KERN COUNTY SUBBASIN PROBATIONARY HEARING DRAFT STAFF REPORT

July 2024

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

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Definitions and Abbreviations

2020 GSP(s) – The Kern County Subbasin Groundwater Sustainability Plans (Five GSPs and 15 Management Area Plans, for a total of 20 Plans) adopted by Groundwater Sustainability Agencies on January 30, 2020, and submitted to the Department of Water Resources on January 30, 2020.

2020 GSP(s) Incomplete Determination – The Department of Water Resources' January 28, 2022, determination that the 2020 GSPs were "incomplete" pursuant to California Code of Regulations, title 23, section 355.2, subdivision (e)(2).

2022 GSP(s) – The Kern County Subbasin Groundwater Sustainability Plans (Six GSPs and 12 Management Area Plans, for a total of 18 Plans) adopted by Groundwater Sustainability Agencies resubmitted to the Department of Water Resources on July 27, 2022.

2022 GSP(s) Inadequate Determination – The Department of Water Resources' March 02, 2023, determination that the 2022 GSPs were "inadequate" pursuant to California Code of Regulations, title 23, section 355.2, subdivision (e)(3).

AEWSD – Arvin-Edison Water Storage District (Arvin GSA)

ACS – American Community Survey, an annual survey conducted by the U.S. Census (Title 13, Sections 141 and 193, U.S. Code)

AF – Acre-feet

AFY – Acre-feet per year

AGSA – Alpaugh Groundwater Sustainability Agency

AMSL – Above Mean Sea Level

Annual Report – The report Groundwater Sustainability Agencies must submit annually to the Department of Water Resources (Wat. Code, § 10728).

Aquifer – Water system within a body of porous sediment or rock beneath the Earth's surface. The water in an aquifer is referred to as groundwater.

Aquifer, confined – An aquifer beneath a body or layer of less permeable sediment or rock. The confining layer of less permeable sediment or rock "traps" the underlying aquifer, which can allow water pressure in the confined aquifer to increase. In the California Central Valley, confined aquifers are often located below unconfined aquifers, so confined aquifers are commonly referred to as "lower" aquifers. Confined aquifers typically provide more water for agricultural use, because confined aquifers often hold more groundwater.

Aquifer, semi-confined – An aquifer that is only partially confined by bodies or layers of less permeable rock.

Aquifer, unconfined – An aquifer that is not confined by a layer of less porous sediment or rock. In the California Central Valley, unconfined aquifers are commonly located above confined aquifers, so unconfined aquifers are commonly referred to as “upper” aquifers. Unconfined aquifers typically provide more water for household use, because domestic wells are usually not drilled very deep. In several cases, unconfined or shallow aquifers may also exist within perched aquifers.

B118 or Bulletin 118 – The Department of Water Resource’s report entitled “California’s Groundwater,” which is updated periodically, as indicated by the year of issuance (e.g., Bulletin 118-80 (1980)).

Basin – Groundwater basin or subbasin

bgs – Below Ground Surface

BMA – Buttonwillow Management Area

Board or State Water Board – State Water Resources Control Board

BVWSD – Buena Vista Water Storage District (GSA)

CalGEM – California Geologic Energy Management Division

Caltrans – California Department of Transportation

CASGEM – The California Statewide Groundwater Elevation Monitoring Program

Central Valley Water Board – Central Valley Regional Water Quality Control Board

CEQA – California Environmental Quality Act

CDFA – California Department of Food and Agriculture

CDFW – California Department of Fish and Wildlife

CDP – Census Designated Place

CGPS – Continuous Global Positioning System

CNRA – California Natural Resources Agency

Constituents – Chemical elements and compounds

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 Part 2.74 of the California Water Code (Wat. Code, §10721, subd. (d)).

CV-SALTS – Central Valley Salinity Alternatives for Long-Term Sustainability

CWS – Community Water System

DAC – Disadvantaged Community, meaning a community with an annual median household income less than 80 percent of the statewide annual Median Household Income (Wat. Code, §79505.5).

SDAC – Severely Disadvantaged Community, meaning a community with an annual median household income less than 60 percent of the statewide annual median household income (Wat. Code, § 13476, subd. (j)).

Data Gap – 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 (Cal. Code Regs., tit. 23, § 351, subd. (l)).

DDW – State Water Board's Division of Drinking Water

De-designated area – The portion of the Kern County Subbasin containing groundwater that the Central Valley Regional Water Quality Control Board de-designated for municipal and agricultural supply beneficial uses, as described in the Regional Board's Tulare Lake Basin Plan Amendment.

De minimis extractor – A person who extracts, for domestic purposes, two AF or less per year (Wat. Code, § 10721, subd. (e)).

DBCP – 1,2-Dibromo-3-chloropropane

Domestic Purposes – The use of water in homes, resorts, motels, organization camps, campgrounds, etc., including the incidental watering of domestic stock for family sustenance or enjoyment and the irrigation of not to exceed one-half acre in lawn, ornamental shrubbery, or gardens at any single establishments. The use of water at a campground or resort for human consumption, cooking or sanitary purposes is a domestic use (Cal. Code Regs., tit. 23, § 660).

DPR – Department of Pesticide Regulation

DWR or Department – Department of Water Resources

E-clay – Corcoran clay

EPA – United States Environmental Protection Agency

ET – Evapotranspiration

FKC – Friant-Kern Canal

Ft – US feet

FWA – Friant Water Authority

GAMA Program – Groundwater Ambient Monitoring and Assessment Program

GDEs – Groundwater Dependent Ecosystems

GEARS – Groundwater Extraction Annual Reporting System

GL – Groundwater Level

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 unless included pursuant to Section 10722.5 (Wat. Code, §10721, subd. (g)).

Groundwater-Dependent Ecosystems – Ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface (Cal. Code Regs., tit. 23, § 351, subd. (m))

Groundwater Flow –The volume and direction of groundwater movement into, out of, or throughout a basin.

Groundwater Recharge – The augmentation of groundwater, by natural or artificial means (Wat. Code, §10721, subd. (i)).

Groundwater Sustainability Program – Coordinated and ongoing activity undertaken to benefit a basin, pursuant to a groundwater sustainability plan.

GSA or Groundwater Sustainability Agency – One or more local agencies that implement the provisions of SGMA (i.e., Part 2.74 of Division 6 of the California Water Code) (Wat. Code, § 10721, subd. (j)).

GSP, Groundwater Sustainability Plan, or Plan – A plan of a groundwater sustainability agency proposed or adopted pursuant to SGMA (i.e., Part 2.74 of Division 6 of the California Water Code) (Wat. Code, § 10721, subd. (k)).

GSP Regulations – California Code of Regulations, title 23, section 350 et seq.

GWQ – Groundwater Quality

HMWD – Henry Miller Water District (GSA)

ibid – The reference is the same as above. It's an abbreviation of the Latin word "ibīdem," which means "in the same place."

ILRP –The State Water Resources Control Board's Irrigated Lands Regulatory Program

IM – Interim Milestone

InSAR – Interferometric Synthetic Aperture Radar

ISW – Interconnected Surface Water(s) - surface water that is hydraulically connected at any point by a continuous saturation zone to the underlying aquifer and the overlying surface water that is not completely depleted.

KCWA – Kern County Water Agency (Pioneer GSA)

KGA – Kern Groundwater Authority (GSA)

KRGSA – Kern River GSA

KTWD – Kern-Tulare Water District – Kern County (GSA)

KWB – Kern Water Bank (GSA)

Long-term Overdraft – The condition of a groundwater basin where the average annual amount of water extracted for a long-term period, generally 10 years or more, exceeds the long-term average annual supply of water to the basin, plus any temporary surplus. Overdraft during a period of drought is not sufficient to establish a condition of long-term overdraft if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

LS – Land Subsidence

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 (Cal. Code Regs., tit. 23, § 351, subd. (r)).

MCL – Maximum Contaminant Level

Meter – A device that measures groundwater extractions and that meets the requirements of California Code of Regulations, title 23, section 1042.

Mg/L – Milligrams per liter

MO – Measurable Objective – Specific, quantifiable goal 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.

MT – Minimum Threshold – A numeric value for each sustainability indicator used to define undesirable results.

NKWSD – North Kern Water Storage District (GSA)

OpenET – Online tool to provide data about water consumption and evapotranspiration

OSWCR – Online System of Well Completion Reports

Overdraft – occurs where the average annual amount of groundwater extraction exceeds the average annual supply of water to the basin.

pCi/L – Picocuries per liter

Plan – See “Groundwater Sustainability Plan”

Perched Aquifer – An unconfined aquifer above a semi-confined aquifer separated and perched upon a less permeable layer of rock and usually separated from the other aquifer by additional zones not fully saturated.

Person – Any person, firm, association, organization, partnership, business, trust, corporation, limited liability company, or public agency, including any city, county, city and county, district, joint powers authority, state, or any agency or department of those entities. “Person” includes, to the extent authorized by federal or tribal law and subject to the limitations described in Water Code section 10720.3, the United States, a department, agency or instrumentality of the federal government, an Indian tribe, an authorized Indian tribal organization, or interstate body.

PMA – Project and Management Action

Principal Aquifers – Aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems (Cal. Code Regs., tit. 23, §351, subd. (aa)).

Probationary Basin – Basin for which the State Water Board has issued a determination under California Water Code Section 10735.2.

Recharge – See “Groundwater Recharge” above.

Recharge Area – The area that supplies water to an aquifer in a groundwater basin (Wat. Code, § 10721, subd. (t)).

Report – A report of groundwater extraction as required by Section 5202 of the Water Code that includes the information required by Section 5203 of the Water Code.

RMS or Representative Monitoring Site – A monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin.

RRBWSD – Rosedale-Rio Bravo Water Storage District (GSA)

RWQCB – Regional Water Quality Control Board

SAFER – Safe and Affordable Funding for Equity and Resilience

SDFR – Socially Disadvantaged Farmer or Rancher

Secondary MCL – Also known as a secondary drinking water standard. Defined in the California Code of Health and Safety, section 116275, subdivision (d), as a standard that specify maximum contaminant level that, in the judgment of the State Water Board, is necessary to protect the public welfare. Secondary drinking water standards may apply to any contaminant in drinking water that may adversely affect the odor or appearance of the water and may cause a substantial number of persons served by the public water system to discontinue its use, or that may otherwise adversely affect the public welfare.

SGMA – Sustainable Groundwater Management Act

SMC – Sustainable Management Criteria - includes the sustainability goals, undesirable results, minimum thresholds, and measurable objectives outlined within a given GSP use to evaluate GSPs likelihood to achieve sustainability and avoid undesirable results.

SOKR – South of Kern River (GSA)

SSJMUD – South San Joaquin Municipal Utility District (GSA)

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 (Wat. Code, §10721, subd. (u)).

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. (Wat. Code, §10721, subd. (v)).

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, subd. (x) (Cal. Code Regs., tit. 23, § 351, subd. (ah)).

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 (Wat. Code, § 10721, subd. (w)).

SWID – Shafter-Wasco Irrigation District (GSA)

SWSD – Semitropic WSD (GSA)

TCWD – Tejon-Castac Water District

WKWD – West Kern Water District (GSA)

WDWA – Westside District Water Authority

WRMWSD – Wheeler Ridge-Maricopa Water Storage District (WRMGSA)

1,2,3 – TCP – 1,2,3-Trichloropropane

TDS – Total Dissolved Solids

µg/L – Micrograms per liter

UR or Undesirable Result – one or more of the following effects caused by groundwater conditions occurring throughout a basin as described in Wat. Code, § 10721, subd. (x):

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
2. Significant and unreasonable reduction of groundwater storage.
3. Significant and unreasonable seawater intrusion.
4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
5. Significant and unreasonable land subsidence that substantially interferes with surface land uses.
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

USBR – United States Bureau of Reclamation

USGS – United States Geological Survey

Water Budget – An accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.

Water Year or WY – October 1 to September 30 of the following year would be categorized as the water year for the following year (Oct. 1, 2023 – Sept. 30, 2024, would be WY 2024).

Executive Summary

This Executive Summary briefly summarizes key sections of the Draft Kern County Subbasin GSP Assessment Staff Report (Draft Staff Report). A full discussion of these sections is provided in the Draft Staff Report. Where appropriate, the section titles in this Executive Summary refer to the corresponding section in the Draft Staff Report. For example, the “SGMA and State Intervention (Section 2)” section of this Executive Summary covers Section 2 of the Draft Staff Report.

Introduction

The mission of the State Water Resources Control Board (State Water Board) is to preserve, enhance, and restore the quality of California’s water resources and drinking water for the protection of the environment, public health, and all beneficial uses, and to ensure proper water resource allocation and efficient use, for the benefit of present and future generations. The State Water Board is committed to racial equity and working towards a California where race no longer predicts a person’s access to, or quality of, water resources.

In 2014, the state Legislature passed the historic Sustainable Groundwater Management Act (SGMA) that established a new framework for how groundwater would be managed locally at the basin scale to achieve long-term sustainability. Under SGMA, local agencies are responsible for the sustainable management of their groundwater basins; however, state agencies are responsible for ensuring local groundwater management achieves SGMA's goals. SGMA provides the State Water Board and the California Department of Water Resources (DWR) with oversight of groundwater resources to protect them for current and future use by the communities, farms, and environmental resources that depend upon them. The Kern County Subbasin (subbasin) is critically overdrafted: on average, water is pumped out of the basin faster than it is recharged by rain and other sources. Overdraft can cause the land surface to sink, potentially damaging infrastructure and reducing aquifer storage.

In addition, overdraft threatens groundwater levels and drinking water quality and could have disparate impacts on communities that rely on shallow wells. Due to historic and political factors, many of these are economically disadvantaged and communities of color.

The State Water Board recognizes that local public agencies in the Kern County Subbasin made significant efforts since the passage of SGMA to form groundwater sustainability agencies (GSAs) and then develop detailed technical and other information supporting the adoption and implementation of five groundwater sustainability plans (GSPs) for the subbasin. Despite those efforts, in January of 2022, DWR reviewed GSPs to determine if the GSPs met SGMA’s requirements and found the GSPs to be incomplete. Following revisions made by the GSAs in the subbasin, DWR reevaluated the six GSPs (one additional GSP was submitted) in March of 2023, determined the GSPs to be inadequate, and referred the subbasin to the State Water Board, as required by SGMA. Consistent with SGMA, the State Water Board may now

consider whether to designate the Kern County Subbasin as a “probationary basin,” a term that is used in SGMA to describe a basin in the first stage of state intervention.

The goals of this executive summary are to:

- Describe SGMA and the State Water Board’s state intervention process to provide context for the State Water Board’s upcoming Kern County Subbasin Probationary Hearing (Probationary Hearing);
- Briefly describe the demographics, geology, and hydrology of the Kern County Subbasin;
- Summarize the actions State Water Board staff (Board staff) recommend the State Water Board could take at the Kern County Subbasin Probationary Hearing. These recommended actions are to:
    - Designate the entire subbasin probationary. In the short-term, this would mean most groundwater pumpers in the basin would need to start: 1) measuring their groundwater extractions, 2) reporting extractions to the State Water Board, and 3) paying groundwater extraction fees. State Water Board staff recommend that most domestic household users (people who use less than two acre-feet per year for domestic purposes only) be exempt from reporting extractions and paying fees.
    - Identify certain deficiencies (issues with the subbasin’s current groundwater sustainability plans) and potential actions that the GSAs could take to address them.
    - Require people who extract more than 500 acre-feet per year of groundwater from the subbasin to install and use meters to measure their groundwater extractions.
    - Require people extracting groundwater from the wells located in the Friant-Kern Canal and California Aqueduct subsidence monitoring corridors to install and use meters to measure their groundwater extractions.
    - Shift the reporting deadline for groundwater extractors from February 1 of each year to December 1.

SGMA and State Intervention (Section 2)

SGMA established a framework for groundwater management in California. SGMA requires local agencies to form GSAs in high-priority and medium-priority basins and to develop and implement GSPs. GSAs are responsible for achieving long-term sustainable management of their groundwater basins that avoids certain undesirable results within 20 years of implementing their GSPs.

When DWR, in consultation with the State Water Board, deems the GSP or GSPs in a high-priority or medium-priority basin inadequate, DWR refers the basin to the State

Water Board for a determination as to whether to begin the state intervention process[1]. State intervention is additional to local management and intended to be temporary, and is a two-step process:

- The first step of state intervention under SGMA is for the State Water Board to determine, through a public process, whether to place the basin on probation.
- In the second step, through a public process, the State Water Board may implement an interim plan for the basin. This can only happen if deficiencies are not fixed after at least one year of the basin being on probation.

In determining whether to put a basin on probation, the State Water Board analyzes whether deficiencies identified by DWR were sufficiently addressed prior to the probationary hearing. Board staff may recommend additional deficiencies as necessary. As part of its analysis, and as reflected in State Water Board Resolution 2021-0050, *Condemning Racism, Xenophobia, Bigotry, and Racial Injustice and Strengthening Commitment to Racial Equity, Diversity, Inclusion, Access and Anti-Racism,* the State Water Board considers the impacts of basin non-compliance on vulnerable communities, including communities of color.

During a probationary period, GSAs would have time to resolve deficiencies identified in their GSPs and the State Water Board would collect data on groundwater extractions, collect fees from certain groundwater users, and may conduct additional investigations. Importantly, the GSA retains its authorities and responsibilities and must continue to implement its GSP regardless of if the basin is in probation.

Basin Description (Section 3)

Located in California's Central Valley in the southern portion of the San Joaquin Valley, the Kern County Subbasin (**Figure 3-1**) is bounded to the north by the Tulare Lake and Tule Subbasins, the west by the California Coastal Range, the south by the White Wolf Subbasin, and the east by the Sierra Nevada Mountains. The Subbasin covers approximately 1,945,000 acres or about 3,040 square miles[2].

The subbasin contains 65 localized urban areas listed in Section 3.4 and eight incorporated cities: Bakersfield, Delano, McFarland, Wasco, Shafter, Arvin, Taft, and Maricopa. According to the Census Block Group Data 2021, the Kern County Subbasin has an estimated population of 762,696 people. Most of the land within the subbasin and surrounding areas is used for growing crops and raising livestock. The primary land use designations for urban land are residential, commercial, and industrial. The Kern County Subbasin is currently, as of February 2024, managed by twenty GSAs, and the full list of member agencies can be found in Section 3.

Groundwater in the subbasin is used for drinking water, agriculture, wildlife habitat, industrial use, and oil and gas production. The subbasin contains several aquifers,

[1] Wat. Code, § 10735
[2] DWR, 2016.

which are bodies of rock and/or sand and soil that hold groundwater. These aquifers are separated by layers of clay, which slow the movement of water between aquifers and can act as a barrier. Groundwater is the main source of water for agricultural and urban land uses, but surface water is also available as a resource. Surface water sources include Kern River, Poso creek, and imported water.

For more information on the history, demographics, economy, governance context, groundwater levels, groundwater quality, and subsidence in the subbasin, please refer to Section 3 of the Draft Staff Report.

Recommendations for State Water Board Action (Section 4)

SGMA states, “in those circumstances where a local groundwater management agency is not managing its groundwater sustainably, the State needs to protect the resource until it is determined that a local groundwater management agency can sustainably manage the groundwater basin or subbasin.” In March 2023, DWR determined the Kern County Subbasin 2022 GSPs to be inadequate. Board staff agree with this determination. Now, the State Water Board may determine whether a probationary designation is warranted. Board staff have reviewed the GSPs, Coordination Agreements, and the DWR staff reports and letters documenting DWR’s review of the GSPs.

Staff recommend the State Water Board designate the subbasin as probationary, and find the following:

The GSPs will allow substantial impacts to people who rely on domestic wells for drinking, bathing, food preparation, and cleaning, as well as impacts to critical infrastructure such as canals (e.g., Friant-Kern Canal or California Aqueduct), levees, and the aquifer itself within the subbasin. These impacts are likely to occur to an extent that the subbasin will be unable to prevent undesirable results, as required by SGMA. Moreover, the current plans are unlikely to allow the subbasin to achieve sustainability by 2040. Designating the subbasin probationary is critical for getting the subbasin back on track to avoid undesirable results and achieve sustainability by 2040.

Section 4 of the Draft Staff Report explains Board staff recommendations for a potential probationary designation of the subbasin. These recommendations are summarized below.

Consideration of Groundwater Sustainability Plan Revisions

The Kern County Subbasin GSAs submitted seven new draft GSPs and a coordination agreement to Board staff on May 28, 2024, referred to here as the 2024 Draft GSPs. The plans are considered draft because they have yet to be adopted by the GSAs and are currently undergoing public review. Board staff conducted a preliminary review of the 2024 Draft GSPs to determine if any deficiencies identified in this draft staff report remain and whether to delay release of this draft staff report while a more thorough review of the 2024 Draft GSPs takes place. However, based on the preliminary review, staff feel that the 2024 Draft GSPs still have significant deficiencies and that Board staff

analysis of the 2022 GSPs and identification of potential actions to resolve deficiencies remain relevant. The draft staff report will be helpful for GSAs to consider when further revising the 2024 Draft GSPs. The preliminary review of the 2024 Draft GSPs is discussed below in more detail.

GSP Deficiencies and Potential Actions to Address Deficiencies (Section 4.1)

Board staff have identified specific deficiencies in the Kern County Subbasin 2022 GSPs and have outlined potential corrective actions to address those specific deficiencies. The Draft Staff Report also incorporates deficiencies identified by DWR's determination. Deficiencies that Board staff identified within the GSPs relate to:

- Coordination across the Subbasin and GSAs.
- Chronic lowering of groundwater levels with insufficient management criteria.
- Continued land subsidence (sinking).
- Further degradation of groundwater quality.
- Depletion of interconnected surface water.

Board staff agree with DWR that the coordination deficiencies effectively require that the subbasin redevelop undesirable results and sustainable management criteria (criteria GSAs will use to evaluate success and avoidance of undesirable results) for multiple sustainability indicators so that they are consistent across the GSAs and Management Areas. Board staff have reviewed the 2022 DWR Inadequate Determination, Kern County GSPs, and Management Area Plans carefully to describe the coordination deficiency broadly in this section and in detail for each sustainability indicator that it applies to in subsequent sections. Due to the fundamental issues in coordination, Board staff observe additional issues within technical deficiencies exacerbated by the fragmented approach for groundwater levels, subsidence, groundwater quality, and interconnected surface water.

To end State Water Board intervention in a groundwater basin, GSAs in that basin must demonstrate to the State Water Board their ability and willingness to manage groundwater sustainably and address the issues that caused state intervention to occur. Ultimately, the State Water Board will evaluate any updated and adopted GSPs as a whole and will determine whether the GSAs have addressed the deficiencies, whether the GSPs are consistent with SGMA, and whether the GSAs are implementing the GSPs in a manner that the State Water Board finds will likely achieve sustainability in the subbasin.

Defining and Avoiding Undesirable Results Related to Coordination in the Subbasin (Deficiency CRD – Section 4.1.1)

Under SGMA, achieving sustainability requires a basin's GSAs to be coordinated and on track to meet the same sustainability goal. Since SGMA allows multiple entities to participate with and form GSAs to develop one or more GSPs, it is important for the GSAs to demonstrate that they're well-coordinated and using the same data and methodology for setting sustainable management criteria and defining undesirable results. However, due to different approaches across the numerous plans, DWR staff found it difficult to evaluate the plans. Ultimately, the differing data and methodology used to set sustainable management criteria and undesirable results would allow for disparate impacts across the subbasin. DWR concluded that it is unclear how or whether the Kern County Subbasin 2022 GSPs will achieve sustainability due to the fragmented Management Area approach to groundwater management.

Board staff agree and have built on DWR's analysis. Staff note that coordination in the subbasin does not satisfy the requirements of SGMA. Staff note inconsistencies: 1) in undesirable results and sustainable management criteria, 2) between the numerous GSPs, 3) in the implementation of SGMA, and 4) in basin management. Staff note that the GSPs and Management Area Plans currently effectively function as individual plans for separate basins with separate sustainability goals.

Staff propose the following deficiencies and potential actions to address poor coordination:

- **Deficiency**: Undesirable results and sustainable management criteria are not coordinated.
  Potential Action: Redevelop undesirable results and sustainable management criteria using consistent data and methods and adequate detail for implementation across many plans.
- **Deficiency**: The Coordination Agreement, GSPs, and Management Area Plans lack key details necessary for coordinated implementation.
  Potential Action: Add key details to the coordination agreement and ensure Management Areas help facilitate rather than hinder plan implementation.
- **Deficiency**: GSAs in the Subbasin have not demonstrated Basin-wide management.
  Potential Action: Provide key details demonstrating adequate GSA coverage.

Defining and Avoiding Undesirable Results Related to Chronic Lowering of Groundwater Levels (Deficiency GL – Section 4.1.2)

Under SGMA, achieving the sustainability goal for a basin requires avoiding "chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon."[3] Declining groundwater levels can cause shallow wells to go dry or reduce their productivity, increase the energy costs of pumping, bring polluted water closer to well screens (the

[3] Wat. Code, § 10721, subd. (x).

area where groundwater enters a well), reduce water available for deep-rooted plants, cause subsidence, and impact the structural integrity of wells. Declining groundwater levels also make it more difficult to avoid other related undesirable results caused by groundwater conditions, especially land subsidence, degradation of groundwater quality, reduction in storage, and depletions of interconnected surface water.

DWR concluded that the Kern County Subbasin 2022 GSPs rely on inconsistent data and methodologies used to define what the significant and unreasonable conditions for the subbasin are and do not adequately establish what groundwater level conditions throughout the basin would result in significant and unreasonable impacts. DWR also concluded that the 2022 GSPs do not adequately or consistently establish the sustainable management criteria for the lowering groundwater levels consistent with the GSP regulations. In addition, DWR notes that the sustainable management criteria would likely result in significant and unreasonable impacts to wells and people who rely on them.

State Water Board staff have built on DWR's analysis, additionally noting the GSPs do not consistently address the likelihood that approximately 20% of domestic wells in the basin could go dry based on the GSPs' approaches and available well data. Staff also describe gaps in 1) the GSAs' proposed approach to addressing wells they allow to go dry (well mitigation plans) and 2) the feasibility of avoiding chronic lowering of groundwater levels with the projects and management actions proposed in the GSPs.

Staff propose the following deficiencies and potential actions to address declining groundwater levels:

- **Deficiency (Coordination):** Undesirable results and sustainable management criteria are poorly coordinated.
  Potential Action: Redevelop undesirable results and sustainable management criteria using consistent data and methods and adequate detail for implementation across many plans.

- **Deficiency**: Well mitigation plans lack crucial detail.
  Potential Action: Add detail to well mitigation plans.

- **Deficiency**: Demand management plans (how GSPs will reduce groundwater pumping) lack crucial detail.
  Potential Action: Add detail to demand management plans.

Defining and Avoiding Undesirable Results Related to Land Subsidence (Deficiency LS – Section 4.1.3)

Another consideration under SGMA is avoiding "significant and unreasonable land subsidence that substantially interferes with surface land uses."[4] In the Central Valley, the majority of subsidence, which is the sinking of land, is caused by over pumping of groundwater. Land subsidence from excessive groundwater extraction can cause

[4] Wat. Code, § 10721, subd. (x).

irreversible damage to infrastructure (bridges, roads, pipelines, canals, levees, and buildings) and aqueduct operations. Land subsidence can also diminish the storage capacity of an aquifer, which reduces the amount of available groundwater storage for the future.

In the Kern County Subbasin, subsidence is primarily caused by the removal of water from the clay layers by groundwater extraction of the confined aquifer, which causes irreversible compaction and sinking of the land surface.

DWR determined that the Kern County Subbasin 2022 GSPs do not adequately define sustainable management criteria for subsidence. DWR also noted that the 2022 Plans, revised GSP after 2020 GSPs were considered incomplete by DWR, continue to lack consistent data and methodologies when setting sustainable management criteria and describing the conditions throughout the Subbasin that would cause undesirable results. State Water Board staff have built on DWR's analysis, noting that the 2022 GSPs lack a detailed and consistent analysis of the effects of subsidence in the Subbasin on all beneficial uses and users and infrastructure. Additionally, Board staff also note that GSPs do not provide key details on how they will prevent damage to infrastructure. State Water Board staff therefore conclude that undesirable results may occur under the 2022 GSPs.

Staff propose the following deficiencies and potential actions to address subsidence:

- **Deficiency (Coordination):** Undesirable results and sustainable management criteria are poorly coordinated.
  Potential Action: Redevelop undesirable results and sustainable management criteria using consistent data and methods and adequate detail for implementation across all plans.

- **Deficiency**: GSPs lack crucial detail about how they plan to meet their goals and avoid undesirable results.
  Potential Action: Develop and implement plans to limit pumping near critical infrastructure. Do not allow new wells near critical infrastructure. Develop plans to repair damage caused by subsidence.

Degraded Groundwater Quality (Deficiency GWQ – Section 4.1.4)

Another consideration under SGMA is avoiding "significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies."[5] Degradation of water quality can limit local water supplies and beneficial uses, and SGMA requires GSAs to consider the interests of all beneficial uses and users of groundwater, especially drinking water users.[6] Water quality degradation that significantly and unreasonably affects the supply or suitability of groundwater for use in drinking water systems is an undesirable result.

[5] Wat. Code, § 10721, subd. (x).
[6] Wat. Code, § 10723.2.

DWR did not define the degradation of groundwater quality as a deficiency for the Kern County Subbasin. However, DWR staff did note that GSPs should include descriptions explaining the relationship between groundwater levels and other sustainability indicators, specifically groundwater quality. As mentioned above, DWR staff noted that the fragmented approach used to set sustainable management criteria for all sustainability indicators used inconsistent data and methodologies. Board staff also reviewed the 2022 GSPs and have additional concerns about: 1) the monitoring network of wells that will be used to test water quality and whether it is sufficient to be protective of all beneficial users and 2) key implementation and mitigation details (how they will address water quality issues if exceedances occur). Board staff also would like to see a mitigation plan for the entire subbasin to address water quality issues that arise and ensure continued access to clean and affordable drinking water.

Staff propose the following deficiencies and potential actions to address degraded groundwater quality:

- **Deficiency (Coordination):** Undesirable results and sustainable management criteria are poorly coordinated.
  Potential Action: Redevelop undesirable results and sustainable management criteria using consistent data and methods and adequate detail for implementation across many plans.
- **Deficiency**: The GPSs are not consistent on how they will monitor groundwater quality. They also do not monitor frequently enough.
  Potential Action: Clearly describe how groundwater quality will be monitored. Monitor frequently enough to detect short-term and seasonal trends.
- **Deficiency**: The GSPs do not include plans to help people whose well water is allowed to degrade below drinking water standards. The GSPs do not:1) plan for the additional sampling necessary to understand the extent of degraded water or 2) include the well mitigation planning necessary to restore well water to drinking water standards.
  Potential Action: Collect and analyze more water samples when drinking water degrades below drinking water standards. Develop clear plans to restore access to clean drinking water when it degrades below drinking water standards.

Interconnected Surface Water (Deficiency ISW – Section 4.1.5)

Another consideration under SGMA is avoiding "[d]epletions of interconnected surface water [– surface water that is hydraulically connected at any point by a continuous saturation zone to the underlying aquifer –] that have significant and unreasonable adverse impacts on beneficial use of the surface water."[10] Groundwater and surface water are often connected. As a result, groundwater pumping can reduce the amount of water that flows into rivers and streams. Depletions of interconnected surface water within the basin may have negative impacts on surface water uses, such as degradation

or loss of groundwater dependent ecosystems and reduced downstream surface water flow to users.

The GSP regulations state that "[a]n Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators." However, after analysis of the Coordination Agreement and the six 2020 and 2022 GSPs submitted for the Kern County Subbasin, State Water Board staff concluded that the GSPs are inconsistent in how they analyze interconnected surface water and therefore do not adequately justify an approach for identifying and defining interconnected surface water in accordance with best management practices and SGMA. It is therefore unclear if interconnected surface waters, ephemeral or perennial (seasonal or continuous), are present and if sustainable management criteria and monitoring networks should be developed to meet the requirements of SGMA.

Staff propose the following deficiencies and potential actions to address depletion of interconnected surface waters:

- **Deficiency (Coordination):** Undesirable results and sustainable management criteria are poorly coordinated.
  Potential Action: Redevelop undesirable results and sustainable management criteria using consistent data and methods and adequate detail for implementation across all plans.

- **Conditional Deficiency**: The GSP currently does not include plans to avoid significant and unreasonable impacts related to interconnected surface water. If GSAs identify interconnected surface water, using the best available data and correct definition of interconnected surface water, then the lack of plan is a deficiency.
  Conditional Potential Action: If the basin identifies interconnected surface water, then the GSP should be revised to avoid significant and unreasonable impacts related to interconnected surface water.

Preliminary Review of 2024 Draft Groundwater Sustainability Plans

In addition to reviewing the 2022 GSPs, staff conducted a preliminary review of the 2024 Draft GSPs. Staff recognize that coordination among GSAs has substantially improved, but the three fundamental deficiencies identified by DWR's inadequate determination (poor coordination, lowering of groundwater levels, and subsidence) still remain for the 2024 Draft GSPs. For example, key parts of the sustainable management criteria, referred to as minimum thresholds, used for groundwater level were determined using the lowest of projected historical trends or historical water level ranges, rather than using thresholds focusing on protection of beneficial uses and users. Staff noted numerous minimum thresholds are deeper, several by more than 50 feet and some more than 100 feet, compared to minimum thresholds set in the 2022 GSPs. These thresholds could result in groundwater levels declining below historic lows without

triggering any management actions. Also, Board staff noted that the use of regionally-averaged declining trends leads to minimum thresholds that vary dramatically across areas of the subbasin. This results in inconsistent management action triggers across plan areas, an issue previously identified by DWR across the 2022 GSP plan areas due to lack of coordination. Board staff also identified deficiencies in the 2024 Draft GSPs related to degradation of groundwater quality and depletion of interconnected surface water, similar to those observed by Board staff in the 2022 GSPs. For example, lack of separate monitoring in the confined and unconfined aquifers is likely to greatly limit understanding and management of groundwater quality degradation and prevent protection of beneficial users.

The draft staff report identifies potential actions that the GSAs can incorporate to address the deficiencies identified in 2022 GSPs. Board staff have conducted 10 consultation meetings with the Kern County Subbasin GSAs since March 2023 to provide feedback on deficiencies in 2022 GSPs and potential actions for remedying those deficiencies. A significant amount of this feedback forms the basis for the written recommendations of the draft staff report. Because the deficiencies identified after the preliminary review of the 2024 Draft GSPs are consistent with the deficiencies in the 2022 GSPs, GSAs can use the draft staff report as guidance to correct the deficiencies in the 2024 Draft GSPs and address the Board staff recommendation to designate the basin as probationary. Board staff will continue to review the 2024 Draft GSPs in greater depth and work with the GSAs to provide feedback to resolve remaining deficiencies. Board staff will incorporate review of the 2024 Draft GSPs into the final staff report. Staff invite interested persons to also review the 2024 Draft GSPs and to provide written comments to the Board on whether and how deficiencies and potential actions identified in the draft staff report remain applicable to the 2024 Draft GSPs.

Additional Staff Recommendations for State Water Board Action (Sections 4.2-4.4)

Exclusions from Probationary Status

SGMA directs the State Water Board to exclude from probationary status any portion of the basin for which a GSA demonstrates compliance with the sustainability goal[7]. Staff believe no GSAs in the Kern County Subbasin have demonstrated compliance with the sustainability goal. All seven GSAs have adopted and are implementing six GSPs, which DWR has determined to be inadequate. Board staff do not recommend excluding any portions of the subbasin from the probationary designation.

Modification to Water Year and Reporting Dates

[7] Wat. Code, § 10735.2, subd. (e).

Board staff do not recommend modifying the water year for reporting of extractions but do recommend modifying the extraction reporting deadline for groundwater extraction reports required pursuant to Water Code Section 5202 by changing it from February 1 to December 1.

Requirements for Installation and Use of Measuring Devices

As part of a probationary designation, the State Water Board may require groundwater extraction reporters to install and use measuring devices, such as flow meters, for measuring their groundwater extractions.

State Water Board staff recommend the State Water Board:

- Require groundwater extraction reporting and paying fees for: 1) any person extracting more than two acre-feet per year for any reason OR 2) any person extracting 2 or fewer acre-feet of groundwater per year for any reason other than domestic purposes.
- Require any person extracting more than 500 acre-feet per year to install and use meters that meet the requirements of Cal. Code Regs., tit. 23, § 1042 on all their production wells within the subbasin.
- Require any person extracting groundwater from the wells located in the CA Aqueduct and Friant-Kern Canal subsidence monitoring corridors to install and use meters that meet the requirements of Cal. Code Regs., tit. 23, § 1042 on all their production wells within the basin.
- Exclude any person who extracts two acre-feet or less per year for domestic uses only (de minimis users) from reporting requirements and paying fees. This exception includes most household users, including those extracting from wells located in the CA Aqueduct and Friant-Kern Canal subsidence monitoring corridors.

Conclusion

Despite significant efforts by GSAs in the Kern County Subbasin, Board staff analysis supports DWR's determination that the Kern County Subbasin 2022 GSPs are inadequate. Due to poor coordination and inconsistency in goals and implementation, the current plans do not achieve sustainability or prevent substantial impacts to communities who rely on domestic wells and to critical infrastructure. The Kern County Subbasin is therefore unlikely to achieve sustainability by 2040, as required by SGMA.

Addressing deficiencies related to lowering groundwater levels and groundwater quality degradation is also consistent with the State Water Board's goal to ensure every Californian has safe and affordable drinking water as reflected in its commitment to the Human Right to Water and administration of the Safe and Affordable Drinking Water Fund.

Board staff recommend probationary status as a next step for getting the subbasin back on track to achieve sustainability and protect groundwater resources for the communities, farms, and environmental resources that depend on them.

1.0 Purpose and Organization of Staff Report

The purpose of this Staff Report is to inform the State Water Resources Control Board (State Water Board) as it considers whether to designate the Kern County Subbasin as a probationary basin consistent with the requirements of the Sustainable Groundwater Management Act (SGMA). The Department of Water Resources (DWR) deemed the groundwater sustainability plans (GSPs) for the Kern County Subbasin to be inadequate. This Staff Report provides the Board staff's characterization of the specific deficiencies in the GSPs, outlines an approach to state intervention for the Kern County Subbasin, and more generally explains the State intervention process.

The Staff Report consists of five sections of subbasin specific content regarding state intervention and a final section of references.

- **Section 1.0. Purpose and Organization.** Discusses the purpose of the report and provides an outline of the content.
- **Section 2.0**. **SGMA Background, State Intervention Process, and Equity Considerations.** Details what it means for a subbasin to be deemed inadequate by DWR, provides a history of SGMA, and discusses what it means for a groundwater subbasin to go into the state intervention process. This section also includes a discussion of probation, a potential first step in state intervention; the reporting and fee requirements; and an interim plan, the potential second step in state intervention, as well as describing Board consideration of groundwater challenges for disadvantaged communities (DACs).
- **Section 3.0. Historical, Physical, and Demographical Description of the Basin.** Describes the Kern County Subbasin and contains the geographic, demographic, economic, and governance context within the subbasin, including a history of human use and development. This section also details the Groundwater Sustainable Agencies (GSAs) and their members, beneficial uses of groundwater, geologic history of the basin, and basin hydrology.
- **Section 4.0. Board staff Recommendations.** Details DWR's inadequate determination and its purpose, and the deficiencies and potential actions to address those deficiencies that have been identified by DWR and Board staff. Also included in this section is a discussion of exclusions from probationary status (Wat. Code, § 10735.2, subd. (e)), modification to water year (WY) reporting dates, and requirements for installation and use of measuring devices (Wat. Code, § 10735.2, subd. (c)(3)).
- **Section 5.0. Additional Considerations.** Presents other considerations that Board staff have addressed related to the California Environmental Quality Act (CEQA), the human right to water, and the public trust doctrine.

The State Water Board will consider public comments, this Staff Report, and other relevant information that is presented during its public process as it evaluates whether to designate the Kern County Subbasin as a probationary basin.

2.0 The Sustainable Groundwater Management Act and State Intervention

Section 2.1 provides general background on SGMA, including its goals and the role it defines for local and state agencies. Section 2.2 describes the State Water Board's role as a backstop, to protect groundwater and those who depend on it when local efforts alone are inadequate.

2.1 The Sustainable Groundwater Management Act Background

2.1.1 Legislative Enactment of the Sustainable Groundwater Management Act

Groundwater, one of California's greatest natural resources, makes up a significant portion of the state's water supply. Approximately 80 percent of Californians use groundwater for drinking or other household uses. Rain replenishes groundwater each year, but the amount of replenishment (or recharge) varies and depends on local conditions. Overdraft occurs when groundwater pumping removes water faster than precipitation can recharge the groundwater in a basin. Some groundwater basins in California are in a state of critical overdraft causing significant adverse environmental, economic, and social impacts. In some cases, groundwater levels have dropped so low that many existing wells are no longer able to pump water, including domestic supply wells in rural, largely economically disadvantaged communities (DACs). Wildlife and ecosystems that rely on shallow groundwater or rivers and streams connected to groundwater can also be adversely affected by low groundwater levels (CDFW, 2019). Excessive pumping has led to land subsidence in some areas, in turn causing damage to critical infrastructure such as levees and canals.

To protect California's groundwater resources, former California Governor Jerry Brown signed a three-bill legislative package in 2014, composed of Assembly Bill 1739 (Dickinson), Senate Bill (SB) 1168 (Pavley), and SB 1319 (Pavley). These bills created SGMA, the first legislative act in California to establish a statewide framework for sustainable groundwater management.

SGMA applies to California's alluvial groundwater basins that are designated as high and medium priority by DWR. SGMA requires local public agencies in those basins to form GSAs and develop and implement GSPs. GSAs are responsible for achieving a long-term management of their groundwater basins that avoids "undesirable results" (as defined under SGMA) within 20 years of implementing their GSPs.

SGMA's framework to sustainably manage groundwater at the local level is implemented through a division of governance between GSAs, DWR, and the State

Water Board. Under SGMA, governance of groundwater sustainability in a subbasin begins with GSAs. SGMA provides the GSAs with authorities to implement rules and regulations for GSPs, monitor and enforce compliance with plans, and oversee or control groundwater extractions. DWR is the primary state technical assistance and oversight agency in SGMA and is tasked with assessing and evaluating GSPs for compliance with SGMA's requirements. The State Water Board acts when necessary to ensure SGMA is implemented successfully and may temporarily intervene in groundwater management when the proposed management of a groundwater basin is deemed inadequate due to deficiencies in the GSP. The State Water Board's role is discussed further in Section 2.2.

The federal government and federally recognized California Native American Tribes are subject to SGMA only to the extent authorized under federal or tribal law; however, they may voluntarily participate in development or administration of GSPs and in Board SGMA processes (Wat. Code, § 10720.3).

2.1.2 Path to Sustainability

As noted above, SGMA required the formation of GSAs in high-priority or medium-priority groundwater basins and subbasins (basins) by June 30, 2017. Any local public agency with water supply, water management, or land use responsibilities within a groundwater basin was eligible to be a GSA. The current set of GSAs and the set of local public agencies that compose those GSAs reflect local decision-making. GSAs have authority to create new rules and ordinances to manage groundwater users located within the GSA boundary.

GSAs operating within a given basin are collectively required to ensure groundwater is managed sustainably. To this end, SGMA provides GSAs with authorities to develop and implement GSPs, conduct investigations, register groundwater wells or require installation of meters, require pumpers to report extractions or recharge activities, build and operate projects, gather data, regulate or restrict extractions, and charge fees (Wat. Code, § 10725 et seq.). In developing and updating a GSP, GSAs must create opportunities for public engagement, encourage active involvement of diverse social, cultural, and economic elements of the population within the basin, and inform the public about their progress implementing the GSP (Cal. Code Regs., tit. 23, § 354.10, subd. (d)). A GSA may also "appoint and consult with an advisory committee consisting of interested parties" as it develops and implements a GSP (Wat. Code, § 10727.8).

GSPs outline how groundwater is to be used and managed without causing the following six undesirable results in the basins: significant and unreasonable declines in groundwater levels, reductions in groundwater storage, intrusion of seawater, degradation of water quality, subsidence of land, and depletions of interconnected surface waters. These are often referred to as the sustainability indicators. GSPs are not required to address undesirable results that occurred before and were not corrected by January 1, 2015 (Wat. Code, § 10727.2, subd. (b)(4)).

SGMA requires that GSAs develop a sustainability goal description for each basin. According to SGMA, the sustainability goal is the implementation of measures identified to ensure the basin is operated without causing undesirable results (Wat. Code, § 10721, subds. (u), (w)).

2.1.2.1 Define Undesirable Results

GSAs are required to develop a definition of when effects caused by groundwater conditions occurring throughout a basin are considered to be significant and unreasonable for their basin (Cal. Code Regs., tit. 23, § 354.26). The definition of undesirable results includes both a narrative definition and a quantitative definition for each sustainability indicator. The definitions are based on sustainable management criteria (SMC) developed by the GSAs.

2.1.2.2 Define Quantitative Thresholds to Avoid Undesirable Results

To avoid undesirable results and to achieve the basin's long-term sustainability goals, GSPs must set quantitative minimum thresholds (MTs) and measurable objectives (MOs) for each of the sustainability indicators, as well as interim milestones. MTs quantify groundwater conditions for each applicable sustainability indicator at representative monitoring sites (RMSs) within the basin (Cal. Code Regs., tit. 23, § 354.28). MOs define quantifiable goals for sustainability indicators that maintain or improve sustainable groundwater conditions within the subbasin. Interim milestones define measurable target values for groundwater conditions over increments of five years (Wat. Code, § 10727.2, subd. (b)(1); Cal Code Regs., tit. 23, § 354.30).

2.1.2.3 Achieve Sustainability through Project and Management Actions

GSPs are required to describe project and management actions that the GSA has determined will achieve the sustainability goal for the subbasin (Cal. Code Regs., tit. 23, § 354.44). The project descriptions must include the criteria that would trigger implementation, a timetable for implementation, an explanation of the source and reliability of the water on which the projects rely, and a funding plan (Cal. Code Regs., tit. 23, § 355.44). GSPs must provide descriptions of current or future projects to achieve balanced levels of groundwater to reach long-term sustainable conditions. For those groundwater basins experiencing the most severe (critical) overdraft, GSPs were due by 2020 and must achieve groundwater sustainability within 20 years (by 2040). For the remaining high-priority and medium-priority basins, GSPs were due by 2022, thus requiring them to achieve groundwater sustainability by 2042 unless submitted earlier (Wat. Code, § 10720.7, subd. (a)) (Wat. Code, § 10727.2, subd. (b)).

2.2 State Intervention

When DWR, in consultation with the State Water Board, deems the GSP or GSPs in a basin inadequate (Wat. Code, § 10735.2, subd. (a)(3)), DWR refers the basin to the State Water Board for potential state intervention pursuant to the provisions of Chapter 11 of SGMA (Wat. Code, § 10735 et seq.). State intervention under the SGMA statute is a two-step process. The Board may decide not to take the first step if basins address deficiencies before the Board is ready to take the first step.

- The first step is for the Board to consider and potentially designate a basin as probationary (described in Section 2.2.1). During probation, GSAs have at least one year to resolve deficiencies while the State Water Board collects data on groundwater extractions, collects fees from certain groundwater users, and, optionally, conducts additional investigations. If deficiencies have not been resolved after at least one year of probation, the Board may decide to move to the second step.
- The second step is for the Board to consider and potentially impose an interim plan for the basin (described in Section 2.2.2). An interim plan is intended to be a temporary measure to protect groundwater until the State Water Board determines that locally led management complies with SGMA and will be effective. Under an interim plan, the State Water Board can manage groundwater use in a basin, including enacting restrictions on groundwater extractions (Wat. Code, § 10735.8).

Importantly, throughout the state intervention process, and even before the Board potentially takes the first step in state intervention:

- The state intervention process may end after deficiencies are addressed. If the Board determines deficiencies have been resolved and the basin is likely to achieve sustainability, the Board will end state intervention. The Board may also decide not to designate a basin as probationary if deficiencies are addressed before the Board considers probation.
- GSAs retain authorities and responsibilities and must continue to implement their plans. Basins may be held in intervention after deficiencies are addressed if plans are not being adequately implemented.

2.2.1 Probation – First Potential Step

If DWR determines a GSP for a medium-priority or high-priority basin in critical overdraft to be inadequate, the State Water Board may, after notice and a public hearing, designate the basin as a probationary basin (Wat. Code, § 10735.2, subd. (a)(3)). Other situations can also trigger the State Water Board's state intervention authorities (Wat. Code, § 10735.2, subds. (a)(1)-(5)).

The State Water Board can only designate a basin probationary at a public hearing after ample public notice (see Section 2.2.1.1). Following a probationary designation, certain groundwater pumpers in the basin must report information about their groundwater use to the State Water Board (Section 2.2.1.2) and pay associated fees (Section 2.2.1.3). As part of the probationary designation, the State Water Board has discretion to require certain groundwater pumpers to use meters or other specific methods to measure groundwater extractions (Section 2.2.1.4) or to exempt certain categories of pumpers from reporting and fees (Section 2.2.1.4). SGMA directs the State Water Board to exclude from probationary status any portion of a basin for which a GSA demonstrates compliance with the sustainability goal (Section 4.2; Wat. Code, § 10735.2, subd. (e)).

2.2.1.1 Probationary Hearing Process

The State Water Board must provide notice of the hearing at least 90 days before it occurs by publishing the hearing dates on its website and notifying DWR and each city and county overlapping with the basin (Wat. Code, § 10736, subds. (a), (b)(1)-(2)).

In addition, at least 60 days before the hearing, the Board must mail or send by electronic mail notice to all persons known to the Board who extract or who propose to extract water from the basin, or who have made written or electronic mail requests to the Board for special notice of hearing pursuant to SGMA (Wat. Code, § 10736, subd. (b)(3)(B)).

Although not required by the statute, the Board staff are providing these draft recommendations for action in the basin, in the form of a draft staff report, to the public for a minimum 60-day public comment period prior to the probationary hearing. Staff also expect to host one or more in-person or virtual public engagement meetings during the public comment period to explain state intervention and receive public comments on staff's recommendations.

2.2.1.2 Reporting

Any person who extracts or pumps groundwater from a probationary basin must file a groundwater extraction report (report) with the State Water Board each year (Wat. Code, § 5202; see possible exceptions below). Reports must be submitted electronically (Cal. Code Regs., tit. 23, § 1032). On May 16, 2017, the State Water Board adopted a resolution for an emergency regulation to help implement SGMA that included electronic filing requirements. The emergency regulation was authorized under Water Code § 348, which allows DWR or the Board to adopt emergency regulations for the electronic filing of reports required under Water Code § 5200 et seq. The Office of Administrative Law approved the final regulation on June 29, 2017.

These reports must include:

- the name and address of the person who extracted groundwater

- the name of the basin from which the water was extracted
- the place of groundwater extraction
- the capacity of the groundwater extraction facilities
- monthly records of the groundwater extractions
- the purpose of use
- a general description of the area in which the water was used, and
- the year groundwater extraction commenced (Wat. Code, § 5203).

Persons extracting groundwater within a basin will be required to begin reporting their extractions to the Board 90 days after any probationary designation (Wat. Code, § 5202, subd. (a)(1)). Groundwater extraction reports, by default, are due by February 1 of each year for groundwater extractions made during the previous water year (Wat. Code, § 5202, subd. (b)). However, the Board may modify the water year or reporting date for a report of groundwater extractions (also see Section 4.3) (Wat. Code, § 10735.2, subd. (c)(4)).

Data collected by the State Water Board can be used by GSAs and stakeholders in remedying deficiencies and achieving sustainable groundwater management. If the State Water Board eventually develops an interim plan for a basin, the State Water Board may rely on the data to ensure the interim plan is consistent with water rights priorities, as required by SGMA (Wat. Code, § 10735.8, subd. (d)).

2.2.1.3 Fees

The State Water Board will notify well-owners and landowners of their extraction reporting requirements and associated filing fees. Any person that is required to file a groundwater extraction report to the State Water Board is also required to pay a report filing fee. Fees are required because Water Code section 1529.5 directs the State Water Board to recover the costs of state intervention activities via a schedule of fees. These fees were adopted under the 2017 emergency regulation described above.

The current annual fee for groundwater extractions (excluding de minimis extractions) in a probationary groundwater basin is a base fee of $300 per well and $20 per acre-foot (AF) of water extracted in the probationary basin (SWRCB, 2024). The State Water Board may amend fees as needed by subsequent emergency regulation (Wat. Code, § 348).

2.2.1.4 Measurement Requirements

All groundwater extractors subject to reporting requirements must submit annual reports that tabulate monthly records of groundwater extractions. The measurements of the extractions must be made by a methodology, water-measuring device, or combination

thereof satisfactory to the Board (Wat. Code, § 5203, subd. (e)). The State Water Board's *Options for Measuring Extraction Volumes* guidance document identifies acceptable ways to measure extractions (State Water Resource Control Board, 2022). Options include a totalizing flowmeter, the run time method, or other methods as evaluated and approved in advance by staff on a case-by-case basis.

For basins in probation or subject to an interim plan, the State Water Board can require extractors to install meters to measure and report their groundwater extractions accurately, or the State Water Board can specify other means for measuring and reporting groundwater extractions (Wat. Code, § 10735.2, subd. (c)(3)).

Default Exemption for De Minimis Users

A well owner who extracts two acre-feet (AF) or less of groundwater per year from a parcel of land for domestic purposes only is defined as a "de minimis user" under the SGMA statute. De minimis users in probationary basins are exempt from reporting and fees unless the State Water Board determines reporting information from those users is necessary to sustainably manage the basin (Wat. Code, §§ 5202, subd. (c)(1), 10735.2, subd. (c)(2)).

Optional Exemption from Reporting for Certain Classes or Categories of Users

The State Water Board may choose to exclude certain classes or categories of groundwater extractions from extraction reporting and associated fees (Wat. Code, § 10735.2, subd. (c)). Specifically, the State Water Board could exempt classes or categories of extractors subject to a local plan or program that adequately manages groundwater within a portion of the basin if extractors are likely to have a minimal impact on basin withdrawals.

2.2.2 Interim Plan – Second Potential Step

The potential second step of state intervention involves the development and implementation of an interim plan for the basin by the State Water Board. The Board may develop an interim plan for the probationary basin one year after the probationary designation of the basin if the Board, in consultation with DWR, determines that a GSA(s) has not remedied the deficiencies that resulted in designating the basin as probationary (Wat. Code, § 10735.4, subd. (c)).

If the State Water Board adopts an interim plan, it would temporarily manage groundwater in the basin pursuant to the interim plan until the local agencies could demonstrate their ability to resume sustainable management of the basin. An interim plan is intended to be a temporary measure to protect groundwater until the State Water Board determines that locally led management complies with SGMA's requirements. An interim plan will include corrective actions, a schedule for those actions, monitoring, and enforcement (Wat. Code, § 10735.8, subd. (b)). An interim plan will likely focus on

reducing groundwater use in the basin to sustainable levels as soon as practical. An interim plan may include elements of an existing plan or adjudication that the Board finds would help meet the basin's sustainability goal.

2.2.3 Equity Considerations in State Water Board Decisions

The State Water Board mission—to preserve, enhance, and restore the quality of California's water resources and drinking water—is strengthened by the Board's commitment to racial equity and environmental justice[8] (State Water Resources Control Board, 2021a). The State Water Board acknowledges and condemns inequities, past and present, in water access, affordability, and quality. The Board seeks to proactively use existing processes and authorities to help address structures and practices that may perpetuate these inequities. These considerations have informed the analyses employed in this report, as well as the determination of deficiencies, and proposed corrective actions identified herein. Some of these proposed actions, if implemented, would both help address past and present inequities and resolve GSP deficiencies by addressing groundwater supply and quality impacts related to management actions. Proposed actions would ensure, where appropriate, that sufficient mitigation measures are in place to protect communities from chronic lowering of groundwater levels and other undesirable results that are significant and unreasonable. The State Water Board will continue to engage with and consider the needs of potentially affected DACs and Black, Indigenous, and people of color (BIPOC) communities in the Kern County Subbasin as it implements its responsibilities under SGMA.

It is estimated that in California 9.4 million people, 25% of the state's population, live in DACs. In the San Joaquin Valley approximately 2.2 million people, 55% of the valley's population, live in DACs (Fernandez-Bou, et al., 2021a). The geography of DACs is a product of urban segregation, redlining, and the racialized exclusion from public benefits that occurred as people of color were pushed outside of city limits, into industrial and service worker areas, or relegated to far flung farmworker camps where they often experienced degraded and exploitative (London, et al., 2021).

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[8] For the State Water Board, racial equity is achieved when race can no longer be used to predict life outcomes (that is, when racial information does not help explain patterns of outcomes) and when outcomes for all groups are improved. For the State Water Board, environmental justice means the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. One way that inequities can relate to outcomes for water users is through the likelihood of success of policies and efforts. Theory and numerous case studies of local organizations with roles in the management of groundwater or other natural resources with common-pool properties, for example, suggest those organizations may be more likely to succeed where more resource users perceive the organizations and outcomes as fair (Ostrom, 2012).

DACs often are served by small public water systems and rely on groundwater either in whole or in part for their water supply. Their groundwater wells often are shallow and thus are more susceptible to water quality issues or the risk of going dry if the groundwater level is lowered. While the public water systems serving DACs still are required to maintain essential resources and meet public health requirements, these systems are less likely to have the resources (e.g., infrastructure and financing) of more affluent communities to respond adequately to water supply or water quality emergencies. Systems serving DACs may be unable to treat their water source, find alternative supplies for a contaminated drinking water source, deepen their wells, or build new wells. As a result, DACs may be more vulnerable than other municipalities and cities to impacts on surface water and groundwater supplies. Section 3.3 includes information regarding the history of human occupation and development of the San Joaquin Valley and Kern County Subbasin; and existing inequalities in water access, affordability, and quality.

3.0 Basin Description

The basin is the default physical scale at which SGMA responsibilities and authorities, at the state and local levels, apply.

3.1 Geographic Context

Located in California's Central Valley in the southern portion of the San Joaquin Valley, the Kern County Subbasin (subbasin) (**Figure 3-1**) is bounded:

- to the north by the Tulare Lake and Tule Subbasins,
- to the west by the Temblor Range within the California Coast Ranges,
- to the south by the White Wolf Subbasin and the San Emigdio Mountains within the Transverse Ranges, and
- to the east by the Sierra Nevada foothills and Tehachapi mountains.

The subbasin covers approximately 1,782,318 acres or about 2,785 square miles **Invalid source specified.** (DWR, 2006).

The land slopes from higher elevations along the eastern and western margins of the subbasin to lower elevation in the central portion of the subbasin (USGS Topo **Figure 3-2**). The highest elevations within the subbasin are approximately 3,000 feet (ft) Above Mean Sea Level (AMSL) and occur along the western and eastern boundaries of the subbasin (USGS Topo **Figure 3-2**). Groundwater generally flows toward the center of the subbasin due to recharge from the higher elevations that boarder the subbasin on the south, east, and west and in most areas, there is a slight groundwater flow gradient

from northwest along the San Joaquin Valley Syncline (Kern Groundwater Authority , 2022, p. 72).

3.2 Geologic Context

The Kern County Subbasin sits in the south-central segment of the San Joaquin Valley. The San Joaquin Valley is a linear sediment-filled depression, typically known as a structural trough. The sediments overlay crystalline basement rocks (Bartow, 1991). The structural trough is 200 miles long, as much as 70 miles wide, and is filled with 32,000 ft of marine and continental sediments at its greatest depth (DWR, 2006). Sediments were deposited during inundation of the Pacific Ocean and by erosion of the surrounding Sierra Nevada and Coast Range mountains. These sediments of loose clay, silt, sand, or gravel, deposited by flowing water, are known as alluvial deposits. When deposited away from direct connection to the ocean, they are known as continental deposits. Continental deposits form an alluvial wedge that thickens from the eastern edge of the valley toward the structural trough. The axis, or center line, of sediment deposition is beneath and slightly west of the rivers, lakes, sloughs, and marshes, and marks the current and historic artery of surface water drainage in the San Joaquin Valley.

See **Figure 3-3** for a map of the geology of the subbasin.

3.2.1 Geologic History

The subbasin within the San Joaquin Valley is geologically complex and was shaped predominantly by a compressional tectonic regime that resulted in the development of a subduction zone, one crustal plate descending below the edge of another, along the western margin of the continent (USGS, 2001). During the Late Mesozoic and early Cenozoic (145 to 65.5 million years ago) a mountain building phase, known as the Cordilleran Orogeny, took place as the Farallon Plate subducted under the North American Plate (**Figure 3-4**). This orogenic episode resulted in the development of:

- an accretionary prism (marine sediments scraped off from the Farallon Plate) now known as the Coast Range Mountains.
- a continental volcanic arc, creating the batholith that would become the Sierra Nevada Mountains.
- a forearc basin (region between a subduction zone and the mountain belt) which was beginning to develop the Central Valley where the subbasin is located.

The Kern County Subbasin was originally connected to the Pacific Ocean which periodically flooded the forearc basin with marine waters, allowing for deep marine sediment deposition (Bartow, 1991). As the rising mountains from the Coast Ranges blocked the flow of marine water between the forearc basin and the Pacific Ocean, the

Sierra Nevada Mountains continued to uplift, while erosion from the surrounding mountains and subsequent deposition filled the valley for millions of years.

The depositional history of the San Joaquin Valley, from deepest to relatively shallow sediments, can be divided into several periods:

- Late Mesozoic and early Cenozoic: The San Joaquin Valley was part of a forearc basin that was open to the Pacific Ocean as deep marine sediment was deposited in the basin.
- Late Miocene: The San Andreas Fault to the west of the forearc basin shifted movement and began to close off the area that now forms the San Joaquin Valley from the ocean, creating an extensive inland sea where marine sediments of the Etchegoin Formation and San Joaquin Formation were deposited.
- Pliocene: The portion of the San Joaquin Basin west of the San Andreas Fault continued to close off, causing the extensive inland sea to shallow. Marine sediments were deposited in the shallow sea bottom.
- Late-Pliocene and early-Pleistocene: The San Joaquin Valley began to evolve into its current form. Tulare Formation sediments were eroded from the uplifting mountains and deposited into the subsiding valley.
- Pleistocene: Quaternary sediments filled the basin and were deposited on alluvial fans and along the San Joaquin Basin axis by the rivers and streams emanating from the adjoining mountains.
- Pleistocene: Aggrading alluvial fans cut off the flow of the San Joaquin Basin rivers to the sea due to glacial and wet climate events (Atwater, et al., 1986). Large-scale lacustrine deposits (formed at lake bottoms) accumulated in the shallow lakes that developed as a result of the internal drainage. This is also when the Corcoran Clay (E-Clay of Croft 1972) accumulated in the Tulare and Kern Lakebeds.

3.2.2 Stratigraphy

Sediments comprising the Kern County Subbasin subsurface include younger and older alluvium, flood-basin deposits, lacustrine and marsh deposits, and continental deposits (**Figure 3-3** and **Figure 3-5**). Older alluvium consists of poorly sorted lenticular (lentil or lens shaped) deposits of clay, silt, sand, and gravel, which may range from loosely consolidated to cemented. Younger alluvium consists of heterogeneous complex of interstratified discontinuous beds of unsorted to fairly-well sorted clay, silt, sand, and gravel.

3.3 Human Use and Development

California Native American Tribes have inhabited the southern Central Valley since time immemorial. For thousands of years, much of the Kern County Subbasin was covered by saltbush scrub and alkali grassland habitats. In the central portion of the subbasin, freshwater tule marshes and alkaline wetlands were located along the slow-moving sloughs and shallow margins of Kern Lake, Buena Vista Lake, and Goose Lake, which were fed by the Kern River (Network, 2024) (**Figure 3-6**).

Prior to European contact, the southern Central Valley held one of the densest populations of peoples north of Mexico (Cook, 1955). California Native Americans in the Kern Subbasin hunted and managed a wide variety of game on the lakeshores and on the lakes themselves, fished and managed fisheries in the lakes and streams, and cultivated a variety of pines, oaks, and grasses. Tules, many of which were located on islands that dotted the lakes, also provided material for building boats, baskets, and dwellings.

Since time immemorial, the Sierra Miwok and the Valley Yokut have tended to the landscape of the Central Valley. There are several California Native American tribes with cultural, ancestral, traditional, subsistence, and spiritual ties to the land within the Kern County Subbasin, including: Big Pine Paiute Tribe of the Owens Valley, Chumash Council of Bakersfield, Coastal Band of the Chumash Nation, Fernandeno Tataviam Band of Mission Indians, Kern Valley Indian Community, Quechan Tribe of the Fort Yuma Reservation, Salinan Tribe of Monterey, San Luis Obispo Counties, San Fernando Band of Mission Indians, San Manuel Band of Mission Indians, Santa Ynez Band of Chumash Indians, Tejon Indian Tribe, Tubatulabals of Kern Valley, Xolon-Salinan Tribe, yak tityu tityu yak tiłhini – Northern Chumash Tribe, Santa Rosa Rancheria Tachi Yokut Tribe, Tule River Indian Tribe, and the Kitanemuk and Yowlumne Tejon Indians, (NAHC 2023, personal communication, 11 May). What Europeans were seeing when they encountered the rich diversity of people, plants, animals, and landscapes (more than 2,000 native plant species are endemics and grow nowhere else on earth) and when they “admired the grand vistas of Yosemite and the gold and purple flowers carpeting the Central Valley were the fertile gardens of the Sierra Miwok and Valley Yokuts Indians, modified and made productive by centuries of harvesting, tilling, sowing, pruning, and burning” (Anderson, 2006, pp. 3, 13-14).

Indigenous Californian land and water management

As part of land, plant, and animal management, Native Californians managed water resources, and practiced flood control and erosion control (Anderson, 1993, p. 21). Since time immemorial, Native Californians adapted to variable climate conditions by managing water to keep groundwater close to valley surfaces, to keep springs and streams usable, and to benefit plant and animal species. Irrigation "was an indigenous technique, practiced long before the Spanish and other Europeans introduced their

agricultural knowledge." Native Californians used groundwater to supplement surface water.

When Europeans arrived, they were witnessing the culmination of centuries, or perhaps millennia, of the use of sophisticated practices and traditional knowledge that allowed plants, animals, and ecosystems to thrive (Heizer & Elsasser, 1980). Although Native Californians faced many challenges to practicing traditional land and water management after European contact,[9] expertise persists, traditional techniques endure and have been revived in many places, and in some cases are integrated with state and local agencies land management practices.[10]

European Contact

The Spanish did not build any missions in the interior of California, but they did visit the Central Valley. Later immigrants saw the grasslands of the Central Valley, the interior of the coastal range, and the Sierra foothills as prime ranching land, moving into the valley from 1836 to 1848, with at least one Mexican land grant made in the area north of Tulare Lake: Laguna de Tache ranch, located on approximately 48,800 acres between present-day Kingsburg and present-day Laton (Smith & Secrest, 2004). From the 1820s to the 1840s, hunters and trappers came overland, followed by the gold rush of 1849, which brought a rapid influx of tens of thousands of people to California and major physical change to water and the environment.

Ranchers, herders, and speculators competed for land and rights up and down the San Joaquin Valley (Smith & Secrest, 2004). In 1853, hydraulic mining eclipsed other mining activities when it was discovered that forceful jets of water at hillsides would reveal gold-bearing alluvium. As extensive networks of reservoirs, flumes, ditches, and iron pipes were built to carry billions of gallons of Sierran water to hydraulic mining operations, waste mud and gravel washed downstream forcing rivers out of their banks, causing major flooding, sweeping away farm structures, drowning cattle, and wiping out orchards (Anderson, 2006, p.99). Prior to contact with Europeans, the valley landscape consisted of large swaths of brackish and freshwater marshes, which are "among the most productive ecosystems on earth" (Barbour, et al., 1993). In 1850, Congress passed the Swamp Land Act, which encouraged the reclamation of swampy "overflow"

[9] Governor's Exec. Order No. N-15-19 (June 18, 2019).

[10] For examples of Tribal, public and private funding efforts, e.g., "Partnering and Learning from Tribes to Integrate Traditional Ecological Knowledge" article, Yurok Condor Restoration Program website, California Department of Fish and Wildlife Tribal Affairs website). California's Fourth Climate Assessment, Summary Report of Tribal and Indigenous Communities within California)

lands. Landowners and speculators began forming canal and ditch companies that corralled previously freely flowing streams, sloughs, and marshes into new channels, drying the land and making it more suitable for ranching and farming. The remaining marsh land in the Central Valley is now a fraction of what once existed (Mason, 1957, p. 55).

Groundwater Development

In the San Joaquin Valley, reclamation efforts resulted in more acreage being available for crop farming, which drove agricultural innovation, which in turn drove further interest in developing land for agriculture. Diversion and channelization of regional surface waters resulted in significantly less water flowing to Tulare Lake. By 1899, Tulare Lake had lost nearly 60,000 acres and was largely dry (U.S. Bureau of Reclamation, 1970; Smith & Secrest, 2004). Modification of the surface water systems in the San Joaquin Valley would continue through the 20th century with the completion of several large dams in the region, including Pine Flat Dam on the Kings River in 1954, Success Dam on the Tule River in 1961, Terminus Dam on the Kaweah River in 1962, and Isabella Dam on the Kern River. Nevertheless, as surface supplies dwindled, people in the region turned to groundwater supplies. The end of the 19th century saw the first development of pump-driven irrigation wells, driven by steam and gasoline engines, in the San Joaquin Valley.

In the late 1800s, three lakes and swampland in the Kern County subbasin were reclaimed to allow farming of the lakebed and a large construction effort was undertaken developing Buena Vista Lake into a reservoir to store Kern River water for irrigation throughout the region (Lynch, 2009). The old Buena Vista Lake reservoir operated until the 1950s and then was converted to cropland (Lynch, 2009). Today, a man-made recreational lake occupies a portion of the former Buena Vista Lake and is supplied by the Kern River. Modification of the surface water systems would continue through the 20th century, including the forementioned completion of Isabella Dam on the Kern River in 1953.

Even in the early days of the rapid development of groundwater use there was recognition that groundwater pumping lowered the water table, resulting in the need to sink deeper and deeper wells to keep up production (Smith and Secrest, 2004; Anderson, 2006, p.97). People who came from East, Southeast, and South Asia, south of the border with Mexico, from states affected by the Dust Bowl, and from the Great Migration (of Black farmers from the South) were employed as farm laborers (Pannu, 2012, pp. 231-232). Historically exclusionary policies meant that they were not able to incorporate into towns and cities, often increasing dependance on shallow groundwater wells for domestic and farm use. Depletion of the aquifers has posed increasing threats to the ability of these communities to access needed water for health, sanitation, and farming, which is often exacerbated by a lack of representation, investment, and exclusion from infrastructure services (*ibid*). In 1980, DWR Bulletin 118-80 identified the Kern County Subbasin as being subject to conditions of critical overdraft. By the turn of

the 21st century, agriculture accounted for more than 90 percent of groundwater use in the Tulare Lake hydrologic region (Sumner, et al., 2003, p. 81). Continued declines were noted in the early 2000's: DWR well monitoring data indicate that groundwater levels in the valley portion of the basin dropped over 30 feet from spring 2013 to spring 2014—just prior to the passage of SGMA—DWR released a report noting that groundwater levels were experiencing record historical lows throughout the state (U.S. Bureau of Reclamation, 2015; DWR, 2014).

Groundwater banking projects in Kern County Subbasin started increasing storage in the 1990s. As of 2020, approximately 90% of the total statewide groundwater bank volume is located in Kern County Subbasin. The subbasin contains nine primary groundwater banks (PPIC, 2021). Wetlands and wildlife habitat are a feature of the groundwater bank properties.

3.4 Native American Tribes, Demographics, Economy, and Governance Context

The subbasin contains 65 localized urban areas:

Alameda
City of Arvin
City of Bakersfield
Bakersfield Country Club
Bear Valley Springs
Benton Park
Buttonwillow
Caliente
Casa Loma
Cawelo
Cherokee Strip
Choctaw Valley
Cottonwood
City of Delano
Derby Acres
Di Giorgio
Dustin Acres
East Bakersfield
East Niles
Edison
Edmundson Acres
El Adobe
Fairfax
Famoso
Fellows
Ford City
Fuller Acres
Goodmanville
Greenacres
Greenfield
Hillcrest
Keene
La Cresta
Lakeside
Lamont
Lost Hills
City of Maricopa
City of McFarland
McKittrick
Mettler
Mexican Colony
Oildale
Old River
Old Stine
Olde Stockdale
Panama
Pond
Potomac Park
Pumpkin Center
Rexland Acres
Richgrove
Rio Bravo
Rivergrove
Rosedale
City of Shafter
Smith Corner
South Taft
Stebbins
City of Taft
Taft Heights
Tarina
Tupman
Valley Acres
City of Wasco
Weedpatch

Of the 65 localized urban areas, only the City of Bakersfield is a member agency of a GSA that manages the basin.

The Kern County Subbasin has heavily relied on groundwater and surface water over the decades. Primary native surface water rights are diverted from the limited resources of the Kern River, which has resulted in numerous legal disputes. These disputes consist of accusations of misuse and hoarding of water, disagreements of water rights, accusations of violations of water supply agreements, and more following the Conn and Reed Judgements (forfeiture of pre-1914 water rights). On February 16, 2010, the Board order (Order) WR 2010-0010 was issued, which amended the FAS declaration to remove Kern River as fully appropriated, as available evidence demonstrated periods of flow that exceeded previous recognized rights. The lack in clarity on whether the periods of flow that exceeded previous recognized rights are the result of storm flow or forfeited rights have resulted in several new applications for additional water rights. The amount of water available and the order in which these applications should be processed have been disputed between agencies during the Board's Administrative Hearing Office (AHO) Kern River Water Rights hearings. Additionally, in October 2023, an injunction was granted mandating that some amount of water be left in the Kern River for fish. It is unclear how these issues will affect the implementation of the Kern County GSPs.

California Native American Tribes

Some of the land in the subbasin is reportedly in the process of transferring to Tribal trust land according to the 2022 Arvin-Edison Management Area Plan. The subbasin is part of the ancestral homelands of the Southern Valley Yokut-affiliated Tribes, including the Tejon Indian Tribe, and Kitanemuk & Yowlumne Tejon Indians (Native American Heritage Commision, 2024). According to the California Native American Heritage Commission, in addition to the Tejon Indian Tribe and Kitanemuk & Yowlumne Tejon Indians, other California Native American tribes may have knowledge of cultural resources in the subbasin. These tribes include the Big Pine Paiute Tribe of Owens Valley, Chumash Council of Bakersfield, Coastal Band of the Chumash Nation, Fernandeno Tataviam Band of Mission Indians, Kern Valley Indian Community, Quechan Tribe of the Fort Yuma Reservation, Salinan Tribe of Monterey, San Luis Obispo Counties, San Fernando Band of Mission Indians, San Manuel Band of Mission Indians, Santa Rosa Rancheria Tachi Yokut Tribe, Santa Ynez Band of Chumash Indians, Tubatulabals of Kern Valley, Tule River Indian Tribe, Xolon-Salinan Tribe, and the yak tityu tityu yak tiłhini – Northern Chumash Tribe (NAHC 2023, personal communication, 11 May).

Demographics

State Water Board staff performed GIS analysis using 2022 U.S. Census Bureau data. For census blocks that extend beyond the subbasin boundary, staff clipped the census block at the subbasin boundary and estimated the population based on the clipped area ratio. Based on this analysis, Kern County Subbasin has an estimated population of

762,696 people. Approximately 60.4% of the population is Hispanic or Latino, 26.6% white, 5.2% Asian, 4.6% Black, 2.7% identified as other, and approximately 0.1% Native American. The analysis also showed average annual household income within the Kern County Subbasin in 2022 is $72,916. This is less than the California median household income of $91,551 (U.S. Census Bureau, 2022b). The subbasin is largely rural, outside of Bakersfield, with an average population density of approximately 274 people per square mile (U.S. Census Bureau, 2022a).

Economies

In 2019, Kern County was ranked 7th in the nation for oil and natural gas production by county (Kern Economic Development Foundation, 2021). In 2021, Kern County was ranked 1st in the nation for almond, grape, pistachio, and total agricultural production by county; and 5th in the nation for milk production (California Department of Food and Agriculture, 2022). As of 2022, almond orchards comprise the largest crop acreage in the county (Kern County Department of Agriculture, 2023).

As Public Policy Institute of California has noted:

> Like many agriculturally dependent regions, the [San Joaquin] valley faces significant socioeconomic challenges, including a high rate of unemployment and pockets of extreme rural poverty that worsen when the farm economy suffers. The region also faces difficult public health challenges in which farming plays a role, including unsafe drinking water in many small rural communities and some of the nation's worst air quality (Hanak, et al., 2017; Hang, et al., 2021).

The Bakersfield metropolitan area is consistently ranked in the top five for U.S. cities with the unhealthiest air quality days (Kern County Public Health Serviecs Department, 2019).

3.4.1 Groundwater Sustainability Agencies

As of February 2024, twenty GSAs manage groundwater in the Kern County Subbasin (**Figure 3-7**). The GSAs, member agencies, and date the GSAs formed are listed in **Table 3-1**. The GSAs that formed before 2022 developed six GSPs under a coordination agreement.

As of January 2020, 10 GSAs submitted GSPs to DWR for review. After DWR determined the plans incomplete in January 2022, an additional 3 GSAs posted formation notices to DWR, after separating from KGA and submitted their own GSP to DWR for review in addition to the resubmission of the five GSPs. This resulted in 14 GSAs and 6 GSPs. However, since June 2022, 7 new GSAs (Westside District Water Authority (WDWA), Shafter-Wasco Irrigation District (SWID), North Kern Water Storage District (NKWSD), South San Joaquin Municipal Utility District (SSJMUD), Rosedale-Rio Bravo Water Storage District (RRBWSD), Kern-Tulare Water District (KTWD), and the

Kern Water Bank (KWB)) submitted formation notices to DWR, as they separated from Kern Groundwater Authority (KGA). Additionally, 14 GSAs have amended their GSA formation notices to DWR for numerous reasons that are not clear to Board staff. And lastly, the City of McFarland submitted its withdrawal notice to DWR in March 2023.

Table 3-1 – Kern Subbasin Groundwater Sustainability Agencies – February 2024

#	GSA	Signatory Member Agencies	Date GSA Formed	GSP
1	Kern Water Bank (KWB)	• Kern County Water Agency • Semitropic Water Storage District • Dudley Ridge Water District • Tejon-Castac Water District • Wheeler Ridge Maricopa Water Storage District	12/1/2023	Expected spring/summer 2024 Notice of Intent posted in portal
2	Kern-Tulare Water District (KTWD)	• Kern-Tulare Water District	5/8/2023	Kern Groundwater Authority GSP
3	Rosedale-Rio Bravo Water Storage District (RRBWSD)	• Rosedale-Rio Bravo Water Storage District	4/6/2023	Expected 2024 Notice of Intent posted in portal
4	Southern San Joaquin Municipal Utility District (SSJMUD)	• Southern San Joaquin Municipal Utility District	3/3/2023	Kern Groundwater Authority GSP
5	North Kern Water Storage District (NKWSD)	• North Kern Water Storage District	11/9/2022	Kern Groundwater Authority GSP
6	Shafter-Wasco Irrigation District (SWID)	• Shafter-Wasco Irrigation District	11/9/2022	Kern Groundwater Authority GSP

#	GSA	Signatory Member Agencies	Date GSA Formed	GSP
7	Westside District Water Authority (WDWA)	• Belridge Water Storage District • Berrenda Mesa Water District • Lost Hills Water District	9/2/2022	Kern Groundwater Authority GSP
8	Arvin	• Arvin-Edison Water Storage District	12/3/2021	South of Kern River GSP
9	Tejon-Castac Water District (TCWD)	• Tejon-Castac Water District	12/3/2021	South of Kern River GSP
10	Wheeler Ridge-Maricopa (WRMSD)	• Wheeler Ridge-Maricopa Water Storage District	12/3/2021	South of Kern River GSP
11	Cawelo Water District (Cawelo)	• Cawelo Water District	6/12/2017	Kern Groundwater Authority GSP

#	GSA	Signatory Member Agencies	Date GSA Formed	GSP
12	Kern Groundwater Authority (KGA)	• Cawelo Water District • Kern County Water Agency • Kern-Tulare Water District • Kern Water Bank Authority • North Kern Water Storage District • Rosedale-Rio Bravo Water Storage District • Semitropic Water Storage District • Shafter-Wasco Irrigation District • Southern San Joaquin Municipal Utility District • West Kern Water District • Westside District Water Authority	5/30/2017	Kern Groundwater Authority GSP
13	Semitropic Water Storage District (SWSD)	• Semitropic Water Storage District	5/15/2017	Kern Groundwater Authority GSP
14	Henry Miller Water District (HMWD)	• Henry Miller Water District	5/1/2017	Henry Miller Water District GSA GSP
15	Olcese Water District (Olcese)	• Olcese Water District	3/8/2017	Olcese GSA GSP
16	Pioneer	• Kern County Water Agency	2/24/2017	Kern Groundwater Authority GSP
17	West Kern Water District (WKWD)	• West Kern Water District	8/3/2016	Kern Groundwater Authority GSP

#	GSA	Signatory Member Agencies	Date GSA Formed	GSP
18	Greenfield County Water District (GCWD)	• Greenfield County Water District	4/21/2016	Kern River GSA GSP
19	Kern River (KRGSA)	• Kern Delta Water District • City of Bakersfield • Kern County Water Agency Improvement District 4	4/21/2016	Kern River GSA GSP
20	Buena Vista Water Storage District (BVWSD)	• Buena Vista Water Storage District	3/10/2016	Buena Vista Water Storage District GSA GSP

3.5 Basin Hydrology - Groundwater

The Kern County Subbasin is hydraulically bound by the surface contact between alluvial sediment and crystalline rock of the Sierra Nevada and Tehachapi Mountains on the east and southeast side of the subbasin, which can be seen as darker shades in **Figure 3-8,** which also shows major urban areas. The remaining subbasin boundaries are defined by DWR and water Management Areas, but the actual physical water-bearing formations extend into adjacent areas of the Tulare Basin hydrologic area.

Groundwater flows into the Kern County Subbasin from natural recharge areas, away from the Sierra and Coastal Mountain Ranges, and along major streams including the Kern River and Poso Creek (**Figure 3-9(a-d**)) toward the center of the subbasin (DWR, 2006). Groundwater generally flows northwest along the San Joaquin Valley Syncline. Groundwater recharges from the Kern River and flows along the Bakersfield Arch to the north and south (Kern Groundwater Authority , 2022). There are three active faults within the subbasin including the Edison, Pond-Poso, and White Wolf faults (DWR, 2006). Other features that affect groundwater flow include structural geologic features, like folds, unconformities, and rock contacts (ibid). The average annual precipitation entering the subbasin ranges from 5 inches within the interior portion of the subbasin and 9 to 13 inches along the eastern, southern, and western portions of the subbasin (ibid).

3.5.1 Groundwater Use

DWR surveyed land uses within the subbasin area in 2022 (**Figure 3-10**). Using data from the CA DWR Land Use Viewer, Board staff estimate the subbasin area contains approximately 45.5% agricultural, 48.5% undeveloped, and 6% urban land use designation (California Department of Water Resources, 2024). According to the six Kern County Subbasin 2022 GSPs, agricultural land across the GSAs is predominantly used for row crops, cotton, corn, hay, grain, grapes, nuts, citrus, and subtropical fruits. The primary land use designations for urban land are residential, commercial, and industrial. Groundwater is the main source of water for agricultural and urban land uses amounting to 74% of the total supplies during the 2022 WY (Kern Groundwater Authority, WY 2022, p. 27). According to data reported by the GSAs in their WY 2019 - 2022 Annual Reports, the average annual total groundwater extraction volume was approximately 1,983,505 AF, or 58% of the average annual total water use (excluding precipitation) in the subbasin, which was 3,448,521 AF.

3.5.1.1 Drinking Water

The subbasin contains eight incorporated cities: Bakersfield, Delano, McFarland, Wasco, Shafter, Arvin, Taft, and Maricopa. The incorporated cities use groundwater from the subbasin and, apart from Bakersfield, meet the criteria of disadvantaged communities (DAC) or severely disadvantaged communities (SDAC) (Community Water Center, n.d.). The water systems within six of the eight incorporated cities are failing, at-risk, or potentially at-risk, meaning the system is out of compliance or consistently fails to meet primary drinking water standards (California State Water Resources Control Board, 2024).

The State Water Board's Division of Drinking Water (DDW) evaluates the drinking water systems for the incorporated cities, towns, and Census Designated Places (CDPs)[11] within the subbasin: Wasco, Taft, Shafter, Maricopa, McFarland, Delano, Bakersfield, Arvin, Buttonwillow, Derby Acres, Dustin Acres, Fellows, Lamont, Lost Hills, McKittrick, Mettler, Oildale, Rosedale, South Taft, Tupman, Valley Acres, and Greenfield. The estimated population of the incorporated cities, towns, and CDPs is 624,969 (American Community Survey, 2021). The CDPs that are evaluated by DDW fit DACs or SDACs criteria. Seven of these communities (Wasco, McFarland, Shafter, Rosedale, Bakersfield, Lamont, Arvin, and Mettler) are served by one or more failing drinking water systems (**Figure 3-11**) (California State Water Resources Control Board, 2024). The systems serving these seven CDPs, incorporated cities, or towns are failing, in part, because the water the systems deliver has exceeded MCLs for total dissolved solids, arsenic, or nitrate (ibid).

Domestic wells and community water systems in DACs and communities of color are disproportionately impacted by poor drinking water quality (Pace, et al., 2022). There are now around 450 disadvantaged unincorporated communities in the eight counties of the San Joaquin Valley[12] and "over 30% of the population [of the San Joaquin Valley] lives in unincorporated areas with little infrastructure to support clean drinking water, sewage treatment, and other services" (Hang, et al., 2021).

Regarding water quality, "the region is a hot spot for unsafe drinking water," a problem that is most acute for small, economically disadvantaged, rural communities (Hanak, et al., 2019). A "pervasive problem is the accumulation of nitrate in groundwater, due to decades of intensive use of nitrogen fertilizer and dairy manure on fields. The nitrate problem is most acute for small communities and domestic wells that are relatively

[11] CDPs are concentrations of population that are not incorporated as cities, towns, or villages.

[12] San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, and Kern counties.

shallow, where nitrate concentration is often higher" (Hanak, et al., 2017). High salinity can also make water unsuitable for drinking; studies in the Southern San Joaquin Valley have noted that TDS in shallow groundwater in areas with poor drainage can be higher than 40,000 milligrams per liter (mg/L) (U.S. Dept. of the Interior, 1995). Other constituents of concern in the Subbasin are further discussed in Section 3.5.6 include 1,2,3-Trichloropropane (1,2,3-TCP), Arsenic, Uranium, gross alpha radioactivity, 1,2-Dibromo-3-chloropropane (DBCP), and nitrates.

Drinking water users who are dependent on a community water system that is out of compliance with standards or requirements will be more impacted by groundwater management that affects water quality. As mentioned above, seven of the CDPs, incorporated cities, or towns in the Kern County Subbasin are listed as failing for reasons related to water quality, treatment, and supply shortage or drought risk (California State Water Resources Control Board, 2024). In both disadvantaged unincorporated communities and economically disadvantaged cities in the San Joaquin Valley, "people of color are 84% and 83%, respectively, of those served by out-of-compliance [community water systems] […] These levels are roughly 10 percentage points higher than the overall representation of this group in the population" (London, et al., 2021). Domestic wells in the subbasin could also be experiencing water quality impacts, but specific monitoring data are not available.

3.5.1.2 Agriculture

Approximately 700,000 acres of crops in the subbasin were irrigated between 2021 and 2022 based on an aggregate of land use data from the DWR Land Use Viewer (California Department of Water Resources, 2024). According to the six Kern County Subbasin GSPs submitted in 2022, the irrigated land consists mostly of nut trees, fruits, grains, grapes, cotton, and pastures. To decrease water consumption, some of the GSAs have started planting more permanent crops that use less water than row crops. (Buena Vista GSA, 2022), fallowing land (ibid), using drip systems (Henry Miller Water District GSP, 2022), and using treated recycled water to irrigate their crops (Kern River Groundwater Sustainability Agency, 2022).

The GSAs estimate that from 2019 to 2022, agricultural groundwater extractions increased approximately 70% from 1,096,779 AFY (2019) to 1,554,176 AFY (2022) and averaged 1,450,869 AFY in the subbasin (Kern Groundwater Authority, WY 2019-WY 2022).

3.5.1.3 Environment

Potential environmental users include naturally occurring vegetative and aquatic groundwater-dependent ecosystems (GDEs), and the wildlife they support. Vegative

GDEs include, but are not limited to, wetlands, riparian, drought- stressed, and phreatophytic (deep-rooted) dominated plant communities. Aquatic GDEs are floral and faunal communities dependent on rivers, streams, ponds, etc. Potential environmental beneficial uses of groundwater include providing water for natural habitat found along portions of public navigable waterways located in the subbasin. The Kern River north of Highway 58 in Bakersfield, for example, is a public navigable waterway with natural habitat. Natural habitat is also present within the Kern National Wildlife Refuge that is located within the northwest portion of the subbasin. The Sacramento-San Joaquin Delta is the largest supply of surface water in the subbasin. The second largest supply of surface water in the subbasin is from local surface water sources including the Kern River and Poso Creek (2022 KGA GSP, p.29).

The Natural Communities Commonly Associated with Groundwater (NCCAG) (California Department of Technology, 2022) dataset describes potential groundwater-dependent ecosystems (GDEs) based on aerial imagery and field surveys **(Figure 3-12)**. Vegetative GDEs constituted 2.5% of the subbasin's total area. In the Kern County Subbasin, the NCCAG dataset identifies 2,740 potential GDE polygons, many of which have been ground-truthed during expert-lead field surveys. Of those, 1,832 were vegetative and 908 were wetlands. Vegetative GDEs constituted 94% (45,657 acres) of total GDE area compared to 6% (3,015 acres) for wetland GDEs. Furthermore, there were 33 types of vegetative GDEs and 20 types of wetlands GDEs.

The GDE types Southwestern North American Salt Basin and High Marsh cover approximately 24% (10,933 acres) of the subbasin, and the *Suaeda nigra* (formerly *Suaeda Moquinii* and with the common name Shrubby Seepweed) alliance is the most dominant vegetation type covering approximately 22.51% (10,093 acres) of the subbasin. Importantly, according to the California Native Plant Society, *S. nigra* alliance is particularly rare, as much of the preferred alkaline habitats have been converted to agriculture, and *S. nigra* is defined by the National Wetland Inventory as an obligate wetland species (Barbour, et al., 2016; Jones and Stokes Associates, 2006; Engineers, US Army Corps of, 2020). Other vegetation types in the subbasin include *Allenrolfea occidentalis* (18.3%), *Atriplex spinifera* (11.8%), *Tamarix spp* (8.2%), *Isocoma acradenia* (4.3%), *Populus fremontii* (2.8%), *Lepidospartum squamatum* (2.4%), *Atriplex lentiformis* (1.3%), *Salix gooddingii* (1.2%), *Schoenoplectus acutus* (0.6%), *Baccharis salicifolia* (0.5%), *Salix laevigata* (0.4%), *Quercus lobata* (0.1%), and *Sambucus nigra* (0.1%). Ten other types of vegetation associated with GDEs are also present in the subbasin in very small quantities.

Palustrine, emergent, persistent, seasonally flooded wetlands constitute 56.5% of potential wetland GDEs (1,749 acres) in the subbasin. Seeps and springs only constitute 0.1% (3.4 acres) of all subbasin wetland GDE area.

The Semitropic GSA area had the greatest number of potential vegetative GDE polygons (865) and had the greatest total area of vegetative GDEs (47.2% or 29,164 acres). As with the subbasin in general, the Southwestern North American Salt Basin and High Marsh land type was most dominant in the Semitropic GSA area, representing 24% (10,933 acres) of all potential vegetative GDEs within the GSA area. Similarly, the Semitropic GSA area also had the greatest number of wetland GDE polygons (249) and the greatest total area of wetland GDEs (44.3% or 1,345 acres). As with the subbasin overall, the palustrine, emergent, persistent, seasonally flooded wetlands were most dominant in the Semitropic GSA area (54.5% or 954 acres).

3.5.1.4 Oil and Gas Production

Oil production is the leading non-agricultural industry in the Tulare Lake [Hydrological Region] (State of California Employment Development Department, 2024). According to data from the California Geologic Energy Management Division (CalGEM), production in the Kern County Subbasin is mostly constrained to 87 oil fields (California Geologic Energy Management Division, 2024). State Water Board staff reviewed CalGEM's Well Finder web mapping application and found a total of 105,422 oil and gas wells (**Figure 3-13**) of which 27,928 were active in the Kern County Subbasin (**Figure 3-14**) (California Geologic Energy Management Division, 2024). The largest fields within the Subbasin are Midway-Sunset (65,299 acres), Elk Hills (46,963 acres), and Buena Vista (29,996 acres) oil fields, which contain 5,580, 3,114, and 392 active oil and gas (OG) wells, respectively. The oil and gas fields with the most active OG wells are Kern River (24.1%, with 7,105 OG wells), Midway Sunset (18.9% with 5,580 OG wells), and South Belridge (15.9% with 4,689 OG wells). Other wells associated with oil and gas production in the Subbasin include wells used for enhanced oil recovery purposes (injection, steamflood, waterflood, cyclic steam, pressure maintenance, and water source wells), water disposal, observation, multi-purpose, dry gas, core hole, gas disposal, air injection, gas, gas storage, and liquefied gas wells (ibid).

Enhanced oil recovery (EOR) is a process used by oil companies to decrease the viscosity of leftover oil that is trapped between the grains of the reservoir by introducing heat in the form of steam (Office of Fossil Energy and Carbon Management, n.d.). EOR is a common practice in the Kern County Subbasin with 11,170 steamflood, 10,851 cyclic steam, 6,795 waterflood, 840 injection 134 water source, and 123 pressure maintenance wells (including active and abandoned) within the subbasin as of 2024. Additionally, as of early 2024, there are 7,044 cyclic steam, 3,453 steamflood, 2,195 waterflood, 90 pressure maintenance, 19 injection, and 10 water source wells in the subbasin (California Geologic Energy Management Division, 2024). Based on the CalGEM well data, it appears most of the EOR processes have occurred on the western

and eastern fifth of the subbasin, especially in the Midway Sunset and Kern River oil fields.

Historically, produced water (the leftover water that was used to extract oil) was placed in disposal ponds or dry streambeds for it to then either percolate into the subsurface or evaporate (Gillespie, et al., 2019). This method of water disposal causes degradation of groundwater due to the contaminants from the oil recovery processes and violates water quality regulations such as the Porter Cologne Water Quality Act, Clean Water Act, and Safe Drinking Water Act. To address these violations, produced water has been disposed in exempt aquifers that are not used for drinking water because of total dissolved solids (TDS) concentrations greater than 10,000 milligrams per liter (mg/L) (Gillespie, et al., 2019). The Environmental Protection Agency (EPA), CalGEM, and the State Water Board developed a process to allow aquifers that are not acceptable for drinking water to be used for disposal of energy, mining, and oil extraction waste products (United States Environmental Protection Agency, 2022). This exemption of a potential underground source of drinking water from coverage under the Safe Drinking Water Act is a federal process that is separate from beneficial use de-designations, which is a state process further discussed in Section 3.5.6.4 (Central Valley Regional Water Quality Control Board, 2023).

3.5.2 Aquifer Framework

The complex subbasin aquifer setting generally includes unconfined and semi-confined aquifers above the Corcoran Clay in the central and southern portions of the subbasin, and confined aquifers below the Corcoran Clay (**Figure 3-15a-b**). Additional confined aquifers exist beneath confining Pliocene marine sediments in the eastern areas of the subbasin. The unconfined and semi-confined units are comprised of course-grained to medium-grained sediments with abundant lenses of fine-grained deposits (clay, sandy clay, sandy silt, and silt) (Gronberg, et al., 1998). A study conducted in the 1960s subdivided the coarser grained deposits into three units: older alluvium, younger alluvium, and undifferentiated continental deposits (Croft & Gordon, 1968).

The primary groundwater aquifer within the subbasin occurs primarily in the unconfined, semiconfined, and confined continental sediment deposits. These deposits comprise the Kern River Formation and the Tulare Formation in the eastern and western margins of the subbasin, respectively (Kern Groundwater Authority , 2022). Unconsolidated alluvial deposits that form the primary aquifer range in thickness from 0 ft below ground surface (bgs) at the eastern contact with crystalline rocks at the base of the Sierra Nevada Mountain Range, to approximately 3,000 ft-bgs in the central portion of the subbasin (ibid). The confined aquifers of the Santa Margarita Formation and Olcese Sand are also considered principal aquifers in the eastern areas of the subbasin and are hydraulically disconnected from the Kern River Formation by Pliocene marine deposits.

Physiography (geography that deals with physical features of the earth), weathering characteristics, and soils have typically been used to map formations in the subbasins within the Central Valley. However, classifying stratigraphic units (layers of sedimentary rock) in the subsurface has been challenging since lithology (type of rock formation) variations are not distinct (Bertoldi, et al., 1991). As a result, most groundwater studies of the Central Valley define hydrogeologic units—aquifers and confining units—rather than stratigraphic units (Jurgens, et al., 2009). In the Kern Groundwater Authority GSP, the hydrogeologic setting was simplified for the Hydrogeologic Conceptual Model (Kern Groundwater Authority , 2022). For groundwater level monitoring, the subbasin is divided into six different aquifer/aquitard zones:

- The primary aquifer in the central-northern portion of the subbasin is the Tulare Formation, Kern River Formation, and overlying alluvium which are unconfined to semiconfined above the Corcoran Clay.
- The Corcoran Clay (E-clay) of the Tulare Formation is the laterally discontinuous confining unit. It occurs within the central, central-northern, and central-southern portion of the subbasin.
- The primary aquifer in the central and central-southern areas of the subbasin is the confined Tulare Formation and Kern River Formation occurring below the E-clay.
- Another confining unit consisting of Pliocene siltstone and interbedded sandstone exists below the Kern River Formation and Tulare Formations in the eastern portion of the subbasin. These Pliocene sediments separate the Kern River Formation from the Santa Margarita Formation and the Olcese Sand.
- The Santa Margarita Formation and the Olcese Sand exist exclusively within the eastern portion of the Kern County Subbasin below the Pliocene sediments and are considered hydraulically disconnected from the Kern River Formation.
- The western portion of the subbasin yields limited groundwater due to poor groundwater quality except for localized areas in the northwest where the Tulare Formation exists.

3.5.3 Groundwater Levels

The Public Policy Institute of California (PPIC) states that “Long-term depletion of the [San Joaquin Valley] region’s aquifers” can be traced back to the 1930s (Hanak et al., 2017). State Water Board staff confirmed ongoing groundwater level declines specifically in the Kern County Subbasin by evaluating groundwater level data from the

past 75 years, although the declines appear to have become substantially more significant since 2000.

Board staff analyzed groundwater level data from the California Statewide Groundwater Elevation Monitoring (CASGEM) Program to determine both long-term and more recent groundwater level trends.

3.5.3.1 Long Term Groundwater Trends

CASGEM data are often spatially and temporally inconsistent, as CASGEM wells are not all systemically monitored at the same time. To reduce the impact of disproportionate spatial and temporal monitoring, staff only analyzed data from wells with both:

- groundwater level data from at least 40 percent of the years in the study period of 1948 to 2023
- at least one groundwater measurement after 2000

Of the 3,676 total CASGEM wells in the subbasin, 511 met these criteria to analyze trends in spring groundwater levels and 311 met these criteria to analyze trends in fall groundwater levels. These wells were then analyzed for trends at the 90% confidence level using a Mann Kendall test, which is a common statistical test for detecting trends.

- For spring, 62% (317) of the wells had a negative trend, 16% (80) had a positive trend, and the remaining 22% (114) had no trend at the 90% confidence level.
- For fall, 55% (172) of the wells had a negative trend, 23% (70) had a positive trend, and the remaining 22% (69) had no trend at the 90% confidence level.

3.5.3.2 Recent Groundwater Trends

Staff's long-term trend analysis revealed more significant declines in groundwater levels after 2000. To better understand the recent changes in groundwater level, staff analyzed the trend in groundwater elevation data from 2000 to 2023 using wells with:

- groundwater level data from at least 10 years (42% of the years) between the study period of 2000 to 2023.

Of the 3,676 wells available in CASGEM, 562 met the criteria to analyze trends in spring groundwater levels and 387 met the criteria to analyze trends in fall groundwater levels.

- For spring, 79% (446) of the wells had a negative trend, 3% (19) had a positive trend, and the remaining 17% (97) had no trend at the 90% confidence level.

- For fall, 68% (263) of the wells had a negative trend, 4% (14) had a positive trend, and the remaining 28% (110) had no trend at the 90% confidence level.

Further, these analyses indicate that: (1) groundwater levels declined modestly between 1948 and 2000, and (2) groundwater has declined more significantly since 2000. It is noted that of the 3,676 wells analyzed for groundwater level data, at least 72% of wells are missing data for any given year throughout the study period of 1948–2023. Additionally, these data show a statistically significant decrease in the number of available fall measurements following 2000, and a statistically significant decrease in the number of available spring measurements following 2003.

3.5.4 Groundwater Recharge

Groundwater recharge in the subbasin occurs primarily by two methods: (1) natural recharge via underflow of surface water from the Kern River, Poso Creek, Caliente Creek, and other natural streams, springs and seeps and mountain-front recharge originating from the Sierra Nevada, and (2) anthropogenic recharge such as direct recharge via unplanned percolation of water through unlined conveyances (canals) and planned managed recharge through banking projects (Kern Groundwater Authority , 2022, p. 109).

The GSAs have documented that 73,188 AF of water was diverted for recharge in the Kern County Subbasin for WY 2022 (2022 Annual Report, Table 7, pdf p. 28). The GSAs have also proposed a variety of groundwater recharge projects, which if successfully implemented, are assumed to help achieve the subbasin reach its groundwater level sustainability goals by 2040. This includes new or updated recharge projects for BVWSD GSA, Henry Miller GSA, Cawelo GSA, NKWSD, RRBWSD GSA, Semitropic WSD, SSJMUD GSA, and Arvin GSA (2022 Annual Report, Table 11, pdf p. 44). Most of these recharge projects focus on installation of additional measurement devices, expanding recharge distribution systems (canals and pipelines), increasing recharge capacity of groundwater banking facilities, or working towards construction of entirely new groundwater banking facilities.

Groundwater banking projects are an essential recharge component for groundwater sustainability in the Kern County Subbasin, and banking facilities are widespread across the GSAs. Unconsolidated alluvial sediments along the Kern River and elsewhere within the subbasin provide an excellent means of recharge due to the sediments' capability to store and transmit large quantities of water. As a result, Kern County Subbasin agencies have invested more than $300 million into groundwater banking projects; a figure that will continue to increase throughout GSP implementation (Kern County Water Agency, 2021).

Most of the GSAs within the subbasin own, operate, or are affiliated with one or more banking projects since their widespread implementation began in the late 1980s and early 1990s. The most notable banking facilities operating within the Kern County Subbasin prior to the implementation of SGMA include the Kern Water Bank (KWB), Kern Delta Water District Groundwater Banking Program, Pioneer Project, Semitropic Groundwater Storage Bank, City of Bakersfield's 2,800 Acre Groundwater Recharge Facility, West Kern Water District's Groundwater Banking Program, Berrenda Mesa Property Joint Water Banking Project, North Kern Water District Groundwater Storage Project, and the Buena Vista Water Storage District Water Management Program among others. Collectively, these banking projects within the subbasin are able to store 5.7 million AF of groundwater recharge sourced from SWP, CVP, and the Kern River. Imported surface waters are also supplied to these groundwater banks which are provided by agencies operating outside of the Kern County Subbasin such as the Metropolitan Water District and Irvine Ranch Water District.

Groundwater banking facilities may also operate as GSAs within the Kern County Subbasin. Like other GSAs, water banks that choose to become a GSA have the potential to reduce ground water levels, contribute to land subsidence, and degrade water quality within the subbasin through the import and recovery of banked water. Water banks that become GSAs therefore own the responsibility of implementing PMAs and mitigation programs for undesirable results caused under their jurisdiction. However, private water or mutual water companies affiliated with a water bank GSA cannot enforce SGMA powers upon its constituents. SGMA regulations state, "A private water corporation regulated by the Public Utilities Commission or a mutual water company may participate in a GSA through legal agreement, but do not confer any additional powers, and therefore cannot enforce SGMA (Wat. Code, § 10723.6, subd. (b))." So far, the only water bank to form a GSA in the Kern County Subbasin is the Kern Water Bank GSA, which has recently provided public notice of its intent to operate under its own GSP.

Additionally, groundwater banks operating under SGMA statute may be subject to report their groundwater extractions and pay fees on recovered water. Whether or not groundwater banks are required to report and pay fees on extractions is determined by accounting procedures for water that is recharged to the facility. Board staff would need to evaluate whether water classified as stored under in-lieu operations is native groundwater and subject to SGMA reporting and fees, "Any person who extracts or pumps groundwater from a probationary basin must file a groundwater extraction report (report) with the State Water Board each year" (Wat. Code, § 5202). Surface water that is recharged or stored directly may continue to be extracted without being subject to reporting and fees. Considering the numerous groundwater banking facilities in the subbasin, agreements with parties outside of the basin, and a large network of water

exchanges, the accounting details of each groundwater banking facility remain unclear to Board Staff and are presently difficult to assess.

3.5.5 Groundwater Storage

DWR estimated the total potential and actual storage capacity of the Kern County Subbasin, based on an estimated specific yield that ranges from 5.3 to 19.6 percent with an average of about 12%, water level data collected by DWR, and data from well owners who shared information voluntarily. According to calculations, the basin is estimated to have about 40 million AF of water in storage occurring in water bearing units that range in thickness across the subbasin from about 175 to 2,900 feet (Department of Water Resources, 2006a).

In the 2020 Groundwater Flow Model of the Kern County Subbasin Model (C2VSimFG-Kern), prepared for the GSPs, a numerical model was calibrated to validate surface and groundwater budgets, evaluate sustainable yield, develop water budgets, and evaluate historical land subsidence. The model uses the DWR California Central Valley Groundwater-Surface Water Simulation Model, with Kern County subbasin-specific input data. In the model, the subbasin was separated into five layers: an Upper Aquifer representing an unconfined aquifer above the Corcoran Clay, the confining layer Corcoran Clay which separates the Upper from Lower Aquifers, an active confined aquifer with high levels of pumping, an inactive confined aquifer with limited pumping, and a saline confined aquifer (2020 Coordination Agreement, p. Appendix 2).

From the results of the groundwater flow model simulations, the GSAs estimate the sustainable yield to be approximately 1,313,000 AFY with an uncertainty range of about 10 to 20 percent (2020 Coordination Agreement, p. Appendix 2).

The GSA's groundwater flow model projects groundwater storage in the Kern County subbasin (in the absence of projects and management actions) over the duration of the baseline period (2020 to 2040) to decline by around 324,326 AFY. Model simulation assuming successful implementation of proposed projects and management actions in the subbasin yield estimates for change in storage to be positive (~42,144 to 85,578 AFY) for the same period (2020 Coordination Agreement, p. Appendix 2).

3.5.6 Groundwater Quality

Groundwater quality in the subbasin varies spatially (including depth) and is impacted by both natural and anthropogenic (human caused) water quality constituents. Generally, groundwater quality increases with depth, with the poorest quality groundwater within the unconfined and semi-confined aquifers (see Section 3.5.2, above, for more information on the aquifers). Unconfined aquifers are primarily

degraded by anthropogenic constituents such as total dissolved solids (TDS), nitrate measured as nitrogen (N), and other anthropogenic constituents from land use. The highest quality groundwater is typically in the deeper confined aquifer, below the E-clay in the subbasin. The confined aquifer is generally unimpacted by anthropogenic constituents unless improperly constructed wells or other conduits allow for mixing of the higher and lower quality waters, such as wells screened between multiple aquifers. However, significant pumping in the confined aquifer may increase concentrations of naturally occurring constituents such as arsenic. Arsenic and other constituents can be released from reduced pore waters within clays through dewatering and compaction related to subsidence.

Several existing water quality programs have either conducted sampling programs or required regulated entities (such as public water systems or state small water systems) to sample groundwater in the subbasin for Title 22 constituents. Agencies that regulate or monitor groundwater quality in the subbasin include:

- State Water Board
    - Division of Drinking Water (regulatory)
    - Groundwater Ambient Monitoring and Assessment (GAMA) (monitoring)
- Central Valley Regional Water Quality Control Board (Central Valley Water Board)
    - Irrigated Lands Regulatory Program (ILRP) (regulatory)
    - Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) (regulatory)
- U.S. Geological Survey (monitoring)
- Department of Water Resources (DWR) (monitoring)
- Department of Pesticide Regulation (DPR) (regulatory)

These agencies have collected groundwater quality samples from wells within the unconfined, semi-confined, and confined aquifers within the subbasin. Groundwater quality data from these agencies' programs and others can be accessed through the GAMA Program's groundwater information system tool (California State Water Resources Control Board, 2023c).

3.5.6.1 Key Constituents

State Water Board staff developed the SGMA Groundwater Quality Visualization Tool (California State Water Resources Control Board, 2023b) to help GSAs and other

interested parties identify the groundwater quality constituents that each GSP should address. The tool uses data from the GAMA dataset to summarize, by basin, constituents that: 1) may be influenced by basin-wide groundwater management and 2) have exceeded regulatory thresholds since 2015 in 3 or more wells.

As of January 25, 2024, the tool identifies 13 such constituents for Kern County, 12 of which are listed in Table 3-2 below (excluding nitrate+nitrite). Of 821 wells sampled in the subbasin, 450 (55%) of the wells sampled had concentrations exceeding one or more regulatory standards for these 12 constituents, in Water Supply Wells (**Figure 3-16**). An additional constituent, benzene, was detected in monitoring wells and one municipal supply well, as listed in Table 3-2, in the northwest portion of the basin. And, an additional five constituents, including benzene, were detected in three or more water supply wells prior to 2015 (post-2000), that were not detected in three or more wells post-SGMA, as listed in Table 3-2. Moreover, this tool does not address whether all constituents are consistently monitored in the subbasin. Thus, there may be other water quality issues in the subbasin that are not identified by the tool that should be identified as data gaps.

Table 3-2 - Summary of Water Supply Wells in the Kern County Subbasin Exceeding Regulatory Water Quality Thresholds for selected Constituents

Constituent	Regulatory Threshold	Wells above Regulatory Threshold	Risk
1,2,3-Trichloropropane (1,2,3-TCP)	0.005 µg/L	44%	Risk of cancer (EPA, 2009)
Arsenic	10 µg/L	22%	Digestive health, motor health, may cause cancer, and more (ATSDR, 1998)
Nitrate as Nitrogen	10 mg/L	15%	Decreases the ability for blood to carry oxygen to tissues (EPA, 2006)
Total Dissolved Solids*	500 – 1000 mg/L	10%	No health risk at SMCL (EPA, 2017)
Uranium	20 pCi/L	7%	Kidney damage and risk of cancer (EPA, 2001)
Perfluorooctanoic Sulfonate (PFOS)**	6.5 ng/L	10%	Risk of cancer (EPA, 2017)

Gross Alpha radioactivity	15 pCi/L	5%	Risk of cancer (EPA, 2001)
1,2-Dibromo-3-chloropropane (DBCP)	0.2 µg/L	2%	Depression of central nervous system, digestive issues, and reproduction issues in men, and more (EPA, 2000)
Nitrite as Nitrogen****	1 mg/L	2%	Decreases the ability for blood to carry oxygen to tissues (EPA, 2006)
Perfluorooctanoic acid** (PFOA)	5.1 ng/L	5%	Risk of cancer (EPA, 2017)
1,2 Dibromoethane (EDB)	0.05 µg/L	1%	Decreased vitality, risk of cancer, and death (EPA, 2004)
Selenium	50 µg/L	1%	Damage to liver, kidneys, and central nervous and circulatory systems (EPA, 2009)
Benzene***	1 µg/L	1%	Anemia; decrease in blood platelets; increased risk of cancer (ibid)
1,2 Dichloroethane (1,2 DCA)	0.5 µg/L	1%	Increased risk of cancer (ibid)
Tetrachloroethene (PCE)	0.5 µg/L	1%	Liver problems; increased risk of cancer (ibid)
Di(2-ethylhexyl)phthalate (DEHP)	1 µg/L	<1%	Reproductive difficulties; liver problems; increased risk of cancer (ibid)
Dichloromethane (Methylene Chloride)	5 µg/L	<1%	Liver problems; increased risk of cancer (ibid)

* Secondary MCL (SMCL)

** Notification level (NL)

*** Present in three monitoring wells (19% of monitoring wells sampled post-SGMA) and 1 Municipal well sampled post-2015

**** Should be considered where active nitrification and denitrification are occurring

Rows highlighted in grey are additional constituents detected after 2000 but before 2015

3.5.6.2 Driving Mechanisms

Constituent concentrations in groundwater are dependent on physical and chemical influences. Examples of physical influences include changes in groundwater levels, gradients, 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).

As the need for deeper wells increases, users may encounter constituents such as arsenic, uranium, and TDS at elevated concentrations.

Furthermore, 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 to deeper depths resulting in those constituents being pulled into well screens at these deeper depths.
- Continued groundwater level decline at different rates may alter groundwater elevation gradients which may cause constituents to migrate along new flow paths.
- Artificial recharge or changes in groundwater levels that alter redox conditions may cause the mobilization of constituents (e.g., Haugen et. al., 2021).
- Groundwater 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 (EPA, 2023).
- Improperly constructed or sealed wells may act as conduits into confined and unconfined aquifers for constituents of concern (Department of Water Resources, 1991).

3.5.6.3 Impacts to Drinking Water Users

Sixteen of the seventeen constituents listed in Table 3-2 may pose health risks to drinking water users. As shown in Table 3-2, these constituents pose health risks by causing digestive issues (arsenic and DBCP), mobility and vision issues (arsenic and DBCP), kidney disease (uranium), respiratory issues (nitrate and nitrite), cancer (arsenic, gross alpha, uranium, 1,2,3-TCP, PFOA, and PFOS), and reproductive issues (DBCP) (EPA, 2001; ATSDR, 1998). The remaining constituent in Table 3-2, TDS, does not pose a significant health risk but is assigned a Secondary Maximum Contaminant Level (SMCL) of 500 mg/L for taste, staining, hardness, and other non-health risk factors.

3.5.6.4 De-designated Area

A Basin Plan Amendment is a California state process under the Porter-Cologne Act to remove or de-designate an assigned beneficial use from a Regional Water Quality Control Board's Basin Plan. Studies were conducted in the Southern Lost Hills Oilfield area that identified confined groundwater conditions within the Project Zone (below the Mid-Tulare Shale, within the Lower Tulare Member of the Tulare Formation and the Etchegoin Formation) and groundwater of very poor quality with naturally occurring Total Dissolved Solids (TDS) concentrations exceeding 10,000 mg/L (R5-2022-0035). The salinity concentrations in this area already exceeded the maximum salinity concentration of 3,000 mg/L TDS for municipal beneficial use, which is also the maximum salinity concentration identified to support agricultural beneficial uses (Resolution No. 2023-0040). Therefore, an amendment to the Tulare Lake Basin Water Quality Control Plan (Tulare Lake Basin Plan) to remove municipal and agricultural designations from a horizontally and vertically delineated portion of the groundwater aquifer in the Southern Lost Hills Oilfield was adopted by the Central Valley Water Board and the State Water Board in 2022 and 2023, respectively (R5-2022-0035 and Resolution No. 2023-0040).

Additionally, the Central Valley Water Board is evaluating for consideration additional amendments to the Tulare Lake Basin Plan to potentially remove municipal and agricultural designations for McKittrick Area Oilfields and California Independent Petroleum Association (CIPA) requested Oilfields. If adopted, this would de-designate (remove uses from specified areas where those uses are not suitable) beneficial use in these areas for municipal or agricultural supply purposes (Central Valley Regional Water Quality Control Board, 2023).

3.5.7 Subsidence

Land subsidence impacts in the subbasin have been attributed to groundwater management processes, predominantly from over-pumping in areas where fine-grained sediments overlie coarser grained sediments (USGS, 2018). As water is pumped and

removed from sediment pore space, the sediment structure collapses, land surface elevations decline, and groundwater storage capacity is lost. Land subsidence in the basin can impact infrastructure, increase flooding due to sinking of levees, and permanently reduce aquifer storage. A small portion of subsidence can also be attributed to other processes such as hydro compaction of moisture-deficient deposits above the water table, oil extraction within the oil and gas fields of the subbasin, and deep-seated tectonic movement (Sneed, et al., 2018).

Several areas within the Kern County Subbasin have experienced subsidence mostly due to groundwater extractions and minimally due to oil and gas related activities. Interferometric Synthetic Aperture Radar (InSAR) uses radar images to remotely sense surface elevation changes over time. Recent InSAR data spanning June 2015 to October 2023 indicate the maximum subsidence in that time period in the Kern County Subbasin is approximately 2.47 ft on the northern edge of the subbasin in the Semitropic Water Storage District GSA and the Southern San Joaquin Municipal Utility District (**Figure 3-17**). Other areas of subsidence include the western side of the basin with a maximum subsidence of approximately 1.66 ft within the Westside District Water Authority GSA, the northern central and northeastern central portion of the basin with approximately 1.29 ft of subsidence in the North Kern Water Storage District, Cawelo Water District GSA, and Kern Groundwater Authority GSA, and the southern portion of the subbasin with a maximum subsidence of 1.46 ft in the Wheeler Ridge-Maricopa GSA, Kern River GSA, and Arvin GSA. In areas where oil and gas operations are occurring the activity is likely contributing to subsidence. However, where both extraction activities are occurring, then it is probable that both activities are contributing to the overall subsidence.

3.6 Basin Hydrology - Surface Water

Human activities over the last few centuries have substantially altered surface water hydrology in the area (see Section 3.3) (**Figure 3-18**).

The Central Valley Water Board's Tulare Lake Basin Plan (2018) summarizes surface water systems in the Tulare Lake hydrological region, which includes the Kern groundwater subbasin:

> The Kings, Kaweah, Tule, and Kern Rivers, which drain the west face of the Sierra Nevada Mountains, are of excellent quality and provide the bulk of the surface water supply native to the basin. Imported surface supplies, which are also of good quality, enter the basin through the San Luis Canal/California Aqueduct System, Friant-Kern Canal, and the Delta-Mendota Canal. Adequate control to protect the quality of these resources

is essential, as imported surface water supplies contribute nearly half the increase of salts occurring within the basin.

Buena Vista Lake and Tulare Lake, natural depressions on the valley floor, receive flood water from the major rivers during times of heavy runoff. During extremely heavy runoff, flood flows in the Kings River reach the San Joaquin River as surface outflow through the Fresno Slough. These flood flows represent the only significant outflows from the basin.

In addition to the Kings, Kaweah, Tule, and Kern Rivers, the Tulare Lake hydrological region contains numerous mountain streams. These streams have been administratively divided into eastside streams and westside streams using Highway 58 from Bakersfield to Tehachapi. Streams from the Tehachapi and San Emigdio Mountains are grouped with westside streams. In contrast to eastside streams, which are fed by Sierra snowmelt and springs from granitic bedrock, westside streams derive from marine sediments and are highly mineralized, and intermittent, with sustained flows only after extended wet periods (Central Valley Regional Control Board, 2018).

The Kings, Kaweah, St. Johns, and Tule Rivers are all fully appropriated year-round, meaning those sources have insufficient supply for new surface water right applications for diversions at any time of the year. Poso Creek is fully appropriated from June 15 through October 31 of each year, meaning no water is available for new water rights applications for diversions during those months (SWRCB, 1998). The Kern River had been fully appropriated from 1964 to 2010, when the SWRCB amended the Declaration of Fully Appropriated Streams to remove the designation of the Kern River as fully appropriated (SWRCB, 2010).

The reaches of the Kern River in the Tulare Lake Hydrologic Region, below the Southern California Edison Kern River Powerhouse No. 1 support the following beneficial uses (Central Valley Regional Control Board, 2018):

- Municipal and Domestic Supply (MUN)
- Agricultural Supply (AGR)
- Industrial Service Supply (IND)
- Industrial Process Supply (PRO)
- Hydropower Generation (POW)
- Water Contact Recreation (REC-1)
- Non-Contact Water Recreation (REC-2)
- Warm Freshwater Habitat (WARM)

- Wildlife Habitat (WILD)
- Rare, Threatened, or Endangered Species (RARE)
- Ground Water Recharge (GWR)

The Kern County Groundwater subbasin is bounded on the north by the Kern County line and the Tule Groundwater subbasin, on the east and southeast by granitic bedrock of the Sierra Nevada foothills and Tehachapi mountains, and on the southwest and west by the marine sediments of the San Emigdio Mountains and Coast Ranges. Principal rivers and streams include Kern River and Poso Creek. Active faults include the Edison, Pond-Poso, and White Wolf faults. Average precipitation values range from 5 in. at the subbasin interior to 9 to 13 in. at the subbasin margins to the east, south, and west (DWR, 2016). It should be noted that the subbasin also receives major contributions of water deliveries through the State Water Project deliveries.

4.0 Recommendations for Board Action

SGMA states, “in those circumstances where a local groundwater management agency is not managing its groundwater sustainably, the State needs to protect the resource until it is determined that a local groundwater management agency can sustainably manage the groundwater basin or subbasin.” To ensure SGMA is implemented successfully, the State Water Board may temporarily intervene in groundwater management after DWR determines that proposed management of a groundwater basin is inadequate due to deficiencies in the GSP(s) for the basin (Wat. Code § 10735 et. seq).

GSPs for critically over-drafted high- and medium-priority basins had to be adopted and submitted to DWR for their assessment by January 31, 2020 (Wat. Code § 10735.2, subd. (a)(2)). The Kern County Subbasin 2020 GSPs were submitted to DWR in January 2020, and DWR posted the GSPs to their website and established a 75-day comment period on February 19, 2020. DWR had two years within the GSPs’ submittal date to issue a written assessment and a determination of the status of the GSPs. On January 28, 2022, DWR gave the Kern County Subbasin 2020 GSPs an incomplete determination and the Kern County GSAs had 180 days to address the GSPs’ deficiencies identified in DWR’s Incomplete Determination of the 2020 Kern County Subbasin GSPs. The Kern County GSAs then adopted revised GSPs (Kern County Subbasin 2022 GSPs), which were submitted to DWR on July 27, 2022, and posted to DWR’s website on August 1, 2022. DWR evaluated the 2022 GSPs and officially determined the Kern County Subbasin 2022 GSPs “inadequate” on March 2, 2023.

The State Water Board now must determine whether a probationary designation is warranted (See Section 2.2.1.0). Board staff have reviewed the GSPs and the DWR staff reports documenting DWR's review of the GSPs. Staff concur with DWR's determination that the Kern County GSPs are inadequate, and staff analyses indicate the Kern County GSAs are not managing their groundwater sustainably. Staff note:

- The GSP's SMC will allow substantial impacts to 1) people who rely on domestic wells for human consumption, cooking, and sanitary purposes, 2) on infrastructure such as canals (e.g., Friant-Kern Canal) and levees, and 3) to the aquifer itself within the subbasin.
- Based on the above, the Kern County subbasin GSAs are not on track to achieve sustainability by 2040. Designating the subbasin probationary is critical for getting the basin back on track to achieve sustainability by 2040.

Consideration of Groundwater Sustainability Plan Revisions

The Kern County Subbasin GSAs submitted seven new draft GSPs and a coordination agreement to Board staff on May 28, 2024, referred to here as the 2024 Draft GSPs. The plans are considered draft because they have yet to be adopted by the GSAs and are currently undergoing public review. Board staff conducted a preliminary review of the 2024 Draft GSPs to determine if any deficiencies identified in this draft staff report remain and whether to delay release of this draft staff report while a more thorough review of the 2024 Draft GSPs takes place. However, based on the preliminary review, staff feel that the 2024 Draft GSPs still have significant deficiencies and that Board staff analysis of the 2022 GSPs and identification of potential actions to resolve deficiencies remain relevant. Therefore, this draft staff report, and potential actions will remain helpful for GSAs in correcting deficiencies. The preliminary review of the 2024 Draft GSPs is discussed following the five deficiencies below in more detail.

Board staff therefore recommend the State Water Board designate the subbasin as a probationary basin.

The State Water Board may designate a basin probationary if state intervention authorities are triggered and after providing notice and holding a public hearing (Wat. Code, § 10735.2, subd. (a)). The overall goal of probation is to gather information to help local GSAs address deficiencies in their plans, so they can sustainably manage their groundwater resources as soon as possible. During a probationary designation, the State Water Board would require many groundwater extractors to report their extractions, which would help resolve data gaps related to groundwater use, and State Water Board staff would continue to provide guidance to GSAs working to develop an adequate sustainability plan (or plans). Concurrently, GSA efforts to fix deficiencies should continue.

Under a potential probationary designation, GSAs can seek to exit probationary status by submitting a revised, adopted plan (or plans) to the State Water Board. If the State Water Board determines that deficiencies were addressed, the Board may resolve to have the GSA (or GSAs) exit probation; however, if the Board does not believe that the plan (or plans) are being adequately implemented, it may resolve to continue probation (Wat. Code, § 10735.8, subd. (g)(4)). If deficiencies are not addressed after a year, the State Water Board can take steps to manage groundwater more directly by developing and adopting, after noticing and a hearing, an interim plan for the basin. An interim plan is intended to temporarily manage the basin until GSAs can develop and implement an adequate plan or plans. A probationary determination is a first step to addressing continuing overdraft while also resolving plan deficiencies and is required before the State Water Board can move to the step of developing an interim plan.

The following sections explain staff recommendations for a probationary determination:

- Section 4.1 recommends identification of specific GSPs deficiencies and potential actions to address deficiencies
- Section 4.2 recommends that no areas in the subbasin be excluded from probationary status
- Section 4.3 recommends that the groundwater extraction annual reporting deadline be altered such that:
    - Users who are required to report their extractions do so by December 1 of each year for the previous water year
- Section 4.4 recommends that:
    - Users extracting 2 AFY or less for domestic purposes only be excluded from reporting groundwater extractions and paying fees
    - Users extracting more than 2 AFY for any reason be required to report groundwater extractions and pay fees
    - Users extracting more than 500 AFY for any reason be required to install flow meters
    - Users extracting from the wells adjacent to Friant-Kern Canal and California Aqueduct be required to install flow meters

4.1 Groundwater Sustainability Plan Deficiencies and Potential Actions to Address Deficiencies

If the State Water Board designates a basin probationary, the Board must identify the specific deficiencies and potential actions to address the deficiencies (Wat. Code § 10735.6, subd. (a)). This Staff Report incorporates deficiencies identified in DWR's determination. For the Kern County Subbasin 2022 GSPs, Board staff reviewed the GSPs and identified additional key issues generally within the scope of DWR deficiencies. These additional deficiencies are similar to the recommended corrective actions that DWR identified for basins with approved plans. Board staff are also considering the time it would take for basins to address deficiencies and exit probation. While other basins began implementing plans in 2020 that are now approved, the Kern County subbasin does not yet have a plan that will achieve sustainable groundwater management by 2040. In order to meet the 20-year timeline, plan deficiencies should be addressed now, including the additional Board-identified issues that are similar to the DWR-identified recommended corrective actions that other basins with approved plans are already working to address.

Below, State Water Board staff have identified specific deficiencies within the Kern County Subbasin 2022 GSPs and Coordination Agreement and have outlined potential actions to address those specific deficiencies. Deficiencies that have been identified within the GSP(s) generally include but are not limited to: (1) GSA coordination; (2) chronic lowering of groundwater levels with insufficient SMC; (3) continued land subsidence; (4) degradation of groundwater quality, and (5) depletions of interconnected surface water. These five deficiencies continue to be apparent upon a preliminary review of the 2024 Draft GSPs submitted for review as described in section 4.1.6.

DWR's 2022 Inadequate Determination evaluates the subbasin's 2022 GSPs against the deficiencies DWR identified for the 2020 GSPs (in DWR's 2020 GSP Incomplete Determination). Consequently, for each of the five overarching deficiencies, State Water Board staff describe 1) relevant portions of the 2020 GSPs, 2) DWR's 2020 Incomplete Determination, and 3) the 2022 GSPs. Staff then break down the deficiency into components. Finally, staff identify potential actions to address each component. Staff identified more than one potential action for some deficiencies, and some potential actions may address more than one deficiency. The potential actions to address the deficiencies provide the GSAs with a possible path out of state intervention and State Water Board oversight. Ultimately, the State Water Board will evaluate any updated and adopted GSPs as a whole and will determine whether the GSAs have addressed the deficiencies, whether the GSPs are consistent with SGMA, and whether the GSAs are implementing the GSPs in a manner that the Board finds will likely achieve the sustainability goal.

In some cases, a GSP revision may resolve a deficiency identified by the Board, but the Board may find the revision adversely affects other management criteria. For example, if the plain-language definition of an undesirable result is revised, then the quantitative undesirable result and minimum thresholds may no longer adequately represent the significant and unreasonable conditions that the basin is trying to avoid, and the measurable objectives may no longer provide operational flexibility about the minimum thresholds.

Additionally, the Board may consider how GSPs that do not meet SGMA's mandate to sustainably manage groundwater by avoiding undesirable results affect other Board programs and policies. For example:

- Chronic lowering of groundwater levels can impact shallow domestic wells, many of which are located in communities of color. Failure to avoid this undesirable result (Wat. Code, § 10721, subd. (x)(1)) may also be inconsistent with or impact:
    - The Human Right to Water Resolution (State Water Board, 2016)
    - Racial Equity Resolution (State Water Resources Control Board, 2021a)
    - Policy implementing the Safe and Affordable Funding for Equity and Resilience (SAFER) Program Fund Expenditure Plan (Division of Financial Assistance, 2021)
    - Groundwater Management Principles & Strategies to Monitor, Analyze & Minimize Impacts to Drinking Water Wells (DWR, 2021)
- Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies (Wat. Code, § 10721, subd. (x)(4)) may also be inconsistent with or impact:
    - Antidegradation policy (State Water Resource Control Board, 1968)
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water (Wat. Code, § 10721, subd. (x)(6)) may also be inconsistent with or impact:
    - Tribal beneficial uses of water (State Water Board, 2017)
    - The Board's public trust obligations (see section 5.3)

The Board may amend or rescind a probationary designation decision after providing appropriate public notice of the proceeding (Wat. Code, § 10736, subd. (c)).Roadmap to Proposed Deficiencies

Table 4-1, below, summarizes the deficiencies described in sections 4.1.1 through 4.1.5. See the following sections for additional detail on each deficiency including potential

actions to address the deficiencies. Appendix A summarizes the text in sections 4.1.1 through 4.1.5, including the sub deficiencies, what SGMA requires, a summary of deficiencies, and potential actions to correct the deficiencies.

While Board staff believe that the subbasin has made substantial progress in addressing many of the deficiencies identified below since their 2020 plans, Board staff stress that this staff report is based on the 2022 GSPs that DWR determined to be inadequate. This report clearly defines the deficiencies in those plans so that GSAs know exactly what they need to address in revised and adopted GSPs.

Table 4-1 – Summary of Proposed State Water Board Deficiencies

Deficiency Coordination (CRD)-1– Undesirable results and SMC are not coordinated.
Deficiency CRD-2 – Coordination in the basin does not Satisfy SGMA requirements.
Deficiency CRD-3 – GSAs in the Subbasin have not demonstrated Basin-wide management.
Deficiency Groundwater Levels (GL)-1 – Undesirable results and SMC are not coordinated. (Corresponds to CRD-1; provides specific detail for groundwater levels)
Deficiency GL-2 – The GSPs and Coordination Agreement lack necessary detail about well mitigation.
Deficiency GL-3 – The GSPs do not describe a feasible path for halting chronic lowering of groundwater levels.
Deficiency Land Subsidence (LS)-1 - Undesirable results and SMC are not coordinated. (Corresponds to CRD-1; provides specific detail for land subsidence)
Deficiency LS-2 - The GSPs do not provide adequate implementation details.
Deficiency Groundwater Quality (GWQ)-1 – Undesirable results and SMC are not coordinated. (Corresponds to CRD-1; provides specific detail for groundwater quality)
Deficiency GWQ-2 – Groundwater quality monitoring networks are not consistent with SGMA requirements.

Deficiency GWQ-3 – Management actions are not responsive to water quality degradation.
Deficiency Interconnected Surface Water (ISW)-1 – Undesirable results and SMC are not coordinated. (Corresponds to CRD-1; provides specific detail for ISW)

4.1.1 Deficiency CRD – Inadequate Coordination

SGMA allows any local agency – an agency with water supply, water management, or land use responsibilities – or combination of local agencies overlying a groundwater basin to become a GSA for that basin (Wat. Code, § 10723, subd. (a)). A private water corporation regulated by the Public Utilities Commission or a mutual water company may participate in a GSA through legal agreement, but do not confer any additional powers, and therefore cannot enforce SGMA (Wat. Code, § 10723.6, subd. (b)). Local Agencies who decide to become a GSA are not authorized to impose regulatory requirements or fees on activities outside of the agency's jurisdictional boundaries (Wat. Code, § 10726.8, subd. (b)). SGMA allows multiple GSAs to develop and implement multiple GSPs if plans are developed and implemented pursuant to a single coordination agreement that covers the entire basin or subbasin (Wat. Code, § 10727, subd. (b) paragraph (3)). The coordination agreement shall ensure that coordination amongst GSAs preparing GSPs are utilizing the same data and methodologies (Wat. Code, § 10727). The coordination agreement should be adopted by all relevant parties, explain how the multiple plans will satisfy SGMA requirements, and should ensure that the agreement is binding on all parties and sufficient to address any disputes (Cal. Code Regs § 355.4(b)(8) and Cal. Code Regs § 357.4).

A GSA will be responsible for their management area (area of coverage) (Wat. Code, § 10724). Each agency may define one or more management areas in the basin, or their area of coverage, if the agency has determined the need for a separate management area to facilitate implementation of that plan (Cal. Code Regs § 354.20). Each agency shall justify the necessity for each defined management area, specifically how it can operate under different minimum thresholds and measurable objectives without causing undesirable results within and outside of the management area (ibid).

DWR concluded that the Kern County Subbasin 2020 GSPs, which include the Coordination Agreement, did not establish undesirable results (for each of the six sustainability indicators) that are consistent for the entire Subbasin because: (1) GSPs do not describe how they utilized the same data and methodologies; (2) do not describe how they consider all beneficial uses and users; (3) how the fragmented approach

would prevent localized substantial exceedances by area without being considered a significant and unreasonable impact to beneficial uses and users; and (4) GSAs do not use clear and consistent terminology according to SGMA (2020 Incomplete Determination of Kern County Subbasin, 2022).

DWR conducted a review of the Kern County Subbasin 2022 GSPs and concluded that the GSAs made considerable progress toward understanding potential impacts to beneficial uses and using consistent definitions and terminology throughout the subbasin. However, DWR found that the plan generally lacks a comprehensive description of the groundwater conditions. DWR staff determined the fragmented approach to groundwater management, particularly in establishing SMC and undesirable results, undermines the GSAs' ability to clearly define Subbasin-wide significant and unreasonable effects GSAs hope to avoid (2022 Inadequate Determination). DWR staff could therefore not determine how or whether the management approach described and included in the Coordination Agreement would achieve sustainability, specifically how the approach would: (1) Collectively bring the subbasin into sustainability and maintain sustainability over the implementation horizon; (2) Maintain groundwater use within the sustainable yield as demonstrated by monitoring and reporting groundwater conditions; (3) Operate within the established sustainable management criteria which are based on collective technical information (ibid). Therefore, DWR staff determined that the GSAs did not take sufficient actions to correct this deficiency, which materially affects the ability of the Agencies to achieve sustainability and the ability of the staff to evaluate the likelihood of the Plan to achieve sustainability (ibid).

Board staff add that, according to the SGMA statute, some aspects of coordination are not required, but other coordination requirements are defined in SGMA statute or DWR Regulations and are crucial for SGMA implementation. Additionally, as described in this section and 4.1.2 - 4.1.5, a coordinated approach is necessary in avoiding undesirable results when managing groundwater in the subbasin. Due to the numerous entities involved in managing groundwater in the Kern County Subbasin, Board staff believe it necessary to address Coordination as its own deficiency as it pertains to the requirements of SGMA, and to emphasize the need for a more coordinated approach. Six GSPs, 12 Management Area Plans, and one coordination agreement were submitted by the GSAs to DWR in 2022. All submitted documents are vital to implementation and Board staff find it difficult to evaluate the basin for sustainability with the current fragmented approach. Board staff would also like to note that several meetings have been held with the Kern Technical Team and the Kern Technical Team has indicated that revised and additional GSPs will be submitted. Therefore, staff emphasize the importance of coordination to adequately review the numerous GSPs to avoid additional deficiencies in the future.

Table 4-2 – Summary of DWR's Coordination Deficiency Relevant Components of the 2020 and 2022 Kern County Subbasin GSPs

2020 GSPs	DWR's 2020 GSP Incomplete Determination
Five GSPs, 15 Management Area Plans (part of the KGA GSP), and a Coordination agreement were submitted in 2020 to DWR. • The Coordination agreement defined an undesirable result as "the point at which significant and unreasonable impacts over the plan's duration, as caused by water management action, and determined by SMC, affect the reasonable and beneficial use of and access to, groundwater by overlying users." • Defines an undesirable result as occurring when minimum thresholds for SMC are exceeded in at least three adjacent Management Areas that represent at least 15% of the subbasin area or greater than 30% of the subbasin (as measured by each Management Area). • GSPs' and Management Area Plan's use widely varying approaches to define the management-area-specific undesirable results that would contribute to an undesirable result. • GSPs' and Management Area Plans use varying definitions representing when a localized undesirable result occurs and contributes to the basin wide undesirable result.	The GSPs do not establish undesirable results that are consistent for the entire subbasin. • DWR staff could not evaluate whether the plan is likely to reach sustainability due to the fragmented plans. • Plans emphasize that more than 180 projects and management actions must be implemented to avoid MTs. • The Plan does not provide readily available or comparable data and information to evaluate potential impacts, to beneficial uses and users. • The varied and fragmented approaches to establish individual water budgets and SMC might allow for groundwater conditions to worsen at a greater rate or extent than otherwise would have occurred with a more coordinated Plan. • Although GSPs often state that the minimum thresholds were coordinated and compared, there appears to be no real analysis or understanding of the effects if the minimum MTs are exceeded. • The way that the subbasin's SMC and undesirable results are defined and set, pose a risk that groundwater conditions may worsen in various portions of the subbasin without causing and undesirable result.

	DWR found the 2020 GSP incomplete.
2022 GSPs	**DWR's 2022 GSP Inadequate Determination**
Six GSPs, 12 Management Area Plans (part of the KGA GSP), and an Amended Coordination agreement were submitted in 2022 to DWR. The coordination agreement: • Defines undesirable results as, "[t]he point at which significant and unreasonable impacts over the plan's duration, as caused by water management action, as determined by [SMC], affect the reasonable and beneficial use of and access to, groundwater by overlying users" and "[s]hould only be referred to as a basin-wide condition and not a Management Area exceedance." • Defines an undesirable result as occurring when Management Area exceedances occur in at least three adjacent Management Areas that represent at least 15% of the basin area or greater than 30% of the subbasin (as measured by each Management Area). • Defines a Management Area exceedance as exceeding the MT trigger (>40% RMW) within a Management Area. • Indicates that each GSP or Management Area would establish its own minimum thresholds; does not provide a unified methodology for establishing minimum thresholds	The GSPs do not establish undesirable results that are consistent with the goals of SGMA. • DWR staff state that in order to comply with SGMA and the GSP Regulations and achieve sustainability, the basin needs a well-explained Plan that will be implemented in a coordinated manner. • Continued need for more than 180 PMAs to be implemented to marginally avoid MTs and avoid URs. • The newly defined Management Area exceedance concept still does not represent or explain groundwater conditions that would be occurring throughout the subbasin. • Individual Management Areas continue to use various data and methodologies to establish SMC. DWR determined the plan to be inadequate.

4.1.1.1 Kern County Subbasin 2020 Groundwater Sustainability Plans

This subsection and following subsections describe the portions of the Coordination Agreement, individual GSPs, or DWR's determination relevant to the proposed Board deficiencies.

Plain-language Definition of an Undesirable Result

The 2020 GSPs defined an undesirable result as "the point at which significant and unreasonable impacts over the plan's duration, as caused by water management action, as determined by [SMC], affect the reasonable and beneficial use of and access to, groundwater by overlying users."

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The 2020 coordination agreement defined an undesirable result as occurring when, "minimum thresholds for SMC are exceeded in at least three adjacent management areas that represent at least 15% of the subbasin area or greater than 30% of the subbasin [as measured by each Management Area]". A Management Area would only contribute to an undesirable result when local undesirable results are occurring. Different Management Area's define local undesirable results as occurring based on various conditions as noted:

Buena Vista Water Storage District (BVWSD) stated that the minimum threshold is the trigger level for assessment of undesirable result but did not clearly define what would constitute an occurrence of a local undesirable result (2020 Buena Vista GSA GSP, p. 132).

Henry Miller Water District (HMWD) did not clearly define when the respective Management Areas would contribute to an undesirable result but stated, "if a level reading from any two (2) monitoring wells for any two consecutive years is below this value, the GSA has exceeded its MT," (2020 Henry Miller Water District GSP, p. 80).

Olcese GSA defined a local undesirable result as occurring if one MT exceedance occurs for groundwater levels, subsidence, or groundwater storage, but does not define a quantitative definition for an undesirable result with groundwater quality (2020 Olcese GSP, p. 73).

Kern River GSA (KRGSA) defined a local undesirable result as occurring under various conditions in each of their three Management Area's subareas (further division of the Management Area). This includes a local undesirable result as occurring if a single groundwater level MT exceedance occurred for more than 3 consecutive months within the KRGSA Urban Management Area or KRGSA banking Management Area. The

KRGSA Agricultural Management Area is further fragmented and defined a local undesirable result as occurring when 40% of agricultural wells for more than 2 consecutive years, 40% of urban wells for more than 2 consecutive years, or the exceedances in a specific single monitoring well (2020 Kern River GSA GSP, pp. 5-10).

The Kern Groundwater Authority (KGA) states for each of the 15 Management Area Plans, “each management area has defined the criteria for the number of representative monitoring sites to exceed their minimum threshold for the management area to become an undesirable result watch area and potentially an undesirable result at the basin level,” (2020 Kern Groundwater Authority GSA GSP, p. 170). The various Management Area Plans defined the following:

Cawelo Water District (Cawelo WD) defined that a local undesirable result would be triggered when 30% or more of the monitoring wells in the Management Area fall below MTs during three consecutive spring measurements (2020 Cawelo Water District Management Area Plan, p. 150).

Rosedale-Rio Bravo Water District (RRBWSD) subdivides its Management Area into five zones and states that, “the RRBMA will seek to maintain at least two water level monitoring points for each monitoring zone. To the extent that average water levels in of [sic] designated monitoring points has exceeded the minimum threshold of the monitoring zone, it will be considered an undesirable result. To the extent that two of the North, Central, and South of River zones exceed this criterion, the RRBWSD will consider it an undesirable result. To the extent that either the South or East zones exceed this criterion, the RRBMA will consider it an undesirable result.” (2020 Rosedale Rio Bravo Management Area Plan, p. 69).

Pioneer Project, West Kern Water District (WKWD) , and Westside District Water Authority (WDWA) Management Area Plans did not clearly define when local undesirable results would occur and contribute to the overall basin undesirable result (2020 Pioneer GSA, 2020, pp. 5-1; 2020 West Kern Water District GSA, pp. 5-3; 2020 Wastside District Water Authority Management Area Plan, p. 80).

Arvin Edison Water Storage District (AEWSD) and Wheeler Ridge-Maricopa Water Storage District (WRMWSD) quantitatively define a local undesirable result to occur when 40% of RMS or one well for WQ RMW MTs are exceeded over four consecutive measurements (2 years) (2020 Arvin-Edison Water Storage District Management Area Plan, p. 115; 2020 Wheeler Ridge-Maricopa Water Storage District Management Area Plan, p. 107).

Eastside WMA defined a local undesirable result to occur when MTs are exceeded in no less than 50% of their 9 RMWs, rounded down to the nearest whole number, four (4) wells, over 2 years (2020 Eastside Water Management Area Management Plan, p. 83).

Kern-Tulare Water District (KTWD) defined the undesirable result to occur when 30% of MTs are exceeded in monitoring wells (2020 Kern Tulare Water District Management Area Plan, pp. 3-1).

Northern Kern Water Storage District (NKWSD) and Shafter Wasco Irrigation District (SWIS), Semitropic GSA (SWSD) and South San Joaquin Municipal Utilities District (SSJMUD), state that the Management Area will be considered to contribute to an undesirable result when 51% of RMS in a Management Area exceed their MTs (2020 North Kern Water Storage District and Shafter-Wasco Irrigation District Management Area Plan, p. 190; 2020 Semitropic Water Storage Management Area Plan, p. 148; 2020 Southern San Joaquin Utility District Management Area Plan, p. 144).

Shafter Wasco ID 7th Standard Annex defined an undesirable result to occur if one of the three RMS wells exceed MTs over three consecutive monitoring periods (2020 Shafter-Wasco ID 7th Standard Annex Manaement Area Plan, p. 80).

Tejon Castac Water District (TCWD) defined an undesirable result as occurring if an MT exceedance occurred in the single RMW in a manner inconsistent with the temporal driver of natural climatic and hydrologic variability (2020 Tejon-Castac Water District Management Area Plan, p. 63).

4.1.1.2 Department of Water Resources' 2020 Groundwater Sustainability Plan Incomplete Determination

In its January 28, 2022, incomplete determination letter, DWR identified a deficiency in the subbasin's 2020 GSP related to coordination:

Deficiency 1 – The [2020] GSPs do not establish undesirable results that are consistent for the entire subbasin.

DWR defined three sub-deficiencies:

1. [T]he Plan's lack an explanation of the specific effects, occurring throughout the Subbasin, that, when significant and unreasonable, would-be undesirable results. As described below, the Coordination Agreement includes a calculation framework for determining when a certain portion of the Subbasin experiences negative effects, which have been defined in isolation by a multitude of individual management areas. However, this calculation framework is not accompanied by any cogent description of Subbasin-wide effects caused by groundwater management that the entire Subbasin is attempting to avoid by implementing the Plan. […] The Plan provides no specific information on the Subbasin-wide effects of groundwater lowering related to accessing groundwater by beneficial uses and users.

2. Notwithstanding the first component of this deficiency and taking the Subbasin's area-based approach at face value, the second component of this deficiency relates to the individual GSPs' and Management Area Plan's widely varying approaches to define the management-area-specific undesirable results. […] The Coordination Agreement states that an undesirable result occurs "when the minimum thresholds for groundwater levels are exceeded in at least three (3) adjacent management areas that represent at least 15% of the Subbasin or greater than 30% of the Subbasin (as measured by each management area). Minimum thresholds shall be set by each of the management areas through their respective management area plans or Groundwater Sustainability Plans." It is apparent to Department staff that the Coordination Agreement's use of the term "minimum thresholds" in the definition above does not refer to minimum thresholds as defined in the GSP Regulations. Instead, it refers to some, often byzantine, combination of several minimum threshold exceedances, at times coupled with a temporal constraint.

3. [T]he Plan's incomplete descriptions of the conditions under which an undesirable result would occur, according to the Coordination Agreement's land area calculation framework and the various GSPs and Management Area Plans. By the Subbasin's definition of an undesirable result [...] tracking which management area(s) have been triggered as "undesirable" [...] is paramount to determining when an undesirable result occurs. […] Department staff found this to be true for all applicable sustainability indicators.

(2020 Incomplete Determination of Kern County Subbasin, pp. 13-40)

DWR's 2020 GSP Corrective Actions

To address the deficiency in the 2020 GSP, DWR staff recommended that the GSAs do the following corrective actions:

1a. The Plan's Coordination Agreement should be revised to explain how the undesirable results definitions are consistent with the requirements of SGMA and the GSP Regulations, which specify that undesirable results represent effects caused by groundwater conditions occurring throughout the Subbasin. The discussion should include descriptions of how the Plans have utilized the same data and methodologies to define the Subbasin-wide undesirable results and how the Plan has considered the interests of beneficial uses and users of groundwater (2020 Incomplete Determination of Kern County Subbasin, 2022).

1b. Because of the fragmented approach used in the Subbasin that could allow for substantial exceedances of locally defined minimum thresholds over sustained

periods of time, the GSAs must commit to comprehensively reporting on the status of minimum threshold exceedances by area in the annual reports and describe how groundwater conditions at or below the minimum thresholds may impact beneficial uses and users prior to the occurrence of a formal undesirable result (ibid).

1c. The GSAs must adopt clear and consistent terminology to ensure the various plans are comparable and reviewable by the GSAs, interested parties, and Department staff. This terminology should also adhere to the definitions of various terms in SGMA and the GSP Regulations including the understanding that undesirable results are conditions occurring throughout the Subbasin. The Plan and associated coordination materials must also be revised to clearly document how all of the various undesirable results definitions and methodologies achieve the same common sustainability goal. […] GSAs need to provide a comprehensive description of the groundwater conditions that would lead to localized undesirable results in the GSAs and other management areas which ultimately contribute to the 15 percent or 30 percent of land area criteria (ibid).

4.1.1.3 Kern County Subbasin 2022 Groundwater Sustainability Plan Submission and Water Year 2022 Annual Report

The GSAs each submitted a revised GSP to DWR on August 1, 2022, in compliance with the 180-day resubmittal deadline. While not considered in DWR's assessment of the 2022 GSPs, the GSAs also each filed a WY 2022 Annual Report for their portion of the subbasin on March 31, 2023.

Plain-Language Definition of an Undesirable Result

The 2022 GSPs defined an undesirable result as "the point at which significant and unreasonable impacts over the planning and implementation horizon, as caused by water management action, affect the reasonable and beneficial use of and access to, groundwater by overlying users."

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The 2022 amended Coordination Agreement maintains the quantitative Subbasin-wide undesirable result definition for chronic lowering of groundwater levels as "when the minimum threshold for groundwater levels are exceeded in at least three (3) adjacent management areas that represent at least 15% of the Subbasin or greater than 30% of the Subbasin." Additionally, the Coordination Agreement defines the quantitative definition of when local management areas contribute to an undesirable result as occurring when MTs are exceeded in 40% or more of any representative monitoring

wells within in the management area over four consecutive bi-annual SGMA required monitoring events.

DWR noted that each of the GSP resubmissions included a well impact analysis for wells that would potentially go dry at proposed water levels, though methodologies were inconsistent (**Section 5.1.1.3**). However, only the SOKR GSAs and BVGSAs addressed the process of developing mitigation plans for dry wells. The GSPs did not include clear impact analyses on beneficial uses and users for all sustainability indicators, such as groundwater quality degradation (**Section 5.3**).

Potential Effects of Minimum Thresholds on Other Sustainability Indicators

It is important to recognize the importance of a well-coordinated plan to avoid undesirable results for all sustainability indicators.

4.1.1.4 Proposed State Water Board Deficiencies and Potential Actions

In DWR's 2022 GSP Inadequate Determination dated March 2, 2023, DWR staff determined that the GSAs had not taken the necessary actions to resolve the deficiency.

Overall, DWR staff concluded that:

> The Staff Report indicates that the Agencies did not take sufficient actions to correct this deficiency, which materially affects the ability of the Agencies to achieve sustainability and the ability of the Department to evaluate the likelihood of the Plan to achieve sustainability (2022 Inadequate Determination).

And:

> Ultimately, the fragmented management area approach to groundwater management, particularly in establishing minimum thresholds and measurable objectives, undermines the GSAs ability to clearly define the Subbasin-wide significant and unreasonable effects they hope to avoid. It is, therefore, unclear to Department staff how or whether the sustainable groundwater management approach described in the Plan will achieve the sustainability goals included in the amended Coordination Agreement (ibid).

Board staff agree with DWRs findings in their 2022 GSP Inadequate Determination in that the Subbasin has made progress towards addressing, but has not taken sufficient actions, to correct the coordination deficiency. After reviewing all 6 GSPs, 12 Management Area Plans, the Coordination Agreement, and the 2021-2022 WY annual reports, Board staff have identified additional concerns regarding coordination. In some instances, deficiencies related to coordination may also relate to other sustainability

indicator deficiencies. Given the current complexities of the coordination agreement, Board staff cannot be sure additional deficiencies will not become more apparent when coordination is further clarified. However, in some instances where coordination is improved, additional deficiencies may also be resolved. Below are deficiencies and potential actions for the subbasin related to coordination defined by DWR (**Deficiency 1**) followed by State Water Board defined deficiencies.

Deficiency Coordination 1 (CRD-1) – Undesirable results and SMC are not coordinated

What SGMA Requires: SGMA requires that "Agencies intending to develop and implement multiple plans pursuant to Water Code § 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies…", and Regulations requires that "elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting" (Cal. Code Regs., tit. 23, § 357.4, subd. (a)).

In defining undesirable results, GSAs are required to "describe the process and criteria relied upon to define undesirable results [that would occur when significant and unreasonable effects are caused by groundwater condition in the Subbasin]" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition should include the cause of groundwater conditions occurring throughout the Subbasin that has or may lead to an undesirable result, the criteria used to define when and where the effects of groundwater conditions cause undesirable results, and the impacts on beneficial uses and users (Cal. Code Regs., tit. 23, § 354.26 subd. (b)).

In establishing SMC, GSAs must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26." (Cal. Code Regs. tit. 23 § 354.28). Discussion of the MTs should include among other things the "relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (Cal. Code Regs. tit. 23 § 354.28).

Undesirable results and SMC should be consistent with key details in the Coordination Agreement. Agencies should describe how they use the same data and methodologies for assumptions described in Water Code § 10727.6 by including monitoring objectives, a coordinated basin water budget, and sustainable yield for the basin supported by a

description of an undesirable result for the basin, and an explanation of how the minimum threshold and measurable objectives relate to the undesirable result (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). The coordination agreement shall also explain how the Plans implemented together, satisfy the requirements of the Act (Cal. Code Regs., tit. 23, § 357.4, subd. (c)).

GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).

Deficiency:

Undesirable results and SMC are poorly coordinated across the subbasin. Plain language undesirable results are vague and don't clearly describe the effects that basins are trying to avoid. Quantitative undesirable results are unworkably complex to the point that it's not clear what effects they represent or how they would be evaluated. Because undesirable results don't clearly describe the effects that the subbasin is trying to avoid, SMC may result in substantially different conditions across the subbasin. This means that Management Area Plans and GSPs are effectively managing to avoid different undesirable results and therefore effectively pursuing their own sustainability goals with no regard for the rest of the subbasin as a whole.

DWR describes these issues in their 2022 Inadequate Determination, noting that:

- "The complexity… can allow for situations where groundwater conditions could degrade for potentially sustained periods of time in potentially significant portions of the Subbasin without triggering Subbasin-wide management actions necessary to address Subbasin-wide undesirable results" (2022 Inadequate Determination, p. 10).
- The GSPs "lack a comprehensive description of the groundwater conditions that would lead to localized undesirable results in the GSAs and other management areas…" (ibid, p.9).
- "It remains unclear to Department staff what effects or conditions would be occurring in each management area if a Management Area Exceedance was to be realized without triggering a Subbasin-wide undesirable result, especially bring that the data and methodologies to establish groundwater level minimum thresholds varies across the management areas" (ibid, p. 9).

- “It is still unclear to Department staff how minimum threshold exceedances will be tracked and reported in each management area and evaluated against the land area-based Subbasin-wide undesirable results definition” (ibid, p. 12)
- “Department staff cannot evaluate how the various management areas would assess whether any minimum threshold exceedance, for any amount of time and in any area, is causing effects that could be or become significant and unreasonable” (ibid, p. 12).

Board staff agree and further note that this deficiency is so fundamental that it will effectively require the subbasin to redevelop undesirable results and SMC for multiple sustainability indicators. As such, Board staff have reviewed the 2022 DWR Inadequate Determination, GSPs, and Management Area Plans carefully in order to describe this deficiency in detail for each sustainability indicator that it applies to. This deficiency is broadly described in this Coordination deficiency section. But it is also described in corresponding deficiencies in each of the other sustainability indicator sections. These corresponding deficiencies are as follows:

	Undesirable results poorly described, unworkably complex, and implemented inconsistently	SMC rely on inconsistent datasets and methodologies
Coordination Deficiency	CRD-1a	CRD-1b
Corresponding Groundwater Level Deficiency	GL-1a	GL-1b
Corresponding Subsidence Deficiency	LS-1a	LS-2a
Corresponding Groundwater Quality Deficiency	GWQ-1a	GWQ-2a
Corresponding Interconnected Surface Water Deficiency	ISW-1a	ISW-2a

These corresponding deficiencies provide sustainability-indicator-specific examples to help GSAs understand what to avoid when redeveloping undesirable results and SMC. They also provide detailed potential actions to help guide GSAs toward more robust and better coordinated undesirable results and SMC. Importantly, however, Board staff do not provide a comprehensive list of every example that GSAs should avoid. There are too many examples from the numerous GSPs and Management Area Plans for Board staff to include here. Board staff therefore caution that addressing these deficiencies could create new deficiencies. Close coordination with and technical review by Board staff will be crucial to ensure GSAs avoid creating new deficiencies as they completely redevelop their groundwater level undesirable results and SMC.

Moreover, Board staff notes that addressing these coordination deficiencies effectively requires that groundwater level, subsidence, degraded groundwater quality, and depletion of Interconnected Surface Water (ISW) undesirable results and SMC be completely redeveloped.

Deficiency CRD-1a – Undesirable results are poorly described, unworkably complex, and inconsistently implemented.

For each sustainability indicator:

- The plain-language undesirable results from the Coordination Agreement are poorly described. While each GSP and Management Area Plan adopts the same plain-language undesirable results, they are interpreted and implemented very differently because they are too vague. This inconsistent interpretation exacerbates other issues with quantitative undesirable results and SMC.
- The quantitative undesirable results: 1) require a complex set of conditions occur across multiple GSAs and Management Areas, 2) are too poorly described and coordinated to be consistently implemented across GSPs and Management Area Plans, and thus 3) result in SMC that describe different conditions and impacts across different GSAs and Management Area Plans.

This deficiency is explained in greater detail for Declining Groundwater Levels (Deficiency GL-1a), Subsidence (Deficiency LS-1a), Degraded Groundwater Quality (Deficiency GWQ-1a) and Depletion of Interconnected Surface Water (Deficiency ISW-1a).

Board staff propose the below Potential Action CRD-1a to address the deficiency.

Potential Action CRD-1a – Develop consistent, clear undesirable results.

For Declining Groundwater Levels, Subsidence, Degraded Groundwater Quality, and Depletions of Interconnected Surface Water, GSAs should:

- Update the Coordination Agreement with consistent plain-language undesirable results that clearly describe the impacts that the basin would consider significant and unreasonable and therefore is attempting to avoid.

  The plain-language undesirable results should be specific enough that GSAs and others can evaluate, over time, whether an undesirable result has occurred and whether the quantitative definition is sufficient to detect undesirable results. They should also be detailed and clear enough that they are implemented relatively consistently across the subbasin, which requires that all GSAs and Management Areas clearly understand the effects that are "significant and unreasonable" for the basin.

- Then, update the Coordination Agreement with consistent, quantitative undesirable results that clearly describe the combination of MT exceedances that represent the conditions that would cause the plain-language undesirable result. Importantly, this quantitative undesirable result should be coordinated well enough across the subbasin that it is straight-forward and easy to track and evaluate, and the Coordination Agreement should explain how it represents the conditions that would cause a plain-language groundwater level undesirable result.

- Update GSPs and Management Area Plans with the updated plain-language and quantitative undesirable result definitions.

This Potential Action is explained in greater detail for Declining Groundwater Levels (Potential Action GL-1a), Subsidence (Potential Action LS-1a), Degraded Groundwater Quality (Potential Action GWQ-1a) and Depletion of Interconnected Surface Water (Potential Action ISW-1a).

Deficiency CRD-1b – Sustainable management criteria rely on inconsistent datasets and methodologies.

SMC for each sustainability indicator: 1) use inconsistent data and methodologies across GSPs and Management Area Plans that, combined with vague, inconsistent undesirable results, 2) fail to represent the key conditions that groundwater managers must evaluate in order to achieve sustainability and avoid undesirable results.

This deficiency is explained in greater detail for Declining Groundwater Levels (Deficiency GL-1b), Subsidence (Deficiency LS-1b), Degraded Groundwater Quality

(Deficiency GWQ-1b) and Depletion of Interconnected Surface Water (Deficiency ISW-1b).

Board staff propose the below Potential Action CRD-1b to address the deficiency.

Potential Action CRD-1b – Use consistent data and methods to develop SMC.

For Declining Groundwater Levels, Subsidence, Degraded Groundwater Quality, and Depletions of Interconnected Surface Water, GSAs should:

- Develop MTs using consistent data and methods. The MTs should be calibrated so that, when they are exceeded per the quantitative undesirable result definition, they represent the conditions that would cause the plain-language undesirable results.
- Redevelop MOs. Importantly, MOs must provide operational flexibility against MTs, so redeveloping MTs might require redeveloping MOs. MOs should be high enough above MTs that drought does not cause MT exceedances.
- Redevelop interim milestones. Interim milestones that basins plan to achieve as they manage toward MOs, so redeveloping MOs will require redeveloping IMs. IMs are set in 5-year increments, and they are important benchmarks to evaluate whether a basin is on track to reach its MOs by 2040.
- Finally, ensure that GSPs and Management Area Plans explain how some SMC impact other sustainability indicators. DWR noted in its 2022 Inadequate Determination that discussions of groundwater level MTs should "include how other sustainability indicators may be affected by the various minimum thresholds within the specific management areas but also in adjacent management areas" (2022 Inadequate Determination, p. 31). Board staff agree that these discussions should extend to adjacent GSAs and Management Areas and further note that these discussions should not be limited to only groundwater level SMC.

Deficiency CRD-2 – The Coordination Agreement, GSPs, and Management Area Plans lack key details necessary for coordinated implementation.

What SGMA Requires:

The coordination agreement should be adopted by all relevant parties, explain how the multiple plans will satisfy SGMA requirements, should ensure that the agreement is binding on all parties and sufficient to address any disputes, and satisfies SGMA requirements (Code Regs., tit. 23, § 355.4, subd. (b)(8) and Cal. Code Regs., tit. 23, §357.4).

GSP Regulations allow agencies to create “one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin” (Cal. Code Regs., tit. 23, § 350.20).

Deficiency: The Coordination Agreement does not include a basin-wide exceedance policy to properly demonstrate how exceedances are investigated for relevance to SGMA. This policy is important because different exceedance investigations (e.g., for water quality or subsidence) may require evaluating different data. Because this policy is not included in the Coordination Agreement, annual reports do not thoroughly discuss exceedance investigations and often shake responsibility without evidence. Moreover, Management Area Plans are inconsistent and therefore do not facilitate implementation.

Deficiency CRD-2a – The Coordination Agreement is not sufficient to address disputes.

According to the Coordination Agreement, MT exceedances are addressed by the KGA exceedance policy or the KRGSA exceedance action plan. Given the numerous Management Areas, data, and methodologies proposed in the Basin, Board staff believes there is potential for misunderstandings between adjacent Management Areas. For example, in the 2022 WY annual report, WKWD suggests that prolonged recovery in adjacent groundwater banking projects may be contributing to observed MT exceedances. WKWD therefore does not consider these MT exceedances to contribute to the Management Area MT exceedance. Another example in the 2022 WY annual report is the KRGSA investigation of an MT exceedance, which reports that the well may have been influenced by adjacent groundwater banking. In both cases the Management Area did not take responsibility for or identify a responsible party, nor did they propose or discuss a response to the exceedances. Moreover, the discrepancies between banking and adjacent Management Areas indicate MT discrepancies.

Board staff recognize the importance and complexities of groundwater banking in the Subbasin, as described in Section 3.5.4. According to SGMA, an agency may not alter another person’s or agency’s existing storage program except under a finding that the program interferes with implementation of the agency’s GSP(s) (Wat. Code, § 10726.2(b)). Yet the coordination agreement provides no unified way to investigate the cause of MT exceedances throughout the subbasin, so GSAs cannot know if they are interfering with each other’s storage programs. Nor can GSAs know when to propose Management Area responses to MT exceedances.

Board staff propose the below Potential Action CRD-2a to address the deficiency.

Potential Action CRD-2a – The Coordination Agreement should include a basin-wide minimum threshold exceedance plan.

The Coordination Agreement should include a description of how MT exceedances will be investigated and addressed throughout the Subbasin by each Management Area or GSA. The coordination agreement should also describe how the GSAs will determine when Management Areas are causing MT exceedances in adjacent Management Areas and how those issues will be addressed. For example, if a Management Area is determined to be responsible for impacts in adjacent Management Areas, immediate changes, mediation, and/or adjustments to pumping may be necessary. GSAs should also consider how this coordination between GSAs may also impact interim milestones and MOs set by adjacent Management Areas and how they may impact the basin's ability to reach sustainability.

Deficiency CRD-2b – GSAs do not explain how the multiple plans will satisfy SGMA requirements, particularly for Management Areas.

The Kern County Subbasin 2022 GSPs included five GSPs, one umbrella GSP, and 12 Management Area Plans. Regulations allow each agency to "define one or more management areas if the Agency has determined that creation of management areas will facilitate implementation of the plan" (Cal. Code Regs., tit. 23, § 354.2). A "Management Area" is "an area within a basin for which the [GSP] may identify different MTs, MOs, monitoring, or PMA based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors" (Cal. Code Regs § 351).

Many of the coordination deficiencies described in Deficiencies CRD-1a and CRD-1b are exacerbated by inconsistent implementation across Management Areas. As such, the Management Areas as implemented in the 2022 GSPs do not help facilitate plan implementation. Board staff note that, essentially, each Management Area Plan is its own GSP with its own sustainability goal. GSAs have therefore not implemented Management Areas consistent with GSP Regulations.

Board staff acknowledge that BVWSD GSA and KRGSA clearly explain how Management Areas may facilitate implementation due to specific geography and water use type. However, the KRGSA Management Areas are further divided into 11 subareas, which each have different approaches to setting SMC (2022 Kern River GSA GSP, pp. 5-11).

Board staff propose the below Potential Action CRD-2b to address the deficiency.

Potential Action CRD-2b – GSAs should revise plans to demonstrate the necessity and compliance of Management Areas

GSAs should revise GSPs and Management Area Plans per Potential Actions CRD-1a and CRD-1b. GSPs should also demonstrate how Management Areas will help facilitate implementation.

Board staff appreciate the unique challenge the subbasin faces in coordinating across so many GSAs and Management Areas. Board staff, however, note that Management Areas are intended to facilitate implementation. Board staff therefore urge GSAs to substantially improve coordination across Management Areas or substantially reduce the number of Management Areas in the subbasin.

Deficiency CRD-3 – GSAs in the Subbasin have not demonstrated Basin-wide management.

What SGMA Requires: Any *local agency* –a local public agency with water supply, water management, or land use responsibilities (Wat. Code, § 10721, subd. (n)) – or combination of local agencies overlying a groundwater basin may decide to become a GSA for that basin (Wat. Code, § 10723, subd. (a)). The statute allows some private and non-governmental water entities to *participate* in a GSA, but SGMA does not provide them any additional authorities (Wat. Code, § 10723.6, subd. (b)). Private entities therefore do not have authorities to manage the subbasin, so all areas of a GSA must still be covered by a local agency.

GSAs are required to develop “one or more groundwater sustainability plans that will collectively serve as a groundwater sustainability plan for the entire basin” (Water Code § 10735.2, subd. (1)(B)). Portions of high- and medium-priority basins not within the management area of a GSA are considered unmanaged (Water Code § 10724.6, subd. (a)). Groundwater extractors in unmanaged areas must report extractions and pay fees to the State Water Board (Water Code § 10724.6, subd. (b)).

Deficiency: Board staff are concerned that the subbasin may not be able to reach sustainability because it lacks authority to manage pumping across the entire basin. It appears to Board staff that substantial portions of the Kern subbasin may be unmanaged as a result of Kern County withdrawing from the KGA GSA and groundwater management under SGMA more broadly.

The KGA GSA relied on Kern County membership to provide coverage for almost 450,000 acres where there are no local agencies. But Kern County withdrew from KGA GSA. Board staff understand that the Kern County Water Agency “lent” its jurisdiction to KGA GSA member agencies. The member agencies then provided coverage by entering into agreements with private landowners from areas without local agencies (KGA GSP, p. 16). It does not appear to Board staff to be an approach that is consistent with SGMA:

- It is unclear to Board staff if a public agency can lend authority to private entities under SGMA.
- It is unclear to Board staff whether Kern County Water Agency has jurisdictional authority/coverage under SGMA over areas without member agencies with authorities (KGA GSP, Figure 4-1, p. 19).
- If this authority could be lent, and KCWA had the jurisdiction under SGMA to lend it, it is still unclear to Board staff whether KGA GSA would be legally allowed to exercise it given KGA GSA's Joint Powers Agreement (JPA). According to the JPA, KGA GSA will not have the authority to limit or interfere with the respective members' rights and authorities over their own internal matters, including but not limited to, surface water supplies, groundwater supplies, operations, and more (KGA JPA, p. 4).

Board staff are aware that there have been substantial changes to GSAs and member agencies since the 2022 GSPs. Board staff also understand that one of these areas without local agency coverage created a private entity (The Eastside Water Management Area) so that it could participate in the KGA GSA. The 2022 KGA GSP indicates that this private entity was "working towards becoming a public agency in the future" (2022 Kern Groundwater Authority GSA GSP, p. 13). But Board staff are unaware of their progress and uncertain whether it meets the requirements to participate in the GSA and have authority (2022 Kern Groundwater Authority GSA GSP, p. 13).

Board staff are unable to properly evaluate basin management due to the complex arrangement of agencies involved and lack of clear detail demonstrating adequate coverage. Board staff note that inadequate coverage could undermine the subbasin's ability to reach sustainability, as pumping could shift to unmanaged areas where no GSA has authority to limit extractions or a portion of the Subbasin will become unmanaged and required to report to the Board, regardless of probationary determination.

Board staff propose the below Potential Action CRD-3 to address the deficiency.

Potential Action CRD-3 – GSAs should clearly define relationships and responsibilities consistent with SGMA requirements.

The Coordination Agreement should be updated with a table and maps that clearly depict which local agencies provide SGMA authority coverage across the subbasin. The table should list each member agency, its GSA affiliation, and its enforcement authorities. Each member agency should be clearly depicted on a map. Multiple maps may be required to depict spatial details. Importantly, any area in the Subbasin outside

the jurisdiction of member local agency that therefore relies on “lent” county authorities should be clearly symbolized and labeled. Importantly, unless the county decides to actively participate again, Board staff should be notified, and the Coordination Agreement should be updated and resubmitted to the DWR GSP Portal every time there is a change in agency participation or jurisdiction.

4.1.2 Deficiency GL – Defining and Avoiding Undesirable Results Related to Chronic Lowering of Groundwater Levels

Under SGMA, one requirement of achieving the sustainability objective for a basin is avoiding “chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon.” (Wat. Code § 10721, subd. (x).) Lowering groundwater levels can cause shallow wells to go dry or reduce their productivity, increase the energy costs of pumping, bring polluted water closer to well screens (the area where groundwater enters a well), or reduce water available for deep-rooted plants (see definition of groundwater-dependent ecosystems in Section 1.2). Lowering groundwater levels also makes it more difficult to avoid other, related undesirable results caused by groundwater conditions, including subsidence and depletions of ISW.

DWR concluded that the Kern County Subbasin 2022 GSPs made management area specific progress and impact analyses, but do not adequately justify: (1) how the various approaches for developing SMC for chronic lowering of groundwater levels will meet the same objective and avoid undesirable results for the Subbasin, (2) how lowering of groundwater level MTs beyond historical lows would impact other sustainability indicators, (3) the criteria that the GSAs will use to evaluate success in the subbasin (See sections below Table 4-1 below) (2022 Inadequate Determination, pp. 31-32). Board staff concur with DWR’s findings and further note that the 2022 GSPs: 1) Lack necessary detail about well mitigation and 2) do not describe a feasible path for halting chronic lower of groundwater levels.

Table 4-1 – Summary of DWR’s Chronic Lowering of Groundwater Levels Deficiency and Relevant Components of the 2020 and 2022 Kern County Subbasin GSPs

2020 GSPs	DWR’s 2020 GSP Incomplete Determination
The GSPs and Management Area plans use inconsistent data and methods to develop MTs.	The GSPs do not set the MTs for chronic lowering of groundwater levels in accordance with the GSP regulations.

2022 GSPs	DWR's 2022 GSP Inadequate Determination
The GSPs and Management Area plans still use inconsistent data and methods to develop MTs.	The GSPs do not adequately describe basin groundwater conditions at MTs that would lead to or help avoid undesirable results in the subbasin.

4.1.2.1 Kern County Subbasin 2020 Groundwater Sustainability Plans

This subsection and the following subsections describe the portions of the Coordination Agreement, individual GSPs, or DWR's determination relevant to the proposed Board deficiencies.

Plain-language Definition of an Undesirable Result

The 2020 Coordination Agreement for the Kern County subbasin described undesirable results for groundwater levels as "the point at which significant and unreasonable impacts over the planning and implementation horizon, as determined by depth/elevation of water, affect the reasonable and beneficial use of, and access to, groundwater by overlying users" (2020 Coordination Agreement, p. 299).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

MTs are the numeric values used to define undesirable results. MOs are specific, quantifiable goals for the maintenance or improvement of groundwater conditions to achieve the sustainability goal for the basin.

The 2020 Coordination Agreement quantified undesirable groundwater level results as the unreasonable lowering of groundwater levels when MTs "are exceeded in at least three (3) adjacent Management Areas that represent at least 15% of the subbasin or greater than 30% of the subbasin (as measured by each Management Area)" (2020 Coordination Agreement, Appendix 3). The MTs were set for each Management Area in their respective GSP. Additionally, local conditions that would need to occur in each Management Area to contribute toward the basin-wide quantitative undesirable result definition was not well defined across the subbasin (2020 Coordination Agreement, p. 299).

The 2020 GSPs did not describe how groundwater conditions at the MTs would impact beneficial uses of groundwater (e.g., estimating how many wells in the subbasin would be dry if groundwater levels were to drop to the MTs). Therefore, the associated impacts on beneficial uses and users are unknown.

Representative Monitoring Sites and Monitoring Network

The groundwater level monitoring network as described in the 2020 Coordination Agreement includes about 170 monitoring wells shown on a map (2020 Coordination Agreement, App. 3 Fig. 3-1). The Coordination Agreement does not summarize the number of wells to be monitored for chronic lowering of groundwater elevations, nor does it provide a summary table listing all Representative Monitoring Wells and their sustainable management criteria. DWR's SGMA Portal "Summary of Monitoring Sites" indicates there are 234 monitoring wells for the subbasin. Total depth information is not available for 50 of these 234 wells and values for the remainder range from 219 to 2,290 feet below ground surface.

The KRGSA proposed 34 wells to be monitored for water levels semi-annually in the spring between January 15 and March 30 and in the fall between September 15 and November 15 (2022 KRGSA GSP, pp. 6-3 to 6-7). The BVWSD GSA proposed 13 wells to be monitored for water levels (two of which are nested for two discrete intervals) also semi-annually in the spring and fall (2022 BVGSA GSP, pp. 93-95). The 13 monitoring locations consist of 9 monitoring wells, 3 production wells, and 1 landowner well. The spatial density of the proposed water level monitoring for the BVGSA is one monitoring location per 5.5 square miles (2022 BVGSA GSP, p. 95). The HMWD GSA GSP proposed 5 wells to be monitored for water levels. The SOKR GSA proposed 16 wells to be monitored semi-annually for water levels (2022 SOKRGSA GSP, p. 281). The spatial density of the proposed water level monitoring for the SOKRGSA is 9.7 monitoring sites per 100 miles squared. The KGA GSA proposed 194 to be monitored semi-annually in the spring and fall (2022 KGA GSA GSP, p. 271). The Olcese GSA proposed two wells to be monitored semi-annually in the spring and fall (2022 Olcese GSP, p. 94). The GSA proposed also monitoring groundwater elevations in three additional wells, two district production wells and a new shallow monitoring well, to inform management decisions: the three additional wells would not be part of the SGMA compliance monitoring network.

Well Impact Mitigation

The 2020 Coordination Agreement and GSPs did not mention plans for any well impact mitigation that would lessen the significance of impacts to wells from groundwater level declines allowed in the GSPs.

Projects and Management Actions

The local GSAs have proposed Projects and Management Actions for the subbasin to address groundwater level decline and loss of storage (as well as land subsidence and groundwater quality). The discussion of projects and management actions was general in most GSPs and did not specify the criteria that would trigger implementation, a timetable for implementation, a description of how the GSAs would meet costs, or an explanation of the source and reliability of the water necessary for the supply augmentation projects.

Many of the GSAs summarized the projects and management actions in the Todd Groundwater Tech Memo, an appendix in the Coordination Agreement (2020 Coordination Agreement, Appendix. 2, pp. 22-23). The proposed project and management actions include demand reduction (e.g. agricultural demand reduction, crop fallowing, and land-use conversion to urban), new supply projects from imported water (e.g. projected water purchases, new conveyance facilities, and expansion of surface water deliveries to reduce pumping), and other categories of supply from recharge, diversions, reallocations, and brackish water treatment. Water budget benefits of the proposed projects and management actions are projected to be about 422,000 AF/Y and most of that benefit is expected to come from demand reduction. The water budget aspects of the proposed projects and management actions were included in the Groundwater Flow Model of the Kern County Subbasin Model (C2VSimFG-Kern).

The KGA GSA umbrella GSP listed 173 projects and management actions from 18 member agencies (2020 Kern Groundwater Authority GSA GSP, Table 4-1). Olcese GSP provided a list of projects containing three contingent and three non-contingent projects (2020 Olcese GSP, Table PMA-1). The projects and management actions mainly include installing one shallow well to monitor the aquifer's hydraulic connection, installing the second shallow monitoring well in the vicinity of GDEs, developing a network of subsidence benchmarks, conducting new studies to fully understand the basin setting, and refining the definitions of SMCs for applicable sustainability indicators (ibid). KRGSA summarized six supply augmentation and land use change projects to provide about 148,972 AFY to 150,823 AFY of additional water supply to the KRGSA (2020 Kern River GSA GSP, Table 7-1, Section 7, p. 2).

BVWSD GSA suggested five categories of projects that will enable the GSA to sustainably manage groundwater, including water measurement, sustainability monitoring, groundwater recharge and recovery, water distribution system improvement, and water conservation and treatment (2020 Buena Vista GSP, p. 225). HMWD GSA suggested one project to optimize the recovery of Pioneer Project banked supplies in dry years (2020 Henry Miller Water District GSP, p. 85). Since HMWD is a recharge participant in the Pioneer Project and banked water from different resources since 1995, the district has a second priority right to recover the banked supplies when surface

supplies are sparce and deliver recovered water to the lands in the district (ibid). NKWSD projects and management actions focused mainly on improving the water conveyance infrastructure, expanding water banking program, and reusing of oilfield produced water (2020 North Kern Water Storage District and Shafter-Wasco Irrigation District Management Area Plan, p. 246).

Potential Effects of Minimum Thresholds on Other Sustainability Indicators

The 2020 Coordination Agreement did not explain how MTs had been selected to avoid causing undesirable results. The 2020 Coordination Agreement also did not explicitly discuss how groundwater level MTs relate to the MTs for other sustainability indicators; nor did the 2020 Coordination Agreement explain how the GSAs had determined that basin conditions at groundwater level MTs will avoid undesirable results for each of the sustainability indicators (2022 Inadequate Determination, p. 18).

4.1.2.2 Department of Water Resources' 2020 Groundwater Sustainability Plan Incomplete Determination

In the January 28, 2022, DWR determination letter, DWR identified a deficiency in the 2020 GSPs related to groundwater level SMC:

"Deficiency 2. The [2020] Plan does not set minimum thresholds for chronic lowering of groundwater levels in a manner consistent with the requirements of SGMA and the GSP Regulations" (2020 Incomplete Determination of Kern County Subbasin, p. 18).

DWR further noted that the approaches to developing groundwater level MTs was not coordinated across GSPs, stating that "the approaches used and the level of analysis to support those approaches, is disparate across the various plans" (ibid, p. 19).

Plain-Language Definition of an Undesirable Result

The GSP defined an undesirable result related to chronic lowering of groundwater levels as "[t]he point at which significant and unreasonable impacts over the planning and implementation horizon, as determined by depth/elevation of water, affect the reasonable and beneficial use of, and access to, groundwater by overlying users." (2020 Coordination Agreement, Appendix 3), and DWR found that the GSPs:

> [D]o not consistently explain how the lowering of groundwater levels to minimum thresholds and measurable objectives that are set below historical lows will impact other sustainability indicators specifically water quality, land subsidence, and reduction of groundwater storage (2020 Incomplete Determination of Kern County Subbasin, p. 2).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

DWR noted that the GSPs "do not consistently explain how the lowering of groundwater levels to minimum thresholds and measurable objectives that are set below historical lows will impact other sustainability indicators specifically water quality, land subsidence, and reduction of groundwater storage" (2022 Inadequate Determination, p. 19).

DWR's 2020 GSP Corrective Actions

DWR determined for all GSPs that the GSAs needed to take corrective actions to address groundwater level deficiencies, "All GSPs must demonstrate the relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the GSA has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators". Additionally, DWR presented GSP-specific corrective actions in Table 2 of the 2020 Incomplete Determination of Kern County Subbasin GSP (ibid, p. 20-35). Some GSPs proposed limiting groundwater level declines to 2013-2016 drought levels while others proposed MTs that were lower than recent drought groundwater levels with proposed mitigation for domestic well impacts. Alternatively, other GSPs for the subbasin proposed trend-projected groundwater level declines as their MTs (ibid, p. 19). Table 2 also summarizes DWR's proposed corrective actions. For example, DWR recommended that the KGA GSP provide description including maps of the areas not covered by their various Management Area Plans and to establish sustainable management criteria for these locations (ibid, p. 20).

4.1.2.3 Kern County Subbasin 2022 Groundwater Sustainability Plan Submission and Water Year 2022 Annual Report

The GSAs submitted revised GSPs to DWR on August 1, 2022, in compliance with the 180-day resubmittal deadline. While not considered in DWR's assessment of the 2022 GSPs, the GSAs also each filed a WY 2022 Annual Report for their portion of the subbasin on March 31, 2023.

Plain-Language Definition of an Undesirable Result

The 2022 Coordination Agreement for the Kern County subbasin described undesirable results for groundwater levels as "[t]he point at which significant and unreasonable impacts over the planning and implementation horizon, as determined by depth/elevation of water, affect the reasonable and beneficial use of, and access to, groundwater by overlying users" (2022 Coordination Agreement, p. 298). This does not differ from what was presented in the 2020 Coordination Agreement.

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

As with the previous Coordination Agreement, the 2022 Coordination Agreement does not summarize MTs and MOs in a table. A table summarizing MTs and MOs would allow for easier and more complete review and consideration of the sustainable management criteria. However, both Coordination Agreements do present maps of groundwater elevation contours, one each for the MTs and MOs, and those maps are identical, suggesting that the MTs and MOs were not revised for the 2022 Coordination Agreement.

The 2022 Coordination Agreement quantitatively defines an undesirable result for groundwater levels as when "the minimum threshold for groundwater levels are exceeded in at least three (3) adjacent Management Areas [MAs] that represents at least 15% of the subbasin or greater than 30% of the subbasin (as measured by each Management Area). Minimum thresholds shall be set by each of the Management Areas through their respective Groundwater Sustainability Plans" (2022 Coordination Agreement, Appendix 3, p. 298).

The 2022 Coordination Agreement also includes a Management Area groundwater level MT exceedance trigger, defined as "when groundwater levels decline below established MTs in 40% or more of any representative monitoring wells within the Management Area over four consecutive bi-annual SGMA required monitoring events" at which point a Management Area is potentially contributing to a basin-wide undesirable result (2022 Coordination Agreement, Appendix 3, p. 300). Still, the various GSAs and Management Areas used different methods for establishing SMC as described below:

BVWSD GSP used a three-tiered approach to establish SMCs. Tier 1 involved defining MTs and MOs for each monitoring site in a hydrogeologic zone (HZ) (an area of common physical characteristics independent of GSA or district boundaries). This was done to avoid conflicting SMC with neighboring GSAs or Management Areas. Tier 2 is the management of MTs and MOs, which recognized that while all GSAs within a HZ are collectively responsible for avoiding undesirable results, each GSA will have its own management tools for doing so. Tier 3 allows for the formation of Management Area boundaries based on the extent of a sustainability indicator of concern, or by physical boundaries between Management Areas (2022 Buena Vista Water Storage District GSA GSP, pp. 113-114).

Eleven representative monitoring wells (nine well sites with two nested wells) and their corresponding hydrographs were used to develop initial MTs for the Buttonwillow Management Area (BMA). Using the decreasing GWL trends from the 2011-2018 drought period, a "worst case" MT was created (up to a 354 ft decline in GWL by 2040). These "worst case" projections were then adjusted at each RMS to account for local

well construction (domestic, agricultural, municipal, and industrial wells), and aquifer characteristics. MTs were not set below the top of confining or semi-confining clay layers; were developed to minimize loss of production from existing domestic and municipal wells; are intended to keep the groundwater gradient floor at elevations observed in Fall of 2015; and are consistent with other Management Areas in the subbasin (undesirable result triggered when GWLs are below MTs in 40% of RMSs for four consecutive bi-annual SGMA required monitoring events). MOs were set at nine RMSs and all but one MO was set above January 2015 WLs. A margin of operational flexibility (the difference between the MO and MT) for each RMS ranges from 65-87 ft (2022 Buena Vista Water Storage District GSA GSP, pp. 115-141).

KRGSA GSP clarified their approach to undesirable results in response to DWR's Determination Letter. GSAs in the subbasin now have consistent definitions and terminology for avoiding undesirable results at the subbasin and local Management Area level, as defined in Appendix 3 of the 2022 Coordination Agreement. Local KRGSA undesirable results are now called "Management Area Exceedances" or "Local Adverse Impacts" to avoid confusing them with subbasin-wide undesirable results. Subbasin wide "triggers" differ from Management Area Exceedances (2022 Kern River GSA GSP, ch. 5, pp. 7-8). The quantitative definition of undesirable results mirrors that which is provided in the 2022 Coordination Agreement (see above). This definition was compared with conditions in each KRGSA Management Area to evaluate if impacts occur locally at 2015 (baseline) levels, or if the sustainability indicator could have future impacts. This process was used to establish the various MTs and MOs for each Management Area:

> KRGSA Urban Management Area had MTs set at the historical low water level measured in RMSs. The MO was defined as the average high-water level of the historical study period and the MT of each monitoring well, which represents the mid-point of each well's "operable range". The Urban Management Area states the water level that prevents adverse impacts cannot be quantified with certainty, and that MTs, MOs, and triggers for Management Area exceedances will need future adjustments. The trigger for a Management Area exceedance is the WL in an RMS falling below the MT for three consecutive months (2022 Kern River GSA GSP, ch. 5, p. 16). Northeast ENCSD Wellfield requested an MT 50ft below the historic low WL for their area. Their MO is the average between the historic high WL and the MT. The Management Area exceedance is the same as the Urban Management Area (2022 Kern River GSA GSP, ch. 5, p. 17). Northwest Agricultural Wells of the Urban Management Area had MTs 20ft lower than the historic low WLs in the area (This is the same for the Banking MA). The MO and Management Area exceedance are defined as above for the Urban and ENCSD areas. The GSP states differing well construction and generally lower GW levels as the reason for the enhanced "operational flexibility" (lower MT) for the Northwest agricultural wells (ibid).

Management Area Exceedance criteria for the Agricultural Management Area is triggered when “40 percent or more of the [RMWs] in the Agricultural MA remain below the MT over a period of two years” - this differs from the trigger described for the other Management Areas above. For small water systems, such as Lamont PUD, it was decided that MTs and MOs in the vicinity of the water systems should be set higher than in other Management Areas (2022 Kern River GSA GSP, ch. 5, pp. 19-22).

HMWD GSP defined their MO as all static GWLs averaging no more than 150 ft bgs by 2040. This represents the 2015 baseline conditions. Interim milestones were calculated using “recent groundwater levels of approximately 115 ft bgs” as their starting point and the 150 ft MO as the 2040 end point. The interim milestones for 2025, 2030, and 2035 each consist of a 9 ft decrease in WL elevation, while the final period (2035-2040) is 8 ft (2022 Henry Miller WD GSP, p. 76). The MT for GWLs was developed using construction information for production wells and was set to 350 ft bgs. If GWLs are below the MT in 40% of the RMWs over four consecutive bi-annual SGMA required monitoring events then the GSA has exceeded its MT and is considered an undesirable result (2022 Henry Miller WD GSP, p. 80 & 84).

Olcese GSP’s basin-wide definition for a WL undesirable result matches that of the 2022 Coordination Agreement (see above). Undesirable Results may result in well dewatering, increased pumping lift, and impacts to ISW and GDEs (2022 Olcese Water District GSP, p. 76-78). MTs have been established for two RMSs and were set to the top elevation of their respective well screens. The MOs are defined as GWLs 40 ft below July 2017 WLs in the RMSs. Data prior to 2017 was not available for the RMSs, and the GSP assumes 2017 WLs would have been higher than the years prior, due to relatively wet conditions, thus the MOs are higher than historical lows. A linear interpolation from 2017 levels to the MT was used to calculate interim milestones (note: the interim milestones demonstrate a negative GWE trend) (2022 Olcese Water District GSP, p. 86-92).

SOKR GSP’s basin-wide and quantitative definition for a WL undesirable result is the same as the 2022 Coordination Agreement (see above). Within the GSP boundary, there are three primary Management Areas: Arvin-Edison, Wheeler Ridge-Maricopa, and Tejon-Castac. The potential effects of undesirable results in all three Management Area are well dewatering, increased pumping lift, and land subsidence. The development of MTs considered historical WLs from RMSs, proximity of RMS to critical infrastructure, well construction information, and consideration of adjacent GSAs, basins, and other sustainability indicators. Initial MTs were set at each RMS following this calculation: the lower of either (a) historic low GWL minus a variability correction factor, or (b) Fall 2015 GWL minus the greater of the variability correction factor or trend continuation factor (2022 South of Kern River GSP, pp. 229-231). The initial MTs were

adjusted as needed in proximity to critical infrastructure, often being set at historical lows to prevent further subsidence. Spatial patterns of the MTs were evaluated to divide Management Areas into zones to help with selecting appropriate RMSs (ibid).

KGA Umbrella GSP defined a WL undesirable results as impacts affecting 15% of the subbasin area (using combined acreage of three adjacent Management Areas with exceedances) or 30% of the subbasin area (using the combined acreage of any Management Area with exceedances). MTs shall be set by each Management Area through their Management Area Plans or GSPs (2022 Kern Groundwater Authority GSA GSP, pp. 207 and 211). This definition is essentially the same as that found in the 2022 Coordination Agreement (see above). The potential impacts of lowering GWLs are addressed by each MAP (2022 Kern Groundwater Authority GSA GSP, p. 212). A Managers Group was created to develop the MTs and MOs for the entire subbasin. More details are found in the individual Management Area Plans (2022 Kern Groundwater Authority GSA GSP, Page 218).

Two examples regarding methods Management Areas used when setting SMC in individual Management Area Plans within KGA are as follows:

> Cawelo WD Management Area Plan MTs are set approximately 80 ft below the low GWL experienced during the 2007-2016 drought period and are established for the seven RMSs in the WD (2022 Cawelo Water District Management Area Plan, p. 168). MOs were set to the low GWL observed at each RMS, or nearby monitoring well, during the same drought period. Interim milestones were calculated by adding one-quarter of the difference between the MT and MO onto the MT every five years (p. 169).
>
> EWMA Plan MO is “provisionally” defined as the WL elevation measured in 2015 in each RMW – if 2015 data is not available, the measurement closest to 2015 is used (2022 Eastside Water Management Area MAP, p. 93). Interim Milestones will start from the lowest GWL measured after the GSP is adopted and follow a linear progression toward the MO (ibid). The EWMA recognizes that more GWL data is needed to better understand trends. Due to the lack of historical data for many of the wells in the monitoring network, MTs were not calculated using historical trends. A 20% drawdown of saturated water column height from the bottom of the well (based on 2015 levels) was used instead (2022 Eastside Water Management Area MAP, p. 97). If a MT did not allow for a minimum of 30 feet of head above the existing pump intake it was adjusted on a well-by-well basis (2022 Eastside Water Management Area MAP, p. 98).

Representative Monitoring Sites and Monitoring Network

The groundwater level monitoring network as described in the 2022 Coordination Agreement includes 198 monitoring wells summarized as number of wells per Management Area in a table (2022 Coordination Agreement, Appendix 3, p. 303). There appear to be 28 more monitoring wells reported for the monitoring network in the 2022 Coordination Agreement, compared with the 170 monitoring wells in the 2020 Coordination Agreement. However, there is no explanation provided in the Coordination Agreement for this difference. The Coordination Agreement does not list all wells to be monitored for chronic lowering of groundwater elevations, nor does it provide a table of their sustainable management criteria. DWR's SGMA Portal Summary of Monitoring Sites, Groundwater Wells contains 234 monitoring wells for the subbasin. Total depth information is not available for 50 of these 234 wells and values for the remainder range from 219 to 2,290 feet below ground surface.

BVWSD has eleven RMS wells that serve as dedicated monitoring wells used for collecting WL data. These wells are currently used for CASGEM reporting and follow a north-south axis through the BMA. Three additional BVWSD production wells will be added to the monitoring network (along the eastern boundary of the GSA), as well as one private landowner's well in the southeastern portion of the GSA. The wells are distributed over the 72 square-mile (one site per 5.5 square miles) BMA. All wells in the monitoring network will have WLs measured semi-annually in Spring and Fall. New monitoring wells will be installed in the instance of questionable data quality from production wells or the presence of data gaps. Additional wells installed for the Palms Project will be added to the monitoring network to increase coverage in the southern portion of the BMA (2022 Buena Vista Water Storage District GSA GSP, pp. 93-98).

KRGSA includes 39 RMWs (38 KRGSA and 1 Greenfield CWD), many of which are production wells that will require pumps to be shut off, for sufficient time periods, to measure representative GWLs. Many of the wells also lack detailed construction information. The RMWs represent the Urban, Agricultural, and Banking Management Areas. The frequency of monitoring is semi-annually, with some Urban wells being monitored monthly (2022 Kern River GSA GSP, ch. 6, pp. 1-9). As of the writing of the 2022 GSP, access agreements were not in place. Updates to the monitoring network over the first five years of implementation are planned and discussed in the management actions section (2022 Kern River GSA GSP, s. 7.2.8).

HMWD GSP monitoring network consists of five wells that are intended to represent the conditions within the GSA based on well construction and pumping demand. The five wells also have CASGEM data associated with them. Semi-annual GWL measurements will be taken between January 15 – March 30 and September 15 – November 15. There exist no monitoring wells specifically for domestic or other beneficial uses. The GSA does not feel they need to change their monitoring network and that no data gaps will arise (2022 Henry Miller WD GSA GSP, pp. 86-90).

Olcese GSP monitoring network consists of two existing production wells, which are part of the CASGEM network. Two additional existing production wells and a new shallow monitoring well will be used to monitor GWLs. GWLs will be measured at the RMSs bi-annually (spring and fall). If monitoring results demonstrate a hydraulic connection between the Olcese sand aquifer and shallow alluvium, an additional shallow monitoring well will be installed for data collection (2022 Olcese Water District GSP, p. 94).

SOKR GSP includes details for the monitoring network in their three MAs. Arvin-Edison has 16 sites to be measured semi-annually (9.7 sites/100 mi^2). Wheeler Ridge-Maricopa has 14 sites to be measured semi-annually (10.4 sites/100 mi^2). Tejon-Castac only has one site currently, but the GSA is looking to add one or more additional wells to the network (2022 South of Kern River GSP, pp. 265-269).

KGA Umbrella GSP provides a table that lists the monitoring network for the entire subbasin. The monitoring network consists of 111 RMSs (2022 Kern Groundwater Authority GSA GSP, Table 3-3. p. 222). Until a sufficient number of monitoring wells are installed in the subbasin, production wells will continue to be relied on for data collection. There are six new RMSs in the subbasin (included in the 111), two in North Kern WSD, two in Shafter-Wasco ID, one in Rosedale-Rio Bravo WSD, and one in Semitropic WSD (2022 Kern Groundwater Authority GSA GSP, Table 3-4, p. 223). Table 3-4 does not include proposed changes in the updated MAPs. The monitoring protocols require that data be collected from each principal aquifer, during approved time frames only (Jan 15th to Mar 30th and Sept 15th to Nov 15th) (2022 Kern Groundwater Authority GSA GSP, p. 247).

Well Impact Mitigation

The 2022 Coordination Agreement did not mention plans for any well impact mitigation that would lessen the significance of impacts to wells from groundwater level declines allowed in the GSPs. GSPs discuss well mitigation to varying degrees as summarized below.

BVWSD GSP states that a mitigation plan will be developed to respond to declining GWLs where they interfere with groundwater production and will be modeled after DWR-approved mitigation plans. The BVGSA will also maintain a fund for well rehabilitation such as deepening, well replacement, or pump lowering (2022 Buena Vista Water Storage District GSA GSP, pp. 132 and 269).

KRGSA plans to avoid adverse well impacts due to lowering of GWLs by “reasonably modif[ying]” a well to account for GWL declines, redistribute pumping, or utilizing alternative water supplies. In the event that well impacts cannot be mitigated they may need to reduce pumping rates or implement temporary cessation of pumping (2022

Kern River GSA GSP, ch.5, p. 14). The KRGSA GSP does not contain a section dedicated to well impact mitigation.

KGA GSP states that “A Domestic Well Mitigation Program will be developed and implemented by all KGA members.” (2022 KGA GSA GSP, 293). These well mitigation programs are intended to mitigate the potential impact to wells from declining groundwater levels as a consequence of groundwater management actions.

The SOKR GSP states that they “have committed to mitigating potential impacts of dewatering on domestic wells that may occur as a result of SGMA implementation by establishing an Impacted Well Mitigation Program, to be developed as part of implementation” (SOKR GSA GSP, p. 246). Actions that the program may take to mitigate impacted wells include pump replacement or lowering, well deepening or replacement, or providing for alternative water sources (SOKR GSA GSP, p. 343).

HMWD and Olcese GSPs do not include well impact mitigation plans.

Projects and Management Actions

The GSAs summarized projects and management actions in the Todd Groundwater Tech Memo, an appendix in the Coordination Agreement (2022 Coordination Agreement, Appendix 2, pp. 22-23). The proposed project and management actions include demand reduction (e.g. agricultural demand reduction, crop fallowing, and land-use conversion to urban), new supply projects from imported water (e.g. projected water purchases, new conveyance facilities, and expansion of surface water deliveries to reduce pumping), and other categories of supply from recharge, diversions, reallocations, and brackish water treatment. Water budget benefits of the proposed projects and management actions were projected in both the 2020 and 2022 Coordination Agreements to be about 422,000 AF/Y and most of that benefit is expected to come from demand reduction. The water budget aspects of the proposed projects and management actions were included in the Groundwater Flow Model of the Kern County Subbasin Model (C2VSimFG-Kern).

The BVWSD GSP lists five project categories: water measurement, sustainability monitoring, water distribution system improvements, groundwater recharge and recovery, and water conservation and treatment projects. Magnetic flow meters were installed on all production wells in the GSA boundary. Portions of the canals are being converted to pipelines with flow meters, and upgraded canal gates are to be installed to better measure surface water deliveries. Groundwater banking facilities are also being developed inside and outside of the GSA (such as the Palms Project or McAllister Ranch). The Brackish Groundwater Remediation Project is designed to improve shallow (perched) groundwater quality in the northern BMA by blending low salinity water before application to crops. Such projects are to be implemented regardless of groundwater

conditions. Also included in the GSP are adaptive management actions that will be implemented if the aforementioned actions do not result in reaching MOs. Adaptive management actions include curtailment of Kern River water exchanges with other entities, fallowing annual crop land, bolstering of surface water supplies via transfers or exchanges, limiting agricultural and industrial extractions within a specified radius of RMSs with breached MTs, and doubling of assessments or tripling of water rates (2022 Buena Vista Water Storage District GSA GSP pp. 246-272).

The KRGSA GSP includes various projects and management actions that encompass two phases. Phase one projects include the following: Water Allocation Plan, Kern River Conjunctive Use Optimization, Expand Recycled Water Use in KRGSA Plan Area, Land Use Conversion - Urbanization of Agricultural Lands, ENCSD North Weedpatch Water System Consolidation, and Possible Water Exchange for Improved Drinking Water Quality in DACs. The phase one management actions are: Implement Action Plan if Water Levels Fall Below Minimum Thresholds, Optimize Conjunctive Use in the KRGSA, Establish Well Metering Policy in the KRGSA, Implement Groundwater Extraction Reporting Program, Support Delta Conveyance Project to Preserve Imported Water Supplies, Incorporate Climate change Adaptation Strategies, Support Sustainable Groundwater Supplies for KRGSA DACs, Improve Groundwater Monitoring in the KRGSA Plan Area, Avoid Widespread Impacts to Domestic and Small Water System Wells, Incorporate a Policy of Adaptive Management in the KRGSA GSP Process. The phase one project and management actions have an implementation timeline for 2020-2040, and many of the timelines have continuation periods. Phase two projects and management actions are: Expansion of the Northeast Treatment Plant to Buildout, Re-negotiation of Banking Contract, Capital Improvements to Municipal Wells, Install Dedicated Monitoring Wells, Expansion of Recharge Facilities, Pumping Reductions and Allocation of Agricultural Groundwater, Conversion of Agricultural Lands, Additional Urban Conservation Measures, Additional Considerations for Adaptive Management. Phase two is slated for 2031-2040 ((2022 Kern River GSA GSP, ch.7, pp. 1-32 and ch. 8, pp. 1-3).

HMWD GSP identifies two project and management actions. The first project is optimizing the recovery of Pioneer Project banked supplies in dry years. The purpose of this project is to avoid overdraft. The second project is demand reduction due to land fallowing in dry years, which will also help avoid overdraft (2022 Henry Miller WD GSA GSP, pp. 91-92).

The Olcese GSP categorized their projects and management actions as non-contingent and contingent. The non-contingent actions are installing a shallow monitoring well to evaluate potential hydraulic connection between Olcese Sand Aquifer and Shallow Alluvium and conduct a study on this potential hydraulic connection. The contingent actions are, in the case of a demonstrated connection between the two aquifers, to

install a second shallow monitoring well near potential GDEs along Cottonwood Creek to monitor groundwater levels for at least three years, and to refine their definitions of undesirable results, MTs, and MOs based on the results from the previous actions in the first 5-year GSP update (2022 Olcese Water District GSP, p. 101).

SOKR GSP grouped their project and management actions into water supply augmentation projects, water demand reduction management actions, projects to improve drinking water quality in ACSD service area, and additional data-gap filling efforts. The projects most focused on GWLs include enhanced recharge and banking, floodwater capture, increasing surface storage capacity and deliver, new supplies (such as reclamation of oilfield produced water and wastewater from Arvin and Bakersfield), some of which are planned for each of the Management Areas (2022 South of Kern River GSP, pp. 291-296).

KGA GSP states that projects and management actions were developed at the MA level, and lists them all in Table 4-1 (2022 Kern Groundwater Authority GSA GSP, p. 276-290). KGA also listed several project and management actions it plans to implement to help coordination GW management subbasin-wide: Subsidence monitoring, groundwater modeling, study of native yield of the subbasin, Kern County subbasin, basin-wide study, subbasin wide consumptive use monitoring, managing to measurable objectives, domestic well mitigation program, KGA monitoring network improvement program, basin-wide coordination, and annual reporting (2022 Kern Groundwater Authority GSP, pp. 268-269). The Management Area specific PMAs are as follows:

> Cawelo WD – KGA action plan related to exceedance of minimum thresholds for chronic lowering of groundwater (NEW), domestic well mitigation program (NEW), voluntary land conversion, crop conversion and irrigation efficiency, land acquisition, secure access to additional monitoring locations, new water supply purchases, increase groundwater recharge and banking capacity, new Cawelo GSA banking partners, water treatment facilities, Friant pipeline project, Poso Creek flood water capture, surface water storage, and out of Cawelo GSA banking. Many of these PMAs are ongoing since 2020 (2022 Kern Groundwater Authority GSA GSP, p. 276-290).
>
> EWMA – development of oilfield produced water supplies, fill-in data gaps with aquifer-specific monitoring wells, installation of pressure transducers in select wells in the monitoring network, surface runoff and infiltration impoundments, exceedance policy, reduction of irrigated acres/modification of irrigation methods or crop types, assess GW use fees, and establish transferrable water credit system. None of these PMAs were initiated as of the 2022 GSP (ibid).

KWB – operations plans, groundwater storage improvement, water quality protection, subsidence monitoring, and KWB recharge enhancement project. All are ongoing with the exception of the recharge enhancement, which is completed (ibid).

KTWD – modify district pricing structure, CRC pipeline project – produced water project, and in-district surface storage. These PMAs are in the design and permitting stages (ibid).

NKWSD and SWID – Calloway canal improvements, expanded water banking program, GW banking conveyance improvements to NKWSD recharge and recovery, beneficial reuse of oilfield produced water, SCADA automation and evapotranspiration measurement improvements, Poso Creek weir, spreading pond facility, expanded recharge, allocation of available NKWSD supplies, Dilts Intertie Lateral piping and WMI, Bell recharge project, Leonard Avenue conveyance improvement project, improved WL measurement of district recharge facility, expanded water banking program, refinement of water budget components, “Surface Water First” incentive program, On-Farm efficiency/deficit irrigation practices incentive program, on-farm recharge activities incentive program, subsurface recharge feasibility study, land conversion from agricultural use to urban use, urban water conservation program, mitigation program for potential impacts to domestic wells, in-district allocation structure, voluntary land fallowing, pumping restrictions, coordinate with existing water quality programs, domestic well survey (NEW), KGA exceedance policy (NEW), and ongoing evaluation of GWLs and water quality trends (NEW). These PMAs are at different stages of implementation (ibid).

Pioneer GSA – installed monitoring well in North Pioneer, continued balanced pumping and recharge, continued participation in basin-wide coordination with other GSAs, and increase surface spreading losses from 6 to 10 percent. These PMAs are at different stages of implementation (ibid).

RRBWSD MA – West Basin improvements, Stockdale East GW storage recovery project, pilot projects, Onyx Ranch, James GW storage and recovery project, Kern Fan GW storage project, Wester Rosedale in-lieu service area, Ten Section water recharge project, water charge demand reduction, and RRBWL (White Land) water supplies and demand imbalance reduction, RRBWD 3rd party recharge and storage program, emergency domestic water response (NEW), coordination with State regulatory programs (NEW), KGA action plan related to exceedance of MTs for chronic lowering of GW (NEW), and unmitigated domestic well replacements (NEW). The PMA are in various stages of implementation (ibid).

SSJMUD – In-district spreading and recovery facility (REVISED), Regan recharge facility (NEW), SSJMUD and Semitropic Schuster Intertie, SSJMUD and CWD intertie pipeline, SSJMUD and North Kern WSD 9-28 intertie pipeline, Southeast

Delano spreading grounds, City of Delano spreading grounds (REVISED), Pond Road spreading grounds, in-district spreading grounds, conversion of dairy to recharge facility, “Surface Water First” incentive program, on-farm efficiency/deficit irrigation practices incentive program. On-farm recharge activities incentive program, conversion of agricultural land to urban use, urban water conservation program, coordinate with existing water quality programs, KGA exceedance policy (NEW), domestic well mitigation program (NEW), in-district allocation structure, voluntary land fallowing, and pumping restrictions. These PMAs are at various stages of implementation (ibid).

SWID – 7th standard – evaluation of potential to utilize SWID Kimberlina ponds for recharge (or other facilities), evaluate potential to partner in Kern Fan GW storage project, 7th Standard Annex Management Area storage pond project, identify opportunities to utilize existing infrastructure, on-farm GW recharge, Flat Rock Canal extension, new interconnections within SWID conveyance system, increase recycled water and recharge, on-farm water conservation, voluntary rotational land fallowing, and education of GW use per acre. These PMAs are at various stages of implementation (ibid).

SWSD – landowner water budgets, tiered pricing for GW pumping, district fallowing program, enhanced GW recharge, monitoring network improvement plan, evaluation and assessment of GDEs within the Semitropic Management Area, brackish water desalination, in-district water markets and transfers, Poso Creek MAR, Tulare Lake project, water market acquisitions, stored water recovery unit, Pond-Poso spreading grounds (phase 2), Pond-Poso entrance ponds, multi-district conveyance, Schuster spreading grounds, Leonard Avenue system, Diltz intertie, Cox canal, and stored water recovery unit – XYX. These PMAs are in various stages of implementation (ibid).

WKWD – automatic meter reading project, participation in California WaterFix, Buena Vista Recreation Area water supply management coordination, continued balanced pumping and recharge, implement water shortage response plan, continued participation in basin-wide coordination, Taft recycled water program, shift balance of pumping between north and south wellfields, and implement permanent demand management measures. These PMAs are in various stages of implementation (ibid).

WDWA – collect representative hydrogeologic data, water resource coordination, and conjunctive reuse of naturally degraded brackish GW (ibid).

Groundwater Allocations and Demand Management

Proposed demand management is summarized in the Todd Groundwater Tech Memo, an appendix in the Coordination Agreement (2022 Coordination Agreement, Appendix 2, pp. 22-23). These projects and management actions include incentivized agricultural demand reduction projects, fallowing land to use as groundwater recharge areas, and conversion of agricultural land to urban use. Allocations for individual groundwater pumpers are not discussed in the 2022 Coordination Agreement. The KRGSA GSP does propose to develop allocation plans, and the Todd Groundwater Tech Memo does propose reallocations of water by reducing banked groundwater and surface water sales to retain water within the agency.

Potential Effects of Minimum Thresholds on Other Sustainability Indicators

The 2022 Coordination Agreement did not explain how MTs had been selected to avoid causing undesirable results.

The 2022 Coordination Agreement also did not explicitly discuss how groundwater level MTs relate to the MTs for other sustainability indicators; nor did the 2022 Coordination Agreement explain how the GSAs had determined that basin conditions at groundwater level MTs will avoid undesirable results for each of the sustainability indicators.

4.1.2.4 Proposed State Water Board Deficiencies and Potential Actions

In DWR's 2022 GSP Inadequate Determination dated March 2, 2023, DWR staff determined that the GSAs had not corrected the chronic lowering of groundwater levels deficiency in the 2022 GSPs. DWR's 2022 GSP Inadequate Determination states:

> "the revised GSPs did not take sufficient action to explain how the various minimum thresholds will collectively achieve the sustainability goals and avoid undesirable results for the subbasin, which materially affects the ability of the agencies to achieve sustainability and the ability of the Department to evaluate the likelihood of the plan to achieve sustainability" (2022 Inadequate Determination, p. 3).

Board staff agree with DWR's findings in their 2022 GSP Inadequate Determination and hereby incorporate it by reference. In addition, Board staff have identified additional issues with the role of well impact mitigation in avoiding undesirable results.

Below, Board staff break down deficiencies for the subbasin related to lowering of groundwater levels. Deficiencies from DWR's inadequate determination are summarized below as Groundwater Level Deficiency GL-1, which corresponds to Coordination Deficiency CRD-1. Coordination Deficiency CRD-1 concerns poorly coordinated undesirable results and SMC for multiple indicators. Deficiency GL-1 describes how Deficiency CRD-1 applies to groundwater levels. The Board's well mitigation and allocation deficiencies are included as Groundwater Level Deficiencies GL-2 and GL-3.

Deficiency Groundwater Levels - 1 (GL-1) – Groundwater Level Undesirable results and SMC are not coordinated

What SGMA Requires: SGMA requires that "Agencies intending to develop and implement multiple plans pursuant to Water Code § 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies…", and Regulations requires that "elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting" (Cal. Code Regs., tit. 23, § 357.4, subd. (a)).

In defining undesirable results, GSA are required to "describe the process and criteria relied upon to define undesirable results [that would occur when significant and unreasonable effects are caused by groundwater condition in the Subbasin]" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition should include the cause of groundwater conditions occurring throughout the Subbasin that has or may lead to an undesirable result, the criteria used to define when and where the effects of groundwater conditions cause undesirable results, and the impacts on beneficial uses and users (Cal. Code Regs., tit. 23, § 354.26 subd. (b)).

In establishing SMC, GSAs must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26" (Cal. Code Regs. tit. 23 § 354.28). Discussion of the MTs should include among other things the "relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators" (Cal. Code Regs. tit. 23 § 354.28).

Undesirable results and SMC should be consistent with key details in the Coordination Agreement. Agencies should describe how they use the same data and methodologies for assumptions described in Water Code § 10727.6 by including monitoring objectives, coordinated basin water budget, and sustainable yield for the basin supported by a description of an undesirable result for the basin, and an explanation of how the minimum threshold and measurable objectives relate to the undesirable result (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). The coordination agreement shall also explain how the Plans implemented together, satisfy the requirements of the Act (Cal. Code Regs., tit. 23, § 357.4, subd. (c)).

GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate

implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).

Deficiency:

This is the corresponding groundwater level deficiency for coordination deficiency CRD-1. Deficiency CRD-1 concerns undesirable results and SMC that are poorly coordinated across the subbasin. It includes two corresponding sub-deficiencies:

Deficiency	Coordination Deficiency	Corresponding Groundwater Level Deficiency
Undesirable results are not coordinated	CRD-1a	GL-1a
SMC rely on inconsistent datasets and methodologies	CRD-1b	GL-1b

Board staff note that addressing these coordination deficiencies effectively requires that groundwater level undesirable results and SMC be redeveloped.

Deficiency GL-1a – Undesirable results are poorly described, unworkably complex, and inconsistently implemented.

Deficiency: This is the groundwater level deficiency that corresponds to Coordination Deficiency CRD-1a. Coordination Deficiency CRD-1a concerns undesirable results. For each sustainability indicator:

- The plain-language undesirable results from the Coordination Agreement are poorly described. While each GSP and Management Area Plan adopts the same plain-language undesirable results, they are interpreted and implemented very differently because they are too vague. This inconsistent interpretation exacerbates other issues with quantitative undesirable results and SMC.
- The quantitative undesirable results: 1) require a complex set of conditions occur across multiple GSAs and Management Areas, 2) are too poorly described and coordinated to be consistently implemented across GSPs and Management Area Plans, and thus 3) result in SMC that describe different conditions and impacts across different GSAs and Management Area Plans.

For groundwater levels:

- The quantitative undesirable result is unworkably complex to prevent undesirable results. The Coordination Agreement requires two conditions to trigger an undesirable result: 1) an MT exceedance must occur in 40% of RMS for four consecutive measurements (at least 2 years) for a management area to contribute to an undesirable result and 2) three adjacent management areas (accounting for at least 15% of basin area) or any management areas accounting for 30% or more of the basin area must be contributing to the undesirable results. This set of conditions is so complex that DWR found that it "may allow for situations where groundwater conditions could degrade for sustained periods of time for portions of the Subbasin without triggering an undesirable result" (2022 Inadequate Determination, p. 10). DWR also noted that "it is unclear… how minimum threshold exceedances will be tracked and reported in each management area and evaluated against the land area-based Subbasin-wide undesirable result definition" (ibid, p. 12). DWR stressed that the set of conditions was so complex that "Department staff cannot evaluate how the various management areas would assess whether any minimum threshold exceedance, for any amount of time and in any area, is causing effects that could be or become significant and unreasonable" (ibid, p. 12).

- The quantitative undesirable result is unworkably complex to support the plain-language undesirable result. DWR notes that "it remains unclear to Department staff what effects or conditions would be occurring in each management area if a Management Area Exceedance was to be realized without triggering a Subbasin-wide undesirable result…"

- Board staff find that the plain-language undesirable results are not detailed enough for consistent implementation across so many different GSPs and Management Area Plans. Board staff acknowledge that GSPs and Management Area Plans did adopt common plain-language undesirable results. But plain-language undesirable results should clearly describe the effects that a subbasin is trying to avoid. If they do, the conditions that trigger quantitative undesirable results should be similar across GSAs and Management Areas. Instead, as illustrated in Deficiency GL-1b, the conditions that would trigger quantitative undesirable results vary substantially across GSAs and Management Areas. Board staff understand the unique challenge of coordinating undesirable results and SMC across so many GSAs and Management Areas. Board staff stress, however, that this challenge only makes it more crucial for the Kern County Subbasin to develop clear, robust undesirable results and SMC.

Board staff propose the below Potential Action GL-1a to address the deficiency.

Potential Action GL-1a – Develop consistent, clear undesirable results.

GSAs should:

- Update the Coordination Agreement with a consistent plain-language groundwater level undesirable result that clearly describes the impacts that the basin would consider significant and unreasonable and therefore is attempting to avoid. For example, for groundwater levels, this might be a percentage of impacted of domestic wells.

  In developing the plain-language undesirable result, GSAs should prioritize engaging with representatives from the range of users in the subbasin, including domestic well owners, small farmers, infrastructure managers, state and federal fish and wildlife agencies, and others, to clearly describe the impacts that would be considered significant and unreasonable. Feedback from users in the subbasin can help identify a definition of an undesirable result for chronic lowering of groundwater levels that is specific to the uses in the subbasin.

  The plain-language undesirable results should be specific enough that GSAs and others can evaluate, over time, whether undesirable results have occurred and whether the quantitative definition is sufficient to detect them. Undesirable results should also be detailed and clear enough that they are implemented relatively consistently across the subbasin, which requires that all GSAs and Management Areas clearly understand the effects that are “significant and unreasonable” for the basin.

- Update the Coordination Agreement with a consistent, quantitative undesirable result that clearly describes the combination of MT exceedances that represent the conditions that would cause the plain-language undesirable result. Importantly, this quantitative undesirable result should be coordinated well enough across the subbasin that it is straight-forward and easy to track and evaluate, and the Coordination Agreement should explain how it represents the conditions that would cause a plain-language groundwater level undesirable result.

- Update GSPs and Management Area Plans with the updated plain-language and quantitative undesirable result definitions. Regulations allow Management Areas to define different MTs and MOs, so long as “undesirable results are defined consistently throughout the basin” (Cal. Code Regs., tit. 23, § 354.20). Board staff suggest that to substantially comply with consistently defining undesirable results, GSPs and Management Area Plans should adopt the same undesirable result language as the rest of the basin, unless:

- They demonstrate that their different undesirable results are: 1) more protective than those in the Coordination Agreement **and** 2) easily integrated into basin-wide evaluation of undesirable results,

  OR

- They demonstrate: 1) unique needs for different undesirable results, 2) that their undesirable results are at least as protective as those in the Coordination Agreement, **and** 3) that they are easily integrated into basin-wide evaluations of undesirable results.

Deficiency GL-1b – SMC rely on inconsistent datasets and methodologies.

Deficiency: This is the groundwater level deficiency that corresponds to Coordination Deficiency CRD-1b. Coordination Deficiency CRD-1b concerns the fact that SMC for each sustainability indicator: 1) use inconsistent data and methodologies across GSPs and Management Area Plans that, combined with vague, inconsistent undesirable results, 2) fail to represent the key conditions that groundwater managers must evaluate in order to achieve sustainability and avoid undesirable results.

For groundwater levels:

- The GSPs and Management Area plans are not coordinated in their approach to developing minimum thresholds. For example some approaches are as follows:
  - The SOKR GSA GSP established MTs by considering fall 2015 groundwater levels, historic low groundwater levels, and historic variability and trends (2022 SOKRGSA GSP, p. 278).
  - The BVWSD GSP established MTs by considering 2011 through 2018 hydrographs and projections of the hydrographs to 2040 as ”worst-case” scenarios. The worst-case scenarios were then adjusted to account for confining layers and extraction well construction details (2022 BVWSD GSA GSP, p. 116).
  - The Kern River GSP established MTs using either historic low groundwater levels or 20 or 50 feet below the historic low groundwater levels (2022 KRGSA GSP, p. 5-12).
  - The HMWD GSP established MTs using a static water depth of 350 feet below ground surface. It also added a stipulation that this depth to groundwater be observed in 40 percent of the monitoring sites in 4 consecutive biannual measurements for an MT to be exceeded (2022 HMWDGSA GSP, p. 81).

- The KGA GSP completed a Well Impact Study to identify where extraction wells may be impacted by groundwater levels at the proposed sustainable management criteria (2022 KGAGSA GSP, p. 237-238).
- The Olcese GSP established MTs by considering the elevation of well construction details of the only domestic well and the shallowest irrigation well in the Olcese GSA area (2022 Olcese GSA GSP, p. 87).
- The KGA GSP SWSD Revised Management Area Plan (2022 KGA GSP Semitropic Water Storage District Revised Management Area Plan, pp. 232-240) describes establishing MTs by projecting recent (2010 to 2016) groundwater level trends to 2040 and setting them at levels over 200 feet below historic lows (2023 DWR Inadequate Determination, p. 31). DWR notes in their 2022 Inadequate Determination that these MTs are all "below all of the projected water level model scenarios, including the projected climate scenarios that exclude the implementation of the projects and management actions." This means that MTs are deeper than business-as-usual groundwater level projections.

- Due to inconsistent MTs, DWR's inadequate determination notes that "[t]he various approaches, data, and methodologies used to establish MTs across Management Areas complicates understanding of the groundwater conditions the subbasin describes as significant and unreasonable and would lead to a subbasin-wide undesirable result" (2022 Inadequate Determination, p. 31). Board staff agree, noting that there are over 100 feet of vertical difference between groundwater level MTs in different Management Areas of the subbasin.
- The GSPs and Management Area Plans do not consistently explain how groundwater level SMC impact other sustainability indicators. DWR noted substantial inconsistencies in explanations of how groundwater SMC impact subsidence. For example:
  - For the KCWA Pioneer GSA Management Area, DWR found that "MTs for GW levels were set to mitigate potential inelastic subsidence, but the plan does not provide additional info on the relationship between GW levels and inelastic subsidence" (2022 Inadequate Determination, pp. 18-19).
  - For the SWSD Management Area, DWR noted that "Inelastic subsidence can occur from aquifer [compaction] by overdraft from groundwater extraction, however, the Plan does not provide analysis of the relationship between chronic lowering of groundwater levels and land subsidence sustainability indicators" (ibid, pp. 20-21).

- For the SSJMUD Management Area, DWR found that the “plan does not consider impacts of lowering groundwater elevations to land subsidence” (ibid, p. 23-24).
- For the WKWD Management Area, DWR stated that the “plan acknowledges land subsidence may result from groundwater extraction but does not provide analysis of relationship between lowering groundwater levels and subsidence” (ibid, pp. 24-25).
- For the WDWA, DWR noted that the “plan acknowledges inelastic subsidence occurring within the Management Area but data gaps exist to fully understand cause of subsidence” (ibid, p. 26).

- SMC do not appear to have considered key aspects of the Coordination Agreement:
  - The results and analyses presented in the Todd Groundwater Technical Memorandum (2022 Coordination Agreement, Appendix 2) were generally not incorporated into the various data and methods used to develop and report proposed groundwater level SMC. DWR notes that “some Management Areas’ [approaches] to setting sustainable management criteria do not appear to be informed by the Todd Groundwater Technical Memorandum results” (2022 Inadequate Determination of Kern County Subbasin, p. 10). The Todd Groundwater Technical Memorandum establishes overdraft and sustainable yield values, as well as water budgets for the subbasin. These are fundamental aspects of the subbasin’s groundwater hydrogeology that should be used to inform SMC.
  - Conversely, the projected future water budgets and analyses presented in the Todd Groundwater Technical Memorandum do not incorporate the proposed SMC when calculating future changes in storage and projected groundwater conditions (2022 Inadequate Determination, p. 32).

Board staff proposes the below Potential Action GL-1b to address the deficiency.

Potential Action GL-1b – Use consistent data and methods to develop SMC.

The GSPs should:

- Develop MTs using consistent data and methods. The MTs should be calibrated so that, when they are exceeded per the quantitative undesirable result definition, they represent the conditions that would cause the plain-language groundwater quality undesirable result. MTs should therefore not be based solely on groundwater trend projections. Groundwater trend projections may be used to

inform MTs so that MTs better represent a reasonable groundwater elevation surface. But the groundwater elevation surface should represent the conditions that would cause the significant and unreasonable effects described by the plain-language undesirable result.

MTs should be based on groundwater elevations that maintain access to water supplies. In establishing MTs, GSAs should use existing well construction information and interpolated MT groundwater surfaces to clearly describe the impacts of MTs on groundwater wells.

In critically overdrafted basins, MTs should generally not represent groundwater levels that would occur only if basins increased pumping rates. While Board staff acknowledge that some continued overdraft may not cause undesirable results, Board staff stresses that SGMA is being implemented because it is broadly acknowledged that current overdraft has already caused significant and unreasonable impacts. Accordingly, if MTs are lower than water levels that would occur at existing pumping rates, additional analysis of impacts should be provided.

- If GSAs establish different MT methods for Management Areas, the description of the Management Area should adequately explain how the MTs 1) still represent the basin-wide conditions that would cause plain-language undesirable results and 2) are easily integrated into basin-wide evaluations of undesirable results (Cal. Code Regs., tit. 23, § 354.20 subd. (b)).
- Redevelop groundwater level MOs. Groundwater levels MOs are the groundwater levels that basins plan to achieve. Importantly, MOs must provide operational flexibility above MTs, so redeveloping MTs might require redeveloping MOs. MOs should be high enough above MTs that drought does not cause MT exceedances.

  In developing MOs, GSAs should:

  - Ensure data and methods are consistent with The Todd Groundwater Technical Memorandum. This memorandum establishes overdraft and sustainable yield for the subbasin and detailed water budget summaries, which should all inform SMC.
  - Update the Todd Groundwater Technical Memorandum to incorporate SMC when evaluating change in storage or future projected conditions.
- Redevelop interim milestones. Interim milestones are the groundwater levels that basins plan to achieve as they manage toward MOs, so redeveloping MOs will require redeveloping interim milestones. Interim milestones are set in 5-year

increments, and they are important benchmarks to evaluate whether a basin is on track to reach its MOs by 2040.

- Finally, ensure that GSPs and Management Area Plans explain how groundwater level SMC impact other sustainability indicators, like subsidence or water quality. DWR noted in its 2022 Inadequate Determination that discussions of groundwater level MTs should "include how other sustainability indicators may be affected by the various minimum thresholds within the specific management areas but also in adjacent management areas" (2022 Inadequate Determination, p. 31). Board staff agree and further note that these discussions should not be limited to only groundwater level SMC.

Deficiency GL-2 – The GSPs and Coordination Agreement lack necessary detail about well mitigation.

What SGMA Requires: Although SGMA and the GSP Regulations do not require development of a well impact mitigation plan, the State Water Board considers them to be an important component of SGMA implementation to ensure for availability of water for all beneficial uses and users in the subbasin.

Deficiency: There is insufficient information in the Coordination Agreement about the plans for well mitigation in the subbasin.

Details of GSP-proposed well mitigation efforts are summarized above in Section 4.1.2.3. In summary, the GSPs discuss well mitigation to varying degrees. The BVWSD GSP, the KGA GSP, and the SOKR GSP all state their intention to develop well mitigation programs. KRGSA GSP plans to avoid adverse impacts by repositioning pumps, providing alternative water supplies, or reducing pumping rates. Neither the HMWD nor Olcese Water District GSPs discuss well mitigation. Moreover, well mitigation plans are not coordinated across the subbasin and it is not clear where well mitigation plans have been implemented.

Board staff propose the below Potential Action GL-2 to address the deficiency.

Potential Action GL-2 – Establish accessible, comprehensive, and appropriately funded well impact mitigation programs that mitigate impacts to wells affected by lowering of groundwater levels and/or degradation of water quality. Develop well mitigation programs with clear triggers, eligibility requirements, and funding sources.

GSAs should develop mitigation plans that include mitigation for both declining groundwater levels and water quality impacts. The mitigation plans should:

- Identify clear triggers for well mitigation that avoid undesirable results (e.g., employ mitigation prior to a well losing supply).
- Identify adequate and highly reliable funding sources for mitigation efforts commensurate with the magnitude of impacts allowed under the GSAs' MTs; demonstrating adequate funding may involve projecting out fee revenues to demonstrate financial capacity that matches expected need. Board staff note that fee revenues levied by the GSAs on groundwater extractions are a more reliable funding source than grants and subsidies.
- Prioritize program accessibility by defining broad eligibility requirements, avoiding reimbursement-based mitigation that may not be accessible to low-income well users, offering translated program materials, and partnering with trusted community leaders and organizations in program development and roll-out.
- Identify approaches for preventing even the temporary loss of safe and reliable drinking water supplies, due to basin management, for people reliant on wells. For example, GSAs may proactively contact the owners of wells that are at risk of impacts from groundwater level declines or water quality degradation. Coordinating proactively with well owners may also reduce the overall financial costs of mitigation by reducing or eliminating the need for interim water supplies.

Mitigation options may include:

- Replacing or deepening wells.
- Support for expansion of public water system boundaries to private well communities or consolidation of smaller drinking water systems dependent on at-risk wells with larger public water systems. This would involve identifying vulnerable areas where consolidation or extension of service is feasible. Consolidation efforts may include: (1) providing financial assistance, particularly for low-cost intertie projects that are adjacent to larger systems, (2) working with County Planning agencies to ensure that communities served by at-risk wells are annexed into the service areas of larger water systems to limit barriers to future interties, and (3) facilitating outreach and introductions between small water systems and owners of domestic wells and larger water systems to assist in developing future partnerships.
- To address water quality degradation, treating well water (point-of-entry (POE)) for wells impacted by arsenic, nitrate, 1,2,3-Trichloropropane (1,2,3-TCP), and 1,2-Dibromo-3-chloropropane (DBCP) (State Water Board et. al., 2022), drilling new wells completed in aquifers with better water quality, consolidation of existing water systems, or expanding service areas for existing public water systems not facing water quality impacts.

GSAs should not plan to fund well mitigation via the Safe and Affordable Drinking Water Fund administered through the State Water Board or any other alternately funded program. This specific funding program was designed for addressing legacy impacts that are not within the scope of SGMA and not for addressing impacts caused by groundwater management actions or inactions by GSAs.

Where GSAs' mitigation plans rely on cooperation with the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) program, the GSAs should explain the relationship between the mitigation programs, including timelines, mitigation strategies, and funding sources. Board staff encourage demonstrating coordination with existing programs where SGMA objectives may overlap to reduce costs where appropriate.

Deficiency GL-3 – The GSPs do not describe a feasible path for halting chronic lowering of groundwater levels.

What SGMA Requires: Each GSP is required to include a description of the projects and management actions the GSA has determined will achieve groundwater sustainability in the basin. The description must include project and management actions, a summary of data used to support proposed actions, and a review of the uncertainty associated with the basin setting when developing projects or management actions. The GSP must also describe the criteria that would trigger implementing or stopping a project or management action and the process for determining whether that trigger has occurred (Cal. Code Regs., tit. 23, § 354.44). More fundamentally, for basins in a condition of overdraft, the GSP "shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft" (Cal. Code Regs., tit. 23, § 354.44, subd. (b)(2)) GSPs need to include a description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods (Cal. Code Regs., tit. 23, § 354.44, subd. (b)(9)).

In reviewing GSPs, DWR must consider, among other questions, "whether sustainable management criteria and projects and management actions are commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the plan" and "whether the projects and management actions are feasible and likely to prevent undesirable results and ensure that the basin is operated within its sustainable yield" (Cal. Code Regs., tit. 23, § 355.4, subds. (b)(3), (5)).

Deficiency: State Water Board staff have determined that the 2022 GSPs do not demonstrate that projects and management actions are feasible or sufficient to prevent undesirable results.

The 2022 GSPs do not demonstrate feasibility of projects, but they rely heavily on projects to demonstrate future sustainability. DWR notes in its 2022 Inadequate Determination that the GSPs rely on more than 180 projects and management actions to reach sustainability and that, without these projects and management actions, "extractions would exceed the estimated sustainable yield by 25 to 34 percent" (2022 Inadequate Determination, p. 32).

Demonstrating the feasibility of supply augmentation projects is crucial because water sources are limited. Local surface water sources are generally fully appropriated (see Section 3.6). Imported water available from the State Water Project or Central Valley Project or other sources will vary from year to year based on statewide hydrogeology. Both local and imported sources of surface water will be in high demand as GSAs and interests in other critically over drafted basins in the region and elsewhere in the state implement SGMA. Climate change will continue to affect both the water demand of crops and regional hydrology.

The Coordination Agreement for the 2022 GSPs does not contain a groundwater allocations plan, though the KRGSA GSP did propose to develop allocation plans. The Todd Groundwater Tech Memo also proposed reallocations of water as a project and management action, with reduced banked groundwater and surface water sales to retain water within local authority. Additionally, the KGA GSP proposes an in-district groundwater allocation structure for both available NKWSD supplies and the SSJMUD. Otherwise, demand management actions in the 2022 GSP appear voluntary and therefore unlikely to provide sufficient contingency in case GSAs fail to secure new supplies or overdraft is greater than estimated. State Water Board staff propose Potential Actions GL-3a, GL-3b, and GL-3c to address the deficiency.

Potential Action GL-3a – Evaluate the feasibility of proposed supply augmentation projects.

Implementing some of the projects identified in the 2022 GSP may require new or amended water rights. If a project would rely on existing water rights, the GSAs should identify the water right identification numbers and other relevant details. It may be unreasonable for the GSP to assume that projects that currently lack adequate water rights for implementation can obtain either new water rights or modifications to existing water rights within a timeframe that will allow the project to contribute to the GSP achieving sustainability. For the GSP to demonstrate a likelihood of attaining the sustainability goal, the GSP should discuss the timing for obtaining approvals and describe any uncertainties, such as water availability in source streams (e.g., will less surface water be available with projected Bay-Delta Plan implementation? Is the source on the inventory of fully appropriated streams? Can potential protests be anticipated from downstream water users?).

Potential Action GL-3b – Develop basin-wide allocations or utilize another demand management structure to help bring the subbasin into balance and meet basin sustainability goals.

Bringing the subbasin into balance requires action to align demand with available supplies. The extent of groundwater overdraft in the subbasin and the uncertainty, limited availability, and expense of new water supplies make demand management likely necessary to achieve groundwater sustainability in the subbasin. The California Water Supply Strategy directs Californians to reduce demand (Action 3), and more specifically, recognizes the need to "Help stabilize groundwater supplies for all groundwater users, including a more drought-resilient agricultural economy" (CNRA, 2022).

The GSAs should develop programs that would enable demand management now and identify clear triggers for initiating or ramping up groundwater pumping restrictions. Information on the feasibility and timing of proposed supply projects developed for Potential Action GL-3a should inform the scope and timeline for demand management actions.

Demand management actions could include allocations, pumping cutbacks/ramp-down rates, pumping caps, water trading, and/or fee structures. Demand management fee structures could include tiered fee structures. Demand management should be equitable and should include consideration of the human right to water, reasonable and beneficial use, and potential economic impacts on all extractors.

Sustainable management under SGMA requires planning for the range of likely hydrologic conditions. GSAs should account for a future scenario in which extended droughts occur within the SGMA timeframe (Cal. Code Regs., tit. 23, § 354.44, subd. (b)(9)). The 2013-2015 period of the 2012-2016 drought in California was the hottest and driest period on record at the time of the passage of SGMA. GSAs should make groundwater management plans for a recurrence of such conditions, as well as for conditions that occur in extreme wet years.

GSAs should plan for the impacts from pumping cutbacks that will be necessary during wet years, dry years, and multi-year severe drought periods. GSAs can hold stakeholder meetings to educate irrigators on crop conversions, water efficiency practices, fallowing schemes, land transition options (particularly multi-benefit land repurposing), and other adaptation methods. Multi-benefit land repurposing options include dryland crops, grazing, recharge basins, parks/recreational spaces for communities, solar (renewable energy), and wildlife habitat. GSAs could encourage farmers to work together to strategically locate repurposed lands to maximize benefits (e.g., use lands adjacent to existing habitat, recreation areas, or communities). Planning

well for fallowing and land conversion can reduce possible land conversion impacts related to dust, pests, and/or invasive plants.

Potential Action GL-3c – Identify key indicator wells in each aquifer, with sufficient spatial coverage to represent beneficial uses and users in each aquifer and identify groundwater levels that will trigger specific demand management.

GSAs should use groundwater elevations as a subbasin management metric. Groundwater levels in key representative monitoring wells are the clearest and simplest empirical data that reflect groundwater conditions in the subbasin. Groundwater elevation is simple to measure and can be monitored continuously and remotely using pressure transducers.

GSAs should identify key indicator wells in each of the three subbasin aquifers (Principal (confined, semi-, and unconfined), Olcese, and Santa Margharita) that will serve as index wells that trigger pumping cutbacks when groundwater levels decline to critical groundwater elevations. Indicator wells should have sufficient spatial coverage to be representative of beneficial uses and users; drinking water users in particular should be represented by indicator well(s) that reflect shallow groundwater conditions in the same portion of the aquifer those wells are completed within.

GSAs could determine pumping cutbacks that will be triggered at specific groundwater elevations in a tiered trigger scheme based on the groundwater conditions on September 1 of each year (or as close to annual low measurements as is possible). Determining cutbacks on or shortly after September 1 for the subsequent year should provide irrigators with time to make crop planting and other business decisions. GSAs could re-evaluate the cutbacks and adjust as needed if a wet winter occurs. If GSAs establish management zones around each indicator well, extraction wells within an indicator well's management zone could follow pumping cutbacks according to the triggers for that indicator well and the aquifer in which they are completed. For example, when groundwater levels drop to the Trigger 1 level at an index well, all non-exempt pumpers within the index well's management zone must reduce their extractions by X%; if water elevations drop to the Trigger 2 level, then all non-exempt pumpers must reduce pumping by Y%. Trigger elevations and the pumping cutback amounts could be set based on the groundwater level SMC. Pumping reduction amounts may be best determined through an iterative process and observations of the aquifers' responses.

This management approach is responsive to real-time conditions in the subbasin, making it nimbler than an approach based strictly on groundwater models, but cutback metrics should be informed by a revised water budget and groundwater model. The impacts of recharge projects should be accounted for under this approach as groundwater levels respond to recharge, incorporating the time delay of infiltration to the

aquifer(s). Alternate approaches that accomplish the same goal with adequate data and evidence may be sufficient upon review if conducted according to the best available science and using best available data and methodologies.

4.1.3 Deficiency LS – Defining and Avoiding Undesirable Results Related to Land Subsidence

Another consideration under SGMA is avoiding "significant and unreasonable land subsidence that substantially interferes with surface land uses" (Wat. Code, § 10721, subd. (x)(5).) Land subsidence from excessive groundwater extraction can cause irreversible damage to infrastructure and aqueduct operations. Land subsidence can also diminish the storage capacity of an aquifer, which reduces the amount of available water for the future.

DWR concluded that the Kern County Subbasin 2022 plans "made progress in moving towards coordinated Subbasin-wide subsidence management", however, "the Plan still lacks a description and discussion of the conditions occurring throughout the Subbasin that would cause undesirable results that the GSAs propose to manage the basin to avoid" (2022 Inadequate Determination, p. 45). Board staff have built on DWR's analysis, noting that subsidence may substantially impact the Friant-Kern Canal and California Aqueduct, and have concluded that the 2022 GSPs lack a detailed analysis of the effects of subsidence on all beneficial uses and users within the subbasin. Board staff therefore conclude that significant and unreasonable subsidence may occur under the Kern County Subbasin 2022 GSPs.

Table 4-2 – Summary of DWR Land Subsidence Deficiency and Relevant Components of the 2020 and 2022 Kern County Subbasin GSPs

2020 GSPs	DWR's 2020 GSP Incomplete Determination
There is no basin wide definition of critical infrastructure in the Subbasin.	It is apparent that the subbasin does not have a basin wide, coordinated assessment of critical infrastructure.
The 2020 Coordination Agreement defined undesirable results for land subsidence in the subbasin as "The point at which significant and unreasonable impacts, as determined by a subsidence rate and extent in the basin, that affects the surface land uses or critical infrastructure. This is determined when subsidence results in	It is apparent that "the Subbasin does not have a 'basin wide coordinated GSP subsidence monitoring plan', nor any coordinated, Subbasin-wide subsidence sustainable management criteria or assessment of critical infrastructure that would be susceptible to substantial interference from future subsidence."

significant and unreasonable impacts to critical infrastructure as indicated by monitoring points established by a basin wide coordinated GSP subsidence monitoring plan."	
2022 GSPs	**DWR's 2022 GSP Inadequate Determination**
A new definition was established for "Regional Critical Infrastructure" and "Management Area Critical Infrastructure".	The Plan made progress in moving towards coordinated Subbasin-wide subsidence management by establishing sustainable management criteria for the Regional Critical Infrastructure and defining Management Area Critical Infrastructure.
The 2022 Coordination Agreement defined the undesirable results for land subsidence in the subbasin as "the point at which the amount of inelastic subsidence, if caused by subbasin groundwater extractions, creates a significant and unreasonable impact to surface land uses or Subbasin critical infrastructure."	The Plan still lacks a description and discussion of the conditions occurring throughout the Subbasin that would cause undesirable results that the GSAs propose to manage the basin to avoid. The Plan still lacks detailed, supporting information describing and demonstrating the understanding of land uses and critical infrastructure in the Subbasin and the amount of subsidence that would substantially interfere with those uses and critical infrastructure.

4.1.3.1 Kern Subbasin 2020 GSP

Plain-language Definition of an Undesirable Result

The 2020 Coordination Agreement defined the Subbasin-wide undesirable result for land subsidence as, "[t]he point at which significant and unreasonable impacts, as determined by a subsidence rate and extent in the basin, that affects the surface land uses or critical infrastructure. This is determined when subsidence results in significant and unreasonable impacts to critical infrastructure as indicated by monitoring points established by a basin wide coordinated GSP subsidence monitoring plan" (2020 Coordination Agreement, Appendix 3, pdf, p. 300). The subbasin did not develop a

coordinated, Subbasin-wide “assessment of critical infrastructure that would be susceptible to substantial interference from future subsidence” (2020 Incomplete Determination of Kern County Subbasin, p. 37).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The 2020 Coordination Agreement described an undesirable result as “[t]he point at which significant and unreasonable impacts, as determined by a subsidence rate and extent in the basin, that affects the surface land uses or critical infrastructure. This is determined when subsidence results in significant and unreasonable impacts to critical infrastructure as indicated by monitoring points established by a basin wide coordinated GSP subsidence monitoring plan” (2020 Coordination Agreement, Appendix 3, pdf, p. 300). The basin-wide, coordinated MOs and MTs were not established for the subbasin.

To avoid damages to infrastructure, some GSPs set the MTs and MOs for chronic lowering of groundwater levels at elevations that are intended to be protective of critical infrastructure (e.g., 2020 Cawelo GSP, p. 154; 2020 Buena Vista Water Storage District GSP, p. 157; KTWD Plan, Chapter 3, p. 2; Southern San Joaquin Municipal Utility District Plan, p. 148; Tejon-Castac Water District Plan, p. 65). The HMWD GSA identified the California Aqueduct as the only critical infrastructure and defined the MT as “the point at which freeboard on the California Aqueduct Pools 29 and 30 is reduced by two-feet relative to the freeboard values in the most recent Aqueduct Subsidence Study” (2020 Henry Miller Water District GSP, p. 81). According to the recent California Aqueduct Subsidence Study, 14.8 miles of the canal (from Pools 22 to 40) were calculated to have less than 2.5 feet of freeboard because of subsidence (DWR, 2017). It is expected that the two feet reduction in freeboard on the Pools 29 and 30 may cause storage and flow capacity issues (2020 Henry Miller Water District GSP, p. 81).

Other GSAs, either did not define MTs and MOs for land subsidence or did not include adequate justification to show how the defined MTs would prevent any impact of subsidence on the critical infrastructure. Olcese GSA claimed no evidence of critical infrastructure being affected by land subsidence and therefore defined no MTs and MOs for land subsidence (2020 Olcese GSP, p. 83). KRGSA claimed no historical subsidence in urban areas (2020 Kern River GSA GSP, Ch. 5, p. 33). However, the GSA set the MTs for agricultural areas according to historical water level. For agricultural areas in the northwest and north-central portions, the MTs were selected to be the historic low water level that occurred during the 2012–2016 drought (ibid, p. 34). For agricultural areas in the south and east, the MTs were defined as the allowance of 20 ft below the historic low water levels (ibid, p. 34).

Some Management Area Plans stated that the current subsidence rates are not detrimental and there is no historical record of impacts on local infrastructure (2020

Pioneer GSA Management Area Plan, Section 7, p. 22; 2020 West Kern Water District GSA Management Area Plan, Section 7, p. 33). Pioneer GSA set MTs for the subsidence without adequate justification on how the defined MTs (0.5 inch per year) prevent the undesirable results in the future (2020 Pioneer GSA Management Area Plan, Section 7, p. 22). WKWD GSA claimed that "[b]ecause subsidence has not impacted local infrastructure, and the fact that surface elevations have increased since 1994, an MT rate for subsidence of 2 inches per year (as measured at Kern Water Bank Extensometer 30S/25E16L) is reasonable for warranting a management action to investigate the cause" (2020 West Kern Water District GSA Management Area Plan, Section 7, p. 33). WRMWSD Management Area defined the MTs for California Aqueduct as the only critical infrastructure to be 0.5 inch per year (2020 Wheeler Ridge-Maricopa Water Storage District Management Area Plan, p. 123). The GSA claimed that "[t]he rationale for this Minimum Threshold rate of subsidence is that such subsidence has been historically managed by DWR through maintenance and improvements to its facilities" (ibid). It is unclear how the subbasin is accounting for loss of storage capacity where subsidence is allowed to continue and impact other water conveyance infrastructure in the basin.

RRWSD Management Area Plan, a KGA member agency, claimed that the historical extensometer data, located in the Kern Water Bank, proved subsidence is not an applicable sustainability indicator in the area, and as of June 2018, the land surface elevation was 0.27 feet higher than the land surface in June 1994 (2020 Rosedale Rio Bravo Management Area Plan, p. 55). RRBWSD states that until a regional subsidence program is developed, a threshold of two feet will be assigned for subsidence (2020 Rosedale Rio Bravo Management Area Plan, p. 78). KGA GSA stated that "[t]he development of minimum thresholds for land subsidence at the basin level is ongoing due to data gaps in monitoring and identification of undesirable results in the Subbasin" (2020 Kern Groundwater Authority GSA GSP, p. 178).

Representative Monitoring Sites and Monitoring Network

The 2020 GSPs described the use of continuous global positioning surveys (CGPS), extensometers, level surveying (benchmark monuments), and satellite data using interferometric synthetic aperture radar (InSAR). The GSAs used two extensometers located in the SWSD and KWB (2020 Coordination Agreement, Technical Memorandum, Figure 2, pdf, p. 323). The Coordination Agreement stated the possibility of adding additional extensometer locations but did not offer any further information on the exact timeline (2020 Coordination Agreement, Technical Memorandum, p.7).

In addition to extensometers, the Scripps Orbit and Permanent Array Center (SOPAC) Continuous GPS sites, the NOAA Continuously Operating Reference Stations (CORS), Southern California Integrated GPS Network, the United States Bureau of Reclamation (USBR) Friant-Kern Benchmark Subsidence Survey, and the NKWSD subsidence

monitoring sites were listed in the subbasin's regional subsidence monitoring network (2020 Coordination Agreement, Technical Memorandum, Figure 2; 2020 North Kern WSD Plan, Table 2-31, p. 177). Lastly, the GSAs stated the use of InSAR data to monitor regional land surface changes (2020 Coordination Agreement, Technical Memorandum, pp. 6-10).

The KGA GSA was the lead on a coordinated effort to fill the data gaps in the regional subsidence monitoring network. Five Areas of Interest (AOIs) were identified to improve the subbasin's monitoring network. Of the selected AOIs, two areas were located along the Friant-Kern Canal, two areas were along the California Aqueduct, and one area was located along the northern boundary of the subbasin where a significant amount of subsidence has been reported in the InSAR data (2020 Coordination Agreement, Technical Memorandum, p. 4). The technical memorandum did not indicate the exact timeline for implementation, or a description of how the GSAs would meet funding requirements.

Infrastructure Mitigation

The 2020 GSPs did not include specific plans to mitigate the impacts of subsidence even though the developed SMCs allowed continued subsidence.

Projects and Management Actions

The 2020 Coordination Agreement listed the proposed future (WY2021–WY2040) projects and management actions provided by GSAs to project future water budgets in the subbasin. The management actions were categorized into three groups: 1) demand reduction by land use change (reduce crop water use, fallowing of agricultural land and using the land as recharge basins, and conversion of agricultural land to urban land), 2) increase of imported water supply (increasing imported surface water, adding new water conveyance facilities, and expanding the surface water delivery areas), and 3) increase of local water supply (recharging treated waste water from urban areas and oil production operations, increasing stream flow diversion, reallocation of water, and treating the brackish groundwater in areas not currently in overdraft and mixing it with surface water) (2020 Coordination Agreement, p. 22).

KGA umbrella GSP listed 173 projects and management actions from 18 member entities with the implementation status, benefits of the project, and project description (2020 Kern Groundwater Authority GSA GSP, Table 4-1). Olcese GSP provided a list of projects containing three contingent and three non-contingent projects with details on the suggested timeline for initiation and completion (2020 Olcese GSP, Table PMA-1). The projects and management actions mainly include installing one monitoring shallow well to understand the aquifer's hydraulic connection, installing the second monitoring

shallow wells in the vicinity of GDEs, developing a network of subsidence benchmarks, conducting new studies to fully understand the basin setting, and refining the definitions of SMCs for applicable sustainability indicators (ibid). The KRGSA summarized six supply augmentation and land use change projects to provide about 148,972 AFY to 150,823 AFY of additional water supply to the KRGSA (2020 Kern River GSA GSP, Table 7-1, Section 7, p. 2).

To provide a secure water supply for the future, BVWSD GSA suggested five categories of projects that will enable the GSA to sustainably manage groundwater, including water measurement, sustainability monitoring, groundwater recharge and recovery, water distribution system improvement, and water conservation and treatment (2020 Buena Vista GSP, p. 225). HMWD GSA suggested one project to optimize the recovery of Pioneer Project banked supplies in dry years (2020 Henry Miller Water District GSP, p. 85). Since HMWD is a recharge participant in the Pioneer project and banked water from different resources since 1995, the district has a second priority right to recover the banked supplies when surface supplies are sparce and deliver recovered water to the lands in the district (ibid). NKWSD projects and management actions focused mainly on improving the water conveyance infrastructure, expanding water banking program, and reusing of oilfield produced water (2020 North Kern Water Storage District and Shafter-Wasco Irrigation District Management Area Plan, p. 246).

The discussion of projects and management actions was general in most GSPs and did not specify the criteria that would trigger implementation, a timetable for implementation, a description of how the GSAs would meet costs, or an explanation of the source and reliability of the water necessary for the supply augmentation projects.

4.1.3.2 DWR's 2020 GSP Incomplete Determination

In the January 28, 2022, DWR Incomplete Determination Letter, DWR identified a deficiency in the 2020 GSPs related to the land subsidence SMC:

> Deficiency 3 – The [2020] Plan's land subsidence sustainable management criteria do not satisfy the requirements of SGMA and the GSP regulations.

(2020 Incomplete Determination of Kern County Subbasin, p. 35)

Plain-language Definition of an Undesirable Result

The DWR 2020 GSP Incomplete Determination indicated that the GSAs should "document the conditions for undesirable results for which the GSAs are trying to avoid, supported by their understanding of land uses and critical infrastructure in the Subbasin

and the amount of subsidence that would substantially interfere with those uses" (2020 Incomplete Determination of Kern County Subbasin, pp. 38-39).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

DWR staff noted issues with the way the GSAs defined an undesirable result, stating that:

> "the Coordination Agreement should be revised to clearly identify the undesirable result parameters for each of the GSPs, management areas, and management area plans so it is clear how the various plans work together at the Subbasin level" (ibid., p. 39).

DWR also noted issues with how the minimum threshold was defined, stating that:

> "The revised Plan, and component GSPs and management areas, should identify the rate and extent of subsidence corresponding with substantial interference that will serve as the minimum threshold, or should thoroughly demonstrate that another metric can serve as a proxy for that rate and extent" (ibid., p. 39).

And,

> "The Plan should include clearly defined undesirable and appropriate minimum thresholds and measurable objectives" (ibid., p. 38).

Some plans appeared to use the MTs and MOs developed for the chronic lowering of groundwater level as a proxy for subsidence; however, DWR staff noted that the developed criteria:

> "…do not include the required demonstration showing that the values developed for chronic lowering of groundwater levels are reasonable proxies for the amount of land subsidence that would substantially interfere with surface land uses" (ibid).

Although GSAs proposed projects and management actions, it was not clear how implementing these projects is consistent with avoiding MTs and undesirable results. Furthermore, DWR staff concluded that:

> "Because the Plan lacks a coordinated, Subbasin-wide management approach for subsidence, Department staff cannot meaningfully and completely review the fragmented approaches to establish sustainable management criteria for subsidence in the various GSPs and management area plans" (ibid).

And,

… “the Plan, including the Coordination Agreement and all GSPs, should be revised to present a Subbasin-wide management approach for subsidence that includes the elements required by SGMA and the GSP Regulations” (ibid).

DWR’s 2020 GSP Corrective Actions

DWR staff proposed corrective action 3 to address the subsidence deficiency in the 2020 GSP. DWR staff recommended that:

- The Subbasin’s GSAs should coordinate and collectively satisfy the requirements of SGMA and the GSP Regulations to develop the sustainable management criteria for land subsidence. The GSPs should document the conditions for undesirable results for which the GSAs are trying to avoid, supported by their understanding of land uses and critical infrastructure in the Subbasin and the amount of subsidence that would substantially interfere with those uses.
- The revised Plan, and component GSPs and management areas, should identify the rate and extent of subsidence corresponding with substantial interference that will serve as the minimum threshold, or should thoroughly demonstrate that another metric can serve as a proxy for that rate and extent.
- … the Coordination Agreement should be revised to clearly identify the undesirable result parameters for each of the GSPs, management areas, and management area plans so it is clear how the various plans work together at the Subbasin level.
- The revised Plan should explain how implementing projects and management actions proposed in the various GSPs is consistent with avoiding subsidence minimum thresholds, sufficient to avoid substantial interference, similar to the original Plan’s assessment of whether implementation would avoid undesirable results for groundwater levels.
- If land subsidence is not applicable to parts of the Subbasin, the GSPs must provide supported justification of such. The supporting information must be sufficiently detailed and the analyses sufficiently thorough and reasonable and must be supported by the best available information and best available science. (2020 Incomplete Determination of Kern County Subbasin, pp. 38-39).

4.1.3.3 Kern County Subbasin 2022 GSP Submission

The GSAs submitted six revised GSPs along with 12 revised Management Area Plans to DWR on August 1, 2022, in compliance with the 180-day resubmittal deadline.

Plain-language Definition of an Undesirable Result

The 2022 Coordination Agreement develops coordinated definitions for undesirable results and critical infrastructure for land subsidence. The Coordination Agreement defines the undesirable results as "[t]he point at which the amount of inelastic subsidence, if caused by Subbasin groundwater extractions, creates a significant and unreasonable impact to surface land uses or Subbasin critical infrastructure" (2022 Amended Coordination Agreement, Appendix 3, pdf, p. 355).

The Kern County Subbasin has adopted two classifications for critical infrastructure: Regional critical infrastructure and Management Area critical infrastructure. Regional critical infrastructure is defined as "infrastructure located within the Subbasin that serves multiple areas of the Subbasin and whose loss of significant functionality due to inelastic subsidence, if caused by SGMA related Subbasin groundwater extractions, would have significant impacts to beneficial uses. The Subbasin has collectively determined that the only infrastructure that meets the definition for Regional Critical Infrastructure are the California Aqueduct and the Friant-Kern Canal" (ibid).

The 2022 Coordination Agreement then defines the undesirable results for Regional critical infrastructure as follow:

For the California Aqueduct, the undesirable result is defined as "the point at which the amount of inelastic subsidence, if caused by SGMA-related Subbasin groundwater extractions, creates a significant and unreasonable impact (requiring either retrofitting or replacement to a point that is economically unfeasible to the beneficial users) to surface land uses or critical infrastructure. A significant loss in functionality that could be mitigated through retrofitting and is considered economically feasible to the beneficial users would not be considered undesirable" (ibid, pdf, p. 363-364).

The Friant-Kern Canal undesirable result is defined as "the point at which the amount of inelastic subsidence, if caused by Subbasin groundwater extractions, creates a significant and unreasonable impact to surface land uses or critical infrastructure. A significant and unreasonable impact to the FKC is determined when the flow capacity through the Lower Reach is reduced to capacities below historical operational flow capacities over the previous 10 years, impacting surface land uses of available water supplies, as a result of groundwater extractions from agricultural, domestic, municipal, or urban beneficial users within the Kern County Subbasin" (ibid, pdf, p. 395).

Management Area Critical Infrastructure is defined as "infrastructure located within a particular Subbasin Management Area whose loss of significant functionality due to inelastic subsidence if caused by SGMA related Subbasin groundwater extractions would have significant impacts to beneficial users within that Subbasin Management Area. Each Subbasin Management Area has identified their respective Management

Area Critical Infrastructure in their Management Area Plan or individual GSP" (ibid, Appendix 3, pdf, p. 355).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The 2022 Coordination Agreement explains that the established SMC can be interim (valid until 2025) for subsidence due to "significant data gaps" and the new SMC will be established in 2025, informed by subsidence modeling and data from additional studies (ibid, pdf, p. 363).

The 2022 Coordination Agreement states the qualitative undesirable results for Regional critical infrastructure as "the occurrence of a single minimum threshold exceedance along either the Aqueduct or the Friant-Kern Canal" (ibid, pdf, p. 362).

The 2022 Coordination Agreement defines the interim measurable objectives for the California Aqueduct as "the avoidance of a permanent loss (associated with inelastic subsidence) of conveyance capacity as attributable to subsidence as limited by remaining concrete liner freeboard for a specific Aqueduct Pool that exceeds the average observed rate from 2016–2022" (ibid, pdf, p. 367).

The interim minimum threshold for the California Aqueduct follows the same definition as the MO for the specific pool that "…exceeds twice the average observed rate from 2016–2022" (ibid).

Using the 2022 California Aqueduct Subsidence Program (CASP), the average observed rate (MO) and the twice average observe rate (MT) are calculated to be -0.05 and -0.1 ft per year (ibid).

For the Friant-Kern Canal, the 2022 Coordination Agreement defines the interim minimum threshold as the "average annual rate of subsidence over the last 6 years and the corresponding total interim extent from 2022 until 2040" (ibid, pdf, p. 396). Using available data, the GSAs established -0.2 ft per year as the Friant-Kern Canal MT (ibid).

For the Management Area Critical Infrastructure, the definition of critical infrastructures and the establishment of SMC are not coordinated across the GSPs and Management Area Plans.

Representative Monitoring Sites and Monitoring Network

The 2022 Coordination Agreement states that "[i]n the intervening 18 months since submittal of the [Kern County Subbasin] GSPs in 2020, the [Kern County Subbasin] has made progress in acquiring the data necessary to set sustainable management criteria. This work includes (some completed and other ongoing) the two aforementioned

studies, retaining the Lawrence Berkeley National Laboratory (LBNL) to perform a baseline subsidence and infrastructure status assessment of the Aqueduct and other critical infrastructure in the [Kern County Subbasin], preparing a revised basin study and the planned installation of additional subsidence monitoring sites in consultation with the DWR-California Aqueduct Subsidence Project (CASP) and the Friant water Authority (FWA)" (2022 Amended Coordination Agreement, pdf, pp. 355-356). The 2022 Coordination Agreement also claims that the data gap to identify the various causes and rates of subsidence remains and further studies are needed to better define realistic management objectives. To fully quantify the causes of subsidence and establish data-based MOs and MTs for critical infrastructure, the GSAs state that "in addition to the LBNL study, the [Kern County Subbasin] will install extensometers, near the Friant-Kern Canal, and work in close consultation with DWR- CASP and Friant Water Authority to update and interpret new InSAR and oilfield data" (ibid). The Kern County Subbasin is committed to working cooperatively with both CASP and the FWA "in the planning and installation of other geodetic-based monitoring technology" in the subbasin (ibid).

For California Aqueduct, GSAs will assess subsidence in a five-mile-wide monitoring corridor (i.e., 2.5 miles on either side of the Aqueduct) using the DWR subsidence monitoring reports (ibid, pdf, p. 364). GSAs will ground truth the InSAR data by comparing the InSAR subsidence against the subsidence values from existing NOAA CORS and CGPS stations, and available local extensometers in or adjacent to the Aqueduct monitoring corridor. This review will happen at least on an annual basis to use the InSAR data as supplement to DWR subsidence monitoring reports (ibid).

For the Friant-Kern Canal, in addition to using InSAR data, the Kern County Subbasin is coordinating with Friant Water Authority on filling data gaps and developing a monitoring network to evaluate subsidence within the Lower Reach monitoring corridor which is 2.5 miles on either side of the Friant-Kern Canal (ibid, pdf, p. 398). The 2022 Coordination Agreement states that "land-based monitoring of focused areas of interest will be established utilizing survey control points and NOAA CORS. A recently awarded DWR grant also provides for installation of 2 extensometers in the Lower Reach area that will be incorporated into the monitoring network. Kern Subbasin is committed to coordinate with the FWA on establishing this network" (ibid).

Infrastructure Mitigation

The 2022 Coordination Agreement did not include specific plans to mitigate the impacts of subsidence to the critical infrastructure. The Coordination Agreement states that "[a]dditional studies and subsidence modeling is necessary to understand the cause of subsidence, identify appropriate management actions, and to develop an appropriate mitigation plan that considers beneficial users and all contributors to significant and unreasonable impacts to surface land uses or the FKC" and "[o]nce the subsidence

modeling is complete, the Kern County Subbasin will develop and implement any necessary mitigation plan" (2022 Amended Coordination Agreement, pdf, p. 398).

Some GSPs adopted a draft "Domestic Well Mitigation Plan" to mitigate the adverse impacts of the GSP implementation on domestic groundwater wells. However, the plans did not discuss mitigating the impact of subsidence on any land uses and infrastructure including wells.

Project and Management Actions

The categories of the proposed future (WY2021–WY2040) management actions to project future water budget in the subbasin has not changed in the revised 2022 Coordination Agreement (2022 Amended Coordination Agreement, p. 22). KGA umbrella revised GSP lists 143 projects and management actions from 15 member entities with the implementation status, benefits of the project, and project description (2022 Kern Groundwater Authority GSA GSP, Table 4-1). The number of projects has reduced compared to 2020, as the number of member entities dropped from 18 to 15 and some entities added or removed projects.

The Olcese WD 2022 GSP provides a revised list of projects with details on the suggested timeline for initiation and completion and removed two projects from the 2020 list including development of subsidence monitoring network (2022 Resubmission Olcese GSP, Table PMA-1). The HMWD revised GSP suggests a demand reduction due to land fallowing in dry years project in addition to optimizing the recovery of the Pioneer Project banked supplies in dry years which was suggested in the 2020 GSP (2022 Henry Miller Water District GSP, 2022, pp. 91-92). The KRGSA and BVWSD GSA list the same management actions listed in the 2020 GSPs (2022 Kern River GSA GSP, Table 7, Section 7, p. 2; 2022 Buena Vista Water Storage District GSA, p. 250).

SOKR GSA proposes management actions to support achievement of the sustainability goal and groups the actions into two major categories based on their expected benefits including water supply augmentation and water demand reduction (2022 South of Kern River GSP, Table MN-3, pp. 286-289). The GSP states that the projects also have secondary benefits, including water quality improvement, flood control, water management flexibility/efficiency, and data improvement to better understand the basin setting components (ibid). The GSP identifies more details on the status of project, completion timetable, potential funding, and source of water for the supply augmentation projects (ibid).

4.1.3.4 Proposed State Water Board Deficiencies and Potential Actions

DWR's 2022 GSP Inadequate Determination dated March 2, 2023, found that the subsidence deficiency was not corrected in the 2022 GSPs submitted on August 1, 2022. DWR's 2022 GSP Inadequate Determination states:

> … the Plan made progress in moving towards coordinated Subbasin-wide subsidence management by establishing sustainable management criteria for the Regional Critical Infrastructure and defining Management Area Critical Infrastructure. However, the Plan still lacks a description and discussion of the conditions occurring throughout the Subbasin that would cause undesirable results that the GSAs propose to manage the basin to avoid. The Plan lacks detailed, supporting information describing and demonstrating the understanding of land uses and critical infrastructure (the Management Area Critical Infrastructure in particular) in the Subbasin and the amount of subsidence that would substantially interfere with those uses and critical infrastructure (2022 Inadequate Determination, p. 45).

State Water Board staff concur with DWR's findings in the 2022 GSP Inadequate Determination and hereby incorporate them by reference. Board staff have also identified additional, related issues.

Board staff have broken out deficiencies for the subbasin related to subsidence into LS-1 (a and b) and LS-2 (a, b, and c). Deficiencies from DWR's inadequate determination are summarized below as Land Subsidence Deficiency LS-1, which corresponds to Coordination Deficiency CRD-1. Coordination Deficiency CRD-1 concerns poorly coordinated undesirable results and SMC for multiple sustainability indicators. Deficiency LS-1 describes how CRD-1 applies to land subsidence. The Board's implementation and mitigation deficiency is included as Subsidence Deficiencies LS-2.

Deficiency Land Subsidence 1 (LS-1) – Land Subsidence undesirable results and SMC are not coordinated

What SGMA Requires: SGMA requires that "[a]gencies intending to develop and implement multiple plans pursuant to Water Code § 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies…", and Regulations requires that "elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting" (Cal. Code Regs., tit. 23, § 357.4, subd. (a)).

In defining undesirable results, GSA are required to "describe the process and criteria relied upon do define undesirable results" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)).

The undesirable result definition should include the cause of groundwater conditions occurring throughout the Subbasin that has or may lead to an undesirable result, the criteria used to define when and where the effects of groundwater conditions cause undesirable results, and the impacts on beneficial uses and users (Cal. Code Regs., tit. 23, § 354.26 subd. (b)).

In establishing SMC, GSAs must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26" (Cal. Code Regs. tit. 23 § 354.28). Discussion of the MTs should include among other things the "relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators" (Cal. Code Regs. tit. 23 § 354.28).

Undesirable results and SMC should be consistent with key details in the Coordination Agreement. Agencies should describe how they use the same data and methodologies for assumptions described in Water Code § 10727.6 by including monitoring objectives, coordinated basin water budget, and sustainable yield for the basin supported by a description of an undesirable result for the basin, and an explanation of how the minimum threshold and measurable objectives relate to the undesirable result (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). The coordination agreement shall also explain how the Plans implemented together, satisfy the requirements of the Act (Cal. Code Regs., tit. 23, § 357.4, subd. (c)).

GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).

Deficiency:

This is the corresponding LS-1 deficiency for CRD-1. Deficiency CRD-1 concerns undesirable results and SMC that are poorly coordinated across the subbasin. It includes two corresponding sub-deficiencies:

Deficiency	Coordination Deficiency	Corresponding Land Subsidence Deficiency
Undesirable results are poorly coordinated	CRD-1a	LS-1a
SMC rely on inconsistent datasets and methodologies	CRD-1b	LS-1b

Board staff note that addressing these coordination deficiencies effectively requires that subsidence undesirable results and SMC all be completely redeveloped.

Deficiency LS-1a – Undesirable results are poorly described, unworkably complex, and inconsistently implemented.

Deficiency: This is the subsidence deficiency that corresponds to Coordination Deficiency CRD-1a. Coordination Deficiency CRD-1a concerns undesirable results. For each sustainability indicator:

- The plain-language undesirable results from the Coordination Agreement are poorly described. While each GSP and Management Area Plan adopts the same plain-language undesirable results, they are interpreted and implemented very differently because they are too vague. This inconsistent interpretation exacerbates other issues with quantitative undesirable results and SMC.
- The quantitative undesirable results: 1) require a complex set of conditions occur across multiple GSAs and Management Areas, 2) are too poorly described and coordinated to be consistently implemented across GSPs and Management Area Plans, and thus 3) result in SMC that describe different conditions and impacts across different GSAs and Management Area Plans.

For subsidence:

- The undesirable results in GSPs and Management Area plans rely on inconsistently identified and categorized infrastructure. The Coordination Agreement indicates that a subsidence undesirable result is determined when "subsidence results in significant and unreasonable impacts to critical infrastructure…" (2022 Coordination Agreement, PDF p. 299). The DWR Inadequate Determination finds, however, that GSPs and Management Area plans did not consistently identify critical infrastructure. Specifically, DWR notes that "[t]he definitions of Management Area Critical Infrastructure and the responses from their respective agencies vary across the Subbasin" (DWR Inadequate Determination, p. 38). DWR further notes that "[s]ome GSPs or

management area plans defined Management Area Critical Infrastructure but did not develop sustainable management criteria…" (ibid, p. 38). Board staff agree and further note that GSPs and Management Areas do not consistently define "significant and unreasonable," as evidenced by the examples Board staff provide below of inconsistent quantitative undesirable results and MTs.

- Where GSPs or Management Area plans identified critical infrastructure, quantitative undesirable result definitions are inconsistent. For example:
    - The Olcese WD GSP indicates that an undesirable result would occur when subsidence caused the Olcese WD canal to lose 25% of its capacity, which it indicates would occur if one monitoring location subsided 0.75 feet more than another[13] (Olcese GSP, p. 84).
    - The AEWD Management Area plan indicates that an undesirable result would occur if "[subsidence] rates observed during the 2014 – 2018 time period were to continue through 2020)," which it considers to have occurred if the "MT is exceeded in at least 40% [of Representative Monitoring Sites]" (Arvin-Edison Water District Management Area Plan, p. 120-121).
    - The RRBWSD Management Area Plan does not establish undesirable results for its critical infrastructure. It instead indicates that a "Management Area exceedance"[14] occurs when the "average measured subsidence rate at the representative monitoring sites exceeds the established minimum threshold over a six-year rolling average" (Rosedale-Rio Bravo Management Area Plan, p. 107).
    - The Cawelo WD GSP also defines "Management Area Exceedances" rather than undesirable results. It appears to consider a Management Area

[13] The Olcese GSP indicates that a 25% loss of canal capacity would be considered significant and unreasonable. The GSP therefore calculates the change in gradient that would result in 25% capacity loss, establishes two monitoring locations along a canal that it considers critical infrastructure, and defines the MT as the differential subsidence between the two locations that would change gradient enough to lose 25% of canal capacity.

[14] Management Area Exceedances are used for groundwater level results. They are "triggered" when groundwater levels exceed MTs in 40% or more of a management area's representative monitoring locations over four consecutive bi-annual monitoring events. The Kern Groundwater Authority GSP "List of Kern Subbasin Definitions" explicitly indicates that a Management Area Exceedance is not an Undesirable Result.

exceedance an additional 1 foot of subsidence, which it considers to have occurred after just one MT exceedance—except that it uses groundwater level MTs as a proxy for subsidence.

Importantly, the KGA GSP explicitly states that Management Area Exceedances apply to groundwater levels (and groundwater storage by proxy)—not to subsidence (Kern Groundwater Authority GSP, p. 205). The fact that some Management Area plans define Management Area exceedances for subsidence indicates substantial confusion and poor coordination regarding how undesirable results are established.

Board staff acknowledge and appreciate that GSPs and Management Area Plans are better coordinated on Regional Critical Infrastructure. But Regional Critical Infrastructure only includes the two most prominent canals in the subbasin. Without better coordination around Management Area Critical Infrastructure, it appears unlikely that the basin will be able to avoid subsidence undesirable results.

- Board staff find that plain-language undesirable results are not detailed enough for consistent implementation across so many different GSPs and Management Area Plans. Board staff acknowledge that GSPs and Management Area Plans did adopt common plain-language undesirable results. But plain-language undesirable results should clearly describe the effects that a subbasin is trying to avoid. If they do, the conditions that trigger quantitative undesirable results should be similar across GSAs and Management Areas. The effects used to inform the MTs and quantitative results should also be similar. Instead, as illustrated above, the conditions (and therefore effects) that would trigger quantitative undesirable results vary substantially across GSAs and Management Areas.

Board staff propose the below Potential Action LS-1a to address the deficiency.

Potential Action LS-1a – Develop consistent, clear undesirable results.

GSAs should:

- Update the Coordination Agreement with a consistent plain-language subsidence undesirable result that clearly describes the impacts that the basin would consider significant and unreasonable and therefore is attempting to avoid. DWR notes in its 2022 GSP Inadequate Determination that “the [GSPs and Management Area Plans] should define their undesirable results supported by the amount of subsidence that would substantially interfere with the land uses

and critical infrastructure in the Subbasin…" (2022 Inadequate Determination of Kern County Subbasin GSP, p. 42-43).

The undesirable result should also clearly describe other conditions or terms that may impact how it is interpreted and implemented in the numerous GSPs and Management Area Plans. For example:

- If the basin decides to continue establishing different undesirable results for critical and non-critical infrastructure, then the Coordination Agreement should include clear criteria for identifying critical infrastructure.
- If the basin decides that undesirable results should still be caused only by "SGMA-related groundwater extractions," then the Coordination Agreement should include clear criteria and methodology for evaluating and quantifying subsidence cause. The 2022 Coordination Agreement currently states that SMC for California Aqueduct will be only applied if the subsidence occurs due to "SGMA-related groundwater extractions" from the agricultural, domestic, municipal, or urban beneficial uses/users (2022 Amended Coordination Agreement, pdf, p. 368). The 2022 Coordination Agreement also states that "[p]ermanent loss of freeboard from land subsidence due to other causes including but not limited to: due to oil or gas production, natural compaction of shallow underlying soils beneath or near the Aqueduct, or any other cause that is not within the jurisdiction of a GSA, shall not be considered as a loss of freeboard that contributes to the amount specified for any MO or MT" (ibid).

  The Coordination Agreement does not, however, explain how such a determination would be made. As DWR notes in its 2022 GSP Inadequate Determination "the [GSPs and Management Area Plans] lack discussion on how the GSAs would determine whether the subsidence was caused by so-called 'SGMA-related' activities rather than other causes of subsidence," and that it is unclear "whether the Plan has the capability to quantify 'SGMA-related' subsidence when evaluating its subsidence monitoring which it will be using to monitor the minimum thresholds" (2022 Inadequate Determination, p. 44).

  This clarity is needed to ensure that GSPs and Management Area Plans are coordinated. Without it, Board staff can't evaluate whether undesirable results and resulting SMC are consistent with the goals of SGMA.

Moreover, Board staff caution that undesirable results should not contain conditions or terms that exclude effects that may still be significant and unreasonable and within GSA authority. For example:

- While Board staff recognize that inelastic effects are often inherently more significant and unreasonable because they are irreversible, Board staff caution that: 1) elastic subsidence could still substantially interfere with surface land use and 2) GSAs have authorities to manage elastic subsidence.
- While Board staff appreciate the identification of, and focus on, critical infrastructure, Board staff caution that subsidence elsewhere may still be significant and unreasonable if it substantially interferes with surface land uses. For example, subsidence elsewhere may substantially reduce capacity in canals that the GSAs did not identify as critical. Subsidence elsewhere may also undermine controls to protect critical infrastructure. For example, subsidence in areas where GSAs have not established SMC could eventually spread to critical infrastructure, and GSAs may not be able to control it, because there would be no management actions.

In developing the plain-language undesirable result, GSAs should prioritize engaging with representatives from the range of users in the subbasin, including domestic well owners, small farmers, infrastructure managers, state and federal fish and wildlife agencies, and others, to clearly describe the impacts that would be considered significant and unreasonable. Feedback from users in the subbasin can help identify a definition of an undesirable result for chronic lowering of groundwater levels that is specific to the uses in the subbasin.

The plain-language undesirable results should be specific enough that GSAs and others can evaluate, over time, whether an undesirable result has occurred and whether the quantitative definition is sufficient to detect undesirable results. They should also be detailed and clear enough that they are implemented relatively consistently across the subbasin, which requires that all GSAs and Management Areas clearly understand the effects that are “significant and unreasonable” for the basin.

- Then, update the Coordination Agreement with a consistent, quantitative undesirable result that clearly describes the combination of MT exceedances that represent the conditions that would cause the plain-language undesirable result. Importantly, this quantitative undesirable result should be coordinated well enough across the subbasin that it is straight-forward and easy to track and evaluate, and the Coordination Agreement should explain how it represents the conditions that would cause a plain-language groundwater level undesirable result.
- Update GSPs and Management Area Plans with the updated plain-language and quantitative undesirable result definitions. Regulations allow Management Areas

to define different MTs and MOs, so long as “undesirable results are defined consistently throughout the basin” (Cal. Code Regs., tit. 23, § 354.20). Board staff suggest that to substantially comply with consistently defining undesirable results, GSPs and Management Area Plans should adopt the same undesirable result language as the rest of the basin, unless:

- They demonstrate that their different undesirable results are: 1) more protective than those in the Coordination Agreement **and** 2) easily integrated into basin-wide evaluation of undesirable results.

  OR

- They demonstrate: 1) unique needs for different undesirable results, 2) that their undesirable results are at least as protective as those in the Coordination Agreement, **and** 3) that they are easily integrated into basin-wide evaluations of undesirable results.

Deficiency LS-1b – SMC rely on inconsistent datasets and methodologies.

Deficiency: This is the subsidence version of Coordination Deficiency CRD-1b. Coordination Deficiency CRD-1b concerns the fact that SMC for each sustainability indicator: 1) use inconsistent data and methodologies across GSPs and Management Area Plans that, combined with vague, inconsistent undesirable results, 2) fail to represent the key conditions that groundwater managers must evaluate in order to achieve sustainability and avoid undesirable results.

For subsidence:

- SMC are inconsistent across GSPs and Management Areas. For example:
  - KGA GSP SWSD Management Area and The BVWSD GSP considered subsidence as a “data gap” and did not define MTs at this time.
  - The WKWD the SSJMUD, the KCWA Pioneer, the KWB Management Area Plan, the SWID 7th Standard Annex, the NKWSD/SWID, the TCWD, the Eastside Water, the KTWD, and the WDWA Management Area Plans did not define SMC either because they purported that there were no historical subsidence related impacts or because they expected minimal impacts.
  - KRGSA GSP, RRBWSD Management Area Plan, AEWD Management Area Plan, Cawelo WD Management Area Plan, and Olcese WD GSP defined the MTs for Management Area Critical Infrastructure. However, the defined MTs were either based on the historical rate of subsidence (e.g.,

2022 SOKR GSP; AEWD Management Area, p. 247) or according to groundwater level (e.g., 2022 Kern River GSP, Section 5, p. 39; 2022 Cawelo WD Management Area Plan, p. 182).

- There are inconsistencies in defining SMC in the GSPs located adjacent to regional critical infrastructure.

  The 2022 Coordination Agreement established a subbasin-wide definition for "Regional Critical Infrastructure" and "Management Area Critical Infrastructure" and most of the GSPs and Management Area Plans adopted these new definitions when updating the plans (2022 Amended Coordination Agreement, Appendix 3, pdf, p. 355). Regional critical infrastructure includes the California Aqueduct and Friant-Kern Canal. The California Aqueduct is contained within the boundaries of the KGA GSP WDWA and WKWD Management Areas, HMWD GSP, BVWSD GSP, and the SOKR GSA WRMWSD Management Area. The Friant-Kern Canal is contained within the boundaries of the KGA GSP SSJMUD Management Area, KGA GSP NKWSD Management Area, and the KRGSA GSP. These listed GSPs and Management Areas were updated to define the regional critical infrastructure consistent with the coordination agreement (2022 Inadequate Determination, p. 36).

  Inconsistencies in defining SMCs in the GSPs adjacent to regional critical infrastructure include:

  - The BVWSD GSP is inconsistent with the Coordination Agreement. The BVWSD GSP Buttonwillow Management Area defined an MT for the CA Aqueduct, but the MT is not coordinated with the Aqueduct defined MT in the subbasin (2022 Buena Vista Water Storage District GSA, Table 5-24, p. 173). The 2022 Coordination Agreement defines the California Aqueduct interim MT as -0.1 ft per year and accumulatively -1.8 ft by 2040 (2022 Amended Coordination Agreement, pdf, p. 367). The BVWSD GSP, however, provides cumulative MTs for Pools 24 through 28 ranging from -0.38 ft to -2.62 ft (2022 Buena Vista Water Storage District GSA, Table 5-24, p. 173), which is higher than the coordinated MT for some Pools.
  - The KWB Management Area Plan is inconsistent with the Coordination Agreement. The KWB Management Area Plan, part of the KGA GSP, is located within the monitoring corridor of the California Aqueduct but did not adopt the subbasin-wide Aqueduct MT (2022 Kern Water Bank Map, p. 27). The KWB Management Area Plan explained that "[t]he changes seen in this data are indicative of elastic rebound and recovery, rather that inelastic subsidence." (ibid, p. 27).

- The SWSD Management Area Plan in inconsistent with the Coordination Agreement. The KGA GSP SWSD Management Area, located to the east of California Aqueduct, did not discuss any potential impacts of subsidence on the Aquifer and did not adopt the subbasin-wide MT (2022 Semitropic Water Storage District Map, p. 182).

DWR notes in its 2022 GSP Inadequate Determination that although the GSAs made progress in moving toward coordinated subbasin-wide subsidence management by defining SMC for regional critical infrastructure, "the Subbasin still does not have a Subbasin-wide approach for managing subsidence because of the differing data and methodologies used to establish Management Area Critical Infrastructure and corresponding sustainable management criteria" (2022 Inadequate Determination, p. 45). DWR also states that "[d]ue to the variations in the plans' responses, Department staff conclude that the plans did not define "Management Area Critical Infrastructure" consistently and many do not set corresponding sustainable management criteria" (ibid).

Board staff propose the below Potential Action LS-1b to address the deficiency.

Potential Action LS-1b – Use consistent data and methods to develop groundwater level MTs.

The GSPs should:

- Develop MTs using consistent data and methods. The MTs should be calibrated so that, when they are exceeded per the quantitative undesirable result definition, they represent the conditions that would cause the plain-language groundwater quality undesirable result. Due to the numerous GSPs and Management Areas, the subbasin should coordinate these MTs to ensure they can be easily tracked and monitored to keep the basin on track. GSPs and Management Areas should generally establish MTs that can be easily evaluated for exceedances across the basin.

  To this end, DWR notes that "[GSPs and Management Area Plans] should identify the rate and extent of subsidence corresponding with substantial interference that will serve as the minimum threshold or should thoroughly demonstrate that another metric can serve as a proxy for that rate and extent" (2022 Inadequate Determination of Kern County Subbasin GSP, pp. 42-43). While GSAs provided two white papers to define MTs for the regional critical infrastructure, DWR notes that "the rates and cumulative amounts of subsidence that are defined for minimum thresholds along the California Aqueduct and Friant-Kern Canal are not consistently analyzed in terms of lasting impacts, but

rather from estimates from observed subsidence rates from previous studies" (ibid, p. 43). The 2022 Coordination Agreement defines the California Aqueduct interim MT to be equal to twice the average observed rate of subsidence from 2016 to 2022, which is quantified as -0.1 ft per year according to the 2022 CASP report (2022 Amended Coordination Agreement, pdf, p. 367). The Friant-Kern Canal interim MT is also established as -0.2 ft per year according to "average annual rate of subsidence over the last 6 years and the corresponding total interim extent from 2022 until 2040" (ibid, pdf, p. 396).

Because regional critical infrastructure MTs are not based on substantial interference with land surface uses, it is unclear how the established interim MTs would not interfere with the operations of regional critical infrastructure. For instance, it is unclear how the defined interim MTs would prevent reduction in flow capacity of the Friant-Kern Canal or preserve freeboard along the California Aqueduct. Therefore, DWR notes that the staff are unable to determine "how or whether the Agencies determined the proposed or allowable rates of subsidence under the interim minimum thresholds would avoid substantial interference to the Friant-Kern Canal" (ibid, p. 43).

- If GSAs establish different MT methods for Management Areas, the description of the Management Area should adequately explain how the MTs 1) still represent the basin-wide conditions that would cause plain-language undesirable results and 2) are easily integrated into basin-wide evaluations of undesirable results (Cal. Code Regs., tit. 23, § 354.20 subd. (b)).
- If a GSA wants to use groundwater levels as a proxy for subsidence, they must demonstrate that the "representative value is a reasonable proxy" (Cal. Code Regs., tit. 23, § 354.28). Staff consider a proxy reasonable if a GSA demonstrates: 1) a strong correlation between groundwater levels and subsidence, 2) a compelling reason why groundwater level proxy data are superior for tracking subsidence, especially considering that high-quality InSAR data are freely available and ground-based elevation surveys are relatively inexpensive, and 3) that the proxy data are easily integrated into basin-wide evaluations of undesirable results.
- Redevelop subsidence MOs. Subsidence MOs are the land surface elevations that basins plan to achieve. Importantly, MOs must provide operational flexibility below MTs, so redeveloping MTs might require redeveloping MOs. Importantly, MOs should be high enough above MTs that drought does not cause MT exceedances.
- Redevelop interim milestones. Interim milestones are the land surface elevations that basins plan to achieve as they manage toward MOs, so redeveloping MOs

will require redeveloping interim milestones. Interim milestones are set in 5-year increments, and they are important benchmarks to evaluate whether a basin is on track to reach its MOs by 2040.

Deficiency LS-2 – The GSPs do not provide adequate implementation details.

What SGMA Requires: Each GSP is required to include a description of the projects and management actions the GSA has determined will achieve groundwater sustainability in the basin. The description must include project management actions, summary of data used to support proposed actions, and a review of the uncertainty associated with the basin setting when developing projects or management actions (Cal. Code Regs., tit. 23, § 354.44).

In reviewing GSPs, DWR must consider, among other questions, "whether sustainable management criteria and projects and management actions are commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the plan" and "whether the projects and management actions are feasible and likely to prevent undesirable results and ensure that the basin is operated within its sustainable yield" (Cal. Code Regs., tit. 23, § 355.4, subd. (b)(3), (5)).

Deficiency: The 2022 Coordination Agreement does not provide details about projects and management actions to slow subsidence for both regional and Management Area critical infrastructure. The 2022 Coordination Agreement states that "it is apparent that key data gaps pertaining to the various causes and rates of subsidence in the [Kern County Subbasin] still remain and that further study is needed to better define realistic management objectives for the [Subbasin]" (2022 Amended Coordination Agreement, pdf, p. 356).

The 2022 Coordination Agreement has identified the areas of interest (AOIs) for California Aqueduct as the "[p]ools that have experienced subsidence which has significantly reduced freeboard and, in some cases, impacted flow capacity" and will be subject to focused monitoring (2022 Amended Coordination Agreement, pdf, p. 365). If the GSAs find that the groundwater extraction is the cause of subsidence in the AOIs, these sites will be identified for additional Subbasin monitoring stations in the future and/or management actions based on the data (ibid). Five AOIs are identified in the Coordination Agreement, two along the Friant-Kern Canal, two along the California Aqueduct, and one along the northern boundary of the subbasin where a significant amount of subsidence has been reported in the InSAR data (ibid, pdf, p.430). However, no exact management actions are listed in the Coordination Agreement or GSPs to manage subsidence, even in the AOIs. The GSAs also define the "Watch Areas (WAs)" as "[p]ools that have experienced minimal subsidence historically" (ibid, pdf, p. 365). The Coordination Agreement states that any changes in the rate of

subsidence would lead to redesignation of the WAs as AOIs. However, no management actions are suggested.

For the Friant-Kern Canal, the 2022 Coordination Agreement states that "[i]dentifying all of the potential factors (local, regional, out of region) contributing to subsidence will be a critical first step to managing current and future impacts and identifying appropriate management actions" (ibid, pdf, p. 395). GSAs have considered developing a mitigation plan to manage the impacts of subsidence on the Friant-Kern Canal; however, the 2022 Coordination Agreement states that "[a]dditional studies and subsidence modeling is necessary to understand the cause of subsidence, identify appropriate management actions, and to develop an appropriate mitigation plan that considers beneficial users and all contributors to significant and unreasonable impacts to surface land uses or the [Friant-Kern Canal]" (ibid, pdf, p. 398).

Recent InSAR data spanning June 2015 to October 2023 indicate total land subsidence ranging from zero to a maximum of 2.5 ft (along the northern boundary of the subbasin). A 2.5-mile buffer area around the regional critical infrastructure shows the cumulative land subsidence ranges from zero to a maximum of 1.1 ft adjacent to California Aqueduct (near Lost Hills), and ranges from zero to around 1.2 ft around the Friant-Kern Canal (north of the city of Shafter, east of the city of Wasco). The development and implementation of the subsidence projects and management actions is critical in the Kern County Subbasin to halt subsidence by 2040 and assess the progress of the subbasin toward sustainable groundwater management. Board staff proposes the below Potential Actions LS-2a, LS-2b, and LS-2c to address the deficiency.

Potential Action LS-2a – Develop and implement a plan to trigger sufficient management actions when subsidence exceeds defined thresholds, especially near critical infrastructure/facilities.

The GSPs should include detailed demand management plans for the entire subbasin to provide contingency in case future conditions are more difficult than anticipated. The GSAs should develop and implement reasonable actions (e.g., pumping reductions for nearby wells) to halt subsidence along critical infrastructure when it exceeds defined thresholds, and ensure these thresholds are established in a manner that avoids undesirable results. Because pumping is the primary cause of subsidence in the subbasin, GSAs should identify the wells that have the greatest impact on subsidence near critical infrastructure and the specific aquifers from which they pump and reduce or eliminate pumping from these wells if thresholds are exceeded.

These management plans should ensure that subsidence is monitored frequently enough that triggered actions avoid undesirable results. If actions aren't triggered, for example, until right before MTs are exceeded, the quarterly monitoring provided by

InSAR data may not be frequent enough to avoid exceedances. In these cases, continuous, ground-based GPS monitoring may be necessary.

Potential Action LS-2b – Reduce pumping and do not allow new wells in areas where subsidence threatens critical infrastructure.

GSAs should develop a well registration program to prevent new wells from being installed near, and move existing wells away from, critical infrastructure. The GSAs should proactively analyze the ongoing impacts of subsidence on critical infrastructure to determine not just where new wells should not be installed, but also where existing wells should be relocated or decommissioned to protect essential infrastructure. Moreover, GSAs should limit groundwater pumping to prevent subsidence from substantially interfering with the Friant-Kern Canal and California Aqueduct. It should also be noted that, in some cases, switching pumping from the confined to unconfined aquifers may cause additional undesirable results and impact other sustainability indicators; thus, it may not always be a feasible option.

Potential Action LS-2c - Develop infrastructure mitigation programs with clear triggers, eligibility requirements, metrics, and funding sources.

GSAs should minimize or avoid subsidence, as it causes irreversible harm; however, GSAs should also develop mitigation plans to repair infrastructure damaged by subsidence. The mitigation plans should:

- Identify infrastructure that may be damaged by subsidence and estimate associated repair costs.
- Identify adequate and reliable funding sources for mitigation efforts commensurate with the magnitude of impacts allowed under the GSPs' MTs; demonstrating adequate funding may involve projecting out fee revenues to demonstrate financial capacity that matches expected need. Board staff note that fee revenues levied by the GSAs on groundwater extractions are a more reliable funding source than grants and subsidies.
- Coordinate with local agencies responsible for maintaining and repairing infrastructure so that they understand how to apply for mitigation funds.

GSAs should not plan to fund infrastructure repairs necessitated by land subsidence with state or federal funding. For example, GSAs should develop funding necessary to restore capacity to canals rather than planning to rely on funding from DWR.

4.1.4 Deficiency GWQ – Degraded Groundwater Quality

A consideration under SGMA is avoiding "significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies" (Wat. Code, § 10721, subd. (x)). Degradation of water quality can limit local water supplies and beneficial uses, and SGMA requires GSAs to consider the interests of all beneficial uses and users of groundwater such as: drinking water uses (municipal, public water system, and domestic wells), agricultural uses, and environmental uses (Wat. Code, § 10723.2). Water quality degradation that significantly and unreasonably affects the supply or suitability of groundwater for any beneficial uses and users is an undesirable result. SGMA also requires that each GSP shall develop a sufficient monitoring network to track progress and potential undesirable results (Cal. Code Regs § 354.34).

The DWR Incomplete Determination did not include a specific Groundwater Quality deficiency; however, the coordination deficiency (Deficiency 1) applied to all sustainability indicators, including Groundwater Quality (2020 Incomplete Determination, pp 14-16). Additionally, the groundwater level deficiency (Deficiency 2), indicated that groundwater levels were potentially inappropriately used as proxies for groundwater quality (ibid, pp 19), that the impacts of groundwater level MTs on water quality were not adequately described (ibid, pp 20-35), and that GSPs should leverage existing programs and agencies in evaluating how GSP implementation may degrade water quality.

DWR gave the GSAs 180 days to address and resolve DWR's identified deficiencies. GSAs updated their GSPs and resubmitted them to DWR for review. DWR determined that the revised GSPs were inadequate.

The DWR Inadequate Determination did not include a specific Groundwater Quality deficiency; however, the coordination deficiency (Deficiency 1) again applied to all sustainability indicators, including Groundwater Quality (2022 Inadequate Determination, p 14-16). Again, the groundwater level deficiency (Deficiency 2), indicated that groundwater levels were potentially inappropriately used as proxies for groundwater quality (ibid, pp 27). DWR noted that GSAs made progress better describing the impacts of groundwater level MTs on groundwater quality but found that level of analysis supporting groundwater level MTs was inadequate.

Table 4-4 – Summary of DWR's Degraded Groundwater Quality Sub-deficiencies and Relevant Components of the 2020 and 2022 Kern County Subbasin GSPs

2020 GSPs	DWR's 2020 GSP Incomplete Determination

Five GSPs, 15 Management Area plans (part of the KGA GSP), and a Coordination Agreement were submitted in 2020 to DWR. • The 2020 Coordination Agreement defined an undesirable result as "the point at which significant and unreasonable impacts over the plan's duration, as caused by water management action, as determined by SMC, affect the reasonable and beneficial use of and access to, groundwater by overlying users." • Defined an undesirable result as occurring when minimum thresholds for SMC are exceeded in at least three adjacent Management Areas that represent at least 15% of the subbasin area or greater than 30% of the designated monitoring points within the basin (as measured by each Management Area). • GSPs' and Management Area Plan's took a fragmented approach to define management-area-specific undesirable results that would contribute to a basin-wide undesirable result. Variations include: o Constituents addressed. o Groundwater level SMC as a proxy to groundwater quality o Groundwater quality analyte concentrations. o No water quality SMC set.	• The Incomplete Determination did not include a specific Groundwater Quality deficiency; however: 1) its coordination deficiency applied to all sustainability indicators, including Water Quality, which meant that water quality undesirable results and SMC were inconsistent across the basin. 2) The groundwater level deficiency indicated that groundwater levels may have been inappropriately used as proxies for water quality. 3) The groundwater level deficiency indicated that the impacts of groundwater level MT on water quality were not adequately analyzed. 3) The groundwater level deficiency indicated that GSPs should leverage existing programs and agencies to help understand whether implementation of the GSPs is resulting in degradation of water quality.
2022 GSPs	**DWR's 2022 GSP Inadequate Determination**
Six GSPs, 12 Management Area plans (part of the KGA GSP), and an Amended Coordination agreement were submitted in 2022 to DWR. • The Coordination agreement defined an undesirable result as "the point at which significant and unreasonable	• The Inadequate Determination did not include a specific Groundwater Quality deficiency; however: 1) Its coordination deficiency applied to all sustainability indicators, including Water Quality, which meant that water quality undesirable results and SMC were inconsistent across the basin.

impacts over the planning and implementation horizon, as caused by water management actions, that affect the reasonable and beneficial use of and access to, groundwater by overlying users." • Defines an undesirable result as occurring when Management Area exceedances for a groundwater quality constituent occur in at least three adjacent Management Areas that represent at least 15% of the basin area or greater than 30% of the designated monitoring points within the basin (as measured by each Management Area in their plans). • Defines a Management Area exceedance as exceeding the MT trigger (>40% RMW) within a Management Area. • GSPs' and Management Area Plan's take fragmented approaches to define MTs that may contribute to an undesirable result. Variations include: o Constituents addressed. o Groundwater level SMC as a proxy for groundwater quality and how that relationship was justified. o Groundwater quality analyte concentrations. o Monitoring network.	2) The groundwater level deficiency indicated that groundwater levels may have been inappropriately used as proxies for water quality. 3) The groundwater level deficiency indicated that the impacts of groundwater level MT on water quality were still not adequately analyzed.

4.1.4.1 Kern County Subbasin 2020 Groundwater Sustainability Plans

This subsection and the following subsections describe the portions of each GSP or DWR determination relevant to the proposed Board deficiencies.

Plain-language Definition of an Undesirable Result

The 2020 Coordination Agreement defined an undesirable result for degraded groundwater quality as "the point at which significant and unreasonable impacts over

the planning and implementation horizon, as caused by water management actions, that affect the reasonable and beneficial use of, and access to, groundwater by overlying users" (2020 Coordination Agreement, Appendix A).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

GSAs defined an undesirable result as occurring when minimum thresholds for a groundwater quality constituent of concern is exceeded in at least three (3) adjacent Management Areas that represent at least 15% of the subbasin or greater than 30% of the designated monitoring points within the basin (as measured and set by each management area). A Management Area would only contribute to an undesirable result when local undesirable results are occurring. Different Management Areas define local undesirable results as occurring based on various conditions as mentioned in Section 4.1.1. It should also be noted that the method for determining which constituents should be considered for SMC and how SMC are monitored varied across all plans. A few examples are provided as follows:

> BVWSD GSP proposed to use groundwater quality data from representative monitoring wells and public water system (DDW) wells and set conservative MTs (drinking water standards vs. agricultural) for analyte concentration regardless of existing exceedances. Minimum thresholds were set for Arsenic, Boron, Chloride, DBCP, Hexavalent Chromium, Nitrate, Sodium, TCP, and TDS (2020 Buena Vista GSP, p. 150). The quantitative definition of what would contribute to an undesirable results for degradation of groundwater quality was not defined.
>
> KRGSA GSP proposed to use groundwater quality data from DDW, DWR, KCWA, USGS, and other data sources. After the conducted a statistical analysis, between groundwater levels and constituent concentrations, the GSA determined that only arsenic could be impacted by groundwater management actions and set SMC at groundwater level lows as a proxy for degradation of groundwater quality (2020 Kern River GSA GSP, pp. 3-39 and 5-28). The Kern River GSP defined a local undesirable result as occurring under various conditions in each of their three subareas (additional Management Areas). This includes a local undesirable result as occurring if a single groundwater level MT exceedance occurred for more than [three] consecutive months within the KRGSA Urban Management Area or KRGSA banking Management Area. The KRGSA Agricultural Management Area is further fragmented and defined a local undesirable result as occurring when one of the following occurred: (1) 40% of agricultural wells for more than [three] consecutive years, (2) 40% of urban wells for more than [two] consecutive years, or (3) there are exceedances in a specific single monitoring well (ibid, pp. 5-10).

In other cases, SMC for degradation of groundwater quality were not set. For example, the Olcese GSP did not establish SMC for the degradation of groundwater quality since "drinking and irrigation water quality are monitored by existing regulatory compliance efforts and no casual nexus between groundwater quality and water management activities are identified" (2020 Olcese GSP, p. 83).

Variations of the above examples result in additional use of data and methodologies to establish SMC. Additional issues related to coordination between plans are discussed in more detail in Section 4.1.1.

Monitoring

As mentioned above, the GSPs utilized various data and methods for setting SMC in their 2020 GSPs. This is also true for monitoring network sampling, parameters collected, spatial density, and frequency. The following examples serve to demonstrate a few examples of the variability between the GSPs. Other methods may be included in GSPs that are not listed here. Examples from 2020 Plans for monitoring are as follows:

KRGSA GSP proposed to monitor groundwater levels as a proxy to groundwater quality in 19 wells, monthly. The GSA proposed to also use periodic DDW and ILRP data from local Public Water systems and small water systems that may be used periodically for groundwater characterization (2020 KRGSA GSP, Sec. 6, p. 7-12).

BVWSD GSP proposed to collect groundwater quality samples from ILRP wells (GQTMWP wells), district production wells, and landowner wells on a semi-annual basis. A total of 13 sites, within the 72 square-mile Management Area of Buttonwillow, were included in the network resulting in a monitoring network with a spatial density of one site per 6.8 square miles (2020 Buena Vista GSP, p. 104). The Maple Management Area monitoring network was not defined in the GSP as the monitoring plan for this Management Area will be developed and monitored by the KRGSA (ibid, p. 102-104).

AEWSD Management Area Plan (KGA Member) defined an MT for one of eight proposed RMS for degradation of groundwater quality that would be sampled annually, resulting in a density of 4.84 sites per 100 square-mile area or one site per 20 square miles. The proposed RMS are all presumed to be active and in use for industrial, irrigation, or municipal use (2020 Arvin-Edison Water Storage District Management Area Plan, pp. 144-146).

The above examples demonstrate the basin's fragmented approach for monitoring degradation of groundwater quality in the subbasin. Additional data and methodologies are defined in the numerous 2020 GSPs and Management Area Plans which make it difficult to evaluate for sustainability.

4.1.4.2 DWR's 2020 GSP Incomplete Determination

In its January 28, 2022, incomplete determination letter, DWR identified the following deficiencies in the subbasins 2020 GSPs related to groundwater quality:

> Deficiency 1 – The GSPs do not establish undesirable results that are consistent for the entire subbasin.
>
> [This] deficiency (also described in Section 4.1.1) relates to the below sub-deficiencies as they impact groundwater quality, potentially in addition to other sustainability indicators, as defined by DWR:
>
> 1. GSAs do not establish a consistent definition of undesirable results within the subbasin. Particularly where the two-tiered approach does not specify when a management area would contribute to the basin wide definition of an undesirable result (3 adjacent management areas exceedances accounting for at least 15% of basin area or management area exceedances totaling more than 30% of the basin area). As defined in Section 4.1.1, different management areas would contribute, if at all, to the basin definition of an undesirable result under widely variable instances (2022 Inadequate Determination, p. 13-14).
> 2. GSAs use disparate data and methodology to set SMC throughout the subbasin (ibid). (Board staff observed that this deficiency has resulted in differences in parameters measured, frequency in monitoring, and SMC concentrations).

And,

> Deficiency 2 – The Plan does not set minimum thresholds for chronic lowing of groundwater levels in a manner consistent with the requirements of SGMA and the GSP regulations.
>
> [This] deficiency relates to the below sub-deficiencies that may impact groundwater quality as defined by DWR:
>
> > The GSPs also do not consistently explain how the lowering of groundwater levels [sic] minimum thresholds and measurable objectives that are set below historical lows will impact other applicable sustainability indicators, particularly groundwater quality (2022 Inadequate Determination, p. 19).
> >
> > Additionally, the GSPs use differing constituents and methods to establish minimum thresholds including some GSPs using groundwater levels as a proxy for degradation of water quality. Department staff recognize that a subbasin the size of the Kern County Subbasin will have a wide variety of

> water quality concerns requiring different management strategies; however, at this time, it is clear that the GSPs do not consider, or at least do not document, the potential for degradation to occur due to further lowering of groundwater levels beyond the historic lows. The GSPs should also consider and discuss the opportunities to coordinate and leverage existing programs and agencies to help understand whether implementation of the GSPs is resulting in degradation of water quality (ibid, p. 19-20).

Plain-Language Definition of an Undesirable Result

The coordination agreement defined the undesirable result for degradation of groundwater quality as “the point at which significant and unreasonable impacts over the planning implementation horizon, as caused by water management action, that affect the reasonable and beneficial use of and access to, groundwater by overlying users” (2020 Coordination Agreement, Appendix 3, p. 2).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The Coordination Agreement defined the quantitative definition for an undesirable result as occurring when, “minimum thresholds for SMC are exceeded in at least three adjacent management areas that represent at least 15% of the subbasin area or greater than 30% of the designated monitoring points within the basin. Minimum thresholds shall be set by each management areas through their respective Groundwater Sustainability Plans” (2020 Coordination Agreement). The condition in which each management area would be considered to contribute to the undesirable result, as defined in the coordination agreement, is inconsistently defined in each of the plans (see Section 4.1.1).

DWR staff expressed concern with the way the undesirable results and sustainable management criteria are defined and set in the individual plans, and then defined at the Subbasin level, and believe that there is a real possibility of groundwater conditions being significantly worse than the established minimum thresholds in various portions of the Subbasin before the GSAs determine the Subbasin as a whole has experienced an undesirable result (2020 Incomplete Determination of Kern County Subbasin, p. 13).

DWR’s 2020 GSP Corrective Actions

To address the deficiency in the 2020 GSP, DWR staff recommended that the GSAs do the following corrective actions:

DWR Deficiency 1 corrective actions:

1a. The Plan's Coordination Agreement should be revised to explain how the undesirable result definitions are consistent with the requirements of SGMA and the GSP Regulations, which specify that undesirable results represent effects caused by groundwater conditions occurring throughout the Subbasin. The discussion should include descriptions of how the Plans have utilized the same data and methodologies to define the Subbasin-wide undesirable results and how the Plan has considered the interests of beneficial uses and users of groundwater (2022 Inadequate Determination).

1b. Because of the fragmented approach used in the Subbasin that could allow for substantial exceedances of locally defined minimum thresholds over sustained periods of time, the GSAs must commit to comprehensively reporting on the status of MT exceedances by area in the annual reports and describe how groundwater conditions at or below the MTs may impact beneficial uses and users prior to the occurrence of a formal undesirable result.

1c. The GSAs must adopt clear and consistent terminology to ensure the various plans are comparable and reviewable by the GSAs, interested parties, and Department staff. This terminology should also adhere to the definitions of various terms in SGMA and the GSP Regulations including the understanding that undesirable results are conditions occurring throughout the Subbasin. The Plan and associated coordination materials must also be revised to clearly document how all of the various undesirable result definitions and methodologies achieve the same common sustainability goal.[…] GSAs should provide a comprehensive description of the groundwater conditions that would lead to localized undesirable results in the GSAs and other management areas which ultimately contribute to the 15 percent or 30 percent of land area criteria.

(2020 Incomplete Determination Kern County Subbasin, pp. 16-17)

DWR Deficiency 2 corrective actions (specific to groundwater quality sub-deficiency):

2a. Based on the groundwater level declines allowed for by many of the minimum thresholds, the GSPs need to explain how those groundwater level declines relate to the degradation of groundwater quality sustainability indicator. The GSPs must describe, among other items, the relationship between minimum thresholds for a given sustainability indicator (in this case, chronic lowering of groundwater levels) and the other sustainability indicators, degradation of water quality in particular. The GSPs generally commit to monitoring a wide range of water quality constituents, but they do not establish a consistent definition of undesirable results. Additionally, the GSPs use differing constituents and methods to establish minimum thresholds including some GSPs using groundwater levels as a proxy for degradation of water quality.

2b. The GSPs should also consider and discuss the opportunities to coordinate and leverage existing programs and agencies to help understand whether implementation of the GSPs is resulting in degradation of water quality.

(2020 Incomplete Determination of Kern County Subbasin, pp. 19-35)

4.1.4.3 Kern County Subbasin 2022 GSP Submission and WY 2022 Annual Report

The GSAs each submitted a revised GSP to DWR on August 1, 2022, in compliance with the 180-day resubmittal deadline. While not considered in DWR's assessment of the 2022 GSPs, the GSAs also filed a single WY 2022 Annual Report for the subbasin on March 31, 2023.

Plain-Language Definition of an Undesirable Result

The 2022 Coordination Agreement defined an undesirable result as "the point at which significant and unreasonable impacts over the planning and implementation horizon, as caused by water management actions, that affect the reasonable and beneficial use of, and access to, groundwater by overlying users" (2022 Coordination Agreement, pdf p. 298).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

Consistent with the two-tiered process defined in 2020 plans, the 2022 Coordination Agreement quantitatively defines an undesirable result to occur when "the minimum threshold for a groundwater quality constituent of concern is exceeded in at least three (3) adjacent management areas that represent at least 15% of the subbasin or greater than 30% of the designated monitoring points within the basin. Minimum thresholds shall be set by each of the management areas through their respective Groundwater Sustainability Plans" (2022 Coordination Agreement, Appendix 3).

Previously, the GSPs' definitions of how the Management Area would contribute to the basin wide undesirable result varied. To remedy this, the 2022 Coordination Agreement defines a minimum threshold trigger, which occurs when a Management Area is experiencing groundwater level decline beyond established MTs in 40% or more RMSs, within the Management Area over four consecutive bi-annual SGMA required monitoring events (ibid.). Board staff assume this applies to all SMC and not just declining groundwater levels. However, the methods used to set SMC are not unified across the various plans. A summary of the methods GSAs use to set SMC are as follows:

BVWSD GSP did not set MO for groundwater quality in the subbasin since their goal is to prevent degradation of water quality consistent with existing groundwater

quality regulatory programs and plan to correct exceedances detected under these programs (2022 Buena Vista Water Storage District GSA GSP, p. 152). Using existing public water system data and data collected from representative wells, the GSA established MTs at the more conservative drinking water or agricultural water quality goal concentrations for nine constituents (ibid).

The KRGSA GSP defines SMC for arsenic since it is the only constituent where groundwater levels appear to impact concentrations. Therefore, the GSA proposes to use groundwater level SMC as a proxy for degradation of groundwater quality and set MOs and MTs consistent with water level MOs and MTs (2022 Kern River GSA GSP, Chapter 5, p. 33-34).

The HMWD GSP defines water quality SMC for a single RMS. The MO for groundwater quality was set to not degrade at a rate higher than 10% every five (5) years. The MT is set based on observed concentrations from groundwater monitoring wells that operate for irrigation purposes and were set at WQO for agricultural use since drinking water in the Management Area is not occurring. The GSA states, “the district will manage groundwater extractions to minimize the application of saline water to crops, but it will not voluntarily preclude itself from pumping poorer-quality groundwater until MTs are reached […]” (2022 Henry Miller Water District GSP, pp. 80-81).

The Olcese WD GSP does not define SMC for degradation of groundwater quality in their Management Area, and stated the reason is due to, ”the location of and hydrogeologic conditions within the GSA [and] there are no water management-related mechanisms in this area that have caused or have potential to cause an undesirable result for this sustainability indicator” (2022 Resubmission Olcese GSP, p. 81).

SOKR GSP provides the statement, “available data indicate that groundwater extractions or recharge will not worsen degraded water quality conditions with the exception for arsenic, because no correlation was able to be established between water levels and water quality.” The MT for arsenic was set at regulatory thresholds or at pre-SGMA baselines plus 5 ug/L where exceedances have already occurred (2022 South of Kern River GSP, pp. 242-244).

KGA Umbrella GSP reiterates that the basin-wide undesirable definition allows for local definition, within each Management Area of the subbasin, of the MTs that constitute a significant and unreasonable impact to the beneficial uses within each Management Area. It is also mentioned that some of the Management Areas chose to use groundwater levels as a proxy for monitoring water quality. Each Management Area is responsible for defining what is considered a significant and unreasonable impact to beneficial uses and users from degraded water quality

(2022 Kern Groundwater Authority GSA GSP, p. 215). Each Management Area plan addresses the cause of degraded water quality in their Management Area differently since the Subbasin has dynamic differences in hydrology, water supplies, and water uses (ibid).

WDWA Management Area Plan does not propose to set SMC for water quality due to the overall naturally degraded groundwater quality west of the California Aqueduct, which has no current or planned significant SGMA related pumping (2022 Westside District Water Authority Management Area Plan, p. 83).

WKWD Management Area Plan demonstrated that the agency conducted a linear regression to correlate groundwater levels with arsenic, TDS, sulfate, chloride, and fluoride in representative monitoring wells and determined that no regulatory thresholds are expected to be exceeded at groundwater level SMC (2022 West Kern Water District Management Area Plan, Chapter 7, p. 10-11).

SSJMUD's Management Area Plan proposes to use groundwater levels as a proxy for groundwater quality. The plan states, "for the SSJMUD management area to contribute towards a Subbasin-wide undesirable result the criterion would be the same as for chronic lowering of groundwater elevations." (2022 Southern San Joaquin Municipal Utility Management Area Plan, p. 176).

SWID 7th Standard Annex Management Area Plan proposes a series of tests to consider if SMC should be set for a constituent. The tests consider regional occurrence, anthropogenic influence, sensitive beneficial users, pre-SGMA, other regulatory regime, and groundwater management "nexus." Based on the tests' criteria, SMC are only set for arsenic. MTs and MOs were both set at the regulatory threshold (2022 Shafter-Wasco Irrigation District 7th Standard Annex Management Area Plan, pp. 94-107).

SWSD Management Area Plan proposes to use groundwater levels as a proxy for water quality since they do not anticipate changes in groundwater quality from fluctuations of groundwater levels above MT values (2022 Semitropic Water Storage Management Area Plan, p. 174).

RRBWSD's Management Area Plan proposes to monitor groundwater quality for constituents that were identified during the coordination process. The GSP states, "[t]he measurable objective will be any applicable beneficial use COC value that is less than the current MCL and MT will be greater than the MCL and an increase of 10% of the 2015-2020 value [sic]." However, the district identified only arsenic to be influenced by lowering of groundwater levels (2022 Rosedale Rio Bravo Management Area Plan, pp. 106-107). It should be noted that exact concentrations for MOs or MTs are not clear.

NKWSD & SWID Management Area agencies reviewed water quality data from approximately 120 wells and trending analyses were performed for municipal and agricultural wells to evaluate the relationship between groundwater levels and water quality. GSAs determined that arsenic concentrations decrease with groundwater level decline, nitrate and salinity tend to increase when groundwater levels decrease, and 1,2,3-TCP has no relationship with groundwater levels. It should also be noted that in response to the relationship seen between nitrate and groundwater levels, the GSAs do not consider lowering groundwater levels as the contributing factor, despite the observed relationship. Therefore, the Management Area Plan proposes to use groundwater levels as a proxy (2022 North Kern Water Storage District and Shafter-Wasco Irrigation District Management Area Plan, pp. 236-237).

KTWD Management Area Plan states that, “the District believes that the main constituent of concern associated with groundwater levels is TDS,” due to potential change in gradient impacting the “fresh-saltwater interface” to the west. Therefore, the MT and MO are set at 750 mg/L and 500 mg/L, respectively (2022 Kern-Tulare Water District Management Area Plan, pp. 3-7).

KWB Management Area Plan analyzed four consecutive storage cycles and two significant recovery cycles which indicate groundwater degradation is not occurring and will not likely occur in the future (2022 Kern Water Bank, p. 36).

Pioneer Project Management Area Plan proposes to use groundwater levels as a proxy for groundwater quality and claims it is therefore consistent with groundwater level SMC. The agency used historical groundwater quality measurements for arsenic, nitrate, and specific conductance to correlate with groundwater level measurements and created a linear regression to estimate the resulting groundwater quality at the groundwater level minimum threshold for each well. One of their analyzed wells was projected to exceed the MCL for arsenic but will be blended with additional recovery wells before conveyance from the GSA (2022 Kern County Water Agency-Pioneer Project, Chapter 7, p. 23).

Eastside Water Management Area Plan defines TDS as the only constituent to be affected by groundwater pumping increases or decreases due to the nearby Olcese and Santa Margarita formations which contain higher TDS concentrations in groundwater. The MTs and MOs are set at 750 and 500 mg/L, respectively (2022 Eastside Water Management Area Plan, pp. 93-98).

Cawelo WD Management Area Plan did not find a clear correlation of significant differences in water quality with groundwater depth. Since a clear relationship was not observed and legacy issues are being addressed by existing regulatory

programs, the Cawelo GSA only proposed to set SMC for TDS with concerns to migrating salt water. The MT and MO were set at 1,500 and 1,000 mg/L, respectively (2022 Cawelo Water District Management Area Plan, pp. 187-192).

Monitoring

The 2022 Kern County Coordination agreement includes Appendix 3, which also includes the Kern Subbasin Monitoring Network & Protocols document. The intent of the document is to establish monitoring network objectives to demonstrate progress, monitor impacts, monitoring changes relative to sustainability indicators, and quantify annual changes in the water budget. For groundwater quality, monitoring networks shall be designed to demonstrate the sustainability goal is being met. Groundwater quality should be measured from each principal aquifer, data should be sufficient for mapping and to assess impacts to users, all analysis should be performed by certified labs, and collected according to the USGS National Field Manual for the collection of Water Quality Data. Specific analytes and how they should be monitored were not specified.

Similar to the fragmented approach for setting SMC, data and methodologies for monitoring networks are also disparate. Individual Management Areas were responsible for defining which analytes are considered constituents of concern and setting SMC to monitor them. The RMS were selected using various approaches from new well installations, relying on existing monitoring data, using wells where only groundwater levels are collected (as a proxy for groundwater water quality), using continuous measurements and discrete monitoring measurements, and more. Below are the various monitoring network designs and approaches for each plan:

BVWSD GSP defined the monitoring network for water quality to consist of wells used for ILRP compliance and GSA monitoring resulting in 13 wells total for the Buttonwillow Management Area's 72 square-miles area (1 per 6.8 square-miles) (2022 Buena Vista Water Storage District GSA GSP, p. 88). Samples will be collected on a semi-annual basis (ibid, pp. 102-104).

KRGSA GSP will collect groundwater levels as a proxy for water quality from 18 of 19 wells being monitored monthly (2022 Kern River GSA GSP, Chapter 6, pp. 7-12).

HMWD GSP states that only a single well will serve as an RMS for TDS concentrations and will be sampled on an annual basis (2022 Henry Miller Water District GSP, pp. 89-90).

Olcese WD GSP does not identify SMC for groundwater quality monitoring as part of SGMA but will continue to monitor groundwater quality as part of the District's own agricultural water management activities and in their public water system to track for potential changes (2022 Olcese Water District GSP, pp. 96-97).

SOKR GSP propose to monitor 10 wells in the Arvine-Edison Management Area and 9 wells in the Wheeler Ridge-Maricopa Management Area (one well per 15 and 16 square-miles, respectively) for several constituents and field parameters (pH, temperature, etc.) (2022 South of Kern River GSP, pp. 262-274). The third Management Area, Tejon-Castac, does not have a monitoring network in place for water quality. The GSA is evaluating options to add one or more wells to monitor water quality in its Management Area (ibid).

KGA Umbrella GSP states that, “the existing monitoring network in the KGA includes production wells and dedicated monitoring wells. Until enough dedicated monitoring wells are installed to fill data gaps, production wells will be used to expand spatial coverage of the existing network” (2022 Kern Groundwater Authority GSA GSP, p. 249). Specific details regarding monitoring networks in each Management Area are defined in the Management Area Plans as follows:

> WDWA monitoring will occur once every 5 years to reassess if groundwater quality SMC should be reconsidered (2022 Westside District Water Authority Management Area Plan, p. 93).
>
> WKWD uses groundwater levels as a proxy to monitor degradation of groundwater quality. The District will collect groundwater level data monthly from 6 and 17 monitoring wells in the North and South Project Management Areas, respectively (2022 West Kern Water District Management Area Plan, Sec. 6, pp. 12-17).
>
> SSJMUD uses groundwater levels as a proxy for groundwater quality. The proposed monitoring network consists of semi-annual groundwater level measurements from 10-11 monitoring wells covering the 101 square-miles area (conflicting values presented in the GSP’s Tables 4-3 and 4-4) (2022 Southern San Joaquin Municipal Utility Management Area Plan, pp. 209-213).
>
> SWID monitors for TDS, arsenic, and nitrate concentrations in three RMSs to allow for future water quality trend analysis, but only arsenic concentration exceedances may result in a Management Area exceedance trigger (2022 Shafter-Wasco Irrigation District 7th Standard Annex Management Area Plan, p. 117).
>
> SWSD uses the same 14 monitoring network wells defined for groundwater level monitoring which will be visited semi-annually for the three identified Management Areas (2022 Semitropic Water Storage Management Area Plan, pp. 207-213). The Management Area monitoring network consists of one well per 25 square miles, on average.

RRBWSD identifies 11 reference monitoring wells within their Management Area Plan that will be monitored annually for TDS, chloride, nitrate, and arsenic (2022 Rosedale Rio Bravo Management Area Plan, pp. 91-93). There is approximately one monitoring well per 7.1 square-miles.

NKWSD monitors groundwater levels as a proxy for groundwater quality since a relationship between groundwater levels and water quality constituent concentrations was not observed by the GSA. The groundwater level monitoring network will collect measurements from 20 monitoring wells, one well per 8.2 square-miles, semi-annually (2022 North Kern Water Storage District and Shafter-Wasco Irrigation District Management Area Plan, pp. 253-261).

KTWD samples 15 wells from within and around the District once every 5 years during fall seasonal lows, since 2019, for 11 constituents (2022 Kern-Tulare Water District Management Area Plan, Sec. 4, p. 11).

KWB will not monitor groundwater quality as part of SGMA since the Management Area must meet monitoring requirements consistent with DWR's Pump-in Policy for salts (2022 Kern Water Bank, p. 39).

Pioneer GSA considers DWR, GAMA, and Pioneer Project water quality data but groundwater levels will serve as a proxy for groundwater quality monitoring. Groundwater level monitoring consists of 5 RMS wells that will be measured monthly (2022 Kern County Water Agency-Pioneer Project, Chapter 6, pp. 9-14).

Eastside Water Management Area plans to collect water quality samples from 9 RMS wells on a semi-annual basis (2022 Eastside Water Management Area Plan, pp. 107-111).

Cawelo WD GSA monitoring network will include eight wells which are part of the ILRP network and are agricultural production wells in both agricultural and oil drilling land use activities (2022 Cawelo Water District Management Area Plan, p. 150). The frequency in which these samples are collected is not clear, but water levels, temperature, pH, electrical conductivity, dissolved oxygen, and nitrate parameters are sampled annually in addition to cation and anions being sampled once every five years as part of ILRP requirements (ibid).

4.1.4.4 Proposed State Water Board Deficiencies and Potential Actions

In DWR's 2022 Kern County GSP Inadequate Determination dated March 2, 2023, DWR staff determined that the GSAs had not corrected deficiencies that Board staff have determined impact degradation groundwater quality (Coordination Deficiency CRD-1) in the 2022 GSPs. DWR's March 2, 2023, Inadequate Determination states:

> The Plans still use various data and methods to establish the sustainable management criteria […] (2022 Inadequate Determination, p. 31).

And,

> The Plan's discussion related to why the various minimum thresholds reflect different groundwater conditions across the Subbasin and between adjacent management areas is still incomplete. These discussions should include how other sustainability indicators may be affected by the various minimum thresholds within the specific management areas but also in adjacent management areas (ibid).

Board staff concur with DWR's findings in their 2022 GSP Inadequate Determination in that the Subbasin has taken significant steps in improving corrective actions specific to each Management Area and conducting impact analyses for water level SMC. Additionally, DWR acknowledges KGA and KRGSA GSPs for providing discussions for PMA that could offset impacts to beneficial uses and users (ibid). After reviewing the six GSPs, 13 Management Area Plans, the Coordination Agreement, and DWR's determination letter, Board staff support DWRs determinations related to coordination and have identified additional deficiencies specific to degradation of groundwater quality.

Below, Board staff break down deficiencies for the subbasin related to groundwater quality. Deficiencies from DWR's inadequate determination are summarized below as Groundwater Quality Deficiency GWQ-1, which corresponds to Coordination Deficiency CRD-1. Coordination Deficiency CRD-1 concerns poorly coordinated undesirable results and SMC for multiple sustainability indicators. Deficiency GWQ-1 describes how CRD-1 applies to groundwater quality. The Board's monitoring network deficiency is included as GWQ-2, and its implementation and mitigation deficiency is included as GWQ-3.

Deficiency Groundwater Quality 1 (GWQ-1) – Groundwater Quality undesirable results and SMC are not coordinated

What SGMA Requires: SGMA requires that "Agencies intending to develop and implement multiple plans pursuant to Water Code § 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies…", and Regulations requires that "elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting" (Cal. Code Regs., tit. 23, § 357.4, subd. (a)).

In defining undesirable results, GSAs are required to "describe the process and criteria relied upon do define undesirable results [that would occur when significant and

unreasonable effects are caused by groundwater condition in the Subbasin]" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition should include the cause of groundwater conditions occurring throughout the Subbasin that has or may lead to an undesirable result, the criteria used to define when and where the effects of groundwater conditions cause undesirable results, and the impacts on beneficial uses and users (Cal. Code Regs., tit. 23, § 354.26 subd. (b)).

In establishing SMC, GSAs must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26." (Cal. Code Regs. tit. 23 § 354.28). Discussion of the MTs should include among other things the "relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (Cal. Code Regs. tit. 23 § 354.28).

Undesirable results and SMC should be consistent with key details in the Coordination Agreement. Agencies should describe how they use the same data and methodologies for assumptions described in Water Code § 10727.6 by including monitoring objectives, coordinated basin water budget, and sustainable yield for the basin supported by a description of an undesirable result for the basin, and an explanation of how the minimum threshold and measurable objectives relate to the undesirable result (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). The coordination agreement shall also explain how the Plans implemented together, satisfy the requirements of the Act (Cal. Code Regs., tit. 23, § 357.4, subd. (c)).

GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management Areas may define different MTs be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).

Deficiency:

This is the corresponding groundwater quality deficiency for coordination deficiency CRD-1. Deficiency CRD-1 concerns undesirable results and SMC that are poorly coordinated across the subbasin. It includes two corresponding sub-deficiencies:

Deficiency	Coordination Deficiency	Corresponding Groundwater Level Deficiency
Undesirable results are poorly coordinated	CRD-1a	GWQ-1a
SMC rely on inconsistent datasets and methodologies	CRD-1b	GWQ-1b

Board staff note that addressing these coordination deficiencies effectively requires that water quality undesirable results and SMC be redeveloped.

Deficiency GWQ-1a – Undesirable results are poorly described, unworkably complex, and inconsistently implemented.

Deficiency: This is the groundwater quality deficiency that corresponds to Coordination Deficiency CRD-1a. Coordination Deficiency CRD-1a concerns undesirable results. For each sustainability indicator:

- The plain-language undesirable results from the Coordination Agreement are poorly described. While each GSP and Management Area Plan adopts the same plain-language undesirable results, they are interpreted and implemented very differently because they are too vague. This inconsistent interpretation exacerbates other issues with quantitative undesirable results and SMC.
- The quantitative undesirable results: 1) require a complex set of conditions occur across multiple GSAs and Management Areas, 2) are too poorly described and coordinated to be consistently implemented across GSPs and Management Area Plans, and thus 3) result in SMC that describe different conditions and impacts across different GSAs and Management Area Plans.

For groundwater quality:

- The quantitative undesirable result would result in disproportional impacts in the Subbasin. The Coordination Agreement requires two conditions to trigger an undesirable result: 1) an MT exceedance must occur in 40% of RMS for four consecutive measurements (at least 2 years) for a management area to contribute to an undesirable result and 2) three adjacent management areas (accounting for at least 15% of basin area) or any management areas accounting for 30% or more of the basin area must be contributing to the undesirable results. The Coordination Agreement used the same complex approach for groundwater

levels. While DWR did not evaluate groundwater quality deficiencies, it did evaluate this approach for groundwater levels. For groundwater levels, DWR found that this set of conditions is so complex that it "may allow for situations where groundwater conditions could degrade for sustained periods of time for portions of the Subbasin without triggering an undesirable result" (2022 Inadequate Determination, p. 10). DWR also noted that "it is unclear… how minimum threshold exceedances will be tracked and reported in each management area and evaluated against the land area-based Subbasin-wide undesirable result definition" (ibid, p. 12). DWR stressed that the set of conditions was so complex that "Department staff cannot evaluate how the various management areas would assess whether any minimum threshold exceedance, for any amount of time and in any area, is causing effects that could be or become significant and unreasonable" (ibid, p. 12).

Board staff agree and emphasize that this complexity does not adequately protect beneficial uses and users from significant and unreasonable impacts.

- Undesirable results are poorly coordinated when considering constituents. Each GSP and Management Area Plan defines analytes specific to each GSA and Management Area's existing detections. This approach does not consider analytes that may also be: 1) present but not investigated, 2) in an adjacent management area, 3) naturally occurring but not mobilized, or 4) detected in shallower or deeper wells than were considered.

- Undesirable results are poorly coordinated when considering beneficial uses and users. Where drinking water users are not present, GSPs use agricultural water quality objectives for SMC, so GSPs do not consider it significant and unreasonable for groundwater to degrade below drinking water standards. This would be problematic on its own, as groundwater that is designated as municipal and domestic supply (MUN) should not be allowed to degrade below drinking water standards. Allowing such groundwater to degrade fails to protect the resource for future uses and users. But given that many Management Areas are relatively small, this approach also fails to protect existing drinking water users in adjacent Management Areas. Under these circumstances, beneficial uses and users could be severely impacted without an undesirable result being triggered.

- Board staff find that plain-language undesirable results are not detailed enough for consistent implementation across so many different GSPs and Management Area Plans. Board staff acknowledge that GSPs and Management Area Plans did adopt common plain-language undesirable results. But plain-language undesirable results should clearly describe the effects that a subbasin is trying to avoid. If they do, the conditions that trigger quantitative undesirable results should be similar across GSAs and Management Areas. Instead, as DWR notes

repeatedly in its Inadequate Determination, the conditions (and therefore effects) that would trigger quantitative undesirable results vary substantially across GSAs and Management Areas. Board staff understand the unique challenge of coordinating undesirable results and SMC across so many GSAs and Management Areas. Board staff stress, however, that this challenge only makes it more crucial for the Kern basin to develop clear, robust undesirable results and SMC.

Board staff propose the below Potential Action GWQ-1a to address the deficiency.

Potential Action GWQ-1a – Develop consistent, clear undesirable results.

GSAs should:

Update the Coordination Agreement with a consistent plain-language groundwater quality undesirable result that clearly describes the impacts that the basin would consider significant and unreasonable and therefore is attempting to avoid. For groundwater quality, this might be a percentage of impacted of domestic wells, for example.

In developing the plain-language undesirable result, GSAs should prioritize engaging with representatives from the range of users in the subbasin, including domestic well owners, small farmers, infrastructure managers, state and federal fish and wildlife agencies, advocates, and others, to clearly describe the impacts that would be considered significant and unreasonable. Feedback from users in the subbasin can help identify a definition of an undesirable result for chronic lowering of groundwater levels that is specific to the uses in the subbasin.

The plain-language undesirable results should be specific enough that GSAs and others can evaluate, over time, whether an undesirable result has occurred and whether the quantitative definition is sufficient to detect undesirable results. It should also be detailed and clear enough that it is implemented relatively consistently across the subbasin, which requires that all GSAs and Management Areas clearly understand the effects that are “significant and unreasonable” for the basin.

- Update the Coordination Agreement with a consistent, quantitative undesirable result that clearly describes the combination of MT exceedances that represent the conditions that would cause the plain-language undesirable result. This quantitative undesirable result should be a basin wide MT exceedance percentage that would protect against the significant and unreasonable impacts described by the plain-language undesirable result. Importantly, this quantitative

undesirable result should be coordinated well enough across the subbasin that it is straight-forward and easy to track and evaluate, and the Coordination Agreement should explain how it represents the conditions that would cause a plain-language groundwater quality undesirable result. The subbasin should evaluate conditions across the basin to develop a list of constituents that GSPs and Management Area Plans should monitor and manage.

This consistent quantitative undesirable approach should include revision of the basin settings to consider all analytes that have been detected in the subbasin in each aquifer.

In defining how groundwater quality degradation is caused by groundwater management, the Coordination Agreement should further consistently define:

- Which analytes can be influenced by groundwater management activities and therefore could contribute to an undesirable result. GSAs could make use of the SGMA groundwater quality visualization tool for reference. The tool uses GAMA data and regulatory standards to list the analytes that may have already impacted beneficial uses since 2015. GSPs and Management Area Plans should at least consider each constituent listed in the tool (See Table 3-2 in Section 3.5.6 of this report for listed constituents). GSAs may also consider additional constituents not listed by the tool: 1) constituents detected at any level within or upgradient of the GSA or Management Area, 2) constituents known to naturally occur, 3) constituents that may be mobilized by GSP or Management Area Plan implementation (for example, by recharge).

  GSPs and Management Area Plans should also develop SMC for each listed constituent for the subbasin, unless they demonstrate that an undesirable result from a constituent is unlikely. In addition to GSA or Management Area conditions, such a demonstration would need to consider: 1) adjacent GSA or Management Area conditions, 2) groundwater gradients and plume migration, 3) existing groundwater quality data gaps across the basin.

- Which management activities could influence groundwater quality. Importantly, this should not just include actions that contribute to groundwater level declines. For example: 1) recharge projects may alter groundwater gradients, which may cause contamination plumes to migrate into drinking water wells, 2) recharge may also change groundwater geochemistry, which may mobilize new constituents, 3) subsidence may lead to an increase in concentrations of arsenic, or 4) the chronic lowering

of groundwater levels may present need for deeper wells constructed at depth with existing constituents (Smith et al., 2018). At a minimum, GSPs should clearly explain how they would determine the water quality impacts of:

1) Projects and management actions. Board staff note that recharge projects could result in the mobilization of shallow constituents into wells. Recharge projects may influence the migration of legacy constituents within the vadose zone (unsaturated zone between the ground surface and the top of the water table) or may change groundwater conditions that may favor the mobilization of constituents not previously in solution.

2) Subsidence. Subsidence can mobilize constituents as the aquifer matrix or clay layers compact, as oxic groundwater levels decline, or as flooding frequency or severity increase (U.S. Department of the Interior, 1999; Haugen et al, 2021; Smith et al. 2018). Portions of the Kern County subbasin may be subsiding due to continued and extensive groundwater extractions beneath the E-clay. Because of this, the GSP should consider associated impacts when assessing the relationship between basin management and degraded groundwater quality, allowing continued subsidence, or switching to pumping of the shallow aquifer to avoid subsidence.

3. Continued pumping. Continued pumping may increase constituent concentrations via declining groundwater levels. Board staff also note that continued pumping in certain areas of the subbasin may cause changes in groundwater flow directions and/or gradients. These changing gradients may allow existing constituents to migrate to new areas. This is especially concerning where there may be existing cleanup sites within the subbasin or disposal of produced waters.

- Update GSPs and Management Area Plans with the updated plain-language and quantitative undesirable result definitions. Regulations allow Management Areas to define different MTs and MOs, so long as “undesirable results are defined consistently throughout the basin” (Cal. Code Regs., tit. 23, § 354.20). Board staff suggest that to substantially comply with consistently defining undesirable results, GSPs and Management Area Plans should adopt the same undesirable result language as the rest of the basin, unless:
    - They demonstrate that their different undesirable results are: 1) more protective than those in the Coordination Agreement **and** 2) easily integrated into basin-wide evaluation of undesirable results,

OR

- They demonstrate: 1) unique needs for different undesirable results, 2) that their undesirable results are at least as protective as those in the Coordination Agreement, **and** 3) that they are easily integrated into basin-wide evaluations of undesirable results.

Deficiency GWQ-1b – SMC rely on inconsistent datasets and methodologies.

Deficiency: This is the groundwater quality version of Coordination Deficiency CRD-1b. Coordination Deficiency CRD-1b concerns the fact that SMC for each sustainability indicator: 1) use inconsistent data and methodologies across GSPs and Management Area Plans that, combined with vague, inconsistent undesirable results, 2) fail to represent the key conditions that groundwater managers must evaluate in order to achieve sustainability and avoid undesirable results.

For groundwater quality:

- The GSPs and Management Area plans are not coordinated in their approach to developing minimum thresholds. For example:
  - Some GSPs and Management Area Plans use publicly available GAMA data while others rely on local monitoring well network data to describe basin settings and to conduct methodology for setting SMC.
  - Some GSPs and Management Area Plans use groundwater levels as a proxy to monitor groundwater quality degradation. Some management area agencies even justify the using a proxy because their analyses do not indicate a correlation between groundwater quality and groundwater levels. For example, the NKWSD & SWID used the lack of a correlation for arsenic and TDS to justify the use of groundwater levels as a proxy while others use it to justify setting concentrations for those analytes.
  - GSPs and Management Area Plans use different approaches to determine which constituents will be monitored and managed. This is a consequence of poorly coordinated undesirable results that are discussed in Deficiency GWQ-1a. Because the undesirable results do not include a list of constituents, GSPs and Management Area Plans are using inconsistent methods to determine which constituents require SMC.
  - SMC are not informed by consistent basin settings, as the basin settings in GSPs and Management Area Plans do not include 1) water quality backgrounds specific to each aquifer (confined, semi-, vs. unconfined in all

principle aquifers) or 2) proper information to demonstrate that enough interaction is occurring between aquifers to be considered a single principle aquifer.

- Some GSPs use the presence of existing regulatory programs to justify not setting SMC for constituents known to be influenced by groundwater levels such as nitrate and other analytes.
- In some cases, impacts of SMC did not consider all uses or users. For example, the WKWD GSP defined MTs based on how they would impact the district, since it is the only user to exceed “de minimis” amounts of water (greater than 2 acre feet per year for domestic purposes only) in the Management Area (2022 West Kern Water District Management Area Plan, Ch. 7, p. 4). This approach, however, does not consider impacts to most household drinking water users, who are typically considered de minimis.
- Some GSPs and Management Area Plans do not establish SMC for constituents with MCL exceedances before 2015.

Board staff proposes the below Potential Action GWQ-1b to address the deficiency.

Potential Action GWQ-1b – The GSPs should use consistent data and methods to develop groundwater level MTs.

The GSPs should:

- Develop MTs using consistent data and methods. The MTs should be calibrated so that, when they are exceeded per the quantitative undesirable result definition, they represent the conditions that would cause the plain-language groundwater quality undesirable result.
- If GSAs establish different MT methods for Management Areas, the description of the Management Area should adequately explain how the MTs 1) still represent the basin-wide conditions that would cause plain-language undesirable results and 2) are easily integrated into basin-wide evaluations of undesirable results (Cal. Code Regs., tit. 23, § 354.20 subd. (b)).
- If a GSA wants to use groundwater levels as a proxy for subsidence, they must demonstrate that the “representative value is a reasonable proxy” (Cal. Code Regs., tit. 23, § 354.28). Staff consider a proxy reasonable if a GSA demonstrates: 1) a well-specific strong correlation between groundwater levels

and water quality that is consistent with expected causation[15], 2) a compelling reason why groundwater level proxy data are superior for tracking groundwater quality, and 3) that proxy data are easily integrated into basin-wide evaluations of undesirable results. No GSP or Management Area Plan should justify using groundwater levels as a proxy for water quality based on a purported lack of correlation.

SGMA does not require GSAs to address undesirable results that occurred before and were not resolved by January 1, 2015. If appropriate, GSAs may therefore demonstrate specific locations where pre-2015 undesirable results are occurring. In these instances, MOs and MTs potentially exceeding regulatory thresholds may be appropriate, so long as they are limited to RMS in the pre-2015 undesirable result locations. Importantly, these MOs and MTs should still prevent the further degradation of groundwater quality.

Where pre-2015 undesirable results make it appropriate to establish MTs that exceed health-protective and quality-protective regulatory thresholds, MTs should still prevent continued degradation of groundwater quality. It is therefore reasonable for GSAs to evaluate pre-2015 groundwater conditions to 1) determine if there were already undesirable results that SGMA does not require GSAs to address and 2) quantify the pre-2015 conditions that the GSA inherited so that the basin can establish reasonable SMC. However, if constituent concentrations anomalously exceeded MCLs for a short period sometime prior to 2015 but thereafter returned to levels below MCLs, then the GSA did not inherit an undesirable result. It instead experienced a temporary exceedance of MCLs, and the GSA should therefore not use the exceedance data to determine MTs.

- Redevelop groundwater level MOs. Groundwater levels MOs are the constituent concentrations that basins plan to achieve. Importantly, MOs must provide operational flexibility below MTs, so redeveloping MTs might require redeveloping MOs. MOs should be low enough below MTs that drought impacts (for example, groundwater level decline or additional recharge) do not cause MT exceedances.
- Finally, predevelop interim milestones. Interim Milestones are the constituent concentrations that basins plan to achieve as they manage toward MOs, so

[15] Groundwater levels can impact different constituents differently. For example, in some situations, declining groundwater levels may cause arsenic concentrations to increase via either increasing oxic conditions or subsidence-caused expulsion from clay layers. But in other situations, declining groundwater levels may cause arsenic concentrations to decrease via desaturation of arsenic-bearing units. Causation should therefore be evaluated using local data and hydrogeology.

redeveloping MOs will require redeveloping interim milestones. Interim milestones are set in 5-year increments, and they are important benchmarks to evaluate whether a basin is on track to reach its MOs by 2040.

Board staff encourage GSAs to work with existing regulatory programs to minimize monitoring and data collection efforts. But Board staff caution that GSAs should not narrow the list of constituents that they consider, monitor, and manage just because a constituent is also considered by another regulatory program.

Deficiency GWQ-2 – Groundwater quality monitoring networks are not consistent with SGMA requirements.

What SGMA Requires: The GSP Regulations require GSPs to include a description of the monitoring network objectives for the basin including how the GSA will "monitor impacts to the beneficial uses or users of groundwater" (Cal. Code Regs., tit. 23, § 354.34, subd. (b)(2)). The monitoring network must be "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 [GSP] implementation" (Cal. Code Regs., tit. 23, § 354.34, subd. (a)). Data collected must be of "sufficient quality, frequency, and distribution" to characterize and evaluate groundwater conditions (Cal. Code Regs., tit. 23, § 354.32).

GSAs "may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin...", known as RMSs (Cal. Code Regs., tit. 23, § 354.36). GSAs identify MTs, MOs, and Interim Milestones at these sites. "The designation of [an RMS] shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area" (Cal. Code Regs., tit. 23, § 354.36, subds. (a) & (c)).

Deficiency: Board staff find that the GSPs monitoring networks are not protective of beneficial uses and users and do not promote the sufficient quality and collection of data, frequency, and distribution to characterize groundwater quality conditions and evaluate changing conditions that occur throughout the implementation of the GSP.

Deficiency GWQ-2a – The Monitoring Networks are not protective of all beneficial uses and users in the subbasin.

The monitoring well network often relies on existing monitoring programs, which primarily consist of public supply or irrigation wells. Domestic wells are typically completed at much shallower depths and are underrepresented in the monitoring well network. Domestic wells therefore may experience impacts from degradation of groundwater quality without an MT exceedance occurring. This is especially true for shallow aquifer constituents such as nitrate. Additionally, where E-clay is present, GSAs

do not differentiate between confined and unconfined aquifers for monitoring networks. This is especially concerning when it comes to monitoring conditions for shallow domestic well owners if the proposed RMS well is completed at depths below the E-clay.

Board staff propose the below Potential Action GWQ-2a to address the deficiency.

Potential Action GWQ-2a – GSAs should add additional wells to monitoring well networks.

Monitoring networks should either 1) include domestic wells or monitoring wells with similar screens and well depths to monitor for potential impacts to domestic users or 2) demonstrate that RMS wells are completed at similar depths and are influenced by similar hydrological processes as are domestic wells. Additionally, where E-clay or a confined aquifer is present, GSAs should define the aquifers being monitored by each well or adequately demonstrate that the aquifers are interconnected and are therefore affected by the same hydrological influences.

Deficiency GWQ-2b – Data collection sampling frequencies are sometimes inadequate.

Where groundwater samples are being collected, GSAs sometimes rely on existing sampling from existing regulatory programs. Board staff are pleased to see the coordination between GSAs and existing regulatory programs in the subbasin. However, GSAs should ensure the data from other regulatory programs will meet SGMA goals. Specifically, sampling frequencies from other regulatory programs are sometimes inadequate. Regulations require that monitoring networks be capable of detecting short-term, seasonal, and long-term trends. Board staff recommend that, at minimum, semi-annual sampling is required in monitoring seasonal highs and lows. In some cases, however, quarterly sampling may be required. GSAs should base sampling frequency not on pre-existing sampling schedules from other regulatory programs, but on constituent- and site-specific details. For example, GSAs should consider increasing sampling frequency as concentrations approach MTs. They should also consider the impacts of MT exceedances when scheduling sampling events. For example, it may be necessary to sample more frequently for constituents that can impact human health more severely.

Board staff note that many regulatory programs may not sample constituents frequently enough to ensure a GSA avoid undesirable results. For example, DDW monitoring frequencies depend on well and county requirements. In some cases, this may result in some constituents not being monitored for several years while others may be monitored monthly (usually where there are existing exceedances). In other cases, other regulatory programs may not sample for constituents that may cause undesirable

results. For example, ILRP monitoring efforts may not include constituents that are relevant to SGMA and are generally sampled on an annual basis (CV Salinity Coalition, 2023). And lastly, where CV-SALTS nitrate control program monitoring is proposed, it should be noted that implementation for priority 2 “Basins” (portions of the Kern County Subbasin) is not required before December 2025 (CV-SALTS).

Board staff propose the below Potential Action GWQ-2b to address the deficiency.

Potential Action GWQ-2b – Revise GSPs and monitoring well networks and exercise coordination with existing regulatory programs to meet the goals of SGMA.

Board staff support the collaboration between existing programs and SGMA to prevent duplication of monitoring efforts so long as the data collected are sufficient to meet SGMA water quality objectives. GSAs should revise their monitoring well networks and sampling plans to ensure they can detect seasonal and short-term trends, as necessary. In addition, where MT exceedances occur, Board staff recommend increased sampling frequencies to protect beneficial uses and users (See Potential Action GWQ-4a).

Additionally, specific to using existing monitoring by regulatory programs such as ILRP wells, if GSAs demonstrate that concentrations are well below regulatory thresholds and exceedances are unlikely to occur, less frequent annual fall measurements may be appropriate for some constituents as necessary. This should be in addition to having adequate network coverage and in some cases may be supplementary. If the well is an RMS, GSAs should consider a contingency of monitoring publicly available nearby well data similar portions and depths for an exceedance to determine if additional seasonal samples should be collected. This may be appropriate with other programs as necessary but should not take the place of SGMA requirements and must provide robust evidence to demonstrate beneficial users are unlikely to be impacted.

Deficiency GWQ-2c – It is unclear how monitoring networks are monitoring for recharge projects.

SGMA requires that GSAs must prevent “significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.” Board staff appreciate the significant efforts the Kern subbasin has made to reduce overdraft through recharging and water banking. But Board staff caution that recharging and water banking can substantially change groundwater gradients, which can cause existing contamination plumes to migrate. Recharging and water banking can also change groundwater conditions, mobilizing certain constituents. It is not clear to Board staff how the monitoring network will detect whether recharge or water banking projects are causing degradation of groundwater quality.

Board staff propose the below Potential Action GWQ-2c to address the deficiency.

Potential Action GWQ-2c – GSAs should define RMS that will be used to ensure PMAs do not impact groundwater quality in the Subbasin.

GSAs should revise GSPs to define and describe which PMA may influence groundwater quality, especially where recharge is occurring, and describe how they propose to monitor for potential degradation of groundwater quality.

In addressing this deficiency, GSAs should analyze the Board's GAMA Aquifer Risk Map (GAMA ARM) to determine existing groundwater quality risk to domestic and small system users. GSAs should consider existing constituents of concern, aquifers, and beneficial uses and users. Board staff recognize the complexities of groundwater management and groundwater quality and suggest GSAs consider the influence of groundwater levels, the potential changes in groundwater flow directions caused by recharge and water banking, and the subsidence impacts that may influence groundwater quality in the subbasin.

Deficiency GWQ-3 – Management actions are not responsive to water quality degradation.

What SGMA Requires: Each GSP is required to include a description of the projects and management actions the GSA has determined will achieve groundwater sustainability in the basin. The GSAs must include projects and management actions "that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent" (Cal. Code Regs., tit. 23, § 354.44, subd. (b)(1)).

The description must include project and management actions, a summary of data used to support proposed actions, and a review of the uncertainty associated with the basin setting when developing projects or management actions (Cal. Code Regs., tit. 23, § 354.44).

In reviewing GSPs, DWR must consider, among other questions, "whether sustainable management criteria and projects and management actions are commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the plan" (Cal. Code Regs., tit. 23, § 355.4, subd. (b)(3)).

Although SGMA and the GSP Regulations do not require development of specific management actions like well mitigation plans or additional sampling, the State Water Board considers them to be an important component of SGMA implementation to ensure for availability of water for all beneficial uses and users in the subbasin in order to avoid undesirable results.

Deficiency: GSPs lack management actions that are responsive to MT exceedances. These management actions are important in ensuring that GSAs avoid undesirable results.

Deficiency GWQ-3a – Additional sampling is not triggered when Minimum Thresholds are exceeded.

The 2022 GSPs do not include management actions that are responsive to MT exceedances. Board staff note that elevated concentrations of arsenic, nitrate, uranium, gross alpha, 1,2,3,-Trichloropropane, and other constituents can severely impact human health (See Table 3-2). It is difficult to understand how GSAs can avoid significant and unreasonable impacts from degradation of groundwater quality if MT exceedances don't trigger additional monitoring to better characterize risks to beneficial uses and users.

Board staff propose the below Potential Action GWQ-3a to address the deficiency.

Potential Action GWQ-3a – Plan additional sampling when water quality is degraded.

GSAs should plan to add RMS wells where project management and actions are implemented and should increase sampling frequency when MTs are exceeded. This is especially true for exceedances of regulatory threshold MCLs, as elevated concentrations of these thresholds can severely impact human health. MT exceedances should trigger further sampling to guide additional management actions and better understand the risk to drinking water beneficial uses and users—especially domestic well users. Additional sampling could include increased sampling frequency and sampling of additional nearby wells completed within the same aquifer.

Additionally, the subbasin should create a clear mitigation plan on how MT exceedances are investigated and addressed to prevent further degradation.

Deficiency GWQ-3b – Well mitigation plans don't address water quality degradation.

The 2022 GSPs do not include a consistent well mitigation plan. Only two of the GSAs, KGA and KRGSA, have proposed mitigation plans in effect for the chronic lowering of groundwater levels. However, these efforts do not specifically address potential to mitigate degradation of groundwater quality. As Board staff note in above Deficiency GWQ-3a, elevated concentrations of some constituents severely impact human health. It is therefore difficult for Board staff to understand how GSAs can avoid significant and unreasonable impacts from degradation of groundwater quality if the GSAs have not developed a well mitigation plan that can be reasonably implemented to address water quality degradation caused by groundwater management activities in the Subbasin.

Relatedly, MT exceedances have already been noted in the WY 2022 annual report, but GSAs propose only to continue monitoring.

Deficiency GWQ-3b is addressed by Groundwater Level Potential Action GL-2.

4.1.5 Deficiency ISW – Interconnected Surface Water

Under SGMA, achieving sustainability involves, among other things, avoiding "depletions of interconnected surface water (ISW) that have significant and unreasonable adverse impacts on beneficial uses of the surface water" (Water Code §10721, subd. (x)(6)). GSP regulations define ISW 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" (Cal. Code Regs, tit. 23, §351, subd. (o)). Depletions of ISW within the basin may have adverse impacts on surface water uses, such as degradation or loss of aquatic groundwater dependent ecosystems (GDEs) and reduced downstream surface water flow to users (Barlow & Leake, 2012).

The GSP regulations state that "[a]n Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators" (Cal. Code Regs, tit. 23, §354.26, subd. (d)). However, after analysis of the Coordination Agreement and the 2020 and 2022 GSPs submitted for the Kern Subbasin, Board staff have concluded that the GSPs do not consistently adequately justify an approach for identifying ISW in accordance with SGMA. Moreover, some of the GSPs incorrectly define ISW.

While other basins began implementing plans for ISWs in 2020 that are now approved (i.e., Paso Robles, Santa Cruz Mid-County), the Kern subbasin does not yet have an adequate plan to address the depletion of ISWs and achieve groundwater sustainability by 2040. To meet this timeline, Kern County Subbasin GSAs must adequately define, monitor and assess ISW within the basin in accordance with the SGMA Statute and DWR's Best Management Practices (BMPs). Failure to reasonably assess ISW could produce undesirable results, likely causing significant and unreasonable impacts to surface water users and nearby groundwater users prior to the 2025 GSP evaluation period.

4.1.5.1 Kern County Subbasin 2022 GSP

Undesirable Result and Sustainable Management Criteria

The GSAs' 2020 and 2022 GSPs claim there are no ISW in the Subbasin. Therefore, the GSAs did not define undesirable results or set sustainable management criteria for

ISWs. Additionally, the Coordination Agreement states that “the monitoring network will not be designed to monitor depletion of ISW because the issue is not applicable to the basin” (2022, Coordination Agreement, Sec. 6.3.5). However, the Coordination Agreement does not provide adequate evidence to justify why depletion of ISWs are not applicable to the Subbasin, nor does it describe consistent data and methods GSAs must use to evaluate if ISW exists. It appears to Board staff that ISWs were not properly considered in the Subbasin. Therefore, the GSPs do not define undesirable results, SMC, monitoring networks, or mitigation to prevent and protect depletion of interconnected surface water.

Interconnected Surface Water Evaluation

The approaches taken by GSAs for each of the GSPs to determine whether ISW were present are summarized as follows:

Henry Miller Water District GSA

The GSA based the absence of ISW on a map that references the Safe Drinking Water Information System (2019) that shows no GDEs (2022 Henry Miller Water District GSP). The GSP also notes that ISWs are not interconnected based on their assessment of a 22.5 mile research area for the Kern River. The GSP where states, “[a]lthough available data confirm that the Kern River is not interconnected with the underlying groundwater downstream of the First Point of Measurement, it appears that the Kern River from Democrat Springs to the First Point of Measurement may be gaining flow, with accretion from groundwater being one of the sources contributing to these gains. However, available data between these two locations are not adequate to refine the assessment of gaining and losing segments from the east boundary of the Subbasin to the First Point of Measurement" (2022 Henry Miller Water District GSP, Sec. 2.2.5).

Olcese WD GSP

The GSP states that the Kern River is fully disconnected from deeper groundwater systems (the Olcese Sand Aquifer Unit) since water level elevations are greater than 100 feet below the bottom elevation of the riverbed (2022 Olcese Water District GSP, 2022). The GSP also suggests that “the principal aquifer is hydraulically separated from the Shallow Alluvium and surface water bodies interconnected” (ibid). However, a study to monitor groundwater levels in the Shallow Alluvium zone during regular seasonal pumping from the Olcese Sand Aquifer Unit will allow the District to further evaluate the degree of hydraulic connection between the principal aquifer and the Shallow Alluvium and ISWs (ibid, p. 84). Lastly, the GSP states that “[i]f results from that project indicate a hydraulic connection between the two zones does exist, and that changes to groundwater level conditions in the Olcese Sand Aquifer Unit are likely to have an effect on Shallow Alluvium groundwater levels and ISW, the criteria for defining [undesirable results] for depletion of Interconnected Surface Water will be revisited” (ibid).

BVWSD GSP

The GSP notes the absence of water bodies in the plan area, and therefore concludes that natural surface water cannot be connected to groundwater. “The potential for depletions of interconnected surface waters is small given [...] the absence of streams flowing into or through the BVGSA, and the depth of the principal aquifer system which makes it unlikely that groundwater pumping has the potential to deplete surface water” (2022 Buena Vista Water Storage District GSA GSP, p. 80 and p.249), and “the absence of groundwater dependent ecosystems (GDEs) mapped within the boundaries of the BVGSA” (2020 Buena Vista GSA GSP; 2022 Buena Vista Water Storage District GSA GSP, p. 249). The GSP states that “a monitoring of depletion of interconnected surface waters is not needed in the BVGSA because there are no rivers, streams or lakes, supplied from direct recharge of groundwater, that lie within the GSA’s boundaries.”

KRGSA GSP

The KRGSA GSP analyzed Kern River operations and flow, channel elevation, and groundwater elevation data over a 20-year period (2022 Kern River GSP, p. 3-56). The GSP describes their analysis of potential ISW by using mapped polygons provided by DWR, the Natural Communities Commonly Associated with Groundwater (NCCAG). A shallow monitoring well at the Calloway Weir is included in the GSP monitoring network to support future analyses of ISWs as needed (2022 Kern River GSA GSP, pp. ES-9 and ES-10). An additional evaluation of potential surface/groundwater interaction beneath the Kern River includes well hydrographs along the entire reach of the Kern River in the Plan Area. However, many of the wells used for contouring are water supply wells with larger and deeper screen intervals that may represent a lower water level than at the water table. Seasonal variability of demand is not reflected in the analysis, since the analysis primarily focused on spring measurements. The range of groundwater elevations and the amount of groundwater separation from the ground surface suggest that groundwater elevations occur well below the entire reach of the Kern River within the Plan Area. Additional monitoring has been added along the Kern River to track any future changes in interconnected surface water, including wells 30S/27E-05D01 and ID4#13 as shown on Figures 3-47a and 3-47b, respectively” (2022 Kern River GSA GSP, ch.5, p.57).

SOKR GSP

The GSP evaluated the presence of ISWs by determining the depth to groundwater levels in the principal aquifer and/or the “undeveloped nature of land uses available data” (2022 South of Kern River GSP, p. 7). The depth to groundwater represents 2015 Spring conditions, and covers the Arvin-Edison, the Wheeler Ridge-Maricopa, and the Tejon-Castac Management Areas. According to the 2015 Groundwater conditions and the 2022 GSP: 1) ISW Sustainability Indicators are not applicable to the Management Areas, 2) no Basin-wide definition of undesirable results for Depletions of ISW has been developed by the Kern Subbasin GSAs, and 3) no SMCs for this Sustainability Indicator are defined in the Kern Subbasin.

KGA GSP (and Management Areas Plans)

KGA GSPs state there are no ISW in the KGA Area that are under the influence of groundwater pumping. The GSP states that 1) “[w]ithin the Subbasin, there are no interconnected natural surface water systems in monitored areas associated with the pumping zone of the regional aquifer system, 2) “[s]ince the advent of groundwater pumping in the Subbasin and subsequent impoundment and regulation of flow of the Kern River, groundwater levels near the river are no longer connected with the riverbed by a continuous saturated zone”, and 3) “there is no interconnected surface water under the influence of groundwater pumping in the principal aquifer in this area and no impacts to interconnected surface water have been observed.” Given these three statements and the implications of each of these statements, it is unclear if the GSA’s understanding of ISW is consistent with SGMA definition of ISW. KGA GSPs do not provide a detailed discussion on ISW, instead they refer to the Olcese WD and KRGSA’s GSPs, for a more detailed analysis (2022 Kern Groundwater Authority GSA GSP, p. 222).

4.1.5.2 Proposed State Water Board Deficiencies

In DWR’s 2022 Kern County GSP Inadequate Determination dated March 2, 2023, DWR staff determined that the GSAs had not corrected deficiencies that Board staff have determined impact depletion of ISW (Coordination Deficiency CRD-1) in the 2022 GSPs. DWR’s March 2, 2023, Inadequate Determination states:

> The Plans still use various data and methods to establish the sustainable management criteria […] (2022 Inadequate Determination, p. 31).

And:

> The Plan’s discussion related to why the various minimum thresholds reflect different groundwater conditions across the Subbasin and between adjacent management areas is still incomplete. These discussions should include how other sustainability indicators may be affected by the various minimum thresholds within the specific management areas but also in adjacent management areas (ibid).

After reviewing the six GSPs, 12 Management Area Plans, the Coordination Agreement, and DWR’s determination letter, Board staff support DWRs determinations and have identified additional deficiencies specific to coordination and add additional deficiencies specific to ISWs.

Below, Board staff break down deficiencies for the subbasin related to depletions of ISW. Deficiencies from DWR’s inadequate determination are summarized below as Interconnected Surface Water Deficiency ISW-1, which corresponds to Coordination Deficiency CRD-1. Coordination Deficiency CRD-1 concerns poorly coordinated

undesirable results and SMC for multiple sustainability indicators. Deficiency ISW-1 describes how CRD-1 applies to depletions of interconnected surface water.

Deficiency Interconnected Surface Water 1 (ISW-1) – Interconnected Surface Water Undesirable results and SMC are not coordinated

What SGMA Requires: SGMA requires that "[a]gencies intending to develop and implement multiple plans pursuant to Water Code § 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies…", and Regulations requires that "elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting" (Cal. Code Regs., tit. 23, § 357.4, subd. (a)).

In identifying ISWs, GSP Regulations state that ISWs refer 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," (Cal. Code Regs., tit. 23, § 351, (o)). The GSP Regulations require GSAs to provide "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," (Cal. Code Regs., tit. 23, § 354.16, (f)). Where ISWs are identified, GSPs define ISW undesirable results unless they demonstrate that ISWs undesirable results are "not present and are not likely to occur…" (Cal. Code Regs., tit. 23, § 354.26, (d)).

In defining undesirable results, GSA are required to "describe the process and criteria relied upon do define undesirable results [that would occur when significant and unreasonable effects are caused by groundwater condition in the Subbasin]" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition should include the cause of groundwater conditions occurring throughout the Subbasin that has or may lead to an undesirable result, the criteria used to define when and where the effects of groundwater conditions cause undesirable results, and the impacts on beneficial uses and users (Cal. Code Regs., tit. 23, § 354.26 subd. (b)).

In establishing SMC, GSAs must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26" (Cal. Code Regs. tit. 23 § 354.28). Discussion of the MTs should include among other things the "relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at

each minimum threshold will avoid undesirable results for each of the sustainability indicators" (Cal. Code Regs. tit. 23 § 354.28).

Undesirable results and SMC should be consistent with key details in the Coordination Agreement. Agencies should describe how they use the same data and methodologies for assumptions described in Water Code § 10727.6 by including monitoring objectives, coordinated basin water budget, and sustainable yield for the basin supported by a description of an undesirable result for the basin, and an explanation of how the minimum threshold and measurable objectives relate to the undesirable result (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). The Coordination Agreement shall also explain how the Plans implemented together, satisfy the requirements of the Act (Cal. Code Regs., tit. 23, § 357.4, subd. (c)).

GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).

Deficiency:

This is the corresponding ISW deficiency for coordination deficiency CRD-1. Deficiency CRD-1 concerns undesirable results and SMC that are poorly coordinated across the subbasin. It includes two corresponding sub-deficiencies:

Deficiency	Coordination Deficiency	Corresponding Groundwater Level Deficiency
Undesirable results are poorly coordinated	CRD-1a	ISW-1a
SMC rely on inconsistent datasets and methodologies	CRD-1b	

Board staff note that addressing these coordination deficiencies effectively requires that depletion of ISW undesirable results and SMC be redeveloped.

Deficiency ISW-1a – Undesirable results are poorly described, unworkably complex, and therefore inconsistently implemented.

Deficiency: This is the depletion of ISW that corresponds to the Coordination Deficiency CRD-1a. Coordination Deficiency CRD-1a concerns undesirable results. For each sustainability indicator:

- The plain-language undesirable results from the Coordination Agreement are poorly described. While each GSP and Management Area Plan adopts the same plain-language undesirable results, they are interpreted and implemented very differently because they are too vague. This inconsistent interpretation exacerbates other issues with quantitative undesirable results and SMC.
- The quantitative undesirable results: 1) require a complex set of conditions occur across multiple GSAs and Management Areas, 2) are too poorly described and coordinated to be consistently implemented across GSPs and Management Area Plans, and thus 3) result in SMC that describe different conditions and impacts across different GSAs and Management Area Plans.

For ISW:

- Despite the fact that GSAs and Management Areas claim there is no ISW and therefore no potential undesirable results, the methods used to determine that there are no potential undesirable results are inconsistent. For example:
    - The HMWD GSA bases the absence of ISW in the subbasin on a Safe Drinking Water Information System (2019) map that shows no GDEs. Board staff note, however, that the GSP also states, "water quality data suggest that some portion of the recharge to the principal water-bearing aquifer underlying the far eastern portion of the Subbasin (the Olcese Sand Aquifer) may come from percolation of Kern River surface water via seepage through the Kern Gorge Fault and/or through the overlying shallow alluvium" (2022 Henry Miller Water District GSP, p. 65).
    - The KRGSA analyzes Kern River operations and flow, channel elevation, and groundwater elevation data over a 20-year period (2022 Kern River GSP, p. 3-56). The GSP describes their analysis of potential ISW (2022 Henry Miller Water District GSP, pp. 37; 2022 Kern River GSP, sec 3, p.56 - 61). Board staff note, however, that the Kern River GSP states, "[a]lthough groundwater levels may rise within 20 feet of the base of the channel in some areas, this appears to occur only in wet years and/or as a result of intentional recharge along the channel" (2022 Kern River GSA GSP, p. 3-57).

- The BVWSD GSP claimed that there are no ISW because there is no surface water.
- The KGA GSPs claim that there is no ISW "under the influence of groundwater pumping in the principal aquifer," which indicates that the GSP used the wrong definition of ISW.

Potential Action ISW-1a – Revise GSPs to use consistent Data and Methodologies to evaluate for ISW.

Board staff acknowledge that the best data and methods for evaluating ISW may be different in some GSAs or Management Areas. But Board staff caution that GSPs and Management Area Plans should still be consistent on: 1) what ISWs are, 2) what ISW undesirable results would be if there were ISW, and 3) the acceptable methods and data that GSAs and Management Areas should use when assessing ISWs. This consistency is important to ensure that GSAs and Management Areas implement their plans consistently with the subbasin's goals. GSPs and Management Area Plans should include ISW undesirable results and SMC unless they demonstrate that ISWs undesirable results are "not present and are not likely to occur…" (Cal. Code Regs., tit. 23, § 354.26, (d)).

The GSPs and Coordination Agreement should be revised to define consistent data and methodologies to determine if ISWs are present. The approach should be sufficient for all GSAs and Management Area Agencies to determine if ISWs exist in their respective areas. The method(s) identified should be consistent with the best available data and science practices.

This coordinated approach should:

- First, reevaluate ISWs using the definition of ISWs as outlined by SGMA. Board Staff note that ISWs are defined by SGMA as groundwater that is in hydraulic connection at any time with a stream or surface water body (whether gaining or losing). Importantly, this means that ISWs can be seasonal, so evaluations should consider seasonality.

  To better consider seasonality, GSPs should at least assess groundwater level data from wetter seasons over multiple years. These assessments should incorporate historically wet years such as 2017 and 2019. The GSAs should use Interconnected Surface Water in the Central Valley (ICONS) data or other best available data as appropriate. Additionally, groundwater levels should only be assessed from shallow wells completed in the unconfined aquifer near surface water bodies. GSAs should consider surface or aerial geophysical resistivity surveys where ISW may be present to determine the

extent of the connection, since freshwater will have a higher resistivity than dry aquifer materials.

GSAs should also include coordinated surface water monitoring data such as flow data and stream bed elevations in their evaluation of the presence or absence of ISW. The GSAs should also consider incorporating groundwater quality data (water-type and stable water isotopes) to help support the presence or absence of connection. These data are essential to understanding potential hydraulic connections with groundwater.

- If ISWs are identified, evaluate whether ISW undesirable results are occurring or likely to occur. For example, the KGA GSPs should not simply claim that there is no ISW "under the influence of groundwater pumping in the principal aquifer." Board staff stresses that these are two separate evaluations that should be transparently described so that they can be reviewed by DWR, Board staff, and other interested parties.

If this coordinated approach identifies ISWs, then GSPs and Management Area Plans should:

- Develop SMC:
    - Develop MTs using consistent data and methods. The MTs should be calibrated so that, when they are exceeded per the quantitative undesirable result definition, they represent the conditions that would cause the plain-language ISW undesirable result.
    - If GSAs establish different MT methods for Management Areas, the description of the Management Area should adequately explain how the MTs 1) still represent the basin-wide conditions that would cause plain-language undesirable results and 2) are easily integrated into basin-wide evaluations of undesirable results (Cal. Code Regs., tit. 23, § 354.20 subd. (b)).
    - Redevelop groundwater level MOs. Groundwater levels MOs are the groundwater levels that basins plan to achieve. Importantly, MOs must provide operational flexibility below MTs, so redeveloping MTs might require redeveloping MOs. MOs should be high enough above MTs that drought does not cause MT exceedances.
    - Redevelop interim milestones. Interim milestones are the groundwater levels that basins plan to achieve as they manage toward MOs, so redeveloping MOs will require redeveloping interim milestones. Interim milestones are set in 5-year increments, and they are important

benchmarks to evaluate whether a basin is on track to reach its MOs by 2040.

- Finally, ensure that GSPs and Management Area Plans explain how ISW SMC impact other sustainability indicators, like groundwater levels or water quality. DWR noted in its 2022 Inadequate Determination that discussions of groundwater level MTs should "include how other sustainability indicators may be affected by the various minimum thresholds within the specific management areas but also in adjacent management areas" (2022 Inadequate Determination, p. 31). Board staff agree and further note that these discussions should not be limited to only groundwater level SMC.

- Establish an ISW monitoring network. Board Staff recommend creating a dedicated ISW monitoring network by identifying or constructing shallow wells within a reasonable distance to surface waters and associated surface water monitoring sites. According to DWR's Monitoring Network BMPs, the "network should extend perpendicular and parallel to stream flow to provide adequate characterization" (Department of Water Resources, 2016). The addition of shallowly screened wells, specifically along Jerry Slough and Kern River, will better characterize the spatial and temporal exchanges between surface water and groundwater.

  An ISW network is essential to understanding how groundwater extractions adjacent to streams may impact surface water flow. Pump tests should be conducted at nearby production wells to understand interactions between groundwater and surface water under projected demand stressors. Wells that are found to pump from zones or aquifers that lead to significant impacts on surface water flow or to groundwater dependent ecosystems may need increased monitoring during dry seasons or to be placed on hiatus.

- Develop appropriate models. Board staff recommends supplementing groundwater elevation data with ISW modeling efforts. Modeling will more accurately identify areas where surface water and groundwater may be hydraulically connected. According to DWR's Monitoring Network BMPs, accurate modeling requires, "empirical observations determining the extent of the connection of surface water and groundwater systems, the timing of those connections, the flow dynamics of both the surface water and groundwater systems, and hydrogeologic properties of the geologic framework connecting these systems" (Department of Water Resources, 2016).

4.1.6 Preliminary Review of 2024 Draft Groundwater Sustainability Plans

Staff recognize that coordination among GSAs has substantially improved, but the three fundamental deficiencies identified by DWR's inadequate determination (poor coordination, lowering of groundwater levels, and subsidence) still remain for the 2024 Draft GSPs, in addition to board identified deficiencies (groundwater quality and deletion of ISWs). The draft staff report identifies potential actions that the GSAs can incorporate to address the deficiencies identified in the 2022 GSPs. Board staff have conducted 10 consultation meetings with the Kern County Subbasin GSAs since March 2023 to provide feedback on deficiencies in 2022 GSPs and potential actions for remedying those deficiencies. A significant amount of this feedback forms the basis for the written recommendations of the draft staff report. Because the deficiencies identified after the preliminary review of the 2024 Draft GSPs are consistent with the deficiencies in the 2022 GSPs, GSAs can use the draft staff report as guidance to correct the deficiencies in the 2024 Draft GSPs and address the Board staff recommendation to designate the basin as probationary. Board staff will continue to review the 2024 Draft GSPs in greater depth and work with the GSAs to provide feedback to resolve remaining deficiencies. Board staff will incorporate review of the 2024 Draft GSPs into the final staff report. Staff invite interested persons to also review the 2024 Draft GSPs and to provide written comments to the Board on whether and how deficiencies and potential actions identified in the draft staff report remain applicable to the 2024 Draft GSPs.

Below are deficiencies observed by staff during the preliminary review of the 2024 Draft GSPs and the corresponding deficiencies and potential actions in this report:

- Board staff note that the use of regionally-averaged declining elevation trends leads to groundwater level MTs that vary dramatically across "hydrological areas" of the subbasin and may have resulted in a skewed (heavily weighted toward areas of more pumping and lower elevation) approach in setting MTs. This results in inconsistent management action triggers across plan areas, an issue previously identified by DWR across the 2022 GSP plan areas due to lack of coordination (Consistent with Coordination deficiency 1a).

- Groundwater level MTs were determined using the lowest of projected historical trends or historical water level ranges, rather than using thresholds focusing on protection of beneficial uses and users. This method is consistent with a method called out by DWR's 2022 inadequate determination letter, previously referred to as "trend averages" and "range dominated minus a correction" which is now referred to as "trend dominated" and "range dominated" in the 2024 Draft GSPs (2022 DWR Inadequate Letter, pp. 31-32; 2024 Draft Main GSP, ch. 7, pp. 7-10). In many cases this results in MTs that exceed historical lows and are more than one-hundred feet deeper than current groundwater levels with no justification.

Also, staff noted that GSAs lowered numerous MTs, several by more than 50 feet and some by more than 100 feet, compared to MTs set in the 2022 GSPs. These MTs could result in groundwater levels declining well below historic lows without triggering any management actions (Groundwater Level deficiency).

- Plans lack clarity on banking operations and how they impact the ability of the basin to avoid hitting MTs. This is especially true given that the GSPs' Appendix E, Kern Fan Water Banking Program, stated that, " [t]he Projects cannot cause chronic lowering of groundwater levels or a reduction in storage" (2024 Draft Main GSP, Appendix E. p. 7) (Groundwater Level deficiency).

- The GSAs do not demonstrate a fundamental understanding of the Subbasin's settings. For example, monitoring well networks for groundwater levels and groundwater quality do not differentiate between confined and unconfined aquifers separated by the E-clay (a confining layer), or other clay layers. Most monitoring wells appear to be screened in the confined aquifer, and therefore may not be protective of all beneficial users when water levels in the unconfined aquifer are lower than that in the confined aquifer. An understanding of groundwater levels and groundwater quality in the unconfined and confined aquifers, as well as subsidence and groundwater quality, is essential for characterizing hydrogeologic conditions throughout the subbasin. Well impact analyses, monitoring plans, or mitigation strategies developed without this knowledge are insufficient and may not be protective of beneficial uses and users (Consistent with Groundwater Level and Groundwater Quality deficiencies).

- The GSPs state that mitigable subsidence is not considered an undesirable result but do not propose a mitigation plan aside from an external mitigation already being implemented by FWA. The GSPs also propose that subsidence along the CA aqueduct is the result of oil and gas extraction without substantial evidence (2024 Draft Main GSP, ch. 13, p. 75 and 2024 Draft Main GSP, ch. 14, p. 17) (Land Subsidence deficiency).

- Board staff also identified deficiencies in the 2024 Draft GSPs related to degradation of groundwater quality, similar to those observed by Board staff in the 2022 GSPs. For example, when an exceedance occurs with respect to groundwater quality MTs, GSAs will investigate if it is a result of groundwater management actions using statistical and/or spatial analyses between water levels and water quality (2024 Draft GSP, ch 13, p. 55). However, GSPs lack details of what the investigation would entail or potential mitigation measures if the exceedance is determined to be a result of groundwater management (Groundwater Quality deficiency).

- GSAs do not define ISWs or propose monitor for ISWs consistent with the requirements of SGMA (Cal. Code Regs., tit. 23, § 354) (Interconnected Surface Water deficiency).

4.2 Exclusions from Probationary Status

The State Water Board must exclude from probation any portions of the basin for which a GSA demonstrates compliance with the sustainability goal (Wat. Code, § 10735.2, subd. (e)). Staff believe no GSAs, or members of GSAs, in the subbasin have demonstrated compliance with the sustainability goal. All GSAs have adopted and are implementing six developed GSPs and 12 Management Area Plans, which DWR has determined to be inadequate. Based on DWR's findings and Board staff's thorough review of each GSP and Management Area Plan, Board staff find that no GSP or Management Area Plan has an adequate sustainability goal. Staff therefore recommend that the State Water Board not exclude any portions of the subbasin from the probationary designation at this time.

4.3 Modification to Water Year and Reporting Dates

Staff do not recommend the State Water Board modify the water year for reporting extractions, but staff do recommend modifying the extraction reporting deadline for groundwater extraction reports required pursuant to Water Code section 5202.

4.3.1 Proposed Change

The "water year" is the period of October 1 to September 30. For basins designated probationary, SGMA requires groundwater extraction data for the preceding water year be submitted to the State Water Board by February 1 of each year (Wat. Code § 5202, subd. (b)). Board staff recommend modifying the extraction reporting deadline for reporters in the Kern County Subbasin to December 1 of each year. Staff do not recommend any modifications to the water year.

4.3.2 Justification

As stated in section 4.0 above, the overall goal of a probationary designation is to gather information to help local GSAs address deficiencies in their plans so they can sustainably manage their groundwater resources as soon as possible without outside help.

Requiring extraction reports be submitted to the State Water Board by December 1 of each year rather than February 1 will make extraction data available to staff, and GSAs

if requested, two months sooner compared to relying on the default reporting date. Groundwater extractors would have two months from the end of the Water Year to the reporting deadline to file their reports. Obtaining these data sooner means that staff and GSAs will fill data gaps sooner, potentially enabling GSAs to better address plan deficiencies and forestalling the need for the Board to develop and implement an interim plan. If GSAs do not address plan deficiencies, the earlier reporting deadline will give staff additional time to evaluate extraction reporting information when evaluating the need to develop an interim plan.

Groundwater pumpers subject to reporting in a probationary basin must begin measuring and recording extractions 90 days after the probationary designation (Wat. Code, § 5202, subd. (a)(1)). If the State Water Board designates the subbasin probationary on February 19, 2025, pumpers would start recording extractions on May 12, 2025 and would file their first report of groundwater extraction on or before December 1, 2025.

4.4 Requirements for Installation and Use of Measuring Devices

As part of a probationary designation, the State Water Board may require groundwater extraction reporters to install and use measuring devices, such as flow meters, for measuring their groundwater extractions (Wat. Code § 10735.2, subd. (c)(3)).

4.4.1 Proposed Requirement

Board staff recommends the Board:

- Require groundwater extraction reporting and paying fees for: 1) any person extracting more than two acre-feet per year for any reason OR 2) any person extracting 2 or fewer acre-feet of groundwater per year for any reason other than domestic purposes.
- Require any person extracting more than 500 acre-feet per year to install and use meters that meet the requirements of Cal. Code Regs., tit. 23, § 1042 on all their production wells within the subbasin.
- Require any person extracting groundwater from the wells located in the CA Aqueduct and Friant-Kern Canal subsidence monitoring corridors to install and use meters that meet the requirements of Cal. Code Regs., tit. 23, § 1042 on all their production wells within the basin.
- Exclude any person who extracts two acre-feet or less per year for domestic uses only (de minimis users) from reporting requirements and paying fees. This

exception includes most household users, including those extracting from wells located in the CA Aqueduct and Friant-Kern Canal subsidence monitoring corridors.

These recommendations are specific to the water use and landownership patterns of the Kern County Subbasin, as described below in Section 4.4.1.3.

4.4.1.1 Importance of Measuring Groundwater Extractions with Meters

Despite the importance of monitoring water for management purposes, most agricultural water use worldwide—both from groundwater and surface water—remains unmetered (OECD, 2015). In the United States, only 36% of groundwater irrigation wells are equipped with flow meters (USDA, 2019), with large monitoring gaps in states such as California that have experienced severe aquifer depletion over recent decades (Scanlon, et al., 2012; Liu, et al., 2022). Many western states affected by long-term overdraft and severe drought conditions have begun requiring meters on groundwater extractions to fill these data gaps (e.g., Idaho Code § 42-701; Idaho Eastern Snake Plain Aquifer measurement order; Oregon ORS 540.435; Oregon ORS 537.780; Washington RCW 90.44.450; Arizona § 45-604 Water measuring devices, Montana Rule 36.12.1211, New Mexico statewide groundwater measurement specifications, Colorado well metering, Wyoming meter selection specification, Nevada NRS 534.180 and NRS 534.193).

The sustainable management of groundwater under SGMA will be difficult without measuring groundwater extractions by the subbasin's groundwater users. Estimating the volume of groundwater extractions using indirect methods can provide valuable information such as total water use. However, these methods have some drawbacks. For example, satellite measurements of evapotranspiration (ET) cannot be used to estimate groundwater extractions for sectors that do not apply groundwater for irrigation purposes (e.g., dairy operations, groundwater exports, commercial uses, and oil and gas injection). Estimates of groundwater extractions using crop water demand can vary due to climatic conditions, such as rainfall or temperature, and involves determining and monitoring agricultural practices, which can be a challenge (Meza-Gastelum, et al., 2022).

The most appropriate and robust method for collecting groundwater use data is the measurement of groundwater extractions by metering devices. Requiring well owners to install meters and report groundwater extractions will help improve analysis of groundwater conditions and lead to more effective management of groundwater in the subbasin. Board staff recommend that the Board 1) require groundwater extractors who extract over 500 AFY of groundwater to install meters, 2) require groundwater extractors

who extract groundwater from FKC and California Aqueduct subsidence monitoring corridors to install meters, and 3) encourage other extractors using less than 500 AFY of groundwater to install meters voluntarily to improve the accuracy of pumping measurements in the subbasin.

4.4.1.2 Existing GSA Requirements for Metering in the Subbasin

Kern County Department of Public Health requires permanent flow meters on all new wells. Kern-Tulare Water District is the only agency in the subbasin that provides on its website an adopted policy requiring flow meters on all existing wells in the district.

4.4.1.3 Rationale for Proposed Meter Requirement

Accurate measurement of groundwater extraction with meters will fill key data gaps that limit our understanding of overdraft conditions and effects on all beneficial uses in the subbasin.

In order to evaluate potential thresholds for requiring meters, Board staff used OpenET[16] to estimate how much water is used by groups of landowners (grouped by water use) in the subbasin. While using ET data alone has limitations mentioned above, this was the best proxy for groundwater use in the subbasin that staff could use to evaluate potential thresholds. Staff evaluated OpenET data and the GSP Annual Report for Water Year 2022 (October 2021-September 2022) for the subbasin to evaluate water use. According to the Annual Report for water year 2022, surface water accounted for 24% of total water use (excluding precipitation) and included State Water Project supplies (11% of total water use), Central Valley Project supplies (5% of total water use), and local supplies (including Kern River) (9% of total water use). Groundwater accounted for 74% of the total water use. Recycled and reused water accounted for 2% of the total water use (Groundwater, 2023).

Board staff summarized OpenET data for each non-residential parcel and consolidated the water use for all parcels owned by each parcel owner. Water users of more than 500 AFY of water as measured by OpenET:

- Are 1022 landowners (or 20.0% of 5,219 owners of non-residential parcels in the subbasin).
- Own 84.5% of lands in the subbasin.

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[16] OpenET provides satellite-based estimates of the total amount of water that is transferred from the land surface to the atmosphere through the process of evapotranspiration [OpenET website].

- Use 89.0% of water in the subbasin.

Staff find that the proposed requirement that all groundwater extractors of more than 500 AFY install meters will provide accurate extraction information for a large percentage of groundwater use in the basin while only impacting a small percentage of all groundwater extractors. If, after collecting reports, staff find that meters are needed for well owners extracting less than 500 AFY in order to evaluate basin conditions and potentially implement an interim plan, staff may adjust meter requirements for groundwater extractors in the subbasin via subsequent State Water Board action.

5.0 Additional Considerations

This section describes how the state intervention process is CEQA exempt and details the State Water Board's obligations to consider the Human Right to Water and the Public Trust Doctrine.

5.1 The California Environmental Quality Act

Pursuant to Water Code section 10736.2, the California Environmental Quality Act (Division 13 [commencing with Section 21000] of the Public Resources Code) does not apply to the State Water Board's designation of a basin as probationary under SGMA.

5.2 Human Right to Water

Assembly Bill 685 (2012) made California the first state in the nation to legislate the Human Right to Water. Section 106.3 of the Water Code states that "every human being has the right to safe, clean, affordable, and accessible water for human consumption, cooking, and sanitary purposes." The State Water Board holds the Human Right to Water as a top priority and core value and Senate Bill 200 tasks the State Water Board with administration of the Safe and Affordable Drinking Water Fund.

5.2.1 Human Right to Water in the Subbasin

Access in the subbasin to safe, clean, and affordable water to human consumption would be enhanced by addressing the recommended deficiencies related to lowering groundwater levels (Section 4.1.2) and groundwater quality degradation (Section 4.1.4). According to DWR's My Dry Wells tool (as of April 2024), 40 domestic wells have been reported dry in the subbasin since 2016. Thirty-eight of these wells were reported dry in 2022, ten in 2023, and one thus far in 2024 subbasin. According to SAFER program data, there are 41 reported State Small Water Systems in the subbasin. Thirteen of these State Small Water Systems are considered At-Risk and twenty-four are considered Potentially-At-Risk (State Water Resources Control Board, 2023d): Wells going dry within the subbasin due to a lack of local management poses a significant threat to human health and safety. Even when hauled water is available extreme conservation is usually required, and sanitary conditions can continue to degrade. Homes without an adequate supply of water are not habitable (Civ. Code § 1941.1). Below is a list of State Small Water Systems currently with some level of risk, according to the State Water Board:

<u>At-Risk</u>

Crider Mutual Water System	CFB Company Water System	Greeley Property Owners Assoc	Breckenridge Estates Mutual Water Company
Redbank Water System	Johnson & Rugger Water System	Josephina & Enrique Water System	Jaysix Water System
Well 2748 Corporation Water System	Hylton Water System	G And C Water Works	Esquivias Water Pacini Street Water Well Association

Potentially-At-Risk

Rio Viejo Water System	Sandoval Water System	Water Well Association
Maple Village Water	South Pond Water Well	West Snow Water System
McCarthy Family Farms Inc	Swan Water System	Westfarmers/Paramount
Paradise Lakes	Swan-Sephus Water System	Baker Road Community Water
Ronnie Street Water System	Vineland Properties Water System	Darline's Country Corner
Creekside Water System	Heatherwood North Water System	Five Way Water Assoc
Heath Road Community Water System	Heatherwood Drive South, Inc.	Jenica Water Company
Jeffrey B Knox Water System	Ashe & Houghton Water Association	Tulare Ranch

Although the above risks are relative to groundwater quality, if management leads to a drop in groundwater elevations to MTs, there is a risk of dewatering more domestic, state small, and public supply wells; those risks are summarized earlier in this document.

5.3 Public Trust

5.3.1 General Principles and Brief History

The public trust doctrine is rooted in ancient Roman codes and English common law judicial opinions about public rights to use water, air, wildlife, and common spaces that are held in trust by the sovereign for the benefit of the public. The sovereign in the public trust doctrine refers to the entity charged with protecting resources within the public trust. Within SGMA, the entities acting on behalf of the people are the State of California and local jurisdictions implementing SGMA. California incorporated English common law into its legal framework prior to statehood and subsequent California legal decisions have explicitly recognized that the public trust doctrine provides for protection of coastlines, navigable surface waters, their non-navigable tributaries, aquatic resources, and the ecosystems that rely on them.

In a 2018 decision, *Environmental Law Foundation v. State Water Resources Control Board* (2018) 26 Cal.App.5th 844 (*Environmental Law Foundation*), the court recognized that “the public trust doctrine applies if extraction of groundwater adversely impacts a navigable waterway to which the public trust doctrine does apply” (26 Cal.App.5th at 859). *Environmental Law Foundation* concerned increased pumping of groundwater near the Scott River, which had greatly affected the Scott River system and, in some years, left the system nearly dry. The court found that the passage of SGMA had not preempted application of the public trust doctrine and that both “coexist and neither occupies the field to the exclusion of the other” (*Id.* at pp. 854-855).

5.3.2 The Public Trust Doctrine in the SGMA Context

When the state or its subdivisions are engaged in the planning and allocation of water resources, the public trust doctrine requires consideration of the potential impacts of groundwater extractions on public trust resources and protection of those resources where feasible. This duty arises in the SGMA context because SGMA involves the planning (Wat. Code, § 10727) and allocation (Wat. Code, § 10726.4) of water resources. Moreover, sustainable management under SGMA is defined as avoiding undesirable results in a basin, including “[d]epletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of surface water” (Wat. Code, § 10721, subd. (x)(6)). GSPs that meet SGMA’s requirements will assist in evaluating impacts to public trust resources, such as fish and wildlife beneficial uses, because they will include a physical description of groundwater-surface water interaction in the basin and, if applicable, monitoring and management of changes in surface flow and surface water quality caused by groundwater extraction in the basin (Wat. Code, § 10727.2, subds. (a)(2), (d)(2)).

5.3.3 Public Trust Doctrine in the Subbasin

The record snowfall and precipitation in the Sierra Nevada and Tulare Hydrologic Basin during the 2022-23 winter, amplified in part by extreme precipitation events and climate change, points to a future hydrology where flooding is expected to occur more frequently. The Sacramento San Joaquin Delta provides the largest supply of surface water used in the subbasin. The second largest supply of surface water in subbasin is local surface water sources, including Kern River and Poso Creek. Sustainable groundwater management efforts in the subbasin should consider how altered hydrologic, surface water and flooding patterns may impact public trust resources. This should include consideration of public trust when operating or permitting wells in places where groundwater and surface water may be connected.

References

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KERN COUNTY SUBBASIN PROBATIONARY HEARING DRAFT STAFF REPORT

Appendix A – Summary Table of Proposed Deficiencies and Potential Actions

July 2024

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency Coordination 1 (CRD)-1: Undesirable results and SMC are not coordinated. • **Deficiency CRD-1a –** Undesirable results are poorly described, unworkably complex, and inconsistently implemented. • **Deficiency CRD-1b** – Sustainable management criteria rely on inconsistent datasets and methodologies.	SGMA requires that "Agencies intending to develop and implement multiple plans pursuant to Water Code § 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies…", and Regulations requires that "elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting" (Cal. Code Regs., tit. 23, § 357.4, subd. (a)). In defining undesirable results, GSAs are required to "describe the process and criteria relied upon do define undesirable results [that would occur when significant and unreasonable effects are caused by groundwater condition in the Subbasin]" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition should include the cause of groundwater conditions occurring throughout the Subbasin that has or may lead to an undesirable result, the criteria used to define when and where the effects of groundwater conditions cause undesirable results, and the impacts on beneficial uses and users (Cal. Code Regs., tit. 23, § 354.26 subd. (b)). In establishing SMC, GSAs must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26." (Cal. Code Regs. tit. 23 § 354.28). Discussion of the MTs should include among other things the "relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (Cal. Code Regs. tit. 23 § 354.28). Undesirable results and SMC should be consistent with key details in the Coordination Agreement. Agencies should describe how they use the same data and methodologies for assumptions described in Water Code § 10727.6 by including monitoring objectives, a coordinated basin water budget, and sustainable yield for the basin supported by a description of an undesirable result for the basin, and an explanation of how the minimum threshold and measurable objectives relate to the undesirable result (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). The coordination agreement shall also explain how the Plans implemented together, satisfy the requirements of the Act (Cal. Code Regs., tit. 23, § 357.4, subd. (c)). GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).	**DWR Inadequate Determination summary:** Ultimately, the fragmented management area approach to groundwater management, particularly in establishing minimum thresholds and measurable objectives, undermines the GSAs ability to clearly define the Subbasin-wide significant and unreasonable effects they hope to avoid. It is, therefore, unclear to Department staff how or whether the sustainable groundwater management approach described in the Plan will achieve the sustainability goals included in the amended Coordination Agreement (2022 Inadequate Determination). **Board issues:** None	**Potential Action CRD-1a –** Develop consistent, clear undesirable results. **Potential Action CRD-1b –** Use consistent data and methods to develop SMC.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency CRD-2: The Coordination Agreement, GSPs, and Management Area Plans lack key details necessary for coordinated implementation. • **Deficiency CRD-2a** – The Coordination Agreement is not sufficient to address disputes. • **Deficiency CRD-2b** – GSAs do not explain how the multiple plans will satisfy SGMA requirements, particularly for Management Areas.	The coordination agreement should be adopted by all relevant parties, explain how the multiple plans will satisfy SGMA requirements, should ensure that the agreement is binding on all parties and sufficient to address any disputes, and satisfies SGMA requirements (Code Regs., tit. 23, § 355.4, subd. (b)(8) and Cal. Code Regs., tit. 23, §357.4). GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).	**DWR Inadequate Determination summary:** None **Board issues:** GSP and Coordination agreements do not have a basin wide exceedance policy to properly demonstrate how exceedances are investigated for relevance to SGMA or addressed if driving mechanism is outside of the local management area.	**Potential Action CRD-2a –** The Coordination Agreement should include a basin-wide minimum threshold exceedance plan. **Potential Action CRD-2b –** GSAs should revise plans to demonstrate the necessity and compliance of Management Areas.
Deficiency CRD-3 – GSAs in the Subbasin have not demonstrated Basin-wide management.	Any *local agency* –a local public agency with water supply, water management, or land use responsibilities (Wat. Code, § 10721, subd. (n)) – or combination of local agencies overlying a groundwater basin may decide to become a GSA for that basin (Wat. Code, § 10723, subd. (a)). The statute allows some private and non-governmental water entities to *participate* in a GSA, but SGMA does not provide them any additional authorities (Wat. Code, § 10723.6, subd. (b)). Private entities therefore do not have authorities to manage the subbasin, so all areas of a GSA must still be covered by a local agency. GSAs are required to develop "one or more groundwater sustainability plans that will collectively serve as a groundwater sustainability plan for the entire basin" (Water Code § 10735.2, subd. (1)(B)). Portions of high- and medium-priority basins not within the management area of a GSA are considered unmanaged (Water Code § 10724.6, subd. (a)). Groundwater extractors in unmanaged areas must report extractions and pay fees to the State Water Board (Water Code § 10724.6, subd. (b)).	**DWR Inadequate Determination summary:** None **Board issues:** Board staff are concerned that the subbasin may not be able to reach sustainability because it lacks authority to manage pumping across the entire basin. Board staff are unable to properly evaluate basin management due to the complex arrangement of agencies involved and lack of clear detail demonstrating adequate coverage. Board staff note that inadequate coverage could undermine the subbasin's ability to reach sustainability, as pumping could shift to unmanaged areas where no GSA has authority to limit extractions.	**Potential Action CRD-3a –** GSAs should clearly define relationships and responsibilities consistent with SGMA requirements.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency Groundwater Level 1 (GL-1) – Groundwater Level undesirable results and SMC are not coordinated. • **Deficiency GL-1a** – Undesirable results are poorly described, unworkably complex, and inconsistently implemented. • **Deficiency GL-1b** – SMC rely on inconsistent datasets and methodologies.	SGMA requires that "Agencies intending to develop and implement multiple plans pursuant to Water Code § 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies…", and Regulations requires that "elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting" (Cal. Code Regs., tit. 23, § 357.4, subd. (a)). In defining undesirable results, GSA are required to "describe the process and criteria relied upon do define undesirable results [that would occur when significant and unreasonable effects are caused by groundwater condition in the Subbasin]" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition should include the cause of groundwater conditions occurring throughout the Subbasin that has or may lead to an undesirable result, the criteria used to define when and where the effects of groundwater conditions cause undesirable results, and the impacts on beneficial uses and users (Cal. Code Regs., tit. 23, § 354.26 subd. (b)). In establishing SMC, GSAs must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26." (Cal. Code Regs. tit. 23 § 354.28). Discussion of the MTs should include among other things the "relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (Cal. Code Regs. tit. 23 § 354.28). Undesirable results and SMC should be consistent with key details in the Coordination Agreement. Agencies should describe how they use the same data and methodologies for assumptions described in Water Code § 10727.6 by including monitoring objectives, coordinated basin water budget, and sustainable yield for the basin supported by a description of an undesirable result for the basin, and an explanation of how the minimum threshold and measurable objectives relate to the undesirable result (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). The coordination agreement shall also explain how the Plans implemented together, satisfy the requirements of the Act (Cal. Code Regs., tit. 23, § 357.4, subd. (c)). GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).	This is the corresponding subsidence level deficiency for coordination deficiency CRD-1. **DWR Inadequate Determination summary:** The Coordination Agreement requires two conditions to trigger an undesirable result: 1) an MT exceedance must occur in 40% of RMS for four consecutive measurements (at least 2 years) for a management area to contribute to an undesirable result and 2) three adjacent management areas (accounting for at least 15% of basin area) or any management areas accounting for 30% or more of the basin area must be contributing to the undesirable results. DWR found that it "may allow for situations where groundwater conditions could degrade for sustained periods of time for portions of the Subbasin without triggering an undesirable result" (2022 Inadequate Determination, p. 10). DWR also found that the SMC set by each management are, to avoid MA exceedance (40% of MTs for 2 years), were set using various methods and sources and are not easily comparable across plans. **Board issues:** None	**Potential Action GL-1a –** Develop consistent, clear undesirable results. **Potential Action GL-1b –** Use consistent data and methods to develop SMC.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GL-2 – The GSPs and Coordination Agreement lack necessary detail about well mitigation.	Although SGMA and the GSP Regulations do not require development of a well impact mitigation plan, the State Water Board considers them to be an important component of SGMA implementation to ensure for availability of water for all beneficial uses and users in the subbasin.	**DWR Inadequate Determination summary:** The 2022 GSPs are not implementing or plan to implement a well mitigation plan. **Board issues:** There is a lack of coordination on well mitigation plans for the subbasin and when present, discussion of well mitigation does not contain sufficient detail and is not yet implemented.	**Potential Action GL-2 –** Establish accessible, comprehensive, and appropriately funded well impact mitigation programs that mitigate impacts to wells affected by lowering of groundwater levels and/or degradation of water quality with clear triggers, eligibility requirements, and funding sources.
Deficiency GL-3 – The GSPs do not describe a feasible path for halting chronic lowering of groundwater levels.	Each GSP is required to include a description of the projects and management actions the GSA has determined will achieve groundwater sustainability in the basin. The description must include project and management actions, a summary of data used to support proposed actions, and a review of the uncertainty associated with the basin setting when developing projects or management actions. The GSP must also describe the criteria that would trigger implementing or stopping a project or management action and the process for determining whether that trigger has occurred (Cal. Code Regs., tit. 23, § 354.44). More fundamentally, for basins in a condition of overdraft, the GSP "shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft" (Cal. Code Regs., tit. 23, § 354.44, subd. (b)(2)) GSPs need to include a description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods (Cal. Code Regs., tit. 23, § 354.44, subd. (b)(9)). In reviewing GSPs, DWR must consider, among other questions, "whether sustainable management criteria and projects and management actions are commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the plan" and "whether the projects and management actions are feasible and likely to prevent undesirable results and ensure that the basin is operated within its sustainable yield" (Cal. Code Regs., tit. 23, § 355.4, subds. (b)(3), (5)).	**DWR Inadequate Determination summary:** The 2022 GSPs do not demonstrate feasibility of projects, but they rely heavily on projects to demonstrate future sustainability. DWR notes in its 2022 Inadequate Determination that the GSPs rely on more than 180 projects and management actions to reach sustainability and that, without these projects and management actions, "extractions would exceed the estimated sustainable yield by 25 to 34 percent" (2022 Inadequate Determination, p. 32). **Board issues:** Demand management actions in the 2022 GSP appear voluntary and therefore unlikely to provide sufficient contingency in case GSAs fail to secure new supplies or overdraft is greater than estimated.	**Potential Action GL-3a –** Evaluate the feasibility of proposed supply augmentation projects. **Potential Action GL-3b –** Develop basin-wide allocations or utilize another demand management structure to help bring the subbasin into balance and meet basin sustainability goals. **Potential Action GL-3c –** Identify key indicator wells in each aquifer, with sufficient spatial coverage to represent beneficial uses and users in each aquifer and identify groundwater levels that will trigger specific demand management.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency Land Subsidence 1 (LS-1) – Land Subsidence undesirable results and SMC are not coordinated. • **Deficiency LS-1a** – Undesirable results are poorly described, unworkably complex, and inconsistently implemented. • **Deficiency LS-1b** – SMC rely on inconsistent datasets and methodologies.	SGMA requires that "Agencies intending to develop and implement multiple plans pursuant to Water Code § 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies…", and Regulations requires that "elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting" (Cal. Code Regs., tit. 23, § 357.4, subd. (a)). In defining undesirable results, GSA are required to "describe the process and criteria relied upon do define undesirable results [that would occur when significant and unreasonable effects are caused by groundwater condition in the Subbasin]" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition should include the cause of groundwater conditions occurring throughout the Subbasin that has or may lead to an undesirable result, the criteria used to define when and where the effects of groundwater conditions cause undesirable results, and the impacts on beneficial uses and users (Cal. Code Regs., tit. 23, § 354.26 subd. (b)). In establishing SMC, GSAs must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26." (Cal. Code Regs. tit. 23 § 354.28). Discussion of the MTs should include among other things the "relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (Cal. Code Regs. tit. 23 § 354.28). Undesirable results and SMC should be consistent with key details in the Coordination Agreement. Agencies should describe how they use the same data and methodologies for assumptions described in Water Code § 10727.6 by including monitoring objectives, coordinated basin water budget, and sustainable yield for the basin supported by a description of an undesirable result for the basin, and an explanation of how the minimum threshold and measurable objectives relate to the undesirable result (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). The coordination agreement shall also explain how the Plans implemented together, satisfy the requirements of the Act (Cal. Code Regs., tit. 23, § 357.4, subd. (c)). GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).	This is the corresponding subsidence level deficiency for coordination deficiency CRD-1. **DWR Inadequate Determination summary:** The DWR Inadequate Determination found that GSPs and Management Area plans did not consistently identify critical infrastructure. DWR further notes that, "[s]ome GSPs or management area plans defined Management Area Critical Infrastructure but did not develop sustainable management criteria…" (ibid, p. 38). **Board issues:** Board staff agree and further note that GSPs and Management Areas do not consistently define "significant and unreasonable," as evidenced by evidence in text and additional inconsistent definitions of the quantitative undesirable results.	**Potential Action LS-1a –** Develop consistent, clear undesirable results. **Potential Action LS-1b –** Use consistent data and methods to develop subsidence MTs.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency LS-2 – The GSPs do not provide adequate implementation details.	Each GSP is required to include a description of the projects and management actions the GSA has determined will achieve groundwater sustainability in the basin. The description must include project management actions, summary of data used to support proposed actions, and a review of the uncertainty associated with the basin setting when developing projects or management actions (Cal. Code Regs., tit. 23, § 354.44). In reviewing GSPs, DWR must consider, among other questions, "whether sustainable management criteria and projects and management actions are commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the plan" and "whether the projects and management actions are feasible and likely to prevent undesirable results and ensure that the basin is operated within its sustainable yield" (Cal. Code Regs., tit. 23, § 355.4, subd. (b)(3), (5)).	**DWR Inadequate Determination summary:** None. **Board issues:** The 2022 Coordination Agreement does not provide details about projects and management actions to slow subsidence for both regional and Management Area critical infrastructure. The 2022 Coordination Agreement states that "it is apparent that key data gaps pertaining to the various causes and rates of subsidence in the [Kern County Subbasin] still remain and that further study is needed to better define realistic management objectives for the [Subbasin]." (2022 Amended Coordination Agreement, pdf, p. 356).	**Potential Action LS-2a –** Develop and implement a plan to trigger sufficient management actions when subsidence exceeds defined thresholds, especially near critical infrastructure/facilities. **Potential Action LS-2b –** Reduce pumping and do not allow new wells in areas where subsidence threatens critical infrastructure. **Potential Action LS-2c –** Develop infrastructure mitigation programs with clear triggers, eligibility requirements, metrics, and funding sources.

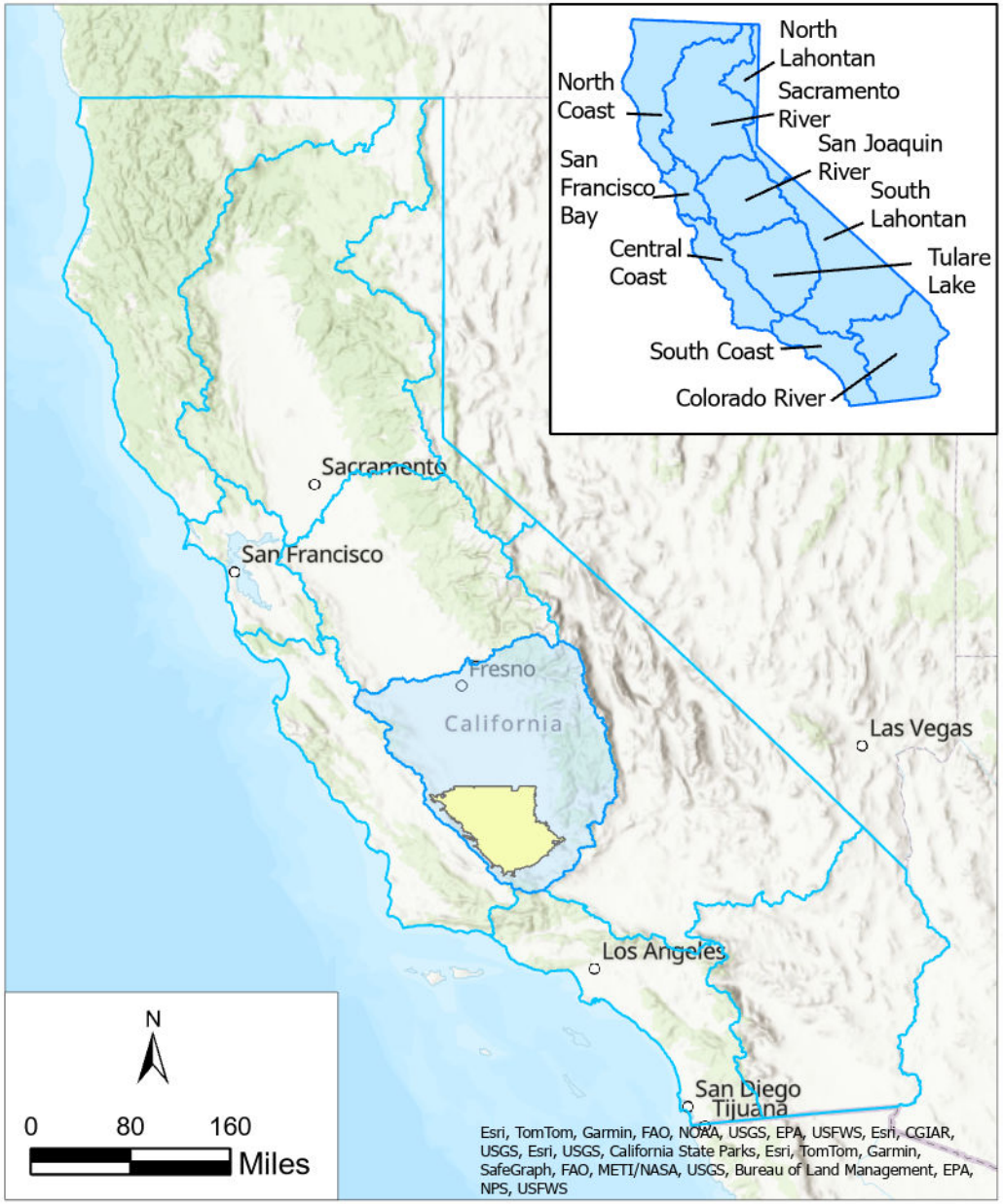
Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency Groundwater Quality 1 (GWQ-1) – Groundwater Quality undesirable results and SMC are not coordinated. • **Deficiency GWQ-1a –** Undesirable results are poorly described, unworkably complex, and inconsistently implemented. • **Deficiency GWQ-1b –** SMC rely on inconsistent datasets and methodologies.	SGMA requires that "Agencies intending to develop and implement multiple plans pursuant to Water Code § 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies…", and Regulations requires that "elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting" (Cal. Code Regs., tit. 23, § 357.4, subd. (a)). In defining undesirable results, GSA are required to "describe the process and criteria relied upon do define undesirable results [that would occur when significant and unreasonable effects are caused by groundwater condition in the Subbasin]" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition should include the cause of groundwater conditions occurring throughout the Subbasin that has or may lead to an undesirable result, the criteria used to define when and where the effects of groundwater conditions cause undesirable results, and the impacts on beneficial uses and users (Cal. Code Regs., tit. 23, § 354.26 subd. (b)). In establishing SMC, GSAs must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26." (Cal. Code Regs. tit. 23 § 354.28). Discussion of the MTs should include among other things the "relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (Cal. Code Regs. tit. 23 § 354.28). Undesirable results and SMC should be consistent with key details in the Coordination Agreement. Agencies should describe how they use the same data and methodologies for assumptions described in Water Code § 10727.6 by including monitoring objectives, coordinated basin water budget, and sustainable yield for the basin supported by a description of an undesirable result for the basin, and an explanation of how the minimum threshold and measurable objectives relate to the undesirable result (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). The coordination agreement shall also explain how the Plans implemented together, satisfy the requirements of the Act (Cal. Code Regs., tit. 23, § 357.4, subd. (c)). GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).	This is the corresponding groundwater quality deficiency for coordination deficiency CRD-1. **DWR Inadequate Determination summary:** Not specific to groundwater quality, see CRD - 1. **Board issues:** Board staff agree and elaborate that the fragmented approach for setting SMC would result in localized disproportional impacts in the subbasin without triggering undesirable results. The fragment approach is further exacerbated by lack of coordination between GSAs using inconsistent data and methodologies for monitoring groundwater quality throughout the subbasin.	**Potential Action GWQ-1a –** Develop consistent, clear undesirable results. **Potential Action GWQ-1b –** The GSPs should use consistent data and methods to develop groundwater level MTs.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GWQ-2 – Groundwater quality monitoring networks are not consistent with SGMA requirements. • **Deficiency GWQ-2a –** The Monitoring Networks are not protective of all beneficial uses and users in the subbasin. • **Deficiency GWQ-2b –** Data collection sampling frequencies are sometimes inadequate. • **Deficiency GWQ-2c –** It is unclear how monitoring networks are monitoring for recharge projects.	The GSP Regulations require GSPs to include a description of the monitoring network objectives for the basin including how the GSA will "monitor impacts to the beneficial uses or users of groundwater" (Cal. Code Regs., tit. 23, § 354.34, subd. (b)(2)). The monitoring network must be "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 [GSP] implementation" (Cal. Code Regs., tit. 23, § 354.34, subd. (a)). Data collected must be of "sufficient quality, frequency, and distribution" to characterize and evaluate groundwater conditions (Cal. Code Regs., tit. 23, § 354.32). GSAs "may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin...", known as RMSs (Cal. Code Regs., tit. 23, § 354.36). GSAs identify MTs, MOs, and Interim Milestones at these sites. "The designation of [an RMS] shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area" (Cal. Code Regs., tit. 23, § 354.36, subds. (a) & (c)).	**DWR Inadequate Determination summary:** None. **Board issues:** Board staff find that the GSPs monitoring networks are not protective of beneficial uses and users and do not promote the sufficient quality and collection of data, frequency, and distribution to characterize groundwater quality conditions and evaluate changing conditions that occur throughout the implementation of the GSP.	**Potential Action GWQ-2a –** GSAs should add additional wells to monitoring well networks. **Potential Action GWQ-2b –** Revise GSPs and monitoring well networks and exercise coordination with existing regulatory programs to meet the goals of SGMA. **Potential Action GWQ-2c –** GSAs should define RMS that will be used to ensure PMAs do not impact groundwater quality in the Subbasin.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GWQ-3 – Management actions are not responsive to water quality degradation. • **Deficiency GWQ-3a –** Additional sampling is not triggered when Minimum Thresholds are exceeded. • **Deficiency GWQ-3b –** Well mitigation plans don't address water quality degradation.	Each GSP is required to include a description of the projects and management actions the GSA has determined will achieve groundwater sustainability in the basin. The GSAs must include projects and management actions "that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent" (Cal. Code Regs., tit. 23, § 354.44, subd. (b)(1)). The description must include project and management actions, a summary of data used to support proposed actions, and a review of the uncertainty associated with the basin setting when developing projects or management actions (Cal. Code Regs., tit. 23, § 354.44). In reviewing GSPs, DWR must consider, among other questions, "whether sustainable management criteria and projects and management actions are commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the plan" (Cal. Code Regs., tit. 23, § 355.4, subd. (b)(3)).	**DWR Inadequate Determination summary:** None. **Board issues:** To ensure the human right to water, GSAs should develop mitigation plans for sustainability indicators impacted by basin management. Board staff note that elevated concentrations of arsenic, nitrate, uranium, gross alpha, 1,2,3,-Trichloropropane, and other constituents detected above regulatory thresholds in the Subbasin can severely impact human health (See Table 3-2). Given the potential for these exceedances to occur, GSAs do not propose PMA to mitigate for groundwater quality exceedances as a result of groundwater management activities in the Subbasin.	**Potential Action GWQ-3a –** Plan additional sampling when water quality is degraded. **Potential Action GWQ 3b** is addressed by Groundwater Level Potential Action GL-2.

Deficiency Interconnected Surface Water 1 (ISW-1) – Interconnected Surface Water undesirable results and SMC are not coordinated. • **Deficiency ISW-1a** – Undesirable results are poorly described, unworkably complex, and inconsistently implemented.	SGMA requires that "Agencies intending to develop and implement multiple plans pursuant to Water Code § 10727(b)(3) shall enter into a coordination agreement to ensure that the Plans are developed and implemented utilizing the same data and methodologies…", and Regulations requires that "elements of the Plans necessary to achieve the sustainability goal for the basin are based upon consistent interpretations of the basin setting" (Cal. Code Regs., tit. 23, § 357.4, subd. (a)). In identifying ISWs, GSP Regulations state that ISWs refer 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," (Cal. Code Regs., tit. 23, § 351, (o)). The GSP Regulations require GSAs to provide "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," (Cal. Code Regs., tit. 23, § 354.16, (f)). Where ISWs are identified, GSPs define ISW undesirable results unless they demonstrate that ISWs undesirable results are "not present and are not likely to occur…" (Cal. Code Regs., tit. 23, § 354.26, (d)). In defining undesirable results, GSA are required to "describe the process and criteria relied upon do define undesirable results [that would occur when significant and unreasonable effects are caused by groundwater condition in the Subbasin]" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition should include the cause of groundwater conditions occurring throughout the Subbasin that has or may lead to an undesirable result, the criteria used to define when and where the effects of groundwater conditions cause undesirable results, and the impacts on beneficial uses and users (Cal. Code Regs., tit. 23, § 354.26 subd. (b)). In establishing SMC, GSAs must "establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26." (Cal. Code Regs. tit. 23 § 354.28). Discussion of the MTs should include among other things the "relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (Cal. Code Regs. tit. 23 § 354.28). Undesirable results and SMC should be consistent with key details in the Coordination Agreement. Agencies should describe how they use the same data and methodologies for assumptions described in Water Code § 10727.6 by including monitoring objectives, coordinated basin water budget, and sustainable yield for the basin supported by a description of an undesirable result for the basin, and an explanation of how the minimum threshold and measurable objectives relate to the undesirable result (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). The coordination agreement shall also explain how the Plans implemented together, satisfy the requirements of the Act (Cal. Code Regs., tit. 23, § 357.4, subd. (c)). GSP Regulations allow agencies to create "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of	**DWR Inadequate Determination summary:** None. **Board issues:** This is the corresponding Interconnected Surface Water level deficiency for CRD-1. Deficiency CRD-1 concerns undesirable results and SMC that are poorly coordinated across the subbasin. And, Despite the fact that GSAs and Management Areas claim there is no ISW and therefore no potential undesirable results, the methods used to determine that there are no potential undesirable results are inconsistent. And in some cases, the GSPs do not provide adequate technical justification to demonstrate ISW is not present in the subbasin.	**Potential Action ISW-1a** – Revise GSPs to use best available consistent Data and Methodologies to evaluate for ISW.

Deficiency	What SGMA Requires	Deficiency Summary	Potential Actions to Correct the Deficiency
	the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 350.20).		



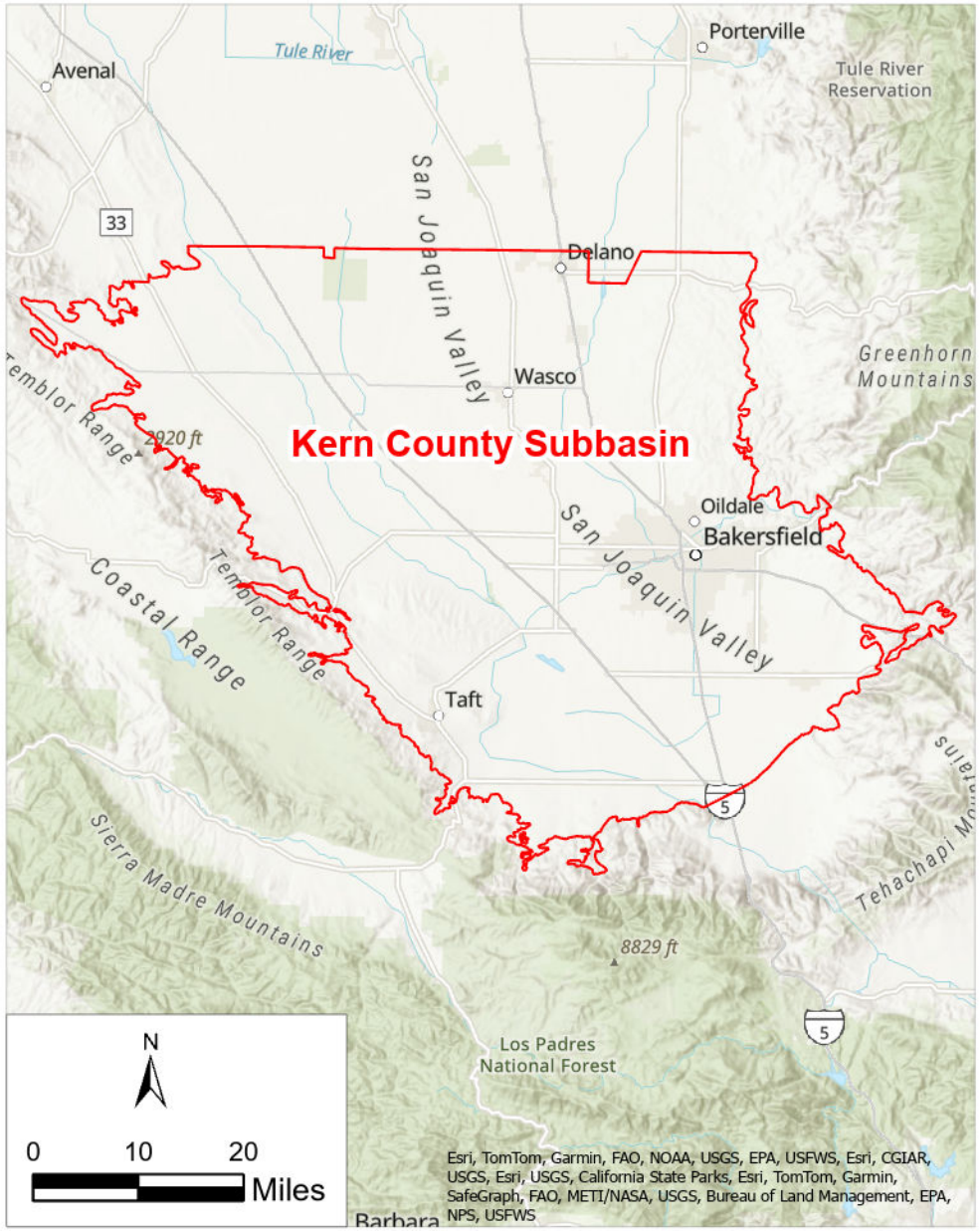


Figure ES-1

Overview of the Kern County Subbasin

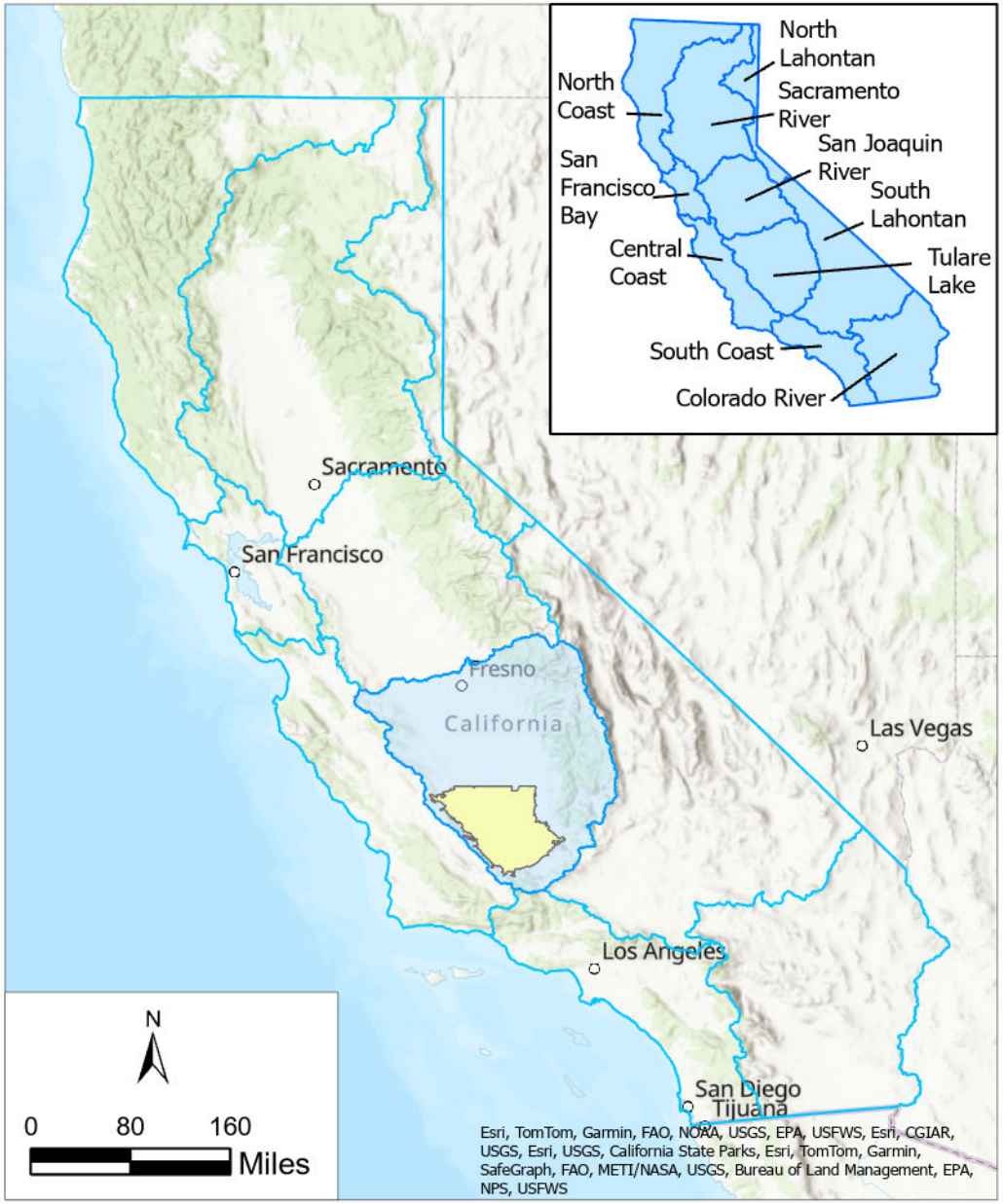
Draft Staff Report
Kern County Subbasin
July 2024

Kern County Subbasin

Hydrologic Regions

Tulare Lake Hydrologic Region

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS



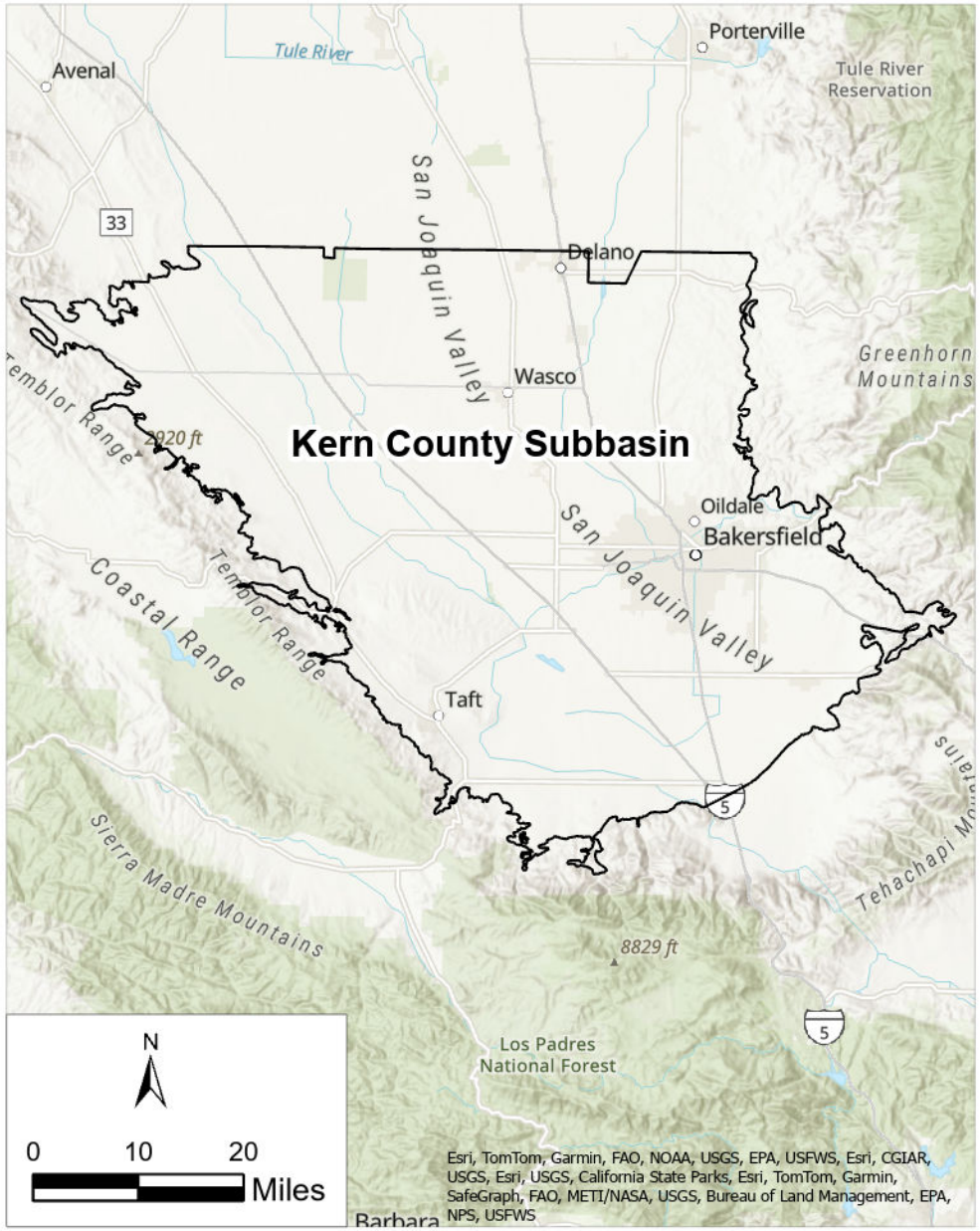


Figure 3-1

Overview of the Kern County Subbasin

Kern County Subbasin

Hydrologic Regions

Tulare Lake Hydrologic Region

Draft Staff Report
Kern County Subbasin
July 2024

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

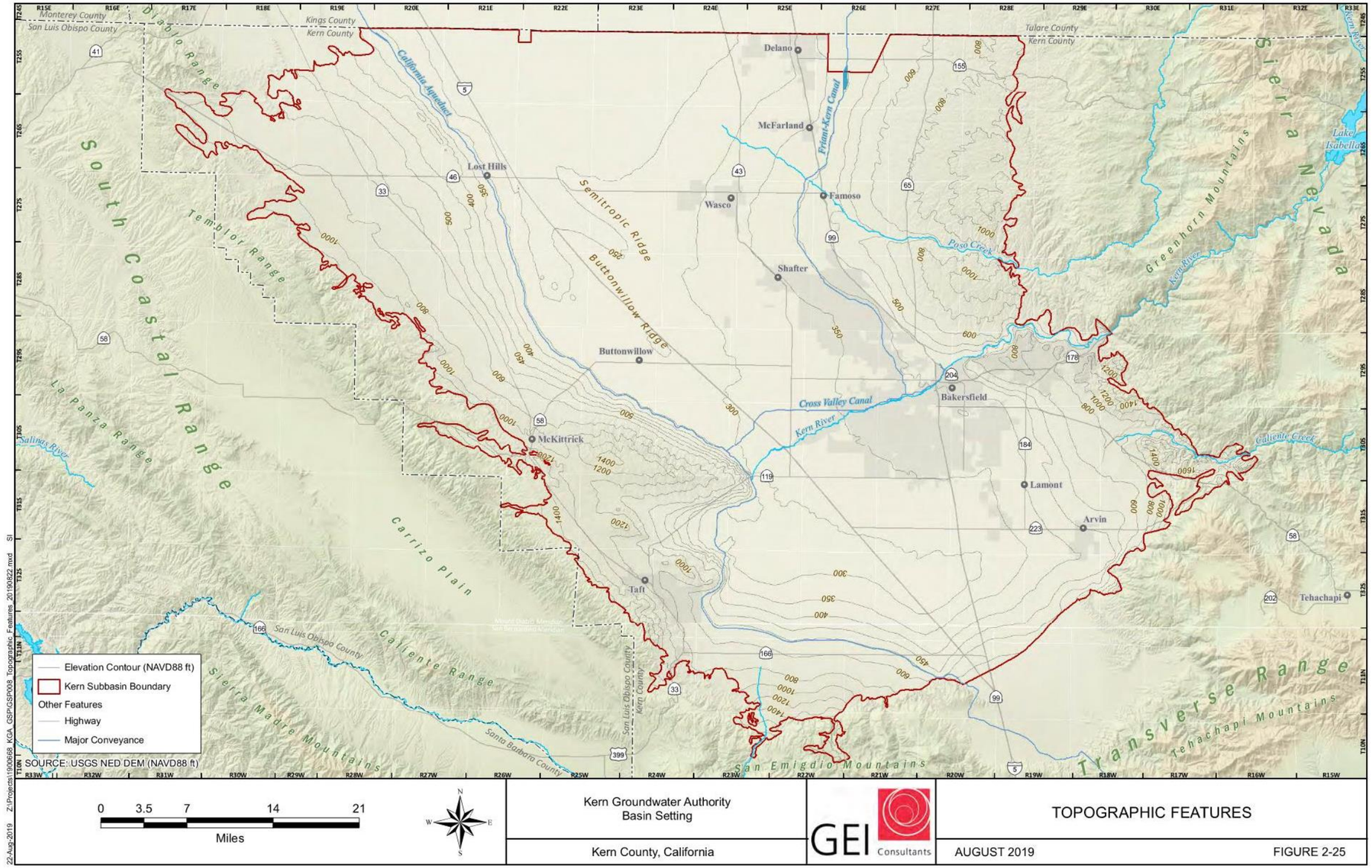


Figure 2-25. Topographic Features

Figure 3-2 Topographic Map of the Kern County Subbasin Excerpt from the KGA 2022 GSP

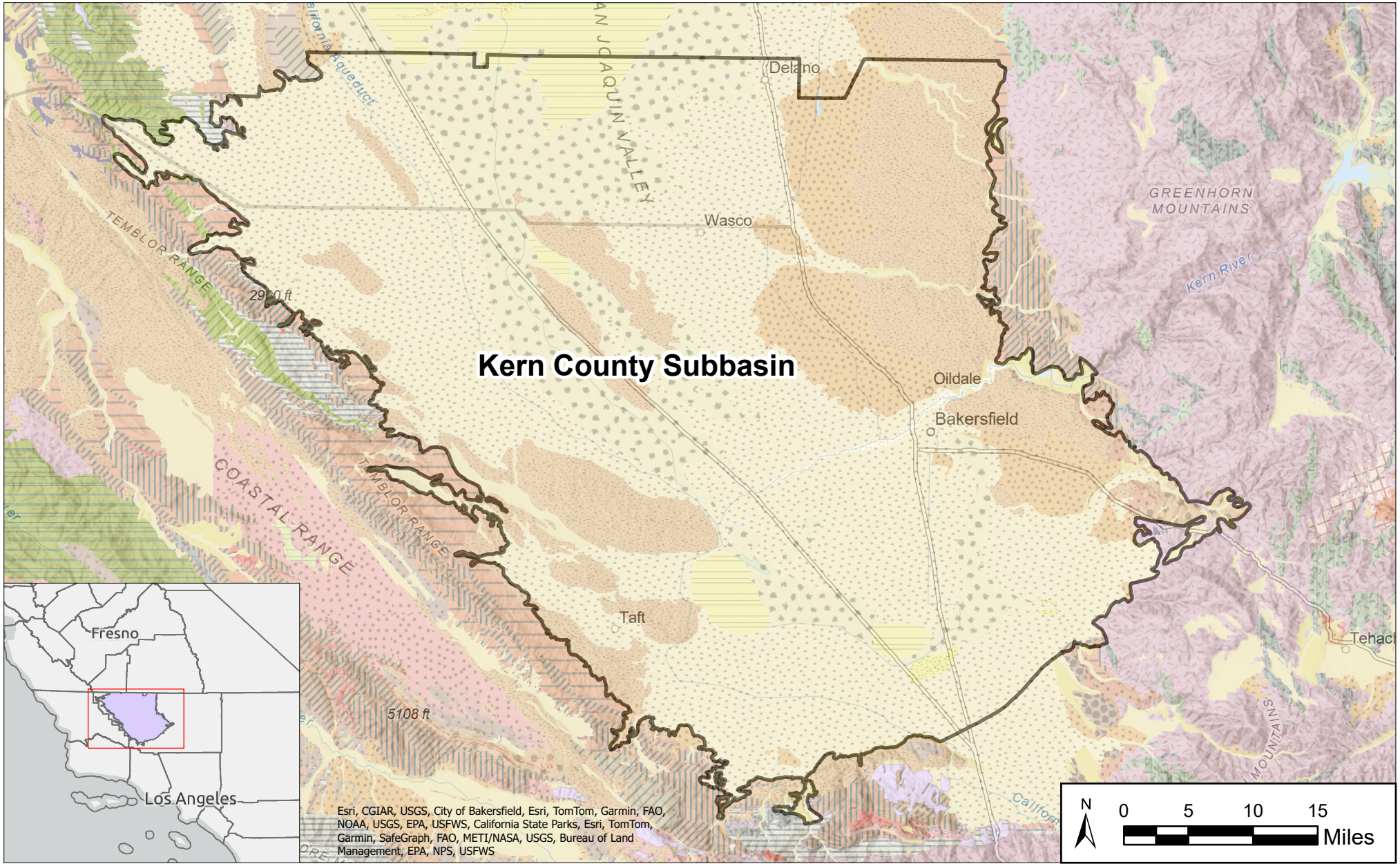


Figure 3-3

Geology of the Kern County Subbasin

Draft Staff Report
Kern County Subbasin
July 2024

Geo. Unit							
E	Mu	Pc	Qal	Qt	gr	ms	
Kl	Mva	Pml	Qb	Tc	gr-m	ub	
Ku	Mvb	Pmlc	Qc	Tia	gra	water	
Mc	Mvp	Pu	Qf	Tib	grg	Kern Boundary	
Ml	Mvr	Pva	Ql	Tir	grt		
Mm	Og	Pvr	Qs	Tvb	ls-m		
	Ogc	QP	Qsc	bi	m		

Data Source:
The Geologic Atlas of California (1:250,000 scale) Los Angeles Sheet, Jennings C.W. and Strand, R. G., 1969.

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

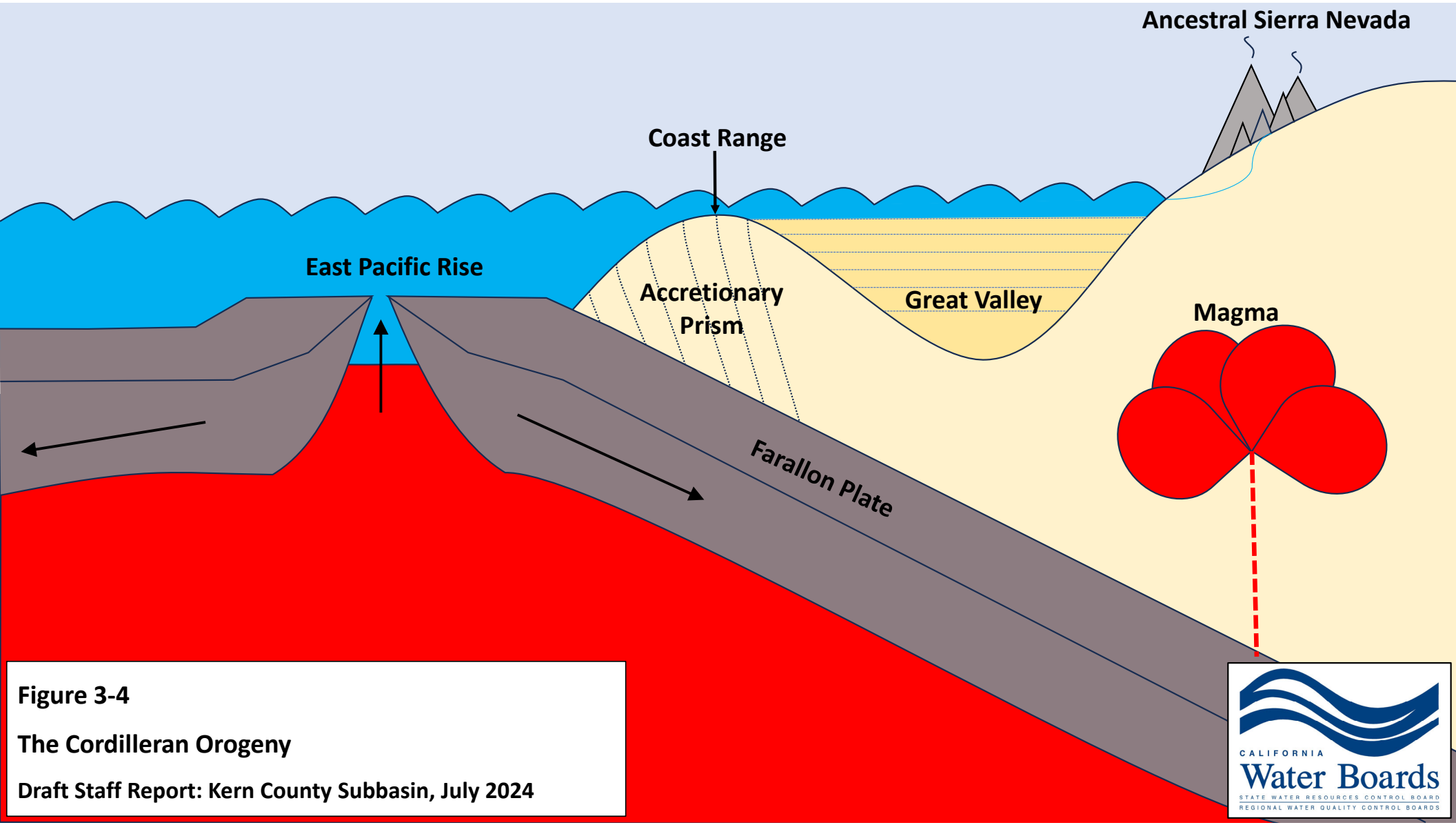


Figure 3-4

The Cordilleran Orogeny

Draft Staff Report: Kern County Subbasin, July 2024

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

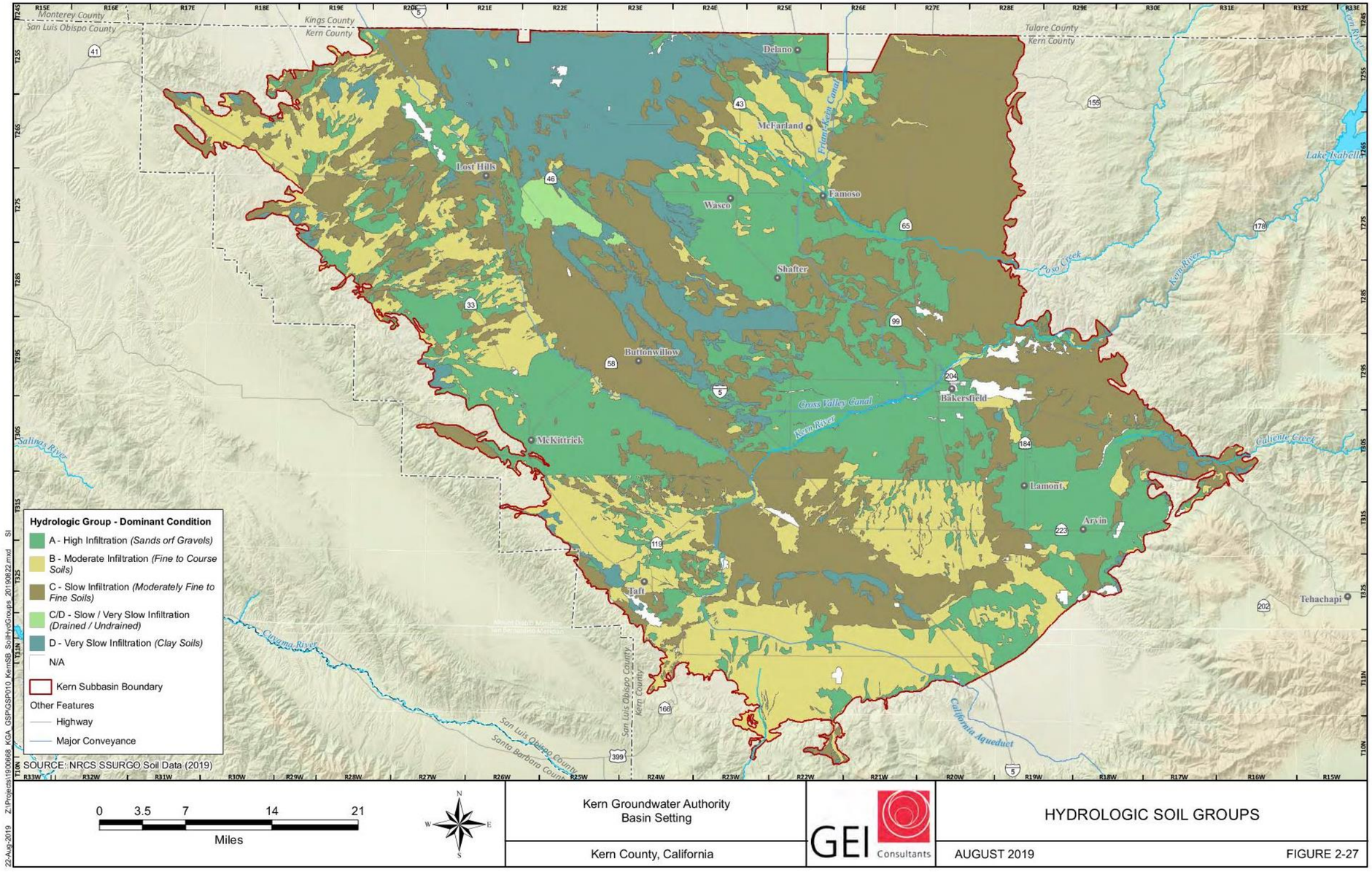
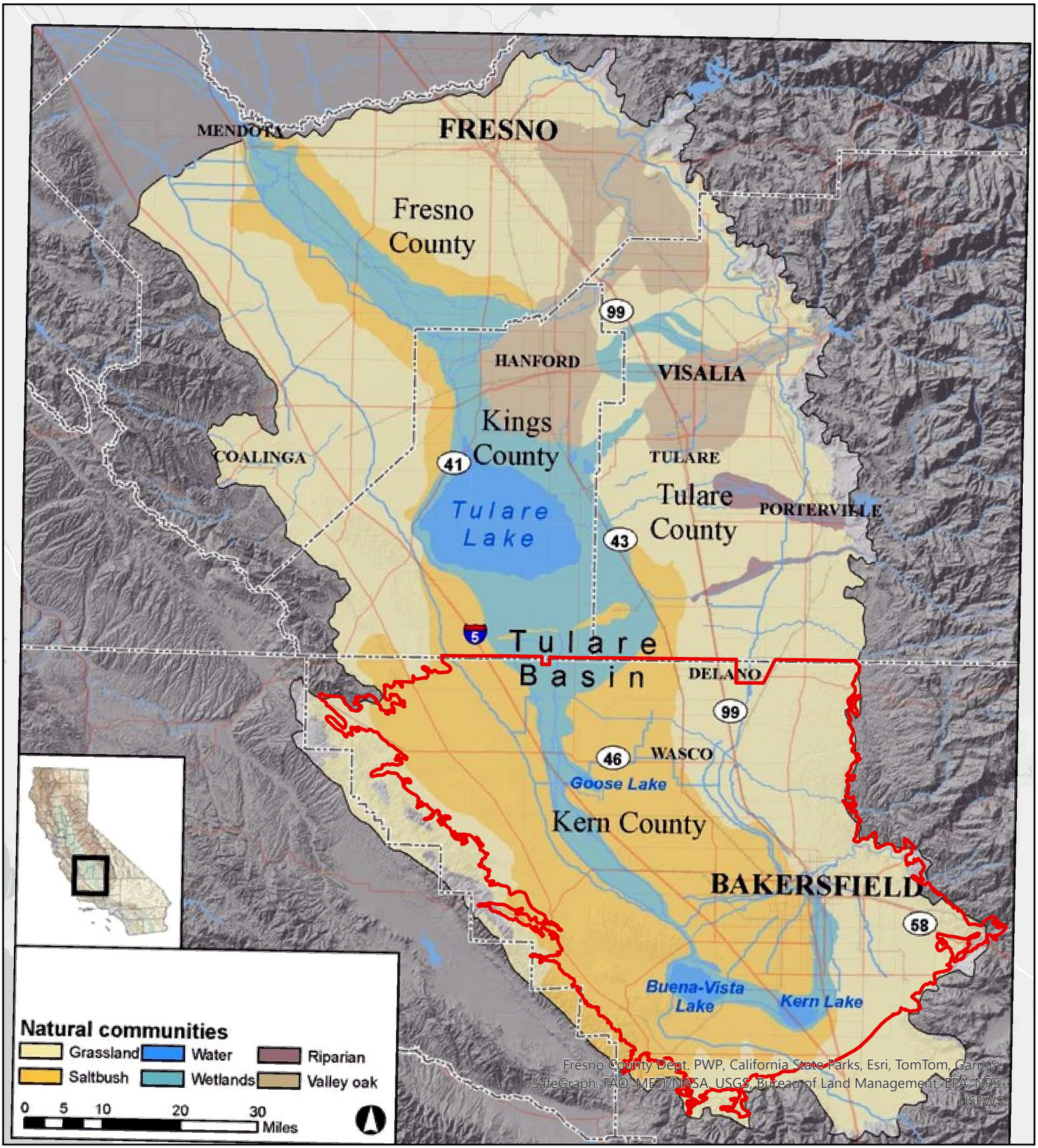


Figure 2-27. Hydrologic Soil Groups

Figure 3-5: Soils of the Kern County Subbasin
Excerpt from the KGA 2022 GSP

Draft Staff Report: Kern County Subbasin
July 2024



Kern County Subbasin

Figure 3-6

Historical Map of the Kern County Subbasin

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July 2024

California Water Boards
State Water Resources Control Board
Regional Water Quality Control Boards

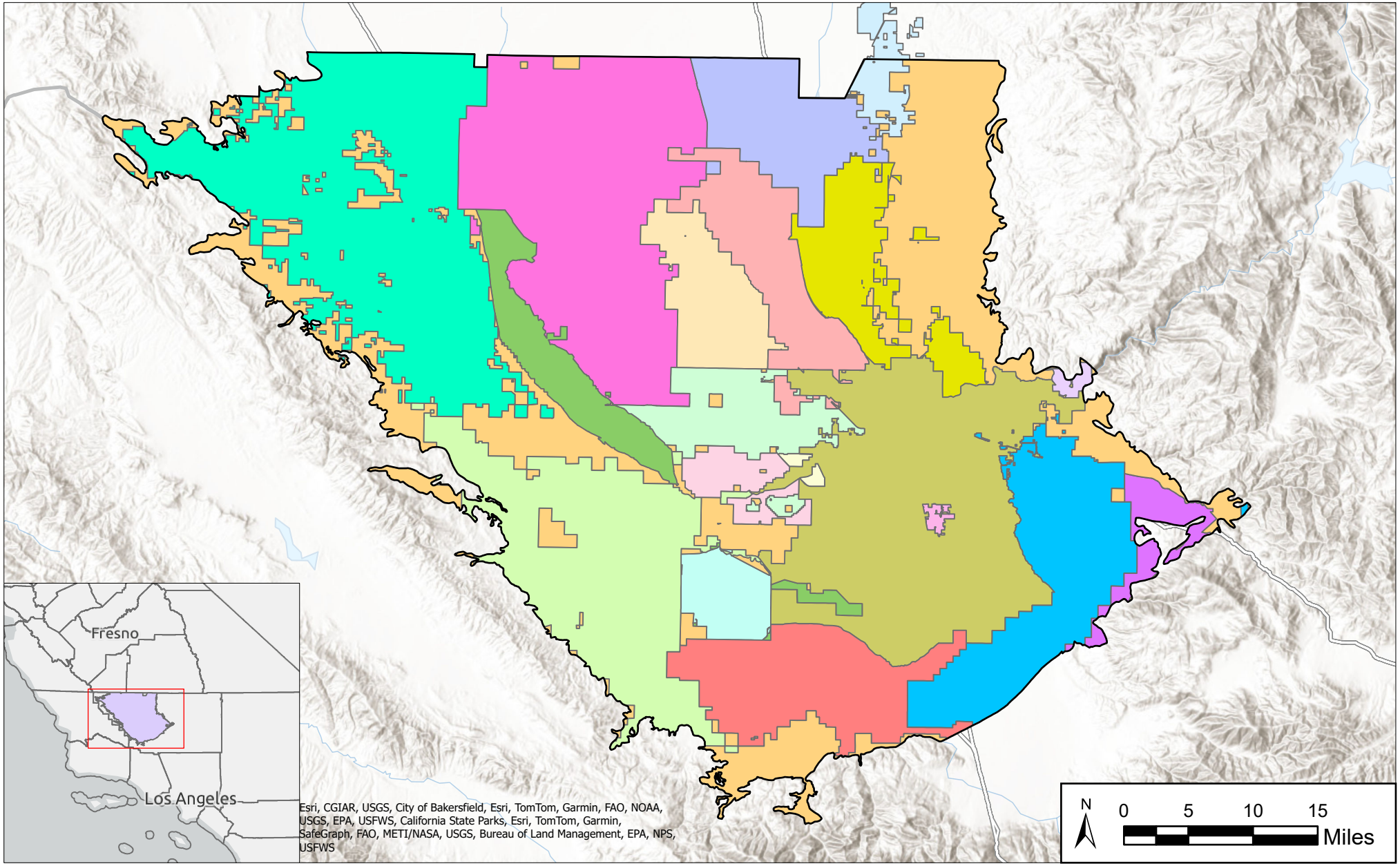

Figure 3-7

GSAs in the Kern County Subbasin

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July 2024

- Arvin GSA
- Buena Vista Water Storage District GSA
- Cawelo Water District GSA
- Greenfield County Water District GSA
- Henry Miller Water District GSA
- Kern Groundwater Authority GSA
- Kern River GSA
- Kern Water Bank Groundwater Sustainability Agency
- Kern-Tulare Water District GSA
- North Kern Water Storage District GSA
- Olcese Water District GSA
- Pioneer GSA
- Rosedale-Rio Bravo Water Storage District GSA
- Semitropic Water Storage District GSA
- Shafter-Wasco Irrigation District GSA
- Southern San Joaquin Municipal Utility District
- Tejon-Castac Water District GSA
- West Kern Water District GSA
- Westside District Water Authority GSA
- Wheeler Ridge-Maricopa GSA

Data Source:
DWR SGMA Portal
-Accessed May 2024

California Water Boards
State Water Resources Control Board
Regional Water Quality Control Boards

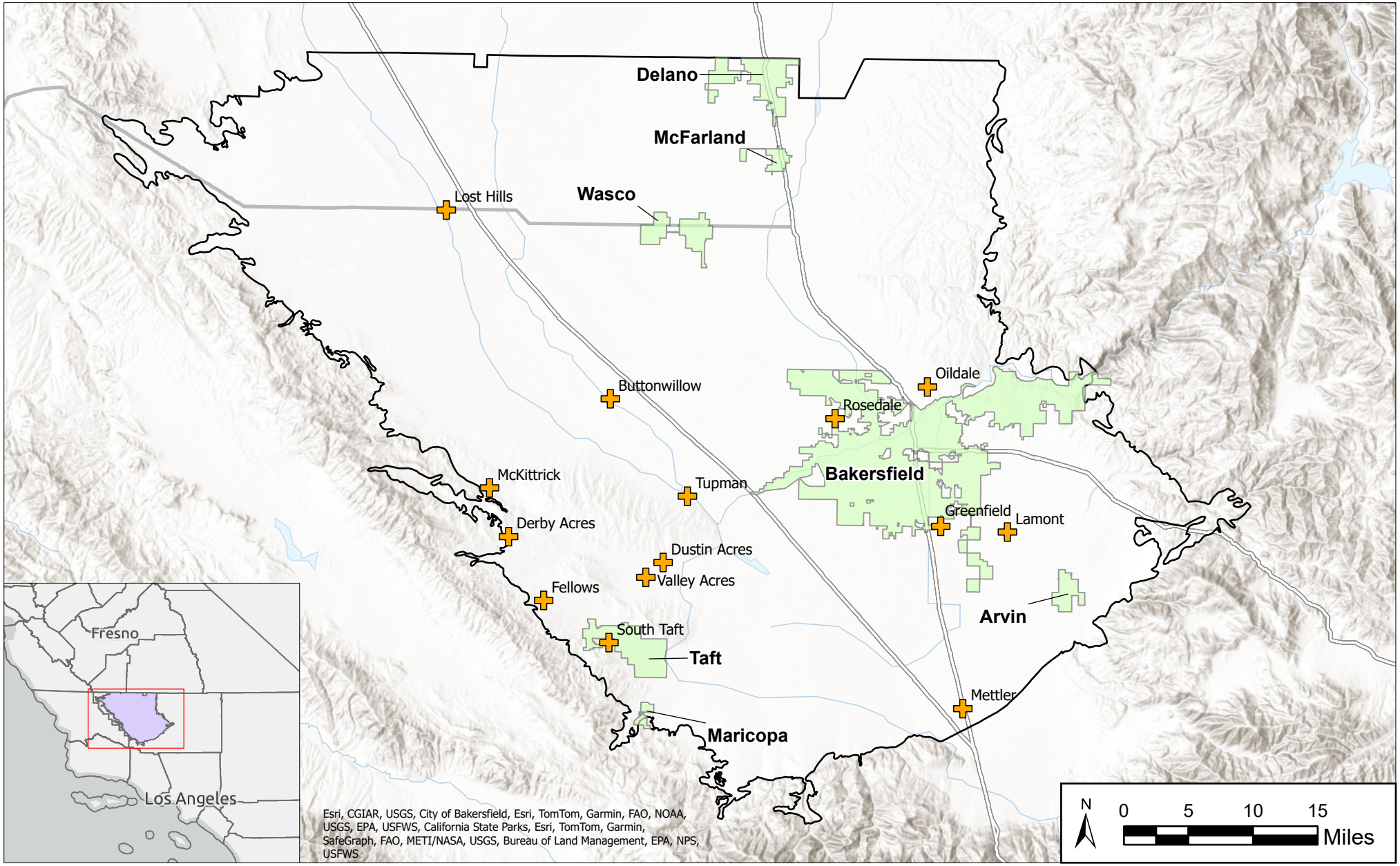

Figure 3-8

Urban Areas in the Kern County Subbasin

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Kern County Subbasin
July 2024

Kern County Subbasin

Incorporated Cities

Communities

Data Source:
California Department of Forester and Fire Protection
-Accessed May 2024

https://data.cnra.ca.gov/dataset/california-incorporated-cities

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Regional Water Quality Control Boards

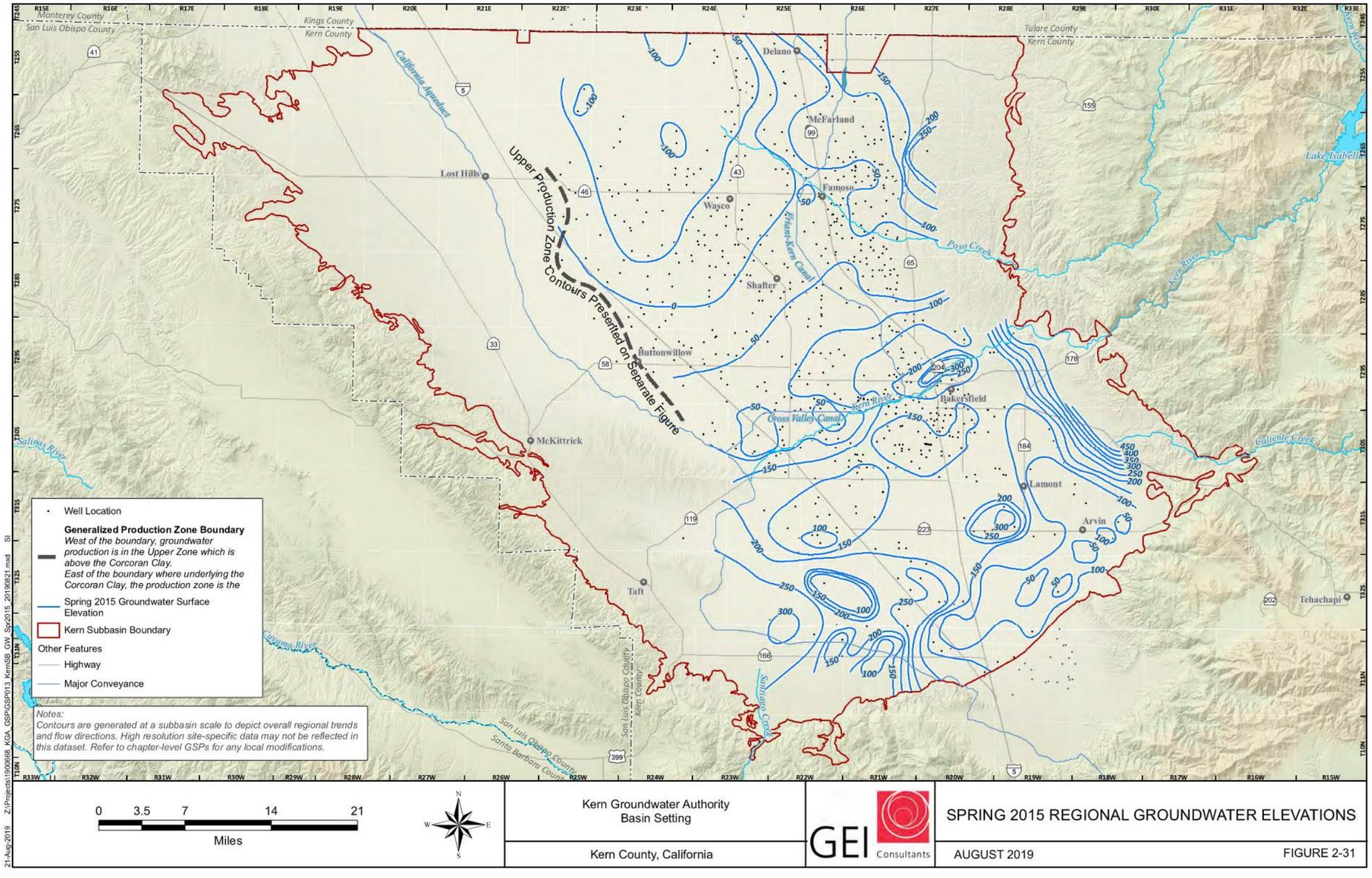

Figure 2-31. Spring 2015 Regional Groundwater Elevations

Figure 3-9a: 2015 Groundwater Elevations in the Kern County Subbasin Excerpt from the KGA 2022 GSP

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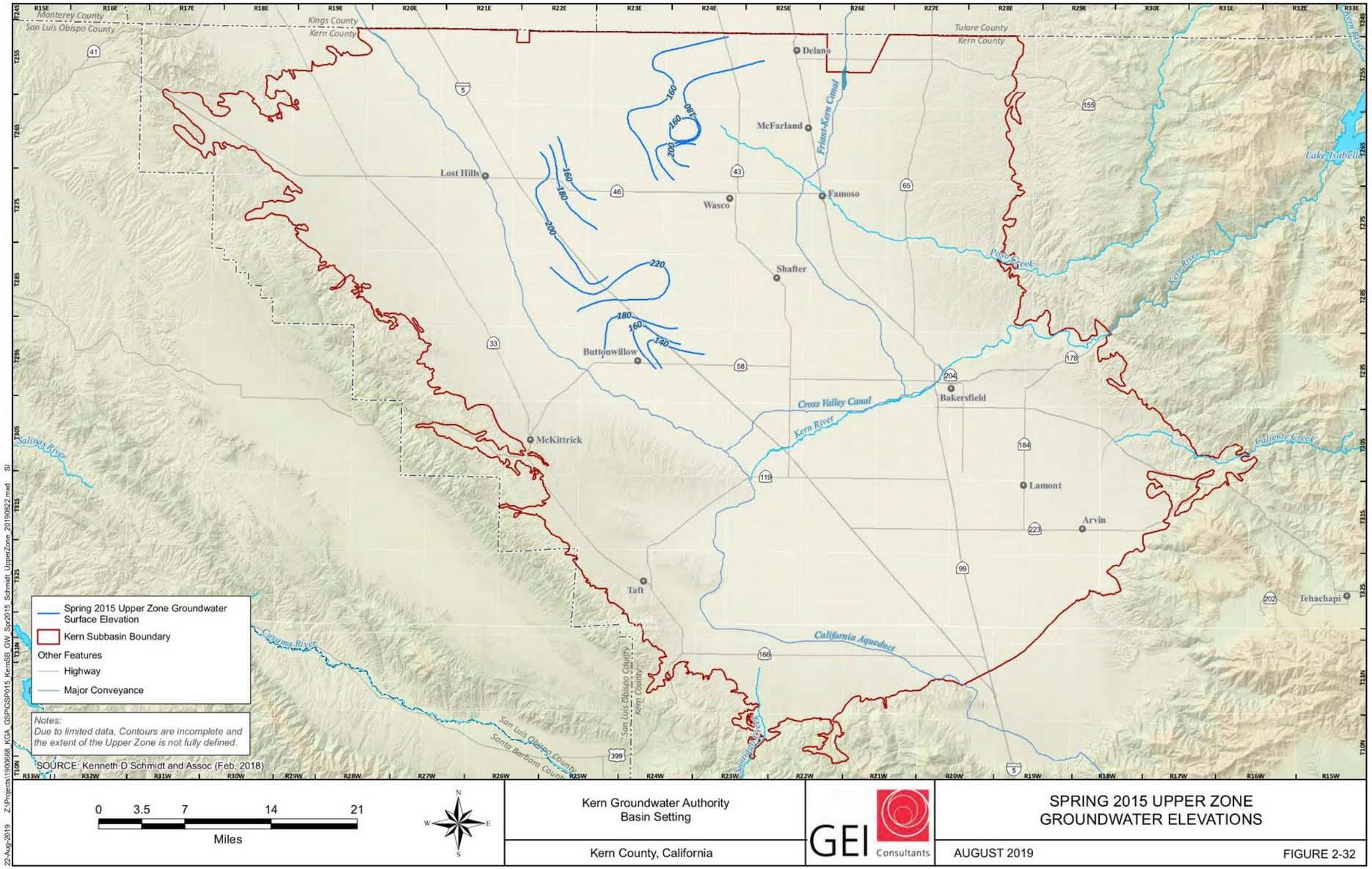

Figure 2-32. Spring 2015 Upper Zone Groundwater Elevations

Figure 3-9b: 2015 Groundwater Elevations in the Kern County Subbasin Excerpt from the KGA 2022 GSP

Draft Staff Report: Kern County Subbasin July 2024

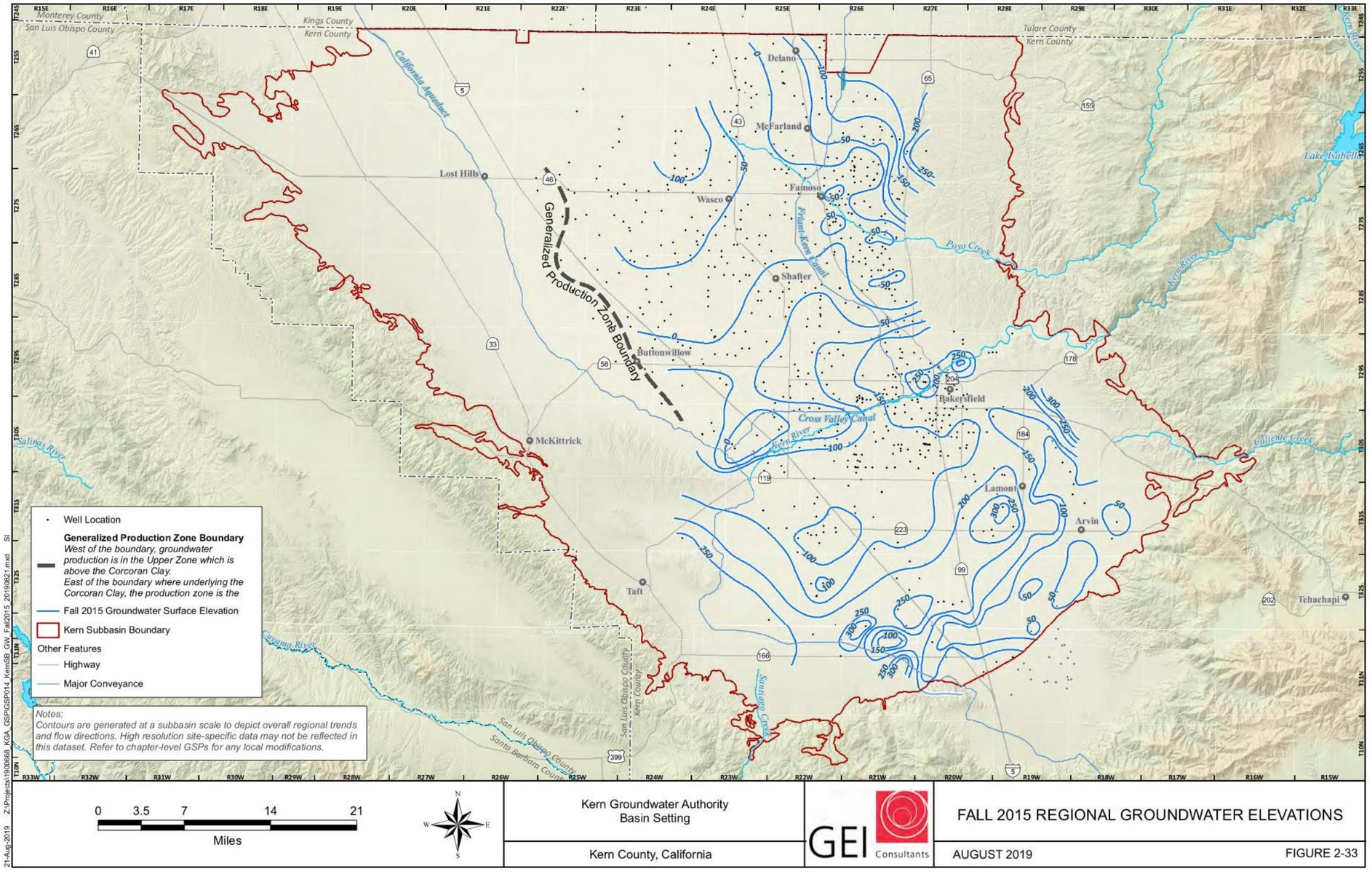

Figure 2-33. Fall 2015 Regional Groundwater Elevations

Figure 3-9c: 2015 Groundwater Elevations in the Kern County Subbasin Excerpt from the KGA 2022 GSP

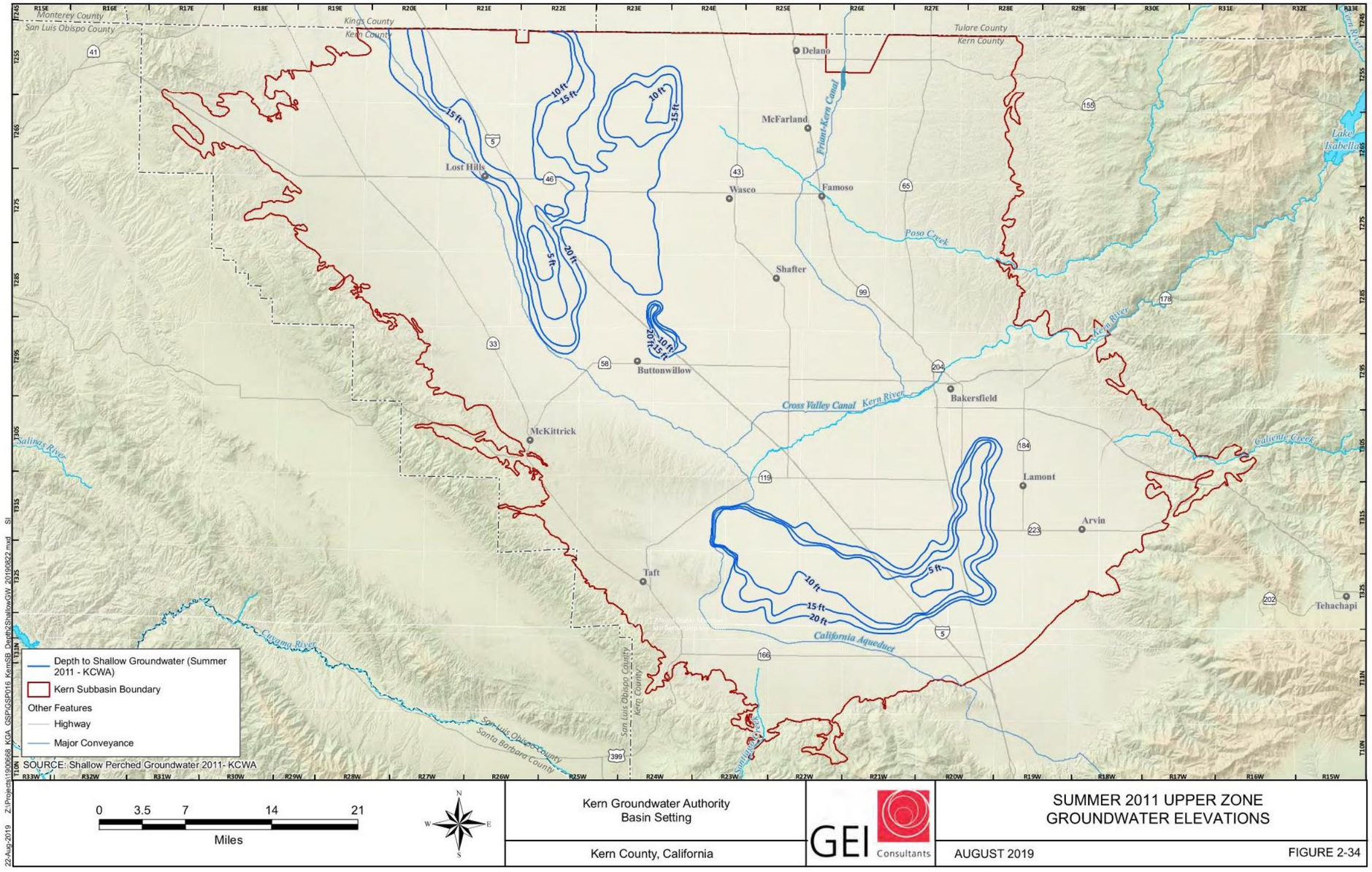

Figure 2-34. Summer 2011 Upper Zone Groundwater Elevations

Figure 3-9d: 2011 Groundwater Elevations in the Kern County Subbasin Excerpt from the KGA 2022 GSP

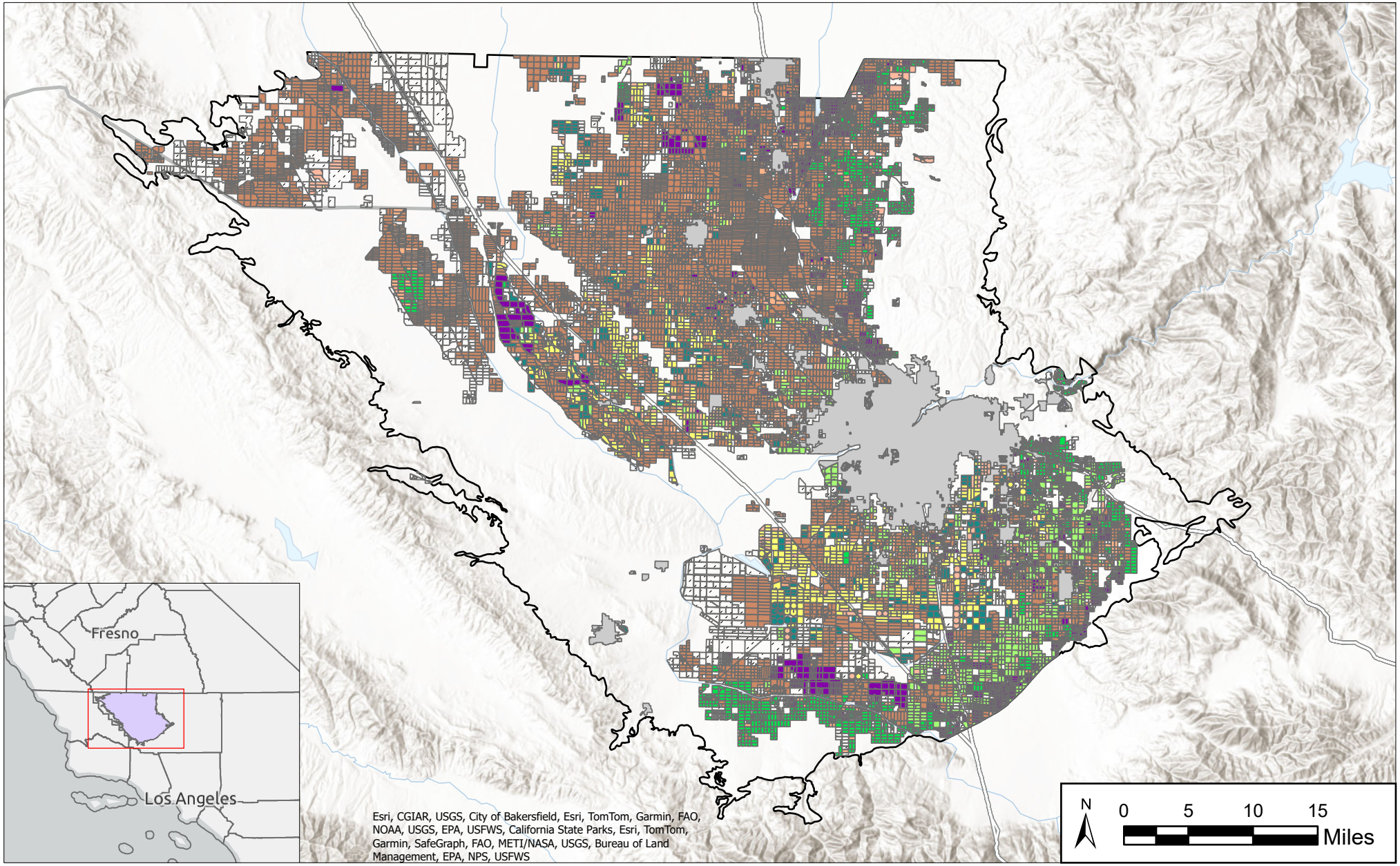

Figure 3-10

2022 Land Use in the Kern County Subbasin

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Kern County Subbasin
July 2024

- Citrus and Subtropical
- Deciduous Fruits
- Field Crops
- Grain and Hay Crop
- Idle
- Pasture
- Truck Nursery and Berry Crops
- Urban Unspecified
- Urban Landscape
- Vineyard
- Unclassified
- Young Perennial
- Kern County Subbasin

Data Source:
DWR Open Portal
Provisional 2022
Statewide Land Use data
-Accessed May 2024

https://data.cnra.ca.gov/dataset/statewide-crop-mapping

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

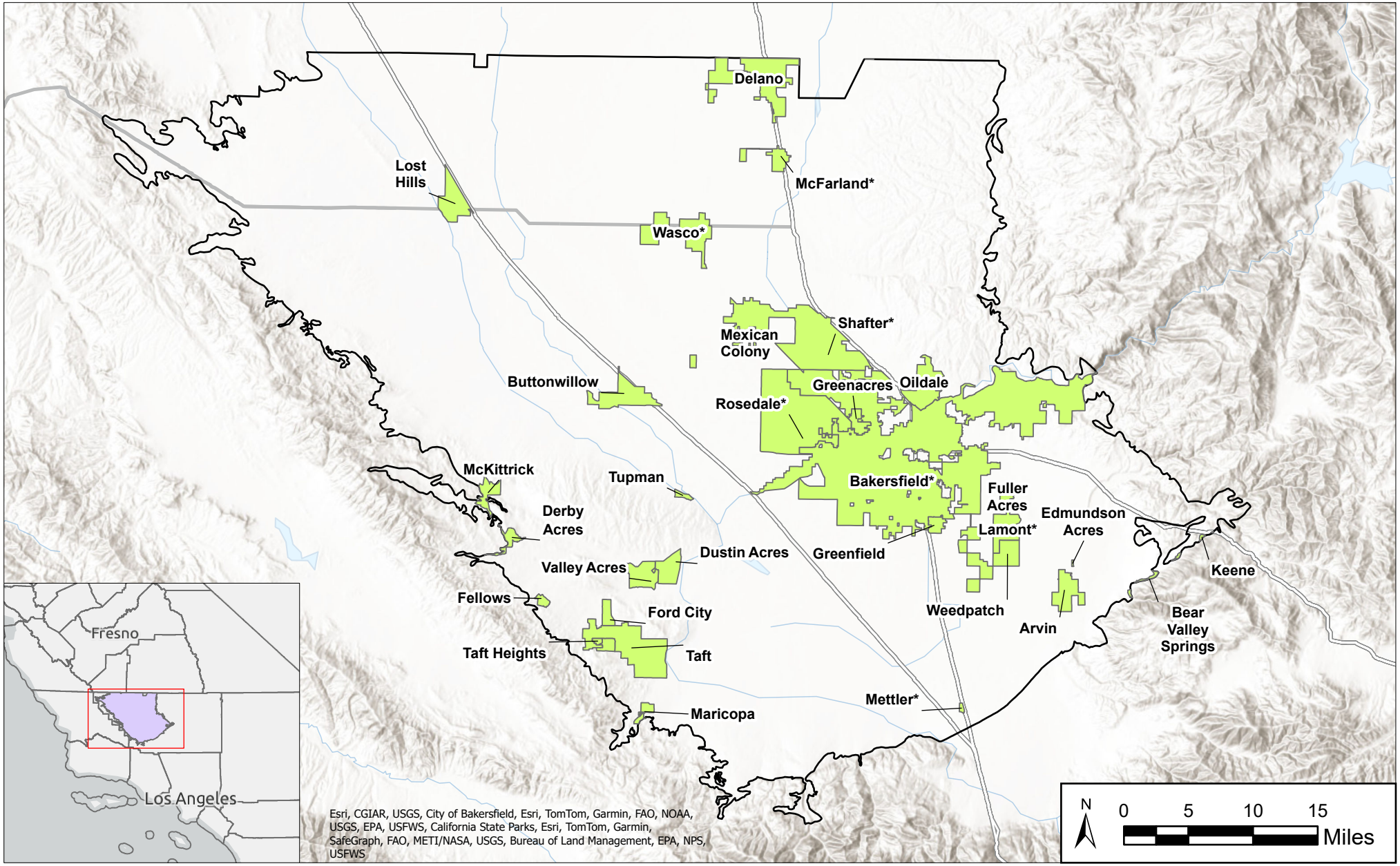

Figure 3-11

DACs in the Kern County Subbasin

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Kern County Subbasin
July 2024

Kern County Subbasin

Disadvantaged Communities

* Failing Drinking Water System (DDW)

Data Source:
DWR Open Data Portal
Copy of Statewide Census Place Tiger File.
-Accessed May 2024

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Regional Water Quality Control Boards

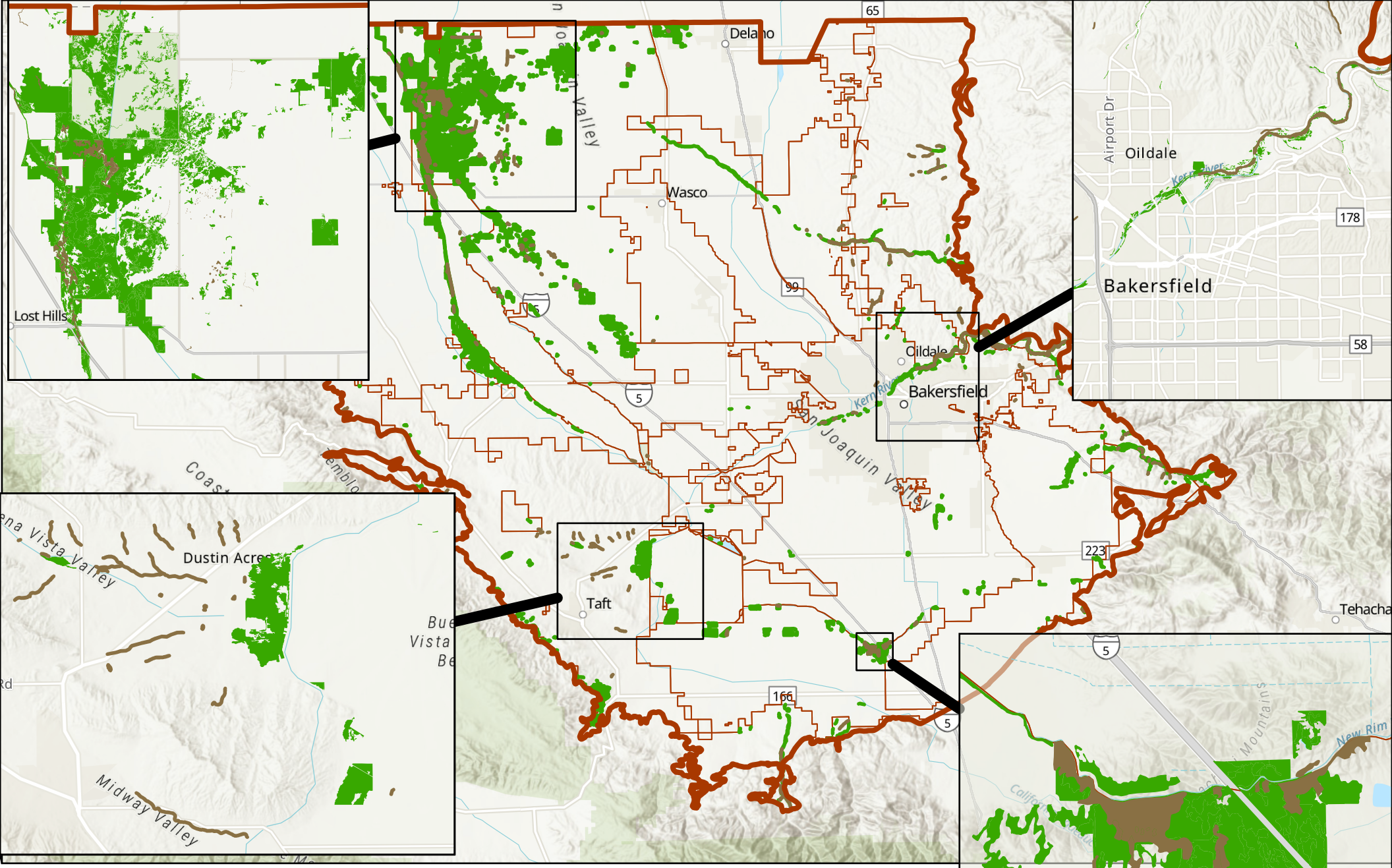

Figure 3-12a

Aquatic and Vegetative Groundwater-Dependent Ecosystems in the Kern Subbasin

Aquatic
Vegetative
Tule Boundary

Data Source:
-Natural Communities Commonly Associated with Groundwater dataset
-California Native Plant Society Manual

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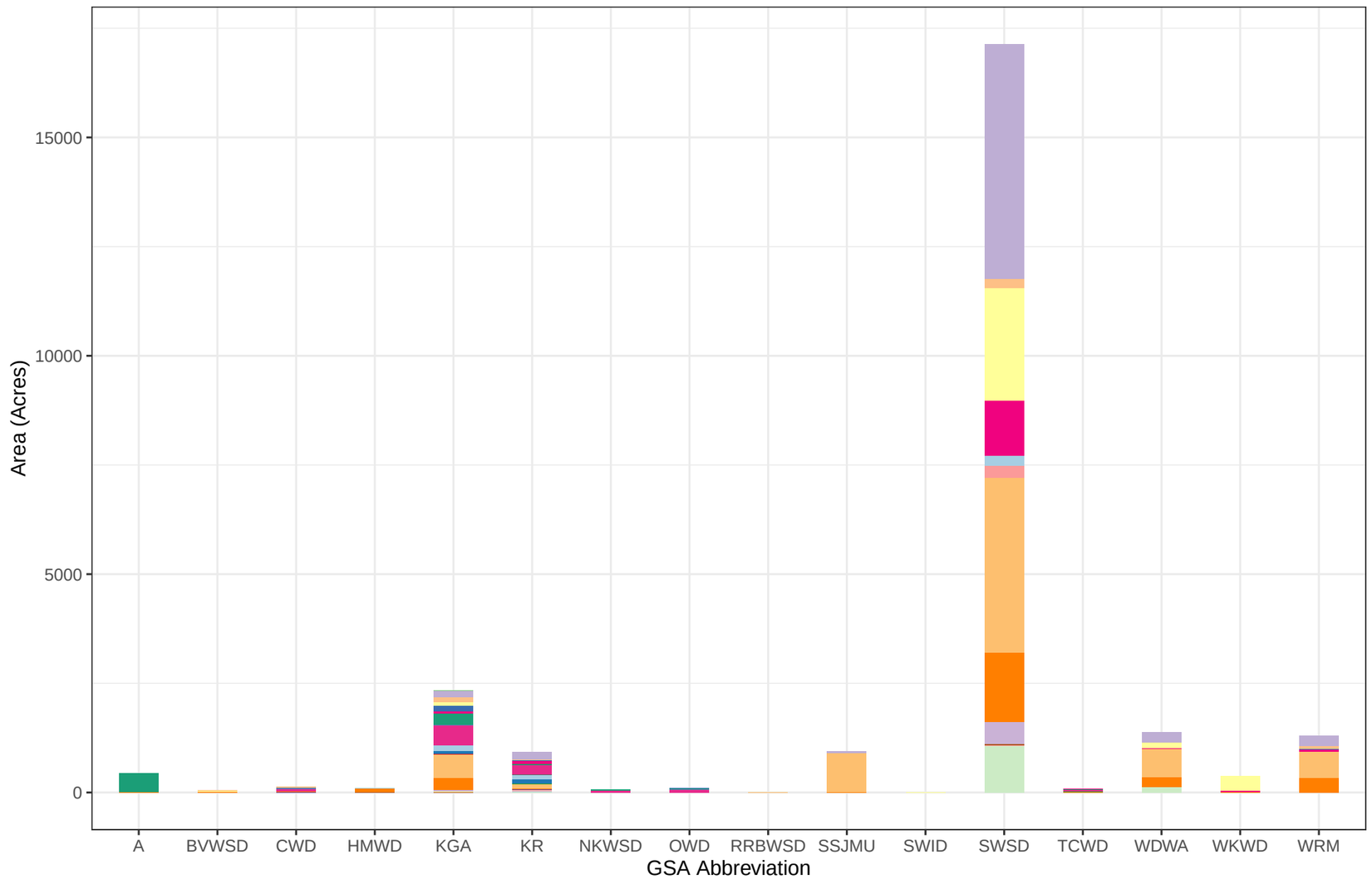
Kern Subbasin
July 2024

Figure 3−12b Vegetative Groundwater Dependent Ecosystems Area By Type Per GSA



Vegetation Type

- *Ailanthus altissima*
- *Allenrolfea occidentalis*
- *Atriplex lentiformis*
- *Atriplex spinifera*
- *Baccharis salicifolia*
- *Isocoma acradenia*
- *Juncus arcticus*
- *Lepidium latifolium*
- *Lepidospartum squamatum*
- *Platanus racemosa*
- *Pluchea sericea*
- *Populus fremontii*
- *Prosopis glandulosa*
- *Quercus lobata*
- *Rubus armeniacus*
- *Salix exigua*
- *Salix gooddingii*
- *Salix laevigata*
- *Salix lasiolepis*
- *Sambucus nigra*
- *Schoenoplectus (acutus, californicus)*
- *Schoenoplectus americanus*
- *Suaeda moquinii*
- *Tamarix spp.*
- *Typha spp.*
- *Vitis californica*
- California Warm Temperate Marsh/Seep
- Freshwater Emergent Marsh
- Riparian Evergreen and Deciduous Woodland
- Southwestern North American Riparian Wash/Scrub
- Southwestern North American Salt Basin and High Marsh

Abrev	GSA
KGA	Kern Groundwater Authority GSA
KR	Kern River GSA
TCWD	Tejon−Castac Water District GSA
A	Arvin GSA
SWSD	Semitropic Water Storage District GSA
SSJMU	Southern San Joaquin Municipal Utility District
WDWA	Westside District Water Authority GSA
WRM	Wheeler Ridge−Maricopa GSA
BVWSD	Buena Vista Water Storage District GSA
CWD	Cawelo Water District GSA
SWID	Shafter−Wasco Irrigation District GSA
WKWD	West Kern Water District GSA
NKWSD	North Kern Water Storage District GSA
OWD	Olcese Water District GSA
HMWD	Henry Miller Water District GSA
RRBWSD	Rosedale−Rio Bravo Water Storage District GSA

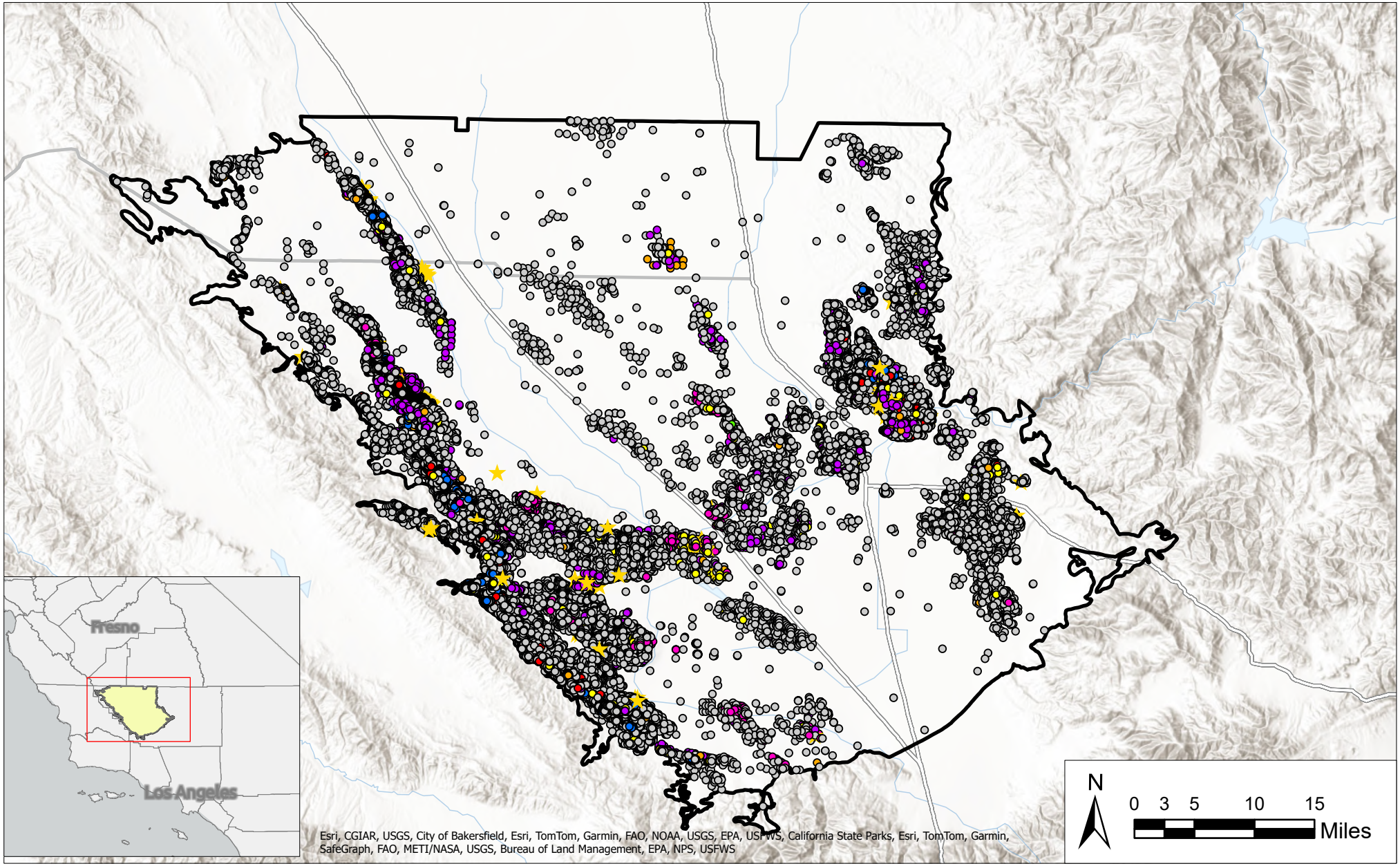


Figure 3-13
Wells Related to Oil Extraction

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Kern County Subbasin
July 2024

- Kern County Subbasin boundary selection
- Water Source
- Cyclic Steam
- Injection
- Multi-Purpose
- Pressure Maintenance
- Steamflood
- Water Disposal
- Waterflood
- Oil & Gas

Data Source: CalGEM Well Finder
-Accessed May 2024

https://maps.conservation.ca.gov/doggr/wellfinder/

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REGIONAL WATER QUALITY CONTROL BOARDS

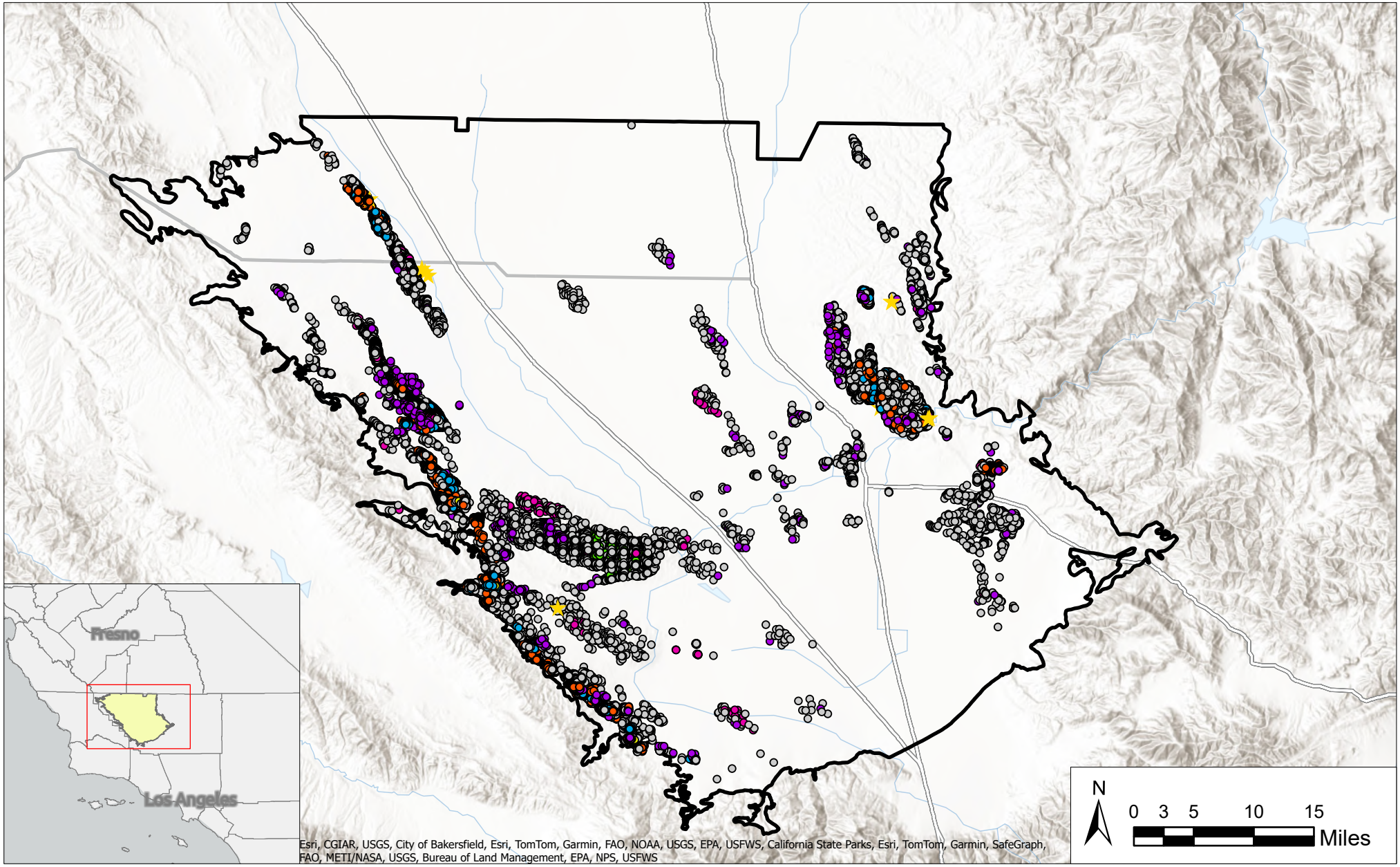

Figure 3-14
Active Wells Related to Oil Extraction

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July 2024

- Kern County Subbasin boundary selection
- Water Source
- Cyclic Steam
- Injection
- Multi-Purpose
- Pressure Maintenance
- Steamflood
- Water Disposal
- Waterflood
- Oil & Gas

Data Source: CalGEM Well Finder
-Accessed May 2024

https://maps.conservation.ca.gov/doggr/wellfinder/

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REGIONAL WATER QUALITY CONTROL BOARDS

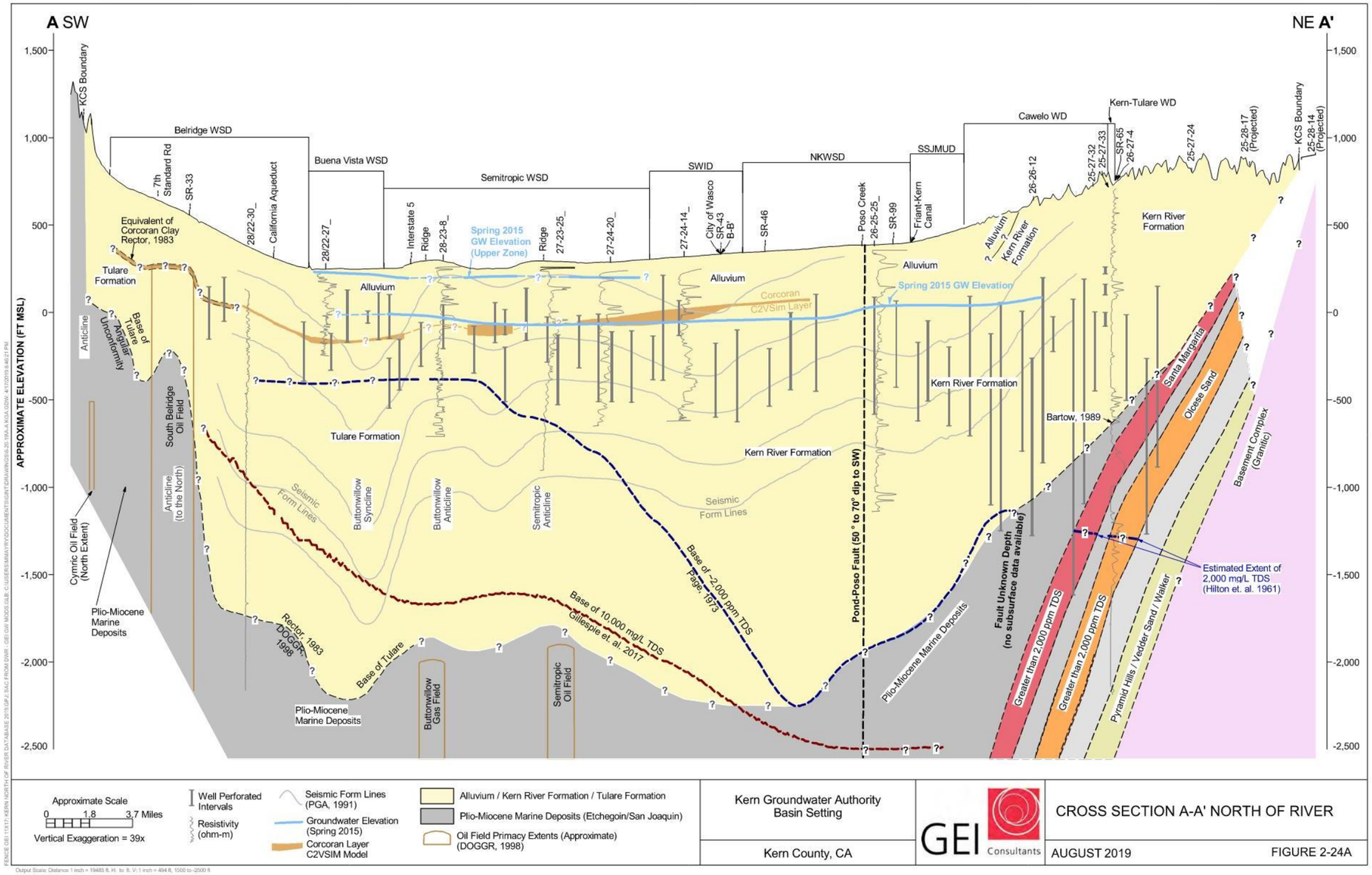
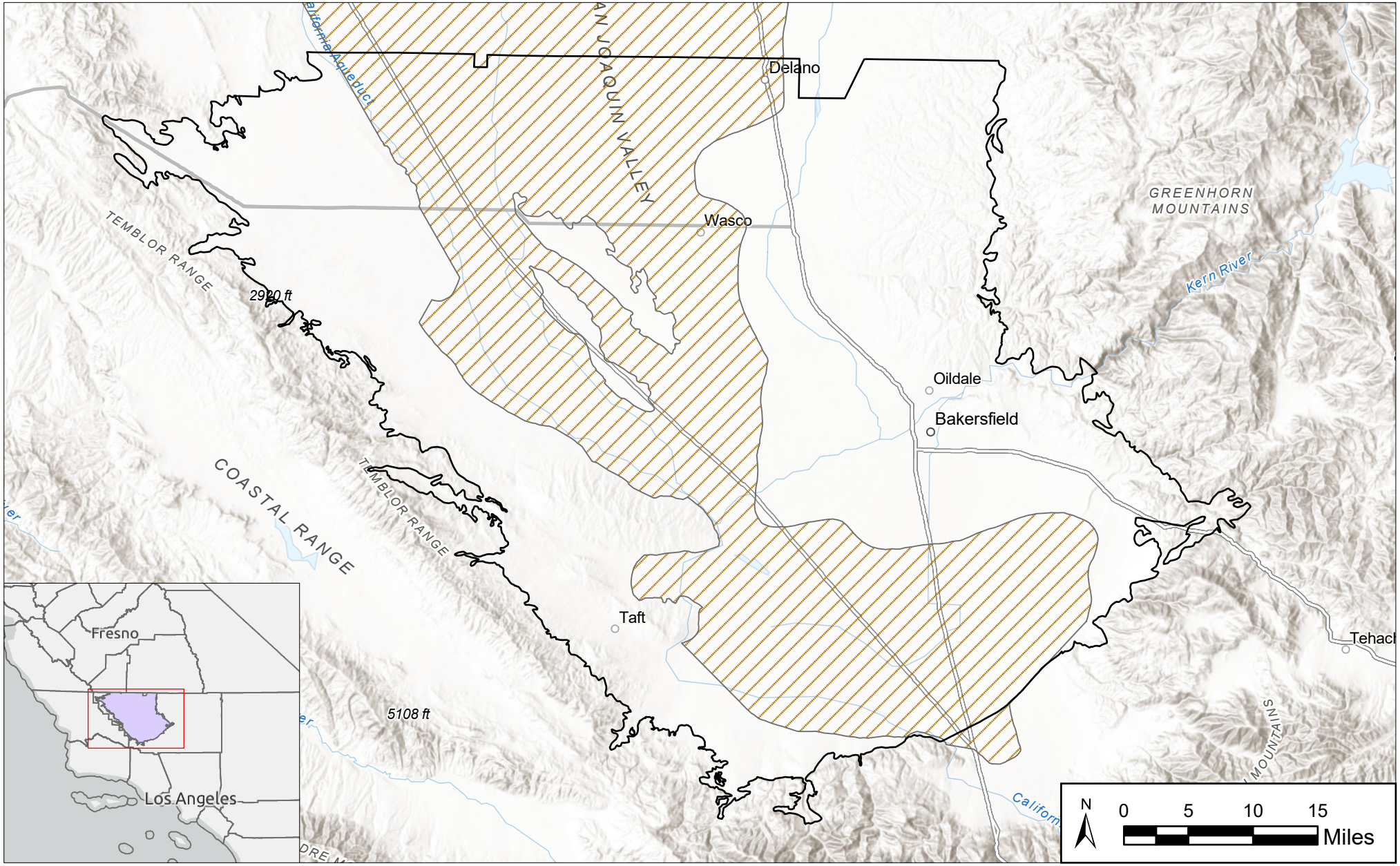


Figure 2-24a. Cross Section A-A' North of River

Figure 3-15a: Cross Sections of the Kern County Subbasin Excerpt from the KGA 2022 GSP



Kern County Subbasin

Corcoran Clay (E-Clay)

Figure 3-15b

Corcoran Clay in the Kern County Subbasin

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July 2024

Data Source:
Faunt C.C. USGS, (2023)
-Accessed May 2024

https://doi.org/10.5066/P983J3B3

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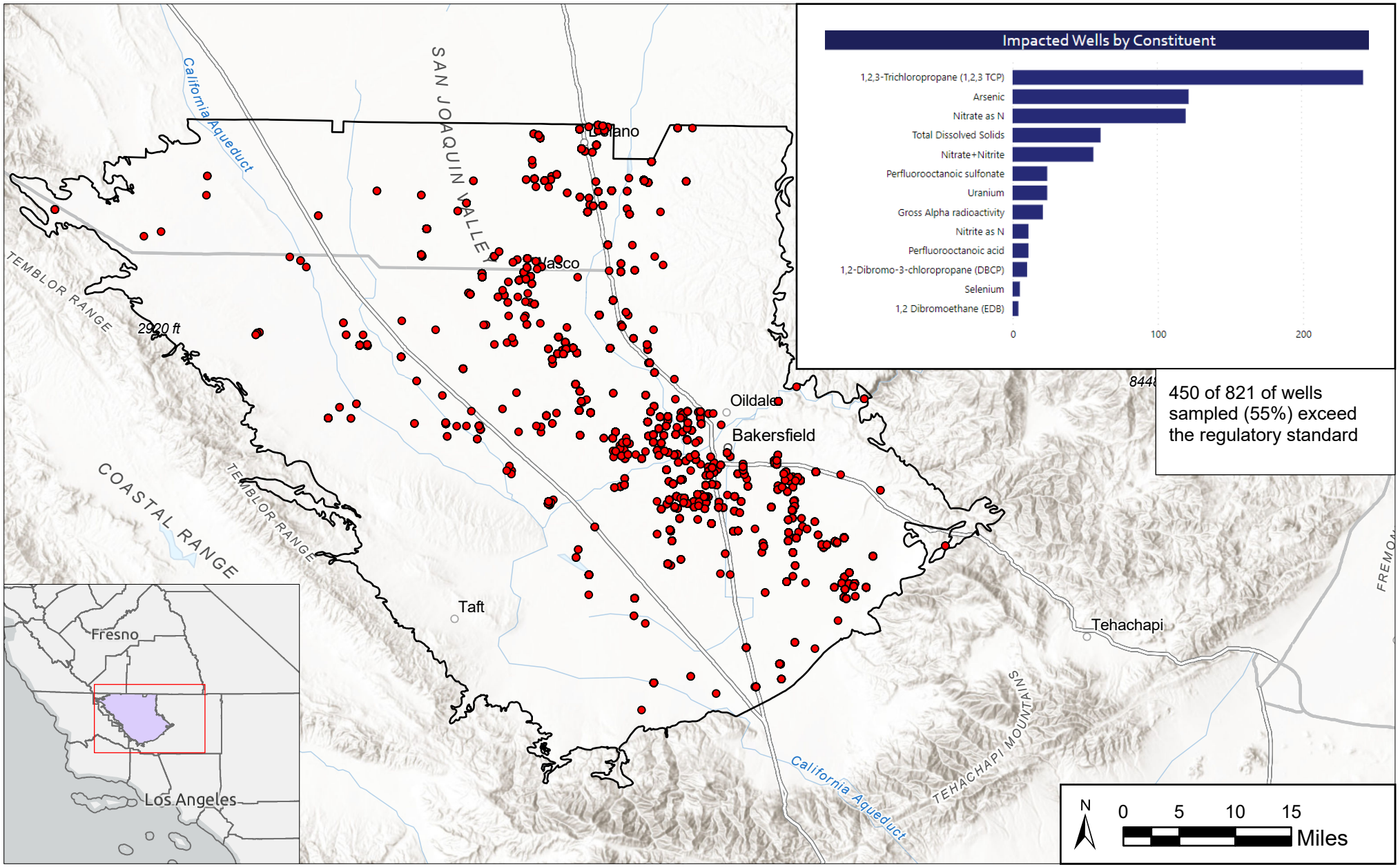

Figure 3-16
Wells with Detections Greater than the Comparable Concentration Value

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Kern County Subbasin
July 2024

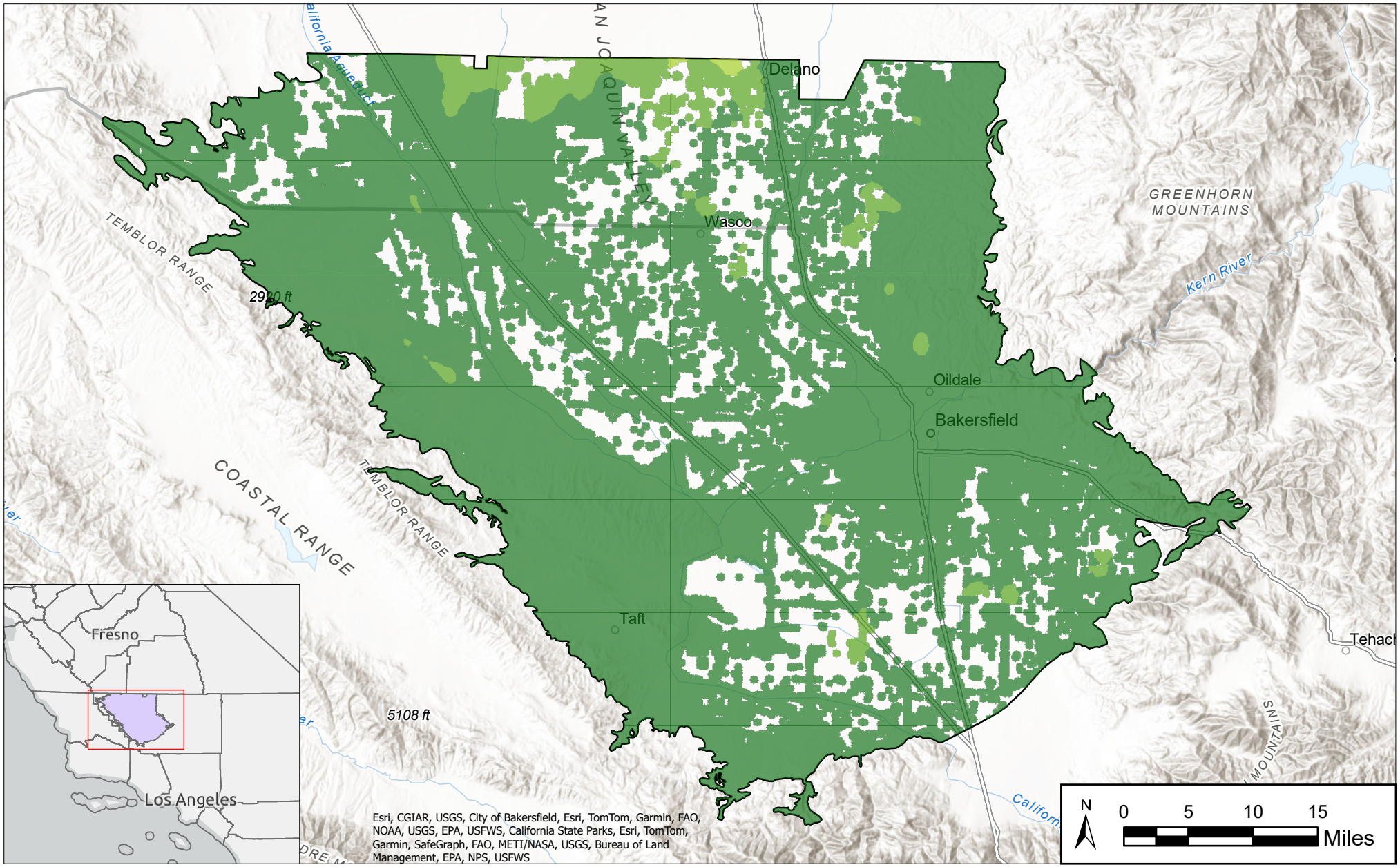
Kern County Subbasin

Wells with Detections Greater than the Comparable Concentration Value

Data Source:
SWRCB SGMA Groundwater Quality Visualization Tool
-Accessed May 2024

https://www.waterboards.ca.gov/water_issues/programs/sgma/water-quality-visualization-tool.html

California Water Boards
State Water Resources Control Board
Regional Water Quality Control Boards



Kern County Subbasin

Subsidence from InSAR (ft.)

-7 to -6
-6 to -5
-5 to -4
-4 to -3
-3 to -2
-2 to -1
-1 to .25

Data Source:
California Department of Water Resources TRE ALTAMIRA database
-Accessed January 2024

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Figure 3-17

Subsidence in the Kern County Subbasin (June '15 - Jan '24)

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July 2024

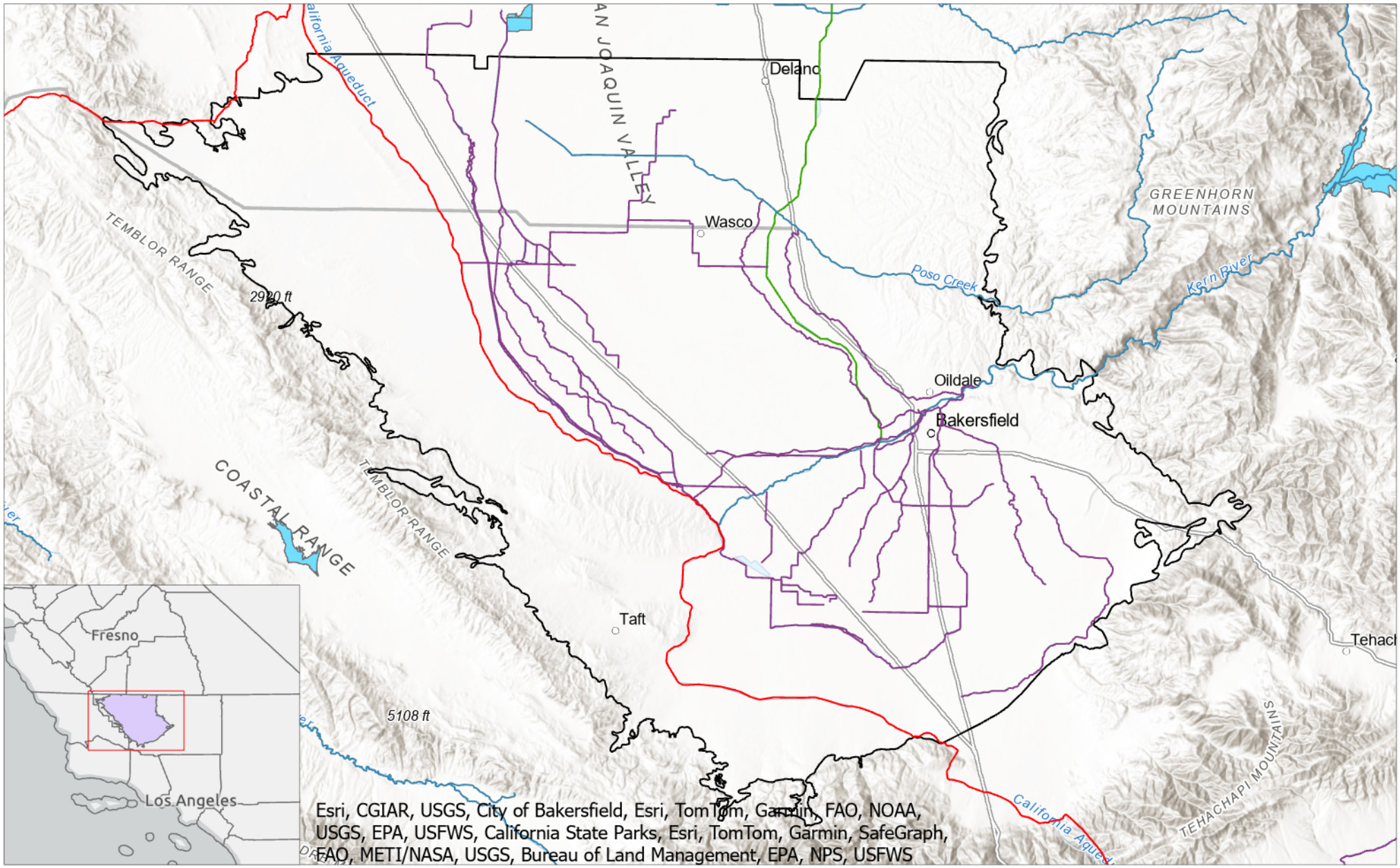

Figure 3-18

Surface Waters of the Kern County Subbasin

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July 2024

- Kern County Subbasin
- California Aqueduct
- Friant Kern Canal
- Local Canals

Data Source:
Department of Water Resources SGMA Data Viewer (Accessed May 2024)
-Major Rivers and Creeks (NHD)
-Local Canals and Aqueducts
-Federal Canals and Aqeducts

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