

# EXECUTIVE SUMMARY

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The Kern County Subbasin Amended Groundwater Sustainability Plan (2025 Plan)<sup>1</sup> consists of seven closely coordinated (and nearly identical) Groundwater Sustainability Plans (GSPs) and a Coordination Agreement. The 2025 Plan represents a critical milestone in the Kern Subbasin and all 20 Kern Subbasin Groundwater Sustainability Agencies' (GSAs) ongoing commitment to achieving long-term groundwater sustainability under California's Sustainable Groundwater Management Act (SGMA). Developed collaboratively by all 20 GSAs, the 2025 Plan responds directly to regulatory feedback from the California Department of Water Resources (DWR) and the State Water Resources Control Board (SWRCB), incorporating the latest data, technical refinements, and input from interested parties. Table ES-1 presents the overview of each of the seven GSPs that together constitute the 2025 Plan, including which GSAs are covered by each GSP and whether the GSP includes supplemental "blue pages" specific to the portion of the Kern Subbasin that the GSA manages.

**Table ES-1. 2025 Plan GSPs**

GSP Name	Area (acres)	Percentage of Subbasin Area (percent)	GSA	GSP Contents
Kern Subbasin GSP	1,205,482	67.6%	Arvin GSA Cawelo Water District GSA Kern Non-Districted Land Authority GSA (formerly Kern Groundwater Authority GSA) Kern River GSA Kern Water Bank GSA Greenfield County Water Districts GSA North Kern WSD GSA Pioneer GSA Rosedale-Rio Bravo WSD GSA Shafter-Wasco ID GSA Southern San Joaquin MUD GSA Tejon-Castac Water District GSA West Kern Water District GSA Wheeler Ridge-Maricopa GSA	Kern Subbasin GSP

<sup>1</sup> The 2025 Plan is prepared by 20 GSAs, which collectively manage the Kern Subbasin under one Coordination Agreement. Six GSAs have prepared a version of the 2025 Plan that includes supplemental information specific to the portion of the Kern Subbasin that the GSA manages. This supplemental information is provided on blue pages so differences between the versions can be easily identified by reviewers.

<b>GSP Name</b>	<b>Area (acres)</b>	<b>Percentage of Subbasin Area (percent)</b>	<b>GSA</b>	<b>GSP Contents</b>
Buena Vista GSA GSP	51,070	2.9%	Buena Vista GSA	Kern Subbasin GSP Supplemental GSA information included on blue pages
Henry Miller Water District GSA GSP	26,063	1.5%	Henry Miller Water District GSA	Kern Subbasin GSP; Supplemental GSA information on blue pages
Kern-Tulare Water District GSA GSP	11,344	0.6%	Kern-Tulare Water District GSA	Kern Subbasin GSP; Supplemental GSA information on blue pages
Olcese Water District GSA GSP	3,199	0.2%	Olcese Water District GSA	Kern Subbasin GSP; Supplemental GSA information on blue pages
Semitropic Water Storage District GSA GSP	224,350	12.6%	Semitropic Water Storage District GSA	Kern Subbasin GSP; Supplemental GSA information on blue pages
Westside District Water Authority GSA GSP	260,061	14.6%	Westside District Water Authority GSA	Kern Subbasin GSP; Supplemental GSA information on blue pages

The 2025 Plan outlines a coordinated, science-based approach to address DWR Deficiencies<sup>2</sup> and SWRCB Potential Actions to Correct the Deficiencies<sup>3</sup> to ensure the sustainability of groundwater resources for all beneficial uses and users.

This Executive Summary is intended to provide decision-makers, interested parties, and the public with a clear understanding of the 2025 Plan’s amendments, purpose, structure, and path forward. Table ES-2 below provides an overview of the Executive Summary topics to guide readers to an overview of areas of interest in the 2025 Plan.

<sup>2</sup> DWR Deficiencies as identified in Appendix A-1.

<sup>3</sup> SWRCB Potential Actions to Correct the Deficiencies as identified in Appendix B-1.

**Table ES-2. Executive Summary Topics Overview**

Title	Overview of Topics Discussed in the 2025 Plan Sections
ES.1: Introduction	Introduces SGMA and the requirement for local agencies to develop GSPs to manage groundwater sustainably.
ES.2: Sustainability Goal	Defines the Kern Subbasin’s shared goal to achieve groundwater sustainability by 2040 through coordinated management and monitoring.
ES.3: Agency Information	Describes the structure, roles, and coordination among the 20 GSAs managing the Kern Subbasin.
ES.4: GSP Organization	Outlines the structure and content of the GSP.
ES.5: Description of the Plan Area	Provides geographic, demographic, and land use context for the 1.78-million-acre area of the Kern Subbasin.
ES.6: Introduction to Basin Setting	Summarizes the physical and hydrologic characteristics that influence groundwater conditions in the Kern Subbasin.
ES.7: Hydrogeological Conceptual Model	Details the geologic framework and aquifer systems that define groundwater flow and storage.
ES.8: Current and Historical Groundwater Conditions	Presents data on groundwater levels, storage, quality, and land subsidence trends.
ES.9: Water Budget Information	Quantifies groundwater inflows, outflows, and storage changes using historical and projected data.
ES.10: Management Areas	Defines sub-areas within the Kern Subbasin for localized groundwater management and monitoring.
ES.11: Introduction to Sustainable Management Criteria	Introduces the framework for setting measurable thresholds to evaluate sustainability.
ES.12: Sustainability Goal	Reaffirms the Kern Subbasin’s long-term goal and the metrics used to track progress.
ES.13: Sustainable Management Criteria	Specifies thresholds, objectives, and triggers for each sustainability indicator.
ES.14: Projects and Management Actions	Describes planned actions to reduce groundwater deficits and improve sustainability outcomes.
ES.15: Monitoring Network	Details the network of sites used to track groundwater conditions and compliance with sustainable management criteria.
ES.16: Plan Implementation	Outlines the timeline, responsibilities, and funding mechanisms for executing the GSP.

## ES.1 Introduction

On September 16, 2014, the California legislature enacted the SGMA for the primary purpose of achieving and maintaining sustainability within the State’s high and medium priority groundwater basins. Key tenets of SGMA are preservation of local control, use of best available data and science, and active engagement and consideration of all beneficial uses and users of groundwater. SGMA requires local agencies to form GSAs who are tasked with managing basins sustainably through the development and implementation of GSPs.

Figure ES-1 provides an overview of the 20 GSAs within the Kern County Subbasin of the San Joaquin Valley Groundwater Basin.<sup>4</sup> The Kern Subbasin is one of 21 basins and subbasins identified by the DWR as being critically overdrafted. This designation triggered an accelerated timeline for GSP development by 2020 and long-term sustainability by 2040.

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<sup>4</sup> Kern County Subbasin (DWR No. 5-022.14) located within San Joaquin Valley Groundwater Basin (DWR No. 5-022).

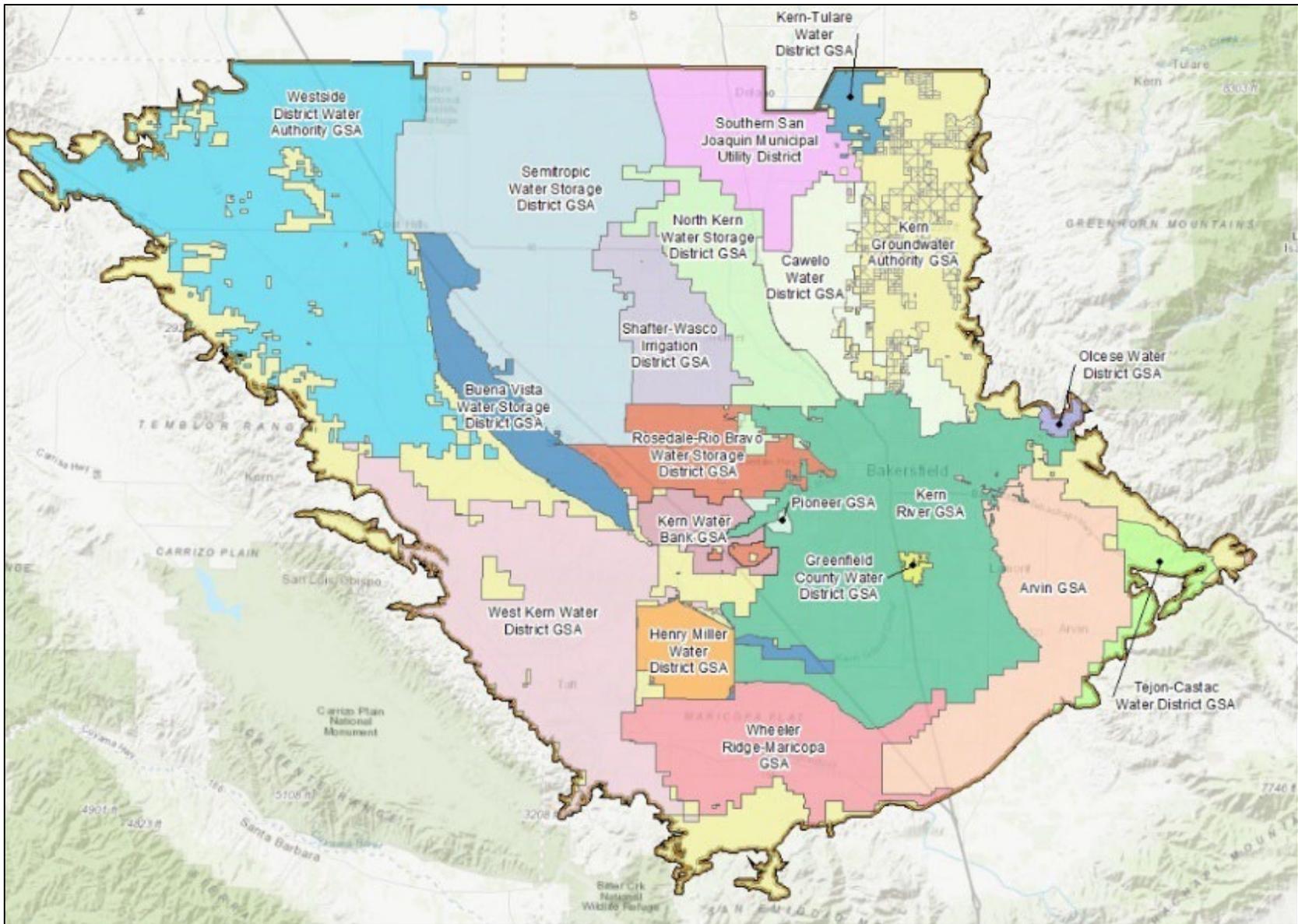


Figure ES-1. Kern County Subbasin GSAs

## Kern Subbasin Timeline

In response to the DWR Deficiencies and SWRCB Potential Actions to Correct Deficiencies, the Kern Subbasin has undertaken a rigorous, coordinated, and collaborative process to revise and strengthen the 2025 Plan. The Kern Subbasin worked together to address identified deficiencies and potential actions, incorporate updated data, and enhance coordination and stakeholder outreach. The timeline of SGMA implementation in the Kern Subbasin is reflected in Figure ES-2 and summarized below.

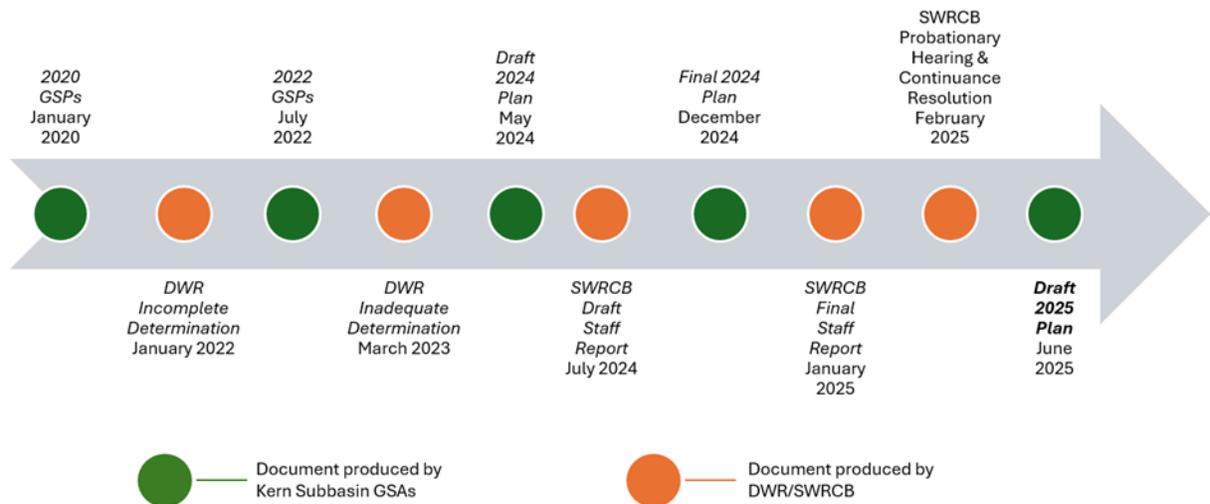


Figure ES-2. Kern Subbasin Timeline

### DWR Process (2020 – 2023)

In January 2020, the Kern Subbasin GSAs executed a Coordination Agreement and subsequently submitted five GSPs to DWR (2020 GSPs). DWR designated the 2020 GSPs as “incomplete” in January 2022 and identified three deficiencies. In July 2022, the GSAs amended the Coordination Agreement and the five GSPs, plus a new independent GSA was formed, which resulted in submitting six GSPs to DWR to address the identified deficiencies (2022 GSPs). In March 2023, DWR designated the Kern Subbasin as “inadequate” after reviewing the 2022 GSPs. As a result, the Kern Subbasin is subject to the state intervention process with the SWRCB as defined in California Water Code (CWC) §10735 et seq. The most significant deficiency was the lack of coordination among the six GSPs, which led to the next phase of work and development of a single Subbasin-wide plan.

### SWRCB Process (2023 – June 2025)

In 2023 and 2024, the Kern Subbasin GSAs collaborated to amend the Coordination Agreement and integrate their plans under the SWRCB intervention process. In December 2024, the 20 GSAs adopted seven coordinated GSPs, with one subbasin-

wide foundational GSP (the Kern Subbasin GSP) along with six additional GSPs (coordinated and consistent with the Kern Subbasin GSP) containing GSA-specific supplemental information included as “blue pages”. In February 2025, the SWRCB held a public hearing to consider probationary designation of the Kern Subbasin. The SWRCB resolved, through Resolution No. 2025-0007, that the hearing would be continued to allow time for the SWRCB and the GSAs to continue working collaboratively on addressing the DWR Deficiencies and SWRCB Potential Actions to Correct Deficiencies. In the Resolution, SWRCB directed the Kern Subbasin to revise and submit its 2025 Plan by June 2025.

### **Summary of 2025 Plan Amendments**

The 2025 Plan amendments focus on addressing remaining SWRCB Corrective Actions to Address the Deficiencies. Key revisions include:

1. Reevaluation of groundwater level and groundwater quality monitoring network data gaps, and development of a Project and Management Action (P/MA) that includes a plan to fill those data gaps.
2. Local refinements of Minimum Thresholds (MTs) for Chronic Lowering of Groundwater Levels targeting additional protection of beneficial uses and users.
3. Revisions of Sustainable Management Criteria (SMCs) and the Undesirable Results (UR) definition for Degraded Water Quality to provide additional protection of beneficial uses and users.
4. Additions to the Exceedance Policy and associated Action Plans for Groundwater Levels, Degraded Water Quality, and Land Subsidence (Appendix K-1) that elaborates on factors used to evaluate and act on groundwater level, quality, and subsidence related exceedances and expands on the GSAs’ commitment to ongoing collaboration with key critical infrastructure operators, respectively.
5. Development of a Degraded Water Quality Implementation Provisions (Appendix K-2) that includes summaries of related water quality provisions including, notification procedures for an exceedance, investigation procedures when representative monitoring well data exceed MTs (Appendix K-1), coordination efforts among existing programs, and Degraded Water Quality Mitigation (Appendix G-1).
6. Expansion of the Kern Subbasin Well Mitigation Program to include additional details (under a separate “*Degraded Water Quality Mitigation Track*”) related to domestic well mitigation for Degraded Water Quality (Appendix G-1).
7. Subbasin-wide coordination among all Kern Subbasin GSAs on all GSP revisions and extensive community outreach and engagement.

Table 1-13 in Section 1 of the 2025 Plan provides a “crosswalk” between the DWR Deficiencies and SWRCB Potential Actions to Correct the Deficiencies reflected in the SWRCB January 2025 Final Staff Report, and a summary of amendments incorporated

in the 2025 Plan. The 2025 Plan provides a clear and coordinated path to achieve sustainable groundwater management in the Kern Subbasin.

## ES.2 Sustainability Goal

Under SGMA, a Sustainability Goal is defined as a statement that describes the intended purpose of the GSP, including the desired conditions of the groundwater basin at the end of the 20-year planning and implementation horizon, and how the basin will achieve and maintain those conditions.

The Sustainability Goal must reflect avoidance of undesirable results, which include six conditions of groundwater known as Sustainability Indicators defined by SGMA:

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

The Kern Subbasin GSAs share a common Sustainability Goal, which is foundational to the development and implementation of the 2025 Plan. The Kern Subbasin GSAs' Sustainability Goal is to achieve sustainable groundwater management within the SGMA 20-year implementation period. Achieving the Sustainability Goal will be demonstrated by eliminating chronic lowering of groundwater levels caused by overdraft conditions and avoiding undesirable results for groundwater levels, groundwater storage, land subsidence, and groundwater quality.

## ES.3 Agency Information

The 2025 Plan was prepared by the 20 GSAs within the Kern Subbasin pursuant to the Coordination Agreement. Each GSA within the Kern Subbasin applied for and was granted exclusive GSA status for a portion of the Kern Subbasin under CWC §10723(c) and §10723.8. The Coordination Agreement was developed to establish the governance structure for the Kern Subbasin GSAs cooperative and coordinated exercise of authorities and responsibilities under SGMA. Each GSA has designated representative(s) to help lead or participate in coordination activities among GSAs, State agencies, local governments, local water suppliers, neighboring entities, non-governmental organizations, and other interested parties. Pursuant to Title 23 of the California Code of Regulations (CCR) §357.4(b)(1), a single point-of-contact was

established for the purposes of organizing the various coordination activities and ensuring cohesion between GSA activities.

## ES.4 GSP Organization

The 2025 Plan details and consolidates the Kern Subbasin GSAs' plans for achieving long-term sustainability. The organizational structure, as shown in Table ES-1, follows DWR's Annotated Outline (December 2016) with additional Sections incorporated to more thoroughly characterize the complexities of the Kern Subbasin, including its water supplies and long history of conjunctive management.

## ES.5 Description of the Plan Area

The Kern Subbasin Plan Area (Plan Area) covers 1.78-million-acres and is located at the southern end of the Tulare Lake Hydrologic Region, including most of the San Joaquin Valley area within Kern County. For purposes of the 2025 Plan, the Kern Subbasin has been separated into five Hydrogeological Conceptual Model (HCM) Areas that are

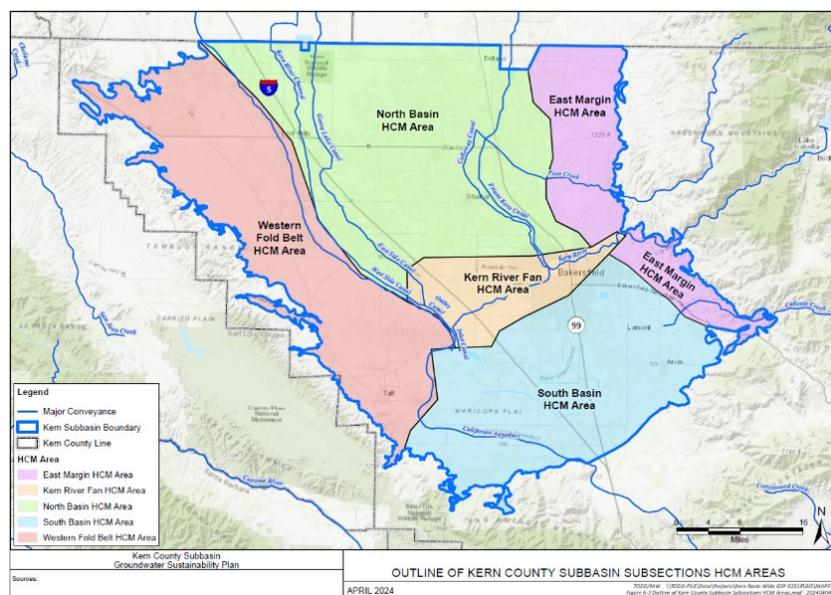


Figure ES-3. HCM Areas in the Plan Area

characterized by specific geologic and hydrogeologic attributes that dictate land and water uses in the area. The HCM Areas include the Western Fold Belt, East Margin, Kern River Fan, North Basin (North of Kern River Fan), and South Basin (South of Kern River Fan), as shown on Figure ES-3.

### Adjacent Subbasins

The Kern Subbasin neighbors four separate and distinct groundwater subbasins: (1) the Tulare Lake Subbasin (DWR 5-022.12), (2) the Tule Subbasin (DWR 5-022.13), (3) the Kettleman Plain Subbasin (DWR 5-022.17), and (4) the White Wolf Subbasin (DWR 5-022.18), all also located within the San Joaquin Valley Groundwater Basin. The Tulare Lake and Tule Subbasins are designated as high priority and critically overdrafted by DWR. The adjacent Tulare Lake, Tule, and White Wolf Subbasins are each managed according to separate GSPs and SGMA-related activities. The Kern Subbasin GSAs consult with these subbasins to coordinate cross-boundary interactions (e.g.,

accounting for groundwater subsurface inflows and outflows and evaluating consistency of SMCs).

### ***Land Use***

The Plan Area is predominately two land use types: (1) irrigated agriculture, including a diverse array of crop types dictated largely by the economics of private farming and water supply availability, and (2) other uses. Table ES-3 breaks down land use type and acreage within the Plan Area. Water demands are met through conjunctive use programs that include diversions from the Kern River, imported surface water from the State Water Project (SWP) and Central Valley Project (CVP), and in more recent years, recycled water.

**Table ES-3. Land Use and Acreage in the Plan Area**

<b>Land Use Type</b>	<b>Acreage</b>	<b>Percentage of Total Area</b>
Actively Cropped Agriculture Lands	644,000	36%
Idle Agriculture Lands (not actively irrigated)	256,000	15%
Urban, Suburban, and Rural Communities	81,000	8%
Industrial Oil Fields	159,000	5%
Other Uses (native/riparian vegetation, refuge, recharge basins, etc.)	~640,000	36%

### ***Incorporated Cities and Unincorporated Communities***

The Kern Subbasin is located within Kern County and includes eight incorporated cities and twenty-five unincorporated communities and census designated places as shown in Table ES-4. Areas within the Kern Subbasin identified as Disadvantaged Communities (DACs) or Severely Disadvantaged Communities (SDACs) based on the median household income (MHI) of the area compared to the Statewide MHI are identified in the table below, which reflects 1.43 million acres or 80 percent of the Plan Area.

**Table ES-4. Incorporated Cities and Unincorporated Communities in the Plan Area**

<b>Incorporated Cities</b>	
Arvin	McFarland
Bakersfield	Shafter
Delano	Taft
Maricopa	Wasco
<b>Unincorporated Communities and Census Designated Places</b>	
Buttonwillow	Lost Hills
Cherokee Strip	McKittrick
Derby Acres	Metter
Dustin Acres	Mexican Colony
Edison	Oildale



Principal Aquifer is the most productive freshwater aquifer, and the source of nearly all groundwater used within the Kern Subbasin.

2. **Santa Margarita Principal Aquifer:** The Santa Margarita Principal Aquifer is a confined unit located in the northeastern portion of the Kern Subbasin and is comprised of both the Santa Margarita Formation and Olcese Sand.
3. **Olcese Principal Aquifer:** The Olcese Principal Aquifer is a confined unit located in the vicinity of where the Kern River enters the eastern portion of the Kern Subbasin and consists of the Olcese Sand.

A series of hydrogeologic cross-sections have been developed to illustrate the Kern Subbasin physical characteristics and the formations present in the Plan Area. Figure ES-5 illustrates an example of the conditions parallel to the southern Plan Area. Cross sections for other portions of the Kern Subbasin are shown in Section 7. This example shows the prevalence of Tulare and Kern River Formations, with the Santa Margarita Formation and Olcese Sand shallowing in the East Margin, and the extent of spatially discontinuous clay layers which can locally influence groundwater percolation and lateral flows. The cross sections developed improve understanding of Kern Subbasin conditions in the HCM Areas and provide the information necessary to develop water budgets from the Kern Subbasin’s local numerical model, establish representative monitoring networks, develop applicable SMCs, and effectively convey hydrogeologic conditions to stakeholder groups.

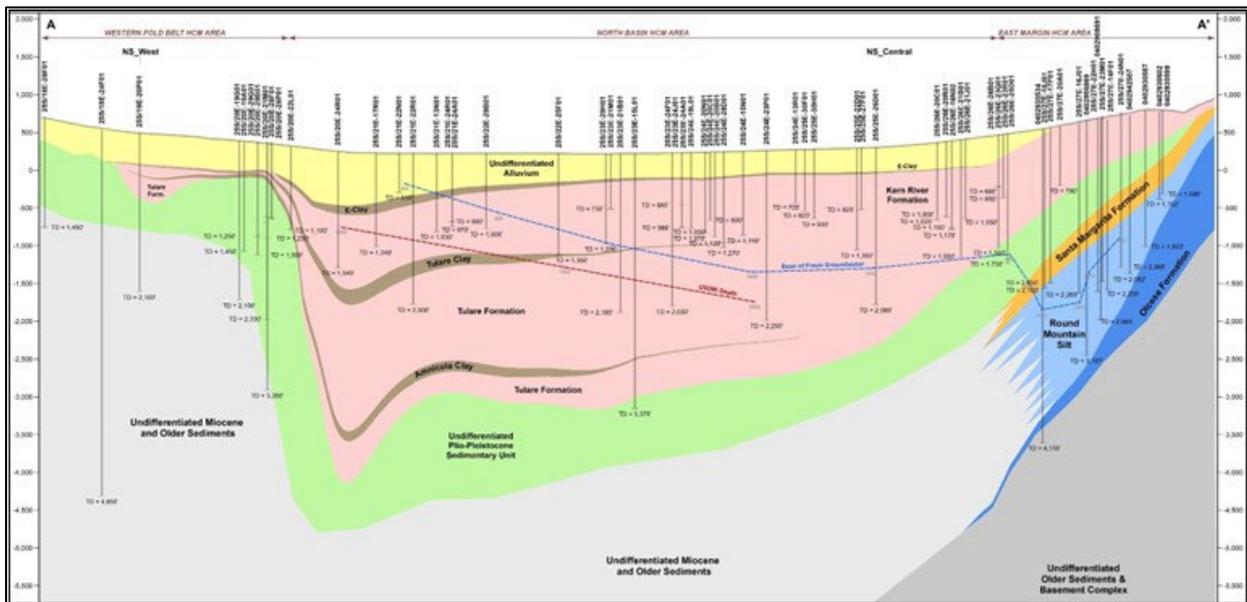


Figure ES-5. Kern Subbasin Cross Section

The Kern Subbasin contains several surface water features. The Kern River is the largest river in the Kern Subbasin and flows east to west through the center of the Plan Area. The Kern Subbasin also contains significant infrastructure that conveys imported water supplies, including the Friant-Kern Canal (FKC), California Aqueduct, and local canals.

Significant water recharge occurs in the Kern Subbasin through managed conjunctive use and water banking (surface water storage and recovery) projects along the Kern River and in other HCM Areas. The conjunctive use projects are dedicated to the management of surface water and storage of surface water within a specific portion of the Kern Subbasin for use at a later time by the overlaying lands of the Kern Subbasin, whereas water banking projects store surplus surface water supplies from the SWP, CVP, Kern River, and other flood waters for subsequent recovery for beneficial uses.<sup>5</sup>

## **ES.8 Current and Historical Groundwater Conditions**

This section provides a comprehensive overview of the Kern Subbasin’s physical and hydrologic characteristics, offering essential context for sustainable groundwater management. It includes an evaluation of both current and historical groundwater conditions to inform the development of sustainability goals and management actions. Key components of this section include:

1. Analysis of groundwater levels, highlighting seasonal and long-term changes in water levels.
2. Estimates of groundwater storage variations over time.
3. Assessment of seawater intrusion, where applicable, including its extent and progression.
4. Review of groundwater quality, identifying trends and areas of concern.
5. Documentation of land subsidence linked to groundwater extraction.
6. Evaluation of interconnected surface water systems and the impacts of groundwater use on surface water flows.

### ***Groundwater Levels***

Groundwater levels within the Kern Subbasin are presented using contour maps depicting the current (2023) seasonal high and seasonal low for each principal aquifer (Primary Alluvial Principal Aquifer, Santa Margarita Principal Aquifer, and Olcese Principal Aquifer) and hydrographs for various wells across the Kern Subbasin depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients

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<sup>5</sup> “The storing of water underground ... constitutes a beneficial use of water if the water so stored is thereafter applied to the beneficial purposes for which the appropriation for storage was made.” CWC § 1242.

between and within principal aquifers. The available data indicate that the Kern River effectively bisects the Plan Area (Figure ES-2). Groundwater tends to diverge from the Kern Fan HCM Area, with groundwater flowing toward extraction areas. Relative highs and lows appear to be controlled, at least in part, by the distribution of groundwater pumping and surface water deliveries. Hydrographs show the long-term positive effects of surface water importation and corresponding conjunctive use and water banking activities in raising groundwater levels, tempered by the effects of the recent severe droughts.

### Groundwater Storage

Changes in groundwater storage over selected time periods were calculated from the Kern Subbasin’s local numerical model (C2VSimFG-Kern) and validated through a groundwater storage calculation that considers changes in measured groundwater elevations across the Kern Subbasin.

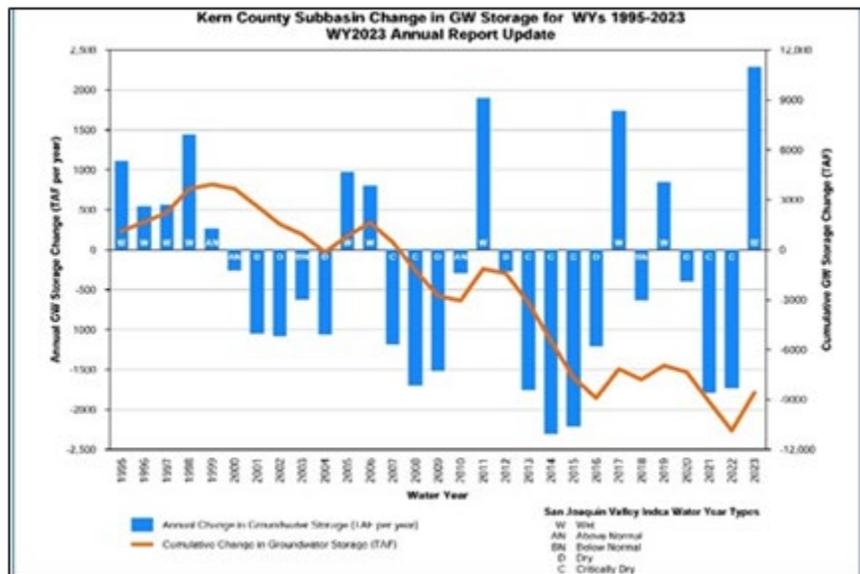


Figure ES-6. Kern Subbasin Annual Change in Groundwater in Storage

The variation in the simulated change in groundwater storage over the historical period generally corresponds with the variation in climatic conditions and surface water supply availability (Figure ES-6). The change in storage is more pronounced in the Kern Subbasin due to numerous conjunctive use and banking operations that store surface water in the aquifer typically during wet periods and then recover it for beneficial use during dry periods. As a result of these factors, the change in storage within the Kern Subbasin has had annual increases and decreases of up to 2,300,000 acre-feet per year (AFY).

### Groundwater Quality

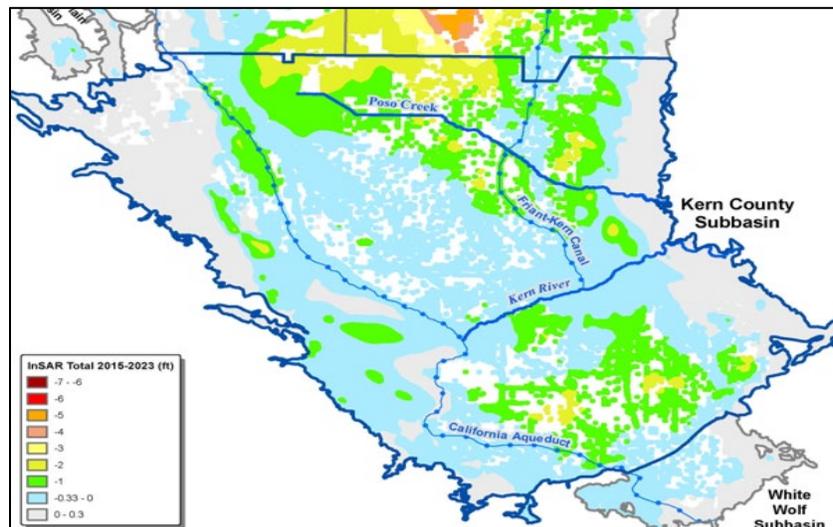
Certain constituents of concern (COCs) have been identified in the Kern Subbasin above the water quality objective, as set forth in the Water Quality Control Plan for the Tulare Lake Basin (Tulare Lake Basin Plan), which incorporates by reference maximum contaminant levels (MCLs) specified in Title 22 of the California Code of Regulations as applicable. The Kern Subbasin employed the SWRCB’s methodology for identifying

COCs from State and Regional Water Board datasets, and assessed the following constituents: 1,2,3-trichloropropane (1,2,3-TCP), arsenic, benzene, dibromochloropropane (DBCP), ethylene dibromide (EDB), gross alpha radiation, nitrate (as N), nitrate + nitrite (as N), nitrite (as N), perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), selenium, total dissolved solids (TDS), and uranium. Of the 14 constituents recommended for evaluation, six were identified as COCs for SGMA monitoring across the Kern Subbasin: 1,2,3-TCP, arsenic, nitrates (including nitrite and nitrate+nitrite), TDS, and uranium.

Trend analyses were conducted on the six COCs to evaluate the relationship between groundwater management activities and degraded water quality, and to identify driving mechanisms for exacerbating constituent concentrations. No direct correlation has been observed between groundwater management activities and exacerbating concentrations of 1,2,3-TCP, TDS or uranium. While there is no clear Kern Subbasin-wide correlation for arsenic and nitrates, the driving mechanisms for degradation may require additional investigation. The GSAs have identified Representative Monitoring Wells for Degraded Water Quality (RMW-WQs) and will collect samples from these wells seasonally, coincident groundwater elevation measurements across the Kern Subbasin to monitor for potential impacts to beneficial users.

### **Land Subsidence**

Land subsidence has been documented within the San Joaquin Valley over both historical and recent timeframes, with the greatest documented land subsidence occurring north of the Kern Subbasin (Figure ES-7). Not all land subsidence is GSA-related, nor is all land subsidence inelastic (i.e., non-recoverable). Land subsidence rates within the Kern Subbasin range from 0 to 0.3 feet per year



**Figure ES-7. Cumulative Subsidence between 2015 – 2023 (ft) based on InSAR data**

resulting in a cumulative land subsidence of 0 to 2.41 feet since 2015. Land subsidence caused by factors within the GSAs’ authority to manage is due to aquitard depressurization following groundwater withdrawal, which tends to be greater in the areas that rely solely on groundwater for water supply (agricultural and urban pumping) and are underlain by a greater proportion of fine-grained deposits. Additional causes of land subsidence that are outside of the GSAs’ control, include oil and gas extraction,

natural processes (i.e. faulting), expansive/soluble soil types susceptible to hydro-compaction, and others (e.g., deficient Aqueduct pre-construction hydro-compaction, age of infrastructure, etc.). Recent technical studies commissioned by the GSAs have been able to differentiate the land subsidence signals associated with these other causal factors.

Land subsidence has the potential to affect Kern Subbasin regional critical infrastructure (i.e., the California Aqueduct and Friant-Kern Canal) and local GSA area critical infrastructure, including gravity-driven water conveyance systems (canals). Both non-recoverable and recoverable land subsidence occurs in the area of the Kern Fan HCM Area. In some areas of the Kern Fan HCM Area, especially where significant recharge occurs at the Kern Fan banking programs, the average rate of land subsidence calculated for the Kern Fan HCM Area using the period from 2015 to 2024 likely overestimates projected land subsidence through 2040. To assess land subsidence, the Kern Subbasin has conducted a series of studies and continues on-going collaboration and communication with the California Aqueduct Subsidence Program (CASP) and the Friant Water Authority.

### ***Seawater Intrusion***

The Kern Subbasin is located far from coastal areas, and therefore seawater intrusion is not considered to be a relevant Sustainability Indicator.

### ***Interconnected Surface Water***

Data on depth to groundwater, geology, and other local conditions indicate that the vast majority of surface water features in the Kern Subbasin are not connected to groundwater, and in the few limited areas where a connection may occur, the connection is likely transient, short-lived, and involves shallow or perched groundwater that is not part of the principal aquifer systems. As such, the areas of vegetation mapped as Natural Communities Commonly Associated with Groundwater (NCCAG) and areas identified by the ICONS dataset are not likely groundwater dependent ecosystems (GDEs) or ISWs but instead are supported by irrigation water infiltration and agricultural return flows. In these areas, infiltration of irrigation water and agricultural return flows is impeded by clay soils and subsurface clay sediments creating shallow perched groundwater that is disconnected from groundwater in the principal aquifers that are the focus of SGMA.

## **ES.9 Water Budget Information**

This section presents a detailed accounting of the Kern Subbasin's water inflows, outflows, and changes in storage over time. The water budget is a critical tool for understanding the Kern Subbasin's hydrologic balance and for evaluating the sustainability of current and projected groundwater use. It supports the development of

measurable objectives (MOs) and SMCs by quantifying the relationship between water supply and demand under various conditions.

The water budget includes:

1. Historical Water Budget – A retrospective analysis of water conditions over a representative period, establishing baseline trends.
2. Current Water Budget – A snapshot of recent water year conditions, reflecting current management and climate influences.
3. Projected Water Budget – Future scenarios incorporating anticipated changes in land use, climate, and water demands.
4. Components of the Budget – Including natural and artificial recharge, groundwater extraction, evapotranspiration, surface water interactions, and subsurface flows.

### ***Water Budget Model***

The Kern Subbasin GSAs coordinated on the development of a single water budget using a local numerical model (C2VSimFG-Kern) that is based on the California Central Valley Groundwater/Surface Water Simulation Model (C2VSim) developed by DWR. The C2VSimFG-Kern is enhanced with additional data applied at the GSA level based on locally derived managed water supply and demand data to better represent the local water budgets. These model enhancements have been provided to DWR to help support their ongoing C2VSimFG model development. The Kern Subbasin has continued to support annual updates to the C2VSimFG-Kern model to incorporate recent conditions and estimate the current water budget.

Modeling results show that the Kern Subbasin, as a whole, had a total storage deficit of:

- Approximately 274,200 AFY over the historical period (i.e., WYs 1995-2014); and
- Approximately 344,000 AFY over the current period (i.e., WYs 2015-2023).

The Sustainable Yield has been conservatively estimated to be approximately 1.31 million AFY based on results for the historical period using model-calculated groundwater pumping and recharge to quantify the volume of water that, if pumped over the water budget period of interest, would have resulted in zero change in storage.

The projected water budget assesses the magnitude of the net water supply deficit under future conditions that would need to be addressed through P/MAs to prevent Undesirable Results and achieve the Sustainability Goal. Three projected water budget scenarios have been developed for this analysis: (1) a Baseline Scenario, (2) a 2030 Climate Change Scenario, and (3) a 2070 Climate Change Scenario.

The projected (future) conditions were developed following the DWR guidance for developing future climate variables (i.e., adjusted precipitation and evapotranspiration)

and water supply assumptions (i.e., changes to imported water supplies). This approach allows for inclusion of more complex variables, including factors influenced by climate change, resulting in more accurate projections.

Each projected (future) scenario was run twice. One version was run without P/MAs to evaluate the projected deficit, and a second version was run with a representative set of demand reduction and water augmentation P/MAs to identify the quantitative goal of planned P/MAs necessary to provide a reasonable approach to achieve sustainable groundwater management through 2040 and beyond. The results for each scenario are provided in Table ES-5. The Kern Subbasin GSAs used the projected deficit of 372,120 AFY from the 2030 Climate Change Scenario to define the target quantitative goal for planning purposes.

While the current C2VSimFG-Kern model provides an appropriate tool to determining the Kern Subbasin-scale water budgets, additional analysis was necessary to track GSA-level water management operations including those, such as water banking, that occur outside of the GSA boundary. The GSA operational water budgets are a spreadsheet-based accounting of surface water operations for individual GSAs. The GSA operational water budgets provide a complimentary analysis to accompany the Subbasin-wide analysis using the C2VSimFGKern model.

There are inherent limitations in using models to predict future conditions given the uncertainties surrounding input variables (e.g., uncertain future hydrologic conditions, recharge, and pumping volumes). A revised Subbasin-wide model is being developed and calibrated as part of 2025 Plan implementation and as additional information becomes available through the Basin Study (P/MA KSB-4).

**Table ES-5. Summary of Simulated Change in Groundwater Storage Results**

<b>Period / Scenario</b>	<b>General Hydrologic Conditions of Period</b>	<b>Change in Groundwater Storage (acre-feet per year)</b>
Historical Period (WYs 1995-2015)	Average	-274,200
Current Period (WYs 2015-2023)	Dry	-344,019
Projected Period (WYs 2041-2070) Baseline	Average	-324,326
Projected Period (WYs 2041-2070) Baseline with Projects	Average	85,578
Projected Period (WYs 2041-2070) 2030 Climate Change	Average with DWR climate change adjustments	-372,120
Projected Period (WYs 2041-2070) 2030 Climate Change with Projects	Average with DWR climate change adjustments	46,829
Projected Period (WYs 2041-2070) 2070 Climate Change	Average with DWR climate change adjustments	-472,336
Projected Period (WYs 2041-2070) 2070 Climate Change with Projects	Average with DWR climate change adjustments	-45,969

Note: a negative change in groundwater storage indicates a deficit and a positive change in groundwater storage indicates a surplus.

## ES.10 Management Areas

For the purpose of SGMA compliance, the Kern Subbasin is divided into GSA areas which provide coverage for the entirety of Kern Subbasin including both districted lands and non-districted “white lands.” There is no need to create management areas below the GSA level. The two exceptions are:

- The Eastside Water Management Area (EWMA) is a non-profit corporation governed by a seven-member Board of Directors that aims to become a public agency and function as its own GSA. Until then, it is treated as a separate management area within the Kern Non-Districted Lands Authority.
- The 7th Standard Annex, historically non-districted, was annexed into the Shafter-Wasco Irrigation District (SWID) in 2019 solely for SGMA compliance. It operates as a separate management area within SWID, as it does not share SWID’s surface water supply benefits under the landowner agreement.

The 2025 Plan does divide the Kern Subbasin into five HCM Areas that each have similar geologic and aquifer characteristics distinct from those of other HCM Areas as described above in Section ES.7.

## ES.11 Introduction to Sustainable Management Criteria

The SMCs are the metrics by which groundwater sustainability is evaluated under SGMA. Uniform definitions for the following SMC components were developed in the 2025 Plan through a coordinated effort of the Kern Subbasin GSAs.

1. **Undesirable Results (URs):** URs are the significant and unreasonable occurrence of conditions, for any of the six Sustainability Indicators that adversely affect beneficial uses and users and substantially interfere with surface land uses in the Kern Subbasin.
2. **Minimum Thresholds (MTs):** MTs are the numeric criteria for each Sustainability Indicator that, if exceeded in a locally defined combination of monitoring sites, may constitute an UR for that indicator.
3. **Measurable Objectives (MOs):** MOs are specific, quantifiable goals for the maintenance or improvement of groundwater conditions. MOs use the same units and metrics as the MTs allowing for direct comparison.
4. **Interim Milestones (IMs):** IMs are a set of target values representing measurable groundwater conditions in increments of five years over the 20-year statutory timeline for achieving sustainability.

Table ES-6 summarizes the SMCs for each applicable Sustainability Indicator in the Kern Subbasin.

**Table ES-6. Summary of Sustainable Management Criteria**

Sustainability Indicator	Undesirable Result	Minimum Threshold	Measurable Objective
 <p><b>Chronic Lowering of Groundwater Levels</b></p>	<p>One of the following occurs:</p> <ul style="list-style-type: none"> <li>(1) MTs exceed at least 25 percent of RMW-WLs over a single year (i.e., two consecutive seasonal measurements).</li> <li>(2) More than 15 drinking water wells are reported dry in any given year. If 15 drinking water wells were impacted every year, no more than 255 drinking water wells cumulatively would be impacted by 2040, or</li> <li>(3) Mitigation<sup>1</sup> backstop: a GSA is unable to meet well mitigation needs.</li> </ul>	<p>The lower of:</p> <ul style="list-style-type: none"> <li>(1) Groundwater level in 2030 if the regional trend is extended from the 2015 low (the MO), or</li> <li>(2) Groundwater level that allows for operational flexibility below the 2015 low, based on an RMW-WL-specific record of groundwater level fluctuations.</li> </ul> <p>MTs are then adjusted so that:</p> <ul style="list-style-type: none"> <li>(3) MTs do not exceed 61 feet below the recent historical low,</li> <li>(4) MTs do not newly fall below the Corcoran Clay, and/or</li> <li>(5) MTs are raised locally per State Water Resources Control Board staff feedback.</li> </ul>	<p>The 2015 low groundwater elevation.</p>
 <p>Reduction of Groundwater Storage</p>	<p>The MTs for Chronic Lowering of Groundwater Levels are exceeded in at least 25 percent of the RMW-WLs over a single year (i.e., two consecutive seasonal measurements).</p>	<p>MTs for Chronic Lowering of Groundwater Levels used as a proxy.</p>	<p>MOs for Chronic Lowering of Groundwater Levels used as a proxy.</p>
 <p>Seawater Intrusion</p>	<p>Groundwater conditions in the Kern Subbasin show that Seawater Intrusion is not present and is not anticipated to be present in the future, and therefore, the Sustainability Indicator is not applicable.</p>		
 <p>Degraded Water Quality</p>	<p>One of the following occurs:</p> <ul style="list-style-type: none"> <li>(1) Subbasin-wide, 15 percent of the Representative Monitoring Well for Degraded Water Quality (RMW-WQs) exceed the MT for the constituents of concern per water year based on confirmed sample and MT Exceedance investigation results<sup>1</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>(1) MT is set as close to the water quality objective as feasible.</li> <li>(2) If historical data exceeds the water quality objective, and at least five sample results are available, then the MT is set at the 80<sup>th</sup> Percentile value.</li> <li>(3) When clear trends are present, discretion should be applied</li> </ul>	<p>The water quality objective.</p>

Sustainability Indicator	Undesirable Result	Minimum Threshold	Measurable Objective
	<p>(2) Annually, five percent of domestic wells have an assumed MT exceedance<sup>1</sup> based on radius of influence analysis around the RMW-WQ that exceeds the MT, with a cumulative maximum of 15 percent of domestic wells through 2040.</p> <p>(3) Mitigation<sup>1</sup> backstop: a GSA is unable to meet well mitigation needs.</p>	<p>a. If there is an increasing trend, set the MT at the 80<sup>th</sup> Percentile of the Pre-2015 data</p> <p>b. If there is a decreasing trend, MT should be set at the median value or as close to water quality objective as reasonable. If the 80<sup>th</sup> Percentile is within 10 percent of the drinking water MCL, the MT should be set at the water quality objective.</p> <p>(4) Proxy data are predominately used to demonstrate baseline conditions; however, data may be used when the RMW-WQ and Proxy Well are similar enough to represent the same lithology/aquifer conditions.</p>	
 Land Subsidence	<p>MT extent of land subsidence is exceeded at any RMS-LS along the Regional Critical Infrastructure at a <u>single</u> milepost or GSA or HCM Area MTs after six quarterly consecutive sampling events measured using InSAR data published by DWR or annual survey data, if available, and can be attributed, based on a technical analysis using best available data and tools, to groundwater management activities (e.g. groundwater level changes, P/MAs). Note: The GSAs' management authority does not extend to all activities and processes that cause Kern Subbasin land subsidence.</p>	<p>MTs are established along regional critical infrastructure as a rate and extent based on either the protective level of land subsidence (the rate and extent of subsidence that would not lead to loss of conveyance capacity) or the historical rate of land subsidence projected to 2040 (where the projected amount of subsidence is not expected to lead to loss of conveyance capacity). Additionally, MTs are set for the Kern Subbasin as the average historical rate of land subsidence in each HCM Area from 2015-2023.</p>	<p>50 percent of the MT rate and MT extent.</p>

Sustainability Indicator	Undesirable Result	Minimum Threshold	Measurable Objective
 Interconnected Surface Water	Groundwater conditions in the Kern Subbasin show that there are a few areas with potential Interconnected Surface Waters. However, data show the connection is likely transient, short-lived, and involves shallow or perched groundwater that is not part of the principal aquifer systems. Therefore, the Sustainability Indicator is not applicable to the Kern Subbasin.		

**Notes:**

1. Exceedances and mitigation applications are evaluated as defined in the Exceedance Policy and Action Plan (Appendix K-1) and Well Mitigation Program (Appendix G).

## ES.12 Sustainability Goal

The sustainability goal for the Kern Subbasin is to implement its 2025 Plan to achieve sustainable groundwater management within the SGMA 20-year implementation period. Achieving the sustainability goal will be demonstrated by eliminating chronic lowering of groundwater levels caused by overdraft conditions and avoiding Undesirable Results of groundwater levels, groundwater storage, land subsidence, and groundwater quality.

This goal will be accomplished through the following objectives:

1. Implement the Stakeholder Communication and Engagement Plan.
2. Eliminate long-term groundwater overdraft and attain sustainability through conjunctive use, water banking, and demand management programs.
3. Continuously monitor and evaluate groundwater conditions to avoid undesirable results.
4. Maintain long-term sustainability of water resources available to the Kern Subbasin.
5. Maintain a comprehensive database of beneficial uses and users to inform on the efficacy of groundwater management policies and programs.

## ES.13 Sustainable Management Criteria

The Kern Subbasin GSAs identify primary beneficial uses and users of groundwater as agricultural, industrial, domestic well owners, small community wells, and municipal well operators. Additionally, infrastructure susceptible to land subsidence has been categorized based on land subsidence vulnerability and impacts to beneficial users (critical regional, GSA area, and others). The SMCs in Table ES-6 have been developed to prevent significant and unreasonable impacts to groundwater uses and users and land uses and are justified (i.e., will not result in significant and unreasonable impacts) as follows for all applicable Sustainability Indicators.

### ***Chronic Lowering of Groundwater Levels***

The Kern Subbasin GSAs' approach to developing the Chronic Lowering of Groundwater Levels SMCs applies a method that is consistent with the GSP Regulation, relies on consistent data and methodologies across the Kern Subbasin, and

would not unreasonably impact beneficial uses and users of groundwater. The Kern Subbasin GSAs will strive through the implementation of P/MAs to manage groundwater levels toward the MOs, which are set at the 2015 low groundwater level. The MTs account for historical regional groundwater level trends (extended through 2030) and well-specific water level fluctuations to ensure sufficient groundwater supply and operational flexibility through variable hydrologic conditions and projected water uses. MTs are further capped to 61 feet below recent historical lows, raised to prevent groundwater levels from newly declining below the Corcoran Clay where it exists, and raised locally per SWRCB staff feedback.

### ***Impacts to Beneficial Users***

The 2025 Plan includes a well impacts analysis using the MTs and the Kern Subbasin's February 2025 well inventory to quantify potential impacts to beneficial users at the MTs as compared to the Chronic Lowering of Groundwater Levels URs definition. The (highly unlikely) worst-case scenario suggests that 185 drinking water wells may be potentially impacted if all RMW-WLs reach their MTs simultaneously, while the more likely scenario shows that under the URs definition that considers 25 percent of RMW-WLs reaching MTs, between 42 and 48 drinking water wells may be potentially impacted by 2040. Note, the groundwater level UR has an additional layer of protection by limiting the number of reported dry wells to 15 in a given year or 255 cumulatively, by 2040. The Kern Subbasin GSAs have developed and funded a Mitigation Program to address potential impacts from Chronic Lowering of Groundwater Levels to drinking water wells. A final protective "mitigation backstop" has been included, such that URs are triggered if a GSA is unable to well meet mitigation needs.

The potential "depletion of supply" for this scenario estimates the percentage of urban supply that may be impacted at MTs and the UR definition. Even under the worst-case scenario, less than two percent of the total estimated urban water supply would be impacted by 2040. With implementation of the proposed P/MAs, the C2VSimFG-Kern model estimates that 19 drinking water wells may be potentially impacted, which corresponds to less than one percent of the Kern Subbasin's urban pumping.

### ***Consideration of Adjacent Basins and Other Sustainability Indicators***

Groundwater level SMCs have been compared to those in the neighboring Tule, Tulare Lake, and White Wolf Subbasins and are not projected to cause a change in historical gradients or prevent neighboring subbasins from achieving their Sustainability Goals. Groundwater level SMCs have also been determined to be protective of the other relevant Sustainability Indicators through quantitative analysis.

## ***Reduction of Groundwater Storage***

The Chronic Lowering of Groundwater Levels SMCs serve as a proxy for Reduction of Groundwater Storage pursuant to 23 CCR §354.28(d). Annual change in storage based on groundwater elevation change has good agreement with the simulated change in water in storage based on the C2VSimFG-Kern model, and therefore, groundwater level measurements have been demonstrated to serve as a reasonable proxy to estimate changes in groundwater storage. Furthermore, if groundwater levels decline from the MOs to the MTs, the reduction of storage would total approximately 7.2-million-acre feet (MAF). Consistent with the Chronic Lowering of Groundwater Level UR criteria, 25 percent of this volume results in a reduction of storage of approximately 1.80 MAF per year. This decline in groundwater storage is less than the storage change observed during recent multi-year droughts (i.e., 2013-2016 and 2021-2022) without an unreasonable amount of potentially impacted wells (Figure ES-6).

## ***Degraded Water Quality***

The MTs for Degraded Water Quality are set at the Kern Subbasin's RMW-WQs and are tied to regulatory water quality standards – namely, water quality objectives (WQOs) – that are considered protective of the municipal beneficial use (i.e., primary and secondary MCLs contained in CCR Title 22), as applicable for each of the six relevant COCs. Where historical data is consistently below the WQOs (as is the case for most of the RMW-WQs) or there is lack of supporting water quality data, MTs are set at WQOs. When baseline conditions (as assessed from best available historical data for pre-2015 and post-2015 water quality trends) were above WQOs, discretion was applied to set the MTs as close to the WQOs as possible, while being consistent with available water quality data trends. Where available, proxy data from nearby wells was used to augment baseline water quality data at the RMW-WQs. Water quality MOs were set at the WQOs. In general, the water quality SMCs are set to maintain concentrations of each COC at or below the applicable WQOs, or for wells that were already impacted before the SGMA effective date, to try and maintain concentrations at their pre-SGMA baseline levels.

## ***Impacts to Beneficial Users***

Approximately 93 percent of the water quality MTs are set at the WQO with the other 7 percent set at baseline conditions. MOs are set to WQOs. Hence, water quality SMCs within the Kern Subbasin are set to be protective of domestic and municipal beneficial uses. Where MTs are set above the WQOs, these represent baseline conditions based on best available data. Use of a baseline condition acknowledges that “the plan may, but is not required to, address undesirable results that occurred before, and have not been corrected by, January 1, 2015” (CWC §10727.2(b)(4)). The GSAs continue to coordinate with other groundwater quality programs in the Kern Subbasin (Appendix K-2) that address pre-2015 or non-GSA related groundwater quality impacts.

Assuming a simple one to one ratio between RMW-WQ and domestic wells, MT exceedances at 15 percent of the RMW-WQs could result in up to 348 potentially impacted domestic wells. However, the distribution of domestic wells and RMW-WQs is not uniform across the subbasin, hence additional protective measures were incorporated into the UR. The Kern Subbasin GSAs' \$3.5 million Well Mitigation Program (Appendix G-1) reserve includes a conservative estimated cost for water quality mitigation of \$2,500 per mitigated domestic well, with an annual budget of \$500,000 (sufficient to cover 200 wells). The second water quality UR criterion of 5 percent domestic wells equates to approximately 116 potentially impacted domestic wells annually. This translates to groundwater quality mitigation cost of approximately \$300,000, which is well within the Well Mitigation Program budgeted amount of \$500,000 for water quality mitigation. While highly unlikely, the third UR criterion provides yet another protective "mitigation backstop", wherein undesirable results would be declared if any GSA is unable to meet its mitigation needs.

Detailed notification and exceedance evaluations have been included (Appendix K-1) such that domestic well users impacted by Degraded Water Quality are fully informed of RMW-WQ results if WQO are exceeded, and testing and mitigation is made available for such users if MTs are exceeded due to groundwater management activities.

Additional details related to implementation of groundwater quality monitoring, SMCs, and P/MAs, including coordination with other groundwater quality programs in the Kern Subbasin are included in Appendix K-2.

### ***Consideration of Adjacent Basins***

Groundwater flow exits the Kern Subbasin across its northern boundary (Figure 8-1). The Chronic Lowering of Groundwater Levels MTs are not predicted to cause significant changes to local groundwater gradients and thus should be protective in terms of preventing migration of poor-quality water to adjacent subbasins. The adjacent subbasins similarly have SMCs established for key COCs that impact drinking water users.

### ***Land Subsidence***

The SMCs for Land Subsidence have been developed in recognition that land subsidence in the Kern Subbasin has been caused by several factors, some of which are within the GSAs' authorities to control ("GSA-related" land subsidence - e.g., groundwater pumping for agricultural and urban uses), and others that are outside of the GSAs' authorities to control ("non-GSA" land subsidence – e.g., oil and gas extraction,<sup>6</sup> natural processes, and expansive/soluble soil types susceptible to hydro-compaction). Consistent with the legislative intent of SGMA "to avoid or minimize subsidence" (CWC §10720.1(e)), the objective of the Kern Subbasin subsidence SMCs

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<sup>6</sup> This sentence refers to United States Environmental Protection Agency-exempt oil and gas extraction.

approach is to achieve zero GSA-related subsidence post-2040 and beyond. This will be accomplished through focused implementation of proactive demand reduction or other P/MAs designed to reduce land subsidence rates to meet the IM glide path (Section 13.5.3.2). The subsidence MTs are established along regional critical infrastructure as a rate and extent based on either the protective level of land subsidence (the rate and extent of subsidence that would not lead to loss of conveyance capacity) or the historical rate of land subsidence projected to 2040 (where the projected amount of subsidence is not expected to lead to loss of conveyance capacity or can be adequately mitigated by the GSAs, as is the case for certain sections of the FKC). Additionally, MTs are set for the Kern Subbasin as an average rate and extent of land subsidence in each HCM Area or adjacent to GSA area critical infrastructure. Note, that, where applicable, the subsidence MTs are based on a conservative extrapolation of the historical (2015-2024) subsidence rates through 2040. Future subsidence rates are expected to be lower as overdraft is eliminated and groundwater levels stabilize through P/MAs implementation. As noted above, groundwater level MTs are based on extrapolating regional historical trends through 2030. The ten-year lag between groundwater level and subsidence trends are meant to capture potential future residual subsidence. Subsidence MOs are set at 50 percent of the subsidence MT rates and extents.

### ***Impacts to Beneficial Users***

MTs for regional critical infrastructure were developed in coordination with operators of the infrastructure (i.e., Friant Water Authority and CASP) and designed to avoid significant and unreasonable impacts to infrastructure functionality. MTs for the FKC are set at conservative levels with the GSAs committed to mitigating post-2020 subsidence impacts (due to groundwater management activities) on conveyance capacity (Appendix G-2). The MTs for the California Aqueduct are defined to avoid loss of conveyance capacity attributable to subsidence as limited by the remaining or required liner freeboard for specific Aqueduct mileposts (MP) 184 to 279. CASP has indicated that 2.5 feet of freeboard above the design water surface is required to maintain operations (DWR, 2017b), and is the best available metric to conduct an impacts analysis at this time. Therefore, MTs based on an extrapolation of the historical (2013-2024) subsidence rates through 2040 are adjusted to prevent available freeboard (as of 2024) falling below the 2.5 feet minimum design freeboard with a 0.1-foot margin for measurement error. Where land subsidence has already encroached on the minimum 2.5 feet of freeboard requirements, the MT is set to zero additional subsidence. The 2017 California Aqueduct Subsidence Study published by CASP does not suggest that operational impacts have occurred within the southern pools (DWR, 2017b). The MTs for the southern pools are primarily set at the future projected rates of subsidence as they do not infringe into the 2.5 feet minimum operating freeboard height, and MT rates are reduced at select MPs. The 2025 Plan defines a UR for land subsidence as a single representative monitoring site (e.g., milepost) exceeding the MT extent after 6-quarterly

consecutive sampling events. Subbasin GSAs will meet with CASP quarterly to review land subsidence data trends compared to SMCs. Furthermore, the Kern Subbasin Exceedance Policy and associated Action Plan for Land Subsidence initiates an investigation proactively after an IM exceedance (see Appendix K). This ensures proactive investigation responses before a MT exceedance and accounts for the complex (GSA and non-GSA related) driving mechanisms for subsidence and residual subsidence, which can continue for years after groundwater levels are stabilized.

The MTs for GSA area critical infrastructure are based on land subsidence rates that have historically occurred and have been managed by Kern Subbasin GSAs through ongoing maintenance and improvements to facilities. In addition to infrastructure-specific MTs, MTs for the entire Kern Subbasin are set based on HCM Area historical average land subsidence rates. As such, the Kern Subbasin GSAs will continue to monitor and report land subsidence throughout the entire Kern Subbasin, and coordinate with other entities that have interests in and responsibilities for land subsidence caused or influenced by activities or processes outside of the GSAs' management authorities.

The GSAs have developed a comprehensive Action Plan for Land Subsidence (Appendix K-1) that covers subsidence monitoring, reporting, exceedance evaluation, coordination with key agencies (e.g., FWA and CASP), and future updates to Subsidence protocols and P/MAs based on forthcoming documents.

### ***Consideration of Adjacent Basins***

MT extents in the Kern Subbasin are half the MT extents in the adjacent northward Tule and Tulare Lake Subbasins. Therefore, implementation of the 2025 Plan would not prevent neighboring subbasins from achieving their Land Subsidence sustainability goal(s). Although Land Subsidence MTs in the adjacent southern White Wolf Subbasin are currently set using groundwater levels as a proxy, Kern Subbasin GSAs are actively collaborating with the White Wolf GSA to ensure consistency as the White Wolf GSA develops more specific Land Subsidence SMCs.

### ***Relationships Between Sustainability Indicators***

The Kern Subbasin recognizes the interconnected nature of SGMA's Sustainability Indicators and evaluates how changes in one may influence others. Key relationships are summarized below:

1. Groundwater Levels and Groundwater Storage
  - Direct Relationship: Chronic lowering of groundwater levels is directly related to reductions in groundwater storage.
  - Proxy Use: Groundwater level MTs are used as a proxy for storage reduction.
  - Impact Estimate: If groundwater levels decline from the MOs to the MTs, the reduction of storage would total approximately 7.2 million acre feet (MAF).

Consistent with the Chronic Lowering of Groundwater Level UR criteria, 25 percent of this volume results in a reduction of storage of approximately 1.80 MAF per year. The estimated total decrease in storage from the historical and current water budgets (Section 9.3.2 and Appendix H-1) during the 2013-2016 drought was 7.47 MAF, and the annual decrease in storage during the 2013-2016 and 2021-2022 droughts was on average 1.832 MAF. Hence, a reduction of storage of less than 1.80 MAF per year and cumulative reduction in storage of 7.2 MAF is not considered significant and unreasonable, as it is similar to the storage change observed during recent multi-year droughts without unreasonable dewatering of wells.

## 2. Groundwater Levels and Degraded Water Quality

- **No Subbasin-Wide Correlation:** Trend analysis shows no consistent correlation between declining groundwater levels and degraded water quality across the Subbasin.
- **Localized Exceptions:** Some areas show localized relationships due to specific geochemical or hydrologic conditions. These will be taken into consideration along with other relevant driving mechanisms when evaluating future MT exceedances (see Appendix K-1 for detail).
- **Monitoring Approach:** RMW-WQs and data from 42 Department of Drinking Water (DDW) regulated small community systems with 55 active groundwater wells are used to monitor potential interactions.

## 3. Groundwater Levels and Land Subsidence

- **Simplified Predictive Analysis:** Historical groundwater level declines and land subsidence data were used to project average HCM Area future subsidence extents at MTs.
- **Protective Thresholds:** Based on regional correlation analysis, projected subsidence at groundwater level MTs is below the MTs for land subsidence, indicating that groundwater level MTs are protective. Moreover, groundwater level MTs have been raised in areas to avoid groundwater levels falling newly below the Corcoran where they have not in the past. Groundwater level declines are projected through 2030, which is ten years before subsidence levels are projected to stabilize to account for potential residual subsidence in the future.
- **Ongoing Monitoring:** GSAs will compare observed subsidence with IMs and MTs annually and manage to the most protective indicator. GSAs will conduct quarterly check-ins with critical infrastructure operators to discuss land subsidence trends.

- Ongoing Modeling: The GSAs are integrating land subsidence into the C2VSimFG-Kern model as part of implementation of the 2025 Plan; the results of which will be used to ensure that MTs for chronic lowering of groundwater levels are protective of MTs set for land subsidence.

#### 4. Land Subsidence and Groundwater Storage

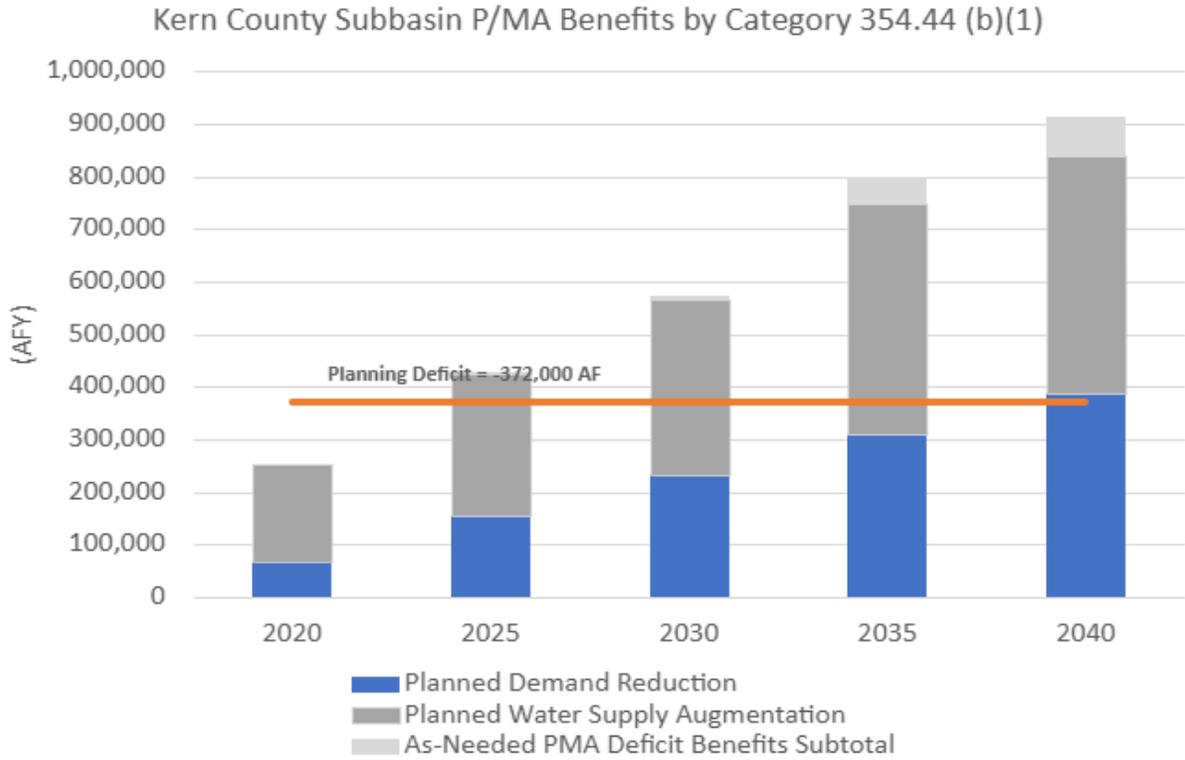
- Potential Impact: Subsidence can reduce storage capacity through compaction of fine-grained layers.
- Conclusion: Given the correlation with groundwater level SMCs, land subsidence MTs are not expected to cause unreasonable storage loss.

#### 5. Land Subsidence and Water Quality

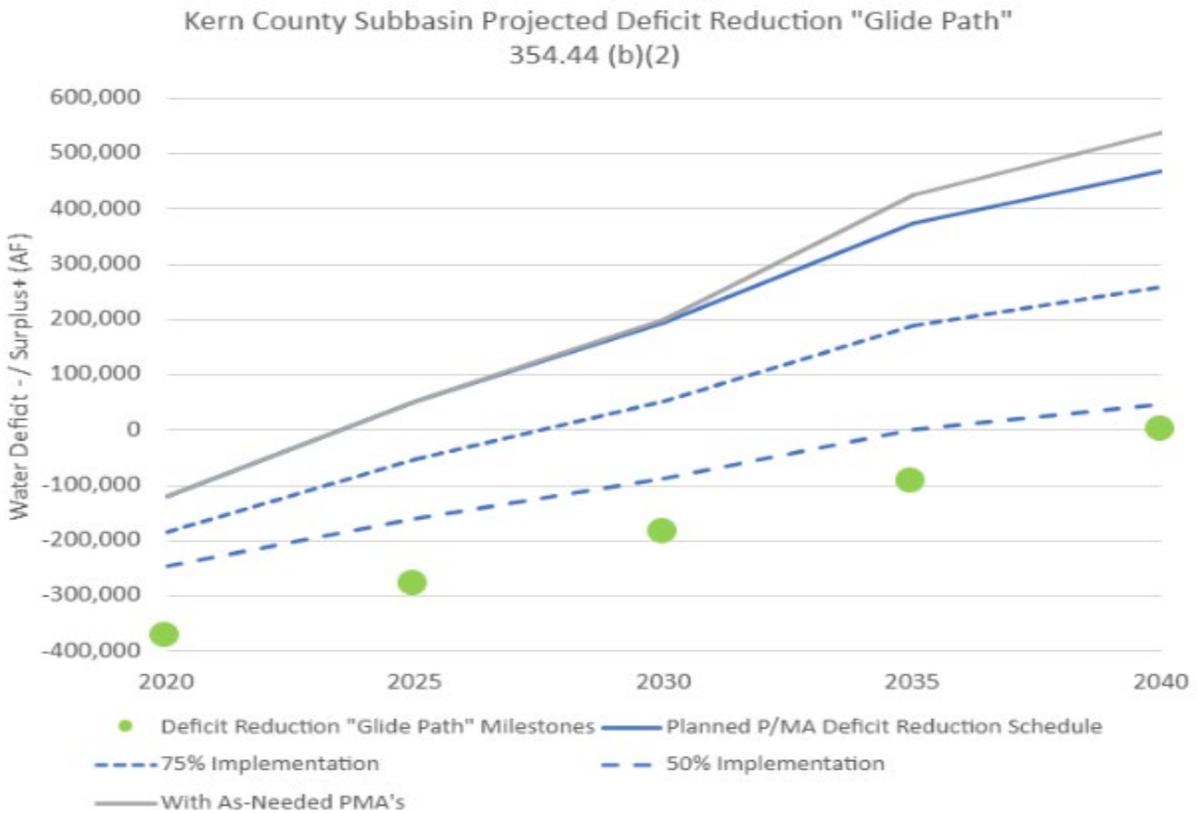
- Arsenic Mobilization: Some studies suggest clay layer compaction may release arsenic.
- No Observed Correlation: No link has been observed between land subsidence and arsenic or other COCs in the Kern Subbasin.
- Monitoring Strategy: RMW-WQs in historically subsiding areas are used to track potential relationships.

### **ES.14 Projects and Management Actions**

Achieving sustainability in the Kern Subbasin will require the implementation of P/MAs to address projected water budget deficits that contribute to groundwater level and storage declines, land subsidence, and water quality impacts. The Kern Subbasin has developed a portfolio of P/MAs, each with specific projected benefits, implementation triggers, and costs. The P/MA portfolio includes 387,000 AFY in demand reduction management actions and 452,000 AFY in water supply augmentation projects. To date, the Kern Subbasin has already begun to implement 47 percent of the identified P/MAs.



**Figure ES-8. P/MA Benefits by Category**



**Figure ES-9. Projected-Future Scenario Overdraft Correction Glide Path**

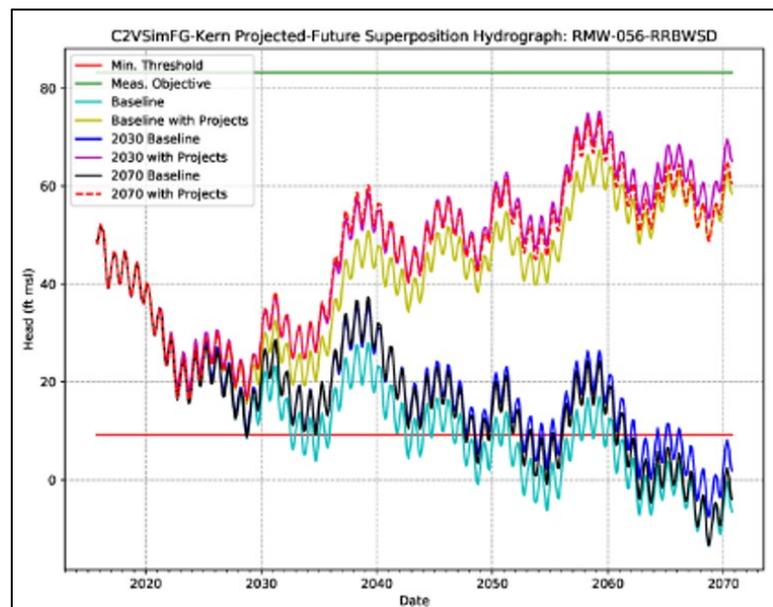
A linear “glide path” has been developed that will result in closing the projected Kern Subbasin deficit<sup>7</sup> of approximately 372,000 AFY by 2040, of which 100 percent is projected to be met with demand reduction P/MAs (Figure ES-8). Kern Subbasin GSAs have also included supply augmentation P/MAs. The 2025 Plan includes significantly more P/MAs than are required to address the projected deficit. In the event full estimated P/MA benefits are not ultimately realized, there is a built-in “safety factor” of nearly 2.3 and a plan to ensure that the Kern Subbasin projected deficit is reduced by 2040. Furthermore, under the Kern Subbasin Exceedance Policy, implementation of P/MAs could be triggered and/or accelerated if MT exceedances occur.

The supply augmentation and demand reduction P/MAs identified by the Kern Subbasin GSAs comprises a diverse portfolio of options that can be implemented as necessary to achieve sustainability from a comprehensive water quantity and water quality perspective. Additionally, eight Kern Subbasin P/MAs establish Subbasin-wide programs, policies, collaborations, and ongoing data gap filling.

The modeled simulated results for the planned P/MAs indicate that P/MA implementation along the planned glide path will successfully achieve sustainability and avoid URs for Groundwater Levels (and by proxy for the other applicable Sustainability Indicators) throughout the Kern Subbasin.

Specifically, the C2VSimFG-Kern model results have been used to compare simulated groundwater levels to the MTs and MOs for each RMW-WL. In general, across most of the Kern Subbasin, groundwater levels fall near or below MTs without P/MAs implementation but are typically above the MT for the simulations that include P/MAs (Figure ES-10).

The implementation glide path identified by the Kern Subbasin provides a general guide to how quickly these benefits are to be realized. To date the Kern Subbasin GSAs have taken action on multiple P/MAs (e.g., development of new recharge basins). The exact schedule and order of implementation for other P/MAs, as seen in Figure ES-9, will be



**Figure ES-10. C2VSimFG-Kern Projected Future Superposition Hydrograph (2030 Climate Change)**

<sup>7</sup> The net deficit to be addressed by the 2040 GSP implementation deadline is the estimated deficit under the 2030 Climate Change scenario.

adaptively managed. Further analysis will be conducted to prioritize the P/MAs based on consideration of factors such as permitting, engineering feasibility, cost effectiveness, need to prevent particular URs, funding opportunities, etc. In general, P/MAs being considered for implementation will be discussed during GSA Board Meetings, which are noticed and open to the public. Additional stakeholder outreach efforts will be conducted prior to and during P/MA implementation, as required by law.

## **ES.15 Monitoring Network**

The objective of monitoring networks under SGMA is to continue to collect sufficient data to evaluate the Sustainability Indicators and assess potential impacts to the beneficial uses and users of groundwater. The Kern Subbasin representative monitoring network incorporates existing monitoring efforts conducted by local agencies and regional programs, including DWR’s California Statewide Groundwater Elevation Monitoring (CASGEM) program, the Irrigated Lands Regulatory Program (ILRP), Central Valley-Salinity Alternatives for Long-term Sustainability (CV-SALTS), among others. Within this broader network, the Representative Monitoring Network (RMN) serves as a focused subset of monitoring sites used to characterize general basin conditions and evaluate Sustainability Indicators in accordance with SGMA requirements.

In the Kern Subbasin, the current RMN consists of:

- 187 representative monitoring wells for chronic lowering of groundwater levels (RMW-WLs) and, by proxy, groundwater storage;
- 55 representative monitoring wells for degraded water quality (RMW-WQs); and
- 123 representative monitoring sites for land subsidence (RMW-LSs), which include extensometers, benchmarks, and GPS stations. Basin-wide land subsidence is also monitored using InSAR satellite data.

To ensure the RMN is spatially and vertically representative of groundwater conditions and beneficial use and users across the Kern Subbasin, the Kern Subbasin GSAs conducted a detailed monitoring network assessment. This analysis considered the spatial and depth distribution of representative monitoring wells in relation to the distribution of wells that support various beneficial uses. Using a standardized hexagonal grid framework, the Kern Subbasin GSAs identified data gaps—particularly in monitoring of localized shallow groundwater conditions—and developed an implementation plan to address those gaps. The groundwater level monitoring network analysis identified 3 confirmed data gaps and 7 potential data gaps related to representation of localized shallow groundwater conditions. The groundwater quality network analysis identified 30 data gaps, primarily in areas with medium to high domestic well density. The Kern Subbasin GSAs plan to fill these data gaps using existing or newly installed monitoring wells by the end of 2026. These findings and planned actions are summarized in Section 15.5.

Data collected through the RMN follows established monitoring protocols, is stored in the Kern Subbasin Data Management System (DMS), and is submitted to DWR in accordance with SGMA requirements. Quality assurance and quality control procedures are conducted by each GSA prior to data reporting. In the event of a MT exceedance for any Sustainability Indicator, all Kern Subbasin GSAs will be notified, triggering the Kern Subbasin Exceedance Policy and associated investigations and actions as outlined in Appendix K-1.

## **ES.16 Plan Implementation**

Collectively, the SGMA implementation activities described in the 2025 Plan demonstrate the Kern Subbasin GSAs have actively implemented specific P/MAs, policies, and programs to sustainably manage groundwater resources for all beneficial uses and users and will continue to do so in order to meet the defined Sustainability Goal. Key SGMA and groundwater management implementation activities to be undertaken by the Kern Subbasin GSAs through 2040 include:

- Annual reporting
- Monitoring and data collection
- Data gap filling
- P/MA implementation, including policy development to support Plan implementation
- Technical and non-technical coordination with other water management entities within and outside the Kern Subbasin
- Continued outreach and engagement with stakeholders
- Enforcement and response actions, including:
  - Exceedance Policy
  - Well Mitigation Program
- Evaluation and updates as part of the required periodic evaluations (i.e., “five-year updates”)

Costs associated with implementation of groundwater management activities fall under two categories: (1) Subbasin-wide groundwater management activities, and (2) Individual GSAs to implement P/MAs within their jurisdictions, including capital/one-time costs and ongoing costs. Most costs for Subbasin-wide groundwater management activities are shared equally between the GSAs and are estimated as an annual cost of approximately \$1.4 million. For GSA-specific P/MA implementation, the GSAs intend to meet these cost obligations through a combination of landowner contributions (within their jurisdictions), partnering agencies, grant funding (DWR, United State Bureau of Reclamation, Federal Emergency Management Agency, etc.), locally available funds, and other available sources to be determined.

## Conclusion

The passage of the SGMA has fundamentally reshaped groundwater governance in California, introducing clear concepts, actions, and timelines to achieve sustainability and prevent Undesirable Results. For high-priority and critically overdrafted basins like the Kern Subbasin, this has created a renewed urgency to enhance monitoring, planning, and response efforts. Each GSA within the Kern Subbasin is actively exercising its authority to implement the coordinated groundwater management strategy outlined in the 2025 Plan.

The Kern Subbasin GSAs remain committed to the SMCs established to prevent URs. The Kern Subbasin GSPs have multiple layers of protection: a robust groundwater level, quality, and subsidence monitoring network that is being actively expanded to fill data gaps; protective MTs while managing groundwater to MOs; a well-funded well mitigation program to address groundwater level and quality impacts (particularly on domestic well users) due to groundwater management activities; and implementation of targeted P/MAs that correct the projected deficit (under 2030 climate-change conditions) to avoid Undesirable Results and maintain Subbasin sustainability.

With a shared vision and a science-based approach, the Kern Subbasin GSAs are confident in their ability to achieve the Sustainability Goal by SGMA's statutory deadline. The Kern Subbasin GSAs are dedicated to long-term, coordinated groundwater management, ongoing engagement, and building consensus to ensure a reliable groundwater supply for current and future generations.