KERN COUNTY SUBBASIN PROBATIONARY HEARING FINAL STAFF REPORT

January 2025

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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).

2024 Draft GSP(s) – unadopted Kern County Subbasin Groundwater Sustainability Plans (one main GSP and six GSPs that include GSA-specific details to supplement the information provided in the umbrella plan) submitted to the State Water Resources Control Board on May 28, 2024.

2024 Final GSP(s) – revised and adopted Kern County Subbasin Groundwater Sustainability Plans (one main GSP and six GSPs that include GSA-specific details to supplement the information provided in the umbrella plan) submitted to the State Water Resources Control Board on December 16, 2024.

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 or acre-foot

AFY – acre-feet per year or acre-foot per year

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

BIPOC – Black, Indigenous, and people of color

Blue pages – the additional pages that were included in the six separately submitted 2024 Draft GSPs that differ from the Main 2024 Draft GSP. The 2024 Draft GSPs for Henry Miller Water District GSA, Semitropic GSA, Olcese GSA, Kern-Tulare Water District GSA, Buena Vista Water Storage District GSA, and Westside District Water Authority GSA include blue pages with GSA-specific information.

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 – California Statewide Groundwater Elevation Monitoring Program

CASP – California Aqueduct Subsidence Program

Cawelo – Cawelo Water District

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

COC – constituent of concern

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)).

CVP – Central Valley Project

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

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).

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 – the 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 acre-feet 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

Draft Staff Report - Kern County Subbasin Probationary Hearing Draft Staff Report released by the State Water Resources Control Board on July 25, 2024

DWR or Department – Department of Water Resources

E-clay – Corcoran clay

EOR – enhanced oil recovery

EPA – United States Environmental Protection Agency

ET – Evapotranspiration

EWMA – Eastside Water Management Area

Ft – US feet

FWA – Friant Water Authority

GAMA Program – the State Water Board's Groundwater Ambient Monitoring and Assessment Program

GDEs or 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))

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 Water Code section 10722.5 (Wat. Code, §10721, subd. (g))

Groundwater flow –the volume and direction of groundwater movement into, out of, or throughout a basin

Groundwater recharge or recharge – the augmentation of groundwater, by natural or artificial means (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

HCM (Hydrogeologic Conceptual Model) Areas – areas that are characterized by specific geologic and hydrogeologic attributes that dictate land and water uses in the area. The HCM areas include the Western Fold Belt, East Margin, Kern River Fan, North Basin (North of Kern River Fan), and South Basin (South of Kern River Fan) (2024 Kern County Subbasin Draft GSP, pp. ES-5)

HMWD – Henry Miller Water District (GSA)

HZ – hydrogeologic zone

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

ICONS – Interconnected Surface Water in the Central Valley. A dataset which categorizes rivers and streams in the Central Valley on the likelihood that they are interconnected surface water.

Id. – the reference is the same as the previous citation with a different page number. It is an abbreviation of the Latin word "idem," which means "the same person."

ILRP – the State Water Board's Irrigated Lands Regulatory Program

IM or interim milestone – a target value representing measurable groundwater conditions, in increments of five years, set by a GSA as part of a GSP.

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.

JPA – joint powers agreement

KCWA – Kern County Water Agency (Pioneer GSA)

KGA – Kern Groundwater Authority (GSA)

KNDLA – Kern Non-Districted Land Authority

KRGSA – Kern River GSA

KTWD – Kern-Tulare Water District (GSA) – refers to the portion of KTWD within the Kern County Subbasin

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))

MAF – million acre-feet

MAP or Management Area Plan – required in basins with one or more management areas and must describe the following:
The reason for the creation of each management area.
The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large.
The level of monitoring and analysis appropriate for each management area.
An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable.
(Cal. Code Regs., tit. 23, § 354.20, subd. (b))

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 or 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 or Minimum Threshold – a numeric value for each sustainability indicator used to define undesirable results.

NCCAG – Natural Communities Commonly Associated with Groundwater. A spatial database that provides locations of seeps and springs, wetlands, and vegetation likely to depend on groundwater.

ng/L – nanogram per liter

NKWSD – North Kern Water Storage District (GSA)

NOAA CORS – National Oceanic and Atmospheric Administration Continually Operating Reference Station System

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

OSWCR – Online System for 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

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.

PMAs or P/MAs – Projects and management actions

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 Water Code Section 10735.2

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

RMW or representative monitoring well – a monitoring well within a broader network of wells that typifies one or more conditions within the basin or an area of the basin. RMWs may be used for groundwater quality (RMW-WQ) or groundwater water level analysis (RMW-WL)

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

RWQCB – Regional Water Quality Control Board

SAFER – Safe and Affordable Funding for Equity and Resilience

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))

Secondary MCL – also known as a secondary drinking water standard. Defined in the California Health and Safety Code, 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. The Act passed in 2014 and is found at Water Code § 10720 et seq.

SMC or 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

Subsidence management areas – areas encompassing a 2.5-mile buffer on either side of A) the California Aqueduct at Mile Posts 195-215 and 262-267, and B) the Friant-Kern Canal MPs 120-137. Board staff is not defining new management areas. Board staff uses this term to generically refer to the entire area described by DWR's CASP, not withstanding the fact that Kern County Subbasin GSPs variably refer to these areas within their jurisdiction as "buffer zones" or "monitoring corridors."

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, subdivision (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)

SWP – State Water Project

SWSD – Semitropic Water Storage District (GSA)

TCWD – Tejon-Castac Water District

WKWD – West Kern Water District (GSA)

WDWA – Westside District Water Authority

WRMWSD – Wheeler Ridge-Maricopa Water Storage District

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 Water Code section 10721, subdivision (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

The State Water Resources Control Board (State Water Board or Board) staff developed the Probationary Hearing Final Staff Report (Final Staff Report) for the Kern County Subbasin (subbasin) to help inform the Board's decision pursuant to the Sustainable Groundwater Management Act (SGMA or Act) as to whether to designate the Kern County Subbasin a probationary basin, as defined in the Act. This Executive Summary briefly summarizes key sections of the Final Staff Report, however a full discussion of each section referenced in the Executive Summary is provided in the Final Staff Report. Where appropriate, the section titles in this Executive Summary refer to the corresponding section in the Final Staff Report. For example, the "SGMA and State Intervention (Section 2)" section of this Executive Summary covers Section 2 of the Final Staff Report.

Introduction

The mission of the State Water Board and the nine Regional Water Quality Control Boards (Regional Water Boards and, together with the State Water Board, Water Boards) 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. Consistent with this goal, 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 SGMA, an historic action 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 primarily responsible for the sustainable management of their groundwater basins; however, the Department of Water Resources (DWR or Department) and the State Water Board are also responsible for ensuring local groundwater management achieves SGMA's sustainability goals. SGMA provides DWR and the State Water Board with review and 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 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 the GSPs to determine if they met SGMA's requirements and found them to be incomplete. Following revisions made by the GSAs in the subbasin, DWR reevaluated the GSPs (plus one additional GSP that 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 recommends the 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. Board staff recommends that most domestic household users (people who use two acre-feet or less per year for domestic purposes only) be exempt from reporting extractions and paying fees.
    - Identify certain deficiencies (issues with the subbasin's current GSPs) 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 wells located in the Friant-Kern Canal and California Aqueduct Subsidence Management Areas to install and use meters to measure their groundwater extractions.

SGMA and State Intervention (Section 2)

SGMA established a framework for groundwater management in California. SGMA requires local public agencies in alluvial groundwater basins designated as high-priority

and medium-priority by DWR, and subject to the Act, to form GSAs that must develop and implement GSPs. GSAs are responsible for achieving long-term sustainable management of their groundwater basins that avoids certain undesirable results and achieves sustainable groundwater management within 20 years.

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. It is a two-step process:

- The first step of state intervention under SGMA is for the State Water Board to determine, through a noticed public hearing, whether to place the basin on probation.
- In the second step, through an additional 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 and Board staff were sufficiently addressed prior to the probationary hearing. 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. This is a recognition that many of these communities are reliant on shallow wells, which can be the first to be affected by undesirable results as defined under the Act (e.g., chronic lowering of groundwater levels) and can be the least resourced to address such impacts.

Even if a basin is placed on probation, GSAs have time to resolve deficiencies identified in their GSPs before the state proceeds to active management in the basin. During the probationary period, the State Water Board collects data on groundwater extractions, collects fees from certain groundwater users, and may conduct additional investigations. Data collection helps the state to better evaluate conditions in the basin and SGMA mandates that the State Water Board collect fees in the probationary basin so that the costs of state intervention are not borne by basins that are in compliance or the public at large. Low-income residents, public schools, and public water systems or state small water systems that serve disadvantaged communities are eligible to request fee waivers, if they report extraction data by the reporting deadline. Importantly, the GSA retains its authorities and responsibilities during probation and there is no exemption in SGMA from the GSA continuing to implement its GSP.

[1] Wat. Code, § 10735

Basin Description (Section 3)

Located in California's Central Valley in the southern portion of the San Joaquin Valley, the Kern County Subbasin (**Figure ES-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 December 2024, managed by 20 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, 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 this Final 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 agreed with this determination.

Consideration of Groundwater Sustainability Plan Revisions

The Kern County Subbasin GSAs submitted seven new draft GSPs and a Coordination Agreement to the Board on May 28, 2024, collectively referred to here as the 2024 Draft Groundwater Sustainability Plans (2024 Draft GSPs). The plans were considered draft

[2] DWR, 2016.

because they were undergoing public review and not adopted by the GSAs at the time of submission. Board staff conducted a full review of the 2024 Draft GSPs and determined that the GSPs did not sufficiently resolve all of the deficiencies that State Water Board staff identified in the Kern County Subbasin Probationary Hearing Draft Staff Report (Draft Staff Report).

The Kern County Subbasin GSAs also recently adopted seven new GSPs, and submitted these to the Board on December 16, 2024, which are referenced in the Final Staff Report as the 2024 Final GSPs (2024 Final GSPs). Board staff conducted a preliminary review to evaluate how well the GSAs addressed the deficiencies described in the Draft Staff Report. From the preliminary review, Board staff determined that the 2024 Final GSPs do not resolve all of the deficiencies. The Final Staff Report includes a 2024 Final GSP Evaluation section for each deficiency to summarize Board staff's preliminary review. The Final Staff Report should be helpful to the GSAs when considering further GSP revisions.

While Board staff recognize that the GSAs made progress, especially in the topic areas of subsidence and interconnected surface water, staff still finds important deficiencies concerning the basin's ability to reach sustainability. Specifically, staff notes that some important details regarding the monitoring networks for water levels and water quality are missing and that sustainable management criteria could allow water levels to decline and water quality to degrade in such a way that significant and unreasonable impacts could occur.

Board staff recommends the State Water Board designate the subbasin as probationary, and finds the following:

The 2024 Draft GSPs would have allowed 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 system itself within the subbasin. Preliminary review of the 2024 Final GSPs indicates that concerns remain. The impacts are likely to occur to an extent that the subbasin will be unable to prevent undesirable results, as required by SGMA. Therefore, the 2024 Draft GSPs even as revised in the 2024 Final GSPs appear unlikely to allow the subbasin to achieve sustainability by 2040. Designating the subbasin probationary is critical for getting the subbasin on track to avoid undesirable results and achieve sustainability by 2040.

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

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

This Staff Report incorporates deficiencies identified by DWR's 2022 GSP Inadequate Determination based on DWR's review of 2022 GSPs. Board staff also identified specific deficiencies in the Kern County Subbasin 2024 Draft GSPs and outlined potential corrective actions to address those deficiencies. 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 agreed with DWR that the coordination deficiencies from the 2022 GSPs effectively required 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 reviewed the 2022 DWR Inadequate Determination, Kern County Subbasin 2024 Draft GSPs, and preliminarily reviewed the 2024 Final GSPs and the Coordination Agreement carefully to evaluate the progress in resolving the coordination deficiency, which is broadly described in this section and described in detail for each sustainability indicator that it applies to in subsequent sections. Board staff recognizes that coordination among GSAs has substantially improved in the 2024 Draft GSPs and preliminary review of the 2024 Final GSPs. However, Board staff notes issues remain with the new, coordinated approaches for groundwater levels, and groundwater quality. Board staff will continue to evaluate the sufficiency of the 2024 Final GSPs' approach to subsidence and interconnected surface waters.

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, as noted above, the State Water Board will continue to 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 are well-coordinated and using the same data and methodologies for setting sustainable management criteria and defining undesirable results.

Upon review of the 2024 Draft GSPs, Coordination Agreement, and preliminary review of the 2024 Final GSPs, Board staff finds that the GSAs have taken significant action in addressing DWR's coordination deficiencies by using consistent plain language and quantitative definitions for undesirable results, using coordinated methodologies and data for setting sustainable management criteria, and implementing a subbasin-wide minimum threshold exceedance policy. However, by addressing the fundamental coordination deficiencies (CRD-1a and CRD-1b), the subbasin has created other deficiencies that Board staff explains in greater detail in sections 4.1.2 through 4.1.4.

Board staff also finds that two of the deficiencies identified in the 2022 GSPs are not sufficiently addressed in the 2024 Draft GSPs or the 2024 Final GSPs after preliminary review, and may continue to hinder the subbasins progress towards sustainability. These coordination deficiencies include: (1) the GSAs do not explain how the multiple plans will satisfy SGMA requirements, particularly for management areas (CRD-2b) and (2) the GSAs in the subbasin have not demonstrated basin-wide management (CRD-3). As noted above, Section 4.1.1 includes a tentative evaluation (subject to change based on continued staff review) of whether the 2024 Final GSPs address the remaining deficiencies.

Board staff describes the following coordination deficiencies that were not adequately addressed in the 2024 Draft GSPs, proposes potential actions to resolve the deficiencies, and describes the tentative evaluation of whether the 2024 Final GSPs resolve the deficiencies:

- **Deficiency (2024 Draft GSPs):** The Coordination Agreement, GSPs, and Management Area Plans lack key details necessary for coordinated implementation.

  Potential Action: Revise methodologies that result in incompatible sustainable management criteria across various boundaries within the subbasin.

  Tentative Evaluation (2024 Final GSPs): This deficiency appears to be partially addressed. Methods used to develop groundwater level minimum thresholds and define undesirable results could lead to inconsistent outcomes across the subbasin, with beneficial users in some areas being disproportionately impacted.

- **Deficiency (2024 Draft GSPs):** GSAs in the subbasin have not demonstrated basin-wide GSA coverage.

  Potential Action: Provide key details demonstrating adequate GSA coverage.

  Tentative Evaluation (2024 Final GSPs): This deficiency appears to be partially addressed. Board staff is further evaluating GSA coverage, including whether there is authority for asserted GSAs in some areas of the subbasin.

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

Under SGMA, achieving the basin's sustainability goal 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 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 2022 GSPs relied on inconsistent data and methodologies to define significant and unreasonable conditions in the subbasin and did not adequately establish what groundwater level conditions throughout the basin would result in significant and unreasonable impacts. DWR also concluded that the 2022 GSPs did not adequately or consistently establish the sustainable management criteria for the lowering groundwater levels consistent with the GSP regulations. In addition, DWR noted that the sustainable management criteria would likely result in significant and unreasonable impacts to wells and people who rely on them.

Board staff primarily identifies issues regarding: (1) the GSAs' proposed approach to addressing wells they allow to go dry (well impacts and mitigation plans) and (2) the feasibility of avoiding chronic lowering of groundwater levels with the projects and management actions proposed in the GSPs. Upon review of the 2024 Draft GSPs, Board staff found that in resolving the coordination issues described above (CRD-1a and CRD-1b), the GSAs created new issues with respect to groundwater level sustainable management criteria. Board staff also finds that the two other unresolved deficiencies identified from the 2022 GSPs by Board staff, in addition to a newly identified deficiency in the 2024 Draft GSPs, may continue to hinder the subbasin's progress towards sustainability. The chronic lowering of groundwater level deficiencies and sub-deficiencies specify issues related to: (1) sustainable management criteria, (2)

[3] Wat. Code, § 10721, subd. (x).

monitoring, (3) mitigation plans, (4) water budgets and demand management, and (5) groundwater storage. Section 4.1.2 includes a tentative evaluation (subject to change based on continued staff review) of whether the 2024 Final GSPs address the remaining deficiencies.

Board staff describes the following deficiencies that were not adequately addressed in the 2024 Draft GSPs, proposes the following potential actions to address declining groundwater levels, and describes the tentative evaluation of whether the 2024 Final GSPs resolve the deficiencies:

- **Deficiency (2024 Draft GSPs):** GSPs do not establish undesirable results and sustainable management criteria for groundwater levels consistent with the requirements of SGMA.

  Potential Action: The GSAs should revise sustainable management criteria to be consistent with the requirements of SGMA and protective of beneficial uses and users.

  Tentative Evaluation (2024 Final GSPs): This deficiency does not appear to be addressed. The GSAs did not take sufficient action to revise the undesirable result definition and sustainable management criteria consistent with the requirements of SGMA. This deficiency may impact the GSAs' ability to achieve sustainability and avoid undesirable results in the subbasin.

- **Deficiency (2024 Draft GSPs):** The GSPs' groundwater level monitoring network and mitigation plans are incomplete.

  Potential Action: Revise monitoring network and include construction details of monitoring wells. Re-evaluate the well impact analysis. Establish accessible, comprehensive, and appropriately funded well impact mitigation programs.

  Tentative Evaluation (2024 Final GSPs): This deficiency appears to be partially addressed. The GSPs identified some data gaps for shallow monitoring wells with a plan to address them within a year, but additional work to identify and address data gaps may be warranted. Monitoring well construction information (depths and screen intervals) is still missing. The GSPs include a mitigation plan that could repair or replace domestic wells impacted by declining water levels, but the feasibility of the mitigation plan is unclear because of technical issues with the well impact analysis and limited funding based on that analysis.

- **Deficiency (2024 Draft GSPs):** The GSPs do not describe a feasible path for halting chronic lowering of groundwater levels.

  Potential Action: Re-evaluate water budgets and add detail to demand management plans.

  Tentative Evaluation (2024 Final GSPs): This deficiency appears to be partially addressed. The GSPs include additional water budget information but appear to

lack key components and details. It remains unclear whether projects and management actions are enough to reach sustainable groundwater management.

- **Deficiency (2024 Draft GSPs):** The GSPs do not define groundwater storage sustainable management criteria consistent with SGMA requirements.

  Potential Action: Revise groundwater storage sustainable management criteria.

  Tentative Evaluation (2024 Final GSPs): This deficiency does not appear to be addressed. The GSAs have not revised their methodology used to calculate groundwater storage.

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, most subsidence, which is the sinking of land, is caused by over-pumping of groundwater. SGMA recognizes that land subsidence from excessive groundwater extraction can cause 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 groundwater storage available for the future.

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

DWR determined that the 2022 GSPs did not adequately define sustainable management criteria for subsidence. DWR also noted that the 2022 GSPs continued to lack consistent data and methodologies when setting sustainable management criteria and describing the conditions throughout the subbasin that would cause undesirable results. Board staff also noted that the 2022 GSPs lacked a detailed and consistent analysis of the effects of subsidence in the subbasin on all beneficial uses, users, and infrastructure. Additionally, Board staff noted that GSPs did not provide key details on how plan implementation would prevent damage to infrastructure.

Upon review of the 2024 Draft GSPs, Board staff recognizes that the GSAs took action to identify critical infrastructure within the subbasin and refined the approach to establish undesirable results and sustainable management criteria. Data and methods for measuring subsidence were adopted consistently across the subbasin. A method for qualitatively (but not quantitatively) identifying subsidence attributable to GSA and non-GSA activities was developed using Interferometric Synthetic Aperture Radar (InSAR)

[4] Wat. Code, § 10721, subd. (x).

time-series data. GSAs also developed a risk-based approach to establish sustainable management criteria. However, despite the progress that was made to address land subsidence in the subbasin, there are deficiencies with the plain-language and quantitative definitions for undesirable results and the minimum threshold exceedance policy which include:

- Inconsistencies in the sustainable management criteria that may stem from the methods used to establish them.
- GSAs have not demonstrated an ability to quantify their relative contribution to subsidence impacts to infrastructure.
- A lack of detailed plans to reduce risk and mitigate the impacts of subsidence to infrastructure.

Section 4.1.3 includes a tentative evaluation (subject to change based on continued staff review) of whether the 2024 Final GSPs address the remaining deficiencies.

Board staff describes the following deficiencies that were not adequately addressed by the 2024 Draft GSPs, proposes potential actions to address subsidence, and describes the tentative evaluation of whether the 2024 Final GSPs resolve the deficiencies:

- **Deficiency (2024 Draft GSPs):** GSPs do not establish undesirable results and sustainable management criteria consistent with the requirements of SGMA.

  Potential Action: Redevelop undesirable results and sustainable management criteria using consistent data, methods, and adequate detail for implementation throughout the subbasin, such that they are protective of all beneficial uses and users.

  Tentative Evaluation (2024 Final GSPs): This deficiency appears to be partially addressed. The updated plain-language undesirable result definition is improved. Minimum thresholds appear to protect critical canals. Sustainable management criteria for subsidence trend to zero as they approach 2040. However, 2040 interim milestones exceed measurable objectives in some areas near canals and other critical infrastructure, which is not technically feasible and requires adjustments.

- **Deficiency (2024 Draft GSPs):** GSPs do not provide adequate implementation details.

  Potential Action: Develop and implement plans to limit groundwater extractions near critical infrastructure. Do not allow new non-de minimis wells near critical infrastructure. Develop plans to mitigate damage caused by subsidence.

  Tentative Evaluation (2024 Final GSPs): This deficiency does not appear to be addressed. The GSAs developed a subsidence action plan to investigate subsidence threshold exceedances, but actions triggered by this plan do not

include repairs or retrofitting for infrastructure. The GSAs' subsidence mitigation plan is specifically for addressing impacts on drinking water wells. The GSPs do not address how groundwater extracted for oil and gas operations will be managed to ensure subsidence does not worsen.

Defining and Avoiding Undesirable Results Related to 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.

DWR did not define the degradation of groundwater quality as a deficiency for the 2022 GSPs. 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 reviewed the 2024 Draft GSPs and have additional concerns about: (1) the monitoring network of wells that will be used to evaluate water quality and whether it is sufficient to protect all beneficial users and (2) implementation and mitigation details (how GSAs will address water quality issues if minimum threshold exceedances occur). Board staff also recommends a mitigation plan for the entire subbasin to address water quality issues that arise and ensure continued access to clean and affordable drinking water.

Board staff recognizes that the 2024 Draft GSPs include actions to address concerns raised by DWR and Board staff related to the degradation of groundwater quality. However, Board staff has identified three deficiencies in the 2024 Draft GSPs related to: (1) sustainable management criteria, (2) monitoring, and (3) management actions and mitigation plans. Section 4.1.4 includes a tentative evaluation (subject to change based on continued staff review) of whether the 2024 Final GSPs address the remaining deficiencies.

Board staff describes the following deficiencies that were not adequately addressed in the 2024 Draft GSPs, proposes potential actions to address degradation of groundwater quality, and describes the tentative evaluation of whether the 2024 Final GSPs resolve the deficiencies:

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

- **Deficiency (2024 Draft GSPs):** GSPs do not establish undesirable results and sustainable management criteria for degradation of groundwater quality consistent with the requirements of SGMA.

  Potential Action: Revise the undesirable result and sustainable management criteria to be consistent with the requirements of SGMA and protective of beneficial uses and users.

  Tentative Evaluation (2024 Final GSPs): This deficiency does not appear to be addressed. The GSPs still allow significant and unreasonable degradation of water quality before an undesirable result is triggered. The GSPs propose to determine whether impacts to water quality are for the GSAs to address based on methods that do not adequately characterize the driving mechanisms of water quality degradation.

- **Deficiency (2024 Draft GSPs):** The GSPs' groundwater quality monitoring network is insufficient and does not consider all beneficial uses and users in the subbasin.

  Potential Action: Clearly describe how groundwater quality will be monitored for all types of beneficial uses and users and update the monitoring network where monitoring gaps may be present.

  Tentative Evaluation (2024 Final GSPs): This deficiency does not appear to be addressed. Monitoring well construction information (depths and screen intervals) is still missing, so staff cannot evaluate the effectiveness of the monitoring network. It is unclear how potential water quality impacts from projects and management actions will be evaluated.

- **Deficiency (2024 Draft GSPs):** The GSPs do not include adequate actions to respond to groundwater quality minimum threshold exceedances.

  Potential Action: Develop methods to determine the impact of a minimum threshold exceedance to beneficial uses and users, including additional sampling necessary to understand the extent of the impact. Describe how the public will be notified should a minimum threshold exceedance occur. Develop clear plans to restore access to clean drinking water when water quality degrades below drinking water standards.

  Tentative Evaluation (2024 Final GSPs): This deficiency appears to be partially addressed. The new mitigation plan includes mitigation for domestic wells impacted by water quality degradation. However, the GSPs' exceedance policy for water quality lacks clear timelines.

Defining and Avoiding Undesirable Results Related to Interconnected Surface Water (Deficiency ISW – Section 4.1.5)

Another consideration under SGMA is avoiding "[d]epletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial use of the surface water."[10] Interconnected surface water is surface water that is hydraulically connected at any point by a continuous saturation zone to the underlying aquifer. Groundwater and surface water are often connected. As a result, groundwater pumping can reduce the amount of water that flows in 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 "[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." The 2022 GSPs claimed that there is no interconnected surface water in the basin and therefore did not establish sustainable management criteria, and DWR did not identify a deficiency associated with interconnected surface water. Upon review of the 2024 Draft GSPs and Coordination Agreement, Board staff recognized that the GSAs used coordinated and consistent methodologies to identify interconnected surface water. However, Board staff concluded that the GSPs did not use best available data to analyze interconnected surface water and therefore did not adequately justify an approach for identifying and defining interconnected surface water in accordance with best management practices and SGMA. From the review of the 2024 Draft GSPs, it was unclear if interconnected surface waters, ephemeral or perennial (seasonal or continuous), were present and whether sustainable management criteria and monitoring networks should be developed to meet the requirements of SGMA. Section 4.1.5 includes a tentative evaluation (subject to change based on continued staff review) of whether the 2024 Final GSPs address the remaining deficiencies.

Board staff describes the following deficiencies that were not adequately addressed in the 2024 Draft GSPs, proposes potential actions to address depletion of interconnected surface water, and describes the tentative evaluation of whether the 2024 Final GSPs resolve the deficiencies:

- **Deficiency (2024 Draft GSPs):** GSAs do not adequately demonstrate that undesirable results related to the depletion of interconnected surface water are not present and are not likely to occur

  Potential Action: Use best available data and DWR's Best Management Practices for identification of interconnected surface water and groundwater dependent ecosystems to better understand possible influences from groundwater management practices in the subbasin.

Tentative Evaluation (2024 Final GSPs): This deficiency appears to be addressed. The GSPs satisfactorily describe the methodology used to conclude the absence of interconnected surface water in the subbasin.

- **Conditional Deficiency (2024 Draft GSPs):** The GSPs exclude 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 a plan to avoid significant and unreasonable impacts is a deficiency.

  Conditional Potential Action: If GSAs identify interconnected surface water, then the GSPs should be revised to avoid significant and unreasonable impacts related to interconnected surface water.

  Tentative Evaluation (2024 Final GSPs): This conditional deficiency does not appear applicable if the 2024 Final GSPs adequately demonstrate that interconnected surface water does not exist in the subbasin.

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

Exclusions from Probationary Status or Reporting Requirements

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] Board staff does not recommend any GSAs for probationary exclusion at this time.

The Board may also exclude a class or category of extractions from the reporting requirement if those extractions are subject to a local plan or program that adequately manages groundwater or if those extractions are likely to have minimal impact on basin withdrawals.[8] Based on preliminary review of the 2024 Final GSPs, staff does not recommend that any GSA or category or class of extractors, other than de minimis extractors, be excluded from the requirement to report groundwater extractions and pay fees. Staff will continue to review the 2024 Final GSPs and any new materials provided to determine whether exclusions may be appropriate.

Water Year and Reporting Dates

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

[7] Wat. Code, § 10735.2, subd. (e).

[8] Wat. Code, § 10735.2, subd. (c).

be submitted to the State Water Board by February 1 of each year (Wat. Code, § 5202, subd. (b)).

Board staff does not recommend modifying the water year for reporting of extractions and does not recommend modifying the extraction reporting deadline for groundwater extraction reports. If the State Water Board designates the subbasin probationary on February 20, 2025, pumpers would start recording extractions on May 21, 2025 and would file their first report of groundwater extraction on or before February 1, 2026.

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 recommends 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 and (2) any person extracting two or fewer acre-feet of groundwater per year for any reason other than domestic purposes.
- 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 de minimis users located in the California Aqueduct and Friant-Kern Canal Subsidence Management Areas.
- Require any person extracting more than 500 acre-feet per year from the subbasin to install and use meters that meet the requirements of California Code of Regulations, title 23, section 1042 on all their production wells within the subbasin.
- Require non-de minimis users extracting groundwater from the wells located in the California Aqueduct and Friant-Kern Canal Subsidence Management Areas to install and use meters that meet the requirements of California Code of Regulations, title 23, section 1042

Public Process, Tribal Consultation and Engagement, and Draft Staff Report Comments

The State Water Board has been performing public outreach and engagement during the state intervention process for the Kern County Subbasin. As part of this effort, Board staff contacted California Native American Tribes, drinking water systems, cities and counties, and approximately 1,800 parcel owners in the subbasin.

The State Water Board hosted an online public workshop on August 26, 2024, and an in-person public workshop in Bakersfield on August 29, 2024. During the workshops,

Board staff shared information about the state intervention process and gathered public input. Spanish and Punjabi language interpretation was provided during the workshops.

Board staff released a Draft Staff Report on July 25, 2024, and accepted written public comments on the report for 60 days. Copies of public comments are available upon request. Changes have been made to the Staff Report based on some of the comments received. The written responses to comments and detailed information regarding the public participation process are provided in Appendix C.

Conclusion

Despite significant efforts made by the Kern County Subbasin GSAs, Board staff's evaluation of the 2024 Draft and 2024 Final GSPs identifies that deficiencies remain. Most were previously included in the Draft Staff Report and DWR's inadequate determination of the 2022 GSPs. Due to insufficiently implemented sustainable management criteria across sustainability indicators, Board staff's preliminary conclusion is that the 2024 Draft and 2024 Final GSPs will 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 chronic lowering of 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 recommends probationary status as a next step for gathering necessary information, helping the subbasin achieve sustainability, and protecting 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 Final Kern County Subbasin GSP Assessment Staff Report (Final Staff Report) is to inform the State Water Resources Control Board (State Water Board or 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 Final 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.

This Final 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 Demographic 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 Sustainability 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 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 has 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 Final 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% 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 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 for purposes of 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 or under other limited circumstances. 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 (ISW). These are often referred to as the sustainability indicators. GSPs are not required to address undesirable results that occurred prior to 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 (IMs). MTs quantify groundwater conditions for each applicable sustainability indicator at representative monitoring sites (RMS) 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. IMs 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 Projects and Management Actions

GSPs are required to describe projects and management actions (PMAs) 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), 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 SGMA 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, and, optionally, conducts additional investigations. If deficiencies have not been resolved within one year of a probationary designation, the Board may decide to move to the second step. Per statute, the Board must collect fees to recover its costs if state intervention activities, which are usually triggered by a probationary designation (Wat. Code, § 1529.5; Cal. Code Regs., tit. 23, § 1040).
- 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 remain in state 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 statutorily-prescribed public notice (see Section 2.2.1.1). Following a probationary designation, certain groundwater pumpers in the basin will have to 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 groundwater pumpers to use meters or other specific methods to measure groundwater extractions (Section 2.2.1.4) as well as 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 statute, Board staff also endeavors to provide notice and an opportunity for comment on Board staff recommendations for actions in the basin regarding identified GSP deficiencies, in the form of a Draft Staff Report.

2.2.1.2 Reporting

With a few exceptions, 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). Reports must be submitted electronically (Cal. Code Regs., tit. 23, § 1032). On May 16, 2017, the State Water Board adopted regulations to help implement SGMA that included electronic filing requirements. The regulations were authorized under Water Code section 348, which allows DWR or the Board to adopt regulations for the electronic filing of reports required under Water Code section 5200 et seq. The Office of Administrative Law approved the regulations 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.
- The year groundwater extraction commenced (Wat. Code, § 5203).

Persons extracting groundwater within a basin will generally 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 in the 2017 regulation described above, and have been updated periodically since then.

The current annual fee for groundwater extractions (excluding de minimis extractions) in a probationary groundwater basin is a base fee of $300 per well plus $20 per acre-foot (AF) of water extracted in the probationary basin (Cal. Code Regs., tit. 23, § 1040).

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 Board, 2024b). Options include a totalizing flowmeter, the run time method, or other methods as evaluated and approved in advance by Board staff on a case-by-case basis.

For basins designated probationary, 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 AF or less of groundwater per year from a parcel of land for domestic purposes only is defined as a "de minimis extractor" or de minimis user under SGMA (Wat. Code, § 10721, subd. (e)). 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 groundwater in 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 also 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 can exempt classes or categories of extractors if they are subject to a local plan or program that adequately manages groundwater within a portion of the basin or if the 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 as early as one year after the probationary designation of the basin if the Board, in consultation with DWR, determines that a GSA or GSAs have 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 will temporarily manage groundwater extractions in the basin pursuant to the interim plan until the local agencies 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 generally will include corrective actions, a schedule for those actions, monitoring, and enforcement mechanisms (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.[9] (State Water Board, 2021). 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 conditions (London, et al., 2021).

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

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[9] 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).

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.
- To the east by the Sierra Nevada foothills and Tehachapi Mountains.

The subbasin covers approximately 1,945,000 acres or about 3,040 square miles (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 Topographic map - **Figure 3-2**). Groundwater generally flows toward the center of the subbasin due to recharge from the higher elevations that border 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.

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

3.2.1 Geologic History

The Kern County Subbasin is situated within in the San Joaquin Valley, which 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.
- a continental volcanic arc, creating the batholith that would become the Sierra Nevada.
- 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 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 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 of the Etchegoin Formation and San Joaquin Formation 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, marine 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 County 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, May 11, 2023). 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” (Anderson, 2006, p. 137). 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,[10] 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.[11]

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

[11] Examples of Tribal, public and private funding efforts are discussed in "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)

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 Coast Range, and the Sierra Nevada 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 forcing 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” 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 in 1953. 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 (*Ibid.*). 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.

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 & Secrest, 2004; Anderson, 2005, 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 these farm laborers were not able to form incorporated 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% 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 the Kern County Subbasin. Wetlands and wildlife habitat are a feature of the groundwater bank.

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

The subbasin contains 65 localized urban areas:

Alameda	Bear Valley Springs	Casa Loma
City of Arvin	Benton Park	Cawelo
City of Bakersfield	Buttonwillow	Cherokee Strip
Bakersfield Country Club	Caliente	Choctaw Valley

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

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

California Native American Tribes

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 (NAHC, 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, May 11, 2023).

Recently, 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.

Demographics

Board staff performed GIS analysis using 2022 U.S. Census Bureau data. For census blocks that extend beyond the subbasin boundary, Board 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 making up about 39% of the total bearing acreage (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, the county experiences an annual weighted average of 87.5 days with poor air quality (Kern County Public Health Services Department, 2019; American Lung Association, 2024).

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Governance

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 disputes before the State Water Board and the courts. These disputes consist of accusations of misuse and hoarding of water, disagreements regarding water rights, accusations of violations of water supply agreements, and more, including in the lead up to and following the Conn and Reed Judgements (forfeiture of pre-1914 water rights). On February 16, 2010, the Board

issued Order WR 2010-0010, which amended the fully appropriated stream declaration to remove Kern River as fully appropriated, as available evidence demonstrated periods of flow that exceeded previous recognized rights. With the fully appropriated stream designation lifted, a number of water right applications were submitted to the Board. The amount of water available and the order in which these applications should be processed have been disputed between applicants and interested parties during the Kern River Water Rights hearings being conducted by the Board's Administrative Hearing Office.

3.4.1 Groundwater Sustainability Agencies

As of December 2024, 20 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.

In January 2020, 10 GSAs submitted five GSPs to DWR for review. After DWR determined the plans incomplete in January 2022, an additional three GSAs posted formation notices to DWR, after separating from the Kern Groundwater Authority (KGA) GSA, and submitted their own GSP to DWR for review in addition to the resubmission of the six existing GSPs. This resulted in 13 GSAs and six GSPs. However, since June 2022, seven 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 KGA (now Kern Non-Districted Land Authority- KNDLA). Additionally, the 14 GSAs dating to June 2022 have amended their GSA formation notices to DWR for reasons that are not clear to Board staff. And lastly, the City of McFarland withdrew its GSA formation notice to DWR in March 2023 in accordance with Water Code section 10723.8, subdivision (e).

Table 3-1 – Kern County Subbasin Groundwater Sustainability Agencies (as of December 2024)

	GSA	Signatory Member Agencies	Date GSA Formed	GSP
1	Buena Vista Water Storage District (BVWSD)	Buena Vista Water Storage District	3/10/2016	Kern County Subbasin GSP (Main GSP) + Buena Vista Water Storage District GSP Blue Pages
2	Greenfield County Water District (GCWD)	Greenfield County Water District	4/21/2016	Kern County Subbasin GSP (Main GSP)
3	Kern River (KRGSA)	Kern Delta Water District City of Bakersfield Kern County Water Agency Improvement District 4	4/21/2016	Kern County Subbasin GSP (Main GSP)
4	West Kern Water District (WKWD)	West Kern Water District	8/3/2016	Kern County Subbasin GSP (Main GSP)
5	Pioneer	Kern County Water Agency	2/24/2017	Kern County Subbasin GSP (Main GSP)
6	Olcese Water District (Olcese)	Olcese Water District	3/8/2017	Kern County Subbasin GSP (Main GSP) + Olcese Water District GSP Blue Pages

	GSA	Signatory Member Agencies	Date GSA Formed	GSP
7	Henry Miller Water District (HMWD)	Henry Miller Water District	5/1/2017	Kern County Subbasin GSP (Main GSP) + Henry Miller Water District GSP Blue Pages
8	Semitropic Water Storage District (SWSD)	Semitropic Water Storage District	5/15/2017	Kern County Subbasin GSP (Main GSP) + Semitropic Water Storage District GSP Blue Pages
9	Kern Non-Districted Land Authority (KNDLA) - Previously Kern Groundwater Authority GSA (2024 Final GSP, p. 5-106)	Cawelo Water District Eastside Water Management Area Kern County Water Agency (Pioneer GSA & ID4) 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 San Joaquin Municipal Utility District West Kern Water District Westside District Water Authority	5/30/2017	Kern County Subbasin GSP (Main GSP)
10	Cawelo Water District (Cawelo)	Cawelo Water District	6/12/2017	Kern County Subbasin GSP (Main GSP)

	GSA	Signatory Member Agencies	Date GSA Formed	GSP
11	Arvin	Arvin-Edison Water Storage District	12/3/2021	Kern County Subbasin GSP (Main GSP)
12	Tejon-Castac Water District (TCWD)	Tejon-Castac Water District	12/3/2021	Kern County Subbasin GSP (Main GSP)
13	Wheeler Ridge-Maricopa (WRMWSD)	Wheeler Ridge-Maricopa Water Storage District	12/3/2021	Kern County Subbasin GSP (Main GSP)
14	Westside District Water Authority (WDWA)	Belridge Water Storage District Berrenda Mesa Water District Lost Hills Water District	9/2/2022	Kern County Subbasin GSP (Main GSP)
15	North Kern Water Storage District (NKWSD)	North Kern Water Storage District	11/9/2022	Kern County Subbasin GSP (Main GSP)
16	Shafter-Wasco Irrigation District (SWID)	Shafter-Wasco Irrigation District	11/9/2022	Kern County Subbasin GSP (Main GSP)
17	Southern San Joaquin Municipal Utility District (SSJMUD)	Southern San Joaquin Municipal Utility District	3/3/2023	Kern County Subbasin GSP (Main GSP)
18	Rosedale-Rio Bravo Water Storage District (RRBWSD)	Rosedale-Rio Bravo Water Storage District	4/6/2023	Kern County Subbasin GSP (Main GSP) + Rosedale-Rio Bravo Water Storage District GSP Blue Pages

	GSA	Signatory Member Agencies	Date GSA Formed	GSP
19	Kern-Tulare Water District (KTWD)	Kern-Tulare Water District	5/8/2023	Kern County Subbasin GSP (Main GSP) + Kern Tulare Water District GSP Blue Pages
20	Kern Water Bank (KWB)	Kern County Water Agency Dudley Ridge Water District Tejon-Castac Water District Wheeler Ridge Maricopa Water Storage District	12/1/2023	Kern County Subbasin GSP (Main 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 Lake hydrologic region (DWR, 2016b).

Groundwater flows into the Kern County Subbasin as mountain-front recharge from the Sierra Nevada 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 Creek, 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 five inches within the interior portion of the subbasin and nine to thirteen inches along the eastern, southern, and western portions of the subbasin (*Ibid.*). It should be noted that the subbasin also receives major contributions of surface water through State Water Project (SWP) deliveries.

3.5.1 Groundwater Use

DWR surveyed land uses within the subbasin area in 2022 (**Figure 3-10).** Using data from the DWR Land Use Viewer, Board staff estimates the subbasin area comprises approximately 45.5% agricultural land use, 48.5% undeveloped land use, and 6% urban land use (DWR, 2024b). According to the six Kern County Subbasin 2022 GSPs, agricultural land across the GSAs is predominantly used for growing 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 (*Ibid*.). Groundwater is the main source of water for agricultural and urban land uses, amounting to 74% of the total water supply 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 for the subbasin was 1,983,505 AF, or 58% of the average annual total water use (excluding precipitation) for the same period for the subbasin, which was 3,448,521 AF.

3.5.1.1 Drinking Water

The State Water Board's Division of Drinking Water (DDW) identifies seven incorporated cities[12] (Bakersfield, Delano, McFarland, Wasco, Shafter, Arvin, and Taft) and five Census Designated Places[13] (Buttonwillow, Lamont, Lost Hills, Oildale, and Old River) with public drinking water systems in the 2024 Drinking Water Needs Assessment report (DDW Report) (State Water Boards, 2024a). This report is compiled by the Safe and Affordable Funding for Equity and Resilience (SAFER) Program on an annual basis, and it identifies Failing and At-Risk public water systems, state small water systems, and domestic wells. Of the 72 public drinking water systems identified in the DDW Report as located within the subbasin, 39 are in areas considered as DACs or Severely Disadvantaged Communities (SDACs). The DDW Report also categorizes 30 drinking water systems in the subbasin as Failing and 18 of these water systems are in DACs or SDACs generally failing, in part, because they have monitoring, reporting, treatment technique or source capacity/water outage violations, or the systems deliver water that has exceeded primary or secondary MCLs for one or more water quality constituents **(Figure 3-11**) (*Ibid*.). These systems may rely on various allocations of surface water deliveries during wet and dry years.

Domestic wells and community water systems in DACs and communities of color are disproportionately impacted by poor drinking water quality (Pace, et al., 2022). In the eight counties of the San Joaquin Valley[14] there are now over 450 DAC 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 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 total dissolved solids (TDS) in shallow groundwater in areas with poor

[12] The City of Maricopa is not included in this list. The West Kern Water District serves Maricopa and Taft, and the water system is listed under Taft.

[13] Census Designated Places are concentrations of population that are not incorporated as cities, towns, or villages.

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

drainage can be higher than 40,000 milligrams per liter (mg/L) (Fujii & Swain, 1995). Other constituents of concern in the subbasin are further discussed in Section 3.5.6 and include 1,2,3-Trichloropropane (1,2,3-TCP), Arsenic, Uranium, gross alpha radioactivity, 1,2-Dibromo-3-chloropropane (DBCP), and nitrates (State Water Board, 2023c).

One indicator of water quality issues for drinking water users is dependency on a community water system that is out of compliance with standards or requirements. As mentioned above, 18 water systems that serve 154,076 residents in DACs or SDACs within the Kern County Subbasin are listed as failing for reasons related to water quality, treatment, and supply shortage (State Water Boards, 2024a). 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 (DWR, 2024b). According to the six Kern County Subbasin GSPs submitted in 2022, the cropland consists mostly of nut trees, fruits, grains, grapes, cotton, and pastures. To decrease water consumption, some growers in the subbasin are 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 GSA, 2022).

The GSAs estimate in their annual reports that from 2019 to 2022, agricultural groundwater extractions increased approximately 41% from 1,096,779 acre-feet per year (AFY) (2019) to 1,554,176 AFY (2022). Board staff calculated an average of 1,450,870 AFY for agricultural pumping in the subbasin over this same four–year period (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. Vegetative 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 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 GDEs based on aerial imagery and field surveys **(Figures 3-12a and 3-12b)**. Potential vegetative GDEs constitute 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 constitute 94% (45,657 acres) of total GDE area compared to 6% (3,015 acres) for wetland GDEs. Furthermore, there are 33 types of vegetative GDEs and 20 types of wetlands GDEs.

The Southwestern North American Salt Basin and High Marsh GDE types 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 22.5% (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 Water Storage District (SWSD) GSA area had the greatest number of potential vegetative GDE polygons (865) and had the greatest total area of potential vegetative GDEs (47.2% or 29,164 acres). As with the subbasin in general, the Southwestern North American Salt Basin and High Marsh GDE types were the most dominant in the SWSD GSA area, representing 24% (10,933 acres) of all potential

vegetative GDEs within the GSA area. Similarly, the SWSD 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 the most dominant GDE types in the SWSD GSA area (54.5% or 954 acres).

Additionally, the SWSD GSA boundary encompasses the Kern National Wildlife Refuge. According to the Kern County Subbasin 2024 Draft Groundwater Sustainability Plans (2024 Draft GSPs), “The Kern National Wildlife Refuge is now sustained by Central Valley Project (CVP) water that is wheeled through the California Aqueduct and conveyed by the Goose Lake Canal to the refuge (2024 Kern County Subbasin Draft GSP, pp. 7-16). However, the wetlands may rely on groundwater to support vegetation and habitat systems according to public comments on the Draft Staff Report submitted by the US Fish and Wildlife Service, US Department of Agriculture - Natural Resources Conservation Service, California Waterfowl Association, and Tulare Basin Wetlands Association, which have vested interests in, and help maintain the wetlands. Wetlands are considered a beneficial user of groundwater, and their protection should be considered in GSPs in accordance with Executive Order W-59-93 and Assembly Bill 2875 to ensure no overall net loss, and a long-term net gain, in the quantity, quality, and permanence of wetlands acreage and values in California.

3.5.1.4 Oil and Gas Production

Oil and gas production is the leading non-agricultural industry in the Tulare Lake Hydrologic Region (Employment Development Department, 2024). According to data from the California Geologic Energy Management Division (CalGEM), oil production in the Kern County Subbasin is mostly constrained to 87 oil fields (CalGEM 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 in Kern County (**Figure 3-13**) of which 27,928 were active in the subbasin (**Figure 3-14**) (*Ibid.*). The largest fields by area 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 (EOR) 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*.).

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, 2024). 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 were 7,044 cyclic steam, 3,453 steamflood, 2,195 waterflood, 90 pressure maintenance, 19 injection, and 10 water source wells in the subbasin (*Ibid*.). Based on the CalGEM well data, it appears most of the EOR processes have occurred on the western and eastern margins 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 to either evaporate or percolate into the subsurface (Gillespie, et al., 2019). This method of water disposal causes degradation of groundwater due to the contaminants from the oil recovery processes migrating to groundwater 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 TDS concentrations greater than 10,000 mg/L (*Ibid*.). The Federal 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 Water Board, 2023).

3.5.2 Aquifer Framework

The complex subbasin aquifer setting generally includes unconfined and semi-confined aquifers above the Corcoran Clay, which exists 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 Range, to approximately 3,000 ft-bgs in the central portion of the subbasin (*Ibid.*). The Santa Margarita and Olcese Aquifers are confined aquifers, are considered principal aquifers in the eastern areas of the subbasin, and are hydraulically disconnected from the Kern River Formation by Pliocene marine deposits. The Santa Margarita aquifer is compromised of the Santa Margarita Formation and the Olcese Sand in the northeast while the Olcese Aquifer consists of the Olcese Sand in the east where the Kern River enters the basin (2024 Kern County Subbasin Draft GSP, ES-6).

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 KGA GSP, the hydrogeologic setting was simplified for the Hydrogeologic Conceptual Model (HCM) (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 for potable and agricultural uses due to poor groundwater quality except for localized areas in the northwest where the Tulare Formation exists.

In addition to identifying the aquifer framework, the 2024 Draft GSPs also use HCM Areas to characterize the subbasin. The 2024 Draft GSPs divide the subbasin into five different HCM Areas: the North Basin, Kern River Fan, South Basin, East Margin, and Western Fold Belt. These HCM Areas are identified as distinct hydrogeological zones that require their own suite of SMC to define undesirable results due to "hydrologically significant clay layers, geologic structures, groundwater divide, and faults" along with distinct groundwater management actions and projects (2024 Kern County Subbasin Draft GSP, p. 7-80). The HCM Areas and their relationship to sustainability indicators are further discussed in sections 4.1.2 through 4.15.

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). 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, Board staff only analyzed data from wells with both:

- Groundwater level data from at least 40% of the years in the study period of 1948 to 2023; and
- 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

Board staff's long-term trend analysis revealed more significant declines in groundwater levels after 2000. To better understand the recent changes in groundwater level, Board 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 levels have 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.

3.5.4 Groundwater Recharge

Groundwater recharge in the subbasin occurs primarily by three methods: (1) natural recharge via infiltration of surface water from the Kern River, Poso Creek, Caliente Creek, and other natural streams, springs and seeps, (2) mountain-front recharge originating from the Sierra Nevada, and (3) anthropogenic recharge such as direct recharge via percolation of water through unlined conveyances (canals) and managed recharge or underground storage through banking projects (Kern Groundwater Authority, 2022, p. 109).

The GSAs have documented that 73,188 AF of water was diverted from surface water for recharge or underground storage in the Kern County Subbasin for WY 2022 (2022 Annual Report, Table 7, p. 28). The GSAs have also proposed a variety of groundwater recharge projects, which if successfully implemented, are planned to help the subbasin reach its sustainable groundwater management goals by 2040. This includes new or updated recharge projects for Buena Vista Water Storage District (BVWSD) GSA, Henry Miller Water District (HMWD) GSA, Cawelo Water District (Cawelo) GSA, NKWSD,

RRBWSD GSA, SWSD GSA, SSJMUD GSA, and Arvin GSA (2022 Annual Report, Table 11, 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.

Water Banking

Groundwater banking projects are widespread across the GSAs. Unconsolidated alluvial sediments along the Kern River Fan, in the north-central subbasin, south-central subbasin and elsewhere within the subbasin, provide an efficient 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 likely 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. Notable banking facilities operating within the Kern County Subbasin prior to the implementation of SGMA include the Kern Water Bank, 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 (WKWD) Groundwater Banking Program, Berrenda Mesa Property Joint Water Banking Project, North Kern Water District Groundwater Storage Project, and the BVWSD Water Management Program among others. Collectively, these banking projects within the subbasin are able to store up to 5.7 million AF of water sourced from SWP, CVP, and the Kern River.

Imported surface water is also stored in banking facilities by agencies operating outside of the Kern County Subbasin including but not limited to the Metropolitan Water District, Irvine Ranch Water District, Zone 7 Water Agency, and Alameda County Water District. One result of banking operations is contractual leave-behind obligations, which result in recharge for the benefit of the subbasin, and is generally dependent on the water bank and banking party's contractual agreement.

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% 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 (DWR, 2006a).

The Groundwater Flow Model of the Kern County Subbasin (C2VSimFG-Kern), is a partially calibrated numerical model used to estimate surface water and groundwater budgets, evaluate sustainable yield, and predict future groundwater levels in the subbasin under different scenarios for the GSPs. The model uses the DWR California Central Valley Groundwater-Surface Water Simulation Model (C2VSim Fine Grid), 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 (2024 Kern County Subbasin Draft GSP, p. 9-6, 2024).

From the C2VSimFG-Kern model simulations, the GSAs estimate the sustainable yield to be approximately 1,312,218 AFY with an uncertainty range of about 10% to 20% (2024 Kern County Subbasin Draft GSP, p. 9-56, 2024). The model projects groundwater storage in the subbasin to decline by about 333,358 AFY over the period of 2021 to 2040 and 324,326 AFY over the period of 2041 to 2070, under baseline conditions and in the absence of PMAs (2024 Kern County Subbasin Draft GSP, Appendix M, 2024). Assuming successful implementation of proposed PMAs under baseline conditions, the model estimates a storage decline of about 67,687 AFY over the 2021-2040 period and a storage increase of about 42,144 to 85,578 AFY over the 2041-2070 period (*Ibid*.).

3.5.6 Groundwater Quality

Groundwater quality in the subbasin varies across the basin and with depth and is impacted by both natural and anthropogenic water quality constituents. Generally, groundwater quality increases with depth, with the poorest quality groundwater in 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 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 caused by dewatering and compaction related to subsidence.

Several existing water quality programs have conducted sampling or required regulated entities (such as public water systems) to sample groundwater in the subbasin for Title 22 (California Code of Regulations, 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 (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 (State Water Board, 2023c).

3.5.6.1 Key Constituents

Board staff developed the SGMA Groundwater Quality Visualization Tool to help GSAs and other interested parties identify the groundwater quality constituents that each GSP should address (State Water Board, 2023b). 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 three 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 (**Figure 3-16**). This tool does not identify all water quality impairments in a subbasin. For example, five constituents, including benzene, were detected in several water supply wells between 2000 and 2015, but were not flagged by the tool since they were not detected in three or more

water supply wells in 2015 to present. 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.

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 (TDS)*	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, 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)

Constituent	Regulatory Threshold	Wells above Regulatory Threshold	Risk
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)

* Secondary MCL (SMCL)

** Notification level (NL)

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

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 (See, 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).
- 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

Out of the 17 constituents listed in Table 3-2, 16 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

The preparation, adoption, and periodic review of Water Quality Control Plans (Basin Plans) is required by Water Code section 13240 and supported by the Federal Clean Water Act. Section 303 of the Clean Water Act requires states to adopt water quality standards which "consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses" (33 U.S.C. § 1313). According to Water Code section 13050, Basin Plans consist of a designation or establishment for the waters within a specified area of beneficial uses to be protected, water quality objectives to protect those uses, and a program of implementation needed for achieving the objectives. California's Basin Plans establish standards for groundwater in addition to surface waters. These Basin Plans are not to be mistaken as Groundwater Sustainability Plans.

A Basin Plan Amendment may be adopted to remove or de-designate an assigned beneficial use. The Tulare Lake Basin Water Quality Control Plan (Tulare Lake Basin Plan) administered by the Central Valley Water Board was amended in the Southern

Lost Hills Oilfield area that identified confined groundwater conditions within a Project Zone (the area investigated 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 TDS concentrations exceeding 10,000 mg/L (Central Valley Water Board Order 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 (State Water Board Resolution No. 2023-0040). Additionally, characterization studies confirmed that no active drinking water supply or agricultural supply wells are located within the proposed de-designation zone nor will the closest drinking water wells or agricultural supply wells to the Project Area be impacted by groundwater from within the proposed de-designation zone (*Ibid*.). Therefore, the Central Valley Water Board adopted an amendment to the 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, which the State Water Board subsequently approved (Central Valley Water Board Order R5-2022-0035; State Water Board Resolution No. 2023-0040).

Additionally, the Central Valley Water Board is evaluating 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) Oilfields. If adopted, this would de-designate (or remove) beneficial use in these areas for municipal or agricultural supply purposes (Central Valley Water 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 hydrocompaction 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. InSAR data show a maximum subsidence of approximately 2.56 feet between June 2015 to July 2024 in the SWSD GSA and the SSJMUD portions of the subbasin (**Figure 3-17**). Other areas of subsidence include the

western side of the subbasin with a maximum subsidence of approximately 1.66 feet within the WDWA GSA, the northern central and northeastern central portion of the subbasin with approximately 1.29 feet of subsidence in the North Kern Water Storage District, Cawelo GSA, and KGA GSA, and the southern portion of the subbasin with a maximum subsidence of 1.46 feet in the Wheeler Ridge-Maricopa Water Storage District (WRMWSD) GSA, Kern River GSA (KRGSA), 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 subbasin (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 hydrologic region, which includes the Kern County 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 (Central Valley Regional Control Board, 2018).

In addition to the Kings, Kaweah, Tule, and Kern Rivers, the Tulare Lake hydrologic 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 (*Ibid.*). 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 (*Ibid*.):

- 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)

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 (State Water Board, 1998). The Kern River was designated fully appropriated from 1964 until 2010 when the State Water Board amended the Declaration of Fully Appropriated Streams to remove the designation (State Water Board, 2010).

4.0 Recommendations for Board Action

In adopting SGMA, the legislature made it clear that, “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” (SB 1168 (2013-2014 Reg. Sess. § 1)). 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 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 its 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 were given 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 to be “inadequate” on March 2, 2023.

The inadequate determination triggered state intervention. The State Water Board now must determine whether a probationary designation is warranted (see Section 2.2.1.0). Board staff has reviewed the 2022 GSPs, DWR staff reports documenting DWR’s evaluations of the GSPs, and the 2024 Draft GSPs. Board staff concurred with DWR’s determination that the Kern County GSPs were inadequate, and Board staff’s analyses of the final and draft GSPs indicates that the Kern County GSAs are not managing their groundwater sustainably. Board staff notes that the GSPs’ SMC will allow substantial impacts: 1) to people who rely on domestic wells for human consumption, cooking, and sanitary purposes, 2) on infrastructure such as canals (e.g., California Aqueduct and Friant-Kern Canal) and levees, and 3) to the aquifer system 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 one Main 2024 Draft GSP and six supplemental GSA-specific 2024 Draft GSPs, along with a Coordination Agreement to the Board on May 28, 2024. Collectively, these GSPs are referred to here as the 2024 Draft GSPs. The six GSA-specific 2024 Draft GSPs differ from the Main 2024 Draft GSP by including supplemental pages (referred to as Blue Pages) that are only relevant to the specific GSA's area, such as GSA hydrology and PMAs; these GSPs do not differ in SMC or definitions of undesirable results. The plans are considered draft because they were undergoing public review and not adopted by the GSAs at the time of submission. Following the release of the Draft Staff Report in July 2024, Board staff conducted a thorough review of the 2024 Draft GSPs and Coordination Agreement to determine if the GSAs made sufficient progress in resolving the deficiencies identified in the 2022 GSPs. Based on this review, Board staff believes that the 2024 Draft GSPs still have significant deficiencies and many of the previously identified deficiencies and corrective actions remain relevant. The full review of the 2024 Draft GSPs is discussed below in more detail.

Subsequently, on December 16, 2024, the Kern County Subbasin GSAs submitted adopted final GSPs for the subbasin. Board staff has completed an initial review of the 2024 Final GSPs and believes that the Kern County Subbasin GSAs have made substantial progress in addressing many deficiencies identified by the Draft Staff Report. Preliminary review of these GSPs indicates that many deficiencies appear to be addressed, and many of the significant and unreasonable impacts allowed by the 2022 GSPs appear to be addressed or mitigated. Board staff is encouraged by and appreciative of the considerable improvements in these revised GSPs, and the Final Staff Report has been updated to reflect which deficiencies Board staff presently believes appear to be addressed and which appear to still remain. Board staff, however, stresses that its review is still preliminary. Full evaluation will take months to complete. The preliminary findings in this Final Staff Report may therefore change.

While Board staff believes GSAs have made progress in 2024 Final GSPs, especially in the topic areas of subsidence and ISW, Board staff still finds important deficiencies concerning the basin's ability to reach sustainability. Specifically, staff notes that details regarding the monitoring networks for water levels and water quality are missing and that SMC could allow water levels to decline and water quality to degrade in such a way that significant and unreasonable impacts could occur. The impacts are likely to occur to an extent that the subbasin will be unable to prevent undesirable results, as required by SGMA. Therefore, the 2024 Draft GSPs, even as revised in the 2024 Final GSPs, appear unlikely to allow the subbasin to achieve sustainability by 2040. **Therefore, Board staff recommends 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, 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 will require many groundwater extractors to report their extractions, which will help resolve data gaps related to groundwater use, and Board staff will continue to provide guidance to GSAs working to fix deficiencies in their sustainability plans.

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 have been addressed, the Board may resolve to have the GSA (or GSAs) exit probation; however, even if the plan deficiencies have been resolved, if the Board does not believe that the plan (or plans) are being adequately implemented, it may decline to lift the probationary designation (Wat. Code, § 10735.2, subd. (a)(5)(B)). 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 holding 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.

The following sections explain staff recommendations for a probationary determination:

- Section 4.1 identifies the specific GSPs deficiencies and potential actions to address deficiencies.
- Section 4.2 recommends that no areas in the subbasin be excluded from probationary status, and no GSA or category or class of extractors, other than de minimis extractors, be excluded from reporting and fees.
- Section 4.3 recommends that the groundwater extraction annual reporting deadline not be altered from February 1 of each year for the previous water year.
- Section 4.4 recommends that the Board:
    - Require groundwater extraction reporting and paying fees for: (1) any person extracting more than two AF per year for any reason and (2) any person extracting two or fewer AF of groundwater per year for any reason other than domestic purposes.
    - Exclude any person who extracts two AF or less per year for domestic uses only (de minimis users) from reporting requirements and paying fees. This exception includes most household users, including de minimis users located in the California Aqueduct and Friant-Kern Canal Subsidence Management Areas.

- Require any person extracting more than 500 AF per year from the subbasin to install and use meters that meet the requirements of California Code of Regulations, title 23, section 1042 on all their production wells within the subbasin.
- Require non-de minimis users extracting groundwater from the wells located in the California Aqueduct and Friant-Kern Canal Subsidence Management Areas to install and use meters that meet the requirements of California Code of Regulations, title 23, section 1042.

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 Final Staff Report incorporates deficiencies originally identified in DWR's inadequate determination of the Kern County Subbasin 2022 GSPs. Board staff reviewed the Kern County Subbasin 2022 GSPs, the 2024 Draft GSPs, and the 2024 Final GSPs and identified additional key issues generally within the scope of DWR deficiencies. Board staff is 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 consistent with the requirements of SGMA.

Below, Board staff has identified remaining deficiencies within the Kern County Subbasin 2024 Draft GSPs and Coordination Agreement and has 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, (3) continued land subsidence, (4) degradation of groundwater quality, and (5) depletions of ISW.

DWR's 2022 Inadequate Determination evaluated the subbasin's 2022 GSPs against the deficiencies DWR identified for the 2020 GSPs (in DWR's 2020 GSP Incomplete Determination (See Appendix D)). Consequently, for each of the five overarching deficiencies, State Water Board staff describes: (1) relevant portions of the 2022 GSPs, (2) DWR's 2022 Inadequate Determination, and (3) the 2024 Draft GSPs. Board staff then breaks down the deficiency into components. Finally, Board staff identifies potential corrective actions to address each component. Board staff identified more than one

potential action for some individual deficiencies, and some potential actions may address more than one individual 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 have resolved a deficiency identified by the Board, but the Board may find the revision adversely affects other management criteria (Sections 4.1.1 - 4.1.4). For example, if the plain-language definition of an undesirable result is revised, then the quantitative undesirable result and MTs may no longer adequately represent the significant and unreasonable conditions that the basin is trying to avoid, and the MOs may no longer provide operational flexibility above the MTs. Therefore, GSAs should ensure that all actions are sufficient and consistent with the requirements of SGMA.

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 disadvantage communities or communities of color. Failure to avoid this undesirable result (Wat. Code, § 10721, subd. (x)(1)) may also be inconsistent with or impact:
    - The Board's Human Right to Water Resolution (State Water Board, 2016)
    - The Board's Racial Equity Resolution (State Water Board, 2021)
    - The Board's Policy implementing the 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:
    - The Board's Antidegradation policy (State Water Board, 1968)

- Depletions of ISW 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)
    - Public trust resources (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 or if the deficiency has been resolved. 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 as they pertain to the Board staff's full review of the 2022 and 2024 Draft GSPs and preliminary review of the 2024 Final GSPs.

While Board staff believes that the subbasin has made substantial progress in addressing many of the deficiencies identified below since their 2022 plans were deemed inadequate by DWR, Board staff stresses that this Final Staff Report is mainly based on the 2024 Draft GSPs, the GSPs submitted to the Board in May 2024 that allowed sufficient time for a complete review prior to the Board's Kern County Subbasin Probationary Hearing in February 2025 that was noticed on July 25, 2024**.** Board staff also considers the 2024 Final GSPs submitted on December 16, 2024, but was unable to conduct a complete review of these GSPs given the time constraints of the Probationary Hearing. As explained in section 4.0 above, tentative evaluations of the 2024 Final GSPs are included for each deficiency in this report.

This Final Staff Report is meant to clearly identify the deficiencies in the Kern County Subbasin GSPs, recommend corrective actions to resolve those deficiencies, and memorialize feedback Board staff has been providing GSAs in multiple meetings preceding the Probationary Hearing. To the extent GSAs have not resolved identified deficiencies with subsequent GSPs, this Final Staff Report can serve as a helpful guide regarding remaining deficiencies and potential corrective actions.

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

Deficiency Coordination (CRD)-1– Undesirable results and sustainable management criteria are not coordinated.
Deficiency CRD-2 – The Coordination Agreement, GSPs, and Management Area Plans lack key details necessary for coordinated implementation.
Deficiency CRD-3 – The GSAs in the subbasin have not demonstrated basin-wide management.
Deficiency Groundwater Levels (GL)-1 – Groundwater level undesirable results and sustainable management criteria are not defined consistent with the requirements of SGMA.
Deficiency GL-2 – The GSPs' monitoring network and mitigation plans are incomplete.
Deficiency GL-3 – The GSPs do not describe a feasible path for halting chronic lowering of groundwater levels.
Deficiency GL-4 – The GSPs do not define groundwater storage sustainable management criteria consistent with the requirements of SGMA.
Deficiency Land Subsidence (LS)-1 - Land subsidence undesirable results and sustainable management criteria are not defined consistent with the requirements of SGMA.
Deficiency LS-2 - The GSPs do not provide adequate implementation details.
Deficiency Groundwater Quality (GWQ)-1 – The GSPs do not establish undesirable results and sustainable management criteria consistent with the requirements of SGMA.
Deficiency GWQ-2 – Groundwater quality monitoring networks are not consistent with the requirements of SGMA.
Deficiency GWQ-3 – Management actions are not responsive to water quality degradation.
Deficiency Interconnected Surface Water (ISW)-1 – Undesirable results and sustainable management criteria are not coordinated.
Deficiency Interconnected Surface Water (ISW)-2 – The GSAs do not adequately demonstrate that undesirable results related to the depletion of ISW are not present and are not likely to occur.

4.1.1 Deficiency CRD – 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 SGMA does not confer any additional powers to those entities (Wat. Code, § 10723.6, subd. (b)). Additionally, Local agencies that 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)(3)). The coordination agreement must ensure that GSAs preparing GSPs are utilizing the same data and methodologies (Wat. Code, § 10727). The coordination agreement must be adopted by all relevant parties, explain how the multiple plans will satisfy SGMA requirements, and be binding on all parties and sufficient to address any disputes (Cal. Code Regs., tit. 23, §§ 355.4(b)(8), 357.4).

Each GSA is responsible for its 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., tit. 23, § 354.20). Each agency shall justify the necessity for each defined management area, specifically how it can operate under different MTs and MOs 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) the GSPs do not describe how they utilized the same data and methodologies; (2) the GSPs do not describe how they consider all beneficial uses and users; (3) the GSPs do not describe 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) the GSPs 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 plans generally lacked a comprehensive description of the groundwater conditions. DWR 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 occurrences GSAs hope to avoid (2022 Inadequate Determination). DWR could 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; or (3) operate within the established SMC, which are based on collective technical information (*Ibid*.). DWR determined that the GSAs did not take sufficient actions to correct this deficiency, which materially affects the ability of the GSAs to achieve sustainability and the ability of DWR to evaluate the likelihood of the GSPs achieving sustainability (*Ibid*.).

As described in this section and sections 4.1.2 through 4.1.5, a coordinated approach is necessary for 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 believes it is necessary to address coordination as its own deficiency. In response to coordination deficiencies identified by DWR, the Kern County Subbasin GSAs submitted seven draft (i.e., not yet adopted) GSPs and one coordination agreement to the Board on May 28, 2024. The main GSP, the Kern County Subbasin GSP, contains details pertaining to the entire subbasin while encompassing 14 GSAs in the subbasin (approximately 68% of the subbasin area). Each of the other GSPs covers a specific GSA area and includes GSA-specific details to supplement the information provided in the Kern County Subbasin GSP. Board staff initially conducted a preliminary review of these plans prior to the release of the Draft Staff Report to determine if the GSAs had made sufficient progress toward addressing the deficiencies identified by staff in the Draft Staff Report. As a result of that preliminary review, and a subsequent more thorough review, Board staff concludes that the GSAs have addressed a portion of their coordination deficiencies but continue to have significant deficiencies related to: (1) coordination, (2) chronic lowering of groundwater levels, (3) land subsidence, (4) degradation of groundwater quality, and (5) depletion of ISW. Table 4-2, below, summarizes the key aspects of the coordination deficiency and relevant components from the 2020, 2022, and 2024 Draft Kern County Subbasin GSPs.

Table 4-2 – Summary of Coordination Deficiency and Relevant Components of the 2020, 2022, and 2024 Draft 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 MTs 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 Plans use widely varying approaches to define the management-area-specific undesirable results that would contribute to a basin-wide 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 could not evaluate whether the plans are likely to reach sustainability due to the fragmented plans. • Plans emphasize that more than 180 PMAs must be implemented to avoid MTs. • The plans do 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 more coordinated Plans. • Although GSPs state the MTs are coordinated and compared, there appears to be no real analysis or understanding of the effects if the 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 being considered an undesirable result.

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% RMWs) within a management area. • Indicates that each GSP or Management Area Plan would establish its own MTs; does not provide a unified methodology for establishing MTs.	The GSPs do not establish undesirable results that are consistent with the goals of SGMA. • DWR stated 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. • DWR flagged the continued need for more than 180 PMAs to be implemented to marginally avoid MTs and avoid undesirable results. • 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.

2024 Draft GSPs	Board Staff 2024 Draft GSPs Evaluation
Seven Draft GSPs and an amended Coordination Agreement were submitted to the Board on May 28, 2024. The Coordination Agreement states: • That Parties have agreed to the same data and methodologies used in their respective GSPs for the following: 1) groundwater elevation data; 2) groundwater extraction data; 3) stored water recovery data; 4) surface water supply; 5) total water use; 6) change in groundwater storage; 7) water budget; and 8) sustainable yield. • That Parties agree to rely upon the Subbasin Monitoring Networks and Subbasin Monitoring Networks Objectives, developed in compliance with California Code of Regulations, title 23, §§ 354.32 - 354.40. • That Parties agree to rely on the coordinated Water Budgets, developed in compliance with California Code of Regulations, title 23, § 357.4, subdivision (b).	Board staff believes that the 2024 Draft GSPs and amended Coordination Agreement have resolved some coordination deficiencies identified in previous plans and the previous Coordination Agreement. However, in correcting the coordination deficiencies, the 2024 Draft GSPs have created sustainability-indicator-specific technical deficiencies that result in inconsistent management action triggers across defined boundaries within the subbasin (HCM Area boundaries and GSA jurisdictional boundaries). Board staff is concerned that some SMC in the 2024 Draft GSPs, although coordinated, are disparate across management or administrative boundaries, and thus unprotective of beneficial users at a local scale.

4.1.1.1 Kern County Subbasin 2020 Groundwater Sustainability Plans

On January 30, 2020, 11 GSAs submitted their five 2020 GSPs to DWR in compliance with the statutory deadline. Upon DWR review, DWR found the 2020 GSPs to be incomplete and provided corrective actions related to undesirable results, SMC definitions, and inconsistencies between GSPs in how management areas were implemented in the 2020 GSPs. The GSAs were given 180 days to address the corrective actions and required to adopt such modifications into their respective GSPs. In preparation for this Final Staff Report, Board staff reviewed the five 2020 GSPs and concurred with DWR's "incomplete" findings. For a summary of Board staff review of the 2020 GSPs, see Appendix D.

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

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. While not considered in DWR's assessment of the 2022 GSPs, the GSAs also filed WY 2022 annual reports 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" (2022 Coordination Agreement, Appendix 3, p. 298). Additionally, the Coordination Agreement quantitatively defines 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 the management area over four consecutive bi-annual SGMA required monitoring events (2022 Coordination Agreement, Appendix 3, p. 300).

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 South of Kern River (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**).

4.1.1.3 Kern County Subbasin 2024 Groundwater Sustainability Plan Submission

The Kern County Subbasin GSAs submitted seven draft 2024 GSPs for Board review on May 28, 2024. This subsection describes the portions of the 2024 Draft GSPs that are relevant to the proposed Board deficiencies identified in Section 4.1.1.4.

Plain-Language Definition of an Undesirable Result

The 2024 Draft GSPs defined plain-language undesirable results for four sustainability indicators deemed relevant to the subbasin:

> Groundwater Levels (Section 4.1.2): "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" (2024 Kern County Subbasin Draft GSP, p. 13-2).
>
> Groundwater Storage (See Section 4.1.2): "The point at which significant and unreasonable impacts, as determined by the amount of groundwater in the basin, affect the reasonable and beneficial use of, and access to, groundwater by overlying users over an extended drought period" (*Id.*, p.13-44).
>
> Groundwater Quality (Section 4.1.3): "The point at which significant and unreasonable impacts occur 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" (*Id*., p. 13-50).
>
> Land Subsidence (Section 4.1.4): "The point at which the amount of subsidence, if caused by GSA-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" (*Id*., p.13-75).

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

The 2024 Draft GSPs made improvements to the quantitative subbasin-wide undesirable results definitions for four sustainability indicators deemed relevant to the subbasin.

Groundwater Levels (Section 4.1.2):

- Undesirable results: If either of the following two conditions are met:
    1. More than 15 drinking water wells are reported as dry in any given year. If 15 drinking water wells were impacted every year, no more than 255 drinking water wells cumulatively would be impacted by 2040.
    2. The MTs for chronic lowering of groundwater levels are exceeded in at least 25% of the Representative Monitoring Sites for Water Level (RMW-WLs) over

a single year (i.e., two consecutive seasonal measurements) (2024 Kern County Subbasin Draft GSP, p. 13-4).

- Minimum Thresholds: The RMW-WL-specific MTs are set as the lower (deeper) of the following:
    1. Trend Dominated: Groundwater level in 2030 if the regional trend is extended from the 2015 low (the MO), or
    2. Range Dominated: Groundwater level that allows for operational flexibility below the 2015 low (MO), based on an RMW-WL-specific record of groundwater level fluctuations.
- Measurable Objectives: Set at the “2015 low” groundwater level at each RMW-WL. This is defined as the lowest groundwater level measurement observed in an RMW-WL during calendar year 2015, when measurements are available, or an estimated value based on available data.

Groundwater Storage:

- Undesirable Results: Cumulative reduction in usable groundwater storage in the Primary Principal Aquifer of more than 9.3 million acre-feet (MAF) relative to the baseline (water year 2015) total usable groundwater storage volume.
- Minimum Thresholds: Uses Groundwater Level MTs
- Measurable Objectives: Uses Groundwater Level MOs

Groundwater Quality (Section 4.1.3):

- Undesirable Results: Defined to occur within the subbasin if and when MTs for a groundwater quality constituent of concern (COC) are exceeded in three (3) Representative Monitoring Sites for Water Quality (RMW-WQs) in an HCM Area based on the average of confirmed seasonal sample results and can be attributed to groundwater management actions, based on a technical analysis.
- Minimum Thresholds: Set as the greater concentration of:
    1. the applicable health-based screening standard, or
    2. the maximum 2010 – 2014 baseline concentration at each RMW-WQ.
- Measurable Objectives: Set as the greater concentration of:
    1. the applicable health-based screening standard, or
    2. the median 2010 to 2014 baseline concentration at each RMW-WQ.

Land Subsidence (Section 4.1.4):

- Undesirable Results: Defined to occur within the subbasin if and when the MT extent of subsidence is exceeded at any of the subbasin's Representative Monitoring Sites for Land Subsidence (RMS-LS) or as measured using InSAR data published annually by DWR averaged across an HCM Area.
- MTs are defined as:

  > …levels of land subsidence that, if they occurred, would result in URs to surface land uses and Regional and GSA Area Critical Infrastructure, which is identified in Section 13.5.1.1. The MTs… are [expressed] in terms of total vertical extent of land subsidence (in feet) from 2024-2040, as well as a corresponding average annual rate of subsidence (in feet per year) measured quarterly and reported annually….
  >
  > (2024 Kern County Subbasin Draft GSP, p. 13-84)

- MTs for the entire subbasin are further established as:

  > …the maximum observed average subsidence rate in each HCM area from 2015 to 2023 as determined by InSAR data published by DWR [and] [s]eparate SMCs are established in areas susceptible to future land subsidence….
  >
  > (2024 Kern County Subbasin Draft GSP, p. 13-85)

- For areas where subsidence is attributable to non-GSA activities, "…MT rates are set as the observed average subsidence rate in each HCM area from 2015 to 2023 and the MT extent is set as the cumulative amount of subsidence at that rate from 2024 to 2040…." with GSAs acknowledging that they will continue to monitor subsidence in these areas and coordinate with other entities that are influenced by non-GSA subsidence, and collaborate with relevant regulatory agencies to demonstrate a lack of GSA-related subsidence if non-GSA activities are contributing to subsidence along critical infrastructure (*Ibid*.). The subbasin used a five-step approach in MT development which is described in more detail in Section 4.1.4.
- Measurable Objectives: Set to 50% of the MT rate and MT extent from 2024 to 2040.

Potential Effects of Minimum Thresholds on Other Sustainability Indicators

It is important to recognize the need for a well-coordinated plan to avoid undesirable results for all sustainability indicators. See sections 4.1.2 through 4.1.5 for sustainability indicator specific information.

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 coordination deficiency (2022 Inadequate Determination). Board staff agreed with DWR's findings in its 2022 GSP Inadequate Determination that the subbasin had made progress towards addressing the deficiency but had not taken sufficient actions to correct the coordination deficiency.

Upon review of the 2024 Draft GSPs and respective Coordination Agreement, Board staff has noted that some coordination deficiencies identified by DWR in its 2022 GSP inadequate determination, and additional deficiencies identified by Board staff, require no further corrective actions (see CRD-1A, CRD-1B, and CRD-2A). Although some of these coordination-specific deficiencies require no further action, elements of these deficiencies may still impact other sustainability indicators as detailed in sections 4.1.2 through 4.1.4 (see GL-1a, GL-1b, GWQ-1a, GWQ-1b, LS-1a, and LS-1b). However, Board staff still believes that deficiencies CRD-2B and CRD-3 require additional coordination-specific corrective actions. Below are the deficiencies and potential actions related to coordination defined by DWR (**Deficiency 1**) followed by State Water Board defined deficiencies **(Deficiency 2 and Deficiency 3**).

Deficiency Coordination 1 (CRD-1) – Undesirable results and sustainable management criteria are not coordinated.

What SGMA Requires: SGMA requires that "Agencies intending to develop and implement multiple Plans pursuant to Water Code Section 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 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 must 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 minimum thresholds must 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 must be consistent with key details in the coordination agreement. Agencies need to describe how they use the same data and methodologies for assumptions described in Water Code section 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 MTs and MOs 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 SGMA (Cal. Code Regs., tit. 23, § 357.4, subd. (c)).

SGMA 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, § 354.20).

Deficiency Background: Undesirable results and SMC were poorly coordinated across the subbasin in the 2022 GSPs, Management Area Plans, and the Coordination Agreement. Plain language undesirable results were vague and did not clearly describe the effects that basins are trying to avoid. Quantitative undesirable results were unworkably complex to the point where it was not clear what effects they represent or how they would be evaluated. Because undesirable results did not clearly describe the effects that the subbasin is trying to avoid, SMC may have resulted in substantially different conditions across the subbasin. This meant that Management Area Plans and GSPs were 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 described these issues in its 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…." (*Id*., p.9).
- "[I]t 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 being that the data and methodologies to establish groundwater level minimum thresholds varies across the management areas" (*Id*., 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" (*Id*., 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" (*Id*., p. 12).

Board staff agrees with DWR's 2022 Inadequate Determination and further notes that this deficiency is so fundamental that it would effectively require the subbasin to redevelop undesirable results and SMC for multiple sustainability indicators. As such, Board staff describes this deficiency in detail for each sustainability indicator that it applies to for GL-1, LS-1, GWQ-1, and ISW-1.

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

The plain-language undesirable results from the 2022 GSPs and respective Coordination Agreement were poorly described. While each GSP and Management Area Plan adopted the same plain-language undesirable results, they were interpreted and implemented very differently because they are too vague. This inconsistent interpretation exacerbated other issues with quantitative undesirable results and SMC.

The quantitative undesirable results: (1) require a complex set of conditions that 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.

As described in section 4.1.1.3, the 2024 Draft GSPs made significant corrective actions to develop a consistent and coordinated approach across the subbasin for quantitative definitions of an undesirable result, MTs, MOs, and impacts associated with sustainability indicators. These revisions in the 2024 Draft GSPs and Coordination Agreement have fundamentally led the subbasin toward more robust and better coordinated undesirable results and SMC that Board staff can evaluate.

2024 Draft GSPs Evaluation: The 2024 Draft GSPs implement consistent and clear plain language definitions for undesirable results for Groundwater Levels, Groundwater Storage, Groundwater Quality, and Land Subsidence as noted above in section 4.1.1.3. The quantifiable definitions for undesirable results are also 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. With this revision, Board staff does not recommend further action specific to Deficiency CRD-1a, but does still note a fragmented approach for defining undesirable results across the HCM Areas from the changes made in correcting this deficiency.

As Board staff cautioned GSAs, addressing the fundamental coordination deficiencies (CRD-1a and CRD-1b) could create new sustainability-indicator-specific deficiencies and Board staff could not provide a comprehensive list of every example that GSAs should avoid. These sustainability-indicator-specific deficiencies related to CRD-1a are 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).

2024 Final GSPs Tentative Evaluation: This deficiency was addressed in the 2024 Draft GSPs based on Board staff's full review. This evaluation remains consistent with Board staff's initial, high-level review of the 2024 Final GSPs. Board staff previously proposed Potential Action CRD-1a in the Draft Staff Report to address the deficiency.

Potential action CRD-1a has been omitted from this Final Staff Report because Board staff is not recommending further action after review of the 2024 Final GSPs.

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

The SMC set in the 2022 GSPs and Management Area Plans for each sustainability indicator: (1) used inconsistent data and methodologies across GSPs and Management Area Plans that, combined with vague, inconsistent undesirable results, (2) failed to represent the key conditions that groundwater managers must evaluate in order to achieve sustainability and avoid undesirable results (2022 Inadequate Determination, p. 9). As noted in section 4.1.1.3 of this report, Board staff agrees that the 2024 Draft GSPs and the Coordination Agreement set SMC that rely on consistent data and methodologies and quantifiably undesirable results that could occur basin-wide. For example, the 2024 Draft GSPs use the lowest of either a range dominated or trend dominated calculated MT value surface throughout the basin. These MTs are tied to the number of drinking water wells projected to go dry if MTs were reached, which GSAs note they can mitigate. In contrast, the 2022 GSPs and Coordination Agreement set different MTs in individual management areas that relied on varying methodologies and data, leading to localized areas of groundwater depletion without triggering undesirable results or an effective understanding of well impacts. Similarly, Land Subsidence SMC utilize agreed-upon InSAR data, benchmark surveys, and extensometers to assess undesirable results, while Groundwater Quality SMC use a coordinated sampling protocol and suite of analytes to assess undesirable results in the 2024 Draft GSPs. As a result of these improvements in coordination, the GSAs no longer rely on specific management area methodologies. Board staff commends the GSAs on redeveloping coordinated MOs, MTs, and IMs in conjunction with consistent methodologies and data across HCM Areas that will help the subbasin reach sustainability.

2024 Draft GSPs Evaluation: The 2024 Draft GSPs utilize consistent data and methodologies to assess Groundwater Levels, Groundwater Storage, Groundwater Quality, and Land Subsidence as outlined in section 4.1.1.3. These data and methodologies applied to SMC are now specific enough that GSAs and others can evaluate, over time, whether an undesirable result has occurred and whether the SMC align with the quantitative definition of an undesirable result. The GSAs have also made strides to incorporate how SMC will impact other sustainability indicators within the 2024 Draft GSPs. Board staff notes that these inclusions will be integral to ensuring all aspects of sustainability are achieved. With this revision, Board staff does not recommend further action specific to Deficiency CRD-1b, but still notes a fragmented approach for defining SMC across the HCM Areas.

As Board staff cautioned GSAs, addressing the fundamental coordination deficiencies (CRD-1a and CRD-1b) could create new sustainability-indicator-specific deficiencies and Board staff could not provide a comprehensive list of every example that GSAs should avoid. These sustainability-indicator-specific deficiencies related to CRD-1b are

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).

2024 Final GSPs Tentative Evaluation: This deficiency was addressed in the 2024 Draft GSPs based on Board staff's full review. This evaluation remains consistent with Board staff's initial, high-level review of the 2024 Final GSPs. Board staff previously proposed Potential Action CRD-1b in the Draft Staff Report to address the deficiency.

Potential action CRD-1b has been omitted from this Final Staff Report because Board staff is not recommending further action after review of the 2024 Final GSPs.

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, be binding on all parties, be sufficient to address any disputes, and satisfy SGMA requirements (Cal. Code Regs., tit. 23, §§ 355.4, subd. (b)(8), 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, § 354.20).

Deficiency Background: The 2022 GSPs and their Coordination Agreement did not include a basin-wide exceedance or dispute 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 was not included in the Coordination Agreement, annual reports did not thoroughly discuss exceedance investigations and often avoided responsibility without evidence. Moreover, Management Area Plans were inconsistent and therefore did not facilitate implementation.

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

According to the 2022 GSPs Coordination Agreement, MT exceedances were 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 noted that there would be potential for misunderstandings between

adjacent management areas. For example, in the WY 2022 GSP annual report, WKWD suggested that prolonged recovery pumping in adjacent groundwater banking projects may be contributing to observed MT exceedances. WKWD therefore did not consider these MT exceedances to contribute to the management area 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 indicated MT discrepancies.

The 2024 Draft GSPs and Coordination Agreement now outline an exceedance policy and dispute resolution in Appendix W and Appendix C, respectively. Appendix W states "[a]n exceedance policy is hereby developed to provide protocols and guidelines for groundwater sustainability agencies (GSAs) in the Kern County Subbasin (subbasin) to investigate exceedance of minimum thresholds (MTs) at Representative Monitoring Wells (RMW) following the collection of RMW monitoring data and identification of a MT exceedance" (2024 Kern County Subbasin Draft GSP, Appendix W, p. 1). This newly developed exceedance policy is an important component of the GSP because it: (1) sets a timeline for investigatory procedures, (2) places the onus on the GSAs for determining the cause for the exceedance, (3) ensures coordination with other agencies and beneficial users, and (4) occurs in conjunction with the subbasin Well Mitigation Program. Additionally, the dispute resolution in Appendix C (2024 Draft GSP Coordination Agreement) outlines procedures for conflict resolution when disputes arise among parties subject to the agreement, ensuring that exceedances and undesirable results do not go unresolved within the subbasin. Board staff is encouraged by this unified effort by the GSAs to take responsibility for investigating causes of an MT exceedance within the 60-day timeline and ensure undesirable conditions are not occurring (*Id.*, p.2).

2024 Draft GSPs Evaluation: The GSAs have developed a MT exceedance policy that describes how MT exceedances will be investigated by GSAs and reported to the subbasin coordination committee for recommended actions (2024 Kern County Subbasin Draft GSP, Appendix W). This policy guides GSAs to determine the cause(s) of the exceedance including operations in adjacent GSAs. With this revision, Board staff does not recommend further action specific to deficiency CRD-2a.

However, Board staff reiterates, it is of the utmost importance that GSAs and the subbasin Coordination Committee take actions to prevent continued MT exceedances within the boundaries of the responsible GSA(s) and in impacted adjacent GSA boundaries. For example, if a GSA is determined to be responsible for impacts in adjacent GSA areas, immediate changes, mediation, and/or adjustments to pumping

may be necessary. Also, it will be critical in plan implementation for the GSAs to coordinate with other entities and beneficial users to ensure integrity of the exceedance policy. For specific issues related to specific sustainability indicators, GSAs should see each of the corresponding deficiencies described in sections 4.1.2 through 4.1.5.

2024 Final GSPs Tentative Evaluation: This deficiency was addressed in the 2024 Draft GSPs based on Board staff's full review. This evaluation remains consistent with Board staff's review of the 2024 Draft GSPs. Board staff is not proposing further action specific to deficiency CRD-2a.

Potential action CRD-2a has been omitted from this Final Staff Report because Board staff is not recommending further action after review of the 2024 Final GSPs.

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 one main GSP, five GSPs, and 12 Management Area Plans. SGMA 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., tit. 23, § 351). Many of the coordination deficiencies described in Deficiencies CRD-1a and CRD-1b were exacerbated by inconsistent implementation across management areas.

Instead of management areas, the 2024 Draft GSPs divided the subbasin into five HCM Areas defined as, "[a]reas with each area comprised of contiguous lands having similar hydrogeologic attributes," to "help inform the formulation of the various PMAs developed by the GSAs" (2024 Kern County Subbasin Draft GSP, p. 10-2). Board staff recognizes that each of the five HCM Areas is managed by multiple GSAs, but no longer requires a standalone plan with its own sustainability metrics or unworkably complex coordination to evaluate the efficacy of groundwater management in it. However, these HCM Areas still pose problems for how they are implemented when applying methodologies to establish SMC. Therefore, the GSAs do not demonstrate the HCM Areas, essentially management areas, are working toward the same goal as required by SGMA.

2024 Draft GSPs Evaluation: As noted in CRD-1a and CRD-1b, Board staff does not agree with the justification of some SMC and undesirable results established based on HCM Areas in the 2024 Draft GSPs. See sustainability-indicator-specific deficiencies, sections 4.1.2 through 4.1.4, for more detail on how HCM Areas have created technical deficiencies hindering the subbasin's ability to reach sustainability and avoid impacts to

beneficial users. GSAs have therefore implemented HCM Areas consistent with GSP Regulations but have not resolved Deficiency CRD-2b.

2024 Final GSPs Tentative Evaluation: This deficiency does not appear to be addressed. The GSPs continue to use HCM Areas to set SMC in a manner that may not be protective of beneficial uses and users. The determination remains consistent with Board staff identified determination for the 2024 Draft GSPs.

Potential Action CRD-2b – GSAs should revise plans to demonstrate the necessity and compliance of management areas.

GSAs should revise the 2024 Draft GSPs' SMC for sustainability-indicator-specific sections GL-1, LS-1 and GWQ-1. GSPs should also demonstrate how HCM Areas will avoid impacts to beneficial users and achieve sustainability within the subbasin.

GSAs should revise methodologies that result in incompatible SMC across HCM Area boundaries. Sustainability-indicator-specific technical deficiencies resulting from these methodologies are described in sections GL-1, LS-1, and GWQ-1.

Board staff recognizes the unique challenge the subbasin faces in coordinating across many GSAs and five HCM Areas. Board staff, however, notes that HCM Areas are intended to facilitate implementation and urge the GSAs to substantially improve SMC within the respective HCM Areas to avoid impacts to beneficial users and achieve sustainability in the subbasin.

Deficiency CRD-3 – GSAs in the subbasin have not demonstrated basin-wide management.

What SGMA Requires: Any *local agency* – defined as 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)). SGMA limits the ability of local agencies to impose fees or regulatory requirements to within their designated legal boundaries (Wat. Code, § 10726.8, subd. (b)). The statute allows some private and non-governmental water entities (e.g., private water companies, mutual water companies, etc.) to *participate* in a GSA, but SGMA does not empower them to exercise SGMA authorities (Wat. Code, § 10723.6, subd. (b)). Private entities therefore do not manage pursuant to SGMA, so all areas of a GSA must still be covered by local public agency oversight. In addition, this defect cannot be cured by a joint powers agreement (JPA) (Gov. Code, § 6500 et seq.) because a joint powers authority, even though it may be a separate legal entity, is limited to the powers that members hold in common and non-governmental entities do not hold SGMA powers (Gov. Code, § 6502, Wat. Code, § 10723.6, subd. (b)).

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

Deficiency: Board staff is concerned that the subbasin may not be able to reach sustainability if there are areas that are outside the designated boundaries of a local public agency. It appears to Board staff that substantial portions of the Kern County Subbasin may have been and continue to be unmanaged as a result of the loss of local agency coverage that occurred when Kern County withdrew from the KGA GSA in 2018, lack of GSP coverage by the 2020 and 2022 KGA GSPs, and the recent 2024 formation of a new authority, the Kern Non-Districted Lands Authority (KNDLA), created under provisions of Government Code sections 6500 et seq., to replace KGA without the official formation of a new GSA.

In the 2022 GSPs, the KGA GSA relied on Kern County membership to provide coverage where there were no local agencies. Board staff understands that the Kern County Water Agency entered into a JPA with other member agencies to form the KGA, resulting in the formation of the KGA GSA. The KGA GSA then provided coverage by writing an umbrella GSP in coordination with several member agencies’ management area plans. The KGA GSA also entered into agreements with private landowners from areas without local agencies, despite having county authorities under the agreement, and no complete GSP coverage for the local areas not covered under local plans (KGA GSP, p. 16). Therefore, it appeared to Board staff there was not basin-wide GSP and GSA coverage.

After reviewing the 2024 Draft GSPs and the JPA in the included 2024 Draft GSPs’ Appendix D, Board staff continues to be concerned that the subbasin may not be able to reach sustainability because there remains uncertainty regarding GSA coverage and authority across the basin. The JPA defined the KNDLA intent as, “to adopt and implement a GSP or GSP chapter for Non-Districted Lands, and enter into agreements, as necessary and as requested, with General Members [(public agencies)] to provide them with required authority within their respective GSAs where their local districts lack coverage” (*Ibid*.). It is unclear what areas or GSAs are relying on additional agreements with the KNDLA, or if those agreements are in place. Additionally, the GSP states “landowners who did not respond to water district agreements received coverage by the Kern Non-Districted Land-Authority GSA formerly the Kern Groundwater Authority” (2024 Kern County Draft GSP). However, the KNDLA GSA does not exist as a recognized GSA in DWR’s portal, which is DWR’s official list of GSAs. Therefore, it appears to Board staff that substantial portions of the Kern County Subbasin may lack

GSA management and coverage, specifically areas represented by the recently established KNDLA (previously covered by KGA) that are not located within any active participating GSA-covered management area or any other GSA coverage area.

The JPA defined the intent of the KNDLA as being to provide GSP coverage for the non-districted lands and only in some cases offer regulatory authority to certain members for the Outside Member Land (members who entered into agreement with KGA or the County of Kern Non-districted lands), through a grant of jurisdiction from Kern County Water Authority, to maintain GSA and GSP coverage (2024 Kern County Subbasin Draft GSP Appendix D, p. 2). It is unclear if there are additional areas or Outside Member areas where regulatory authority is not offered. The KNDLA relies on Kern County membership to provide authority for almost 239,420 acres of non-districted lands and 39,420 acres of the Eastside Water Management Area (EWMA), a non-public agency (2024 Kern County Subbasin Draft GSP, pp. 5-10 - 5-11). Board staff understands that the Kern County Water Agency is currently purporting to grant its jurisdiction to KNDLA and member agencies (2024 Kern County Subbasin Draft GSP, Appendix D, p. 1). Board staff is not convinced that GSAs can legally delegate their authorities to non-governmental entities under SGMA without, by necessity, maintaining an oversight role and responsibility. If this authority can be delegated, it is still unclear to Board staff whether GSAs that are not public agencies can be legally allowed to exercise it.

2024 Draft GSPs Evaluation: Board staff is aware that there have been substantial changes to GSAs and member agencies during the preparation of the 2024 Draft GSPs and observes basin-wide coverage of GSPs. However, it is unclear if the basin possesses basin-wide GSA oversight or management.

Board staff is unable to properly evaluate basin management due to the complex arrangement of agencies involved and lack of clear detail demonstrating adequate coverage. Board staff notes that insufficient coverage and authorities could undermine the subbasin's ability to reach sustainability. Additionally, if unmanaged, extractors in this portion of the subbasin would be required to report groundwater extractions to the Board as required by Water Code section 5202 subdivision (a)(2), and pay associated fees, regardless of a probationary determination.

2024 Final GSPs Tentative Evaluation: This deficiency does not appear to be addressed. It is still unclear to Board staff if KNDLA is an official GSA. This issue, if not resolved, could result in (1) areas without sustainable groundwater management, and (2) extractors in the unmanaged area being required to begin reporting groundwater extractions to the State Water Board and paying associated fees.

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

GSAs should ensure they have the proper authorities to fully implement and enforce SGMA within their respective management areas. In instances where GSAs rely on the KNDLA, it should be clarified that the public agency's oversight and responsibility will ensure the public agency's public purpose is met, specifically with respect to SGMA coverage for the area and that the JPA does not redefine or supersede authorities defined under SGMA. Additionally, the Coordination Agreement should be updated with a table and maps that clearly depict which official local agencies provide SGMA authority coverage across the subbasin and where the authorities originate from (e.g. public agency, KNDLA, other agreement, one or more of the previous mention examples). 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 GSA that relies on GSP-implementation authority through a JPA should be clearly symbolized and labeled. Finally, the Coordination Agreement should be updated and resubmitted to the DWR GSP Portal every time there is a change in agency participation or jurisdiction; all GSAs required to implement the GSP must be submitted to the Department for review (Wat. Code, § 10723.8).

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 and migration of contaminants, 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 such as land subsidence, degradation of groundwater quality, depletion of groundwater storage, and depletions of ISW.

DWR concluded that the Kern County Subbasin's 2022 GSPs made management area-specific progress and impact analyses, but did 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 (2022 Inadequate Determination, pp. 31-32). Board staff concurs with DWR's findings and further notes that the 2022 GSPs: (1) lacked necessary detail about well

mitigation, (2) did not describe a feasible path for halting chronic lowering of groundwater levels supported by water budgets, and (3) did not define how objectives sufficiently prevent impacts to other sustainability indicators (See Table 4-3 below).

Table 4-3 – Summary of Chronic Lowering of Groundwater Levels Deficiency and Relevant Components of the 2020, 2022, and 2024 Draft Kern County Subbasin GSPs

2020 GSPs	DWR's 2020 GSP Incomplete Determination
The GSPs and Management Area Plans used inconsistent data and methods to develop MTs that were incomparable and disparate across boundaries.	"The [plans do] not set minimum thresholds for chronic lowering of groundwater levels in a manner consistent with the requirements of SGMA and the GSP regulations" and "[s]hould be supported by potential effects on other sustainability indicators" (2022 Determination Letter, p. 18).
2022 GSPs	**DWR's 2022 GSP Inadequate Determination**
The GSPs and Management Area Plans still used inconsistent data and methods to develop MTs.	"The subbasin's chronic lowering of groundwater levels sustainable management criteria do not satisfy the requirements of SGMA and the GSP regulations" (2023 Determination Letter, p. 14).
2024 Draft GSPs	**Board Staff 2024 Draft GSPs Evaluation**
The 2024 Draft Plans use consistent data and methodologies when setting SMC (Cal. Code Regs., tit. 23, § 357.4 subd. (b). (3)). However, criteria are not set using reasonable assumptions or methodologies and continue to result in disparate values across defined boundary areas and are not supported by best available science. (Cal. Code Regs., tit. 23, § 354.268, subd. (b)., Cal. Code Regs., tit. 23, § 354.18, Cal. Code Regs., tit. 23, § 3, subd. (b)).	The subbasin's chronic lowering of groundwater levels sustainable management criteria do not satisfy the requirements of SGMA and the GSP regulations and do not demonstrate a path to sustainability.

4.1.2.1 Kern County Subbasin 2020 Groundwater Sustainability Plans

On January 23, 2020, five 2020 GSPs were submitted to DWR in compliance with SGMA statutory deadline. Upon review, DWR found the 2020 GSPs incomplete and provided corrective actions related to identified deficiencies. The GSAs were given 180 days to address DWR's deficiencies and corrective actions.

If new corrective actions are developed or adopted, such modifications should be addressed within their respective GSPs. In preparation for this Final Staff Report, Board staff reviewed the 2020 and 2022 Kern County Subbasin GSPs, and concured with DWR's findings. Board staff also reviewed the 2024 Draft GSPs as described herein. For a summary of Board staff review of the 2020 GSPs, see Appendix D.

4.1.2.2 Kern County Subbasin 2022 Groundwater Sustainability Plan Submissions 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

Consistent with the 2020 Coordination Agreement, the 2022 Coordination Agreement for the Kern County Subbasin described undesirable results for the 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 (2022 Coordination Agreement, p. 298).

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

The 2022 Coordination Agreement quantitatively defined a two-tiered approach for occurrence of an undesirable result for the chronic lowering of groundwater levels. First, a local management area exceedance must occur to contribute to an undesirable result: this occurs when MTs for groundwater levels are exceeded in 40% of representative monitoring wells over four bi-annual measurements (2022 Coordination Agreement, Appendix 3, p. 300). Second, there must be a total of three adjacent management areas that represent at least 15% of the subbasin or when greater than 30% of the subbasin (as measured by each management area) experience management area exceedances. According to the 2022 Coordination Agreement, MTs were to be set by each of the

management areas through their respective GSPs (*Id.*, p. 298). Still, the various GSAs and management areas used different methods for establishing SMC, resulting in disparate values across the basin, as described below:

BVWSD GSP used a three-tiered approach to establish SMC. 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 was the management of MTs and MOs, and recognized that while all GSAs within a HZ were collectively responsible for avoiding undesirable results, each GSA would have its own management tools for doing so. Tier 3 allowed 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 groundwater level trends from the 2011-2018 drought period, a “worst case” MT was created (up to a 354 ft decline in groundwater levels by 2040). These “worst case” projections were then adjusted at each RMW 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; developed to minimize loss of production from existing domestic and municipal wells; intended to keep the groundwater gradient floor at elevations observed in Fall of 2015; and consistent with other management areas in the subbasin (undesirable result triggered when groundwater levels are below MTs in 40% of RMWs for four consecutive bi-annual SGMA required monitoring events). MOs were set at nine RMWs and all but one MO were set above January 2015 groundwater levels. The margin of operational flexibility (the difference between the MO and MT) for each RMW ranged from 65-87 feet (2022 Buena Vista Water Storage District GSA GSP, pp. 115-141).

The KRGSA GSP quantitative definition of undesirable results mirrors that provided in the 2022 Coordination Agreement (see above). Each management area within the KRGSA area defined SMC using its own method. 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 at RMWs. 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 trigger for a management area exceedance is the groundwater level in an RMW falling below the MT for three consecutive months, a more conservative MT exceedance definition than that

identified in the Coordination Agreement (2022 Kern River GSA GSP, ch. 5, p. 16).

- Northeast East Niles Community Service District Wellfield set an MT 50 feet below the historic low groundwater level for their area. Their MO is the average between the historic high groundwater level 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 20 feet lower than the historic low groundwater levels in the area (the same as for the Banking management areas).
- For small water systems, such as Lamont PUD, the GSAs decided to set MTs and MOs in the vicinity of the water systems higher than in other management areas (2022 Kern River GSA GSP, ch. 5, pp. 19-22).

HMWD GSP defined their MO as all static groundwater levels averaging no more than 150 ft-bgs by 2040. According to the GSP, this represented the 2015 baseline conditions. IMs were calculated using “recent groundwater levels of approximately 115 ft bgs” as their starting point and the 150 feet MO as the 2040 end point. The IMs for 2025, 2030, and 2035 each consisted of a nine-foot decrease in groundwater elevation, while the final period (2035-2040) was eight feet (2022 Henry Miller Water District GSP, p. 76). The MT for groundwater levels was developed using construction information for production wells and was set to 350 ft-bgs. If groundwater levels were below the MT in 40% of the RMWs over four consecutive bi-annual SGMA-required monitoring events, then the GSA would have exceeded its MT and that was considered an undesirable result (2022 Henry Miller WD GSP, pp. 80 & 84).

Olcese GSP’s basin-wide definition for a groundwater level undesirable result matched that of the 2022 Coordination Agreement (see above). MTs were established for two RMWs and were set to the top elevations of their respective well screens. The MOs are defined as groundwater levels 40 feet below July 2017 groundwater levels at the RMWs. Data prior to 2017 were not available for the RMWs, and the GSP assumed 2017 groundwater levels were higher than the years prior, due to relatively wet conditions; thus, the GSP contended MOs were higher than historical lows. A linear interpolation from 2017 levels to the MT was used to calculate IMs (note: the IMs demonstrate a declining groundwater elevation trend) (2022 Olcese Water District GSP, pp. 86-92).

SOKR GSP’s boundary contained three primary management areas: Arvin-Edison, WRMWSD, and Tejon-Castac Water District (TCWD). The potential effects of undesirable results in all three management areas were well-dewatering, increased

pumping lift, and land subsidence. The development of MTs considered historical groundwater levels from RMWs, proximity of RMWs to critical infrastructure, well construction information, and adjacent GSAs, basins, and other sustainability indicators. Initial MTs were set at each RMW according to an algorithmic calculation for either (a) historic low groundwater levels minus a variability correction factor, or (b) Fall 2015 groundwater levels minus the greater of the variability correction factor or trend continuation factor, with the lower of the two elevations selected (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 RMWs *(Ibid.*).

KGA Umbrella GSP defined undesirable results consistent with the Coordination Agreement (see above). However, MTs were set by each management area through their individual Management Area Plans or GSPs (2022 Kern Groundwater Authority GSA GSP, pp. 207 and 211). The potential impacts of lowering groundwater levels were addressed by each Management Area Plan (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, p. 218).

Two examples of methods management areas used when setting SMC in individual Management Area Plans within KGA are as follows:

- Cawelo Management Area Plan MTs are set approximately 80 feet below the low groundwater level experienced during the 2007-2016 drought period and are established for the seven RMWs within the water district (2022 Cawelo Water District Management Area Plan, p. 168). MOs were set to a low observed groundwater level at each RMW, or nearby monitoring well, during the same drought period. IMs were calculated by adding one-quarter of the difference between the MT and MO to the MT every five years (*Id*., p. 169).
- EWMA Plan MOs were “provisionally” defined as the groundwater elevation measured in 2015 at each RMW; however, if 2015 data were not available, the measurement closest to 2015 was used (2022 Eastside Water Management Area Plan, p. 93). IMs started from the lowest groundwater level elevation measured after the GSP was adopted and followed by a linear progression toward the MO (*Ibid*.). The EWMA recognized that more data were 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 Plan, 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 (*Id*., p. 98).

Representative Monitoring Sites and Monitoring Network

The groundwater level monitoring network in the 2022 Coordination Agreement included 198 monitoring wells (2022 Coordination Agreement, Appendix 3, p. 303). The Coordination Agreement summarized monitoring wells, including total monitoring wells per management area, and the number of wells required to be exceeded for each management area to contribute to an undesirable result (*Ibid*.). This includes 28 more monitoring wells reported for the monitoring network in the 2022 Coordination Agreement than the 170 monitoring wells in the 2020 Coordination Agreement. The 2022 Coordination Agreement did not list all wells to be monitored for chronic lowering of groundwater elevations, nor did it provide a table of the SMC established at each reference monitoring site. 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 ft-bgs.

The BVWSD GSP proposes eleven RMWs that serve as dedicated monitoring wells used for collecting water level data. The wells are distributed over the 72 square-mile BMA, with one site per 5.5 square miles. Per the GSP, all wells in the monitoring network will have water levels 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 included 39 RMWs (38 in KRGSA and one in Greenfield County Water District), many of which are production wells that will require pumps to be shut off for sufficient time periods to measure representative groundwater levels. Many of these wells also lack detailed construction information. The RMWs represent the urban, agricultural, and water 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). At the time the 2022 GSPs were written, 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, p. 7.2.8).

The HMWD GSP monitoring network consists of five wells 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, and the GSA proposed to measure semi-annually between January 15 to March 30 and September 15 to November 15. There are no other wells specifically for monitoring 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 Water District GSP, pp. 86-90).

The 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 groundwater levels. Groundwater levels will be measured at the RMWs bi-annually (spring and fall). If monitoring results demonstrate a hydraulic connection between the Olcese Sand Aquifer (Olcese Principal Aquifer) and shallow alluvium, an additional shallow monitoring well will be installed for data collection (2022 Olcese Water District GSP, p. 94).

The SOKR GSP includes details for the monitoring network in their three management areas to be monitored semi-annually. Arvin-Edison has 16 sites (9.7 sites/100 mi^2), WRMWSD has 14 sites (10.4 sites/100 mi^2), and TCWD 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).

The KGA Umbrella GSP provides a table that lists the monitoring network for the entire subbasin. The monitoring network consists of 111 RMWs (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 RMWs in the subbasin (included in the 111), two in NKWSD, two in SWID, one in RRBWSD, and one in SWSD (2022 Kern Groundwater Authority GSA GSP, Table 3-4, p. 223). Table 3-4 does not include proposed changes in the updated Management Area Plans. The monitoring protocols require that data be collected from each principal aquifer, during approved time frames only (January 15 to March 30 and September 15 to November 15) (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 discussed well mitigation to varying degrees as summarized below.

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

KRGSA GSP plans to avoid adverse well impacts due to lowering of groundwater levels by “reasonably modif[ying]” a well to account for groundwater level declines, redistribute

pumping, or utilizing alternative water supplies. If well impacts could not be mitigated, they plan to reduce pumping rates or implement temporary cessation of pumping (2022 Kern River GSA GSP, ch.5, p. 14).

The KGA GSP states that a “Domestic Well Mitigation Program will be developed and implemented by all KGA members” (2022 Kern Groundwater Authority GSA GSP, 2022, p. 293). These well mitigation programs were intended to mitigate the potential impact to domestic 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” (2022 South of Kern River GSP, p. 246). The GSA proposed the following potential action to mitigate impacted wells: pump replacement or lowering, well deepening or replacement, or providing for alternative water sources (*Id*., p. 343).

HMWD and Olcese GSPs did not include well impact mitigation plans. It should be clarified that there are minimal domestic users within these management areas, especially Olcese.

Projects and Management Actions

The GSAs summarized PMAs in the Todd Groundwater Tech Memo, an appendix in the Coordination Agreement (2022 Coordination Agreement, Appendix 2, pp. 22-23). The proposed PMAs 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 PMAs were projected in both the 2020 and 2022 Coordination Agreements to be about 422,000 AFY and most of that benefit is expected to come from demand reduction. The water budget aspects of the proposed PMAs were included in the Groundwater Flow Model of the Kern County Subbasin Model (C2VSimFG-Kern).

The BVWSD GSP listed 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. These projects would be implemented regardless of groundwater conditions. Also included in the GSP were adaptive management actions that would be implemented if the aforementioned actions did not result in reaching MOs. Adaptive management actions included 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 RMWs 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 included various PMAs in two phases. Phase one projects included 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, East Niles Community Service District North Weedpatch Water System consolidation, and possible water exchange for improved drinking water quality in DACS. The phase one management actions were identified as: 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, and incorporate a policy of adaptive management in the KRGSA GSP process. The phase one PMA implementation timeline was 2020-2040, and many of the timelines had continuation periods. Phase two PMAs were: 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, and additional considerations for adaptive management. Phase two was slated for 2031-2040 (2022 Kern River GSA GSP, ch.7, pp. 1-32 and ch. 8, pp. 1-3).

The HMWD GSP identified two PMAs to avoid overdraft during dry years. The first project was to optimize the recovery of Pioneer Project banked supplies in dry years. The second project was “demand management,” a reduction in pumping due to land fallowing of lands in dry years (2022 Henry Miller Water District GSP, pp. 91-92).

The Olcese GSP categorized its PMAs as non-contingent and contingent. The non-contingent actions were installing a shallow monitoring well to evaluate potential hydraulic connection between the Olcese Sand Aquifer Unit (Olcese Principal Aquifer) and the shallow alluvium and conducting a study on potential hydraulic connection. The contingent actions were, 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 the 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).

The SOKR GSP grouped its PMAs into water supply augmentation projects, water demand reduction management actions, projects to improve drinking water quality in the Arvin Community Services District service area, and additional data-gap filling efforts. The projects most focused on groundwater levels include enhanced recharge and banking, floodwater capture, increasing surface storage capacity and delivery, and 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 PMAs were developed at the management area level and listed them all in Table 4-1 (2022 Kern Groundwater Authority GSA GSP, pp. 276-290). KGA also listed several PMAs it planned to implement to help coordination of groundwater management subbasin-wide: subsidence monitoring, groundwater modeling, study of native yield of the subbasin, Kern County Subbasin-wide study, subbasin-wide consumptive use monitoring, managing to MOs, domestic well mitigation program, KGA monitoring network improvement program, basin-wide coordination, and annual reporting (*Id.*, pp. 268-269). The management area-specific PMAs are as follows:

> Cawelo Management Area Plan – KGA action plan related to the exceedance of MTs for chronic lowering of groundwater, domestic well mitigation program, 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 were and continue to be ongoing since 2020 (2022 Kern Groundwater Authority GSA GSP, pp. 276-290).
>
> EWMA Management Area Plan – 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.*).
>
> Kern Water Bank Management Area Plan – operations plans, groundwater storage improvement, water quality protection, subsidence monitoring, and Kern Water

Bank recharge enhancement project. All are ongoing with the exception of the recharge enhancement, which is completed (*Ibid*.).

KTWD Management Area Plan – modified district pricing structure, California Resources Corporation pipeline project – produced water project, and in-district surface storage. These PMAs are in the design and permitting stages (*Ibid*.).

NKWSD and SWID Management Area Plans – Calloway canal improvements, expanded water banking program, groundwater banking conveyance improvements to NKWSD recharge and recovery, beneficial reuse of oilfield produced water, supervisory control and data acquisition automation and evapotranspiration measurement improvements, Poso Creek weir, spreading pond facility, expanded recharge, allocation of available NKWSD supplies, Diltz Intertie Lateral Piping and Water Management Improvements, Bell recharge project, Leonard Avenue conveyance improvement project, improved water level 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, KGA exceedance policy, and ongoing evaluation of groundwater levels and water quality trends. These PMAs were at different stages of implementation at the time of the plans release (*Ibid*.).

Pioneer GSA Management Area Plan – 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%. These PMAs are at different stages of implementation (*Ibid*.).

RRBWSD Management Area Plan – 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, RRBWSD 3rd party recharge and storage program, emergency domestic water response, coordination with State regulatory programs, KGA action plan related to exceedance of MTs for chronic lowering of GW, and unmitigated domestic well replacements. The PMAs are in various stages of implementation (*Ibid*.).

SSJMUD Management Area Plan – In-district spreading and recovery facility, Regan recharge facility, SSJMUD and Semitropic Schuster Intertie, SSJMUD and

Cawelo intertie pipeline, SSJMUD and NKWSD intertie pipeline, Southeast Delano spreading grounds, City of Delano spreading grounds, 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, domestic well mitigation program, in-district allocation structure, voluntary land fallowing, and pumping restrictions. These PMAs were and continue to be at various stages of implementation (*Ibid*.).

SWID – 7th Standard Management Area Plan– 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 Management Area Plan – 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 Management Area Plan – 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 Management Area Plan – collect representative hydrogeologic data, water resource coordination, and conjunctive reuse of naturally degraded brackish GW (*Ibid*.).

Groundwater Allocations and Demand Management

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 PMAs include incentivized agricultural demand reduction projects, fallowing agricultural land for 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 also proposed reallocations of water by reducing banked groundwater and surface water sales to retain water within the agency.

4.1.2.3 Kern County Subbasin 2024 Groundwater Sustainability Plan Submission and Water Year 2023 Annual Report

The GSAs submitted seven new Draft GSPs to the Board for review on May 28, 2024. The GSAs all submitted the Kern County Subbasin GSP, but six of the seven GSPs included “Blue Pages” that contain additional information relevant to each of the six respective areas covered by individual GSPs. This subsection describes the portions of the 2024 Draft GSPs that are relevant to the proposed Board chronic lowering of groundwater level deficiencies identified in section 4.1.2.4.

Plain-Language Definition of an Undesirable Result

The 2024 Draft GSPs’ undesirable result is defined as “The point at which significant and unreasonable impacts over the planning and implementation horizon, as determined by depth/elevation of water, after the reasonable and beneficial use of, and access to, groundwater by overlying users” (2024 Kern County Subbasin Draft GSP, pp. 13-2). This definition is adopted by all seven GSPs.

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

The 2024 Draft GSPs identified an undesirable result as occurring when one of the following is present:

- More than 15 drinking water wells are reported as dry in any given year (2024 Kern County Subbasin Draft GSP, pp. 13-4).
- The MTs for chronic lowering of groundwater levels are exceeded in at least 25% RMW-WLs over a single year (*Ibid*.).

The MO for the chronic lowering of groundwater levels is defined as the “2015 low” at each RMW-WL if groundwater level data from 2015 are available (*Id*., pp. 13-38). Where no groundwater level data were collected during the 2015 water year, other methods were used to estimate/substitute the “2015 low” such as closest temporal measurement,

spatial interpolation of the groundwater level, average interpolation or linear interpolation between two bookend temporal measurements, or a surrogate level from a nearby well. Board staff notes that it is unclear how, why, or when the priority of these methodologies might have been used if 2015 data were not available and also notes that other methodologies for establishing MO values are specified in the Main Kern County GSP's Table 13-2 of the Kern County GSP, not identified in the MO methodology (*Ibid*.).

GSAs established five HCM Areas based on areas with similar geology and aquifer characteristics that will allow GSAs to succinctly explain why their management approach may be different from neighboring GSAs. It is Board staff's interpretation that these newly defined HCM areas operate as management areas based on evidence and reasoning provided in the 2024 Draft GSPs, consistent with California Code of Regulations, title 23, section 354.26, subdivision (b)(1) (2024 Kern County Subbasin Draft GSP, p. 5-2). The five HCM areas are Western Fold Belt (WFB HCM), North Basin (North of Kern River HCM), Kern River Fan HCM, South Basin HCM, and East Margin HCM (*Id*., pp. 5-2 to 5-3).

Local GSAs defined MTs in the new GSPs by selecting the lowest of a "range dominated" method or "trend dominated" method calculated value, the latter being based on a central tendency applied for an entire HCM Area (2024 Kern County Subbasin Draft GSP, p. 13-8). Range dominated MT values are calculated by: (1) taking the maximum and minimum water level elevations during water years 2009-2022 to determine the maximum difference, (2) calculating 25% of the identified difference, and (3) subtracting the 25% from the 2015 low groundwater elevation (*Id*., p. 13-10). Trend dominated values are calculated from wells with recent declining trends. The average rate for wells with declining trends is calculated for each HCM Area and then applied to all wells within an HCM Area. The average trend is then projected from the 2015 low groundwater elevation for each RMW-WL within the HCM Area to estimate 2030 values. Each method is compared at each well and the lowest groundwater elevation value between the two methods is selected as the MT.

The GSAs conducted well impact analysis to justify the MTs. The GSAs' analysis considered 1,477 drinking water wells in all three identified aquifers in the subbasin – Olcese, Santa Margarita, and the Primary Principal Aquifer – out of 2,840 identified drinking water wells (2024 Kern County Subbasin Draft GSP, pp. 13-24 to 13-25). The GSAs removed 1,363 wells from consideration through a screening process. Wells were removed if they: (1) were considered to have been dewatered during "2015 low" values (MOs) as GSAs believed these wells to be affected by groundwater conditions prior to 2015 conditions, despite being 2015 lows or (2) would be 70 years or older by 2040 (55 years old by 2025) based on the assumption of an average well retirement age (*Ibid*.). The impact analysis was conducted with the remaining 1,477 drinking water wells using

various statistical scenarios such as: (1) Worst Case (409 drinking water wells impacted), (2) High-End Bracketed Result (327 drinking water wells), (3) Low-End Bracketed Result (0 drinking water wells), (4) Stochastic Prediction (103 drinking water wells), and (5) Modeled Projected Future Conditions (77 wells, but 13 with PMAs) (*Id.*, p.13-27). The worst-case scenario assumes all MTs are reached while the remaining scenarios assume 25% of MTs in RMW-WLs are reached. The high-end bracket result scenario assumes the 25% occurs in the highest density of drinking water wells while the low-end assumes the exceedances occur in the lowest density of drinking water wells. The stochastic projection is a randomized repetitive variation of the 25% exceedances, and the modeled projection considered the most likely outcome based on areas rate of decline and pumping.

The GSAs also investigated other impacts of SMC on adjacent basins. The 2024 Draft GSPs states that the GSAs cannot evaluate impacts SMC have on the Tulare Lake Subbasin to the Northwest because the adjoining basin's SMC are "currently" under revision (2024 Kern County Subbasin Draft GSP, p. 13-23). The GSPs states, "[i]n discussion with the Tulare Lake representative, the preliminary revised approach sets MOs as the 2015 low groundwater elevation at representative monitoring sites, which is the same methodology used in the Subbasin" (*Ibid*.). The GSPs also states that, "[t]here are no state, federal, or local standards pertaining to groundwater levels in the Kern Subbasin" (2024 Kern County Subbasin Draft GSP, p.13-28).

Representative Monitoring Sites and Monitoring Network

The Draft GSPs include RMW for the chronic lowering of groundwater levels (RMW-WL) in three identified aquifers – the Primary Principal, Olcese, and Santa Margarita Aquifers. The Draft GSPs states that, "DWR Best Management and Practices (BMPs) served as guiding principles" and "played a crucial role in determining the optimal density of monitoring wells suitable for the subbasin" (2024 Kern County Subbasin Draft GSP, pp. 15-6). The GSAs used a modified 1984 Hopkins method, one of the analytical methods mentioned in DWR's BMP-2, to develop the groundwater level monitoring network. Using this approach, the GSAs determined a minimum of 111 RMWs were required. Additionally, a hexagonal tessellation was generated across the subbasin using 25 square mile area cells, consisting of 111 cells, to develop a uniform approach to ensure an equal distribution of the RMWs. The GSPs note that this method fails to account for variations in pumping across the subbasin. The GSPs also describe the consideration of basin area, 2,785 square miles, and the average pumping rate, 1,470,139 AFY for the 1995-2022 period. Therefore, the GSPs describe a new metric to justify the distribution of monitoring using a scaled monitoring well density approach, which identifies pumping groups (2024 Kern County Subbasin Draft GSP, Table 15-4, p. 15-7). Using this approach, the GSAs showed a single well would represent a 25 square mile area exceeding 2,500 AFY.

The method was further modified by evaluating the pumping volumes per HCM Area, flow from low to high pumping, and impacts from recharge. The pumping rate was determined for each cell category and cell areas with similar pumping rates merged. The results were paired with the 1984 Hopkins Density method and the previously calculated 111 wells were distribute across the merged areas. In total, the representative groundwater level monitoring network for the subbasin comprises 185 wells. However, the number of existing representative monitoring wells in pumping groups two and three are below the calculated minimum according to this method. Board staff notes that many of the RMW-WL locations have not changed as a result of this method.

Well Impact Mitigation

The GSAs are planning on mitigating wells dewatered due to groundwater management activities through a contract with Self-Help Enterprises. The mitigation plan is still in development and a letter of intent from Self-Help Enterprises is included in the 2024 Draft GSPs' Appendix K. The partnership with Self-Help Enterprises aims to evaluate the cause of well or pump failures and degraded water quality, and provides an appropriate remedy for well owners who have been impacted by groundwater conditions, as defined within the policy. Funding for the Impacted Well Mitigation Program is sourced from each of the GSAs in the subbasin with the level and mechanism for funding determined by the individual GSAs. GSAs have estimated that well mitigation will annually cost $900,000 and plan to budget for $1 million per year via GSA contributions assuming an average of $66,000 per mitigated well and mitigate an average of 15 drinking water wells per year (2024 Kern County Subbasin Draft GSP, pp. 13-4 and 13-5). For planning purposes, GSAs consider a well is "dewatered" only if the groundwater level declines below 80% of the total well depth (*Id*., p. 13-25).

In addition to mitigating dewatered wells, GSAs state that they will have an MT exceedance policy for groundwater quality which requires: (1) additional sample collection to confirm exceedance and (2) investigation of whether the degradation is due to groundwater management activities. The investigation of whether the degradation is due to groundwater management activities will be conducted using statistical and/or spatial analysis between water levels and water quality to determine causation, depending on available data. There is no estimation of cost for mitigation of groundwater quality impacts due to management activities or discussions of how impacted beneficial users will be notified what assistance will be provided (*Id*., p. 13-55).

Projects and Management Actions

The 2024 Draft GSPs estimates the subbasin's sustainable yield at 1,312,219 AFY, annual groundwater extractions at 1,586,417 AFY, and the pumping deficit as 274,200 AFY. However, these pumping totals are calculated using WY 1995-2014 (2024 Kern

County Subbasin Draft GSP, pp. 9-56 - 9-57). During dry years, groundwater extraction volumes have reached as much as 2.8 MAF annually (2024 Kern County Subbasin Draft GSP, Appendix M, 2024). GSAs calculated an average storage deficit of 344,019 AFY between 2015-2023, demonstrating that the average reliance on groundwater has increased. The 2024 Draft GSPs includes a summary of simulated changes in groundwater storage for baseline, 2030 Climate Change, and 2070 Climate Change Scenarios (2024 Kern County Subbasin Draft GSP, p. 9-84). For the 2041-2070 period, the estimated change in groundwater storage without projects would be -324,326 AFY, -372,120 AFY, and -472,336 AFY for each scenario, respectively (negative numbers are representative of a deficit). Simulations that assume implementation of all projects estimate groundwater storage changes of 85,578 AFY, 46,829 AFY, and -45,969 AFY for the three scenarios, respectively (*Ibid*.). The GSAs estimate the above groundwater storage changes assuming that simulated groundwater outflow attributed to addition of projects remains within the subbasin (2024 Kern County Subbasin Draft GSP, Appendix M).

To address these budgets over the planning and implementation horizon of the GSPs, the GSAs propose a glidepath of implementing several PMAs. Implementation of PMAs began in 2020, and the glidepath is designed to address 25% of the -372,000 AFY (deficit) projected budget under the 2030 Climate Change Scenario during each five-year milestone through 2040 (Kern County Subbasin 2024 Draft GSP, pp. 14-2 – 14-4). Approximately 227,819 AFY of PMAs contributions were scheduled to be completed by 2020, although the status of this is unclear. At the five-year milestones of 2025, 2030, 2035 and 2024, expected PMAs contributions are approximately 403,220 AFY, 538,141 AFY, 697,218 AFY, and 762,001 AFY (*Ibid*.). The GSAs summarize the PMAs general implementation schedule and forecasted deficit reductions in the GSPs' Table 14-1, copied below as Table 4-4. Overall, the GSAs estimate implementing approximately 100 supply augmentation projects and about 80 demand reduction projects, although some of the efforts across GSAs are in coordination on the same objective, specifically where canals run through multiple GSAs or cumulative demand reduction volumes in all GSAs with white areas.

Table 4-4 – General Implementation Schedules of PMAs and Forecasted Deficit Reductions in the Kern County Subbasin (2024 Draft GSP, Table 14-1)

Project and Management Action Implementation Schedule (AFY)						
Kern County Subbasin Projected-Future Scenario Deficit Reduction "Glide Path" 354.44 (b)(2)		2020	2025	2030	2035	2040
Projected Deficit			-372,000			
Target Deficit Reduction (%)		0	25%	50%	75%	100%
Projected Deficit No P/MA's		372,000	372,000	372,000	372,000	372,000
Deficit Reduction "Glide Path" Milestones		-372,000	-279,000	-186,000	-93,000	0
Project and Management Action, by Type (AFY)						
Planned Demand Reduction	Land Retirement	14,965	28,091	36,384	42,603	42,603
	Demand Reduction	3,855	64,512	124,460	168,100	213,133
	Ag to Urban Conversion	1,067	8,078	15,450	22,850	30,250
	Water Conservation-Efficiency	25,099	28,690	28,690	28,690	28,690
Subtotal		**44,986**	**129,371**	**204,984**	**262,243**	**314,676**

Project and Management Action Implementation Schedule (AFY)						
Kern County Subbasin Projected-Future Scenario Deficit Reduction "Glide Path" 354.44 (b)(2)		2020	2025	2030	2035	2040
Project and Management Action, by Type (AFY)						
Planned Water Supply Augmentation	Supplemental Water Recharge	35,219	53,278	81,664	84,884	84,884
	Supplemental Water Use	34,072	49,752	55,762	66,647	73,447
	Third-Party Banking	12,215	33,222	33,222	31,935	31,935
	New Local Supply	0	8,000	25,557	114,557	120,107
	Exercise of Rights	101,327	129,597	136,952	136,952	136,952
Subtotal		**182,833**	**273,849**	**333,157**	**434,975**	**447,325**
P/MA Implementation Schedule*		227,819	403,220	538,141	697,218	762,001
As-Needed PMA Deficit Benefits		0	550	4,800	51,826	71,645
Planned P/MA Deficit Reduction Schedule*		**-144,181**	**31,220**	**166,141**	**325,218**	**390,001**
* Implementation Date includes estimated time to start accruing benefits						

Potential Effects of Minimum Thresholds on Other Sustainability Indicators

The new 2024 Kern County Subbasin Draft GSPs describe the potential effects that the groundwater level MTs may have on other sustainability indicators as follows:

- Groundwater storage: groundwater levels and storage are directly related, and if the MTs were to exceed RMW-WL MTs, a 4%-10% decline in total usable groundwater storage would occur relative to the baseline (2024 Kern County Subbasin Draft GSP, pp. 13-21).
- Groundwater quality: shows no clear correlation for the majority of the subbasin. However, in some localized areas of the subbasin, a direct relationship has been observed between chronic lowering of groundwater levels and degraded water quality (*Ibid*.).
- Land subsidence: has been attributed to chronic lowering of groundwater levels, in part due to groundwater extractions from the subbasin (*Ibid*.).
- Interconnected surface water: local groundwater and surface water conditions indicate that the vast majority of surface water features in the subbasin are not connected to groundwater, and in the few limited areas where a connection may occur, the connection is likely transient, short-lived, and involves shallow or perched groundwater that is not part of the principal aquifer systems (*Id*., p. 8-206).

4.1.2.4 Proposed State Water Board Deficiencies and Potential Actions

In DWR's 2022 GSP Inadequate Determination dated March 2, 2023, DWR determined that the GSAs had not corrected the deficiency related to the Chronic Lowering of Groundwater levels originally identified by DWR with respect to the 2020 GSPs. DWR's 2022 GSP Inadequate Determination states:

> [T]he 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).

Board staff agrees with DWR's findings in its 2022 GSP Inadequate Determination and hereby incorporates it by reference. In addition, Board staff identified additional issues with the role of well impact mitigation in avoiding undesirable results. Board staff has reviewed the 2024 Draft GSPs in full and incorporated that review into the below deficiencies (*Ibid*.).

Deficiency Groundwater Levels - 1 (GL-1) – Groundwater level undesirable results and sustainable management criteria are not defined consistent with the requirements of SGMA.

What SGMA Requires: SGMA requires that "agencies intending to develop and implement multiple Plans pursuant to Water Code Section 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 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)). The coordination agreement must describe how each of the agencies use the same data and methodologies for assumptions in Water Code section 10727.6 for groundwater elevation data, supported by the quality, frequency, and spatial distribution of data in monitoring network and the objectives as described in California Code of Regulations, title 23, sections 354.32 through 354.40 (Cal. Code Regs., tit. 23, § 357.4, subd. (b)).

In defining undesirable results, GSAs are required to describe the "processes and criteria relied upon to define undesirable results [that would] occur when significant and unreasonable effects … are caused by groundwater conditions [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 led 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)).

Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions at each monitoring site or representative monitoring site, and the value shall represent a point in the basin that, if exceeded, may cause undesirable result (Cal. Code Regs., tit. 23, § 354.28). The description of minimum thresholds shall include: (1) justification for the value supported by information provided in the basin setting, (2) relationship between the value and the sustainability indicator, (3) explanation of how the agency determined the conditions at each minimum threshold will avoid undesirable results, (4) how the value will avoid causing undesirable results in adjacent basins, (5) how beneficial uses and users will be impacted, (6) affects to state, federal, and local standards, (6) and how each will be measured consistent with monitoring network requirements (*Ibid*.). The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may cause undesirable results and shall be supported by historical trends, water year type, and projected water use in the basin and potential effects on other sustainability indicators (Cal. Code Regs., tit. 23, § 354.28, subd. (c))

Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years

of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon (Cal. Code Regs., tit. 23, § 354.30). Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty (*Ibid.*).

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, § 354.20).

Deficiency: In the 2022 GSPs, the Kern County Subbasin GSAs defined undesirable results and SMC in a manner that would result in a disproportional impact to beneficial uses and users in the subbasin. This was the result of various plans and management areas using and implementing inconsistent data, methodologies, and assumptions when defining sustainability management criteria coupled with the two-tiered undesirable result definition. The impact could have resulted in certain portions of the subbasin experiencing impacts of chronic lowering groundwater levels for sustained periods before or without an undesirable result occurring as defined by the GSPs.

The 2024 GSPs address this deficiency by revising the undesirable result definition and methodology for establishing SMC in a more coordinated approach. However, MTs may still result in disproportionate impacts, especially across HCM Area boundaries.

Deficiency GL-1a – Undesirable results are not protective of beneficial uses and users.

The 2022 Coordination Agreement required two conditions to trigger an undesirable result:

(1) An MT exceedance must occur in 40% of RMW for four consecutive measurements (at least two 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 was so complex that DWR stated 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, 2023, 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" (*Id.*, p. 12). DWR stressed that the set of conditions was so complex that DWR "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*.). Instead, as illustrated in Deficiency GL-1b, the conditions that would trigger undesirable results vary substantially across GSAs and management areas.

The subbasin's 2024 Draft GSPs identify the plain-language undesirable result 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. (2024 Kern County Subbasin Draft GSP, pp. 13-2).

The quantitative definition of an undesirable result is established as:

(1) More than 15 drinking water wells are reported as dry in any given year (2024 Kern County Subbasin Draft GSP, pp. 13-4); or

(2) The MTs for Chronic Lowering of Groundwater Levels are exceeded in at least 25% RMW-WLs over a single year (*Ibid*.).

The plain language and quantitative definitions are adopted consistently in each GSP and are based on conditions of the subbasin.

2024 Draft GSPs Evaluation: This deficiency appears to be addressed. Board staff believes that resolving deficiencies GL-1b and GL-2a may resolve the remainder of this GL-1a deficiency. However, because deficiencies GL-1b (SMC), GL-2a (monitoring network), and GL-2b (impact analysis and mitigation) are all interconnected with GL-1a, Board staff cannot verify if the quantitative definition for an undesirable result is appropriate for the subbasin conditions.

Potential action GL-1a has been omitted from this Final Staff Report because Board staff is not recommending further action after review of the 2024 Final GSPs.

2024 Final GSPs Tentative Evaluation: This deficiency was addressed in the 2024 Draft GSPs based on Board staff's full review.

Deficiency GL-1b – Sustainable management criteria were not established consistent with the requirements of SGMA.

This deficiency concerns the fact that SMC for each sustainability indicator: (1) use inconsistent data, methodologies, and assumptions across GSPs and Management Area Plans, combined with vague, inconsistent undesirable results, and (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 2022 GSPs and Management Area Plans were not coordinated in their approach when developing SMC. For example:

- The SOKR GSA GSP established MTs by using a quantitative algorithm derived from historical lows, trend projections, and water level variability (2022 South of Kern River GSP, pp. 14-279).
- The BVWSD GSP established MTs by considering 2011 through 2018 hydrographs and projections of the hydrographs to 2040 as a "worst-case" scenario (2022 Buena Vista Water Storage District GSA GSP, p. 116).
- The KGA GSP SWSD Revised Management Area Plans describes establishing MTs by projecting recent (2010 to 2016) groundwater level trends to 2040 and setting MTs at levels over 200 feet below historic lows (2022 Semitropic Water Storage Management Area Plan, pp. 232-240; 2022 Inadequate Determination, 2023, p. 31).

DWR noted in its 2022 Inadequate Determination that these identified MTs were "below all of the projected water level model scenarios, including the projected climate scenarios that exclude the implementation of the projects and management actions" (2022 Inadequate Determination, 2023, p. 31). This means that MTs were deeper than business-as-usual groundwater level projections.

Due to inconsistent MTs, DWR's 2022 GSP 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 described as significant and unreasonable and would lead to a subbasin-wide undesirable result" (2022 Inadequate Determination, p. 31). Board staff agreed, noting that there are over 100 feet of vertical difference between groundwater level MTs in different management areas of the subbasin.

DWR also noted that the GSPs and Management Area Plans did not consistently explain how groundwater level SMC impact other sustainability indicators. DWR noted substantial inconsistencies in explanations of how groundwater SMC impacted subsidence and groundwater quality (2022 Inadequate Determination, 2023, pp. 18-19).

The 2024 Draft GSPs establish MTs based on methods similar to those in the SOKR 2022 GSP. DWR noted concerns with this method in the SOKR 2022 GSP, stating "…

the minimum thresholds in these [areas using this method in the 2022 GSPs] are still below historical water levels [by up to 100 ft in contrast to 200 ft to the north] of the lowest observed water level. It remains unclear to Department staff why management areas have employed such different approaches to estimate [SMC] that results in a disparate level of *continued groundwater level declines beyond historical lows*" (italics added) (2022 Inadequate Determination, 2023, pp. 31-32).

The new revised method utilizes the lowest of a "range dominated" or "trend dominated" value, the latter being based on a central tendency (average trend) applied for an entire HCM Area's wells. Range dominated trends were calculated using maximum and minimum water level change in elevation values from 2009 to 2022, minus 25% of the change. Trend dominated values were calculated from wells with recent declining trends. The average rate for wells with declining trends for each HCM Area was applied for all wells. These trends were then projected for each RMW-WL to reach the new projected 2030 level. The difference between MOs and MTs would result in 9.3 MAF change in "usable storage" which would account for 4% to 10% of total usable basin storage (2024 Kern County Subbasin Draft GSP, pp. 13-46).

The methodology is not consistent with the requirements of SGMA because:

- The trends that inform MTs are based on broad spatial averages rather than well-specific data. The trend-dominated approach does not consider depletion of supply at the RMW-WL location, because it uses the central tendency of the HCM Area instead. This results in MTs that vary significantly across HCM Area boundaries, despite the RMW-WLs currently experiencing similar conditions and similarly established MOs (2015 lows).
- Some MTs, for example in Olcese GSA, HMWD GSA, and BVWSD GSA, would only be reached if pumping were accelerated. In critically overdrafted basins, MTs should generally not represent groundwater levels that would occur only with increased pumping rates. While Board staff acknowledges 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.
- The MTs and the trends that inform MTs do not differentiate between upper and lower portions of the aquifer system. The methodology assumes that all wells experience the same conditions; however, Board staff observes shallow and deep groundwater levels (confined, unconfined, and semi-confined in transient system) when assessing clustered well data.

- Board staff also notes that MOs were set at 2015 lows. Although this is not explicitly disallowed by SGMA requirements, GSAs should still consider conditions post SGMA implementation (post January 1, 2015). In some cases, water levels are currently well above MOs in the subbasin. For example, water levels at RMW-020 in KRGSA would need to drop 50 feet to reach the 2025 IM. Similarly, to reach the 2025 IM, water levels would need to drop more than 75 feet at RMW-029, more than 100 feet in areas of HMWD GSA, and more than 150 feet at Canyon View Ranch well. MOs should be set at higher water levels where current conditions exceed MOs, and possibly at locations where water levels are below MOs.

2024 Draft GSPs Evaluation: Board staff has determined that the GSAs have made improvements in creating a method that is coordinated and consistently used across the subbasin. However, Board staff finds that this method has not resulted in SMC that are consistent with the requirements of the SGMA in that: (1) the trends that inform MTs are based on broad spatial averages rather than well-specific data and therefore do not represent local conditions of depletion of supply that may cause undesirable results and result in MTs that vary substantially across HCM boundaries, (2) some MTs would never be reached unless pumping accelerated, and (3) the MTs and the trends that inform MTs do not differentiate between upper and lower portions of the aquifer system. Therefore, Board staff offers Potential Action GL-1b for GSAs' consideration to correct this deficiency.

2024 Final GSPs Tentative Evaluation: This deficiency does not appear to be addressed. The GSAs updated the groundwater level methodology to include a 61-foot cap from the most recent (2015-2023) historical low. Although some MTs were improved, the identified issues in the deficiency remain. The method which relies on HCM area declining water level trend averages continue to not account for local conditions which may result in disproportional impacts throughout the basin. This is observed in the well impact analysis where 2% of 90 domestic wells within the Arvin GSA and 45% of 69 domestic wells within the SWID GSA could be dewatered at MTs (2024 Kern County GSP, Appendix Q). Therefore, Board staff finds the deficiency remains for the 2024 Final GSPs.

Additionally, Board staff is concerned that groundwater levels approaching MTs could cause other undesirable results, such as groundwater quality degradation and land subsidence, consistent with the best available science.

Potential Action GL-1b – Revise sustainable management criteria consistent with requirements of SGMA.

Potential actions to correct the MT methodology deficiency include:

- Develop a “trend dominated” approach for representative wells in the upper and lower portions of the aquifer system separately. Revise the method to normalize for spatial variances across HCM Areas to establish levels representative of conditions in the subbasin that will avoid undesirable results consistent with best available science (Helsel, 2020).
- For wells that fall outside of a reasonably set range from the natural central tendency for each HCM Area, determine an alternate range dominated approach appropriate to represent that RMW-WL. Then compare and calibrate values across boundaries.
- Except where banking operations affect localized groundwater level elevations, use the higher of the two proposed values. Then, compare and calibrate values across boundaries. Correct Deficiency GL-2 and conduct impact analyses to check values.
- Set MTs at modeled values that consider project implementation and potential periods of droughts, and are commensurate with reasonable levels of uncertainty to provide operational flexibility below the MO.

In developing SMC, GSAs should also:

- Demonstrate MTs, with banking operations in effect, would not result in an undesirable result and impacts to beneficial users inside or outside of the basin during prolonged periods of drought and banking recovery operations.
- Analyze construction information from the GSAs’ well inventory (based on Online System for Well Completion Reports (OSWCR), USGS, and County record to data) against interpolated MT groundwater surfaces to clearly describe the impacts of MTs on groundwater wells. GSAs should then review analyses for bias in spatial variations using best available science.
- Ensure data and methods result in values consistent with the Todd Groundwater Technical Memorandum. This memorandum establishes overdraft and sustainable yield values for the subbasin and includes detailed water budget summaries, which should inform values selected for SMC.
- Update the Todd Groundwater Technical Memorandum to incorporate SMC when evaluating change in storage or future projected conditions.

Deficiency GL-2 – The GSPs’ monitoring network and mitigation plan are incomplete.

What SGMA Requires: Each plan shall include monitoring protocols adopted by agencies for data collection and management, developed according to best

management practices or similar protocols that will yield comparable data, and shall be reviewed at least every five (5) years as part of a periodic evaluation as necessary (Cal. Code Regs., tit. 23, § 352.2). The plan shall include a summary of monitoring information such as well depth, screened intervals, aquifer zones monitored, and a summary of the type of well(s) relied on for the information including public, irrigation, domestic, industrial, and monitoring wells (Wat. Code. § 10727.2, subd. (e)).

Although SGMA and the GSP Regulations do not require development of a well impact mitigation plan, many GSAs have proposed to couple such plans with MTs to allow for greater groundwater level declines while avoiding undesirable results. The 2024 Draft GSPs state "...the Subbasin GSAs are developing a coordinated and comprehensive Well Mitigation Program to address domestic and small community wells impacted by groundwater level declines" (2024 Kern County Subbasin Draft GSP, pp. 13-27).

Deficiency: The monitoring network does not adequately monitor the upper and lower portions of the aquifer, and well construction data are not disclosed. Similarly, analyses of MT impacts don't differentiate between upper and lower portions of the aquifer. Board staff therefore cannot assess whether the mitigation plan will correct the impacts caused by groundwater management activities.

Deficiency GL-2a – The monitoring network was not developed consistent with the requirements of SGMA.

The 2022 Coordination Agreement did not list all wells to be monitored for chronic lowering of groundwater elevations, nor did it provide a table of SMC. DWR's SGMA Portal's summary of groundwater monitoring well sites contains 234 monitoring wells for the subbasin.[15] Total depth information is not available for 50 of the 234 wells, while the remainder range from 219 to 2,290 ft bgs. Each of the GSAs proposed to monitor their monitoring networks semi-annually, at minimum, using CASGEM wells and production wells. It should be noted that production wells will need to be shut off for sustained periods of time to collect static water levels. No efforts were mentioned to include domestic wells in the monitoring network.

The 2024 Draft GSPs generally rely on consistent representative monitoring wells previously identified in the 2022 plans. A single table of 198 RMW-WL and MT is provided on Table 13-2 in the Main Draft GSP at page 13-15. Depth and construction information for these wells are not explicitly provided in the GSPs, and monitoring wells in the primary principal aquifer are identified as being one hydrologically connected aquifer across the subbasin, despite identification of prominent clay layers in the subbasin for several of the HCM Areas identified (2024 Kern County Subbasin Draft

[15] https://sgma.water.ca.gov/portal/gsp/monitoringsites

GSP, pp. 5-2). Because of the heterogeneous character of most unconsolidated alluvial deposits, confinement is commonly a matter of degree, and the pumping time from an aquifer must be considered (Department of the Interior, 1966). These areas should be monitored separately because there is enough hindrance to the vertical movement of ground water between separate aquifers to produce differences in hydraulic head between the upper and lower portions of the aquifer, especially during periods of heavy pumping, regardless of connectivity.

2024 Draft GSPs Evaluation: The monitoring network does not adequately monitor the upper and lower portions of the aquifer and well construction data are not disclosed.

2024 Final GSPs Tentative Evaluation: This deficiency does not appear to be addressed. The GSAs identified some data gaps for shallow monitoring wells to be addressed within a year, but it remains unclear if they have addressed all areas that may have separate shallow and deep groundwater users. The GSAs developed a monitoring well analysis which compared median user well depths and Kern DMS water levels with RMW data. Board staff continues to have concerns regarding potential impacts to beneficial uses and users if local conditions regardless of degree of connectivity are not considered. Additional work to identify and address data gaps may be warranted. Monitoring well construction information is still missing.

Potential Action GL-2a – Develop a monitoring network consistent with SGMA requirements.

GSAs should include in their summary of monitoring information: well depth, screened intervals, aquifer zones monitored, and a summary of the type of wells relied on for the information, including public, irrigation, domestic, industrial, and monitoring wells (Wat. Code, § 10727.2, subd. (e)). GSAs should add monitoring wells where vulnerable users are present and there are no monitoring wells. Board staff recommends incorporating data and coordinating with existing agencies that have already visited and sampled wells, particularly domestic wells, in the subbasin.

The monitoring network should treat the upper and lower portions of the aquifer as separate conditions if cluster well hydrographs, and any other hydrological data, demonstrate that shallow well groundwater elevations vary from deeper well elevations, especially where shallow wells show evidence of higher groundwater elevations than deeper groundwater wells. This should be considered when the variability between upper and lower portions of the aquifer would disproportionately impact beneficial users if the monitoring well with the lower groundwater elevation was chosen as the RMW-WL and could even result in delayed detection of impacts to users and undesirable results (i.e. subsidence or degradation of groundwater quality). The users most likely to be disproportionately impacted by this approach would be dependent on shallow or deep aquifer areas with lower groundwater elevations. For example, if shallow groundwater

extractors are present and the RMW-WL is screened in the deeper portion of the aquifer, that RMW-WL would not be adequate to capture the impacts to shallow groundwater extractors.

Deficiency GL-2b – The well impact mitigation plan is incomplete.

Details of GSP-proposed well mitigation are summarized above in Section 4.1.2.3. In summary, the 2022 GSPs discussed well mitigation to varying degrees. The BVWSD GSP, the KGA GSP, and the SOKR GSP all stated their intent to develop well mitigation programs. The KRGSA GSP planned to avoid adverse impacts by repositioning pumps, providing alternative water supplies, or reducing pumping rates. Neither the HMWD nor Olcese GSA GSPs discussed well mitigation. Moreover, well mitigation plans were not coordinated across the subbasin, and it was not clear where, if any, well mitigation plans have been implemented.

The 2024 Draft GSPs include a domestic well mitigation plan that includes a basin-wide Self-Help Enterprises letter of intent (2024 Kern County Subbasin Draft GSP, Appendix K). The mitigation plan will provide two weeks' worth of emergency bottled water and a well assessment provided by Self-Help Enterprises (2024 Kern County Subbasin Draft GSP, pp. 14-18). Self-Help Enterprises plans to install a tank system, if necessary, and continue bottled water deliveries until a long-term solution is provided (*Ibid.*). Long-term solutions identified are well repairs, well replacements, and installing new service connections to existing water systems. GSAs determined that it is economically feasible to contribute $1 million per year toward well mitigation, which would mitigate about 15 wells per year, or 255 wells by 2040, which averages to approximately $66,000 per well starting January 2025 (*Id.*, p. 13-5).

Board staff acknowledges and appreciates this improvement for a more coordinated mitigation plan. However, as described in the basin conditions, although it is not basin-extensive, the e-clay covers a large portion of the subbasin and hinders recharge to the lower portions of the aquifer. Because well construction information is unknown for many RMW-WL, the impact analysis cannot differentiate between upper and lower groundwater level SMC, even though upper and lower groundwater levels can be significantly different, regardless of total hydraulic connection. As a result, Board staff cannot evaluate whether the mitigation plan will be able to address impacts.

2024 Draft GSPs Evaluation: Board staff cannot assess whether the mitigation plan will correct the impacts caused by groundwater management activities, because the monitoring network may not be representative of all beneficial uses and users. Board staff has determined that Deficiency GL-2b is not resolved.

2024 Final GSPs Tentative Evaluation: This deficiency appears to be partially addressed. The GSAs have developed a mitigation plan that could repair or replace

domestic wells impacted by declining water levels and degradation of groundwater quality if determined to be caused by management actions. However, Board staff continues to have concerns regarding potential impacts on beneficial uses and users, because it is unclear whether the impact analysis and subsequent budget are adequate. Therefore, the potential action identified remains applicable.

Potential Action GL-2b – Establish an appropriate well impact mitigation program.

The GSAs should reassess their mitigation plan after they update their analysis of the impacts of MTs on domestic wells to consider the upper and lower portions of the aquifer. Importantly, GSAs should confirm that their proposed funding will cover the expected costs to mitigate wells impacted by declining groundwater levels.

GSAs should further ensure their mitigation plan:

- Identifies clear triggers for well mitigation that avoid undesirable results (e.g., employ mitigation prior to a well losing supply).
- Identifies 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 notes that fee revenues levied by the GSAs on groundwater extractions are a more reliable funding source than grants and subsidies.
- Prioritizes 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.
- Identifies 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:

- Lowering pumps.
- Replacing or deepening wells.

- Support for expansion of public water system boundaries to communities that use private wells, 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-TCP, and DBCP, drilling new wells 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 (see deficiency GWQ-3b).

Where GSAs' mitigation plan relies on cooperation with the CV-SALTS program or other regulatory programs, the GSAs should explain the relationship between the mitigation programs, including timelines, mitigation strategies, funding sources, and contribution to funding as appropriate. Board staff encourages demonstrating coordination with existing programs where SGMA objectives may overlap to reduce costs as applicable.

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 PMAs the GSA has determined will achieve groundwater sustainability in the basin. The description must include PMAs, 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)). Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total

annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored (Cal. Code Regs., tit. 23, § 354.18, subd. (a)). Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information (Cal. Code Regs., tit. 23, § 354.18, subd. (c)(1)). Historical water budget information shall be used to evaluate availability or reliability of past surface water supply (Cal. Code Regs., tit. 23, § 354.18, subd. (c)(2)).

SGMA requires a quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon (Cal. Code Regs., tit. 23, § 354.18, subd. (c)(2)(B)). Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components (Cal. Code Regs., tit. 23, § 354.18, subd. (c)(3)).

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 has determined that the 2022 GSPs did not demonstrate that PMAs were feasible or sufficient to prevent undesirable results. Demand management and allocation plans were only defined as PMAs in a portion of GSAs’ areas. Where defined, it was unclear which PMAs would be voluntary or how mandatory demand management PMAs would be enforced.

Board staff also notes concern with water budgets and how they inform PMAs:

- The current water budget appears to include a significant period of time before the Kern Water Bank was fully operational. Board staff cautions that the Kern Water Bank may have changed basin dynamics. The bank represents a substantial change in incoming water, but the bank also supports new agriculture. Board staff cautions that this could impact overdraft calculations.
- The C2VSimFG-Kern groundwater-surface water model simulated future scenarios representing baseline, 2030 climate and 2070 climate conditions, each

with and without the proposed PMAs for a total of six projected scenarios. The GSAs use the 2030 climate change scenario to assess the sustainability of the GSPs. Without PMAs, under this scenario, the subbasin could experience an estimated 372,120 AFY overdraft during the 2041-2070 period. If all PMAs are implemented, the subbasin may experience a surplus of 46,829 AFY. Board staff notes projected overdraft increases by nearly 100,000 AFY from 2030 to 2070 climate change scenario projections (potentially dryer climate conditions). Under the 2070 climate change scenario, if all PMAs are implemented, nearly 45,969 AFY of overdraft could still occur during the 2041-2070 period. This indicates that further PMAs may be required to reach sustainability if the state experiences dryer conditions.

Board staff determined that the 2022 GSPs did not demonstrate that PMAs were feasible or sufficient to prevent undesirable results. The 2022 GSPs did not demonstrate feasibility of projects but relied heavily on projects to demonstrate future sustainability. DWR noted in its 2022 GSP Inadequate Determination that the GSPs relied on more than 180 PMAs to reach sustainability and that, without these PMAs, “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 SWP, CVP, or other sources will vary year-to-year based on statewide hydrogeology and storm flow. Both local and imported sources of surface water have been and will continue to be in high demand as GSAs and other interests 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 did not contain a groundwater allocation plan, though the KRGSA GSP did propose to develop allocation plans. The Todd Groundwater Tech Memo also proposed reallocation of water as a PMA, with reduced banked groundwater and surface water sales to retain water within local authority from leave behind. 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 appeared voluntary and therefore unlikely to provide sufficient contingency in case GSAs failed to secure sufficient, and sufficiently reliable, new supplies or overdraft was greater than estimated.

The 2024 Draft GSPs develop a more clearly coordinated demonstration of PMAs to be implemented by each GSA. However, it is unclear how demand management efforts will be accomplished, and only a portion of the GSAs have defined efforts to remove land from production either permanently or during periods of drought (HMWD, BVGSA, and SWID). The other proposed reductions are conceptual, “as-needed,” voluntary, and/or fee-based with the intention the fees would deter pumping or proposed to only apply to

extractors in non-districted lands. A portion of the GSAs – KRGSA, KTGSA, NKWSD, and RRBWSD – have established allocation plans in place while WRMWSD defines an acreage assessment charge and SWSD defines a landowner owner water budget. Rather than reduce supply, other GSAs propose land retirement for recharge projects. In addition, to reduce extractions, some GSAs have purchased acreage for retirement conversion into supplemental recharge projects. PMAs are summarized in the 2024 Draft GSP, Table 14-4 – 14-23.

The Kern County Subbasin GSAs estimate their groundwater storage deficit to be approximately 274,200 AFY based on historical averages calculated from WY 1995 - WY 2014 (2024 Kern County Subbasin Draft GSP, pp. 9-56 - 9-57). However, during dry years extraction volumes were as much as 2.8 MAF (2024 Kern County Subbasin Draft GSP, Appendix M). Additionally, between 2015-2023, GSAs calculated an average groundwater storage deficit of approximately 344,019 AFY, demonstrating that the average reliance on groundwater has increased (2024 Kern County Subbasin Draft GSP, p. 9-38).

Appendix M states, “Operational Storage does not include subsurface flow with adjacent basins,” and assumes simulated subsurface outflows from projects, which total 27,056 AFY and are not consistent with hydraulic flow concepts, stay in the subbasin. Table 9-7, on page 9-84 of the 2024 Draft GSP, includes a summary of simulated changes in groundwater storage for baseline, 2030 Climate Change Scenario, and 2070 Climate Change Scenario. The table states that over the WY 2040-2070 period, the estimated change in groundwater storage deficit without projects would be 324,326 AFY, 372,120 AFY, and 472,336 AFY for each scenario, respectively. Simulations with projects estimate approximately 85,578 AFY surplus groundwater storage for the baseline, 46,829 AFY surplus for 2030 Climate Change, and 45,969 AFY deficit for 2070 Climate Change scenarios.

2024 Draft GSPs Evaluation: The GSAs do not establish that they are on a path to reach sustainability. Demand management PMAs still lack key details and do not appear to be developed for many parts of the subbasin. The glidepath does not provide sufficient clarity in regard to which PMAs are included in projected paths to sustainability. It is unclear how GSAs will stop overdraft in the subbasin and avoid undesirable results. Moreover, Board staff notes key concerns over water budgets that may indicate that need for further PMAs. Board staff has therefore determined that Deficiency GL-3 is not resolved and proposes Potential Action GL-3a and GL-3b to resolve the deficiency.

2024 Final GSPs Tentative Evaluation: This deficiency appears to remain partially addressed. The GSAs included additional operational water budgets derived from a mass balance analysis that is inconsistent with overlying crop types and with the Todd Groundwater Model. The GSAs continue to appear reliant on various proposed

individual and basin PMAs efforts, currently at various stages of implementation, to reach sustainability. Board staff cannot assess the feasibility of the PMAs without representative water budgets and clarity on PMAs implementation. It remains unclear whether PMAs, if implemented, are feasible and are enough to reach sustainable groundwater management.

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

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 and influenced the passage of SGMA. GSAs should develop plans for the recurrence of such conditions, as well as for conditions that occur in extreme wet years.

GSAs should reevaluate baseline conditions using values consistent with SGMA regulations (Cal. Code Regs., tit. 23, § 354.18). Board staff appreciates the clear list of all PMAs provided by GSAs in the 2024 Draft GSPs with the estimated timetable for completion. However, due to the complexity of the various plans and reliance on various water sources, it should be clear which PMAs volumes were considered in the modeled projections and which, if any, were not. Additionally, Board staff recommends running alternate scenarios that do not consider “conceptual” PMAs. After that, if all PMAs are implemented successfully GSAs should commit to re-evaluating PMAs at annual intervals. GSAs should also consider the following:

- If a project relies on existing water rights, the GSAs should identify the water right identification number(s) and other relevant details. It is unreasonable for the 2024 Draft GSPs to assume that projects which currently lack adequate water rights for implementation can obtain either new water rights or modifications of existing water rights within a timeframe adequate to contribute to the GSPs’ implementation. The GSPs should discuss the timing for obtaining approvals of needed water rights and describe the uncertainties for each PMA, such as water availability in source streams (e.g., will less surface water be available with projected Bay-Delta Plan implementation? Is the source from the inventory of fully appropriate streams or reliant on there being storm flows? Can potential protests be anticipated by other water users?).
- GSAs should be clear on obligations of water expected to be delivered from the Kern County Subbasin to other subbasins, as applicable.

- GSAs should calculate overdraft and sustainable yield based on time periods that are more representative of current conditions. It is unclear if the WY 1995 - WY 2014 period represents current conditions. For example, banking operations have played a critical role in the subbasin for decades. With them, land uses have changed. The largest of the banks, Kern Water Bank, was established in 1995 and major recovery from the bank did not appear to occur until the early 2000's (2022 Coordination Agreement, p. 66). GSAs should consider developing a water budget from a period during which the banks were fully operational. Board staff cautions that water banks have changed basin dynamics considerably by bringing in more water and influencing land uses.

After GSAs re-evaluate their water budget based on more representative conditions, more informed decisions can be made by GSAs implementing PMAs. 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 "[h]elp stabilize groundwater supplies for all groundwater users, including a more drought-resilient agricultural economy" (California Natural Resources Agency, 2022).

GSAs should develop programs that would enable demand management now and identify clear triggers for initiating or ramping up groundwater pumping restrictions when periods of drought occur. GSAs should ensure implementation is done in a manner that is equitable and should mitigate to offset impacts on small farmers or growers who have historically relied entirely on groundwater. Information on the feasibility and timing of proposed supply projects developed for PMAs should inform the scope and timeline and should be sustainable throughout the implementation plan horizon.

Demand management actions could include allocations, pumping cutbacks/ramp-down rates, pumping caps, water trading, and/or fee structures, plus further considerations when PMAs are not able to be implemented. Board staff recommends that users who rely entirely on groundwater with efficient irrigation methods do not share a disproportionate impact of this burden without alternate resources made reasonably available. Additionally, Board staff recommends resources be provided to low-income small farmers to upgrade irrigation efficiencies and provide incentives for efficient farming. Demand management fee structures could include tiered fee structures. Demand management should include consideration of the human right to water, reasonable and beneficial use, and potential economic impacts on all extractors, particularly drinking water users and small farmers.

Potential Action GL-3b – 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.

The 2070 Climate Change projections indicate that the basin will be in overdraft even with PMAs. To prepare for dryer conditions, Board staff recommends GSAs develop basin-wide allocations that use groundwater elevations as a key metric. Groundwater levels in key representative monitoring wells are the clearest and simplest empirical data that reflect groundwater conditions in the subbasin. GSAs should identify key indicator wells in each of the three subbasin aquifers (Principal (confined, semi-, and unconfined), Olcese, and Santa Margarita) that will serve as index wells that trigger pumping cutbacks when groundwater levels decline to critical groundwater elevations outside of expected scenarios. Indicator wells should have sufficient spatial coverage to be representative of beneficial uses and users; drinking water users should be represented by indicator well(s) that reflect shallow groundwater conditions in the same portion of the aquifer as those wells.

GSAs should 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 applicable aquifer. 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 potential 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 if conducted according to the best available science and using the best available data and methodologies.

Deficiency GL-4 – The GSPs do not define groundwater storage sustainable management criteria consistent with the requirements of SGMA.

What SGMA Requires: The MT for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, and calculated based on historical trends, water year type, and projected water use in the basin (Cal. Code Regs., tit. 23, § 354.28, subd. (c)(2)).

Deficiency: The undesirable result definition in the 2024 draft GSPs is stated as,

> The point at which significant and unreasonable impacts, as determined by the amount of groundwater in the basin, affect the reasonable and beneficial use of, and access to, groundwater by overlying users over an extended drought period (2024 Kern County Draft GSPs, p. 13-44).

This is defined as occurring when there is a cumulative reduction in usable groundwater storage in the Primary Principal Aquifer of more than 9.3 MAF relative to the baseline total usable storage volume. The GSPs states that the reduction of 9.3 MAF in usable storage is not unreasonable (*Ibid*.). GSAs define storage as “usable storage” but only specific to the Primary Principal Aquifer (*Ibid*.). Board staff concurs that usable storage considerations are more protective to beneficial uses and users than total groundwater storage and their reliability of supply but acknowledges there are significant uncertainties associated with loss of “usable storage” values. Specifically, the GSPs states that if all MTs are met, 4% to 10% of storage loss would occur, and therefore the loss would not be considered significant and unreasonable (*Ibid*.). This range is based on total usable storage values of 90 MAF – 260 MAF. However, these storage values appear to include areas in the subbasin that include clay layers, exempt areas, and areas or poor groundwater quality (*Ibid*.). This means that the calculated percentage of lost usable storage is likely too low.

Additionally, the GSAs do not explain why a loss of 9.3 MAF would not constitute an undesirable result. It appears that GSAs simply calculated the volume of storage that would be lost if groundwater levels reached groundwater level MTs. Board staff acknowledges that a loss of 9.3 MAF may be a reasonable quantitative definition for the reduction in groundwater storage undesirable result, but it is important that undesirable results for each sustainability indicator be carefully considered. GSAs should evaluate groundwater overdraft during previous droughts to determine how much storage must be maintained to ensure groundwater supply reliability for future droughts.

2024 Draft GSPs Evaluation: The GSAs do not demonstrate that the 9.3 MAF quantitative definition undesirable result has been defined consistent with the requirement of SGMA.

2024 Final GSPs Tentative Evaluation: This deficiency does not appear to be addressed. The GSAs have not revised their methodology used to calculate groundwater storage.

Potential Action GL-4 – Redefine undesirable result for reduction of storage.

GSAs should define the quantitative definition of an undesirable result as the total volume of groundwater that can be withdrawn without causing an undesirable result. GSAs should consider sustainable yield, historical trends (see GL-3), water-year type, and projected water use in the basin when defining the undesirable result. Additionally, usable storage should include only aquifers where groundwater is being extracted for beneficial use and should exclude areas where the basin setting identifies conditions that are not supportive of beneficial use of the subbasin. This does not infer these areas are exempt from SGMA impact or monitoring, only that they do not meet the definition of "usable storage."

Secondly, GSAs should explain their reasoning for variations in "usable storage" and how storage relates to other sustainability indicators, especially chronic lowering of groundwater levels and groundwater quality.

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 such as roads (and other transportation structures) and aqueducts (among other water conveyance structures). Land subsidence can also exacerbate flood risks in some regions, and diminish the storage capacity of an aquifer, which reduces the amount of available water for the future.

DWR concluded that the 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). In the Draft Staff Report, Board staff built on DWR's analysis, noting that subsidence may substantially impact the Friant-Kern Canal and California Aqueduct and concluded that the 2022 GSPs lacked a detailed analysis of the effects of subsidence on all beneficial uses and users within the subbasin. Board staff

therefore concluded that significant and unreasonable subsidence may occur under the 2022 GSPs.

The Kern County GSAs submitted seven draft 2024 GSPs for Board staff review on May 28, 2024. Board staff initially conducted a preliminary review of these 2024 Draft GSPs prior to the release of the Draft Staff Report. The purpose of the preliminary review was to determine whether the basin had made sufficient progress toward addressing the DWR-identified deficiencies. After the preliminary review, and a subsequent more thorough review, Board staff concludes that deficiencies related to the impacts of land subsidence persist. Table 4-5, below, summarizes the key aspects of the land subsidence deficiency and relevant components from the 2020, 2022, and 2024 Draft Kern County Subbasin GSPs.

Table 4-5 – Summary of Land Subsidence Deficiency and Relevant Components of the 2020, 2022, and 2024 Draft Kern County Subbasin GSPs

2020 GSPs	DWR's 2020 GSP Incomplete Determination
There is no basin-wide definition of critical infrastructure in the subbasin. The 2020 Coordination Agreement defined undesirable results for land subsidence in the subbasin 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).	DWR stated that, "[b]ecause 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." (2020 Incomplete Determination, p. 38).
2022 GSPs	**DWR's 2022 GSP Inadequate Determination**
A new definition was established for "Regional Critical Infrastructure" and "Management Area Critical Infrastructure."	DWR staff stated, "the Plan made progress in moving towards coordinated Subbasin-wide subsidence management by establishing sustainable management criteria for the

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.” (2022 Coordination Agreement, Appendix 3).	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).
2024 Draft GSPs	**Board Staff 2024 Draft GSPs Evaluation**
GSAs define regional, critical, and other infrastructure in the subbasin. (2024 Kern County Subbasin Draft GSP, p. 13-76). The 2024 GSPs define undesirable results as, “[t]he point at which the amount of subsidence, if caused by GSA-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.” (2024 Kern County Subbasin Draft GSP, p. 13-75). A more coordinated approach to defining undesirable results and establishing SMC was used, including a “risk-based” method.	Board staff acknowledges more work was done to further improve subbasin-wide coordination on subsidence. However, there remain issues with the plain-language and quantitative definitions of undesirable results and the MT exceedance policy. There are also questions about the methods used to establish subbasin-wide SMC and the development and implementation of PMAs to address subsidence. Thus, Board staff has provided potential actions to address these subsidence deficiencies.

4.1.3.1 Kern County Subbasin 2020 Groundwater Sustainability Plans

On January 23, 2020, five GSPs were submitted to DWR in compliance with the applicable SGMA deadline. Upon review, DWR found the 2020 GSPs incomplete and provided corrective actions related to the identified deficiencies. DWR's determination of the 2020 GSPs was released on January 28, 2022. The GSAs were given 180 days to address corrective actions and required to adopt such modifications into their respective GSPs. In the preparation of the Draft Staff Report, Board staff reviewed the 2020 GSPs and concurs with DWR's findings. For a summary of Board staff's review of the 2020 GSPs, see Appendix D.

4.1.3.2 Kern County Subbasin 2022 GSP Submission

The Kern County Subbasin 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 Kern County Subbasin GSAs' 2022 Coordination Agreement developed definitions for undesirable results and critical infrastructure for land subsidence. The Coordination Agreement defined 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 Coordination Agreement, Appendix 3, p. 363).

The Kern County Subbasin adopted two classifications for critical infrastructure: Regional Critical Infrastructure and Management Area Critical Infrastructure. Regional Critical Infrastructure was 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 meet the definition for Regional Critical Infrastructure are the California Aqueduct and the Friant-Kern Canal" (*Id*., p. 355).

The 2022 Coordination Agreement then defined the undesirable results for Regional Critical Infrastructure as follows:

- For the California Aqueduct, "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" (*Id*., pp. 363-364).

- For the Friant-Kern Canal, "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 Friant-Kern Canal 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" (*Id*., p. 395).

Management Area Critical Infrastructure was 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" (*Id*., p. 355).

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

The 2022 Coordination Agreement explained that the SMC for subsidence would be interim (valid until 2025) due to "significant data gaps" and the new SMC would be established in 2025, informed by subsidence modeling and data from additional studies (2022 Coordination Agreement, Appendix 3, p. 363).

The 2022 Coordination Agreement defined the interim MOs 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" (2022 Coordination Agreement, p. 367).

The interim MT for the California Aqueduct followed 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 GSAs calculated the average observed rate (MO) and the twice average observe rate (MT) to be -0.05 and -0.1 feet per year, respectively (*Ibid*.).

For the Friant-Kern Canal, the 2022 Coordination Agreement defined the interim MT as the "average annual rate of subsidence over the last 6 years and the corresponding total interim extent from 2022 until 2040" (2022 Coordination Agreement, p. 367). Using available data, the GSAs established -0.2 feet per year as the Friant-Kern Canal MT (*Ibid*.).

The 2022 Coordination Agreement stated the quantitative undesirable result for Regional Critical Infrastructure was "the occurrence of a single minimum threshold exceedance along either the [California] Aqueduct or the Friant-Kern Canal." (2022 Coordination Agreement, p. 367)

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

Quantitative undesirable result definitions for Management Area Critical Infrastructure were inconsistent. For example:

- The Olcese GSP indicated that an undesirable result would occur when subsidence caused the Olcese Water District canal to lose 25% of its capacity, which the GSP indicated would occur if one monitoring location subsided 0.75 feet more than another[16] (2022 Olcese Water District GSP, p. 84).
- The AEWSD Management Area Plan indicated that an undesirable result would occur if "[subsidence] rates observed during the 2014 – 2018 time period were to continue through 2020," which it considered to have occurred if the "MT is exceeded in at least 40% [of Representative Monitoring Sites]" (2022 South of Kern River GSP, pp. 120-121).
- The RRBWSD Management Area Plan did not establish undesirable results for its critical infrastructure. It instead indicated that a "management area exceedance"[17] occurs when the "average measured subsidence rate at the

[16] The Olcese Water District GSP calculated the change in gradient that would result in 25% capacity loss, established two monitoring locations along a canal that it considered critical infrastructure, and defined the MT as the differential subsidence between the two locations that would change gradient enough to lose 25% of canal capacity.

[17] 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 KGA GSP "List of Kern Subbasin Definitions" explicitly indicates that a Management Area Exceedance is not an Undesirable Result.

representative monitoring sites exceeds the established minimum threshold over a six-year rolling average" (2022 Rosedale Rio Bravo Management Area Plan, p. 107).

- The Cawelo GSP also defined "management area exceedances" rather than undesirable results. The GSP considered a management area exceedance to be an additional one foot of subsidence, which it considers to have occurred after just one MT exceedance - except that it used groundwater level MTs as a proxy for subsidence (2022 Cawelo Water District Management Area Plan).

The 2022 Coordination Agreement described a number of efforts the GSAs had undertaken since 2020 to fill subsidence-related data gaps, including:

- Performing a baseline subsidence and infrastructure status assessment of the California Aqueduct and other critical infrastructure in the subbasin.
- Preparing a revised basin study.
- Planning installation of additional subsidence monitoring sites in consultation with DWR CASP and the Friant Water Authority (FWA) (2022 Coordination Agreement, pp. 355-356).

The 2022 Coordination Agreement also claimed that the GSAs still needed to better understand the causes and rates of subsidence to better define realistic management objectives. To fully quantify the causes of subsidence and establish data-based MTs and MOs for critical infrastructure, the GSAs stated they would "install extensometers, near the Friant-Kern Canal, and work in close consultation with DWR- CASP and [FWA] to update and interpret new InSAR and oilfield data" (2022 Coordination Agreement, p. 356). The GSAs also committed to working cooperatively with both DWR CASP and the FWA "in the planning and installation of other geodetic-based monitoring technology" in the subbasin (*Ibid*.).

For the California Aqueduct, GSAs were to assess subsidence in a five-mile-wide monitoring corridor (i.e., 2.5 miles on either side of the California Aqueduct) using the DWR subsidence monitoring reports (2022 Coordination Agreement, p. 364). GSAs would have ground-truthed the InSAR data by comparing the InSAR subsidence against the subsidence values from existing National Oceanic and Atmospheric Administration (NOAA) Continually Operating Reference Station System (CORS) and Continuous Global Positioning System (CGPS) stations, and available local extensometers in or adjacent to the California Aqueduct monitoring corridor. This review was to happen on at least 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 GSAs planned to coordinate with FWA to fill data gaps and develop 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 (2022 Coordination Agreement, p. 398). The 2022 Coordination Agreement stated that "land-based monitoring of focused areas of interest will be established utilizing survey control points and NOAA CORS. A DWR grant also provided 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, but did discuss potentially developing a plan in the future. The Coordination Agreement stated 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" and "[o]nce the subsidence modeling is complete, the Kern County Subbasin will develop and implement any necessary mitigation plan" (2022 Amended Coordination Agreement, 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 funding or mitigating the impact of subsidence on any land uses and infrastructure including wells.

Projects and Management Actions

The categories of the proposed future (WY2021–2040) management actions to project future water budget in the subbasin did not change significantly in the revised 2022 Coordination Agreement (2022 Amended Coordination Agreement, p. 22). The KGA umbrella 2022 revised GSP listed 143 PMAs from 15 member entities and the implementation status, benefits of the project, and project description for each PMA (2022 Kern Groundwater Authority GSA GSP, Table 4-1). The number of projects decreased compared to 2020, as the number of member entities dropped from 18 to 15 and some entities added or removed projects.

The Olcese 2022 GSP provided 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 suggested a project for demand reduction due to land fallowing in dry years 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 listed the same management actions as 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 proposed management actions to support achievement of the sustainability goal and grouped 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 stated 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 identified more details on the status of projects, completion timetable, potential funding, and source of water for the supply augmentation projects (*Ibid*.).

4.1.3.3 Kern County Subbasin 2024 Groundwater Sustainability Plan Submission

The Kern County Subbasin GSAs submitted seven draft 2024 GSPs for Board review on May 28, 2024. The GSAs all submitted the Kern County Subbasin GSP, but six of the seven GSPs included “Blue Pages” that contain additional information relevant to each of the six respective areas covered by individual GSPs. This subsection describes the portions of the 2024 Draft GSPs that are relevant to the proposed Board land subsidence deficiencies identified in section 4.1.3.4.

Plain-language Definition of an Undesirable Result

The 2024 Draft GSPs define the subbasin-wide undesirable result for Land Subsidence as follows:

> The point at which the amount of subsidence, if caused by GSA-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 (2024 Kern County Subbasin Draft GSP, p. 13-75).

The GSAs identified all groundwater production wells (agricultural, domestic and small community users, municipal and public water systems, and industrial users), totaling approximately 7,227 wells, as beneficial users of groundwater who may potentially be

impacted by land subsidence (*Id.*, p. 13-2). In addition to those wells, the subbasin also considered land uses and property interests that may be impacted by land subsidence. For this effort, the subbasin adopted three classifications for critical infrastructure (one more than the 2022 Coordination Agreement): Regional Critical Infrastructure, GSA Critical Infrastructure, and other 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 subsidence, if caused by GSA-related Subbasin groundwater extractions, would have significant impacts to beneficial users. 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" (*Id*., p. 13-76).
- GSA Area Critical Infrastructure is defined as "infrastructure located within a particular GSA whose loss of significant functionality due to subsidence if caused by GSA-related Subbasin groundwater extractions would have significant impacts to beneficial users within that GSA. Each Subbasin GSA has identified their respective GSA Area Critical Infrastructure" (*Ibid*.).
- Other infrastructure is defined as "other water supply, water conveyance, water treatment, transportation, or interstate gas distribution pipelines not included under Regional Critical Infrastructure or GSA Area Critical Infrastructure" (*Ibid*.).

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

The 2024 Draft GSPs provide the following as the criteria for undesirable results, but do not explicitly state a quantitative definition:

> [Undesirable Results] for Land Subsidence are defined to occur within the Subbasin if and when the MT extent of subsidence is exceeded at any of the Subbasin's Representative Monitoring Sites for Land Subsidence (RMS-LS) or as measured using InSAR data published annually by DWR averaged across an HCM area. (2024 Kern County Subbasin Draft GSP, p. 13-83).

The criteria are said to be justified as "an exceedance of the MT extent of GSA-related subsidence at any RMS-LS could interfere with the functionality of critical infrastructure and require significant mitigation to avoid impacts to beneficial users. Only the exceedance of the MT extent of subsidence triggers a [sic] [undesirable result]. Per the subbasin's MT exceedance policy (Section 16.2.1), exceedance of the MT subsidence rate in any one year would trigger monitoring, and exceedance of the MT subsidence

rate over any two years would trigger investigation and potential initiation of P/MAs" (*Ibid*.).

The MTs for land subsidence are defined as follows:

> …levels of land subsidence that, if they occurred, would result in [undesirable results] to surface land uses and Regional and GSA Area Critical Infrastructure, which is identified in Section 13.5.1.1. The MTs… are [expressed] in terms of total vertical extent of land subsidence (in feet) from 2024-2040, as well as a corresponding average annual rate of subsidence (in feet per year) measured quarterly and reported annually… (2024 Kern County Subbasin Draft GSP, p. 13-84).

MTs for the entire subbasin are further established as:

> … the maximum observed average subsidence rate in each HCM area from 2015 to 2023 as determined by InSAR data published by DWR [and] [s]eparate SMCs are established in areas susceptible to future land subsidence… (2024 Kern County Subbasin Draft GSP, p. 13-85).

For areas where subsidence is attributable to non-GSA activities, "…MT rates are set as the observed average subsidence rate in each HCM area from 2015 to 2023 and the MT extent is set as the cumulative amount of subsidence at that rate from 2024 to 2040…" with GSAs acknowledging that they will continue to monitor subsidence in these areas and coordinate with other entities that are influenced by non-GSA subsidence, and collaborate with relevant regulatory agencies to demonstrate a lack of GSA-related subsidence if non-GSA activities are contributing to subsidence along critical infrastructure (*Ibid*.).

The subbasin used a five-step approach in MT development:

1. Identify areas with historical land subsidence or potential for future land subsidence (2024 Kern County Subbasin Draft GSP, p. 13-84).
2. Identify areas of the subbasin where agricultural, municipal and industrial pumping (i.e., GSA-related causes) occur and potentially contribute to subsidence (*Id*., p.13-85).
3. Classify the potential for subsidence due to GSA-related activities to cause significant and unreasonable impacts (*Id*., p. 13-86).

   For areas in the subbasin with agricultural or M&I pumping, subsidence potential was divided into four categories based on historical InSAR cumulative subsidence from 2015 to 2023:

   High: Greater than 3 feet

Moderate: 1 to 3 feet

Low: 0.33 to 1 foot

Minimal: less than 0.33 feet (*Id*., p. 13-86).

4. Project future rates and extents of subsidence to assess potential significant and unreasonable impacts on infrastructure.

5. Develop risk-based SMC

   The risk-based SMC consider the subsidence potential and vulnerability of surface land uses to impacts caused by subsidence. For Regional Critical Infrastructure, MTs are based on observed and allowable rates of subsidence. For GSA Area Critical Infrastructure, MTs are proposed for infrastructure with low to high potential and vulnerability to subsidence. For all other infrastructure and areas of the subbasin with minimal subsidence potential, SMC are based on the historical rate of subsidence by HCM Area, as is depicted in Table 13-8 in the 2024 Draft GSPs (*Id*., p. 13-102).

According to the 2024 Draft GSPs, the only infrastructure where maximum future subsidence and change in slope is expected to lead to unreasonable impacts is along a section of the Friant-Kern Canal (2024 Kern County Subbasin Draft GSP, p. 13-102). The highest estimated future subsidence extent in the subbasin is 4.41 feet, located near the northern boundary and is attributed to higher subsidence rates in the subbasins to the north of Kern (*Ibid*.). Local impacts in this region, if they occur and are caused by GSA-activity, will be addressed via mitigation (*Id*., p. 13-103).

<u>Regional Critical Infrastructure SMC</u>

Northern Aqueduct MT: within the five-mile-wide CASP buffer zone the MT is defined as the avoidance of a permanent loss of conveyance capacity due to subsidence as limited by the remaining concrete liner freeboard for a specific aqueduct pool that exceeds twice the average observed rate from 2016-2022. For example, for pools 23-30, twice the average observed rate was calculated to be 0.1 feet per year, which equates to an MT subsidence extent of 1.6 feet from 2024-2040. Since this portion of the California Aqueduct has significant non-GSA activity, an MT exceedance would trigger an assessment of the cause – if the exceedance is related to non-GSA activity it will be defined as outside of GSA authority to manage and the relevant regulatory agency will be contacted (2024 Kern County Subbasin Draft GSP, p. 13-104).

Southern Aqueduct MT: CASP maintains a minimum freeboard requirement of 2.5 feet within the southern pools, thus the undesirable results are defined as available freeboard falling below 2.5 feet. The MTs are defined as 75% of the difference between the reported 2016 freeboard and the 2.5 feet of minimum freeboard requirement for

each benchmark location in the southern portion of the California Aqueduct (2024 Kern County Subbasin Draft GSP, p. 13-106).

Friant-Kern Canal MT: The FWA's position on subsidence along the canal is "any unmitigated conveyance loss due to subsidence beyond 2020 would lead to undesirable results" (2024 Kern County Subbasin Draft GSP, p. 13-111). The subbasin proposed MT for the canal is a five-year annual average rate of 0.1 feet per year with a maximum three feet of cumulative subsidence from 2015-2040. Subsidence should be minimized through demand reduction and other PMAs beyond 2040.

GSA Area Critical Infrastructure SMC

This includes infrastructure such as the Calloway Canal, Lerdo Canal, Beardsley Canal, Cross Valley Canal, Kern River Canal, Arvin-Edison Water Storage District Canal, Olcese Canal, Interstate 5, and Highway 99. The amount of projected subsidence in these areas is similar to the historical (2015-2023) conditions. A change in slope analysis for most of these infrastructure facilities yielded a result of less than 0.1 feet/1000 feet (0.01%), with the maximum change (~0.3 feet/1000 feet or 0.03%) occurring along the Arvin Edison Canal. These slope changes are not predicted to lead to significant differential subsidence impacts, and thus they can be dealt with by retrofitting and upgrades. Nevertheless, Arvin GSA is monitoring that region of the canal at five RMS annually (2024 Kern County Subbasin Draft GSP, p. 13-114).

Other Critical Infrastructure SMC

The projected subsidence through 2040 is not expected to cause significant and unreasonable impacts to other infrastructure as a result of differential subsidence. The subbasin cites as an example the High Speed Rail maximum acceptable change of grade of 0.1% (1 foot/1000 feet) being nearly 10 times greater than the maximum change of slope estimates for other infrastructure. Thus, the subbasin set the MTs as the average historical subsidence rates and extents in each HCM Area projected from 2024-2040 (2024 Kern County Subbasin Draft GSP, p. 13-114).

Measurable Objectives and Interim Milestones

Measurable objectives are set at half the rate and extent of the MTs for the given HCM Area from 2024-2040 (2024 Kern County Subbasin Draft GSP, p. 13-132). IMs were set to follow a glidepath in five-year increments, at 25% of the MT extent in 2025, 40% in 2030, and 45% in 2035 (*Ibid.*).

Relationship with other sustainability indicators

Within the subbasin, chronic lowering of groundwater levels has been associated with historical land subsidence, and the GSAs are working to incorporate subsidence into the subbasin groundwater flow model. The results of the model will be used to ensure

subsidence MTs are protective of groundwater level MTs. Subsidence caused by chronic lowering of groundwater levels to the proposed MTs is not projected to exceed subsidence MTs. Groundwater level IMs increase after 2030, which hypothetically provides a 10-year period where residual subsidence may occur and be addressed between 2030 and 2040 (2024 Kern County Subbasin Draft GSP, p. 13-123). Subsidence could lead to a reduction of groundwater storage due to dewatering and compaction of fine-grained layers during pumping. The 2024 Draft GSPs state that groundwater level MTs and SMC are protective of groundwater storage and would avoid undesirable results. The GSAs developed a correlation between groundwater levels and groundwater storage reduction; thus, they conclude subsidence MTs will not lead to unreasonable reduction of groundwater storage (*Ibid*.). The GSAs evaluated correlations between groundwater quality constituents and subsidence and found no significant correlations; only arsenic saw weak negative correlations with subsidence in the North Basin HCM (*Ibid*.). They also did not find correlations between depletion of ISW and subsidence (*Ibid*.).

Consideration of adjacent basins

According to the 2024 Draft GSPs, MT extents proposed by the Kern County Subbasin GSAs are lower in magnitude and more protective than those established in the subbasins to the north, where most of the subsidence is concentrated. The subbasin GSAs are also working with the White Wolf Subbasin to develop a consistent approach to subsidence SMC (2024 Kern County Subbasin Draft GSP, p. 13-124).

Impacts to beneficial users

The 2024 Draft GSPs state that subsidence MTs are set to maintain functionality of Regional and GSA Area Critical Infrastructure and avoid undesirable results to surface land uses. For the Northern Aqueduct, MTs were set to avoid permanent loss of conveyance capacity related to GSA activity by limiting the reduction of remaining concrete freeboard in Pools 23-30. However, the 2024 Draft GSPs suggest non-GSA activity is the primary cause of subsidence along this section of the California Aqueduct, thus some of the subsidence will be outside of GSA authority to manage (*Ibid*.). For the Southern Aqueduct, MTs are set above the minimum 2.5 feet of freeboard and therefore should maintain the functionality of the aqueduct between pools 31 and 35. MTs have been set at 67 individual benchmark locations along this stretch. The FWA's Hydrological Engineering Center – River Analysis System (HEC-RAS) Friant-Kern Canal model identified two sections within the subbasin where subsidence impacts resulted in permanent loss of conveyance capacity: Mile Post 122.85-125.29 and Mile Post 130.05-137.2. If subsidence occurred at historical rates going forward, these two sections would lose enough freeboard to prevent conveyance. GSAs are currently working with FWA on mitigation studies, cost estimates, and cost allocations based on attribution of subsidence (*Id*., p. 13-126). Based on historical subsidence rates along

various types of linear infrastructure (e.g., various canals, Interstate 5, and Highway 99), the GSAs are not expecting significant and unreasonable impacts to occur (*Ibid*.). Various other types of infrastructure (e.g., railroads, oil and gas pipelines, water treatment plants, domestic, agricultural and other wells, buildings and county roads, and flood control structures) are not expected to experience significant impacts related to subsidence at the MTs developed by using the average historical subsidence in each HCM Area (*Id*., p. 13-128).

The 2024 Draft GSPs identify some GSA Area Critical Infrastructure (e.g., Calloway Canal, Lerdo Canal, Olcese Canal, Interstate 5, and Highway 99), and Other Infrastructure (e.g., railroads, interstate oil and gas pipelines, water treatment facilities, domestic, agriculture and other wells, and buildings and county roadways), in Table 13-12 (2024 Kern County Subbasin Draft GSP, p. 13-117). This table identifies the GSAs in which specific infrastructure is located and the SMC that have been applied to them, however it does not appear to represent all critical infrastructure in the basin that are shown in the 2024 Draft GSP's Figures 13-17 and 13-19 (*Id*., p. 13-76). Additional information or assessment of critical infrastructure presented by the other 2024 Draft GSPs' Blue Pages in the subbasin is provided below.

The BVWSD GSA, HMWD GSA, KTWD GSA, and Olcese GSA do not provide additional details on GSA Area or Other Critical Infrastructure in their Blue Pages, nor did they propose a subsidence mitigation plan or subsidence specific PMAs. The BVGSA does state it has a water surplus, and no target deficit has been assigned to it by the Kern County Subbasin (2024 Buena Vista GSA Draft GSP, pp. BP-14-1). It also states the GSA has established a "reserve fund" to support implementation of KSB-5 Domestic Well Mitigation, though the amount in the fund is not specified (2024 Buena Vista GSA Draft GSP).

The SWSD GSA identified infrastructure related to the groundwater bank, such as recovery wells, conveyance pipelines, regulating basins and pump stations, and ancillary facilities – however, they were not discussed in the context of subsidence and its potential impacts to infrastructure (2024 Semitropic Water Storage District Draft GSP, pp. BP-5-2). The GSP does not propose plans to mitigate the potential impacts of subsidence (*Ibid*.).

The WDWA notes that the California Aqueduct is the only Regional Critical infrastructure impacted by subsidence in its GSA area; it does not identify any GSA Area or Other Critical Infrastructure that may potentially be impacted by subsidence within the GSA boundaries (2024 Westside District Water Authority Draft GSP, pp. BP ES-3). The GSP does not include a subsidence mitigation plan; it claims the primary cause of subsidence along the aqueduct (Mile Post 195-215) is non-GSA activity (*Id*., p. BP 8-2). WDWA has funded studies to fill data gaps regarding the cause of subsidence along the aqueduct and has developed the following PMAs to limit any future GSA-related

subsidence: mandatory well registration for all landowners within WDWA GSA; well extraction volume reporting within the five-mile CASP buffer zone; and a “net-zero” well drilling moratorium within the CASP buffer zone (*Id*., p. BP 8-4).

Representative Monitoring Sites and Monitoring Network

The subbasin has 145 monitoring sites specific to subsidence, consisting of extensometers, Global Positioning System (GPS) benchmarks, survey locations, and InSAR (2024 Kern County Subbasin Draft GSP, Appendix X, pp. 15-3). The monitoring sites were selected based on their proximity to critical infrastructure as well as to anticipate future subsidence issues across the subbasin (*Id*., p. 15-31). InSAR data (TRE Altamira) will be acquired from DWR and verified against benchmarks and GPS stations. The data will be used to generate time-series that monitor subsidence rates and extents across the subbasin (*Ibid*.). Adjacent to the Friant-Kern Canal, NKWSD and NOAA have 21 and 15 surveyed benchmark locations, respectively. Along the California Aqueduct CASP has surveyed benchmark locations, new extensometer data (to help “ground-truth” InSAR), and plans to install additional monitoring wells between 2023-2025. There are two USGS extensometers and a third under construction near the Friant-Kern Canal. There are five University NAVSTAR Consortium (UNAVCO) GPS stations and seven Scripps Orbit and Permanent Array Center (SOPAC) GPS stations in the subbasin. DWR maintains 67 GPS survey locations and monitors an extensometer in the Kern Water Bank. AEWSD has five survey locations along its canal (*Ibid*.). Appendix X indicates there are 15 NOAA Online Positioning User Service (OPUS) Benchmarks, 21 historical benchmarks, 21 NKWSD benchmarks, 12 continuous GPS locations, four extensometers, five new survey locations, and 67 DWR Aqueduct survey locations in the monitoring network throughout the subbasin (2024 Kern County Subbasin Draft GSP, Appendix X). InSAR data are to be downloaded on a quarterly basis, while benchmark survey data will be acquired annually (*Id*., p.15-38). Table 16-1 indicates that only InSAR and Benchmark Survey data are to be collected and reported to DWR (*Id*., p.16-2).

The critical infrastructure matrix from Section 13.5 of the 2024 Draft GSPs sets the framework for establishing subsidence SMC and the approach to monitoring for it within the subbasin. The 2024 Draft GSPs state that GSAs will evaluate InSAR and site-specific data annually to assess whether modifications to the monitoring network are needed (2024 Kern County Subbasin Draft GSP, p.15-41). Each GSA is obligated to report data to the Kern County Subbasin Data Management System (DMS), from there it will be compiled and reported to DWR (*Id*., p. 15-42).

Infrastructure Mitigation

The 2024 Draft GSPs do not detail a specific mitigation plan, or cost estimates, for impacted or potentially impacted infrastructure except for one section of the Friant-Kern Canal (2024 Kern County Subbasin Draft GSP, Appendix T). Mitigation details are not provided in any of the 2024 Draft GSPs or their Blue Pages, though WDWA does discuss its plans to implement PMAs that will reduce the potential for GSA-related subsidence along the California Aqueduct. It is mentioned that GSAs are coordinating with public agencies that are participating in the update of the California Governor's Office of Emergency Services (Cal OES) Hazard Mitigation Plan, though the extent of their involvement is not detailed (*Id*., p. 13-130). No additional mitigation plans are proposed, planned, or discussed for impacts of subsidence.

The subbasin GSAs are working to implement a well mitigation program that is to be managed within the respective GSAs in partnership with Self-Help Enterprises (2024 Kern County Subbasin Draft GSP, Appendix T). This mitigation program does not appear to account for the potential impacts that subsidence may have on wells, because the GSAs do not anticipate significant subsidence-related impacts to wells in the subbasin (*Id*., p. 13-129). It is unclear, however, whether the mitigation plan would remedy such impacts if they do occur. As it is currently devised, the $1 million in annual funds for well mitigation appear to be allocated specifically for well mitigation related to dewatering domestic wells (*Id*., p. 13-4). Kern County Subbasin PMA KSB-1 is cited as a project that will be used to mitigate GSA-related subsidence impacts to wells as described in Section 14.2.3 of the GSP PMAs (*Id*., p. 13-103). This is the previously existing Friant-Kern Canal capacity mitigation plan, which is focused on mitigating subsidence related conveyance loss along sections of the canal (*Id*., p. 14-17). Mitigation of wells impacted by GSA-related subsidence is not addressed in KSB-1 in the main body of the 2024 Draft GSPs nor Appendix T, which is cited in GSP Section 14.2.3.

Projects and Management Actions

KSB-1 (Friant-Kern Canal Capacity Mitigation) is an ongoing project that aims to work with FWA and other relevant agencies to minimize subsidence along the Friant-Kern Canal (i.e., pumping reductions) and mitigate the impacts of subsidence (i.e., raising liners to increase freeboard) (2024 Kern County Subbasin Draft GSP, Appendix T; 2024 Kern County Subbasin Draft GSP, Appendix S). This is the only proposed PMA that would explicitly address the impacts of subsidence. There are numerous other PMAs, in varying stages of implementation, that list subsidence as an "As-Needed" relevant sustainability indicator as per Tables 14-4 through 14-23 in the 2024 Draft GSPs. However, most of these PMAs are focused on exercising water rights, new local

supply/supplemental water use, increasing surface supply, land fallowing/conversion and demand reduction, in-lieu recharge, or water banking. Some of these PMAs are: AE-25 (Arvin-Edison groundwater extraction quantification method), AE-26 (incentives for land conversion/retirement in Arvin-Edison), KSB-6 (White land demand management), AE-29 (Groundwater allocation per acreBV-2 (Palms recharge project), BV-3 (Corn Camp recharge project), BV-4 (Annexation demand reduction project, CWD-1 (new water supply purchases), CWD-4 (new Cawelo GSA banking partners), CWD-6 (water treatment facilities for oilfield produced water), CWD-11 (crop conversion and irrigation efficiency), EWMA-7 (agricultural demand reduction), HMWD-1 (demand reduction due to land fallowing), HMWD-2 (maximize water banking during wet years), KRGSA-7 (expand recycled water use in KRGSA), KRGSA-8 (conversion of agricultural lands in urban use), KTWD-6 (produced water project), KTWD-7 (in-district surface storage, NKWSD-18 (voluntary land fallowing), NKWSD-19 (pumping restrictions), RRB-5 (Sites Reservoir), and RRB-8 (land acquisition and retirement) among many others.

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 stated,

> [T]he 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).

Board staff concurred with DWR's findings in the 2022 GSP Inadequate Determination and hereby incorporate those findings by reference. Board staff has also identified additional related issues. Furthermore, upon reviewing the subbasin's 2024 Draft GSPs, Board staff acknowledges continued improvements in the subbasin's plans, especially with regard to coordination. However, some key subsidence deficiencies remain in the 2024 Draft GSPs and are described below.

Board staff has broken out deficiencies 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 concerns poorly coordinated undesirable results and SMC for multiple sustainability indicators. The Board's implementation and mitigation deficiency is included as Land Subsidence Deficiencies LS-2.

Deficiency Land Subsidence 1 (LS-1) – Land subsidence undesirable results and sustainable management criteria are not defined consistent with the requirements of SGMA.

What SGMA Requires: SGMA requires that "Agencies intending to develop and implement multiple Plans pursuant to Water Code Section 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 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)). The coordination agreement must describe how each of the agencies use the same data and methodologies for assumptions in Water Code section 10727.6 for land subsidence data, supported by the quality, frequency, and spatial distribution of data in monitoring network and the objectives as described in California Code of Regulations, title 23, sections 354.32 through 354.40 (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(2)).

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 conditions in the Subbasin]" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). Further, "undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin" (Ibid.). The undesirable result definition should include the cause of groundwater conditions occurring throughout the subbasin that have 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)).

Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to California Code of Regulations, title 23, section 354.36, and the value shall represent a point in the basin that, if exceeded, may cause undesirable results (Cal. Code Regs., tit. 23, § 354.28). The description of minimum thresholds shall include: (1) justification for the value supported by information provided in the basin setting, (2) relationship between the value and the

sustainability indicator, (3) explanation of how the agency determined the conditions at each minimum threshold will avoid undesirable results, (4) how the value will avoid causing undesirable results in adjacent basins, (5) how beneficial uses and users will be impacted, (6) state, federal, and local standards, (7) how each will be measured consistent with monitoring network requirements (Ibid.).

The minimum threshold for Land Subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results, and shall be supported by: (A) Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects; and (B) Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives (Cal. Code Regs., tit. 23, § 354.28, subd. (c)).

Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon (Cal. Code Regs., tit. 23, § 354.30). Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty (Ibid.).

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, § 354.20).

Deficiency: In the 2022 GSPs, the Kern County Subbasin GSAs defined undesirable results and SMC in a manner that would have resulted in disproportional impacts throughout the subbasin. This was the result of various plans and management areas using and implementing inconsistent data, methodologies, and assumptions when defining sustainability management criteria coupled with the two-tiered undesirable result definition. The impact could have led certain portions of the subbasin to experience impacts of chronic lowering of groundwater levels for sustained periods before or without an undesirable result occurring.

The 2024 Draft GSPs address this deficiency by revising the undesirable result definition and methodology for establishing SMC in a more coordinated approach using

a consistent method for each HCM Area. However, without further investigations into how SMC are applied across HCM Areas there may continue to be disproportional impacts throughout the subbasin.

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

The plain-language undesirable results from the 2022 Coordination Agreement were poorly described. While each GSP and Management Area Plan adopted the same plain-language undesirable results, they were interpreted and implemented very differently because they were too vague. This inconsistent interpretation exacerbated other issues with quantitative undesirable results and SMC. The 2022 quantitative undesirable results: (1) required a complex set of conditions to occur across multiple GSAs and management areas, (2) were too poorly described and coordinated to be consistently implemented across GSPs and Management Area Plans, and thus (3) resulted in SMC that describe different conditions and impacts across different GSAs and Management Area Plans.

The 2022 undesirable results in GSPs and Management Area Plans relied on inconsistently identified and categorized infrastructure. The 2022 Coordination Agreement indicated that a subsidence undesirable result is determined when "subsidence results in significant and unreasonable impacts to critical infrastructure…" (2022 Coordination Agreement, p. 299). The DWR Inadequate Determination found, however, that GSPs and Management Area Plans did not consistently identify critical infrastructure. Specifically, DWR noted 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 noted that "[s]ome GSPs or management area plans defined Management Area Critical Infrastructure but did not develop sustainable management criteria…" (*Id.*, p. 38). Board staff agrees and further notes that GSPs and management areas did not consistently define what constitutes "significant and unreasonable," as evidenced by the examples of inconsistent quantitative undesirable results and MTs provided in the 2022 plan background section.

Importantly, the 2022 KGA GSP explicitly stated that management area exceedances applied to groundwater levels (and groundwater storage by proxy)—not to subsidence (2022 Kern Groundwater Authority GSP, p. 205). The fact that some Management Area Plans defined management area exceedances for subsidence indicates substantial confusion and poor coordination regarding how undesirable results were established.

Board staff acknowledges and appreciates that GSPs and Management Area Plans were 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 would be able to avoid subsidence undesirable results.

Board staff found that plain-language undesirable results were not detailed enough for consistent implementation across the many different GSPs and Management Area Plans. Board staff acknowledges that GSPs and Management Area Plans adopted 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 varied substantially across GSAs and management areas.

The 2024 Draft GSPs define an undesirable result as, "[t]he point at which the amount of subsidence, if caused by GSA-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" (2024 Draft GSP, p. 13-75). The quantitative definition is stated as when, "…the MT extent of subsidence is exceeded at any of the Subbasin's Representative Monitoring Sites for Land Subsidence (RMS-LS) or as measured using InSAR data published annually by DWR averaged across an HCM area" (*Id*., 13-83).

Additionally, "[p]er the Subbasin's MT exceedance policy, exceedance of the MT subsidence rate in any one year would trigger monitoring, and exceedance of the MT subsidence rate over any two years would trigger investigation and potential initiation of P/Mas" (*Id*., 13-84).

Board staff acknowledges the plain-language and quantitative definitions of undesirable results are adopted across the subbasin and are based on conditions occurring within the subbasin. Also, the management area approach has been replaced by the HCM Area approach and likely reduces variability and inconsistencies across the subbasin. However, the plain-language definition hinges on being able to distinguish between GSA and non-GSA related subsidence, as well as ascertaining the "economic feasibility" of repair costs to beneficial users. The GSAs have not demonstrated an ability to quantify and attribute subsidence extents in regions where both GSA and non-GSA activity is likely contributing to subsidence. Also, SGMA does not exclude water wells in any portions of an identified aquifer or industry extractions, which may need to be managed to avoid undesirable results. Continued extractions may further contribute to adverse conditions throughout the subbasin. Therefore, without reasonable hydrogeologic isolation and no other beneficial uses and users, it is not within GSA authority to exclude

certain extractors from SGMA requirements, regardless of water quality. Therefore, GSAs have not adequately explained why some groundwater extraction wells, such as source water wells used in oil and gas production, are considered to be outside GSA authority.

Additionally, the 2024 Draft GSPs do not define a process, or specific criteria used to determine the economic feasibility of retrofitting or replacing infrastructure and does not account for the possibility that different beneficial users may have disparate opinions on what is considered economically feasible.

DWR SWP provided public comments in September 2024 and shared these same opinions about the undesirable results definition, especially as they relate to the subbasin's approach to addressing subsidence along the California Aqueduct (Project, 2024). DWR SWP also reiterated a comment it made in its September 30, 2022 letter in response to the 2022 plans that the "ongoing rehabilitation of subsidence to the [California] Aqueduct is costly and disproportionately burdensome" noting that it was "already financially daunting" in 2022, thus it is implied some agencies and beneficial users consider the current subsidence impacts to be significant and unreasonable (Project, 2022; Project, 2024). This highlights key criticisms of the subbasin's undesirable results definitions.

The quantitative definition of an undesirable result is tied to an MT exceedance policy that may not be sufficiently protective of beneficial users, as it only triggers an investigation into the cause of subsidence after two years of MT rate exceedances – this could result in significant delays in the implementation of PMAs (i.e., pumping restrictions in areas adjacent to critical infrastructure) or critical mitigation measures (repairs/retrofitting of infrastructure), and lead to significant and unreasonable impacts to beneficial uses and users that depend on the impacted infrastructure.

2024 Draft GSPs Evaluation: Board staff recognizes the 2024 Draft GSPs reflect changes to the undesirable results definitions with respect to the 2022 plans. Also, that effort was made to include more infrastructure located within the subbasin and to have a more coordinated approach to defining undesirable results. However, there are issues with the 2024 definitions that relate to: delineating and quantifying GSA and non-GSA subsidence; adequately assessing the "economic feasibility" of retrofitting or replacement of infrastructure for the subbasin's various beneficial users; and an insufficiently protective MT exceedance policy that could lead to significant or unreasonable impacts to beneficial users. Thus, Board staff has determined that Deficiency LS-1a is not resolved.

2024 Final GSPs Tentative Evaluation: This deficiency appears to be partially addressed based on a high-level review of the 2024 Final GSPs. The updated plain-language undesirable result definition no longer hinges on the economic feasibility of

retrofitting or replacement of infrastructure on the part of beneficial users. The updated definition also indicates that GSAs will be responsible for mitigating losses of infrastructure functionality. Changes were made to the MT exceedance policy, but it is not clear if they are sufficiently protective of all beneficial uses and users for reasons discussed in the tentative evaluation for Deficiency LS-2. The MT exceedance language added to the undesirable result criteria differs from what is found in the MT exceedance policy.

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

GSAs should update the GSPs with a consistent plain-language subsidence undesirable result that clearly describes the significant and unreasonable impacts in the basin that the GSAs are attempting to avoid. DWR noted 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, pp. 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.

Consistent with SGMA and DWR's regulations, if the GSAs decide that undesirable results should still be caused only by "GSA-related Subbasin groundwater extractions," (2024 Kern County Subbasin Draft GSP, p. 13-75) then the GSPs should include clear criteria and methodology for evaluating and quantifying subsidence caused by non-GSA related activities. GSAs should address other wells within the subbasin that extract groundwater, such as oil and gas source water wells, and account for them as GSA-related extractions. The 2024 Draft GSPs state that the MT for subsidence for the Northern Aqueduct is established to avoid permanent loss of conveyance capacity "associated with GSA-related subsidence…" (2024 Kern County Subbasin Draft GSP, p. 13-124). The 2024 Draft GSPs also state that since subsidence along the Northern Aqueduct is "influenced by various non-GSA activities and conditions some subsidence and its affects will likely be outside the GSA authority to manage" (*Ibid*.).

The 2024 Draft GSPs describe a methodology using InSAR time-series cross-sections to distinguish characteristic subsidence signatures. GSA-related activity is interpreted as having a "seasonal" or "sinuous" pattern, whereas non-GSA activity is interpreted as "noisy" and has steeper declining slopes. Board staff recognizes this effort as a valid approach to discerning whether GSA pumping may be contributing to subsidence, but the subbasin falls short of using such analyses to quantify the vertical extent of subsidence along infrastructure which is attributable specifically to GSA activity and could be contributing to undesirable results. If the undesirable result definition requires such a distinction between GSA and non-GSA caused subsidence, the GSAs must be

capable of quantifying their contribution to subsidence in areas where both GSA and non-GSA activities are culpable. Board staff encourages the GSAs to develop clear methodology that quantifies the respective contributions to subsidence (historical and projected) by GSA activity and provide sufficient evidence that supports these conclusions and can be used to evaluate SMC established for critical infrastructure.

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 subsidence that is specific to the uses in the subbasin.

Additionally, in conducting outreach to the beneficial users it is recommended that the economic feasibility of retrofitting or replacement is adequately characterized for the range of beneficial users within the subbasin. Either that or remove the language pertaining to what is considered “economically feasible” as a determinant of whether impacts are undesirable from the plain-language definition and address them as part of mitigation.

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 clearly understand the effects that are “significant and unreasonable” for the basin.

Since the quantitative undesirable results definition relies on MT exceedances, and the MT exceedance policy may not be sufficiently protective of beneficial users, it is recommended that the MT exceedance policy be revised prior to the quantitative undesirable results definition being considered adequate. A recommended change to the MT exceedance policy would be to continually monitor and evaluate the causes of subsidence even in the absence of an exceedance, and that a single MT exceedance trigger mitigation or PMAs. This contrasts with initiating an investigation after two consecutive years with exceedances.

Deficiency LS-1b – Sustainable management criteria were not established consistent with the requirements of SGMA.

This deficiency concerns the fact that 2022 SMC for subsidence used inconsistent data, methodologies, and assumptions across GSPs, combined with vague, inconsistent

undesirable results, and failed to represent the key conditions that groundwater managers must evaluate to achieve sustainability and avoid undesirable results.

The 2022 SMC were 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 Kern Water Bank 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, AEWSD Management Area Plan, Cawelo Management Area Plan, and Olcese 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; AEWSD Management Area, p. 247) or according to groundwater level (e.g., 2022 Kern River GSP, Section 5, p. 39; 2022 Cawelo Management Area Plan, p. 182).

There were inconsistencies in defining 2022 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). 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).

One example of inconsistencies in defining 2022 SMC in the GSPs adjacent to Regional Critical Infrastructure can be found in the 2022 BVWSD GSP, which was inconsistent with the Coordination Agreement. The 2022 BVWSD GSP BMA defined an MT for the California Aqueduct, but the MT was not coordinated with the California Aqueduct-defined MT in the subbasin (2022 Buena Vista Water Storage District GSA, Table 5-24, p. 173). The 2022 Coordination Agreement defined the California Aqueduct interim MT as -0.1 feet per year and accumulatively -1.8 feet by 2040 (2022 Amended Coordination Agreement, pdf, p. 367). The BVWSD GSP, however, provided cumulative MTs for

Pools 24 through 28 ranging from -0.38 feet to -2.62 feet (2022 Buena Vista Water Storage District GSA, Table 5-24, p. 173), which is higher than the coordinated MT for some Pools.

DWR noted 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 stated 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*.).

The 2024 Draft GSPs include three classifications for infrastructure within the subbasin, keeping Regional Critical Infrastructure, swapping Management Area Critical Infrastructure for GSA Area Critical Infrastructure, and adding Other Infrastructure (2024 Draft GSP, pp. 13-79 through 13-81). The 2024 Draft GSPs lack detail regarding the process GSAs used to decide how the various infrastructure and facilities were selected for the latter two classifications.

The 2024 Draft GSPs also adopted an HCM Area approach to evaluate historical and potential future subsidence rates and extents, and calculated projected subsidence based on the average historical (2015-2023) subsidence rate per HCM Area as determined from InSAR data. However, the method used to calculate average HCM Area subsidence rates is questionable and poorly described. For example, there are discrepancies between the HCM Area average subsidence rates in Figure 13-23 (*Id*., p. 13-94) and mean subsidence rates in Table 8-27 (*Id*., p. 8-150): The North Basin HCM is broken into an Upper (-0.006058 ft/yr) and Lower (0.002966 ft/yr) region in Table 8-27 but is presented as a single area (-0.053 ft/yr) in Figure 13-23 (negative values indicate a decrease in land surface elevation while positive values indicate an increase in elevation). The same was done for the East Margin HCM Area where the North (-0.009824 ft/yr) and South (0.007636 ft/yr) means contrast with the average rate of -0.03 ft/yr. The Western HCM Area has a mean of -0.009083 ft/yr but an average of -0.007 ft/yr; the Kern River Fan HCM Area has a mean of 0.00598 ft/yr but an average of -0.017 ft/yr; the South Basin HCM Area has a mean of 0.002207 ft/yr but an average of -0.03 ft/yr. There is no explanation for why the values should be different, or why the same data were not used for both the table and the figure.

Additionally, SMC are set for infrastructure using a "risk-based" approach that considers subsidence potential, and the vulnerability of surface land uses and is assigned a subsequent ranking (high, moderate, low, and minimal) (2024 Draft GSP, p. 13-101).

The subsidence potential and projected future rates and extents were developed using historic InSAR subsidence rates as discussed previously, and as such the accuracy and consistency of this method (specifically for steps #3 and #4) deserves close scrutiny by the GSAs. The vulnerability ranking is assigned based on infrastructure type, but a detailed description of how specific infrastructure vulnerability is evaluated is not provided. Applying this risk-based approach, the subbasin set MTs for Regional Critical Infrastructure based on "observed and allowable rates of subsidence," and GSA Area Critical Infrastructure MTs were set for infrastructure with low-to-high vulnerability. All other infrastructure SMC were based on the historical subsidence rate by HCM Area (Ibid.).

It is unclear if this approach is adequate to assess subsidence risk and thus assign SMC to critical infrastructure. The Northern Aqueduct MT rate is the same for all the aqueduct pools evaluated (2024 Draft GSP, p. 13-104) and DWR, commenting in its capacity as the SWP operator, notes that cumulative subsidence differs greatly within and among these pools, so it is assumed an average rate was applied. Staff from the DWR SWP submitted comments and expressed concerns about this method not being sufficiently protective of the California Aqueduct (DWR SWP Sept 2024 Comment). The MT rate is also presented as a range from 0.05-0.1 ft/yr – it is not clear whether the MO rate (also 0.05 ft/yr) would trigger an MT exceedance since there is no operational flexibility below the MO. Also, IM rates identified in the 2024 Draft GSPs appear to increase over time instead of "ramping down" toward 2040. The Southern Aqueduct SMC by Survey Benchmark appear incorrect, as the MT and MO rates would significantly exceed the 2024-2040 MT and MO extents respectively, as would the IM rates with respect to the IM extents (2024 Draft GSP, pp. 13-107 through 13-109). This seems to permeate all listed Benchmark locations (IM rates also increase as they approach 2040). If this is not how the IM rate is intended to be interpreted, clarification is needed.

The Friant-Kern Canal has MT rates that are consistent with the MT extents. But IM rates once again appear to increase as they approach 2040 and would result in an MT exceedance (2024 Draft GSP, p. 13-112). For example, for Mile Post 116.9-124.3, the IM rate is 0.02 ft/yr from 2025-2029, 0.04 ft/yr from 2030-2034, and 0.06 ft/yr from 2035-2040 - this would result in approximately 1.5 feet of cumulative subsidence (over a 15-year period) whereas the MT is set at 1.28 feet (over a 16-year period) (*Ibid*.). Again, if this is not how the IM rate is intended to be interpreted, clarification is needed. Upon reviewing the Subsidence SMC Matrix, it seems the MT and MO rates for GSA Area infrastructure project slightly under MT and MO extents, and IM rates do as well, and no exceedances would be triggered by the proposed SMC (*Id*., pp. 13-117 through 13-119).

2024 Draft GSPs Evaluation: In light of the observed inconsistencies in the SMC tables and concerns from agencies that manage critical infrastructure about not

accounting for pertinent infrastructure details, it seems the subbasin's approach to determining SMC is not sufficiently protective of all infrastructure. Therefore, SMC should be revised to account for the specific characteristics of the infrastructure they intend to protect and take into account the input of the agencies that manage them. Board staff has determined that Deficiency LS-1b is not resolved.

2024 Final GSPs Tentative Evaluation: This deficiency appears to be partially addressed. SMC development is less complicated, and steps were taken to ensure Regional Critical Infrastructure MTs were protective of conveyance capacity in vulnerable areas. SMC values (MTs, MOs, and IMs) now appear to be established consistent with a goal of reducing subsidence as 2040 approaches. IM extents and rates for Regional Critical Infrastructure include values for 2040, however, this is not the case for GSA and Other Critical Infrastructure. The table for HCM Area SMC shows 2040 IM extents but does not include a 2040 rate. Additionally, the HCM Area 2040 IM extents exceed the MO for three of the five HCM areas. The Friant-Kern Canal 2040 IM extents exceed the 2040 MO extents at every Mile Post included in the table. For the California Aqueduct SMC table, there are similar issues. For Mile Post 193.85, the 2040 IM extent is equal to the MT extent (double the MO extent), and the 2040 MO extent is exceeded before the 2030 IM is reached. This error, and the one described previously, occur throughout the California Aqueduct SMC table. Such issues should be addressed.

Potential Action LS-1b – Use consistent data and methods to develop subsidence sustainable management criteria.

The 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 subsidence undesirable result. The MTs should also achieve their goal of avoiding permanent loss of conveyance capacity for regional infrastructure, such as the Friant-Kern Canal or California Aqueduct, and be sufficiently protective of all other identified infrastructure.

To this end, DWR noted 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 noted 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" (*Id.*, p. 43).

Because Regional Critical Infrastructure MTs are not based on substantial interference with land surface uses, it is unclear how the established MTs would avoid interference with the operations of Regional Critical Infrastructure. For instance, it is unclear how the defined MTs would prevent reduction in flow capacity of the Friant-Kern Canal or preserve freeboard along the California Aqueduct. Therefore, DWR noted that it was 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" (2022 Inadequate Determination of Kern County Subbasin GSP, p. 43). This sentiment has been echoed by DWR's SWP staff with regard to the MTs set for the California Aqueduct. Current MT extents could lead to overtopping of the concrete liner at certain MPs that have less than one foot of freeboard, and MTs have not been shown to prevent "permanent loss of conveyance capacity" (Project, 2024). Board staff recommends the following as a way to address the concerns noted above:

- Redevelop subsidence MOs. Subsidence MOs are the land surface elevations that basins plan to achieve. Importantly, MTs must provide operational flexibility below MOs, so redeveloping MOs might require redeveloping MTs. MOs should be high enough above MTs that drought does not cause MT exceedances.
- Redevelop IMs. IMs are the land surface elevations that basins plan to achieve as they manage toward MOs, so redeveloping MOs will require redeveloping IMs. IMs are set in five-year increments, and they are important benchmarks to evaluate whether a basin is on track to reach its MOs by 2040. IMs should also reflect the "glidepath" approach to reducing subsidence rates over time, and as such should not increase at each five-year increment.
- Ensure the SMC are consistent, and that MO and MT rates do not exceed their extents, and that IMs will achieve MOs and not surpass MTs.
- As mentioned above in the undesirable results section, redevelop the MT exceedance policy such that a single exceedance triggers PMAs and that monitoring and investigations into the cause of subsidence are both ongoing.

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

What SGMA Requires: Each GSP is required to include a description of the PMAs 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, subds. (b)(3), (5)).

Deficiency: The 2024 Draft GSPs do not provide details about PMAs intended specifically to slow or address subsidence impacts for either GSA Area Critical Infrastructure or Other Infrastructure. There are many demand management and supply augmentation PMAs that may indirectly help with subsidence across the subbasin, but there is a lack of focused PMAs to address the potential impacts of subsidence near critical infrastructure. KSB-1, the Friant-Kern Canal Capacity Mitigation, is the sole PMA that is set out to directly address subsidence impacts along Regional Critical Infrastructure (2024 Kern County Subbasin Draft GSP, p. 14-17). Also, WDWA has proposed three PMAs that aim to limit GSA contributions to future subsidence along the California Aqueduct: WDWA-4 (NetZero well drilling moratorium within the CASP five-mile buffer zone); WDWA-5 (Mandatory well registration and flow meter installation); and WDWA-6 (Well extraction volume reporting within the CASP five-mile buffer zone) (2024 Kern County Subbasin Draft GSP, p. 14-75).

The 2022 Coordination Agreement identified the areas of interest (AOIs) for the 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 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 were 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 (2022 Amended Coordination Agreement, p.8-98). This remains unchanged in the 2024 Draft GSPs. However, no exact management actions are listed in the Coordination Agreement or GSPs to manage subsidence, even in the AOIs.

For the Friant-Kern Canal, the 2024 Draft GSPs state that the subbasin is working with FWA on additional data collection and modeling to evaluate future impacts of GSA activity on water levels and subsidence along the Friant-Kern Canal (2024 Kern County Subbasin Draft GSP, Appendix T). GSAs have assigned this effort to PMA KSB-1 and are working on a cost-sharing framework to fund future mitigation efforts, and attribute the costs based on future impacts along the Friant-Kern Canal as they occur in different GSAs (*Ibid*.).

Recent InSAR data spanning June 2015 to October 2023 indicate total land subsidence ranging from zero to a maximum of 2.41 feet (along the northern boundary of the subbasin) (2024 Kern County Subbasin Draft GSP, p 8-140). Cumulative subsidence of one to two feet has occurred in places across the subbasin (*Ibid*.). A five-mile buffer area around the Regional Critical Infrastructure shows the cumulative land subsidence ranges from zero to a maximum of 1.1 feet adjacent to the California Aqueduct (near Lost Hills), and ranges from zero to around 1.2 feet around the Friant-Kern Canal (north of the city of Shafter, east of the city of Wasco). The development and implementation of the subsidence PMAs is critical in the Kern County Subbasin to halt subsidence by 2040 and assess the progress of the subbasin toward sustainable groundwater management.

2024 Draft GSPs Evaluation: The 2024 Draft GSPs lack adequate implementation details related to PMAs that address expected, or potential, impacts of subsidence on infrastructure.

2024 Final GSPs Tentative Evaluation: This deficiency does not appear to be addressed. The Final GSPs include a subsidence exceedance “Action Plan” in Appendix W, and a mitigation plan in Appendix K. The mitigation plan is written to address groundwater well impacts. A $3.5 million mitigation fund is discussed in Appendix K, but it is specific to mitigating impacts to wells caused by declining groundwater levels not subsidence, and there is no mention of infrastructure mitigation. It is stated in Appendix K that GSAs do not anticipate subsidence in the subbasin to cause significant impacts to wells, and they point to the contents of Appendix W to explain how their protocols will avoid such impacts.

The subsidence action plan in Appendix W is initiated if: (1) a subsidence IM rate or extent exceedance occurs at a single California Aqueduct or Friant-Kern Canal Mile Post or (2) if a subsidence IM rate or extent is exceeded for a GSA or HCM Area average after six consecutive quarterly sampling events. This language conflicts with the description of the exceedance policy in Section 13.5.1.4 of the GSPs, where it states that action is triggered by exceedances of the MT rate. Such discrepancies should be addressed so the criteria are clear and consistent throughout the GSPs and relevant appendices.

The PMAs that would be triggered by this plan do not include infrastructure repairs or retrofitting. Though, the PMAs in the plan could help mitigate further subsidence in impacted areas. The action plan includes five steps, some of which include redundancies, and there are no estimated timelines for implementing any of the steps in the plan. Overall, the 2024 Draft GSPs still lack adequate information regarding plans to mitigate subsidence related impacts to infrastructure throughout the subbasin.

Potential Action LS-2a – Develop and implement a plan to trigger sufficient management actions when subsidence exceeds defined thresholds, especially near critical infrastructure or 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 non-de minimis wells from being installed near, and move existing non-de minimis 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. Especially since GSAs do not consider subsidence that can be mitigated an undesirable result. 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 GSP's MTs; demonstrating adequate funding may involve projecting out fee revenues to demonstrate financial capacity that matches expected need. Board staff notes 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.
- If no need for mitigation is expected, a GSA must clearly demonstrate and justify that with sufficient data and evidence to avoid any potential impacts to users.

Additionally, 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 – Defining and Avoiding Undesirable Results Related to 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)(4)). 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 develop a sufficient monitoring network to track progress and potential undesirable results (Cal. Code Regs., tit. 23, § 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 a proxy for groundwater quality (*Id*., p. 19), that the impacts of groundwater level MTs on water quality were not adequately described (*Id*., p 20-35), and that GSPs should leverage existing programs and agencies in evaluating how GSP implementation may degrade water quality (*Id*., p. 20).

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, pp. 14-16). Again, the groundwater level deficiency (Deficiency 2), indicated that groundwater levels were potentially inappropriately used as proxies for groundwater quality (*Id.*, p. 27). DWR noted that GSAs made progress, better describing the impacts of groundwater level MTs on groundwater quality but found that the level of analysis supporting groundwater level MTs was insufficient (*Ibid.*). Table 4-6, below, summarizes the key aspects of the degraded groundwater quality deficiency and relevant components from the 2020, 2022, and 2024 Draft Kern County Subbasin GSPs.

Table 4-6 – Summary of Degraded Groundwater Quality Deficiency and Relevant Components of the 2020, 2022, and 2024 Draft Kern County Subbasin GSPs

2020 GSPs	DWR's 2020 GSP Incomplete Determination
The GSPs and Management Area Plans took a fragmented approach to define management-area-specific undesirable results that would contribute to a basin-wide undesirable result. There were differences in: • Which constituents each plan addressed. • Whether groundwater level SMC were used as a proxy for groundwater quality SMC. • Groundwater quality SMC analyte concentration. • Whether water quality SMC were set at all.	The Incomplete Determination did not include a specific Groundwater Quality deficiency, however it stated: • The 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 (2020 Incomplete Determination, p. 14). • The GSPs use differing constituents and methods to establish MTs, including some GSPs using groundwater levels as a proxy for degradation of water quality (2020 Incomplete Determination, p. 19). • The GSPs do not consistently explain how the lowering of

	groundwater levels MTs and MOs that are set below historical lows will impact other applicable sustainability indicators specifically water quality (2020 Incomplete Determination, p. 19). • 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, p. 20).
2022 GSPs	**DWR's 2022 GSP Inadequate Determination**
The GSPs and Management Area Plans still took a fragmented approach to define undesirable results and MTs that may contribute to an undesirable result. Variations included: • Constituents each plan addressed. • Groundwater level SMC as a proxy for groundwater quality and how that relationship was justified. • Groundwater quality analyte concentrations. • Monitoring network.	The Inadequate Determination did not include a specific Groundwater Quality deficiency, however it stated: • The identified coordination deficiency applied to all sustainability indicators, including Water Quality, which meant that water quality undesirable results and SMC were inconsistent across the basin. • The groundwater level deficiency indicated that groundwater levels may have been inappropriately used as proxies for water quality. • The groundwater level deficiency indicated that the impacts of groundwater level MTs on water quality were still not adequately analyzed.
2024 Draft GSPs	**Board Staff 2024 Draft GSPs Evaluation**
Plans use consistent data and methodologies when setting SMC. However, the plans do not use	The subbasin's groundwater quality SMC do not satisfy the requirements of SGMA and the GSP regulations and does not

reasonable assumptions or methodologies when setting criteria. The approaches used to set criteria in the plans continue to result in disparate values across defined boundary areas and are not supported by best available science (Cal. Code Regs., tit. 23, § 354.26, subd. (b)).	demonstrate that undesirable results, with respect to degradation of groundwater quality, will be avoided.

4.1.4.1 Kern County Subbasin 2020 Groundwater Sustainability Plans

On January 23, 2020, GSAs submitted five 2020 GSPs to DWR in compliance with the applicable statutory deadline. Upon review, DWR found the 2020 GSPs incomplete and provided corrective actions related to identified deficiencies. DWR's determination of the 2020 GSPs was released on January 28, 2022. DWR gave the GSAs 180 days to fix and readopt their GSPs. In preparation for this Final Staff Report, Board staff reviewed the six 2020 GSPs and concurs with DWR's findings. For a summary of Board staff's review of the 2020 GSPs, see Appendix D.

4.1.4.2 Kern County Subbasin 2022 GSPs and WY 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 filed a 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, 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 defined 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 varied in how a management area would contribute to the basin-wide undesirable result. To remedy this, the 2022 Coordination Agreement defined an MT trigger, which Board staff presumes applied to all SMC and not just those for declining groundwater levels. The trigger would occur when a Management Area experienced groundwater level declines below MTs in 40% or more RMWs within the management area over four consecutive bi-annual SGMA required monitoring events (2022 Coordination Agreement, Appendix 3). However, the GSAs used very different methods to set SMC across the various plans. A summary of the methods GSAs used to set SMC were as follows:

BVWSD GSP established MTs at the more conservative drinking water or agricultural "water quality goal" (water quality objective [WQO]) concentrations for nine constituents, using existing public water system data and data collected from representative wells (2022 Buena Vista Water Storage District GSA GSP, p. 152). The GSA did not set MOs for groundwater quality, stating its goal is to prevent degradation of water quality consistent with existing groundwater quality regulatory programs, and that it plans to correct exceedances detected under these programs (*Ibid*).

The KRGSA GSP only defined SMC for arsenic because, according to the GSP, arsenic was the only constituent whose concentrations appeared to be impacted by groundwater level changes. Therefore, the GSA proposed using 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, pp. 33-34).

The HMWD GSP defined water quality SMC at a single RMW. The MO for groundwater quality was set to not degrade at a rate higher than 10% every five (5) years. The MT was set based on observed concentrations from groundwater monitoring wells that operate for irrigation purposes and were set at WQOs for agricultural use since there are no drinking water wells in the management area. The GSP stated, "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 GSP did not define SMC for degradation of groundwater quality in its Management Area, stating 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 stated, "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 the regulatory threshold (MCL = 10 micrograms per liter (µg/L)

or, where exceedances have already occurred, at pre-SGMA baselines plus 5 µg/L (50% of the MCL)) (2022 South of Kern River GSP, pp. 242-244).

KGA Umbrella GSP reiterated that the basin-wide undesirable result definition allows for local definitions of SMC within each management area of the subbasin. The GSP also mentioned that some of the management areas chose to use groundwater levels as a proxy for monitoring water quality. According to the KGA Umbrella GSP, 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). The GSP also notes each Management Area Plan addresses the cause of degraded water quality in its management area differently due to dynamic differences in hydrology, water supplies, and water uses within the subbasin (*Ibid*.). The following 12 Management Area Plans' SMC are all part of the KGA Umbrella Plan:

WDWA Management Area Plan, a KGA Management Area Plan, did not set SMC for groundwater quality, referencing the overall naturally degraded groundwater quality west of the California Aqueduct; that area, the plan stated, has no current or planned significant SGMA-related pumping (2022 Westside District Water Authority Management Area Plan, p. 83).

WKWD Management Area Plan, a KGA Management Area Plan, stated 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 were expected to be exceeded if groundwater levels remained above groundwater level SMC (2022 West Kern Water District Management Area Plan, Chapter 7, pp. 10-11).

SSJMUD's Management Area Plan, a KGA Management Area Plan, used groundwater levels as a proxy for groundwater quality. The plan stated, "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, a KGA Management Area Plan, relied on a series of tests to determine whether or not to set SMC for a given constituent. The tests considered regional occurrence, anthropogenic influence, sensitivity to beneficial users, pre-SGMA concentrations, other regulatory regimes, and groundwater management "nexus." Based on the tests' criteria, SMC were only set for arsenic. MTs and MOs were both set at the regulatory threshold, the MCL, (10 µg/L) (2022 Shafter-Wasco Irrigation District 7th Standard Annex Management Area Plan, pp. 94-107).

SWSD Management Area Plan, a KGA Management Area Plan, used groundwater levels as a proxy for water quality since the agency did not anticipate changes in groundwater quality from fluctuations of groundwater levels above MT values (2022 Semitropic Water Storage Management Area Plan, p. 174).

RRBWSD Management Area Plan, a KGA Management Area Plan, intended to monitor groundwater quality for constituents it identified during the correlation process. The GSP stated, “[t]he measurable objective will be any applicable beneficial use [constituent of concern] 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].” The district only identified arsenic to be influenced by lowering groundwater levels (2022 Rosedale Rio Bravo Management Area Plan, pp. 106-107). The exact concentrations for MOs or MTs were not clear.

NKWSD & SWID Management Area Plan, a KGA Management Area Plan, used water quality data from approximately 120 wells and performed trending analyses for municipal and agricultural wells to evaluate the relationship between groundwater levels and water quality. GSAs determined that arsenic concentrations decreased with groundwater level decline, nitrate and salinity tended to increase with groundwater level declines, and 1,2,3-TCP concentrations had no relationship with groundwater level changes; however, the GSAs did not consider lowering groundwater levels a determining factor in increases in nitrate concentrations, despite the observed inverse relationship. Nevertheless, the Management Area Plan used groundwater level SMC as a proxy for groundwater quality SMC (2022 North Kern Water Storage District and Shafter-Wasco Irrigation District Management Area Plan, pp. 236-237).

KTWD Management Area Plan, a KGA Management Area Plan, stated 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, KTWD set the MT and MO at 750 mg/L and 500 mg/L, respectively (2022 Kern-Tulare Water District Management Area Plan, pp. 3-7).

Kern Water Bank Management Area Plan, a KGA Management Area Plan, stated that the Kern Water Bank analyzed four consecutive storage cycles and two significant recovery cycles and determined groundwater degradation was not occurring and was not likely to occur in the future (2022 Kern Water Bank, p. 36).

Pioneer Project Management Area Plan, a KGA Management Area Plan, used groundwater levels as a proxy for groundwater quality. The agency estimated groundwater quality degradation that could occur at groundwater level MTs by using a linear regression to correlate past groundwater levels and groundwater quality measurements for arsenic, nitrate, and specific conductance. One of the RMWs was projected to exceed the MCL for arsenic; however, the agency noted water from that

well would be blended with water from other recovery wells before being conveyed to users (2022 Kern County Water Agency-Pioneer Project, Ch. 7, p. 23).

Eastside Water Management Area Plan, a KGA Management Area Plan, defined TDS as the only constituent affected by groundwater pumping due to the nearby Olcese and Santa Margarita formations which contain higher TDS concentrations in groundwater. The MTs and MOs were set at 750 and 500 mg/L, respectively (2022 Eastside Water Management Area Plan, pp. 93-98).

Cawelo Water District Management Area Plan, a KGA Management Area Plan, stated that Cawelo did not find a clear correlation in water quality with groundwater depth. Cawelo also noted legacy issues were being addressed by existing regulatory programs. Consequently, the Cawelo GSA only set SMC for TDS, noting concerns about the migration of saline 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).

Representative Monitoring Sites and Monitoring Network

The 2022 Kern County Coordination Agreement's Appendix 3 included the Kern County Subbasin Monitoring Network & Protocol document. The intent of the document was to establish monitoring network objectives to demonstrate progress, monitor impacts, monitor changes relative to sustainability indicators, and to quantify annual changes in the water budget. For groundwater quality, the objective of the monitoring networks was to demonstrate the achievement of the sustainability goal. The 2022 Coordination Agreement specified that groundwater quality networks would include measurements from each principal aquifer and would be sufficient for mapping and assessing impacts to users. Additionally, all analyses would be performed by certified labs and samples would be collected according to the USGS National Field Manual for the Collection of Water Quality Data. The Coordination Agreement did not specify which analytes would be monitored, who would be responsible for collecting the samples, or how frequently.

Similar to the fragmented approach for setting SMC, the GSAs and KGA member agencies used very different data and methodologies for developing their monitoring networks. Individual management areas were responsible for defining which analytes were considered constituents of concern and setting SMC to monitor them. The GSAs and KGA member agencies used various approaches to select monitoring networks and RMWs. using various approaches from new well installations, relying on existing monitoring data, using wells where only groundwater levels were collected (as a proxy for groundwater water quality), primarily using continuous measurements and discrete monitoring measurements. Below are the monitoring network designs and approaches for each plan:

> BVWSD GSP monitoring network for water quality consisted of wells used for Irrigated Lands Regulatory Program (ILRP) compliance and GSA monitoring,

resulting in 13 wells total for the BMA's 72 square-miles area (1 per 6.8 square-miles) (2022 Buena Vista Water Storage District GSA GSP, p. 88). Samples were to be collected on a semi-annual basis (*Id*., pp. 102-104).

KRGSA GSP stated the KRGSA would collect groundwater levels as a proxy for water quality from 18 of 19 wells being monitored monthly (2022 Kern River GSA GSP, Ch. 6, pp. 7-12).

HMWD GSP identified a single RMW for TDS concentrations and would be sampled annually (2022 Henry Miller Water District GSP, pp. 89-90).

Olcese GSP did not identify SMC for groundwater quality monitoring, but noted that the Olcese GSA would continue to monitor groundwater quality as part of the District's own agricultural water management activities and in its public water system to track changes (2022 Olcese Water District GSP, pp. 96-97).

SOKR GSP stated it would monitor 10 wells in the Arvine-Edison Management Area and 9 wells in the WRMWSD Management Area (one well per 15 and 16 square-miles, respectively) for several constituents and field parameters (e.g., pH, temperature) (2022 South of Kern River GSP, pp. 262-274). The third management area, TCWD, did not have a monitoring network in place for water quality. The GSA evaluated options to add one or more wells to monitor water quality in its management area (*Ibid*.).

KGA Umbrella GSP stated 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 of the 12 Management Area Plans under the KGA Umbrella GSP were defined as follows:

> WDWA Management Area Plan monitoring was to occur once every 5 years to reassess whether to set groundwater quality SMC (2022 Westside District Water Authority Management Area Plan, p. 93).
>
> WKWD Management Area Plan used groundwater levels as a proxy to monitor degradation of groundwater quality. The District collected 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 Management Area Plan used groundwater levels as a proxy for groundwater quality. The monitoring network consisted of semi-annual groundwater level measurements from 10 to 11 monitoring wells over a 101

square-mile area (conflicting values were presented in the GSP's Tables 4-3 and 4-4) (2022 Southern San Joaquin Municipal Utility Management Area Plan, pp. 209-213).

SWID Management Area Plan proposed monitoring for TDS, arsenic, and nitrate concentrations in three RMWs to allow for future water quality trend analysis, but only arsenic concentration exceedances could have result in a management area exceedance trigger as defined by the GSA (2022 Shafter-Wasco Irrigation District 7th Standard Annex Management Area Plan, p. 117).

SWSD Management Area Plan used the same 14 monitoring network wells defined for groundwater level monitoring, which were to 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 consisted of one well per 25 square miles, on average.

RRBWSD Management Area Plan identified 11 reference monitoring wells within its Management Area Plan that would have been monitored annually for TDS, chloride, nitrate, and arsenic (2022 Rosedale Rio Bravo Management Area Plan, pp. 91-93). There was approximately one monitoring well per 7.1 square-miles.

NKWSD Management Area Plan proposed to monitored groundwater levels as a proxy for groundwater quality, noting the GSA did not observe a relationship between groundwater levels and water quality constituent concentrations. The groundwater level monitoring network was to collected 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 Management Area Plan committed to sampling 15 wells from within and around the District once every 5 years during fall seasonal lows, starting 2019, for 11 constituents (2022 Kern-Tulare Water District Management Area Plan, Sec. 4, p. 11).

Kern Water Bank Management Area Plan did not propose to monitor groundwater quality as part of SGMA, noting that the management area must meet monitoring requirements consistent with DWR's Pump-in Policy for salts (2022 Kern Water Bank, p. 39).

Pioneer GSA Management Area Plan considered DWR, GAMA, and Pioneer Project water quality data but had groundwater levels serve as a proxy for groundwater quality monitoring. Groundwater level monitoring consisted of 5

RMW wells to be measured monthly (2022 Kern County Water Agency-Pioneer Project, Ch. 6, pp. 9-14).

Eastside Water Management Area Plan planned to collect water quality samples from nine RMW wells on a semi-annual basis (2022 Eastside Water Management Area Plan, pp. 107-111).

Cawelo GSA Management Area Plan monitoring network includes eight wells that are part of the ILRP network as well as agricultural production wells used for agricultural and oil drilling land use activities (2022 Cawelo Water District Management Area Plan, p. 150). The sampling frequency for SGMA purposes was not clear in the GSP, but the GSP noted that wells in the ILRP network are sampled annually for water levels, temperature, pH, electrical conductivity, dissolved oxygen, and nitrate parameters, and sampled every five years for cation and anions (*Ibid*.).

4.1.4.3 Kern County Subbasin 2024 Draft Groundwater Sustainability Plan Submission and Water Year 2023 Annual Report

The Kern County Subbasin GSAs submitted seven draft 2024 GSPs for Board review on May 28, 2024. In addition, the GSAs also filed a single WY 2023 Annual Report for the subbasin on March 31, 2024. This subsection describes the portions of the 2024 Draft GSPs and Water Year 2023 Annual Report that are relevant to the proposed Board deficiencies identified in Section 4.1.4.4.

Plain-Language Definition of an Undesirable Result

The 2024 Draft GSPs establish the definition of undesirable results as:

> The point at which significant and unreasonable impacts occur 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. (2024 Kern County Subbasin Draft GSP, p. 13-50).

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

The GSAs revised the quantitative definition of an undesirable result in the 2024 Draft GSPs as follows:

> Undesirable Results for Degraded Water Quality are defined to occur within the Subbasin if and when MTs for a groundwater quality [constituents of concern] are exceeded in three (3) RMW-WQs in an HCM Area based on the average of confirmed seasonal sample results and can

be attributed based on a technical analysis to groundwater management actions (e.g. groundwater level changes). (2024 Kern County Subbasin Draft GSP, p. 13-55).

The GSAs established MTs at all RMW-WQs for a select set of constituents of concern in the subbasin (*Id*., p. 13-56). None of the GSPs still use groundwater levels as a proxy for groundwater quality SMC.

The GSPs developed criteria to determine which constituents to manage for. The GSAs developed SMC for constituents:

- That have an existing regulatory standard.
- Whose concentrations exceeded the regulatory standard in at least 5% of wells sampled since January 1, 2015.
- That have a high or medium potential to impact users (2024 Kern County Subbasin Draft GSP, p. 13-53).

The GSAs classify the potential to impact users using two criteria:

- Median concentrations exceed regulatory standards.
- The constituent is determined to be exacerbated by groundwater management actions if affected by groundwater level changes (*Ibid*.).

If a constituent meets one criterion, the GSAs consider it to have a moderate potential to impact users. If a constituent meets both criteria, it has a high potential to impact users. If a constituent meets neither criterion, it has a low potential to impact users.

Based on their assessment of constituents against those three criteria, the GSAs developed SMC for arsenic, nitrate, nitrite, nitrate/nitrite (as N), TDS, 1,2,3-TCP, and uranium (2024 Kern County Subbasin Draft GSP, p. 13-56).

For each RMW, the MT concentrations are set at “the greater concentration of: (1) the applicable health-based screening standard (Table 13-6) or (2) the maximum 2010 – 2014 baseline concentration at each RMW-WQ” (2024 Kern County Subbasin Draft GSP, p. 13-56). The purpose of these MTs, according to the GSP, is to maintain concentrations at pre-SGMA baseline levels or better (*Ibid*.). For RMWs with insufficient data prior to 2015, the GSAs will use 2010-2023 data, if available, to determine the maximum baseline concentrations. If a well has insufficient data from 2010-2023, the baseline will be set at the 90th percentile of all data collected between 2010-2023, or at the regulatory standard, whichever is higher (*Ibid*.). The GSPs do not explain what thresholds make data “insufficient.”

The MO definitions for each RMW are the same as the MT definitions above, except the second criteria for the 2010 to 2014 baseline uses the median concentration (MOs) instead of the maximum concentration (MT). The MOs are defined as "the greater concentration of: (1) the applicable health-based screening standard [i.e., regulatory standard] or (2) the median 2010 to 2014 baseline concentration at each RMW-WQ. For wells with insufficient 2010 to 2014 data, 2010 to 2023 data are used to determine median baseline concentration at each RMW-WQ. For wells with insufficient 2010 to 2023 data, the MO is set as the 90th percentile 2010 to 2023 baseline concentration in the applicable HCM area" (*Id*., pp. 13-73 and 13-74). See section 3.5.2 for summary of HCM Areas.

The 2024 Draft GSPs state that "the MOs are set in recognition that per the State's Antidegradation Policy (Resolutions No. 68-16), further degradation would pose an unacceptable risk to the Subbasin's drinking water users" (*Id*., p. 13-74).

The GSP indicates a single MT exceedance will trigger an investigation including the collection of a confirmation sample as well as a statistical or spatial analyses depending on available data and suggests a granger causality test may be conducted between water quality and water levels (*Id*., p. 13-55).

Representative Monitoring Sites and Monitoring Network

The 2024 Draft GSPs included RMW for Degraded Water Quality (RMW-WQ) in the three identified aquifers (Principle, Olcese, and Santa Margarita). The GSAs determined monitoring well placement based on locations with high densities of domestic wells or small community water systems and the location of existing water quality regulatory programs like ILRP and public supply wells regulated by the State Water Board's Division of Drinking Water (2024 Kern County Subbasin Draft GSP, pp. 15-24, 15-27). The GSAs updated the groundwater quality monitoring network to contain 51 representative monitoring wells, all of which will be sampled semi-annually. The GSAs also identified wells to monitor groundwater quality related to subsidence and the effects of PMAs (*Id*, p. 15-24). At least one RMW-WQ well is located in each GSA and one in each HCM Area (*Id*., p. 15-27). The vertical extent of the monitoring network is unknown, and no information was given in the 2024 Draft GSPs regarding the well depth or screening interval.

Well Impact Mitigation

The 2024 Draft GSPs planned to mitigate for the impacts to wells dewatered by groundwater management activities through a contract with Self-Help Enterprises. A letter of intent from Self-Help Enterprises is included in the 2024 Draft GSPs' Appendix K. According to the GSPs, the program "aims to evaluate the cause of well or pump failures, or degraded water quality, and provides an appropriate remedy [for] well

owners who have been impacted by groundwater conditions, as defined within the policy" (2024 Kern County Subbasin Draft GSP, p. 16-8).

As mentioned above, the GSAs have developed an MT exceedance policy for groundwater quality. According to the policy, before the GSAs mitigate for groundwater quality-related impacts to a drinking water well, the GSAs require: (1) additional water quality data collection to confirm exceedance and (2) investigation of whether the degradation is due to groundwater management activities. The GSAs will conduct the latter investigation using statistical or spatial analysis between water levels and water quality to determine causation, depending on available data. The GSPs do not include an estimate of cost for mitigation of groundwater quality impacts due to management activities or a discussion of how the GSAs will notify impacted beneficial users about what assistance will be provided (*Id*., p. 13-55).

Projects and Management Actions

The PMAs listed in Chapter 14 (Tables 14-4 through 14-23) of the 2024 Draft GSPs primarily focus on other indicators such as chronic lowering of groundwater levels. The 2024 Draft GSP includes plans to continue working with other water quality regulatory programs such as ILRP, the State Water Board's SAFER Program, and CV-SALTS (2024 Kern County Subbasin Draft GSP, p. 14-18).

4.1.4.4 Proposed State Water Board Deficiencies and Potential Actions

In DWR's 2022 Kern County Subbasin GSP Inadequate Determination dated March 2, 2023, DWR determined that the GSAs had not corrected deficiencies that may impact all sustainability indicators in the subbasin, including degradation of groundwater quality. The 2022 GSP Inadequate Determination states:

> The Plans still use various data and methods to establish the sustainable management criteria [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 (2022 Inadequate Determination, p. 31).

The 2022 GSP Inadequate Determination also found the subbasin had taken significant steps in implementing corrective actions for each management area and conducting an initial impact analysis for groundwater quality SMC (*Ibid*.). Board staff concurs with DWR's assessment of significant improvement and that the plans are still inadequate. Additionally, DWR acknowledged that the KGA and KRGSA GSPs were the only plans

that developed PMAs that would offset impacts to beneficial uses and users through demand management (*Ibid*.). After reviewing the six 2022 GSPs, 13 Management Area Plans, the Coordination Agreement, and DWR's 2022 GSP Inadequate Determination, Board staff supports DWR's determinations related to the degradation of groundwater quality associated with the coordination deficiency and have identified additional deficiencies specific to degradation of groundwater quality.

Appendix A summarizes the remaining Board staff-identified deficiencies as they pertain to the 2022 and 2024 Draft GSPs, as well as Potential Actions. Board staff found the 2022 GSPs were too uncoordinated to be able to evaluate the adequacy of any one approach to setting SMC, defining monitoring networks, or describing PMAs. The 2024 Draft GSPs are much more coordinated, allowing Board staff to evaluate the details of the now-coordinated approach the GSAs have for managing degradation of groundwater quality. The following section is consequently structured differently than the Draft Staff Report. Following Board staff's review of the 2024 Draft GSPs, and consideration of information provided during coordination meetings between Board staff and GSA staff, Board staff has identified the following groundwater quality deficiencies in the 2024 Draft GSPs.

Deficiency Groundwater Quality 1 (GWQ-1) – The GSPs do not establish undesirable results and sustainable management criteria consistent with the requirements of SGMA.

What SGMA Requires: In defining undesirable results, GSAs are required to "describe in [their Plans] the processes and criteria relied upon to define undesirable results [that would] occur when significant and unreasonable effects … are caused by groundwater conditions…." (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition must include the cause of groundwater conditions occurring throughout the subbasin that have 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 must 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).

Additionally, “each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon” (Cal. Code Regs., tit. 23, § 354.30, subd. (a)). “Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty” (Cal. Code Regs., tit. 23, § 354.30, subd. (c)). “The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results [and] shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin” (Cal. Code Regs., tit. 23, § 354.28, subd. (c)(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, § 354.20, subd. (a)).

Deficiency: In the 2022 GSPs, the Kern County Subbasin GSAs defined undesirable results and SMC in a manner that would result in a disproportional impact on beneficial uses and users in the subbasin. This was the result of various plans and management areas using and implementing inconsistent data, methodologies, and assumptions when defining SMC coupled with the two-tiered undesirable results definition. The impact from these methodologies and various times when they would contribute to an undesirable result could have resulted in certain portions of the subbasin experiencing substantial impacts for sustained periods without an undesirable result being triggered.

The 2024 Draft GSPs address this deficiency by using more coordinated approaches for defining undesirable results and establishing SMC. However, the requirement that three wells within a single HCM Area register MT exceedances before an undesirable result occurs could allow significant portions of the subbasin to experience groundwater quality degradation due to groundwater management without triggering an undesirable result. Instead, an undesirable result would not be triggered unless the degradation is highly localized. Additionally, the requirement for three wells to have exceeded the MT values is disproportionate in the various HCM Areas, since each of the five HCM Areas

contains various numbers of wells and users, with the Western HCM containing only a single RMW-WQ.

Deficiency GWQ-1a – Undesirable result definitions are not protective of beneficial uses and users.

The 2022 GSPs' plain-language undesirable results were not detailed enough for consistent implementation across the various GSPs and Management Area Plans (each GSP and Management Area Plan defined analytes specific to each GSA and management area's existing detections) therefore undesirable results were poorly coordinated when considering beneficial uses and users.

Moreover, the quantitative undesirable result could result in a disproportional impact in the subbasin. For an undesirable result to be triggered, an MT exceedance would need to occur in 40% of RMW for four consecutive measurements (at least two consecutive years) for a management area to contribute to an undesirable result, *and* 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 complexity did not adequately protect beneficial uses and users from significant and unreasonable impacts through the subbasin.

Board staff found the 2024 Draft GSPs no longer have inconsistent implementation or coordination issues, but some key concerns remain. The undesirable result definition does not use the best available science and does not contain enough detail to determine if beneficial uses and users will be protected. The plain language undesirable result is defined as:

> The point at which significant and unreasonable impacts occur 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 (2024 Kern County Subbasin Draft GSP, p. 13-50).

The quantitative definition if an undesirable result is defined to occur,

> …If and when MTs for a groundwater quality COC are exceeded in three (3) RMW-WQs in an HCM area based on the average of confirmed seasonal sample results and can be attributed based on a technical analysis to groundwater management actions (e.g. groundwater level changes) (*Id*., p. 13-55).

It is possible to have subbasin-wide impacts to water quality without triggering an undesirable result. For example, if two wells in each HCM Area were to reach the MT exceedance, then approximately 18% of the RMWs across the basin could have exceedances without reaching the undesirable result definition. It is unclear how many

users could be impacted and if this is consistent with what the GSAs define as "significant and unreasonable."

2024 Draft GSPs Evaluation: While the 2024 Draft GSPs contain additional information justifying the quantitative undesirable result threshold, the 2024 Draft GSPs still lack information detailing whether the GSAs considered all beneficial uses and users of groundwater in developing MTs. Board staff cannot assess the adequacy without understanding how the new approach would impact beneficial users for the duration required before an undesirable result would occur. It is also unclear what management actions would be triggered if three RMW-WQs MTs are exceeded. Board staff has determined that Deficiency GWQ-1a is not resolved.

2024 Final GSPs Tentative Evaluation: This deficiency does not appear to be addressed. The updated undesirable result definition still lacks the detail necessary to determine whether all beneficial uses and users have been considered. The undesirable result is not consistent with SGMA requirements and may disproportionately impact beneficial uses and users throughout the basin and therefore does not consistently define what is significant and unreasonable in regard to degradation of groundwater quality caused by groundwater management activities.

The quantitative definition of an undesirable result has been updated to include an MT exceedance in the one RMW-WQ located in the Western Fold Belt area or "Five (5) small community wells sampled under the DDW requirements have a confirmed MCL exceedance of a groundwater quality COC and can be attributed to groundwater management actions based on a technical analysis (e.g. groundwater level changes, PMAs). Table 13-6 summarizes COC concentrations in each small community well. The MT Exceedance Policy and Investigation SOP (Appendix W) provides details on the actions GSAs will take in the event of a single MT exceedance." (2024 Final GSP, p. 13-65). The updated undesirable result may allow impacts to beneficial uses and users before an MT is exceeded.

Potential Action GWQ-1a – Develop undesirable results consistent with SGMA using best available science and considering all beneficial uses and users.

The plain-language undesirable results should be specific enough that GSAs and others can evaluate, over time, whether an undesirable result has occurred due to conditions throughout the subbasin 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. GSAs should use the best available science to develop the quantitative definition of an undesirable result by:

- Developing quantitative undesirable results that clearly describe the combination of MT exceedances and represent the conditions that would cause the plain-language undesirable result. This quantitative undesirable result should protect against the significant and unreasonable impacts described by the plain-language undesirable result.
- Determining which management activities could influence groundwater quality degradation. Importantly, this should not just include actions that contribute to groundwater level declines. Additional SGMA-related activity examples include: (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 temporarily lead to an increase in concentrations of arsenic, and (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, GSAs should clearly explain how they would determine the water quality impacts of:

  1) Projects and management actions. Board staff notes 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. Recycled produced oil field waters may have elevated concentrations of boron, which pose risk to crops sensitive to the salt and should be monitored where applied.

  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 clays, or the E-clay. Because of this, the GSAs 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 changing redox conditions due to declining groundwater levels. Board staff also notes that continued pumping in

certain areas of the subbasin may cause changes in groundwater flow directions 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. The GSAs are responsible for groundwater quality degradation related to groundwater management actions, or lack thereof, except for undesirable results occurring prior to January 1, 2015.

Deficiency GWQ-1b – The GSPs are missing critical information about how GSAs will determine whether an undesirable result has occurred.

The 2022 GSPs developed SMC which: (1) were developed using inconsistent data and methodologies for assumptions across GSPs and Management Area Plans that, combined with vague, inconsistent undesirable results, could have caused disproportional impacts and (2) failed to represent the key conditions that groundwater managers must evaluate in order to achieve sustainability and avoid undesirable results. Some GSPs and Management Area Plans proposed to: (1) use groundwater levels as a proxy to monitor groundwater quality degradation, (2) use constituent concentrations, and (3) not monitor for groundwater quality. The inconsistent approaches for setting SMC for constituents and impacts of SMC did not consider all uses and users within the subbasin.

The 2024 Draft GSP's revised approach establishes SMC for degradation of water quality using consistent methodologies across the subbasin. The GSPs indicates a single MT exceedance will trigger an investigation, including statistical or spatial analyses depending on available data, and suggests a granger causality test may be conducted between water quality and water levels (2024 Kern County Subbasin Draft GSP, p. 13-55). As described above, an undesirable result would only occur if MT exceedances can be attributed to groundwater management actions based on a technical analysis. The 2024 Draft GSPs lacks clarity on which method will be used under different conditions for each constituent. Board staff finds there is insufficient explanation on how factors such as environmental or redox conditions change due to management activities that are not represented in groundwater levels, and how those conditions may also mobilize constituents of concern (e.g., near areas of recharge). The GSPs still lacks detail on how each GSA would determine if MT exceedances will be impacted by groundwater pumping, recharge projects, change in groundwater flow direction, change in groundwater redox conditions, or other GSA management actions and projects, as opposed to other factors. Without this information, Board staff cannot evaluate whether the MTs avoid undesirable results related to groundwater quality degradation.

Additionally, the MT definition is set as the greater of the concentration of the health-based screening standard or the maximum 2010-2014 baseline concentration at each RMW-WQ (*Id*., p. 13-56). If there is evidence that concentrations have declined for a particular analyte between the 2010-2014 maximum and 2015, the GSAs should use the lower, more recent value as the pre-SGMA baseline (or the regulatory standard, whichever is greater). GSPs are not responsible for undesirable results that occurred before January 1, 2015, *unless* the undesirable result was corrected by January 1, 2015, consistent with Water Code section 10727.2, subdivision (b)(4).

2024 Draft GSPs Evaluation: Based on Board staff's review of the 2024 Draft GSPs, concerns remain regarding the lack of clarity and detail regarding how management activities may lead to significant and unreasonable impacts to beneficial uses and users. This is because exceedances of proposed constituents may be screened out by the GSAs' technical analyses, concentrations could still be impacted by GSAs' management activities. Certain constituents have the potential to be influenced by groundwater management in ways other than groundwater level declines, such as migration of contaminant plumes, or MTs are set at pre-SGMA highs where issues have been resolved. Therefore, Board staff cannot evaluate the adequacy or justify the proposed SMC. Board staff has determined that Deficiency GWQ-1b is not resolved.

2024 Final GSPs Tentative Evaluation: This deficiency does not appear to be addressed. The GSPs have not provided necessary information needed to determine whether an undesirable result will occur. The technical analysis process developed by the GSAs fails to consider all driving mechanisms for each COC. New language indicating "localized issues may be exacerbated by SGMA implementation" (2024 Final GSP, p.13-27,13-83, 13-85) concerns board staff, because GSA actions should not further degrade groundwater quality.

Potential Action GWQ-1b – The GSPs should include consistent data and methods to develop groundwater quality minimum thresholds.

GSAs should evaluate more than groundwater level correlations to determine whether water quality degradation is due to management activities. When developing the MT exceedance policy, as described in section 4.1.2.3, GSAs should investigate the causes of water quality degradation for constituents of concern. Using an inverse correlation between groundwater levels and groundwater quality may not be sufficient, especially for redox-sensitive or depth-dependent constituents. In some cases, GSAs may not see a change in water levels but may see a change in the redox conditions that may impact water quality; consequently, the GSAs should monitor redox conditions as applicable in order to complete their exceedance evaluations.

To prevent having to address undesirable results that occurred before and were not resolved by January 1, 2015, GSAs should demonstrate specific locations where pre-

2015 undesirable results occurred and were not corrected by 2015. In these instances, MOs and MTs potentially exceeding regulatory thresholds may be appropriate, so long as they are limited to RMW in the pre-2015 undesirable result locations. Importantly, these MOs and MTs should still prevent further 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 GSAs 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 GSAs did not inherit an undesirable result. It instead experienced a temporary exceedance of MCLs, and the GSAs should therefore not use the exceedance data to determine MTs. If concentration levels of a given constituent have declined since the baseline concentration was established, the GSAs should set the MT to either the lowest detected baseline measurement or the health-based screening standard once the concentration has fallen below the health-based standard.

Deficiency GWQ-2 – Groundwater quality monitoring network is not consistent with the requirements of SGMA.

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 RMWs (Cal. Code Regs., tit. 23, § 354.36). GSAs identify MTs, MOs, and IM at these sites. "The designation of [an RMW] 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 finds that the GSAs' monitoring network in the 2022 and 2024 Draft GSPs is not representative of beneficial uses and users and does not provide sufficient spatial or temporal coverage for characterizing groundwater quality conditions that may occur throughout the implementation of the GSPs. The deficiencies are summarized below as GWQ-2a and GWQ-2b.

Deficiency GWQ-2a – The monitoring network is not protective of all beneficial uses and users in the subbasin.

The monitoring well network in the 2022 GSPs often relied on existing monitoring programs, which primarily consisted of public supply or irrigation wells. Domestic wells are typically completed at much shallower depths and were underrepresented in the monitoring well network. Therefore, domestic wells may have experienced impacts from degradation of groundwater quality without an MT exceedance occurring. This is especially true for shallow aquifer constituents such as nitrate (Levy, 2021). Additionally, where there are clays, or where the E-clay is present, GSAs did not differentiate between confined and unconfined/semi-confined aquifers (upper or lower) for monitoring networks. If the proposed RMW is completed at depths below the E-clay, this is especially concerning when it comes to monitoring conditions for shallow domestic well owners. Regardless of upper or lower defined aquifers, some constituents are known to stratify in the aquifer and shallow groundwater users may have been disproportionately affected if water levels are bringing constituents closer toward well screens or pumps, and monitoring wells were at non-representative depths. Furthermore, many carcinogenic constituents are tasteless but nonetheless have severe impacts to user health.

The same concerns are present in the 2024 Draft GSPs. The water quality monitoring network proposed in the 2024 Draft GSPs contains 51 RMW-WQs (53 RMW-WQs are noted in the table located in Appendix X). Approximately 52% of the RMW-WQ wells throughout the subbasin represent district and public supply wells; however, less than 2% of the water quality monitoring network represent “landowner supply wells” in the subbasin (Appendix X), which Board staff assumes are wells used for domestic water supply. Public supply wells and district supply wells are often completed and screened at much greater depths than domestic wells and, as a result, water quality measurements in public supply wells are not always representative of conditions in shallow domestic wells.

Additionally, the vertical extent of the monitoring network is unknown; the 2024 Draft GSPs give no information regarding the well depth or screening intervals for any of the RMW-WQs. It is unclear whether the representative monitoring wells will be sufficient to identify impacts to shallow domestic well users since an impact analysis was not done relative to groundwater quality (Cal. Code Regs., tit. 23, § 354.34, subd. (f)(3)).

Finally, the RMW-WQ coverage does not support the 2024 Draft GSPs’ definition of undesirable results related to groundwater quality degradation. For example, the proposed monitoring network does not have enough coverage in the Western Fold Belt HCM Area to meet the MT trigger requirement since the area only contains a single RMW-WQ. Additionally, large portions of the Eastern Margin HCM Area do not have

RMW-WQ coverage, meaning water quality could degrade substantially there without triggering an undesirable result.

2024 Draft GSPs Evaluation: Based on the 2024 Draft GSPs' proposed undesirable result for degraded water quality, the horizontal extent of the monitoring network appears to be insufficient in representing all beneficial uses and users within the subbasin. Without more information, Board staff cannot evaluate whether the vertical extent of the monitoring network represents beneficial uses and users, but the depths from which domestic wells pump appear underrepresented. Moreover, the RMW-WQ network extent, in combination with the 2024 Draft GSP's definition of an undesirable result, could allow for substantial regional degradation of groundwater quality. For example, to trigger an undesirable result in the East Margin HCM Area, 38% of the wells within the East Margin HCM Area would have to have an exceedance. It is unclear how many drinking water wells would be impacted at this percentage or if the density of monitoring wells would be sufficient to identify impacts to shallow domestic well users. Board staff has determined that Deficiency GWQ-2a is not resolved.

2024 Final GSPs Tentative Evaluation: This deficiency does not appear to be addressed. The monitoring network is still not protective of all beneficial uses and users in the subbasin.

Potential Action GWQ-2a – GSAs should evaluate the existing monitoring network and add additional wells to monitoring well network to ensure all beneficial uses and users are represented.

The GSPs should demonstrate that the groundwater quality monitoring network will adequately monitor impacts to shallow groundwater well users by: (1) including domestic wells or monitoring wells with similar screened intervals and well depths to monitor for potential impacts to domestic users or (2) demonstrating that RMW wells are completed at similar depths and are influenced by similar hydrogeological processes as domestic wells. Although some public supply wells may be screened in the same aquifer, GSAs should be aware that public supply well screens are typically longer than domestic wells and sampled water would be a variation of averages of the water flowing in through the screen. Therefore, the GSAs would need to demonstrate that the well depth and screen are consistent with local domestic wells to represent local domestic users. Where E-clay or a confined aquifer is present, GSAs should define the aquifers or aquifer portions (upper vs lower) being monitored by each well.

Deficiency GWQ-2b – Water quality sampling frequencies are sometimes insufficient.

In the 2022 GSPs, Board staff found that where groundwater samples are being collected, GSAs sometimes relied on existing sampling from existing regulatory

programs. Sampling frequencies from other regulatory programs are sometimes insufficient. Regulations require that monitoring networks be capable of detecting short-term, seasonal, and long-term trends (Cal. Code Regs., tit. 23, § 354.34, subd. (f)(3)). The 2024 Draft GSPs contains updated sampling procedures to ensure consistent semi-annual sampling events throughout the subbasin (2024 Kern County Subbasin Draft GSP, Appendix Z). Similar to the 2022 GSPs, Board staff recommends 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.

2024 Draft GSPs Evaluation: This deficiency appears to be addressed. With the revisions made to the 2024 Draft GSPs, Board staff has determined the sampling frequencies are sufficient and will capture seasonal fluctuations in groundwater concentrations. The 2024 Draft GSPs indicate each RMW-WQ well will collect samples on a semi-annual basis. Board staff has determined that Deficiency GWQ-2b is resolved.

2024 Final GSPs Tentative Evaluation: This deficiency was addressed in the 2024 Draft GSPs based on Board staff's full review.

Potential action GWQ-2b has been omitted from this Final Staff Report because Board staff is not recommending further action after review of the 2024 Final GSPs.

Deficiency GWQ-2c – It is unclear how the GSAs will assess the impacts of projects and management actions.

SGMA requires that GSAs must prevent "significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies" (Wat. Code, § 10721, subd. (x)(4)). Board staff appreciates the significant efforts the Kern County Subbasin has made to reduce overdraft through PMAs such as groundwater recharge and water banking; however, Board staff cautions that PMAs, in general, can substantially change groundwater and environmental conditions, which can cause existing contamination plumes to migrate or mobilize naturally occurring constituents.

Aside from water quality monitoring wells located within the Kern Fan Banking Area (Appendix E), the 2024 Draft GSPs do not appear to include a detailed discussion of how groundwater banking operations may influence degradation of groundwater quality. Also, the 2024 Draft GSPs fails to discuss how RMW-WQ coverage is adequate for monitoring degradation of groundwater quality from water banking in areas outside the

Kern Fan Banking Area. Moreover, without information about RMW-WQ well depths (see Deficiency GWQ-2a), Board staff cannot independently assess the adequacy of the subbasin's RMW-WQ coverage for this purpose.

2024 Draft GSPs Evaluation: It is not clear to Board staff whether the monitoring network coverage is sufficient to detect degradation of groundwater quality due to PMAs, including recharge or water banking projects. Board staff has determined that Deficiency GWQ-2c is not resolved.

2024 Final GSPs Tentative Evaluation: This deficiency does not appear to be addressed. It is still unclear how monitoring networks are evaluating the potential impacts of PMAs.

Potential Action GWQ-2c – GSAs should better define how they will ensure projects and management actions do not degrade groundwater quality.

GSAs should revise GSPs to define and describe which PMAs 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 State Water Board's GAMA Aquifer Risk Map 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 recognizes the complexities of groundwater management and groundwater quality and suggest GSAs consider the influence of groundwater levels and potential changes in groundwater flow directions caused by recharge and water banking.

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 PMAs that the GSA has determined will achieve groundwater sustainability in the basin. The GSAs must include PMAs "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 PMAs, 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 the development of specific management actions like well mitigation plans or additional sampling, Board staff considers them to be potentially important components of SGMA implementation to ensure availability of water for all beneficial uses and users in the subbasin and for avoiding undesirable results.

Deficiency: The 2024 Draft GSPs lacks management actions that are responsive to MT exceedances. These management actions are important in ensuring that GSAs avoid undesirable results. Board staff notes multiple deficiencies concerning PMAs in the 2022 and 2024 Draft GSPs. The deficiencies are summarized below as GWQ-3a and GWQ-3b.

Deficiency GWQ-3a – Management actions are not protective of beneficial uses and users once a minimum threshold exceedance is triggered.

The 2022 GSPs did not include management actions that were responsive to MT exceedances.

The 2024 Draft GSPs includes an exceedance policy (see section 4.1.2.3) that is triggered when one RMW-GWQ reaches an exceedance. The exceedance policy requires the collection of a single confirmation sample and a correlation analysis between groundwater level changes and groundwater quality to determine if the exceedance is related to groundwater management actions (2024 Kern County Subbasin Draft GSP, p. 13-55).

2024 Draft GSPs Evaluation: The updated management actions still do not trigger additional monitoring to better characterize risks to beneficial uses and users. Additionally, the timeframe is unclear for when the GSAs will respond to exceedances and when the GSAs will notify users and whether or not they will provide testing for users who may be impacted. Board staff has determined that Deficiency GWQ-3a is not resolved.

2024 Final GSPs Tentative Evaluation: This deficiency appears to be partially addressed. Board staff is still concerned that beneficial uses and users may be impacted prior to an undesirable result occurring due to the Exceedance Policy's insufficient correlation procedure (Appendix W).

Potential Action GWQ-3a – Develop a method to determine the impact of an exceedance to beneficial uses and users and clarify how the public will be notified should a minimum threshold exceedance occur.

Board staff recommends GSAs 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/or sampling of additional nearby wells completed within the same aquifer. The Exceedance Policy should clearly state how the GSAs will notify drinking water users of a water quality MT exceedance that potentially affects their water source. In defining how the GSAs will notify drinking water users, the Exceedance Policy should discuss how drinking water users will be identified, the timing of when users will be notified, and a description of the potential impacts to human health that may occur if consumption of contaminated drinking water occurs.

Deficiency GWQ-3b – The well mitigation plan does not address water quality degradation.

The 2022 GSPs did not include a consistent well mitigation plan. Only two of the GSAs, KGA and KRGSA, proposed well mitigation plans to address impacts from the chronic lowering of groundwater levels. However, these efforts did not specifically address potential to mitigate degradation of groundwater quality. As Board staff notes above in Deficiency GWQ-3a, elevated concentrations of some constituents that can be affected by groundwater management severely impact human health. Therefore, it was difficult for Board staff to understand how the GSAs could avoid significant and unreasonable impacts from degradation of groundwater quality if the GSAs had not developed a well mitigation plan that could be reasonably implemented to address water quality degradation caused by groundwater management activities in the subbasin. Relatedly, the GSAs noted MT exceedances in the WY 2022 GSP annual report, but GSAs proposed only to continue monitoring.

The 2024 Draft GSPs includes a letter of intent with an outline for a Well Mitigation Program. The outline states that the Well Mitigation Program will mitigate degraded groundwater quality for domestic and small community wells. (2024 Kern County Subbasin Draft GSP, pp. 13-55 and 16-8). The GSAs plan to work with Self-Help Enterprises to provide both short-term emergency services and long-term solutions to drinking water wells (*Ibid.*). See section 4.1.2.4 for additional description.

Because the vertical extent of the RMW-WQ wells is unknown, Board staff is unable to effectively evaluate whether the mitigation plan will be able to address impacts. Additionally, there are no proposals within the GSPs for funding mitigation for groundwater quality.

2024 Draft GSPs Evaluation: Board staff cannot assess whether the mitigation plan will adequately address the degradation of water quality. Neither the 2024 Draft GSPs nor the letter of intent with Self-Help Enterprises located in Appendix K includes information on funding or methods of mitigation to be provided.

2024 Final GSPs Tentative Evaluation: This deficiency appears to be partially addressed. The GSPs still lack an appropriate method for evaluating whether groundwater quality degradation may be due to groundwater management activities or actions. Without a clear understanding of potential impacts, Board staff cannot determine if the well mitigation plan will address the degradation of water quality.

Board staff previously proposed the Groundwater Level Potential Action GL-2b to address the Deficiency GWQ-3b.

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" (Wat. 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)). Depletion 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, 2022, and 2024 Draft GSPs submitted for the Kern County Subbasin, Board staff has concluded that the GSPs do not sufficiently demonstrate that undesirable results related to the depletion of ISW are not present and are not likely to occur in accordance with SGMA. However, Board staff is encouraged by the GSAs' progress in the 2024 Draft GSPs towards implementing a consistent and coordinated approach to identify ISW and GDE. Furthermore, Board staff looks forward to additional information that the GSAs may include in the subsequent GSPs pending DWR's ISW guidance documents.

While other basins began implementing plans for ISW in 2020 that are now approved (i.e., Paso Robles, Santa Cruz Mid-County), the Kern County Subbasin does not yet have an adequate plan to address the depletion of ISW and achieve groundwater sustainability by 2040. To meet this timeline, Kern County Subbasin GSAs must adequately monitor and assess ISW within the subbasin in accordance with SGMA, and

DWR's guidance documents once they are available. Failure to reasonably assess ISW could result in 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 collectively claimed there were no ISW in the subbasin. Therefore, the GSAs did not define undesirable results or set SMC for ISW. Additionally, the 2022 Coordination Agreement stated 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 2022 Coordination Agreement did not provide adequate evidence to justify why depletion of ISW is not applicable to the subbasin, nor did it describe consistent data and methods GSAs must use to evaluate if ISW exists. It appeared to Board staff that ISW was not properly considered in the subbasin. In conclusion, the 2022 GSPs did not define undesirable results, SMC, monitoring networks, or mitigation to prevent and protect depletion of ISW.

Interconnected Surface Water Evaluation

The approaches taken by GSAs for each of the 2022 GSPs to determine whether ISW was present are summarized as follows:

Henry Miller Water District GSP

GSP noted that ISW is not interconnected based on the GSA's assessment of a 22.5-mile research area for the Kern River. The GSP stated, "[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, p. Sec. 2.2.5).

Olcese GSP

The GSP stated that the Kern River is fully disconnected from deeper groundwater systems (the Olcese Aquifer) 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 suggested 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 would allow the district to further evaluate the degree of hydraulic connection between the principal aquifer and the shallow alluvium and ISW (*Id*., p. 84). Lastly, the GSP stated 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*.).

Buena Vista Water Storage District GSP

The GSP noted the absence of surface water bodies in the plan area, and therefore concluded 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, pp. 80 and 249), plus "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 stated that "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" (2022 Buena Vista Water Storage District GSA GSP, p. 110).

Kern River GSA GSP

The KRGSA GSP analyzed Kern River operations and flow, channel elevation, and groundwater elevation data over a 20-year period (2022 Kern River GSA GSP, pp. 3-56). The GSP assessed the potential for ISW by using mapped polygons provided by The Nature Conservancy (TNC) NCCAG dataset. The GSP monitoring network included a shallow monitoring well at the Calloway Weir to support future analyses of ISW as needed (2022 Kern River GSA GSP, pp. ES-9 and ES-10). An additional evaluation of potential surface and groundwater interaction beneath the Kern River included 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 screened intervals that may represent a lower water level than where ISW would be expected. Seasonal variability in demand was 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 suggested that groundwater elevations occur well below the entire reach of the Kern River within the plan area. The GSP stated that "[a]dditional 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, p.5-36).

South of Kern River GSP

The GSP evaluated the presence of ISW 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 represented 2015 spring conditions, and covered the Arvin-Edison, WRMWSD, and TCWD management areas. According to the 2015 groundwater conditions and the 2022 GSP: (1) ISW Sustainability Indicators were not applicable to the management areas, (2) no basin-wide definition of undesirable results for depletions of ISW had been developed by the Kern County Subbasin GSAs, and (3) no SMC for this sustainability indicator was defined in the Kern County Subbasin (2022 South of Kern River GSP, p. 244).

Kern Groundwater Authority GSP (and Management Areas Plans)

KGA GSP stated there was no ISW in the KGA Area that is under the influence of groundwater pumping; the GSP stated 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" (2022 Kern Groundwater Authority GSA GSP, pp. 162-163). Given these three statements and the implications of each of these statements, it is unclear if the GSA's understanding of ISW was consistent with the SGMA definition of ISW. KGA GSPs did not provide a detailed discussion on ISW. Instead they referred to the Olcese and KRGSA's GSPs for a more detailed analysis (2022 Kern Groundwater Authority GSA GSP, p. 222).

4.1.5.2 Kern County Subbasin 2024 Draft GSPs

The Kern County Subbasin GSAs submitted seven 2024 Draft GSPs to the Board for review on May 28, 2024. This subsection describes the portions of the 2024 Draft GSPs that are relevant to the proposed Board deficiencies identified in Section 4.1.5.

Identification of Interconnected Surface Water

The 2024 Draft GSPs incorporated a consistent and coordinated approach to identify ISW systems within the subbasin's five HCM Areas. The 2024 Draft GSPs analyzed the potential occurrences of ISW in the subbasin based on TNC's Interconnected Surface Water in the Central Valley (ICONS) tool in conjunction with the NCCAG dataset to

identify GDEs. The 2024 Draft GSPs also delineated the NCCAG areas within the subbasin (2024 Kern County Draft GSP, Figure 8-72) and compiled the data into 2024 Draft GSP Table 8-28 to assess the cumulative acreage of wetlands and groundwater dependent vegetation. The ICONS dataset was also spatially delineated in Figure 8-72 to assess the areas where ISW would most likely occur (*Id*., pp. 8-186 to 8-191).

North Basin HCM Area

Building from the ICONS and NCCAG datasets, the 2024 Draft GSPs identified specific areas within each HCM Area of the subbasin to further investigate the potential for ISW or GDE. In the North Basin HCM Area, Poso Creek was assessed for the occurrence of ISW, while the Kern National Wildlife Refuge (Refuge) and Goose Lake Canal were assessed for the presence of GDE. To assess the possibility of interconnection along Poso Creek, ground surface elevation along the stream (a proxy for stream profile) was plotted against groundwater elevation profiles to display vertical separation during different hydrologic periods (1998, 2013, and 2017) (2024 Kern County Subbasin Draft GSP, p. 8-193). The 2024 Draft GSPs note up to several hundred feet of vertical separation between the groundwater table and Poso Creek even during historically wet periods thus assessing the Poso Creek as disconnected (*Ibid*.).

The 2024 Draft GSPs state that the Refuge is not a GDE, due to its sole dependence on surface water deliveries (*Id*., p. 8-193). An approximately 2-3 mile long stretch along the Goose Lake Canal is denoted by the ICONS and NCCAG tools as likely connected; however, the 2024 Draft GSPs refute this, asserting that connection occurring along the canal is likely dependent on surface water deliveries and perched groundwater: the 2024 Draft GSPs state, “Conditions in this HCM Area suggest that the primary production aquifer does not approach the ground surface and lies at depths that prevent surface water expressions or accessibility for vegetation” (*Id*., p. 8-194). The 2024 Draft GSPs also note that shallow groundwater may support potential GDEs in the west-central and south-central portions of the North HCM Area due to shallow clay layers, but because of poor water quality, groundwater is not pumped from these zones (*Ibid*.).

Eastern Margin HCM Area

The 2024 Draft GSPs note that ISW is not likely to occur in the Eastern Margin HCM Area due to the presence of deeper aquifers and a thick vadose zone below ground surface. However, the NCCAG dataset does identify limited sections where potential GDEs may occur. Based on an aerial imagery analysis, the 2024 Draft GSPs concluded that the potential GDEs relied on ephemeral points of wastewater discharge related to oil and gas production (2024 Kern County Subbasin Draft GSP, p. 8-197). No further analysis was conducted in the Eastern Margin HCM Area.

Kern River Fan HCM Area

In the Kern River Fan HCM Area, the 2024 Draft GSPs state they do not consider the Kern River an ISW within the subbasin boundaries. The 2024 Draft GSP notes the absence of interconnection for the Kern River due to the vertical separation between the stream bottom and groundwater table, a similar method used for the Poso Creek analysis (2024 Kern County Subbasin Draft GSP, p. 8-199). Groundwater levels adjacent to the Kern River are typically more than 50 ft-bgs and remained approximately 60 to 100 ft-bgs near the Kern River's Calloway Pool from 2000 through 2017 (*Ibid.*). The 2024 Draft GSPs also state that the ICONS dataset indicates the Kern River is likely disconnected throughout the Kern Fan HCM Area, except a small reach classified as likely connected west of Stevens due to the conservative criterion used in ICONS classifications, according to the 2024 Draft GSPs (*Ibid*.). Therefore, the interconnection of the Kern River in the Kern River Fan HCM Area is unlikely to occur under normal hydrologic conditions (*Ibid.*).

South Basin HCM Area

The 2024 Draft GSPs also conclude that there are no ISW or GDEs in the South Basin HCM Area, stating that "groundwater levels are generally deep below the ground surface, largely precluding interconnected surface water" (2024 Kern County Subbasin Draft GSP, p. 8-205). As noted in the 2024 Draft GSPs, the groundwater table in the South Basin HCM Area occurs approximately 50 to 400 ft-bgs depending on the geographic location, and the ICONS dataset does not identify any potential ISW in the HCM Area. The 2024 Draft GSPs argue that wetlands and GDEs identified in NCCAG dataset along the Old Canal likely rely on perched water disconnected from the principal aquifer (*Ibid*.).

Western Fold Belt HCM Area

The 2024 Draft GSPs do not identify any ISW or GDEs in the Western Fold Belt HCM Area contrary to the NCCAG dataset, which indicates potential GDEs within the Western Fold Belt HCM Area, specifically between the California Aqueduct and the Kern River Flood Canal (2024 Kern County Subbasin Draft GSP, p. 8-206). The 2024 Draft GSPs dismissed these potential GDEs, stating that the vegetation is likely sustained by surface water deliveries along canals, ephemeral streams not connected to the groundwater system, or perched water (*Ibid*.).

In conclusion, the 2024 Draft GSPs do not identify any ISW or GDEs that could be affected by groundwater pumping or management within the subbasin after an analysis that used the ICONS tool, NCCAG tool, groundwater elevation profiles, aerial imagery and local knowledge. Although the 2024 Draft GSPs note that there may be some ISW occurring in the subbasin, "the connection is likely transient, short-lived, and involves shallow or perched groundwater that is not part of the principal aquifer systems" (2024 Kern County Subbasin Draft GSP, p. 8-206). The 2024 Draft GSPs do not reference any

numerical modeling to further characterize or identify ISW or GDEs within the subbasin. Also, the GSAs do not establish or propose a monitoring network for ISW depletions in the 2024 Draft GSPs.

Undesirable Result and Sustainable Management Criteria

Positive changes were made in the 2024 Draft GSPs, respective to coordination and assessment of potential occurrences of ISW and GDE in the subbasin. The updated assessments in the 2024 Draft GSPs maintain the conclusion that there are no ISW that can be impacted by groundwater management practices in the subbasin. Therefore, the GSAs did not define undesirable results, set SMC, establish a monitoring network, or identify beneficial users for ISW (2024 Kern County Subbasin Draft GSP, p. 13-134).

4.1.5.3 Resolved State Water Board Deficiencies and Considerations

Prior to publishing the Draft Staff Report, Board staff conducted a review of the 2022 GSPs and identified deficiencies based on the information presented in the 2022 GSPs. In between Board staff's review of the 2022 GSPs and the publishing of the Draft Staff Report, The Kern County Subbasin GSAs submitted seven draft 2024 GSPs for Board review on May 28, 2024.

In order to include the most up-to-date information in this Final Staff Report, Board staff reviewed the 2024 Draft GSPs and assessed what, if any, deficiencies identified in the 2022 GSPs remained in the 2024 Draft GSPs. Below are the previously identified deficiencies that Board staff determined require no further action from GSAs based on the information presented in the 2024 Draft GSPs.

Deficiency Interconnected Surface Water 1 (ISW-1a and ISW-1b) – Interconnected surface water undesirable results and sustainable management criteria are not coordinated.

What SGMA Requires: SGMA regulations require that "Agencies intending to develop and implement multiple Plans pursuant to Water Code Section 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 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)).

Deficiency: Despite the fact that GSAs and management areas claimed in the 2022 GSPs that there was no ISW and therefore no potential undesirable results, the methods used to determine that there are no potential undesirable results were inconsistent. For example:

- The HMWD GSA based their determination that there is no ISW in the subbasin on a Safe Drinking Water Information System (2019) map that showed no GDEs. However, the HMWD GSP also stated "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 Unit) 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 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 Kern River GSP described its analysis of potential ISW (2022 Henry Miller Water District GSP, p. 37; 2022 Kern River GSP, sec 3, pp.56 - 61). However, the Kern River GSP stated "[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, pp. 3-27).
- The BVWSD GSP claimed that there is no ISW because there is no surface water.
- The KGA GSP claimed 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 (2022 KGA GSA GSP, pp.183).

2024 Draft GSPs Evaluation: The 2024 Draft GSPs use consistent and comparable methodologies to identify potential ISW and GDEs in the HCM Areas by applying the ICONS and NCCAG datasets, alongside groundwater elevations. With this revision, Board staff does not have further concerns related to Deficiency ISW-1a and 1b.

Board staff notes that, if the GSAs find undesirable results could be occurring in the subbasin specific to ISW and GDE, then this deficiency (ISW-1a and ISW-1b) may resurface depending on how SMC are set.

2024 Final GSPs Tentative Evaluation: This deficiency was addressed in the 2024 Draft GSPs based on Board staff's full review. This evaluation remains consistent with Board staff's initial, high-level review of the 2024 Final GSPs. **Potential action ISW-1a has been omitted from this Final Staff Report because Board staff is not recommending further action after review of the 2024 Final GSPs.**

4.1.5.4 Proposed State Water Board Considerations

Below, Board staff specifically discusses a residual concern for the subbasin related to depletions of ISW. Here staff breaks out the content originally discussed in the Draft Staff Report discussion of deficiency ISW-1.

What SGMA Requires: The GSP regulations require GSPs to "provide a description of current and historical groundwater conditions in the basin…based on the best available information" (Cal. Code Regs., tit. 23, § 354.16). This information includes: "[i]dentification 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, subd. (f)).

The GSP regulations define interconnected surface water 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)).

The GSP regulations specify that a GSP must describe the groundwater and surface water model used to quantify surface water depletion and, "[i]f a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model…" (Cal. Code Regs., tit. 23, § 354.28, subd. (c)(6)(B)).

An 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, § 354.28, subd. (e)).

Evaluation: The Kern County Subbasin 2022 GSPs included one main GSP, five GSPs, and 12 Management Area Plans. The 2022 GSPs deferred to the individual GSPs and Management Area Plans to determine the presence and location of ISW (see section 4.1.5.1), leading to inconsistencies in the data and methodologies used to identify ISW within each GSP Plan Area, sometimes with relatively limited information on the methodologies used. Ultimately, these various methodologies within the 2022 GSPs made it difficult to verify the accuracy and comparability of the identification processes for ISW. As such, Board staff appreciates the 2024 Draft GSPs' significant changes from the 2022 GSPs, specifically inclusion of a consistent methodology for identifying ISW by applying the ICONS and NCCAG tools throughout the basin's HCM Areas.

Although the effort to identify ISW and GDEs are now coordinated and consistent (see ISW-1a, 1b), the 2024 Draft GSPs do not sufficiently support the position through the

use of best available data that ISW does not qualify as a sustainability indicator in the subbasin. Board staff believes the ICONS and NCCAG dataset were used effectively as a means to locate areas of potential ISW and GDE; however, the 2024 Draft GSPs' evaluation of groundwater elevations relative to stream thalweg elevations uses data from inappropriate wells in some cases. In other cases, the 2024 Draft GSPs include insufficient information on the wells for staff to assess whether the data are relevant. The wells used to demonstrate this vertical separation appear to be screened too deep (> 100ft-bgs), do not sufficiently demonstrate their location relative to the surface water source, or did not include well construction data at all (2024 Kern County Subbasin Draft GSP, Figure 8-74, p. 8-195). Consequently, Board staff is unable to determine if these wells provide adequate groundwater elevation evidence to omit ISW and GDEs as a sustainability indicator.

Additionally, the 2024 Draft GSPs do not utilize stream gauge data or groundwater extraction data in support of the vertical separation of groundwater levels and stream thalwegs in accordance with DWR's February 2024 guidance in identifying ISW (DWR, 2024a). Board staff finds it difficult to understand how GSAs concluded that groundwater management practices and pumping are not impacting surface water flows without the incorporation of such data. The 2024 Draft GSPs conclude that ISW and GDEs may be present in the subbasin where "the connection is likely transient, short-lived, and involves shallow or perched groundwater," but the finding that they are not impacted by groundwater pumping or groundwater management practices remains unsubstantiated based on the current evidence provided (2024 Kern County Subbasin Draft GSP, p. 8-206). Board staff recognizes that ISW and GDE identified in the HCM Areas may not be influenced by groundwater extraction, and in such cases, the GSAs would not need to consider ISW as a sustainability indicator or set SMC. However, Board staff does not find there is sufficient evidence of this based on the current methodologies and data regarding ISW in the subbasin.

2024 Final GSPs Tentative Evaluation: This deficiency appears to be addressed. The 2024 Final GSPs include a more robust description of the methodology used to conclude the absence of ISW and GDE in the subbasin. Board staff is encouraged by the additional hydrographs and well location data detailed in their findings.

Potential Considerations ISW-2 – Continue using the best available information to evaluate potential ISW in the subbasin.

The approach to determine if ISW is present and affected by groundwater management practices should be consistent with the best available data and science practices.

This approach should:

- Reevaluate ISW using the definition of ISW in the SGMA regulations (Cal. Code Regs., tit. 23, § 351, subd. (o)). Because ISW is defined as groundwater that is in hydraulic connection *at any time* with a stream or surface water body (whether gaining or losing), ISW can be intermittent, so evaluations should consider seasonality (DWR, 2024a).

  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 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 ISW is identified, evaluate whether ISW undesirable results are occurring or likely to occur. For example, the 2024 Draft GSPs should not simply claim that there is no ISW where “the connection is likely transient, short-lived, and involves shallow or perched groundwater that is not part of the principal aquifer systems” (2024 Kern County Subbasin Draft GSP, p. 8-206). 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 the above actions identify ISW, then GSPs and management area plans should:

- Develop MOs, MTs, and IMs for ISW using consistent data and methods. The MOs are the quantitative goals that the subbasin plans to achieve to maintain and/or establish desired conditions for ISW. The MTs should be developed 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. IMs, defined in five-year increments, are used to evaluate whether the subbasin is on track to reach MOs by 2040.

  If GSAs establish different MOs and MTs for management areas, the GSPs will need to adequately explain how each management area can operate under different MTs and MOs without causing undesirable results outside the management area (Cal. Code Regs., tit. 23, § 354.20, subd. (b)).

- Redevelop groundwater level MOs, MTs, and IMs that are protective of ISW, where applicable.

- Establish an ISW monitoring network. Create 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" (DWR, 2016a). The addition of shallowly screened wells, specifically along Jerry Slough, Goose Lake Canal, and Kern River, will better characterize the spatial and temporal exchanges between surface water and groundwater.

  An ISW monitoring 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 have operations cease, at least temporarily. Appropriate models may be needed; 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" (DWR, 2016a).

- Conduct ongoing assessments of ISW and GDE in accordance with any future DWR guidance and include effects of pumping on depletions of surface water bodies in any hydrogeologic model updates. Update ISW and GDE assessments periodically as actions resulting from ongoing litigation could alter the Kern River's and other surface water bodies' interconnection with groundwater systems.

4.2 Exclusions from Probationary Status

SGMA provides mechanisms to exclude portions of a basin from probationary status and to exclude categories of extractions from the requirement to report groundwater extractions to the Board and pay related extraction fees.

Based on its evaluations of the 2024 Final GSPs, it does not appear to Board staff that the GSPs provide adequate information to determine if exclusions are appropriate. Board staff, therefore, does not currently recommend any exclusions for the Kern

County Subbasin. This recommendation may change, however, as Board staff continues coordinating with the subbasin to obtain additional information that may inform exclusion evaluations.

Board staff will reevaluate potential exclusions based on any additional information that is provided. In the interim, GSAs should focus on working together to achieve sustainable, basin-wide management. If the basin avoids probation, exclusions would be unnecessary.

This section describes the potential exclusions provided by statute.

4.2.1 Exclusions in Statute

SGMA provides two potential statutory exclusions from probation and/or extraction reporting and fees, referred to below as the “Probation Exclusion” and the “Reporting and Fees Exclusion.” Board staff stresses that the current GSP deficiencies are based on substantiative issues that are unlikely to be resolved by further subdividing GSAs, including for GSAs that have already requested exclusions. In its descriptions of these exclusions below, Board staff explains how these exclusions should be sought by GSAs or for portions of GSAs that might otherwise believe that they need to split into their own GSAs.

4.2.1.1 Probation Exclusion (Section 10735.2(e)):

Water Code section 10735.2, subdivision (e) is a mandatory exclusion that requires the State Water Board to exclude from probationary status any portions of the basin for which a GSA demonstrates compliance with the sustainability goal.

SGMA defines “sustainability goal” to mean “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)). SGMA defines “sustainable groundwater management” to be “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)). And SGMA defines “sustainable yield” to mean “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 undesirable results” (Wat. Code, § 10721, subd. (w)).

The Probation Exclusion therefore requires demonstrating compliance with a GSP:

Adequately defines and monitors undesirable results. Demonstrating compliance with the sustainability goal requires a GSP that avoids undesirable results. A GSP cannot avoid undesirable results unless it defines undesirable results and other key SMC in accordance with SGMA and includes monitoring provisions that will provide information regarding whether undesirable results are occurring. This means that MOs, IMs, and MTs must avoid undesirable results, that definitions of undesirable results don't allow significant and unreasonable impacts, and that monitoring networks provide adequate coverage to evaluate how well the basin is avoiding undesirable results and progressing toward eliminating overdraft.

Board staff considerations include whether GSAs have addressed any deficiencies pertaining to adequate definitions of undesirable results, including the basis for what impacts are significant and unreasonable, how impacts are mitigated, and the related definitions and monitoring of SMC.

Board staff stresses that GSAs may develop different SMC and undesirable result definitions for different management areas. GSP regulations allow management areas to use different methods to establish MOs and MTs so long as undesirable results are defined consistently (Cal. Code Regs., tit. 23, § 354.30, subd. (a)). In the Draft Staff Report, Board staff noted that regulations do not specify what it means for an undesirable result to be *defined consistently*. Board staff therefore clarify that a management area may develop its own undesirable result definition so long as it: 1) is more protective than the rest of the basin, and 2) is easily integrated into basin-wide evaluations of undesirable results.

Identifies a schedule of projects and management actions that ensure the covered portion of the basin operates within its sustainable yield. Ensuring operation within sustainable yield — meaning ensuring extractions remain within the amount that can be withdrawn annually without causing undesirable results — is a required component of the sustainability goal. If a GSA cannot demonstrate that a GSP includes measures that ensure the portion of the basin is operated within its sustainable yield, it cannot demonstrate compliance with the sustainability goal for that portion of the basin. Board staff considerations include whether the water budgets in the GSPs adequately characterize the deficits (also referred to as overdraft) in their water budgets; whether the PMAs already achieve a balanced water budget for the portion of the basin; whether the PMAs are feasible; whether GSAs have necessary water rights and funding to implement their PMAs; and whether the GSPs identify the management actions necessary to provide contingency in case future conditions are drier than GSPs anticipate.

Board staff stresses that any portion of any GSA may demonstrate a clear path to

balancing their water budgets within their GSA's existing GSP. If a GSA's member agency believes that its GSP does not provide a clear path to balancing water budgets, it can establish itself as its own management area in the GSP. Management areas provide member agencies with flexibility to develop more robust plans than the rest of the member agencies in the GSA. A management area, for example, may provide additional PMAs for its portion of the basin (Cal. Code Regs., tit. 23, § 351, subd. (r)).

4.2.1.2 Reporting and Fee Exclusion (Section 10735.2(c))

Water Code section 10735.2, subdivision (c)(1) is a discretionary exclusion that allows the State Water Board to exclude a class or category of extractions from the probationary *requirement for reporting extractions if*: 1) they are subject to a local plan or program that adequately manages groundwater or 2) they are likely to have a minimal impact on basin withdrawals. Since the requirement to pay groundwater extraction fees is part of the reporting requirement set forth in Water Code section 5202, this exclusion is in effect also an exclusion from the requirement to pay fees to the Board. There are two "prongs" for this exclusion:

The "minimal impact" prong of subdivision (c) appears to be best suited to extraction volumes that clearly will have minimal impact on basin extractions. For example, while de minimis extractors (those who extract two AF or less annually for domestic purposes) are exempt from the reporting and fee paying requirement by default, the Board may determine that extractions of some larger volume or for other uses constitute a category of extractions that has a minimal impact basin-wide and exclude them from reporting requirements.

It does not appear to Board staff that the "minimal impact" prong is likely to be a good fit for entire GSAs or GSA member agencies, such that splitting into new GSAs or developing new GSPs would improve a GSA's chance of obtaining this exclusion.

The "adequate plan or program" prong appears to be best suited to areas where groundwater management may be adequate to manage overdraft but inadequate to meet SGMA's definition of sustainable management. This prong appears best suited for situations in which a class of groundwater extractions is subject to groundwater management actions such as maintaining a balanced water budget through either basin recharge with surface water or measuring and allocating groundwater extractions, or a combination of both, but those management actions do not rise to the level of demonstrating compliance with the sustainability goal as defined by SGMA.

For example, local management may be preventing overdraft but may not avoid undesirable results if management activities like groundwater recharge changes groundwater gradients, which may cause contaminant plumes to migrate into drinking water wells. Alternatively, a water budget may reflect a lack of groundwater overdraft, but extractions may still cause depletions of ISW or interannual fluctuations in groundwater levels that unreasonably affect shallow domestic wells. SGMA requires that GSAs establish SMC and clear definitions of undesirable results to be able to monitor and evaluate these potential impacts so that undesirable results can be avoided. Without these goals and metrics, local management may achieve a balanced water budget but not meet the minimum requirements required for sustainable groundwater management as defined by SGMA. Another example of management that may be adequate for the purposes of exclusion from the Board's reporting and fee requirements, but not for exclusion from probationary status, could be a situation in which management actions appear to avoid undesirable results, but the GSA is not feasibly able to maintain them over the long term. Or, a GSA has minimal users who rely on groundwater and has demonstrated relatively steady groundwater levels within its management areas but must still develop an adequate plan consistent with the requirements of SGMA and in coordination with the remainder of the basin. The ability to continue implementing management actions is crucial for sustainable groundwater management as defined by SGMA because SGMA requires not just that sustainable groundwater management be achieved within 20 years of GSP implementation, but also that it be maintained throughout a 50-year planning and implementation horizon (Wat. Code, § 10721, subds. (r), (v)).

Board staff generally believes there are many pathways through which a local plan or program can "adequately" manage groundwater within the portion of the basin to which that plan or program applies, but that one good indication of adequate management is showing that the water budget for the relevant portion of the basin is generally at least balanced and appropriate measures are being developed or in place to ensure demand for groundwater extractions can be managed if necessary due to future dry conditions.

Board staff stresses that the "adequate plan or program" prong of this exclusion is applied to a class or category of extractions. This class or category may apply to an entire GSA, a member agency of a GSA, or any other class or category of extractions in the GSA. Splitting into new GSAs or developing new GSPs will not improve a GSA's chance of obtaining this exclusion. Instead, a GSA that believes that a class or category of its extractions are adequately managed should focus on providing evidence of adequate management in its GSP or via a program that ensures adequate management of groundwater extractions.

4.2.1.3 Continued Board Staff Evaluation and Future Recommendations

Board staff supports SGMA's multiple policy goals, including the goal of local, sustainable groundwater management. Board staff accordingly encourages GSAs to continue improving and implementing their GSPs. Board staff will continue to work with GSAs to improve management of the critically overdrafted Kern County Subbasin and evaluate applicability of the Reporting and Fee and Probation Exclusions in the subbasin.

4.3 Water Year and Reporting Dates

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 does not recommend the State Water Board modify the period to be covered by extraction reports (water year) required pursuant to Water Code section 5202 or modify the extraction reporting deadline for groundwater extraction reports (February 1). Groundwater pumpers subject to reporting in a probationary basin must begin measuring and recording extractions 90 days after a probationary designation (Wat. Code, § 5202, subd. (a)(1)). If the State Water Board designates the subbasin probationary on February 20, 2025, pumpers would start recording extractions on May 21, 2025 and would, unless the Board identifies a different date, file their first report of groundwater extraction on or before February 1, 2026, for the period of May 21, 2025, to September 30, 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 that the Board:

- Require groundwater extraction reporting and paying fees for: (1) any person extracting more than two AF per year for any reason and (2) any person extracting two or fewer AF of groundwater per year for any reason other than domestic purposes.

- Exclude any person who extracts two AF or less per year for domestic uses only (de minimis users) from reporting requirements and paying fees. This exception includes most household users, including de minimis users located in the California Aqueduct and Friant-Kern Canal Subsidence Management Areas.
- Require any person extracting more than 500 AF per year from the subbasin to install and use meters that meet the requirements of California Code of Regulations, title 23, section 1042 on all their production wells within the subbasin.
- Require non-de minimis users extracting groundwater from the wells located in the California Aqueduct and Friant-Kern Canal Subsidence Management Areas to install and use meters that meet the requirements of California Code of Regulations, title 23, section 1042.

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 (See, 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 involve 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 recommends 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 Friant-Kern Canal and California Aqueduct Subsidence Management Areas 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. KTWD GSA is the only agency in the subbasin that provides on its website an adopted policy requiring flow meters on all existing wells in its coverage area.

4.4.1.3 Rationale for Proposed Meter Requirement

Accurate measurement of groundwater extraction with meters will fill key data gaps that limit a full 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[18] 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 as discussed above, until measured data are collected and reported at a sufficient level, this was the best proxy for groundwater use in the subbasin that Board staff could use to evaluate potential thresholds. Board 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 SWP supplies (11% of total water use), CVP 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.

[18] 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.)

Recycled and reused water accounted for 2% of the total water use (Todd 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. Users of more than 500 AFY of water, as measured by OpenET:

- Total 1022 landowners (or 20% of 5,219 owners of non-residential parcels in the subbasin).
- Own 84.5% of lands in the subbasin.
- Use 89% of water in the subbasin.

Board staff finds that the proposed requirement for all groundwater extractors of more than 500 AFY to 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, Board staff finds that meters are needed for well owners extracting 500 AFY or less in order to effectively evaluate basin conditions and potentially implement an interim plan, the Board may adjust meter requirements for groundwater extractors in the subbasin.

4.5 Other Requests for Exemptions from Reporting and Fees

As described above, SGMA allows the State Water Board to exclude a class or category of extractions from reporting and fees.

Board staff recommends the State Water Board not exempt drinking water systems from reporting requirements at this time. Based on the subbasin's annual reports from October 2018 through September 2023, urban extractions account for approximately 151,000 AFY to 170,000 AFY, or seven to 17% of all annual extractions (Kern County Subbasin Annual Report, WYs 2019, 2020, 2021, 2022, and 2023). Board staff does not currently believe these percentages are minimal in a critically overdrafted basin.

Moreover, requiring reporting of groundwater extractions from drinking water systems, including state small water systems, would provide critical information, such as well-specific monthly pumping volumes, which can affect more localized groundwater trends.

State Water Board fee regulations allow the Board to waive fees for people or organizations which report their groundwater extractions by the reporting deadline and are one of the following:

- A low-income resident
- A public school

- A public water system or state small water system serving a DAC where the primary purpose of providing water is for human consumption, cooking and sanitary purposes (Cal. Code Regs., tit. 23, § 1044, subd. (b))

Board staff will provide information to extractors during the reporting period regarding how to request a fee waiver.

Comments on the Draft Staff Report questioned whether groundwater bank extractions would be exempt from reporting and fees if the subbasin is designated as probationary. “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). 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” or “banked” under in-lieu operations/accounting procedures is native groundwater and subject to SGMA reporting and fees. Surface water that is diverted to underground storage in the subbasin may continue to be extracted without being subject to reporting and fees. Considering the presence of groundwater banking facilities in the subbasin, agreements with parties outside of the basin, and water exchanges, the accounting details of each groundwater banking facility remain unclear to Board staff and will need to be evaluated on a case-by-case basis relative to reporting and fee requirements.

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 (Pub. Resources Code, § 21000 et seq). 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 (Stats. 2012, ch. 524) 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. Relatedly, Senate Bill 200 (Stats. 2019, ch. 120, § 9) 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 for 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 Well reporting system (as of January 2025), 35 domestic wells have been reported dry in the subbasin since 2016, 16 occurring prior to the start of the 2022 water year. A total of 12 wells were reported dry during WY 2022, 7 in 2023, none in 2024, and none in 2025. According to SAFER program data, of the 41 state small water systems in the subbasin, thirteen of these systems are considered at-risk and 24 are considered potentially-at-risk (State Water 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, subd. (a)(3)). Below is a list of state small water systems currently with some level of risk, according to the State Water Board:

At-Risk Water Systems

Crider Mutual Water System	Jaysix Water System
CFB Company Water System	Redbank Water System
Greeley Property Owners Assoc	Hylton Water System
Breckenridge Estates Mutual Water Company	G And C Water Works
Well 2748 Corporation Water System	Esquivias Water
Pacini Street Water Well Association	Johnson & Rugger Water System

Potentially At-Risk water systems

Rio Viejo Water System	Sandoval Water System
Maple Village Water	South Pond Water Well
McCarthy Family Farms Inc	Swan Water System
Baker Road Community Water	Swan-Sephus Water System
Ronnie Street Water System	Jenica Water Company
Heatherwood North Water System	Five Way Water Assoc
Heath Road Community Water System	Heatherwood Drive South, Inc.
Jeffrey B Knox Water System	Paradise Lakes
Ashe & Houghton Water Association	Tulare Ranch
Vineland Properties Water System	Westfarmers/Paramount
West Snow Water System	Water Well Association
Creekside Water System	Darline's Country Corner

(State Water Board, 2023d).

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.,* 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 the subbasin is local surface water sources, including the 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.

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KERN COUNTY SUBBASIN PROBATIONARY HEARING FINAL STAFF REPORT

Appendix A – Summary Table of Proposed Deficiencies and Potential Actions

January 2025

Deficiency	What SGMA & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency Coordination 1 (CRD)-1: Undesirable results and sustainable management criteria 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.	The GSP regulations require 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 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 in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition must 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 sustainable management criteria (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 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. GSAs 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)). Additionally, "The coordination agreement shall 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 define "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 354.20).	**DWR 2022 Inadequate Determination summary:** The fragmented management area approach to groundwater management, particularly in establishing minimum thresholds (MTs) and measurable objectives (MOs), undermines the GSAs ability to clearly define the subbasin-wide significant and unreasonable effects they hope to avoid. It is unclear 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). **2024 Draft GSPs Evaluation:** The 2024 Draft GSPs implement consistent and clear plain language definitions of undesirable results and SMC. Board staff does not recommend further action specific to Deficiency CRD-1a or 1b but still note a fragmented approach for defining undesirable results and SMC across the Hydrogeologic Conceptual Model (HCM) Areas. **2024 Final GSPs Tentative Evaluation**: These deficiencies (CRD-1a and 1b) were addressed in the 2024 Draft GSPs based on Board staff's full review.	**Potential Action CRD-1a:** No further action is necessary. **Potential Action CRD-1b:** No further action is necessary.

Deficiency	What SGMA & SGMA Regulations Require	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:** The 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 regulation requirements (Code Regs., tit. 23, § 355.4, subd. (b)(8) and Cal. Code Regs., tit. 23, §357.4). GSP Regulations allow agencies to define "one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin" (Cal. Code Regs., tit. 23, § 354.20).	**DWR 2022 Inadequate Determination summary:** None. **2024 Draft GSPs Evaluation CRD-2a:** The GSAs have developed an MT exceedance policy that describes how MT exceedances will be investigated by GSAs and reported to the subbasin coordination committee for recommended actions. **2024 Final GSPs Tentative Evaluation CRD-2a:** This deficiency was addressed in the 2024 Draft GSPs. **2024 Draft GSPs Evaluation CRD-2b:** As noted in CRD-1a and CRD-1b, board staff does not agree with the justification of some SMC and undesirable results established based on HCM Areas in the 2024 Draft GSPs. See sustainability-indicator-specific deficiencies for more detail **2024 Final GSPs Tentative Evaluation CRD-2b:** This deficiency does not appear to be addressed. The GSPs continue to use HCM Areas to set SMC in a manner that may not be protective of beneficial uses and users.	**Potential Action CRD-2a:** No further action is necessary. **Potential Action CRD-2b:** Revise methodologies that result in incompatible SMC across HCM Area boundaries. Sustainability-indicator-specific technical deficiencies resulted from these methodologies are described in sections GL-1, LS-1 and GWQ-1.

Deficiency	What SGMA & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency CRD-3: The GSAs in the subbasin have not demonstrated basin-wide management.	Any local public agency, or combination of local agencies, overlying a groundwater basin with water supply, water management, or land use responsibilities may decide to become a GSA for that basin (Wat. Code, § 10721, subd. (n)), 10723, subd. (a)). SGMA allows some private and non-governmental water entities to participate in a GSA but does not provide these entities with any additional authorities (Wat. Code, § 10723.6, subd. (b)). Private entities, therefore, do not have governmental 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. (a)(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. **2024 Draft GSPs Evaluation:** It is unclear whether the basin possesses basin-wide GSA oversight or management. Board staff is unable to properly evaluate basin management due to the complex arrangement of agencies involved and lack of clear detail demonstrating adequate coverage. Board staff notes that insufficient coverage and authorities could undermine the subbasin's ability to reach sustainability. **2024 Final GSPs Tentative Evaluation:** This deficiency does not appear to be addressed. It is still unclear to Board staff if the Kern Non-Districted Land Authority is an official GSA that has the authority to manage groundwater in non-districted areas under the current Joint Exercise of Powers Agreement.	**Potential Action CRD-3:** The GSAs should clearly define authorities and responsibilities consistent with SGMA requirements. Ensure that the GSAs have the proper authorities to enforce SGMA within their respective management areas.

Deficiency	What SGMA & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency Groundwater Level 1 (GL-1): Groundwater level undesirable results and SMC are not defined consistent with the requirements of SGMA. • **Deficiency GL-1a:** Undesirable results are not protective of beneficial uses and users. • **Deficiency GL-1b:** Sustainable management criteria were not established consistent with the requirements of SGMA.	The GSP regulations require 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 require 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)). This must describe how each of the GSAs use the same data and methodologies for assumptions in Water Code § 10727.6 for "groundwater elevation data, supported by the quality, frequency, and spatial distribution of data in monitoring network and the objectives as described in Subarticle 4 of Article 5" (Cal. Code Regs., tit. 23, § 357.4, subd. (b)(3)). In defining undesirable results, GSAs are required to "describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition must 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)). "Each Agency shall establish minimum thresholds that quantify groundwater conditions [...] at each monitoring site or representative monitoring site established pursuant to 354.36. The numeric value [...] shall represent a point in the basin that, if exceeded, may cause undesirable results..." (Cal. Code Regs., tit. 23, § 354.28). The description of minimum thresholds must include: (1) justification for the value supported by information provided in the basin setting, (2) relationship between the value and the sustainability indicator, (3) explanation of how the Agency determined the conditions at each minimum threshold will avoid undesirable results, (4) how the value will avoid causing undesirable results in adjacent basins, (5) how beneficial uses and users will be impacted, (6) affects to state, federal, and local standards, (6) and how each will be measured consistent with monitoring network requirements (ibid). The minimum threshold for chronic lowering of groundwater levels "shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results" and shall be supported by historical trends, water year type, and projected water use in the basin and potential effects on other sustainability indicators (Cal. Code Regs., tit. 23, § 354.28 subd. (c)). "Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon" (Cal. Code Regs., tit. 23, § 354.30 subd. (a)). "Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water	**DWR 2022 Inadequate Determination summary:** Groundwater level undesirable result definitions and methodologies used to set SMC "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). **2024 Draft GSPs Evaluation GL-1a:** This deficiency appears to be addressed. **2024 Final GSPs Tentative Evaluation GL-1a:** This deficiency was addressed in the 2024 Draft GSPs. **2024 Draft GSPs Evaluation GL-1b:** The GSAs have made improvements in creating a method to establish SMC that is coordinated and consistently used across the subbasin. However, this method has not resulted in SMC that are consistent with the requirements of the SGMA in that: (1) the trends that inform MTs are based on broad spatial averages and therefore do not represent local conditions that may cause undesirable results and result in MTs that vary substantially across HCM boundaries, (2) some MTs would never be reached unless pumping accelerated, and (3) the MTs and the trends that inform MTs do not differentiate between upper and lower portions of the aquifer system where necessary.	**Potential Action GL-1a:** No further action is necessary. **Potential Action GL-1b:** Revise SMC consistent with requirements of SGMA. Establish MTs for representative monitoring wells in the upper and lower portions of the aquifer system separately considering spatial variations of hydrogeological conditions in the subbasin. Demonstrate MTs would not result in an undesirable result and impacts to beneficial users during prolonged periods of drought and water banking recovery operations.

	budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty" (Cal. Code Regs., tit. 23, § 354.30 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, § 354.20).	**2024 Final GSPs Tentative Evaluation GL-1b:** This deficiency does not appear to be addressed. Although some MTs were improved, the identified issues in the deficiency remain.	

Deficiency	What SGMA & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GL-2: The GSPs' monitoring network and mitigation plans are incomplete. • **Deficiency GL-2a:** The monitoring network was not developed consistent with the requirement of SGMA. • **Deficiency GL-2b:** The well impact mitigation plan is incomplete.	GSPs are required to include monitoring protocols developed according to best management practices (Cal. Code Regs., tit. 23, § 352.2) and include a summary of monitoring information such as well depth, screened intervals, aquifer zones monitored, and a summary of the type of well(s) relied on for the information including public, irrigation, domestic, industrial, and monitoring wells (Wat. Code § 10727.2, subd. (e)). 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 2022 Inadequate Determination summary:** The 2022 GSPs are not implementing or planning to implement a well mitigation plan. **2024 Draft GSPs Evaluation GL-2a:** The monitoring network does not adequately monitor the upper and lower portions of the aquifer and well construction data are not disclosed. **2024 Final GSPs Tentative Evaluation GL-2a:** This deficiency does not appear to be addressed. The GSAs identified some data gaps for shallow monitoring wells to be addressed within a year, but it remains unclear if they have addressed all areas that may have separate shallow and deep groundwater users. **2024 Draft GSPs Evaluation GL-2b:** Board staff cannot assess whether the mitigation plan will correct the impacts caused by groundwater management activities, because the monitoring network may not be representative of all beneficial uses and users. **2024 Final GSPs Tentative Evaluation GL-2b:** This deficiency appears to be partially addressed. The GSAs have developed a mitigation plan, however, Board staff has concerns regarding potential impacts on beneficial uses and users, because it is unclear whether the impact analysis and subsequent budget are adequate.	**Potential Action GL-2a:** Develop a monitoring network consistent with SGMA requirements. Provide a summary of monitoring well information such as well depths, screened intervals, aquifer zones monitored, and well type, including public, irrigation, domestic, industrial, and monitoring wells. **Potential Action GL-2b:** Establish an appropriate well impact mitigation program. Reassess the well impact mitigation plan after updating the analysis of the impacts of MTs on domestic wells to consider the upper and lower portions of the aquifer. Confirm that the GSAs' proposed funding will cover the expected costs to mitigate impacted wells.

Deficiency	What SGMA & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
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 rely heavily on future project implementation for sustainability but do not demonstrate that such projects are feasible. The GSPs rely on more than 180 projects and management actions to reach sustainability. Without these projects and management actions, "extractions would exceed the estimated sustainable yield by 25 to 34 percent" (2022 Inadequate Determination, p. 32). **2024 Draft GSPs Evaluation:** The GSAs do not establish that they are on a path to reach sustainability. Demand management projects and management actions (PMAs) still lack key details and do not appear to be developed for many parts of the subbasin. It is unclear which PMAs are included in projected paths to sustainability. It is unclear how GSAs will stop overdraft in the subbasin and avoid undesirable results. Moreover, Board staff notes key concerns over water budgets that may indicate that need for further PMAs. **2024 Final GSPs Tentative Evaluation:** This deficiency appears to be partially addressed. The GSAs continue to rely on various proposed PMAs at various stages of implementation to reach sustainability. Board staff cannot assess the feasibility of the PMAs without representative water budgets and clarity on PMAs implementation. The GSAs included new operational water budgets derived from a mass balance analysis that is inconsistent with overlying crop types and with the Todd Groundwater Model. It remains unclear whether PMAs, if implemented, are feasible and sufficient to achieve sustainable groundwater management.	**Potential Action GL-3a:** Evaluate the feasibility of proposed supply augmentation projects. **Potential Action GL-3b:** 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 actions.

Deficiency	What SGMA & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GL-4: The GSPs do not define groundwater storage sustainable management criteria consistent with SGMA requirements.	"The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin" (Cal. Code Regs., tit. 23, § 354.28 subd. (c)(2)).	**DWR Inadequate Determination summary:** None. **2024 Draft GSPs Evaluation:** The 2024 Draft GSPs state that if all groundwater level MTs are met, groundwater storage would decline by 9.3 million acre-feet (MAF) relative to the baseline total usable storage volume. The GSPs further state that this loss is 4% to 10% compared to total usable storage values of 90 MAF to 260 MAF. These total storage values appear to include storage in clay layers, exempt areas, and areas or poor groundwater quality. The calculated percentage of lost usable storage is likely too low. Additionally, the GSAs do not explain why a loss of 9.3 MAF would not constitute an undesirable result. **2024 Final GSPs Tentative Evaluation:** This deficiency does not appear to be addressed. The GSAs have not revised their methodology used to calculate groundwater storage.	**Potential Action GL-4:** Redefine the undesirable result for reduction of groundwater storage. Quantitatively define the undesirable result as a total volume of groundwater that can be withdrawn without causing significant and unreasonable impacts. Usable storage should only include aquifers where groundwater is being extracted for beneficial uses and users. Describe the assumptions that result in a usable storage range from 90 MAF to 260 MAF. Explain how storage relates to other sustainability indicators.

Deficiency	What SGMA & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency Land Subsidence 1 (LS-1): Land Subsidence undesirable results and SMC are not defined consistent with the requirements of SGMA • **Deficiency LS-1a:** Undesirable results are poorly described, unworkably complex, and inconsistently implemented. • **Deficiency LS-1b:** Sustainable management criteria were not established consistent with the requirements of SGMA.	The GSP regulations require 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 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 in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition must 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. GSAs 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)). Additionally, "The coordination agreement shall 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, § 354.20).	**DWR Inadequate Determination summary:** GSPs and management area plans did not consistently identify critical infrastructure. Additionally, "Some GSPs or management area plans defined Management Area Critical Infrastructure but did not develop sustainable management criteria…" (DWR Inadequate Determination, p. 38). **2024 Draft GSPs Evaluation:** The plain-language and quantitative definitions of undesirable results are now adopted across the subbasin, and the HCM Area approach likely reduces variability and inconsistencies across the subbasin. However, Board staff is concerned with: (1) the GSAs' ability to determine GSA vs non-GSA related subsidence, (2) the processes to determine what is economically feasible to repair, (3) The GSPs' exclusions of industry wells (oil and gas) contributing to subsidence, and (4) methodologies used to calculate subsidence SMC for HCM Areas. **2024 Final GSPs Tentative Evaluation LS-1a:** This deficiency appears to be partially addressed. The updated plain-language undesirable result definition no longer hinges on the economic feasibility of retrofitting or replacement of infrastructure on the part of beneficial users. The updated definition also indicates that GSAs will be responsible for mitigating losses of infrastructure functionality. Changes were made to the MT exceedance policy, but it is not clear if they are sufficiently protective of all beneficial uses and users. The MT exceedance language in the undesirable	**Potential Action LS-1a:** Develop consistent, clear undesirable results. If the undesirable result definition requires a distinction between GSA and non-GSA caused subsidence, the GSAs must be capable of quantifying their contribution to subsidence in areas where both GSA and non-GSA activities are culpable. Since the quantitative undesirable results definition relies on MT exceedances, and the MT exceedance policy may not be sufficiently protective of beneficial users, the MT exceedance policy should be revised. **Potential Action LS-1b:** Use consistent data and methods to develop subsidence SMC. Redevelop subsidence MOs, MTs and IMs. MTs must provide operational flexibility below MOs. Ensure that MO and MT rates do not exceed their extents, and that IMs will enable GSAs to achieve MOs and not surpass MTs.

		result criteria differs from what is in the MT exceedance policy. **2024 Final GSPs Tentative Evaluation LS-1b:** This deficiency appears to be partially addressed. SMC development is less complicated, and Regional Critical Infrastructure MTs appear to be protective of conveyance capacity in vulnerable areas. SMC values are now established consistently with a goal of reducing subsidence as 2040 approaches. However, Board staff is concerned that the HCM Area 2040 interim milestones (IMs) for subsidence extents exceed the MOs in three of the five HCM Areas, and 2040 IM extents for the Friant-Kern Canal and California Aqueduct exceed the MOs.	

Deficiency	What SGMA & SGMA Regulations Require	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 [SMC] 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. **2024 Draft GSPs Evaluation:** The 2024 Draft GSPs lack adequate implementation details related to PMAs that address expected, or potential, impacts of subsidence on infrastructure. **2024 Final GSPs Tentative Evaluation:** This deficiency does not appear to be addressed. The Final GSPs include a subsidence exceedance "Action Plan" and a mitigation plan. A $3.5 million mitigation fund is discussed in the mitigation plan, but it is specific to mitigating impacts to wells caused by declining groundwater levels, not subsidence, and there is no mention of infrastructure mitigation. GSPs state that GSAs do not anticipate subsidence to cause significant impacts to wells. The subsidence action plan is initiated if: (1) one subsidence IM rate or extent exceedance occurs at a California Aqueduct or Friant-Kern Canal monitoring location or (2) a subsidence IM rate or extent is exceeded for a GSA or HCM Area average after six consecutive quarterly sampling events. This language conflicts with the description of the exceedance policy in Section 13.5.1.4 of the GSPs, where it states that action is triggered by exceedances of the MT rate.	**Potential Action LS-2a:** Develop and implement a plan to trigger sufficient management actions when subsidence exceeds defined thresholds, especially near critical infrastructure or 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 & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency Groundwater Quality 1 (GWQ-1): The GSPs do not establish undesirable results and sustainable management criteria consistent with the requirements of SGMA. • **Deficiency GWQ-1a:** Undesirable result definitions are not protective of beneficial uses and users. • **Deficiency GWQ-1b:** The GSPs are missing critical information about how GSAs will determine whether an undesirable result has occurred.	The GSP regulations require 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 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 in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin" (Cal. Code Regs., tit. 23, § 354.26, subd. (a)). The undesirable result definition must 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. GSAs 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)). Additionally, "The coordination agreement shall 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, § 354.20).	**DWR Inadequate Determination summary:** Not specific to groundwater quality. See CRD-1. **2024 Draft GSPs Evaluation:** The quantitative definition of an undesirable result is defined as MT exceedances in three representative monitoring wells in an HCM area. Concerns include: (1) significant portions of the subbasin could experience degradation of groundwater quality without triggering an undesirable result, and (2) the trigger for an undesirable result may result in disproportionate impacts in different areas in the subbasin. **2024 Final GSPs Tentative Evaluation GWQ-1a:** The deficiency does not appear to be addressed. The updated undesirable result definition still lacks the detail necessary to determine whether all beneficial uses and users have been considered. **2024 Final GSPs Tentative Evaluation GWQ-1b:** The deficiency does not appear to be addressed. The technical analysis process developed by the GSAs fails to consider driving mechanisms for each COC.	**Potential Action GWQ-1a:** Develop undesirable results consistent with SGMA using best available science and considering all beneficial uses and users. Develop quantitative undesirable results that clearly describe the combination of MT exceedances and represent the conditions that would cause the plain-language undesirable result. **Potential Action GWQ-1b:** The GSPs should include consistent data and methods to develop groundwater quality MTs. Evaluate more than groundwater level correlations to determine whether water quality degradation is caused by management activities. Using an inverse correlation between groundwater levels and groundwater quality may not be sufficient, especially for redox-sensitive or depth-dependent constituents.

Deficiency	What SGMA & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GWQ-2: Groundwater quality monitoring network is not consistent with the requirements of SGMA. • **Deficiency GWQ-2a:** The monitoring network is not protective of all beneficial uses and users in the subbasin. • **Deficiency GWQ-2b:** Water quality sampling frequencies are sometimes insufficient. • **Deficiency GWQ-2c:** It is unclear how the GSAs will assess the impacts of projects and management actions.	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 Plan 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 IMs 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. **2024 Draft GSPs Evaluation:** The GSPs' monitoring network is not protective of beneficial uses and users. It does not result in spatial or temporal coverage sufficient for characterizing groundwater quality conditions or changes to those conditions that may occur throughout the implementation of the GSPs. **2024 Final GSPs Tentative Evaluation GWQ-2a:** This deficiency does not appear to be addressed. The GSPs do not include depths or screen intervals of any representative monitoring wells. Without this information, Board staff cannot evaluate whether the monitoring network adequately represents beneficial uses and users. It is unclear whether the representative monitoring wells will be sufficient to identify impacts to domestic wells since no groundwater quality-specific impact analysis was not completed. **2024 Final GSPs Tentative Evaluation GWQ-2b:** This deficiency was addressed in the 2024 Draft GSPs. **2024 Final GSPs Tentative Evaluation GWQ-2c:** This deficiency does not appear to be addressed. It is unclear how the monitoring network is evaluating the potential impacts of PMAs.	**Potential Action GWQ-2a:** The GSAs should evaluate the existing monitoring network and add additional wells to the monitoring well network to ensure all beneficial uses and users are represented. **Potential Action GWQ-2b:** No further action is necessary. **Potential Action GWQ-2c:** The GSAs should better define how they will ensure projects and management actions do not degrade groundwater quality.

Deficiency	What SGMA & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency GWQ-3: Management actions are not responsive to water quality degradation. • **Deficiency GWQ-3a:** Management actions are not protective of beneficial uses and users once a minimum threshold exceedance is triggered. • **Deficiency GWQ-3b:** Well mitigation plan does not 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. **2024 Draft GSPs Evaluation:** The GSPs lack management actions and mitigation plans that are responsive to MT exceedances. These management actions are important for ensuring that GSAs avoid undesirable results. Board staff notes multiple deficiencies concerning mitigation plans and PMAs in the 2024 Draft GSPs. **2024 Final GSPs Tentative Evaluation GWQ-3a:** This deficiency appears to be partially addressed. Board staff is still concerned that beneficial uses and users may be impacted prior to an undesirable result occurring due to the Exceedance Policy's insufficient correlation procedure. **2024 Final GSPs Tentative Evaluation GWQ-3b:** This deficiency appears to be partially addressed. The GSPs still lack an appropriate method for evaluating whether groundwater quality degradation may be due to groundwater management activities or actions. Without a clear understanding of potential impacts, Board staff cannot determine if the well mitigation plan will address the degradation of water quality.	**Potential Action GWQ-3a:** Develop a method to determine the impact of an exceedance to beneficial uses and users and clarify how the public will be notified should an MT exceedance occur. **Potential Action GWQ-3b:** See Potential Action GL-2b.

Deficiency	What SGMA & SGMA Regulations Require	Deficiency Summary	Potential Actions to Correct the Deficiency
Deficiency Interconnected Surface Water 1 (ISW-1a and ISW-1b): Interconnected Surface Water Undesirable results and SMC are not coordinated.	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)).	**DWR Inadequate Determination summary:** None. **2024 Draft GSPs Evaluation:** None. **2024 Final GSPs Tentative Evaluation:** This deficiency was addressed in the 2024 Final GSPs.	**Potential Action ISW-1a and ISW-1b:** Board staff does not have further concerns related to Deficiencies ISW-1a and 1b.
Deficiency ISW-2: GSAs do not adequately demonstrate that undesirable results related to the depletion of ISW are not present and are not likely to occur.	The GSP regulations require GSAs to "provide a description of current and historical groundwater conditions in the basin…based on the best available information" (Cal. Code Regs., tit. 23, § 354.16). This information includes: "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, subd. (f)). The GSP regulations define interconnected surface water 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)). The GSP regulations specify that a GSP must describe the groundwater and surface water model used to quantify surface water depletion and, "If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model" (Cal. Code Regs., tit. 23, § 354.28, subd. (6)(B)). "An 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)). GSP Regulations allow GSAs to create "one or more management areas within a basin if the [GSA] 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, § 354.20).	**DWR Inadequate Determination summary:** None. **2024 Draft GSPs Evaluation:** The GSPs state that there is no ISW and therefore no potential undesirable results would occur. However, GSPs do not provide adequate technical justification to demonstrate ISW is not present in the subbasin. **2024 Final GSPs Tentative Evaluation:** This deficiency appears to be addressed. The 2024 Final GSPs include a more robust description of the methodology used to conclude the absence of ISW and GDE in the subbasin.	**Potential Considerations ISW-2:** Continue using the best available information to evaluate potential ISW in the subbasin.

Appendix B – Figures

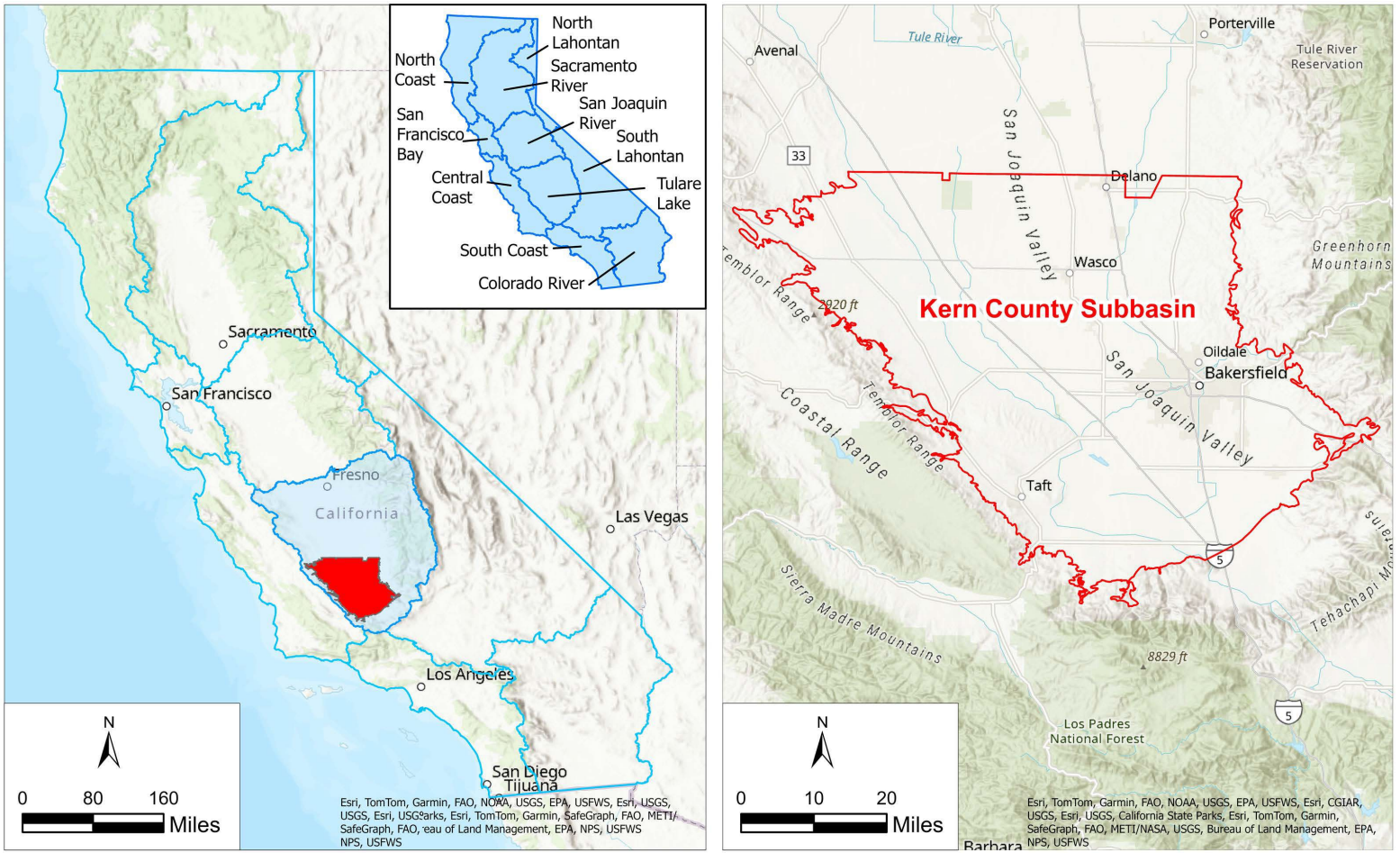

Figure ES-1

Overview of the Kern County Subbasin

Kern County Subbasin

Hydrologic Regions

Tulare Lake Hydrologic Region

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January 2025

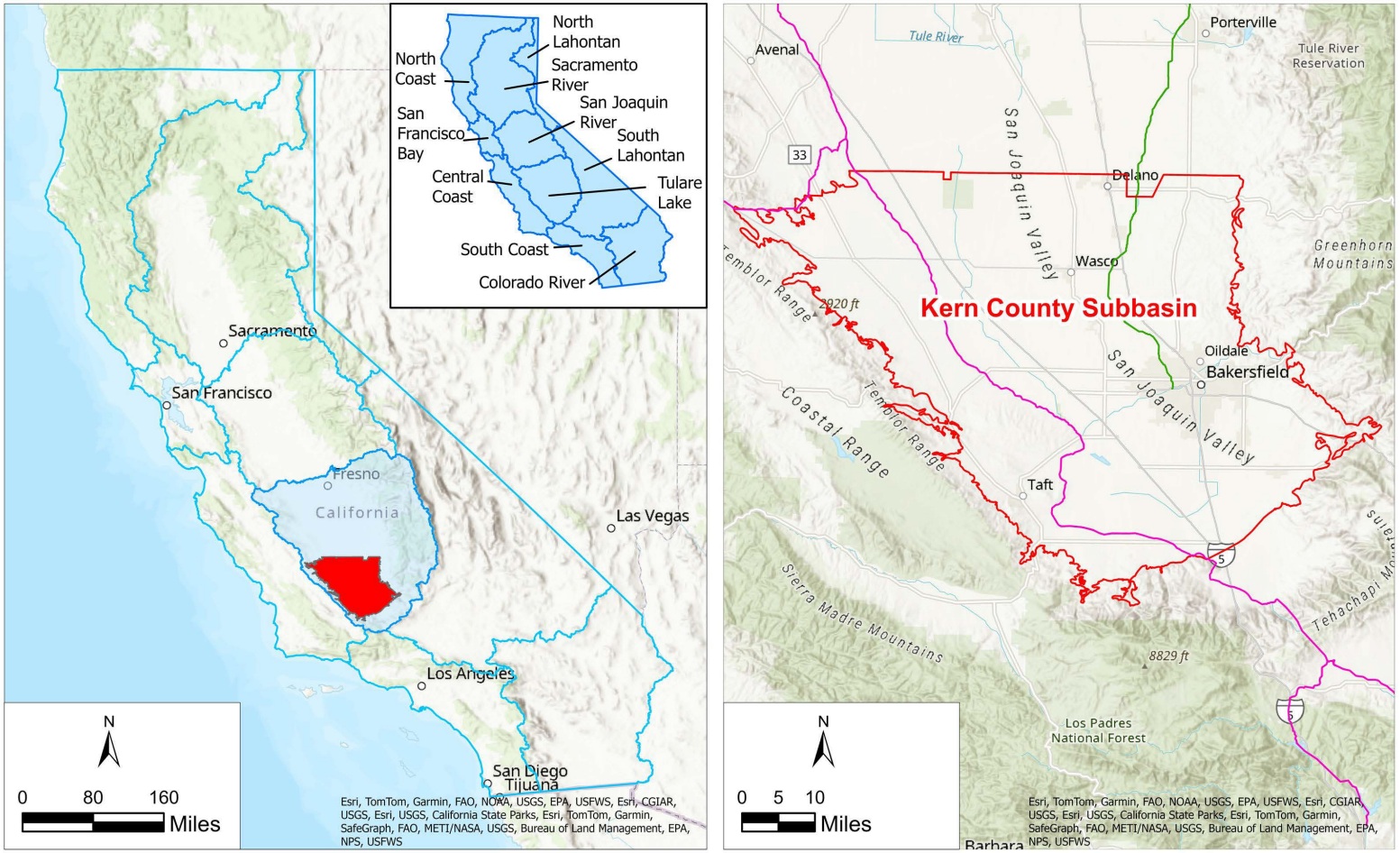

Figure 3-1

Overview of the Kern County Subbasin

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Kern County Subbasin
Hydrologic Regions
Tulare Lake Hydrologic Region
Friant Kern Canal
California Aqueduct

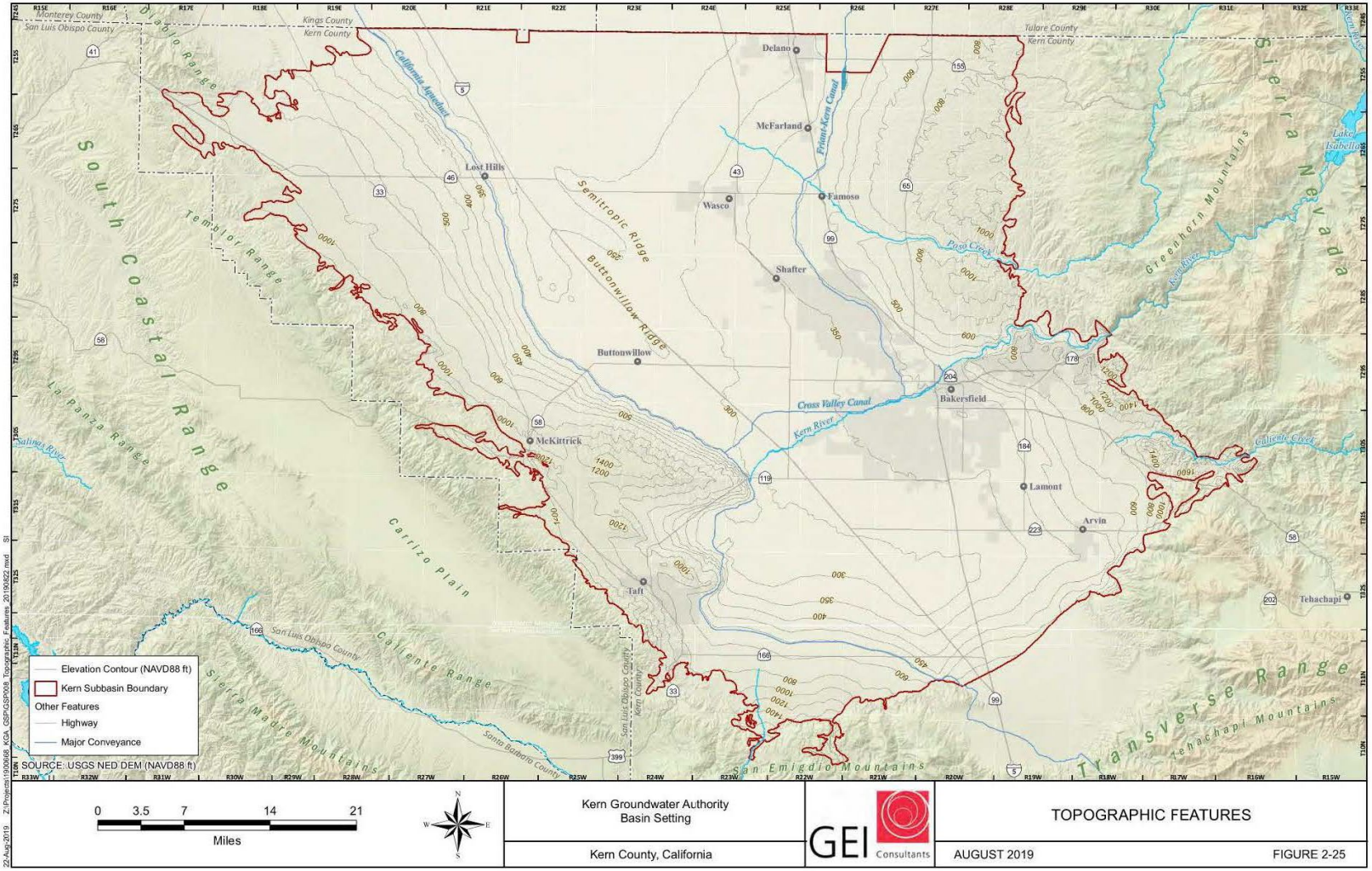

Figure 2-25. Topographic Features

Figure 3-2 Topographic Map of the Kern County Subbasin
Source: Excerpt from the KGA 2022 GSP

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January 2025

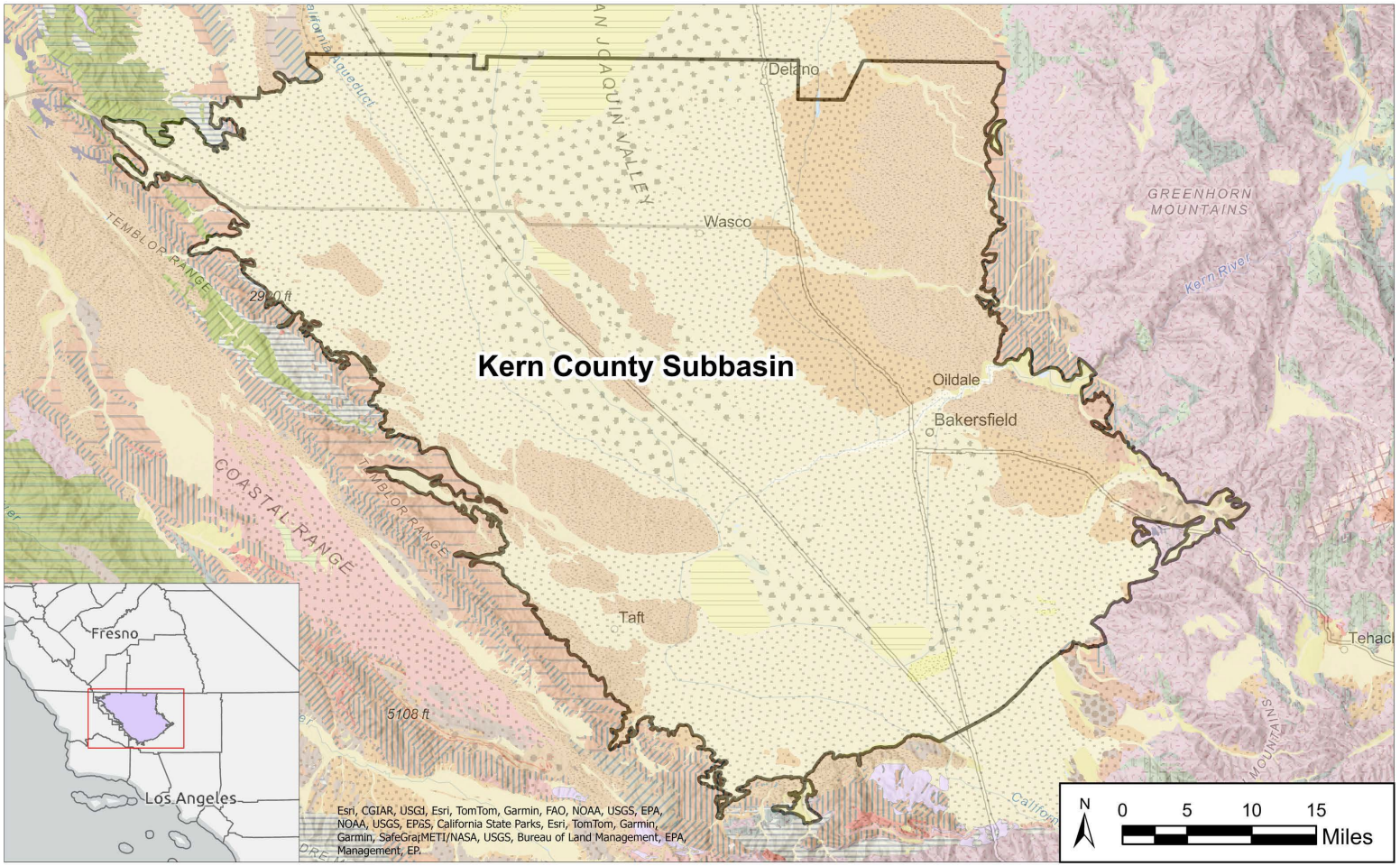

Figure 3-3

Geology of the Kern County Subbasin

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January 2025

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		

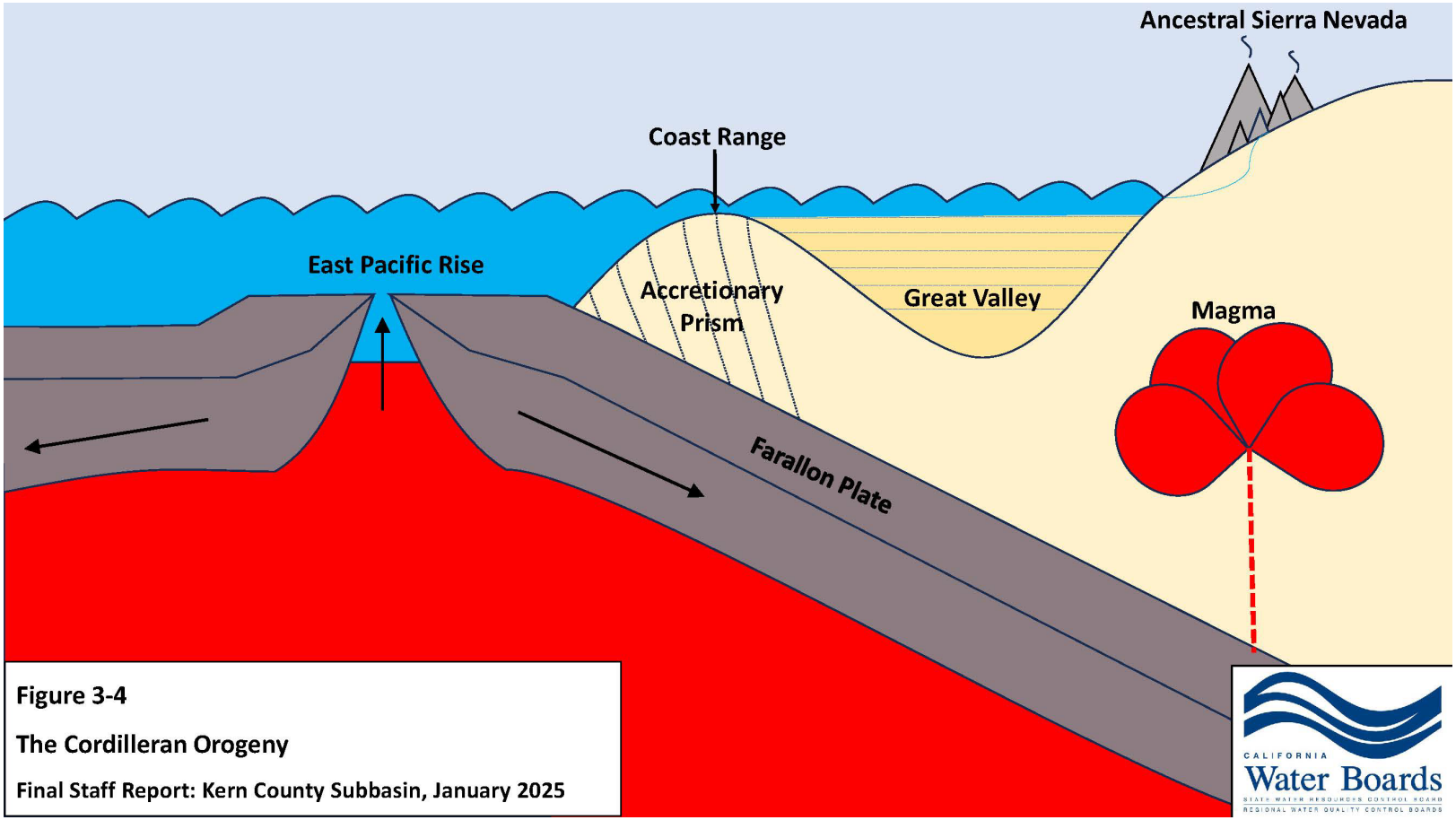

Figure 3-4

The Cordilleran Orogeny

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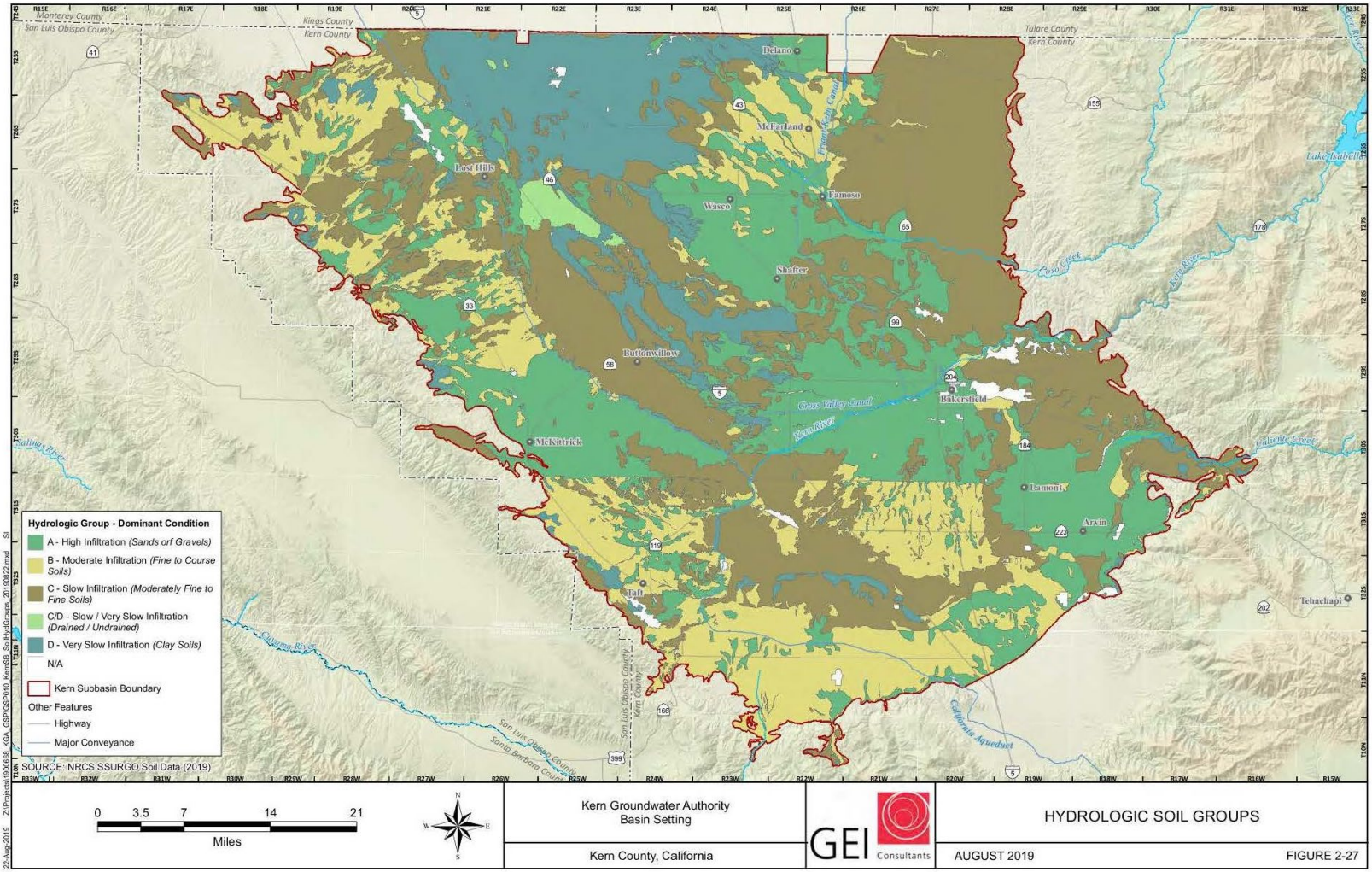

Figure 2-27. Hydrologic Soil Groups

Figure 3-5: Soils of the Kern County Subbasin
Source: Excerpt from the KGA 2022 GSP

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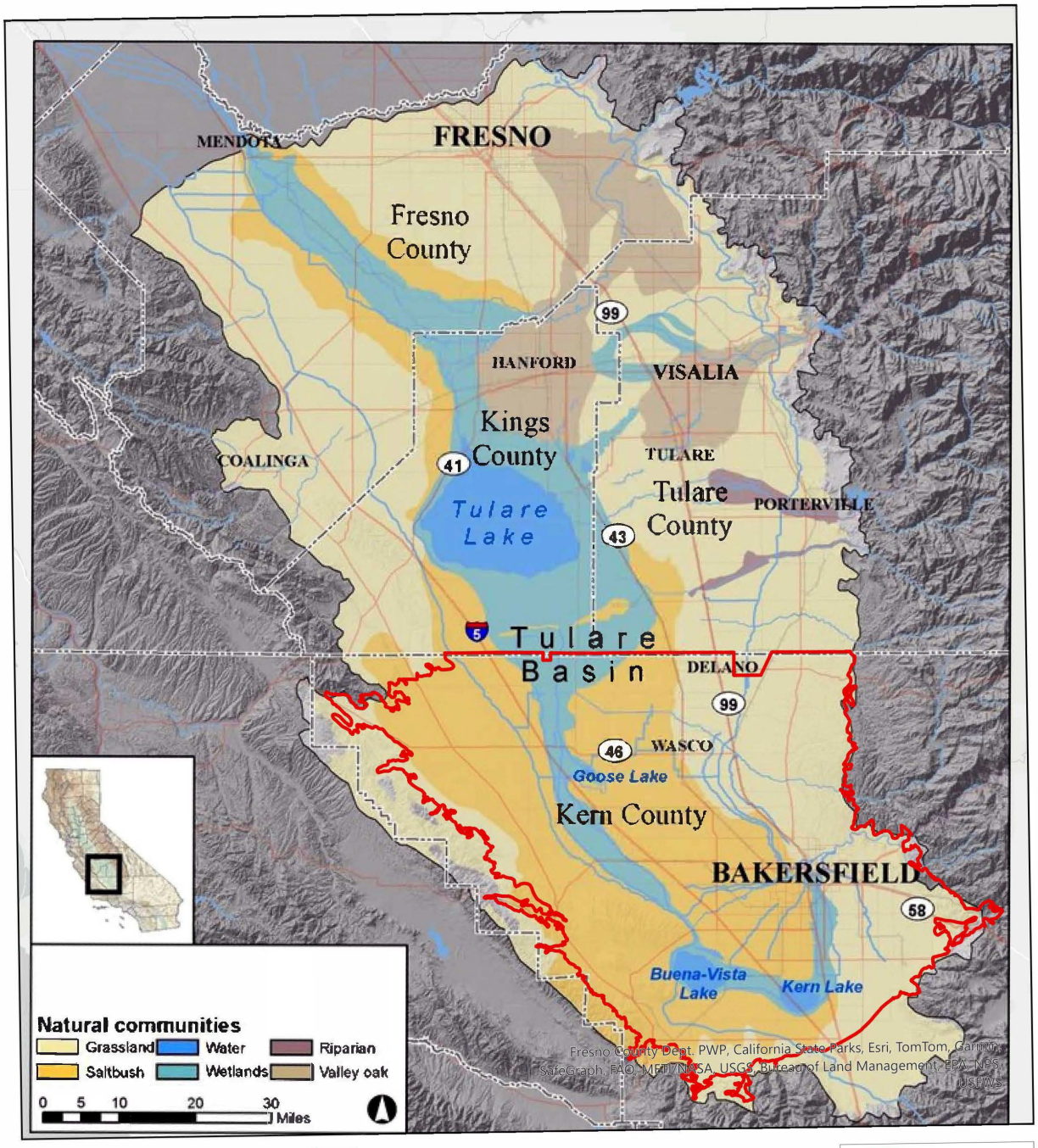

Figure 3-6

Historical Map of the
Kern County Subbasin

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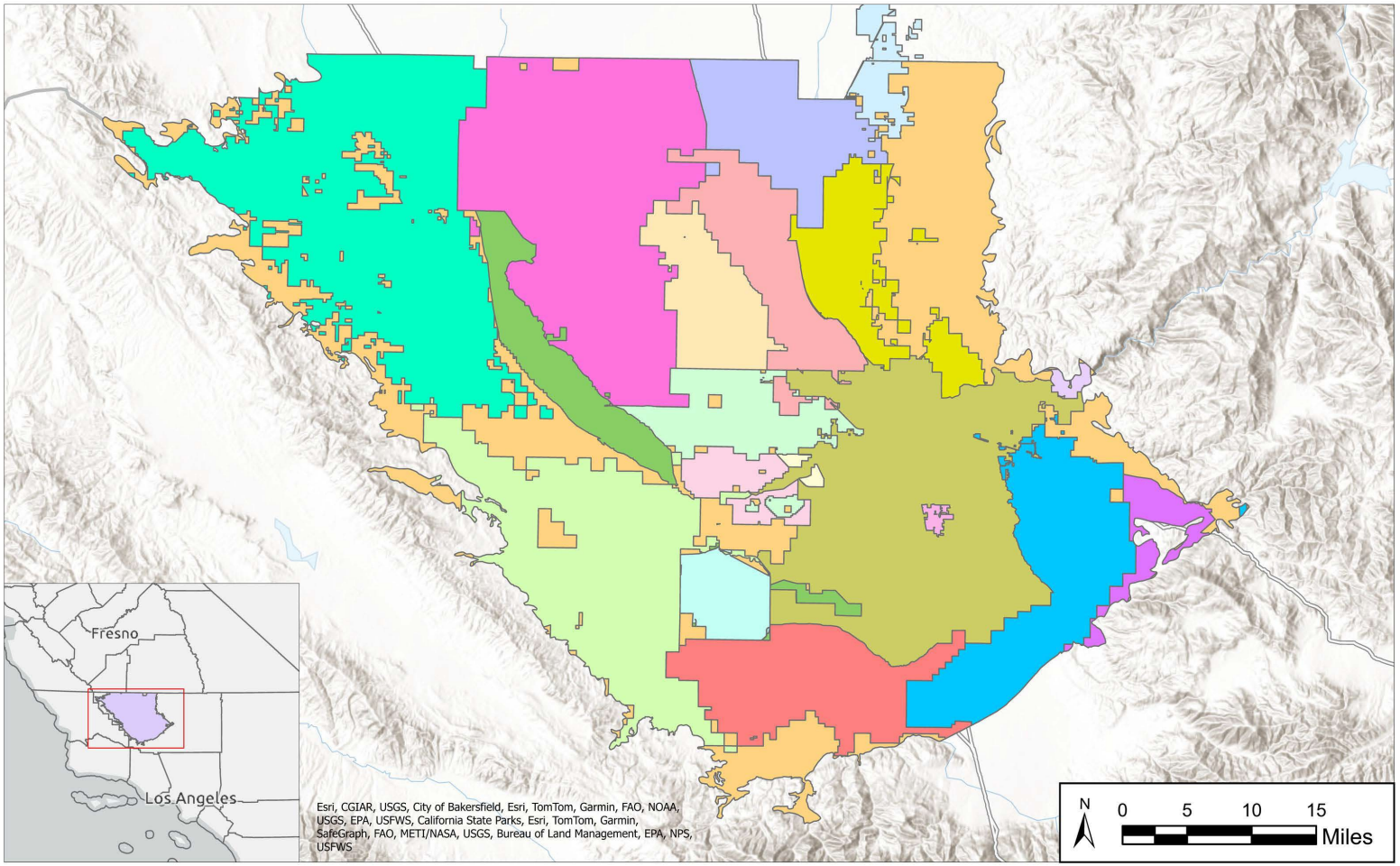

Figure 3-7

GSAs in the Kern County Subbasin

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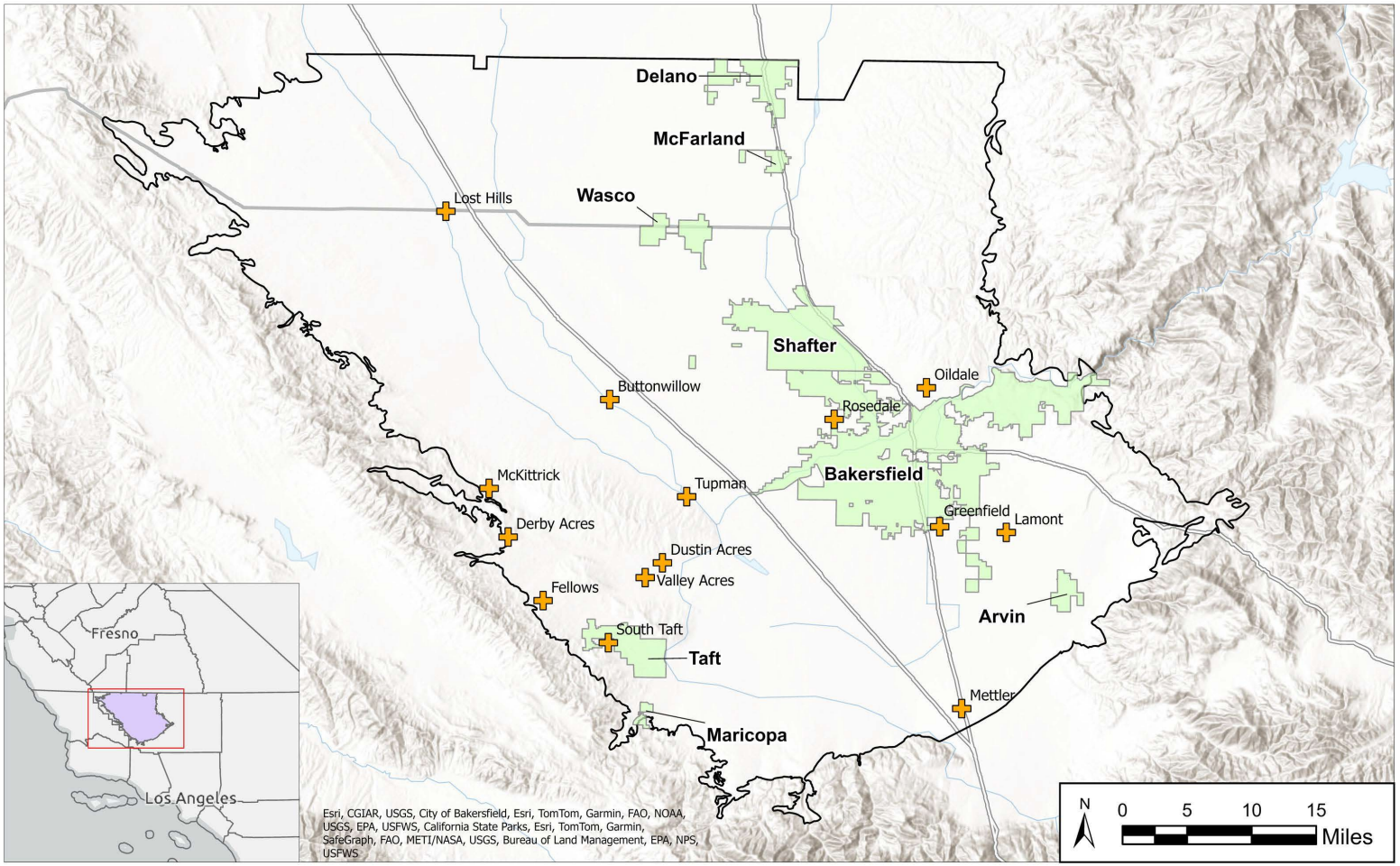

Figure 3-8

Urban Areas in the Kern County Subbasin

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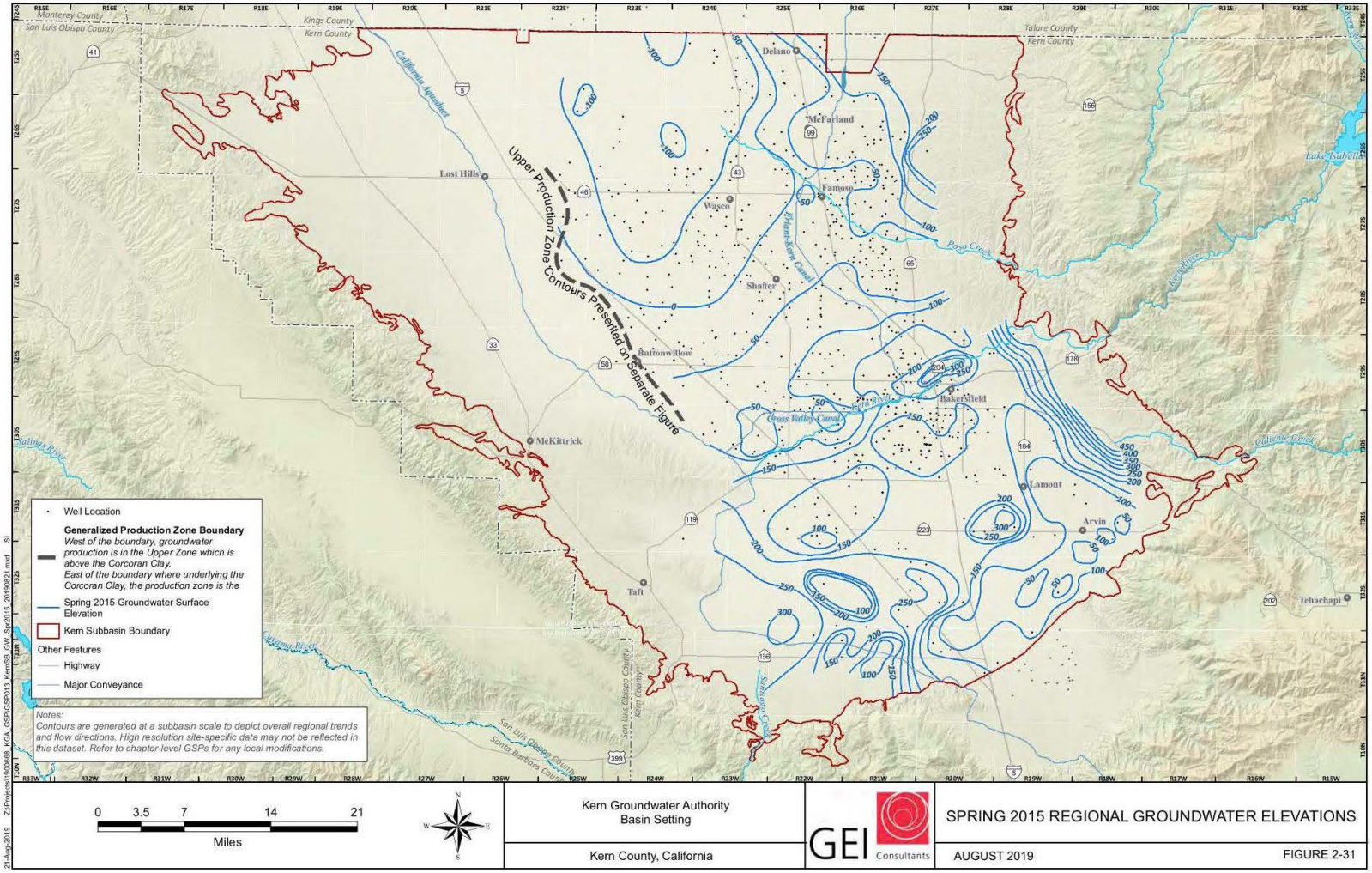

Figure 2-31. Spring 2015 Regional Groundwater Elevations

Figure 3-9a: 2015 Groundwater Elevations in the Kern County Subbasin
Source: Excerpt from the KGA 2022 GSP

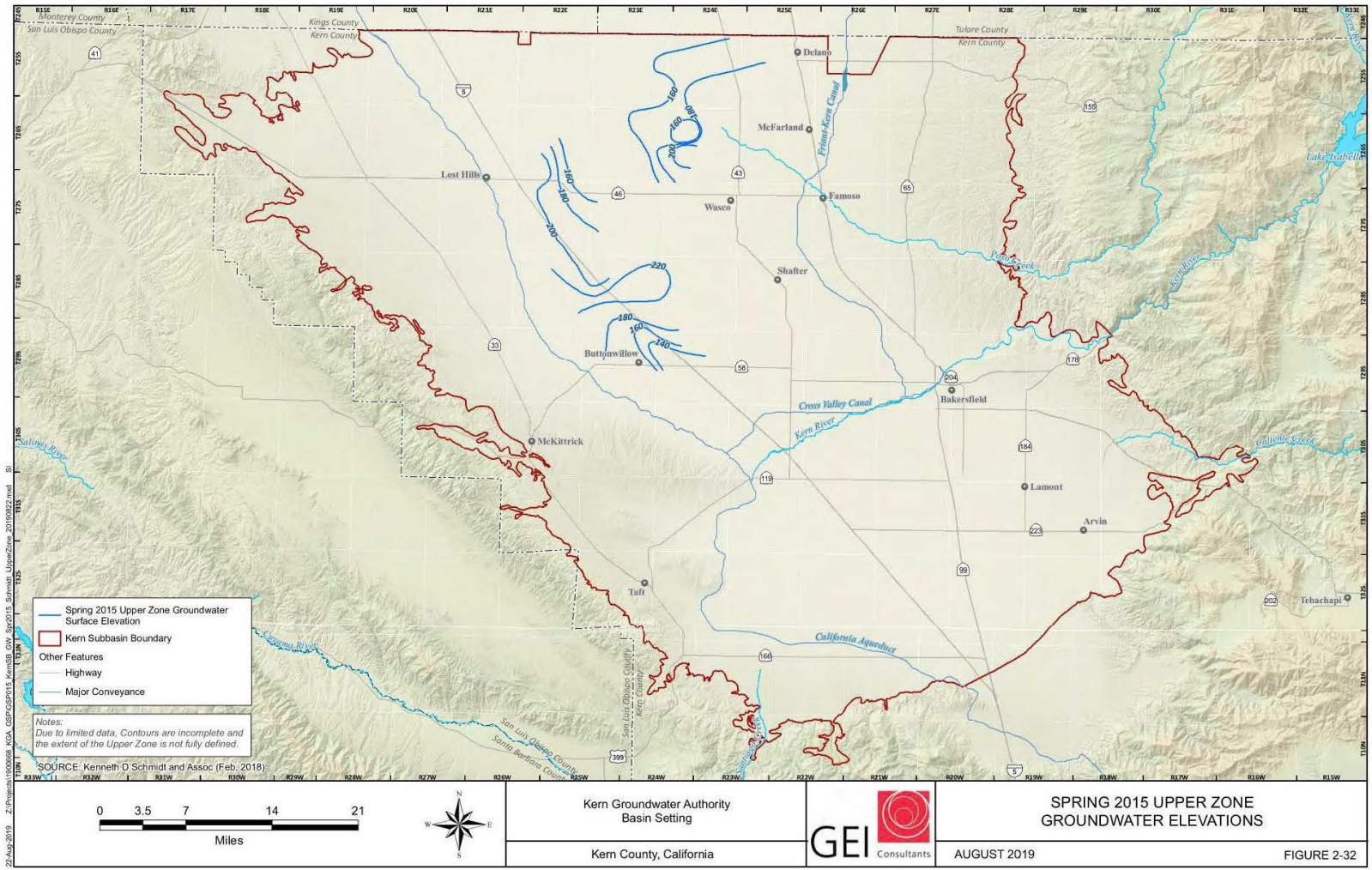

Figure 2-32. Spring 2015 Upper Zone Groundwater Elevations

Figure 3-9b: 2015 Groundwater Elevations in the Kern County Subbasin
Source: Excerpt from the KGA 2022 GSP

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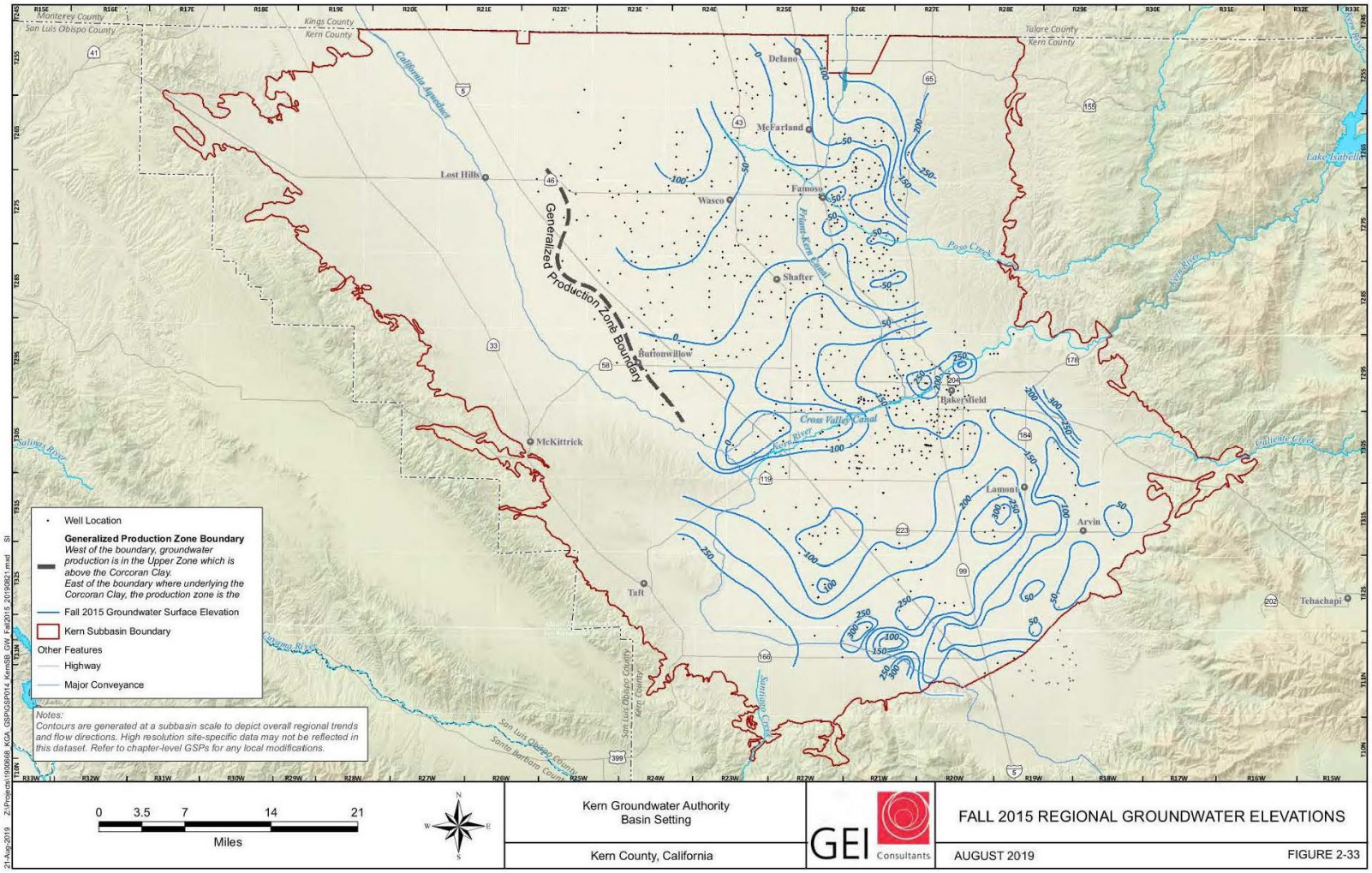

Figure 2-33. Fall 2015 Regional Groundwater Elevations

Figure 3-9c: 2015 Groundwater Elevations in the Kern County Subbasin
Source: Excerpt from the KGA 2022 GSP

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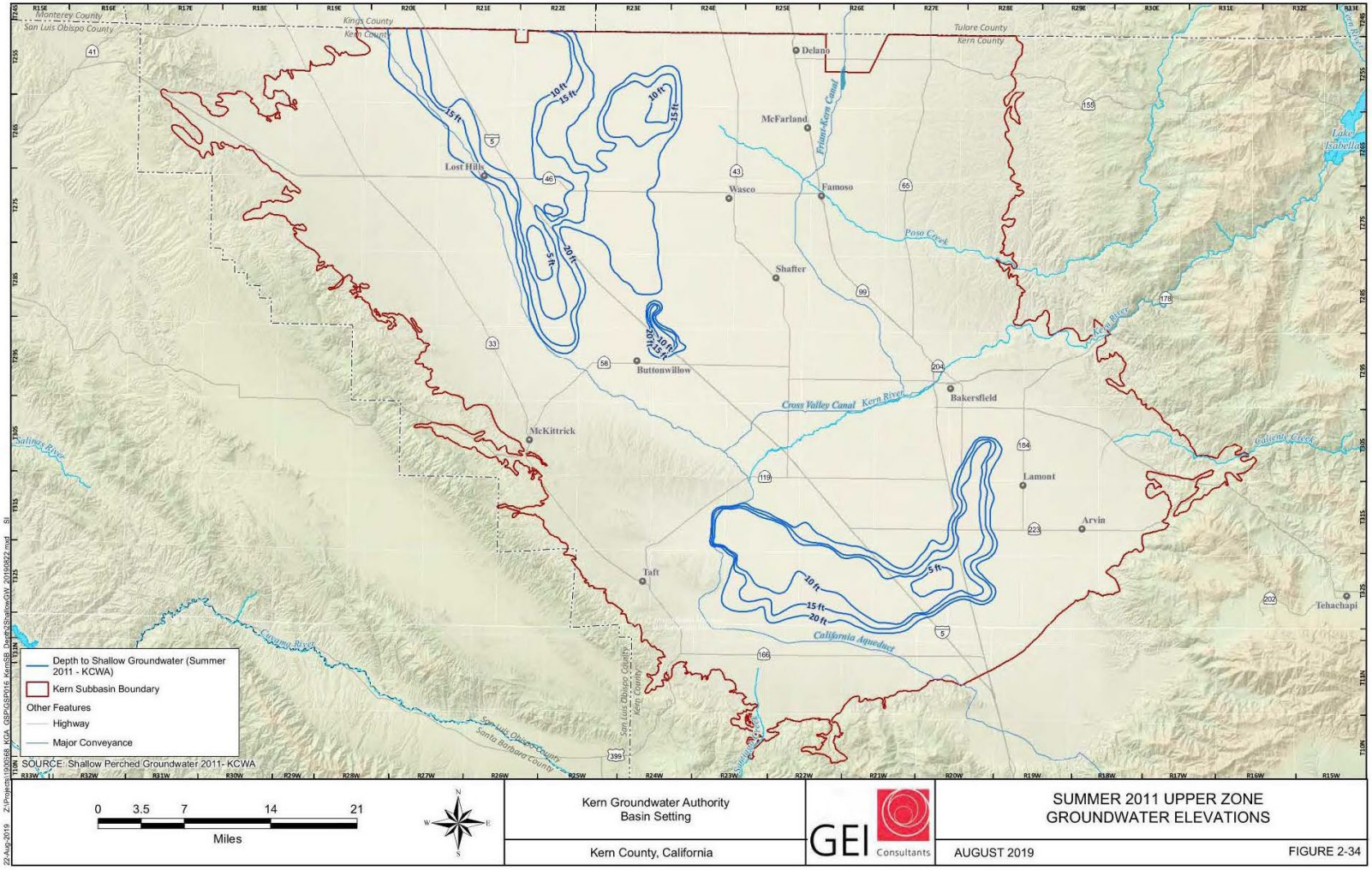

Figure 2-34. Summer 2011 Upper Zone Groundwater Elevations

Figure 3-9d: 2011 Groundwater Elevations in the Kern County Subbasin
Source: Excerpt from the KGA 2022 GSP

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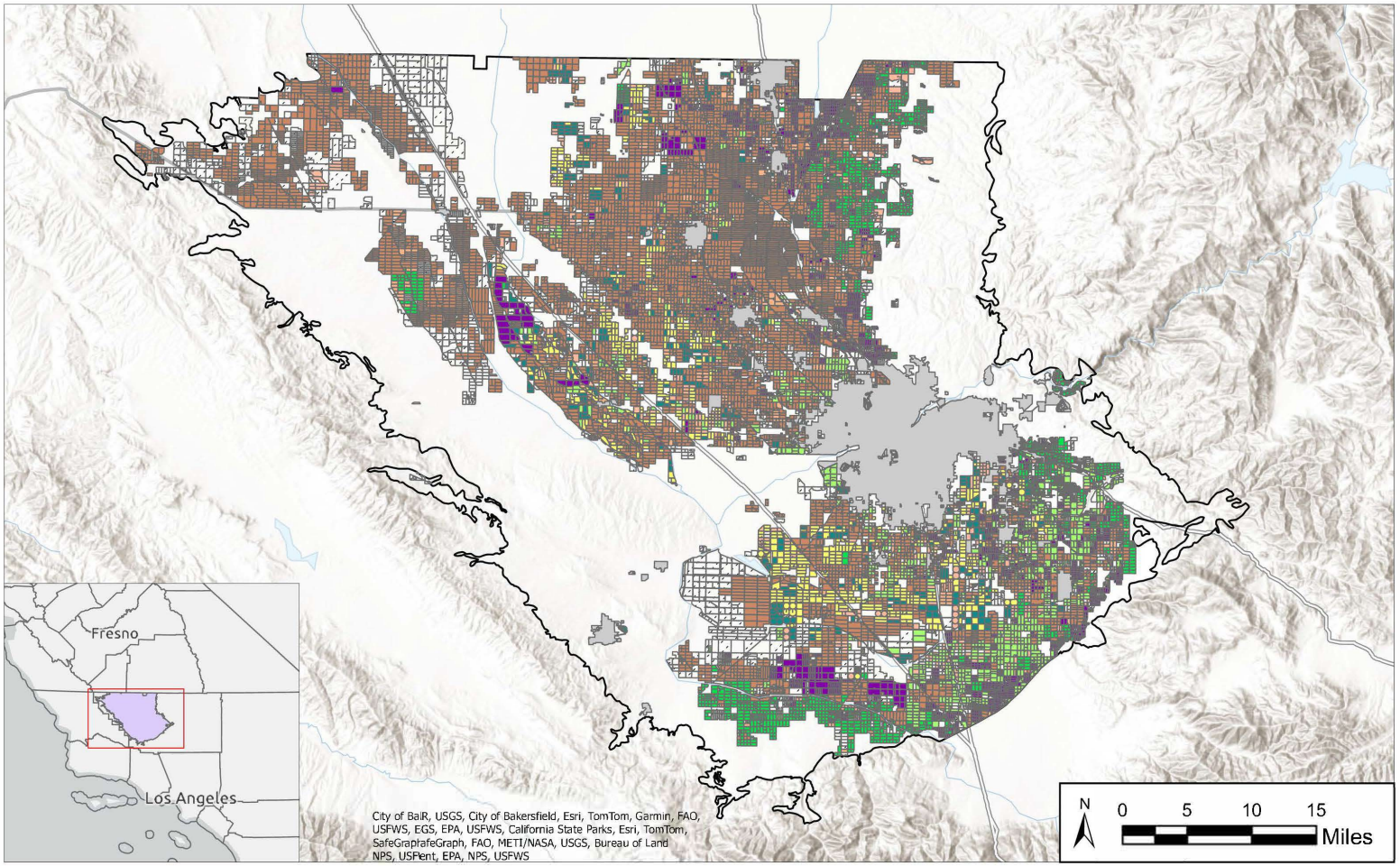

Figure 3-10

2022 Land Use in the Kern County Subbasin

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Source: 2022 DWR Crop Mapping Dataset

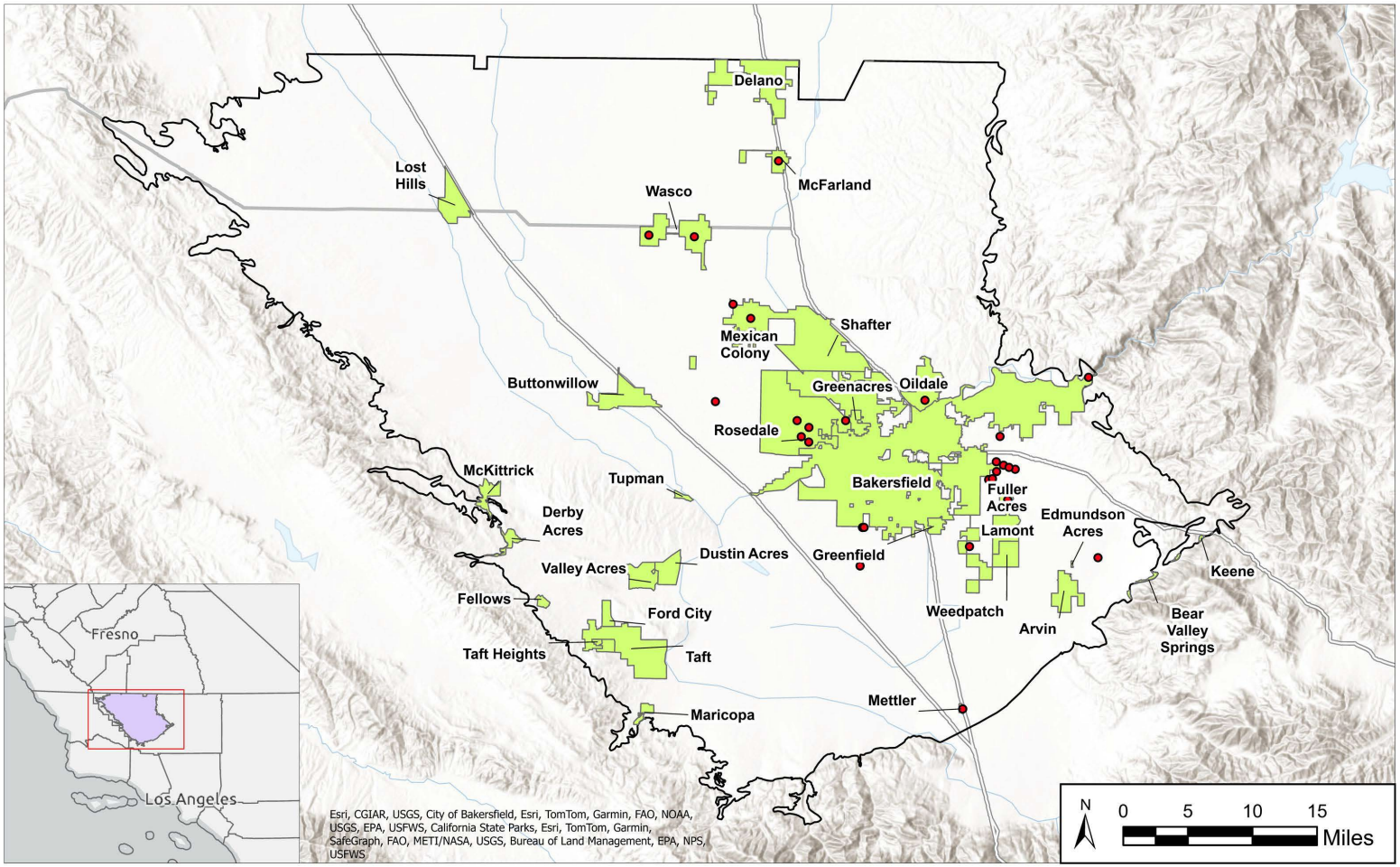

Figure 3-11

DACs in the Kern County Subbasin

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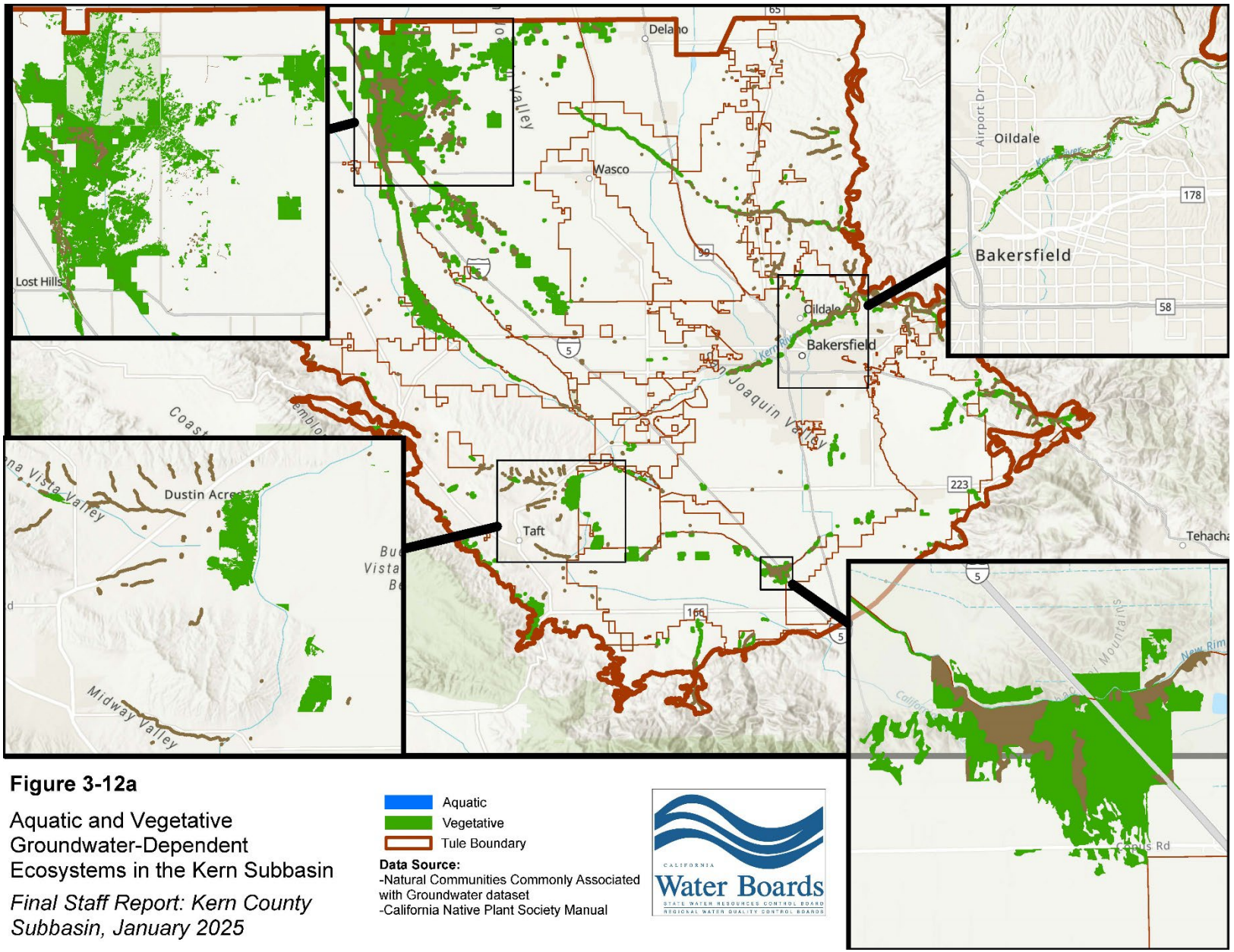

Figure 3-12a

Aquatic and Vegetative Groundwater-Dependent Ecosystems in the Kern Subbasin

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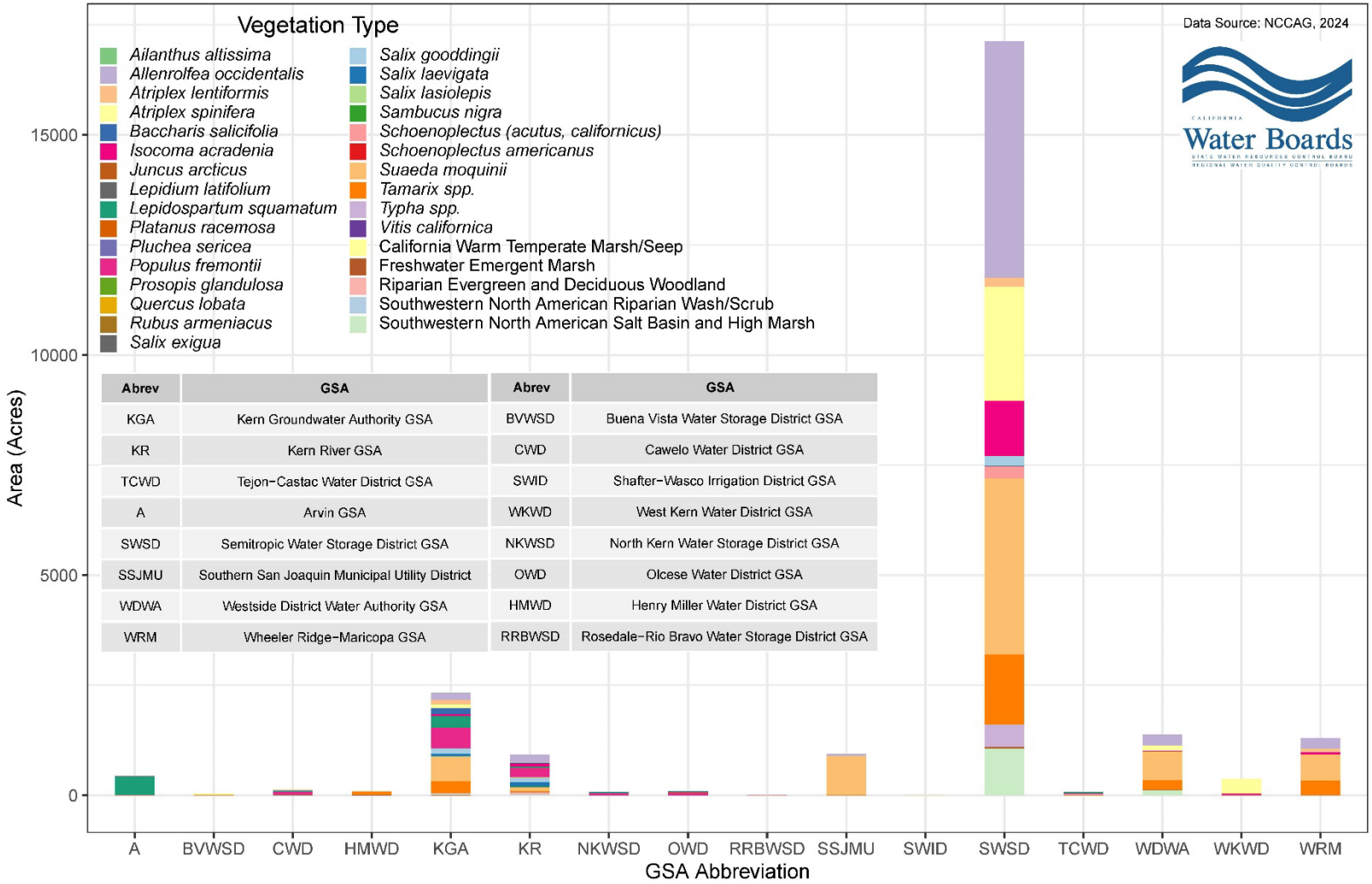

Abrev	GSA	Abrev	GSA
KGA	Kern Groundwater Authority GSA	BVWSD	Buena Vista Water Storage District GSA
KR	Kern River GSA	CWD	Cawelo Water District GSA
TCWD	Tejon-Castac Water District GSA	SWID	Shafter-Wasco Irrigation District GSA
A	Arvin GSA	WKWD	West Kern Water District GSA
SWSD	Semitropic Water Storage District GSA	NKWSD	North Kern Water Storage District GSA
SSJMU	Southern San Joaquin Municipal Utility District	OWD	Olcese Water District GSA
WDWA	Westside District Water Authority GSA	HMWD	Henry Miller Water District GSA
WRM	Wheeler Ridge-Maricopa GSA	RRBWSD	Rosedale-Rio Bravo Water Storage District GSA

Figure 3-12b Vegetative GDEs Area By Type Per GSA

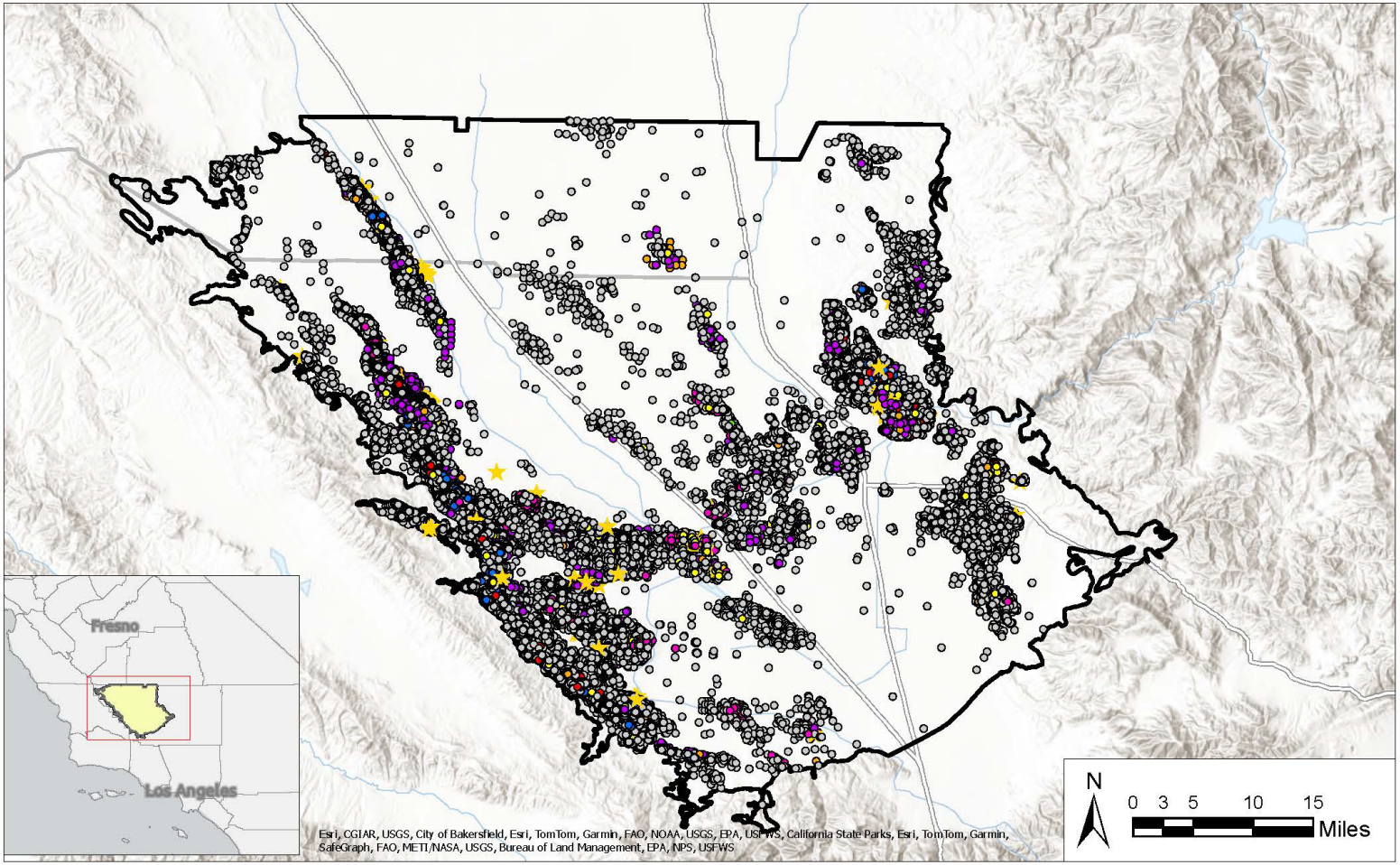

Figure 3-13
Wells Related to Oil and Gas Extraction

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- Kern County Subbasin boundary selection
- Water Source
- Cyclic Steam
- Injection
- Multi-Purpose
- Pressure Maintenance
- Steamflood
- Water Disposal
- Waterflood
- Oil & Gas

Data Source:
CalGEM WellSTAR Dashboard
-Accessed May 2024

https://www.conservation.ca.gov/calgem/Online_Data/Pages/WellSTAR-Data-Dashboard.aspx

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

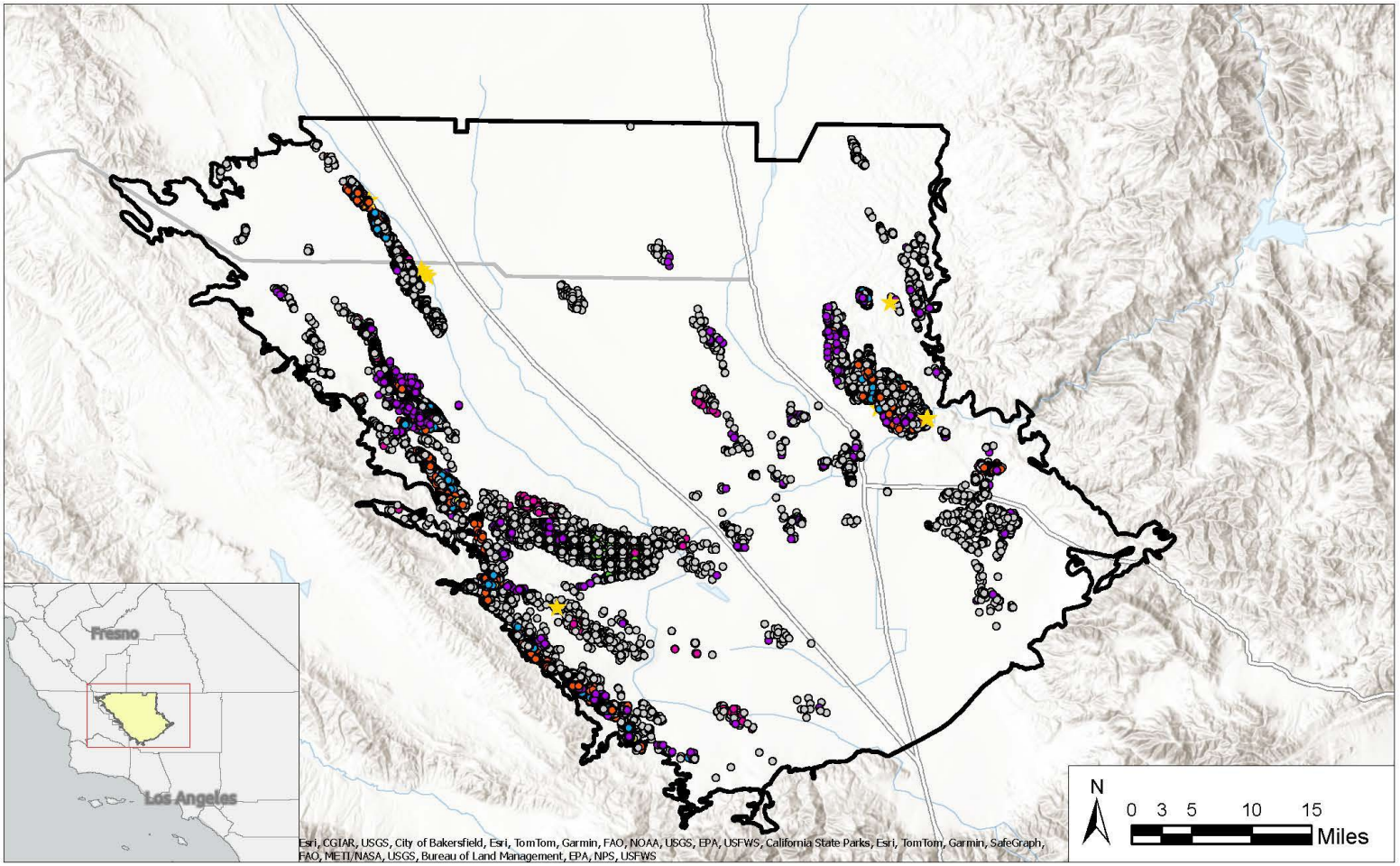

Figure 3-14
Active Wells Related to Oil and Gas Extraction

Final Staff Report
Kern County Subbasin
January 2025

- Kern County Subbasin boundary selection
- Water Source
- Cyclic Steam
- Injection
- Multi-Purpose
- Pressure Maintenance
- Steamflood
- Water Disposal
- Waterflood
- Oil & Gas

Data Source:
CalGEM WellSTAR Dashboard
-Accessed May 2024

https://www.conservation.ca.gov/calgem/Online_Data/Pages/WellSTAR-Data-Dashboard.aspx

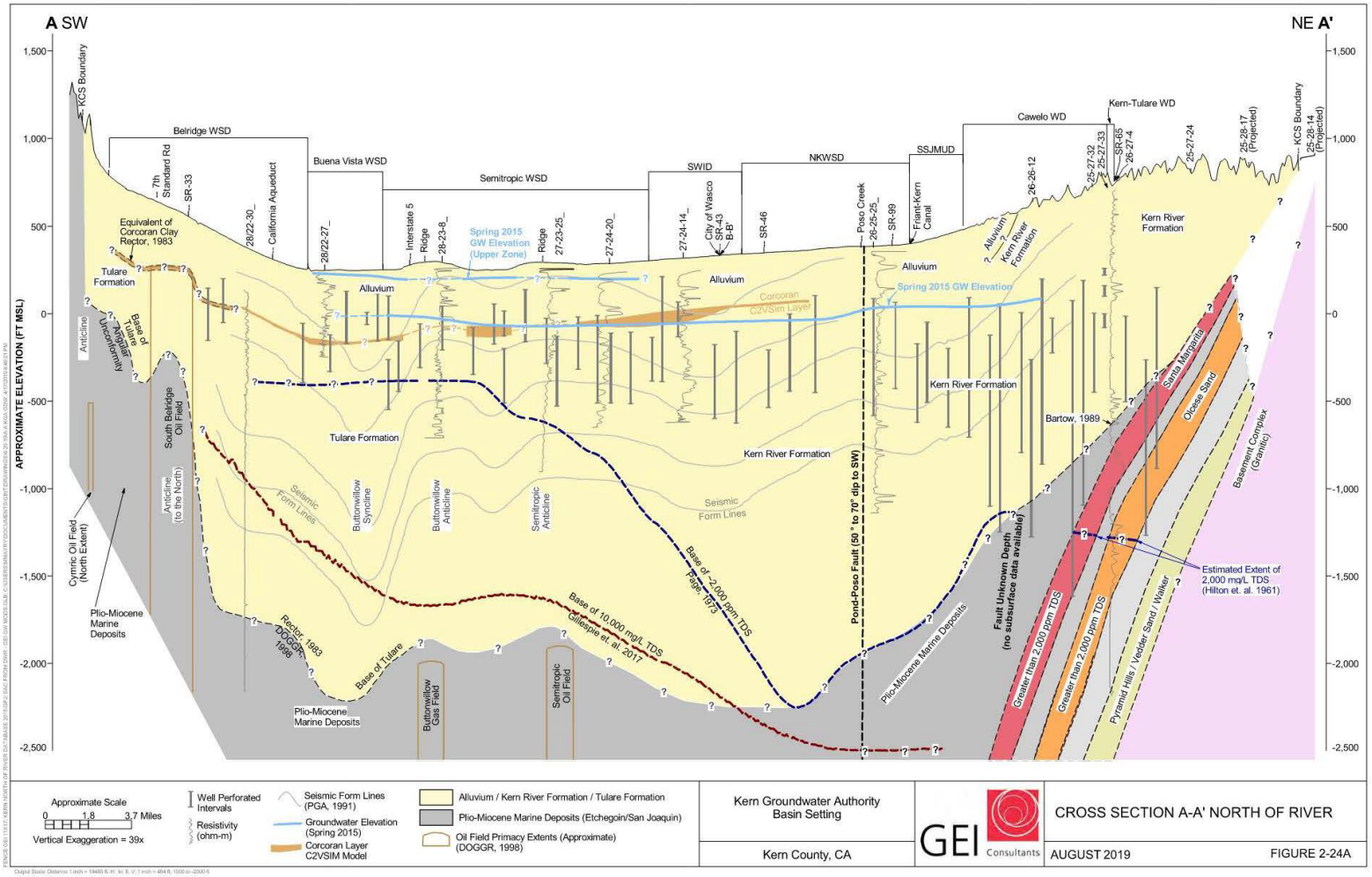

Figure 2-24a. Cross Section A-A' North of River

Figure 3-15a: Cross Sections of the Kern County Subbasin
Source: Excerpt from the KGA 2022 GSP

Final Staff Report: Kern County Subbasin
January 2025

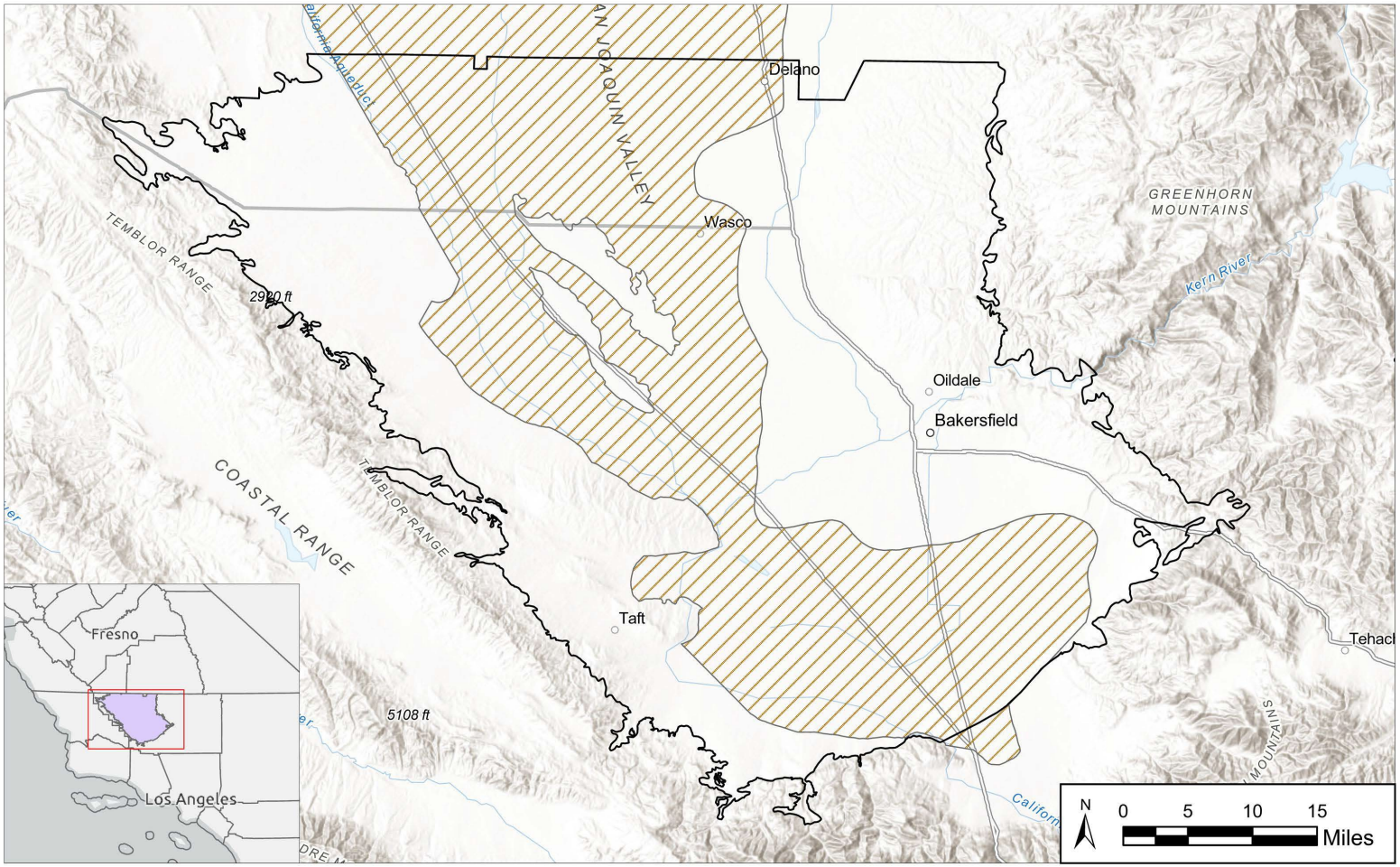

Figure 3-15b

Corcoran Clay Extent in the Kern County Subbasin

Kern County Subbasin

Corcoran Clay (E-Clay)

Source: (SGMA Data Viewer, 2024)

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January 2025

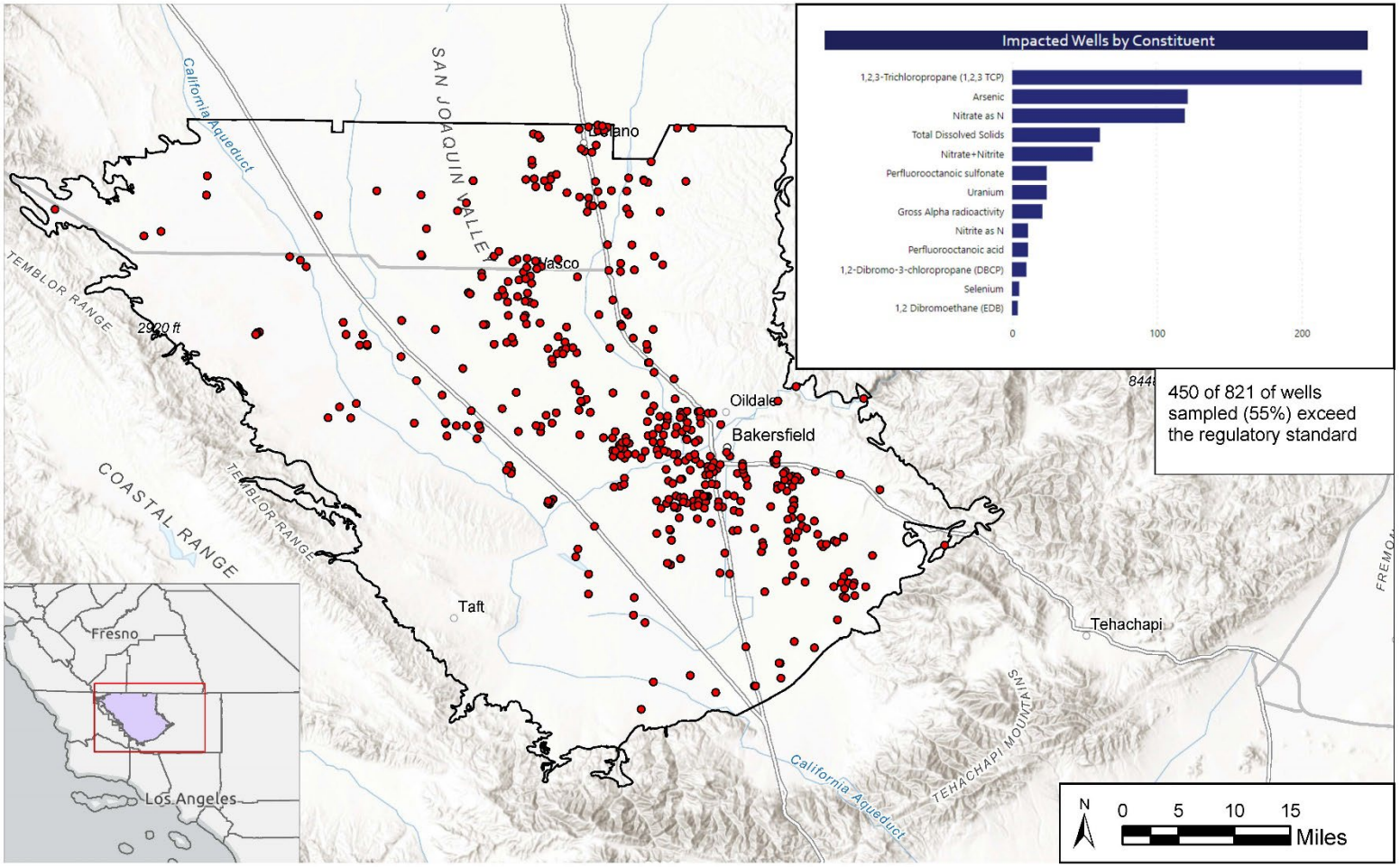

Figure 3-16
Wells with Detections Greater than the Regulatory Thresholds

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Kern County Subbasin

Wells with Detections Greater than the Regulatory Thresholds

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

Source: SGMA Groundwater Quality Visualization Tool

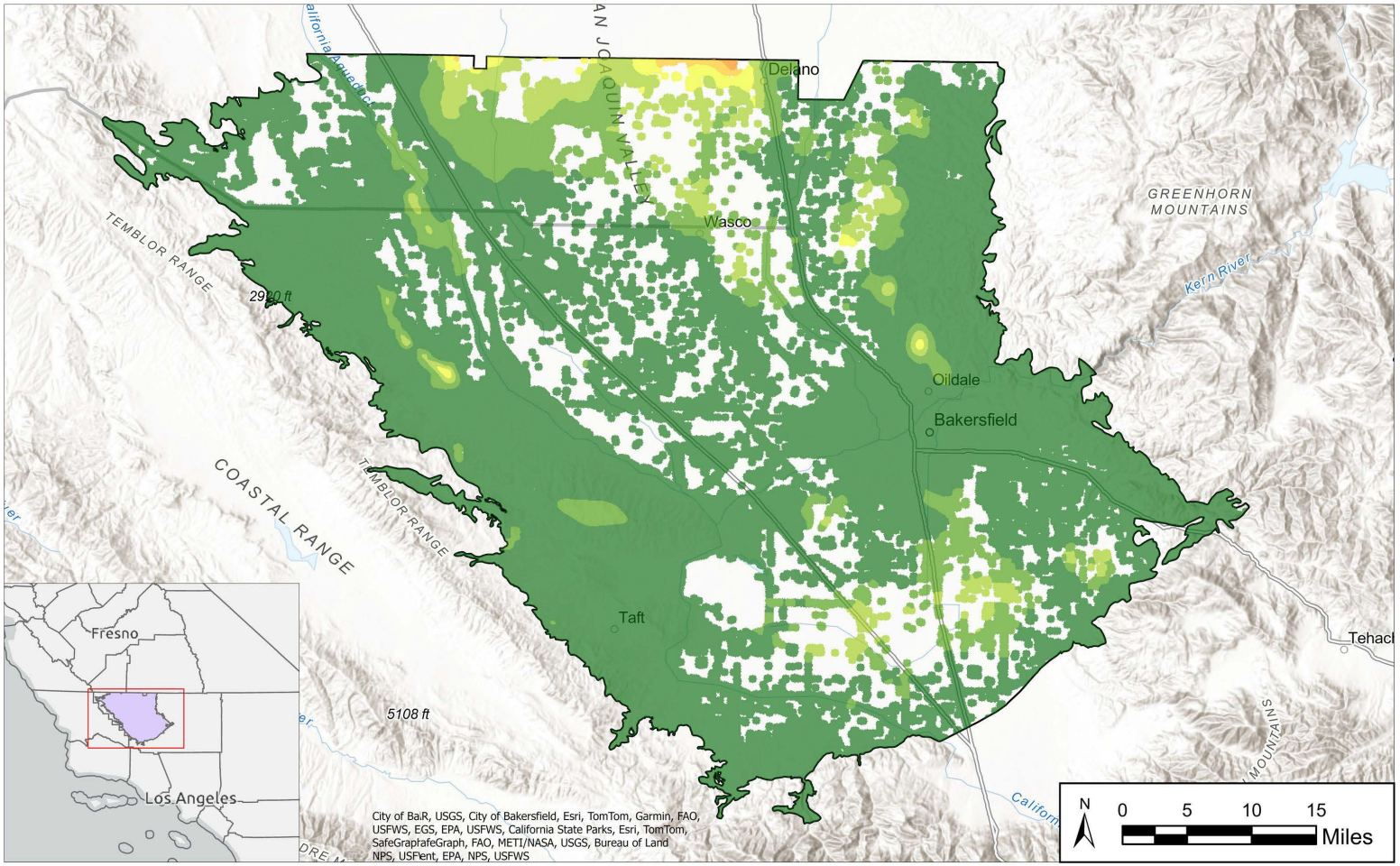

Figure 3-17

Subsidence in the Kern County Subbasin (June '15 - Oct '24)

Final Staff Report
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January 2025

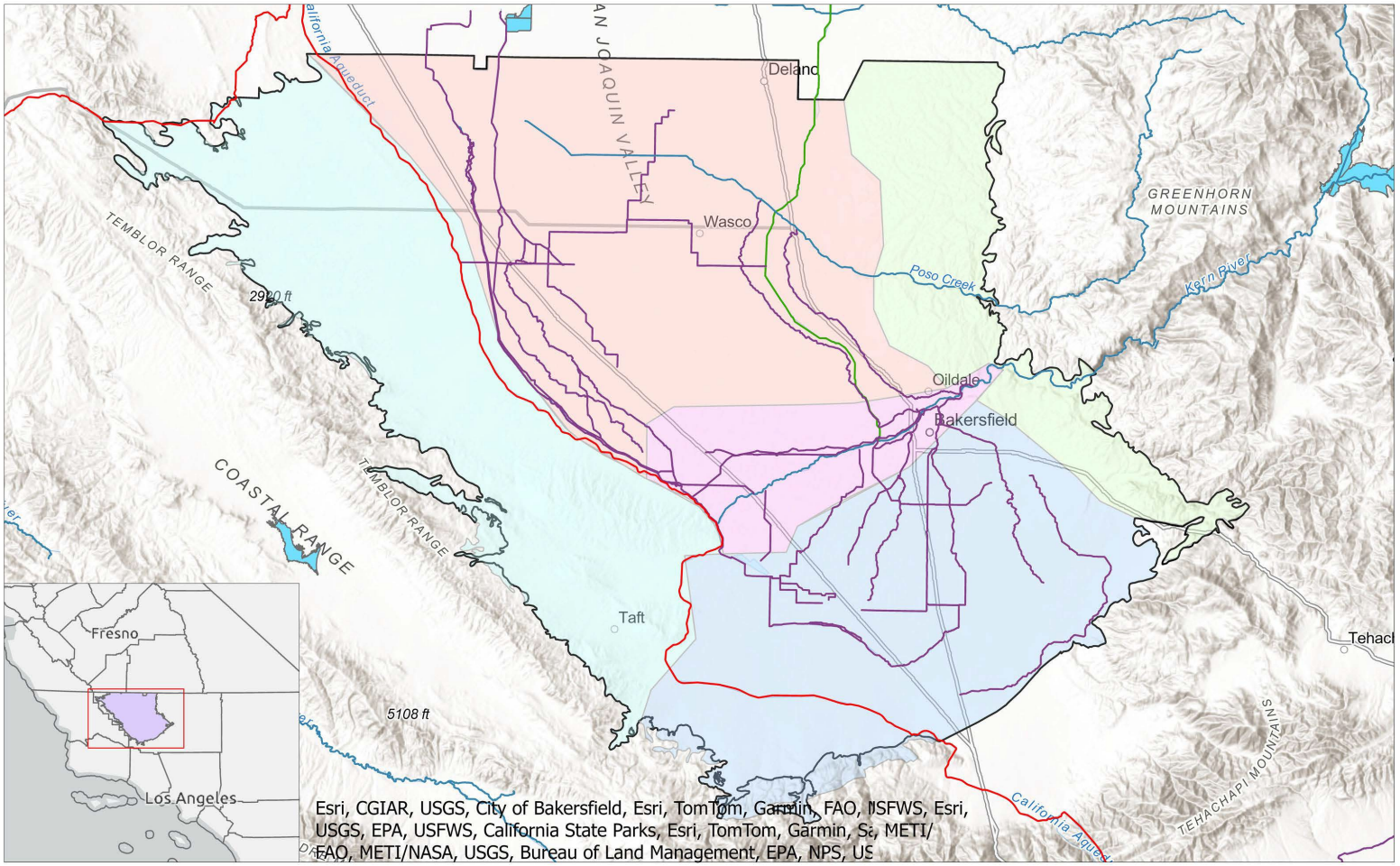

Figure 3-18

Surface Waters of the Kern County Subbasin

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Appendix C – Public Process, Tribal Consultation, and Engagement; Draft Staff Report Comments

State intervention under the Sustainable Groundwater Management Act (SGMA) is a public process. The State Water Resources Control Board (State Water Board or Board and, together with the Regional Water Quality Control Boards, Water Boards) encourages public participation in its decision-making process regarding the Kern County Subbasin. Public participation can help shape State Water Board staff recommendations, help the State Water Board decide whether to place the Kern County Subbasin on probation, and help identify improvements to the Groundwater Sustainability Plans (GSPs) to better manage groundwater in the subbasin.

California Native American Tribes

Meaningful engagement and consultation with California Native American Tribes are fundamental to the mission of the Water Boards. Guided by the Governor's Executive Order B-10-11, the CalEPA Tribal Consultation Policy and the CalEPA Tribal Consultation Protocol, and the State Water Board's Tribal Consultation Policy, the SGMA probationary hearing process includes significant tribal engagement and consultation. The State Water Board mailed and emailed a formal letter with notification of consultation opportunity dated July 26, 2024, to 13 California Native American tribes that are on the list provided by the California Native American Heritage Commission with cultural and traditional affiliation with the Kern County Subbasin. The State Water Board has thus far received no requests for government-to-government consultation on a potential probationary determination.

Hearing Notice

The State Water Board issued a probationary hearing notice for the Kern County Subbasin on July 25, 2024, pursuant to Water Code section 10736. The notice includes information about the GSP, public hearing, Draft Staff Report, public workshops, and public participation opportunities.

The notice was emailed to Kern County, San Luis Obispo County, City of Bakersfield, City of Arvin, City of Delano, City of Los Angeles, City of McFarland, City of Shafter, and City of Wasco.

The notice was mailed to approximately 1,800 parcel owners identified by Board staff as persons who extract or propose to extract groundwater from the subbasin based on

publicly available well information and county parcel information. The owner/extractor mailing list includes all public water systems (community, non-community non transient, transient) and state small water systems in the subbasin. Board staff developed an English and Spanish fact sheet flyer and cover letter that were included in the mailings.

Subscribers to the State Water Board's groundwater management email list received an English and Spanish electronic notification. The notice was also emailed to representatives of the 20 Groundwater Sustainability Agencies (GSAs) and the Department of Water Resources (DWR). The notice, Staff Report Executive Summary, and flyer are available in English and Spanish on the State Water Board's Kern County Subbasin webpage at bit.ly/sgma-kern.

Additional Outreach

In addition to the statutory noticing requirements, Board staff performed focused outreach to over 80 interested parties and local groups (e.g., churches and faith communities, community organizations, libraries, clubs, committees) in the subbasin via phone calls, interviews, and email. In addition, staff conducted targeted email outreach to public water systems in the Kern County Subbasin as a follow up to the formal notices sent by mail. The State Water Board has contracted with DUDEK and Kearns & West to support outreach and engagement services in the subbasin.

Schools and Universities

Board staff sent an email transmittal to the Kern County Superintendent of Schools, Bakersfield City School District, Lakeside Union School District, McFarland School District, and Kern High School District in August 2024 and requested that they distribute English and Spanish flyers about the August 26 and 29, 2024 public workshops to local families. Board staff also shared flyers with other organizations that work with local students and their families, including the Boys and Girls Club of Kern County and the Citizen Scientist Project, and conducted outreach to University of California Agriculture and Natural Resources and California State University Bakersfield.

Community Based Organizations

Board staff has consulted with the Community Water Center, Clean Water Action, Self-Help Enterprises, the Leadership Counsel for Justice and Accountability, and the Central California Environmental Justice Network on outreach efforts in the subbasin. Through these efforts, the State Water Board has been able to gather community input and distribute information about the public hearing and August 2024 workshops to the community.

Workshops

The State Water Board hosted two public workshops to share information about the state intervention process and gather public input. The workshop locations and times, including an evening session, were designed to promote effective engagement and accommodate interested parties who would otherwise be unable to attend.

- August 26, 2024, held remotely via Zoom, 11:00 am to 1:30 pm
- August 29, 2024, in-person in Bakersfield, CA, 5:30 pm to 8:30 pm

Spanish and Punjabi language interpretation was provided during the workshop presentations and time was allotted for public comments and questions to allow the public to engage with the State Water Board and Board staff. A video recording of the August 26th Kern County virtual workshop is posted online on YouTube and the State Water Board website.

Approximately 250 people attended the virtual workshop on August 26th and approximately 145 people attended the in-person workshop in Bakersfield on August 29th.

Public Comments

Board staff invited written and verbal public comments on the Draft Staff Report, which included Board staff's recommendations to the State Water Board regarding a probationary designation. The public comment period was July 26, 2024, to September 23, 2024. At the August 2024 workshops, approximately 25 attendees gave verbal comments. During the public comment period, the State Water Board received 46 written comments on the Kern County Subbasin Draft Staff Report. An additional opportunity for public comment will be provided at the February 2025 hearing.

Board staff considered all comments received and has provided compiled responses to relevant common topics below. Some topics in the comment letters are beyond the scope of the Staff Report and are not addressed in the report. Some comment letters suggested changes to the Staff Report but did not include sufficient evidence to change Board staff recommendations. A summary of comments is provided below.

Well Mitigation

Multiple comment letters commended the inclusion of the well mitigation program in the Kern County Subbasin Draft Staff Report (Potential Action GL-2, or GL-2b in the Final Staff Report). Specifically, comment letters acknowledge that the Kern County GSAs are committed to developing and implementing a subbasin-wide well mitigation plan in coordination with Self-Help Enterprises. One commenter also noted that although Kern

County GSAs are coordinating with Self Help Enterprises, the well-mitigation plan has not been posted for public review nor has a financing plan been provided.

Board staff acknowledges that a well mitigation program may not be necessary in every basin. While not explicitly required in SGMA or GSP regulations, a well-funded, comprehensive, and equitable well mitigation program is likely needed in critically-overdrafted subbasins subject to SGMA to avoid undesirable results by managing impacts to beneficial uses and users of groundwater. A groundwater management plan that allows for significant impacts to drinking water wells would be considered by Board staff to be unreasonable unless mitigation actions are facilitated by the GSAs. The Kern County Subbasin 2024 GSPs allow for significant and unreasonable impacts to well owners and therefore requires the development and implementation of a well-funded, comprehensive, equitable well mitigation program.

The groundwater level sustainable management criteria (SMC) described in the Kern 2024 GSPs may allow for the dewatering of a significant number of wells if groundwater levels decline to the minimum thresholds (MTs) but more information is needed for a more robust analysis (see Section 4.1.2.3 of the Final Staff Report for more details on Well Impact Mitigation). Additionally, since the groundwater quality SMC in the 2024 Draft GSPs do not explicitly consider the impacts from constituents and how each are influenced by management activities, it is unclear how mitigation for degradation of groundwater quality will be addressed. There is no discussions of estimated costs of mitigation for degradation of groundwater quality (see Section 4.1.4.3 for more details). It is also possible for wells to be impacted by subsidence; however, GSAs do not appear to account for subsidence related impacts in their mitigation plan except for one section of the Friant-Kern Canal (see Section 4.1.3.3 for more details).

GSA Projects and Management Actions

Several public comment letters discussed projects and management actions. Context for these discussions included, but was not limited to, i) acknowledging the Kern County GSAs' demand reduction target efforts, which will be executed through their respective Project and Management Actions (PMAs), ii) PMA selections that stabilize groundwater levels by 2030 and minimize GSA-related land subsidence by 2040, iii) noting that the modeling conducted for the Kern County Subbasin demonstrates that the planned PMAs will support the achievement of the subbasin's sustainability goal, and iv) PMAs may be costly and insufficient in supporting wetlands within the subbasin, specifically, wetlands that provide habitat but do not have access to adequate surface water supplies. Board staff appreciates the efforts GSAs continue to take in implementing their plans and making progress towards groundwater sustainability. Board staff encourages the GSAs to include relevant details in any updated GSP so the State Water Board can evaluate how management criteria, monitoring, and PMAs will work in concert to achieve sustainability in the subbasin.

“Good Actor” Exemption: Kern GSA Requests

In a public comment letter, Henry Miller Water District GSA (HMWD) requested to be excluded from probation under Water Code section 10735.2, subdivision (e). This section of the statute, informally called the “good actor” exemption, directs the State Water Board to “exclude from probationary status any portion of the basin for which a groundwater sustainability agency demonstrates compliance with the sustainability goal.”

Based on its evaluations, Board staff does not recommend that HMWD be excluded from probationary status or from reporting extractions and paying fees at this time. Further information about this recommendation can be found in Section 4.2 of the Final Staff Report.

Exemption from Reporting

Several comment letters discussed exemptions for classes of pumpers or drinking water systems from reporting groundwater extractions, paying fees, or metering groundwater well extractions. Additional content in the comment letters included supporting Board staff’s recommendation in the Draft Staff Report to exempt domestic users pumping two acre-feet per year or less, as well as adjusting fee rates so small farms do not pay the same fees per well or per acre-foot as those pumpers responsible for most of the overdraft, and exempting pumpers who are recovering surface water stored underground. The Final Staff Report’s Section 4.5 discusses reporting exclusions for drinking water systems and groundwater banking operations.

"Good Actor” Exemption: Criteria

One comment letter suggests the State Water Board is unequally applying the “good actor” exemption. (Wat. Code, § 10735.2, subd. (e).) Another comment letter stated the 2024 Draft GSPs were inadequate for any GSA to receive a “good actor” exemption.

The criteria for the “good actor” exemption are set in statute. SGMA requires the Board to “exclude from probationary status any portion of a basin for which a groundwater sustainability agency demonstrates compliance with the sustainability goal.” (Wat. Code, § 10735.2, subd. (e).) Section 4.2 of the Final Staff Report describes the statutory requirements in more detail.

Requests to Delay Probationary Hearing

Some comment letters requested that the State Water Board postpone the probationary hearing to allow additional time for GSA collaboration and for Board staff to complete a full review of the 2024 GSPs.

The current probationary hearing date for Kern County Subbasin has allowed the GSAs more than three years to remedy deficiencies after DWR issued its incomplete determination for the basin in January 2022 and five years since their initial 2020 GSP submissions. Board staff is concerned that continuing to prolong SGMA implementation could cause the subbasin to miss SGMA's 2040 deadline for sustainability and put beneficial users of groundwater at risk. The State Water Board acknowledges the GSAs' ongoing efforts to improve the GSPs and these efforts will be taken into consideration at the February 2025 hearing. At the hearing, the State Water Board may adopt a probationary designation or decide to revisit the matter at a future date. As of the time of this report's release, GSAs have not taken sufficient action to correct identified deficiencies, therefore Board staff does not recommend a delay. Additionally, Board staff has reviewed the 2024 Final GSPs and incorporated findings into the Final Staff Report. Board staff has been in coordination with the GSAs to discuss deficiencies since the basin was recommended for state intervention, has provided feedback on GSA methodologies, and provided recommended options that Board staff believes would address the deficiencies.

Impacts of Probation on the Local Economy

Some commenters expressed concern that, if the State Water Board designated the subbasin probationary, groundwater pumpers and the economy of the subbasin would suffer.

Board staff acknowledges this concern; however, the State Water Board's State Intervention authorities represent an important backstop under SGMA to ensure protection of groundwater for beneficial uses and users. SGMA requires the State Water Board to charge fees to recover the cost of its program and has recently reassessed and reduced its fees for extraction reporting in probationary basins.

If the State Water Board designates the subbasin probationary, Board staff would continue to work with GSAs to address the deficiencies in order to return the subbasin to full local control and encourage GSAs to continue to implement their plans.

Board staff also notes that SGMA gives the GSAs authorities to collect fees and enforce their own rules, among other powers. (Wat. Code, § 10725 et seq.).

Fees

Several comments were concerned with fees, assessment of fees, and their impact on local communities.

The State Water Board revised its fees at its March 19, 2024, meeting. To stay informed on new fee assessment and other SGMA topics and receive updates, you can subscribe

to the State Water Board's Groundwater Management listserv at bit.ly/SWRCB-email-subscriptions (under State Water Board General Interests).

Wetlands

Several comment letters were submitted regarding managed wetlands. Many of these commenters expressed concern that groundwater and surface water would no longer be available to support managed wetlands and/or that the cost of water would prohibit these wetlands from continuing to be managed. Commenters stated that reductions in water applied to these wetlands would devastate the wildlife communities that depend on this critical habitat, which comprises less than 1 percent of the geographic area of the subbasin.

Some commenters requested that managed wetlands be excluded from State Water Board fees. Still other commenters expressed concern that the 2024 Draft GSPs do not recognize environmental uses of groundwater.

In Section 3.5.1.3 of the Final Staff Report, Board staff states that wetlands are considered a beneficial user of groundwater and that their protection should be considered in the 2024 GSPs in accordance with Executive Order W-59-93 to ensure no overall net loss, and a long-term net gain, in the quantity, quality, and permanence of wetlands acreage and values in California.

Review of 2024 GSPs

Several comment letters were submitted requesting that Board staff complete a full review of the 2024 Draft GSPs before releasing the Final Staff Report. Board staff has completed a thorough review of the 2024 Draft GSPs. Board staff's findings are located in Section 4.1 of the Final Staff Report.

Land Subsidence

Comments from the Kern County GSAs highlight commitments made by organizations to address land subsidence deficiencies through updated MTs and programs featured in revised GSPs. In addition to the programs proposed by GSAs, other stakeholders have advocated for additional demand and supply mitigation, including pumping and well restrictions, land repurposing, land retirement, fallowing, flood managed aquifer recharge, agricultural managed aquifer recharge, and groundwater recharge.

Mitigating land subsidence near the Friant-Kern Canal and California Aqueduct poses a unique challenge to the Kern County Subbasin with far reaching consequences. The Final Staff Report identifies many of the demand and supply actions proposed by commentors as potential actions to address land subsidence deficiencies.

Groundwater Recharge

A few commenters acknowledged the importance of water infrastructure, such as recharge ponds and unlined canals, to support groundwater recharge in the subbasin. Commenters also noted that the water conveyance networks support implementation of supply augmentation PMAs, supplementing the subbasin's capacity to recharge flood waters. Additionally, commenters stated that to achieve the minimization of subsidence by 2040 and limit declining groundwater levels, there will need to be an increase in the volume of surface water used for groundwater recharge.

Board staff recognizes the Kern County Subbasin's commitment to recharge through existing and planned projects. However, Board staff notes that recharge projects need to be carefully engineered, operated, and monitored to avoid groundwater quality degradation, contamination plume migration, and the alteration the groundwater chemistry (see Potential Action GWQ-1a in Section 4.1.4.4 in the Final Staff Report for more details).

Water Banking

Two primary concerns emerge from comments for water banking operations within the Kern County Subbasin. Firstly, in response to the importance of banking operations in the subbasin, Board staff acknowledges that water banks and conjunctive use can be an important means of sustainably managing water use and Board staff does not dismiss its necessity within the subbasin. Board staff further notes that large fluctuations in groundwater levels as a result of banking operations may be a challenging aspect to appropriately setting SMC in relation to the rest of the subbasin. However, Board staff notes that beneficial users of groundwater in close proximity to water banks may be adversely impacted during extended periods of banking operations withdrawing stored water from the basin. Therefore, Board staff continues to encourage GSAs to ensure SMC and monitoring networks capture the potential impacts that may affect beneficial users as climate extremes continue to persist. See Potential Action GL-3a in Section 4.1.2.4 of the Final Staff Report for more details.

In response to agencies concerned about in-lieu recovery subjected to reporting and fees, Board staff acknowledges that in-lieu banking operations are an important component to conjunctive use in the subbasin. However, Board staff remains concerned that, even with leave-behind obligations from outside banking partners, there may be adverse impacts to groundwater storage volumes due to inconsistencies between the volume of water that is provided in-lieu and the net losses from the primary aquifer system used for return deliveries. This issue is compounded by the large contributions of overdraft from Semitropic Water District and its consistent declines in groundwater levels. If the aquifer is losing water faster than the water that is provided in-lieu, then this may continue to cause periods of overdraft. Board staff will need to further assess

groundwater extractions for in-lieu operations on a case-by-case basis to ensure that the accounting of water aligns with conditions of sustainability.

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” or “banked” under in-lieu operations/accounting procedures is native groundwater and subject to SGMA reporting and fees. (Wat Code, § 5202 [any person who “extracts groundwater from a probationary basin 90 days or more after the board designates the basin as a probationary basin” must file a groundwater extraction report with the State Water Board each year.].) Surface water that is diverted to underground storage in the subbasin may continue to be extracted without being subject to reporting and fees.

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KERN COUNTY SUBBASIN PROBATIONARY HEARING DRAFT STAFF REPORT

Appendix D – State Water Board Review of the 2020 Groundwater Sustainability Plans and DWR Incomplete Determination

January 2025

Deficiency CRD – Defining and Avoiding Undesirable Results Related to Coordination

D.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 results 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) states 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 UR 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 for the District to occur when 30% of MTs are exceeded in monitoring wells located within the district (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).

D.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. Not withstanding 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*.).

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

D.2.1 State Water Board Review of the Kern County Subbasin 2020 Groundwater Sustainability Plan

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).

D.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" (*Id*., 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 (*Id*., pp. 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 (*Id*., 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 (*Id*., p. 20).

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

D.3.1 State Water Board Review of the Kern County Subbasin 2020 Groundwater Sustainability Plan

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 (*Id.,* 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 (*Id*., 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.

D.3.2 Department of Water Resources' 2020 Groundwater Sustainability Plan 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" (*Id*., 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” (*Id*., 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*.).

And,
“The Plan should include clearly defined undesirable and appropriate minimum thresholds and measurable objectives” (*Id*., 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.).

Department of Water Resources’ 2020 Groundwater Sustainability Plan 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).

Deficiency GWQ – Defining and Avoiding Undesirable Results Related to Groundwater Quality

D.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 UR 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 UR 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 (*Id.*, 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 Kern River GSA GSP, Sec. 6, pp. 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, pp. 102-104).
>
> AEWSD Management Area Plan (KGA Member) defined a 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.

D.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 (2023 DWR Determination Letter, pp. 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. (*Id*., 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)