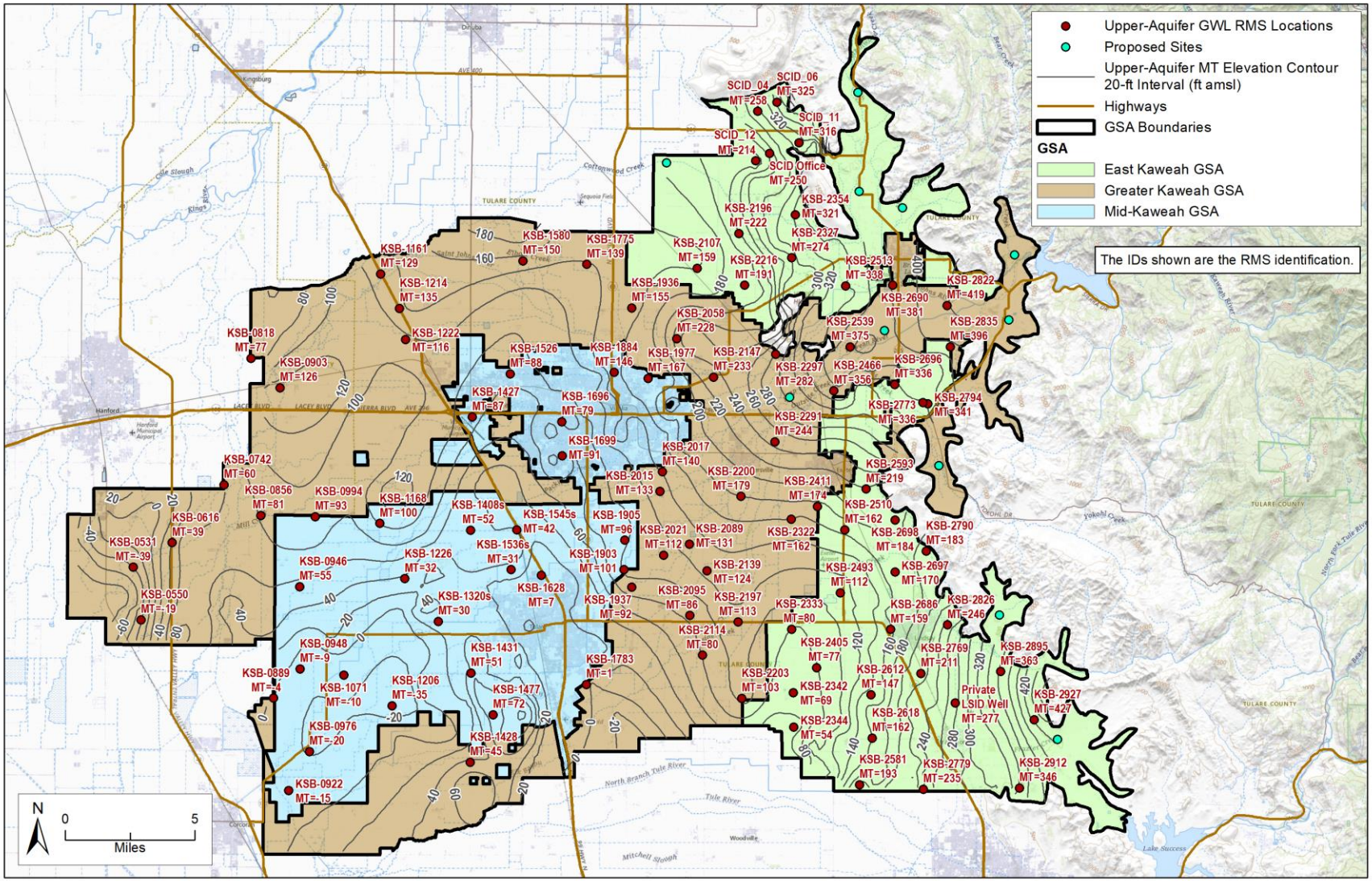


Figure 5-6 Map of Upper Aquifer Groundwater Level MTs

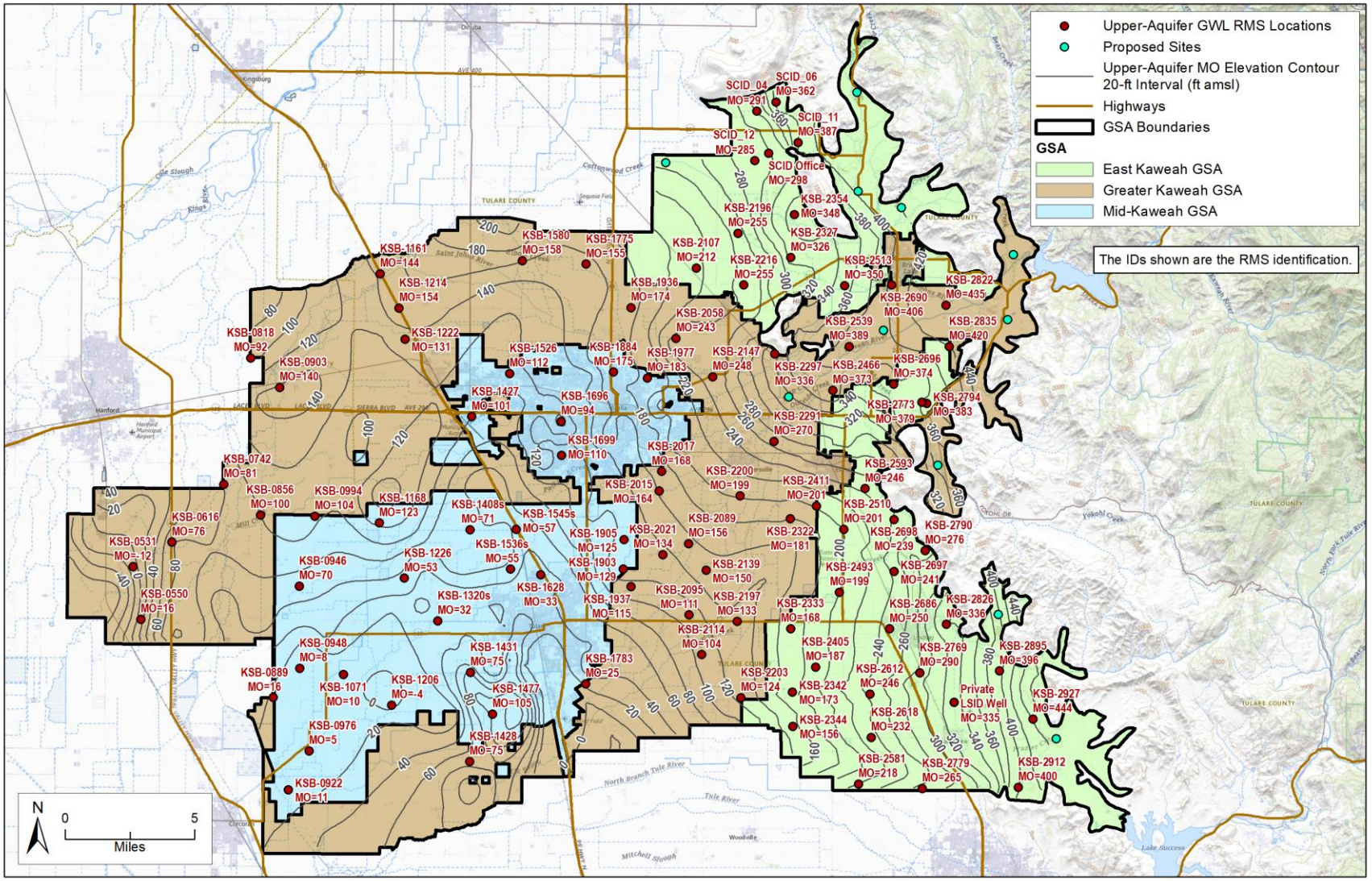


Figure 5-7 Map of Upper Aquifer Groundwater Level MOs

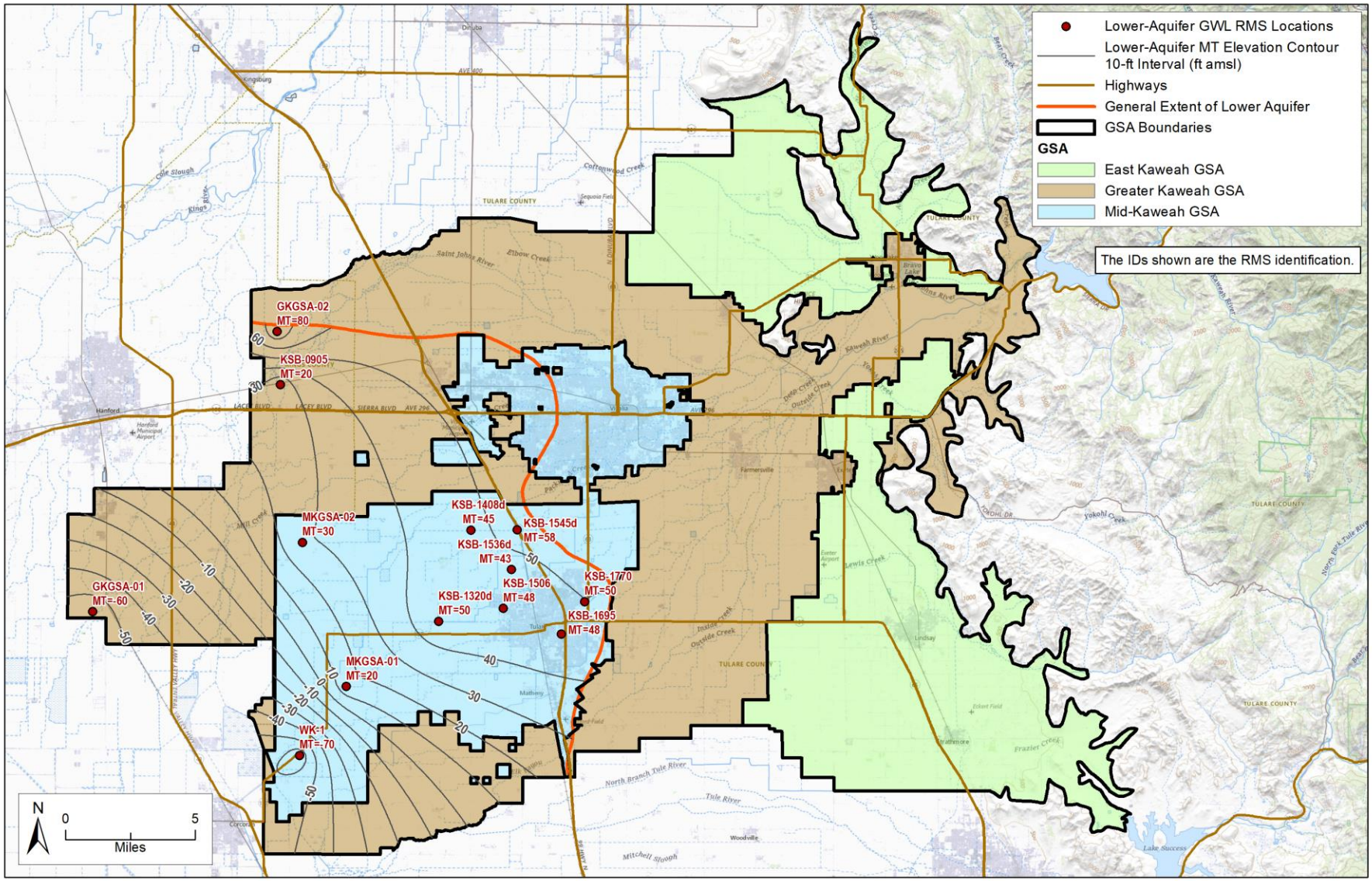


Figure 5-8 Map of Lower Aquifer Groundwater Level MTs

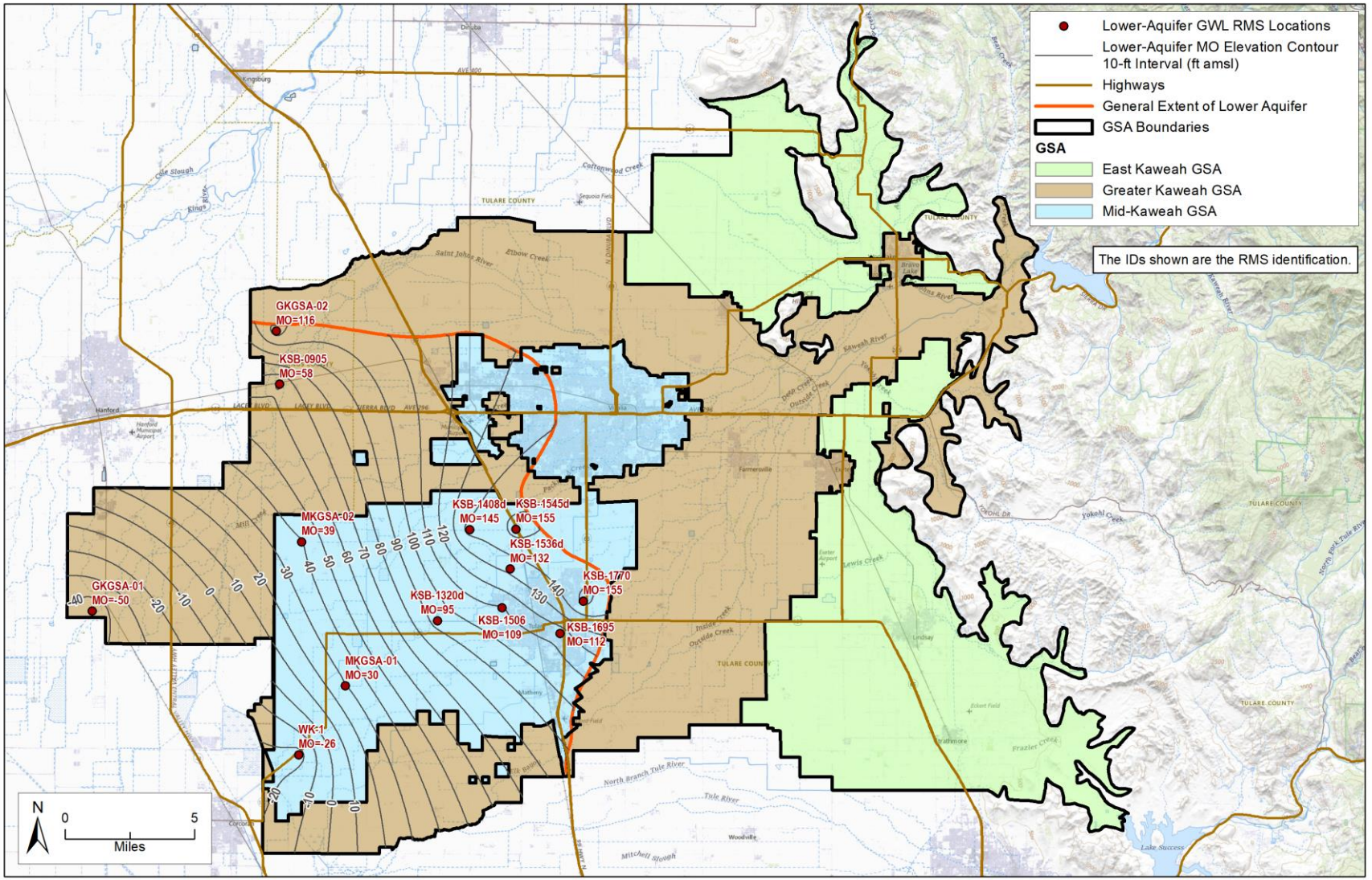


Figure 5-9 Map of Lower Aquifer Groundwater Level MOs

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

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

In the case of groundwater level SMC, 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, and MTs were then proposed and reviewed until agreement and coordination between the GSAs was reached. Ultimately, the ability for 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 level to assign as the MT for the upper aquifer of the Kaweah Subbasin (**APPENDIX 5A**). The lower aquifer MTs are based on the land subsidence SMC (**APPENDIX 5B**) and are listed along with the upper aquifer RMS locations on Table 5-4 and Figure 5-10. As an additional check, the lower aquifer SMC were also evaluated to ensure there were no potential impacts to domestic wells.

Ultimately, the ability for 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 Dry Well Susceptibility Analysis and explained in more detail in Appendix 5A is available in Figure 5-12. 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 in Figure 5-13.

Table 5-5: Stakeholder Coordination Meetings Addressing Groundwater Level SMC Revisions for 2nd Amended GSP (as of May 15, 204)

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 2ND AMENDED GSPS) WERE PRESENTED AND DISCUSSED

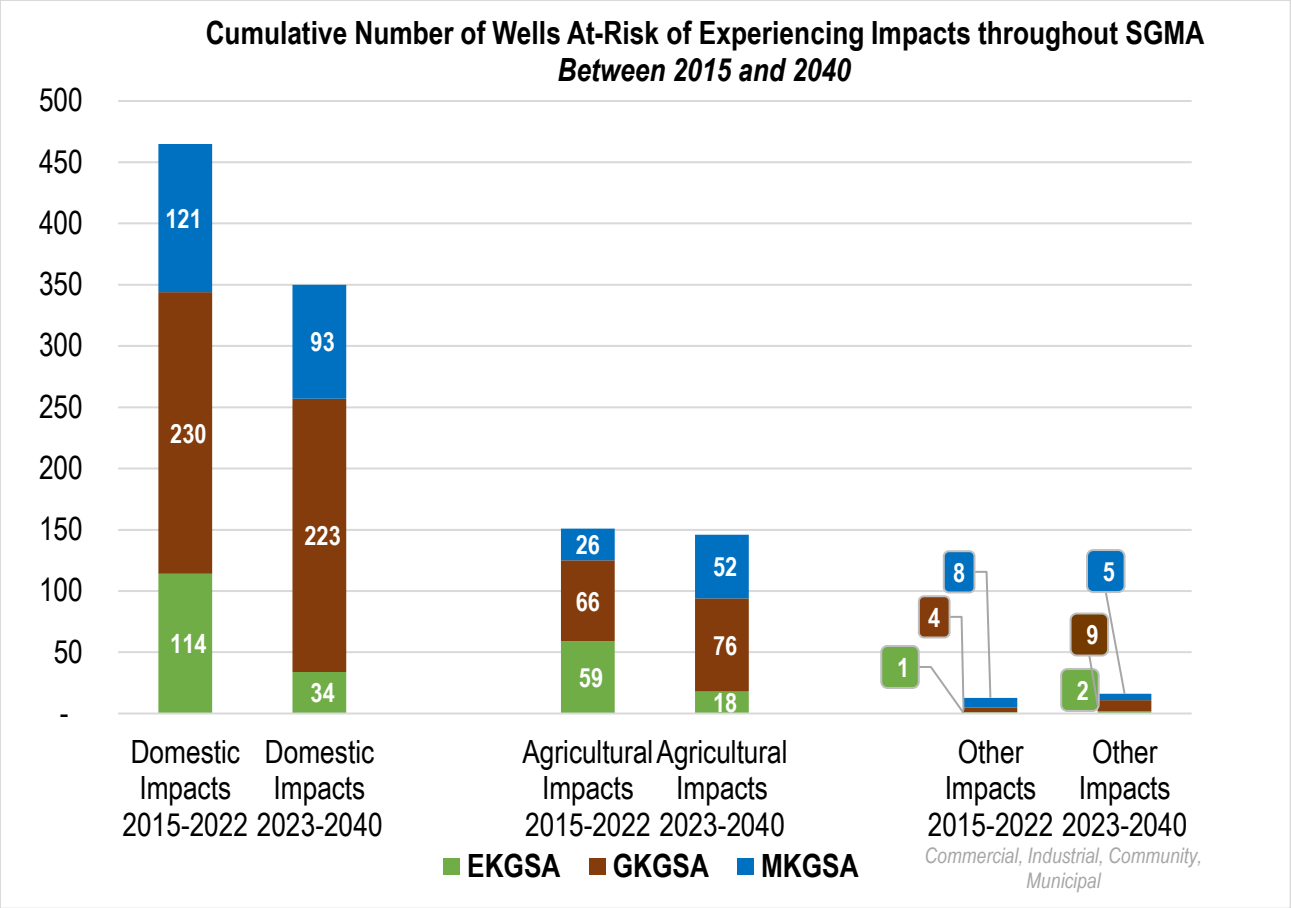


Figure 5-10 Count of Potentially Impacted Wells Based on MT Scenario[8]

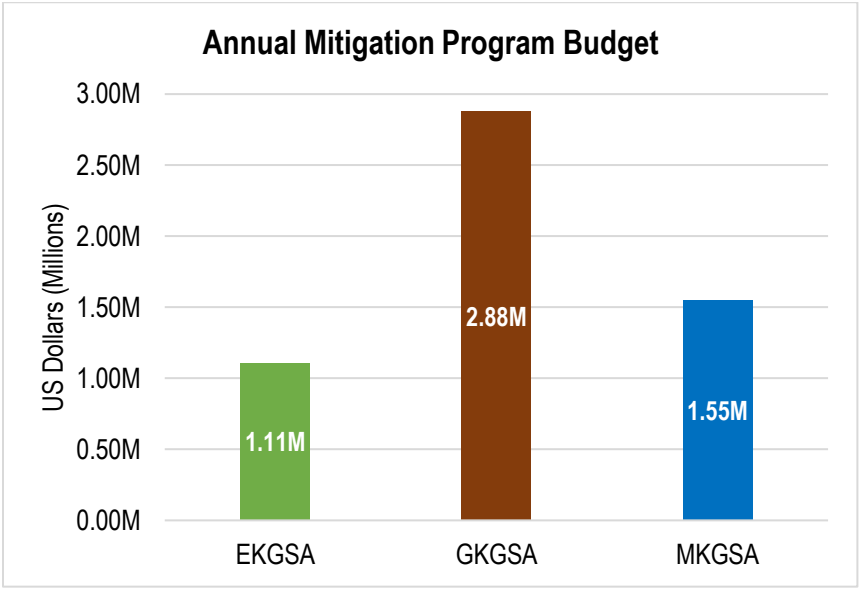


Figure 5-11 Annual Cost to Implement Kaweah Subbasin Mitigation Program

5.5.3.2 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 are reflected in the MTs identified at each RMS site on Figures 5-8 and 5-10.

5.5.3.3 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 (Section 5.6). Therefore, the land subsidence and lower aquifer groundwater level MTs are aligned, and there is no 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 (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 new management action regarding the installation of new dual nested monitoring wells in this area to fill this data gap in Section 6 of the GKGSA GSP. If future investigations suggest 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 minimum thresholds 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

[8] Note: this count of wells assumes all minimum thresholds are exceeded across the Kaweah Subbasin, which theoretically cannot happen due to our definition of Undesirable Results. 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.

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 the eastern regions that have a shallower depth to the base of the aquifer due to the presence of bedrock. This limitation was included in the process of 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 4.1.3). 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 which 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.** In the future, interconnected surface water will be evaluated using a rate of surface water depletion in interconnected channels; however, surface water flow data is limited and is a data gap that the Kaweah Subbasin GSAs are actively working to fill. In the interim, groundwater level data is being collected near potentially interconnected streams in GKGSA and monitored in conjunction with the upper aquifer groundwater level monitoring. The DWR determination letter sent to the Kaweah Subbasin in March 2023 included deficiencies and the Department's recommendations on how to address them. In the case of interconnected surface water, the GSAs were advised to utilize the depletions of interconnected surface water Guidance Document when it becomes available. At this time, the Guidance Document has not been released by DWR. In the interim, groundwater levels are not used as a proxy for establishing SMC for depletions of

interconnected surface water; however, this may be considered in the future pending recommendations from DWR's Guidance Document.

5.5.3.4 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

Three 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 case of the Kaweah Subbasin, the upper aquifer groundwater level MTs and MOs appear generally higher than the neighboring Subbasin in the eastern region of the Kaweah Subbasin. The regular monitoring and review of results for annual reporting will provide more information on whether interbasin policies are needed to avoid impacts to beneficial uses and users of groundwater. Because land subsidence SMC are 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).

Potential effects on beneficial users, uses, and property interests are depicted in Figure 5-4. The beneficial users identified in Figure 5-4 generally occur throughout the subbasin, with domestic wells primarily drilled in the upper aquifer and irrigation wells drilled in both aquifer systems, where the Corcoran Clay extent is present. More information on the causation of impacts and their effects on beneficial users, uses, and property interests is available in Section 5.5.5.3. The MTs for the chronic lowering of groundwater level sustainability indicator seek to prevent significant and unreasonable effects on groundwater supply wells. The GSAs will monitor to ensure the Subbasin is trending towards sustainability as planned, or if further projects and management actions are needed in areas where groundwater level trends are towards the MTs. The key to sustainability in the Kaweah Subbasin is the implementation of groundwater allocation and pumping caps. GSAs intend to actively monitor and allocate groundwater utilization based on achieving sustainability at our MOs. 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 on beneficial users, uses, and property interests could occur in areas where groundwater levels are within the range of operational flexibility (Section 5.5.4.4.. These individual impacts are addressed via the Kaweah Subbasin Mitigation Program and GSA specific Mitigation Plans. Additionally, the land subsidence MTs were explicitly set to prevent significant and unreasonable impacts on groundwater levels.

5.5.3.5 Relevant Federal, State, or Local Standards

There are no federal, state, or local regulations related to groundwater levels outside of SGMA.

5.5.3.6 Method for Quantitative Measurement of Minimum Thresholds

Groundwater level measurements will be assessed annually using the monitoring network described in Section 4, and will be evaluated to determine their relation to 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 geologic conditions in the Subbasin. Groundwater level data will be collected at the RMS sites bi-annually to capture the seasonal high (spring) and seasonal low (fall) water table conditions. This data will be reported to DWR bi-annually via the SGMA Data Portal and reported in the Annual Reports, as has been completed since the submittal of the first GSP in 2020. During Annual Report development, 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.

5.5.4 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 illustrate a reasonable path to achieve the sustainability goal for the Subbasin within 20 years of Plan implementation.

5.5.4.1 Methodology for Setting Measurable Objectives and Interim Milestones

The MOs for the upper aquifer RMS were developed following the establishment of 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 mountainfront (Sierra Nevada foothills). MO was determined to be representative of the Kaweah Subbasin sustainability goal, and reasonable for the Subbasin 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 is prevalent), the spring 2017 groundwater levels were selected as the measurable objectives based on stakeholder feedback and to allow sufficient storage for future drought resiliency. West of this region in the Kaweah Subbasin, the MOS are informed by the projected AARD scenarios from the DWSA. The rate of decline that is 50% the difference between the Fall 2022 and MT groundwater level elevations which is representative of the operational flexibility and minimizes dry well impacts aligned with the qualitative definition of MO, the sustainability goal.

Because the spring 2017 groundwater level surface is much higher in elevation than the MO of the easternmost region, a transition between the surfaces was required for the hydrogeologic plausibility of the measurable objective 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 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 the areas where the aquifer thickness is limited, hindering the ability to maintain groundwater levels at the MO.

The Subbasin numerical groundwater model 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 Figure 5-9. 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 Figure 5-11.

The interim milestones (IMs) represent target groundwater levels at the RMS to demonstrate progress towards the MOs, and are based on incrementally (net) decreasing groundwater level changes over time based on the following:

- 2025 IM– extend the 2014-2022 rate of groundwater level decline (see Section 5.5.3.1) to 2025
- 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 5-14 Groundwater elevations representing MOs for each of the RMS are shown in Table 5-4. Figures 5-15 through 5-17 include an example projected groundwater level hydrographs with the RMS well's SMC for each respective GSA.

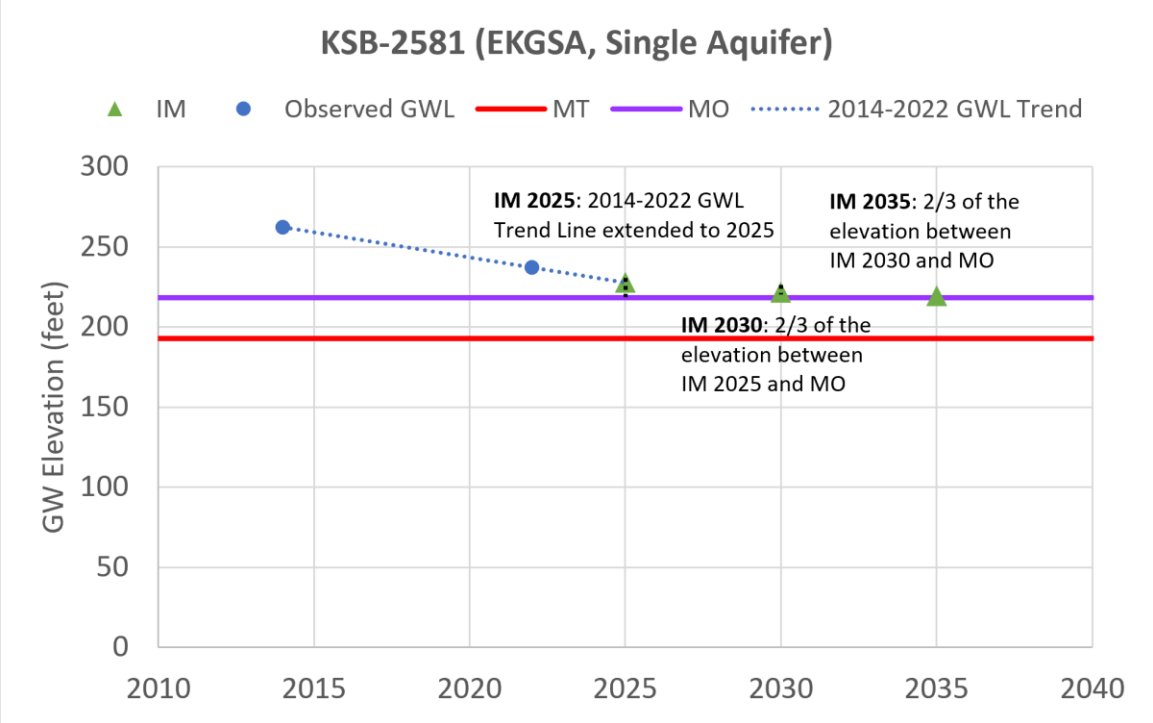


Figure 5-12 Example of IM Method for Groundwater Level SMCs

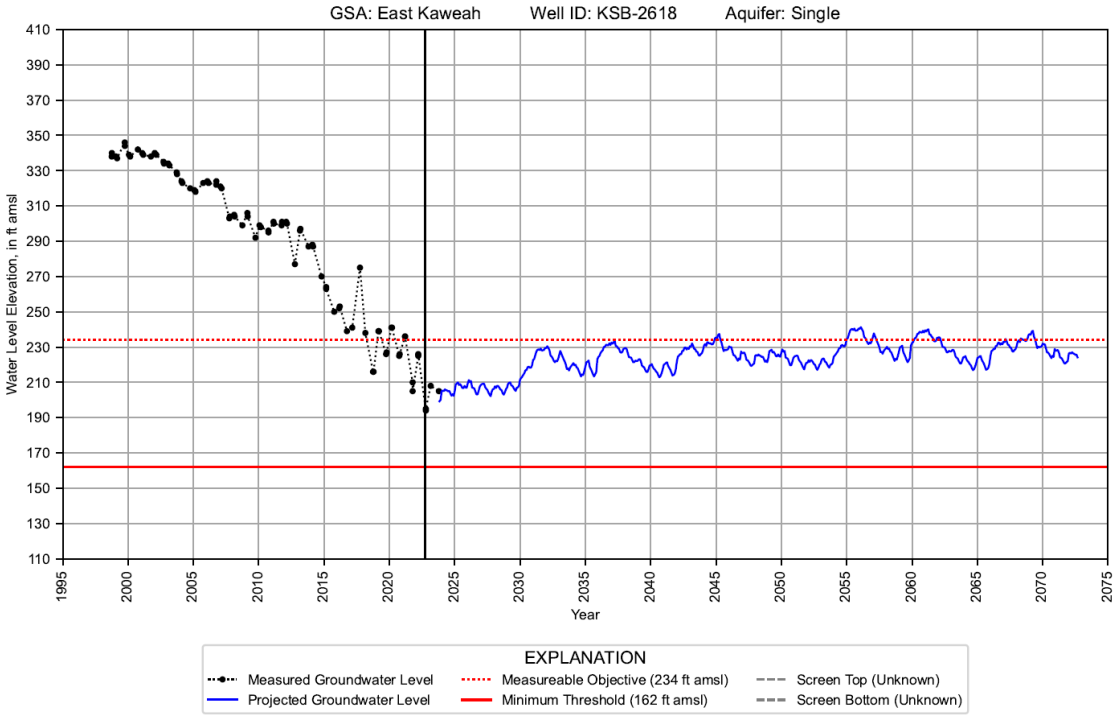


Figure 5-13 Projected RMS Hydrograph with SMC (EKGSA)

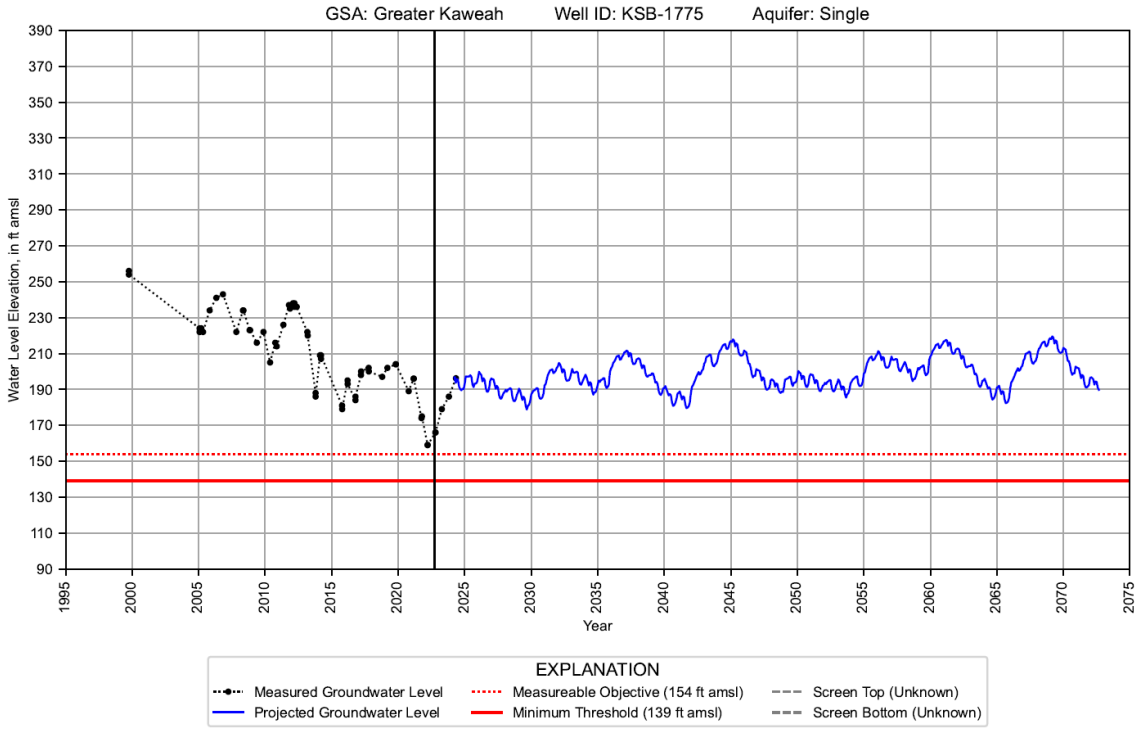


Figure 5-14 Projected RMS Hydrograph with SMC (GKGSA)

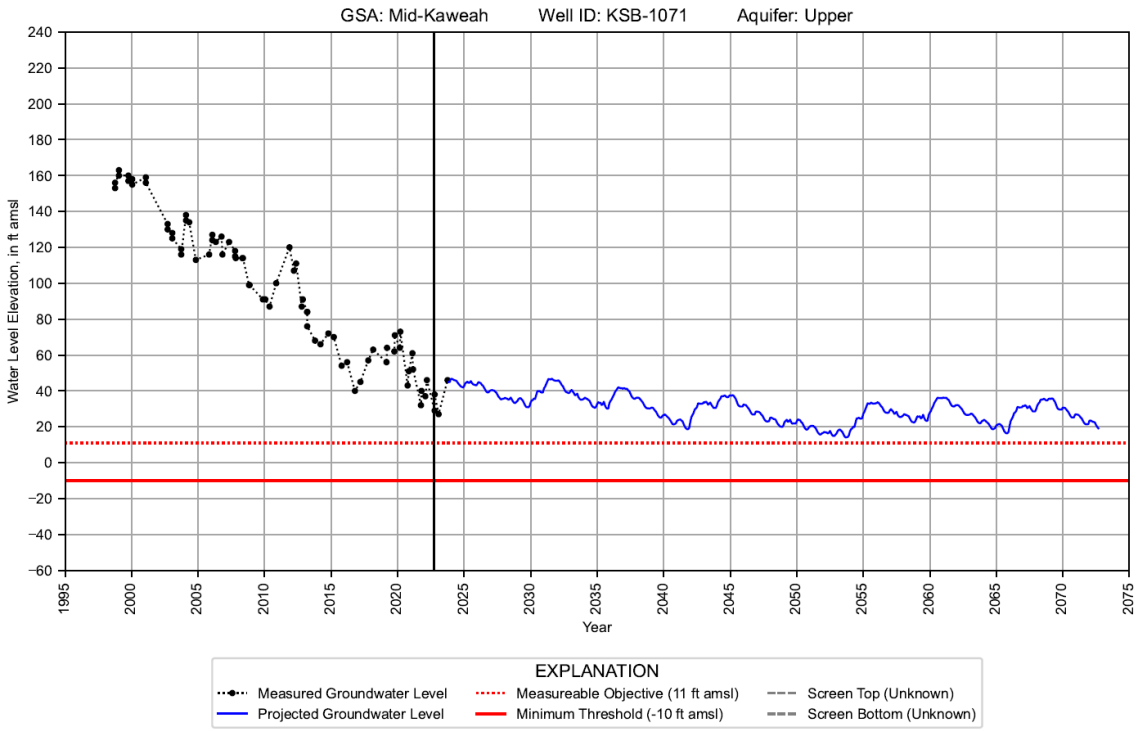


Figure 5-15 Projected RMS Hydrograph with SMC (MKGSA)

More information 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.

5.5.4.2 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; however, much greater operational flexibility is in the easternmost portion of the Kaweah Subbasin, where the aquifer thickness is limited due to the presence of bedrock. Table 5-4 lists the operational flexibility at each RMS.

5.5.5 Future Improvements 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 the SMC for the 2nd Amended GSP has been prioritized to address DWR-identified deficiencies. The potential to meet SMC goals has been informed through a preliminary analysis using an updated and recalibrated Kaweah Subbasin Groundwater Flow Model. The Kaweah Subbasin Groundwater Flow Model has served as a useful tool in updating groundwater budgets and assessing the ability to achieve sustainability in the future with

climactic influences and different operational conditions. Preliminary analysis using the model has shown that the projects and management actions identified in Section 6 will enable the GSAs to meet their sustainability goals. As new data are collected and analyzed, 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 needed to meet SMC, impact attribution analyses, and supplemental impact risk assessments. The timeline to develop, analyze, and engage with stakeholders to establish SMC revisions is highly variable and contingent on receptiveness of approach and results by stakeholders, SWRCB, DWR, and other interested parties. It is important for the Kaweah Subbasin GSAs and Technical Team to remain transparent on the methods and analyses used and the technical basis for all GSP revisions to minimize delays in schedule and continue to build and retain trust with the community and regulatory agencies.

5.6 Land Subsidence SMC [§354.28(c)(5)(A),(c)(5)(B)]

§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.

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 infrastructure
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

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. The land subsidence SMC of all three of the Subbasin's GSPs are coordinated and based on the unified analysis in Appendix 5B.

5.6.1 Land Surface Beneficial Uses and Users[§354.26(b)(3)]

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 from reduced land slope leading to increased risk of flooding	No historical quantifiable impacts. Neighboring subbasins are limiting subsidence based on quantifiable flood mitigation costs.	Tulare County Flood Control District Kaweah Delta WCD Tule Subbasin GSAs Tulare Lake Subbasin GSAs 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

The Kaweah Subbasin GSAs understand the critical, regional importance of the operation of the FKC.

No historical inelastic subsidence has been documented along the portion of the FKC that occurs in the Kaweah Subbasin and no inelastic subsidence or impacts to canal delivery capacity are anticipated in the future.

However, recognizing the regional importance and value of the FKC, the GSAs have developed a Friant-Kern Canal Monitoring and Action Plan (FMAP) (Appendix 6C). The goal of the FMAP is to detect inelastic land subsidence issues early, should they arise, and to have management actions established to prevent further inelastic subsidence.

The FMAP includes the following to avoid impacts:

1. Establishment of a focused monitoring zone located on either side of the FKC.
2. Identification of benchmarks within the monitoring zone for regular monitoring and analysis of InSAR data to monitor land elevation conditions and enable early detection of inelastic subsidence,
3. Establish conditions indicative of inelastic subsidence, and
4. Identify realistic management actions that will be evaluated and implemented to address negative trending conditions that threaten the FKC. Potential actions include:
    a. localized pumping restrictions,
    b. strategic, locational recharge efforts,
    c. importation of surface water to adjacent farm ground, and
    d. strategic, locational land fallowing, to name a few.

5.6.2 Land Subsidence Undesirable Results

As depicted in Figure 5-1, defining beneficial users, significant and unreasonable effects, and URs are 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 looking at 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/Neighboring Subbasins

> *Subsidence of greater than 7 feet may result in significant and unreasonable harm to flood control infrastructure that cannot be mitigated, as established in coordination with neighboring subbasins.*

The neighboring Tule Subbasin has established a maximum subsidence limit of 7 feet, based on the cost of mitigating flood control levees along the Tule River. The Tule Subbasin effectively limits the maximum subsidence in the Kaweah subbasin to 7 feet. Adopting the Tule Subbasin's limit of 7 feet of subsidence along the Tule River ensures subsidence management coordination between the adjoining subbasins.

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 on Table 5- 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 Structures	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 undesirable result is a quantitative combination of subsidence MT exceedances. The primary criteria and metric to determine if land subsidence undesirable results 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 undesirable results is:

An Undesirable Result will occur in the Subbasin if the cumulative subsidence minimum threshold is exceeded at any single RMS location.

An undesirable result 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 undesirable results 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 and remaining 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 GKGSA. The GKGSA intends to pursue a regional subsidence coordination effort as described in Management Action 8: Collaboration with Other Agencies and Interbasin Coordination (Section 6.7.8).

5.6.2.4 Effects on Beneficial Users and Land Uses

Subsidence undesirable results may impact water conveyance, flood control, domestic wells, municipal wells, or potentially other infrastructure. The GSAs have established a Mitigation Program to alleviate subsidence impacts to domestic and small community water system wells as well as critical infrastructure. The GKGSA Well Mitigation Plan Version 1.0, included in Appendix 6B, provides well mitigation for qualifying applicants. In 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.

The Kaweah Subbasin GSAs understand the critical, regional importance of the operation of the FKC. No historical inelastic subsidence has been documented along the portion of the FKC that occurs in the Kaweah Subbasin and no inelastic subsidence or impacts to canal delivery capacity are anticipated in the future. However, recognizing the regional importance and value of the FKC, the GSAs have developed a Friant-Kern Canal Monitoring and Action Plan (FMAP). The goal of the FMAP is to detect inelastic land subsidence issues early, should they arise, and to have management actions established to prevent further inelastic subsidence.The FMAP includes the following to avoid impacts:

5. Establishment of a focused monitoring zone located on either side of the FKC.
6. Identification of benchmarks within the monitoring zone for regular monitoring and analysis of InSAR data to monitor land elevation conditions and enable early detection of inelastic subsidence,
7. Establish conditions indicative of inelastic subsidence, and
8. Identify realistic management actions that will be evaluated and implemented to address negative trending conditions that threaten the FKC. Potential actions include:
    a. localized pumping restrictions,
    b. strategic, locational recharge efforts,
    c. importation of surface water to adjacent farm ground, and

d. strategic, locational land fallowing, to name a few.

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 GKGSA GSP area. The vertical extent of total subsidence is discussed below.

MTs are set at the 28 RMS shown on Figure 5-14. Cumulative MT subsidence values for each of the 44 GKGSA RMS are listed in Table 5-8. These MTs are a subset of the Subbasin-wide MTs developed in Appendix 5B. As explained in Section5.6.3.3, 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 undesirable results occur.

Table 5-8. GKGSA Subsidence Minimum Thresholds

Representative Monitoring Site	Subsidence Minimum Threshold		
	Total (feet)	Action Level (feet)	Rate (feet/year)
36.0878_-119.5028	-6.64	-4.98	-0.42
36.1033_-119.4150	-7.00	-5.25	-0.44
36.1056_-119.4518	-7.00	-5.25	-0.44
36.1303_-119.4196	-7.00	-5.25	-0.44
36.1354_-119.4589	-7.00	-5.25	-0.44
36.1519_-119.2592	-5.72	-4.29	-0.36
36.1537_-119.3043	-6.03	-4.52	-0.38
36.1920_-119.2811	-5.89	-4.42	-0.37
36.2272_-119.5781	-7.00	-5.25	-0.44
36.2611_-119.6612	-7.00	-5.25	-0.44
36.2950_-119.4810	-6.80	-5.10	-0.43
36.3047_-119.5360	-5.27	-3.95	-0.33
36.3224_-119.4399	-4.91	-3.68	-0.31
36.3499_-119.4450	-3.88	-2.91	-0.24
36.3570_-119.4864	-4.45	-3.34	-0.28
36.3940_-119.4880	-2.92	-2.19	-0.18
36.4143_-119.4149	-2.08	-1.56	-0.13
DH6686	-1.26	-0.95	-0.13
DH6739	-5.09	-3.82	-0.32
GKGSA-1 (GK-1)	-7.00	-5.25	-0.44

Representative Monitoring Site	Subsidence Minimum Threshold		
	Total (feet)	Action Level (feet)	Rate (feet/year)
GKGSA-2 (GK-2)	-3.40	-2.55	-0.21
K001	-0.10	-0.08	-0.13
K003	-0.66	-0.50	-0.13
K012	-7.00	-5.25	-0.44
K015	-1.89	-1.42	-0.13
K015X	-2.91	-2.18	-0.18
K016	-3.13	-2.35	-0.20
K1081	-0.10	-0.08	-0.13
Kaweah River Check	-0.10	-0.08	-0.13
KSB-0531	-7.00	-5.25	-0.44
KSB-0550	-7.00	-5.25	-0.44
KSB-0856	-6.81	-5.11	-0.43
KSB-0905	-3.68	-2.76	-0.23
KSB-1259	-5.97	-4.48	-0.37
KSB-1535	-6.47	-4.85	-0.40
KSB-1580	-2.03	-1.52	-0.13
KSB-2017	-2.00	-1.50	-0.13
KSB-2058	-0.56	-0.42	-0.13
KSB-2095	-5.13	-3.85	-0.32
KSB-2114	-6.14	-4.61	-0.38

Representative Monitoring Site	Subsidence Minimum Threshold		
	Total (feet)	Action Level (feet)	Rate (feet/year)
KSB-2203	-4.64	-3.48	-0.29
P566	-0.50	-0.38	-0.13
S228	-7.00	-5.25	-0.44

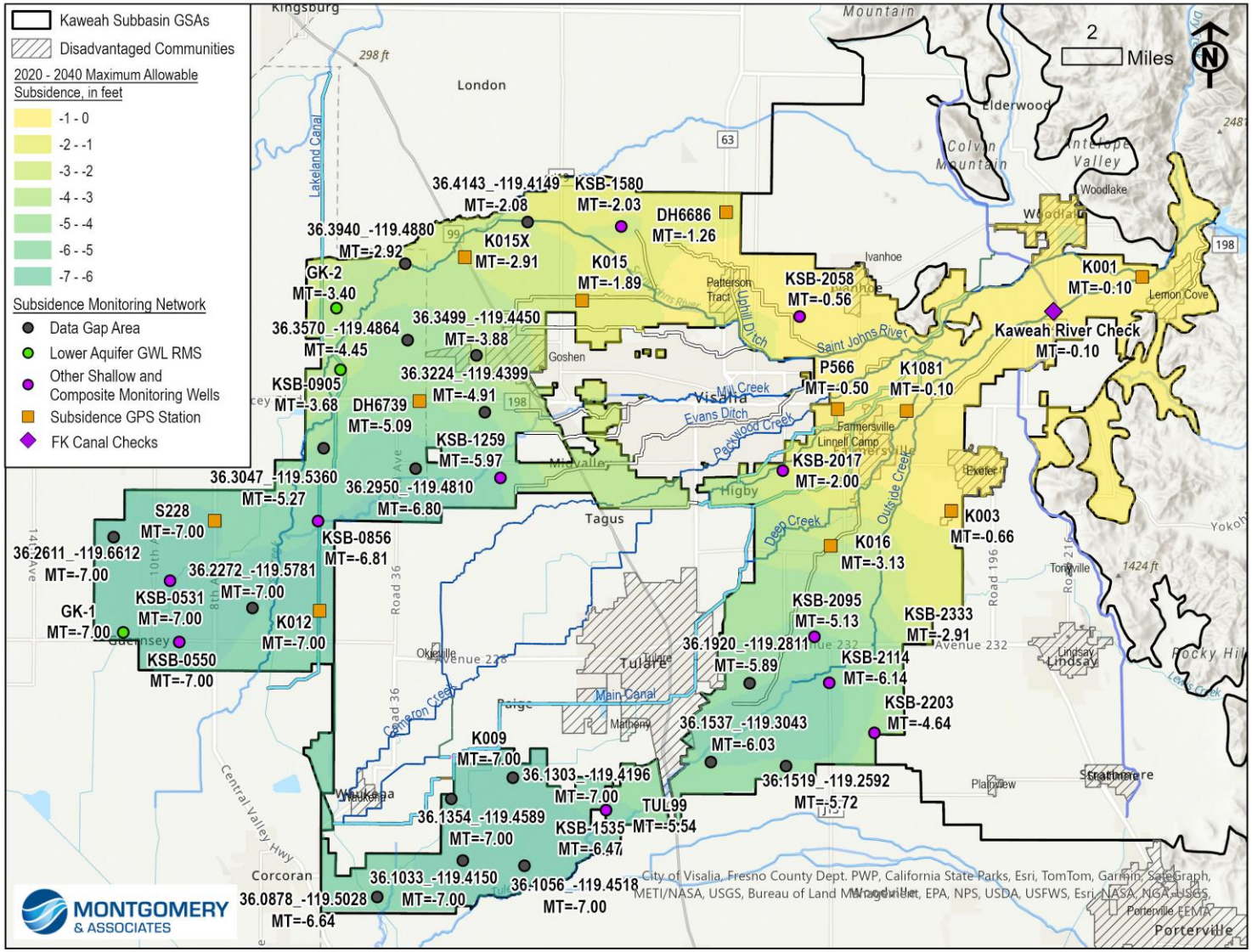


Figure 5-14. GKGSA Subsidence Minimum Thresholds

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

The general process to develop the subsidence SMC is shown in Figure 5-15. The various steps on Figure 5-15 are described in more detail in Appendix 5B.

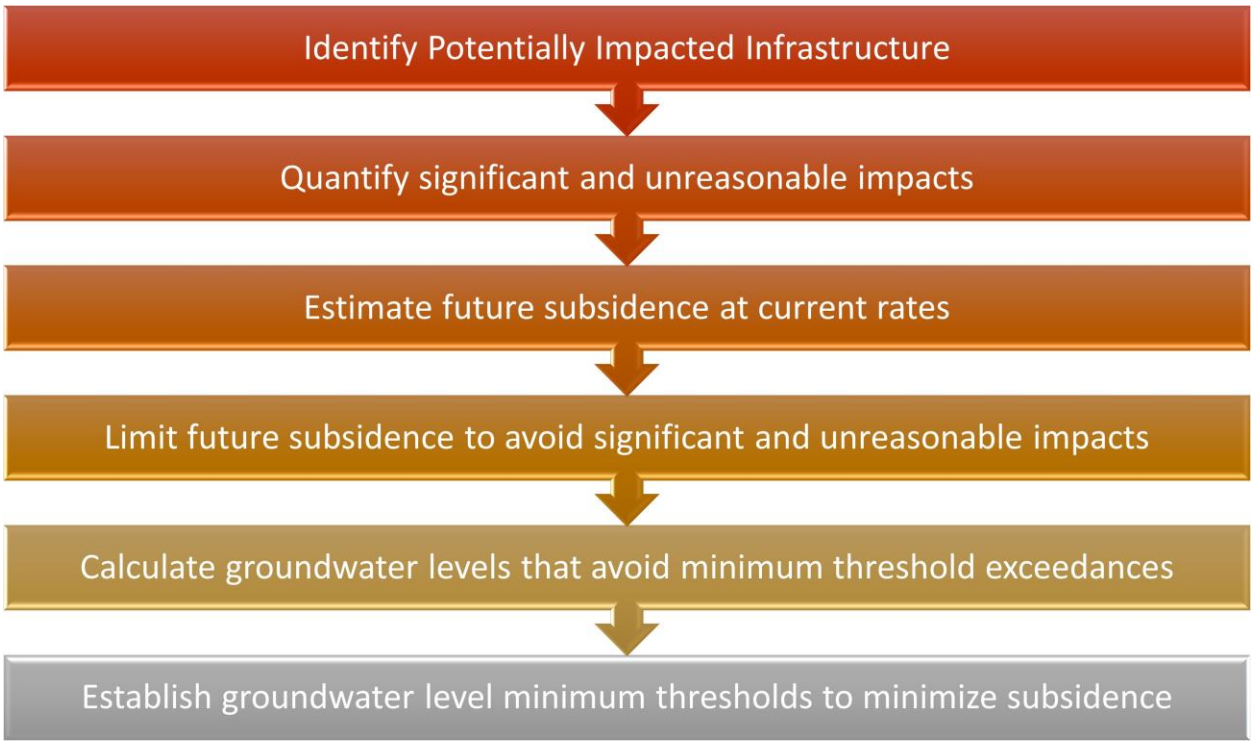


Figure 5-15. Process for Developing Land Subsidence SMC

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 5-16 shows the maximum allowable land subsidence in the GKGSA area on which the subsidence MTs area based and includes a histogram showing MT distribution across the GSP area. Subsidence MTs are different at every point in the GSP area and never exceed the significant and unreasonable levels for infrastructure discussed in Section 5.6.2.2.

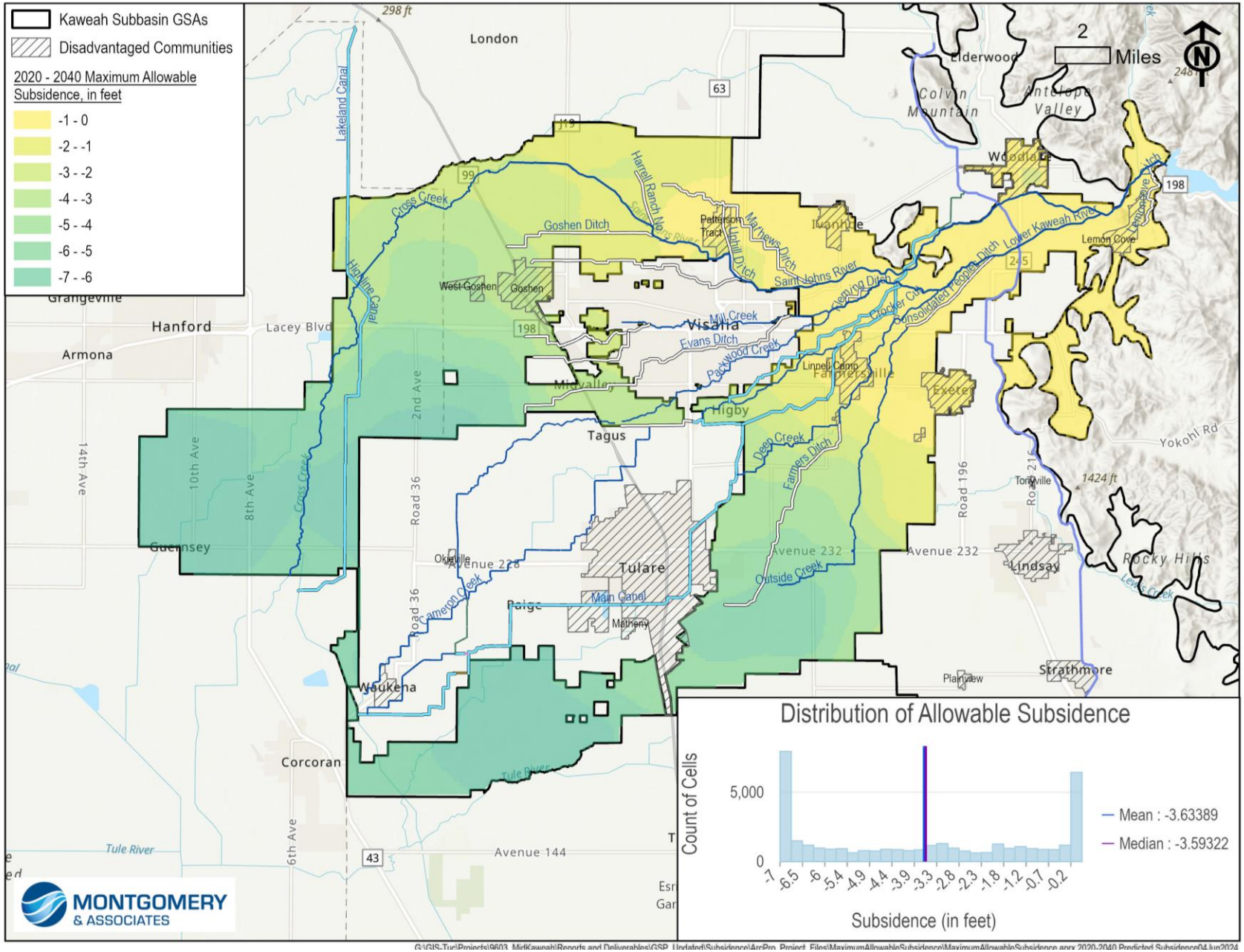


Figure 5-16. GKGSA Subsidence Minimum Threshold (Maximum Allowable Subsidence) and Histogram

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 GKGSA 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 undesirable results. Therefore, subsidence will not continue unabated. If subsidence continues at the MT rate, it will eventually exceed the MT extent, producing an undesirable result.

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 GKGSA.

The subsidence minimum threshold 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. It is not anticipated that land subsidence will 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 interconnected surface water.

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- compares the Kaweah Subbasin MTs with those of surrounding subbasins and GSAs. On this figure, darker green colors indicate more allowable subsidence. Figure 5- 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 collaborationwith 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.

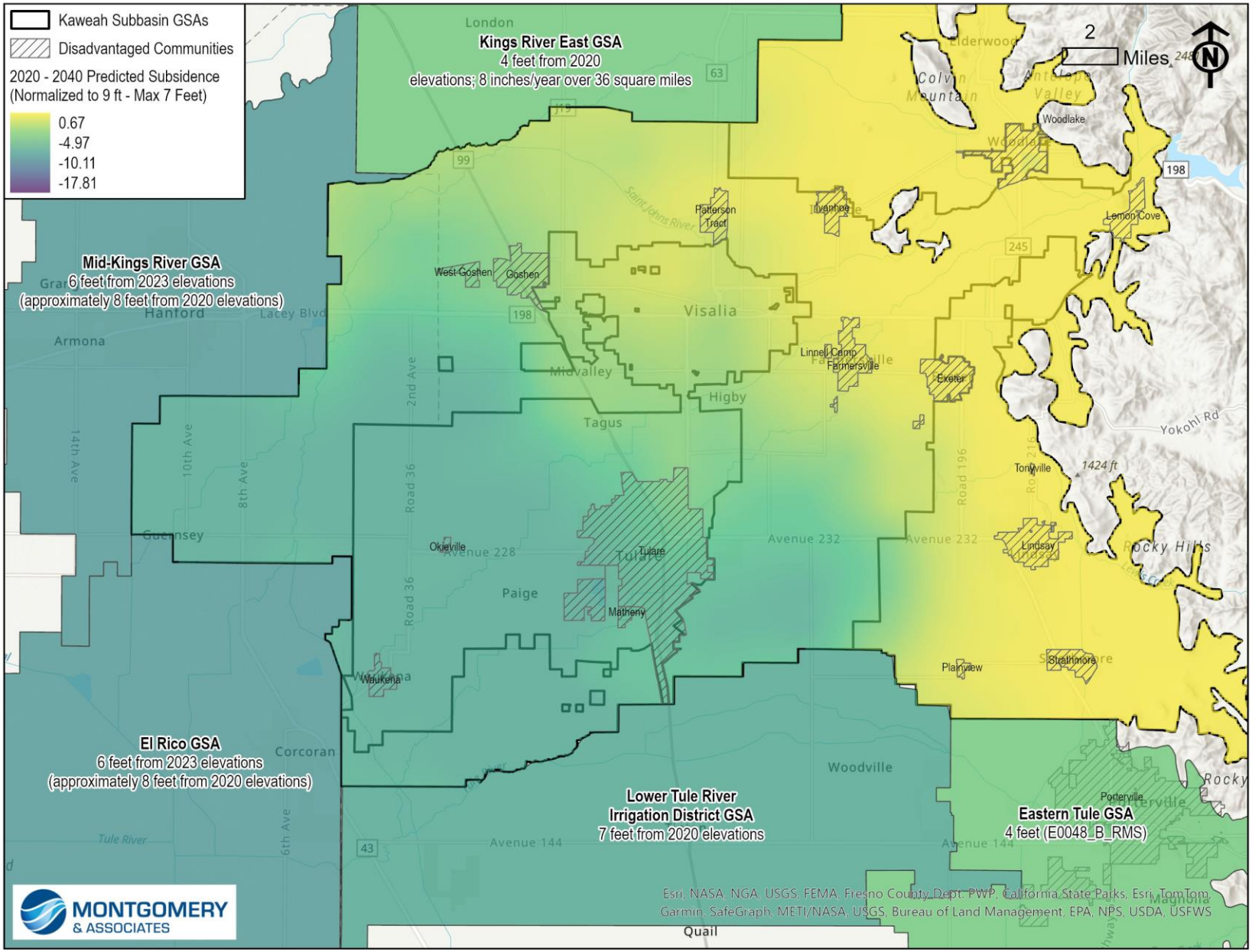


Figure 5-17. Kaweah Subbasin Subsidence Minimum Thresholds Compared to Surrounding Subbasins and GSAs

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 undesirable result. The GSAs have a unified Mitigation Program, and each GSA has its individual Mitigation Plan to lessen subsidence impacts to domestic and small community water system wells should subsidence impacts occur. The Mitigation Program is included as Appendix 6A.

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 GKGSA will assess subsidence annually using the subsidence monitoring network shown on Figure 5-4 and listed in Table 5-9.

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 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 GKGSA is implementing projects and management actions on an accelerated basis to reduce the subsidence 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 1/2 the average annual subsidence rate that achieves the subsidence MT.

5.6.4.2 Measurable Objectives

Measurable objectives for each of the 44 subsidence RMS are set to zero**.**

5.6.4.3 Interim Milestones

IMs for all 44 subsidence RMS are listed in Table 5-18.

Table 5-18 GKGSA Subsidence Interim Milestones

Representative Monitoring Site	Interim Milestone Subsidence Rate (feet/year)		
	IM 2025	IM 2030	IM 2035
36.0878_-119.5028	-0.42	-0.33	-0.17
36.1033_-119.4150	-0.44	-0.35	-0.18
36.1056_-119.4518	-0.44	-0.35	-0.18
36.1303_-119.4196	-0.44	-0.35	-0.18
36.1354_-119.4589	-0.44	-0.35	-0.18
36.1519_-119.2592	-0.36	-0.29	-0.14
36.1537_-119.3043	-0.38	-0.30	-0.15
36.1920_-119.2811	-0.37	-0.29	-0.15
36.2272_-119.5781	-0.44	-0.35	-0.18
36.2611_-119.6612	-0.44	-0.35	-0.18
36.2950_-119.4810	-0.43	-0.34	-0.17
36.3047_-119.5360	-0.33	-0.26	-0.13
36.3224_-119.4399	-0.31	-0.25	-0.12
36.3499_-119.4450	-0.24	-0.19	-0.10
36.3570_-119.4864	-0.28	-0.22	-0.11

Representative Monitoring Site	Interim Milestone Subsidence Rate (feet/year)		
	IM 2025	IM 2030	IM 2035
36.3940_-119.4880	-0.18	-0.15	-0.10
36.4143_-119.4149	-0.13	-0.10	-0.10
DH6686	-0.13	-0.10	-0.10
DH6739	-0.32	-0.25	-0.13
GKGSA-1 (GK-1)	-0.44	-0.35	-0.18
GKGSA-2 (GK-2)	-0.21	-0.17	-0.10
K001	-0.13	-0.10	-0.10
K003	-0.13	-0.10	-0.10
K012	-0.44	-0.35	-0.18
K015	-0.13	-0.10	-0.10
K015X	-0.18	-0.15	-0.10
K016	-0.20	-0.16	-0.10
K1081	-0.13	-0.10	-0.10
Kaweah River Check	-0.13	-0.10	-0.10
KSB-0531	-0.44	-0.35	-0.18
KSB-0550	-0.44	-0.35	-0.18
KSB-0856	-0.43	-0.34	-0.17
KSB-0905	-0.23	-0.18	-0.10
KSB-1259	-0.37	-0.30	-0.15
KSB-1535	-0.40	-0.32	-0.16
KSB-1580	-0.13	-0.10	-0.10
KSB-2017	-0.13	-0.10	-0.10
KSB-2058	-0.13	-0.10	-0.10
KSB-2095	-0.32	-0.26	-0.13
KSB-2114	-0.38	-0.31	-0.15
KSB-2203	-0.29	-0.23	-0.12
P566	-0.13	-0.10	-0.10
S228	-0.44	-0.35	-0.18

5.7 Reduction of Groundwater Storage

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 undesirable results 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 undesirable results is reduction of groundwater storage that will likely cause other sustainability indicators to have undesirable results.

The criteria used to define undesirable results for the reduction of groundwater storage sustainability indicator are based on the qualitative description of undesirable results, which is causing other sustainability indicators to have undesirable results. As explained in Section 5.7.2, groundwater levels will be used as a proxy for the reduction of groundwater storage sustainability indicator minimum thresholds. Based on the foregoing, the combination of minimum threshold exceedances that is deemed to cause significant and unreasonable effects leading to undesirable results in the Basin for the reduction of groundwater storage sustainability indicator is the same as the combination deemed to cause undesirable results for the chronic lowering of groundwater levels sustainability indicator (Table 5.4).

5.7.2 Reduction of Groundwater Storage Minimum Thresholds [§354.28(d)]

§ 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), as described in Appendix 5G. 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 model is used to estimate groundwater in storage for the Basin (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) will be used as a proxy for the reduction of groundwater storage sustainability indicator.

Henceforth, the GSP Emergency Regulations under §354.28 for the reduction of groundwater storage sustainability indicator are described in the chronic lowering of groundwater levels section above (Section 5.5.3).

5.8 Degraded Groundwater Quality SMC [§354.28(c)(4)]

§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 Kaweah Subbasin's strategy is to manage groundwater quality, through the implementation of management actions and projects, to the MOs to achieve the sustainability goal. The priorities to establish the SMC in the Kaweah Subbasin are shown in 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 Central Valley-Salinity Alternatives for Long-Term Sustainability (CV-SALTS), Dairy Program and Irrigated Lands Regulatory Program (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 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. All are listed in Table 5-10 below.

Table 5-10. Beneficial Users and Uses Pertaining 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.

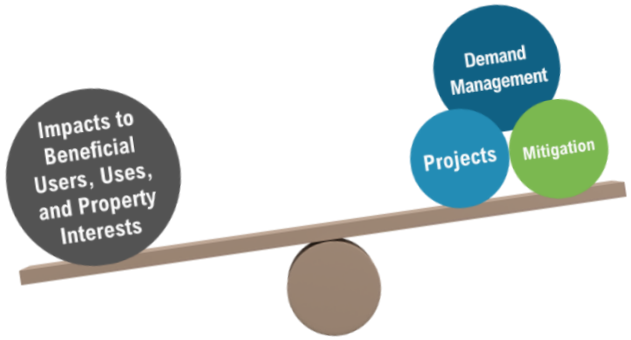
(2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause signed effects in the 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 undesirable result (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 Undesirable Result "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 impacted[9] 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 minimum threshold (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 available below in Table 5-11.

Table 5-11. Basis for Groundwater Quality UR#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.

[9] 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.

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), 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 undesirable results.

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 Kaweah Subbasin's "Small Community Proactive and Protective Action Plan." This management action is detailed in the Kaweah Subbasin GSP's Chapter 6 – Projects and Management Actions. 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 Kaweah 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 o 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(b)(1),(2),(3)]

§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 5-12. 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 the science and health risks

associated with COCs can change over time, therefore the GSAs intends 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 Kaweah Subbasin[10]. 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 a numeric water quality objectives for the protection of the AGR use may be adopted in the future.

The degraded groundwater quality MTs for each COC identified for the Kaweah Subbasin are listed in Table 5-12. 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.

The MTs for groundwater quality are listed in Table 5-12.

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 Kaweah Subbasin. For more information on the Exceedance Policy, see Section 5.8.3.1.

[10] 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

Table 5-12. 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)	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

[[1]Constituent 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 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 commence. The desktop study (described below) will

review historical data within an approximate 1.5 mile-radius[11] 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 causation 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 in Figure 5-19.

[11] 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.

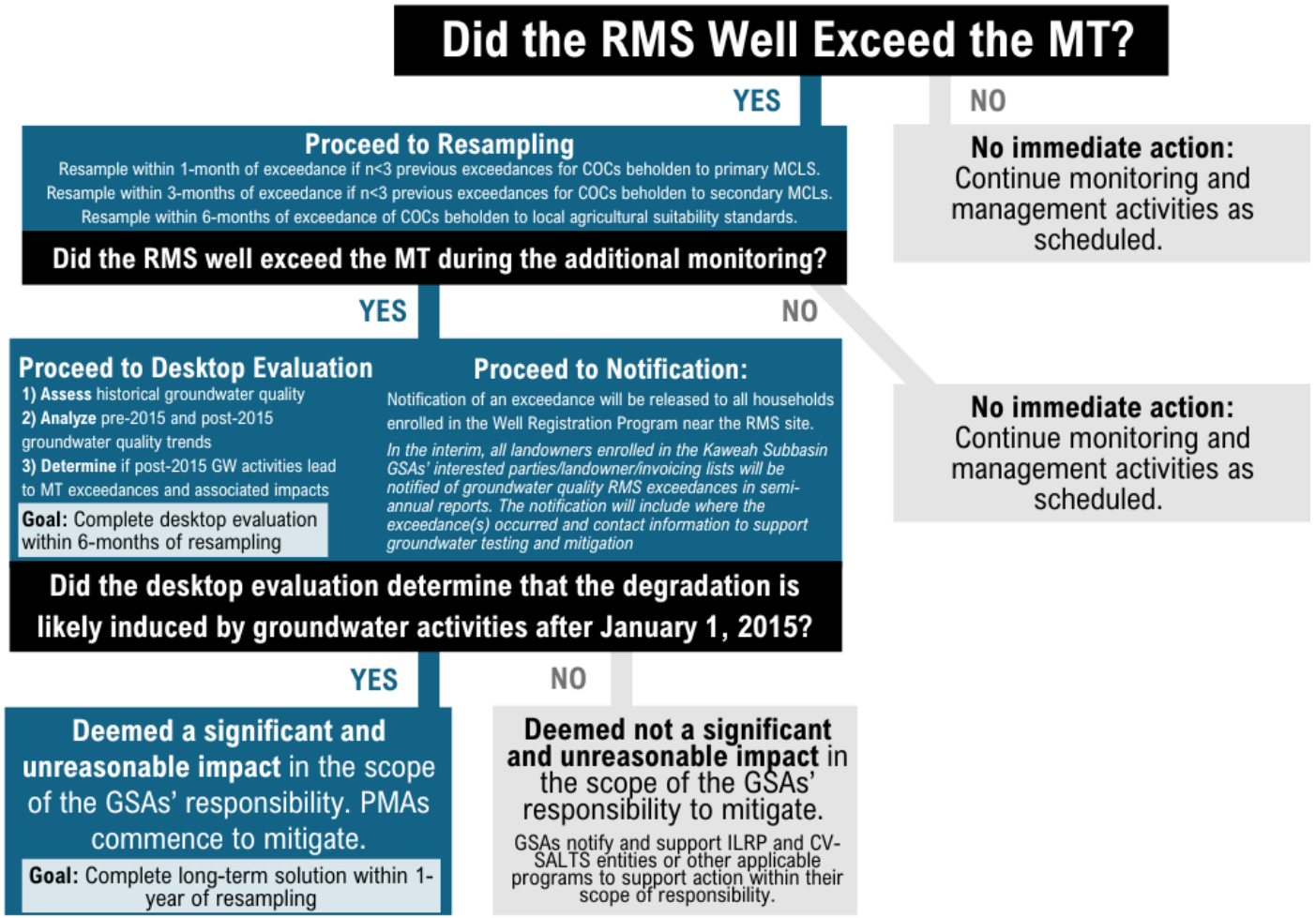


Figure 5-19 Groundwater Quality Exceedance Policy

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® 3-dimensional 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 performed by a qualified technician. An example schematic of a site conceptual model for nitrate, indicating common sources, is available in Figure 3-7 in 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 on 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 by April 1st every year.

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 by are not limited to:

- 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.

- Initiation 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.
- Mitigation by providing water treatment systems.

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 acknowledges and incorporates the designated beneficial uses listed in the Basin Plan and adopted amendments and the MTs are listed in Table 5-12. 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 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[12]. Total dissolved solids and specifically chloride

[12] 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

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 5-12. 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 for Each Sustainability Indicator

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, there exists the potential for increased concentration 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 minimum threshold 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 in Table 5-12. 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 minimum thresholds 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 water quality for evaluation against minimum thresholds is described in Section 4.6.

5.8.4 Measurable Objectives and Interim Milestones [§354.30(a)(b)(c)(d)(e)(f)(g)]

§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 measurable objectives (MOs) and interim milestones (IMs) are consistent with the MTs (Table 5-12). 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 Kaweah Subbasin is to partner and support these complementary programs, while relying on their groundwater quality expertise to guide establishment of groundwater quality standards.

5.9 Depletion of Interconnected Surface Water SMC [§354.28(C)(6)(A), (6)(B)]

§354.28 Minimum Thresholds.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(6)Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:

(A) The location, quantity, and timing of depletions of interconnected surface water.

(B) A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph.

Important Context for ISW:

The Kaweah Subbasin recognizes the limitations that data gaps present for establishing SMC for depletions of ISW. Until these data gaps are resolved via the Interconnected Surface Water Data Gap Workplan (**Section 6.7.12**), the best data, information, will continue to be used to evaluate depletions of interconnected surface water.

Appendix 3D presents a framework for establishing SMCs, with significant progress in terms of identifying beneficial uses/users, evaluating historical impacts, and developing a dedicated ISW RMS network. Preliminary MTs are proposed for a segment of the Kaweah River where we have data. We need a) the data, b) the refined model, c) DWR guidance, and d) additional stakeholder engagement to understand flow requirements for all beneficial users before we can establish basin-wide

This section provides the steps and considerations when establishing location-specific SMC for depletions of interconnected surface water. Surface water data and shallow groundwater level data are considered a data gap in and nearby significant portions of the Kaweah Subbasin's potentially interconnected reaches of surface waterbodies. Therefore, interim SMC are established for the Kaweah Subbasin GSAs using the best available data, information, and technology.

Plans to fill data gaps are inventoried in Section 4.9 as well as Appendix 3D. As these data gaps are resolved, the GSAs will update SMC consistently with the best available data, information, and technology.

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 and avoid significant and unreasonable impacts to all beneficial users, uses, land uses, and property interests. However, the occurrence of one or more URs within the initial 20-year implementation period does not, by itself, indicate that the Subbasin is not being managed sustainably.

The guiding principles to establish the SMC in the Kaweah Subbasin are shown in Figure 5-5 and the stepwise approach to establish these SMC is shown in Figure 5-1. The guiding principles and approach are consistent for the establishment of SMC for all sustainability indicators in the Subbasin.

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 5-13. 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. Note, that there can be overlap between groundwater dependent ecosystems (GDEs) and riparian phreatophytes that depend on recharge from surface water to the shallow subsurface. The Kaweah Subbasin GSAs have used the best available data and tools to identify and characterize all relevant beneficial uses and users as described in the following sections.

Table 5-13. 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 **This includes Phreatophytes within in-stream habitats.*	Groundwater Dependent Ecosystems (GDE)
Riparian Habitat & Ecosystems **This includes Phreatophytes within riparian habitats.*	Groundwater Well Users **This includes domestic/small-community, agricultural, municipal, industrial/commercial,*
Surface Water Rights Holders	
Recreational Users[1]	

[1]Although 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 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 3D shows the location of NCCAG in the Subbasin. The spatial distribution shows that almost all NCCAG primarily coincide 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 located in areas with DTW 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 apparent errors in the NCCAG dataset that are confirmed to not be GDEs, but rather forms of infrastructure, such as a recharge basin near Strathmore that is incorrectly shown as a GDE. Figure 3-4 of Appendix 3D includes a screenshot of this TNC-identified potential GDE being a man-made basin. The Kaweah Subbasin is working to refine the NCCAG dataset to correct for such spatial and attribute errors to 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 ft DTW was considered a primary ISW beneficial user. Vegetation in the 50 – 100 ft DTW were 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 3D) it would be very challenging to assess depletion impacts on this vegetation.

NCCAG in the western areas with Spring 2017 DTW deeper than 100 ft 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, again owing to the deep water table in the area. Vegetation along the stream channel in these areas primarily depend 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 3D), depletions from upstream ISW are likely to have minimal impacts on these habitats. As such, NCCAG in areas with greater than 100 ft DTW were not considered as ISW beneficial users.

Multiple data sources were 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, TNC's rooting depth database, the US Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) web tool, and the California Department of Fish and Wildlife's (CDFW) California Natural Diversity Database (CNDDB).

The NCCAG vegetation and VegCamp data layers are shown in Figure 3-5 and 3-6 of Appendix 3D, 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 ft in TNC's rooting depth database.

The results from USFWS IPaC shown in Table 3-2 of Appendix 3D 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 3D. Table 3-2 of Appendix 3D have designated critical habitat that overlaps the AOI, as shown in Figure 3-7 of Appendix 3D. 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 DTW data gaps in the eastern foothills including Cottonwood Creek, Dry Creek, Yokohl Creek, and parts of Lewis Creek.

CDFW's CNDDB dataset contains siting locations and dates of protected plant and species, termed "elements" in the database. Figures 3-8 and 3-9 of Appendix 3D 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 3D, and Figures 3-12 and 3-13 of Appendix 3D show the same locations and time periods as Figure 3-8 and 3-9 of Appendix 3D, here classified by California and federal protected status. Based on the CDFW CNDDB dataset, most sighting occurrences of endangered, threatened, or rare species are not in areas with potential ISW within the Kaweah 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[13]. 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 FKC, and networks of pipelines and canals operated by the various irrigation districts within the Kaweah Subbasin. These are mapped in Figure 3-14 of Appendix D. Riparian water rights are also present; however, data available for riparian diversions is limited 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.

5.9.1.4 Stakeholder Engagement

The stakeholders associated with the beneficial uses of interconnected surface water were engaged in meetings documented in Table 5-14. This engagement and subsequent feedback was a critical element to the SMC establishment process.

Table 5-14. 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

[13]ISW Core Team Correspondence with Point of Contact Y. Franco, Wukchumni Tribe on September 9, 2024, September 13, 2024, and September 18, 2024.

Meeting or Workshop	Date	Attendees
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
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

5.9.2 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.

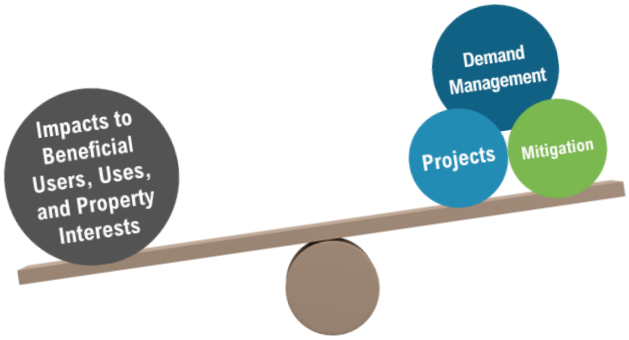
(b) The description of undesirable results shall include the following:

(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.

An UR includes quantitative metrics and qualitative descriptions of significant and unreasonable impacts for each sustainability indicator. The Kaweah Subbasin has broadly defined significant and unreasonable effects for all sustainability indicators 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.

5.9.2.1 Potential Effects on Beneficial Users, Uses and Land Uses

ISW Depletions from pumping can lead to reductions in surface flows, that in turn, may reduce water availability for beneficial use and users. Hence, impacts from depletions are manifest during low flow conditions with limited water availability.

Significant and unreasonable impacts from depletions of ISW due to groundwater pumping on beneficial users (Table 5-13) include:

Reduction in flows leading to reduced water availability and impairments to riparian habitat and ecosystem health beyond what the vegetation is adapted to survive during dry conditions.

- Reductions in flows leading to reduced water availability and impaired health or mortality for in-stream habitat and ecosystem health.

- Reduction in supplies available that lead to impairing surface water rights holders ability to divert requisite volumes of water during times of water demands.

The Kaweah Subbasin GSAs have limited data and modeling tools to assess impacts from ISW depletions on surface water beneficial use/users. Hence, the approach to establishing MTs relies on evaluating post-SGMA historical impacts under a range of different hydrologic conditions, followed by extensive stakeholder outreach and engagement to determine if these impacts were significant and unreasonable. Since potential effects of ISW depletions are manifested as reductions in flows (see above) historical conditions were evaluated to identify a hydrologic period with low flows but without significant and unreasonable impacts. This historical hydrologic period was then used as the basis for protective minimum thresholds, i.e. minimum thresholds that would not lead to significant and unreasonable impacts. Note, the MTs using this methodology are conservative, as higher depletions leading to lower flows may be acceptable if they do not lead to significant and unreasonable impacts.

As depicted in Figure 2-2 of Appendix 3D, groundwater pumping (and any corresponding depletions) is one of several factors influencing surface water and groundwater conditions. Hence, it is important to note that the SMC evaluation is based on evaluating historical impacts during drought/low-flow conditions and not necessarily due to groundwater pumping or depletions alone. The causal linkage between pumping, depletions, flow conditions, and corresponding is best done using models to assess groundwater and surface water conditions with and without pumping (DWR, 2024b; DWR, 2024c). Hence, additional modeling needs to be conducted with the refined groundwater model to quantify ISW depletion SMCs and URs.

Given the data gaps, uncertainties, and lack of appropriate modeling tools, the Kaweah Subbasin cannot define basin-wide ISW SMCs or quantitative URs at this stage. The Subbasin is reviewing the recent DWR ISW technical papers and awaiting additional guidance on setting ISW SMCs before establishing basin-wide ISW SMCs and URs. Furthermore, no minimum flow requirements or flow objectives have been defined for the Kaweah Subbasin Rivers and Creeks. Without such minimum flow requirements or flow objectives, it is challenging to identify depletions that would lead to significant and unreasonable reductions in flows with corresponding impacts. The Kaweah Basin GSAs will continue working with environmental stakeholders to better understand flow requirements for all beneficial use and users within the Kaweah Subbasin. This will inform future SMCs and URs.

Assessment of Historical Vegetation and Habitat

Native vegetation and ecosystems in the San Joaquin Valley are adapted to the climactic cycles of dry and wet conditions – seasonally and over longer periods. Vegetation typically dries up and goes dormant during the late summer and fall months to rebound during the spring months. Similarly, most deep-rooted trees have evolved to have some level of drought tolerance.

However, prolonged drought periods with high temperatures, inadequate precipitation, and low surface water or groundwater availability can lead to excessive vegetative stress and resulting mortality.

Historical impacts from droughts and low flow conditions on phreatophyte vegetation were investigated using remotely sensed normalized difference vegetation index (NDVI) satellite data and high-resolution aerial imagery. NDVI is a unitless measure of plant greenness and health, ranging in value from -1 to 1. Negative values are not associated with vegetation. An NDVI of 0 – 0.2 is typical of dead or dormant vegetation, 0.2 – 0.4 may indicate stressed vegetation. Values above 0.4 are associated with normal healthy vegetation. These qualitative descriptions of plant health vis a vis NDVI are general and will vary depending on vegetation species, vegetation density, the nonuniformity (or spectral mixing) of the area covered by a single remotely sensed pixel (30-meter Landsat data in this case), and the period within the annual plant growth and dormancy cycle.

TNC's GDE Pulse web tool provides processed NDVI data at both the pixel and NCCAG polygon levels and was used as a screening tool to identify areas in the Subbasin where NDVI values exhibited a downward trend. The underlying Landsat NDVI data is filtered to June 1 – September 30, and the medoid image is selected. A medoid is a measure of the median value that is used for multidimensional data. The GDE Pulse NDVI data layer can be filtered by various time windows (five years, 10 years, 15 years, and 1985 to present), and the map layer will display a qualitative representation of the NDVI linear trend over that window: large decrease, moderate decrease, little or no change, moderate increase, or large increase (Figure 3-15 of Appendix 3D) on an NCCAG polygon will display a graph of the average annual NDVI value for that polygon and its linear trend over the selected time period. Data downloads of the NDVI raster (pixel-based) data were available through 2022, while downloads of the polygon-based data and the interactive web map had data through 2023 at the time of this analysis.

Initial screenings using downloaded GDE Pulse NDVI raster trend data were performed on the 2013 – 2022 time window, however based on stakeholder feedback, a shorter time window of 2018 – 2022 was also selected. The longer time window begins pre-SGMA and reflects the vegetation's longer term NDVI response, while the shorter time window reveals more recent and acute effects. Figures 3-16 and 3-17 of Appendix 3D show the downloaded GDE Pulse NDVI raster trend data for 2013 – 2022 and 2018 – 2022, respectively. The precise classification breakpoints were not available in the data, so an attempt was made to match the qualitative NDVI trend descriptions in the web map to the downloaded data. Several areas in Figure 3-16 of Appendix 3D show a moderate or large decrease in NDVI over the period 2013 – 2022, primarily in the McKay Point and Kaweah Oaks Preserve areas, with a few other scattered areas of decline. The 2018 – 2022 timeframe in Figure 3-17 of Appendix 3D shows an overall downward shift in the NDVI trend data in most areas compared to the longer time window.

To investigate this phenomenon in more detail and identify potential impacts to phreatophytes in the Subbasin, areas of negative NDVI trend were compared with historical high resolution aerial imagery on Google Earth (GE) and the National Agricultural Imagery Program (NAIP) imagery, and the annual NCCAG polygon-based NDVI data was downloaded and reviewed. Initial efforts focused on the McKay Point and Kaweah Oaks Preserve areas (Figures 3-18 to 3-20 of Appendix 3D) due to the NDVI trend decline over 2013 – 2022 and the presence of potential phreatophytes indicated in NCCAG and VegCamp data. Available historical imagery over the time period was reviewed, and imagery from 2014 and 2021 was identified as the earliest and latest available on GE for these areas over the time period in question. The imagery revealed that land-based human activity was the cause of NDVI trend decline for many of the areas in question. Additional GE imagery is shown in Attachment B of Appendix 3D. These areas were reviewed with stakeholders with knowledge of local conditions and activity. For example, Figure 3-18 of Appendix 3D shows changes in a mining operation that inundated earlier vegetation and a separate area of vegetation removal due to excessive overgrowth and fire risk. The Kaweah Oaks Preserve exhibits significant change between the available GE imagery in 2014 and 2021—this area is discussed in more detail below.

The annual NDVI polygon-based data in the McKay Point, Kaweah Oaks Preserve, and surrounding areas for 2015 (pre-SGMA), 2018, 2022, and 2023 are shown in Figures 3-21 to 3-24 of Appendix 3D. This dataset shows the average NDVI value for each NCCAG polygon for each year of interest (from June 1 – September 30), instead of the linear-fit trend over multiple years that the raster data shows. While some of the previously identified areas with negative NDVI trends do exhibit consistently low NDVI values year-over-year, there is a significant rebound in NDVI for the final year in this dataset, which is the very wet year of 2023 (Figure 3-24 of Appendix 3D).

NAIP imagery for 2014, 2016, 2018, 2020, and 2022 was also reviewed. While not as high-resolution as the available GE imagery, NAIP is typically captured during the summer growing season while the available GE imagery was captured in late winter to early spring. This summer period more closely aligns with the GDE Pulse NDVI data that is calculated for June 1 – September 30. In addition, since 2018 NAIP imagery in California has been captured with a near-infrared (NIR) wavelength band in addition to the red, green, and blue visible wavelength bands. Sunlight in the NIR is highly reflected by leaves, so higher NIR values correspond to the increasing presence of healthy leaves. NIR is used in the NDVI calculation, so strong NIR reflectance results in high NDVI values, making the NAIP NIR band useful for highlighting vegetation. Figures 3-25 to 3-27 of Appendix 3D some of the areas that were reviewed, and additional areas are available in Attachment B of Appendix 3D. Figure 3-25 of Appendix 3D shows a California sycamore grove that was identified as significant by stakeholders. This grove is in the Dry Creek groundwater elevation data gap area, and is likely to be an area of ISW based on local input. The NCCAG polygon of this area shows a downward NDVI trend for 2018 –

2022, however the NAIP imagery shows consistent tree crown coverage and the annual NDVI graph shows a rebound in NDVI for 2023. Figure 3-26 of Appendix 3D shows an area of a prescribed CalFire burn, where the loss of ground vegetation creates a decrease in NDVI with no concomitant loss of tree canopy.

The Kaweah Oaks Preserve area is shown in Figure 3-27 of Appendix 3D along with NDVI trends and areal imagery. Parts of the Kaweah Oaks Preserve suffered uncontrolled fire damage in 2016 and this is clearly visible in the NAIP imagery. Stakeholder input[14] indicated that the pre-SGMA drought of 2012-2015 contributed to the area's susceptibility to fire and likely resulted in the mortality seen in the northern part of the Preserve in the 2016 NAIP imagery. In the areas not affected by fire, differential conditions between the northern and southern portions of the Preserve are evident in the 2016 and 2018 NAIP imagery. The northern portion shows significant signs of vegetation stress and mortality, while the southern portion largely maintains its tree canopy. Based on local stakeholder input[5], surface water diversions around the time of this fire flowed through the southern stand of trees, while being reduced in the north. The period from 2012 – 2015 was characterized by reduced surface flows, the lowest groundwater levels (over the period of record), and high temperatures. All of these likely contributed to the vegetative stress and tree mortality during that period. Quantifying ISW depletions due to groundwater pumping and estimating the resulting loss of flow in the channels at and near the Kaweah Oak Preserve is not feasible at this time. The vegetation that survived the 2012 – 2015 drought was also stressed during the 2020 – 2022 period (as shown by the low NDVI values), however the dominant vegetation (Valley Oaks) was resilient through this period and showed a significant rebound in 2023 and beyond.

Preliminary Assessment of Interconnected Surface Water Depletions

A preliminary assessment of ISW depletions was conducted for a stretch of the Kaweah River where sufficient data is available. The assessment relied on two methodologies: 1) evaluating channel losses from flow data and comparing with observed groundwater levels and pumping estimates (from the Kaweah Subbasin numerical model), and 2) estimating near-term ISW depletions using a simplified analytical model. SGMA regulations require the ISW MTs account for the location, quantity, and timing of ISW depletions. Progress has been made on identifying potential locations, but significant uncertainty exists on the quantity and timing of depletions. The preliminary assessment of ISW depletions sets up a framework for more rigorous analysis to be conducted in the future with the refined groundwater model (Attachment D of Appendix 3D). The preliminary analytical modeling relies on simplifying assumptions and is expected to be superceded by the numerical model, which can be used to assess the quantity and timing of

[14]Personal communication with the Sequoia Riverlands Trust and KDWCD

depletions and flows by simulating surface and groundwater conditions with and without pumping stresses (per DWR, 2024b; 2024c).

As described in Section 2.3 of Appendix 3D, some potential areas of ISW were identified in the eastern portion of the Kaweah Subbasin along the Kaweah and St. Johns Rivers. Upon review of the available historical surface water flow and diversion data in this shallow groundwater zone, the reach between the surface water gages at Lower Kaweah below McKay Point and Lower Kaweah Peoples Ditch was selected for the evaluation of channel losses and flow impacts. For each month in the 2013 – 2022 water year period, the total channel loss in the selected reach was estimated by taking the measured flow at Lower Kaweah below McKay Point, subtracting the measured flow and diversions at Lower Kaweah Peoples Ditch, Hanna Ranch, Hamilton Ditch, and Consolidated Peoples Ditch, and adding the measured inflow from the FKC. Figure 3-28 of Appendix 3D shows the estimated channel loss in the selected reach and the historical surface water flow and diversion data used in the channel loss calculation. The surface water flows ranged from 0 to 70,000 acre-feet per month, and the diversions ranged from 0 to 30,000 acre-feet per month. The selected reach was mostly losing, with the maximum losses of 12,000 and 10,000 acre-feet per month occurring in the summer months of 2016 and 2020, respectively. The total channel losses in the dry water year 2022 were similar in magnitude to the losses in the prior dry water year 2015. The total channel losses estimated by this method are inclusive of the ISW depletion and other loss factors such as evapotranspiration losses, ungagged/riparian diversions, and losses from disconnected segments.

The estimated channel loss was compared to the total pumping within 2.5 miles of the selected reach. The total pumping values were extracted from the historical numerical groundwater flow model, which included metered pumping data from municipal wells as well as the Farm Process (FMP) agricultural supply well pumping data simulated by the model. Figure 3-19 of Appendix 3D shows the comparison between the total channel loss and pumping, with a map showing the locations of the metered pumping data and the 2.5-mile buffer zone used in the analysis. While some of the peaks in total pumping occurred at the same time as the peaks in total channel loss, there was no consistent pattern and little to no correlation between the total channel loss and pumping. This indicates that depletion is a small component of channel losses in this stretch of the Kaweah River.

Since depletion are driven by changes in groundwater elevations, channel losses were compared to groundwater elevation data adjacent to the select segment along the Kaweah River. Figure 3-30 of Appendix 3D shows the comparison between the estimated channel loss and the nearby groundwater elevations, with a map showing the locations of the monitoring wells used in the analysis. The groundwater elevation at the well near the upstream portion of the selected reach (18S27E05J001M) showed very little variation over time, staying at approximately 440 feet above mean sea level. For the wells closer to the downstream portion of the selected reach (KSB-

2539 and 18S26E27B001M), the groundwater elevations showed higher variations over time, ranging from 380 to 400 feet for KSB-2539 and from 320 to 380 feet for 18S26E27B001M. The lowest groundwater elevations were observed in 2015 and the second lowest in 2022, coinciding with the historical dry periods. Similar to the previous analysis with pumping data, there was little to no correlation between the total channel loss and the nearby groundwater elevations, indicating limited depletion impacts on channel losses/flows.

The second approach for estimating depletion relies on analytical modeling using the Hunt (1999, 2005) analytical stream depletion function. The analytical model is documented in detail in Attachment C of Appendix 3D. The analytical model relies on simplifying assumptions (for example, constant connectivity and stage in River) which makes it unsuitable to estimate long-term depletions with dynamic flow conditions and interconnectedness between the surface water and groundwater systems. As such, the analytical modeling was only used to estimate near-term or direct depletions from pumping within some distance. The analytical modeling was conducted with a representative range of streambed and aquifer properties and different well distances within the riparian corridor from the stream channel. Figure 3-31 of Appendix 3D shows the likelihood (for multiple stochastic realizations of the streambed and aquifer properties) of the percentage of pumped water derived from the stream for a range of distances (from 50 ft to 2,000 ft) over a six-month pumping period. The six-month pumping period was chosen to represent the summer and fall period when surface flows are the lowest and agricultural pumping demands are the highest. The results show that for this portion of the Kaweah River, 2% (for a well 2,000 ft away) to 5% (for a well 50 ft away) of the pumped volume could be derived from the stream over the six-month pumping period with a 90% likelihood. Since the exact spatial distribution of pumping in this area is unknown (the Well Registration Program will likely fill this data gap), a conservative 5% factor was assumed as the average percentage of pumped groundwater coming from the stream. This was used to establish the preliminary MT for this river segment (Section 3.3 of Appendix 3D). Note that the quantity, timing, and location for long-term depletions that account for dynamic flow and stage conditions in the River, changing groundwater levels, and transient pumping will be conducted using the refined groundwater model (Attachment D of Appendix 3D).

5.9.2.2 Significant and Unreasonable Depletion of Interconnected Surface Water

The Kaweah Subbasin has defined significant and unreasonable depletion of ISW ***when the depletions due to groundwater activities lead to low flows that impair habitat, ecosystems, and diversions beyond what was observed over the 2020 to 2022 drought period.***

Based on our evaluation of groundwater levels, surface flows, channel losses, remote sensed imagery, as well as stakeholder feedback[15] on vegetation and diversion impacts, the 2012 – 2015

[15] Personal correspondence with KSJRA and Sequoia Riverlands Trust

drought period was one when significant and unreasonable impacts *were* observed in certain parts of the basin. These include reported tree mortality followed by a wildfire in the Kaweah Oaks Preserve area (Section 3.3.1 of Appendix 3D) and historically low surface flows, diversions, and groundwater levels in areas with potential ISW (Figures 2-7, 2-8 and 2-11 of Appendix 3D). The impacts observed during 2012 - 2015 were likely due to a combination of factors – prolonged drought, high temperatures, low precipitation, limited releases from Lake Kaweah, and low groundwater levels (in turn driven by groundwater pumping). The impact of ISW depletions alone on 2012 – 2015 flows has not been ascertained. Nevertheless, these are considered pre-SGMA impacts that the GSAs would still like to avoid.

The period from 2020 to 2022 was the most significant post-SGMA drought. WY 2022 represents the end of this drought period when impacts due to drought, low flow, and low groundwater levels were most pronounced. WY 2022 flows, diversions, and groundwater levels were below average but at or above 2015 levels. Vegetative stress was observed between 2020 and 2022 in certain areas (Section 3.3.1 of Appendix 3D) but was a) not as significant as 2015 conditions and b) was followed by a rebound in vegetative health in the following wet years (2023 and beyond). Based on stakeholder feedback, no significant and unreasonable impacts on surface-water diversions were reported during this period. Hence, WY 2022 is considered as the basis for preliminary ISW MTs as low flows during that period did not lead to significant and unreasonable impacts on ISW beneficial use and users. Depletions leading to reductions in surface flows beyond low flow conditions observed in WY 2022 could lead to significant and unreasonable impacts on ISW beneficial use/users. Note, that future droughts may lead to flows lower than those observed in 2022. However, the ISW MT would apply if ISW depletions lead to reductions of the flows below 2022 levels. The Kaweah Subbasin GSAs will use a combination of data and models to assess the causal linkage between pumping, depletion, and flow conditions in the future.

The Kaweah Subbasin cannot define a basin-wide quantitative SMCs and UR at this time due: 1) significant shallow aquifer groundwater level and streamflow data gaps, 2) the Kaweah Subbasin Groundwater Flow Model's current inability to effectively evaluate the relationship between groundwater pumping and direct and indirect depletions of interconnected surface water, 3) imminent guidance from DWR on ISW depletions, and 4) lack of basin-wide minimum flow conditions or flow objectives. As part of the Interconnected Surface Water Data Gap Workplan, the SMC (including the UR) will be re-established following completion of Steps 1 through 3 of the Workplan (Section 6.7.12) and the ISW Model Refinement Workplan (Attachment D of Appendix 3D). Without quantitative URs, the Kaweah Subbasin GSAs will continue to monitor low flows, diversions, and channel losses. If surface flow conditions were to fall below WY 2022 low flows, then the GSAs would evaluate depletion-related impacts on the low flows using the best available data and tools at that time (collected under the Interconnected Surface Water Data Gap Work Plan (Section 6.7.12) and Model Refinement Workplan (Attachment D of Appendix

3D) and assess whether these may lead to significant and unreasonable impacts on ISW beneficial use/users.

5.9.3 (Preliminary) Minimum Thresholds [§354.28(b)(1)]

§354.28 Minimum Thresholds.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(6) Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:

(C) The location, quantity, and timing of depletions of interconnected surface water.

(D) A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph.

The MT is the quantitative value that represents the groundwater condition in each representative monitoring well site that when exceeded, may cause an undesirable result. The MTs for interconnected surface water are based on 2022 flow conditions.

5.9.3.1 Information and Methodology Used to Establish Minimum Thresholds

As stated earlier, the significant streamflow, shallow groundwater level, and diversion data gaps hinder the Kaweah Subbasin from establishing final SMC for depletions of interconnected surface water. However, the best available data and information was evaluated to establish interim SMC and the future SMC improvements will be made as progress on the Kaweah Subbasin's Interconnected Surface Water Data Gap Workplan is made. More information on this management action to fill these priority data gaps is available in Section 4.3.

Step 1: Identify Location of Potential ISW

The identification of potential ISW and resources used to make the determinations are addressed in Section 2.3 of Appendix 3D.

Step 2: Identify Location of Beneficial Users and Uses

The identification and location of beneficial users and uses are described in detail in Section 5.9.1.

Step 3: Evaluate Impacts on Beneficial Users from ISW Depletions

Impacts during historical droughts and low flows conditions are described in Section 3.2 above. Results from the historical evaluation concluded that the period from 2012 – 2015 did show local

significant and unreasonable impacts (especially on riparian habitat in the Kaweah Oaks Preserve downstream of the potential ISW area of interest), though it was not determined if these impacts were due to hydrology or depletion impacts. Despite low flow conditions and groundwater levels, no significant and unreasonable impacts on vegetation or diversions were noted during WY 2022. This determination was vetted through the stakeholder process (Section 3.6 of Appendix 3D) that included technical and advisor committee discussions, stakeholder workshops, and beneficial user discussions across the Kaweah Subbasin. Preliminary analytical modeling showed that (near-term) pumping-induced depletions were a small contributor to channel losses.

Step 4: Establish MT That Avoid Significant and Unreasonable Impacts to Beneficial Users and Uses

As a result of Step 3, WY 2022 was used as the basis for the definition of preliminary MTs in areas where flow and groundwater data was available. The preliminary MT is defined as the amount of pumping-induced depletion that would lead to flows lower than those observed in 2022. To be demonstrative of the MT process, preliminary MTs were calculated for the potentially interconnected segment of the Kaweah River between McKay Point and People's Ditch. Table 5-15 shows average flows, channel losses, estimated pumping (within 2.5 miles), and estimated depletions (based on 5% of estimated riparian pumping) in cubic feet per second (cfs) for the six months with the lowest flows in WY 2022. Months with no flows at Lower Kaweah below McKay Point were not included in these calculations as there are no depletions in periods with no flows.

Table 5-14. Average Monthly Water Flows, Diversion, Channel Losses, Pumping, and Depletion Estimates for 6 Months with the Lowest Flows[1] in 2022.

Surface Water Flow RMS Gage	Average Low Flows[1] (cfs)	Net Diversions and Inflows Upstream of Gage (cfs)	Channel Losses[2] (cfs) (From Upstream Gage)	Average Pumping[3] within 2.5 mi of River (cfs)	Estimated Depletions[4] (cfs)
Lower Kaweah below McKay Point	39.4	-	-	-	-
Lower Kaweah at People's Ditch	21.4	14.1	4.0[5]	27.6	1.4

[1]Months with no flows at Kaweah at McKay Point were not considered as there can be no depletions during no-flow conditions.
[2]Channel loss calculations incorporate available diversions and inflow data. Channel losses are inclusive of pumping-induced ISW depletions but could be influenced by other meteorological, hydrologic, and anthropogenic factors.
[3]Pumping estimated using the Kaweah Subbasin groundwater model.[4]Depletions are assumed to be 5% of estimated pumping within 2.5 mi corridor.
[5]Channel loss between Lower Kaweah River below McKay Point and Lower Kaweah at People's Ditch.

The preliminary MT for this segment of the Kaweah River is set as depletions that would lead to low flow conditions lower than WY 2022 low flows (Table 5-15) along this segment. It is important to understand that the MT does not mean the GSAs are responsible for maintaining specified low flows. Even without depletions, flows can go below WY 2022 flows due to hydrologic and other anthropogenic factors. Depletion MTs would only apply in cases when depletions lead to flows lower than WY 2022 low flows (Table 5-15). Hence, in a given year, low flow conditions would be tabulated similarly to WY 2022 (six preceding lowest flow months over a one-year period, not counting months with zero flows) and compared with WY 2022 low flows (Table 5-15). If the low flows are higher than WY 2022 (Table 5-15) then the depletion MT would not apply (as flows were higher than the corresponding low flow period used as the basis for the MT). If the low flows are lower than WY 2022 (Table 5-15), then the GSAs would evaluate if a) depletions led to low flows lower than WY 2022 (Table 5-15) and b) significant and unreasonable impacts to vegetation and diversions occurred at those low flow conditions. If it is determined that depletions led to low flows and significant and unreasonable impacts to surface water beneficial users may occur at those flows, then depletions would be managed (through demand management or flow augmentation) to keep low flows at or above WY 2022 flow levels.

Note that the depletion MTs for this stretch of the Kaweah River are meant to be preliminary, using the best available (albeit limited) data and an approximate analytical model that was developed to estimate the depletions due to groundwater pumping (Attachment C of Appendix 3D). Since, significant and unreasonable impacts were not observed for WY 2022, the MTs are also meant to be conservative. The conditions that would lead to significant and unreasonable impacts have not been determined at this time. MTs and corresponding URs may be revised as: a) additional data is collected through the Interconnected Surface Water Data Gap Filling Work Plan (Section 6.7.12); b) well registrations lead to better characterization of the spatial, vertical, and temporal distributions and rates of pumping along the River corridor; c) a better understanding of flow conditions with significant and unreasonable impacts is developed; d) more accurate modeling tools to estimate depletions are developed (Model Refinement Work Plan); and e) additional guidance from DWR is made available. In addition, continued stakeholder engagement and feedback (described in Section 3.6 of Appendix 3D) may lead to further revisions to the MTs. Finally, additional MTs will also be developed in other areas with potential ISW as additional flow and groundwater level data becomes available.

5.9.4 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The preliminary MT for ISW along the Kaweah River between McKay Point and People's Ditch are consistent with the upper aquifer groundwater level MT, which are set at 2022 water levels in this portion of the subbasin. There are no neighboring basins in this area and in general, surface flows stay within the Kaweah subbasin except under extremely high surface flows (when ISW

depletions are not a material impact on flows). Hence, there are no effects of ISW MT within the Kaweah Subbasin on neighboring Basins.

5.9.5 Effects on Beneficial Users and Land Uses

The potential effects of depletions to interconnected surface water, when exceeding minimum thresholds and thus becoming an undesirable result include:

- Impairments to riparian habitat and ecosystem health
- Impairments to in-stream habitat and ecosystem health
- Reduction in supplies available for surface water rights holders

Localized impacts may occur and are not necessarily deemed a UR. URs are defined under SGMA as being Subbasin-wide impacts.

5.9.6 Relevant Federal, State, or Local Standards

The Kaweah Subbasin GSAs will comply with existing federal, state, or local regulations pertaining to the implementation of the GSPs. In the context of interconnected surface water in the Kaweah Subbasin, riparian water rights and downstream surface water rights, enforced on the state level, will continue to be recognized in analyses, policies, and management actions. The MT and MO are expected to be protective and consistent with recent historic conditions; however, more importantly, the Kaweah Subbasin's demand management strategies are expected to be protective of the potential to interfere with riparian and other surface water rights for downstream users.

5.9.7 Method for Quantitative Measurement of Minimum Thresholds

The method for measuring interconnected surface water is based on monthly flow data, annual estimates of pumping, and the bi-annual groundwater level measurements at three shallow interconnected surface water RMS wells. In the future, through continued implementation of the Interconnected Surface Water Data Gap Workplan (Section 6.7.12), stream flow data and additional shallow, stream adjacent monitoring will be available to establish volumetric change measurements. More information on the interconnected surface water RMS wells and stream gage RMS is available in Section 4.7.

5.9.7.1 Relationship with Other Sustainability Indicators

The relationship between the SMC established for the applicable sustainability indicators in the Kaweah Subbasin are summarized below:

- Groundwater Levels & Groundwater Storage: The interim SMC established for ISW are based on groundwater conditions in 2022. This is consistent with the SMC established for groundwater levels and groundwater storage in this portion of the Subbasin as the MTs in the easternmost portions of the Subbasin (where potential ISW are) were set to Fall 2022 groundwater levels (+1 to 2 additional feet of decline on the westernmost portion of the ISW, where the existing evaluation suggests the stream reaches are likely disconnected).

- Groundwater Quality: The relationship between groundwater quality and depletions of interconnected surface water induced by pumping has not been studied in the Kaweah Subbasin and generally state-wide. In general, surface water quality tends to be better than groundwater quality in the Kaweah Subbasin. Hence, recharge (potentially driven by depletions) from the surface water bodies is expected to improve groundwater quality.

- Land Subsidence: There is no known impact-relationship between interconnected surface water and land subsidence.

As with all SMCs, the Kaweah Subbasin GSAs will make revisions to the ISW SMC as new data, information, and analytical tools are available.

5.9.8 Measurable Objectives and Interim Milestones

Given the significant data gaps and lack of refined modeling tools it is challenging to establish quantitative measurable objectives (MOs) and interim milestones (IMs) at this stage. In general, given the highly managed flow system in the Kaweah Subbasin and the limited impact of depletions on channel losses (based on the preliminary analyses presented herein), it is proposed that MOs and IMs be set the same as MTs. It is noted that the Sustainable Management Criteria Best Management Practice (BMP) document indicates that the measurable objective can be the same as the minimum threshold (DWR, 2017). MOs and IMs will be evaluated once basin-wide MTs are established in the near future.

Appendix 3D presents a framework for establishing SMCs, with significant progress in terms of identifying beneficial uses/users, evaluating historical impacts, and developing a dedicated ISW RMS network. Preliminary MTs are proposed for a segment of the Kaweah River where we have data. We need a) the data, b) the refined model, c) DWR guidance, and d) additional stakeholder engagement to understand flow requirements for all beneficial users before we can establish basin-wide SMCs and URs.

6 PROJECTS & MANAGEMENT ACTIONS

6.1 Introduction

This Section discusses water supply availability for projects (Section 7.2), describes each project (Section 7.3), describes management actions (Section 7.4), discusses an implementation plan (Section 7.5), and summarizes the analyses of water supply benefits afforded by each applicable project (Section 7.6). These Subsections collectively comply with the requirements of Section §354.44 of DWR's Regulations.

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 Subbasin Setting (Appendix 3A) represents the current hydrogeologic water budget for GKGSA, showing all components of inflow to and outflow from the GKGSA region. The hydrogeologic 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 (Sections 3.4.1 and 3.4.2**,** respectively) incorporating groundwater pumping projections 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. Components of Groundwater Inflow

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

Components of Groundwater Inflow (*)
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 below. 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 for Kaweah Subbasin (based on 2020 GSP Water Budget)

(values in acre-feet)

	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 Groundwater	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]	1,050	14,305	**15,355**
Irrigation Return 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**
Wastewater Treatment Plant 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%**

(*) Excludes net sub-surface inflow of 60 TAF/yr
(**) Sustainable yield for the Kaweah Subbasin
Note: Data is based on water budget for the period Water Year 1997 to 2017 for the Kaweah Subbasin
This table is exported from the Water Accounting Framework, which was produced before many of the recharge basins, on-farm recharge and other activities were being implemented (therefore, this field is set to 0 when in reality, there is a sizeable volume of water that is not being recharged in basins across the Kaweah Subbasin.

In the 2020 GSP, the WAF included a comparison of groundwater inflow assignments into KGSA to annual groundwater pumping for the same period (1997-2017). The difference between the numbers results in an imputed water balance surplus for GKGSA. 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 undesirable results 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 taf – (209 taf+56 taf) ≈ 660 taf

Adding back in the mountain front recharge results in:

660 taf + 56 taf ≈ 720 taf, i.e., the safe yield of the Subbasin as discussed in Appendix 3A.

6.2.4 GSA Member Allocation Strategy

GKGSA Members recognize that the GSA water apportionments, as discussed in Section 6.2, may be further apportioned to different areas of the GKGSA area. This effort will take into consideration the existing water management and associated facility ownership agreements among the GKGSA Members as they relate to groundwater recharge activities. This apportionment will aid in determining Member participation in the various projects as well as shaping the extent of management actions (pumping restrictions), as outlined in Chapter 6. Any allocation strategy will give due consideration to the Sustainability Plan Cooperative Statement adopted by the GKGSA Board as stated in Section 6.7.11.

6.3 General Process for Developing Projects and Management Actions

Projects and management actions described in this Plan include groundwater recharge projects and programs, surface reservoir projects, leveraged surface water exchange programs, a groundwater extraction measurement implementation program, a conceptual groundwater marketing program, future urban and agricultural conservation, a groundwater allocation mechanism among well owners and operators, land fallowing program, and other projects and management actions. Following are each project and management action, along with the measurable objective and associated sustainability indicator that will benefit therefrom. The GKGSA will work to improve these projects and programs by evaluating opportunities to also create and enhance ecosystem benefits through the development and implementation of the projects and programsdescribed in this section.

6.4 Overview of Projects and Management Actions

The Projects proposed in this Plan by the GKGSA consist of a combination of completed and ongoing projects, developed by the JPA Members of the GSA, and projects proposed by the GSA in partnership with either a JPA Member or another GSA in the Kaweah Subbasin. The following list includes a summary of the Project types developed by the GSA Board and its committees, and the Sustainability Indicator(s) primarily impacted by the implementation of each Project.

Further planning is necessary to address the partnerships, funding, and benefactors for each project.

Table 6-3: Summary of Projects and Management Action Benefits and Status

Project	Agency	GW Levels	Reduction in Storage	Water Quality	Land Subsidence	Status
Cross Creek Layoff Basin	KCWD LIWD	♦	♦		♦	Summer 2029
Recharge Basin Improvement	LIWD KCWD KDWCD	♦	♦	♦	♦	Summer 2025
New Recharge Basins	LIWD	♦	♦	♦	♦	Summer 2032
Delta View Canal	KCWD	♦	♦	♦	♦	7/1/2031
Lakeland Canal Deliveries	KCWD CID	♦	♦		♦	Ongoing or yearly
Kings River Floodwater Arrangement	KCWD LIWD	♦	♦		♦	Ongoing or yearly
Kings River Surplus Water	KCWD LIWD	♦	♦	♦	♦	Ongoing or yearly
Fallowing Program	KCWD LIWD	♦	♦		♦	Summer 2029
On-Farm Recharge & Storage	KCWD LIWD	♦	♦	♦	♦	Ongoing or yearly
Hannah Ranch Flood Control Project	KDWCD	♦	♦	♦	♦	Summer 2026
Paregien Flood Control & Recharge Project	KDWCD	♦	♦	♦	♦	Complete
Ketchum Flood Control & Recharge Project	KDWCD	♦	♦	♦	♦	Summer 2030
St. Johns River Water Conservation Project	KDWCD	♦	♦	♦	♦	Summer 2031
Basin No. 4 Improvement Project	KDWCD	♦	♦	♦	♦	Complete
Peoples Recharge Expansion Project	KDWCD	♦	♦	♦	♦	Summer 2027
Greater Fallowing Auction Program	GKGSA	♦	♦		♦	Ongoing or yearly
Management Action	Agency	GW Levels	Reduction in Storage	Water Quality	Land Subsidence	Status
Communication and Engagement	GKGSA	Not applicable				Ongoing or yearly
Terminus Reservoir Reoperation Program	KDWCD	Not applicable				7/1/2032
Groundwater Extraction Measurement Program	GKGSA	♦			♦	Ongoing or yearly
Well Characterization Program	GKGSA	Not applicable				7/1/2027

Geophysical Data Survey – Phase I	GKGSA MKGSA EKGSA	Not applicable				Complete
Kaweah Subbasin Mitigation Program & GKGSA Mitigation Plan (*new)	GKGSA	♦	♦		♦	Ongoing or yearly
Collaboration with Other Agencies & Inter-Basin Coordination (Regional Subsidence)	GKGSA	♦	♦	♦	♦	Begin Summer 2024
Land Subsidence Management Plan (LSMP)	GKGSA				♦	Ongoing
Water Importation/Recharge Program (*New)	KDWCD	♦	♦		♦	Ongoing or yearly
Agricultural Water Conservation & Management	GKGSA	Not applicable				Ongoing or yearly
Fee & Incentive Program	GKGSA	Not applicable				Ongoing or yearly
Groundwater Market	GKGSA	Not applicable				Ongoing or yearly
Groundwater Allocation Program	GKGSA	Not applicable				Ongoing or yearly
Interconnected Surface Water Data Gap Work Plan	GKGSA	Interconnected surface water				7/1/2026
Well Registration Program (*New)	GKGSA	Not applicable				Begin Fall 2024
Small Community Well Proactive and Protection Action Plan (PPAP) (*New)	GKGSA	Not applicable				Program Development starts June 2024 Implement in June 2025
Well Permit Application Review and Technical Support (*New)	GKGSA	Not applicable				Beginning Implementation

Figure 6-1 shows the locations of the projects.

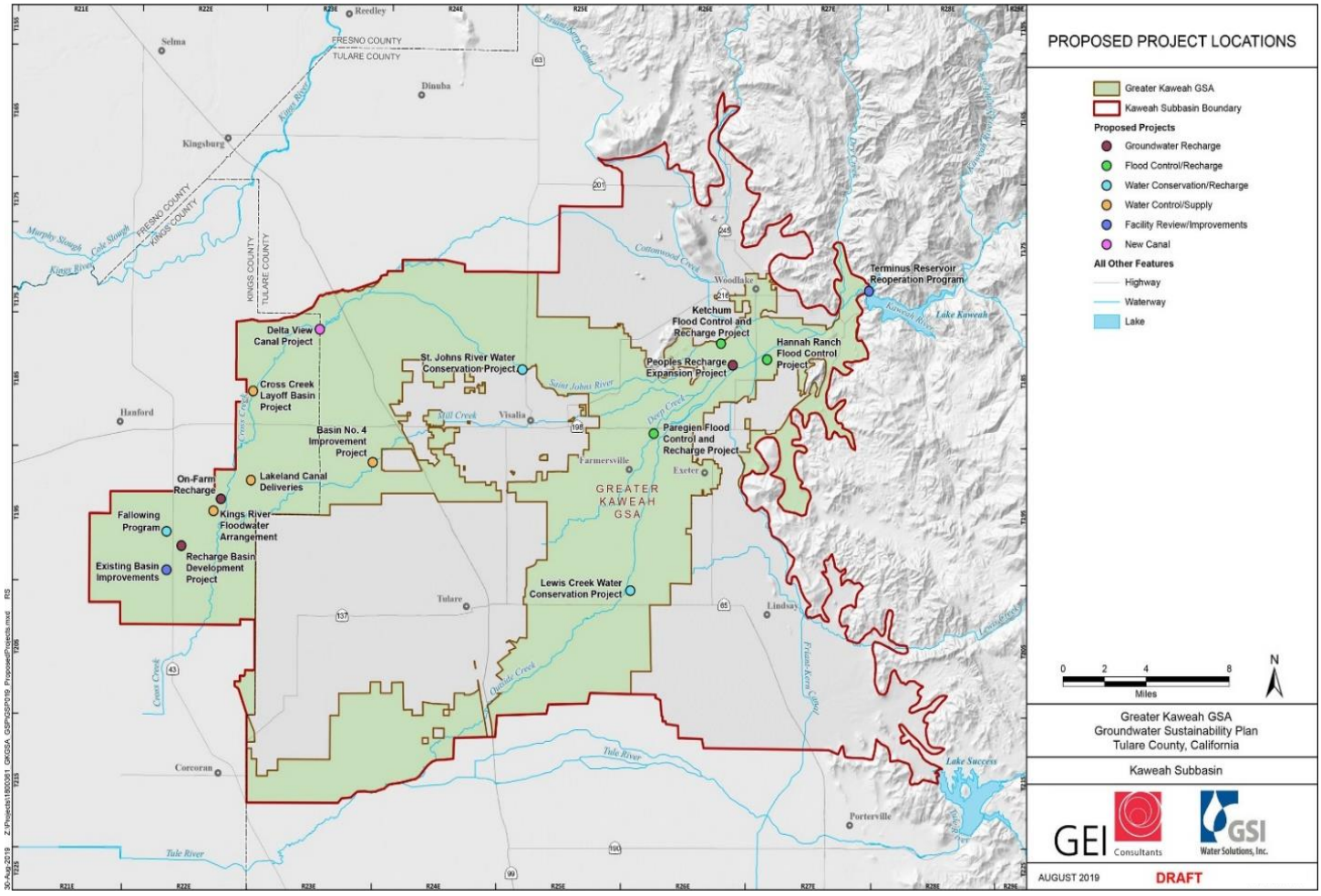


Figure 6-1: Proposed Project Locations

6.5 Water Supply Considerations

Most of the projects and management actions listed in Sections 6.6 and 6.7 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.

6.6 Projects

6.6.1 P1: Cross Creek Layoff Basin

Project Type: Local Surface Storage

Project Location: The preliminary site for this project has been identified, but it is believed that if it is disclosed acquisition will become more costly. For this reason, the area is described as north of Grangeville Avenue, near where the Lakeland Canal, the Lakeside Ditch and Cross Creek cross.

Implementing Agency: Kings County Water District, in partnership with Lakeside Irrigation Water District

6.6.1.1 Project Description

The Cross Creek Layoff Basin will utilize roughly 115 acres to store floodwater for later use within a 125-acre site which will be located in the vicinity of the intersections of Lakeland Canal, the Lakeside Ditch and Cross Creek with Grangeville Avenue. The storable depth of the basin is anticipated to be 10 feet, which translates to a storable volume of roughly 1,100 acre-feet (AF). The basin might be utilized every fourth or fifth year during a wet winter season. Diversion and conveyance facilities will need to be developed for management of flows.

This project is located on agricultural acreage that relies on groundwater for irrigation and the elimination of this acreage will provide roughly 350 AF of in-lieu groundwater recharge per year (125 acres at 95% agriculture using 3 AF per year). Additional recharge may be realized through leakage from the basin during storage as well as deep percolation of the irrigated water.

6.6.1.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.1.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the KCWD is implementing this project to increase recharge to the subbasin.

6.6.1.4 Public Notice and Outreach Process

Environmental review for this project has not yet begun. Appropriate notice and outreach will be provided by the implementing agency (Kings County Water District [KCWD]) to various public agencies and other stakeholders, including Lakeside Irrigation Water District (LIWD), Kaweah Delta Water Conservation District (KDWCD), and GKGSA. In addition, a formal Public Notice is required by the California Environmental Quality Act (CEQA).

6.6.1.5 Estimated Annual Project Benefits

The project is estimated to provide an average annual benefit of 640 AF per year.

6.6.1.6 Permitting and Regulatory Process

The project will be subject to the Kings County Land Use Authority. Other regulatory process for large earth-moving projects include CEQA and the County ordinance (#558) for the Surface Mining and Reclamation Act (SMARA), as well as local permits.

6.6.1.7 Status and Schedule

The project is anticipated to be completed during 2026 and ready to receive floodwater by 2027.

6.6.1.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 29,300 AF of in-lieu recharge during the 50-year planning and implementation horizon with an average annual benefit of 640 AF per year. This estimate includes a total of 16,100 AF of direct in-lieu recharge each year due to the non-agriculture presence of the basin and 13,200 AF for periodic in-lieu recharge during above-normal water years when the basin contains diverted floodwater. The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, and land subsidence. Deep percolation of the stored floodwater could improve groundwater quality since the floodwaters would be high-quality with a relatively low concentrations of total dissolved solids (TDS) and other constituents.

6.6.1.9 Source and Reliability of Water

Current water rights will be utilized for the diversion of the floodwaters that prior to exceeded system capacity, according to past hydrology documented in watermaster reports, are anticipated to occur on a 4-year reoccurrence period.

6.6.1.10 Legal Authority Required

KCWD has the statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its service area. *See, e.g., Cal. Water Code* §§ 31020 et seq.

6.6.1.11 Costs and Funding

The estimated cost of the project is $6.6 million, including property acquisition, design, construction, and financing. The funding mechanism has not been selected but will likely be a land-based assessment and/or a groundwater pumping charge.

6.6.1.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.1.13 Level of Uncertainty

Wet conditions occur infrequently, perhaps every four or five years, so the project will be available during the wet years to capture additional floodwaters for recharge.

6.6.2 P2: Recharge Basin Improvements for Lakeside Irrigation Water District

Project Type: Recharge Basin

Project Location: All existing basin locations within the jurisdictional boundary of Lakeside Irrigation Water District

Implementing Agency: Lakeside Irrigation Water District, in partnership with Kings County Water District and Kaweah Delta Water Conservation District

6.6.2.1 Project Description

The Lakeside Irrigation Water District (LIWD) operates numerous recharge basins and, during maintenance work on several basins, identified methods to improve recharge rates. This project will evaluate and rehabilitate other existing facilities to address sediment buildup, diversion capacities, and other issues.

6.6.2.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.2.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the LIWD is implementing this project to increase recharge to the subbasin.

6.6.2.4 Public Notice and Outreach Process

Appropriate notice and outreach will be provided to various public agencies and other stakeholders by Lakeside Irrigation Water District (LIWD). In addition, a formal Public Notice is required by the California Environmental Quality Act (CEQA).

6.6.2.5 Estimated Annual Project Benefits

The project is estimated to provide an average annual benefit of 1,600 AF per year.

6.6.2.6 Permitting and Regulatory Process

The project will be subject to the Kings County Land Use Authority.

6.6.2.7 Status and Schedule

The evaluation phase of the project is complete and the basin rehabilitation phase will be complete by 2025/2026.

6.6.2.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 78,000 AF of recharge during the 50-year planning and implementation horizon with an average annual benefit of 1,600 AF per year, based on a 4-year reoccurrence period.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, and land subsidence. Deep percolation of the recharge could improve groundwater quality since the surface waters would have relatively low TDS concentrations.

6.6.2.9 Source and Reliability of Water

Based on annual operational reports prepared by Friant Water Authority, the diversion of the CVP Section 215 flood water is anticipated to occur on a 4-year reoccurrence period.

6.6.2.10 Legal Authority Required

LIWD has the statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its service area. See, e.g., Cal. Water Code §§ 31020 et seq.

6.6.2.11 Costs and Funding

The estimated cost of the project is $0.8 million for 250 acres of recharge basin, including geotechnical borings, design, and sediment removal. The cost would be borne by LIWD as a normal maintenance cost for operating a recharge basin.

6.6.2.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.2.13 Level of Uncertainty

Wet conditions occur infrequently, perhaps every four or five years, so the project will be available during the wet years to capture additional recharge.

6.6.3 P3: New Recharge Basins for Lakeside Irrigation District

Project Type: Recharge Basin

Project Location: The preliminary sites for this project have been identified, but it is believed that if they are disclosed, acquisition will become more costly. For this reason, the areas are described as sandy parcels within Lakeside Irrigation Water District's (LIWD) boundary.

Implementing Agency: Lakeside Irrigation Water District

6.6.3.1 Project Description

LIWD currently utilizes recharge basins to store surplus CVP water This project would establish new recharge basins – 275 acres total during the first 20-year of the planning and implementation period. These 10-foot deep basins would have a total storage capacity of 13,600 AF.

6.6.3.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.3.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the LIWD is implementing this project to increase recharge to the subbasin.

6.6.3.4 Public Notice and Outreach Process

Appropriate notice and outreach will be provided to various public agencies and other stakeholders by LIWD, and as necessary it partners KCWD and GKGSA. In addition, the CEQA review process would include a formal Public Notice.

6.6.3.5 Estimated Annual Project Benefits

The project is estimated to provide an average annual benefit of 3,600 AF per year.

6.6.3.6 Permitting and Regulatory Process

The project will be subject to the Kings County Land Use Authority. Other regulatory processes will likely include CEQA and the County ordinance (#558) for SMARA, as well as local permits.

6.6.3.7 Status and Schedule

This project is in the early planning phase with an initial acquisition of land during 2025, followed by phased completions of approximately 25 percent of the project during subsequent 5-year intervals.

6.6.3.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 166,000 AF of recharge during the 50-year planning and implementation horizon with an average annual benefit of 3,600 AF per year. This estimate includes a total of 23,00 AF of in-lieu recharge each year due to the non-agriculture presence of the basin and 143,000 AF from periodic above-normal water years when excess CVP water is available.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, and land subsidence. Deep percolation of the surface could improve groundwater quality since the surface water would likely have a relatively low TDS concentration.

6.6.3.9 Source and Reliability of Water

Current water rights will be utilized for the diversion of the excess CVP Section 215 flood water that, according to reports prepared by Friant Water Authority, are anticipated to occur on a 4-year reoccurrence period.

6.6.3.10 Legal Authority Required

KCWD (*Cal. Water Code* §§ 31020 et seq.) and LIWD (Cal. Water Code §§ 22075 et seq.) have the statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its service area.

6.6.3.11 Costs and Funding

The estimated cost of the project is $21.3 million, including property acquisition, geotechnical and biological surveys, design, permits, construction, and financing. The funding mechanism has not been selected but will likely be a land-based assessment and/or a groundwater pumping charge.

6.6.3.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.3.13 Level of Uncertainty

Wet conditions occur infrequently, perhaps every four or five years, so the project will be available during the wet years to capture additional recharge.

6.6.4 P4: Delta View Canal in Kings County Water District

Project Type: Local Conveyance Improvements/Recharge Basin

Project Location: The envisioned Project is located in the Kings County portion of the Kaweah Subbasin, outside of LIWD. The preliminary alignment for this project is along the western side of 1st Avenue in Kings County, from Cross Creek to Houston Avenue (Caldwell Ave in Tulare County).

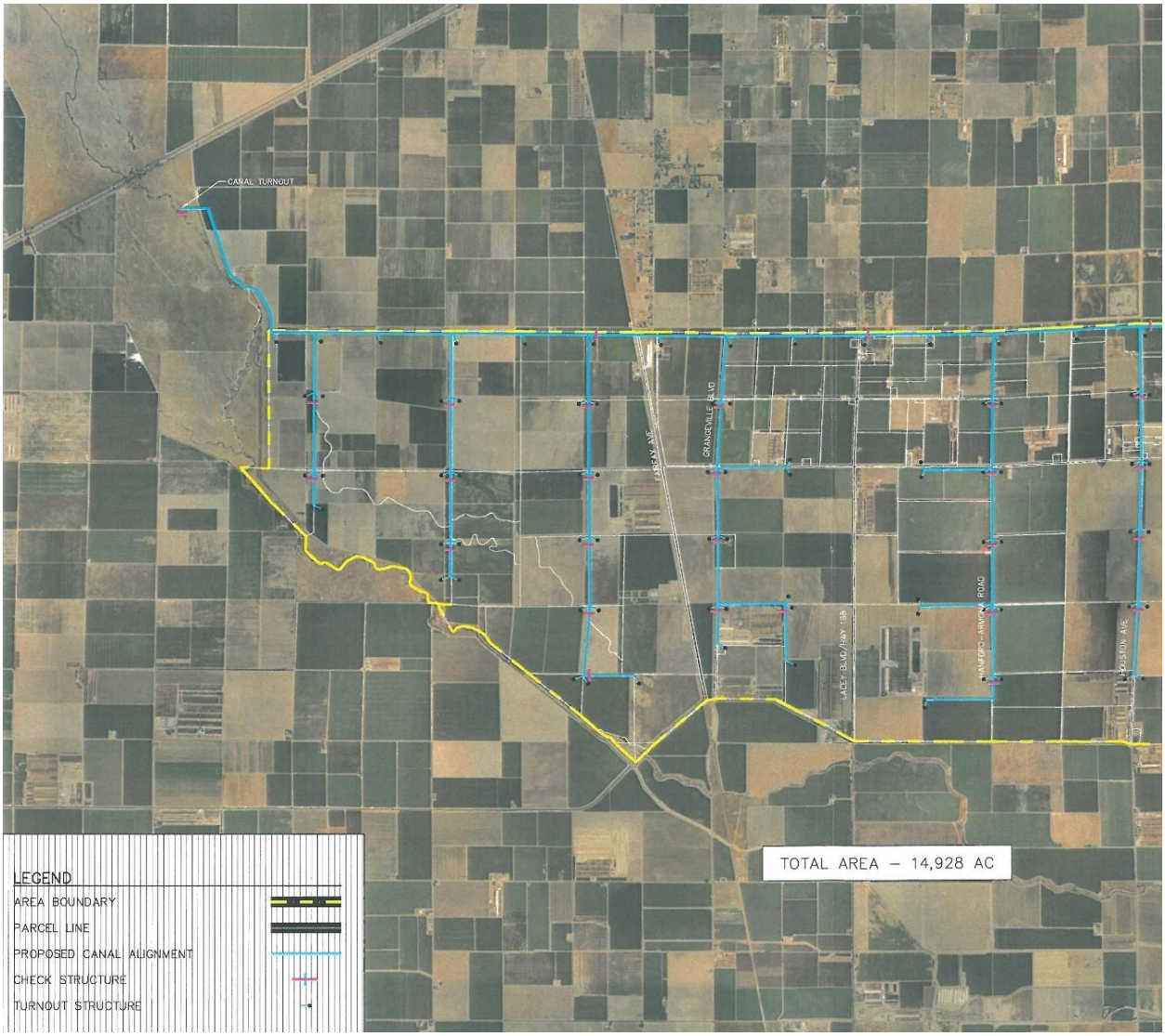
Implementing Agency: Kings County Water District, in partnership with Kaweah Delta Water Conservation District

6.6.4.1 Project Description

The Delta View Canal will create a new 200-foot wide surface water conveyance alignment for roughly 6.5 miles (160 acres) and will terminate at either an existing 160-acre wastewater retention basin owned by the City of Visalia or a property of similar size nearby. The proposed canal alignment is located along 1st Avenue between Cross Creek and Houston Avenue. The canal would have a capacity of 100 cubic feet per second (cfs). The existing basin, if available, is not fully utilized by the City so about 120 acres may be improved to become a recharge basin. The project might be utilized every fourth or fifth year during a wet winter season with flows

lasting up to 100 days. The total volume per use would be 20,000 AF, including 12,400 AF diverted to the groundwater recharge basin and 7,600 AF diverted for irrigation.

This canal will be located on agricultural acreage that relies on groundwater for irrigation and the elimination of this acreage will provide roughly 480 AF of in-lieu groundwater recharge per year (160 acres using 3 AF per year). Additional recharge may be realized through deep percolation of the irrigated water.



6.6.4.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.4.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the KCWD is implementing this project to increase recharge to the subbasin.

6.6.4.4 Public Notice and Outreach Process

Environmental review of the proposed project has not yet begun. Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KCWD and as necessary its partners KDWCD and/or GKGSA.

6.6.4.5 Estimated Annual Project Benefits

The project is estimated to provide an average annual benefit of 3,900 AF per year.

6.6.4.6 Permitting and Regulatory Process

Environmental review of the proposed project has not yet begun. The project will be subject to the typical regulatory process for large earth-moving projects, including CEQA as well as local permits.

6.6.4.7 Status and Schedule

The canal is anticipated to be non-agriculture during 2023 and ready to receive floodwater by 2025.

6.6.4.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 180,000 AF during the 50-year planning and implementation horizon, including 22,100 AF of in-lieu recharge and 158,000 AF of recharge via the basin. The average annual benefit would be 3,900 AF per year.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, and land subsidence. The recharge basin would likely improve groundwater quality since the floodwaters would be high-quality with a relatively low TDS.

6.6.4.9 Source and Reliability of Water

According to past hydrology documented in watermaster reports, floodwaters from the Kings River and/or Kaweah River systems are anticipated to occur on a 4-year reoccurrence period.

6.6.4.10 Legal Authority Required

KCWD has the statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its service area. *See, e.g., Cal Water Code* §§ 31020 et seq.

6.6.4.11 Costs and Funding

The estimated cost of the project is $2.5 million, including property acquisition, design, construction, and financing. The funding mechanism has not been selected but will likely be a land-based assessment and/or a groundwater pumping charge.

6.6.4.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.4.13 Level of Uncertainty

Wet conditions occur infrequently, perhaps every four or five years, so the project will be available during the wet years to capture additional recharge.

6.6.5 P5: Lakeland Canal Deliveries

Project Type: Local Surface Storage

Project Location: The area of this effort would be the Kaweah Subbasin area within Kings County. Generally, this efforts area would be a one to two-mile buffer around the Lakeland Canal within the Kaweah Subbasin.

Implementing Agency: Kings County Water District, in partnership with Corcoran Irrigation District

6.6.5.1 Project Description

The Lakeland Canal deliveries water from the Kings River and Cross Creek to parties in the Tulare Lake area. The capacity of the upper canal, north of Idaho Avenue, is greater than the lower canal and, during the 2017 flood release flows, Corcoran Irrigation District (CID) allowed growers to use temporary floating pumps to divert water from the upper canal. The cost of these temporary diversions was the same as the cost for CID growers. The use of these floodwater for irrigation will reduce a comparable amount of groundwater pumping and provide in-lieu groundwater recharge. This project will formalize this type of diversion and define the condition under which diversions may occur.

6.6.5.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, and subsidence.

6.6.5.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the KCWD is implementing this project to increase recharge to the subbasin.

6.6.5.4 Public Notice and Outreach Process

The proposed project has not yet gone through environmental review. Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KCWD, and as necessary by its partner GKGSA.

6.6.5.5 Estimated Annual Project Benefits

The project is estimated to provide an average annual benefit of 2,900 AF per year.

6.6.5.6 Permitting and Regulatory Process

The project would not be subject to any permitting or regulatory process.

6.6.5.7 Status and Schedule

The project is anticipated to begin in 2025.

6.6.5.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at nearly 140,400 AF of in-lieu groundwater recharge during the 50-year planning and implementation horizon with an average annual benefit of 2,900 AF per year.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, and land subsidence.

6.6.5.9 Source and Reliability of Water

According to past hydrology documented in watermaster reports, floodwaters from the Kings River and/or Kaweah River systems are anticipated to occur on a 4-year reoccurrence period.

6.6.5.10 Legal Authority Required

KCWD (*Cal. Water Code* §§ 31020 et seq.) and CID (*Cal. Water Code* §§ 22075 et seq.) have statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of their respective service areas.

6.6.5.11 Costs and Funding

The cost of negotiating the project is estimated at $0.1 million and would be borne by the benefactors of the project.

6.6.5.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.5.13 Level of Uncertainty

Wet conditions occur infrequently, perhaps every four or five years, so the project will be available during the wet years to capture additional recharge.

6.6.6 P7: Kings River Surplus Water

Project Type: Local Surface Storage

Project Location: To be determined

Implementing Agency: Kings County Water District, in partnership with Lakeside Irrigation Water District

6.6.6.1 Project Description

During wet years, surplus Kings River water is often available late in the season from water-right holders that are at risk of potential flood releases later in the fall. This surplus water could be purchased for recharge and delivered via existing canals to existing and future recharge basins.

6.6.6.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.6.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the KCWD is implementing this project to increase recharge to the subbasin.

6.6.6.4 Public Notice and Outreach Process

Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KCWD, and as appropriate by its partners LIWD and/or GKGSA.

6.6.6.5 Estimated Annual Project Benefits

The project is estimated to provide an average annual benefit of 1,800 AF per year.

6.6.6.6 Permitting and Regulatory Process

The project would be subject to any the surface water permitting process and would have to be coordinated with the water master(s).

6.6.6.7 Status and Schedule

The project is anticipated to begin in 2025 and benefits of the project would be realized immediately following the first year of available surplus water.

6.6.6.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 88,400 AF of groundwater recharge during the 50-year planning and implementation horizon with an average annual benefit would be 1,800 AF per year.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, and land subsidence. The recharge would likely improve groundwater quality since the surplus surface water would be high-quality with a relatively low TDS.

6.6.6.9 Source and Reliability of Water

According to past hydrology documented in watermaster reports, surplus water off of the Kings River system is anticipated to be available on a 4-year reoccurrence period. A floodwater agreement with KRWA has not been obtained and would be necessary to the success of the project.

6.6.6.10 Legal Authority Required

KCWD (*Cal. Water Code* §§ 31020 et seq.) and LIWD (*Cal. Water Code* §§ 22075 et seq.) have statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of their service areas.

6.6.6.11 Costs and Funding

The estimated cost of the project would be $85,000 per year for the purchase of surplus water. The funding mechanism has not been selected but will likely be a land-based assessment and/or a groundwater pumping charge.

6.6.6.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.6.13 Level of Uncertainty

Wet conditions occur infrequently, perhaps every four or five years, so the project will be available during the wet years to capture additional recharge.

6.6.7 P6: Kings River Floodwater Arrangement

Project Type: Local Surface Storage

Project Location: To be determined

Implementing Agency: Kings County Water District, in partnership with Lakeside Irrigation Water District

6.6.7.1 Project Description

The Kings River Service Areas excludes most of the Kings County portion of the Kaweah Subbasin. During significant flood releases, historically the Kings River Water Authority (KRWA) has allowed temporary use of the surplus supply under various flood water agreements.

As the lead agency, KCWD, as well as its partner, LIWD, are stockholders in the Peoples Ditch Company, which has a pre-1914 water right to the Kings River. This project will establish flood water agreements for KCWD and LIWD and reduce the demand for groundwater, which will provide in-lieu groundwater recharge. As new basins are developed in the area, the floodwaters could be used for groundwater recharge.

6.6.7.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, and subsidence.

6.6.7.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the KCWD is implementing this project to increase recharge to the subbasin.

6.6.7.4 Public Notice and Outreach Process

The proposed project has not yet gone through environmental review. Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KCWD and as necessary by its partners LIWD and/or GKGSA.

6.6.7.5 Estimated Annual Project Benefits

The project is estimated to provide an average annual benefit of 4,700 AF per year.

6.6.7.6 Permitting and Regulatory Process

The project would not be subject to any permitting or regulatory process.

6.6.7.7 Status and Schedule

The project is anticipated to begin during 2026 and benefits of the project would be realized immediately following the first year of available flood water.

6.6.7.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at nearly 228,800 AF of in-lieu groundwater recharge during the 50-year planning and implementation horizon with an average annual benefit of 4,700 AF per year.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, and land subsidence.

6.6.7.9 Source and Reliability of Water

According to past hydrology documented in watermaster reports, floodwaters off of the Kings River system are anticipated to occur on a 4-year reoccurrence period. A floodwater agreement with KRWA has not been obtained and would be necessary to the success of the project.

6.6.7.10 Legal Authority Required

KCWD (*Cal. Water Code* §§ 31020 et seq.) and LIWD (*Cal. Water Code* §§ 22075 et seq.) have statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of their service areas.

6.6.7.11 Costs and Funding

The cost of negotiating a flood water agreement with KRWA is estimated at $0.1 million and would be borne by the benefactors of the project.

6.6.7.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.7.13 Level of Uncertainty

Wet conditions occur infrequently, perhaps every four or five years, so the project will be available during the wet years to capture additional recharge.

6.6.8 P8: Fallowing Program by KCWD and LIWD

Project Type: Groundwater Conservation

Project Location: The project area for this program would be fields planted to annual crops where the owner is willing to accept the terms of the arrangement and compensation from the Districts.

Implementing Agency: Kings County Water District, in partnership with Lakeside Irrigation Water District

6.6.8.1 Project Description

KCWD and LIWD will develop a fallowing program in their combined areas to lease 1,500 acres of agricultural land from willing growers who are willing to accept compensation instead of irrigating a crop. This voluntary program would be similar to the former cotton fallowing program that sought to take cotton acreage out of production to synthetically limit the supply. For this program, the goal is to reduce cropped acreage and synthetically limit the amount of groundwater pumped each year while not permanently changing the agricultural land use status at the County Assessor's office.

Conceptually, KCWD and LIWD would determine an acreage target for the year in October, after the previous season was generally over. A sign-up period would be opened during January and February, prior to the next growing season. The lease would provide a payment to the growers for the fallowing of their agricultural land. If the acreage target is not roughly achieved, KCWD and LIWD would consider increasing the lease payment in the following year(s) to improve grower participation. The lease period would be for only one growing season, as defined by each district.

6.6.8.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, and subsidence.

6.6.8.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the KCWD and LIWD are implementing this project to reduce demand on the groundwater resources within the subbasin.

6.6.8.4 Public Notice and Outreach Process

The proposed project has not yet gone through environmental review. Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KCWD, and as appropriate by its partners LIWD and/or GKGSA.

6.6.8.5 Estimated Annual Project Benefits

The project is estimated to provide an average annual benefit of 3,750 AF per year.

6.6.8.6 Permitting and Regulatory Process

The project would not be subject to any permitting or regulatory process.

6.6.8.7 Status and Schedule

The fallowing program began in 2023 and is anticipated to be offered as an annual option for landowners..

6.6.8.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 183,800 AF of in-lieu groundwater recharge during the 50-year planning and implementation horizon with an average annual benefit would be 3,750 AF per year.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, and land subsidence.

6.6.8.9 Source and Reliability of Water

An alternate source of water is not required for a fallowing program.

6.6.8.10 Legal Authority Required

KCWD (*Cal. Water Code* §§ 31020 et seq.) and LIWD (*Cal. Water Code* §§ 22075 et seq.) have statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its service area.

6.6.8.11 Costs and Funding

The initial cost of the program is estimated at $500 per acre or $0.75 million per year for the lease plus annual administration and legal costs $65,000 per year. The funding mechanism has not been selected but will likely be a land-based assessment and/or a groundwater pumping charge

6.6.8.12 Management of Groundwater Extractions

The project will reduce groundwater extraction which will allow groundwater levels to recovery and replenish storage.

6.6.8.13 Level of Uncertainty

The level of participation in the fallowing program is the primary source of uncertainty. Fallowing can occur during the various types of hydrology (wet, normal, dry) within the subbasin.

6.6.9 P9: On-Farm Recharge and Storage in KCWD and LIWD

Project Type: Recharge Basins

Project Location: The area of this effort would be the Kaweah Subbasin area within Kings County.

Implementing Agency: Lakeside Irrigation Water District, in partnership with Kings County Water District

6.6.9.1 Project Description

The On-Farm Recharge in KCWD and LIWD intends to expand an on-going trend during the last ten years for growers to develop small, often temporary basin facilities that centralizes pumped groundwater for improved distribution within the irrigation system. The existing private facilities have taken small areas of acreage out of production and this project will take out an additional 500 acres (total) for use during periods of high surface water flows (every four to five years). Operating assumptions include nearly 60 days of operation and 0.25 AF per day per acre of recharge. The existing basins could also be used to store excess surface water during flood flows.

Conceptually, KCWD and LIWD would determine an acreage target for the year in October, after the previous season was generally over. A sign-up period would be opened during January and February, prior to the next growing season. The lease would provide a payment to the growers for the fallowing of their agricultural land. If the acreage target is not roughly achieved, KCWD and LIWD would consider increasing the lease payment in the following year(s) to improve grower participation. The lease period would be for only one growing season, as defined by each district.

6.6.9.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.9.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the LIWD and KCWD are implementing this project to increase recharge to the subbasin.

6.6.9.4 Public Notice and Outreach Process

The project has not yet begun the environmental review. Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KCWD, and as necessary by its partners LIWD and/or GKGSA.

6.6.9.5 Estimated Annual Project Benefits

The project is estimated to provide an average annual benefit of 1,900 AF per year.

6.6.9.6 Permitting and Regulatory Process

Consultation and coordination will be required with the Kings and Kaweah & St. Johns River Watermasters.

6.6.9.7 Status and Schedule

New facilities are expected to be built during the first 5-year period of implementation.

6.6.9.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 93,600 AF of recharge during the 50-year planning and implementation horizon with an average annual benefit of 1,900 AF per year.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, land subsidence, and water quality since the low TDS surface water will decrease the TDS of the groundwater.

6.6.9.9 Source and Reliability of Water

Pumped groundwater will be available as a property right where production wells exist and will be limited to groundwater availability and any restrictions administered by GKGSA. According to past hydrology documented in watermasters reports, floodwaters off of the Kings River and Kaweah River systems are anticipated to occur on a 4-year reoccurrence period.

6.6.9.10 Legal Authority Required

KCWD (*Cal. Water Code* §§ 31020 et seq.) and LIWD (*Cal. Water Code* §§ 22075 et seq.) have statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of their service areas.

6.6.9.11 Costs and Funding

The cost of the basin development would be borne by the land owner and the cost of the surface water would be an extension of the typical process to receive a normal allotment of surface water.

6.6.9.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.9.13 Level of Uncertainty

Wet conditions occur infrequently, perhaps every four or five years, so the project will be available during the wet years to capture additional recharge.

6.6.10 P10: Hannah Ranch Flood Control Project

Project Type: Local Conveyance Improvements

Project Location: The proposed project is located adjacent and south of the Lower Kaweah River, northeast of the City of Visalia, in Tulare County.

Implementing Agency: Kaweah Delta Water Conservation District

6.6.10.1 Project Description

The Hannah Ranch Flood Control Project is located adjacent and south of the Lower Kaweah River, northeast of the City of Visalia. The Project would develop a 1,500 acre-foot reservoir with diversions occurring from the Lower Kaweah River and the Friant-Kern Canal onto a 380-acre parcel owned by KDWCD. The project will include the construction of five earthen basins built below grade, new diversion structures from the Lower Kaweah River and the Friant-Kern Canal, and a curtain wall with an interceptor/drain system around three sides of the property to protect adjacent landowners from potential impacts related to elevated groundwater levels. An existing rubble dam on the Lower Kaweah River will be replaced with a concrete structure equipped with overshot gates for both backwater head control and flow passage. A regulated discharge facility will be constructed to return water to the Lower Kaweah River.



6.6.10.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.10.3 Circumstances and Criteria for Implementation

KDWCD has developed a Long-Term Master Plan for Water Management/Groundwater Recharge Projects for the purposes of study, design, funding and implementation. The project was able to obtain a matching State grant and it was determined to be a viable improvement for capturing and regulating available native and imported water supplies by the Board of Directors.

6.6.10.4 Public Notice and Outreach Process

Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KDWCD. The district holds monthly Board of Director's meetings and the project will be an agenda item for Board discussion regarding the project status, schedule, budget, necessary approvals and/or required action by the Board. KDWCD also maintains and regularly updates a website with project descriptions, current activities, and progress.

6.6.10.5 Estimated Annual Project Benefits

The primary purpose is the capture, regulation, and management of available native and imported surface water supplies to be distributed throughout multiple facilities within the subbasin for direct and/or in-lieu groundwater recharge. The project is estimated to generate a 2,250 AF annual average increase of water supply to mitigate overdraft within the subbasin.

6.6.10.6 Permitting and Regulatory Process

Numerous permits were retained for the project, including:

- Section 404 permit from the US Army Corps of Engineers (USACE) for in-stream alternations,
- 401 Water Quality Certification from the California Regional Water Quality Control Board (RWQCB) for potential degradation to water quality,
- Lake and Streambed Alteration Agreement from the California Department of Fish and Wildlife (CDFW) to address existing natural resources,
- Caltrans encroachment permit for work within a highway right-of-way,
- Grading permit from Tulare County,
- Dust control plan from the San Joaquin Valley Air Quality Control District (SJVAQCD),
- Storm Water Pollution Prevention Plan from the RWQCB,
- The CEQA process was completed early in the planning phase and resulted in a Mitigated Negative Declaration.

6.6.10.7 Status and Schedule

Design work is completed and permits obtained. Levees have been constructed forming the five basin, and approximately two-thirds of the basins have been excavated to final depth. The Friant Kern Canal turnout into the basin is complete and functional, and the Kaweah River check structure is undergoing construction (this was delayed by the 2023 flood operations). The

Kaweah River inlet and outlet into the basin is designed and going out for bid late Summer of 2024 (this was delayed by the 2023 flood operations). The project has received state and federal grant funding and could be operational by as early as 2025.

6.6.10.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 112,500 AF of in-lieu groundwater recharge during the 50-year planning and implementation horizon with an average annual benefit of 2,250 AF per year. Other benefits would include storm and flood water capture, potential power generation enhancement, and improved local water management and water reliability.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, land subsidence, and improved water quality since the low TDS surface water will decrease the TDS of the native groundwater.

6.6.10.9 Source and Reliability of Water

According to past hydrology documented in watermaster reports, surplus surface water is expected to be available approximately every four to five years, from the Kaweah River as well as from the Friant-Kern Canal via an existing contract with Central Valley Project (CVP).

6.6.10.10 Legal Authority Required

KDWCD has statutory authority to manage, regulate, and engage in water management activities, including groundwater recharge operations, for the benefit of its service area. *See, e.g., Cal. Water Code* §§ 31020 et seq.

6.6.10.11 Costs and Funding

The estimated cost of the project is $6.3 million, including property acquisition, design, and construction. Grant funding that has been awarded will support the majority of the project, including a federal WaterSMART grant of $1.0 million from the US Bureau of Reclamation (USBR) and a state grant of $3.1 million for Storm Water Management. The remainder of funds ($2.2 million) will be provided from local sources.

6.6.10.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.10.13 Level of Uncertainty

The project is currently under construction and in a location to optimize opportunities for maximizing its operational goals. Potential future circumstances that could reduce the effectiveness of the project include changes in climatic conditions, shifts in management schemes of regional native water rights users and imported supply contractors. Overall, the project should exhibit a relativity low level of uncertainty, primarily due to its favorable location near major sources of surface water supply.

6.6.11 P11: Paregien Flood Control Project

Project Type: Recharge Basin

Project Location: The Project is located along Deep Creek, northeast of the City of Farmersville, in Tulare County.

Implementing Agency: Kaweah Delta Water Conservation District

6.6.11.1 Project Description

The Paregien Flood Control and Recharge Project is located along Deep Creek, northeast of the City of Farmersville. The project is a storm and flood water control and groundwater recharge facility. The facility consists of a 60-AF groundwater recharge basin within an earthen levee that is perpendicular to the direction of flow in Deep Creek across a local depression (~20 acres, ~3 feet deep) and includes concrete water management structures and monitor wells. The project was completed in 2018.

6.6.11.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.11.3 Circumstances and Criteria for Implementation

KDWCD has developed a Long-Term Master Plan for Water Management/Groundwater Recharge Projects for the purposes of study, design, funding and implementation. The project was able to obtain a matching State grant and it was determined to be a viable improvement for capturing and regulating available native and imported water supplies by the Board of Directors.



6.6.11.4 Public Notice and Outreach Process

Appropriate notice and outreach were provided to various public agencies and other stakeholders by KDWCD. The district holds monthly Board of Director's meetings and the project will continue to be an agenda item for Board consideration regarding the project status, schedule, budget, necessary approvals and/or required action by the Board. KDWCD also maintains and regularly updates a website with project descriptions, current activities, and progress.

6.6.11.5 Estimated Annual Project Benefits

The primary purpose is the capture, regulation, and management of available native and imported surface water supplies for direct groundwater recharge in the natural channels and developed basins associated with the project. The project is estimated to provide an annual average of 2,370 AF for groundwater recharge to mitigate for overdraft within the subbasin.

6.6.11.6 Permitting and Regulatory Process

Numerous permits were acquired for the project, including

- USACE Section 404 permit for in-stream alternations,
- RWQCB 401 Water Quality Certification for potential degradation to water quality,
- CDFW Lake and Streambed Alteration Agreement to address existing natural resources,
- SJVAPCD Dust Control Plan,
- RWQCB Storm Water Pollution Prevention Plan,

The CEQA process resulted in a "Negative Declaration" and the NEPA determination by the USBR resulting in a "Finding of No Significance."

6.6.11.7 Status and Schedule

The project was completed and started operations in 2018.

6.6.11.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 118,500 AF of groundwater recharge during the 50-year planning and implementation horizon with an average annual benefit of 2,370 AF per year. Other benefits would include storm and flood water capture, potential power generation enhancement, and improved local water management and water reliability.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, land subsidence, and improved water quality since the low TDS surface water will decrease the TDS of the native groundwater.

6.6.11.9 Source and Reliability of Water

Surface water is expected to be available from the Kaweah River as well as from the Friant-Kern Canal via an existing CVP contract. According to past hydrology documented in watermasters reports, this water and floodwaters are expected to be available approximately every four to five years.

6.6.11.10 Legal Authority Required

KDWCD has statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its service area. *See, e.g., Cal. Water Code* §§ 74520 et seq.

6.6.11.11 Costs and Funding

The estimated cost of the project was $1.85 million, including $0.92 million from a USBR WaterSMART grant and $0.93 million from KDWCD.

6.6.11.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.11.13 Level of Uncertainty

The project has been completed recently and is operating in a location to optimize opportunities for maximizing its goals. Potential future circumstances that could reduce the effectiveness of the project include changes in climatic conditions, shifts in management schemes of regional native water rights users and imported supply contractors. Overall, the project should exhibit a relativity low level of uncertainty, primarily due to its favorable location near a significant source of surface water supply.

6.6.12 P12: Ketchum Flood Control & Recharge Project

Project Type: Recharge Basin

Project Location: The Project is proposed to be located along the St. Johns River, adjacent to Ketchum Ditch, southwest of the City of Woodlake, in Tulare County.

Implementing Agency: Kaweah Delta Water Conservation District

6.6.12.1 Project Description

The Ketchum Flood Control and Recharge Project is proposed to be located along the St. Johns River, adjacent to Ketchum Ditch, southwest of the City of Woodlake. The project will consist of a 75-AF groundwater recharge basin built below grade, a new diversion structure from Ketchum Ditch, and a release outlet structure to the St. Johns River. The nominal 20-acre basin will hold nearly four feet of water and is envisioned to be filled and emptied three times during a nominal 2-month period of flood flow. The percolation rate is estimated at 0.3 feet per day. Water should be available during alternating years and would be derived from floodwater, stormwater, and unused entitlement waters (water rights).

6.6.12.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.12.3 Circumstances and Criteria for Implementation

KDWCD has developed a Long-Term Master Plan for Water Management/Groundwater Recharge Projects for the purposes of study, design, funding, and implementation. The project was determined to be a viable improvement for capturing available native and imported water supplies by the Board of Directors. Study and design are currently on-going and additional partnerships are being pursued. A CEQA determination will have to be completed prior to the final dedication of funds for the implementation of construction.

6.6.12.4 Public Notice and Outreach Process

Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KDWCD. The district holds monthly Board of Director's meetings and the project will be an agenda item for Board consideration regarding the project status, schedule, budget, necessary approvals and/or required action by the Board. KDWCD also maintains and regularly updates a website with project descriptions, current activities, and progress.

6.6.12.5 Estimated Annual Project Benefits

The primary purpose is the capture, regulation, and management of available native and imported surface water supplies to be distributed throughout multiple downstream facilities within the sub-basin for direct and/or in-lieu groundwater recharge. The project is estimated to generate a 300 AF annual average increase of water supply to the benefit of the subbasin to mitigate overdraft in the subbasin.

6.6.12.6 Permitting and Regulatory Process

Numerous permits were acquired for the project, including

- USACE Section 404 permit for in-stream alternations,
- RWQCB 401 Water Quality Certification for potential degradation to water quality,
- CDFW Lake and Streambed Alteration Agreement to address existing natural resources,
- Grading permit from Tulare County,
- SJVAPCD Dust Control Plan,
- RWQCB Storm Water Pollution Prevention Plan,

The project will require a full CEQA evaluation and action by KDWCD to address impacts to natural resources.

Water rights and transfer agreements will need to be addressed prior to any operations because the project will receive, utilize, and regulate water from several different local and imported sources.

6.6.12.7 Status and Schedule

The project is in the initial conceptual development phase for evaluation of benefits by KDWCD in coordination with Tulare Irrigation Company (property owner).

6.6.12.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 18,400 AF of recharge during the implementation period if the project is in operation by 2025. The average annual benefit is estimated to be 300 AF per year, including an average of 200 AF per year from direct groundwater recharge during a nominal 2-month period of flow and an average of 100 AF per year from in-lieu groundwater recharge due to conveyance of the stored water. The project would also improve operational management of water in the area.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, land subsidence, and improved water quality since the low TDS surface water will decrease the TDS of the native groundwater.

6.6.12.9 Source and Reliability of Water

Surplus surface water is expected to be available from the Kaweah River and from the CVP contract. According to past hydrology documented in watermasters reports, this water Kaweah system and floodwaters are expected approximately every four to five years.

6.6.12.10 Legal Authority Required

KDWCD has statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its service area. *See, e.g., Cal. Water Code* §§ 74520 et seq.

6.6.12.11 Costs and Funding

The preliminary estimated cost of the project is $0.53 million, including property acquisition, administration, design, permits, and construction. The funds will be provided by KDWCD and possibly from other partners.

6.6.12.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.12.13 Level of Uncertainty

The project is in the initial planning and design phase with a proposed location to optimize opportunities for maximizing its goals. Potential future circumstances that could reduce the effectiveness of the project include changes in climatic conditions, shifts in management schemes of regional native water rights users and imported supply contractors. Overall, the project should exhibit a relativity low level of uncertainty, primarily due to its favorable location near a significant source of surface water supply.

6.6.13 P13: St. Johns River Water Conservation Project

Project Type: Regional Conveyance Improvements

Project Location: The proposed Project would be located along the St. Johns River, north of the City of Visalia, in Tulare County.

Implementing Agency: Kaweah Delta Water Conservation District

6.6.13.1 Project Description

The St. Johns River Water Conservation Project is located north of the City of Visalia and would make improvement to six existing in-stream check structures to better regulate and retain flows within the channel of the St. Johns River. This project would increase the average depth of the water by 1.5 feet (to 3 feet) and double the capacity of the existing structures to nearly 1,000 AF which can be used for irrigation instead of pumping groundwater. The existing structures are 300 feet wide by eight miles long total and will allow groundwater recharge at an estimated percolation rate of 0.3 feet per day during the nominal 3-week period of surplus water during alternating years.

6.6.13.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.13.3 Circumstances and Criteria for Implementation

KDWCD has developed a Long-Term Master Plan for Water Management/Groundwater Recharge Projects for the purposes of study, design, funding, and implementation. The project was determined to be a viable improvement for capturing available native and imported water supplies by the Board of Directors. Study and design are currently on-going and additional partnerships are being pursued along with potential grant funding opportunities. A CEQA determination will have to be completed prior to the final dedication of funds for the implementation of construction.

6.6.13.4 Public Notice and Outreach Process

Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KDWCD. The district holds monthly Board of Director's meetings and the project will be an agenda item for Board consideration regarding the project status, schedule, budget, necessary approvals and/or required action by the Board. KDWCD also maintains and regularly updates a website with project descriptions, current activities, and progress.

6.6.13.5 Estimated Annual Project Benefits

The primary purpose is the capture and management of available native and imported surface water supplies for direct groundwater recharge in the natural channel of the St. Johns River. The project is estimated to provide an annual average of 1,400 AF recharge to mitigate for overdraft within the subbasin.

6.6.13.6 Permitting and Regulatory Process

Numerous permits will be required for the project, including

- USACE Section 404 permit for in-stream alternations,
- RWQCB 401 Water Quality Certification for potential degradation to water quality,
- CDFW Lake and Streambed Alteration Agreement to address existing natural resources,
- SJVAPCD Dust Control Plan,
- RWQCB Storm Water Pollution Prevention Plan,

The project will require a full CEQA evaluation and action by KDWCD to address impacts to natural resources.

Water rights and transfer agreements will need to be addressed prior to any operations because the project will receive, utilize, and regulate water from several different local and imported sources.

6.6.13.7 Status and Schedule

The project is in the initial conceptual development phase for evaluation of benefits by KCWCD in coordination with the City of Visalia and various other water agencies to address stakeholder interests.

6.6.13.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 64,400 AF of recharge during the implementation period if the project is in operation by 2025. The average annual benefit is estimated to be 1,400 AF per year, including an average of 900 AF per year from direct groundwater recharge during the 3-week period of flow and an average of 500 AF per year from in-lieu groundwater recharge due to conveyance of the stored water. The project would also improve operational management of water in the area.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, land subsidence, and improved water quality since the low TDS surface water will decrease the TDS of the native groundwater.

6.6.13.9 Source and Reliability of Water

Surplus surface water is expected to be available from the Kaweah River and from existing CVP contracts. This water and floodwaters are expected approximately half the time – five out of every ten years.

6.6.13.10 Legal Authority Required

KDWCD has statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its service area. *See, e.g., Cal. Water Code* §§ 74520 et seq.

6.6.13.11 Costs and Funding

The preliminary estimated cost of the project is $2.0 million, including property acquisition, administration, design, permits, and construction. The funds will be provided by KDWCD and possibly from other partners.

6.6.13.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.13.13 Level of Uncertainty

The project is in the initial planning and design phase with a proposed location to optimize opportunities for maximizing its goals. Potential future circumstances that could reduce the effectiveness of the project include changes in climatic conditions, shifts in management schemes of regional native water rights users and imported supply contractors. Overall, the project should exhibit a relativity low level of uncertainty, primarily due to its favorable location near a significant source of surface water supply.

6.6.14 P14: Basin No. 4 Improvement Project

Project Type: Recharge Basin

Project Location: The proposed Project would be located on South Mill Creek, southwest of the City of Visalia.

Implementing Agency: Kaweah Delta Water Conservation District

6.6.14.1 Project Description

The Basin No. 4 Improvement Project is located on South Mill Creek, southwest of the City of Visalia on the Tulare County and Kings County line. Subject to agreement being reached with the City of Visalia, it would upgrade water control operations within the creek and to the nominal 120-acre City of Visalia-owned basin. The improvements would include the existing in-stream check structure that regulates water into the basin and downstream and would provide the ability to increase flow rates into the basin. The basin would have a capacity to store 500 AF of surplus water which can be used for irrigation instead of pumping groundwater, and recharge would occur during the nominal 3-week period of surplus water during alternating years at an estimated percolation rate of 0.3 feet per day.



6.6.14.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.14.3 Circumstances and Criteria for Implementation

KDWCD has developed a Long-Term Master Plan for Water Management/Groundwater Recharge Projects for the purposes of study, design, funding, and implementation. The project was determined to be a viable improvement for capturing available native and imported water supplies by the Board of Directors. Study and design are currently on-going and additional partnerships are being pursued along with potential grant funding opportunities. Agreement to proceed by City of Visalia and CEQA determination will have to be completed prior to the final dedication of funds for the implementation of construction.

6.6.14.4 Public Notice and Outreach Process

Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KDWCD. The district holds monthly Board of Director's meetings and the project will be an agenda item for Board consideration regarding the project status, schedule, budget, necessary approvals and/or required action by the Board. KDWCD also maintains and regularly updates a website with project descriptions, current activities, and progress.

6.6.14.5 Estimated Annual Project Benefits

The primary purpose is the capture and management of available native and imported surface water supplies for direct groundwater recharge within the existing 160 acres of basins at the facility. The project is estimated to recharge a 500 AF annual average increase of water supply to mitigate for overdraft within the subbasin.

6.6.14.6 Permitting and Regulatory Process

Numerous permits were acquired for the project, including

- USACE Section 404 permit for in-stream alternations,
- RWQCB 401 Water Quality Certification for potential degradation to water quality,
- CDFW Lake and Streambed Alteration Agreement to address existing natural resources,
- SJVAPCD Dust Control Plan,
- RWQCB Storm Water Pollution Prevention Plan,

The project will require a full CEQA evaluation and action by KDWCD to address impacts to natural resources.

6.6.14.7 Status and Schedule

The project is in the initial conceptual development phase for evaluation of benefits by KCWCD in coordination with the City of Visalia to address the needs of both agencies.

6.6.14.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 9,000 AF of recharge during the implementation period if the project is in operation by 2025. The average annual benefit is estimated to be 500 AF per year from direct groundwater recharge during the 3-week period of increased flows into the facility of 12 cfs per day. The project would also improve local water management.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, land subsidence, and improved water quality since the low TDS surface water will decrease the TDS of the native groundwater.

6.6.14.9 Source and Reliability of Water

Surplus surface water is expected to be available from the Kaweah River and from the CVP contract. This water and floodwaters are expected approximately half the time – five out of every ten years.

6.6.14.10 Legal Authority Required

KCWD has statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its service area. *See, e.g., Cal. Water Code* §§ 74520 et seq.

6.6.14.11 Costs and Funding

The preliminary estimated cost of the project is $0.4 million, including property acquisition, administration, design, permits, and construction. The funds will be provided by KDWCD and the City of Visalia.

6.6.14.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.14.13 Level of Uncertainty

The project is in the initial planning and design phase with a proposed location to optimize opportunities for maximizing its goals. Potential future circumstances that could reduce the effectiveness of the project include changes in climatic conditions, shifts in management schemes of regional native water rights users and imported supply contractors. Overall, the project should exhibit a relativity low level of uncertainty, primarily due to its location.

6.6.15 P15: Peoples Recharge Expansion Project

Project Type: Recharge Basin

Project Location: The proposed Project is proposed to be located along the Lower Kaweah River, adjacent to Peoples Basin, southwest of the City of Woodlake, in Tulare County.

Implementing Agency: Kaweah Delta Water Conservation District

6.6.15.1 Project Description

The Peoples Recharge Expansion Project is being developed as a groundwater recharge facility on about 25 acres and will consist of a 100-AF basin built below grade with a new diversion structure from Peoples Basin. The project would allow recharge to occur using surplus during a nominal 2-month period during alternating years at an estimated percolation rate of 0.3 feet per day.

6.6.15.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, subsidence, and possibly degradation of water quality.

6.6.15.3 Circumstances and Criteria for Implementation

KDWCD has developed a Long-Term Master Plan for Water Management/Groundwater Recharge Projects for the purposes of study, design, funding, and implementation. The project was determined to be a viable improvement for capturing available native and imported water supplies by the Board of Directors. Study and design are currently on-going and additional partnerships are being pursued along with future grant funding opportunities. A CEQA determination will have to be completed prior to the final dedication of funds for the implementation of construction.

6.6.15.4 Public Notice and Outreach Process

Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KDWCD. The district holds monthly Board of Director's meetings and the project will be an agenda item for Board consideration regarding the project status, schedule, budget, necessary approvals and/or required action by the Board. KDWCD also maintains and regularly updates a website with project descriptions, current activities, and progress.

6.6.15.5 Estimated Annual Project Benefits

The primary purpose is the capture and management of available native and imported surface water supplies for direct groundwater recharge within a proposed 40-acre basin at the facility. The project is estimated to provide an annual average of 300 AF of recharge to mitigate overdraft in the subbasin.

6.6.15.6 Permitting and Regulatory Process

Numerous permits will be required for the project, including

- Grading permit from Tulare County,

- SJVAPCD Dust Control Plan,
- RWQCB Storm Water Pollution Prevention Plan,

The project will require a full CEQA evaluation and action by KDWCD.

6.6.15.7 Status and Schedule

The project is in the initial conceptual development phase for evaluation of benefits by KDWCD, which has rights to develop the property under a long-term lease with Lindsay-Strathmore Irrigation District.

6.6.15.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 13,600 AF of recharge during the implementation period if the project is in operation by 2025. The average annual benefit will be about 300 AF per year, including an average of 200 AF per year from direct groundwater recharge during the 2-month period of flow and an average of nearly 100 AF per year from in-lieu groundwater recharge.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, land subsidence, and improved water quality since the low TDS surface water will decrease the TDS of the native groundwater.

6.6.15.9 Source and Reliability of Water

Surface water is expected to be available from the Kaweah River and from the CVP contract.

6.6.15.10 Legal Authority Required

KDWCD has statutory authority to manage, regulate, and engage in groundwater recharge operations for the benefit of its service area. *See, e.g., Cal. Water Code* §§ 74520 et seq. According to past hydrology documented in watermasters reports, this water and floodwaters are expected to occur approximately every four to five years.

6.6.15.11 Costs and Funding

The preliminary estimated cost of the project is $0.53 million, including property acquisition, administration, design, permits, and construction. The funds will be provided by KDWCD and possibly from other partners.

6.6.15.12 Management of Groundwater Extractions

The project will provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.6.15.13 Level of Uncertainty

The project is in the initial planning and design phase with a proposed location to optimize opportunities for maximizing its goals. Potential future circumstances that could reduce the effectiveness of the project include changes in climatic conditions, shifts in management schemes of regional native water rights users and imported supply contractors. Overall, the project should exhibit a relativity low level of uncertainty, primarily due to its location.

6.6.16 P16: Greater Fallowing Auction Program

Project Type: Groundwater Conservation

Project Location: The project area for this program would be fields where the owner is willing to accept the terms of the arrangement and compensation from the GSA for one year of fallowing.

Implementing Agency: Greater Kaweah GSA

6.6.16.1 Project Description

An annual fallowing program will be made available to growers to submit an application/bid to participate in the Program. In the application growers will submit the lowest price they are willing to be compensated by the GSA for fallowing a certain amount of acreage for a year. Growers with the lowest bids will be accepted into the program.

6.6.16.2 Measurable Objective Addressed

The project will assist in achieving the measurable objectives for chronic lowering of groundwater levels, reduction in storage, and subsidence.

6.6.16.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the GSA is implementing this project to reduce demand on the groundwater resources within the subbasin.

6.6.16.4 Public Notice and Outreach Process

The project was first implemented for the Water Year 2023 – 2024 and was noticed through mailers, the GKGSA website, and email blasts. It will be implemented again in Water Year 2024 – 2025 through the same means.

6.6.16.5 Estimated Annual Project Benefits

The project is estimated to provide an average annual benefit of 3,000 AF per year. The first year saved 1,100 acre feet.

6.6.16.6 Permitting and Regulatory Process

The project would not be subject to any permitting or regulatory process.

6.6.16.7 Status and Schedule

The fallowing program is began in 2023 and is expected to be an annual program offered by the GSA.

6.6.16.8 Expected Benefits and Targeted Sustainability Indicators

The expected benefits are estimated at 150,000 AF of in-lieu groundwater recharge during the 50-year planning and implementation horizon with an average annual benefit would be 3,000 AF per year.

The targeted sustainability indicators include stabilization of groundwater levels and, by proxy, groundwater storage, and land subsidence.

6.6.16.9 Source and Reliability of Water

An alternate source of water is not required for a fallowing program.

6.6.16.10 Legal Authority Required

No specific authority is needed for this program.

6.6.16.11 Costs and Funding

The initial cost of the for the Water Year 2023 – 2024 program was approximately $370,000 amounting to an estimated $560 per acre. The funding mechanism is the pumping penalty charges for growers that pump in excess of sustainable yield. Each year the GSA Board of Directors will review the Fallowing Reserve Fund balance and set the total fallowing dollars.

6.6.16.12 Management of Groundwater Extractions

The project will reduce groundwater extraction which will allow groundwater levels to recovery and replenish storage.

6.6.16.13 Level of Uncertainty

The level of participation in the fallowing program is the primary source of uncertainty. Fallowing can occur during the various types of hydrology (wet, normal, dry) within the subbasin.

6.6.17 Conceptual Projects

The following conceptual projects are being explored by GKGSA but have not yet been evaluated for their impact on reaching the Sustainability Goal. When the concepts are adequately developed and determined to be reasonably feasible to move forward, they will be included in future updates to the Greater Kaweah GSP.

6.6.17.1 Lewis Creek Conservation Project

The Lewis Creek Water Conservation Project will be located along Lewis Creek immediately upstream of its confluence with Outside Creek, between the cities of Tulare and Porterville. As envisioned currently, the Project would consist of five in-stream check structures that would regulate and retain flows within the channel (water conservation) and enhance groundwater recharge. The overall dimensions are envisioned to be four miles long, 20 feet wide, and four feet deep, which would provide 40 AF of in-stream storage. The project would provide in-lieu groundwater recharge during a 3-week period of surplus in-stream storage and direct recharge during a nominal 2-month period of stream flow. The expected recharge benefits are estimated at an average annual benefit of 400 AF per year, including 200 AF per year from direct groundwater recharge during a 2-month stream flow period and an average of 200 AF per year from in-lieu groundwater recharge during the temporary storage of surplus water. The project would also improve operational management of water in the area. The source of water would be surplus supply from the Kaweah River and from existing CVP contracts. The preliminary estimated cost of the project is $1.0 million, including property acquisition, administration, design, and construction. Funding has not yet been identified but would likely be provided by KDWCD and Consolidated Peoples Ditch Company (CPDC), and possibly from other partners.

6.6.17.2 Kasbergen Basin Project

The proposed Kasbergen Basin is an example of a project that involves the construction of an on-farm retention and recharge basin. It is one of many projects being negotiated between Consolidated Peoples Ditch Company (CPDC) and its shareholders to construct cost effective, small on-farm basins for the purposes of capturing surface waters when available from the Kaweah River and from existing CVP contracts. Accounting of water conveyed to the project would be the responsibility of CPDC and would be reported to GKGSA in conformance with the Water Accounting Framework and water budgeting informational needs. The Kasbergen Basin could be built within the first year of GSP implementation, has an estimated cost of $5,000 and would be entirely funded by the land owner.

6.7 Management Actions

The Management Actions proposed in this Plan by the GKGSA are generally considered in two phases where the first phase includes pilot programs for the first five years and successful programs are implemented for a second phase during the remainder of SGMA implementation. This pilot phase would allow the GKGSA to monitor and evaluate the efficacy of each action prior to full implementation throughout the GSA.

6.7.1 MA1: Communication & Engagement

6.7.1.1 Management Action Description

The GKGSA will pursue in communication and engagement to all beneficial uses and users of groundwater within its jurisdiction in a manner consistent with the adopted GKGSA Communication and Engagement Plan. The goal is to provide ongoing correspondence to groundwater users and promote awareness of the aquifer condition and efforts and progress towards avoidance of Undesirable Results.

6.7.1.2 Measurable Objectives Addressed

The management action will not directly affect measurable objectives but, hopefully, will raise the awareness of groundwater users of the limited nature of this renewable resource and promote conservation, which will reduce demand and allow the recovery of groundwater levels and storage.

6.7.1.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the GKGSA is implementing this project to increase recharge to the subbasin.

6.7.1.4 Public Notice and Outreach Process

Appropriate notification and outreach will be conducted consistent with GSA authorities and requirements and with the adopted GKGSA Communication and Engagement Plan.

6.7.1.5 Estimated Annual Project Benefits

This management action will provide information to stakeholders and encourage them to conserve water, thus reducing demand on the groundwater resource. Quantification of this demand reduction is not practical and may not be possible given the other tangible efforts to manage the groundwater resource.

6.7.1.6 Permitting and Regulatory Process

Permitting and regulatory processes are not applicable to this management action.

6.7.1.7 Status of Management Action

The Management Action requires an update to the GKGSA Communication and Engagement Plan which will occur beginning in 2020. Updating the plan and initial implementation activities are expected to occur within six to nine months.

6.7.1.8 Expected Benefits and Targeted Sustainability Indicators

The GKGSA expects to benefit from this management action by encouraging involvement, open lines of communication and communicating future opportunities for input. Another expected benefit may include avoidance of Undesirable Results by educating the public on the use and condition of the groundwater resource.

6.7.1.9 Source and Reliability of Water

A source of reliable water is not needed for this Management Action.

6.7.1.10 Legal Authority Required

SGMA (*Cal Water Code* §§ 10725 et seq.) and related provisions and Article II of the agencies' Joint Powers Agreement provide GKGSA with the authority required to carry out activities related to this Management Action.

6.7.1.11 Costs and Funding

The ongoing cost to perform communication and outreach to beneficial users of groundwater in the GKGSA is $10,000 per year. Funding for related activities will be provide for by the GKGSA through either Member assessment, or land-based Proposition 218 assessment.

6.7.1.12 Management of Groundwater Extractions

This management action will promote the wise utilization of the groundwater resource and encourage conservation during wet periods to allow for the recovery of groundwater levels and storage after drought periods.

6.7.1.13 Level of Uncertainty

The success of this communication program and the potential reduction in demand cannot be predicted at this time but will likely produce positive results during the course of the implementation period.

6.7.2 MA2: Terminus Reservoir Reoperation Program

6.7.2.1 Management Action Description

Flow in the Kaweah River is regulated by the United States Army Corps of Engineers (USACE) for flood control purposes via Lake Kaweah and the control works. KDWCD has a contract with USACE for water storage rights at Lake Kaweah, which provides operational management of entitled irrigation supplies for the region.

The proposed program will be a review of the USACE Terminus (Lake Kaweah) Water Control Diagram with the intent to revise the Diagram to improve operational management. The Water Control Diagram provides the basis for determining allowable storage at Lake Kaweah while providing sufficient vacant space to receive inflows that could be a flood risk below the lake. The advent of the Airborne Snow Observatory program offers a new tool for evaluating water stored in the snow pack and predicting watershed run-off under various conditions. This tool could potentially be utilized to refine the USACE approach to regulating the balance between allowable storage for flood control and maximizing the storage for the benefit of irrigation demands.



6.7.2.2 Measurable Objectives Addressed

This management action will maximize the available storage of surface water at Lake Kaweah, retain more of the native surface water within the subbasin, and reduce the overdraft of the groundwater resource. The action will allow the recovery of groundwater levels and an increase in groundwater storage.

6.7.2.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the GKGSA is implementing this project to increase recharge to the subbasin.

6.7.2.4 Public Notice and Outreach Process

Revision to the Water Control Diagram would be completed by the USACE in accordance with federal regulations. Public notices and outreach would occur in compliance with those federal regulations.

KDWCD holds monthly Board of Director's meetings and this management action will be an agenda item for Board consideration regarding the project status, schedule, budget, necessary approvals and/or required action by the Board. KDWCD also maintains and regularly updates a website with project descriptions, current activities, and progress.

6.7.2.5 Estimated Annual Project Benefits

This management action does not address demand reduction so quantification cannot be done, but rather seeks to change the operation of a reservoir to optimize and modernize the distribution of water.

6.7.2.6 Permitting and Regulatory Process

Revision to the Water Control Diagram would be under USACE jurisdiction in accordance with their prescribed procedures. Other permitting or regulatory processes are not expected outside of the USACE actions.

6.7.2.7 Status of Management Action

The proposed action is currently in the preliminary phase of planning. Consultants will be retained to perform an analysis of alternatives prior to seeking the USACE consideration of the revision.

6.7.2.8 Expected Benefits and Targeted Sustainability Indicators

An updated Water Control Diagram will maximize the available storage of surface water at Lake Kaweah, retain more of the native surface water within the subbasin, and reduce the overdraft of the groundwater resource. Increased knowledge of the watershed hydrologic conditions will promote the most efficient use of available storage at Lake Kaweah. In addition, this approach could improve the utilization of imported water to the subbasin via opportunities to capture available CVP water during timespans when there were previous operational conflicts.

6.7.2.9 Source and Reliability of Water

This management action is targeting excess water in the Kaweah River that cannot be stored in Lake Kaweah due to the existing and dated operational procedures. All such excess surface water is covered under the KDWCD entitlement. Any improvement in imported supply would be the result of KDWCD optimizing its CVP contract to gain access to available supplies from other CVP contractors.

6.7.2.10 Legal Authority Required

KDWCD has statutory authority to manage, regulate, and engage in water management activities, including groundwater recharge operations, for the benefit of its service area. *See, e.g.*, *Cal. Water Code* §§ 31020 et seq. USACE has the authority to revise the Water Control Diagram for Lake Kaweah.

6.7.2.11 Costs and Funding

The preliminary estimated cost of the project is $0.33 million, including administration, consultant services, and USACE expense. The funds will be provided by KDWCD and Kaweah & St. Johns Rivers Association.

6.7.2.12 Management of Groundwater Extractions

The management action, if acceptable to the USACE, will optimize the flow of surface water and could provide additional recharge to the subbasin during wetter years to increase groundwater levels and replenish storage as an offset to decreasing levels and storage during drought conditions.

6.7.2.13 Level of Uncertainty

The USACE is responsible for the operation of the facility and has well-established rules for this effort. Revisions to these rules could require a considerable amount of deliberation before revisions are made.

6.7.3 MA3: Groundwater Extraction Measurement Program

6.7.3.1 Management Action Description

Within the GKGSA, all extractions by municipal systems are fully metered and such groundwater extractions and associated constituent levels are reported at least annually to the SWRCB. These municipal systems include the City of Farmersville, the City of Exeter, the City of Woodlake, Ivanhoe PUD, Tract 92 CSD, and Patterson Tract CSD. However, extraction measurements have not been required for private well owners within the irrigation districts and ditch company service areas, or in the undistricted lands within GKGA. Extractions from these wells, primarily for irrigation, must be reported in the aggregate annually to the state according to §10728 and measured according to §10725.8 of SGMA.

GKGSA plans to initiate a pilot program in conjunction with the other two GSAs of the Kaweah Subbasin to determine the most feasible means to comply with the SGMA measurement provision. The measurement alternatives and data processing methods to be evaluated are depicted by **Figure 6-2**:

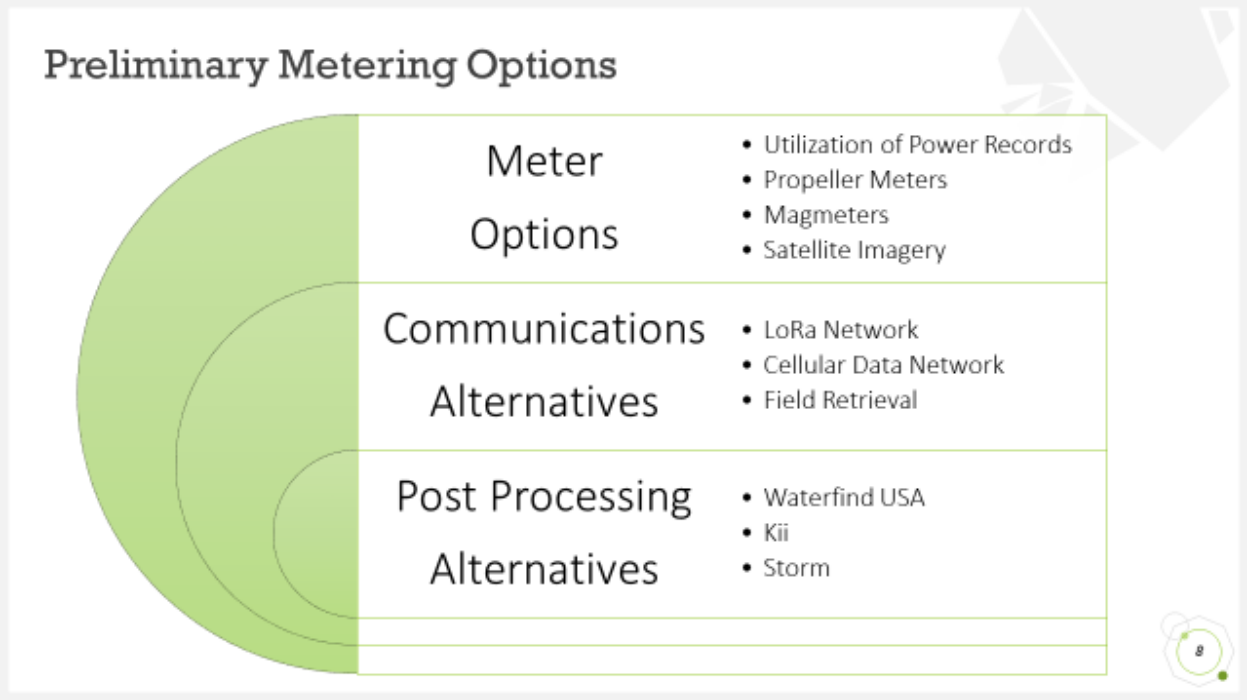


Figure 6-2: Data Measurement Alternatives

6.7.3.2 Measurable Objectives Addressed

This management action will initiate the quantification process for the volume of groundwater extracted by various users versus the assumed volume of extracted groundwater. Ideally, this validation process will lead to better estimates of use and perhaps a reduction in use, which would reduce demand and allow groundwater levels and storage to rise.

6.7.3.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the GKGSA is implementing this project to increase recharge to the subbasin.

6.7.3.4 Public Notice and Outreach Process

Appropriate notification and outreach will be conducted consistent with GSA authorities and requirements. The management action will begin as a voluntary pilot program with a notice sent to landowners and a general call for volunteers at the GKGSA public meetings and on the GKGSA website.

6.7.3.5 Estimated Annual Project Benefits

This management action will provide a better understanding of actual groundwater production versus assumed production and will enhance the management of the resource. An annual benefit cannot be defined at this time.

6.7.3.6 Permitting and Regulatory Process

Authority for groundwater measurement collection and processing resides within SGMA as previously cited. Additional permitting or regulatory compliance will not be necessary to implement a pilot program or to scale up to full coverage within the GSA.

6.7.3.7 Status of Management Action

This proposed action is in the preliminary phase of planning. A proposal to initiate an evaluation of options was submitted to DWR for consideration of Technical Services funding and is currently under review.

6.7.3.8 Expected Benefits and Targeted Sustainability Indicators

The management action will improve the knowledge on the timing and volume of groundwater extraction and, coupled with the aquifer response, should aid in the improvement of the Kaweah Subbasin predictive capability of the numerical model and in future groundwater management in general. Additionally, the development of a measurement standard for groundwater extraction will facilitate the development of a water market/allocation program, should the GKGSA decide to pursue such a program.

6.7.3.9 Source and Reliability of Water

An additional water source is not required for this Management Action.

6.7.3.10 Legal Authority Required

Extractions from these wells, primarily for irrigation, must be reported in the aggregate annually to the state according to §10728 and measured according to §10725.8 of SGMA.

6.7.3.11 Costs and Funding

A proposal to initiate an evaluation of options was submitted to DWR for consideration of Technical Services funding and is currently under review. Costs to measure groundwater extractions within GKGSA could vary widely, from $200,000 to upwards of $4 million for capital and installation, and from under $50,000 to as much as $250,000 annually for O&M. According to SGMA §10725.8(b), costs for the measurement devices will be borne by the well owner/operator, so the cost exposure to the GKGSA in implementing a measurement program is not presently known. Since the municipal GSA Members already fund and operate meters at their facilities, the costs associated with an extraction measurement program lie primarily with the irrigation districts, ditch companies, and private landowners in undistricted lands of the GKGSA and with the GKGSA for the compilation and evaluation of the data.

6.7.3.12 Management of Groundwater Extractions

The management action could lead to better quantification of groundwater production which could optimize the use of the groundwater resource. As such, groundwater levels and storage could improve during wet years and offset decreasing groundwater levels and storage during drought years.

6.7.3.13 Level of Uncertainty

The use of meters will reduce the level of uncertainty associated with the production of groundwater from the subbasin.

6.7.4 MA4: Well Characterization

6.7.4.1 Management Action Description

Many agricultural wells have limited or no information as to depth, casing characteristics or screen intervals. This project would entail video logging and spinner logging to ascertain well construction and delineate groundwater production zones, respectively. Water quality profiling and depth-specific sampling might further delineate differences in aquifer zones, based on the vertical distribution of select constituents.

6.7.4.2 Measurable Objectives Addressed

This management action will enhance the understanding of the wells that provide the characterization data of the aquifer system. The management of the groundwater resource will

benefit from this improved understanding which could allow the recovery of groundwater levels and storage.

6.7.4.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the GKGSA is implementing this project to increase recharge to the subbasin.

6.7.4.4 Public Notice and Outreach Process

Appropriate notification and outreach will be conducted consistent with GSA authorities and requirements. The pilot phase of this program shall be voluntary, with noticing via mailers to landowners and a general call for volunteer participants at the GKGSA's publicly held meetings and on the GKGSA's website.

6.7.4.5 Estimated Annual Project Benefits

This management action provides assistance to well owners that are impacted by the management of the groundwater resources and does not provide an annual benefit to the aquifer system.

6.7.4.6 Permitting and Regulatory Process

Permitting and regulatory process are not applicable to this Management Action.

6.7.4.7 Status of Management Action

This Project will be defined and pursued during the first several years of GSP implementation and progress will be documented in the succeeding five-year assessment report to DWR.

6.7.4.8 Expected Benefits and Targeted Sustainability Indicators

Expected benefits from this program include improved understanding of groundwater production from wells within the GKGSA and associated aquifer responses to groundwater extraction operations. Overall improvements in characterization of principal aquifers and aquitards is expected once we are able tie specific wells and their water level and water quality information with specific aquifers. Sustainability indicators anticipated to benefit via this improved knowledge and incorporation into the Subbasin numerical model would include groundwater level stabilization and, by proxy, groundwater storage stabilization, as well as potentially reduced water quality degradation. In addition, well characterization could be integrated with the AEM data to better improve the understanding of the subsurface hydrogeology.

6.7.4.9 Source and Reliability of Water

An additional water source is not required for this Management Action.

6.7.4.10 Legal Authority Required

SGMA, at §10725.2, allows GSAs to pursue various means to improve its understanding of the subbasin and production wells therein.

6.7.4.11 Costs and Funding

Costs associated with this Management Action could be $15,000 per well, possibly more, for contractor costs and will be refined during the early stages of GSP implementation. A budget of $150,000 would allow ten wells to be characterized per year. An appropriate fee collection structure from GSA members will be determined during that time.

6.7.4.12 Management of Groundwater Extractions

This management action will not have a direct effect on groundwater extraction and recharge.

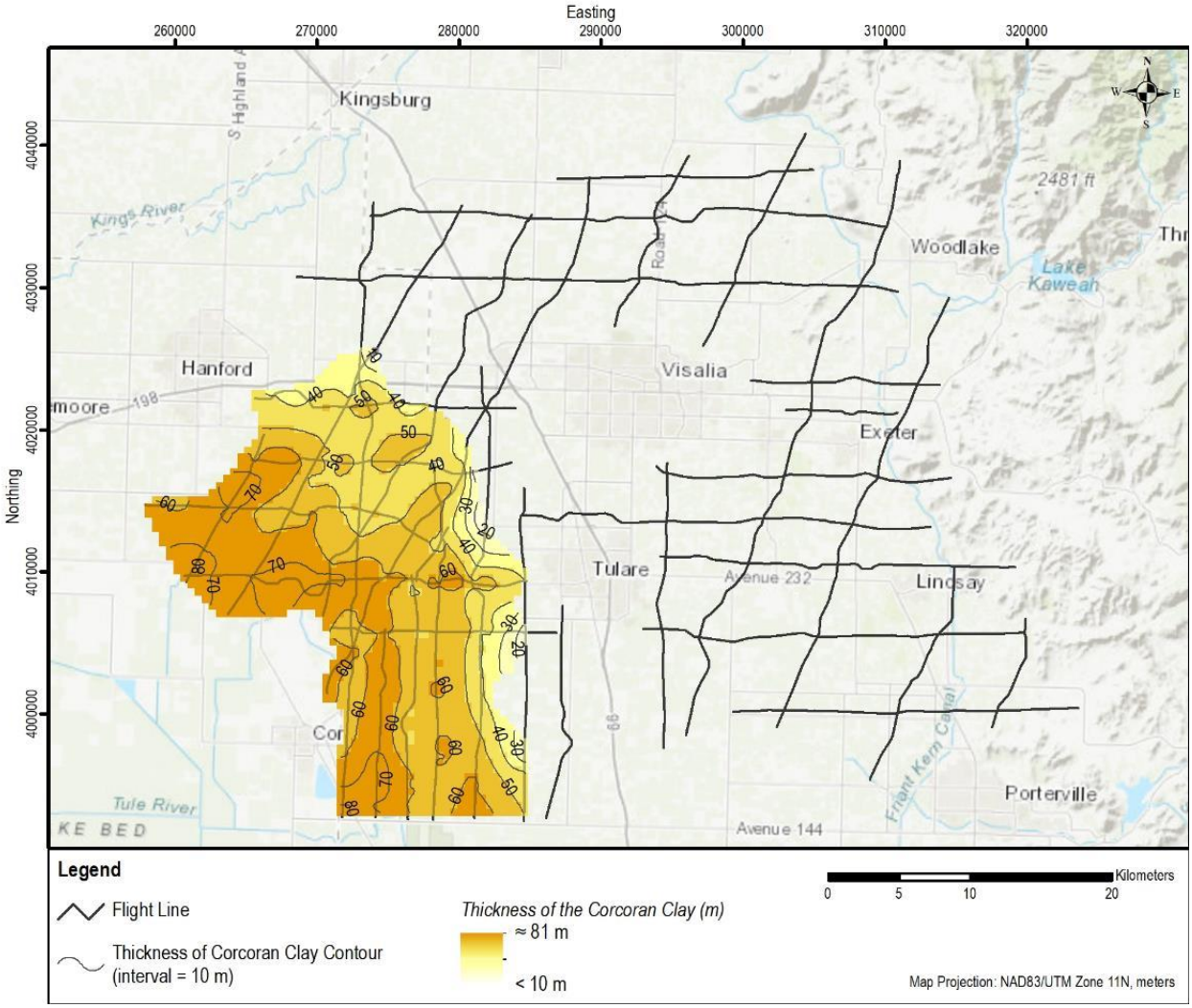
6.7.4.13 Level of Uncertainty

The characterization of wells will reduce the level of uncertainty associated with depths of groundwater production zones within the aquifer system and facilitate the refinement of various components of the basin setting.

6.7.5 MA5: Geophysical Data Survey

6.7.5.1 Management Action Description

GKGSA and the other two Kaweah GSAs in the Kaweah Subbasin served as a pilot geophysical program for hydrogeological subsurface data collection using an airborne electromagnetic method (AEM) via the company Aqua Geo Frameworks during the fall of 2018. This airborne survey method acquires deep aquifer resistivity data to better ascertain its characteristics and geology. The Phase I survey was jointly funded by Stanford University and the three Kaweah Subbasin GSAs, with data processing by Aqua Geo Frameworks using a SkyTEM system. The data was collected by way of helicopter fly-overs along pre-selected flight lines within the Kaweah Subbasin. 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 are developing. The data were not available to the Kaweah GSAs in time for its inclusion in the Basin Setting Report (**Appendix 3A**); however, this information will be reviewed and incorporated into the 2025 Plan Update.



GKGSA may also utilize a towable electromagnetic imaging method that measures the resistivity of soils at depths of 100 ft or less. This resistivity information could be used to determine areas that are best suited (high infiltration rates) for groundwater recharge basins or for on-farm recharge programs. This ground-based technology is currently being evaluated and used within the Tulare Irrigation District areas of Mid-Kaweah GSA.

Stanford has also obtained a grant from National Academy of Sciences to integrate InSAR ground displacement data with AEM to improve groundwater modeling tools for the Kaweah Subbasin. These additional data will enhance the overall understanding of the Kaweah Subbasin and its underlying aquifer characteristics, assist with the Basin Setting and Hydrogeologic Conceptual Model, and provide new calibration parameters for the Subbasin numerical simulation model. The project will also provide direct benefits to the GSAs and landowners along the proposed new flight lines by providing detailed subsurface information not previously available.

6.7.5.2 Measurable Objectives Addressed

The study has improved the understanding of subsurface conditions and does not address measurable objectives and other management criteria.

6.7.5.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the GKGSA is implemented this study to further the understanding of subsurface conditions.

6.7.5.4 Public Notice and Outreach Process

The study was discussed in GKGSA public meetings. Future work, if any, will be appropriately noticed and outreach will be conducted consistent with GSA authorities and requirements.

6.7.5.5 Estimated Annual Project Benefits

The study has improved the understanding of subsurface conditions and will not produce an annual benefit to the groundwater resources.

6.7.5.6 Permitting and Regulatory Process

The regulatory process includes a FCC license due to electromagnetic wave signals and appropriate FAA plans due to the relatively low altitude flights.

6.7.5.7 Status of Management Action

Phase I of the fly-over data collection effort was completed during 2018 and a report was issued during late April 2019. Consideration of this information will be included in the 2025 GSP Update. The report includes several recommendations for a Phase II survey, including:

1. Additional AEM mapping with high density block flights would allow for improved hydrogeologic framework for identifying potential recharge areas and potential managed aquifer recharge sites and for estimating groundwater in storage and hydrogeologic boundary identification.
2. Siting new boreholes used for water quality and water quantity should use the results from this survey and future surveys to optimize locations.
3. Aquifer characteristic studies such as aquifer tests and other methods should be planned, based on the data from this study, to optimize location for studies and observation-production well installation.
4. Improved geophysical borehole logs will benefit current and future studies. This logging should use calibrated equipment for best results.

6.7.5.8 Expected Benefits and Targeted Sustainability Indicators

The anticipated benefits of this study include enhanced knowledge of the subsurface geology and a more robust HCM description as a result. Interpretation of the data resulted in three-dimensional mapping which could allow refinement of the structure of the Kaweah Subbasin numerical model and improved predictive accuracy. The mapping could benefit the siting of groundwater recharge projects and dedicated monitoring wells. These benefits are expected to be realized and documented in the first five-year GSP assessment to be conducted by each Subbasin GSA and submitted to DWR. Sustainability indicators anticipated to benefit via this improved knowledge would include groundwater level stabilization and, by proxy, groundwater storage stabilization, and possibly the identification of degraded water quality.

6.7.5.9 Source and Reliability of Water

An additional water source is not required for this Management Action.

6.7.5.10 Legal Authority Required

SGMA, at §10725.2, allows GSAs to pursue various means to improve its understanding of the subbasin.

6.7.5.11 Costs and Funding

The cost of the Phase I Survey was 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 GEI

A Phase II survey is estimated to cost $400,000. The funding mechanism has not yet been selected but will likely be a mix of grant funding (if available), land-based assessment, and/or a groundwater pumping charge.

6.7.5.12 Management of Groundwater Extractions

This management action will not have a direct effect on groundwater extraction and recharge.

6.7.5.13 Level of Uncertainty

Geophysical methods are an indirect measurement of subsurface conditions that must to correlated with actual data from the subsurface. The Phase 1 results appeared reasonably consistent with known subsurface conditions.

6.7.6 MA6: Kaweah Subbasin Mitigation Program & GKGSA Mitigation Plan (*New)

6.7.6.1 Management Action Description

The Mitigation Program establishes requirements 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. Each GSA has discretion to expand beyond the requirements detailed in the Mitigation Program in their own respective Mitigation Plans **(**Figure 6-2**).** Figure 6-3 describes the Mitigation Program and GKGSA Plan (See Appendix 6A and 6B).

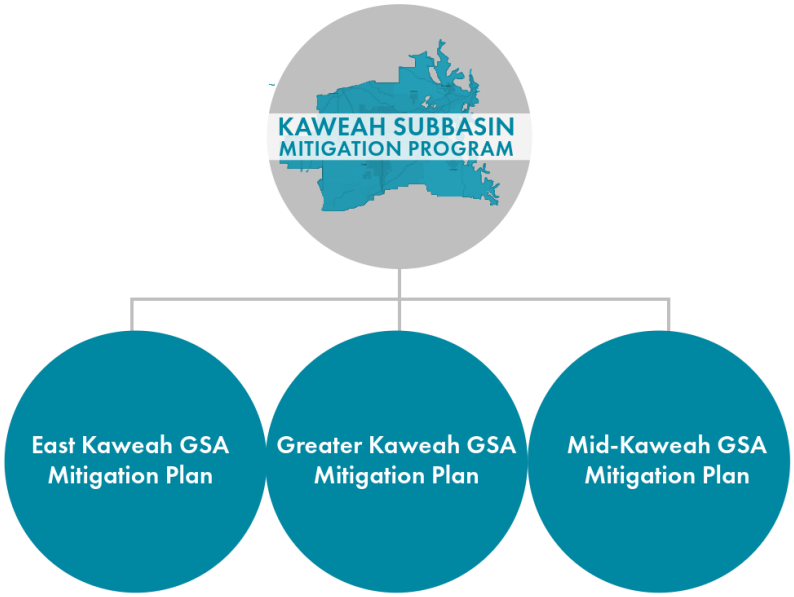


Figure 6-2 Relationship between Kaweah Subbasin Mitigation Program and GSA Mitigation Plans

The Kaweah Subbasin Mitigation Program and GKGSA Mitigation Plan offers two tracks for assistance, Drinking Water Well Mitigation and Technical Assistance for non-drinking water wells and critical infrastructure. Important distinctions between the two tracks are described in Figure 6-4.

The Mitigation Program 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 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.



Figure 6-3 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.

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Figure 6-3 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 & GKGSA
Contact MKGSA or GKGSA 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 disucss 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.

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Figure 6-3 Kaweah Subbasin Mitigation Program Flyer (page 3 of 3)

6.7.6.2 Circumstances 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 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 mitigating such impacts by committing to implementing this Program. Funding is available for the Program through GSAs implementation of assessments, fees, charges, and penalties. In addition, the GSAs will explore other state, federal, and private funding opportunities including grant programs.

6.7.6.3 Process for Public Notification

The public and relevant entities must be given the opportunity and time to comment on the Program prior to adoption by the GSA. Each GSA must engage with its advisory committee(s) 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 an aggressive and broad outreach program to inform groundwater users of the Mitigation Program along with ensuring public input in the development of the Mitigation Program and Plans.

6.7.6.4 Permitting and Regulatory Process

The GSA will confirm with the Claimant that any mitigation efforts that are non-exempt from California Environmental Quality Act (CEQA) and National Environmental Policy Act (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.

6.7.6.5 Status and Schedule of Management Action

Figure 6-4 summarizes the schedule and status of the Mitigation Program and GKGSA 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 6-4 Kaweah Subbasin Mitigation Program and GKGSA Mitigation Plan Schedule

6.7.6.6 Benefit Realization and Evaluation

The proposed Program will directly mitigate impacts due to the following:

- reduction in groundwater storage [1];
- chronic lowering of groundwater levels[1];
- land subsidence[1]; and
- degraded water quality[1]

[1]*induced by chronic lowering of groundwater levels (via overdraft during GSP implementation)*

The Mitigation Program will provide a direct benefit 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 benefits will be the number of wells that are adversely impacted and mitigated and the Subbasin's ability to manage groundwater levels to the measurable objectives and avoid the need for mitigation. The Kaweah Subbasin GSAs will provide an annual

accounting of the number of wells and other impacts that are identified and mitigated in the Kaweah Subbasin Annual Report, provided to the Department of Water Resources in April of each year.

Table 7-1 details the challenges addressed, benefiting parties, and explanation of benefits.

6.7.6.7 How This Management Action Will Be Accomplished

The Mitigation Program is not reliant on securing new groundwater or surface water sources. The Mitigation Program claims process details how the Program will be accomplished.

6.7.6.8 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. Because DWR is required to evaluate whether the GSP provides a reasonable means to mitigate continued overdraft, a mitigation program is an act necessary or proper to implement SGMA. (23 CCR §355.4(b)(6).)

6.7.6.9 Costs

GKGSA underwent significant financial analyses to estimate an annual and cumulative mitigation budget that is directly in alignment with sustainable management criteria in Chapter 5. Funding for the GKGSA Mitigation Plan is made available through fees established through policy changes in 2023 and 2024. A summary of the annual mitigation cost estimates that were used to develop the budgets is available in Figure 6-5 below.

Current mitigation funding comes from penalties charged to growers who overdraft beyond sustainable yield. The GKGSA has established a Reserve Budget that sets aside the Mitigation Plan estimated annual costs (as described below in the Dry Well Susceptibility Analysis). As the GKGSA reaches sustainability, overdraft will diminish and the need to mitigate dry wells will diminish.

The Kaweah Subbasin Technical Team performed a Dry Well Susceptibility Analysis (described more in Chapter 5) which provided a cautious mitigation cost estimate under different drought scenarios with intentional protective funding buffers built-in to account for uncertainties. The mitigation cost estimates include costs to physically mitigate wells, emergency and interim supplies, SHE's administration of the program, GSAs' administration of the program, and contractor assistance during the assessment phase. The Kaweah Subbasin GSAs' mitigation budget estimates were 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 herein this Mitigation Program and respective Mitigation Plans. Alternatives may include raising groundwater extraction fees and/or a property-based tax.

The GSAs will explore grant funding at the state and federal levels. 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.

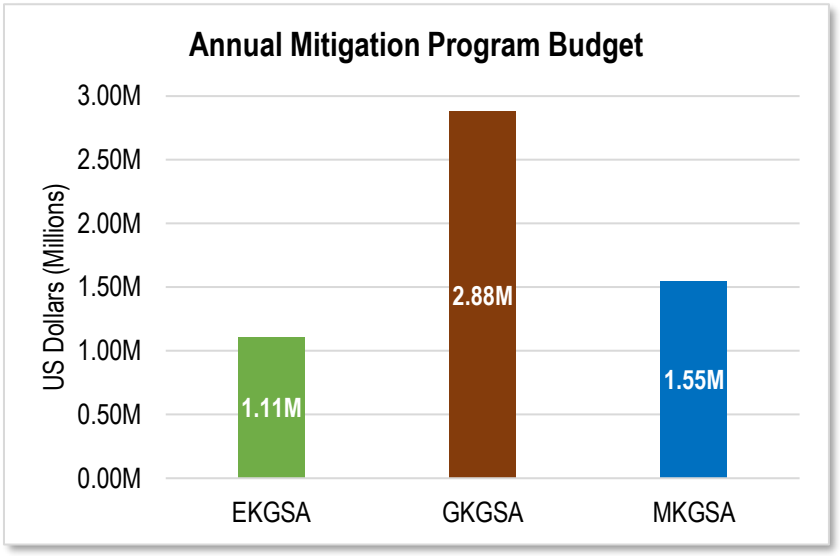


Figure 6-5 Annual Mitigation Cost Estimates and GSA Mitigation Budgets

6.7.7 MA7: Agricultural Water Conservation and Management

6.7.7.1 Management Action Description

The agricultural water service providers that are members of the GKGSA comply with all provisions of SB 7 (amending Division 6, Part 2.55 of the Water Code) passed into law in 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.

6.7.7.2 Measurable Objectives Addressed

The management action encourages the conservation of water and, if successful will reduce groundwater production which could allow the recovery of groundwater levels and increase groundwater storage.

6.7.7.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the GKGSA is implementing this project to reduce the demand on the groundwater resources of the subbasin.

6.7.7.4 Public Notice and Outreach Process

Noticing for this program would be conducted through the processes established by the GKGSA's agricultural water service providers and their respective policies and requirements under law.

6.7.7.5 Estimated Annual Project Benefits

This management action encourages the conservation of water but does not require a specific benefit.

6.7.7.6 Permitting and Regulatory Process

Regulatory compliance resides with those provisions now codified into state law.

6.7.7.7 Status of Management Action

Most provisions of the conservation laws are being complied with by the agricultural water purveyors of the GKGSA. 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 these districts for submittal to DWR.

6.7.7.8 Expected Benefits and Targeted Sustainability Indicators

Benefits cannot be quantified from compliance with the agricultural conservation laws at the present time. The JPA Members of GKGSA that provide agricultural water supply will continue to divert for beneficial use all local and imported water supplies to which they are entitled. Should agricultural demands for irrigation water diminish as a result of some of the conservation provisions, a larger portion of diverted supplies will be devoted to groundwater recharge in the future.

6.7.7.9 Source and Reliability of Water

Additional water source is not required for this Management Action.

6.7.7.10 Legal Authority Required

As irrigation districts per Division 11 of the California Water Code, the agricultural water suppliers within the GKGSA are empowered with ensuring the beneficial use of all water furnished thereby.

6.7.7.11 Costs and Funding

Costs for water management plan report preparation and submittals are ongoing for agricultural water suppliers in the GKGSA, and any future costs related to surface water measurement compliance and associated funding would be borne by each respective district.

6.7.7.12 Management of Groundwater Extractions

This management action encourages the conservation of water and this message will be just as applicable during wet conditions as during drought conditions.

6.7.7.13 Level of Uncertainty

This management action encourages the conservation of water and the success of this action is not certain at this time.

6.7.8 MA8: Urban Water Conservation Program

6.7.8.1 Management Action Description

As referenced in Section 2.5.1.4 of the Basin Setting Report (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 will be capped at 55 gallons per capita per day (gpcd) in 2019 and reduced to 50 gpcd by 2030. Outdoor residential use will be capped in the future based on local climate and size of landscaped areas. Standards for outdoor usage will be defined in a SWRCB rule-making process by June 2022.

6.7.8.2 .Measurable Objectives Addressed

The management action encourages the conservation of water and, if successful will reduce groundwater production which could allow the recovery of groundwater levels and increase groundwater storage.

6.7.8.3 Circumstances and Criteria for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the GKGSA is implementing this project to reduce the demand on the groundwater resources of the subbasin.

6.7.8.4 Public Notice and Outreach Process

Noticing for this program would be conducted through the processes established by the GKGSA's municipal water service providers and their respective policies and requirements under law.

6.7.8.5 Estimated Annual Project Benefits

This management action encourages the conservation of water but does not require a specific benefit.

6.7.8.6 Permitting and Regulatory Process

The Water Conservation Act of 2009 mandated of a 20% reduction in urban per capita water usage by 2020 (SB7X7). 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 city ordinances will eventually embody these recent laws.

6.7.8.7 Status of Management Action

The cities of Farmersville, Exeter, and Woodlake 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 cities presently are complying with the 20X2020 mandates contained in SB7X7 and as embodied in their respective UWMPs. As the SWRCB establishes its compliance deadlines for both indoor and outdoor usage, anticipated to occur by 2025, the municipal JPA Members will have a clearer picture of an implementation schedule.

6.7.8.8 Expected Benefits and Targeted Sustainability Indicators

The Pacific Institute estimated in its 2014 report ("Urban Water Conservation and Efficiency Potential in California") 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 state-wide values are likely to be unrealistic in some regions; however, the report postulates 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. The Sustainability Indicators to benefit from additional urban conservation include stabilization of groundwater levels and, by proxy, groundwater storage stabilization as well as land subsidence.

6.7.8.9 Source and Reliability of Water

Additional water source is not required for this Management Action.

6.7.8.10 Legal Authority Required

Legal authorities for any additional urban water conservation will be as derived from the passage of AB 1668 and SB 606.

6.7.8.11 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.

6.7.8.12 Management of Groundwater Extractions

This management action will lead to less demand on the groundwater resource and should allow groundwater levels and storage to recover further during wet years and offset decreasing groundwater levels and storage during drought years.

6.7.8.13 Level of Uncertainty

This management action encourages the conservation of water and the success of this action is not certain at this time.

6.7.9 MA9: Fee and Incentive Program

6.7.9.1 Management Action Description

The GKGSA has implemented a land-based assessment. In addition, the GKGSA anticipates both a groundwater extraction fee and penalties program to fund programs described herein and also discourage overdraft pumping. The Rules and Regulations were adopted in August 2022 and the GKGSA is currently implementing it's Third Amended version. The Rules and Regulations clarify the authority for the GKGSA and set forth the accounting and procedure for how such fees and penalties will be implemented. The board of directors plans to set the rate for each annually after legal compliance.

6.7.9.2 Measurable Objectives Addressed

This Action will benefit all of the following sustainability indicators: groundwater elevations, groundwater change in storage, land subsidence, and groundwater quality.

6.7.9.3 Circumstances and Criteria for Implementation

The GKGSA implement the fee and penalty structure after compliance with all procedural and substantive requirements of SGMA, and applicable Proposition 218 Constitutional requirements.

6.7.9.4 Public Notice and Outreach Process

The board will annually set groundwater extraction fees and penalty rates both held and noticed at public meetings in accordance with the Brown Act, SGMA, and in addition to any Proposition 218 requirements, if any.

6.7.9.5 Estimated Annual Project Benefits

The imposition of groundwater extraction fees and penalties is in part to disincentivize overdraft pumping and encourage sustainable levels of extraction.

6.7.9.6 Permitting and Regulatory Process

It is not anticipated any permits and other regulatory requirements are required for fees or penalty imposition. The GKGSA will comply with all procedural and substantive requirements of SGMA and any applicable Proposition 218 Constitutional requirements.

6.7.9.7 Status of Management Action

Penalties for all pumping beyond sustainably yield were first imposed during Water Year 2023 (October 1, 2022 – September 30, 2023).

6.7.9.8 Expected Benefits and Targeted Sustainability Indicators

The primary benefit resulting from fees and penalties is the reduction in groundwater overuse over time. The fee and penalty structure will help protect and enhance groundwater resources.

6.7.9.9 Source and Reliability of Water

The GKGSA complied with all procedural and substantive requirements of SGMA and any applicable Proposition 218 Constitutional requirements. Additional water source is not required for this Management Action.

6.7.9.10 Legal Authority Required

SGMA authorizes the imposition of fees and penalties pursuant to Water Code §10730, *et seq*. In addition, the GKGSA has authority to collect land-based assessment, other fees and penalties pursuant to the Joint Exercise of Powers Act and the common powers rule pursuant to Government Code §6500, *et seq*. In addition, a GSA is authorized to perform any act necessary

or proper to carry out the purposes of this part (Water Code § 10725.2(a)) and adopt rules, regulations, ordinances and resolutions for the purposes of carrying out SGMA (Water Code §10725.2(b)).

6.7.9.11 Costs and Funding

Staff and consultant costs are necessary to impose the fees and penalties. The same will be required for collection and enforcement of the same.

6.7.9.12 Management of Groundwater Extractions

Imposition of fees and penalties will encourage use within sustainable limits and disincentivize overdraft pumping. The fees and penalties program will assist the GKGSA in reaching sustainability targets by enhancing groundwater resources and eliminating overdraft conditions.

6.7.9.13 Level of Uncertainty

This management action is active and running, and annually adjusted in the path to sustainability.

6.7.10 MA10: Groundwater Market

6.7.10.1 Management Action Description

The GKGSA will consider the feasibility and acceptance of a voluntary marketing program. With the existence of a groundwater allocation program and a suitable measurement program, the GKGSA will be in a position to administer a marketing program within the confines of the GKGSA and possibly with other GSAs in the Kaweah Subbasin. The program would consist of temporary or permanent transfers of groundwater extraction allotments for immediate use or for banking arrangements, as well as carry-over of unused allotments, all consistent with the provisions of SGMA §10726.4. A share-based methodology may be utilized, which would incorporate a fixed number of shares being issued to all groundwater rights holders, accompanied by an annual allotment dictating the volume of extractable water per share.

Stakeholder involvement will be important to this program, especially for agricultural pumpers, which will likely be the primary sellers/buyers, although the three cities within the GKGSA may be interested in participating in the program.

Prior to implementation, an accurate and reliable extraction measurement data collection protocol will be needed to support the accounting system and annual allotment per well owner. The GKGSA will seek guidance from agencies with experience in water markets to identify options for communications and outreach with stakeholders, program design, and mechanisms to ensure that non-participating stakeholders are not adversely impacted by the program.

6.7.10.2 Measurable Objectives Addressed

Measurable Objectives to be addressed by this action include chronic lowering of groundwater levels and reduction in storage (Section 5) and avoidance of associated Undesirable Results (Section 3).

6.7.10.3 Public Notice and Outreach Process

Noticing for this program would be conducted through the processes established by the MKGSA and the GKGSA, its adopted policies and requirements under law.

6.7.10.4 Estimated Annual Project Benefits

A market/transfer program will not provide any new source of groundwater to the GKGSA area but may improve the distribution and/or application of the available groundwater among stakeholders.

6.7.10.5 Permitting and Regulatory Process

Permitting and other regulatory compliance issues will be identified and addressed during the latter portion of the first 5-year period of the GSP implementation, consistent with city and county ordinances and SGMA §10726.4 (a) (3 & 4).

6.7.10.6 Status of Management Action

Both programs are under construction at this time and will likely be implemented at some scale by 2025.

6.7.10.7 Expected Benefits and Targeted Sustainability Indicators

A market/transfer program will not provide any new source of groundwater to the GKGSA area but could address the lowering of groundwater levels.

6.7.10.8 Source and Reliability of Water

The GKGSA area will be the source of the groundwater and will be limited by the hydrology of the region.

6.7.10.9 Legal Authority Required

SGMA §10726.4 (a) (3 & 4) provides legal authority for a groundwater transfer and accounting programs.

6.7.10.10 Costs and Funding

Costs to implement a marketing/transfer program are estimated to cost $10,000 for programing, but it is not known at this time the full cost for GSA staffing to administer such a program. A grant application was submitted by TID to the USBR and seeks funding for the entire subbasin to establish a pilot program, based on an outreach task, a scoping and planning task and a strategy task. Funding for the complete program will likely be included in the administrative process and will be borne by the participants.

6.7.10.11 Management of Groundwater Extractions

The implementation of a groundwater transfer program will include provisions for the recovery of groundwater levels and groundwater storage during non-drought periods.

6.7.10.12 Level of Uncertainty

The interactions with experienced agencies and the detailed evaluation of the components will reduce the level of uncertainty.

6.7.11 MA11: Groundwater Allocation and Accounting Program

6.7.11.1 Management Action Description

The GKGSA is in the process of developing a groundwater accounting system, referred to as the Water Dashboard, to track groundwater use and implement a groundwater allocation program as also described herein. The rules upon which the Water Dashboard operate based on the GKGSA's Third Amended Rules and Regulations dated February 12, 2024, . The Water Dashboard and the Rules and Regulations specifically restrict groundwater pumping within the GKGSA.

The Water Dashboard was designed to enable to the GKGSA to efficiently manage activity relevant to its SGMA compliance efforts. These activities include management of individual and/or entity groundwater accounts pursuant to various policies, and enable the GKGSA staff to undertake core administrative tasks such as member management, tracking, billing and reporting.

6.7.11.2 Measurable Objectives Addressed

The program directly benefit lowering groundwater levels, groundwater storage, land subsidence, and water quality. The purpose of the program is to reduce groundwater extractions and reach sustainability.

6.7.11.3 Circumstances and Criteria for Implementation

This is a high priority program that is necessary to limit groundwater extractions to ensure the avoidance of undesirable results. Use of groundwater is pursuant to the Rules and Regulations through either meters or Land IQ. GKGSA contracted with Land IQ in 2021 to monitor and

measure total consumptive use. Through the Rules and Regulations, the GKGSA is using Land IQ to measure consumptive use for each individual parcel within the GKGSA. A landowner has the option to use Land IQ or a meter for his/her individual account within the Water Dashboard.

6.7.11.4 Public Notice and Outreach Process

An extensive public review process has been conducted for both the Rules and Regulations and the Water Dashboard. Numerous workshops have been conducted. The Stakeholder and Rural Communities Committee have also directly engaged in the drafting and development of the Rules and Regulations and the Water Dashboard.

6.7.11.5 Estimated Annual Project Benefits

The Rules and Regulations set forth an annual allocation of groundwater based on a ramp down schedule, which overtime reduces pumping to reach sustainability. This action identifies the need to maintain average annual groundwater use within a sustainable limit and proposes to reach this sustainable limit through the gradual reduction in allowable groundwater use over time.

6.7.11.6 Permitting and Regulatory Process

Pursuant to SGMA, groundwater management implemented by GKGSA is consistent with Section 2 of Article X of the California Constitution and does not determine or alter water rights (Water Code § 10720.5). The GSAs will be required to comply with any CEQA requirements prior to approval and implementation of the Program. No other permits or other regulatory requirements are expected to be necessary for the Program at this time.

6.7.11.7 Status of Management Action

Early access to the Water Dashboard began in June 2022. The Dashboard is running and populated with grower accounts. Having completed the first year of implementation, GKGSA is now processing invoices for the first year.

6.7.11.8 Expected Benefits and Targeted Sustainability Indicators

It is anticipated that overtime the Dashboard and the Rules and Regulations will protect and enhance groundwater resources by reducing groundwater overdraft gradually until groundwater use reaches sustainable limits. Other benefits include mitigating decline of groundwater levels, and limiting or eliminating land subsidence and/or the migration of contaminated plumes.

Benefits to relevant sustainability indicators and their associated measurable objectives will be evaluated pursuant to annual reports to DWR.

6.7.11.9 Source and Reliability of Water

The Rules and Regulations will be implemented through board action, which is anticipated to take place in August 2022. The water source is groundwater and the limitation of extractions from the same.

6.7.11.10 Legal Authority Required

A GSA is authorized to:

- Require the registration of groundwater extraction facilities (Water Code § 10725.6);
- Control groundwater extractions by regulating, limiting, or suspending groundwater extractions (Water Code § 10726.4(a)(2).);
- Authorize temporary and permanent transfers of groundwater extraction allocations within the agency (Water Code § 19726.4(a)(3));
- Establish accounting rules to allow unused groundwater allocations issued by the agency to be carried over from one year to another (Water Code § 10726.4(a)(4)).
- Perform any act necessary or proper to carry out the purposes of this part (Water Code § 10725.2(a)); and
- Adopt rules, regulations, ordinances and resolutions for the purposes of carrying out SGMA (Water Code §10725.2(b)).

6.7.11.11 Costs and Funding

The Program cost is staff, legal and consulting time to develop the documents and online program to implement the accounting. The GKGSA previously based a land-based assessment to cover staff, legal and consulting time for purposes such as this Program.

6.7.11.12 Management of Groundwater Extractions

The purpose of the Program is to limit groundwater extractions in order to reach sustainability. Various components of the Rules and Regulations, including allocations, carryover, recharge credits, and enforcement, will ensure that groundwater users are able to plan for and manage against periods of drought while operating within limits determined to be sustainable.

6.7.11.13 Level of Uncertainty

The process of public review has already been conducted and project implemented.

6.7.12 MA12: Interconnected Surface Water Data Gap Work Plan

6.7.12.1 Management Action Description

The Kaweah Subbasin Interconnected Surface Water Data Gap Workplan (Workplan)was first developed in 2022 and included as part of the 2022 1st Amended GSPs. The Workplan has since

been revised as more data and information has been made available through installation of new stream gages, monitoring wells, and publicly accessible analytical tools. This Workplan is intended to evolve as new tools, data, and state guidance become available.

This Management Action sets forth a Work Plan to perform additional efforts specific to filling data gaps and performing additional research and analysis specific to the interconnected surface water indicator in the Kaweah Subbasin, particularly in the EKGSA and GKGSA where the hydrogeologic conditions for interconnectivity is present.

The Workplan phases and schedule are described below and subject to change after the DWR Best Management Practices (BMP) guidance document is released. This BMP is expected to outline optimal strategies to identify, monitor, and establish SMC pertaining to interconnected surface water.

SGMA requires GSAs to develop and enforce groundwater management policies that avoid significant and undesirable results. This is especially challenging for the interconnected surface water sustainability indicator. The ability to assess the relationship between groundwater pumping and depletions of interconnected surface water can be hindered by other variables that can significantly influence depletions and flow stages, such as snowpack declines, snowmelt variability, upstream vegetative conditions, dam release policies, landscape changes (such as indirectly influenced from seasonal fires, such as landslides), and other reasons for reduced surface flow that are unrelated the anthropogenic groundwater management.

This Workplan is intended to (1) better understand the presence of interconnected surface waters, (2) identify potential adverse impacts to interconnected surface water bodies caused by groundwater extraction. The actions to mitigate or avoid impacts will be addressed on a case-by-case basis and may be in the form of groundwater allocation policy changes, recharge activities, or other mitigation/proactive strategies may be implemented, as necessary.

The Workplan will be completed within the following four (4) major components, which are described in further detail below.

Phase 1: Filling Data Gaps and Further Research

Phase 2: Analytical Tool Development

Phase 3: Interconnection Analysis and Impact Attribution Analysis

Phase 4: SMC Refinement and Incorporation into 5-year GSP Update

Phase 1: Filling Data Gaps and Further Research

With interconnected surface water being an identified data gap, the GSAs will work towards filling data gaps through research and further data collection. There are many different types of data to be gathered and/or better understood to improve the GSAs' knowledge of interconnected surface waters. The data and research intended to be collected are listed below:

- Shallow groundwater levels – There are gaps in the groundwater level monitoring points near the waterways of interest. Without sufficient groundwater level data, the GSAs are unable to understand the proximity of groundwater to the surface water channel and how seasonal or annual groundwater elevations interact with the surface water channels.

- Pumping well locations, beneficial uses, and estimated quantity—Active pumping along or in regional proximity to the selected waterways is not understood in the detail needed to determine whether it adversely impacts interconnected surface waterways.

- Stream flow and/or estimated hydrology—Some of the selected waterways cannot monitor surface water flows. Or, studies or analyses that may have been developed to estimate flows based on hydrological conditions are not well known. Pending further research, new or additional stream measurement sites may be installed in locations of the selected waterways.

- Presence of Riparian habitat and/or in-stream habitat– The 2022 2nd Amended GSPs made significant progress on this data gap. However, additional field analyses may be useful to further investigate conditions and the health of these habitat systems.

- Soils/geological considerations – Further investigation and review of the soils and geological conditions will be evaluated to guide the physical parameters for how surface and groundwater move through the strata present in the selected water ways. The flux through the channel bottoms, as well as drawdown characteristics of the regional aquifer around the selected waterways, will be reviewed to incorporate into the analytical tool and further analysis to understand the mechanics of water movement naturally as well as impacted through groundwater extraction.

- Influence of the mountainfront recharge—Additional research is needed to determine the volume coming off the mountainfront watersheds and how it impacts the upper reaches of the waterways. The Kaweah Subbasin has estimated mountainfront recharge in its Water Budgets; however, the location and magnitude of the recharge in different portions of the mountainfront are not well understood.

The representative monitoring network and proposed new monitoring sites are depicted on Figure 6-6**.**

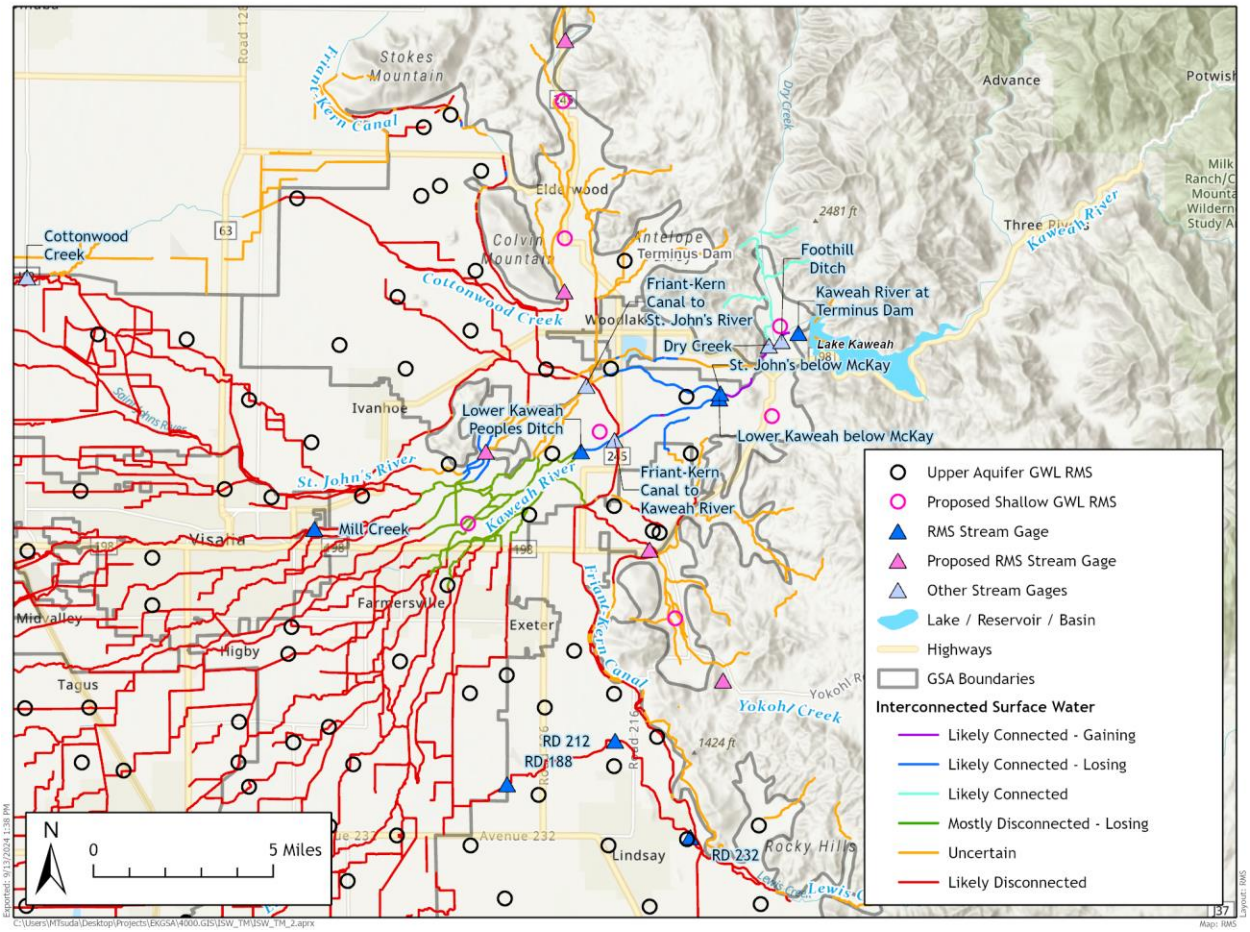


Figure 6-6. Representative Monitoring Network, Areas of Potential Interconnection, and Proposed Future Monitoring Sites

Phase 2: Analytical Tool Development

The Kaweah Subbasin's Groundwater Flow Model underwent significant revisions in 2022 through 2024. Although the new model is helpful for water budget analyses and forecasting the role that projects and management actions play in the Subbasin's sustainability strategy, the model was not built with the capacity for granular analyses of interconnectivity and groundwater extraction impact on interconnectivity. That said, the next phase of model improvements involves addressing this gap.

Phase 3: Interconnection Analysis and Impact-Attribution Analysis

After the Groundwater Flow Model revisions are complete, the model will then be used to evaluate the relationship between groundwater extractions and interconnectivity. This analysis

may require multiple rounds of model calibration and is expected to span at least 6-months to effectively address.

Phase 4: SMC Refinement and Incorporation to 2025 GSP Update

The final phase of the Workplan is the refinement of SMC and incorporation into the 2025 GSP Updates. Once the role that groundwater extractions play on interconnectivity is known, effective SMC can be established to protect beneficial users and uses from groundwater activity induced impacts.

6.7.12.2 Circumstances and Criteria for Implementation

The circumstances for implementing are critical as there is little data and information to inform and support groundwater management related to the interconnected surface water sustainability indicator. The Kaweah Subbasin is committed to implementing the Workplan to better understand the presence of interconnected surface waters and protect beneficial users and uses against adverse impacts caused by groundwater extractions or other groundwater activities.

The management action could lead to better quantification of groundwater production, elevating the risk of depleting interconnected surface waters and the timing and quantity for which it may occur. Pending the Workplan's results, groundwater extractions in certain proximity of surface water channels could be reduced to minimize or eliminate depletions caused by groundwater pumping.

6.7.12.3 Public Notice and Outreach Process

Appropriate notification and outreach will be conducted consistent with GSA authorities and requirements. As results from the Work Plan become available, they will be reported at GSA Board and committee meetings, which are open to the public. Management changes stemming from the Workplan's results will also be discussed in these public forums.

6.7.12.4 Permitting and Regulatory Process

The Kaweah Subbasin GSAs will comply with all existing local, state, and federal permitting requirements. This commitment includes compliance during the design and implementation of any management action, mitigation measure, or project to proactively avoid impacts or mitigate impacts if they occur.

6.7.12.5 Status and Schedule

The schedule for the Work Plan is summarized in the following Table 6-4. This schedule is subject to change, pending data gathered and/or timing of such data and availability of the DWR

BMP on interconnected surface water. There may be shifts or re-ordering of phases/tasks to better adapt and facilitate completion.

Table 6-4: Anticipated ISW Data Gap Work Plan Schedule

Phase	Description	Estimated Timeline
1	Additional research; data gap filling (monitoring well installation, stream gauge installation, etc.); data collection	October 2022 – December 2025
2	Analytical Tool Development – the type of tool will be determined with additional data and research	June 2025 – June 2026
3	Interconnection Analysis and Determination	June 2026 – December 2026
4	SMC Development and Incorporation into draft 5-year update GSP [1]	January 2027 – May 2028

[1]The stakeholder engagement process is critical to SMC development and the timeline to complete effective stakeholder engagement and incorporate feedback is unknown at this time. In the past, the revision process based on stakeholder feedback has taken anywhere from 6-months to over a year.

6.7.12.6 Benefit Realization and Evaluation

The management action will improve knowledge of the timing and volume of interconnected surface water depletions caused by groundwater extraction or other groundwater activity. Pending the results of the Workplan, the GSAs may develop more specific SMC and/or management actions set to protect beneficial users and uses from adverse impacts caused by groundwater activities.

6.7.12.7 How This Management Action Will Be Accomplished

An additional water source is not required for this Workplan effort. However, hydrology is an important factor in understanding the natural variability in surface waterway flow behavior. The ephemeral nature of the waterways and the ranges of flows that naturally occur out of the mountain front are highly dependent on hydrology. Continuing drought conditions may impact the timeline and results of the Workplan.

There is high certainty the Workplan will be implemented, as significant progress has been made through the installation of new stream gages, monitoring wells, and a significant increase in analyses now available with new publicly available tools.

The level of uncertainty associated with the direction of the Work Plan and the corresponding results are high as, absent current data, the certainty related to the presence of interconnected surface waters and the nexus to groundwater extraction is not well understood. Specifically, the potential inability to monitor streamflow data during a range of hydrologic conditions due to

persistent, multi-year drought conditions may impede the gathering of foundational data needed to significantly understand any potential interconnectivity between surface waterways and groundwater.

6.7.12.8 Legal Authority

The Kaweah has the authority to implement and perform the Workplan as the SGMA legislation grants authority to GSAs to perform any act necessary or proper to implement and follow the regulations (§10725.2). This authority allows the GSAs to implement the Workplan and move toward better understanding this sustainability indicator with respect to conditions within the Kaweah Subbasin and develop further SMC or rules, pending results of this Workplan.

6.7.12.9 Costs

As described in the Work Plan, there is some uncertainty in the direction the next steps will take as more data and information is gathered and better understood. Costs to collect more data, develop a methodology to analyze surface water interconnection and nexus to groundwater extractions, and understand the location of interconnected surface waters within the Kaweah Subbasin could vary widely.

Estimates for performing Phases 1 and 2 of the Workplan range from $300,000 to $900,000. The cost that each GSA will contribute is summed into this estimate. EKGSA and GKGSA will be looking to develop partnerships on this effort, as it most directly impacts their GSA boundaries. The GSAs will also look to funding opportunities at State and/or Federal levels that support such efforts.

6.7.13 MA13: Well Registration Program (*New)

6.7.13.1 Management Action Description

The Kaweah Subbasin GSAs have committed to developing a Well Registration Program to be completed in phases and available for full implementation in Spring 2026. The purpose of voluntary registration of wells is to create a baseline record for each 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.

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-ft 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. 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 three primary phases listed below. Additional phases may be added as the program is being developed and implemented.

a. **Phase 1** (Summer 2024-Fall 2024): 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.
b. **Phase 2** (Fall 2024-Spring 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 Data Management System.
c. **Phase 3** (Summer 2025): 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.

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.

6.7.13.2 Circumstances for Implementation

The Kaweah Subbasin has challenges with data gaps, particularly for domestic wells. This makes it especially difficult to evaluate which domestic wells may be at risk and have the ability to

reach out to domestic well owners to notify if their well is at risk. It is important to the Kaweah Subbasin GSAs that sufficient data and information is gathered on all existing wells, with a particular focus on domestic wells, to best achieve sustainability and avoid undesirable results.

6.7.13.3 Process for Public Notification

The process for public notification is described in Phase 1 of the description and the GSA's current outreach and engagement opportunities and strategies are available in **Section 2.7**.

6.7.13.4 Permitting and Regulatory Process

No permitting or regulatory processes are expected to be needed to implement this management action.

6.7.13.5 Status and Schedule

The project is currently in the early stages of planning and development and is broken down into three phases.

- **Phase 1** (Summer 2024-Fall 2024): Initial outreach
- **Phase 2** (Fall 2024-Spring 2025): The well registration database is developed and beta tested
- **Phase 3** (Summer 2025): 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.

6.7.13.6 Benefit Realization and Evaluation

Table 7-1 details the challenges addressed, benefiting parties, and explanation of benefits.

6.7.13.7 How this Management Action Will Be Accomplished

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; however, would prefer partnering with local community leaders and agencies to build trust, offer translation services, and reach the domestic well owners who may note 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.

6.7.13.8 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).)

6.7.13.9 Costs

The capital and ongoing costs are unknown; however, it can be estimated that approximately $75,000 is needed for phases 1 and 2 and $10,000 per year to maintain phase 3 through the implementation period. There may be opportunities for cost-sharing between all three GSAs which would reduce the cost estimate.

6.7.14 MA14: Small Community Well Proactive & Protection Action Plan (PPAP)(*New)

6.7.14.1 Management Action Description

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 is designed more for private domestic and multi-use drinking water well owners, community well owners may still notify Self-Help Enterprises 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 available in **Figure 6-7**.



Figure 6-7. Small Community Well Proactive & Protective Action Program (PPAP) Approach and Schedule

6.7.14.2 Circumstances for Implementation

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, proactive measures to avoid the need for mitigation of the small community water systems.

6.7.14.3 Process for Public Notification

The 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. More information on the public process is available in **Section** 2.7**2.7**.

6.7.14.4 Permitting and Regulatory Process

The GSA will confirm with the Claimant that any mitigation efforts that are non-exempt from California Environmental Quality Act (CEQA) and National Environmental Policy Act (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.

6.7.14.5 Status and Schedule

The schedule for the PPAP is available in **Figure 6-7**.

6.7.14.6 Benefit Realization and Evaluation

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 experience impacts related to:
    a. reduction in groundwater storage [1];
    b. chronic lowering of groundwater levels[1];
    c. land subsidence[1]; and
    d. degraded water quality[1]

[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.

6.7.14.7 How this Management Action Will Be Accomplished

The Mitigation Program is not reliant on securing new groundwater or surface water sources. **Figure 7-13** details the phases to accomplish this management action. This management action will require both technical and outreach expertise and resource prioritization, both of which the GSAs have in-house and on their technical teams.

6.7.14.8 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).)

6.7.14.9 Costs

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 Mitigation Program is through GSA fees. The same funding source is used to fund outreach and technical consultant costs associated with GSA administration and GSP implementation.

6.7.15 MA15: Well Permit Application Review and Technical Support (*New)

6.7.15.1 Management Action Description

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 Representative Monitoring Sites to the proposed well to determine minimum thresholds for groundwater levels, water quality and subsidence.
- Identifying existing domestic wells and critical infrastructure in the area.
- Estimating current groundwater levels around the proposed well.

6.7.15.2 Circumstances for Implementation

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.

6.7.15.3 Process for Public Notification

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 GSA Mitigation Plans (MA9) with the landowner.

6.7.15.4 Permitting and Regulatory Process

The Kaweah Subbasin GSAs will abide by 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.

6.7.15.5 Status and Schedule

This management action is currently active. GSAs receive well permit applications for all domestic and agricultural wells within their respective jurisdiction.

6.7.15.6 Benefit Realization and Evaluation

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. More information on the benefits is found in Table 7-1.

6.7.15.7 How this Management Action Will Be Accomplished

This management action is accomplished by GSA staff and/or their technical team reviewing the considerations listed in the description to evaluate risks. After this assessment, if a risk is identified, the GSAs contact the landowner and share recommendations on changed location, depth, and other construction or connection options.

6.7.15.8 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).)

6.7.15.9 Costs

The cost to implement this management action is minimal. This proactive measure is more affordable than 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.

6.7.16 MA16: Water Importation/Recharge Program (*New)

6.7.16.1 Management Action Description

The GKGSA will form an agreement with the Kaweah Delta Water Conservation District (KDWCD) to actively source CVP water through the District's long-Term Contact with the U.S. Bureau of Reclamation and import and recharge water whenever market conditions are favorable for water purchase.

6.7.16.2 Circumstances for Implementation

The Kaweah Subbasin has been designated as critically overdrafted and the GKGSA is implementing this project to reduce the demand on the groundwater resources of the subbasin.

6.7.16.3 Process for Public Notification

Appropriate notice and outreach will be provided to various public agencies and other stakeholders by KDWCD. The district holds monthly Board of Director's meetings and the project will be an agenda item for Board discussion regarding the project status, schedule,

budget, necessary approvals and/or required action by the Board. KDWCD also maintains and regularly updates a website with project descriptions, current activities, and progress.

6.7.16.4 Permitting and Regulatory Process

No permitting or regulatory processes are expected to be needed to implement this management action.

6.7.16.5 Status and Schedule

This management action is currently active. The GKGSA intends to formalize the importation process by the drafting of a formal agreement with KDWCD to actively fund and support regular CVP water importation activities.

6.7.16.6 Benefit Realization and Evaluation

It is challenging to quantify the benefit of this measure as there are many variables as water year type, price, and KDWCD system capacity issues impact available water.

6.7.16.7 How this Management Action Will Be Accomplished

This management action is accomplished by annual collaboration between GSA staff and KDWCD staff to monitor CVP Water supply status through the United States Bureau of Reclamation management of releases from Friant Dam to manage San Joaquin River resources for flood control and water supply. This will be managed though the administration of transfers from other Long-Term Contractors to KDWCD. KDWCD will then wheel the water to designated recharge channels and basins for percolation.

6.7.16.8 Legal Authority

KDWCD has statutory authority to manage, regulate, and engage in water management activities, including groundwater recharge operations, for the benefit of its service area. *See, e.g., Cal. Water Code* §§ 31020 et seq.

6.7.16.9 Costs

The cost to implement this management action is not known and annual importation water cost will vary significantly from year to year mostly due to the Water Year type (supply and demand pricing). Dry years will result in low supply and high cost per acre foot, whereas wetter years will provide more water, more transfer opportunities, and lower costs per acre foot.

6.7.17 MA17: Collaboration with Other Agencies & Inter-Basin Coordination

The GKGSA'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 subsidence, both active and historical, the impacts of subsidence, and establish a monitoring and action plan to avoid the Minimum Thresholds established by GSAs and 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 Management Action Plan (RSMAP) by December 31, 2025. Appendix 6D includes a Regional Subsidence Monitoring and Action Plan process to develop a RSMAP Committee and develop a coordinated RSMAP that outline 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:

- Participation 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
- Requesting 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.

6.7.18 MA18: Land Subsidence Management Plan (LSMP) (*New)

6.7.18.1 Management Action Description

In order to meet the Kaweah Subbasin's land subsidence goals, it will be necessary to draft and implement a Land Subsidence Management Plan (LSMP) to ensure compliance with the goals. The GKGSA has agreed to implement a LSMP to ensure that groundwater pumping within the GSA is sustained at a level that will enable compliance with the goal to minimize subsidence.

The LSMP is a comprehensive plan that will establish the monitoring, reporting and preventative management to effectively avoid significant and unreasonable impacts to infrastructure in the GKGSA. Infrastructure potentially impacted by subsidence are those that rely on a stable land surface to function properly. In the Kaweah Subbasin, these include water conveyance infrastructure (such as canals, ditches, pipes, and flood control waterways), supply wells, roads, bridges, electrical power lines, gas and water pipelines, sanitary sewers, and railroad tracks. With the implementation of the LSMP the GKGSA can proactively track and respond to identified areas at risk.

Three (3) Components of the LSMP:

The first component of the LSMP is comprised of three (3) primary elements that establish an Early Action Plan:

1. A well registration program, identified and detailed in Management Action MA13 - Well Registration Program (Section 6.7.13), and a well metering program, identified and detailed in Management Action MA3 - Groundwater Extraction Measurement Program (Section 6.7.3).
2. A well reporting process implemented by GKGSA, collecting actual monthly well readings from certified meters from each registered well.
3. A preventative management plan with proactive activities that effectively mitigate for or reduce groundwater extraction that could negatively effect water levels in the GKGSA. These include Projects and management actions such as:
    a. In-Lieu surface water deliveries
    b. Focused recharge
    c. Focused land fallowing

The second component of the LSMP is comprised of two (2) primary elements involving the establishment of:

1. A Land Subsidence Management Area that clearly defines the area(s) of the GKGSA that this LSMA program applies to based on various hydrogeological data and

analysis identifying the characteristics at risk for subsidence due especially to the influence of clay layers.
2. Subsidence Management Zones which divide the Land Subsidence Management Area into effective zones for localized reporting and implementation of preventative management measures.

The third component of the LSMP consists of the preventative management elements that proactively address underlying activities contributing to subsidence:

1. A comprehensive identification and description of Enhanced Management Actions effective at limiting subsidence.
2. Action criteria for implementing the Enhanced Management Actions.
3. A process for evaluating effectiveness, potential corrective actions, and clear enforcement options to insure compliance.

6.7.18.2 Circumstances for Implementation

The initial, critical elements for implementation will be the implementation of the Well Registration Program (MA13) and followed closely by the Groundwater Extraction Measurement Program (MA3). These programs will setup the GKGSA for implementing monthly collection and reporting of well extraction.

6.7.18.3 Process for Public Notification

The public and relevant entities will be given the opportunity and time to comment on the Program prior to adoption by the GSA. Opportunity to comment will be made available at stakeholder advisory committee meetings, Amended GSP public comment period, and at GSA Board Meetings when the Program is presented in a Hearing for review. The GKGSA will include information on this management action through protocols identified in Section 2.7.

In addition, the GKGSA will hold public outreach meetings, email blasts, and website notification with growers to inform them of the LSMP and the need and value for their well information and extraction data.

6.7.18.4 Permitting and Regulatory Process

No permitting or regulatory process are expected to be needed to implement the well registration aspect of this program.

Authority for groundwater measurement collection and process resides within SGMA as previously cited. Additional permitting or regulatory compliance will not be necessary to implement a pilot program or to scale up to full coverage withing the GSA.

Each preventative management action will require individual evaluation as to permit and regulation applicability.

6.7.18.5 Status and Schedule

See Well Registration Program schedule as noted under MA13. See Groundwater Well Extraction Measurement Program as noted under MA3. The preventative management actions are ongoing.

6.7.18.6 Benefit Realization and Evaluation

This management action is designed to provide data and identify potential subsidence impacts due to groundwater conditions, and provide preventative management options that minimize subsidence.

This management action will directly address the impacts of chronic lowering of groundwater levels, reduced groundwater in storage, and land subsidence caused by lowered groundwater levels by implementing well registration, well metering and reporting, and preventative management actions to avoid impacts to infrastructure in the GKGSA. SMC measurable objectives (MOs) for subsidence will be the standard by which the GKGSA will use to judge compliance with objectives to reach sustainability.

6.7.18.7 How this Management Action Will Be Accomplished

At-risk groundwater conditions identified in the required well extraction reporting will trigger preventative management actions which can be implemented on a localized basis to minimize or eliminate subsidence in areas of concern.

6.7.18.8 Legal Authority

California Water code Section 10725.2 provides the GSA has the powers and authorities "perform an act necessary of proper" to implement SGMA regulations and allows the GSA to adopt rules, regulations, ordinances, and resolutions necessary for SGMA implementation (23CCR 355.4(b)(6).)

6.7.18.9 Costs

The costs to develop and implement the LSMP are unknown at this time as the LSMA is undergoing initial planning and development. It may cost approximately $200,000 per year; however, opportunities to cost-share with other Kaweah Subbasin GSAs may reduce that estimate.

6.8 Benefits Analyses

As described in Chapter 2 of this Plan, the GKGSA region, primarily via the conjunctive-use operations of Kaweah Delta Water Conservation District (KDWCD) as a CVP Contractor, has benefited from historical practices of groundwater recharge. There are, however, wet seasons and years during which local stream flows and surplus entitlements from KDWCD's Long-Term Contract for CVP Water are not imported into the area because all such facilities are at capacity from the local Kaweah River system. The Friant CVP Contractor allotments ramp up 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, GKGSA and KDWCD assessed the future availability of CVP/Friant and Kaweah River surplus sources.

Between the two sources there exist about 30 - 45 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. These surplus flows can be troublesome as flood flows can cause damage, so GKGSA diversion and recharge abilities provide a dual role of flood control and groundwater management.

7 GROUNDWATER SUSTAINABILITY PLAN IMPLEMENTATION

The adoption of the GSP will be the official start of the Plan Implementation. The GKGSA will continue its efforts to engage the public and secure the necessary funding to successfully monitor and manage groundwater resources in a sustainable manner. While the GSP is being reviewed by DWR, the GKGSA will coordinate with various stakeholders and beneficial users to improve the monitoring networks and begin the implementation process for projects and management actions.

7.1 Schedule and Estimated Cost [§354.6 (e)]

The GKGSA preliminary estimate of plan implementation costs includes four categories:

1. GSA Administration
2. Ongoing GSP Implementation
3. Plans to Fill Data Gaps
4. Projects & Management Actions

GSA Administration

This includes the costs of annually operating the GKGSA including, but not limited to, the executive officer's salary, audit, legal counsel, insurance, and potentially office space. The extent of administrative costs will be impacted by the direction the GKGSA follows in the years ahead. The GKGSA is utilizing a shared staff model where all labor for executive leadership, engineer, analyst, and administration are shared with a member agency. In the future, the GKGSA can evaluate moving to a hired executive staff model where all labor for executive leadership and administration costs, and all other work is performed by consultants.

Ongoing GSP Implementation

The ongoing costs of GSP implementation include, but are not limited to, basin coordination/policy development, engineering, outreach, monitoring, annual reporting, and data collection for 5-year updates. The expected implementation costs may vary based on GKGSA staffing and/or policy decisions in the future.

Plan to Fill Data Gaps (One-Time Cost)

Proper implementation of this GSP, especially as it relates to execution of projects and management actions, is contingent upon filling current data gaps. This process will require determining which measures are necessary to build and maintain a comprehensive assessment of the water budget and ultimately verify groundwater sustainability. This plan to fill data gaps

includes, but is not limited to, installing stream gauges, dedicated monitoring wells, and conducting a Proposition 218 vote.

Projects & Management Actions

Projects and management actions/programs will be required to achieve groundwater sustainability. Estimated costs generally include planning, design, and construction of infrastructure. The project costs listed are estimates and may be adapted, added to, or eliminated by the GKGSA Board should it be deemed necessary. The funding for projects and management actions will likely come from specific project proponents and/or beneficiaries.

The schedule and costs associated with GSP implementation activities are detailed in Table 7-1.

Table 7-1: Schedule and Cost of Implementation

GKGSA GSP Implementation Cost Estimate & 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
1. Regular/Ongoing SGMA Compliance Activities								
GSA Administration	$ -	$ 816,000	$ -	$ 1,000,000	$ -	$ 1,100,000	$ -	$ 1,250,000
Outreach and Engagement	$ -	$ 40,000	$ -	$ 20,000	$ -	$ 22,000	$ -	$ 24,000
Database Management System	$ -	$ 20,000	$ -	$ 5,000	$ -	$ 5,000	$ -	$ 5,000
Annual Reporting	$ -	$ 30,000	$ -	$ 33,000	$ -	$ 36,000	$ -	$ 40,000
GSP & Allocation Enforcement	$ -	$ 750,000	$ -	$ 500,000	$ -	$ 300,000	$ -	$ 330,000
2. GSP Amendments (Deficiency Updates and 5-Year Updates)								
Technical Consultant(s)	$ -	$ 300,000	$ -	$ 500,000	$ -	$ 400,000	$ -	$ 440,000
3. Plans to Fill Data Gaps								
Coordination and Implementation	$ -	$ 100,000	$ -	$ 50,000	$ -	$ 55,000	$ -	$ 60,000
4. Priority Projects (projects completed or in-process)								
P1 - Cross Creek Layoff Basin	$ 1,500,000	$ -	$ 5,000,000	$ 4,000	$ -	$ 4,400	$ -	$ 4,800
P2 - Recharge Basin Improvements for Lakeside Irrigation Water District	$ 200,000	$ -	$ 200,000	$ -	$ 200,000	$ -	$ -	$ -
P3 - New Recharge Basins	$ -	$ -	$ 6,000,000	$ -	$ 15,000,000	$ -	$ -	$ 4,000
P4 - Delta View Canal	$ -	$ -	$ 2,000,000	$ -	$ 500,000	$ -	$ -	$ 6,000
P5 - Lakeland Canal Deliveries	$ 50,000	$ 37,000.00	$ -	$ 40,000	$ -	$ 45,000	$ -	$ 50,000
P6 - Kings River Floodwater Arrangement	$ 50,000	$ 37,000.00	$ -	$ 40,000.	$ -	$ 45,000	$ -	$ 50,000
P7 - Kings River Surplus Water	$ -	$ 21,000.00	$ -	$ 23,000	$ -	$ 25,000	$ -	$ 27,000

P8 - Fallowing Program	$ -	$ -	$ -	$ 255,000	$ -	$ 255,00	$ -	$ 250,000
P9 - On-Farm Recharge & Storage	$ -	$ 2,000	$ -	$ 2,000	$ -	$ 2,200	$ -	$ 2,400
P10 - Hannah Ranch Flood Control Project	$ 1,600,000	$ -	$ -	$ -	$ -	$ 8,000	$ -	$ 8,800
P11 - Paregien Flood Control & Recharge Project	$ 1,800,000	$ -	$ -	$ 4,000	$ -	$ 4,400	$ -	$ 4,800
P12 - Ketchum Flood Control & Recharge Project	$ -	$ -	$ -	$ 4,000	$ -	$ 4,400	$ -	$ 4,800
P13 - St. Johns River Water Conservation Project	$ 500,000	$ -	$ 1,500,00	$ -	$ -	$ 1,000	$ -	$ 1,100
P14 - Basin No. 4 Improvement Project	$ 400,000	$ -	$ -	$ 4,000	$ -	$ 4,400	$ -	$ 4,800
P15 - Peoples Recharge and Exansion Project	$ 425,000	$ -	$ -	$ 2,000	$ -	$ 2,200	$ -	$ 2,400
P16 – Greater Fallowing Auction Program	$ 1,000	$ 300,000	$ 5,000	$ 500,000	$ 2,000	$ 50,000	$ 2,000	$ 500,000
5. Priority Management Actions (management actions completed or in-process)								
MA1 - Communication and Engagement	$ 10,000	$ -	$ -	$ -	$ 10,000.	$ -	$ 10,00	$ -
MA2 - Terminus Reservoir Reoperation Program	$ -	$ -	$ -	$ -	$ 45,000	$ -	$ -	$ -
MA3 - Groundwater Extraction Measurement Program	$ 10,000	$ -	$ -	$ -	$ 30,000	$ -	$ 40,000	$ -
MA4 - Well Characterization Program	$ 5,000	$ -	$ -	$ -	$ 11,000	$ -	$ 15,000	$ -
MA5 - Geophysical Data Survey - Phase I	$ 200,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
MA5 - Geophysical Data Survey - Phase II	$ -	$ -	$ 200,000	$ -	$ -	$ -	$ -	$ -
MA6 – Kaweah Subbasin Mitigation Program & GKGSA Mitigation Plan *new	$ 1,000,000	$ -	$ 4,000,000	$ -	$ 3,000,000	$ -	$ 1,000,000	$ -
MA7 - Agricultural Water Conservation & Management	$ 10,000	$ -	$ 20,000	$ -	$ 22,00	$ -	$ 30,000	$ -

MA8 - Urban Water Conservation Program	$	-	$	-	$	40,000	$	-	$	-	$	-	$	-
MA9 - Fee & Incentive Program	$	20,000	$	-	$	15,000	$	-	$	17,000	$	-	$	20,000	$	-
MA10 - Groundwater Market	$	25,000	$	-	$	10,000	$	-	$	5,000	$	-	$	5,000	$	-
MA11 - Groundwater Allocation and Accounting Program	$	40,000	$	-	$	20,000	$	-	$	10,000	$	-	$	10,000	$	-
MA12 - Interconnected Surface Water Data Gap Work Plan	$	-	$	100,000	$	-	$	112,000	$	-	$	125,000	$	-	$	140,000
MA13 - Well Registration Program *new	$	5,000	$	-	$	30,000	$	-	$	-	$	-	$	-	$	-
MA14 - Small Community Well Proactive & Protection Action Plan (PPAP) *new	$	5,00	$	-	$	20,000	$	2,000	$	20,000	$	2,200	$	-	$	2,500
MA15 - Well Permit Application Review and Technical Support *new	$	1,000	$	5,000	$	75,000	$	1,000	$	50,000	$	1,200	$	-	$	15,000
MA16 – Water Importation/Recharge Program *new	$	1,000	$	200,000	$	1,00	$	400,000	$	1,000.00	$	600,00	$	1,000	$	2,500
MA17 – Collaboration with Other Agencies and inter-Basin Coordination (Regional Subsidence)	$	-	$	-	$	-	$	-	$	-	$	-	$	-	$	-
MA18 – Land Subsidence Management Plan (LSMP) *new	$	-	$	200,000	$	-	$	200,000	$	-	$	200,000	$	-	$	200,000

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 undesirable results. 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 GKGSA area, respectively. Appendix 5F includes projected hydrographs for RMS to demonstrate avoidance of undesirable results.

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 one 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.

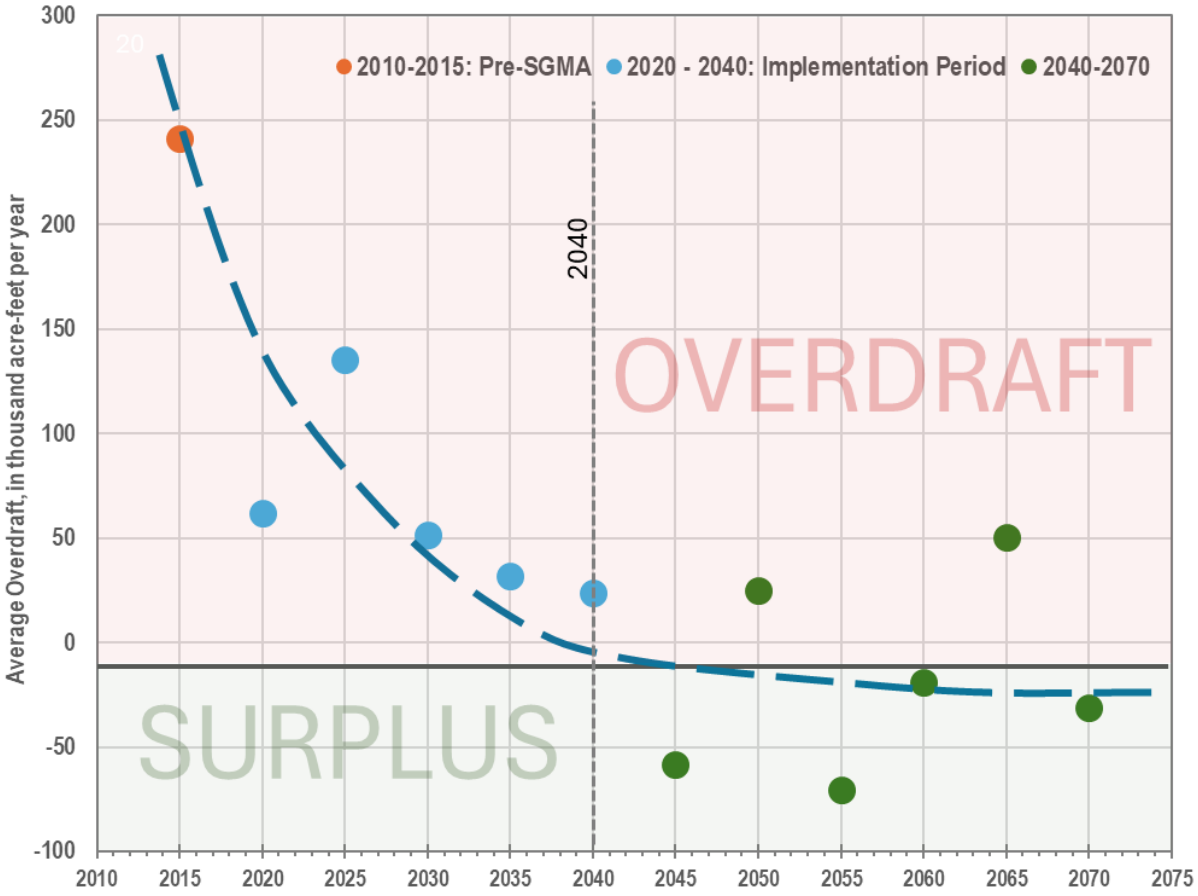


Figure 7-1. Kaweah Subbasin Overdraft Reduction Starting Pre-SGMA through 50-Year Planning Horizon

7.3 Data Management System

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 Interim Milestones) for RMS

The HydroSQL database also stores related groundwater level and subsidence time-series data. The time-series data for groundwater levels include the following fields:

- Site Name
- Measure Date/Time
- Water Level Elevation (ft. NAVD88)
- Depth to Water (ft. bls)
- Measurement Method and Accuracy
- Collecting Agency

The time-series data for subsidence include the following fields:

- Site Name
- Sample Date/Time
- Cumulative Vertical Displacement (ft.) from a specified start date
- Land Surface Elevation (ft. 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 time-series 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 7-2. 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 7-1 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 to on each GSA's website. The link via the GKGSA's website is greaterkaweahgsa.org. 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 time-series charts of groundwater level, groundwater quality, and subsidence time-series data. Users can customize these time-series charts, e.g., plot data for multiple sites, plot multiple time-series, 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]

The GKGSA together with the other two GSAs 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 three 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 towards achieving sustainability

Additionally, GKGSA will re-evaluate and, if needed, amend its GSP at least every five 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*[16]. Periodic evaluations track progress using current

[16] 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

groundwater conditions, status of projects or management actions, evaluation of undesirable results relating to measurable objectives and minimum thresholds, 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 five years, if deemed necessary. This may occur, for example, if sustainability goals are not being met, additional data are acquired that change understanding of the Subbasin or operations, or priorities change. While the GKGSA is evaluating key components of the GSP, such as sustainable management criteria, 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 five years.

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