SUTTER SUBBASIN

2027 Periodic Evaluation of the GROUNDWATER SUSTAINABILITY PLAN

SUTTER SUBBASIN SGMA















Woodard & Curran

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SUTTER SUBBASIN GROUNDWATER SUSTAINABILITY PLAN – 2027 PERIODIC EVALUATION

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ACRONYMS AND ABBREVIATIONS

AEM	airborne electromagnetic
AF	acre-feet
AFY	acre-feet per year
AZ	aquifer zone
BWD	Butte Water District
C&E	communications and engagement
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
CGPS	continuous global positioning system
CSD	Community Services District
DMS	Data Management System
DWR	California Department of Water Resources
EC	electrical conductivity
EO	Executive Order
ET	evapotranspiration
ft bgs	feet below ground surface
ft MSL	feet relative to mean sea level
GAMA	Groundwater Ambient Monitoring and Assessment
GDE	groundwater dependent ecosystem
GPS	global positioning system
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	hydrogeologic conceptual model
InSAR	Interferometric Synthetic Aperture Radar
ISW	interconnected surface water
JPL	Jet Propulsion Laboratory
MCL	Maximum Contaminant Level
mi^2	square mile
MO	measurable objective
MT	minimum threshold
MW	monitoring well
NCWA	Northern California Water Association
ND	not detected
NDVI	Normalized Difference Vegetation Index
OSWCR	Online System for Well Completion Reports
PLSS	Public Land Survey System
PMA	projects and management actions
Prop	proposition

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RCA	recommended corrective action
RMN	representative monitoring network
RMS	representative monitoring site
SCADA	supervisory control and data acquisition
SGMA	Sustainable Groundwater Management Act
SEWD	Sutter Extension Water District
SMC	sustainable management criteria
SMCL	Secondary Maximum Contaminant Level
SOPAC	Scripps Orbit and Permanent Array Center
SRSC	Sacramento River Settlement Contractors
SSGMCC	Sutter Subbasin Groundwater Management Coordination Committee
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TDS	total dissolved solids
TSS	Technical Support Services
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
WD	water district
WY	water year

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EXECUTIVE SUMMARY

Introduction

The Sutter Subbasin Groundwater Sustainability Agencies (GSAs) developed a joint Groundwater Sustainability Plan (GSP) encompassing the entirety of the Sutter Subbasin that was submitted to the California Department of Water Resources (DWR) in January 2022 in compliance with the Sustainable Groundwater Management Act (SGMA). SGMA, passed in 2014, requires the formation of GSAs to oversee the development and implementation of GSPs with the goal of achieving sustainable management of groundwater throughout California. The Sutter Subbasin Periodic Evaluation documents progress in implementing the 2022 GSP over the first five years of the implementation timeframe, Water Years (WYs) 2021 to 2025, to maintain sustainable groundwater through and beyond 2042.

This Periodic Evaluation is accompanied by a GSP amendment, which was adopted by the nine Sutter Subbasin GSAs in January 2027. A Notice of Intent to Adopt the GSP amendment was signed by the Plan Manager on behalf of the Sutter Subbasin GSAs and distributed on October 9, 2026 to all cities and counties in the Sutter Subbasin. Opportunities for stakeholders and interested parties to participate in the development of this Periodic Evaluation and GSP amendment were provided through meetings of the Sutter Subbasin Groundwater Management Coordination Committee (SSGMCC), which were noticed according to the Brown Act.

In October 2023, DWR completed its evaluation of the 2022 GSP and approved the GSP. Seven recommended corrective actions (RCAs) were provided by DWR. These RCAs were addressed as part of the 2027 GSP Amendment. Technical Memoranda (TMs) summarizing the RCA responses are included herein as Appendix A to this Periodic Evaluation.

Periodic Evaluation Overview

The sustainability goal for the Sutter Subbasin is as follows:

> *The Sutter Subbasin will maintain locally-managed groundwater resources for existing and future beneficial uses and users that are economically viable and sustainable by managing groundwater use within the sustainable yield, resulting in the avoidance of undesirable results. This goal will be achieved through implementation of proposed projects and management actions and monitoring activities aiding in reaching or maintaining established interim milestones and measurable objectives culminating in the absence of undesirable results by 2042. Water managers in the Sutter Subbasin will work together and collaboratively with stakeholders and neighboring subbasins through GSP implementation and beyond to achieve this goal.*

The Sutter Subbasin is anticipated to be sustainable relative to all applicable sustainability indicators over the 50-year planning horizon, even with the consideration of potential impacts from climate change. The GSP provides a framework to maintaining sustainability in the Sutter Subbasin through 2042 and beyond. This Periodic Evaluation serves to demonstrate that sustainability was maintained over the evaluation cycle of WYs 2021 to 2025.

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The Sutter Subbasin GSAs conducted the following implementation activities as described in the GSP during the evaluation cycle:

- Monitored groundwater levels and groundwater quality at representative monitoring network sites and evaluate publicly available land subsidence data.
- Developed and submitted to DWR Annual Reports by April 1st each year.
- Sought funding opportunities to support GSP implementation.
- Implemented projects and management actions.
- Held SSGMCC meetings.
- Addressed and responded to DWR's RCAs.

As part of each GSP annual report, an assessment of monitoring data was compared to established sustainable management criteria (SMC) for each sustainability indicator. As part of responses to DWR's RCAs and general updates to the GSP amendment, new information available has been incorporated into the 2027 GSP Amendment, monitoring networks have been updated, and revisions have been made to SMC definitions to support assessment of sustainability over the next evaluation cycle and beyond.

Over the evaluation cycle of this Periodic Evaluation, the Sutter Subbasin GSAs implemented projects and management actions (PMAs) and evaluated new information to improve characterization of the Sutter Subbasin and implementation of the GSP. Significant new information was incorporated into the Periodic Evaluation and 2027 GSP Amendment, where appropriate, and includes:

- New geologic cross-sections in the Hydrogeologic Conceptual Model (HCM) using airborne electromagnetic survey (AEM) data collected by DWR and re-processed for the Sutter Subbasin. AEM data were also used to improve the C2VSimFG-Sutter model for Version 2.0.
- Improved hydrostratigraphic descriptions in response to RCAs clarifying the principal aquifer description and correlating named geologic formations.
- Annual groundwater level and groundwater quality data collection by the Sutter Subbasin GSAs and incorporation into GSP annual reports.
- Updated statewide crop mapping incorporated into C2VSimFG-Sutter Version 2.0 to refine water budgets.
- Utilized DWR's Online System for Well Completion Reports (OSWCR) and available well construction information to assess for potential impacts of groundwater level SMC on domestic and public supply wells in response to RCAs.
- Assessed available Interferometric Synthetic Aperture Radar (InSAR) and publicly available continuous global positioning system (CGPS) and extensometer data to develop updated land subsidence monitoring network in response to RCAs.
- Performed a well siting analysis to identify data gaps in representative monitoring networks for groundwater levels, groundwater quality, and interconnected surface water and to identify locations for potential future monitoring wells.
- C2VSimFG-Sutter integrated flow model improvements.

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- Beneficial uses and users analysis to assess for potential impacts of the established groundwater level SMC on domestic wells, public water systems and Community Water Systems (CWS), and groundwater dependent ecosystems (GDEs) in response to RCAs.
- Identified funding options for GSP implementation, prepared a 5-year budget and preliminary cost allocation by GSA, and began a rate study to identify best option(s) for developing a long-term funding stream.

Throughout development of this Periodic Evaluation and GSP amendment, stakeholders and interested parties were encouraged to provide feedback, primarily through SSGMCC meetings. A total of 15 SSGMCC meetings were held over the evaluation period, with six meetings including discussion of this Periodic Evaluation and GSP amendment. SSGMCC meetings were noticed in accordance with the Brown Act and meeting information was posted to the Sutter Subbasin website ahead of the meetings (www.suttersubbasin.org). Stakeholders and interested parties were also invited to provide comment on the public draft of the Periodic Evaluation and GSP amendment. Comments received were given due consideration and incorporated into the final Periodic Evaluation and GSP amendment where appropriate or identified for future evaluation.

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1. INTRODUCTION

GSP Emergency Regulations §356.4 state that:

> *Each Agency shall evaluate its Plan at least every five years and whenever the Plan is amended, and provide a written assessment to the Department. The assessment shall describe whether the Plan interpretation, including implementation of projects and management actions, are meeting the sustainability goal in the basin…*

1.1 Introduction and Plan Authority

The Sustainable Groundwater Management Act (SGMA), passed in 2014, requires the formation of local Groundwater Sustainability Agencies (GSAs) to oversee the development and implementation of Groundwater Sustainability Plans (GSP), with the goal of achieving sustainable management of California's groundwater basins.

The California Department of Water Resources (DWR) designated the Sutter Subbasin as a medium-priority subbasin, and therefore required the preparation of a GSP by January 31, 2022. The Sutter Subbasin GSP was submitted to DWR in January 2022, and was approved by DWR with identified recommended corrective actions (RCAs) in October 2023. The nine Sutter Subbasin GSAs worked collaboratively to develop the 2022 GSP and have continued their collaboration in implementing the GSP. **Figure 1-1** shows the location of the Sutter Subbasin and nine GSAs.

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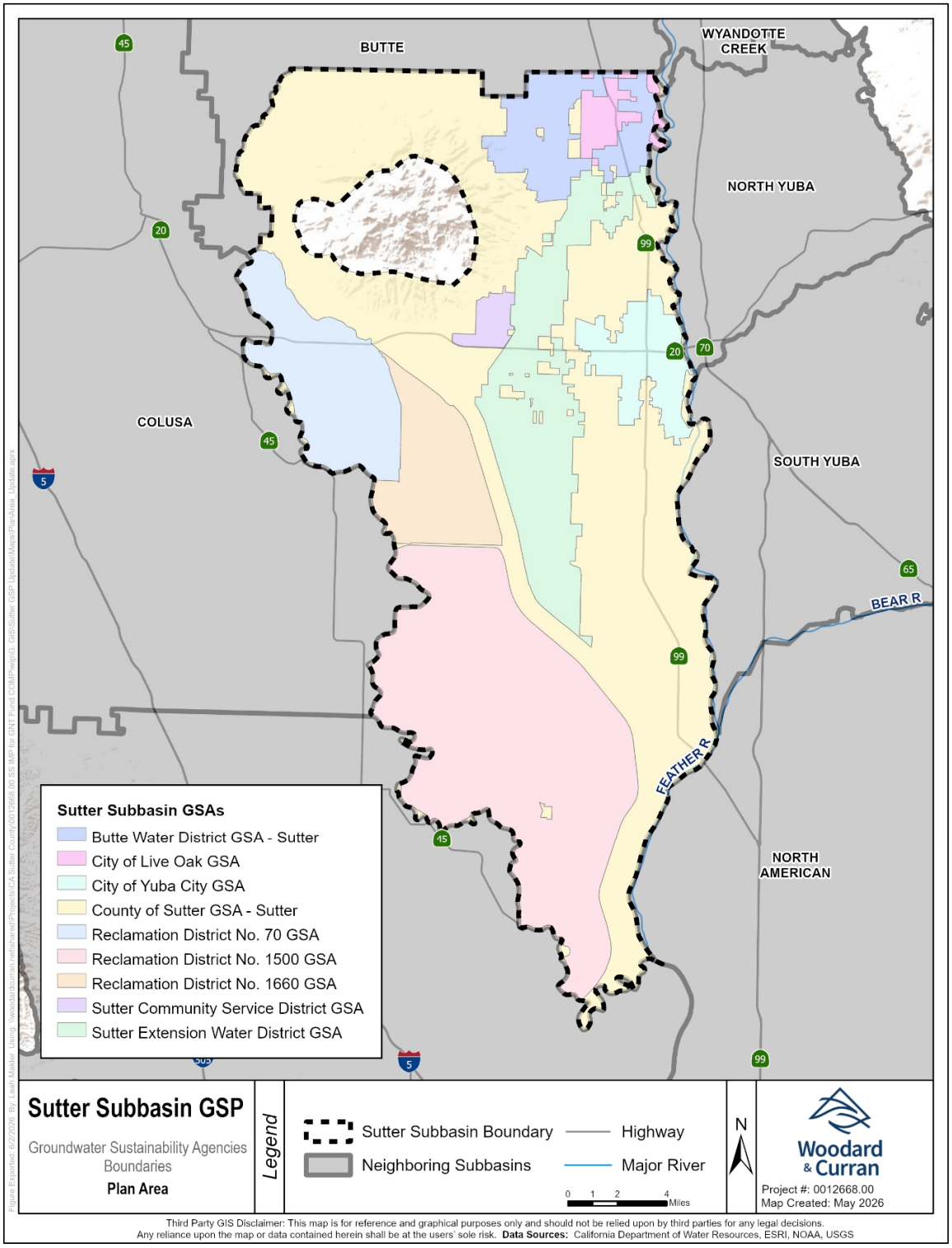

FIGURE 1-1: SUTTER SUBBASIN LOCATION AND GSAS

1.2 Purpose of Periodic Evaluation

This Periodic Evaluation meets the five-year assessment requirement of the GSP Emergency Regulations §356.4. *Periodic Evaluation by Agency* and assesses the GSP implementation period for Water Years (WYs) 2021 through 2025. The organization of this Periodic Evaluation adheres to Section 3.3 of the *Groundwater Sustainability Plan Implementation: A Guide to Annual Reports, Periodic Evaluations, & Plan Amendments* (DWR, 2023). This Periodic Evaluation is accompanied by a GSP Amendment.

The purpose of this Periodic Evaluation is to provide an update to DWR, interested parties, and the public on changing conditions in the Sutter Subbasin, the progress the GSAs have made in implementing the GSP, and the need, if any, for a GSP amendment. This Periodic Evaluation provides an assessment of the progress made towards maintaining the Subbasin's sustainability goal, which states:

> *The Sutter Subbasin will maintain locally-managed groundwater resources for existing and future beneficial uses and users that are economically viable and sustainable by managing groundwater use within the sustainable yield, resulting in the avoidance of undesirable results. This goal will be achieved through implementation of proposed projects and management actions and monitoring activities aiding in reaching or maintaining established interim milestones and measurable objectives culminating in the absence of undesirable results by 2042. Water managers in the Sutter Subbasin will work together and collaboratively with stakeholders and neighboring subbasins through GSP implementation and beyond to achieve this goal.*

This Periodic Evaluation also documents progress in addressing DWR's RCAs to the Sutter Subbasin GSP submitted to DWR in January 2022. In October 2023, DWR completed its evaluation of the 2022 GSP and deemed it Approved. The following proposed RCAs were provided by DWR as part of that evaluation (iterated below) that DWR believes will enhance the GSP and facilitate future evaluation by DWR:

Recommended Corrective Action 1

Provide clarification regarding the various zones of the principal aquifer system, geologic formations comprising the principal aquifer, and the vertical extent of the Subbasin. Consistent descriptions and naming of the aquifer zones should be present throughout the GSP, including in the hydrogeologic conceptual model and the monitoring network.

Recommended Corrective Action 2

Provide further information and justification related to the increases in net subsurface inflows from adjacent subbasins in the projected water budgets and the sustainable yield estimation.

Recommended Corrective Action 3

Revise the sustainable management criteria for the chronic lowering of groundwater levels as follows:

a. Revise the sustainable management criteria to be based on seasonal low groundwater levels to ensure potential impacts to beneficial uses and users are considered.

b. Provide clarification and detailed information related to the methodology of the second criterion for minimum thresholds (i.e., associated with the projected water budget simulation with a 50

percent increase in ET). Clearly describe the processes and terms involved, and the spatial and temporal aggregations that define "interconnected streams that are gaining become losing."

c. Provide more information about how the proposed minimum thresholds for the chronic lowering of groundwater levels may impact beneficial uses and users. Specifically, consider the impact of the selected minimum threshold levels on supply wells. The consideration should identify the degree/extent of potential impact including the percentage, number, and location of potentially impacted wells at the proposed minimum thresholds for chronic lowering of groundwater levels.

d. Reevaluate how groundwater level minimum thresholds may impact land subsidence.

e. Provide estimates of stream depletions when groundwater levels are at the minimum thresholds and evaluate the potential impacts to beneficial uses and users of interconnected surface water.

Recommended Corrective Action 4

Revise the sustainable management criteria for degraded water quality to use water quality monitoring data collected in all water year types including drought years.

Recommended Corrective Action 5

Revise the sustainable management criteria for land subsidence as follows:

a. Describe how undesirable results will be evaluated since it is unclear at what frequency data will be collected from the Sacramento Valley GPS Subsidence Monitoring Network. If data is not collected at a minimum of every 5-years from the network, another method should be utilized to ensure undesirable results are not occurring within the Subbasin.

b. Provide a description of how the InSAR data will be incorporated into identifying undesirable results for land subsidence.

Recommended Corrective Action 6

Department staff understand that estimating the location, quantity, and timing of stream depletion due to ongoing, Subbasin-wide pumping is a complex task and that developing suitable tools may take additional time; however, it is critical for the Department's ongoing and future evaluations of whether GSP implementation is on track to achieve sustainable groundwater management. The Department plans to provide guidance on methods and approaches to evaluate the rate, timing, and volume of depletions of interconnected surface water and support for establishing specific sustainable management criteria in the near future. This guidance is intended to assist GSAs to sustainably manage depletions of interconnected surface water.

In addition, the GSA should work to address the following items by the first periodic update:

a. Provide justification for the criteria of when and where undesirable results occur. Explain how the GSAs have determined that significant and unreasonable effects will not occur before gaining streams become losing, and how the GSAs have considered the seasonality of stream depletions.

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b. Consider utilizing the interconnected surface water guidance, as appropriate, when issued by the Department to establish quantifiable minimum thresholds, measurable objectives, and management actions.

c. Continue to fill data gaps, collect additional monitoring data, and implement the current strategy to manage depletions of interconnected surface water and define segments of interconnectivity and timing.

d. Prioritize collaborating and coordinating with local, state, and federal regulatory agencies as well as interested parties to better understand the full suite of beneficial uses and users that may be impacted by pumping induced surface water depletion within the GSA's jurisdictional area.

Recommended Corrective Action 7

Define the data collection frequency in tabular format for groundwater monitoring sites within the chronic lowering of groundwater levels and depletions of interconnected surface water monitoring networks in the GSP.

The 2027 GSP Amendment for the Sutter Subbasin reflects updates to relevant sections prompted by RCAs. **Appendix A** includes DWR's determination letter and staff report further describing the RCAs, as well as technical memoranda (TMs) that detail how each RCA was addressed in the GSP amendment.

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2. NEW INFORMATION COLLECTED

GSP regulations §356.4(f) include a requirement that the periodic evaluation assessment shall include:

> *A description of significant new information that has been made available since Plan adoption or amendment, or the last five-year assessment. The description shall also include whether new information warrants changes to any aspect of the Plan, including the evaluation of the basin setting, measurable objectives, minimum thresholds, or the criteria defining undesirable results*

New information has been acquired since development of the 2022 GSP, which has been utilized in updating the C2VSimFG-Sutter Version 2.0 and in responding to DWR's RCAs as well as updating the 2027 GSP Amendment to WY 2025 conditions. **Table 2-1** summarizes how the new data sets affected the GSP and where the associated changes can be found in the 2027 GSP Amendment.

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TABLE 2-1: SUMMARY OF NEW INFORMATION SINCE GSP DEVELOPMENT

Significant New Information	Description	Plan Aspects Affected	Warrant Change to Any Aspects of the Plan?
Airborne Electromagnetic (AEM) data	AEM data was collected in the Sutter Subbasin in 2022 and published in *Data Report for Survey Area 6 Solano, South American, North American, Yolo, Sutter, South Yuba, and North Yuba Groundwater Subbasins* (California Department of Water Resources, 2023). Additionally, a separate, more detailed reprocessing of the State's AEM data was completed for the portion of the Subbasin near the Sutter Buttes. These data were incorporated into the C2VSimFG-Sutter Version 2.0 and used to modify the Hydrogeologic Conceptual Model including development of new geologic cross sections.	Basin Setting	Yes – Section 5.1 and Appendix 5-G of the 2027 GSP Amendment
Hydrostratigraphy	Additional hydrogeologic references were used in responding to DWR's RCA 1 requesting clarification of the principal aquifer description and improved correlation with named geologic formations. These additional references were as follows: • Bertoldi, G.L., Johnston, R.H., and Evenson, K.D. 1991. *Ground Water in the Central Valley, California — A Summary Report*. U.S. Geological Survey Professional Paper 1401-A. • California Department of Water Resources (DWR). 1978. *Evaluation of Ground Water Resources: Sacramento Valley*. Bulletin 118-6. • California Department of Water Resources (DWR) and Sutter Subbasin Groundwater Sustainability Agencies. 2026. *Sutter Buttes Water Quality Interbasin Coordination GSA-DWR Discussion*. April 27, 2026. • Curtin, George. 1971. *Hydrogeology of the Sutter Basin, Sacramento Valley, California*. M.Sc Thesis, University of Arizona. • Hausback, B.P., and others. 2011. *Sutter Buttes — The Lone Volcano in California's Great Valley*. U.S. Geological Survey Fact Sheet 2011-3024. • Helley, E.J. and Harwood, D.S. 1985. *Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California*, U.S. Geological Survey Miscellaneous Field Studies Map MF-1790. • Williamson, A.K., Prudic, D.E., and Swain, L.A. 1989. *Ground-Water Flow in the Central Valley, California*. U.S. Geological Survey Professional Paper 1401-D.	Hydrogeologic Conceptual Model	Yes – Section 5.1 of the 2027 GSP Amendment and Appendix A of Periodic Evaluation
Additional monitoring data	Annual groundwater level and groundwater quality data were collected by the GSAs and reported in Annual Reports.	Groundwater Conditions; Numerical Model Update	Yes – Section 5.2 of 2027 GSP Amendment
Statewide Crop Mapping	Incorporated in the C2VSimFG-Sutter Version 2.0 to refine water budgets.	Water Budgets	Yes – Section 5.3 and Appendix 5-F of 2027 GSP Amendment
OSWCR well data	Used to evaluate the locations and depths of domestic or public supply wells to respond to DWR's RCA 3 on groundwater levels sustainable management criteria (SMC). Additional well construction reports collected by DWR as available on DWR website at https://data.cnra.ca.gov/dataset?q=well+completion+report&organization=dwr	Justification of SMC	Yes – Chapter 6 of 2027 GSP Amendment and Appendix A of Periodic Evaluation

Significant New Information	Description	Plan Aspects Affected	Warrant Change to Any Aspects of the Plan?
InSAR data[1]	TRE ALTAMIRA InSAR Subsidence data collected by DWR as available on DWR website at https://data.cnra.ca.gov/dataset/tre-altamira-insar-subsidence to respond to DWR's RCA 5.	Subsidence SMC and Representative Monitoring Network	Yes – Chapter 6 and Section 7.2 of 2027 GSP Amendment, Appendix A of Periodic Evaluation
CGPS Stations	New subsidence monitoring locations added at CGPS stations, provided by Scripps Orbit and Permanent Array Center (SOPAC) and Jet Propulsion Laboratory (JPL).	Representative Monitoring Networks	Yes – Section 7.2 of 2027 GSP Amendment
Extensometer Station	Sutter Land Subsidence Extensometer data provided via the Water Data Library.	Representative Monitoring Networks	Yes – Section 7.2 of 2027 GSP Amendment
Well Siting Analysis	To support the Sutter Subbasin's approved DWR Technical Support Services (TSS) general application, a well siting analysis is in progress to: • Update and revise identified data gaps contained in the Sutter Subbasin representative monitoring networks for groundwater levels, groundwater quality, and interconnected surface water. • Identify recommended locations for new monitoring well construction to be completed by DWR under the TSS program. • Identify recommended locations for new monitoring well construction to be completed utilizing any remaining grant funding in the Subbasin's Proposition 68 SGMA Implementation Grant. The work documented in the well siting analysis technical memoranda will be used as a guidance document to inform monitoring well installation to best fill data gaps.	Representative Monitoring Networks	Yes – Section 7.2 of 2027 GSP Amendment
C2VSimFG-Sutter Model Improvements	Components of the C2VSimFG-Sutter Model are updated annually to incorporate the latest available data. Model results are used annually as part of Annual Report development and to support assessment of basin conditions for groundwater substitution transfers.	Basin Setting	Yes – Section 5.3 and Appendix 5-F of 2027 GSP Amendment
Beneficial Uses and Users Analysis for Chronic Lowering of Groundwater Levels	In response to DWR's RCA 3c, a Subbasin-scale evaluation of potential impacts of the established groundwater level SMC on beneficial uses and users of groundwater was performed. Beneficial uses and users considered in this analysis were domestic wells, public water systems and Community Water Systems (CWS), and groundwater dependent ecosystems (GDEs). This analysis expands on work performed to assess for impacts of chronic lowering of groundwater levels SMC described in the 2022 GSP. Additionally, a sensitivity analysis was performed to assess for potential well and GDE impacts under a range in the number of wells at their minimum thresholds, including at the undesirable result definition.	Sustainable Management Criteria	Yes – Chapter 6 and Appendix 6-C of 2027 GSP Amendment, Appendix A of Periodic Evaluation
Financing Options	The Subbasin received Proposition (Prop) 68 SGMA Implementation grant funding for a number of activities, including the development of a dedicated funding stream for implementing GSP-related activities. A five-year budget and preliminary cost allocation have been prepared. A rate study is currently being prepared to identify the best option(s) for developing a long-term funding stream.	Plan Implementation	Yes – Section 8.2 of the 2027 GSP Amendment

[1] InSAR data available on a quarterly timeframe from DWR's SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub

3. GROUNDWATER CONDITIONS RELATIVE TO SUSTAINABLE MANAGEMENT CRITERIA

GSP Emergency Regulations §356.4(a) state the periodic evaluation assessment shall include:

> *A description of current groundwater conditions for each applicable sustainability indicator relative to measurable objectives, interim milestones and minimum thresholds.*

Table 3-1 summarizes the SMC for all six sustainability indicators, as revised in the 2027 GSP Amendment. Several SMCs have been updated in response to DWR's RCAs and other related factors. These changes are explained in the relevant subsections contained herein, which are organized by sustainability indicator.

The following subsections evaluate current groundwater conditions over the evaluation cycle of this Periodic Evaluation (WYs 2021 to 2025) relative to SMC established in the 2022 GSP, using supporting data to demonstrate sustainable conditions have been maintained in the Sutter Subbasin. Where applicable, modifications to the SMC definitions or methodology due to changes in the representative monitoring networks or DWR's RCAs are described. A comprehensive update to current groundwater conditions beyond comparison to SMC is included in Section 5.2 of the 2027 GSP Amendment.

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TABLE 3-1: SUMMARY OF SUSTAINABLE MANAGEMENT CRITERIA

Sustainability Indicator	Undesirable Results	Identification of Undesirable Results	Minimum Threshold	Measurable Objective / Interim Milestones
Chronic lowering of groundwater levels	Groundwater levels drop to a level at which domestic or irrigation wells go dry or lose functional pumping capacity, resulting in significantly higher pumping costs and/or the significant and unreasonable effort to maintain or deepen production wells.	At least 25% of representative monitoring locations across all aquifer zones drop below the minimum threshold criteria concurrently over two consecutive seasonal low water level measurements.	The deeper of: 1. The historic low from available record at each representative monitoring site; or 2. The average operating range using the above criterion for the following aquifer zones: - Shallow AZ and AZ-1 = 8.0 feet - AZ-2 and AZ-3 = 16.5 feet.	Average of the available historical record at each representative monitoring site.
Reduction of groundwater storage	Same as the chronic lowering of groundwater levels. Groundwater levels are used as proxy.	Same as the chronic lowering of groundwater levels. Groundwater levels are used as proxy.	Same as the chronic lowering of groundwater levels. Groundwater levels are used as proxy.	Same as the chronic lowering of groundwater levels. Groundwater levels are used as proxy.
Seawater intrusion	Undesirable results related to seawater intrusion are not applicable to the Sutter Subbasin.	Undesirable results related to seawater intrusion are not applicable to the Sutter Subbasin.	Minimum thresholds are not developed because undesirable results related to seawater intrusion are not applicable to the Sutter Subbasin.	Measurable objectives are not developed because undesirable results related to seawater intrusion are not applicable to the Sutter Subbasin.

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Sustainability Indicator	Undesirable Results	Identification of Undesirable Results	Minimum Threshold	Measurable Objective / Interim Milestones
Degraded water quality	A result stemming from a causal nexus between groundwater management-related activities, such as groundwater extraction or recharge, and a degradation in groundwater quality that causes a significant and unreasonable reduction in long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP.	At least 50% of representative monitoring wells across all aquifer zones exceed the minimum threshold for two consecutive annual measurements at each location and where these minimum threshold exceedances can be tied to a causal nexus between SGMA-related activities and water quality.	The higher of: 1. The Upper Secondary Maximum Contaminant Level (SMCL) for TDS of 1,000 mg/L and Primary MCL for nitrate as N of 10 mg/L; or 2. Current water quality conditions for TDS and nitrate as N based on available data from 2000 to the time of GSP development or amendment at each representative monitoring well.	The higher of: 1. Current water quality conditions for TDS and nitrate as N based on available data from 2000 to the time of GSP development or amendment at each representative monitoring well. 2. The Recommended SMCL for TDS of 500 mg/L and 70% of the Primary MCL for nitrate as N of 7 mg/L.
Land subsidence	A result due to groundwater extraction that causes a significant reduction in the viability of the use of infrastructure for water distribution and flood control.	At least 25% of representative subsidence monitoring sites exceed the minimum threshold for subsidence over a 5-year rolling average calculated by water year.	0.5 feet of subsidence over a 5-year rolling average calculated by water year.	0.25 feet of subsidence over a 5-year rolling average calculated by water year.

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Sustainability Indicator	Undesirable Results	Identification of Undesirable Results	Minimum Threshold	Measurable Objective / Interim Milestones
Depletions of interconnected surface water	A result that causes significant and unreasonable adverse effects on beneficial uses and users of interconnected surface water within the Sutter Subbasin over the GSP planning and implementation horizon.	Same as the chronic lowering of groundwater levels. Groundwater levels are used as proxy.	Same as the chronic lowering of groundwater levels. Groundwater levels used as proxy.	Same as the chronic lowering of groundwater levels. Groundwater levels used as proxy.

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3.1 Chronic Lowering of Groundwater Levels

DWR's RCA 3 relates to the chronic lowering of groundwater levels SMC in the Sutter Subbasin. DWR requests that the GSAs update the SMCs for chronic lowering of groundwater levels to reflect the following:

a. Revise the sustainable management criteria to be based on seasonal low groundwater levels to ensure potential impacts to beneficial uses and users are considered.

b. Provide clarification and detailed information related to the methodology of the second criterion for minimum thresholds (i.e., associated with the projected water budget simulation with a 50 percent increase in ET). Clearly describe the processes and terms involved, and the spatial and temporal aggregations that define "interconnected streams that are gaining become losing."

c. Provide more information about how the proposed minimum thresholds for the chronic lowering of groundwater levels may impact beneficial uses and users. Specifically, consider the impact of the selected minimum threshold levels on supply wells. The consideration should identify the degree/extent of potential impact including the percentage, number, and location of potentially impacted wells at the proposed minimum thresholds for chronic lowering of groundwater levels.

d. Reevaluate how groundwater level minimum thresholds may impact land subsidence.

e. Provide estimates of stream depletions when groundwater levels are at the minimum thresholds and evaluate the potential impacts to beneficial uses and users of interconnected surface water.

3.1.1 Response to RCA 3

A detailed response to RCA 3 can be found in **Appendix A** of this Periodic Evaluation. A summary of responses to RCA 3a through 3e can be found below.

- As described in RCA 3a, the undesirable result for chronic lowering of groundwater levels was previously identified when "…25% of representative monitoring locations across all aquifer zones drop below the minimum threshold criteria concurrently over two consecutive seasonal high water level measurements." The revised approach, as noted in **Table 3-1**, updates the undesirable result definition to be based on seasonal low groundwater levels rather than seasonal high groundwater levels and evaluates groundwater levels during periods of maximum groundwater stress.

- In response to RCA 3b, the ET-based methodology (second criterion) for establishing minimum thresholds described in the 2022 GSP was reevaluated and removed from the minimum threshold definition. For the wells that previously used this criterion to establish minimum thresholds, minimum threshold values have been recalculated using the two remaining criteria described in **Table 3-1** and are included in the 2027 GSP Amendment.

- To address RCA 3c, a well impact analysis was performed to evaluate effects of the established minimum thresholds values in the 2027 GSP Amendment on beneficial uses and users of groundwater, domestic, public supply, community water system wells, and potential GDEs. Detailed results of this evaluation, including the percentage, number, and location of potentially affected wells, are presented in **Appendix A** of this Periodic Evaluation and have been incorporated into Chapter 6 of the 2027 GSP Amendment.

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- To assess the effects of groundwater level minimum thresholds on potential land subsidence as requested in RCA 3d, minimum threshold exceedances were evaluated against available InSAR data during the height of the most recent drought (WYs 2021 and 2022) considering hydrostratigraphic data. This analysis concluded that the minimum thresholds are not likely to influence inelastic land subsidence in the Subbasin.

- Estimates of stream depletion and its impacts on interconnected surface waters were assessed in response to RCA 3e. An analysis of undesirable result conditions as defined in **Table 3-1** using the representative groundwater level monitoring network in the 2027 GSP Amendment was conducted to assess stream depletion. The results of this analysis justify the use of groundwater levels as proxy for assessment of depletions of interconnected surface water, as described in Section 6.5.6.2 of the 2027 GSP Amendment.

3.1.2 Evaluation of Current Conditions

Undesirable results in the Sutter Subbasin for the chronic lowering of groundwater levels are defined as groundwater levels at least 25% of representative monitoring locations across all aquifer zones dropping below the minimum threshold criteria concurrently over two consecutive seasonal low water level measurements, as noted in **Table 3-1** and in the 2027 GSP Amendment. Over the evaluation period of WY 2021 to 2025, there were no undesirable results recorded per either the 2022 GSP definition (using seasonal high as its basis) and 2027 GSP Amendment definition (using seasonal low as its basis).

As described in each GSP Annual Report, minimum threshold exceedances did occur, but not in quantity and timing such that an undesirable result occurred. In WY 2021, minimum threshold exceedances were observed in 10 wells, where most minimum threshold exceedances were recorded between June and August with recovery to above the minimum threshold by September or October 2021 and likely corresponding to the cessation of irrigation season pumping by early fall. Given the ongoing drought of 2020-2022, additional minimum threshold exceedances occurred in WY 2022 at a total of 13 wells. Similar to WY 2021, minimum threshold exceedances largely were recorded between June and September, coinciding with the irrigation season, with recovery by December 2022. By WY 2023, only two minimum threshold exceedances were recorded in October 2022 with recovery above minimum thresholds by winter/spring 2023. Only one minimum threshold exceedance was observed each in WY 2024 and 2025 during the seasonal high monitoring period (the undesirable result basis at the time).

Over the evaluation period of WYs 2021 to 2025, groundwater level conditions showed similar patterns to historical conditions. Groundwater levels decline throughout the Subbasin during the irrigation season and rebound with seasonal recovery to pre-irrigation levels once irrigation has ceased. Many representative monitoring wells operated within their respective operating range or above the measurable objective during the evaluation period, with interim milestones are set equal to the measurable objective as a means of maintaining currently sustainable conditions.

Based on conditions observed during WYs 2021 to 2025, current trends, and implementation activities described in this Periodic Evaluation, the GSAs find that implementation remains on track to maintain the applicable interim milestones and measurable objectives during the next evaluation cycle and to maintain the Subbasin sustainability goal.

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3.2 Reduction of Groundwater Storage

DWR's determination letter for the Sutter Subbasin did not include any RCAs related to the reduction of groundwater storage sustainability indicator. Groundwater levels are used as a proxy for groundwater storage. Thus, RCA 3 and an evaluation of current conditions as discussed in **Section 3.1** are also applicable to groundwater storage.

As described in the WY 2021 through WY 2025 Annual Reports, C2VSimFG-Sutter is used as a tool jointly with groundwater level monitoring to estimate changes in groundwater storage in the Sutter Subbasin. Over the beginning of the evaluation period, groundwater storage decreased in WYs 2021 and 2022 by 103,000 acre-feet (AF) and 45,000 AF, respectively. Groundwater storage rebounded following the most recent drought of 2020-2022, with groundwater storage increasing by 94,000 AF in WY 2023. Smaller fluctuations in groundwater storage were observed toward the end of the evaluation period in WY 2024 and WY 2025 with a decrease of 4,000 AF and increase of 5,900 AF, respectively. Annual changes in storage are relative to the total estimated groundwater in storage in the Sutter Subbasin of 49 million AF.

3.3 Seawater Intrusion

Seawater intrusion is not applicable to the Sutter Subbasin, as the Subbasin is located inland from the Pacific Ocean and is not adjacent to the Sacramento-San Joaquin Delta.

3.4 Degraded Water Quality

3.4.1 Response to RCA 4

In RCA 4, DWR addresses the Subbasin's identification of undesirable results for degraded water quality, which was based only upon data collected during non-drought years. DWR states:

> *"Excluding water quality data in drought years is likely to exclude more severe impacts on water quality from either groundwater extraction or the GSAs' projects and management actions."*

DWR requests that the identification of undesirable results definition include:

> *"… water quality monitoring data collected in all water year types including drought years."*

In the 2022 GSP, an undesirable result for degraded water quality would occur "when 50% of representative monitoring wells… across all aquifer zones exceed the minimum threshold for two consecutive measurements at each location during non-drought years and where the minimum threshold exceedances can be tied to a causal nexus between SGMA-related activities and water quality" (Sutter Subbasin GSAs, 2022).

As noted in **Table 3-1**, the identification of undesirable results for degraded water quality has been amended to remove the non-drought years qualifier. All other SMC definitions for degraded water quality remain substantially unchanged with the exception of the minimum threshold and measurable objective definition, which allows for incorporation of new groundwater quality data available during future GSP amendments when calculating numeric SMC for existing or newly added wells.

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3.4.2 Evaluation of Current Conditions

As discussed in further detail in **Section 6.4**, following adoption of the 2022 GSP, the Sutter Subbasin GSAs reassessed the original representative groundwater quality monitoring network due to concerns over long-term availability to monitor the original network. A revised network was developed and documented in the WY 2023 Annual Report. Therefore, an assessment of water quality conditions for the evaluation period is limited to WYs 2023 through 2025.

Groundwater quality sampling is conducted for total dissolved solids (TDS) and nitrate as Nitrogen (N). **Table 3-2** and **Table 3-3** summarize TDS and nitrate as N results, respectively, collected from the updated representative monitoring network during sampling events in WYs 2023, 2024, and 2025.

An undesirable result for degraded water quality as defined in **Table 3-1** was not observed during the evaluation period for this Periodic Evaluation. Minimum thresholds that did not constitute an undesirable result were observed for both TDS and nitrate as N. All available samples from WY 2023 through 2025 were below their respective minimum thresholds for TDS with the exception of one well (Local ID SEWD MW-3C), which exceeded its minimum threshold for TDS in each year (**Table 3-2**). A total of three minimum threshold exceedances occurred for nitrate as N during the evaluation period based on available sample results (Local ID Well-2A / 5110001-013 in WY 2023; SEWD MW-3B and SEWD MW-3C in WY 2024) (**Table 3-3**). By the following sampling event, each well that exceeded its minimum threshold for nitrate as N was below its measurable objective, indicating sustainable conditions.

For both TDS and nitrate as N, conditions during the evaluation period were primarily below established measurable objectives with a select few wells between their respective minimum threshold and measurable objective, indicating sustainable conditions. Interim milestones are set equal to the measurable objective as a means of maintaining currently sustainable conditions.

Based on conditions observed during WYs 2021 to 2025, current trends, and implementation activities described in this Periodic Evaluation, the GSAs find that implementation remains on track to maintain the applicable interim milestones and measurable objectives during the next evaluation cycle and to maintain the Subbasin sustainability goal.

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TABLE 3-2: DEGRADED WATER QUALITY THRESHOLD ANALYSIS – TOTAL DISSOLVED SOLIDS (TDS)

Site Code	State Well Number	Local Well ID	Aquifer Zone	Overlying GSA	Measurable Objective (TDS; mg/L)	Minimum Threshold (TDS; mg/L)	WY 2023 Measurement Date [1]	WY 2023 Result (TDS; mg/L) [1]	WY 2024 Measurement Date	WY 2024 Result (TDS; mg/L)	WY 2025 Measurement Date	WY 2025 Result (TDS; mg/L)
390682N1216901W001	14N02E13A003M	SEWD MW-3A	AZ-1	Sutter Extension WD GSA	500	1,000	5/3/2023	230	10/8/2024	250	9/24/2025	278
392970N1216907W003	17N02E25J003M	BWD MW-1C	AZ-1	Butte WD GSA	500	1,000	8/8/2023	210	8/21/2024	250	8/4/2025	240
-	-	Well 2-C	AZ-1	Sutter CSD GSA	500	1,000	*No TDS sample taken*		10/7/2024 *	270	7/7/2025	280
391456N1218904W001	-	MFWC Prop 50	AZ-1	Reclamation District No. 70 GSA	500	1,000	8/30/2023	670	8/28/2024	674	10/21/2025 *	567
390682N1216901W002	14N02E13A004M	SEWD MW-3B	AZ-2	Sutter Extension WD GSA	500	1,000	5/3/2023	260	10/08/2024 *	270	9/24/2025	281
391658N1217070W001	15N02E12E001M	SEWD MW-1A	AZ-2	Sutter Extension WD GSA	500	1,000	5/2/2023	310	8/30/2024	350	9/23/2025	336
391658N1217070W002	15N02E12E002M	SEWD MW-1B	AZ-2	Sutter Extension WD GSA	500	1,000	5/2/2023	220	7/1/2024	270	9/23/2025	265
391279N1216989W001	15N02E24P001M	SEWD MW-2A	AZ-2	Sutter Extension WD GSA	500	1,000	5/2/2023	250	10/08/2024 *	280	9/23/2025	271
391279N1216989W002	15N02E24P002M	SEWD MW-2B	AZ-2	Sutter Extension WD GSA	500	1,000	5/2/2023	270	10/08/2024 *	290	9/23/2025	269
391012N1218222W001	-	BS1-McClatchy	AZ-2	Reclamation District No. 70 GSA	500	1,000	8/30/2023	480	8/28/2024	428	10/21/2025 *	538
392970N1216907W002	17N02E25J002M	BWD MW-1B	AZ-2	Butte WD GSA	500	1,000	8/8/2023	180	8/20/2024	190	8/4/2025	240
-	-	Well-1A / 5110001-011	AZ-2	City of Live Oak GSA	420	1,000	10/24/2023 *	430	11/13/2024 *	390	9/11/2025	405
-	-	Well-2A / 5110001-013	AZ-2	City of Live Oak	450	1,000	10/24/2023 *	510	11/13/2024 *	400	9/11/2025	428
-	-	Akins Well	AZ-2	Reclamation District No. 1500 GSA	500	1,000	*No data available; added in WY 2024*		8/27/2024	516	8/8/2025	610
391613N1216236W001	-	WTP Well	AZ-2 and AZ-3	City of Yuba City GSA	170	1,000	10/4/2023	140	9/11/2024	157	10/21/2025 *	171
390682N1216901W003	14N02E13A005M	SEWD MW-3C	AZ-3	Sutter Extension WD GSA	500	1,000	5/3/2023	1,200	10/08/2024 *	1,200	9/24/2025	1,170
391658N1217070W003	15N02E12E003M	SEWD MW-1C	AZ-3	Sutter Extension WD GSA	500	1,000	5/2/2023	170	10/08/2024 *	200	9/23/2025	214
391279N1216989W003	15N02E24P003M	SEWD MW-2C	AZ-3	Sutter Extension WD GSA	500	1,000	5/2/2023	160	10/08/2024 *	200	9/23/2025	208
392970N1216907W001	17N02E25J001M	BWD MW-1A	AZ-3	Butte WD GSA	500	1,000	8/8/2023	220	8/20/2024	250	8/4/2025	260

** Measurement collected after the end of the associated water year.*

[1] WY 2023 was the first year the revised groundwater quality network was sampled, resulting in missed sampling of TDS at select wells as the new representative monitoring network was implemented.

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TABLE 3-3: DEGRADED WATER QUALITY THRESHOLD ANALYSIS – NITRATE AS N

Site Code	State Well Number	Local Well ID	Aquifer Zone	Overlying GSA	Measurable Objective (Nitrate as N; mg/L)	Minimum Threshold (Nitrate as N; mg/L)	WY 2023 Measurement Date [1]	WY 2023 Result (Nitrate as N; mg/L) [1]	WY 2024 Measurement Date	WY 2024 Result (Nitrate as N; mg/L)	WY 2025 Measurement Date	WY 2025 Result (Nitrate as N; mg/L)
390682N1216901W001	14N02E13A003M	SEWD MW-3A	AZ-1	Sutter Extension WD GSA	7	10	*No nitrate sample taken*		10/8/2024 *	1.41	9/24/2025	1.4
392970N1216907W003	17N02E25J003M	BWD MW-1C	AZ-1	Butte WD GSA	7	10	8/8/2023	*ND*	8/21/2024	0.5	8/4/2025	0.5
-	-	Well 2-C	AZ-1	Sutter CSD GSA	7	10	7/10/2023	7.5	7/1/2024	7.7	7/7/2025	1.2
391456N1218904W001	-	MFWC Prop 50	AZ-1	Reclamation District No. 70 GSA	7	10	8/30/2023	0.49	8/28/2024	0.86	10/21/2025 *	0.75
390682N1216901W002	14N02E13A004M	SEWD MW-3B	AZ-2	Sutter Extension WD GSA	7	10	*No nitrate sample taken*		10/8/2024 *	20	9/24/2025	*ND*
391658N1217070W001	15N02E12E001M	SEWD MW-1A	AZ-2	Sutter Extension WD GSA	7	10	*No nitrate sample taken*		8/30/2024	1.14	9/23/2025	1.1
391658N1217070W002	15N02E12E002M	SEWD MW-1B	AZ-2	Sutter Extension WD GSA	7	10	*No nitrate sample taken*		7/1/2024	1.02	9/23/2025	0.94
391279N1216989W001	15N02E24P001M	SEWD MW-2A	AZ-2	Sutter Extension WD GSA	7	10	*No nitrate sample taken*		10/8/2024 *	1.57	9/23/2025	1.46
391279N1216989W002	15N02E24P002M	SEWD MW-2B	AZ-2	Sutter Extension WD GSA	7	10	*No nitrate sample taken*		10/8/2024 *	1.18	9/23/2025	0.99
391012N1218222W001	-	BS1-McClatchy	AZ-2	Reclamation District No. 70 GSA	7	10	8/30/2023	0.25	8/28/2024	0.54	10/21/2025 *	0.27
392970N1216907W002	17N02E25J002M	BWD MW-1B	AZ-2	Butte WD GSA	7	10	8/8/2023	*ND*	8/20/2024	*ND*	8/4/2025	*ND*
-	-	Well-1A / 5110001-011	AZ-2	City of Live Oak GSA	8	10	10/24/2023 *	7.6	11/13/2024 *	5.79	9/11/2025	7.22
-	-	Well-2A / 5110001-013	AZ-2	City of Live Oak	11	11	10/24/2023 *	12.1	11/13/2024 *	8.07	9/11/2025	10.6
-	-	Akins Well	AZ-2	Reclamation District No. 1500 GSA	7	10	*No data available; added in WY 2024*		8/27/2024	*ND*	8/8/2025	*ND*
391613N1216236W001	-	WTP Well	AZ-2 and AZ-3	City of Yuba City GSA	1	10	10/4/2023 *	0.1	9/11/2024	*ND*	10/21/2025 *	*ND*
390682N1216901W003	14N02E13A005M	SEWD MW-3C	AZ-3	Sutter Extension WD GSA	7	10	*No nitrate sample taken*		10/8/2024 *	20	9/24/2025	*ND*
391658N1217070W003	15N02E12E003M	SEWD MW-1C	AZ-3	Sutter Extension WD GSA	7	10	*No nitrate sample taken*		10/8/2024 *	2.03	9/23/2025	1.98
391279N1216989W003	15N02E24P003M	SEWD MW-2C	AZ-3	Sutter Extension WD GSA	7	10	*No nitrate sample taken*		10/8/2024 *	1.22	9/23/2025	1.18
392970N1216907W001	17N02E25J001M	BWD MW-1A	AZ-3	Butte WD GSA	7	10	8/8/2023	0.5	8/20/2024	0.4	8/4/2025	0.6

** Measurement collected after the end of the associated water year.*

ND = Not detected in sample

[1] WY 2023 was the first year the revised groundwater quality network was sampled, resulting in missed sampling of nitrate at select wells as the new representative monitoring network was implemented.

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3.5 Land Subsidence

3.5.1 Response to RCA 5

RCA 5 in DWR's determination letter defines two specific requests relating to land subsidence:

a. *Describe how undesirable results will be evaluated since it is unclear at what frequency data will be collected from the Sacramento Valley GPS Subsidence Monitoring Network. If data is not collected at a minimum of every 5-years from the network, another method should be utilized to ensure undesirable results are not occurring within the Subbasin.*

b. *Provide a description of how the InSAR data will be incorporated into identifying undesirable results for land subsidence.*

Updates to the representative monitoring network for land subsidence driven by RCA 5 are addressed in **Section 6.5.** As described in the 2027 GSP Amendment, land subsidence conditions will be evaluated using Interferometric Synthetic Aperture Radar (InSAR) data provided by DWR. The subsidence analysis relies on the updated representative monitoring network (as shown in **Figure 6-8**) which includes 125 5-square-mile (mi^2) "InSAR Zones." For each InSAR Zone, annual average vertical displacement is evaluated by averaging vertical displacement across each 5-mi^2 zone over the most recent five-year period by water year, resulting in 125 individual average vertical displacement values. This approach reduces the impacts of localized and climatic variability, allowing for a balanced assessment of long-term subsidence trends across the Subbasin.

The adjustments to the representative monitoring network necessitate only minor changes to the SMC definitions. For the identification of undesirable results, minimum thresholds, and measurable objectives, information specific to benchmark monitoring has been removed and clarification of utilizing a 5-year rolling average by water year has been added, as shown in **Table 3-1**. The overall SMC framework for evaluating land subsidence for the Subbasin remains unchanged from the 2022 GSP.

3.5.2 Evaluation of Current Conditions

The 22 benchmarks of Sacramento Valley Subsidence Network in the Sutter Subbasin, described as comprising the representative monitoring network in the 2022 GSP, were last monitored in 2017 by DWR and its partner agencies before being discontinued in 2022. Therefore, as part of GSP annual reports over the evaluation period (WY 2021 to 2025), annual InSAR data covering each water year was utilized to assess for inelastic land subsidence in the Sutter Subbasin.

Figure 3-1 summarize the annual average vertical displacement in the Subbasin during the observation period (WYs 2021 to 2025) based on the updated land subsidence monitoring methods described in Section 7.2 of the 2027 GSP Amendment. As shown, the InSAR Zones have experienced negligible subsidence over the observation period. No InSAR Zone exceeded the minimum threshold or measurable objective and, therefore, no undesirable results were observed. Interim milestones are set equal to the measurable objective as a means of maintaining currently sustainable conditions.

Based on conditions observed during WYs 2021 to 2025, current trends, and implementation activities described in this Periodic Evaluation, the GSAs find that implementation remains on track to maintain the applicable interim milestones and measurable objectives during the next evaluation cycle and to maintain the Subbasin sustainability goal.

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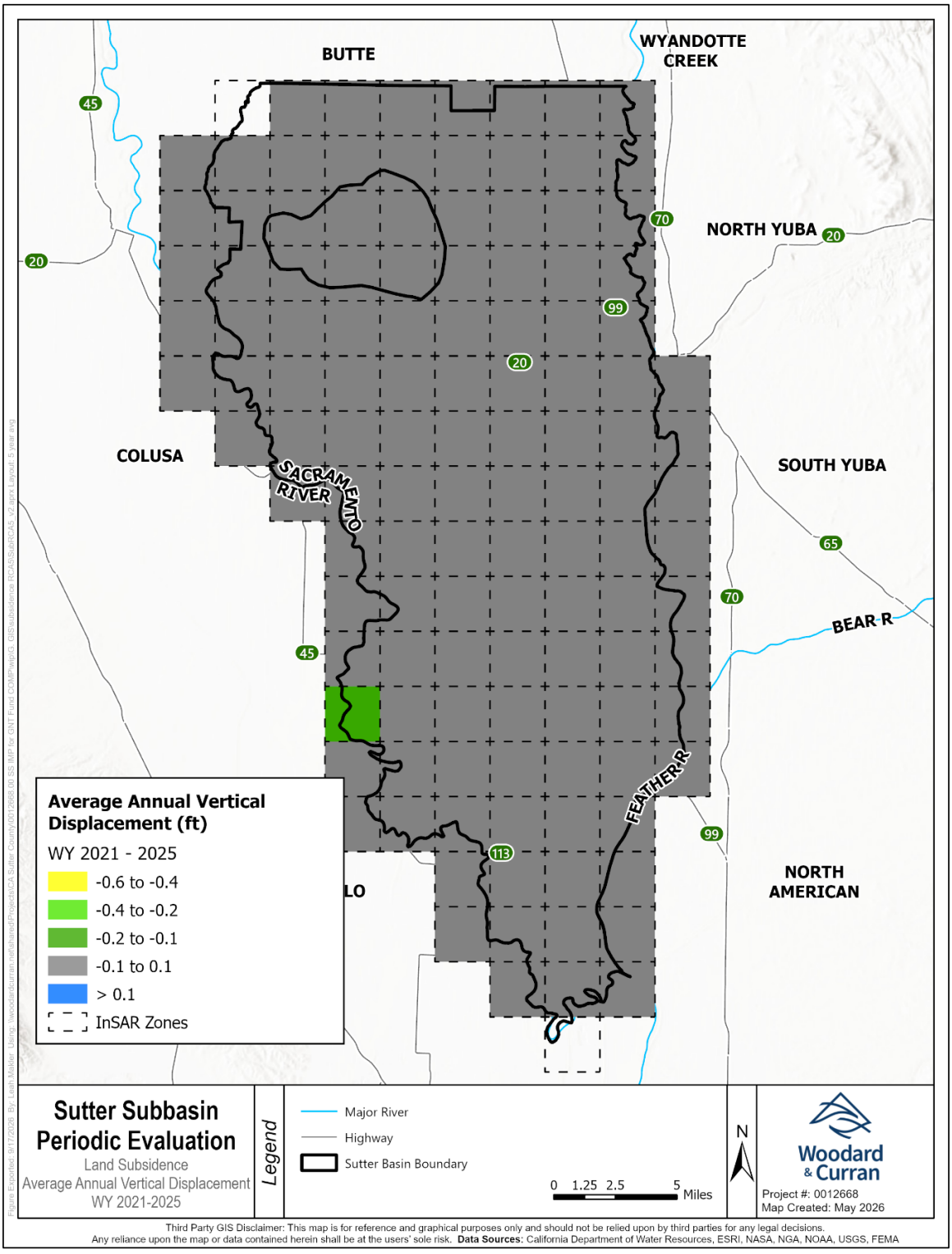

FIGURE 3-1: AVERAGE ANNUAL VERTICAL DISPLACEMENT BY INSAR ZONE, WATER YEARS 2021-2025

3.6 Depletions of Interconnected Surface Water

3.6.1 Response to RCA 3e and 6

DWR addressed aspects of the interconnected surface water analysis and SMCs in RCAs 3e and 6. DWR recommends that the GSAs should further develop their assessment of depletion of interconnected surface water in the following ways:

RCA 3:

> *"e. Provide estimates of stream depletions when groundwater levels are at the minimum thresholds and evaluate the potential impacts to beneficial uses and users of interconnected surface water."*

RCA 6:

> *"a. Provide justification for the criteria of when and where undesirable results occur. Explain how the GSAs have determined that significant and unreasonable effects will not occur before gaining streams become losing, and how the GSAs have considered the seasonality of stream depletions.*
>
> *b. Consider utilizing the interconnected surface water guidance, as appropriate, when issued by the Department to establish quantifiable minimum thresholds, measurable objectives, and management actions.*
>
> *c. Continue to fill data gaps, collect additional monitoring data, and implement the current strategy to manage depletions of interconnected surface water and define segments of interconnectivity and timing.*
>
> *d. Prioritize collaborating and coordinating with local, state, and federal regulatory agencies as well as interested parties to better understand the full suite of beneficial uses and users that may be impacted by pumping induced surface water depletion within the GSA's jurisdictional area."*

A detailed response to RCAs 3e and 6 can be found in **Appendix A** of this Periodic Evaluation. The responses to RCA 3e and RCA 6a through 6d are summarized below.

- Estimates of stream depletion and its impacts on interconnected surface waters were assessed in response to RCA 3e. An analysis of undesirable result conditions, as defined in **Table 3-1,** using the representative groundwater level monitoring network in the 2027 GSP Amendment was conducted to assess stream depletion. The results of this analysis justify the use of groundwater levels as proxy for assessment of depletions of interconnected surface water, as described in Section 6.5.6.2 of the 2027 GSP Amendment.

- In response to RCA 6a and 6b, the groundwater levels representative monitoring network and SMC will be used as proxy for assessing interconnected surface water conditions in the Sutter Subbasin, as detailed in the 2027 GSP Amendment. The Subbasin GSAs are currently working to fill identified data gaps as it relates to shallow wells located near streams and rivers that could be used to create a separate interconnected surface water representative monitoring network. This network would include both groundwater wells and California Data Exchange Center (CDEC) stream gages. Based on the analysis performed in response to RCA 3e, current Sutter Subbasin conditions do not have significant and unreasonable effects related to depletions of interconnected surface water and

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these effects are not estimated to change under groundwater level undesirable results. Furthermore, after DWR releases its final guidance on depletions of interconnected surface water, the Sutter Subbasin will evaluate updating undesirable results, minimum thresholds, measurable objectives, and management actions related to depletions of interconnected surface water as appropriate at that time, in addition to incorporating work conducted to address identified data gaps.

- To address RCA 6c, the GSAs are in the process of improving the interconnected surface water monitoring by filling identified data gaps. The Sutter GSAs are developing a well siting study to identify locations for additional monitoring wells, which will be completed in early 2027. While these efforts are pursued, the groundwater level monitoring network continues to be used as a proxy for interconnected surface water.

- In response to RCA 6d, the Sutter Subbasin GSAs are committed to collaborating with agencies and stakeholders to support sustainable management of interconnected surface water. This includes the Northern California Water Association (NCWA) Groundwater Task Force, the Feather River Corridor coordination group lead by Butte County, the South Sacramento Corridor coordination group lead by Butte County, data sharing with DWR, and ongoing stakeholder outreach through GSAs, city councils, boards of directors, and SSGMCC meetings.

3.6.2 Evaluation of Current Conditions

During the evaluation period of this Periodic Evaluation (WYs 2021 to 2025), interconnected surface water conditions were evaluated using the representative monitoring network established in the 2022 GSP. No undesirable results related to depletions of interconnected surface water occurred during the evaluation period. As part of the 2027 GSP Amendment, the monitoring approach was revised, and groundwater levels are now used as a proxy for this sustainability indicator (both representative monitoring network and SMC).

As described in each GSP annual report, minimum threshold exceedances did occur but did not constitute an undesirable result. In WY 2021, minimum threshold exceedances were observed in six wells, where all minimum threshold exceedances were recorded between June and August with recovery to above the minimum threshold by September 2021. Given the ongoing drought of 2020-2022, additional minimum threshold exceedances occurred in WY 2022 at a total of eight wells. Similar to WY 2021, minimum threshold exceedances were recorded primarily between June and September, coinciding with the irrigation season, with recovery above the minimum threshold by January 2022. By WY 2023, only two minimum threshold exceedances were recorded in October 2022 and January 2023 with recovery to near measurable objectives during winter 2023. No minimum threshold exceedances were observed in WY 2024 or 2025 during the seasonal high monitoring period (the undesirable result basis at the time).

Over the evaluation period of WYs 2021 to 2025, groundwater level conditions showed similar patterns to historical conditions. Groundwater levels decline throughout the Subbasin during the irrigation season and rebound with seasonal recovery to pre-irrigation levels once irrigation has ceased. Many representative monitoring wells operated within their respective operating range or above the measurable objective during the evaluation period, where interim milestones are set equal to the measurable objective as a means of maintaining currently sustainable conditions.

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Based on conditions observed during WYs 2021 to 2025, current trends, and implementation activities described in this Periodic Evaluation, the GSAs find that implementation remains on track to maintain the applicable interim milestones and measurable objectives during the next evaluation cycle and to maintain the Subbasin sustainability goal.

As of the 2027 GSP Amendment, groundwater levels are now used as proxy for interconnected surface water so the evaluation of current conditions presented in **Section 3.1.2** also now applies.

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4. PROJECTS AND MANAGEMENT ACTIONS

GSP Emergency Regulations §356.4(b) include a requirement that the periodic evaluation assessment shall include:

> *A description of the implementation of any projects or management actions, and the effect on groundwater conditions resulting from those projects or management actions.*

4.1 Projects and Management Actions Summary

Project and management actions (PMAs) defined in the 2022 GSP included monitoring improvements, system upgrades, recharge projects, analyses of groundwater conditions and aquifer dynamics, and a variety of educational and policy programs. As described in Section 7.1 of the 2027 GSP Amendment, the Sutter Subbasin is projected to achieve and maintain groundwater sustainability over the GSP planning and implementation horizon without implementation of PMAs. However, PMAs have been identified to support adaptive management in the Subbasin and to be implemented as needed if monitoring indicates that conditions are changing or that additional actions are necessary to avoid undesirable results and maintain the Subbasin's sustainability goal. Ongoing monitoring and efforts to address identified data gaps will continue to improve understanding of groundwater conditions and inform the need for future PMA implementation.

Table 4-1 summarizes the PMAs included in Section 7.1 of the 2027 GSP Amendment and provides a status update for each PMA as of development of the GSP Amendment. PMAs are included in the following categories:

- **Ongoing and Planned PMAs** – Planned to be completed by 2042. Projected yield of these PMAs are expected to support GSAs in achieving and maintaining the Subbasin's sustainability goal and to respond to changing conditions in the Subbasin.
- **PMAs to be Implemented As Needed** – Proposed as potential projects that GSAs may wish to implement, as needed, to support ongoing sustainability, to adapt to changing conditions in the Subbasin, and to achieve other water management objectives.
- **PMAs to be Implemented as Needed to Address Data Gaps** – Proposed as potential projects that GSAs may wish to implement, as needed, to support ongoing sustainability, to adapt to changing conditions in the Subbasin, and to achieve other water management objectives that will specifically address data gaps identified in the GSP.

During the evaluation cycle, most PMAs were in the planning stages and have not yet produced independently quantifiable changes in groundwater conditions. Consequently, realized groundwater benefits cannot yet be quantified for those PMAs. Where quantified benefits can reasonably be estimated, those benefits are identified in **Table 4-1**. As Subbasin monitoring indicates that sustainable conditions have been maintained without reliance on PMAs to remediate undesirable results, the absence of realized benefits from planned or as-needed PMAs does not indicate that the Subbasin is off track to maintaining sustainable conditions.

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The following PMAs identified in the 2022 GSP or subsequent annual reports have been removed for the reasons listed:

- **Sutter Subbasin Well Permit Application Approval Process** – This management action was developed in response to the Governor's drought emergency executive order. The management action is no longer necessary now that the executive order has been rescinded.
- **Sutter Subbasin Groundwater Transfer Approval Process** – This management action was developed in response to the Governor's drought emergency executive order. The management action is no longer necessary now that the executive order has been rescinded. However, water transfers are still approved by the U.S. Bureau of Reclamation and the State as required under California Water Code.
- **Advanced Treatment and Water Recycling** – Due to withdrawal of funding, the City of Yuba City is no longer moving forward with this feasibility study.
- **Groundwater Well Rehabilitation** – The City of Yuba City is no longer moving forward with this project as the three wells to be rehabilitated were removed from further consideration following a video footage and cost analysis.
- **Sunset Project for Integrated Restoration and Efficiency (SPIRE)** – This project is no longer moving forward per the discretion of Sutter Extension Water District.

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TABLE 4-1: PROJECT AND MANAGEMENT ACTION SUMMARY

Project or Management Action Name	Project Proponent	Targeted Sustainability Indicator	Project or Management Action Description	Status	Project Status Update	Estimated Benefits at Full Implementation
Ongoing and Planned Projects and Management Actions						
System Modernization	Butte Water District	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Upgrade and modernize system infrastructure to improve system operability and efficiency, reduce operational spillage, and enhance the timing of farm deliveries.	Ongoing	Project awarded SGM Grant Program SGMA Implementation – Round 2 grant funding in September 2023. Project is anticipated to be complete in 2027.	3,500 acre-feet per year (AFY)
System Modernization	Sutter Extension Water District	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Upgrade and modernize system infrastructure to improve system operability and efficiency, reduce operational spillage, and enhance the timing of farm deliveries.	Planning	Planned, looking for grant funding	9,100 AFY
Boundary Flow and Primary Spill Measurement and Drainage Recovery Projects	Butte Water District	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Install measurement and monitoring equipment at boundary outflow and spillage sites to allow real-time monitoring and adjustment to upstream operations. Real-time monitoring will be implemented through the establishment of a District SCADA system.	Planning	Planned, looking for grant funding	7,000 AFY
Boundary Flow and Primary Spill Measurement and Drainage Recovery Projects	Sutter Extension Water District	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Install measurement and monitoring equipment at boundary outflow and spillage sites to allow real-time monitoring and adjustment to upstream operations. Real-time monitoring will be implemented through the establishment of a District SCADA system.	Planning	Planned, looking for grant funding	7,500 AFY
Dual Source Irrigation Systems	Butte Water District	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Incentivize the use of irrigation systems capable of using both surface water and groundwater. These systems will increase use of surface water and on-farm recharge of surface water and offset groundwater pumping.	Ongoing	Project awarded SGM Grant Program SGMA Implementation – Round 2 grant funding in September 2023. Project is anticipated to be complete in 2027.	Not available at this time

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Project or Management Action Name	Project Proponent	Targeted Sustainability Indicator	Project or Management Action Description	Status	Project Status Update	Estimated Benefits at Full Implementation
Multi-Benefit Recharge	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	A multi-benefit recharge program will provide groundwater recharge through normal farming operations while also providing critical wetland habitat for waterbirds migrating along the Pacific Flyway. Fields with soil and cropping conditions conducive to groundwater recharge will be flooded and maintained with shallow depths. Water will be sourced from existing water rights contracts, depending on availability. GSAs may also consider financial compensation for participation to offset field preparation, irrigation, and water costs.	Planning	Planned, looking for grant funding	Not available at this time
Grower Education	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	A grower education and outreach program is proposed as a management action for the Sutter Subbasin. The program will provide growers with educational resources that help them to plan and implement on-farm practices that simultaneously support groundwater sustainability and maintain or improve agricultural productivity.	Planning	Planned, looking for grant funding	Not available at this time
Installation of Additional Shallow Groundwater Monitoring Wells	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Depletions of interconnected surface water	Install 15 shallow monitoring wells in key areas of the Subbasin to support monitoring of interconnected surface water, particularly near the Sutter Bypass.	Planning	A Technical Support Services (TSS) application has been submitted and approved by DWR. Sutter County to continue working with DWR on the identification of well locations and will begin outreach to landowners for permission to install wells.	Not available at this time
Sutter Subbasin Well Permit Application Approval Process	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	A Subbasin-wide process is being developed for reviewing and verifying permit applications for new wells and modifications to existing wells to ensure their use does not impact the Subbasin's ability to reach its sustainability goal.	Removed/Withdrawn	A Subbasin-wide approach approved by GSAs in WY 2023, prior to EO N-3-23 being rescinded in September 2024 by EO N-3-24. The need for this management action will be reevaluated as part of future GSP periodic evaluations.	N/A – PMA has been removed/withdrawn

Project or Management Action Name	Project Proponent	Targeted Sustainability Indicator	Project or Management Action Description	Status	Project Status Update	Estimated Benefits at Full Implementation
Sutter Subbasin Groundwater Transfer Approval Process	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	A Subbasin-wide process is being developed for reviewing and approving proposed groundwater substitution transfers to ensure that it does not impact the Subbasin's ability to reach its sustainability goal.	Removed/Withdrawn	This management action was developed in response to EO N-3-23, which was rescinded in September 2024 by EO N-3-24. The need for this management action will be reevaluated as part of future GSP periodic evaluations.	N/A – PMA has been removed/withdrawn
Luther School and De Ree Road Drainage Improvements	City of Live Oak	• Chronic lowering of groundwater levels • Reduction of storage • Land subsidence	The proposed improvements would alleviate existing flooding problems by improving stormwater collection and conveyance infrastructure in the City of Live Oak. The project supports improved stormwater management while providing potential groundwater sustainability benefits.	Planning	Implementation timing is yet to be determined and is contingent upon securing adequate funding, completing project design, obtaining necessary permits and regulatory approvals, and coordinating with applicable agencies.	15-20 AFY
City of Live Oak Sewer Line Replacement Project	City of Live Oak	• Degraded water quality	Identification and replacement of aging, deteriorating, or otherwise deficient sanitary sewer infrastructure throughout the City. Improvements may include replacing existing sewer mains, smaller collection lines, service laterals, sewer pump stations, and associated infrastructure to improve wastewater collection system reliability, reduce leakage, reduce infiltration, and minimize the potential for wastewater releases into surrounding soils. Project is expected to improve collection system integrity, help protect groundwater quality, and reduce ground water infiltration.	Planning	Implementation timing yet to be determined and is contingent upon securing adequate funding, completing necessary engineering design, obtaining applicable permits and regulatory approvals, and coordinating with the City of Live Oak.	Not available at this time
Projects and Management Actions to be Implemented As Needed						
Removal of Bottlenecks on the Sutter-Butte Main Canal	Butte Water District	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Increased ability to meet irrigation and environmental water needs using available surface water.	Planning	Initial in-house planning and study started in 2022. Planning and study still on-going.	Not available at this time
Improved Delivery Service to Pressurized Irrigation Systems	Butte Water District	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Increased ability to meet irrigation water needs using available surface water.	As needed	As needed	Not available at this time

Project or Management Action Name	Project Proponent	Targeted Sustainability Indicator	Project or Management Action Description	Status	Project Status Update	Estimated Benefits at Full Implementation
Wetlands Water Management	Central Valley Joint Venture	• Chronic lowering of groundwater levels • Depletions of interconnected surface water	Securing firm water supplies to wetlands refuges within the Subbasin.	As needed	As needed	Not available at this time
Aquifer Storage & Recovery and Second Well	City of Yuba City	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	This project involves investigating the feasibility of and implementing an aquifer storage recovery (ASR) well to store water during wet periods and provide additional groundwater in dry periods.	Planning	DWR grant funding totaling $6.3 million was awarded in March 2022. Phase 1 included drilling a new well, which was completed in October 2025. Phase 2 began in January 2026, which includes fully equipping well with injection and extraction capabilities.	Not available at this time
Backwash Recovery	City of Yuba City	• Chronic lowering of groundwater levels • Depletions of interconnected surface water	Reduce the amount of water being diverted from the Feather River for supply by 0.42 million gallons per day (MGD) (or 475 acre-feet per year) through treatment and distribution of backwash.	As needed	As needed	Not available at this time
Electrical SCADA and Telemetry	City of Yuba City	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Update the existing 20-year-old SCADA and telemetry for water treatment plant and distribution system to help the City monitor, manage data, and control processes more effectively, and improve management of local water supplies.	As needed	As needed	Not available at this time
New Outfall Diffuser Installation	City of Yuba City	• Chronic lowering of groundwater levels • Depletions of interconnected surface water	Construct a new outfall diffuser from the treatment plant into the Feather River to be able to discharge to the river under all river flows, resulting in 6,600 acre-feet (AF) of treated effluent being placed back into the Feather River for beneficial uses.	Planning	Application for Clean Water State Revolving Fund (SRF) financing was submitted in December 2022. State Water Resources Control Board (SWRCB) Division of Financial Assistance staff continue to review SRF application and project planning documents.	Not available at this time
Replacement of Sewer Mains	City of Yuba City	• Degraded water quality	Replace old and deteriorated sewer lines throughout the City and reduce groundwater quality impacts resulting from leaking sewer lines.	As needed	As needed	Not available at this time

Project or Management Action Name	Project Proponent	Targeted Sustainability Indicator	Project or Management Action Description	Status	Project Status Update	Estimated Benefits at Full Implementation
Replacement of Water Distribution Mains	City of Yuba City	• Chronic lowering of groundwater levels • Reduction of storage	Replace portions of the water distribution close to reaching their end of service life, enabling the City to more effectively control water supply losses due to system leakage and reduce groundwater pumping due to system losses.	As needed	As needed	Not available at this time
Feather River Pump Station Fish Screen Feasibility Study	Garden Highway Mutual Water Company	• Chronic lowering of groundwater levels • Depletions of interconnected surface water	Contribute to wildlife habitat improvement by performing a Feasibility Study which analyzes three fish screen and two non-screen alternatives for Feather River surface water diversion pump station.	As needed	As needed	Not available at this time
Installation of Fish Screens at Sutter Bypass Pumping Plants	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Depletions of interconnected surface water	Install fish screens to prevent entrainment of endangered juvenile salmonids and other fish species.	As needed	As needed	Not available at this time
Rice Field Infiltration Study to Promote FloodMAR Projects	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Conduct an infiltration study to promote Flood Managed Aquifer Recharge (FloodMAR) projects and determine the feasibility and amount of infiltration a FloodMAR project in rice could provide.	As needed	As needed	Not available at this time
Improved Service to Pressurized Irrigation Systems	Sutter Extension Water District	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Increase ability to meet irrigation water needs using available surface water.	As needed	As needed	Not available at this time
Removal of Main Canal Bottlenecks	Sutter Extension Water District	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Increase ability to meet irrigation and environmental water needs using available surface water.	As needed	As needed	Not available at this time
Sunset Project for Integrated Restoration and Efficiency (SPIRE)	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Provide up to 200 cubic feet per second (cfs) increase in conveyance capacity from the Thermalito Afterbay to the District, eliminating the need for the Sunset Pumps Dam as well as the Sunset Pumps to augment surface water supply and improve wildlife habitat.	Removed/Withdrawn	Project no longer moving forward.	N/A – PMA has been removed/withdrawn

Project or Management Action Name	Project Proponent	Targeted Sustainability Indicator	Project or Management Action Description	Status	Project Status Update	Estimated Benefits at Full Implementation
City of Live Oak Water Line Replacement Project	City of Live Oak	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Identification and replacement of aging, deteriorating, or otherwise deficient water distribution infrastructure throughout the City. Improvements may include replacing existing water mains, smaller distribution lines, service lines, and associated infrastructure to improve water system reliability, reduce leakage, and minimize water losses throughout the distribution system in order to improve distribution efficiency and decrease groundwater pumping demands.	Planning	As needed	Not available at this time
Projects and Management Actions to be Implemented As Needed to Address Data Gaps						
Investigation of Interactions Between Rivers and Changes in Groundwater Levels	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Depletions of interconnected surface water	Collect additional data to assist in developing appropriate sustainable management criteria for interconnected surface waters and analyzing changes in stream-aquifer interactions.	As needed	As needed	Not available at this time
Investigation of Source of Elevated Salinity within Shallow Aquifer Zone	Multi-Agency/GSA	• Degraded water quality	Collect additional data needed to evaluate the source of elevated salinity levels within the shallow aquifer zone.	As needed	As needed	Not available at this time
Study of Aquifer Properties	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Land subsidence • Depletions of interconnected surface water	Conduct additional aquifer pumping tests to assess aquifer properties in the Sutter Subbasin.	As needed	As needed	Not available at this time
Additional Assessments of Groundwater Recharge Dynamics and Effects	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Conduct additional aquifer studies to assess the dynamics and effects of groundwater recharge in the Subbasin, particularly those effects of GSP projects.	As needed	As needed	Not available at this time
Analysis of Recharge Rates	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Depletions of interconnected surface water	Conduct additional analyses of recharge rates to assess historical groundwater recharge rates and hydraulic connection between different zones in the aquifer system.	As needed	As needed	Not available at this time

Project or Management Action Name	Project Proponent	Targeted Sustainability Indicator	Project or Management Action Description	Status	Project Status Update	Estimated Benefits at Full Implementation
Data Collection to Improve the Hydrogeologic Conceptual Model	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Land Subsidence • Degraded water quality • Depletions of interconnected surface water	Collect additional data to understand the hydrogeology of the Sutter Subbasin and bolster the hydrogeologic conceptual model.	As needed	As needed	Not available at this time
AEM Survey of Sutter Buttes	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Land Subsidence • Degraded water quality • Depletions of interconnected surface water	Conduct airborne electromagnetic (AEM) survey to improve understanding of the unique geology and hydrogeology of the Sutter Buttes.	Ongoing	Project awarded SGM Grant Program SGMA Implementation – Round 2 grant funding in September 2024. Work anticipated to be completed in 2027.	Not available at this time
Development of Uniform Criteria for Defining Stratigraphic Zones	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Land Subsidence • Degraded water quality • Depletions of interconnected surface water	Develop and recommended a uniform set of criteria for defining stratigraphic zones and for logging cuttings from soil boring drilled in the Subbasin.	As needed	As needed	Not available at this time
Comprehensive Sutter Subbasin Groundwater Quality Evaluation	Multi-Agency/GSA	• Degraded water quality	Conduct a comprehensive groundwater quality evaluation for the Sutter Subbasin.	As needed	As needed	Not available at this time
Video Survey RMS Wells with Unknown Construction	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Degraded water quality • Depletions of interconnected surface water	Conduct video surveys of representative monitoring site (RMS) wells with unknown construction information in order to collect missing information.	As needed	As needed	Not available at this time
Monitoring Well Refinements	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Land Subsidence • Degraded water quality • Depletions of interconnected surface water	Refine and improve the Subbasin monitoring network by identifying and constructing additional, dedicated monitoring wells of known construction, and by collecting and confirming well construction information.	Ongoing	Project awarded SGM Grant Program SGMA Implementation – Round 2 grant funding as part of amendment request to DWR in early WY 2026. A well siting analysis is underway and will be complete by early 2027.	Not available at this time
Sutter Buttes Salinity Monitoring	Multi-Agency/GSA	• Degraded water quality	Monitor groundwater salinity (based on electrical conductivity [EC] measurements) at selected locations near the Sutter Buttes on a temporary or permanent basis.	As needed	As needed	Not available at this time
Sutter Buttes Water Quality Inter-Basin Working Group	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Land Subsidence • Degraded water quality • Depletions of interconnected surface water	Participate in an interbasin working group focused on collaborative discussions, consensus-building and planning to address groundwater quality matters associated with the unique geology of the Sutter Buttes area.	Ongoing	Group has been formed and met in April 2026.	Not available at this time

Project or Management Action Name	Project Proponent	Targeted Sustainability Indicator	Project or Management Action Description	Status	Project Status Update	Estimated Benefits at Full Implementation
Groundwater Dependent Ecosystem Mapping Confirmation	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Depletions of interconnected surface water	Conduct an on-ground survey to confirm mapping of groundwater dependent ecosystems to support ongoing investigation and monitoring of the relationship between the health of GDEs, groundwater levels, and access to water supplies.	As needed	As needed	Not available at this time
Well Census	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Reduction of storage • Degraded water quality	Conduct a survey of wells in the Subbasin to identify the location of previously unknown wells, determine their status (e.g., destroyed, active), and/or collect construction information to better inform groundwater use in the Subbasin.	As needed	As needed	Not available at this time
Land Subsidence Monitoring Evaluation	Multi-Agency/GSA	• Chronic lowering of groundwater levels • Land Subsidence	Conduct an assessment of land subsidence data to determine the optimal frequency for ongoing collection and analysis of data relating to inelastic land subsidence.	As needed	As needed	Not available at this time

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5. BASIN SETTING BASED ON NEW INFORMATION OR CHANGES IN WATER USE

GSP Emergency Regulations §356.4(d) include a requirement that the periodic evaluation assessment shall include:

> *An evaluation of the basin setting in light of significant new information or changes in water use, and an explanation of any significant changes. If the Agency's evaluation shows that the basin is experiencing overdraft conditions, the Agency shall include an assessment of measures to mitigate that overdraft.*

Changes to the GSAs' understanding of the basin setting were incorporated into the 2027 GSP Amendment in four key areas in response to DWR's RCAs and newly available information collected during the evaluation period, as described in **Section 2**. The four key areas are associated with refinements to the hydrogeologic conceptual model, changes in groundwater conditions during the evaluation period, updates to the groundwater flow model used in the 2022 GSP, and changes in water use leading to water budget updates.

The analyses described below have informed the GSAs' developing understanding of the basin setting and continue to demonstrate that the basin is not in overdraft. Therefore, overdraft mitigation measures are not necessary.

5.1 Hydrogeologic Conceptual Model

The hydrogeologic conceptual model (HCM) presented in the 2022 GSP discussed the physical setting, characteristics, and processes that govern groundwater within the Sutter Subbasin. This section discusses new information gathered during the evaluation cycle (WYs 2021 to 2025) that warranted updating the HCM in the 2027 GSP Amendment. New data and analyses conducted during this evaluation cycle are described in the following subsections.

5.1.1 Airborne Electromagnetic (AEM) Data Survey

On May 19, 2023, DWR published the *Data Report for Survey Area 6, Solano, South American, North American, Yolo, Sutter, South Yuba, and North Yuba Groundwater Subbasins* (Data Report) (California Department of Water Resources, 2023). The Data Report discussed the acquisition, processing, inversion, and lithology transformation for the AEM survey conducted in the Area 6 subbasins and provided a description of the well data collected along the planned flight lines and the project's data management system. The survey included flight line planning, local coordination and public outreach, data collection and processing, and lithology modeling.

The AEM survey flight lines were developed to collect high-quality data that are beneficial to local, State, and federal agencies by supporting basin characterization and the implementation of SGMA. The process of developing the survey flight lines includes the following steps: A 2-mile by 8-mile grid was oriented to capture large-scale hydrogeologic features within the surveyed area, including aquifer structures, geologic bedding and buried feature orientations, faults, and presence of brackish to saline groundwater. Flight lines were modified to prevent safety hazards and minimize noise impacts by avoiding interaction with urban areas, structures containing people or confined livestock, oil and gas well fields, highways, transmission lines, railroads, pipelines, and vineyards. Flight lines were then modified to incorporate important areas identified by GSAs and State and federal agencies. Finally, flight lines were modified to be co-located with

existing high-quality lithology or geophysical data provided by the GSAs or public databases. Flight lines were then provided to DWR's consultant team for potential infrastructure interference and safety consideration. Flight lines and boring log locations for the Sutter Subbasins are shown in **Figure 5-1**.

Lithologic data, resistivity logs, water level measurements, and water quality measurements from wells were compiled across the planned flight lines prior to being flown. The AEM survey required a minimum of two "best available" lithology logs per each Public Land Survey System (PLSS) square mile area which the flight lines crossed. Both high-quality and low-quality logs were compiled across the study area. High-quality electrical resistivity logs were also compiled from wells within the PLSS sections in which the flight lines crossed. Several properties can affect the electrical resistivity of the subsurface, including lithology, groundwater salinity, and degree of saturation, but the logs can still be used to predict lithology. DWR used an Accumulated Clay Thickness transform method in conjunction with texture descriptions from well completion report lithology logs to map the resistivity of a depth interval to the amount of coarse material, referred to as the coarse fraction, in each layer. Depth to groundwater supported the AEM data inversion process. Total dissolved solids (TDS) and electrical conductivity data were assembled from the State Water Resources Control Board (SWRCB) Groundwater Ambient Monitoring and Assessment (GAMA) system and are important because the resistivity measured by AEM surveys varies depending on the dissolved constituents in the groundwater. AEM survey data results provided the GSAs with additional information to better refine their HCM, who then evaluated changes to their HCMs and consider its potential implications to groundwater conditions, water budgets, and/or projects favorable to this type of lithology.

As part of the SGM Grant Program SGMA Implementation – Round 2 grant funding awarded to the Sutter Subbasin in September 2023, the AEM survey data for the Sutter Subbasin was reprocessed to improve understanding of the unique geology and hydrogeology of the Sutter Buttes. By early WY 2027, additional AEM survey lines will be conducted to improve the density of survey lines and data collection, as shown in **Figure 5-2**. Results will be processed and evaluated, and incorporated into the Subbasin's HCM in future GSP amendments.

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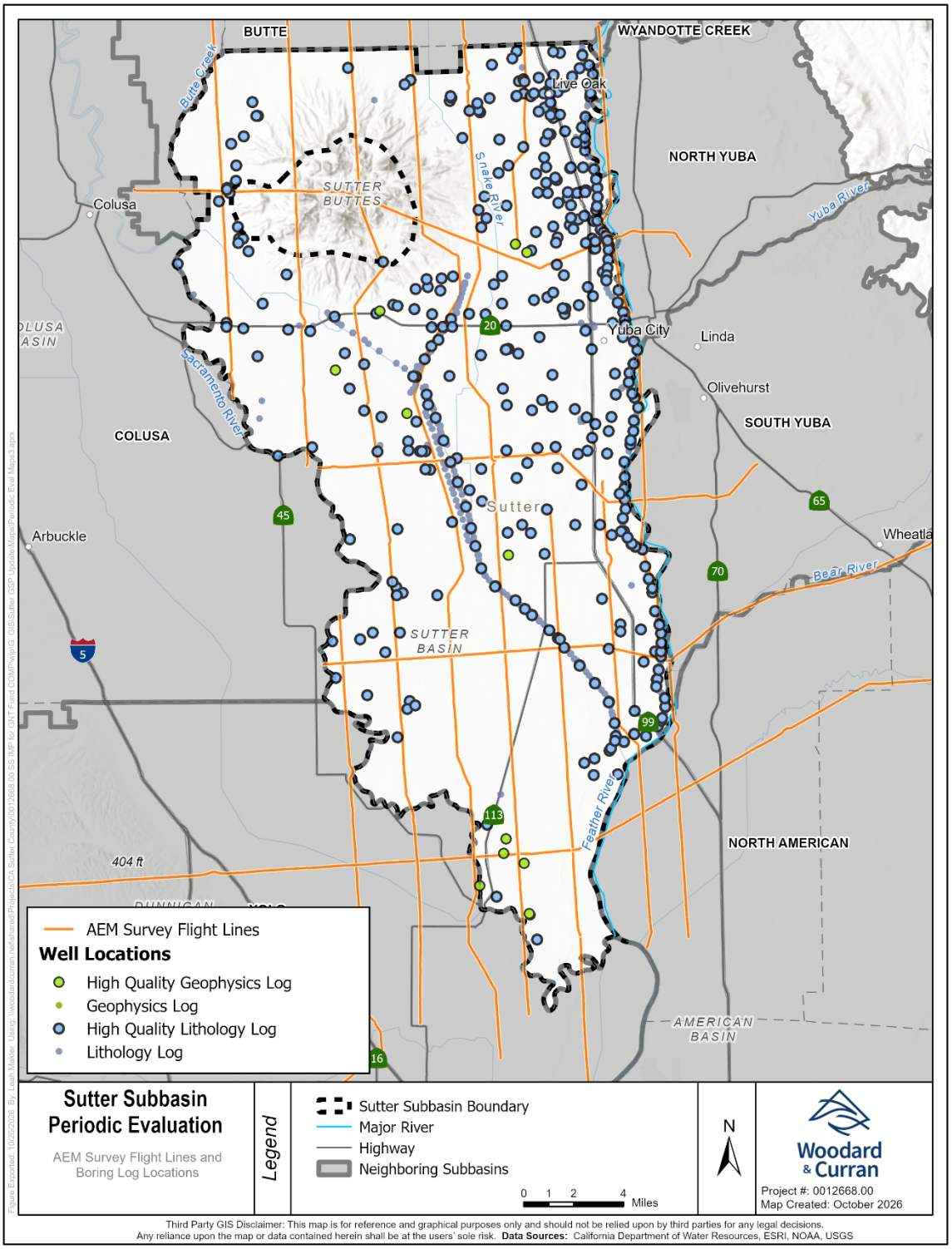

FIGURE 5-1: DWR AEM SURVEY LINES AND BORING LOG LOCATIONS, SUTTER SUBBASIN

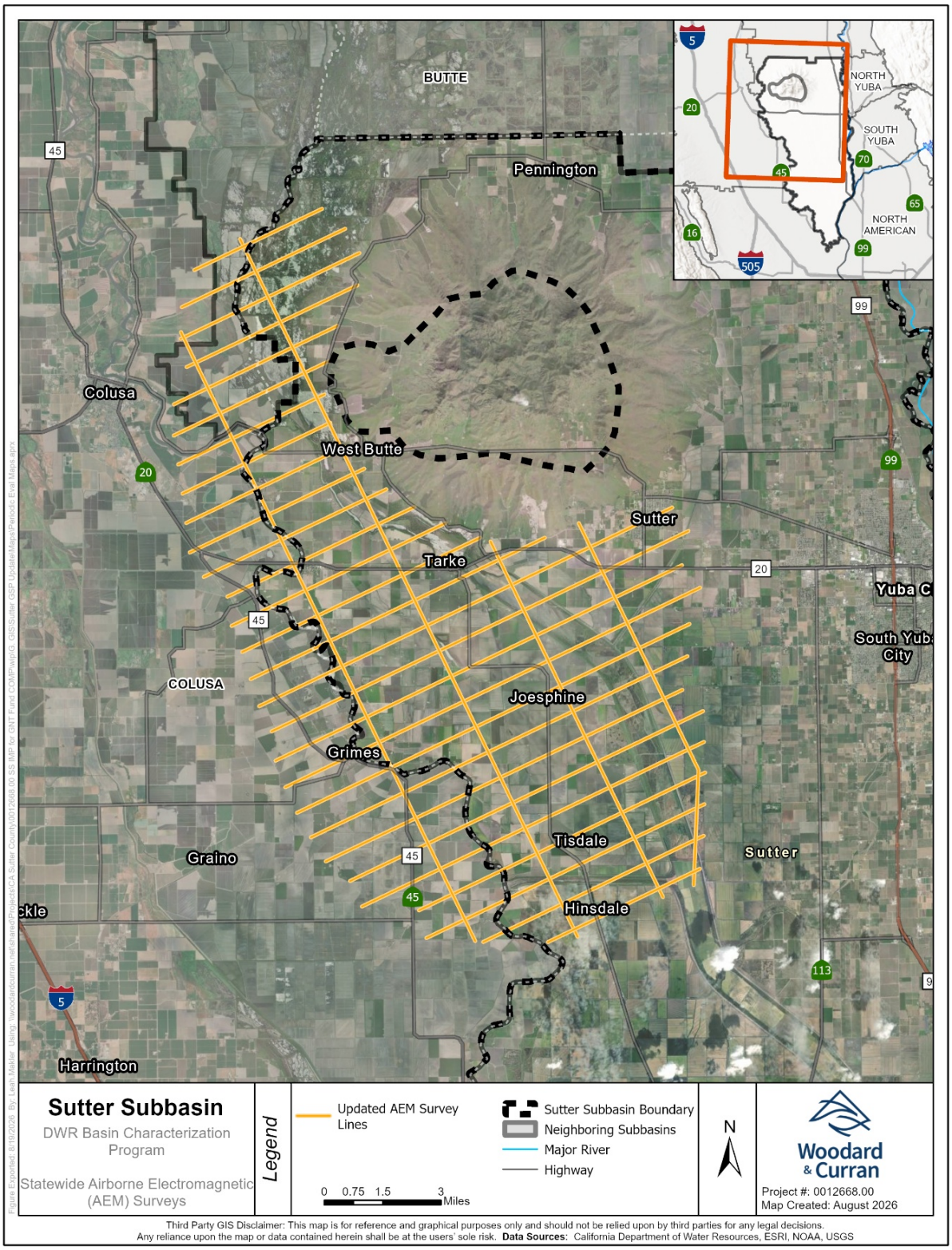

FIGURE 5-2: PLANNED UPDATED AEM SURVEY FLIGHT LINES, SUTTER SUBBASIN

5.1.2 Subbasin Hydrogeology

The HCM, as presented in the 2022 GSP, was revised in response to DWR's RCA 1 to clarify the various zones of the principal aquifer system, geologic formations comprising the principal aquifer, and the vertical extent of the Subbasin using consistent descriptions and naming. While this work did not involve the incorporation of new information (except for the AEM data described in **Section 5.1.1**), it did result in a significant reworking of the HCM section of the 2027 GSP Amendment and utilized additional references not cited in the 2022 GSP. The following sections summarize the revisions to the HCM in the 2027 GSP Amendment.

5.1.2.1 Regional Hydrogeology

The GSP section describing the regional hydrogeology of the Sutter Subbasin was revised to align more consistently with commonly named geologic formations. Additionally, the description of these formations, their appearance in the northern versus southern portion of the Subbasin, and their correlation with the described Aquifer Zones (AZs) of the principal aquifer are summarized in Table 5-1 of the 2027 GSP Amendment.

5.1.2.2 Subbasin Boundaries

While the lateral boundaries of the Sutter Subbasin and the definable bottom of the basin were described in the 2022 GSP, these descriptions have been revised and updated in response to DWR's request for clarification as to the vertical extent of the Subbasin. Specifically, the descriptions of the basin boundaries were clarified and the definable bottom of the basin defined both by the extent of fresh water and the physical base of the Subbasin.

5.1.2.3 Principal Aquifer Definition

In RCA 1, DWR requested consistent descriptions and naming of the AZs throughout the GSP, including in the HCM and the monitoring network (Section 7.2 of the GSP). In response, the AZ framework was described in more detail in the response to RCA 1 (included in **Appendix A**), and this information was carried into the 2027 GSP Amendment as a new section (Section 5.1.3.2). The definitions of the principal aquifer and AZs were further improved through the results of AEM data reprocessing that was conducted for the Subbasin (Appendix 5-G of 2027 GSP Amendment).

5.1.3 HCM Data Gaps

Data gaps identified in Section 5.1.12 of the 2022 GSP include:

- Interactions between Sacramento River, Feather, and other river stage response to changes in groundwater levels
- Sources of elevated salinity within the Shallow Aquifer Zone
- Aquifer properties
- Further assessment of groundwater recharge
- Recharge rate
- Hydrogeologic conceptual model
- Definition of stratigraphic zones

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Updates to filling of HCM data gaps are described in Section 5.1.7 of the 2027 GSP Amendment. The Sutter Subbasin HCM will be updated with future monitoring, modeling, and data refinement efforts throughout the 20-year GSP implementation period as information becomes available through sources outside the GSAs or as funding allows by the GSAs, where many identified data gaps require significant technical studies beyond GSA technical capabilities and require partnering agencies such as the United States Geological Survey or research universities. Sutter County is currently in the process of coordinating with DWR under its Technical Support Services (TSS) program to install nested monitoring wells at sites near selected surface water gage locations near rivers and wetlands to collect the data needed to assess groundwater-surface water interactions. Updates to the HCM based on available AEM surveys (as described in **Section 5.1.1**) have been incorporated into the 2027 GSP Amendment; data collected as part of the planned AEM surveys will be incorporated in future updates.

5.2 Groundwater Conditions

Groundwater conditions were updated based on ongoing groundwater elevation monitoring, improved groundwater storage estimation tools, newly available groundwater quality data, publicly available InSAR data, and improved interconnected surface water characterization. Updated information regarding regional groundwater conditions is described below.

5.2.1 Groundwater Elevation

Groundwater elevation conditions were updated to include data collected through WY 2025. Groundwater level trends in the Sutter Subbasin are largely flat over time, indicating sustainable conditions, as aquifer rebound from seasonal pumping is observed during all water year types. Shallow groundwater levels are relatively stable over time and indicate that most groundwater production is occurring from deeper aquifer zones. More groundwater appears to be produced primarily from AZ-2 and AZ-3, as indicated by large fluctuations in groundwater elevations, where responses to groundwater pumping are observed with rebound following the irrigation season as the aquifer recharges and returns to pre-pumping levels on a seasonal basis.

It should be noted that based on these long-term groundwater trends, the Dry Well Reporting System indicates that no dry wells have been reported in the Sutter Subbasin. In addition to new data sources, applications, and tools published by DWR available to GSAs in order to better understand regional groundwater conditions, the Sutter Subbasin GSAs have revised the representative groundwater level monitoring network to ensure monitoring and reporting at the frequency denoted in the 2027 GSP Amendment (minimum of a seasonal high and low measurement each year).

5.2.2 Groundwater Storage

The C2VSimFG-Sutter Version 2.0 was used to estimate the average annual and cumulative change in storage, including current condition years WYs 2021 to 2025. Over the last five years, the average annual change in storage was a 5,000 AF net increase in groundwater in storage. The total available groundwater in storage in the Subbasin was estimated by C2VSimFG-Sutter to be approximately 49 million AF.

5.2.3 Groundwater Quality

Since WY 2023 and the implementation of the revised representative groundwater quality network (described in Section 7.2 of the 2027 GSP Amendment), annual sampling of total dissolved solids (TDS) and

nitrate as Nitrogen (N) has been conducted by the Sutter Subbasin GSAs at 19 wells. Minimum threshold exceedances have occurred at individual wells; however, no undesirable results for degraded water quality were identified because the criteria defining an undesirable result, including the required causal nexus to groundwater management activities, were not met.

5.2.4 Land Subsidence

The use of InSAR data has been incorporated into the monitoring network to assess for land subsidence following discontinued monitoring by DWR and the United States Bureau of Reclamation (USBR) of the Sacramento Valley subsidence benchmark network. See Section 7.2 of the 2027 GSP Amendment for additional information on how InSAR data will be used for monitoring in the Sutter Subbasin.

5.2.5 Interconnected Surface Water Systems

The C2VSimFG-Sutter Version 2.0 model, which includes a new shallow model layer added to improve the simulation of interconnected surface water, was used to compare simulated groundwater elevations to streambed elevations along the Sacramento River, Feather River, and Sutter Bypass from WYs 1996 to 2025. Stream reaches that were gaining or losing in at least 80% of simulated months were classified accordingly, and the remaining reaches were classified as having mixed conditions. Results indicate that the Sutter Bypass is mostly mixed or gaining, the Feather River alternates between gaining and losing sections, and the Sacramento River has gaining and mixed reaches.

Consistent with DWR's technical papers on depletions of interconnected surface water, current depletions were quantified by comparing the C2VSimFG-Sutter Version 2.0 historical conditions model scenario (With-Pumping) to a Without-Pumping scenario. Current depletions, based on the WYs 2021 to 2025 average, are estimated to be 89 thousand acre-feet (TAF) per year, distributed among the Sutter Bypass (40 TAF per year, 44%), Sacramento River (30 TAF per year, 34%), and Feather River (19 TAF per year, 22%). Depletions occur in all months and water year types, with slightly higher depletions in drier years and in July and August; however, no strong seasonal trend is apparent because depletions in any given period reflect pumping over many prior years.

5.3 Water Use Changes and Associated Water Budget

The water budgets were updated in the 2027 GSP Amendment using the updated C2VSimFG-Sutter Version 2.0, discussed further in **Section 5.4** below. The historical water budget now covers WYs 1996 to 2025, and the current conditions water budget was updated from a single representative year (WY 2013) to the average of WYs 2021 to 2025, which reflects recent land use, demands, and surface water supplies. The projected conditions water budget assumes a 2042 level of development over a 60-year hydrologic period, and a projected conditions with climate change water budget was developed using DWR's 2070 Central Tendency climate change datasets.

The historical water budget estimates an average annual decrease in groundwater storage of approximately 4,000 AF per year (0.008% of the approximately 49 million AF in storage), while the current conditions water budget estimates an average annual increase of approximately 5,000 AF per year (0.010%). The projected conditions water budgets, with and without climate change, have balanced inflows and outflows with no long-term change in storage. The sustainable yield of 182,000 AF per year, estimated in the 2022 GSP using C2VSimFG-Sutter Version 1.0, was retained in the 2027 GSP Amendment as a conservative value, and current

pumping remains below this sustainable yield. The sustainable yield will be reviewed during each Periodic Evaluation and may be revised using future model updates.

RCA 2 from DWR states:

> *"Provide further information and justification related to the increases in net subsurface inflows from adjacent subbasins in the projected water budgets and the sustainable yield estimation."*

A detailed response to RCA 2 is included in **Appendix A** of this Periodic Evaluation. An assessment of subsurface inflows with adjacent subbasins as reported in adopted GSPs was performed. Improvements were made to the water budgets presented in the 2027 GSP Amendment using C2VSimFG-Sutter Version 2.0, where the increases in net subsurface inflows from the historical to the projected scenarios and sustainable yield estimation were a focus when updating the model. In addition to model updates, Sutter Subbasin's involvement in interbasin coordination of modeling approaches also improved subsurface flows between adjacent subbasins. The Sutter Subbasin continues to participate in regional interbasin coordination efforts that will further improve future modeling.

5.4 Model Updates

C2VSimFG-Sutter Version 1.0, adapted from DWR's C2VSimFG v1.0 and used to develop the water budgets in the 2022 GSP, was completely updated to C2VSimFG-Sutter Version 2.0 for the 2027 GSP Amendment. C2VSimFG-Sutter Version 2.0 features a model domain clipped to focus on the Sutter Subbasin and immediately surrounding areas, and model layering was refined based on DWR's AEM survey results, including a new shallow layer added to improve the simulation of interconnected surface water. The simulation period was extended through WY 2025, and calibration focused on groundwater levels to improve the simulation of subsurface flows between the Sutter Subbasin and adjacent subbasins.

C2VSimFG-Sutter Version 2.0 was used to develop the updated water budgets for historical conditions, current conditions, projected conditions, and projected conditions with climate change, to quantify current stream depletions, and to estimate depletions at groundwater level minimum threshold conditions in response to RCA 3e. Documentation of the model update and calibration is provided in the model report included as Appendix 5-F of the 2027 GSP Amendment.

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6. REPRESENTATIVE MONITORING NETWORKS

GSP Emergency Regulations §356.4(e) include a requirement that the periodic evaluation assessment shall include:

> *A description of the monitoring network within the basin, including whether data gaps exist, or if any areas within the basin are represented by data that does not satisfy the requirements of Sections 352.4 and 354.34(c). The description shall include the following:*
>
> *(1) An assessment of monitoring network function with an analysis of data collected to date, identification of data gaps, and the actions necessary to improve the monitoring network, consistent with the requirements of Section 354.38.*
>
> *(2) If the Agency identifies data gaps, the Plan shall describe a program for the acquisition of additional data sources, including an estimate of the timing of that acquisition, and for incorporation of newly obtained information into the Plan.*
>
> *(3) The Plan shall prioritize the installation of new data collection facilities and analysis of new data based on the needs of the basin.*

6.1 Groundwater Levels

The 2022 GSP established the representative groundwater level monitoring network with 63 wells to accurately assess groundwater levels and address sustainability metrics within the different aquifer zones (or AZs) of the principal aquifer within the Subbasin. **Table 6-1** summarizes the monitoring wells removed from the network. A total of 11 wells have been removed from the representative groundwater level monitoring network since 2022 GSP development, primarily due to access issues. The revised groundwater level monitoring network is displayed in **Figure 6-1** through **Figure 6-4**, as presented in the 2027 GSP Amendment.

With 52 wells included in the groundwater level representative monitoring network as of the 2027 GSP Amendment, there is deemed to be sufficient spatial and temporal coverage and density of wells throughout the Sutter Subbasin. As described in the 2027 GSP Amendment, a goal of ten wells per aquifer zone is established by the GSAs to ensure adequate vertical spatial coverage. With the exception of Shallow AZ, all aquifer zones contain more than ten wells. The Sutter Subbasin has identified the Shallow AZ (ground surface to 50 feet below ground surface) as a data gap. In order to fill this data gap, the Sutter Subbasin GSAs are preparing a well siting analysis (to be completed by early 2027) that identifies and proposes locations for the construction of new dedicated monitoring wells to fill data gaps. This effort is being conducted simultaneously with the GSP amendment and Periodic Evaluation effort. Future updates will be provided in subsequent annual reports as data gaps are filled. Sutter County has also submitted a general Technical Support Services (TSS) application to DWR, which proposes construction of dedicated monitoring wells to fill identified data gaps.

Groundwater level monitoring frequencies of two times per year, once each during seasonal high (March and April) and seasonal low (September-October) designated monitoring periods, is appropriate for assessing seasonal and long-term trends in groundwater levels throughout the Subbasin. Rice, the predominant crop grown in the Subbasin, has a significant influence on shallow groundwater levels, so monitoring wells adjacent to rice growing areas may collect water level measurements up to four times per

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year – one each during identified seasonal high and low periods, and once between August and October and between January and March, to capture local seasonal high and low groundwater elevations, respectively. As noted above, the monitoring density across the principal aquifer is sufficient with the exception of the Shallow AZ, which is an identified data gap.

DWR RCA 7 states:

> *"Define the data collection frequency in tabular format for groundwater monitoring sites within the chronic lowering of groundwater levels and depletions of interconnected surface water monitoring networks in the GSP."*

In response to RCA 7, Table 7-45 included in Section 7.2 of the 2027 GSP Amendment indicates the monitoring frequency at each well.

TABLE 6-1: UPDATES TO CHRONIC LOWERING OF GROUNDWATER LEVELS REPRESENTATIVE MONITORING NETWORK

State Well Number	Local ID / Other ID	Aquifer Zone	Reason for Removal
12N02E09B002M	USGS-385431121451401	Shallow	Infrequent monitoring by USGS and unable to obtain access from landowner
12N03E18H001M	USGS-385314121401701	Shallow	Infrequent monitoring by USGS and unable to obtain access from landowner
14N02E10R001M	USGS-390416121433601	Shallow	Infrequent monitoring by USGS and unable to obtain access from landowner
15N02E20D001M	USGS-390832121463601	Shallow	Infrequent monitoring by USGS and unable to obtain access from landowner
16N01E31H001M	-	Shallow	Measurement discontinued and unable to obtain landowner access
16N03E21D002M	-	Shallow	Measurement discontinued and unable to obtain landowner access
14N01E24N001M	-	AZ-1	Measurement discontinued and unable to obtain landowner access
16N03E04E001M	-	AZ-1	Measurement discontinued and unable to obtain landowner access
-	GH Well 2	AZ-1	Unable to obtain access and ensure monitoring
-	Hillcrest Well #5	AZ-1 and AZ-2	Well inaccessible for monitoring
17N02E31A001M	-	AZ-3	Measurement discontinued and unable to obtain landowner access

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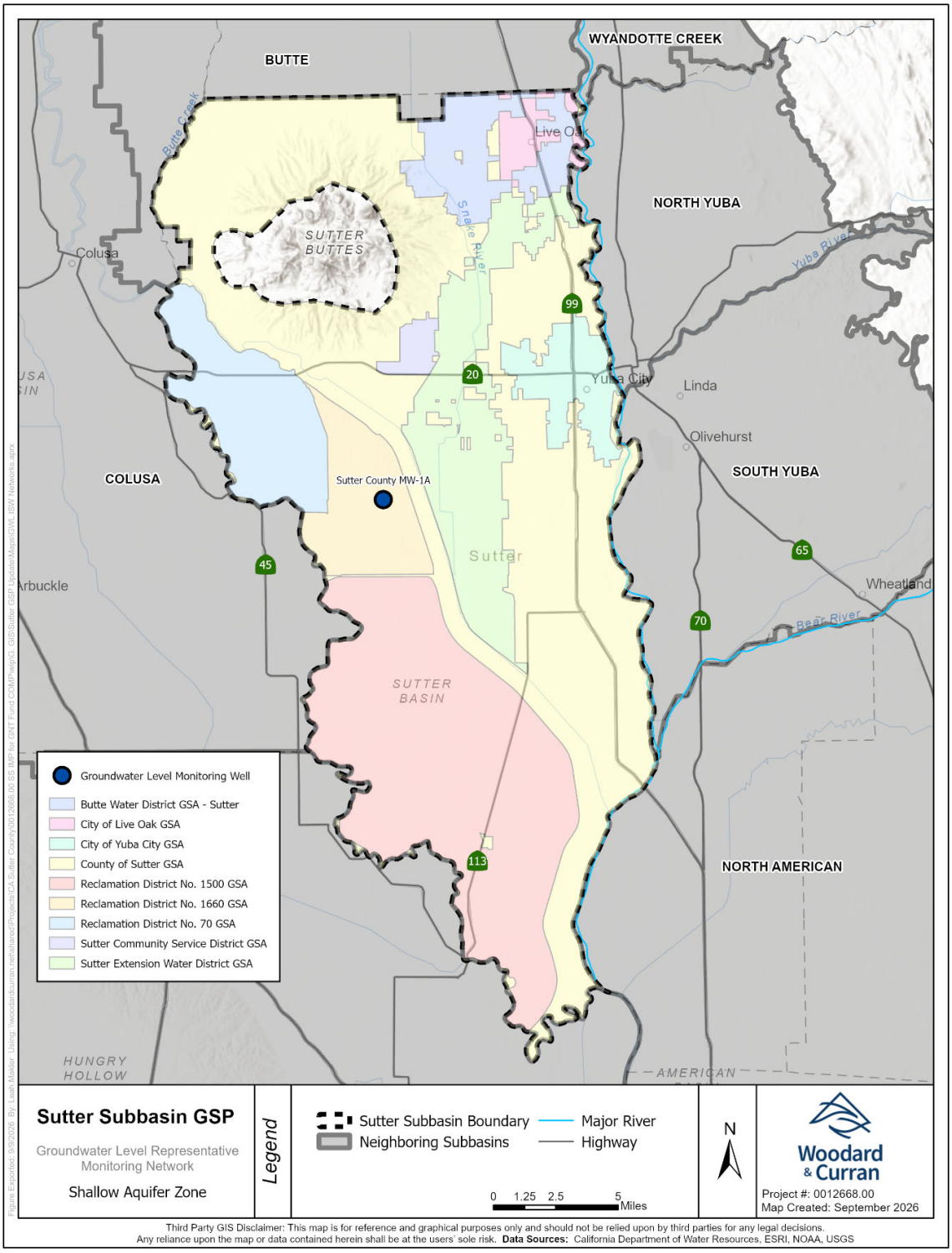

FIGURE 6-1: REVISED GROUNDWATER LEVEL MONITORING NETWORK, SUTTER SUBBASINS (SHALLOW AZ)

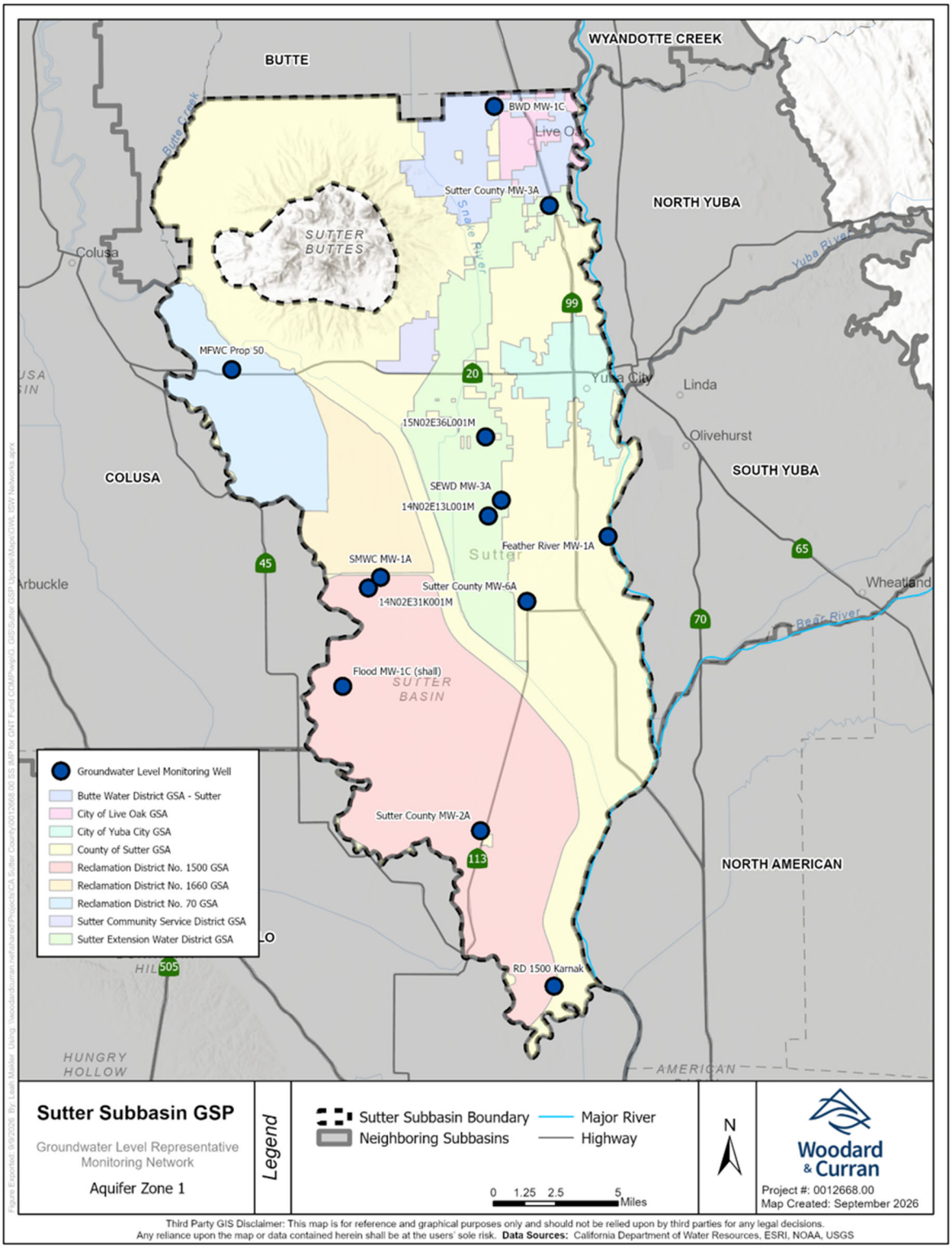

FIGURE 6-2: REVISED GROUNDWATER LEVEL MONITORING NETWORK (AZ-1)

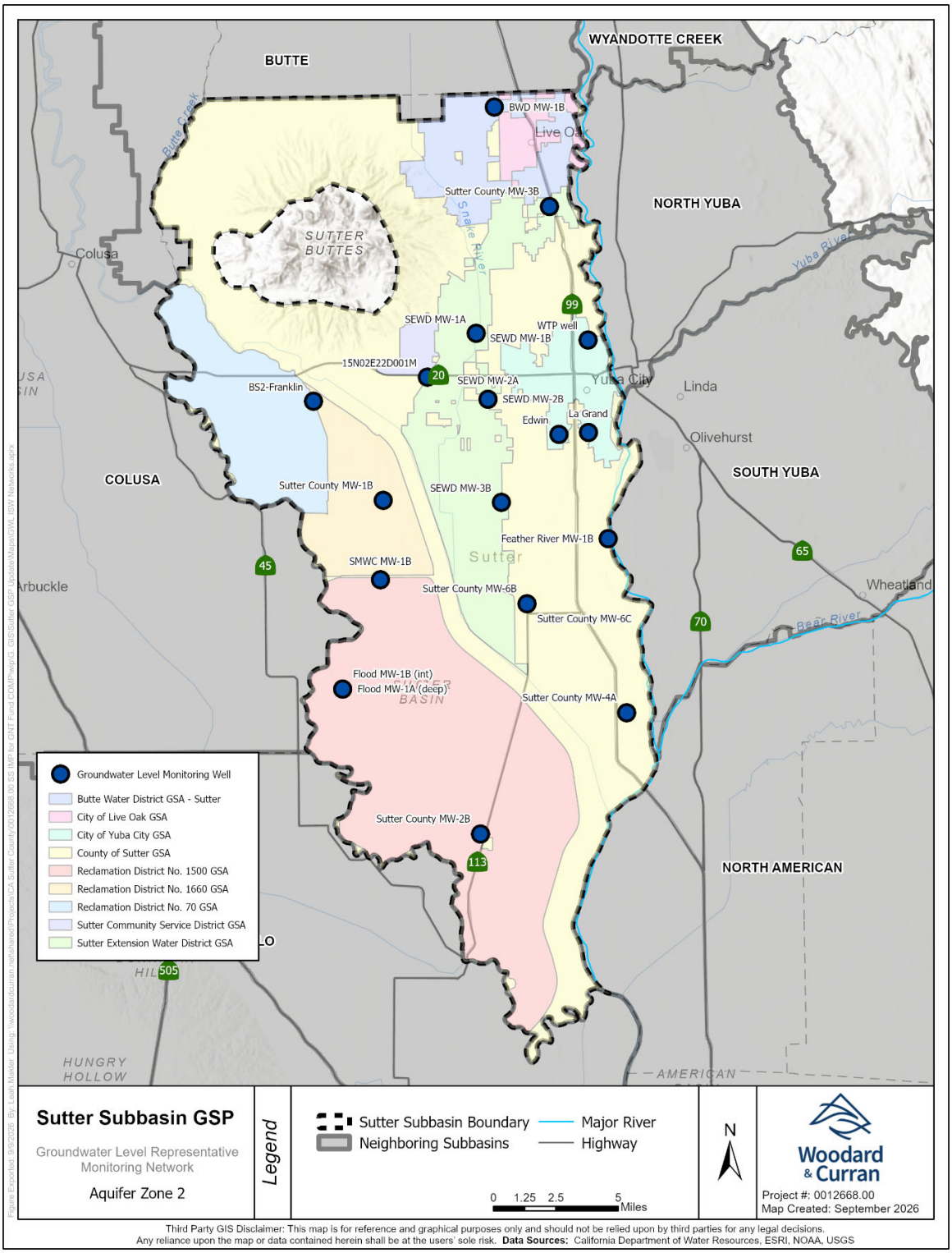

FIGURE 6-3: REVISED GROUNDWATER LEVEL MONITORING NETWORK (AZ-2)

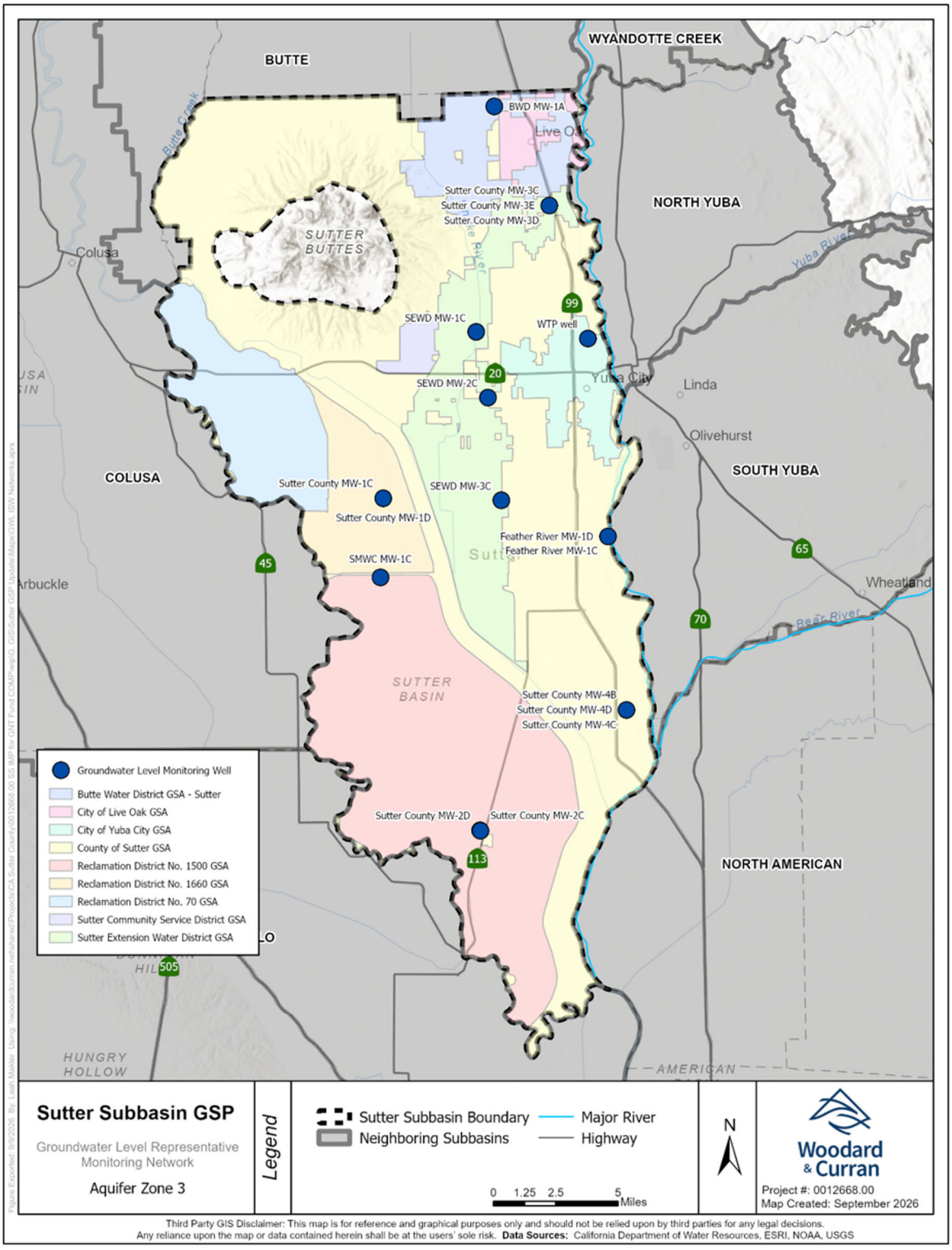

FIGURE 6-4: REVISED GROUNDWATER LEVEL MONITORING NETWORK (AZ- 3)

6.2 Reduction in Groundwater Storage

In the Sutter Subbasin, reduction in groundwater storage is assessed using chronic lowering of groundwater levels as a proxy. Therefore, any changes to the groundwater level representative monitoring network apply to the groundwater storage sustainability indicator.

6.3 Seawater Intrusion

The seawater intrusion sustainability indicator does not apply to the Sutter Subbasin and does not have an associated representative monitoring network.

6.4 Degraded Water Quality

In the 2022 GSP, the representative groundwater quality monitoring network was comprised of 29 wells that met the following criteria: maximize representation of current and historical data; monitor areas of elevated nitrate and elevated TDS; provide upgradient and cross-gradient data points; and represent all aquifer zones of the principal aquifer to assess potential vertical movement of poorer quality groundwater.

In the years since the adoption of the 2022 GSP, the Sutter Subbasin GSAs have reassessed the original network due to concerns over their long-term ability to monitor the original network. Each GSA has proposed a minimum of one groundwater quality monitoring well within its boundaries. As documented in the last several annual report cycles, the GSAs have refined the representative groundwater quality monitoring network to include 19 wells, as summarized in **Table 6-2** and displayed in **Figure 6-5** through **Figure 6-7**.

The monitoring density for groundwater quality is deemed appropriate to accurately characterize concentrations and trends of constituents of concern. TDS and nitrate as N are sampled at each well once per year during the irrigation season (between July and October). The frequency and timing of groundwater quality monitoring are deemed sufficient for evaluating the long-term trends in water quality in the Sutter Subbasin, and will be reevaluated during future GSP updated and revised as deemed necessary. There are no identified data gaps in the representative groundwater quality monitoring network as presented in the 2027 GSP Amendment.

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TABLE 6-2: UPDATED GROUNDWATER QUALITY MONITORING NETWORK

Site Code	State Well Number	Local ID / Other ID	Aquifer Zone	Overlying GSA	Well Use	Depth (ft bgs)	Screen Interval (ft bgs)	Monitoring Frequency
390682N1216901W001	14N02E13A003M	SEWD MW-3A	AZ-1	Sutter Extension WD GSA	Observation	115	90 - 110	Annually
392970N1216907W003	17N02E25J003M	BWD MW-1C	AZ-1	Butte WD GSA	Observation	127	70 - 90	Annually
-	-	Well 2-C	AZ-1	Sutter CSD GSA	Public Supply	120	90 - 120	Annually
391456N1218904W001	-	MFWC Prop 50	AZ-1	Reclamation District No. 70 GSA	Irrigation	320	125 - 155	Annually
390682N1216901W002	14N02E13A004M	SEWD MW-3B	AZ-2	Sutter Extension WD GSA	Observation	245	210 - 240	Annually
391658N1217070W001	15N02E12E001M	SEWD MW-1A	AZ-2	Sutter Extension WD GSA	Observation	173	148 - 168	Annually
391658N1217070W002	15N02E12E002M	SEWD MW-1B	AZ-2	Sutter Extension WD GSA	Observation	266	240 - 260	Annually
391279N1216989W001	15N02E24P001M	SEWD MW-2A	AZ-2	Sutter Extension WD GSA	Monitoring	254	204 - 244	Annually
391279N1216989W002	15N02E24P002M	SEWD MW-2B	AZ-2	Sutter Extension WD GSA	Monitoring	379	354 - 374	Annually
391012N1218222W001	-	BS1-McClatchy	AZ-2	Reclamation District No. 70 GSA	Irrigation	370	-	Annually
392970N1216907W002	17N02E25J002M	BWD MW-1B	AZ-2	Butte WD GSA	Observation	370	320 - 360	Annually
-	-	Well-1A / 5110001-011	AZ-2	City of Live Oak GSA	Public Supply	292	-	Annually
-	-	Well-2A / 5110001-013	AZ-2	City of Live Oak GSA	Public Supply	210	-	Annually
-	-	Akins Well	AZ-2	Reclamation District No. 1500 GSA	Irrigation	270	200 - 260	Annually
-	-	WTP well	AZ-2 and AZ-3	City of Yuba City GSA	Public Supply	-	370 - 390; 453 - 473	Annually
390682N1216901W003	14N02E13A005M	SEWD MW-3C	AZ-3	Sutter Extension WD GSA	Observation	585	550 - 580	Annually
391658N1217070W003	15N02E12E003M	SEWD MW-1C	AZ-3	Sutter Extension WD GSA	Observation	559	524 - 554	Annually
391279N1216989W003	15N02E24P003M	SEWD MW-2C	AZ-3	Sutter Extension WD GSA	Monitoring	488	438 - 478	Annually
392970N1216907W001	17N02E25J001M	BWD MW-1A	AZ-3	Butte WD GSA	Observation	591	486 - 586	Annually

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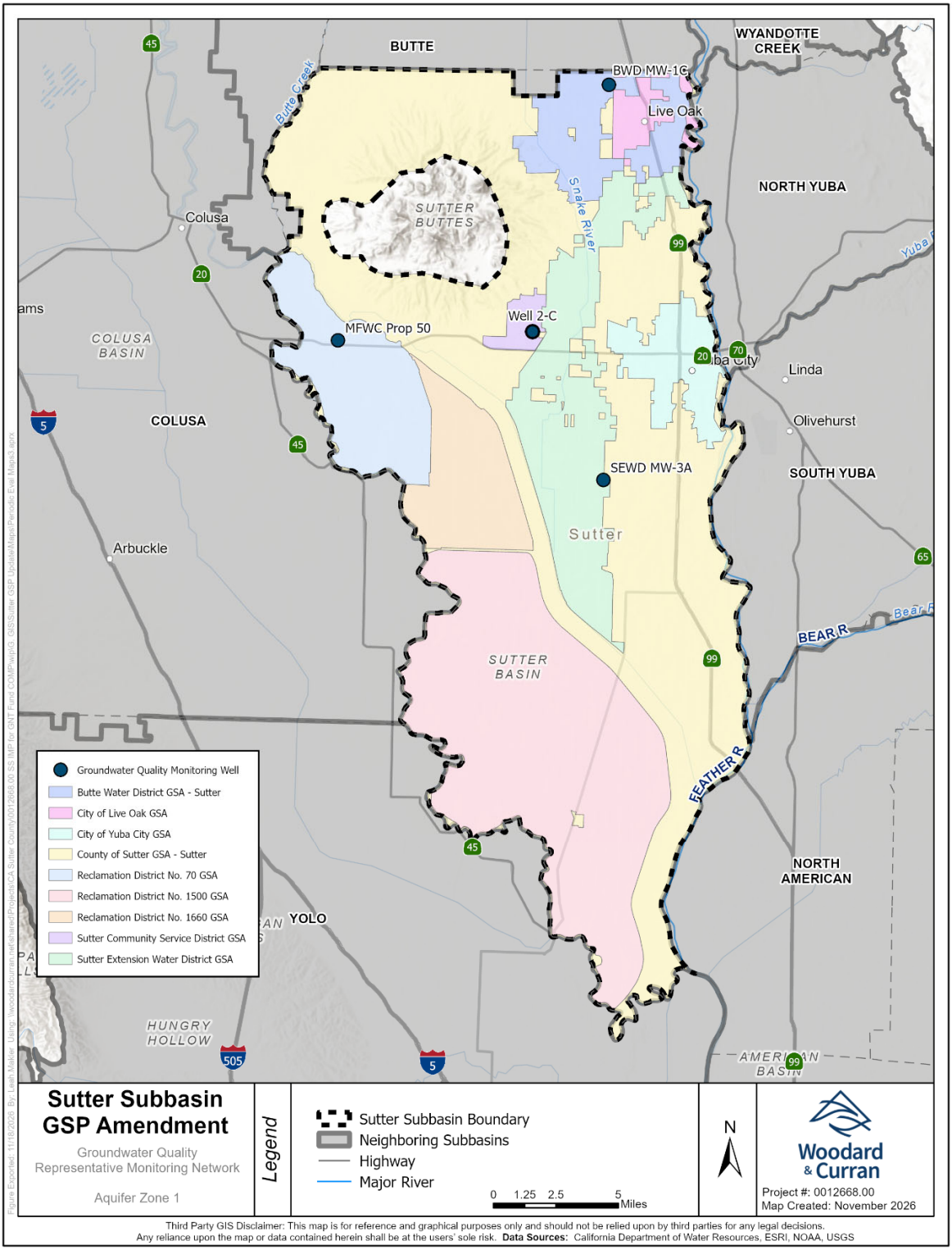

FIGURE 6-5: REVISED GROUNDWATER QUALITY MONITORING NETWORK (AZ-1)

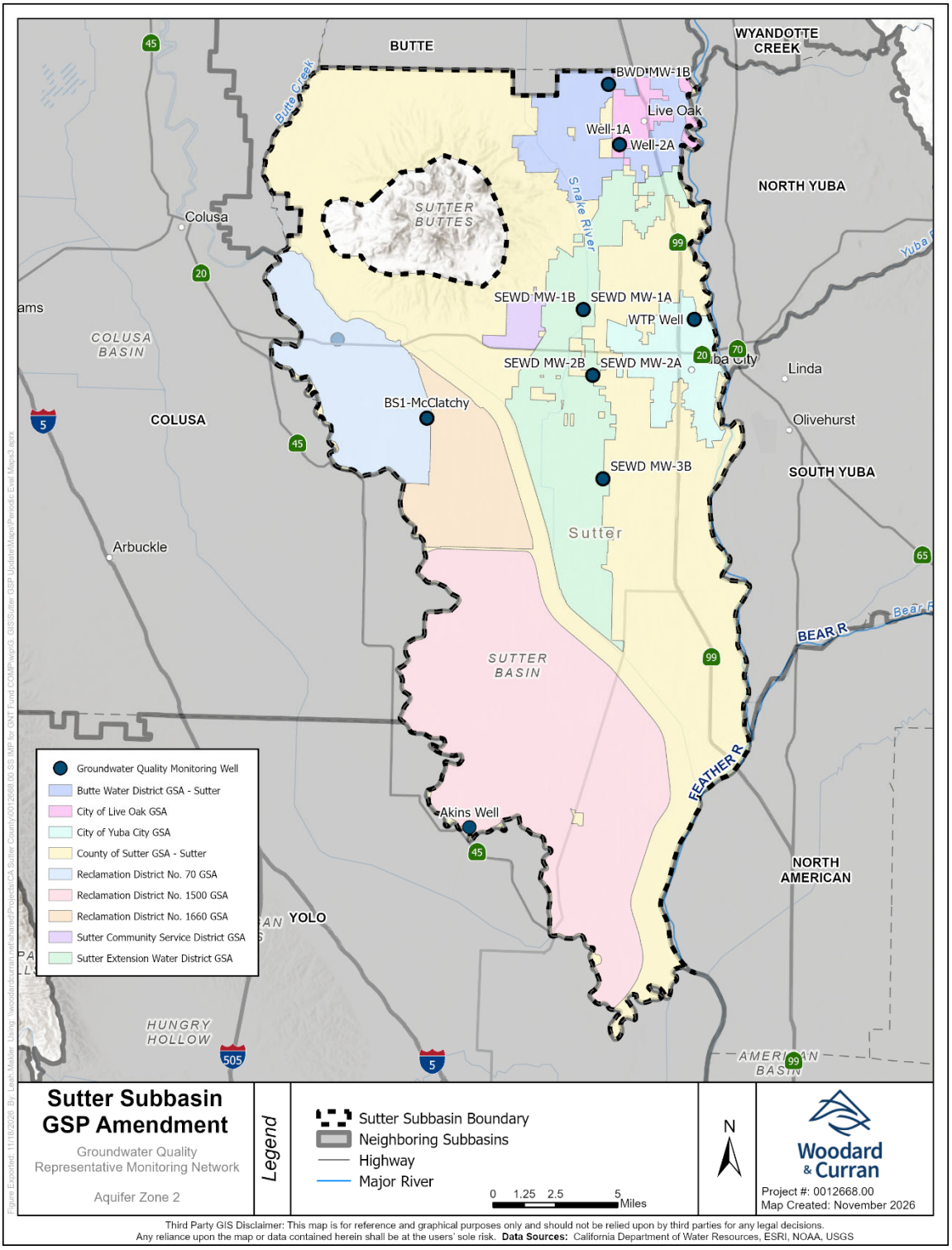

FIGURE 6-6: REVISED GROUNDWATER QUALITY MONITORING NETWORK (AZ-2)

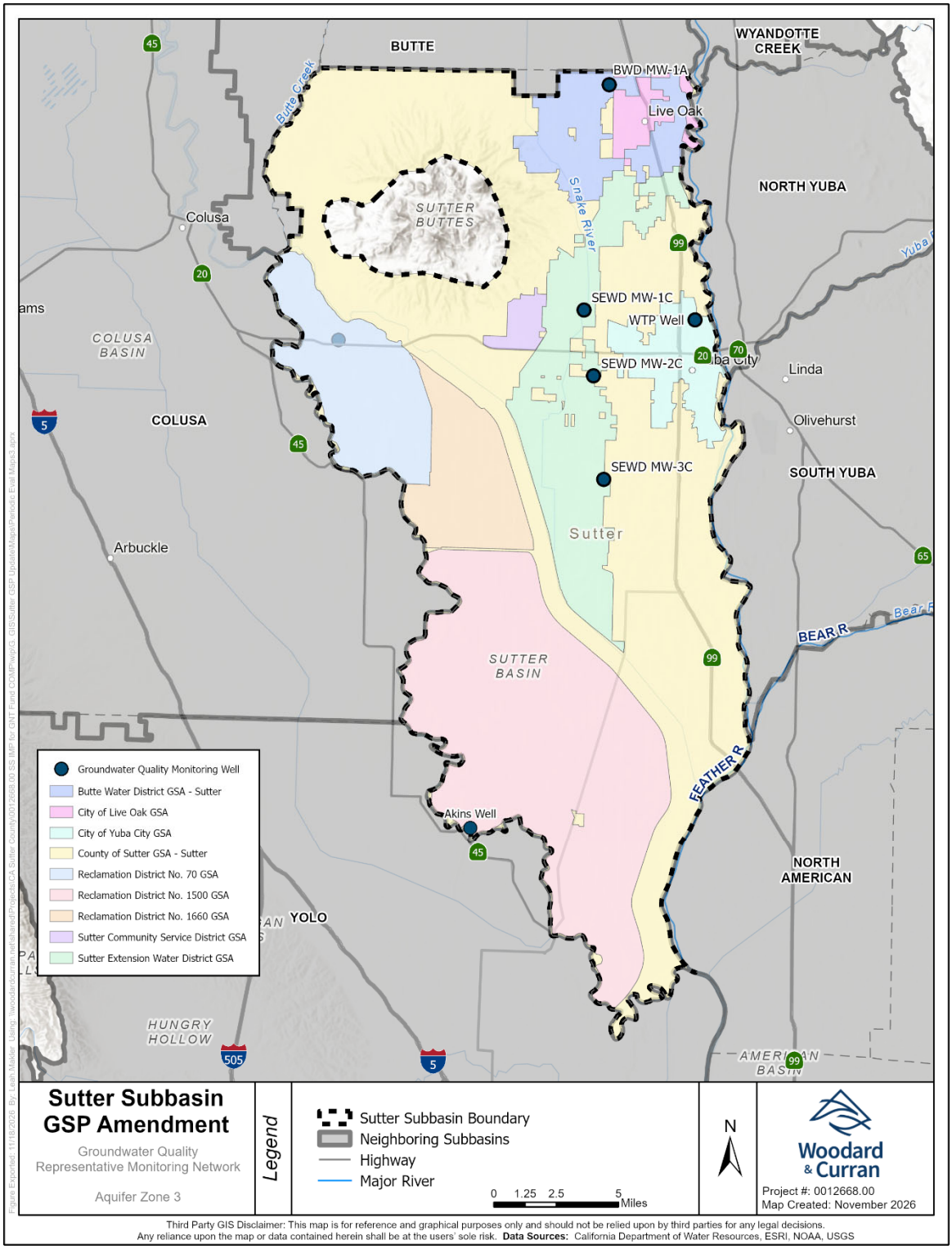

FIGURE 6-7: REVISED GROUNDWATER QUALITY MONITORING NETWORK (AZ-3)

6.5 Land Subsidence

RCA 5 in DWR's determination letter defines two specific requests relating to land subsidence monitoring:

a. *Describe how undesirable results will be evaluated since it is unclear at what frequency data will be collected from the Sacramento Valley GPS Subsidence Monitoring Network. If data is not collected at a minimum of every 5-years from the network, another method should be utilized to ensure undesirable results are not occurring within the Subbasin.*

b. *Provide a description of how the InSAR data will be incorporated into identifying undesirable results for land subsidence.*

As defined in the 2022 GSP, the representative monitoring network for land subsidence was based on the Sacramento Valley Subsidence Network, which included 22 benchmarks in the Sutter Subbasin. The network was developed and monitored jointly by DWR, USBR, and local partners with surveying scheduled to occur every 5 years. Since adoption of the 2022 GSP, DWR and its partners have discontinued monitoring of the Sacramento Valley Subsidence Network.

The GSAs have developed an updated representative monitoring network based primarily on InSAR data published by DWR, which is open source and consistently available (TRE ALTAMIRA Inc., 2026). InSAR has a vertical accuracy of 0.04 to 1.18 inches (0.003 to 0.098 feet) at a 95% confidence level (Towill, 2026). Measurement uncertainties may lead to a rounding influence on the reported value as InSAR vertical displacement data are reported in tenths of a foot (e.g. -0.1 feet, 0.2 feet). To reduce the influence of uncertainty on subsidence evaluations, the InSAR analysis utilizes spatial and temporal averages to characterize subsidence patterns across the entire Subbasin.

The updated representative monitoring network includes 125 5-square-mile "InSAR Zones" (**Figure 6-8**). For each InSAR Zone, average annual vertical displacement is calculated over the most recent 5-year period (based on water year), resulting in 125 individual values. This method reduces the effect of localized and climatic variability, allowing for a balanced assessment of long-term subsidence trends across the Subbasin.

The updated representative monitoring network for land subsidence also includes a CGPS station (CGPS Station 1500) in the southern tip of Subbasin and an extensometer located approximately five miles outside the Subbasin boundary to the southeast, as shown in **Figure 6-8** (California Department of Water Resources, 2026; SOPAC, 2023). Due to their relatively distant position from the majority of the Subbasin, results from the extensometer and CGPS station will be used primarily to validate InSAR observations, rather than to contribute directly to assessments. The updated representative monitoring network is deemed sufficient density and frequency for monitoring vertical displacement, especially as all components of the network provide continuous and publicly available data. Conditions relative to inelastic land subsidence will be evaluated on an annual basis as part of GSP annual report development.

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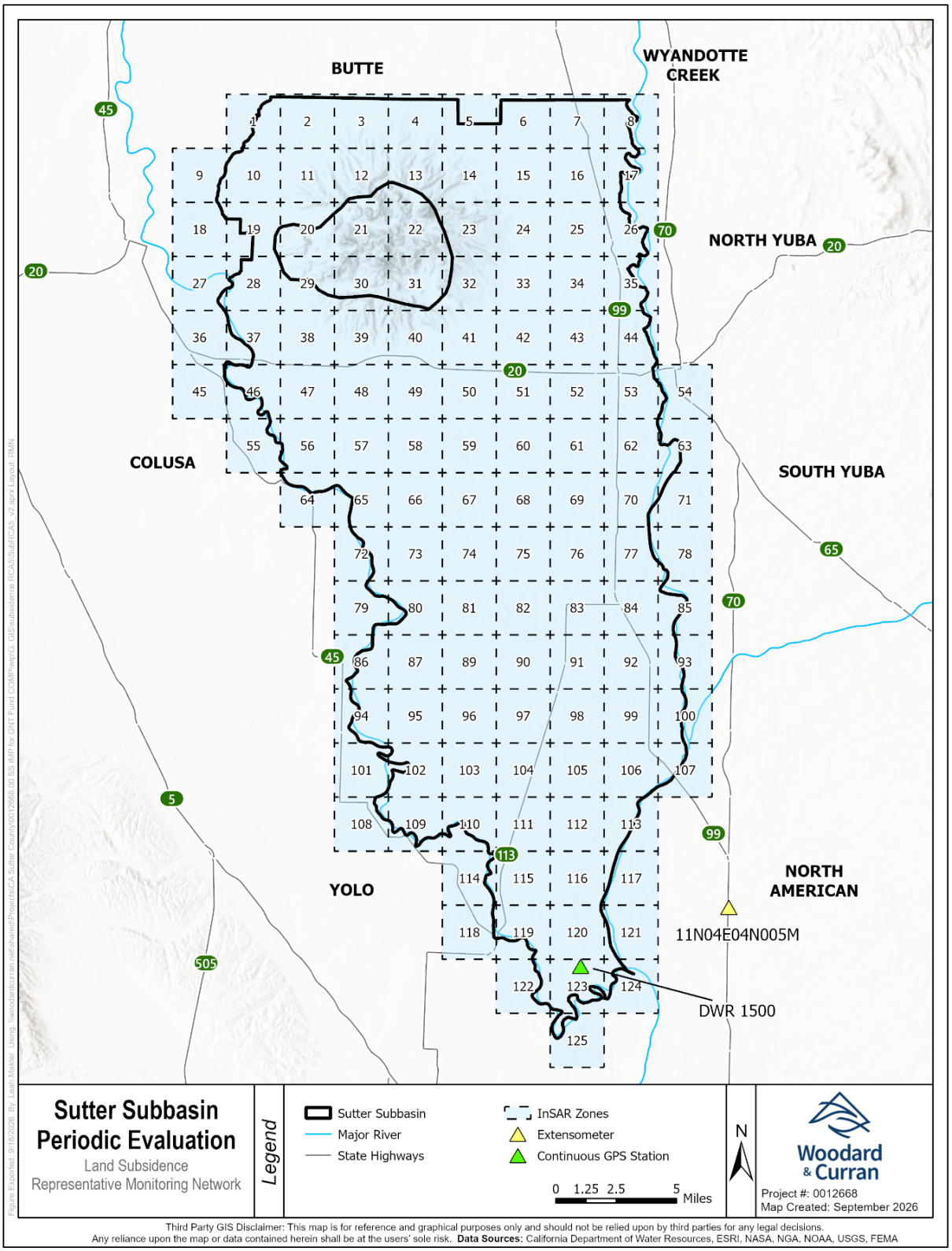

FIGURE 6-8: REVISED LAND SUBSIDENCE MONITORING NETWORK

6.6 Depletions of Interconnected Surface Water

The 2022 GSP established a representative monitoring network for interconnected surface water intended to characterize the location, timing, and volume of depletions of interconnected surface water. During reevaluation of the monitoring networks as part of 2027 GSP Amendment, it was determined that the original monitoring network could no longer adequately assess for conditions related to interconnected surface water. Groundwater levels will be used as proxy in the interim for monitoring of interconnected surface waters, where justification is provided in Section 6.5.6.2 of the 2027 GSP Amendment. Therefore, the updated groundwater level monitoring network as shown in **Figure 6-1** through **Figure 6-4**, including the monitoring frequency and density, are also applicable to interconnected surface water.

Due to a lack of spatial coverage (both horizontally and vertically), the understanding of depletions of interconnected surface water could be improved through the collection of additional groundwater level data along interconnected streams within the Sutter Subbasin, upstream and downstream in neighboring subbasins, and along tributaries to the Sacramento and Feather Rivers.

The Sutter Subbasin GSAs filed a TSS Well Service Request with DWR in April 2021 to support the construction of 13 nested equipped groundwater monitoring wells. The purpose of the TSS undertaking is to construct wells to varying depths at or near selected California Data Exchange Center (CDEC) stream gage locations to add to the interconnected surface water representative monitoring network. These wells will monitor areas where groundwater recharge from rivers occurs, based on groundwater contours, to broaden data collection efforts and support better understanding of interconnected waters. As noted in **Section 6.1**, the Sutter Subbasin GSAs are preparing a well siting analysis (to be completed by early 2027) that identifies and proposes locations to install dedicated monitoring wells to fill data gaps. This effort is being conducted simultaneously with the GSP amendment and Periodic Evaluation effort. Using the results of this analysis, the Subbasin GSAs will confirm the availability of selected sites for well construction and coordinate with DWR to move forward with the TSS process. Future updates will be provided in subsequent annual reports as data gaps are filled.

Figure 6-9 shows the locations of the planned nested wells proposed in the Subbasin's TSS application as well as potential future monitoring locations identified as part of the well siting analysis study.

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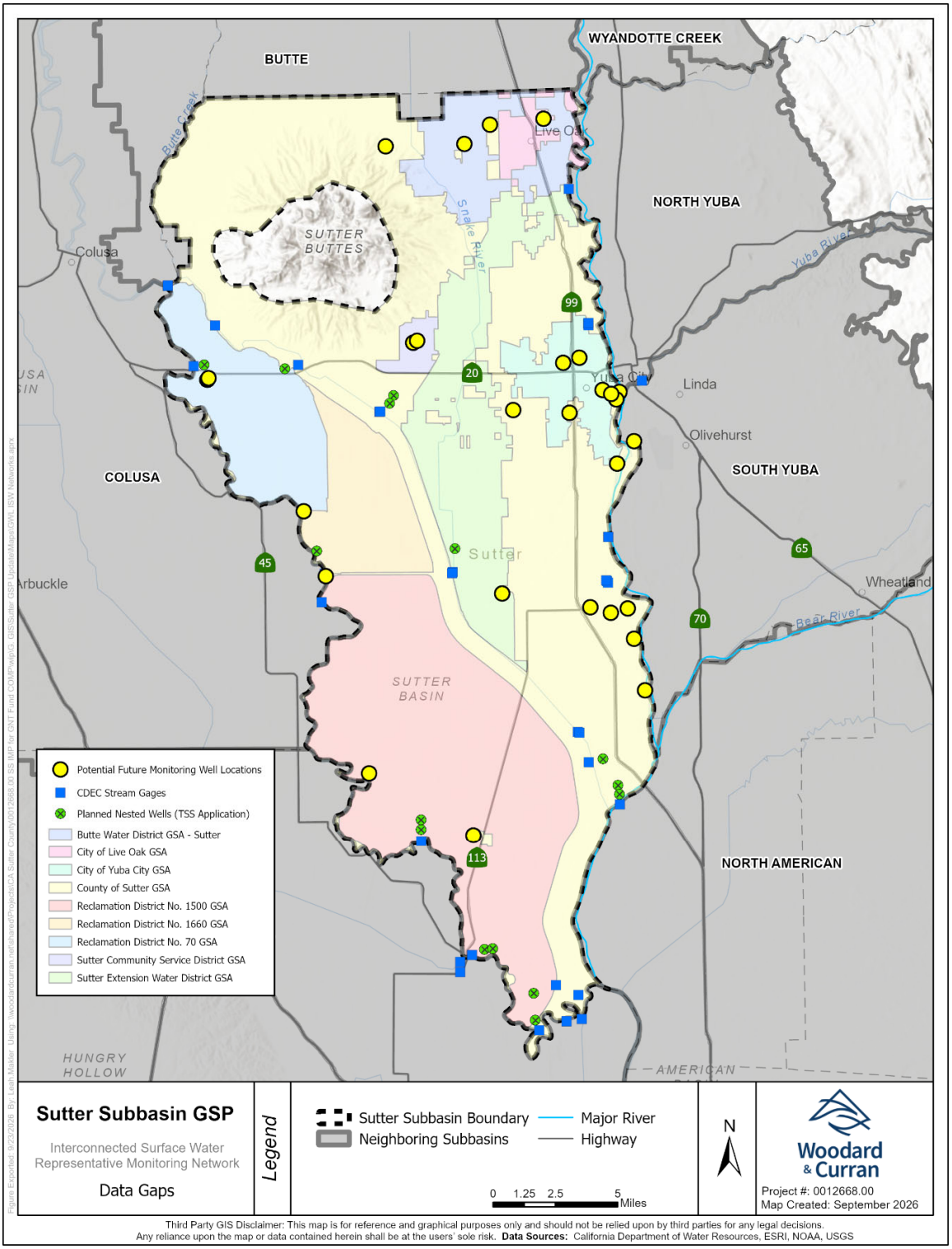

FIGURE 6-9: IDENTIFIED DATA GAPS FOR INTERCONNECTED SURFACE WATER MONITORING

7. GSA AUTHORITIES AND ENFORCEMENT ACTIONS

GSP regulations §356.4 include additional requirements that the periodic evaluation assessment shall include:

> *(g) A description of relevant actions taken by the Agency, including a summary of regulations or ordinances related to the Plan.*
>
> *(h) Information describing any enforcement or legal actions taken by the Agency in furtherance of the sustainability goal for the basin.*

Each of these requirements are described in the subsections below.

7.1 Relevant Actions

Executive Order (EO) N-3-23 required that the overlying GSAs provide written verification where a well is proposed to be located that groundwater extraction by the proposed well (or significant modification to an existing well) would not be inconsistent with any sustainable groundwater management program established in the GSP and adopted by the GSA and does not decrease the likelihood of achieving the sustainability goal for the subbasin. Additionally, issuance of a permit for a new groundwater well, or alteration of an existing well, required prior determination that the proposed well (or well modification) is not likely to interfere with the production and functioning of existing nearby wells and is not likely to cause subsidence that would adversely impact or damage nearby infrastructure. After the issuance of EO N-7-22, which was superseded by EO N-3-23, the Sutter Subbasin GSAs worked jointly with Sutter County's Environmental Health Department to review well permits and provide input on well placement and proposed well construction specifications in order to provide written verification in adherence with the EO. On September 5, 2024, the State's Governor issued EO N-3-24 which terminated the well drilling permit requirements imposed by the prior EOs. At this time, the Sutter Subbasin has suspended its well permit review efforts and the Subbasin GSAs have not implemented any new regulations or ordinances associated with the GSP since this date.

7.2 Enforcement or Legal Actions

The Sutter Subbasin GSAs have not taken any enforcement or legal action as part of GSP or SGMA implementation since adoption of the 2022 GSP. The Subbasin continues to maintain sustainable conditions, and as a result, it is not anticipated that any enforcement or legal actions, such as installing volumetric measuring devices on wells (i.e., flow meters) or collecting other data related to allocation programs or pumping reductions, are necessary. Sustainable conditions are projected to continue through 2042 and beyond based on current information and understanding

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8. OUTREACH, ENGAGEMENT, AND COORDINATION WITH OTHER AGENCIES

GSP Emergency Regulations §356.4(j) include a requirement that the periodic evaluation assessment shall include:

> *Where appropriate, a summary of coordination that occurred between multiple Agencies in a single basin, Agencies in hydrologically connected basins, and land use agencies.*

8.1 Outreach and Engagement

During the initial GSP development process in 2021, a complete draft GSP was distributed to the Sutter Subbasin Groundwater Management Coordination Committee (SSGMCC), the representative boards and councils of the Subbasin GSAs, and the interested stakeholders list and published to the Sutter Subbasin website[1]. The comment period was open from October 1, 2021 to November 12, 2021, and no requests for extension to the comment period were received. Comments were received from the California Department of Fish and Wildlife (CDFW), Audubon California, and a compendium of non-governmental organizations that included The Nature Conservancy, the Union of Concerned Scientists, Audubon California, CivicWell, American Rivers and Clean Water Action. Comments were also received from a private citizen in the Sutter Subbasin. The GSP evaluation period held by DWR following submittal of the 2022 GSP resulted in comment letters from the same group of entities plus the Central Valley Flood Protection Board. The private Sutter Subbasin citizen did not comment during DWR's review period. The comments received are included in Appendix 4-C to the 2022 GSP and 2027 GSP Amendment. Some of the comments were addressed and incorporated into the final 2022 GSP, while the remainder were addressed in the 2027 GSP Amendment.

Public engagement efforts over the last five years consist largely of SSGMCC meetings held quarterly to biannually and outreach during the annual reporting process. **Table 8-1** details key meeting topics discussed during each meeting since February 2022 (the start of the GSP implementation period). As noted in the 2022 GSP, PMAs were identified to maintain sustainable groundwater management and to allow for the GSAs to respond to unexpected changes in conditions in the Sutter Subbasin so that undesirable results can be avoided. As the Sutter Subbasin is currently being sustainably managed, there are no PMAs that are required to achieve sustainability. However, PMAs have been selected to assist in enhancing management capabilities and improving the understanding of the groundwater system, and as such, PMAs have been and continue to be implemented with an as-needed opportunistic approach (based on funding availability and identified need at a given time). Updates on PMAs funded under DWR's SGM Grant Program's SGMA Implementation Funding, Round 2 continue to be discussed at SSGMCC meetings. Attendees at SSGMCC meetings have periodically been encouraged to provide input on PMAs for consideration in the Sutter Subbasin related to SGMA implementation. As of the development of this Periodic Evaluation, no impacts on beneficial users or uses have been identified or observed as part of PMA implementation and none are anticipated as all PMAs implemented to date are focused on improved data collection, filling data gaps, monitoring, and financing implementation. In the unlikely event potential impacts as a result of PMAs are identified, updates on the potential impact will be provided at subsequent SSGMCC meetings and documented in the following Annual Report to the GSP.

[1] The Sutter Subbasin website can be found at http://suttersubbasin.org/

TABLE 8-1: LIST OF SSGMCC MEETINGS SINCE FEBRUARY 2022

Meeting Title	Date	Location	Key Meeting Topics
SSGMCC Meeting	March 28, 2023	Yuba City Wastewater Treatment Facility (302 Burns Drive, Yuba City, CA 95991)	- GSA well application review process - Proposed future activities
SSGMCC Meeting	May 30, 2023	Sutter County Upstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- Monitoring reminders - Well application review forms - TSS well locations - Website and DMS maintenance - SSGMCC coordination
SSGMCC Meeting	June 23, 2023	Sutter County Upstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- Representative monitoring network revisions - Re-evaluation of groundwater quality representative monitoring network - Well application review process - TSS well locations - Groundwater substitution transfer pumping and approval - Status PMAs
SSGMCC Meeting	November 2, 2023	Sutter County Upstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- DWR determination letter and RCAs - Evaluation of surrounding subbasins determination letters and corrective actions - Report on State Board finding on Critically Overdrafted Basins Deemed Inadequate and Potential Lessons Learned - SGMA Implementation Round 2 grant award - Public outreach - SGMA Implementation Support - Well permitting guidance document from DWR - Monitoring reminders - TSS well locations - Status of PMAs
SSGMCC Meeting	March 20, 2024	Sutter County Upstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- SGMA Implementation Round 2 grant - Website and DMS updates - Monitoring reminders - ISW sustainable management criteria and representative monitoring network - TSS well locations - Well permitting guidance document from DWR - Groundwater substitution transfers and approval process
SSGMCC Meeting	September 12, 2024	Sutter County Upstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- SGMA Implementation Round 2 grant - GSA billing customers - Website and DMS maintenance - Outreach

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Meeting Title	Date	Location	Key Meeting Topics
			- Monitoring reminders - Lessons learned from 2025 Periodic Evaluations and Plan Amendments - California Stream Gage Improvement Program - TSS well locations - Groundwater substitution transfers and approval process
SSGMCC Meeting	February 20, 2025	Sutter County Upstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- WY2024 annual report - Financing plan options - Monitoring well instrumentation options - Public outreach & newsletter - Website and DMS maintenance - Monitoring reminders - Addressing data gaps - DWR determination letter and RCAs
SSGMCC Meeting	June 3, 2025	Sutter County Upstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- Financing plan options - Public outreach - Website and DMS maintenance - Monitoring reminders - Addressing data gaps - DWR RCAs - Governance and reporting responsibilities
SSGMCC Meeting	December 15, 2025	Sutter County Upstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- Grant status - Monitoring well instrumentation - 5-year budget for financing plan - WY2025 annual report - Public outreach - Monitoring - DWR RCAs
SSGMCC Meeting	April 16, 2026	Sutter County Upstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- Grant status - WY2025 annual report - DWR determination letter and RCAs - GSP Amendment and Periodic Evaluation update - Monitoring well instrumentation - Geophysical surveys - Fee study for Prop 218 process - Public outreach - Monitoring reminders
SSGMCC Meeting	August 25, 2026	Sutter County Upstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- Grant status - DWR determination letter and RCAs responses - GSP Amendment and Periodic Evaluation update - Monitoring well instrumentation

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Meeting Title	Date	Location	Key Meeting Topics
			- Geophysical survey update - Fee study for Prop 218 process - Public outreach - Monitoring reminders
SSGMCC Meeting	September 30, 2026	Reclamation District No. 1500 offices (15096 Cranmore Road, Robbins, CA 95676)	- Grant status - DWR determination letter and RCAs responses - GSP Amendment and Periodic Evaluation update - Representative monitoring network changes - Monitoring well instrumentation and weather station installation - Geophysical survey update - Financing plan updates - GSP adoption support needs - Public outreach - Monitoring reminders
SSGMCC Meeting	October 26, 2026	Sutter County Downstairs Conference Room (1130 Civic Center Blvd, Yuba City, CA 95993)	- Financing plan updates - Grant status - Future grant funding opportunities - GSP Amendment and Periodic Evaluation update - Well siting analysis and data gaps - Monitoring well instrumentation and weather stations - Geophysical survey updates - GSP adoption support needs - Public outreach - Monitoring reminders
SSGMCC Meeting	December 2, 2026	TBD	- TBD
SSGMCC Meeting	January 11, 2027	TBD	- TBD

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Other ongoing outreach in the Sutter Subbasin includes preparation and distribution of an annual newsletter following submittal of each GSP annual report, updated postings on the Subbasin's website at http://suttersubbasin.org/, and regular reporting to the GSAs boards and/or city councils and at growers' meetings.

A review of outreach and engagement activities as described in the 2022 GSP (specifically Chapter 4 of the 2027 GSP Amendment) and in the Communication and Engagement Plan (C&E Plan, Appendix 4-A of 2027 GSP Amendment) has been completed as part of this Periodic Evaluation. The methods described in the 2022 GSP and C&E Plan are still relevant during GSP implementation and have been adhered to since initial GSP development. Updates to the C&E Plan were made as part of this Periodic Evaluation and GSP amendment, largely focused on documenting all SSGMCC meetings conducted through development of this Periodic Evaluation and GSP amendment.

8.2 Responsibilities of GSA Boards

The Subbasin's nine GSAs each have their own governing boards (either boards of directors or city councils). The SSGMCC is the advisory body that supports and provides recommendations to the GSAs' governing boards/city councils for ongoing sustainable groundwater management and development/implementation of the Sutter Subbasin GSP. All meetings of the SSGMCC and GSA boards/city councils are noticed in accordance with the Brown Act. Periodic SGMA and GSP-related updates are provided during meetings of the GSAs as needed.

The 2027 GSP Amendment and Periodic Evaluation were adopted by the relevant GSA Boards of Directors or City Councils on the following dates:

- Butte Water District – Sutter – January XX, 2027
- City of Live Oak – January XX, 2027
- City of Yuba City – January XX, 2027
- County of Sutter – January XX, 2027
- Reclamation District No. 70 – January XX, 2027
- Reclamation District No. 1500 – January XX, 2027
- Reclamation District No. 1660 – January XX, 2027
- Sutter Extension Water District – January XX, 2027
- Sutter Community Services District – January XX, 2027

Outreach and engagement to interested parties was conducted primarily through SSGMCC meetings, as noted in **Table 8-1**. Of the 15 total SSGMCC meetings held over the evaluation period, a total of six meetings included discussion of this Periodic Evaluation and GSP amendment. Interested parties were invited to provide comment during the SSGMCC meetings, but also during the public review period of this Periodic Evaluation and the 2027 GSP Amendment. Interested parties are also provided a second opportunity for comment during DWR's public review period following submittal of the 2027 GSP Amendment.

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8.3 Coordination with Other Agencies

Sutter Subbasin GSAs and their representatives have participated in inter-agency coordination periodically throughout the first five years of GSP implementation. Representatives from the Sutter Subbasin participate in quarterly meetings of the Groundwater Task Force through NCWA, where representatives from subbasins across the Sacramento Valley coordinate on regional water management. Sutter Subbasin representatives also participated in Northern Sacramento Valley interbasin coordination efforts led by Butte County, meeting with representatives from the Butte, Wyandotte Creek and North Yuba Subbasins on August 7, 2025. The purpose of this collaboration was to establish a foundation and guidelines for sustained interbasin coordination through GSP implementation. The Sutter Subbasin is part of the Feather River Corridor coordination group along with Butte, Wyandotte Creek, and North Yuba Subbasins, and part of the South Sacramento Corridor coordination group along with Colusa and Yolo Subbasin.

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9. OTHER INFORMATION

GSP Emergency Regulations §356.4(k) include a requirement that the periodic evaluation shall include:

> *Other information the Agency deems appropriate, along with any information required by the Department to conduct a periodic review as required by Water Code Section 107033.*

9.1 Consideration of Adjacent Basins

The following subsections evaluate minimum thresholds for all applicable sustainability indicators along the shared boundaries between the Sutter Subbasin and the Butte, North Yuba, South Yuba, Wyandotte Creek[1], Colusa, Yolo and North American Subbasins. **Table 9-1** summarize the minimum threshold definitions in the Sutter Subbasin and its adjacent subbasins for each sustainability indicator.

The purpose of this comparison is to identify future areas of coordination to ensure proposed management of the Sutter Subbasin does not negatively impact adjacent subbasins. Overall, in evaluation of the proposed management of the Sutter Subbasin compared to adjacent subbasins, it is believed that management of the Sutter Subbasin is unlikely to adversely affect the ability of adjacent subbasins to implement their GSPs or to achieving and maintain their sustainability goals. Conversely, it is not anticipated that management of the adjacent subbasins will prevent the Sutter Subbasin from maintaining its sustainability goal.

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[1] Minimum thresholds in the Wyandotte Creek Subbasin are mapped for consistency with other surrounding subbasins but since the Sutter Subbasin and Wyandotte Creek less than 1 mile in length of shared boundary, an assessment/comparison of numeric minimum thresholds/methodology is not performed as groundwater activities are not known to occur in this area.

Table 9-1: Minimum Thresholds in Sutter and Adjacent Subbasins

Sustainability Indicator	Sutter	Butte	Colusa	North American	Wyandotte	Yolo [1]	North and South Yuba
Chronic Lowering of Groundwater Levels	Deepest groundwater elevation of either: 1. Historic low for available record at each representative monitoring site; or 2. The average operating range (difference between measurable objective and minimum threshold) for all representative monitoring sites using the above criteria for the following AZs, applied based on available screen interval or well depth information for each representative monitoring site: a. Shallow AZ and AZ-1 = 8.0 feet b. AZ-2 and AZ-3 = 16.5 feet	Shallower of either: 1. The shallowest 7th percentile of nearby domestic wells, or 2. The range of measured groundwater levels, or 20 feet (whichever is greater), below the observed historic low.	Focus wells: Minimum elevation between 2020 and 2022 Non-focus wells: Same criteria as focus wells minus margin of 15-25 feet selected for each representative monitoring well to be protective of drinking water well impacts and subsidence (whichever is more limiting)	20 feet above the total well depth of the shallow domestic well depth within a 1-mile radius of a representative monitoring site. Where proposed minimum threshold was greater than 20 feet below historical low groundwater levels at the representative site: • Minimum thresholds adjacent to interconnected surface water not established more than 5 feet below historical low groundwater levels • Minimum thresholds not to exceed 20 feet below historical groundwater levels	N/A – Shared boundary is less than one mile in length, where groundwater activities are not known to occur.	Historic minimum groundwater elevation in the period of record (pre-2016) plus 20% of the depth between the historic maximum and historic minimum elevation for the period of record (pre-2016) at each representative monitoring well	Deeper of: 1. The bottom of the shallowest domestic well near a monitoring well, adjusted for March measurements, or 2. The historical low March groundwater level from 1985 to present at the monitoring well, where a 75-foot minimum value was applied to the threshold.
Reduction of Groundwater Storage	Groundwater levels used as proxy	Groundwater levels used as proxy	Groundwater levels used as proxy	Groundwater levels used as proxy	N/A – Shared boundary is less than one mile in length, where groundwater activities are not known to occur.	Groundwater levels used as proxy	Groundwater levels used as proxy
Degraded Water Quality	Highest of: 1. Upper SMCL for TDS (1,000 mg/L) and Primary MCL for nitrate as N (10 mg/L) 2. Current groundwater quality conditions for TDS and nitrate as N based on data available from 2000 to time of GSP development or amendment (Summer 2021 or Summer 2026, respectively) at each representative monitoring well	Higher of: 1. 900 µS/cm for electrical conductivity (EC; recommended SMCL), or 2. Measured historical high EC concentration at each representative monitoring site	Higher of: 1. 900 µS/cm for EC, or 2. Pre-2015 historical maximum recorded EC value	Upper SMCL of 1,000 mg/L TDS and Primary MCL of 10 mg/L for nitrate as N	N/A – Shared boundary is less than one mile in length, where groundwater activities are not known to occur.	1,000 parts per million (ppm) TDS over three-year rolling average	1,000 µS/cm of EC or where historical conditions are above 1,000 µS/cm approximately 10% above historical concentrations
Land Subsidence	0.5 feet of subsidence over 5-year rolling average calculated by water year	0.5 foot of subsidence over 5-year period within same InSAR pixel	0.1 feet/year or cumulative subsidence of 2 feet from January 2024	0.5 feet over 5-year period and the affected area encompassing 5 or more square miles (mi^2)	N/A – Shared boundary is less than one mile in length, where groundwater activities are not known to occur.	0.1 feet/year, or 2 feet total subsidence between 2022 and 2042 based on 5-year rolling average	0.5 feet of subsidence over 5-year period over a 5 mi^2 area using a rolling average by water year
Depletions of Interconnected Surface Water	Groundwater levels used as proxy	10 feet below measured historical low for each representative monitoring well	Where groundwater elevation at each representative monitoring well closest to October 15, 2015 selected with additional 10 feet added to provide appropriate margin of operational flexibility	Groundwater levels used as proxy	N/A – Shared boundary is less than one mile in length, where groundwater activities are not known to occur.	Groundwater levels used as proxy	Groundwater levels used as proxy

Note: Information based on the most recent available adopted or Public Draft GSP or Periodic Evaluation as of October 2026.

[1] Methodology shown only includes North Yolo management area, as it encompasses the area along the shared boundary with Sutter Subbasin.

9.1.1 Chronic Lowering of Groundwater Levels

Figure 9-1 shows the minimum thresholds for the chronic lowering of groundwater levels sustainability indicator in the Sutter Subbasin and adjacent subbasins[1] presented as groundwater elevations (feet relative to mean sea level [ft MSL], relative to the NAVD88 vertical datum), as presented in the most recently available adopted or Public Draft GSP or Periodic Evaluation as of October 2026. Minimum thresholds in depth to groundwater (feet below ground surface [ft bgs]) are calculated from groundwater surface elevations and reference point elevations and presented in **Figure 9-2** to account for changes in topography between monitoring locations.

Within the Sutter Subbasin and surrounding subbasins, minimum thresholds range from more than 300 ft MSL to more than -100 feet MSL (**Figure 9-1**). The highest minimum threshold elevations are concentrated along the Sierra Nevada foothills and Coast Range, with lower minimum threshold elevations along the valley floor, which is reflective of regional topography. When correcting for surface topography, most minimum thresholds are between 50 and 150 feet bgs, although substantially deeper minimum thresholds can be observed in parts of adjacent subbasins (**Figure 9-2**).

Along the shared Colusa Subbasin boundary, minimum thresholds in the Sutter Subbasin (-7.9 to 21.5 ft MSL) are comparable or higher than in the Colusa Subbasin (-8.1 to 7.4 ft MSL) (**Figure 9-1**). Along the Yolo Subbasin shared boundary, minimum thresholds are substantially lower in the Yolo Subbasin (-88.3 to -31.6 ft MSL) compared to the Sutter Subbasin (-0.41 to 10.51 ft MSL). For representative monitoring wells along or near the shared North American Subbasin boundary, minimum thresholds are generally comparable or lower in the North American Subbasin (-17 to 11.2 ft MSL) compared to the Sutter Subbasin (0.34 to 10.51 ft MSL). Compared to the local management levels (LMLs) in the Yuba Subbasins, Sutter Subbasin minimum thresholds range from 31.21 to 45.80 ft MSL along the North Yuba Subbasin boundary and -30.19 to 22.09 ft MSL along the South Yuba Subbasin boundary, where LMLs range from 35 to 50 ft MSL in the North Yuba Subbasin and -7 to 11 ft MSL in the South Yuba Subbasins. Thresholds across the shared Sutter-Yuba Subbasin boundaries generally comparable but are slightly lower in the South Yuba Subbasin. Compared to the Butte-Sutter Subbasin shared boundary, minimum thresholds in the Sutter Subbasin have a wider range (3.90 to 60.03 ft MSL) than in the Butte Subbasin (25 to 50 ft MSL).

When correcting for topography, minimum thresholds in the Sutter Subbasin are generally shallower than those established in adjacent subbasins (**Figure 9-2**). Along the shared boundary with the Colusa Subbasin, minimum thresholds in the Sutter Subbasin (11.06 to 37.73 ft bgs) are shallower than in the Colusa Subbasin (39.63 to 109.47 ft bgs). Similarly, minimum thresholds are shallower in the Sutter Subbasin (14.66 to 22.65 ft bgs) compared to the Yolo Subbasin (71.16 to 115.75 ft bgs) along the shared boundary. Comparing minimum thresholds along the shared North American-Sutter Subbasins shared boundary, values are more comparable though are generally shallower in the Sutter Subbasin (18.92 to 36.74 ft bgs) than the North American Subbasin (14.71 to 68.62 ft bgs). Compared to LMLs in the Yuba Subbasins, Sutter Subbasin minimum thresholds range from 31.55 to 46.14 ft bgs along the North Yuba Subbasin boundary and 31.99 to 82.24 ft bgs along the South Yuba Subbasin boundary, where LMLs range from 30 to 53 ft bgs in the

[1] For the Yuba Subbasins, local management levels (LMLs) are compared to minimum thresholds in adjacent basins. LMLs are a non-regulatory criterion used to identify locally preferred minimum groundwater levels in the Yuba Subbasins. Groundwater levels below the LML are not considered significant and unreasonable and thus are not minimum thresholds but they provide guidance for local management of the Yuba Subbasins, including guidance for implementation of adaptive management.

North Yuba Subbasin and 35 to 50 ft MSL in the South Yuba Subbasins. Thresholds across the shared Sutter-Yuba Subbasin boundaries are generally comparable but are shallower in the South Yuba Subbasin. Compared to the Butte-Sutter Subbasin shared boundary, minimum thresholds in the Sutter Subbasin have a wider range (18.00 to 74.10 ft bgs) than the Butte Subbasin (32.05 to 45.99 ft bgs).

It should be noted that Feather River MW-1B (or FR-1B) is located in the representative monitoring network for both the Sutter Subbasin GSP and Yuba Subbasins GSP. This well is located in the Sutter Subbasin and has a minimum threshold value of -30.19 ft MSL (85 ft bgs) in the Sutter Subbasin GSP and a local management level of -7 ft MSL (or 43 ft bgs) in the Yuba Subbasins GSP. Representatives from the Sutter and South Yuba Subbasins will coordinate to ensure established threshold values do not cause undesirable results in the neighboring subbasin.

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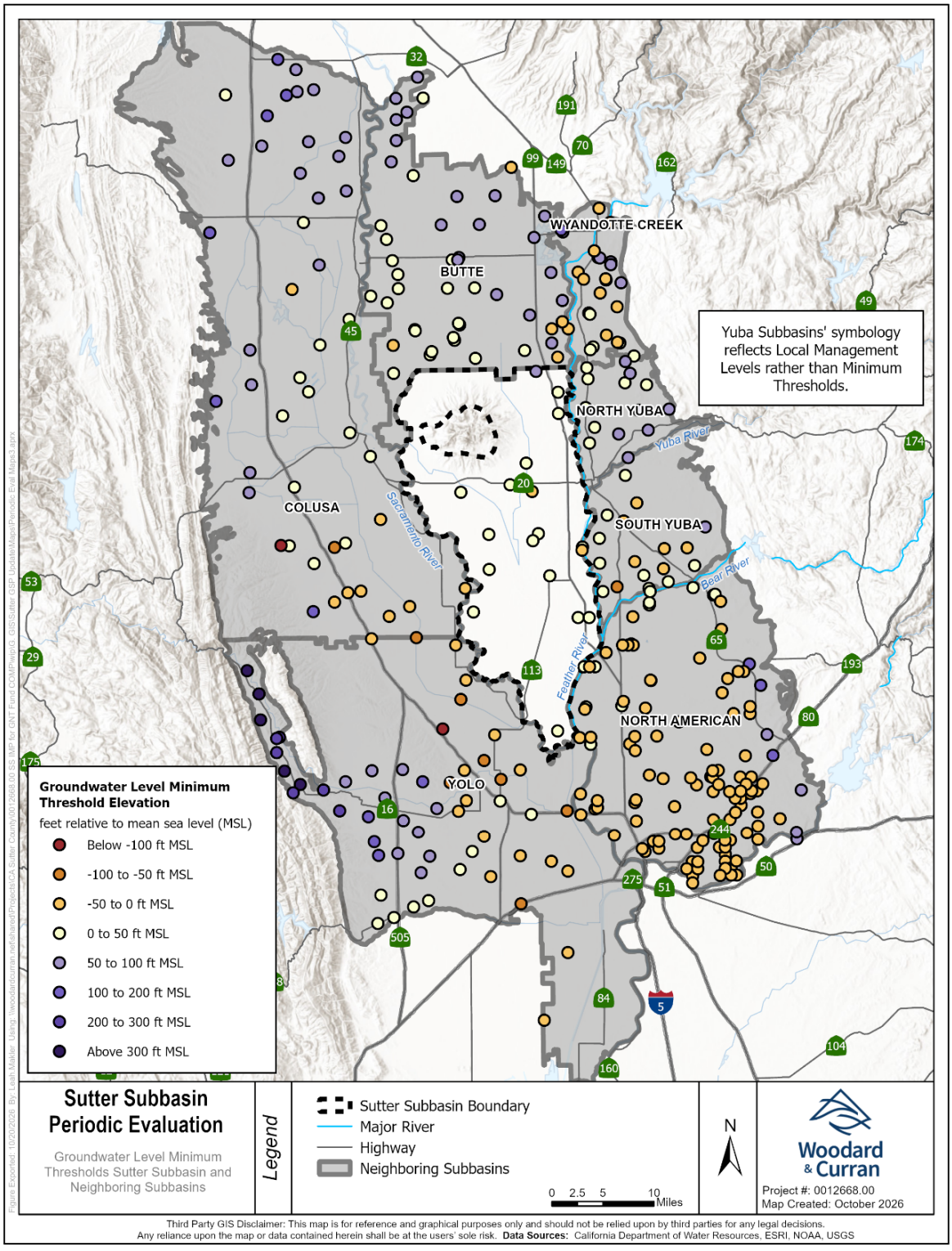

FIGURE 9-1: GROUNDWATER LEVEL MINIMUM THRESHOLDS, SUTTER SUBBASIN AND ADJACENT SUBBASINS (FEET ABOVE/BELOW MSL)

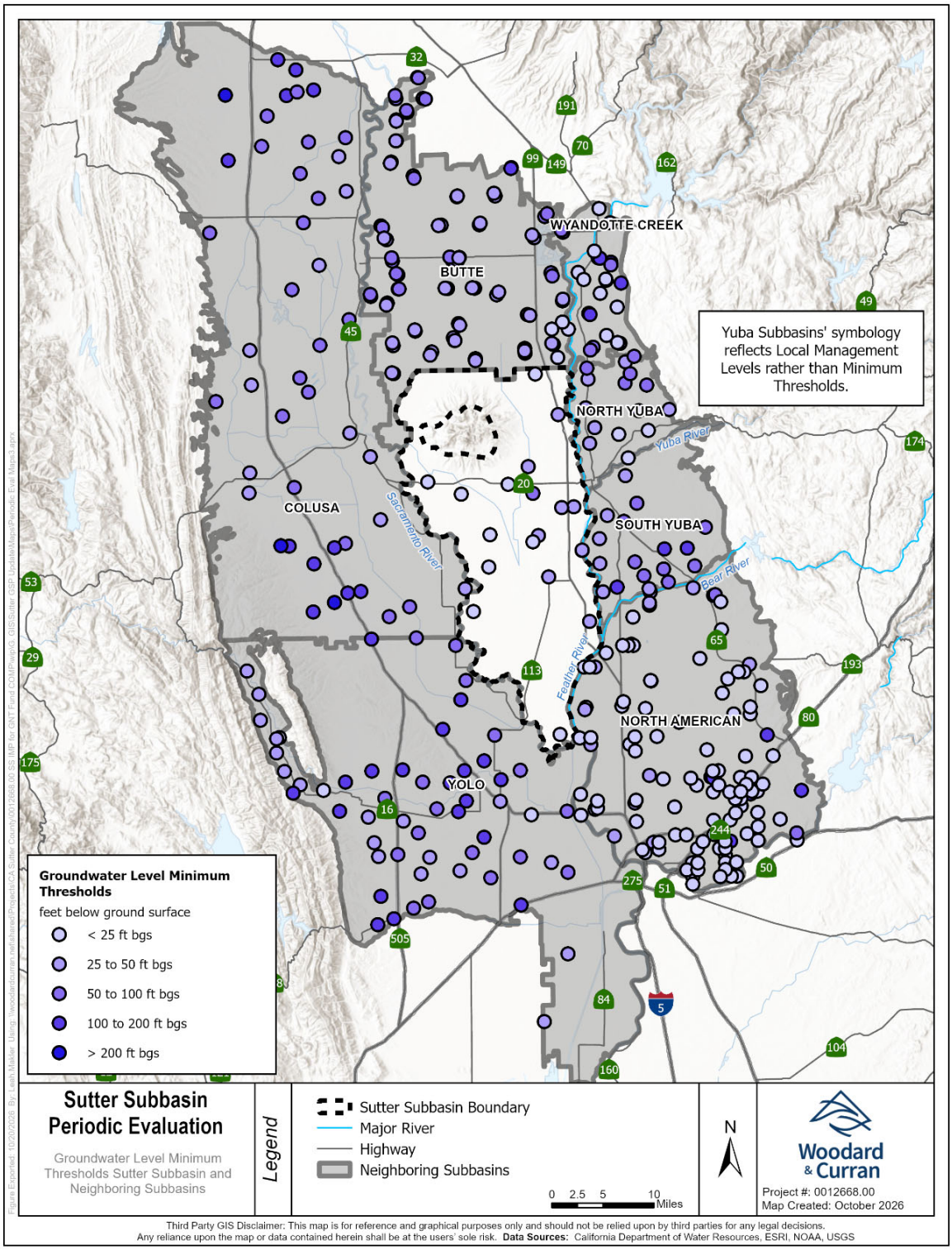

FIGURE 9-2: GROUNDWATER LEVEL MINIMUM THRESHOLDS, SUTTER SUBBASIN AND ADJACENT SUBBASINS (FEET BELOW GROUND SURFACE)

9.1.2 Reduction in Groundwater in Storage

Groundwater levels are used as proxy for the reduction of groundwater in storage sustainability indicator for the Sutter Subbasin and its adjacent subbasins. Therefore, the representative monitoring wells and numeric minimum threshold comparison detailed in **Section 9.1.1** is also applicable to groundwater storage.

9.1.3 Degraded Water Quality

Figure 9-3 shows the representative monitoring sites for the degraded water quality sustainability indicator in the Sutter Subbasin and its adjacent subbasins. A direct comparison of minimum threshold values is not feasible as each subbasin has set SMC for different constituents using different parameters; therefore, a qualitative discussion is contained herein.

Table 9-1 includes the methodologies used to establish minimum thresholds for degraded water quality in the Sutter Subbasin and its adjacent subbasins. As shown in **Figure 9-3**, all subbasins have established minimum thresholds for salinity (specific conductance, electrical conductivity, or TDS). Both the Sutter and North American Subbasins have established minimum thresholds for nitrate as N. All minimum threshold definitions are consistent with California drinking water standards or agricultural water quality objectives for salinity and incorporate historical concentrations of constituents of concern ensuring consistency with California's Antidegradation Policy (State Board Resolution 68-16).

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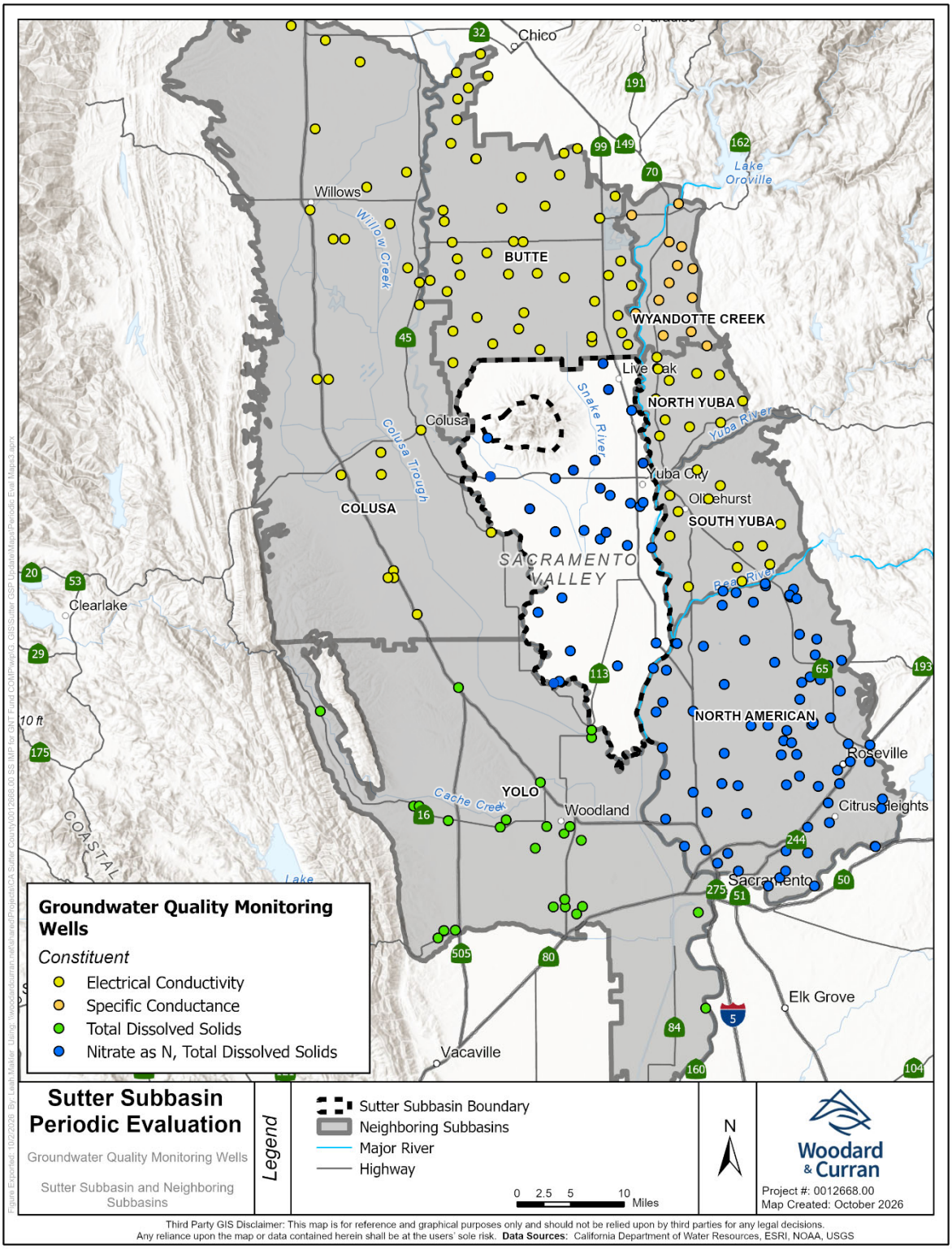

FIGURE 9-3: GROUNDWATER QUALITY REPRESENTATIVE MONITORING SITES – SUTTER AND ADJACENT SUBBASINS

9.1.4 Land Subsidence

Figure 9-4 shows the representative monitoring sites for the land subsidence sustainability indicator in the Sutter Subbasin and adjacent subbasins.[1]

As summarized in **Table 9-1**, minimum thresholds for land subsidence are established similarly between the Sutter Subbasin and its adjacent subbasins. The Sutter, North American, and Yuba Subbasins have established near identical minimum threshold definitions, with the North American and Yuba Subbasin GSPs including an overall metric of 0.5 feet of subsidence per year over a 5-year period over an area at least a 5 mi^2 area. Butte Subbasin's land subsidence minimum threshold definition is similar but without the aerial component and relies on extracting InSAR pixel values at fixed locations as shown in **Figure 9-4**. Minimum threshold definitions for land subsidence in the Colusa and Yolo Subbasins (North Yolo management area only) are established similarly at 0.1 feet/year or 2 feet of cumulative subsidence, where Colusa Subbasin utilizes InSAR data calculating average subsidence values by PLSS sections and Yolo Subbasin incorporates a 5-year running average incorporating benchmarks, extensometers, and CGPS stations along with InSAR data.

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[1] Benchmark, extensometer, and CGPS locations identified as representative monitoring locations in the Yolo Subbasins GSP are not shown due to lack of publicly available location information.

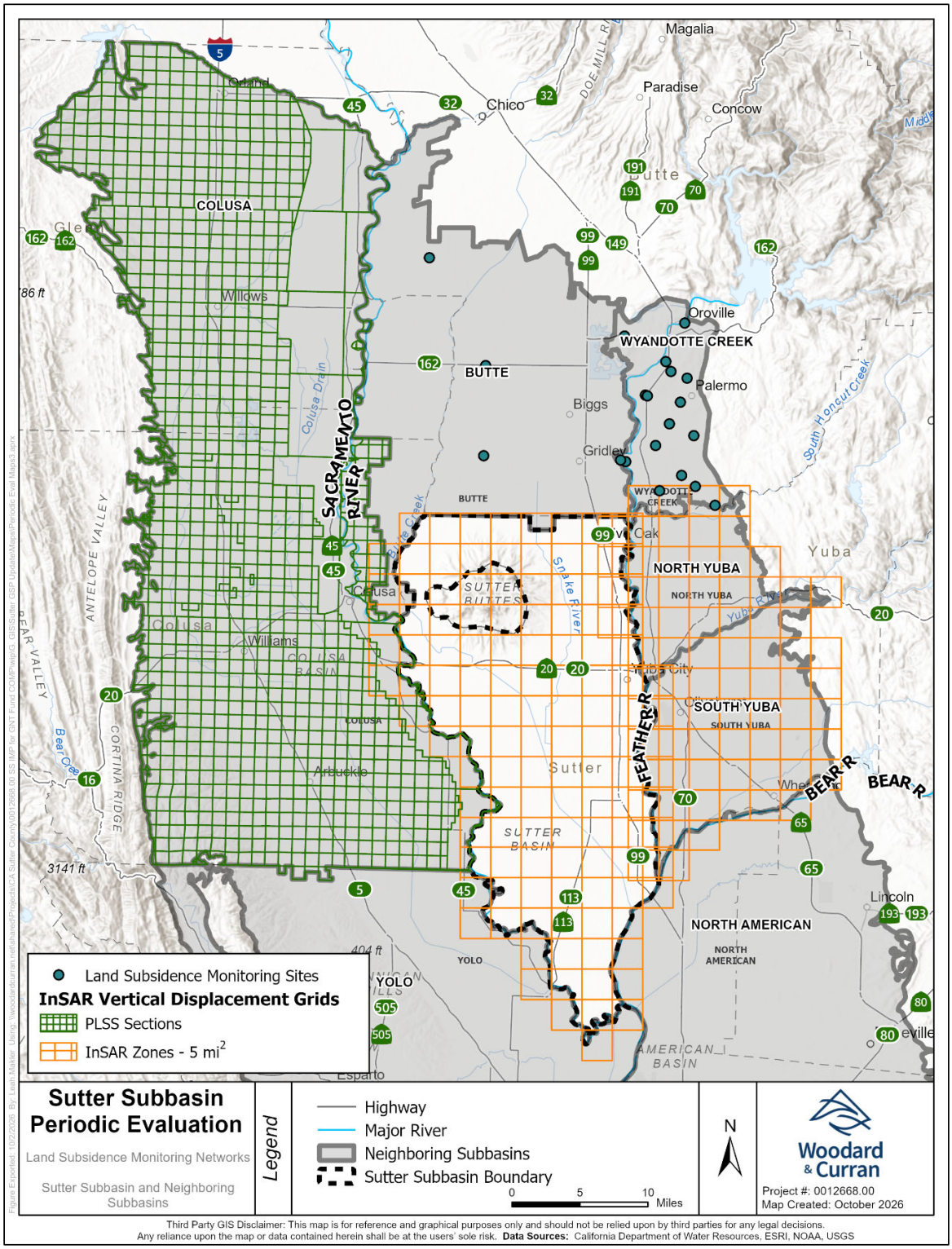

FIGURE 9-4: LAND SUBSIDENCE REPRESENTATIVE MONITORING SITES, SUTTER AND ADJACENT SUBBASINS

9.1.5 Depletions of Interconnected Surface Water

In the Sutter Subbasin and several adjacent subbasins (namely North American, Yolo, and Yuba Subbasins), minimum thresholds for the depletion of interconnected surface water sustainability indicator use groundwater levels as proxy (**Table 9-1**), where representative monitoring networks differ in several subbasins from the groundwater level representative monitoring networks shown in **Figure 9-1** and **Figure 9-2**. In the Butte and Colusa Subbasins, a more conservative minimum threshold definition is established for interconnected surface water as compared to their respective groundwater levels, where interconnected surface water minimum thresholds are established no deeper than 10 feet below historic low conditions or a specified date (October 15, 2015, likely the height of the 2012-2016 drought).

Figure 9-5 and **Figure 9-6** include the interconnected surface water representative monitoring sites and associated minimum thresholds[1] in groundwater surface elevations and depth to groundwater, respectively. The Sutter, North American, and Yuba Subbasins utilize the exact same representative monitoring wells and SMC as their groundwater level representative monitoring networks to assess interconnected surface water criteria, meaning that any comparisons between the two would be identical to the discussion in **Section 9.1.1**. Therefore, comparison included in this section focuses on the shared boundary with Butte, Yolo, and Colusa Subbasins.

As shown in **Figure 9-5**, interconnected surface water minimum thresholds in adjacent subbasins generally range from approximately -50 ft MSL to 50 ft MSL. As with groundwater level minimum thresholds, higher minimum threshold elevations are concentrated along the Sierra Nevada foothills and Coast Range with lower minimum threshold elevations along the valley floor, which is reflective of regional topography. Along the shared Colusa Subbasin boundary, minimum thresholds in the Sutter Subbasin (-7.9 to 21.5 ft MSL) are comparable or higher than in the Colusa Subbasin (-8.1 to 7.4 ft MSL). Along the Yolo Subbasin shared boundary, minimum thresholds are substantially lower in the Yolo Subbasin (-39.2 to -31.6 ft MSL) compared to the Sutter Subbasin (-0.41 to 10.51 ft MSL). For the representative monitoring well along the shared Butte Subbasin boundary (71 ft MSL), minimum thresholds in the Sutter Subbasin are lower (3.9 to 60.03 ft MSL).

Figure 9-6 presents the same minimum thresholds as depth to groundwater (ft bgs). Interconnected surface water minimum thresholds in the Sutter Subbasin are similar to those along shared boundaries with neighboring subbasins. Most interconnected surface water minimum thresholds are between 50 and 100 ft bgs, with few exceeding 100 ft bgs, reflecting the necessity of available shallow groundwater to interconnected surface streams. When corrected for topographic differences by comparing minimum thresholds as depth to groundwater, minimum thresholds in adjacent subbasins are generally deeper than those in the Sutter Subbasin. Along the shared Colusa Subbasin boundary, minimum thresholds in the Sutter Subbasin (11.06 to 37.73 ft bgs) are comparable or shallower than in the Colusa Subbasin (18.8 to 109.47 ft MSL). Along the Yolo Subbasin shared boundary, minimum thresholds are substantially deeper in the Yolo Subbasin (77.19 to 80.03 ft bgs) compared to the Sutter Subbasin (14.66 to 22.65 ft bgs). For the

[1] For the Yuba Subbasins, local management levels (LMLs) are compared to minimum thresholds in adjacent basins. LMLs are a non-regulatory criterion used to identify locally preferred minimum groundwater levels in the Yuba Subbasins. Groundwater levels below the LML are not considered significant and unreasonable and thus are not minimum thresholds but they provide guidance for local management of the Yuba Subbasins, including guidance for implementation of adaptive management.

representative monitoring well along the shared Butte Subbasin boundary (16.77 ft MSL), minimum thresholds in the Sutter Subbasin deeper (18.00 to 74.10 ft MSL).

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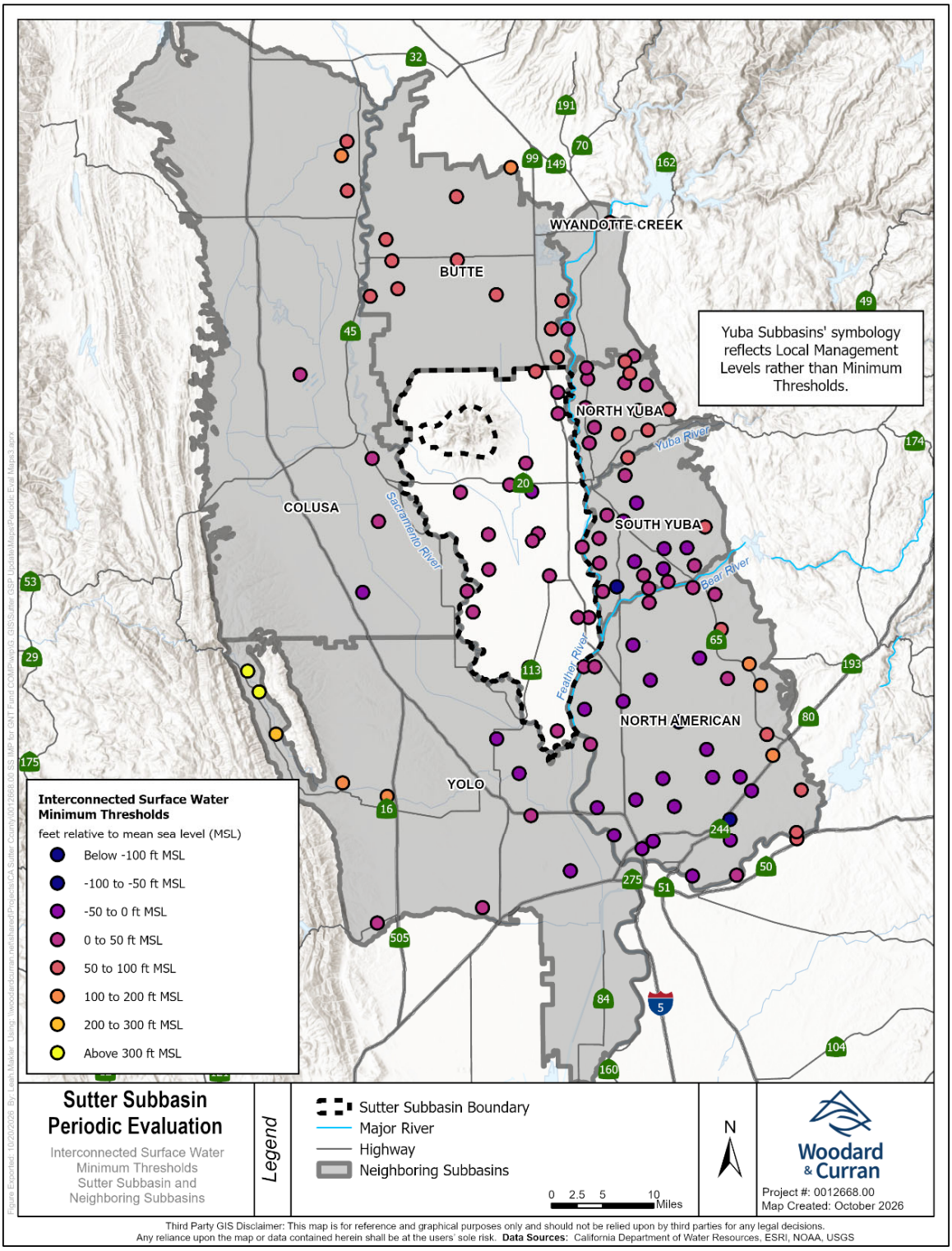

FIGURE 9-5: INTERCONNECTED SURFACE WATER MINIMUM THRESHOLDS, SUTTER SUBBASIN AND NEIGHBORING BASINS (FEET ABOVE/BELOW MSL)

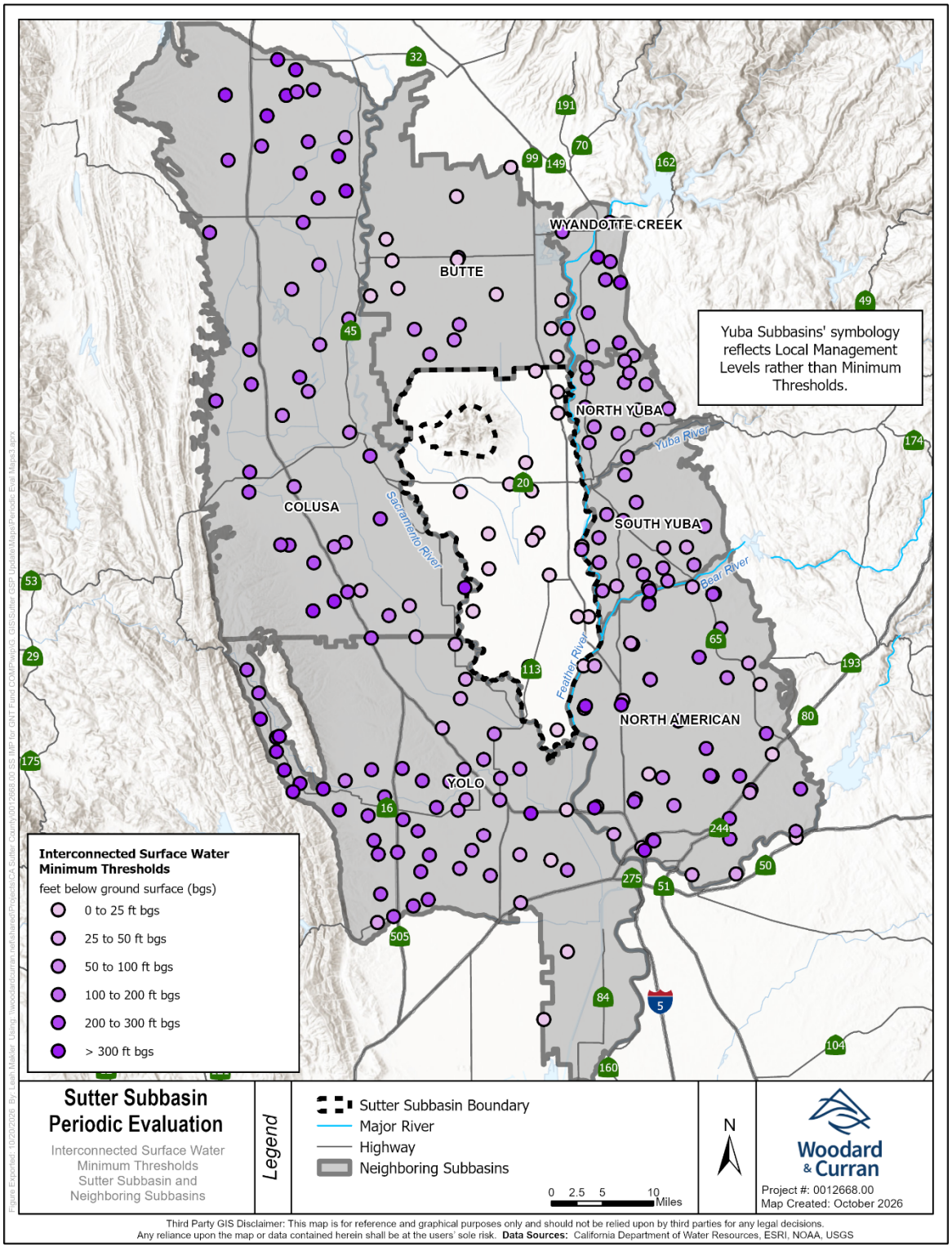

FIGURE 9-6: INTERCONNECTED SURFACE WATER MINIMUM THRESHOLDS, SUTTER SUBBASIN AND NEIGHBORING BASINS (FEET BELOW GROUND SURFACE)

9.1.6 Challenges Not Previously Discussed

There are currently no significant technical challenges/limitations faced by the Subbasin GSAs related to GSP implementation over the planning horizon. Sutter County has taken the lead in implementation of the Subbasin's GSP and is committed to providing support in coordination with other Subbasin GSAs as needed to ensure sustainable conditions are maintained throughout the Sutter Subbasin.

Some costs associated with GSP implementation, such as monitoring, have historically been met through either local or grant funds. The Sutter Subbasin GSAs are still committed to financially supporting implementation of the GSP through existing revenue streams, primarily through general or capital improvement funds, and have been actively working to develop long-term funding streams through the public process. In 2025, the Butte Water District GSA adjusted water rates under a Proposition (Prop) 218 process to provide revenue for their portion of GSP implementation. In 2026, the City of Yuba City GSA and City of Live Oak GSA also conducted Prop 218 processes to adjust their rate structure to provide funding for GSP implementation. In summer 2026, the remaining Subbasin GSAs retained Hansford Economic Consultant to conduct a fee study to determine a defensible fee structure that can be applied in the remaining portions of the Sutter Subbasin to provide additional long-term funding for GSP implementation. This study is currently underway and is expected to be completed in early 2027.

While the GSAs in the Sutter Subbasin have the powers and authority to impose fees and assessments, other funding sources such as State and federal grant programs have been sought out to reduce the local financial burden. The GSAs have tracked and pursed grant opportunities over the evaluation period to fund groundwater sustainability activities and local water infrastructure projects. As the Sutter Subbasin is currently being sustainably managed, there are no PMAs that are required to achieve sustainability. However, PMAs can assist in enhancing management capability and improving the understanding of the groundwater system. The Sutter Subbasin GSAs encourage DWR to continue to provide and advocate for funding opportunities for GSAs to continue to implement PMAs and fill data gaps to promote improved water supply sustainability and characterization of groundwater resources to the benefit of all Californians.

Butte Water District and Sutter Extension Water District are members of a group known collectively as the Joint Water Districts. Under the terms of a 1969 *Agreement on Diversion of Water from the Feather River* with the State of California, these water districts can divert water from the Feather River during the defined irrigation season, acting by and through DWR, using water allocated through a 1970 Joint Operating Agreement. As a result of these agreements, water is diverted by these two water districts from the Thermalito Afterbay, part of the Oroville Complex. The 1969 Diversion of Water agreement requires written approval from DWR before any of the districts can transfer water outside the service areas of the Joint Board. An agreement between DWR and the proposed water purchasers to store or transport the water through the State Water Project (SWP) or Central Valley Project (CVP) facilities may also be required to implement a water transfer.

As part of their regular operating practices, both Butte Water District and Sutter Extension Water District conduct water transfers to temporarily move water from their districts (as a willing seller) to an environmental purpose or willing buyer(s). This is often done by either fallowing lands irrigated with the sale of allocated surface water or by substituting groundwater for irrigation in lieu of the surface water that would otherwise be used and instead is sold. This water transfer process must comply with all applicable State and federal laws and requires approval prior to the transfer; but in sum, these transfers benefit the State by allowing water to be moved to areas with greater need. Butte Water District completed an

Environmental Impact Report (EIR) in early 2026 to facilitate the water transfers by addressing the environmental effects of the Temporary Water Transfers from 2026 to 2030. Sutter Extension Water District, in coordination with the Biggs-West Gridley Water District, is currently working on a similar EIR during the latter part of 2026 and early 2027. These EIRs will enable the water districts to expedite approval of groundwater substitution and/or land fallowing water transfers; however, as a whole, the nine GSAs in the Subbasin are responsible for groundwater basin management and, as such, will need to consider any impacts from the water transfers on the Subbasin's ability to reach its sustainability goal.

9.1.7 Legal Challenges or Adjudication

There have been no legal challenges brought to the Sutter Subbasin GSAs since the adoption and implementation of the 2022 GSP. Additionally, no adjudication has been considered within the Subbasin. The GSAs do not anticipate any future legal challenges that would affect GSP implementation.

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10. SUMMARY OF PROPOSED OR COMPLETED REVISIONS TO PLAN ELEMENTS

GSP Emergency Regulations §356.4(i) include a requirement that the periodic evaluation assessment shall include:

A description of completed or proposed Plan amendments.

Resulting actions from addressing the RCAs identified in DWR's 2023 determination letter for the Sutter Subbasin GSP were deemed significant and resulted in a GSP amendment. The Approved status of the 2022 GSP was accompanied by seven RCAs from DWR, which were addressed by the SSGMCC during this evaluation period. The following revisions to the Sutter Subbasin 2027 GSP Amendment were made:

- Revised the HCM of the Sutter Subbasin to correlate with commonly used names of geologic formations in the State and to provide consistent descriptions and naming of aquifer zones of the principal aquifer (RCA 1)
- Revised the GSP water budgets to provide additional information on net subsurface inflows from adjacent subbasins (RCA 2)
- Revised SMC for the chronic lowering of groundwater levels sustainability indicator (RCA 3)
- Revised SMC for the degraded water quality sustainability indicator (RCA 4)
- Revised SMC for the land subsidence sustainability indicator (RCA 5)
- Improved characterization of interconnected surface waters by providing estimates of the location, quantity, and timing of depletions (RCA 6)
- Provided data collection frequency information in tabular form for groundwater monitoring sites within the chronic lowering of groundwater levels and depletions of interconnected surface water monitoring networks (RCA 7)

A comprehensive update to the Sutter Subbasin 2022 GSP was made as part of the 2027 GSP Amendment preparation to incorporate new information collected during the evaluation period and bring all relevant information current to present day. The following additional revisions have been made in the GSP amendment based on new information during the evaluation period:

- Updated geologic cross-sections developed using AEM survey data collected by DWR
- Updated water budgets using the most recent version of C2VSimFG-Sutter Version 2.0
- Updated monitoring network for chronic lowering of groundwater levels sustainability indicator
- Updated monitoring network/method for land subsidence sustainability indicator
- Updated monitoring network/method for interconnected surface water sustainability indicator
- Revised chronic lowering of groundwater levels SMC definitions

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- Revised degraded water quality SMC definitions
- Revised land subsidence SMC definitions based on use of InSAR data and data from existing CGPS and extensometer stations as a monitoring method
- Status updates to PMAs
- Revisions to chapter text to address public comments received on the 2022 GSP

As part of this Periodic Evaluation, the GSAs reconsidered the basin setting, sustainable management criteria, representative monitoring networks, and other applicable Plan elements pursuant to §356.4(c). Revisions determined to be warranted based on new information, DWR's RCAs, and implementation experience have been incorporated into the 2027 GSP Amendment. Except for the revisions identified in this Periodic Evaluation and the accompanying GSP amendment, the GSAs determined that additional revisions to Plan elements are not necessary at this time.

The GSP appendices were also revised to incorporate the updated model report and additional analyses conducted in responding to DWR's RCAs. Additional revisions were made in the GSP amendment to address comments on the public draft Periodic Evaluation and 2027 GSP Amendment, which took place from:

- September 2 through September 30, 2026 for GSP Amendment Chapters 1-4 and 8
- October 14 through October 30, 2026 for GSP Amendment Chapters 5 and 7
- <<DATE>> through <<DATE>> for GSP Amendment Executive Summary and Chapters 6 and 9
- <<DATE>> through <<DATE>> for Periodic Evaluation.

Public comments were received from XXXX, YYYY and ZZZZ and were given due consideration and incorporated into the final GSP Amendment and Periodic Evaluation, where appropriate or identified for further evaluation. Responses to comments received on the 2027 GSP Amendment are provided as Appendix 4-C of the GSP amendment, and responses to comments on the Periodic Evaluation are included in **Appendix X**.

The primary next step for the Sutter Subbasin GSAs will be to implement the 2027 GSP Amendment, including new monitoring programs, comparison of data against updated SMC, and implementation of projects and management actions as needed. Annual reports will continue to provide progress updates in implementing the Sutter Subbasin GSP and maintaining the sustainability goal through continued monitoring and evaluation of the state of the Subbasin relative to established sustainable management criteria.

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APPENDIX A

DWR Determination Letter and RCA Response Technical Memoranda















TECHNICAL MEMORANDUM NO. 1 – Principal Aquifer Definition

TO: Paul Gosselin, California Department of Water Resources Deputy Director

CC: Guadalupe Rivera, on behalf of the Sutter Subbasin

PREPARED BY: Art Machado & Leslie Dumas/Woodard & Curran

DATE: July 15, 2026

RE: Sutter Subbasin Response to DWR's October 26, 2023 Approved Determination Letter for the Sutter Subbasin's 2022 GSP - Technical Memorandum 1, Response to DWR Recommended Corrective Action No. 1

In a letter dated October 26, 2023, the California Department of Water Resources (DWR) staff concluded that the Sutter Subbasin Groundwater Sustainability Plan (GSP or Plan) met the requirements for a GSP as set forth under the Sustainable Groundwater Management Act (SGMA) and approved the 2022 Plan (see **Attachment 1**). In Section 5 of the determination letter, DWR staff also identified recommended corrective actions (RCAs) for the Sutter Subbasin (Subbasin) Groundwater Sustainability Agencies (GSAs) to address by the Plan's first periodic evaluation.

This technical memorandum (TM) is in response to RCA No. 1 related to the definition of the Subbasin's principal aquifer and geologic formations.

This TM is organized into the following sections:

1) Overview of Recommended Corrective Action No. 1
2) Approach to Recommended Corrective Action No. 1
3) Regional Hydrogeology
4) Sutter Subbasin Hydrogeology
5) Principal Aquifer Definition
6) References

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1. OVERVIEW OF RECOMMENDED CORRECTIVE ACTION NO. 1

In its October 26, 2023 determination letter, DWR states the following for RCA No. 1:

> *Provide clarification regarding the various zones of the principal aquifer system, geologic formations comprising the principal aquifer, and the vertical extent of the Subbasin. Consistent descriptions and naming of the aquifer zones should be present throughout the GSP, including in the hydrogeologic conceptual model and the monitoring network.*

2. APPROACH TO RECOMMENDED CORRECTIVE ACTION NO. 1

This TM provides the information and approach used to clarify the Subbasin's definition of its principal aquifer as it aligns with identified geologic formations comprising the aquifer system in the Sacramento Valley and as described in the GSP Amendment. The approach included a review of the existing hydrogeologic conceptual model (HCM), new and significant geologic and hydrogeology information, well construction information, and groundwater level data from multi-completion monitoring wells. Based on this review, the TM presents the information used to refine the GSP's HCM and details the principal aquifer system and applicable aquifer zones, the varying stratigraphic sequences across the Subbasin, and the vertical extent of the freshwater-bearing zone (i.e., bottom of basin).

3. REGIONAL HYDROGEOLOGY

The Sutter Subbasin is located within the Sacramento Valley Groundwater Basin (Basin Number 5-021), a large depression bounded by the Sierra Nevada to the east and the Coast Ranges to the west. The Sacramento Valley is underlain by a sequence of sedimentary and volcanic deposits that generally dip westward beneath the valley. These deposits exhibit a regional transition from older marine depositional environments to younger continent depositional environments (DWR, 1978).

Younger continental deposits, including alluvial fan, stream channel, and floodplain deposits, comprise the majority of the freshwater aquifer system in the Sacramento Valley. In the Sutter Subbasin, these deposits include formations associated with the Sacramento, Feather, and Yuba River systems, as well as older continental deposits that are laterally continuous across adjacent subbasins. These deposits are primarily composed of interbedded gravel, sand, silt and clay, with groundwater generally present in the more permeable, coarse-grained intervals (Bertoldi et al., 1991; Williamson et al., 1989). Older marine and transitional deposits underlie portions of the Sacramento Valley and generally contain poorer water quality, including brackish groundwater at greater depths (Berkstresser, 1973).

The Sutter Subbasin also includes a local geologic complexity associated with the Sutter Buttes. In the northern and central portions of the Sutter Subbasin, volcanic activity and related uplift modified the regional stratigraphic sequence and resulted in deposition and deformation of volcanic and volcaniclastic sediments around the Sutter Buttes. These sediments primarily consist of gravel, sand, silt, clay, volcanic ash, and other volcaniclastic deposits that form a fan-like apron around the perimeter of the Sutter Buttes (Hausback et al., 2011; Springhorn et al., 2008).

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The Sutter Buttes are comprised of two formations, the Andesitic Ramparts and the Rhyolitic Rampart. Previous investigations evaluated the extent of the Ramparts using surface geologic mapping, oil and gas well logs, and drilling logs. Based on these investigations, the Ramparts vary laterally and are estimated to extend 10 miles north, five miles south, five miles east, and four miles west of the Sutter Buttes (DWR/GSA Interbasin Coordination Meeting, 2026). Information on the igneous formations associated with the Sutter Buttes was provided during a coordination meeting between the Sutter GSAs and DWR staff.

4. SUTTER SUBBASIN HYDROGEOLOGY

4.1 Subbasin Boundaries

4.1.1 Lateral Boundaries

The lateral boundaries of the Sutter Subbasin are defined on the north by the confluence of Butte Creek and the Sacramento River and the Sutter Buttes, on the west by the Sacramento River, on the south by the confluence of the Sacramento River and the Sutter Bypass, and on the east by the Feather River (DWR, 2006). The hydrologic rationale for these boundaries is that the rivers are, or may be, coincidental with groundwater divides (boundary zones of either converging or diverging groundwater flow) and the low-permeability Sutter Buttes rampart creates a barrier to groundwater flow at their contact with the alluvial sediments in the Subbasin.

The modified Subbasin extents have been defined as the jurisdictional boundaries of Sutter County such that:

- The northern subbasin boundary is the County boundary between Sutter and Butte Counties, except for the portion of the Biggs-West Gridley Water District GSA that is within Sutter County, and the County boundary between Sutter and Yuba Counties, except for the portion of the Yuba County Water Agency GSA that is within Sutter County.
- The eastern boundary is the County boundary between Sutter and Yuba Counties.
- The southern boundary is the boundary between the Sutter Subbasin and the North American Subbasin within Sutter County coincident with the South Yuba Subbasin.
- The western boundary is the County boundary between Sutter and Colusa Counties except for the portion of the RD1004 GSA that is within Sutter County (as requested in adjacent modification requests).

4.1.2 Vertical Boundaries

The vertical extent of the Sutter Subbasin is generally defined as the base of groundwater that can also be chemically defined as the base of freshwater. Berkstresser (1973) defines the base of freshwater in the Sacramento Valley as fresh water characterized by an electrical conductivity measurement of less than 3,000 micromhos or approximately 2,000 milligrams per liter (mg/L) total dissolved solids (TDS). The physical base of the Sutter Subbasin is the basement complex, a continuation of the Sierra Nevada fault block that has

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been tilted towards the southwest (Curtin, 1971). More information on the Subbasin's vertical boundary is contained in **Section 5.2.**

4.2 Subbasin Hydrogeology

Both water-bearing and non-water-bearing formations underlie the Sutter Subbasin. As described in various reports from the 1960s through the present, the Sutter Subbasin aquifer system is comprised of continental deposits of Quaternary (Recent) to Late Tertiary (Miocene) age. The identified stratigraphic units are described sequentially in **Table 1**, ranging from Holocene (shallower) to Miocene (deeper).

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Table 1: Identified Stratigraphic Units in Sutter Subbasin

Geologic Epoch	Primary Formation Name	Member or Equivalent Units	Description	Geographic Extent
Holocene - Pleistocene	Alluvial Deposits	• Holocene Alluvium • Modesto • Riverbank	• Coarse sand and gravel along present and historical stream channels of the Yuba, Feather and Sacramento Rivers. • Where coarse-grained, these deposits are highly permeable and form the shallow portion of the principal aquifer. • Thicknesses are variable but may be up to 100 feet near major stream channels.	• Present across the Subbasin at or near ground surface
Pleistocene	Turlock Lake Formation	• Upper Turlock Lake • Lower Turlock Lake	• Alluvial fan deposits composed of loosely consolidated gravel, sand, silt, and clay. • Lenticular beds with decreasing thickness and grain size with increasing distance from the Yuba River and Sierra Nevada foothills. • Hardpan and/or claypan soils may locally reduce vertical permeability and contribute to semiconfined conditions in the Lower Turlock Lake unit. • Estimated thickness of 70 feet.	• A semi-continuous unit situated in the northern and central portions of the Subbasin
Pleistocene	Laguna Formation	• Not differentiated	• Lacustrine and continental deposits consisting of compacted sand, silt, and clay with hardpan in near-surface soils. • Low to moderate permeability, with groundwater present in more permeable sandy intervals. • Thickness is variable; averaging approximately 300 feet but is estimated to be up to 1,000 feet along the valley axis.	• Present across the Subbasin, but depth and thickness vary laterally. The Laguna Formation may occur within more than one aquifer zone interval depending on location.
Pleistocene	Sutter Buttes Rampart	• Andesitic Rampart • Rhyolitic Rampart	• Volcanic and volcaniclastic deposits associated with the Sutter Buttes, including gravel, sand, silt, clay, and volcanic ash. • Reflects multiple stages of volcanic activity, deposition, and erosion around the Sutter Buttes. • Thickness is variable; averaging approximately 400 feet but can be up to 600 feet thick in closer proximity to the Sutter Buttes.	• Laterally variable and associated solely within the north and central portions of the Subbasin near the Sutter Buttes. • Previous investigations indicate that Rampart units form an apron around the Buttes and extend several miles from the center of the Sutter Buttes.
Miocene-Pliocene	Sutter Formation	• Tuscan • Mehrten • Valley Springs • Upper Princeton Valley Fill	• Informally named stratigraphic unit used in the Sutter Subbasin to describe deeper continental and volcaniclastic deposits where regional formation boundaries are complex. • Includes alluvial–fluvial deposits and volcaniclastic deposits interbedded with basaltic or andesitic materials. • Permeable intervals include gray to black, well-sorted fluvial andesitic sand and gravel lenses; lower permeability layers include clay, silt, and tuff-breccia that create semi-confined to confined conditions. • Thickness ranges from approximately 200 feet to over 1,000 feet along the axis of the valley.	• Present across the Subbasin below the Sutter Buttes Ramparts in the northern and central portions of the Subbasin and below the Laguna Formation in the southern portion of the Subbasin.

Geologic Epoch	Primary Formation Name	Member or Equivalent Units	Description	Geographic Extent
Miocene-Pliocene	Lovejoy Basalt	• Not differentiated	• Basaltic lava flows associated with the broader Valley Springs volcanic sequence. • A relatively low-permeability unit where unfractured, although fractured zones may locally transmit groundwater.	• Present across the Subbasin below the Sutter Formation
Miocene	Ione Formation	• Not differentiated	• Continental deposits that are part of the broader Sacramento Valley fill sequence and includes gravels, sand, silt, clay, and tuffaceous sediments. • Groundwater quality and permeability are variable, and the formation generally occurs below the base of freshwater-bearing formations.	• Present across the Subbasin below the Lovejoy Basalt
Miocene	Capay Formation	• Not differentiated	• Marine to transitional marine–continental deposits representing early valley fill. • This formation includes fine-grained deposits and tuff-breccias and is generally associated with poorer water quality compared to the overlying freshwater-bearing formations.	• Present across the Subbasin below the Ione Formation

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There are two structural features in the Sutter Subbasin that affect groundwater flow, both directly and indirectly. The Sutter Buttes is the prominent topographic feature in Sutter County, rising from the valley floor to an elevation of 2,100 feet, over 2,000 feet higher than the valley floor. The Sutter Buttes are composed of late Cenozoic volcanic rocks emplaced between 2.4 and 1.4 million years ago over a northwest-trending tectonic boundary that juxtaposes a basement of dense magnetic, presumed oceanic crust on the west against metamorphic and plutonic rocks of the Sierran basement on the east (Harwood and Helley, 1987). When the volcanic rocks rose, they folded upward and exposed at ground surface older marine sediments including the Ione and Capay Formations. They also created an apron of volcanic sediments, the Sutter Buttes Rampart Formation that extends outward in a shield like apron. The Sutter Buttes impacts the Subbasin's groundwater flow by separating or limiting the direct hydraulic connection between different aquifer zones (as previously discussed), resulting in groundwater flow patterns that are more localized and less interconnected across the butte area. Additionally, due to its impermeable nature, the Sutter Buttes reduces direct recharge from precipitation into the underlying aquifer system. As such, the buttes focus or deflect recharge toward the valley flows towards areas where recharge primarily occurs (in alluvial deposits along the Subbasin's rivers and streams).

The Willows Fault is the primary fault structure within Sutter County. The fault was discovered in the 1950s during the development of a nearby gas field and lies to the southwest and west of the Sutter Buttes. The fault is active and northwest-trending with a 74 degree or steeper dip to the northeast and exhibits approximately 1,610-feet of reverse displacement, indicating the ground east of the fault has moved up relative to the west side (Redwine, 1972). The Willows Fault enters into Sutter County from Colusa County, southwest of the Sutter Buttes, and extends to the southeast portion of the Subbasin towards Sacramento, presumably following the boundary between the ophiolite basement of the west and the Sierran basement to the east (Harwood and Helley, 1987). One primary concern with the Willows Fault is how it may affect groundwater flow in the Sutter Subbasin. In one way, the fault can act as a conduit for the movement of groundwater between the Sutter Subbasin and the adjoining subbasins. In others, the fault can act as a barrier, blocking the lateral movement of groundwater. In all, the fault can change groundwater flow direction due to the orientation and dip of the fault. As shown in Bulletin 118-6, *Evaluation of Ground Water Resources: Sacramento Valley*, the base of freshwater rises close to 400 feet below the ground surface in the area of the Sutter Buttes (DWR, 1978); this could potentially result in connate marine water underlying the base of freshwater to move upward along the fault zone.

5. PRINCIPAL AQUIFER DEFINITION

The Sutter Subbasin is underlain by one principal aquifer composed of freshwater-bearing continental deposits of Quaternary and late Tertiary age. These deposits include alluvial, lacustrine, and volcanic materials that vary in thickness, permeability, and degree of confinement across the Subbasin. The cumulative thickness of the deposits that comprise the principal aquifer generally increases from the eastern boundary of the Sutter Subbasin toward the valley axis and western boundary.

As described in the GSP Amendment, the principal aquifer is defined as the aquifer system occurring above the base of freshwater previously determined in the Subbasin (Berkstresser, 1973). The base of freshwater is the lowest vertical extent of the Subbasin's and GSAs' managed groundwater system. Groundwater below this base of freshwater is generally brackish and unsuitable for potable or agricultural use without treatment;

as such, geologic units below the base of freshwater are not considered part of the Sutter Subbasin's principal aquifer.

5.1 Aquifer Zone Framework

The principal aquifer is described using aquifer zones that represent hydrostratigraphic and management intervals within the Subbasin. These aquifer zones are also used to support groundwater level monitoring and applicable sustainable management criteria. The aquifer zones are not intended to represent laterally continuous, formation-bound aquifers across the entire Subbasin. This framework is based on the stratigraphic units described in **Section 4** (above), low permeability intervals, well construction information, and groundwater level responses observed in multi-completion wells. Because the geologic formations vary spatially, particularly near the Sutter Buttes, the relationship between individual formations and aquifer zones vary by location. As a result, the GSP Amendment uses aquifer zones as intervals within the principal aquifer that vary spatially across the Subbasin, rather than as separate aquifers or fixed formation-based units.

The principal aquifer can be grouped into four zones: the Shallow Aquifer Zone (AZ), Aquifer Zone 1 (AZ-1), Aquifer Zone 2 (AZ-2), and Aquifer Zone 3 (AZ-3). The Shallow AZ is delineated separately from the AZ-1 system and is considered to be the upper 50 feet of the principal aquifer. While the Shallow AZ is not hydraulically separate from AZ-1, this zone was defined separately as it is most likely connected to interconnected surface water (ISW) bodies. Additionally, AZ-2 may be further defined as AZ-2A and AZ-2B where applicable to reflect local hydrostratigraphy differences associated with the Sutter Buttes Rampart. Each aquifer zone (except the Shallow AZ) is separated by a low permeability layer comprised of fine-grained intervals consisting of silt, clay, hardpan, tuff-breccia, and other lower-permeability materials that occur throughout the principal aquifer. These low permeability intervals locally impede vertical groundwater flow and contribute to semiconfined or confined conditions. However, available data and information do not support the presence of laterally continuous aquitards that separate the Subbasin into multiple principal aquifers.

As noted above, the Shallow AZ is considered to be the upper 50 feet of the principal aquifer (surface to 50 feet below the ground surface [ft bgs]). This zone was established to assess and monitor for impacts related to ISW and groundwater dependent ecosystems (GDEs).

AZ-1 is considered to extend from 50 to 150 ft bgs and generally represents the shallow portion of the principal aquifer. AZ-1 is composed of alluvial, stream channel and floodplain deposits. In the northern and central portions of the Subbasin, AZ-1 is approximately 150 feet thick and is comprised of Alluvial Deposits and the Upper Turlock Lake Formation (Helley and Harwood, 1985). In the southern portion of the Subbasin, AZ-1 is approximately 100 feet thick and solely comprised of Alluvial (flood plain) Deposits (Olmstead and Davis, 1961) but could be thicker near the Feather and Sacramento Rivers.

AZ-1 and AZ-2A/-B are separated by the shallower of two low permeability zones present within the Subbasin. This low permeability zone is present across the Subbasin at varying degrees of confinement and does not represent a continuous aquitard. In the northern and central portions of the Subbasin, this low permeability zone is primarily associated with the Lower Turlock Lake unit and approximately 50 feet thick. In the southern portion of the Subbasin, the low permeability zone is associated with the Laguna Formation and approximately 20 feet thick.

AZ-2 is considered to extend from 150 to 400 ft bgs corresponding to the intermediate portion of the principal aquifer and, depending on location within the Subbasin, includes the Laguna Formation and/or the Sutter Buttes Rampart. In the northern and central portions of the Subbasin, AZ-2A is used where the Sutter Buttes Rampart is present in the principal aquifer and underlies the Laguna Formation. In AZ-2A, the Laguna Formation is approximately 200 feet thick, and the Sutter Buttes Rampart is 50 or more feet thick. Away from the Sutter Buttes in the southern portion of the Subbasin, AZ-2B is delineated where the principal aquifer is solely within the Laguna Formation and is approximately 200 to 300 feet thick (Helley and Harwood, 1985).

AZ-2A/-B and AZ-3 are separated by the deeper of the two low permeability zones within the Subbasin. Similar to the shallower low permeability zone, it is present across the Subbasin at varying degrees of confinement and does not represent a continuous aquitard. In the northern and central portions of the Subbasin, this low permeability zone is primarily associated with the Sutter Buttes Rampart and could be approximately 50 feet thick or more. In the southern portion of the Subbasin, the low permeability zone is associated with the Laguna Formation and has been estimated to range in thickness from 180 feet (Helley and Harwood, 1985) to 1,000 feet (Olmstead and Davis, 1961).

AZ-3 is considered to extend from 400 ft bgs to the base of freshwater and represents the deepest portion of the principal aquifer, including the deeper sections of the Laguna Formation, Sutter Buttes Rampart where present, and the Sutter Formation. In the northern and central portions of the Subbasin, AZ-3 is comprised of the three previous formations. Farther south, where the Sutter Buttes Rampart is absent, AZ-3 contains only the Laguna and Sutter Formations. The thickness and depth of the formations within AZ-3 vary across the Subbasin due to changes in depositional environment, formation extent, and the influence of the Sutter Buttes. The base of freshwater defines the bottom of the Subbasin. As a result of the depth to the base of freshwater varying across the Subbasin, the lower extent of AZ-3 also varies spatially and is described further in **Section 5.2**.

Groundwater level data from multi-completion wells were reviewed to evaluate whether the aquifer zone framework is consistent with observed hydraulic responses across the Subbasin. Hydrographs from multi-completion wells show that the degree of connection between aquifer zones varies spatially. In some areas, groundwater levels in AZ-2 and AZ-3 respond similarly while AZ-1 may show a different response, suggesting greater separation between the shallow and deeper portions of the aquifer system. In other areas, groundwater levels across multiple aquifer zones show similar responses, indicating greater hydraulic connection. These observed differences support the interpretation that the Subbasin contains one laterally and vertically heterogeneous principal aquifer system with variable aquifer zones, rather than separate principal aquifers.

Figure 1 shows the location of multi-completion monitoring wells (MWs) around the Subbasin, including:

- Butte Water District (BWD) MW-1
- Flood MW-1
- Sutter Extension Water District (SEWD) MW-1
- SEWD MW-2
- SEWD MW-3
- Sutter Mutual Water Company (SMWC) MW-1
- Sutter County (Sutter) MW-1

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- Sutter MW-2
- Sutter MW-3
- Sutter MW-4
- Sutter MW-6

The hydrographs from these monitoring wells indicate that the vertical hydraulic relationships between aquifer zones varies across the Subbasin. This variability is consistent with the Subbasin's complex geologic setting and supports the presence of two laterally extensive, low permeability zones within the principal aquifer. As observed in the hydrographs, these low permeability zones vary in thickness, continuity, and hydraulic connectivity across the Subbasin and may be locally interrupted, merged, or less distinct where affected by changes in depositional environments.

In the northern portion of the Subbasin, BWD MW-1 shows similar groundwater level fluctuations in AZ-2 and AZ-3 in response to pumping, while AZ-1 shows little to no response, suggesting some separation between the shallow and deeper portions of the aquifer at that location (**Figure 2**). However, at Sutter County MW-3, south-southeast of BWD MW-1, groundwater levels in all three aquifer zones show a more coordinated response suggesting greater vertical hydraulic connection and less confining conditions (**Figure 3**). These differences indicate that the low-permeability intervals are not uniformly expressed near the Sutter Buttes, where uplift and deformation have modified the regional stratigraphic sequence.

In the central portion of the Subbasin, hydrographs for SEWD MW-1 (**Figure 4**), SEWD MW-2 (**Figure 5**), SEWD MW-3 (**Figure 6**), Sutter MW-1 (**Figure 7**), Sutter MW-6 (**Figure 8**), and SMWC MW-1 (**Figure 9**) show mixed but related responses between aquifer zones. In several wells, AZ-2 and AZ-3 exhibit similar groundwater levels or similar seasonal responses, while AZ-1 may occur at a higher groundwater elevation or show a more limited response. These patterns suggest that the aquifer zones are hydraulically connected to varying degrees, but that low permeability intervals locally influence vertical gradients and groundwater level responses. The relationship between zones also appears to vary from east to west, consistent with changes in alluvial fan deposits and proximity to the Sutter Buttes.

At the southern end of the Subbasin, groundwater-level responses in the aquifer zones at monitoring wells Sutter MW-2 (**Figure 10**), Sutter MW-4 (**Figure 11**), and Flood MW-1 (**Figure 12**) are generally reflective of one another, but AZ-3 commonly behaves differently than AZ-1 and AZ-2. This pattern is consistent with a more layered depositional environment farther from the Sutter Buttes, where the low permeability intervals are more distinguishable and more likely to separate AZ-3 from AZ-1 and AZ-2.

The hydrograph observations are also generally consistent with aerial electromagnetic (AEM) survey interpretations presented in **Attachment 2**, which indicate deformation and merging of strata near the Sutter Buttes, more distinguishable layering farther south, and alluvial fan deposits along the eastern side of the Subbasin. Accordingly, the low permeability intervals are best understood as laterally variable hydrostratigraphic features within the principal aquifer system, rather than continuous aquitards that define separate principal aquifers.

5.2 Bottom of Basin Definition and Base of Freshwater

The bottom of the Sutter Subbasin is defined by the base of freshwater, which varies in depth across the Subbasin. As a result, the lower extent of the principal aquifer, including AZ-3, also varies spatially. In

general, the greatest depths to the base of fresh water are in the central trough area in the Sacramento Valley, where the synclinal trough is deepest. In general, the base of freshwater ranges from -400 to -1,200 feet mean sea level (DWR, 1978).

Some geologic formations that comprise AZ-3, including the Sutter Formation, may continue below the base of freshwater. Where these formations extend below this boundary, the deeper portions are considered part of the regional geologic framework but are not included in the principal aquifer managed by the GSAs. Therefore, the base of freshwater, rather than the base of any individual geologic formation, defines the bottom of the Subbasin for GSP implementation.

5.3 Conclusions

The Sutter Subbasin is characterized by one principal aquifer system composed of laterally and vertically variable freshwater-bearing deposits. The geologic framework reflects both regional depositional processes and alterations associated with the Sutter Buttes, including deformation, reworking, and deposition of volcanic and volcaniclastic materials. As a result, the stratigraphic units and low permeability intervals that influence groundwater conditions are not expressed uniformly across the Subbasin.

Available hydrogeologic information, including stratigraphic interpretations, AEM data, and hydrographs from multi-completion monitoring wells, supports the use of aquifer zones to describe vertical intervals within the principal aquifer system. These aquifer zones provide a consistent framework for evaluating pumping depths, groundwater level responses, and monitoring network effectiveness. However, the aquifer zones are not interpreted as separate principal aquifers or as fixed formation-based units.

Two low permeability intervals are interpreted within the principal aquifer system, but their thickness, continuity, and hydraulic effectiveness vary spatially. These intervals locally influence vertical gradients and groundwater level responses, but available data do not support defining laterally continuous aquitards that divide the Subbasin into multiple principal aquifers. Therefore, the GSP Amendment retains the definition of a single principal aquifer system and clarifies the use of aquifer zones as hydrostratigraphic and management intervals within that system.

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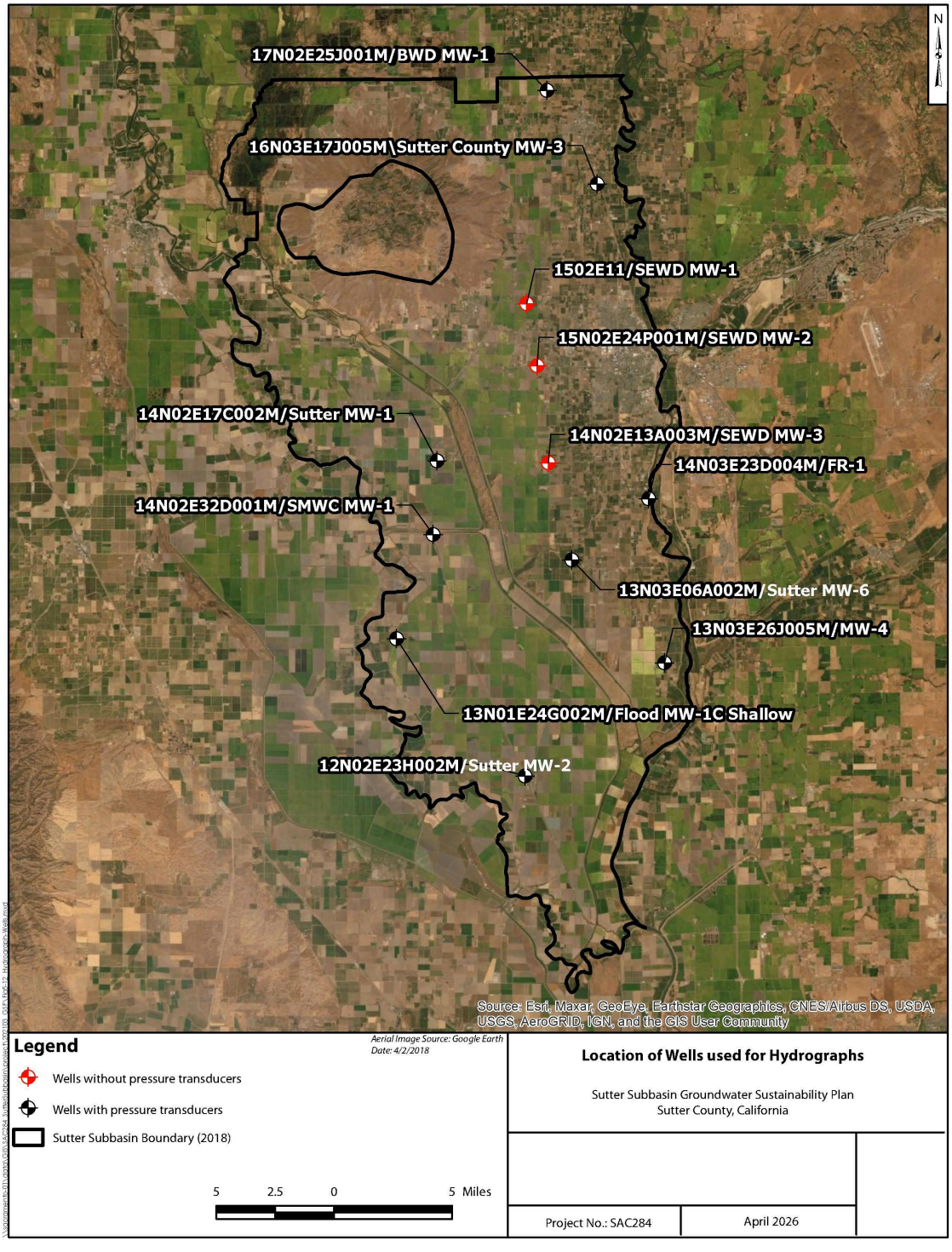


Figure 1: Location of Wells used for Hydrographs

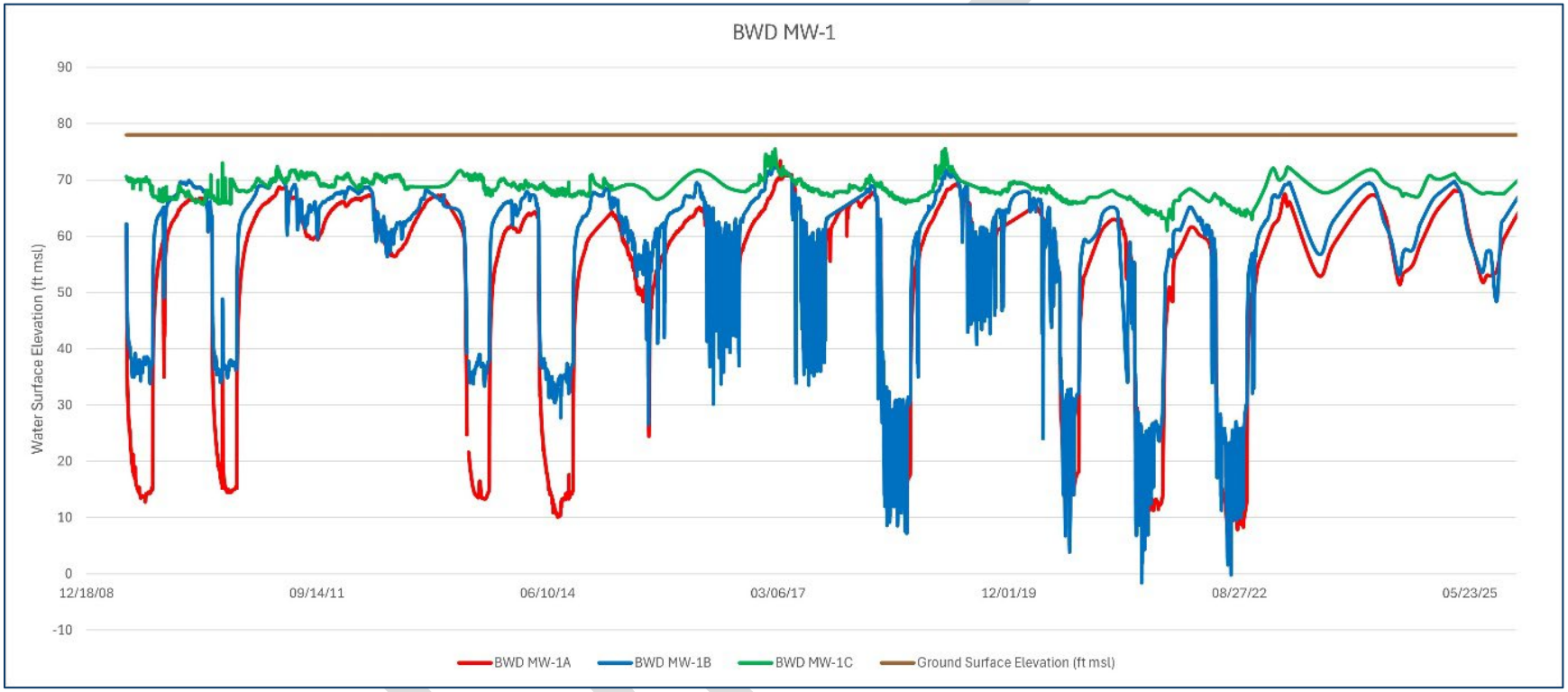


Figure 2: Butte Water District MW-1

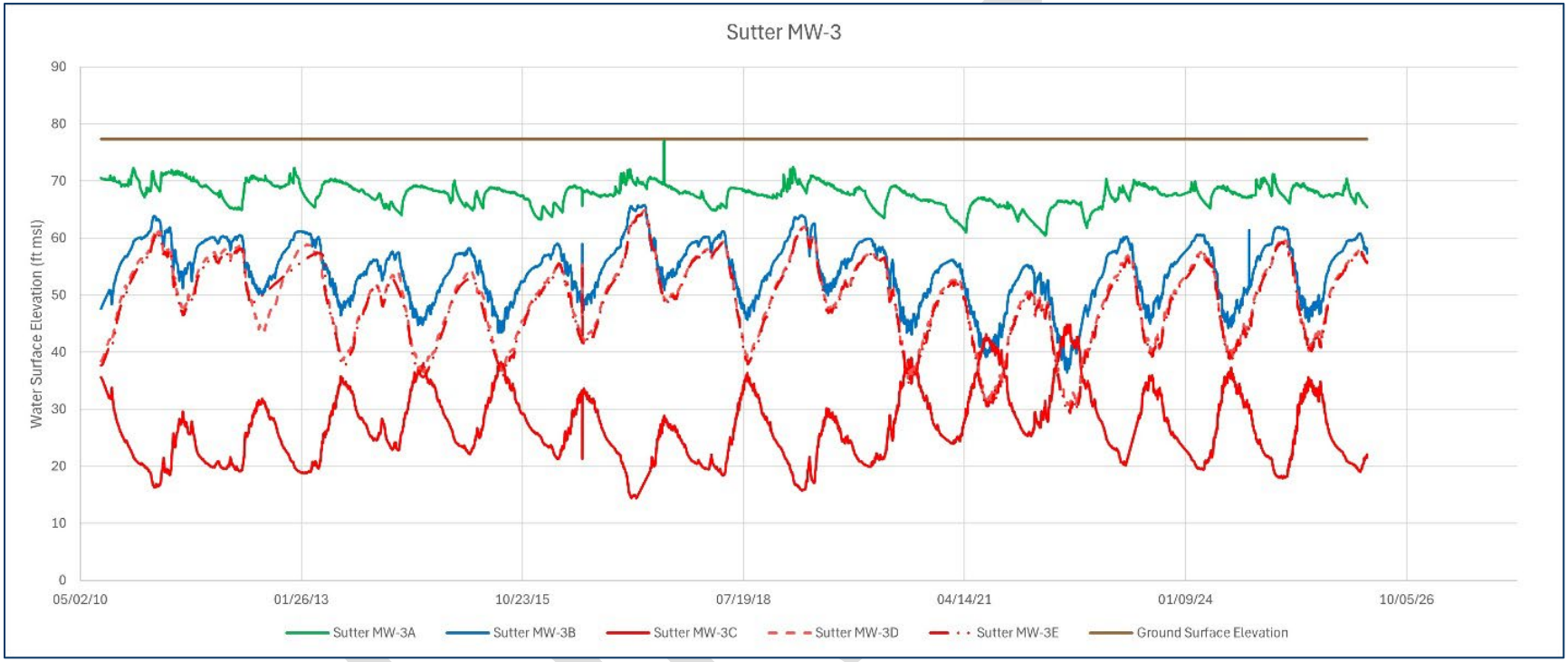


Figure 3: Sutter County MW-3



Figure 4: Sutter Extension Water District MW-1

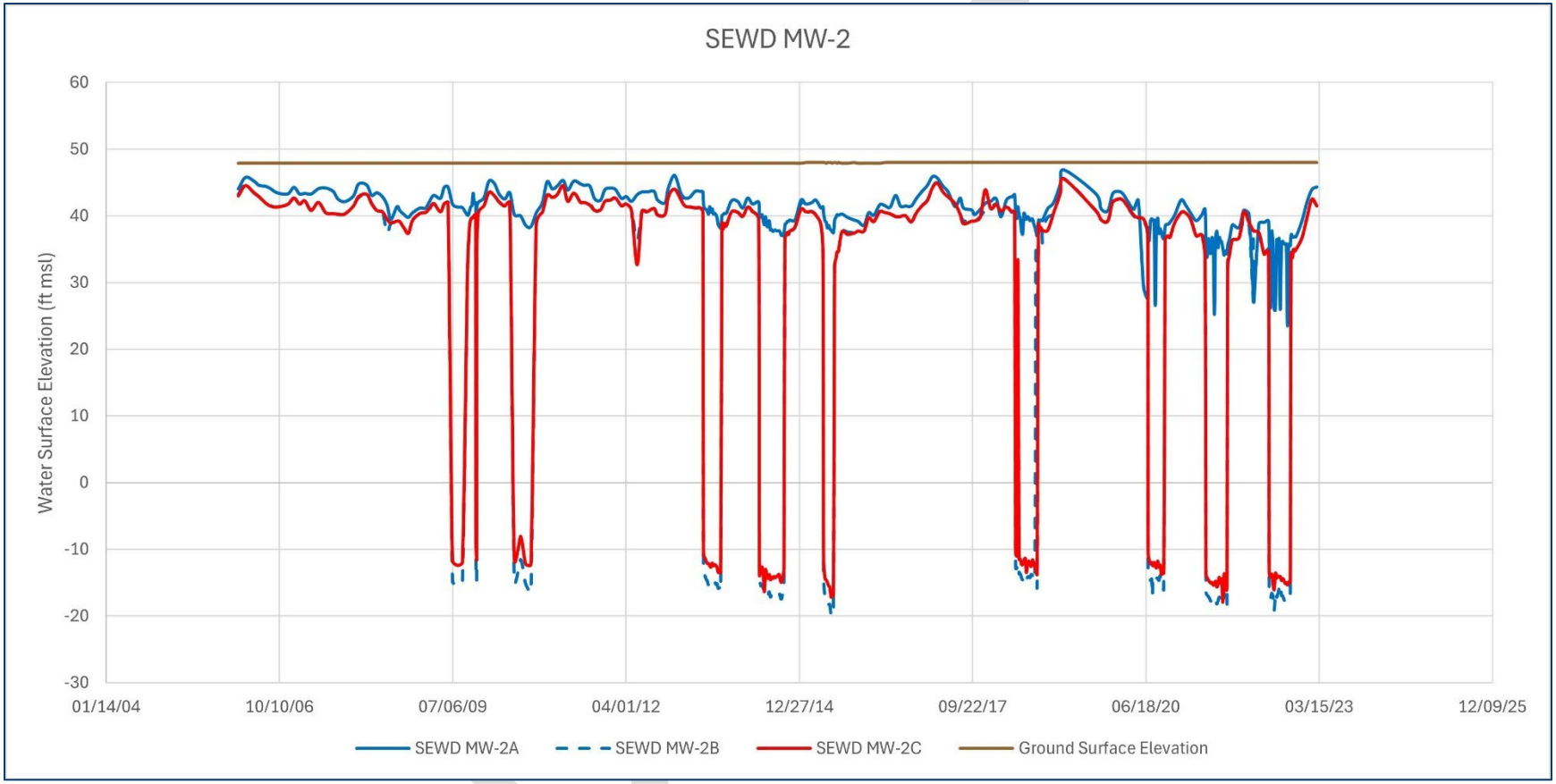


Figure 5: Sutter Extension Water District MW-2

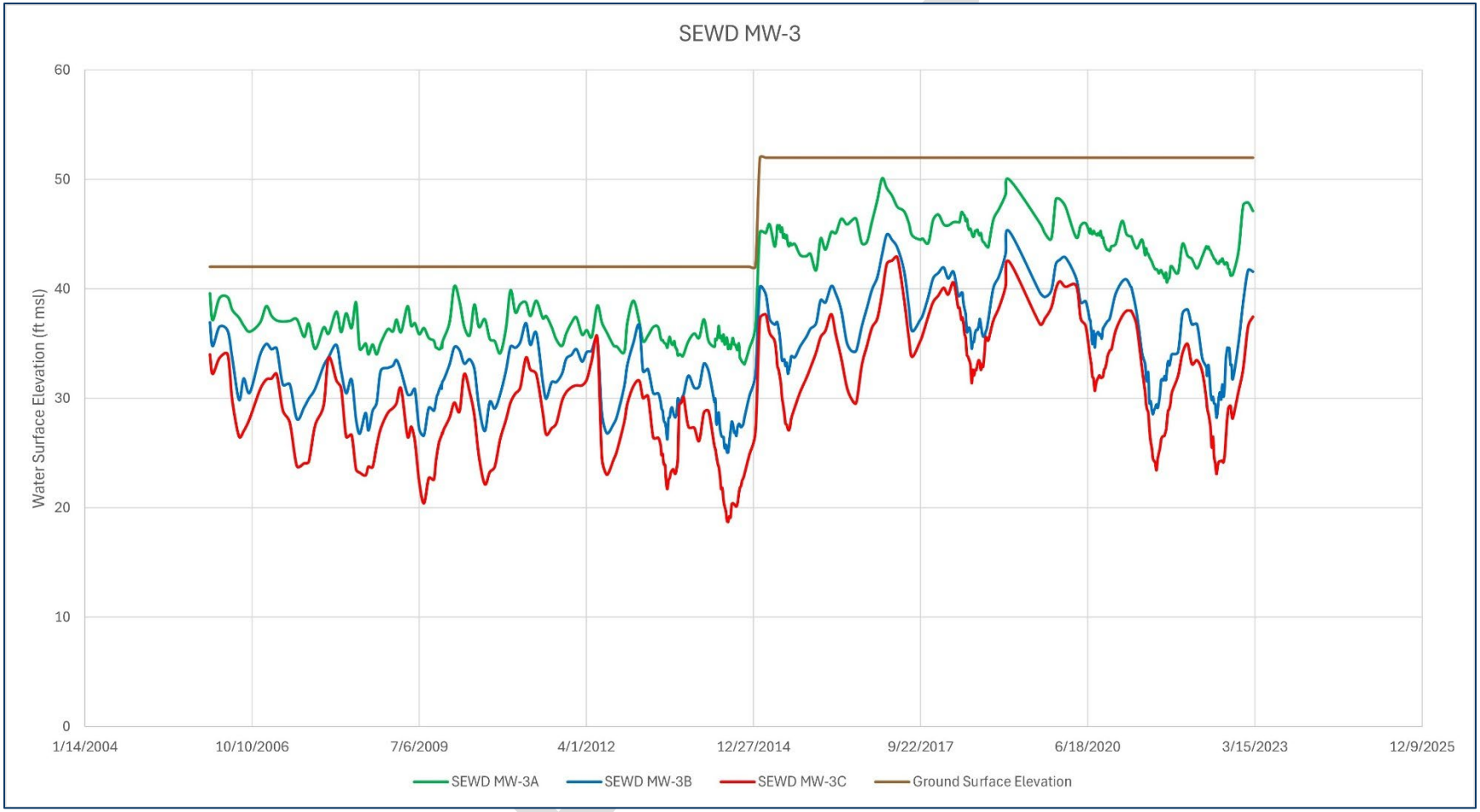


Figure 6: Sutter Extension Water District MW-3

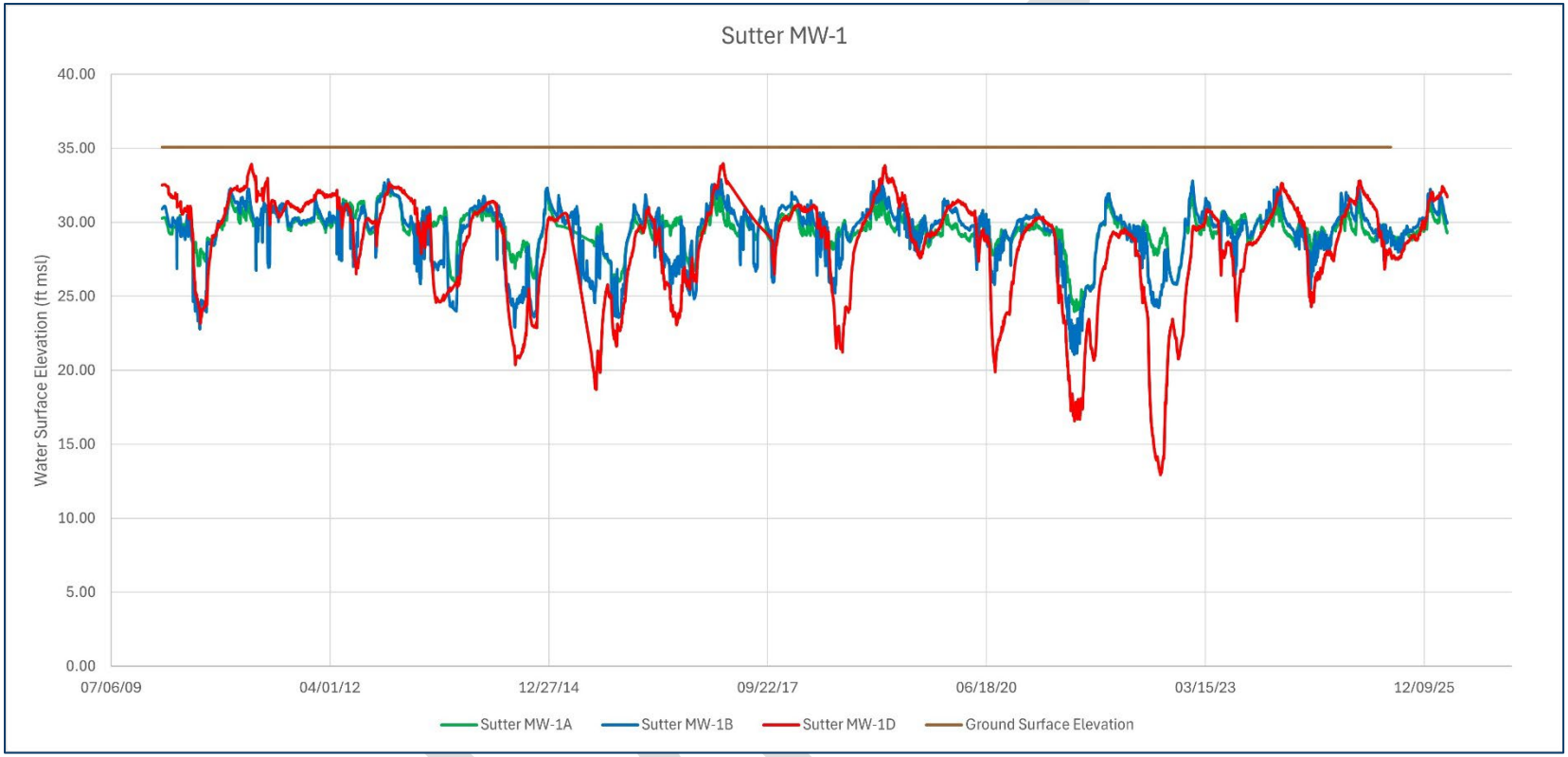
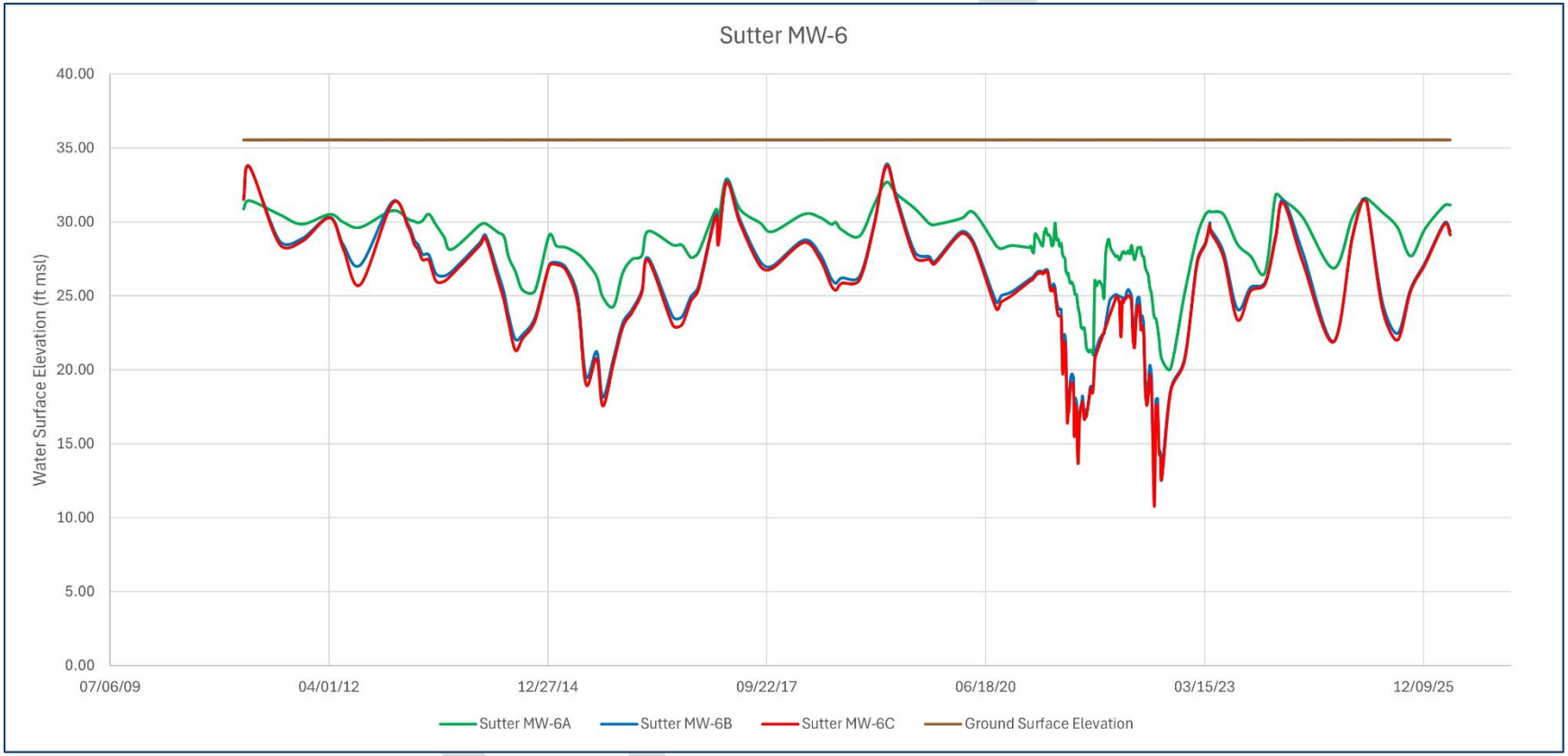


Figure 7: Sutter County MW-1



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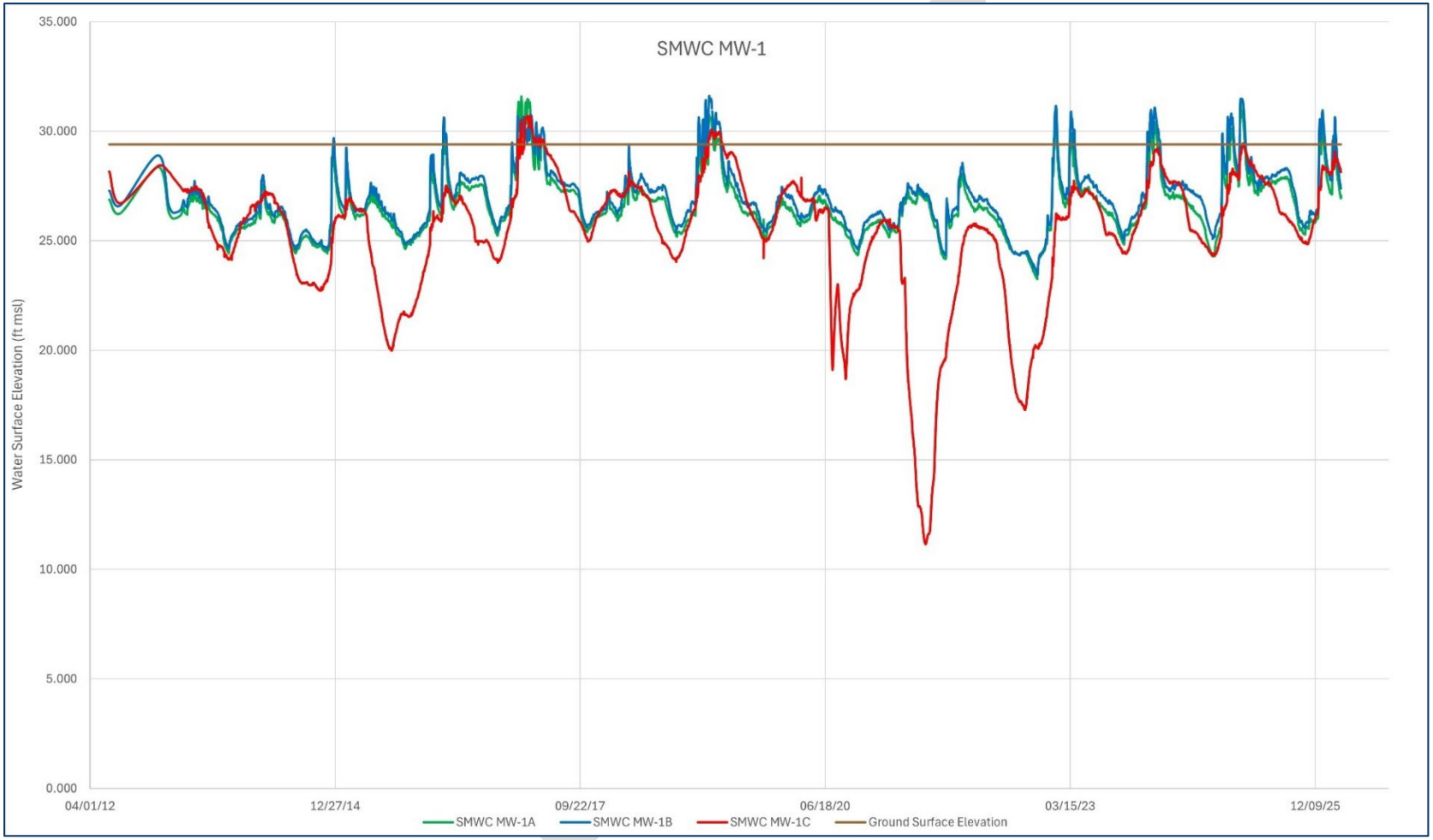

Figure 9: Sutter Mutual Water Company MW-1

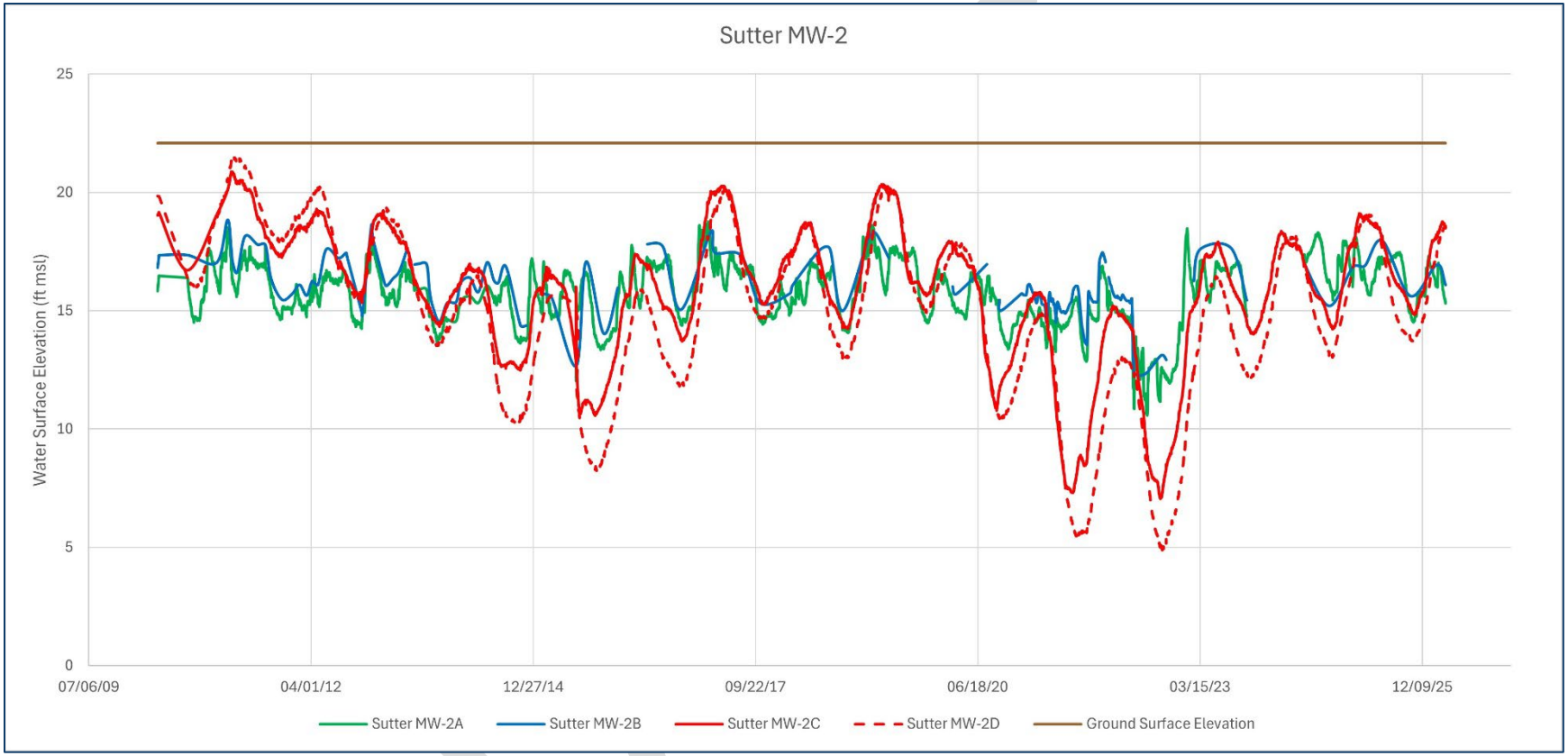

Figure 10: Sutter County MW-2

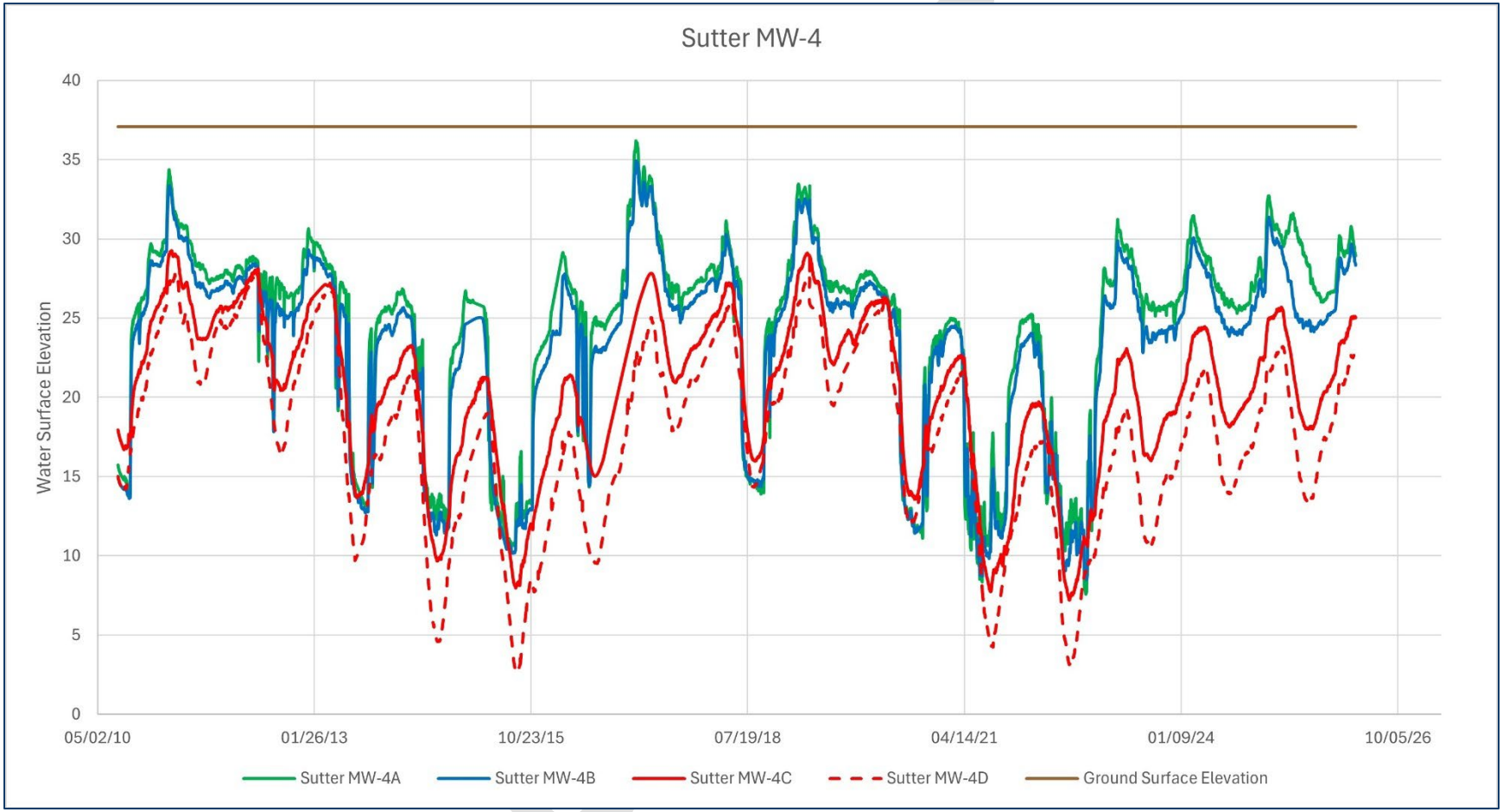

Figure 11: Sutter County MW-4

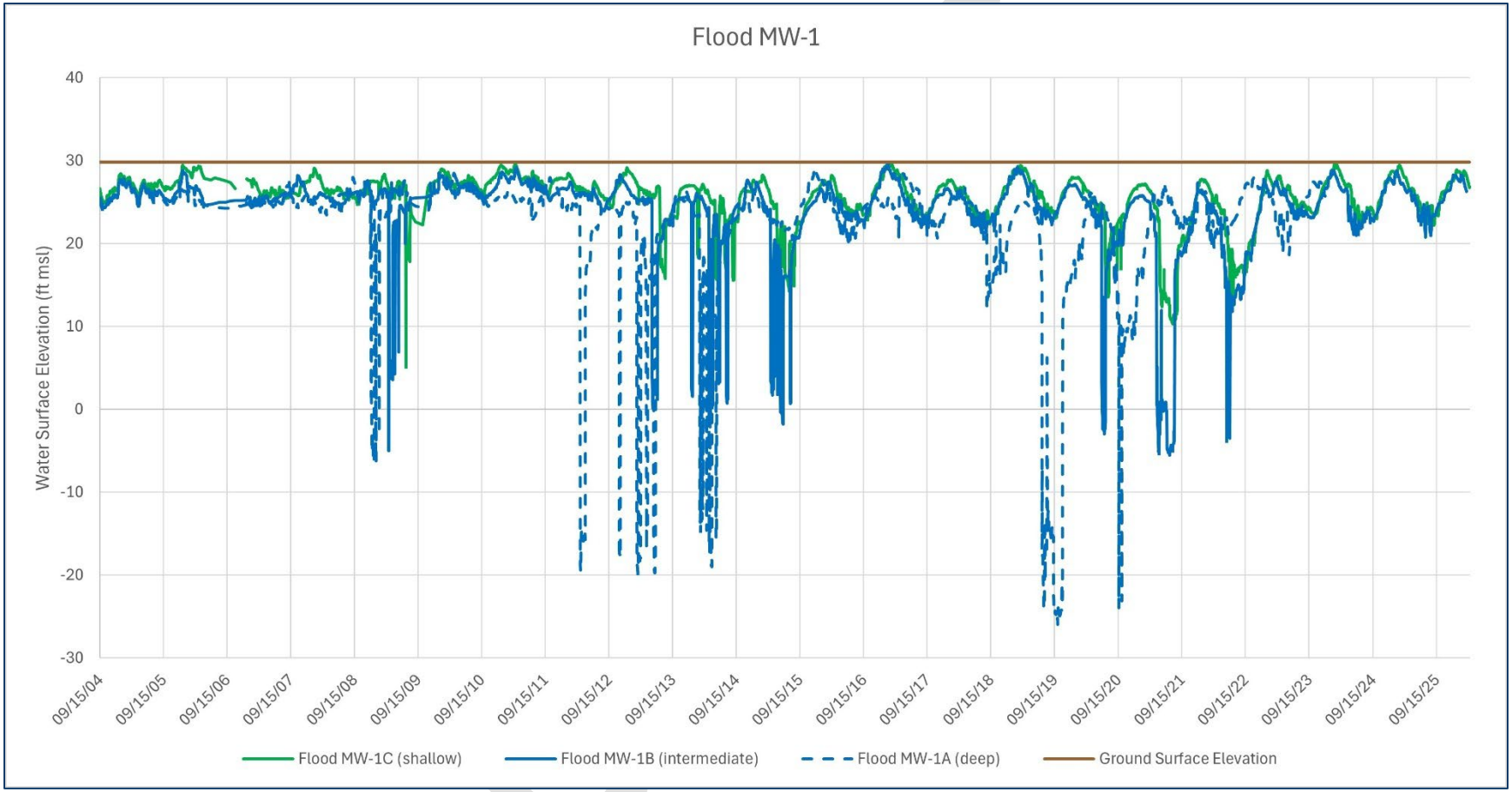

Figure 12: Flood MW-1

TECHNICAL MEMORANDUM NO. 2 – Projected Subsurface Inflows

TO: Paul Gosselin, California Department of Water Resources Deputy Director

CC: Guadalupe Rivera, on behalf of the Sutter Subbasin

PREPARED BY: Woodard & Curran

DATE: September 23, 2026

RE: Sutter Subbasin Response to DWR's October 26, 2023 Approved Determination Letter for the Sutter Subbasin's 2022 GSP - Technical Memorandum 2, Response to DWR Recommended Corrective Action No. 2

In a letter dated October 26, 2023, the California Department of Water Resources (DWR) staff concluded that the Sutter Subbasin Groundwater Sustainability Plan (GSP or Plan) met the requirements for a GSP as set forth under the Sustainable Groundwater Management Act (SGMA) and approved the 2022 Plan (see **Attachment 1**). In Section 5 of the letter, DWR staff also identified recommended corrective actions (RCAs) for the Sutter Subbasin Groundwater Sustainability Agencies (GSAs) to address by the Plan's first periodic evaluation.

This technical memorandum (TM) is in response to RCA No. 2 related to the net subsurface inflows in the projected water budgets and sustainable yield estimation.

This TM is organized into the following sections:

1) Overview of Recommended Corrective Action No. 2
2) Approach to Recommended Corrective Action No. 2
3) Conclusions
4) References

1. OVERVIEW OF RECOMMENDED CORRECTIVE ACTION NO. 2

In its October 26, 2023 determination letter, DWR states the following for RCA #2:

> *Provide further information and justification related to the increases in net subsurface inflows from adjacent subbasins in the projected water budgets and the sustainable yield estimation.*

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2. APPROACH TO RECOMMENDED CORRECTIVE ACTION NO. 2

This TM provides information regarding the Subbasin's subsurface flows with adjacent subbasins and Sustainable Yield. It is important to recognize that at the time the Sutter Subbasin 2022 GSP was being prepared, the GSPs for the adjoining subbasins were also being prepared in parallel. Therefore, the type of analysis contained in this TM would not have been possible due to the inability to access adjoining subbasin model results and meet the regulatory deadline for GSP submittal as set under the Sustainable Groundwater Management Act (SGMA).

2.1 Subsurface Inflows with Adjacent Subbasins as Reported in GSPs

The Sutter Subbasin is located in the Sacramento Valley Groundwater Basin and adjoins the following seven subbasins: Butte, Wyandotte Creek, North Yuba, South Yuba, North American, Yolo, and Colusa (**Figure 1**). The northern boundary of the Sutter Subbasin consists of the Sutter County-Butte County line, except for the portion of Biggs-West Gridley Water District Groundwater Sustainability Agency (GSA) within Sutter County that is included within the Butte Subbasin. The eastern boundary consists primarily of the Sutter County-Yuba County line to its terminus just north of Nicolaus Census Designated Place (CDP), where the Feather River forms the Sutter Subbasin's eastern boundary, until the Feather River reaches the Yolo County line. The southern and western boundaries of the Sutter Subbasin follow the Sutter County boundary shared with Yolo and Colusa Counties and follow the Sacramento River.

C2VSimFG-Sutter Version 1.0 is the locally-refined instance of the fine grid version of the California Central Valley Simulation Model (C2VSimFG) and was used to develop water budgets for the 2022 Plan. As part of the work for the Sutter Subbasin's 2027 GSP Amendment and Periodic Evaluation, as discussed further below and in **Appendix 5-F**, the C2VSimFG-Sutter model was completely updated to a clipped version of the C2VSimFG elements. A major reason for the update was to better control and understand the interbasin groundwater flows entering and leaving Sutter Subbasin and the adjacent groundwater subbasins. The update to the clipped model is called C2VSimFG-Sutter Version 2.0 and allows for more direct control over interbasin flows. These updates are described further below and **Appendix 5-F**.

RCA No. 2 relates to the difference between the Subbasin's subsurface groundwater flows from historical to projected and sustainable yield budgets in the Version 1.0 model. In order to respond, the net subsurface inflow differences from Historical to Projected from the most recent published GSPs are compared for groundwater flows between Sutter Subbasin and the surrounding groundwater subbasins. The differences between the Historical and Current water budgets are relatively minor in Sutter Subbasin's groundwater budgets as presented in Table 5-13 of the 2022 GSP (using C2VSimFG-Sutter Version 1.0), as are the differences between the Projected and Projected with Climate Change water budgets, so this analysis only looks at Historical and Projected water budget subsurface flows (Sutter Subbasin GSA, 2022).

The net subsurface flows from the most recently published GSPs for the surrounding subbasins are compared with values reported in the 2022 Sutter GSP (**Table 1**). As shown in **Table 1,** RCA No. 2 is highlighting the large changes between Historical and Projected subsurface groundwater flows between Sutter Subbasin and the Butte, North American, North Yuba, South Yuba, and Yolo Subbasins. The most recently published versions of the Butte and Yolo Subbasin GSPs show large differences between Historical and Projected subsurface flows with Sutter Subbasin. As also shown in **Table 1**, C2VSimFG-Sutter Version

2.0 dramatically reduces the gap between the Historical and Projected subsurface flows between Sutter Subbasin and the North American, North Yuba, and South Yuba Subbasins and leaves Butte Subbasin as a larger number consistent with the most recently published Butte GSP. Finally, the minor differences in subsurface flows for Colusa and Wyandotte Creek Subbasin subsurface are within the range of normal model error and don't indicate issues with flow direction or magnitude. It is important to note that the Colusa and Yolo Subbasin GSPs did not break out subsurface flow by subbasin and only reported total flow across all borders, making direct comparison with Sutter Subbasin difficult.

Further discussion on model updates between C2VSimFG-Sutter Version 1.0 and Version 2.0 models is presented in **Sections 2.2** and **2.3**, and the updated sustainable yield estimation is discussed in **Section 2.4**.

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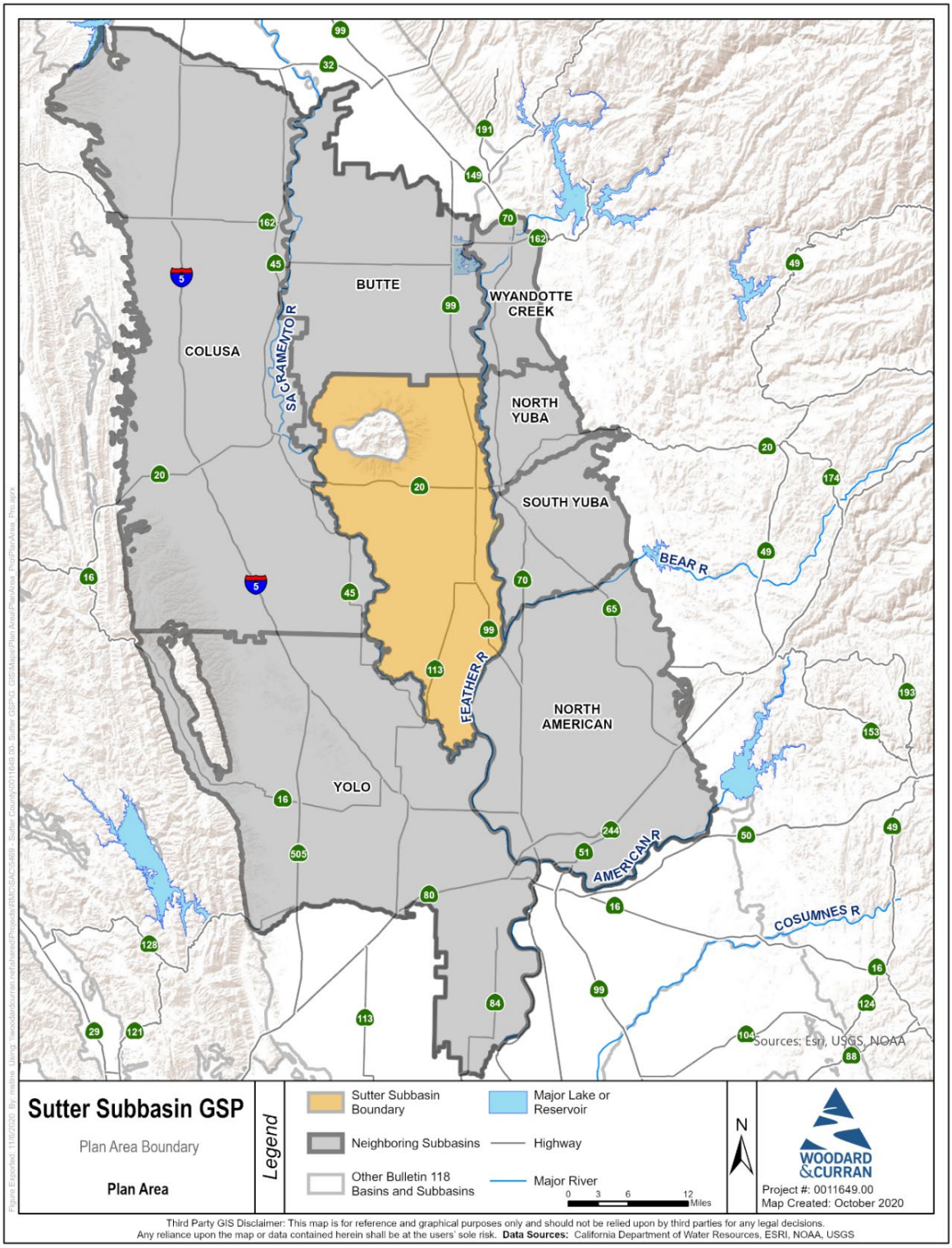

Figure 1. Adjacent Groundwater Subbasins

Table 1. Change in Subsurface Flows from Historical to Projected (No Climate Change) Water Budgets (AFY)

Adjacent Groundwater Subbasin	Net Subsurface Inflow: Change from Historical to Projected (No Climate Change) in Water Budget			
	Sutter Subbasin 2022 GSP Table 5-13 (using C2VSimFG-Sutter Version 1.0)	C2VSimFG-Sutter Version 2.0	Adjacent Subbasin Most Recent Published GSP	Adjacent Subbasin GSP Source
Butte	12,000	11,000	9,300	Table 2-8: Subsurface Inflows and Subsurface Outflows to/from Sutter Subbasin
Colusa	-1,000	1,000	0*	Table 3-12: Subsurface Water Inflows and Subsurface Water Outflows (not broken out by Subbasin)*
North American	26,000	-2,000	600	Table 6-13: Subsurface Inflow and Subsurface Outflow to/from Sutter Subbasin
North Yuba	13,000	0	-900	Table 2-19: Subsurface inflow and subsurface outflow to/from Sutter
South Yuba	22,000	1,000	1,200	Table 2-21: Subsurface inflow and subsurface outflow to/from Sutter
Wyandotte Creek	0	1,000	100	Table 2-6: Subsurface Inflows and Subsurface Outflows to/from Sutter Subbasin
Yolo	7,000	1,000	12,000*	Table 2-28: Lateral GW Flow: Outside Yolo (not broken out by Subbasin)*

AFY = Acre-feet per year

Notes: Values are reported from the Sutter Subbasin perspective. Positive values indicate a net subsurface inflow; negative values indicate net outflow.

*Adjacent subbasin GSP value represents the total net subsurface flow across all subbasin boundaries, so are not directly comparable to C2VSimFG-Sutter Version 2.0 calculated flows.

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2.2 Updated Historical Subsurface Flows in Model

As shown in **Table 1**, subsurface flows reported in the most recent GSPs for the adjacent subbasins show limited consistency with values reported in the Sutter 2022 GSP. This inconsistency reflects the challenge of estimating interbasin groundwater flows, which depends on modeling approach, boundary condition assumptions, and the availability of and calibration of model results to observations from wells and surface water.

To address this challenge, the C2VSim-Sutter Version 1.0 model was updated to Version 2.0 as part of the 2027 GSP Amendment. The primary goal of the update was to clip the model domain closer to the Sutter Subbasin boundary, allowing for greater control over boundary conditions and aligning the model inputs more closely to real-world observations.

Improvements related to subsurface flows in C2VSimFG-Sutter Version 2.0 are summarized below and described more fully in the model report (**Appendix 5-F**):

- **Clipped model domain.** Version 2.0 is spatially clipped from the original C2VSimFG-Sutter Version 1.0 model, which included the simulation of the entire Central Valley and all 36 groundwater subbasins within it. The clipped boundary required explicit groundwater boundary conditions to control subsurface flows, replacing the subsurface flows estimated in the Version 1.0 model (**Figure 2**)**.**

- **Observation-driven boundary conditions.** Boundary condition general head time series were derived from groundwater head time series from the statewide C2VSimFG Version 1.5 model (released June 6, 2025). First, groundwater head timeseries at C2VSimFG Version 1.5 nodes are matched to the closest C2VSimFG-Sutter Version 2.0 model boundary nodes. Simulated C2VSimFG Version 1.5 results are then re-trended using historical nearby well observations. The resulting boundary condition time series retain the seasonal and multi-year climate trends simulated in C2VSimFG Version 1.5, while aligning more closely to local groundwater level observations.

- **Stream inflows.** Stream boundary inflows use observed data from the California Data Exchange Center (CDEC) and the U.S. Geological Survey (USGS) for estimation of flows along most C2VSimFG-Sutter Version 2.0 streams. Flows running into the lower Feather River use adjacent groundwater model (Yuba Groundwater Model) outflows.

- **Updated model layers.** Version 2.0 was revised to a 5-layer model to align closer with the Sacramento Valley Groundwater-Surface Water Simulation Model (SVSim) in order to improve representation of the aquifer zones within the Sutter Subbasin and allow for better simulation of groundwater-surface water interaction. The layers were further refined using recent airborne electromagnetic (AEM) survey data.

- **Calibration to local observations.** Version 2.0 was calibrated against streamflow observations from six stream gages (plus four additional locations without observations) and groundwater level observations from 107 wells in and around the Sutter Subbasin. Calibration also focused on boundary condition heads along the Feather River near the North Yuba and Wyandotte Creek

Subbasins, as well as along Thermalito Afterbay. Additional detail on the calibration methodology is provided in the model report.

In addition to model updates, Sutter Subbasin's involvement in interbasin coordination of modeling approaches also improved subsurface flows between adjacent subbasins. Sutter Subbasin is a participant in regional interbasin coordination efforts; continuing coordination will further improve future modeling.

The comparison of C2VSimFG-Sutter Version 1.0 and Version 2.0 subsurface flows is included in **Table 2**. Note the Version 2.0 historical average is the annual average from water year (WY) 1996 through WY 2025. This is a 10-year extension of the Version 1.0 average from WY 1996 through WY 2015 and may contribute to some of the changes in the numbers. The changes in magnitude and direction between the historical subsurface flows in the two models reflect the adjustments outlined in the beginning of this section related to subsurface flows. Simulated interbasin flows with the Colusa Subbasin changed the most between C2VSimFG-Sutter Version 1.0 and Version 2.0; as mentioned in **Section 2.1**, the most recently available Colusa Subbasin GSP does not individually list subsurface flows with adjacent subbasins, so there is no way to verify C2VSimFG-Sutter's estimation of subsurface flows. Therefore, Sutter remains a net exporter of groundwater subsurface flows to the Colusa Subbasin in Version 2.0, though at a slightly larger magnitude compared to Version 1.0. Subsurface flows with other adjacent groundwater subbasins changed between 2,000 and 5,000 acre-feet per year (AFY), either positive or negative.

Table 2: Historical Subsurface Flows in C2VSimFG-Sutter Model Version 1.0 Versus Version 2.0 (AFY)

Adjacent Groundwater Subbasin	Subsurface Flows C2VSimFG-Sutter Version 1.0 (WY 1996-2015)			Subsurface Flows C2VSimFG-Sutter Version 2.0 (WY 1996-2025)			Net Change from Version 1.0 to Version 2.0
	Inflows to Sutter	Outflows from Sutter	Net Flows	Inflows to Sutter	Outflows from Sutter	Net Flows	
Butte	26,000	15,000	11,000	30,000	14,000	16,000	5,000
Colusa	21,000	34,000	-13,000	7,000	38,000	-31,000	-18,000
North American	1,000	13,000	-12,000	3,000	13,000	-10,000	2,000
North Yuba	7,000	7,000	0	6,000	4,000	2,000	2,000
South Yuba	9,000	5,000	4,000	10,000	4,000	6,000	2,000
Wyandotte Creek	0	2,000	-2,000	2,000	2,000	0	2,000
Yolo	17,000	24,000	-7,000	14,000	26,000	-12,000	-5,000

AFY = Acre-feet per year

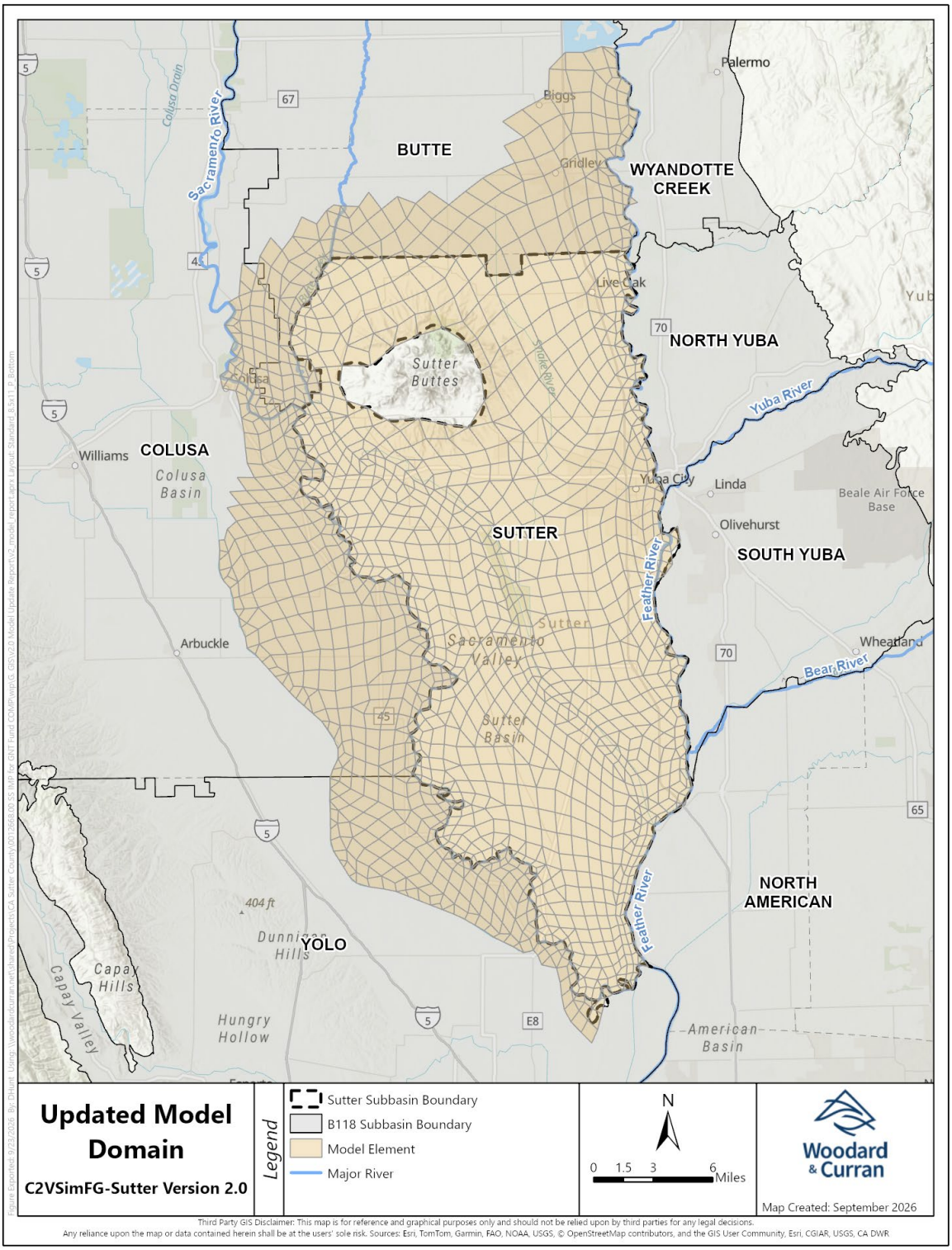

Figure 2: C2VSimFG-Sutter Version 2.0 Model Domain

2.3 Updated Projected Subsurface Flows in Model

The C2VSimFG-Sutter Projected Conditions Baseline (PCBL) Version 2.0 model was developed from the calibrated C2VSimFG-Sutter Version 2.0 historical model. Using Version 2.0 as the source model allowed for further control over projected condition subsurface flows by using a boundary condition time series based on recent historical average subsurface flows. The PCBL boundary head time series were developed from the final 12 years of the C2VSimFG-Sutter Version 2.0 historical simulation (WY 2014 through 2025). Average groundwater elevations were calculated by month and aggregated water year types (Dry, Normal, and Wet years), then applied throughout the projected simulation period. The projected simulation covers 60 years by repeating conditions from WY 2006 through 2025 three times, with hydrology from the WY 1996 through 2015 time period, and with initial conditions set from the ending conditions of the historical Version 2.0 model. Because the PCBL boundary conditions and other input time series are derived from a recent period of the historical model, some difference between the historical and PCBL subsurface flows are expected. Annual average subsurface flows were computed from the full PCBL simulation period (**Table 3**).

Table 3: Projected Subsurface Flows in C2VSimFG-Sutter Model Version 1.0 Versus Version 2.0 (AFY)

Adjacent Groundwater Subbasin	Subsurface Flows C2VSimFG-Sutter PCBL Version 1.0			Subsurface Flows C2VSimFG-Sutter PCBL Version 2.0			Net Change from Version 1.0 to Version 2.0
	Inflows to Sutter	Outflows from Sutter	Net Flows	Inflows to Sutter	Outflows from Sutter	Net Flows	
Butte	36,000	13,000	23,000	41,000	14,000	27,000	4,000
Colusa	21,000	35,000	-14,000	7,000	37,000	-30,000	-16,000
North American	15,000	1,000	14,000	3,000	15,000	-12,000	-26,000
North Yuba	16,000	3,000	13,000	6,000	4,000	2,000	-11,000
South Yuba	28,000	2,000	26,000	10,000	3,000	7,000	-19,000
Wyandotte Creek	0	2,000	-2,000	3,000	2,000	1,000	3,000
Yolo	23,000	23,000	0	15,000	26,000	-11,000	-11,000

AFY = Acre-feet per year

2.4 Sustainable Yield Estimation

RCA No. 2 also mentions boundary flows in the sustainable yield estimation. In the 2022 GSP, sustainable yield was estimated by increasing demand in the projected conditions model (Version 1.0) until the long-term change in groundwater storage approached zero. Demand was increased by raising evapotranspiration (ET) in the Sutter Subbasin. A 20% increase in ET resulted in a change in groundwater storage of approximately zero and a 33% increase in groundwater pumping to meet the additional demand. The sustainable yield of the Sutter Subbasin was estimated at 182,000 AFY (Sutter Subbasin GSAs, 2022).

For the 2027 GSP Amendment, the sustainable yield analysis was evaluated again using the PCBL Version 2.0 model as the basis for analysis. Since the PCBL Version 2.0 already has an average change in groundwater storage of approximately zero, evapotranspiration did not need to be adjusted and boundary flows under

a zero change in storage are as described above in **Section 2.3**. Because the historical groundwater pumping is not close to exceeding the 2022 sustainable yield estimate except in consecutive years of drought, the sustainable yield estimation remains 182,000 AFY for the Sutter Subbasin.

3. CONCLUSIONS

A focus of the C2VSimFG-Sutter model update from Version 1.0 to Version 2.0 was on addressing RCA No. 2 regarding the increases in net subsurface flows from the historical to projected scenarios and the sustainable yield estimation. Updates to the model included clipping the model in order to exert direct control over boundary conditions on most sides of the Sutter Subbasin through the use of general head boundary conditions.

Under Version 1.0, the subbasin-wide change for subsurface flows from historical to projected was approximately 79,000 AFY. This change was not explained in the 2022 GSP and was not consistent with all adjacent subbasin reported values (**Table 4**, which is a reproduction of much of **Table 1** with the addition of totals for Sutter Subbasin subsurface flows from adjacent subbasins). As shown in **Table 4**, the total change from historical to projected subsurface flows was substantially reduced from approximately 79,000 AFY in Version 1.0 to 13,000 AFY in Version 2.0. The difference between Version 1.0 and Version 2.0 is 6,000 AFY or less in the Butte, Colusa, Wyandotte Creek, and Yolo Subbasins. The North American, North Yuba, and South Yuba Subbasins experienced large changes in reported numbers between the historical and projected subsurface flows between the two model versions indicating the extent of updates to subsurface flows from C2VSimFG-Sutter Version 1.0 to C2VSimFG-Sutter Version 2.0.

Table 5 shows the annual average subsurface flows in the historical and PCBL for Version 2.0 for each adjacent groundwater subbasin. In terms of net flows, only the Butte Subbasin flows changed from historical to projected in any magnitude, with the remainder of subbasins only experiencing changes up to 2,000 AFY, which are minor and are within the range of error of the model. Additionally, the most recent published Butte Subbasin GSP also estimated large changes from the historical to projected subsurface flows with Sutter Subbasin. This difference will continue to be a part of data analysis and interbasin coordination moving forward with the Butte Subbasin.

The results of this analysis demonstrates that the changes made in C2VSimFG-Sutter Version 2.0 addressed the concerns raised in RCA No. 2 by eliminating the large changes in subsurface flows observed from the historical to projected model under Version 1.0 model scenarios. Under Version 1.0, the full C2VSimFG model extent was used to run scenarios, but only the Sutter Subbasin area was locally-refined. Assumptions made on historical and projected conditions outside the locally-refined area could compound and distort the subsurface flows with Sutter Subbasin in Version 1.0 modeling. The Version 2.0 model update eliminated most of these issues by clipping the model domain, setting explicit boundary condition time series, and updating the model inputs with improved available data. The use of nearby well observations and seasonal contours assisted in the calibration of historical boundary conditions, resulting in an overall reduction in the historical to projected subsurface flow change from 79,000 AFY in Version 1.0 to 13,000 AFY in Version 2.0, and brought model results closer to adjacent subbasin reported values (**Table 1**). Interbasin coordination and collaboration of modelling approaches with adjacent subbasins will further refine subbasin flows in future updates.

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Table 4: Subsurface Flows Performance Comparison of Version 1.0 Historical versus Version 2.0 PCBL (AFY)

Adjacent Groundwater Subbasin	Net Subsurface Inflow: Change from Historical to Projected (No Climate Change) in Water Budget		
	C2VSimFG-Sutter v1.0	C2VSimFG-Sutter v2.0	Difference
Butte	12,000	11,000	1,000
Colusa	-1,000	1,000	2,000
North American	26,000	-2,000	-28,000
North Yuba	13,000	0	-13,000
South Yuba	22,000	1,000	-21,000
Wyandotte Creek	0	1,000	1,000
Yolo	7,000	1,000	-6,000
Total	**79,000**	**13,000**	**-66,000**

AFY = Acre-feet per year
Notes: Values are reported from the Sutter Subbasin perspective. Positive values indicate a net subsurface inflow; negative values indicate net outflow.

Table 5: Subsurface Flows in Version 2.0 Historical versus Version 2.0 PCBL (AFY)

Adjacent Groundwater Subbasin	Historical Subsurface Flows			Projected Subsurface Flows			Net Historical to Projected
	Inflows to Sutter	Outflows from Sutter	Net Flows	Inflows to Sutter	Outflows from Sutter	Net Flows	
Butte	30,000	14,000	16,000	41,000	14,000	27,000	11,000
Colusa	7,000	38,000	-31,000	7,000	37,000	-30,000	1,000
North American	3,000	13,000	-10,000	3,000	15,000	-12,000	-2,000
North Yuba	6,000	4,000	2000	6,000	4,000	2,000	0
South Yuba	10,000	4,000	6,000	10,000	3,000	7,000	1,000
Wyandotte Creek	2,000	2,000	0	3,000	2,000	1,000	1,000
Yolo	14,000	26,000	-12,000	15,000	26,000	-11,000	1,000
Total	**72,000**	**101,000**	**-29,000**	**85,000**	**101,000**	**-16,000**	**13,000**

AFY = Acre-feet per year

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TECHNICAL MEMORANDUM NO. 3 – Chronic Lowering of Groundwater Levels Sustainable Management Criteria

TO: Paul Gosselin, California Department of Water Resources Deputy Director

CC: Guadalupe Rivera, on behalf of the Sutter Subbasin

PREPARED BY: Leslie Dumas & Ariel O'Callaghan/Woodard & Curran

DATE: October 14, 2026

RE: Sutter Subbasin Response to DWR's October 26, 2023 Approved Determination Letter for the Sutter Subbasin's 2022 GSP - Technical Memorandum 3, Response to DWR Recommended Corrective Action No. 3

In a letter dated October 26, 2023, the California Department of Water Resources (DWR) staff concluded that the Sutter Subbasin Groundwater Sustainability Plan (GSP or Plan) met the requirements for a GSP as set forth under the Sustainable Groundwater Management Act (SGMA) and approved the 2022 Plan (see **Attachment 1**). In Section 5 of the determination letter, DWR staff also identified recommended corrective actions (RCAs) for the Sutter Subbasin (Subbasin) Groundwater Sustainability Agencies (GSAs) to address by the Plan's first periodic evaluation.

This technical memorandum (TM) is in response to RCA No. 3 related to sustainable management criteria (SMC) for the chronic lowering of groundwater levels sustainability indicator.

This TM is organized into the following sections:

1) Overview of Recommended Corrective Action No. 3
2) Approach to Recommended Corrective Action No. 3
3) Response to Recommended Corrective Action No. 3
4) Conclusions
5) References

1. OVERVIEW OF RECOMMENDED CORRECTIVE ACTION NO. 3

RCA No. 3 is composed of five requests relating to the revision of SMC for the chronic lowering of groundwater levels. These five requests are as follows:

a. Revise the sustainable management criteria to be based on seasonal low groundwater levels to ensure potential impacts to beneficial uses and users are considered.

b. Provide clarification and detailed information related to the methodology of the second criterion for minimum thresholds (i.e., associated with the projected water budget simulation with a 50 percent increase in ET). Clearly describe the processes and terms involved, and the spatial and temporal aggregations that define "interconnected streams that are gaining become losing."

c. Provide more information about how the proposed minimum thresholds for the chronic lowering of groundwater levels may impact beneficial uses and users. Specifically, consider the impact of the selected minimum threshold levels on supply wells. The consideration should identify the degree/extent of potential impact including the percentage, number, and location of potentially impacted wells at the proposed minimum thresholds for chronic lowering of groundwater levels.

d. Reevaluate how groundwater level minimum thresholds may impact land subsidence.

e. Provide estimates of stream depletions when groundwater levels are at the minimum thresholds and evaluate the potential impacts to beneficial uses and users of interconnected surface water.

2. APPROACH TO RECOMMENDED CORRECTIVE ACTION NO.3

In the 2022 GSP, the definition of an undesirable result for the chronic lowering of groundwater levels is based on seasonal high (spring) water level measurements; specifically, when groundwater elevations drop below the minimum threshold (MT) criteria at 25% of representative monitoring locations concurrently over two consecutive seasonal high water level measurements. The measurable objective at each representative monitoring well (RMW) was set as the average of the historical record, and the minimum threshold was established as the deepest value produced by one of three methods:

(1) the historic low for the available record;

(2) 90 percent of the average simulated groundwater elevation from the projected water budget over a 60-year period using the C2VSimFG-Sutter model with an artificial 50 percent increase in evapotranspiration (ET); or

(3) a minimum operating range applied by aquifer zone (8.0 feet for the Shallow Zone and AZ-1, and 16.5 feet for AZ-2 and AZ-3).

Several assessments were conducted to reevaluate the SMC for chronic lowering of groundwater levels in response to RCA No. 3. The assessments completed in response to RCA Nos. 3a, 3b, 3c and 3d are described below in **Section 3**. The evaluation conducted in response to RCA No. 3e has been included in the TM prepared in response to RCA No. 6 as both comments reflect questions regarding the depletions of interconnected surface water (ISW).

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3. RESPONSE TO RCA NO. 3

3.1 Response to No. 3a: Basis for the Undesirable Result

This section addresses DWR's RCA regarding the seasonal groundwater level basis used to evaluate the undesirable result for chronic lowering of groundwater levels.

3.1.1 2022 GSP Approach

In the 2022 GSP, the undesirable result for chronic lowering of groundwater levels was evaluated using seasonal high, or spring, groundwater level measurements. This approach was selected by the Sutter Subbasin Groundwater Management Coordination Committee (SSGMCC) and stakeholders based on the understanding that groundwater levels rebound seasonally and that consecutive measurements are useful for evaluating longer-term groundwater level trends. The selection of seasonal high groundwater levels as the metric was selected in that it reflected the importance of the ability of the aquifer system to rebound after drier periods, when groundwater levels may temporarily drop. Similarly, whether or not the lowering of groundwater levels is a temporary occurrence or a long-term trend is reflected in the need for consecutive measurements.

In summary, key elements of the 2022 GSP approach included:

- Seasonal high groundwater levels were used to evaluate whether an undesirable result had occurred.
- The measurable objective at each RMW was defined as the average groundwater elevation over the historical period of record.
- An undesirable result was identified when groundwater levels fell below the minimum threshold at 25% of representative monitoring locations over two consecutive measurement periods.

In the RCA, DWR recommended that the SMC for chronic lowering of groundwater levels be evaluated using seasonal low groundwater levels rather than seasonal high groundwater levels. Specifically, DWR noted that:

- Seasonal low groundwater levels better represent the period of maximum groundwater stress.
- Potential impacts to beneficial uses and users are most likely to occur during late summer and early fall, when irrigation demand and groundwater pumping are highest.
- Evaluating SMC during seasonal low conditions better aligns the evaluation with the period when undesirable impacts are most likely to occur.

3.1.2 Revision and Response to RCA No. 3a

To address RCA No. 3a, an analysis of hydrographs from representative monitoring wells in the groundwater level representative monitoring network (RMN) were reviewed to see if there were any specific patterns relative to when minimum threshold exceedances were occurring. The analysis indicated that, while minimum threshold exceedances did occur, groundwater levels typically rebounded during the next wet

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period. Recognizing the DWR's concern that the undesirable result definition in the 2022 GSP may not capture impacts that could occur during periods of maximum groundwater stress, the definition of the undesirable result will be revised to a seasonal low basis as requested.

Groundwater levels within the Sutter Subbasin are monitored based on individual aquifer zones. The definition of undesirable results refers to impacts occurring in the principal aquifer as defined in the 2027 GSP Amendment. As such, this threshold is applied across the full Subbasin RMN for groundwater levels and is not evaluated or triggered separately by aquifer zone. The fluctuation of groundwater levels by aquifer zones is already reflected in the minimum threshold methodology through zone-specific operating ranges (8.0 feet for the Shallow AZ and AZ-1, 16.5 feet for AZ-2 and AZ-3), and monitoring, and exceedances will continue to be reported and reviewed by AZ in annual reports. This definition may be revisited in future periodic evaluations to determine if AZ-specific impacts or trends are occurring consistently across the Subbasin and whether the monitoring network or undesirable result criteria warrant refinement.

Undesirable results are intended to evaluate overall basin conditions rather than the performance of an individual project management action. Groundwater levels can be influenced by a combination of hydrologic variability, drought conditions, surface water supply, and regional pumping patterns. Many of these factors are outside the direct control of the GSA and occurrence of declining groundwater levels or threshold exceedances does not necessarily indicate a specific project or management action was ineffective. Instead, these conditions should be considered within the broader context of basin wide and regional hydrologic conditions.

3.2 Response to RCA No. 3b: Second Minimum Threshold Criterion, Evapotranspiration

This section addresses DWR's RCA regarding the second minimum threshold methodology criterion, which was based on an evapotranspiration scenario in the 2022 GSP. The section also explains how the removal of the methodology affects representative monitoring wells and the subset of those wells that were also included in the ISW RMN.

3.2.1 2022 GSP Approach

In the 2022 GSP, the minimum threshold at each representative monitoring well was established as the deepest groundwater elevation produced by three criteria. The second criterion was based on a model simulation where evapotranspiration (ET) was artificially increased to simulate groundwater conditions associated with the potential transition of interconnected streams from gaining to losing conditions.

In establishing the minimum thresholds for the chronic lowering of groundwater levels, the historic low groundwater level for each RMW was first considered for establishing the numerical MT. However, when evaluating what this would numerically represent relative to the RMW hydrographs, it was obvious that, for many of the RMWs, this would result in little to no operating range (which was not surprising given the sustainable conditions in the Subbasin). As such, a second criterion for establishing numeric minimum thresholds was sought.

The Sutter Subbasin is bounded on two sides by major rivers – the Sacramento River on the west and the Feather River on the east. Additionally, the Subbasin is bisected by the Sutter Bypass. In practice, the Sacramento and Feather Rivers act as 'regulating reservoirs' in the Sutter Subbasin, feeding water into the

Subbasin as groundwater levels are lowered through natural fluctuations or groundwater pumping. Given the proximity of these significant interconnected surface waters, a methodology to establish minimum thresholds based on impacts to these ISWs was considered. This resulted in modeling scenarios to determine what groundwater levels would look like at the point these ISWs transition from gaining to losing conditions. To simulate this, a projected water budget was created to artificially increase ET by 50% to induce additional groundwater pumping to meet overlying land use demands to the point where the interconnected streams that were gaining become losing. A factor of 90% of the average simulated groundwater levels at the RMWs in this scenario (where ET is increased by 50%) was then applied to be conservative and avoid changes in the direction of stream interconnection while providing for additional operating range in the Sutter Subbasin.

Following the addition of this methodology to establishing the minimum thresholds for groundwater levels, the hydrographs for the RMWs were again examined to assess if significant operating range was present at the various locations, and it was determined that a third criterion would be needed to provide for reasonable future pumping operations.

As discussed in Chapter 6 of the 2022 GSP, for representative monitoring sites with small operating ranges as a result of the application of the first two minimum threshold criterion listed above (historic low groundwater levels and 90% of the groundwater levels simulated in the projected water budget with the artificial 50% increase in ET), a minimum operating range was calculated based on values resulting from the first two criterion. The average operating range for the Shallow AZ and AZ-1 were combined with the goal of being protective of interconnected surface waters, groundwater dependent ecosystems (GDEs), and shallow domestic wells, whereas the average operating range of AZ-2 and AZ-3 were combined because most groundwater is pumped from these AZs by municipal and agricultural production wells in the Sutter Subbasin. The resultant third option for establishing numeric minimum thresholds thus assumed a minimum operating range of either 8 feet or 16.5 feet, depending on the aquifer zone being monitored.

After establishing the three criteria for calculating numeric minimum thresholds at each RMW, all three methods were applied and the minimum thresholds established as the deepest of the three results.

3.2.2 Revision and Response to RCA No. 3b

As noted above, three methodologies were used to establish numeric minimum thresholds for RMWs in both the RMN for the chronic lowering of groundwater levels and for the depletion of interconnected surface water. The impacts of removing the second methodology criterion (90 percent of the average simulated groundwater elevation from the projected water budget over a 60-year period using the C2VSimFG-Sutter model with an artificial 50 percent increase in ET) on established minimum thresholds is discussed below for each RMN.

3.2.2.1 Minimum Thresholds for Groundwater Levels

In response to DWR's comments, an analysis was conducted to (1) determine how many of the numeric minimum thresholds for groundwater levels were established using the second criterion, and then (2) calculate what the numeric minimum thresholds for groundwater levels would be at all RMWs should this second methodology be removed. **Table 1** summarizes the initial assessment.

Table 1: Representative Monitoring Wells Minimum Threshold by Criterion

Representative Monitoring Network	Number of RMWs	Criterion 1 Historic Low	Criterion 2 90% avg projected elevation with +50% ET	Criterion 3 Minimum Operating Range
Groundwater Levels	63	14	4	45
Interconnected Surface Water	23	5	3	15

The four RMWs with minimum thresholds established using Criterion 2 are all located in the Shallow AZ or AZ-1, both of which have an established minimum operating range of eight feet under minimum threshold Criterion 3. **Table 2** shows what the revised minimum thresholds would be if Criterion 2 is removed and the minimum thresholds for the four RMWs are calculated based on the remaining two methodologies.

Table 2: Revised Minimum Thresholds[3]

State Well Number	Site Code / Local ID	Aquifer Zone	MO (ft)	Historic Low (ft)	New MT, no ET (ft)	Old 2022 MT, ET (ft)
14N02E10R001M[1]	USGS-390416121433601	Shallow	36.63	18.5	18.5	25.09
16N03E21D002M[1]	392328N1216469W001	Shallow	61.53	44.58	44.58	44.44
15N02E36L001M[2]	391051N1217012W001	AZ-1	41.09	37.00	33.09	22.54
16N03E17J001M[2]	392394N1216509W001 Sutter County MW-3A	AZ-1	67.82	62.59	59.82	45.80

Notes:
MO – measurable objective
MT – minimum threshold
1. Revised minimum threshold uses Criterion 1, lowest historic groundwater level.
2. Revised minimum threshold uses Criterion 3, minimum operating range.
3. Please see the Periodic Evaluation report for proposed changes to the representative monitoring networks.

For two of the RMWs (14N02E10R001M and 16N03E21D002M), both of which are in the Shallow AZ, removing Criterion 2 resulted in minimal changes or increases to the RMW's operating range. For the other two wells located in AZ-1 (15N02E36L001M and 16N03E17J001M), a minimum operating range was necessary to establish a reasonable minimum threshold close to, but below the lowest historic groundwater elevation. For all other RMWs in the chronic lowering of groundwater levels RMN, the established minimum thresholds do not change nor are there any changes to established measurable objectives.

3.2.2.2 Minimum Thresholds for Interconnected Surface Water

The ET-based methodology for establishing minimum thresholds was intended to indirectly represent potential impacts to interconnected surface water. Of the monitoring sites in the representative monitoring network for ISW, minimum thresholds for three RMWs were calculated using Criterion 2 for establishing the numeric threshold. These three wells (14N02E10R001M, 16N03E21D002M and 16N03E17J001M) were also included in the representative monitoring network for groundwater levels. No other ISW wells utilized the ET based criterion.

As discussed above, removal of the ET-based methodology for minimum threshold calculation (Criterion 2) does not affect the Subbasin's ability to evaluate groundwater conditions adjacent to interconnected surface water reaches.

3.2.3 Summary of Changes

Removing the ET-based methodology for minimum threshold calculation (Criterion 2) only impacts four RMWs in the groundwater levels RMN, three of which are also in the ISW RMN identified in the 2022 GSP. In reevaluating numeric minimum thresholds at these four wells using the remaining two methodologies, minimum thresholds would be calculated using the historic low groundwater level (Criterion 1) and two would use the minimum operating range (Criterion 3), resulting in minimum thresholds that are near or higher than those calculated using Criterion 2.

Removal of Criterion 2 improves transparency, consistency, and reproducibility of the SMC framework by relying on observed groundwater elevations and aquifer zone-specific operating ranges (historic low groundwater elevation and measurable objective minus the applicable minimum operating range) and not requiring interpretation of a modeled ET stress scenario or a modeled gaining-to-losing stream transition to establish groundwater level minimum thresholds. Additionally, removing the ET-based methodology does not reduce protection for beneficial uses and users. The methodology for calculating the minimum threshold was applied at only four RMWs; therefore, only those four wells receive revised thresholds. All other RMWs retain the minimum thresholds established in the 2022 GSP. Any modification to the representative monitoring networks themselves is discussed in the Periodic Evaluation report and reflected in the 2027 GSP Amendment.

3.3 Impacts to Beneficial Uses and Users (Response to RCA No. 3c)

This section addresses DWR's concerns regarding potential impacts to the beneficial uses and users of groundwater in the Sutter Subbasin, specifically potential impacts on domestic and water supply wells.

3.3.1 Previous GSP Analysis

Section 6.5.1.4 of the 2022 GSP evaluated the effects of the minimum thresholds on beneficial uses and users. Beneficial uses and users are identified in Section 4.1 of the 2022 GSP and generally include domestic, municipal, agricultural, and environmental uses and users. All beneficial uses and users of groundwater, and their associated land uses and property interests, were considered in establishing the minimum thresholds for the chronic lowering of groundwater levels. Stakeholders, including the public, were invited to provide feedback on the minimum thresholds during SSGMCC meetings (noticed under the Brown Act) and at a

public workshop held on August 11, 2021; municipal and agricultural representatives are members of the SSGMCC and participated in developing the minimum thresholds.

The 2022 GSP described how the minimum thresholds may affect each category of beneficial use and user as follows:

- **Domestic.** Minimum thresholds are established to avoid undesirable results for domestic well users, whose wells are typically screened in the Shallow AZ or AZ-1. If minimum thresholds are exceeded (even without an undesirable result), some areas may see shallow domestic wells temporarily go dry, which may require lowering well pumps, accessing alternative supplies in emergencies until levels recover, or deepening the wells.

- **Municipal.** Municipal wells tend to be deeper than domestic wells, with production typically from the lower portion of AZ-1 and from AZ-2 and AZ-3, and municipal systems are designed with redundancy to adapt to changing conditions. The minimum thresholds are established to be protective of municipal production needs, and exceedances are not anticipated to negatively impact municipal production given that redundancy and operating flexibility.

- **Agricultural**. As the primary user of groundwater in the Subbasin, agricultural production is similarly protected by the minimum thresholds. Exceedances are not anticipated to negatively impact agricultural production due to seasonal aquifer rebound and the availability of surface water supplies for agricultural purposes.

- **Environmental.** Environmental users typically rely on shallow groundwater (within about 50 feet of ground surface) for recharge to interconnected streams and for access by groundwater dependent ecosystems (GDEs). If minimum thresholds are exceeded (even without an undesirable result), reduced groundwater recharge to streams and groundwater levels too deep for GDE species to access may be observed.

DWR requested more information on how the proposed minimum thresholds may impact beneficial uses and users, specifically the impact of the selected minimum threshold levels on supply wells, including the degree and extent of potential impact and the percentage, number, and location of potentially impacted wells at the proposed minimum thresholds.

3.3.2 Beneficial Users Impact Analysis

The following subsections describe the methods and associated results assessing for potential impacts to beneficial uses and users of groundwater in the Sutter Subbasin using established minimum threshold and undesirable result definitions in the 2027 GSP Amendment. A summary is contained herein and more details regarding this analysis can be found in **Attachment 3**.

3.3.2.1 Well Impact Analysis Methods

An inventory of all wells within the Sutter Subbasin was compiled by their use, type, and depth using DWR's Online System for Well Completion Reports (OSWCR) database. This list was then filtered by each well's

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active status, known coordinates[1] and depths, and construction dates during or after 1976. These wells were categorized as either domestic or public supply wells. To assess the effectiveness of the groundwater level RMN, a 3-mile radius was delineated around each RMW to represent an "Impact Zone" of that well. To be most conservative, it was assumed that groundwater levels, and therefore their impact, are uniform within the Impact Zone. **Table 3** shows the total number of wells, by type, within each RMW's Impact Zone. The range in well depths, as well as the average well depth, are also shown by type. The supply wells within the impact zones represent 94% and 91% of the domestic and public supply wells within the Subbasin, respectively. Thus, the current monitoring network is representative of conditions for beneficial users within the Subbasin.

Figure 1 and **Figure 2** show the impact zones for each RMW for domestic wells and public supply wells, respectively. These impact zones are shown overlying the inventory of wells that meet the above criteria for each well group. **Figure 3** shows the same, but with public supply wells that are within a community water system (CWS).

Table 3: Well Detail for Impacts Analysis, by Type

Well Type	Total Number in Sutter Subbasin[2]	Within 3-mile Radius Impact Zone of RMWs		
		Total Number of Wells	Well Depth Range (ft bgs)[1]	Well Depth Average (ft bgs)
Domestic Wells	863	809	14 to 457	123
Public Supply Wells	34	31	75 to 720	231
Public Supply Wells – Community Water System	8	8	114 to 535	292

1. ft bgs = feet below the ground surface
2. Excludes wells constructed prior to 1976 and wells lacking depth data.

[1] In the OSWCR database, wells lacking precise location data are assigned the centroid coordinates of their associated PLSS section. Including these wells may have resulted in inaccurate impact assessments if assigned to the incorrect Impact Zone.

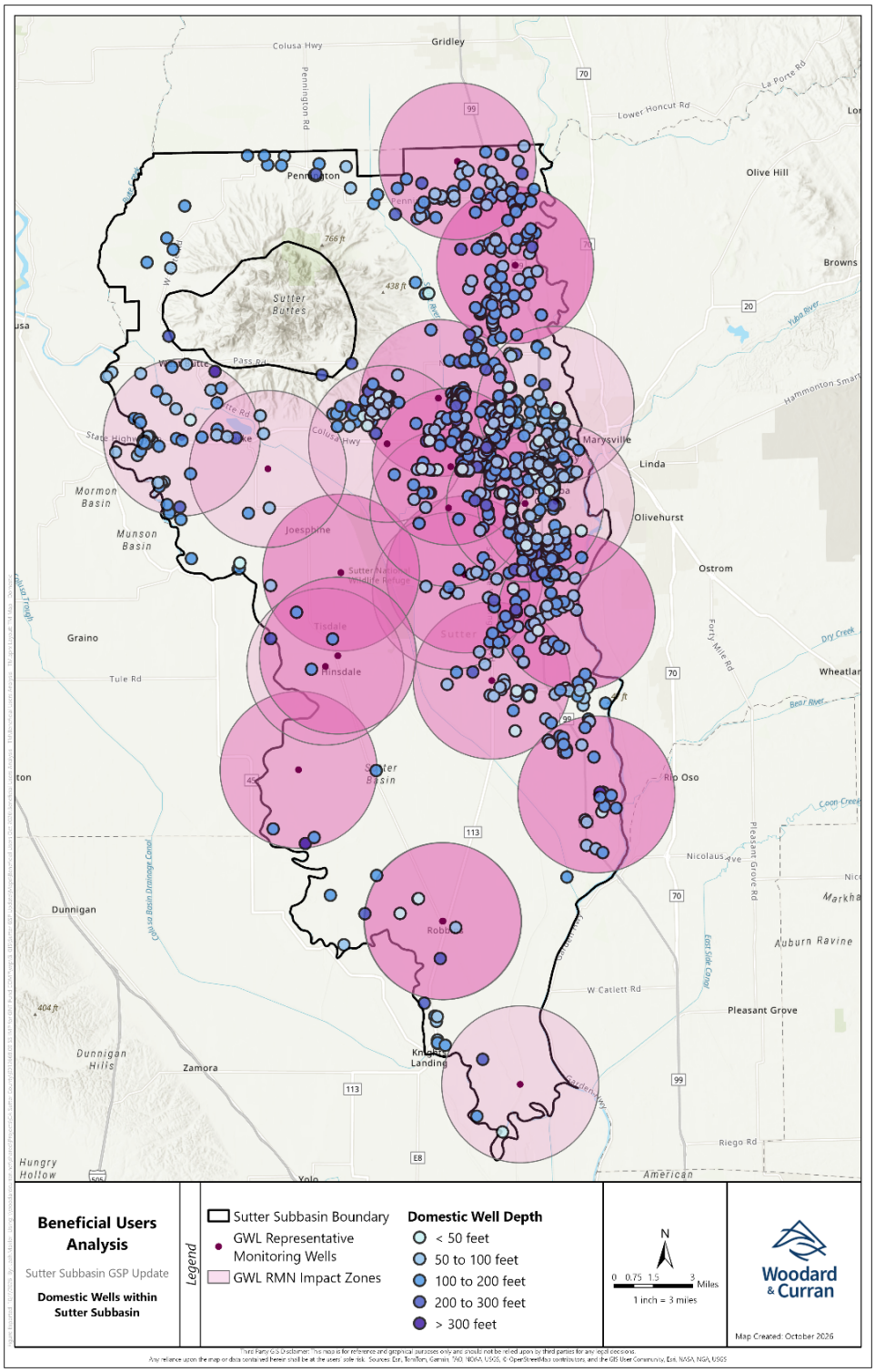

Figure 1: Inventory of Domestic Wells

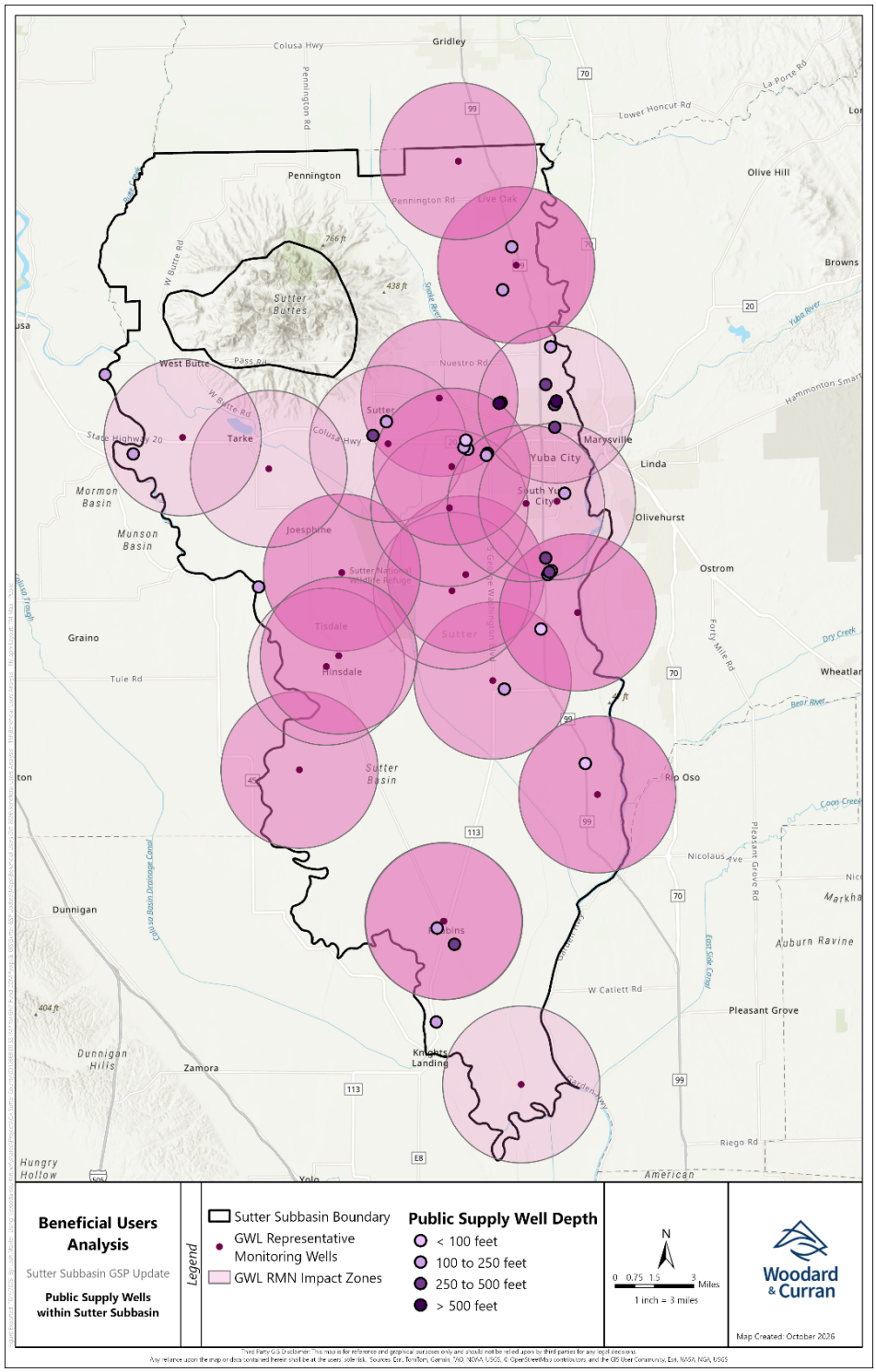

Figure 2: Inventory of Public Supply Wells

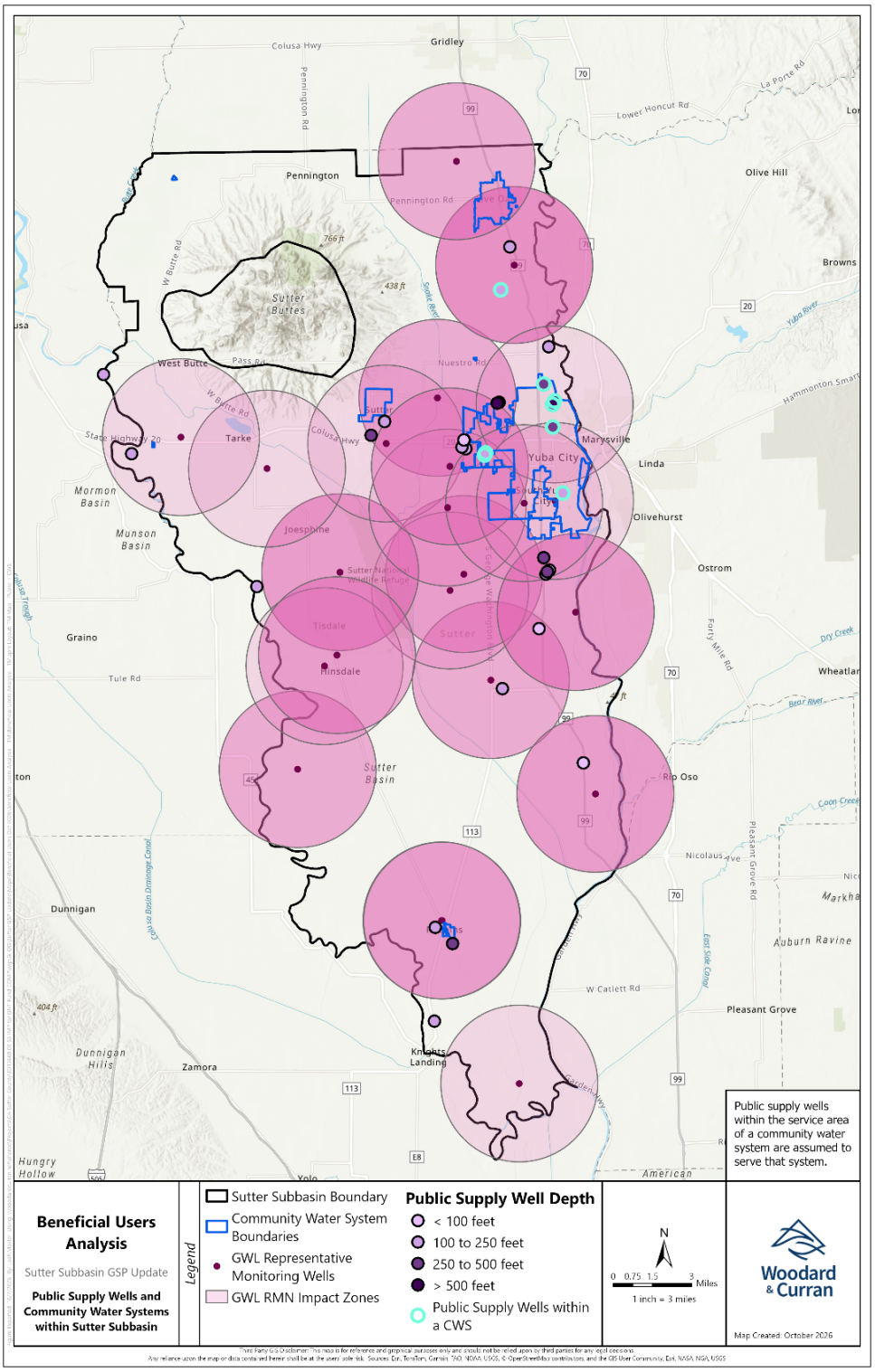

Figure 3: Inventory of Public Supply Wells within Community Water Systems

To identify which RMWs were most vulnerable to reaching their minimum thresholds during extended dry conditions, each RMW was ranked by the difference between its minimum threshold and groundwater measurements during a critical-low year (lowest groundwater elevation observed during WY 2021 or WY 2022). It was assumed that smaller differences between these values represented wells that were at higher risk of dropping to their minimum threshold.

The undesirable result for chronic lowering of groundwater levels is observed when at least 25% of the RMN reaches their minimum thresholds. With the RMN in the 2027 GSP Amendment, an undesirable result requires at least 13 wells to meet this criteria. To replicate an undesirable result scenario, the 13 most at-risk RMWs were assumed to drop to their minimum thresholds. The depths of the domestic and public supply wells within those RMWs' impact zones were then evaluated to determine whether they were at risk of going dry during the scenario. The same analysis was repeated at different percentages of RMWs reaching their MTs to serve as a sensitivity analysis. The impacts of the following sensitivity scenarios were calculated: 8%, 15%, 40%, and 100%, as described further in **Section 3.3.2.2**

3.3.2.2 Well Impact Analysis Results

Of the 809 domestic wells included, 3 wells could be impacted in the event of an undesirable result (25%), as highlighted in **Figure 4**. The impacted wells represent less than 1% of evaluated domestic wells in the Subbasin. There were no impacts to public supply wells under all sensitivity scenarios, including the extreme scenario in which 100% of RMWs drop to their MT, likely due to their relatively deep depths.

Furthermore, the sensitivity analysis indicates that well impacts are largely static regardless of the percentage of RMWs that reach their MTs. As shown in Error! Reference source not found., most scenarios result in less than 1% of domestic wells being impacted. Even in the worst-case scenario (100% of RMWs dropping to their MTs), less than 2% of domestic wells would be impacted.

Table 4: Sensitivity Analysis of Undesirable Result Scenarios – Domestic Wells

Percent RMWs at Groundwater Level MTs	Number of RMWs dropped to MTs	Total Number of Domestic Wells Analyzed	Number of Potentially Impacted Domestic Wells	Percentage of Total Domestic Wells Analyzed
8%	4	809	2	0.2%
15%	8	809	3	0.4%
40%	21	809	3	0.4%
100%	52	809	15	1.9%

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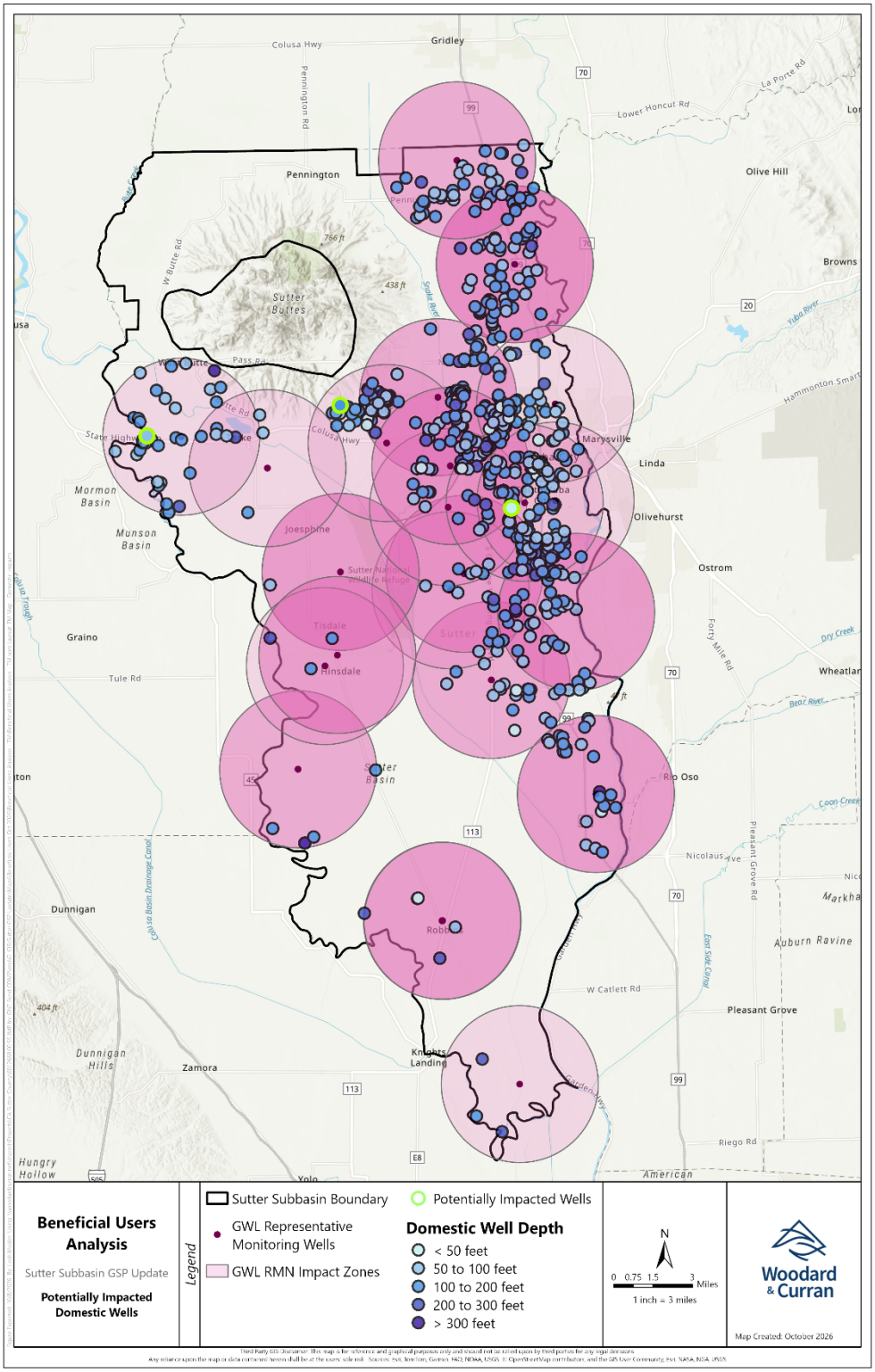

Figure 4: Domestic Wells at Risk of Impact

3.3.2.3 Groundwater Dependent Ecosystem (GDE) Impact Methods

For the purposes of this analysis, GDEs were identified and screened using the same methods as the 2027 GSP Amendment, starting with DWR's Natural Communities Commonly Associated with Groundwater (NCCAG) dataset, which includes vegetation communities and wetlands commonly associated with groundwater. NCCAG areas were screened out if they: (1) occurred where groundwater depths exceeded vegetation rooting depths (30 feet), (2) were located within 150 feet of losing streams or rivers that provide surface water recharge, or (3) were adjacent to irrigated lands, within 50 feet for most irrigated lands and 150 feet for irrigated rice fields. Additionally, only GDEs identified under 2015 dry-year conditions were used in this analysis to simplify analysis and maintain conservative evaluations.

While not a comprehensive analysis of potential GDE impacts across the Subbasin, impacts to potential GDEs were assessed in a similar manner to the well impact analysis described above. The total number of potential GDE polygons identified in the NCCAG dataset within each Impact Zone radii was counted. In the GDE analysis, plant rooting depth was used to define the threshold at which groundwater levels might impact the viability of the GDE. If a potential GDE falls anywhere within an Impact Zone, it is designated as either potentially "impacted" or "not impacted," depending on where the groundwater level falls in relation to the rooting depth threshold (30 feet below ground surface). **Figure 5** shows the locations of potential GDEs relative to the RMN Impact Zones.

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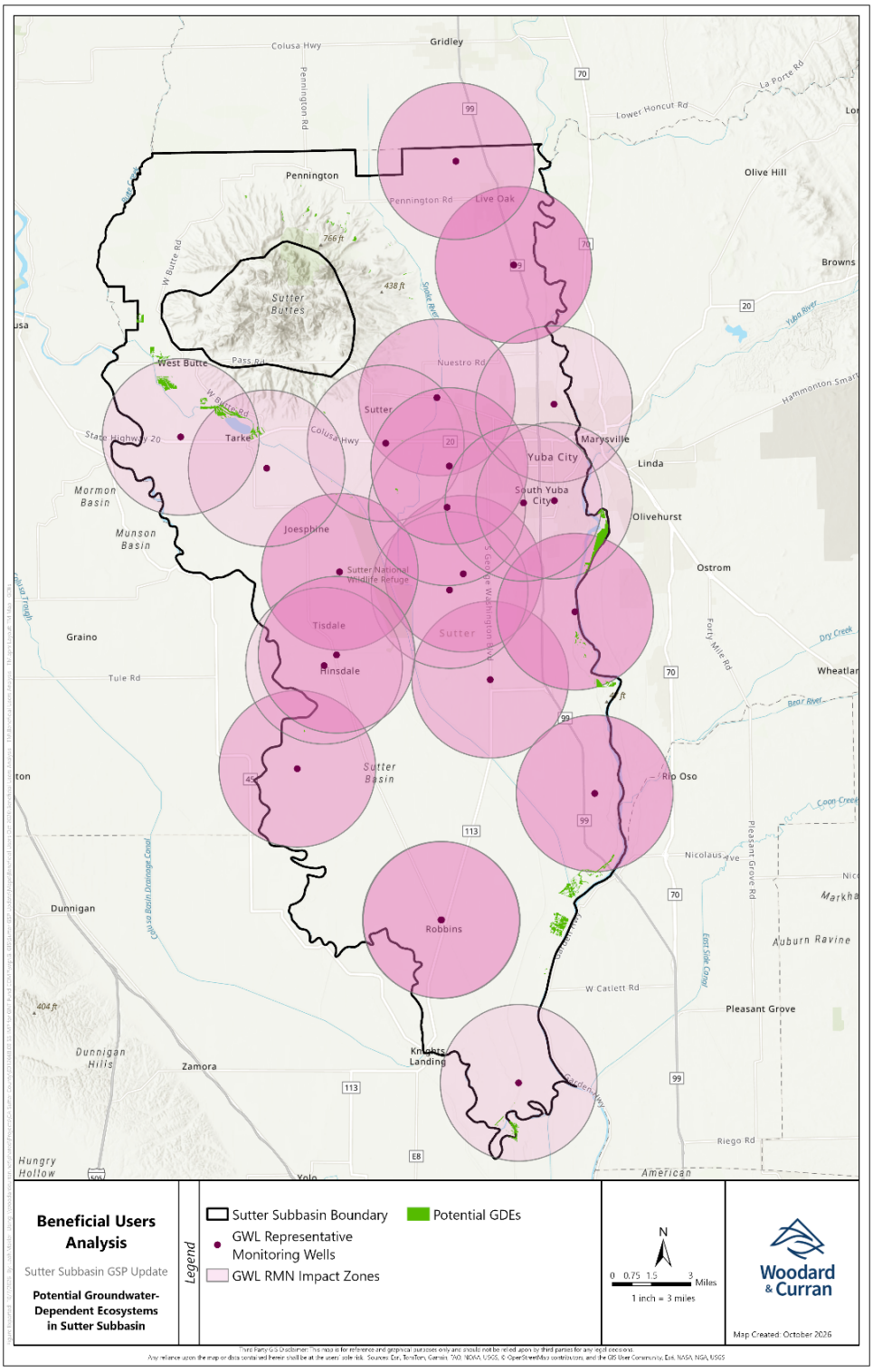

Figure 5: Inventory of GDEs within Impact Zones

3.3.2.4 Groundwater Dependent Ecosystem (GDE) Impact Results

Of the 285 GDEs identified within the Subbasin, zero are expected to be impacted in the undesirable result scenario (25% RMWs reaching their MTs).

3.3.2.5 Well and GDE Impact Analysis Conclusions

The beneficial users impact analysis described in this section indicates that the undesirable result definition and minimum thresholds for chronic lowering of groundwater levels are established with the intent to protect beneficial uses and users of groundwater in the Sutter Subbasin.

3.4 Reevaluation of Land Subsidence (Response to RCA No. 3d)

The 2022 GSP evaluated land subsidence using the Sacramento Valley Subsidence Network (SVSN) and other available monitoring information. The GSP concluded that inelastic land subsidence had not been observed within the Sutter Subbasin and established inelastic land subsidence SMC based on protection of vulnerable infrastructure and prevention of significant and unreasonable subsidence. Groundwater level minimum thresholds developed for the chronic lowering of groundwater levels were assumed to also be protective of other sustainability indicators, including land subsidence.

DWR noted that several groundwater level minimum thresholds were established at elevations deeper than historical low groundwater levels. DWR requested that the GSAs reevaluate whether the minimum thresholds for chronic lowering of groundwater levels could result in conditions that may trigger inelastic aquifer-system compaction and associated land subsidence.

3.4.1 Revision and Response to RCA No. 3d

As described in Hydrogeologic Conceptual Model (HCM) contained in Chapter 5 of the 2027 GSP Amendment, the principal aquifer system includes alluvial deposits of the Holocene Alluvium and Modesto, and Riverbank Formations. These formations are generally characterized by interfingering layers of gravels, cobbles and sand with some silt and clay. These formations have been reworked in the area of the Subbasin near the Sutter Buttes but maintain more of their lenticular beds in the southern part of the Subbasin. The Turlock Lake Formation acts as a mixed aquifer/local aquitard system in the Subbasin, with the lower unit including hardpan/claypan soils that locally reduce vertical permeability. The Upper Turlock Formation unconformably overlays the Laguna Formation in the northern and central portions of the Subbasin, whereas the Riverbank Formation unconformably overlays the Laguna Formation in the southern portion of the Subbasin. The Laguna Formation consists of sandy gravel channel facies, sandy channel facies, and sandy clay to clay floodplain facies, and is underlain by the Sutter Buttes Rampart in the northern portion of the Subbasin. The Sutter Buttes Rampart and Sutter Formation generally describe deeper continental and volcaniclastic deposits where regional formation boundaries are complex. It includes alluvial–fluvial deposits and volcaniclastic deposits interbedded with basaltic or andesitic materials.

The volcanic nature of the Sutter Buttes, along with the deposition and erosion that has occurred around them, has resulted in little to no compressible clay formations in the northern and central portion of the Subbasin. In the southern portion of the Subbasin, localized lenses of clay layers exist, but overall, the Sutter Subbasin does not contain any sizable compressible formations similar to the Corcoran Clay in the San

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Joaquin Valley and therefore is unlikely to experience any significant level of inelastic land subsidence. This is evidenced by the negligible levels of historical subsidence in the Subbasin.

The minimum thresholds for the chronic lowering of groundwater levels RMWs were established in mid-2021. GSP implementation began formally in 2022. As seen in the hydrographs for the representative monitoring wells contained in the annual reports, several representative monitoring wells reached or exceeded their minimum thresholds during Water Years (WYs) 2021 and 2022. However, as seen in the InSAR data available on the SGMA Data Viewer, essentially no subsidence was observed during those two water years. **Figure 6** superimposes several hydrographs at RMWs where groundwater levels met or exceeded the minimum threshold in WY 2021 on InSAR data from that same water year. **Figure 7** presents the same information for WY 2022. These comparisons of groundwater levels, the associated minimum thresholds and InSAR data indicate that the minimum thresholds, while below historic levels in many places, are not likely to induce inelastic land subsidence. It is important to note that, as GSP implementation began in 2022, the Subbasin GSAs were not actively managing groundwater extractions in 2022 to minimize minimum threshold exceedances. After the first five years of GSP implementation, the GSAs are more experienced and are actively monitoring and managing groundwater levels to minimize minimum threshold exceedances going forward.

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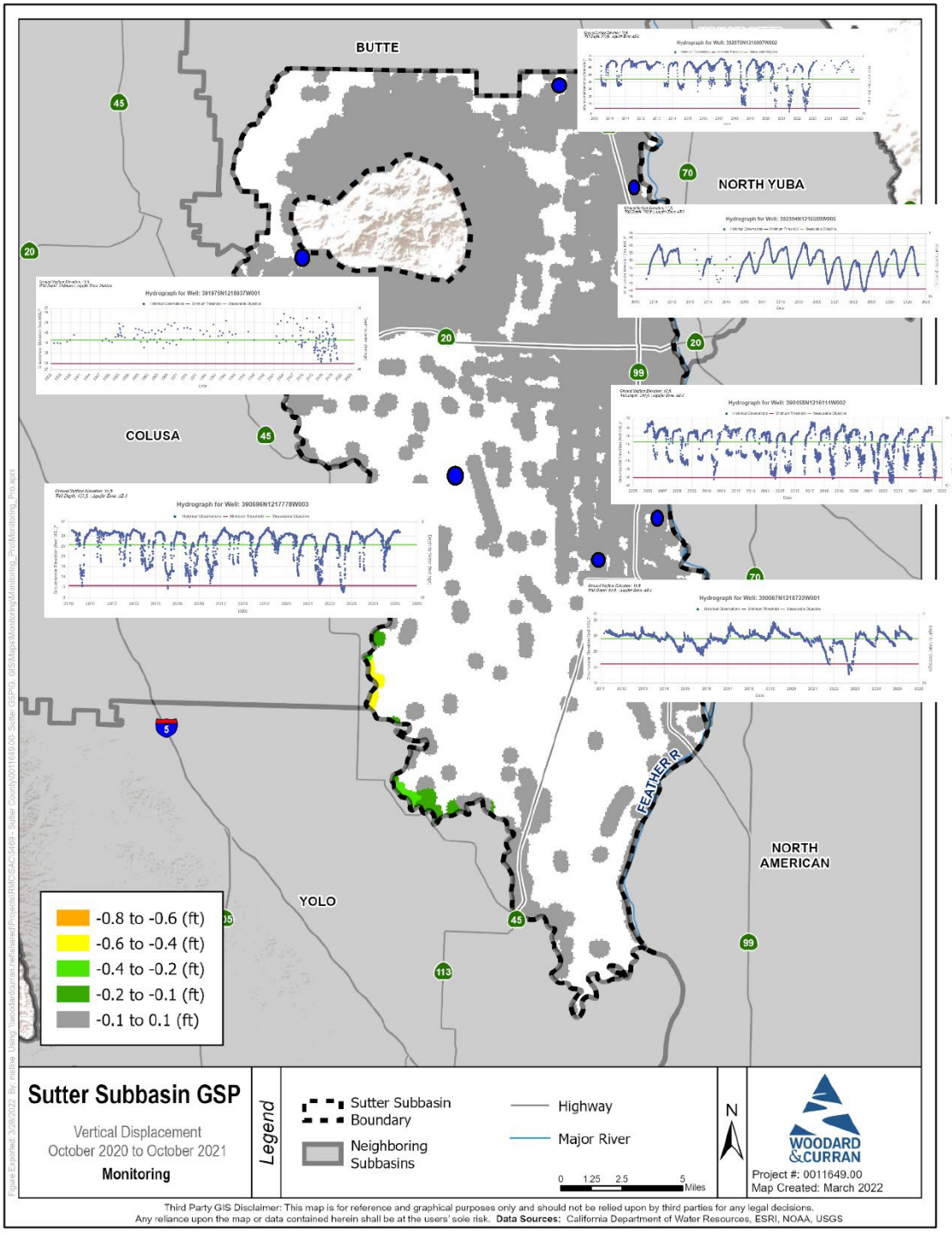

Figure 6: Water Year 2021 InSAR Map with Hydrographs

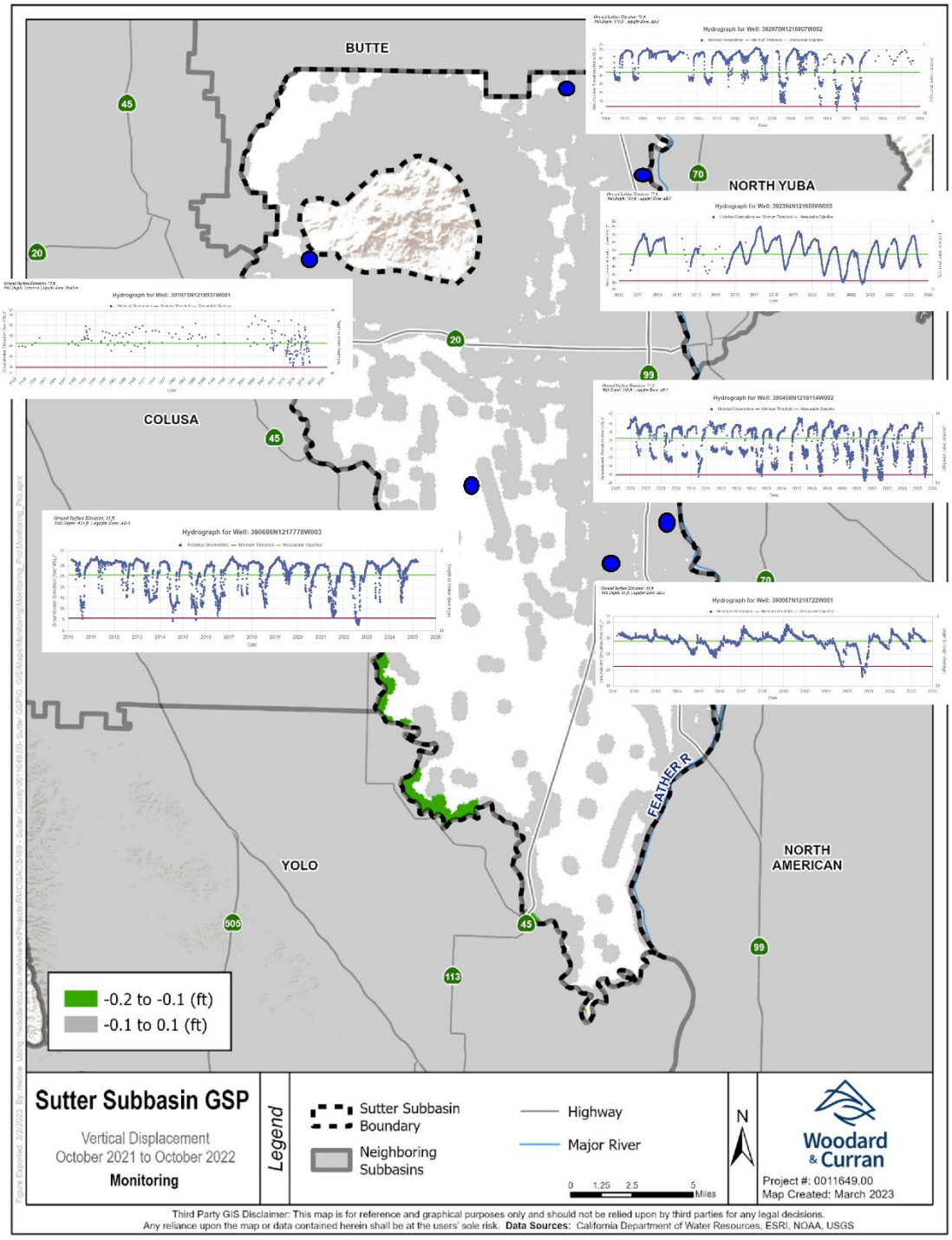

Figure 7: Water Year 2022 InSAR Map with Hydrographs

3.5 Response to RCA No. 3e: Estimates of Stream Depletion with Groundwater Levels at Minimum Thresholds

In the October 26, 2023 Determination letter, as part of RCA No. 3e, DWR requested estimates of stream depletions when groundwater levels are at the minimum thresholds and evaluate the potential impacts to beneficial uses and users of interconnected surface water. This work is discussed in RCA TM 6 – Interconnected Surface Water.

4. CONCLUSIONS

The 2022 GSP will be amended to revise the SMC for the chronic lowering of groundwater levels to be based on seasonal low conditions and to remove the ET-based Criterion 2 from the options for establishing numeric minimum thresholds. The minimum thresholds for the four wells affected by this change will be included in the updated SMC presented in Chapter 6 of the 2027 GSP Amendment.

The beneficial users impact analysis indicates that the undesirable result definition and minimum thresholds for chronic lowering of groundwater levels are established with the intent to protect beneficial uses and users of groundwater in the Sutter Subbasin.

Finally, the analysis to correlate the minimum thresholds for RMWs for the chronic lowering of groundwater levels with InSAR data demonstrates that the MTs will not induce inelastic land subsidence in the Subbasin. The Subbasin GSAs are actively working to maintain groundwater levels above established MTs and will continue to review both groundwater level data and InSAR results on an annual basis to confirm that subsidence is not occurring in the Subbasin.

5. REFERENCES

California Department of Water Resources (DWR). October 26, 2023. *Statement of Findings Regarding the Approval of the Sacramento Valley – Sutter Subbasin Groundwater Sustainability Plan*. Available at: https://sgma.water.ca.gov/portal/gsp/assessments/112

California State Water Resources Control Board. (2021). *Decision tree for classification of water systems.* Retrieved from https://waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/class_dec_tree.pdf

Sutter Subbasin Groundwater Sustainability Agencies. January 2022. *Sutter Subbasin Groundwater Sustainability Plan*. Available at: https://sgma.water.ca.gov/portal/gsp/preview/112

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TECHNICAL MEMORANDUM NO. 4 – Groundwater Quality

TO: Paul Gosselin, California Department of Water Resources Deputy Director

CC: Guadalupe Rivera, on behalf of the Sutter Subbasin

PREPARED BY: Natalie Cochran/Woodard & Curran

DATE: June 1, 2026

RE: Sutter Subbasin Response to DWR's October 26, 2023 Approved Determination Letter for the Sutter Subbasin's 2022 GSP - Technical Memorandum 4, Response to DWR Recommended Corrective Action No. 4

In a letter dated October 26, 2023, the California Department of Water Resources (DWR) staff concluded that the Sutter Subbasin Groundwater Sustainability Plan (GSP) met the requirements for a GSP as set forth under the Sustainable Groundwater Management Act (SGMA) and approved the 2022 Plan (see **Attachment 1**). In Section 5 of the letter, DWR staff also identified recommended corrective actions (RCAs) for the GSAs to address by the Plan's first periodic evaluation.

This technical memorandum (TM) is in response to RCA No. 4 related to groundwater quality.

This TM is organized into the following sections:

1) Overview of Recommended Corrective Action No. 4
2) Approach to Recommended Corrective Action No. 4
3) Conclusions
4) References

1. OVERVIEW OF RECOMMENDED CORRECTIVE ACTION NO. 4

RCA No. 4 states:

> *Revise the sustainable management criteria for degraded water quality to use water quality monitoring data collected in all water year types including drought years.* (p. 4)

An undesirable result for degraded water quality would occur "when 50% of representative monitoring wells (14 out of 28 representative wells)[1] across all aquifer zones exceed the minimum threshold for two

[1] Note that changes to the representative groundwater quality monitoring network have occurred since initial GSP adoption with a total of 19 representative monitoring wells. Such changes are documented in the GSP Amendment and periodic evaluation.

consecutive measurements at each location during non-drought years and where these minimum threshold exceedances can be tied to a causal nexus between SGMA-related activities and water quality."[1] The GSP explains that such criteria "would provide sufficient data to establish a trend in potential worsening groundwater level as a result of GSP-related activities."[1]

2. APPROACH TO RECOMMENDED CORRECTIVE ACTION NO. 4

DWR indicates in the determination letter that:

> *However, the GSP does not justify why drought years are excluded from the criteria for undesirable results. In general, in drought years groundwater pumping increases, groundwater levels decline, and groundwater quality trends degrade. For example, shallow domestic wells tend to experience more water quality issues during drought. Excluding water quality data in drought years is likely to exclude more severe impacts on water quality from either groundwater extraction or the GSAs' projects and management actions.* (p. 26)

The letter further goes on to state that DWR "…staff recommend the GSAs revise the sustainable management criteria for degraded water quality to include water quality monitoring data collected in drought years." (p. 26)

3. CONCLUSIONS

The Sutter Subbasin GSP will be amended to remove the qualifier of non-drought years from the undesirable result definition for degraded water quality. The undesirable result definition for degraded water quality will apply to all years. The following tables and sections of the GSP will be modified:

- Table ES-1. Summary of Sustainable Management Criteria
- Section 6.4.3.2

4. REFERENCES

California Department of Water Resources (DWR). October 26, 2023. *Statement of Findings Regarding the Approval of the Sacramento Valley – Sutter Subbasin Groundwater Sustainability Plan*. Available at: https://sgma.water.ca.gov/portal/gsp/assessments/112

Sutter Subbasin Groundwater Sustainability Agencies. January 2022. *Sutter Subbasin Groundwater Sustainability Plan*. Available at: https://sgma.water.ca.gov/portal/gsp/preview/112.

[1] Sutter Subbasin 2022 GSP, Section 6.4.4.2, p. 418

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TECHNICAL MEMORANDUM NO. 5 – Land Subsidence Sustainable Management Criteria

TO: Paul Gosselin, California Department of Water Resources Deputy Director

CC: Guadalupe Rivera, on behalf of the Sutter Subbasin

PREPARED BY: Leslie Dumas and Leah Makler/Woodard & Curran

DATE: July 15, 2026

RE: Sutter Subbasin Response to DWR's October 26, 2023 Approved Determination Letter for the Sutter Subbasin's 2022 GSP - Technical Memorandum 5, Response to DWR Recommended Corrective Action No. 5

In a letter dated October 26, 2023, the California Department of Water Resources (DWR) staff concluded that the Sutter Subbasin Groundwater Sustainability Plan (GSP) met the requirements for a GSP as set forth under the Sustainable Groundwater Management Act (SGMA) and approved the 2022 Plan (see **Attachment 1**). In Section 5 of the letter, DWR staff also identified recommended corrective actions (RCAs) for the GSAs to address by the Plan's first periodic evaluation.

This technical memorandum (TM) is in response to RCA No. 5 related to sustainable management criteria (SMC) for land subsidence.

This TM is organized into the following sections:

1) Overview of Recommended Corrective Action No. 5
2) Approach to Recommended Corrective Action No. 5
3) Representative Monitoring Network (RMN)
4) Conclusions
5) References

1. OVERVIEW OF RECOMMENDED CORRECTIVE ACTION NO. 5

RCA No. 5 is composed of two requests relating to monitoring for land subsidence and the use of those data. These two requests are as follows:

a. Describe how undesirable results will be evaluated since it is unclear at what frequency data will be collected from the Sacramento Valley GPS Subsidence Monitoring Network. If data is not collected at a minimum of every 5-years from the network, another method should be utilized to ensure undesirable results are not occurring within the Subbasin.

b. Provide a description of how the InSAR data will be incorporated into identifying undesirable results for land subsidence.

2. APPROACH TO RECOMMENDED CORRECTIVE ACTION NO. 5

In the 2022 GSP, undesirable results for the land subsidence sustainability indicator occur when at least 25% of representative subsidence monitoring sites (6 out of 22 sites) exceed the minimum threshold (0.5 feet total) for subsidence over the 5-year monitoring period, which is the point at which differential settlement reduces the ability to deliver surface water supplies or inadequate freeboard on levee systems in wet years impacting conveyance of flood waters. Land subsidence monitoring for undesirable results was based on the Sacramento Valley Subsidence Network developed and monitored jointly by DWR, the U.S. Bureau of Reclamation (USBR), and local partners, where surveying was scheduled to occur every 5 years. Since adoption of the 2022 GSP, DWR has discontinued monitoring of the Sacramento Valley Subsidence Network and no 2022 survey was performed (last survey took place in 2017). In the interim, publicly accessible Interferometric Synthetic Aperture Radar (InSAR) data was evaluated to assess for undesirable results in the GSP annual reports. As a result, the GSAs have evaluated alternative methods for monitoring for subsidence to re-establish a new representative monitoring network or method in response to RCA No. 5.

To address DWR's identified RCA No. 5, a subsidence-specific representative monitoring network (RMN) based on several data sources was developed. Direct subsidence monitoring data now includes the use of data from the Sutter Land Subsidence Extensometer (Station 11N04E04N005M), Continuous Global Positioning System (CGPS) Station 1500, and InSAR vertical displacement data. Analyses were conducted to determine whether significant inelastic land subsidence is currently occurring or has historically occurred in the Subbasin. Subsidence rates across the Subbasin were visualized for the extensometer vertical displacement data, CGPS data, and InSAR data sets.

2.1 Subsidence Data

Subsidence data sets used to address DWR's RCA No. 5 include vertical displacement measurements from (1) the Sutter Land Subsidence Extensometer, (2) CGPS Station 1500, and (3) InSAR data from DWR (California Department of Water Resources, 2026a; California Department of Water Resources, 2026b; TRE ALTAMIRA Inc., 2026; SOPAC, 2023). These sources may be supplemented by data from DWR's Sacramento Valley Subsidence Network survey benchmarks (California Department of Water Resources, 2018). The data sets used are detailed further below.

2.1.1 Extensometer

Vertical displacement data from the Sutter Land Subsidence Extensometer (Station 11N04E04N005M) were downloaded from DWR's Water Data Library (WDL) (California Department of Water Resources, 2026a). The extensometer was selected based on its recent data availability and proximity to the Subbasin. The extensometer is not located within the boundary of the Sutter Subbasin, as shown in **Figure 8**.

Figure 1 shows a time series graph of subsidence for Sutter Land Subsidence Extensometer (Station 11N04E04N005M) from January 2015 to the present. The graph indicates a slight downward trend, reflecting a small increase in subsidence in the Subbasin. From January 2015 to April 2025, subsidence rates slightly increased, though overall subsidence remains minimal. The trend line's slope of $-3x10^{-6}$ feet per month (or

-0.000432 inches per year) confirms that a small amount of subsidence is occurring in the Subbasin. Additionally, the stable trend of the line at the end of 2023/early 2025 indicates possible rebound and demonstrates that the subsidence within the Subbasin is likely elastic in nature.

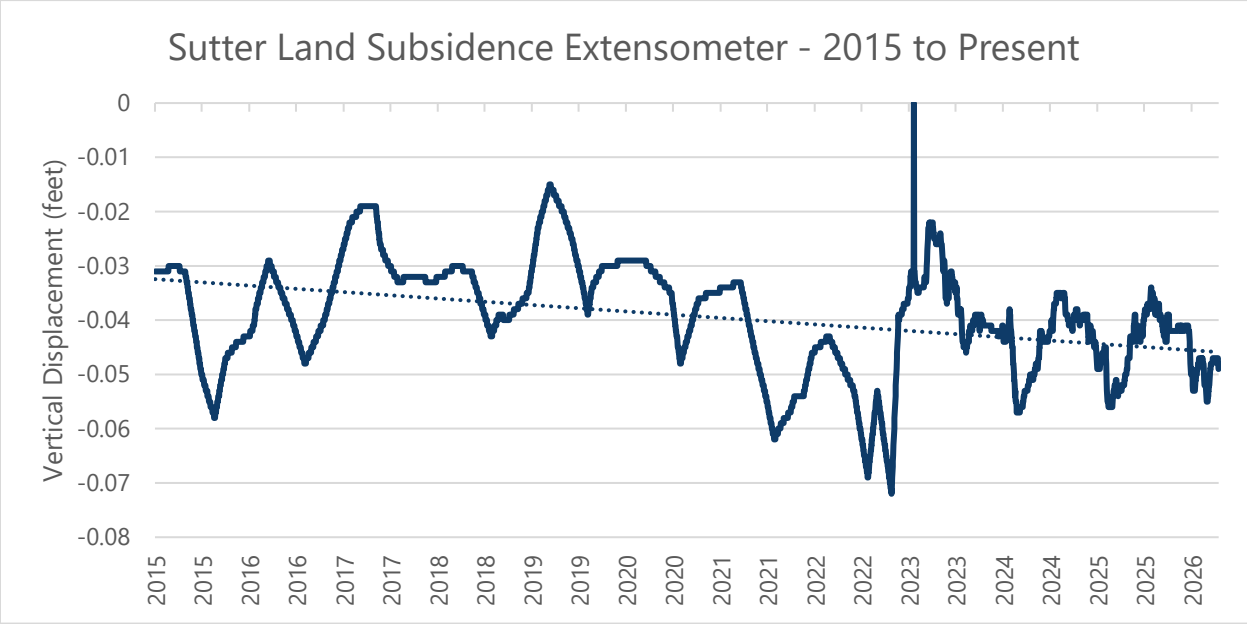

Figure 1: Sutter Land Subsidence Extensometer – Subsidence Time Series 2015 to Present

2.1.2 CGPS Station

Data from a DWR CGPS station located within the Sutter Subbasin is available on the SGMA Data Viewer within the California Spatial Reference Center (CSRC) network monitored by the Scripps Orbit and Permanent Array Center (SOPAC) at UC San Diego (SOPAC, 2023). The accuracy of stations within the network are expected to be between 0.5 to 10 centimeters (cm) at a 95% confidence level (California Land Surveyor's Association & California Spatial Reference Center, 2014).

CPGS Station 1500 is located on the southern edge of the Sutter Subbasin close to the boundary between the Sutter and North American Subbasins (as shown in **Figure 8**). As such, it may provide insights into land subsidence trends in the southern portion of the Subbasin. However, this station is relatively new and only data from 2025 and part of 2026 are available. **Figure 2** shows a time series graph of subsidence for CGPS Station 1500 for the period of record. The graph indicates elastic land subsidence within the Subbasin, but that there is an overall stable land surface.

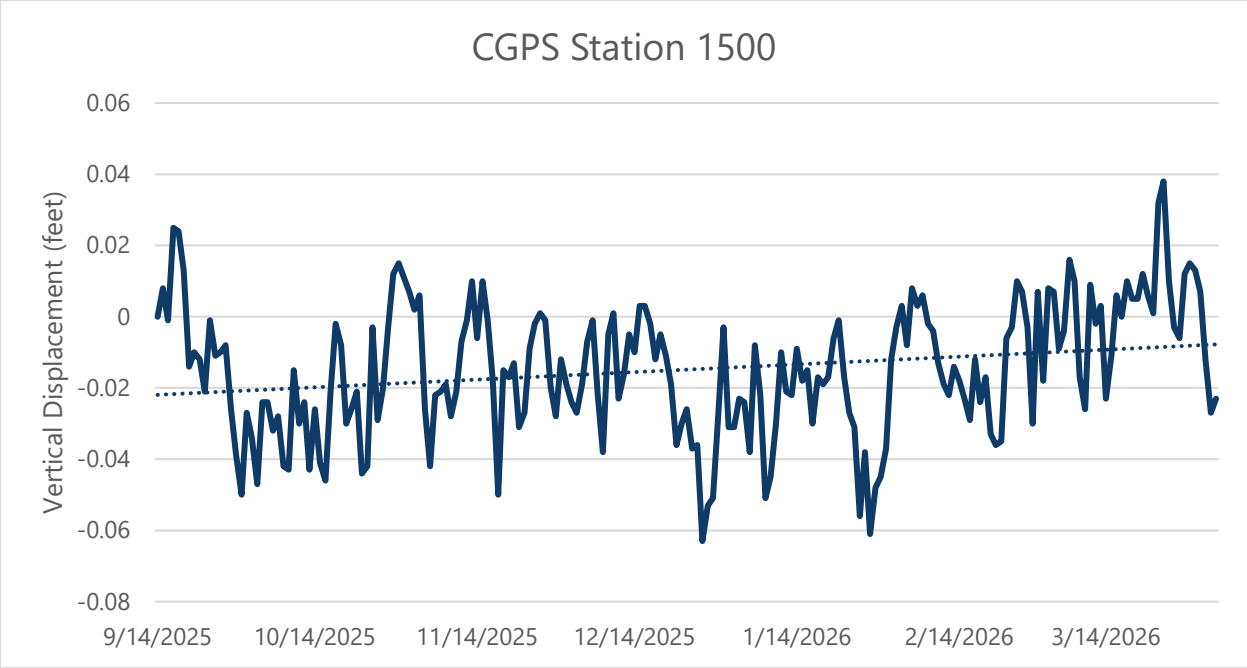

Figure 2: CGPS Station 1500 – Subsidence Time Series

2.1.3 InSAR

InSAR data were collected from the SGMA Data Viewer (TRE ALTAMIRA Inc., 2026). Included in the InSAR data set are point data that represent average vertical displacement values and raster data for total and annual vertical displacement rates in monthly time steps. The longest period of record at the time of this analysis was from October 1, 2015, to January 1, 2026. In comparison to CGPS or extensometer data, InSAR analyses can provide data on subsidence rates over larger geographic areas.

Compared to the estimated accuracy of CGPS stations (0.5 to 10 cm or 0.2 to 3.9 inches), InSAR has a vertical accuracy of 0.04 to 1.18 inches (0.003 to 0.098 feet) at a 95% confidence level (Towill, 2026). InSAR vertical displacement data is reported in tenths of a foot (e.g. -0.1 feet, 0.2 feet). Therefore, measurement uncertainty may lead to a rounding influence on the reported value. To reduce the influence of this uncertainty on subsidence evaluations, the InSAR analysis used to assess subsidence in the Subbasin utilize spatial and temporal averages (see **Figure 5** and **Figure 6**).

A subsidence analysis using InSAR data revealed minimal subsidence rates across the Sutter Subbasin during the 10-year period between Water Years (WY) 2016 and 2025. Error! Reference source not found. shows the total subsidence observed in the Sutter Subbasin from WY 2016 to 2025. During this period, most of the Sutter Subbasin observed total vertical displacement between -0.1 and +0.1 feet, which is within the realm of measurement error. Small areas just south of the Sutter Buttes and in the southern portion of the Subbasin observed vertical displacement values between -0.4 and -0.1 feet. Additionally, there are some areas on the Subbasin's southeastern border where total subsidence was greater than 0.6 feet between 2016 and 2025.

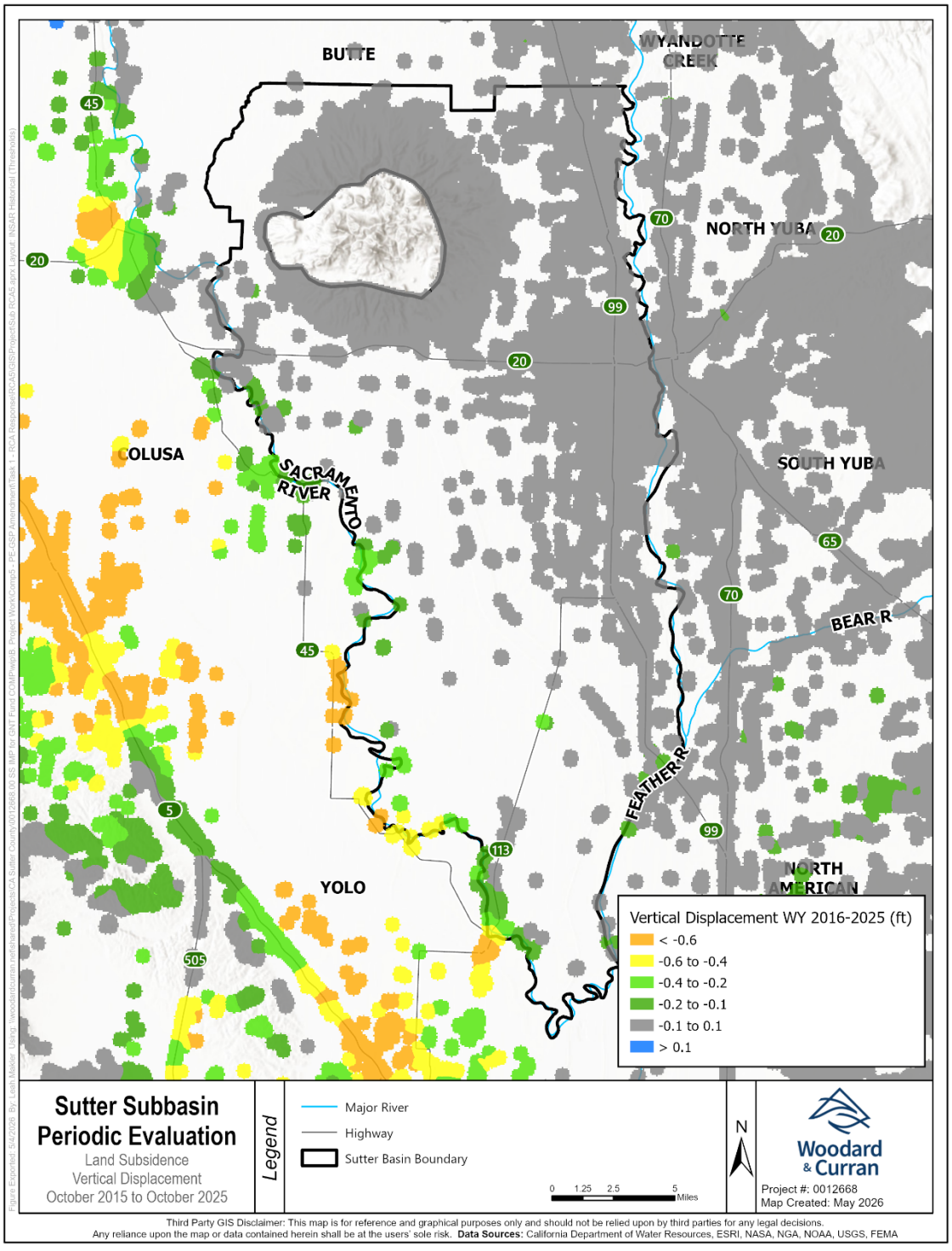

Figure 3: Total Subsidence Observed within the Subbasin (WY 2016-2025)

Note: InSAR period of the record displayed in the figure above is October 1, 2015, to October 1, 2025.

On a year-to-year basis, however, minimal rates of land subsidence are observed within the Subbasin, as shown in **Figure 4**, which presents total vertical displacement during WY 2025. Vertical displacement ranged from -0.1 to +0.1 feet throughout the Sutter Subbasin except for two small areas in the southern portion of the Subbasin where annual vertical displacement was between -0.2 and -0.1 feet (likely a result of leveling/grading of agricultural fields) during WY 2025 (**Figure 4**).

In order to characterize subsidence patterns across the entire Subbasin, zonal statistics were applied to calculate the average vertical displacement within 5 square mile (mi^2) "zones," as presented in **Figure 5** for WY 2025. To evaluate long-term patterns, the same analysis was extended temporally to show average annual vertical displacement during the most recent 5-year period, from WY 2021 to 2025. This analysis is presented in **Figure 6**. By calculating average subsidence in this way, localized and climatic variability are reduced, which allows for a more balanced assessment of subsidence trends within the Subbasin. During WY 2025 (**Figure 5**) and over the most recent 5-year period (**Figure 6**), average annual vertical displacement per 5 mi^2 throughout the Sutter Subbasin ranged from -0.1 to +0.1 feet, aside from one InSAR zone which averaged between -0.2 and -0.1 feet of displacement. The range of values is within the realm of measurement error; thus, utilizing average values lessens the influence of possible errors.

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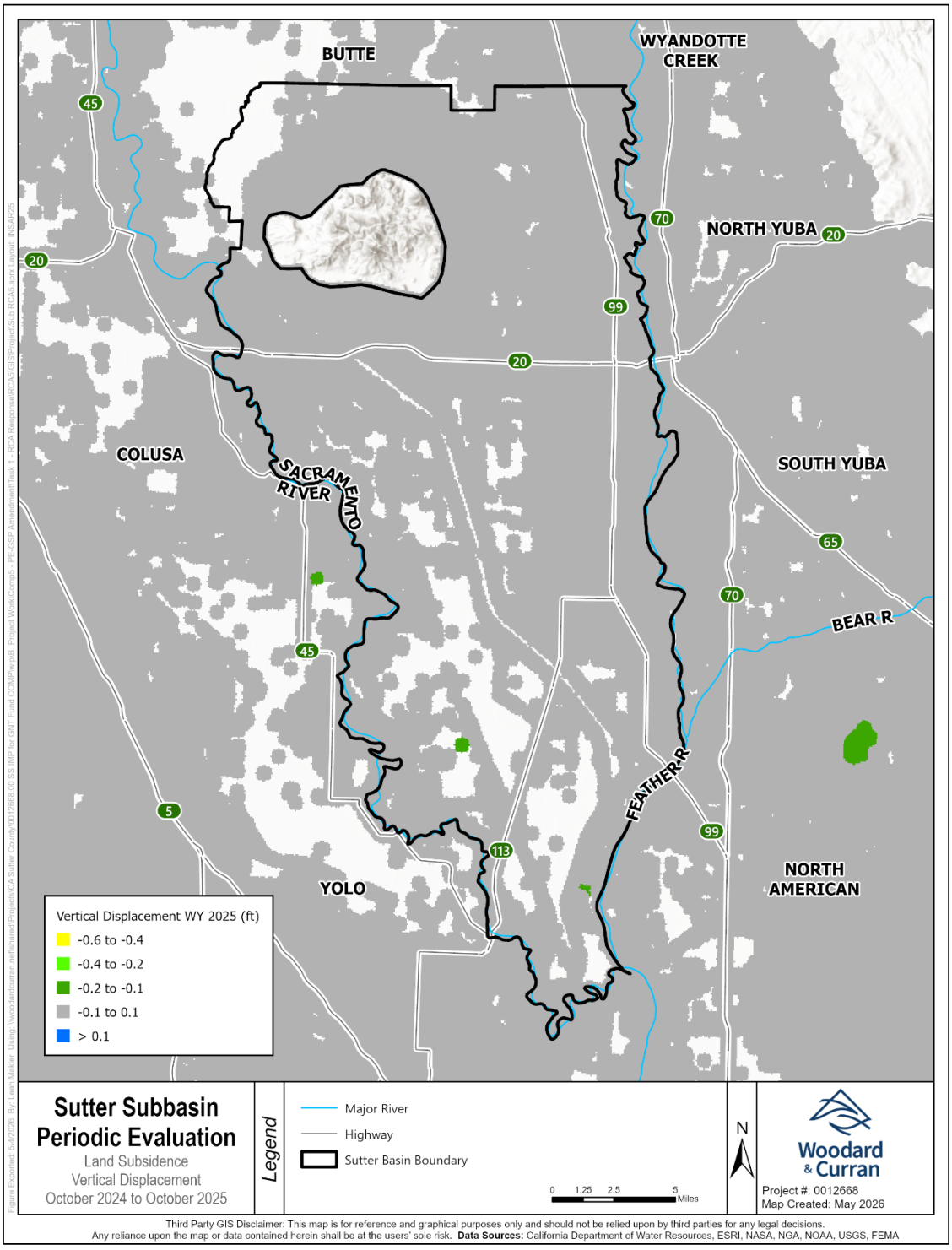

Figure 4: Subsidence Observed During WY 2025

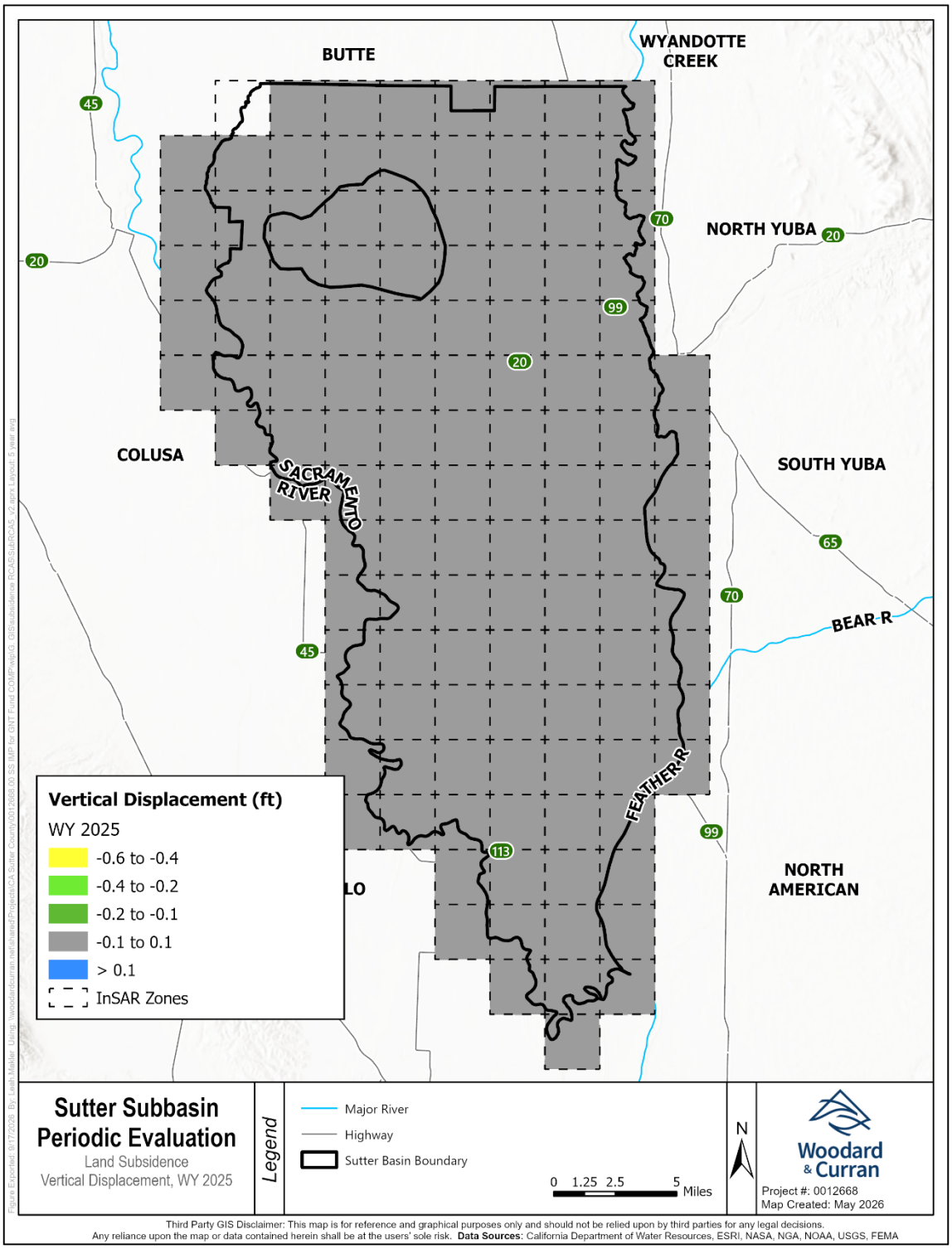

Figure 5: Zonal Average Subsidence (5-mi^2 Zones) Observed in WY 2025

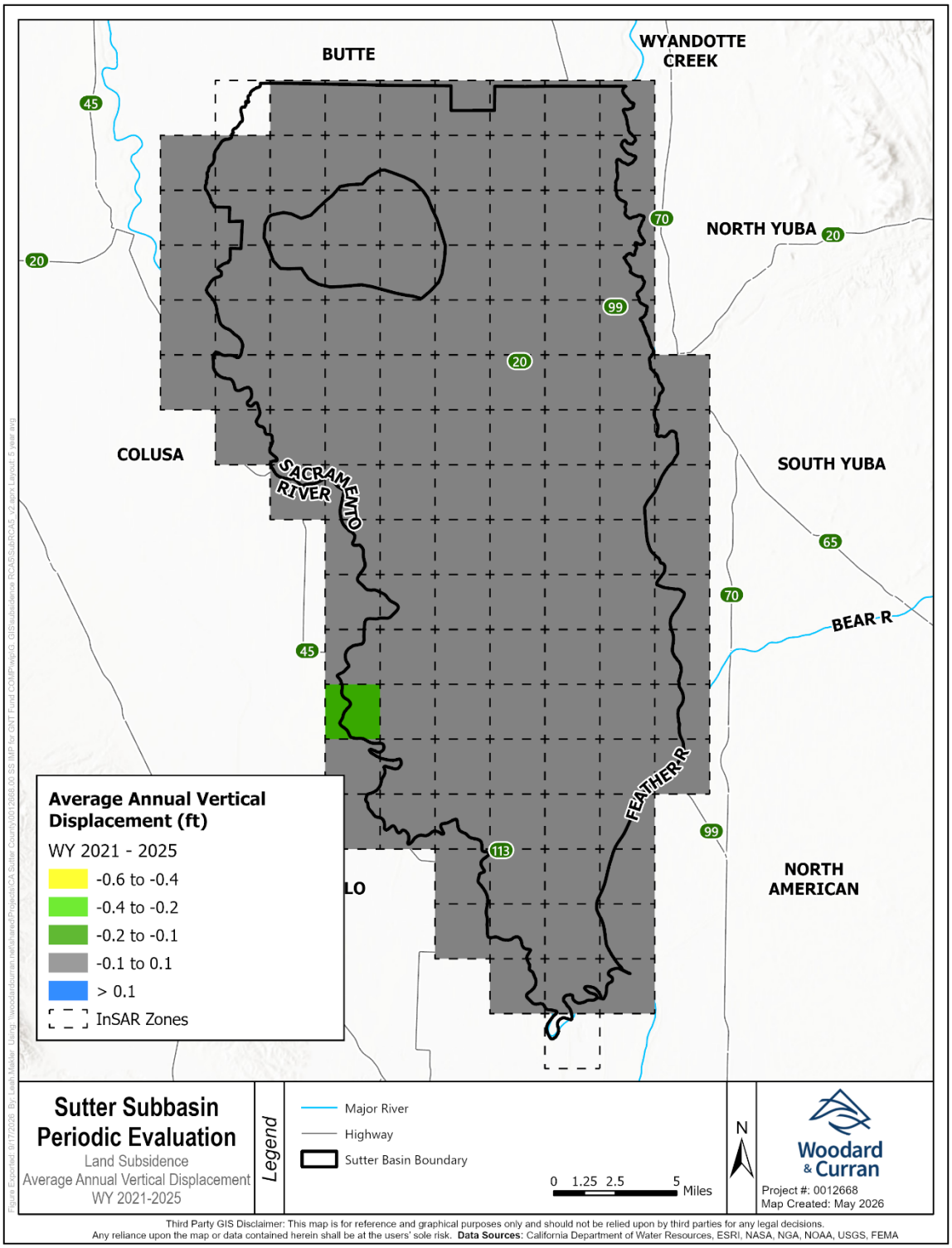

Figure 6: Average Annual Subsidence (5-mi² Zones), WY 2021 to 2025

2.1.4 Survey Benchmarks

As noted in the 2022 GSP, the Sacramento Valley Subsidence Network was developed in 2008 by DWR, U.S. Bureau of Reclamation (USBR), and other State and local entities. The network consists of 339 monuments, 22 of which are located within the Sutter Subbasin (California Department of Water Resources, 2018). All 22 monuments within the Subbasin were included within the original subsidence monitoring network (**Figure 7**).

DWR no longer actively monitors the Sacramento Valley Subsidence Network. In the event of subsidence concerns or the identification of a potential undesirable result, the Subbasin GSAs may collect GPS survey data from the 22 survey benchmarks to supplement the data provided by InSAR, the Sutter Land Subsidence Extensometer, and CGPS Station 1500. These measurements would be used to corroborate and address trends observed by the other aspects of the network.

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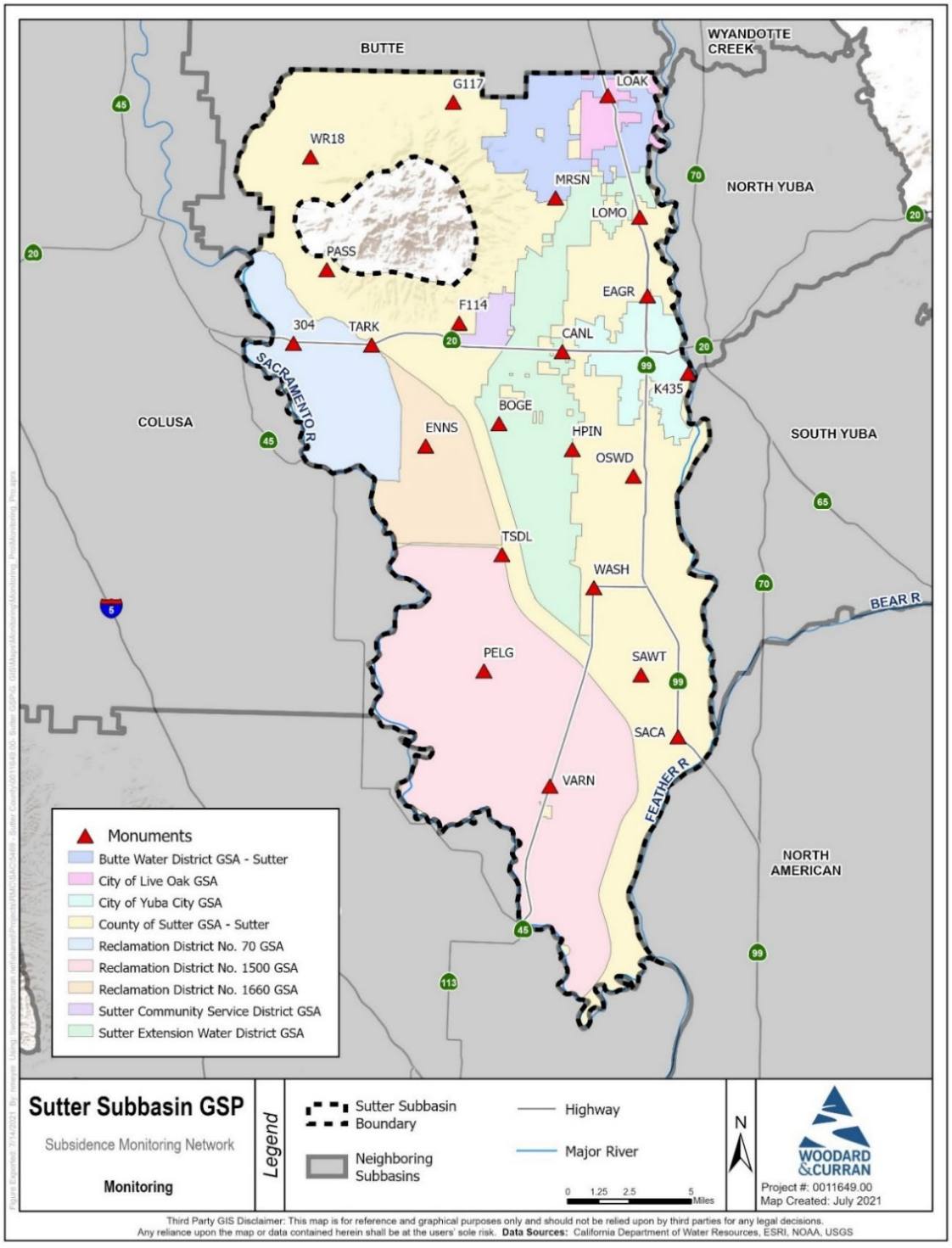

Figure 7: Sacramento Valley Subsidence Network in Sutter Subbasin

2.1.5 Summary

Historical data from all 4 sources described above indicate that land subsidence within the Subbasin has been minimal. In further subsidence monitoring, the Subbasin GSAs will use InSAR as the primary tool to evaluate subsidence because it provides consistent data on vertical displacement across the entire Subbasin. Additional publicly available data from the Sutter Land Subsidence Extensometer and CGPS Station 1500 will be used to validate InSAR observations. These methods are deemed sufficient to set new subsidence SMC and the required subsidence-specific RMN. The Sutter Land Subsidence Extensometer and CGPS Station 1500 will be included in the Subbasin's RMN. The 22 monuments within the Sutter Subbasin from the former Sacramento Valley Subsidence Network will only be proposed for future monitoring in the event that subsidence concerns or identification of potential undesirable results are observed using the revised RMN discussed further in **Section 3**.

3. REPRESENTATIVE MONITORING NETWORK

As a primary component of the RMN, InSAR data will be evaluated within 5 mi^2 monitoring zones across the entire Subbasin. The zones can be considered representative monitoring locations for assessing inelastic land subsidence. To supplement data collected from the InSAR zones, the RMN will also include CGPS Station 1500 and the Sutter Land Subsidence Extensometer. These components will provide continuous data availability to monitor vertical displacement throughout the Subbasin.

Table 1 describes monitoring site type, location, and data source for InSAR, the Sutter Land Subsidence Extensometer, and CGPS Station 1500 that will make up the Subbasin's RMN. **Figure 8** shows the updated representative monitoring network.

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Table 1: Subsidence Representative Monitoring Network

Name	Station/Zone ID	Latitude [1]	Longitude [1]	Monitoring Type	Frequency of Measurement
Sutter Land Subsidence Extensometer	Station No. 11N04E04N005M	38.8238	-121.5430	Extensometer	Continuous
DWR 1500	DWR 1500	38.7870	-121.6562	CGPS	Continuous
InSAR Monitoring Zone (5 mi^2)	InSAR Zones 1 to 125	Monitoring zones cover the entirety of the Subbasin		Sentinel-2 Satellite Imagery	Monthly; published quarterly

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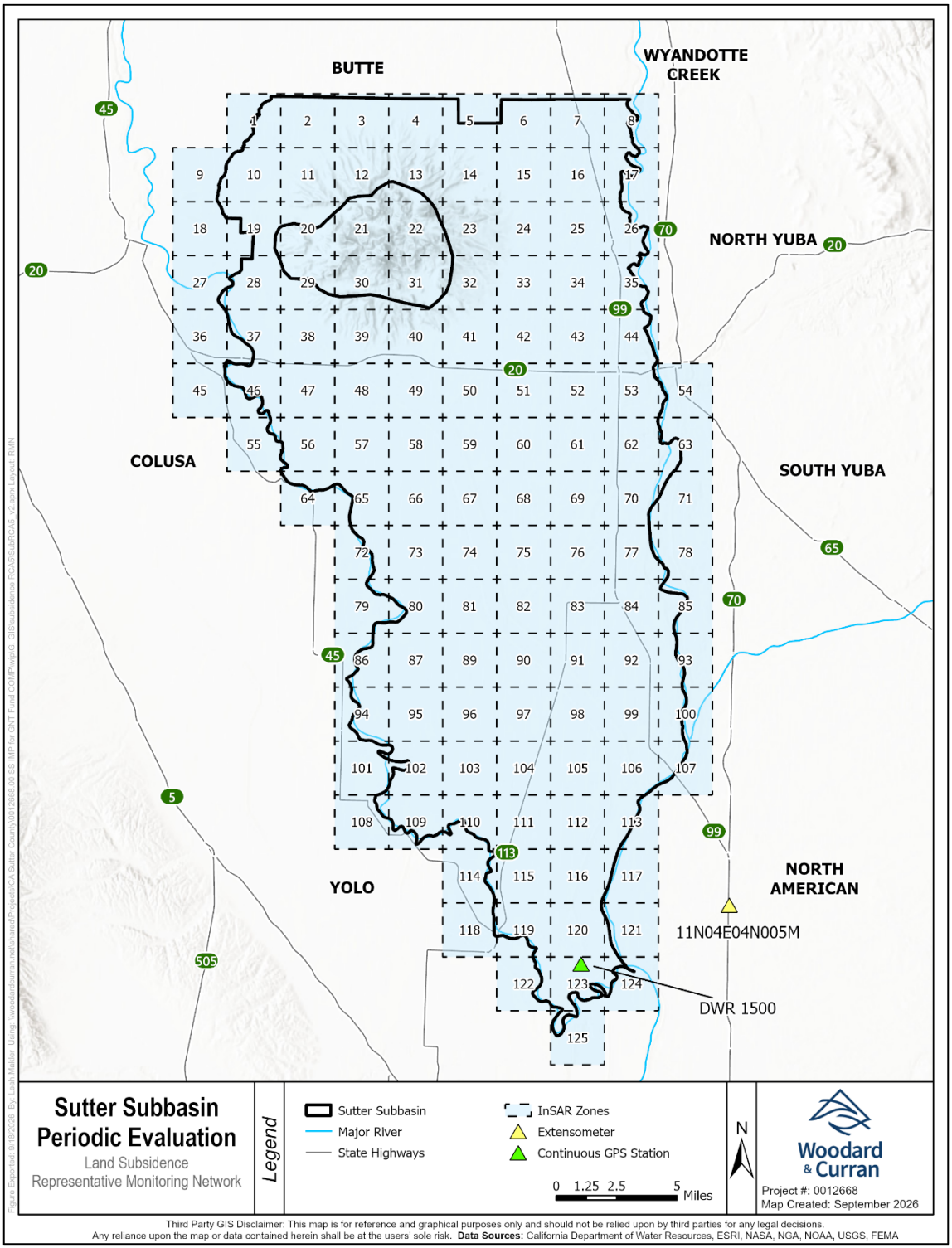

Figure 8: Subsidence Representative Monitoring Network

4. CONCLUSIONS

4.1 Sustainable Management Criteria Modifications

As described in the 2022 GSP, historical subsidence measurements were used as a basis to establish SMC for the Subbasin. Because DWR is no longer collecting data from the Sacramento Valley Subsidence Network (the basis for the RMN in the 2022 GSP), a new land subsidence RMN was developed that relies on one extensometer, one CGPS station, and Subbasin-wide InSAR data. The current level of monitoring is considered appropriate for the Sutter Subbasin based on the limited observation of and potential for subsidence. Should data begin to show evidence of subsidence, the GSAs may pursue additional monitoring activities, including benchmark subsidence surveys as discussed in **Section 2.1.5** above.

The subsidence minimum thresholds are established to prevent inelastic subsidence that could affect critical infrastructure. At present, there is no significant inelastic subsidence in the Subbasin affecting any beneficial user. The minimum threshold is conservatively set to prevent subsidence impacts and allow for adaptive mitigation measures if necessary. The measurable objectives and interim milestones are intended to prevent any further subsidence after 2042.

Table 2 summarizes the SMC definitions established for land subsidence in the 2022 GSP. Proposed changes to SMC definitions consist of modifying the identification of undesirable result, minimum threshold, and measurable objective/interim milestone definitions to include calculating average subsidence at each representative monitoring site using a 5-year rolling average by water year. Undesirable results will be assessed and reported in each GSP annual report for the prior water year.

Table 2: Subsidence Sustainable Management Criteria Definitions

Term	Definition
Undesirable Result	A result due to groundwater extraction that causes a significant reduction in the viability of the use of infrastructure for water distribution and flood control.
Identification of Undesirable Result	At least 25% of representative subsidence monitoring sites exceed the minimum threshold for subsidence over a 5-year rolling average, calculated by water year.
Minimum Threshold	0.5 feet of subsidence over a 5-year rolling average by water year, representing the point at which water conveyance and levee infrastructure become sensitive to land subsidence and twice the operational error of land survey measurements.
Measurable Objective/Interim Milestones	0.25 feet of subsidence over a 5-year rolling average by water year, representing the range of error for land survey measurements.

4.2 Modifications to the GSP

Chapter 6: Sustainable Management Criteria and Chapter 7: Sustainability Implementation of the Sutter Subbasin GSP will be amended to reflect the updated RMN and data analysis methods, noting that the

survey benchmarks are no longer included within the RMN. However, the survey benchmarks may be used to corroborate evidence of undesirable results related to subsidence within the Subbasin should it be observed in the future.

5. REFERENCES

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TECHNICAL MEMORANDUM NO. 6 – Interconnected Surface Water

TO: Paul Gosselin, California Department of Water Resources Deputy Director

CC: Guadalupe Rivera, on behalf of the Sutter Subbasin

PREPARED BY: Sara Roche and Leslie Dumas/Woodard & Curran

DATE: October 14, 2026

RE: Sutter Subbasin Response to DWR's October 26, 2023 Approved Determination Letter for the Sutter Subbasin's 2022 GSP - Technical Memorandum 6, Response to DWR Recommended Corrective Actions No. 3e and 6

In a letter dated October 26, 2023, the California Department of Water Resources (DWR) staff concluded that the Sutter Subbasin Groundwater Sustainability Plan (GSP) met the requirements for a GSP as set forth under the Sustainable Groundwater Management Act (SGMA) and approved the 2022 GSP (see **Attachment 1**). In Section 5 of the letter, DWR staff also identified recommended corrective actions (RCAs) for the GSAs to address by the Plan's first periodic evaluation.

This technical memorandum (TM) is in response to RCA No. 3e and RCA No. 6 related to depletions of interconnected surface water (ISW).

This TM is organized into the following sections:

1) Overview of Recommended Corrective Action Nos. 3e and 6
2) Approach to Recommended Corrective Action Nos. 3e and 6
3) Conclusions
4) References

1. OVERVIEW OF RECOMMENDED CORRECTIVE ACTION NOS. 3E AND 6

RCA No. 3e states:

> *Revise the sustainable management criteria for the chronic lowering of groundwater levels as follows:*
>
> *e. Provide estimates of stream depletions when groundwater levels are at the minimum thresholds and evaluate the potential impacts to beneficial uses and users of interconnected surface water.*

RCA No. 6 states:

> *Department staff understand that estimating the location, quantity, and timing of stream depletion due to ongoing, Subbasin-wide pumping is a complex task and that developing suitable tools may take additional time; however, it is critical for the Department's ongoing and future evaluations of whether GSP implementation is on track to achieve sustainable groundwater management. The Department plans to provide guidance on methods and approaches to evaluate the rate, timing, and volume of depletions of interconnected surface water and support for establishing specific sustainable management criteria in the near future. This guidance is intended to assist GSAs to sustainably manage depletions of interconnected surface water.*
>
> *In addition, the GSA should work to address the following items by the first periodic update:*
>
> *a. Provide justification for the criteria of when and where undesirable results occur. Explain how the GSAs have determined that significant and unreasonable effects will not occur before gaining streams become losing, and how the GSAs have considered the seasonality of stream depletions.*
>
> *b. Consider utilizing the interconnected surface water guidance, as appropriate, when issued by the Department to establish quantifiable minimum thresholds, measurable objectives, and management actions.*
>
> *c. Continue to fill data gaps, collect additional monitoring data, and implement the current strategy to manage depletions of interconnected surface water and define segments of interconnectivity and timing.*
>
> *d. Prioritize collaborating and coordinating with local, state, and federal regulatory agencies as well as interested parties to better understand the full suite of beneficial uses and users that may be impacted by pumping induced surface water depletion within the GSA's jurisdictional area.*

2. APPROACH TO RECOMMENDED CORRECTIVE ACTION NOS. 3E AND 6

DWR indicates in the determination letter that:

> *The GSP does not quantify the rate or volume of surface water depletions due to groundwater pumping as required by the GSP Regulations. Instead, the GSP proposes to use groundwater elevations as a proxy metric to manage depletions of interconnected surface water. The GSP indicates that groundwater levels associated with gaining streams turning into losing streams are considered undesirable results. Department staff note the GSP does not demonstrate, with adequate evidence, that the use of groundwater elevations as a proxy for depletions of interconnected surface water is sufficient to quantify the location, quantity, and timing of depletions.* (p. 30-31)

The letter further goes on to state that DWR "…staff recommend the GSAs present justification for its criteria of when and where undesirable results occur for depletions of interconnected surface water." (p. 31) The letter also recommends that the GSAs provide clarification related to the methodology of the second criterion for minimum thresholds (that 90% of the average groundwater elevation from the projected water budget (baseline condition over 60-year period using C2VSimFG-Sutter) at each representative monitoring

site with an artificial increase in evapotranspiration (ET) of 50%),[1] and that the GSAs provide estimates of correlated stream depletion and present justification as to why the impacts are not considered significant and unreasonable.

Resources for the evaluation of interconnected surface waters are available in three technical papers released by DWR: *Depletions of Interconnected Surface Water: An Introduction* (DWR, 2024a), *Techniques for Estimating Interconnected Surface Water Depletion Caused by Groundwater* (DWR, 2024b), and *Examples for Estimating Interconnected Surface Water Depletion Caused by Groundwater Use* (DWR, 2024c). The final technical paper, a guidance document, has not yet been released as of October 2026.

2.1 Estimates of Current and Historical Stream Depletions

Depletions of interconnected surface water refers to reductions in flow or water levels of interconnected surface waters due to groundwater pumping. In other words, groundwater pumping causes changes to flow paths and alters the net stream gain/loss. Depletions reflect groundwater pumping over many prior years, not just pumping occurring within a particular month or year.

As required under the California Code of Regulations (CCR) Title 23, §354.16, "[e]ach Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015 to current conditions, based on the best available information that includes the following: …(f) Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information."

The 2022 GSP did not analyze the quantity, timing, and location of depletions of interconnected surface water in the Sutter Subbasin. Included in the 2027 GSP Amendment is this analysis, described in detail in the model report in **Appendix 5-F** and summarized in **Section 5.2.7.1**. The updated C2VSimFG-Sutter Version 2.0 integrated flow model was utilized to conduct the analysis on current stream depletions. The model results estimated that current stream depletions are approximately 89 thousand acre-feet (TAF) per year (averaged over the last five years of the historical model, Water Year [WY] 2021-2025), have no strong correlation to either water year type or month of year, and is split among the Sutter Subbasin streams with the Sutter Bypass experiencing 44% of the depletions, the Sacramento River experiencing 34% of the depletions, and the Feather River experiencing 22% of the total depletions.

2.2 Estimates of Stream Depletion at Minimum Thresholds (Response to RCA No. 3e)

As described in **Section 6.4.1.1** of the 2027 GSP Amendment, an undesirable result for the chronic lowering of groundwater levels sustainability indicator occurs when groundwater elevations drop below the minimum threshold criteria at a minimum of 25% of representative monitoring locations concurrently over

[1] Refer to RCA No. 3 TM. This criterion has been removed from the minimum threshold definition as part of the 2027 GSP Amendment.

two consecutive seasonal low[1] water level measurements.[2] As described in **Section 7.2.6.1** of the 2027 GSP Amendment, the groundwater level representative monitoring network has 52 wells, meaning an undesirable result occurs when at least 13 wells exceed minimum thresholds over two consecutive seasonal low monitoring periods.

The modeling analysis performed increased evapotranspiration in the Projected Conditions scenario of C2VSimFG-Sutter Version 2.0 by 136% as compared to a No Pumping version of the model with the same increased evapotranspiration in order to calculate the stream depletion when groundwater level undesirable results occur. This analysis, summarized herein, is described in detail in the model report in **Appendix 5-F** and summarized in **Section 6.5.6.2** of the 2027 GSP Amendment.

Based on the analysis, stream depletions under undesirable result conditions are approximately 193 TAF per year (averaged over the last twelve years of the Projected Conditions scenario, Baseline Years 49-60). Similar to the current depletions described in Section 2.1 above, depletions of interconnected surface water under undesirable result conditions also show no strong correlation to either water year type or month of year and are split among the Sutter Subbasin streams with the Sutter Bypass experiencing 46% of the total depletions, the Sacramento River experiencing 32% of total depletions, and the Feather River experiencing 22% of total depletions. It is important to note that the depletion volume is the point where 13 representative monitoring wells have exceeded minimum thresholds for at least two consecutive seasonal low water level measurements and not when all groundwater level monitoring network wells are at minimum thresholds. Depletion when all groundwater level monitoring network wells are at minimum thresholds would be much larger.

To evaluate potential impacts to beneficial uses and users of interconnected surface water, depletions at undesirable result conditions were (1) compared to streamflow and instream flow requirements in each stream, (2) evaluated for changes in the direction of stream-aquifer exchange by reach, and (3) compared to the surface water users and environmental resources that rely on each stream during the months of highest depletion.

Monthly depletions are slightly higher in July and August under current conditions, and in May through August at undesirable result conditions. Under current conditions (WY 2021-2025), the average August depletion of 9.2 TAF (**Table 5-16** of the 2027 GSP Amendment) equals a rate of approximately 150 cubic feet per second (cfs) across all three streams. Apportioned by each stream's share of annual depletion, this is approximately 66 cfs along the Sutter Bypass, 51 cfs along the Sacramento River, and 33 cfs along the Feather River. Under undesirable result conditions, average total depletion in August is approximately 310 cfs, an increase of 160 cfs over current conditions. By comparison, August flows from WY 2021-2025 at measured stream gages are approximately 5,883 cfs in the Sacramento River below Wilkins Slough and 6,009 cfs in the Feather River at Olivehurst. Depletions at undesirable results therefore represent approximately 1.7% and 1.1% of August flows in each stream. Peak agricultural season stream flows are protective of the environmental uses of the rivers. **Section 6.5.6.6** of the 2027 GSP Amendment describes

[1] Defined as September and October.

[2] Refer to RCA No. 3 TM. In response to RCA No. 3a, the undesirable result definition for the chronic lowering of groundwater levels is based on seasonal low water level measurements. This change is reflected in the 2027 GSP Amendment.

the Feather River instream flow requirements under State Water Resources Control Board (SWRCB) Order WQ 2010-0016 and the Sacramento River instream flow requirements below Keswick Dam under SWRCB Order 90-05, which are a minimum of 1,000 cfs and 3,250 cfs, respectively, during August (Keswick Dam is operated to achieve a daily average temperature). Because both rivers are regulated by upstream reservoir releases operated to meet these requirements, the total depletion of 310 cfs in August would not measurably affect the ability to meet these instream requirements.

To assess whether changes in direction of stream-aquifer interaction occur, simulated net stream-aquifer exchange was compared by reach between current conditions and undesirable result conditions. Under current conditions (WY 2021-2025), the Sacramento River and Feather River are overall gaining and the Sutter Bypass is slightly losing. Under undesirable result conditions, Sutter Bypass becomes losing in almost all months. Both the Sacramento River and Feather River switch from mixed to losing or gaining to mixed conditions in over half the months. The following streams change from gaining to losing in the following months: Sutter Bypass (April) and Feather River (May and July). The Sacramento River does not change from gaining to losing in any month. **Section 6.5.6.1** of the 2027 GSP Amendment describes the Sacramento and Feather Rivers as feeding water into the Subbasin as groundwater levels are lowered, so they become less gaining and trend more towards losing. For reaches that are already losing under current conditions (like Sutter Bypass), additional pumping increases stream losses rather than reversing the direction of flow.

Surface water diversions from the Sacramento and Feather Rivers are supported by regulated reservoir releases and senior water rights, and the Thermalito Afterbay deliveries originate upstream of the Subbasin's stream reaches. Because simulated depletions at undesirable result conditions represent only approximately 2% of peak-season flow, they are not expected to measurably affect the availability of these supplies. Unlike the Sacramento and Feather Rivers, summer flows in the Sutter Bypass are not sustained by reservoir releases and Bypass diverters rely on lower-priority supplies. Simulated depletions at undesirable result conditions represent approximately 17% of simulated August Sutter Bypass flow. The overlap of Sutter Bypass flows with peak agricultural demand is limited, but depletions in September and October may coincide with refuge flood-up. The GSAs will coordinate with refuge and wetland managers to confirm timing and water sources and will evaluate whether additional monitoring or management actions are warranted.

The Sacramento and Feather Rivers collectively support Sacramento River winter-run Chinook salmon (federally and state endangered), Central Valley spring-run Chinook salmon (federally and state threatened), California Central Valley steelhead (federally threatened), the southern distinct population segment of North American green sturgeon (federally threatened), and fall-run Chinook salmon. The Sutter Bypass provides floodplain rearing habitat for juvenile fish during winter and spring flood events, serves as a migration corridor for adult spring-run Chinook salmon traveling to Butte Creek, and provides habitat for North American green sturgeon. During August, use of all the river reaches adjacent to the Sutter Subbasin is limited for environmental users and water temperature is the primary habitat constraint. As previously mentioned, August depletions under undesirable result conditions total approximately 310 cfs across the three interconnected surface waters, of which about 134-145 cfs is attributed to the Sutter Bypass. Because summer flows in the Sutter Bypass are not supported by reservoir releases, there is a limited ability to regulate flow or temperature. Depletions of this volume could measurably impact flows and temperature in the Sutter Bypass. No fish habitat flow threshold has been established for Sutter Bypass. In the Sacramento River and Feather River, reductions in August streamflow (less than 2%) would remain well above the

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instream flow requirements under SWRCB orders. Therefore, impacts to fish habitat in these rivers are expected to be minimal.

Based on this evaluation, using groundwater levels as proxy and undesirable result conditions for groundwater levels would not cause significant and unreasonable impacts to beneficial uses and users of interconnected surface water.

2.3 Revised Depletions of Interconnected Surface Water Sustainable Management Criteria (Response to RCA Nos. 6a and 6b)

In the 2027 GSP Amendment, the groundwater levels representative monitoring network and sustainable management criteria (SMC) are used as proxy for assessing interconnected surface water conditions in the Sutter Subbasin as described above in **Section 2.2**. The Subbasin GSAs are currently working to fill identified data gaps as it relates to shallow wells located near streams that could be used to create a separate interconnected surface water representative monitoring network. This network would include both groundwater wells and California Data Exchange Center (CDEC) stream gages.

Based on the analysis described herein, current Sutter Subbasin conditions do not have significant and unreasonable effects related to depletions of interconnected surface water and these effects are not estimated to change under groundwater level undesirable results, as described in **Section 2.2** above. Furthermore, after DWR releases its final guidance on depletions of interconnected surface water, the Sutter Subbasin will evaluate updating undesirable results, minimum thresholds, measurable objectives, and management actions related to depletions of interconnected surface water as appropriate at that time, in addition to incorporating work conducted to address identified data gaps.

2.4 Managing Depletions of Interconnected Surface Water (Response to RCA Nos. 6c and 6d)

The Sutter Subbasin GSAs are continuing to work to enhance or fill data gaps in all of their representative monitoring networks, including for interconnected surface water. Because of the data gaps in the interconnected surface water representative monitoring network, the groundwater level representative monitoring network is being used as a proxy for depletions of interconnected surface water. The Subbasin is currently in the process of completing a well siting study to identify specific locations where additional monitoring wells could be constructed to augment both the interconnected surface water and groundwater level representative monitoring networks. The results of this study will be available in 2027 and will be used to identify locations for the DWR Technical Support Services (TSS) application that has been approved for the Subbasin.

The Subbasin GSAs are prioritizing collaborating and coordinating with local, state, and federal regulatory agencies, as well as other water managers and interested parties, to better understand the full suite of beneficial uses and users that may be impacted by pumping-induced depletions of interconnected surface water within the GSAs' jurisdictional areas and to look for opportunities to coordinate in projects and actions to support interconnected surface waters. The Subbasin GSAs participate in quarterly meetings of the Groundwater Task Force through the Northern California Water Association (NCWA), where representatives from groundwater subbasins across the Sacramento Valley coordinate on regional water management, including the interconnected surface waters that form the boundaries between many of these subbasins.

Additionally, the Sutter Subbasin is part of the Feather River Corridor coordination group, along with the Butte, Wyandotte Creek, and North Yuba Subbasins, and part of the South Sacramento Corridor coordination group along with the Colusa and Yolo Subbasins. These coordination groups were formed to promote collaboration and establish a foundation and guidelines for sustained interbasin coordination through GSP implementation. The Subbasin GSAs also continue to coordinate and exchange data with DWR through upload of GSP-related monitoring data to the SGMA Data Portal Monitoring Network Module at a minimum of twice per year. Finally, the Sutter Subbasin GSAs continue to coordinate and share information with other subbasin water managers; land use planning, water, and wastewater management entities; the public; and local, state, and federal agencies through GSA board or city council meetings, Sutter Subbasin Groundwater Management Coordination Committee (SSGMCC) meetings, and/or other periodic meetings and workshops, as deemed necessary.

3. CONCLUSIONS

The Sutter Subbasin GSP will be amended to include additional justification to address RCA Nos. 3e and 6a in GSP sections as noted in **Sections 2.2** above. The Sutter Subbasin will continue to evaluate guidance as appropriate when considering updating sustainable management criteria for interconnected surface waters (RCA No. 6b), fill data gaps and collect additional monitoring data (RCA No. 6c), and collaborating with various stakeholders to understand the full suite of beneficial uses and users that may be impacted by pumping induced surface water depletion within the Sutter Subbasin and larger Sacramento Valley (RCA No. 6d).

4. REFERENCES

California Department of Water Resources (DWR). (2023) *Statement of Findings Regarding the Approval of the Sacramento Valley – Sutter Subbasin Groundwater Sustainability Plan*. October 26. Available at: https://sgma.water.ca.gov/portal/gsp/assessments/112

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DWR. (2024b) *Techniques for Estimating Interconnected Surface Water Depletion Caused by Groundwater Use*. September. Available at: https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents

DWR. (2024c) *Examples for Estimating Interconnected Surface Water Depletion Caused by Groundwater Use*. September. Available at: https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents

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TECHNICAL MEMORANDUM NO. 7 – Monitoring Frequency

TO: Paul Gosselin, California Department of Water Resources Deputy Director

CC: Guadalupe Rivera, on behalf of the Sutter Subbasin

PREPARED BY: Natalie Cochran/Woodard & Curran

DATE: June 1, 2026

RE: Sutter Subbasin Response to DWR's October 26, 2023 Approved Determination Letter for the Sutter Subbasin's 2022 GSP - Technical Memorandum 7, Response to DWR Recommended Corrective Action No. 7

In a letter dated October 26, 2023, the California Department of Water Resources (DWR) staff concluded that the Sutter Subbasin Groundwater Sustainability Plan (GSP) met the requirements for a GSP as set forth under the Sustainable Groundwater Management Act (SGMA) and approved the 2022 Plan (see **Attachment 1**). In Section 5 of the letter, DWR staff also identified recommended corrective actions (RCAs) for the GSAs to address by the Plan's first periodic evaluation.

This technical memorandum (TM) is in response to RCA No. 7 related to monitoring.

This TM is organized into the following sections:

1) Overview of Recommended Corrective Action No. 7
2) Approach to Recommended Corrective Action No. 7
3) Conclusions
4) References

1. OVERVIEW OF RECOMMENDED CORRECTIVE ACTION NO. 7

RCA No. 7 states:

> *Define the data collection frequency in tabular format for groundwater monitoring sites within the chronic lowering of groundwater levels and depletions of interconnected surface water monitoring networks in the GSP.*

2. APPROACH TO RECOMMENDED CORRECTIVE ACTION NO. 7

DWR indicates in the determination letter that:

> *While the GSP does provide tables and includes maps identifying the location of the representative monitoring sites for the chronic lowering of groundwater levels and depletions of interconnected*

> *surface water monitoring networks, Department [DWR] staff have determined additional information should be provided in the GSP regarding the monitoring network for these sustainability indicators. The GSP did not report, in tabular format, the measurement frequency for groundwater elevation measurements within the chronic lowering of groundwater levels and depletions of interconnected surface water monitoring networks as required by the GSP Regulations.[1] Providing this information will provide the Department additional clarity on how the Subbasin will comply with the requirements of the GSP Regulations and SGMA.* (p. 35)

3. CONCLUSIONS

The Sutter Subbasin GSP will be amended to include monitoring frequency in tabular form for all sites in the chronic lowering of groundwater levels and depletions of interconnected surface water monitoring networks, as required by the GSP Regulations.[1]

The following tables of the 2022 GSP will be modified to indicate monitoring frequency at each well:

- Table 7-48. Groundwater Level Monitoring Network Wells (Table 7-45 in GSP Amendment)
- Table 7-52. Depletions of Interconnected Surface Water Monitoring Well Sites[2]

The Sutter Subbasin GSP indicates monitoring frequency for the chronic lowering of groundwater levels monitoring network will be "at least two times per year to represent seasonal low and seasonal high groundwater conditions."[3] Seasonal high measurements will be taken once between March and April and seasonal low measurements will be taken between September and October at each well. Rice, the predominant crop grown in the Sutter Subbasin, has a significant influence on shallow groundwater levels. Monitoring wells adjacent to rice growing areas may collect groundwater level measurements up to four times per year, during seasonal high and low periods identified as well as between August and October and January and March to capture local seasonal high and low groundwater elevations, respectively.

As groundwater levels are used as proxy for monitoring depletions of interconnected surface water, the frequency and timing of monitoring events is the same as for the chronic lowering of groundwater levels monitoring network.[4] Table 7-53. Selected Stream Gages already denotes measurement frequency (Table 7-49 in GSP Amendment).

[1] 23 CCR § 354.34 (h)

[2] In the 2027 GSP Amendment, the groundwater levels monitoring network will be used as proxy for depletions of interconnected surface water monitoring. Therefore monitoring frequency denoted in Table 7-45 of the GSP Amendment also applies to interconnected surface water.

[3] Sutter Subbasin GSP, Section 7.2.6.1.3, p. 601-602

[4] Sutter Subbasin GSP, Section 7.2.6.6.3, p. 635

ATTACHMENT 1 – DWR 2023 Approved Determination Letter

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CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE
715 P Street, 8th Floor | Sacramento, CA 95814 | P.O. Box 942836 | Sacramento, CA 94236-0001

October 26, 2023

Guadalupe Rivera
Sutter County
1130 Civic Center Blouvard
Yuba City, CA 95993
grivera@co.sutter.ca.us

RE: Sacramento Valley – Sutter Subbasin - 2022 Groundwater Sustainability Plan

Dear Guadalupe Rivera,

The Department of Water Resources (Department) has evaluated the groundwater sustainability plan (GSP or Plan) submitted for the Sacramento Valley – Sutter Subbasin and has determined the GSP is approved. The approval is based on recommendations from the Staff Report, included as an exhibit to the attached Statement of Findings, which describes that the Sutter Subbasin GSP satisfies the objectives of the Sustainable Groundwater Management Act (SGMA) and substantially complies with the GSP Regulations. The Staff Report also proposes recommended corrective actions that the Department believes will enhance the GSP and facilitate future evaluation by the Department. The Department strongly encourages the recommended corrective actions be given due consideration and suggests incorporating all resulting changes to the GSP in future updates.

Recognizing SGMA sets a long-term horizon for groundwater sustainability agencies (GSAs) to achieve their basin sustainability goals, monitoring progress is fundamental for successful implementation. GSAs are required to evaluate their GSPs at least every five years and whenever the Plan is amended, and to provide a written assessment to the Department. Accordingly, the Department will evaluate approved GSPs and issue an assessment at least every five years. The Department will initiate the first periodic review of the Sutter Subbasin GSP no later than January 28, 2027.

Please contact Sustainable Groundwater Management staff by emailing sgmps@water.ca.gov if you have any questions related to the Department's assessment or implementation of your GSP.

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Thank You,

Paul Gosselin

Paul Gosselin
Deputy Director
Sustainable Groundwater Management

Attachment:

1. Statement of Findings Regarding the Approval of the Sacramento Valley – Sutter Subbasin Groundwater Sustainability Plan

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STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

STATEMENT OF FINDINGS REGARDING THE APPROVAL OF THE SUTTER SUBBASIN GROUNDWATER SUSTAINABILITY PLAN

The Department of Water Resources (Department) is required to evaluate whether a submitted groundwater sustainability plan (GSP or Plan) conforms to specific requirements of the Sustainable Groundwater Management Act (SGMA or Act), is likely to achieve the sustainability goal for the basin covered by the Plan, and whether the Plan adversely affects the ability of an adjacent basin to implement its GSP or impedes achievement of sustainability goals in an adjacent basin. (Water Code § 10733.) The Department is directed to issue an assessment of the Plan within two years of its submission. (Water Code § 10733.4.) This Statement of Findings explains the Department's decision regarding the Plan submitted by the Butte Water District – Sutter Groundwater Sustainability Agency (GSA), City of Live Oak GSA, City of Yuba City GSA, County of Sutter GSA, Reclamation District No. 70 GSA, Reclamation District No. 1500 GSA, Reclamation District No. 1660 GSA, Sutter Extension Water District GSA, and Sutter Community Service District GSA (GSAs or Agencies) for the Sutter Subbasin (Basin No. 5-021.62).

Department management has discussed the Plan with staff and has reviewed the Department Staff Report, entitled Sustainable Groundwater Management Program Groundwater Sustainability Plan Assessment Staff Report, attached as Exhibit A, recommending approval of the GSP. Department management is satisfied that staff have conducted a thorough evaluation and assessment of the Plan and concurs with staff's recommendation and all the recommended corrective actions. The Department therefore **APPROVES** the Plan and makes the following findings:

A. The Plan satisfies the required conditions as outlined in § 355.4(a) of the GSP Regulations (23 CCR § 350 et seq.):

    1. The Plan was submitted within the statutory deadline of January 31, 2022. (Water Code § 10720.7(a); 23 CCR § 355.4(a)(1).)

    2. The Plan was complete, meaning it generally appeared to include the information required by the Act and the GSP Regulations sufficient to warrant a thorough evaluation and issuance of an assessment by the Department. (23 CCR § 355.4(a)(2).)

    3. The Plan, either on its own or in coordination with other Plans, covers the entire Subbasin. (23 CCR § 355.4(a)(3).)

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B. The general standards the Department applied in its evaluation and assessment of the Plan are: (1) "conformance" with the specified statutory requirements, (2) "substantial compliance" with the GSP Regulations, (3) whether the Plan is likely to achieve the sustainability goal for the Subbasin within 20 years of the implementation of the Plan, and (4) whether the Plan adversely affects the ability of an adjacent basin to implement its GSP or impedes achievement of sustainability goals in an adjacent basin. (Water Code § 10733.) Application of these standards requires exercise of the Department's expertise, judgment, and discretion when making its determination of whether a Plan should be deemed "approved," "incomplete," or "inadequate."

   The statutes and GSP Regulations require Plans to include and address a multitude and wide range of informational and technical components. The Department has observed a diverse array of approaches to addressing these technical and informational components being used by GSAs in different basins throughout the state. The Department does not apply a set formula or criterion that would require a particular outcome based on how a Plan addresses any one of SGMA's numerous informational and technical components. The Department finds that affording flexibility and discretion to local GSAs is consistent with the standards identified above; the state policy that sustainable groundwater management is best achieved locally through the development, implementation, and updating of local plans and programs (Water Code § 113); and the Legislature's express intent under SGMA that groundwater basins be managed through the actions of local governmental agencies to the greatest extent feasible, while minimizing state intervention to only when necessary to ensure that local agencies manage groundwater in a sustainable manner. (Water Code § 10720.1(h).) The Department's final determination is made based on the entirety of the Plan's contents on a case-by-case basis, considering and weighing factors relevant to the particular Plan and Subbasin under review.

C. In making these findings and Plan determination, the Department also recognized that: (1) the Department maintains continuing oversight and jurisdiction to ensure the Plan is adequately implemented; (2) the Legislature intended SGMA to be implemented over many years; (3) SGMA provides Plans 20 years of implementation to achieve the sustainability goal in a Subbasin (with the possibility that the Department may grant GSAs an additional five years upon request if the GSAs have made satisfactory progress toward sustainability); and, (4) local agencies acting as GSAs are authorized, but not required, to address undesirable results that occurred prior to enactment of SGMA. (Water Code §§ 10721(r); 10727.2(b); 10733(a); 10733.8.)

D. The Plan conforms with Water Code §§ 10727.2 and 10727.4, substantially complies with 23 CCR § 355.4, and appears likely to achieve the sustainability goal for the Subbasin. It does not appear at this time that the Plan will adversely

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affect the ability of adjacent basins to implement their GSPs or impede achievement of sustainability goals.

1. The sustainable management criteria to maintain water levels near the historical range of groundwater level conditions is reasonable. The overall groundwater level and storage conditions in the Subbasin are generally stable based on the information included in the GSP so the recommended corrective actions do not preclude plan approval. The Plan relies on credible information and science such as long-term groundwater level data, a reasonable understanding of aquifer properties, and an updated groundwater model to quantify the groundwater conditions that the Plan seeks to avoid and provides an objective way to determine whether the Subbasin is being managed sustainably in accordance with SGMA. (23 CCR § 355.4(b)(1).)

2. The Plan identified and provided reasonable measures to eliminate data gaps, including additional monitoring wells and data collection to better characterize Subbasin groundwater conditions. (23 CCR § 355.4(b)(2).)

3. The projects and management actions proposed are designed to maintain sustainability through an adaptive management strategy to ensure undesirable results do not occur. The projects and management actions are reasonable and commensurate with the level of understanding presented in the basin setting. The projects and management actions described in the Plan provide a feasible approach to achieving the Subbasin's sustainability goal and should provide the GSAs with greater versatility to adapt and respond to changing conditions and future challenges during GSP implementation. (23 CCR § 355.4(b)(3).)

4. The Plan provides a detailed explanation of how the varied interests of groundwater uses and users in the Subbasin were considered in developing the sustainable management criteria and how those interests, including groundwater supply wells and groundwater dependent ecosystems, would be impacted by the chosen minimum thresholds. (23 CCR § 355.4(b)(4).)

5. The Plan's projects and management actions appear feasible at this time and appear capable of preventing undesirable results and ensuring that the Subbasin is managed within its sustainable yield within 20 years. The Department will continue to monitor Plan implementation and reserves the right to change its determination if projects and management actions are not implemented or appear unlikely to prevent undesirable results or achieve sustainability within SGMA timeframes. (23 CCR § 355.4(b)(5).)

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6. The Plan includes a reasonable assessment of overdraft conditions and includes reasonable means to mitigate overdraft, if present. (23 CCR § 355.4(b)(6).)

7. At this time, it does not appear that the Plan will adversely affect the ability of an adjacent basin to implement its GSP or impede achievement of sustainability goals in an adjacent basin. The Plan states that the Subbasin's minimum thresholds are generally comparable to those of the adjacent subbasins' and the GSAs will coordinate with adjacent subbasins to ensure that subbasin management activities do not cause undesirable results in either the Sutter Subbasin or adjacent subbasins. (23 CCR § 355.4(b)(7).)

8. Because a single plan was submitted for the Subbasin, a coordination agreement was not required. (23 CCR § 355.4(b)(8).)

9. The nine GSAs have historically managed large surface water canal systems or groundwater supplies for irrigation and municipal uses. The GSAs' history of groundwater management provide a reasonable level of confidence that the GSAs have the legal authority and financial resources necessary to implement the Plan. (23 CCR § 355.4(b)(9).)

10. Through review of the Plan and consideration of public comments, the Department determines that the GSAs adequately responded to comments that raised credible technical or policy issues with the Plan, sufficient to warrant approval of the Plan at this time. The Department also notes that the recommended corrective actions included in the Staff Report are important to addressing certain technical or policy issues that were raised and, if not addressed before future, subsequent plan evaluations, may preclude approval of the Plan in those future evaluations. (23 CCR § 355.4(b)(10).)

E. In addition to the grounds listed above, DWR also finds that:

1. The Department developed its GSP Regulations consistent with and intending to further the State's human right to water policy through implementation of SGMA and the Regulations, primarily by achieving sustainable groundwater management in a basin. By ensuring substantial compliance with the GSP Regulations, the Department has considered the state policy regarding the human right to water in its evaluation of the Plan. (Water Code § 106.3; 23 CCR § 350.4(g).)

2. The Plan acknowledges and identifies interconnected surface waters within the Subbasin. The GSAs propose initial sustainable management criteria to manage this sustainability indicator and measures to improve understanding and management of interconnected surface water. The

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GSAs acknowledge, and the Department agrees, many data gaps related to interconnected surface water exist. The GSAs should continue filling data gaps, collecting additional monitoring data, and coordinating with resources agencies and interested parties to understand beneficial uses and users that may be impacted by depletions of interconnected surface water caused by groundwater pumping. Future periodic evaluations of the Plan and amendments to the Plan should aim to improve the initial sustainable management criteria as more information and improved methodology becomes available.

3. The basin is not currently in a state of long-term overdraft and projections of future basin extractions are likely to stay within current and historic ranges, at least until the next periodic evaluation by the GSAs and the Department. Projections of future basin extractions appear likely to stay within current and historic ranges, at least until the next periodic evaluation by the GSA and the Department. Basin groundwater levels and other SGMA sustainability indicators appear unlikely to substantially deteriorate while the GSA implements the Department's recommended corrective actions.

4. The California Environmental Quality Act (Public Resources Code § 21000 *et seq*.) does not apply to the Department's evaluation and assessment of the Plan.

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Accordingly, the GSP submitted by the Agencies for the Sutter Subbasin is hereby **APPROVED.** The recommended corrective actions identified in the Staff Report will assist the Department's future review of the Plan's implementation for consistency with SGMA and the Department therefore recommends the Agencies address them by the time of the Department's periodic review, which is set to begin on January 28, 2027, as required by Water Code § 10733.8. Failure to address the Department's recommended corrective actions before future, subsequent plan evaluations, may lead to a Plan being determined incomplete or inadequate.

Signed:

Karla Nemeth

Karla Nemeth, Director
Date: October 26, 2023

Exhibit A: Groundwater Sustainability Plan Assessment Staff Report – Sacramento Valley – Sutter Subbasin

State of California
Department of Water Resources
Sustainable Groundwater Management Program
Groundwater Sustainability Plan Assessment
Staff Report

Groundwater Basin Name:	Sacramento Valley - Sutter Subbasin (No. 5-021.62)
Submitting Agency:	Butte Water District Groundwater Sustainability Agency, City of Live Oak Groundwater Sustainability Agency, City of Yuba City Groundwater Sustainability Agency, County of Sutter Groundwater Sustainability Agency, Reclamation District No. 70 Groundwater Sustainability Agency, Reclamation District No. 1500 Groundwater Sustainability Agency, Reclamation District No. 1660 Groundwater Sustainability Agency, Sutter Extension Water District Groundwater Sustainability Agency, and Sutter Community Service District Groundwater Sustainability Agency
Submittal Type:	Initial GSP Submission
Submittal Date:	January 28, 2022
Recommendation:	Approved
Date:	October 26, 2023

The Butte Water District – Sutter Groundwater Sustainability Agency (GSA), City of Live Oak GSA, City of Yuba City GSA, County of Sutter GSA, Reclamation District No. 70 GSA, Reclamation District No. 1500 GSA, Reclamation District No. 1660 GSA, Sutter Extension Water District GSA, and Sutter Community Service District GSA (collectively referenced to as the GSAs or Agencies) submitted the Sutter Subbasin Groundwater Sustainability Plan (GSP or Plan) for the Sacramento Valley – Sutter Subbasin (Subbasin) to the Department of Water Resources (Department) for evaluation and assessment as required by the Sustainable Groundwater Management Act (SGMA) [1] and GSP Regulations.[2] The GSP covers the entire Subbasin for the implementation of SGMA.

After evaluation and assessment, Department staff conclude that the Plan includes the required components of a GSP, demonstrates a thorough understanding of the Subbasin based on what appears to be the best available science and information, sets well explained, supported, and reasonable sustainable management criteria to prevent undesirable results as defined in the Plan, and proposes a set of projects and management actions that will likely achieve the sustainability goal defined for the

[1] Water Code § 10720 *et seq*.
[2] 23 CCR § 350 *et seq*.

Subbasin.[3] Department staff will continue to monitor and evaluate the Subbasin's progress toward achieving the sustainability goal through annual reporting and future periodic evaluations of the GSP and its implementation.

- ***Based on the current evaluation of the Plan, Department staff recommend the GSP be approved with the recommended corrective actions described herein.***

This assessment includes five sections:

- **Section 1 – Summary:** Provides an overview of Department staff's assessment and recommendations.
- **Section 2 – Evaluation Criteria:** Describes the legislative requirements and the Department's evaluation criteria.
- **Section 3 – Required Conditions:** Describes the submission requirements, Plan completeness, and basin coverage required for a GSP to be evaluated by the Department.
- **Section 4 – Plan Evaluation:** Provides an assessment of the contents included in the GSP organized by each Subarticle outlined in the GSP Regulations.
- **Section 5 – Staff Recommendation:** Includes the staff recommendation for the Plan and any recommended or required corrective actions, as applicable.

1 SUMMARY

Department staff recommend approval of the Sutter GSP. The GSAs have identified areas for improvement of their Plan (e.g., additional well construction information collection, and installation of additional wells to improve the understanding of depletions of interconnected surface water). Department staff concur that those items are important and recommend the GSAs address them as soon as possible. Department staff have also identified additional recommended corrective actions within this assessment that the GSAs should consider addressing by the first periodic evaluation of the Plan. The recommended corrective actions generally focus on the following:

(1) Providing more information about how the proposed minimum thresholds for the chronic lowering of groundwater levels may impact the beneficial uses and users of groundwater, as well as other sustainability indicators.

(2) Providing more information about the sustainable management criteria for land subsidence.

[3] 23 CCR § 350 *et seq*.

(3) Continuing to fill data gaps, collecting additional monitoring data, coordinating with resource agencies and interested parties to understand the beneficial uses and users that may be impacted by depletions of interconnected surface water caused by groundwater pumping, and potentially refine sustainable management criteria.

(4) Revising the sustainable management criteria for degraded water quality to include monitoring data from drought years.

Addressing the recommended corrective actions identified in Section 5 of this assessment will be important to demonstrate, on an ongoing basis, that implementation of the Plan is likely to achieve the sustainability goal.

2 EVALUATION CRITERIA

The GSAs submitted a single GSP to the Department to evaluate whether the Plan conforms to specified SGMA requirements[4] and is likely to achieve the sustainability goal for the Sutter Subbasin.[5] To achieve the sustainability goal for the Subbasin, the GSP must demonstrate that implementation of the Plan will lead to sustainable groundwater management, which means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.[6] Undesirable results must be defined quantitatively by the GSAs.[7] The Department is also required to evaluate whether the GSP will adversely affect the ability of an adjacent basin to implement its GSP or achieve its sustainability goal.[8]

For the GSP to be evaluated by the Department, it must first be determined that the Plan was submitted by the statutory deadline,[9] and that it is complete and covers the entire basin.[10] If these conditions are satisfied, the Department evaluates the Plan to determine whether it complies with specific SGMA requirements and substantially complies with the GSP Regulations.[11] Substantial compliance means that the supporting information is sufficiently detailed and the analyses sufficiently thorough and reasonable, in the judgment of the Department, to evaluate the Plan, and the Department determines that any discrepancy would not materially affect the ability of the Agency to achieve the sustainability goal for the basin, or the ability of the Department to evaluate the likelihood of the Plan to attain that goal.[12]

When evaluating whether the Plan is likely to achieve the sustainability goal for the Subbasin, Department staff reviewed the information provided and relied upon in the GSP for sufficiency, credibility, and consistency with scientific and engineering professional standards of practice.[13] The Department's review considers whether there is a reasonable relationship between the information provided and the assumptions and conclusions made by the GSA, including whether the interests of the beneficial uses and users of groundwater in the basin have been considered; whether sustainable management criteria and projects and management actions described in the Plan are commensurate with the level of understanding of the basin setting; and whether those projects and management actions are feasible and likely to prevent undesirable results.[14]

[4] Water Code §§ 10727.2, 10727.4.
[5] Water Code § 10733(a).
[6] Water Code § 10721(v).
[7] 23 CCR § 354.26 *et seq.*
[8] Water Code § 10733(c).
[9] 23 CCR § 355.4(a)(1).
[10] 23 CCR §§ 355.4(a)(2), 355.4(a)(3).
[11] 23 CCR § 350 *et seq.*
[12] 23 CCR § 355.4(b).
[13] 23 CCR § 351(h).
[14] 23 CCR §§ 355.4(b)(1), (3), (4), and (5).

The Department also considers whether the GSAs have the legal authority and financial resources necessary to implement the Plan.[15]

To the extent overdraft is present in a basin, the Department evaluates whether the Plan provides a reasonable assessment of the overdraft and includes reasonable means to mitigate the overdraft.[16] The Department also considers whether the Plan provides reasonable measures and schedules to eliminate identified data gaps.[17] Lastly, the Department's review considers the comments submitted on the Plan and evaluates whether the GSA adequately responded to the comments that raise credible technical or policy issues with the Plan.[18]

The Department is required to evaluate the Plan within two years of its submittal date and issue a written assessment of the Plan.[19] The assessment is required to include a determination of the Plan's status.[20] The GSP Regulations define the three options for determining the status of a Plan: Approved,[21] Incomplete,[22] or Inadequate.[23]

Even when review indicates that the GSP satisfies the requirements of SGMA and is in substantial compliance with the GSP Regulations, the Department may recommend corrective actions.[24] Recommended corrective actions are intended to facilitate progress in achieving the sustainability goal within the basin and the Department's future evaluations, and to allow the Department to better evaluate whether the Plan adversely affects adjacent basins. While the issues addressed by the recommended corrective actions do not, at this time, preclude approval of the Plan, the Department recommends that the issues be addressed to ensure the Plan's implementation continues to be consistent with SGMA and the Department is able to assess progress in achieving the sustainability goal within the basin.[25] Unless otherwise noted, the Department proposes that recommended corrective actions be addressed by the submission date for the first periodic assessment.[26]

The staff assessment of the GSP involves the review of information presented by the GSA, including models and assumptions, and an evaluation of that information based on scientific reasonableness, including standard or accepted professional and scientific methods and practices. The assessment does not require Department staff to recalculate or reevaluate technical information provided in the Plan or to perform its own geologic or engineering analysis of that information. The staff recommendation to approve a Plan

[15] 23 CCR § 355.4(b)(9).
[16] 23 CCR § 355.4(b)(6).
[17] 23 CCR § 355.4(b)(2).
[18] 23 CCR § 355.4(b)(10).
[19] Water Code § 10733.4(d); 23 CCR § 355.2(e).
[20] Water Code § 10733.4(d); 23 CCR § 355.2(e).
[21] 23 CCR § 355.2(e)(1).
[22] 23 CCR § 355.2(e)(2).
[23] 23 CCR § 355.2(e)(3).
[24] Water Code § 10733.4(d).
[25] Water Code § 10733.8.
[26] 23 CCR § 356.4 *et seq*.

does not signify that Department staff, were they to exercise the professional judgment required to develop a GSP for the basin, would make the same assumptions and interpretations as those contained in the Plan, but simply that Department staff have determined that the assumptions and interpretations relied upon by the submitting GSA are supported by adequate, credible evidence, and are scientifically reasonable.

Lastly, the Department's review and approval of the Plan is a continual process. Both SGMA and the GSP Regulations provide the Department with the ongoing authority and duty to review the implementation of the Plan.[27] Also, GSAs have an ongoing duty to provide reports to the Department, periodically reassess their plans, and, when necessary, update or amend their plans.[28] The passage of time or new information may make what is reasonable and feasible at the time of this review to not be so in the future. The emphasis of the Department's periodic reviews will be to assess the progress toward achieving the sustainability goal for the basin and whether Plan implementation adversely affects the ability of adjacent basins to achieve their sustainability goals.

3 REQUIRED CONDITIONS

A GSP, to be evaluated by the Department, must be submitted within the applicable statutory deadline. The GSP must also be complete and must, either on its own or in coordination with other GSPs, cover the entire basin.

3.1 SUBMISSION DEADLINE

SGMA required basins categorized as high- or medium-priority and not subject to critical conditions of overdraft to submit a GSP no later than January 31, 2022.[29]

The GSAs submitted their Plan on January 28, 2022.

3.2 COMPLETENESS

GSP Regulations specify that the Department shall evaluate a GSP if that GSP is complete and includes the information required by SGMA and the GSP Regulations.[30]

The GSAs submitted an adopted GSP for the entire Subbasin. After an initial, preliminary review, Department staff found the GSP to be complete and appearing to include the

[27] Water Code § 10733.8; 23 CCR § 355.6.
[28] Water Code §§ 10728 *et seq.*, 10728.2.
[29] Water Code § 10720.7(a)(2).
[30] 23 CCR § 355.4(a)(2).

required information, sufficient to warrant a thorough evaluation by the Department.[31] The Department posted the GSP to its website on February 14, 2022.[32]

3.3 Basin Coverage

A GSP, either on its own or in coordination with other GSPs, must cover the entire basin.[33] A GSP that is intended to cover the entire basin may be presumed to do so if the basin is fully contained within the jurisdictional boundaries of the submitting GSAs.

The GSP intends to manage the entire Sutter Subbasin and the jurisdictional boundary of the submitting GSAs fully contains the Subbasin.[34]

4 Plan Evaluation

As stated in Section 355.4 of the GSP Regulations, a basin "shall be sustainably managed within 20 years of the applicable statutory deadline consistent with the objectives of the Act." The Department's assessment is based on a number of related factors including whether the elements of a GSP were developed in the manner required by the GSP Regulations, whether the GSP was developed using appropriate data and methodologies and whether its conclusions are scientifically reasonable, and whether the GSP, through the implementation of clearly defined and technically feasible projects and management actions, is likely to achieve a tenable sustainability goal for the basin. The Department staff's evaluation of the likelihood of the Plan to attain the sustainability goal for the Subbasin is provided below.

4.1 Administrative Information

The GSP Regulations require each Plan to include administrative information identifying the submitting Agency, its decision-making process and its legal authority;[35] a description of the Plan area and identification of beneficial uses and users in the Plan area;[36] and a description of the ability of the submitting Agency to develop and implement a Plan for that area.[37]

The nine GSAs that have formed within the Sutter Subbasin and collectively submitted the GSP are: Butte Water District – Sutter, City of Live Oak, City of Yuba City, County of Sutter, Reclamation District No. 70, Reclamation District No. 1500, Reclamation District

[31] The Department undertakes a preliminary completeness review of a submitted Plan under section 355.4(a) of the GSP Regulations to determine whether the elements of a Plan required by SGMA and the Regulations have been provided, which is different from a determination, upon review, that a Plan is "incomplete" for purposes of section 355.2(e)(2) of the Regulations.
[32] https://sgma.water.ca.gov/portal/gsp/preview/112.
[33] Water Code § 10727(b); 23 CCR § 355.4(a)(3).
[34] Sutter Subbasin GSP, Section 2.1.2, p. 64; Figure 2-2, p. 65.
[35] 23 CCR § 354.6 *et seq*.
[36] 23 CCR § 354.8 *et seq*.
[37] 23 CCR § 354.6(e).

No. 1660, Sutter Extension Water District, and Sutter Community Service District.[38] Information related to each GSA's contact information, organization and management structure, and legal authority is provided in the GSP.[39] The GSAs entered into a Memorandum of Understanding[40] (MOU, also referred to in the GSP as the Coordination Agreement[41]) with the purpose of developing, adopting, and implementing the GSP.[42] Activities performed under the MOU are guided by the Sutter Subbasin Groundwater Management Coordination Committee (SSGMCC).[43]

The Sutter Subbasin is located within the County of Sutter and includes the cities of Yuba City and Live Oak.[44] The GSP states that no area of the Subbasin is covered by an alternative and there are no adjudicated areas.[45] The Sutter Subbasin is part of the larger Sacramento Valley Groundwater Basin and neighbors seven subbasins: Butte, Wyandotte Creek, North Yuba, South Yuba, North American, Yolo, and Colusa.[46] All adjacent groundwater subbasins are medium and high-priority basins with GSPs under review by the Department. The Sutter Subbasin is bounded by the Sacramento River on the west and the Feather River on the east. A map showing the Subbasin and adjacent subbasins is shown in Figure 1 below.

[38] Sutter Subbasin GSP, Section 3.1, p. 149.
[39] Sutter Subbasin GSP, Section 3, pp. 149-158.
[40] Sutter Subbasin GSP, Final Appendices, Appendix 3-A, pp. 29-51.
[41] Note that this subbasin has a single GSP, therefore this term used in the GSP does not have the same meaning as interagency agreements addressed under 23 CCR §357, which are for basins with multiple GSPs.
[42] Sutter Subbasin GSP, Section 3.3, pp. 157-158.
[43] Sutter Subbasin GSP, Section 3.3, p. 157.
[44] Sutter Subbasin GSP, Table 2-1, p. 66.
[45] Sutter Subbasin GSP, Section 2.1.2, p. 64.
[46] Sutter Subbasin GSP, ES-2, p. 37.

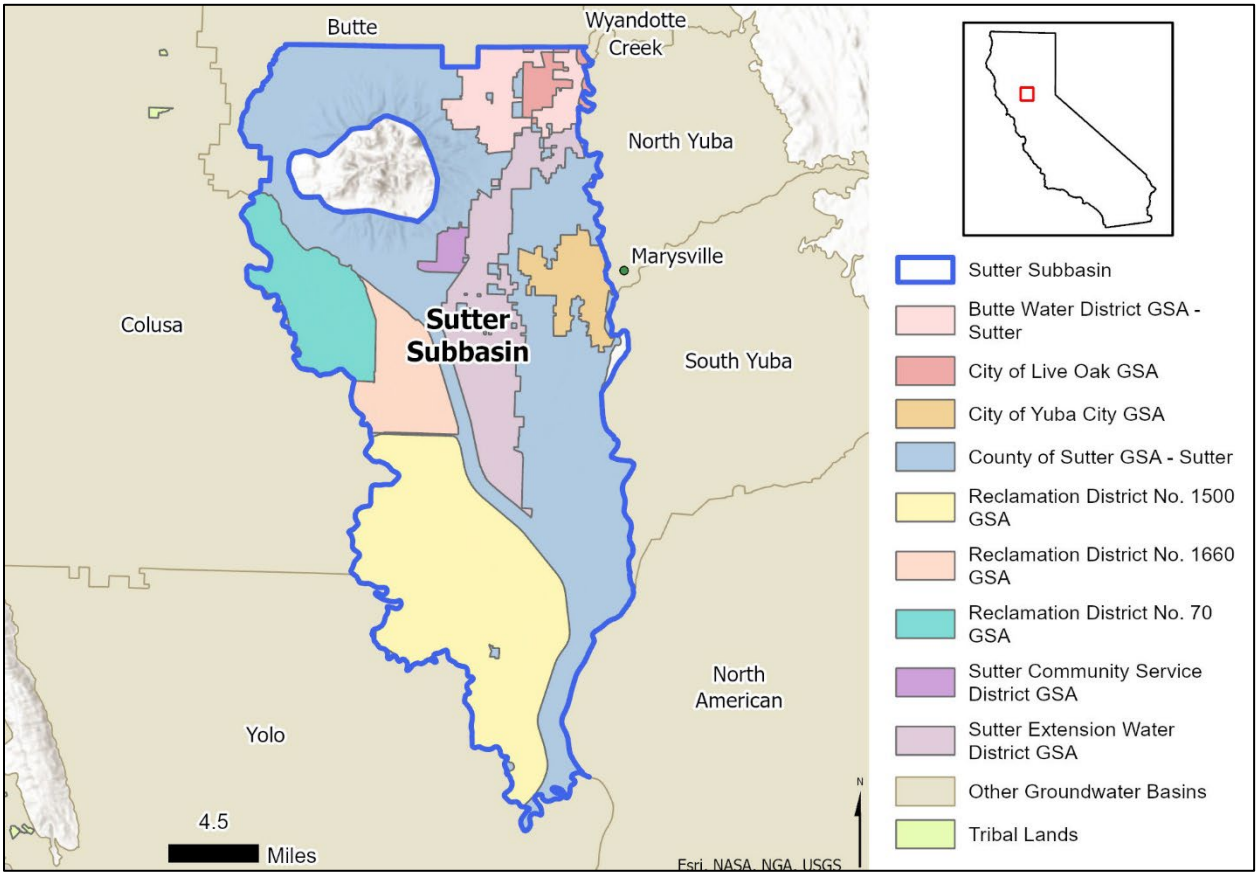


Figure 1: Sutter Subbasin Location Map.

Land use within the Subbasin is predominantly agricultural, with the remaining being urban or riparian vegetation.[47] According to the GSP, state managed lands in the Subbasin are managed by the California Department of Fish and Wildlife and California Department of Parks and Recreation, and federally managed lands are managed by the United States Fish and Wildlife Service.[48] The GSP states that there are an estimated 2,482 domestic wells and 1,210 production wells within the Subbasin.[49]

The Sutter Subbasin's water sources include surface water from the Feather and Sacramento Rivers and groundwater. According to the GSP, most water agencies use surface water as the primary source, augmented by groundwater during "prolonged dry or drought periods."[50] The GSP presents a list of beneficial uses and users of groundwater in the Subbasin, in the following categories: (1) agricultural users, (2) domestic well owners, (3) municipal well operators, (4) public water systems, (5) local land use planning agencies, (6) environmental users of groundwater, (7) the federal

[47] Sutter Subbasin GSP, Table 2-2, p. 81.
[48] Sutter Subbasin GSP, Section 2.1.2, p. 64.
[49] Sutter Subbasin GSP, Section 2.1.3.1, p. 72.
[50] Sutter Subbasin GSP, Section 2.2, p. 81.

government, (8) California Native American tribes, (9) disadvantaged communities, and (10) adjacent subbasins.[51]

The GSP states that "water managers in the Sutter Subbasin will work together and collaboratively with stakeholders and neighboring subbasins through GSP implementation and beyond to achieve [the sustainability] goal."[52] The GSP provides an estimate of general annual costs associated with Plan implementation and GSA operation, as well as costs for proposed projects and management actions.[53] The GSP also presents sources of funding that the GSAs plan to utilize to meet the costs of GSP implementation, which include local fees and grants.[54]

The GSP states that the GSAs "have made note of all comments received and will provide responses to public review period comments along with responses to comments received during [the Department's] 75-day public comment period following GSP submittal and comments received from [the Department] as a result of evaluation of the Sutter Subbasin GSP."[55] Department staff note there are no responses to public comments on the SGMA Portal website,[56] as of the writing of this assessment, and the GSP does not state where responses to public comments will be provided. Department staff recommend the GSAs provide the related information by the next Plan update.

The administrative information included in the Plan substantially complies with the requirements outlined in the GSP Regulations. The GSP's discussion and presentation of administrative information covers the specific items listed in the GSP Regulations in an understandable format using appropriate detail. Department staff are aware of no significant inconsistencies or contrary information to that presented in the GSP and, therefore, have no significant concerns regarding the quality, data, and discussion of this subject in the GSP.

4.2 Basin Setting

GSP Regulations require information about the physical setting and characteristics of the basin and current conditions of the basin, including a hydrogeologic conceptual model; a description of historical and current groundwater conditions; and a water budget accounting for total annual volume of groundwater and surface water entering and leaving the basin, including historical, current, and projected water budget conditions.[57]

[51] Sutter Subbasin GSP, Section 4.1, pp. 163-166.
[52] Sutter Subbasin GSP, Section 1.2, p. 56.
[53] Sutter Subbasin GSP, Section 8.2, pp. 647-658.
[54] Sutter Subbasin GSP, Section 8.2.1, pp. 653-658.
[55] Sutter Subbasin GSP, Section 4.2.2, p. 177.
[56] https://sgma.water.ca.gov/portal/gsp/preview/112.
[57] 23 CCR § 354.12.

4.2.1 Hydrogeologic Conceptual Model

The hydrogeologic conceptual model is a non-numerical model of the physical setting, characteristics, and processes that govern groundwater occurrence within a basin, and represents a local agency's understanding of the geology and hydrology of the basin that supports the geologic assumptions used in developing mathematical models, such as those that allow for quantification of the water budget.[58] The GSP Regulations require a descriptive hydrogeologic conceptual model that includes a written description of geologic conditions, supported by cross sections and maps,[59] and includes a description of basin boundaries and the bottom of the basin,[60] principal aquifers and aquitards,[61] and data gaps.[62]

The GSP describes the Subbasin as a 284,800-acre region of the east-central Sacramento Valley Groundwater Basin dominated by east-west compressional forces associated with regional uplift in the west and extension in the east.[63] The Subbasin contains consolidated and unconsolidated freshwater-bearing continental sediments underlain by marine sediments and igneous and metamorphic rocks.[64] Structural features within the Subbasin include the Sutter Buttes and the Willows Fault.[65] The Sutter Buttes are described as an uplifted Pliocene volcanic plug and the only prominent topographic feature within the Subbasin.[66] The GSP identifies the Willows Fault as a northeast-dipping, northwest-trending, active reverse fault that extends through the entire Subbasin from the northwestern border to the southeastern border.[67] The GSP identifies 18 geologic units or formations in the Subbasin.[68] Nine of these units are fresh water-bearing: the Holocene Alluvium; Pleistocene Modesto, Riverbank, and Victor; Laguna; Sutter Buttes Rampart; Sutter; Mehrten; and Valley Springs Formations.[69] Eight units are non-fresh water-bearing: the Eocene Ione and Capay; Lovejoy Basalt; Forbes; Kione; Sacramento Shale; Winter Sands and Shales; and Starsky Sands Formations.[70] The final unit consists of basement rocks, igneous and metamorphic rocks potentially related to the Coast Range and Sierra Nevada, and the volcanic rocks comprising the Sutter Buttes.[71] The GSP provides descriptions of these units including their general locations and

[58] DWR Best Management Practices for the Sustainable Management of Groundwater: Hydrogeologic Conceptual Model, December 2016: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-3-Hydrogeologic-Conceptual-Model_ay_19.pdf.
[59] 23 CCR §§ 354.14 (a), 354.14 (c).
[60] 23 CCR §§ 354.14 (b)(2-3).
[61] 23 CCR § 354.14 (b)(4) *et seq.*
[62] 23 CCR § 354.14 (b)(5).
[63] Sutter Subbasin GSP, Section 5.1.1, pp. 192-193.
[64] Sutter Subbasin GSP, Section 5.1.1, p. 192.
[65] Sutter Subbasin GSP, Section 5.1.1 and Figure 5-1, pp. 193-195.
[66] Sutter Subbasin GSP, Section 5.1.1.1, p. 199.
[67] Sutter Subbasin GSP, Section 5.1.1, p. 193.
[68] Sutter Subbasin GSP, Section 5.1.4, pp. 204-210.
[69] Sutter Subbasin GSP, Section 5.1.4.1, pp. 206-208.
[70] Sutter Subbasin GSP, Section 5.1.4.2, pp. 208-209.
[71] Sutter Subbasin GSP, Section 5.1.4.2, p. 209.

approximate thicknesses, depositional environments, and water-bearing characteristics. The GSP also notes that the identification of geologic units within the Subbasin is inconsistent across existing literature and that there is a need to standardize the nomenclature for these units; the GSP identifies this concern as a data gap.[72] Department staff have determined that the GSP's discussion and presentation of information of the regional and structural setting, as it pertains to major geologic features that affect groundwater flow, sufficiently covers the specific items listed in the GSP Regulations in an understandable format using appropriate data.

The GSP details that the Sutter Subbasin has complex lateral boundaries defined by geologic features, surface hydrology, and boundaries with other agencies.[73] The Subbasin is generally bounded by the Sutter-Butte County boundary to the north, the Sacramento River to the west and south, and the Feather River to the east. The Subbasin adjoins seven groundwater subbasins: Butte (No. 5-021.70) to the north and northwest; Wyandotte Creek (No. 5-021.69) to the northeast; North Yuba and South Yuba (Nos. 5-021.60 and 5-021.61) to the east; North American (No. 5-021.64) to the southeast; Yolo (No. 5-021.67) to the southwest; and Colusa (No. 5-021.52) to the west.[74]

The Subbasin's vertical extent is defined as the base of freshwater, which generally occurs between 400 to 1,600 feet below mean sea level (ft bmsl) in the Subbasin, and is deepest in the southern region and south of the Sutter Buttes.[75] The GSP provides a cross-section that indicates the depth to the base of freshwater near the Sutter Buttes is uncertain.[76] The GSP also states, "The Buttes divert groundwater around their flanks, and marine sediments surrounding them have been flushed of their saline water by precipitation to great depths."[77] This suggests that some of the identified marine deposits may be a source of fresh (i.e. non-saline) groundwater near the Sutter Buttes; however, because the cross section through the Sutter Buttes does not depict Subbasin boundaries, it is unclear whether these marine units are within or outside of the Subbasin's lateral extent. Department staff encourage the GSP to provide additional information clarifying the lateral and vertical extent of Subbasin near the Sutter Buttes or identify these topics as data gaps to be further refined.

The GSP describes that the Subbasin has one principal aquifer with three aquifer zones (AZ-1, AZ-2, and AZ-3) separated by areas of low permeability.[78] The GSP identifies the Sutter Buttes Rampart and the Modesto, Riverbank, Victor, and Laguna Formations as the main water bearing formations in the principal aquifer.[79] Zone AZ-1 occurs from the ground surface to approximately 120 to 200 feet below ground surface (ft bgs),[80]

[72] Sutter Subbasin GSP, Section 5.1.4 and Section 5.1.12.7, p. 204 and pp. 301-302.
[73] Sutter Subbasin GSP, Section 5.1.2 and Figure 2-1, p. 202 and p. 63.
[74] Sutter Subbasin GSP, Section 5.1.2 and Figure 2-1, p. 202 and p. 63.
[75] Sutter Subbasin GSP, Section 5.1.3 and Figure 5-5, p. 202 and p. 203.
[76] Sutter Subbasin GSP, Figure 5-9, p. 214.
[77] Sutter Subbasin GSP, Section 5.1.2, p. 202.
[78] Sutter Subbasin GSP, Section 5.1.6.1, p. 218.
[79] Sutter Subbasin GSP, Section 5.1.6.1, p. 218.
[80] Sutter Subbasin GSP, Section 5.1.6.2 and Figure 5-12, p. 218 and p. 221.

encompassing the Modesto and Riverbank Formations.[81] Zones AZ-1 and AZ-2 are separated by a 20 to 60 ft thick low permeability zone.[82] Zone AZ-2 occurs from approximately 180 to 450 ft bgs[83] and is divided into sub-zones AZ-2A and AZ-2B.[84] The sub-zones are laterally separated and consist of the Sutter Buttes Rampart and Laguna Formation, respectively.[85] Zones AZ-2 and AZ-3 are separated by a 30 to 80 ft thick low permeability zone.[86] Zone AZ-3 occurs from approximately 480 to 700 ft bgs[87] and encompasses the Laguna Formation, Sutter Buttes Rampart, and Sutter Formation.[88]

The GSP is unclear and inconsistent at times when describing the principal aquifer system, geologic formations, and vertical extent of the Subbasin. Regarding the identification of geologic formations that comprise the principal aquifer and various aquifer zones, the Victor Formation is identified in the description for the principal aquifer[89] but not identified in any aquifer zone, while the Sutter Formation is not mentioned as a formation in the principal aquifer but is identified as part of aquifer zone AZ-3.[90] Regarding the vertical extent of the Subbasin, the cross-sections that depict the aquifer zones (Figures 5-12 and 5-13)[91] show aquifer zone AZ-3 extending below the base of fresh water (i.e. the defined bottom of the Subbasin) making it unclear to Department staff what is considered the bottom of the Subbasin. Additionally, the GSP describes there are three aquifer zones in the principal aquifer (AZ-1, AZ-2, and AZ-3);[92] however, the monitoring network section also identifies wells to monitor a "shallow"[93] aquifer zone not discussed in the hydrogeologic conceptual model section. It appears the AZ-1 zone (0 – 150 feet deep) is divided into the shallow AZ zone (0 – 50 feet deep) and AZ-1 zone (50 – 150 feet deep) in the monitoring network section.[94] Department staff recommend the GSP present consistent descriptions of the aquifer zones in both the hydrogeologic conceptual model and monitoring networks (see Recommended Corrective Action 1).

The GSP does not discuss structural restrictions to groundwater flow in a dedicated section of its hydrogeologic conceptual model, but it does discuss significant structures in context of the regional geology. Significant structural features in the Subbasin include the Willows Fault and the Sutter Buttes.[95] The GSP states "[t]here are no indications that the Willows Fault controls groundwater flow in the Sutter Subbasin and, as shown in

[81] Sutter Subbasin GSP, Section 5.1.6.1 and Figure 5-10, p. 218 and p. 215.
[82] Sutter Subbasin GSP, Section 5.1.6.2, p. 219.
[83] Sutter Subbasin GSP, Section 5.1.6.2, p. 219.
[84] Sutter Subbasin GSP, Section 5.1.6.1 and Figure 5-12, p. 218 and p. 221.
[85] Sutter Subbasin GSP, Section 5.1.6.1, p. 218.
[86] Sutter Subbasin GSP, Section 5.1.6.2 and Figure 5-12, p. 219 and p. 221.
[87] Sutter Subbasin GSP, Section 5.1.6.2 and Figure 5-12, p. 219 and p. 215.
[88] Sutter Subbasin GSP, Section 5.1.6.1 and Figure 5-10, p. 218 and p. 215.
[89] Sutter Subbasin GSP, Section 5.1.6.1, p. 218.
[90] Sutter Subbasin GSP, Section 5.1.6.1, p. 218.
[91] Sutter Subbasin GSP, Figure 5-12 and Figure 5-13, p. 221 and p. 223.
[92] Sutter Subbasin GSP, Section 5.1.6.1, p. 218.
[93] Sutter Subbasin GSP, Section 7.2.6.1.1, Table 7-48, Figure 7-2, p. 593, pp. 595-596, p. 597.
[94] Sutter Subbasin GSP, Table 7-48, pp. 595-596.
[95] Sutter Subbasin GSP, Section 5.1.1 and Figure 5-1, p. 193 and pp. 194-195.

Figure 5-2, offset on this fault does not appear to occur in sediments younger than Eocene."[96] However, Department staff note that the GSP provides a cross-section showing the Willows Fault extending through the base of freshwater to the ground surface.[97] The GSP provides little discussion on how the Sutter Buttes may restrict groundwater flow, only stating "[t]he Buttes divert groundwater around their flanks, and marine sediments surrounding them have been flushed of their saline water by precipitation to great depths."[98] Department staff encourage the GSAs to present additional discussion on how these two structural features may affect groundwater flow to enhance the GSP's hydrogeologic conceptual model discussion.

The GSP identifies several data gaps in a dedicated section of the hydrogeologic conceptual model[99] and proposes steps and timelines to address these gaps in its projects and management actions chapter.[100] Department staff note that actions to address these data gaps are in the planning stages and that timelines have not been established.[101] The GSAs propose the following actions:

- Install additional monitoring wells to better understand groundwater and surface water interactions along the Sacramento and Feather Rivers;[102]
- Collect nitrogen isotope and oxidation-reduction values in AZ-1 to determine the source of elevated salinity in this aquifer zone;[103]
- Conduct additional aquifer pump tests to improve assessment of aquifer properties;[104]
- Collect regular stable isotope data from surface water and existing nested wells to improve available groundwater recharge information;[105]
- Use airborne electromagnetic (AEM) survey data to refine the hydrogeologic conceptual model;[106]
- Develop standardized stratigraphic nomenclature for geologic formations within the Subbasin.[107]

The projects and management actions section of the GSP also includes a project/management action to conduct an AEM survey specifically to improve the GSAs'

[96] Sutter Subbasin GSP, Section 5.1.2, p. 202.
[97] Sutter Subbasin GSP, Figure 5-10, p. 215.
[98] Sutter Subbasin GSP, Section 5.1.2, p. 202.
[99] Sutter Subbasin GSP, Section 5.1.12, pp. 299-302.
[100] Sutter Subbasin GSP, Section 7.1.6, pp. 553-575.
[101] Sutter Subbasin GSP, Tables 7-29 to 7-36, pp. 554-565.
[102] Sutter Subbasin GSP, Section 5.1.12.1 and Table 7-29, p. 299 and pp. 554-555.
[103] Sutter Subbasin GSP, Section 5.1.12.2 and Table 7-30, p. 299 and pp. 556-557.
[104] Sutter Subbasin GSP, Section 5.1.12.3 and Table 7-31, p. 301 and pp. 557-558.
[105] Sutter Subbasin GSP, Section 5.1.12.4 and Tables 7-32 and 7-33, p. 301 and pp. 558-561.
[106] Sutter Subbasin GSP, Section 5.1.12.6 and Table 7-34, p. 301 and pp. 561-562.
[107] Sutter Subbasin GSP, Section 5.1.12.7 and Table 7-36, pp. 301-302 and pp. 564-565.

understanding of the Sutter Buttes area hydrogeology.[108] Department staff note the GSP does not describe the Sutter Buttes area hydrogeology as a data gap. It is unclear if the AEM survey will provide appropriate data to address the location of the Subbasin bottom and potential restrictions to groundwater flow in the Sutter Buttes area.

The GSP provides sufficiently detailed maps that depict topography,[109] surficial geology,[110] soil characteristics,[111] recharge and discharge areas,[112] surface water bodies,[113] and source and point of delivery of imported water supplies[114] that characterizes the physical components and interaction of the surface water and groundwater systems in the Subbasin. The GSP supplements the provided maps with additional discussion and description of soil properties,[115] recharge and discharge areas,[116] and both imported water[117] and surface water sources[118] throughout the Subbasin.

Despite the recommended corrective action described above, the information provided in the GSP that comprises the hydrogeologic conceptual model substantially complies with the requirements outlined in the GSP Regulations. In general, the Plan's descriptions of the regional geologic setting, the Subbasin's physical characteristics, the principal aquifer, and hydrogeologic conceptual model appear to utilize the best available science.

4.2.2 Groundwater Conditions

The GSP Regulations require a written description of historical and current groundwater conditions for each of the applicable sustainability indicators and groundwater dependent ecosystems that includes the following: groundwater elevation contour maps and hydrographs,[119] a graph depicting change in groundwater storage,[120] maps and cross-sections of the seawater intrusion front,[121] maps of groundwater contamination sites and plumes,[122] maps depicting total subsidence,[123] identification of interconnected surface water systems and an estimate of the quantity and timing of depletions of those systems,[124] and identification of groundwater dependent ecosystems.[125]

[108] Sutter Subbasin GSP, Table 7-35, pp. 562-563.
[109] Sutter Subbasin GSP, Figure 5-3, p. 200.
[110] Sutter Subbasin GSP, Figure 5-1, p. 194.
[111] Sutter Subbasin GSP, Figure 5-4, p. 201.
[112] Sutter Subbasin GSP, Figures 5-24 and 5-26, p. 243 and p. 246.
[113] Sutter Subbasin GSP, Figure 2-1, p. 63.
[114] Sutter Subbasin GSP, Figure 5-48, p. 298.
[115] Sutter Subbasin GSP, Section 5.1.6.3, pp. 238-240.
[116] Sutter Subbasin GSP, Section 5.1.7 and 5.1.8, pp. 240-242 and p. 245.
[117] Sutter Subbasin GSP, Section 5.1.11, p. 297.
[118] Sutter Subbasin GSP, Section 5.1.10, p. 297.
[119] 23 CCR §§ 354.16 (a)(1-2).
[120] 23 CCR § 354.16 (b).
[121] 23 CCR § 354.16 (c).
[122] 23 CCR § 354.16 (d).
[123] 23 CCR § 354.16 (e).
[124] 23 CCR § 354.16 (f).
[125] 23 CCR § 354.16 (g).

The GSP provided over 33 hydrographs that depict long-term groundwater elevations and hydraulic gradients for the principal aquifer within the Subbasin.[126] The periods of record for hydrographs provided in the GSP vary, but generally begin in approximately 2010, with some beginning as early as 2004, and extend through 2020. The hydrographs depict relatively stable groundwater levels throughout the Subbasin with historic highs typically occurring in 2016 or 2019 and historic lows typically occurring in 2014 to 2015. The GSP states that groundwater level trends are largely stable over time "indicating sustainable conditions in the Sutter Subbasin as the aquifer rebound is observed during all water year types."[127] The GSP identifies vertical gradients between the zones of the principal aquifer throughout the Subbasin through the use of nested wells but notes that no distinct patten can be identified.[128]

The GSP includes a description of the change in groundwater storage and graphs depicting the change in storage demonstrating the annual and cumulative change in volume of groundwater storage.[129] The average annual decrease in groundwater storage in the Subbasin is estimated at approximately 7,000 acre-feet per year during the historical period of Water Year 1996 to 2015.[130]

The GSP includes a description of current and historical groundwater quality issues, including a map, and has identified total dissolved solids (TDS), nitrate as N, arsenic, and boron as constituents that have been detected above drinking water standards historically.[131] The GSP identifies arsenic and boron as naturally occurring.[132] Groundwater quality data spans from 1952 to 2020 and is sourced from the State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment (GAMA) Program.[133] The GSP also describes several groundwater contamination sites throughout the Subbasin.[134]

The GSP states that the Subbasin is located far from coastal areas and seawater intrusion is not a relevant sustainability indicator for the Subbasin.[135]

The GSP includes a description of current and historical land subsidence conditions, along with maps, in the Subbasin.[136] The maps of current land subsidence cover the extent, cumulative total, and annual rate of subsidence in the Subbasin. The GSP states

[126] Sutter Subbasin GSP, Figures 5-60 through 5-68, pp. 319-327.
[127] Sutter Subbasin GSP, Section 5.2.2.1, p. 317.
[128] Sutter Subbasin GSP, Section 5.2.2.3, p. 342.
[129] Sutter Subbasin GSP, Figure 5-81, p. 345.
[130] Sutter Subbasin GSP, Table 5-13, p. 388.
[131] Sutter Subbasin GSP, Section 5.2.5, p. 345; Figure 5-82, p. 346.
[132] Sutter Subbasin GSP, Section 5.1.9, p. 249.
[133] Sutter Subbasin GSP, Section 5.2.5, p. 347.
[134] Sutter Subbasin GSP, Section 5.1.9.7, pp. 291-292; Figure 5-47, p. 293.
[135] Sutter Subbasin GSP, Section 5.2.4, p. 345.
[136] Sutter Subbasin GSP, Section 5.2.6, pp. 354-358, Figures 5-88 and 5-89, pp. 357-358, Table 5-8, p. 356.

that "land subsidence and its associated impacts have not been recorded within the Sutter Subbasin".[137]

The GSP determines gaining and losing stream segments along the Sacramento and Feather Rivers and the Sutter Bypass.[138] The C2VSimFG-Sutter integrated flow model was used to characterize the interconnected surface waters. The portions of the stream that were found to be gaining or losing in at least 80 percent of the simulated months from 1996 to 2015 were categorized as such (gaining or losing nodes), while stream nodes that did not meet the 80 percent threshold for either categorization were classified as having mixed conditions. Average monthly streamflow gains and losses from 1996 to 2015 are also reported.[139] However, the GSP does not provide volumetric estimates of depletion of interconnected surface water due to groundwater pumping. Department staff recommend the GSAs provide estimates of depletion through modeling and improve their assessment of interconnected surface water based on guidance from the Department as discussed in Section 4.3.2.6.

The GSP includes a description of groundwater dependent ecosystems (GDEs) in the Subbasin, along with maps of potential GDEs during normal (2013), dry (2015), and wet (2017) hydrologic years.[140] The GDE assessment utilized data from the Natural Communities Commonly Associated with Groundwater (NCCAG) database provided by the Department to identify potential vegetative and wetland GDEs in the Subbasin. The GSP also presents an inventory of freshwater species identified by The Nature Conservancy in the Sutter Subbasin that may rely on groundwater.[141]

The Plan sufficiently describes the historical and current groundwater conditions throughout the Subbasin, and the information included in the Plan substantially complies with the requirements outlined in the GSP Regulations.

4.2.3 Water Budget

GSP Regulations require 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,[142] and the sustainable yield.[143]

The Plan estimates historical, current, and projected water budgets with C2VSimFG-Sutter, a numerical groundwater and surface water model developed specifically for the Sutter Subbasin.[144] The C2VSimFG-Sutter model was adapted from C2VSimFG v1.0, released by the Department in December 2020, with updates to better represent local

[137] Sutter Subbasin GSP, Section 5.2.6, p. 354.
[138] Sutter Subbasin GSP, Figure 5-91, p. 361.
[139] Sutter Subbasin GSP, Table 5-9, p. 360.
[140] Sutter Subbasin GSP, Figures 5-96, 5-97, and 5-98, pp. 368-370.
[141] Sutter Subbasin GSP, Table 5-10, pp. 371-373.
[142] 23 CCR §§ 354.18 (a), 354.18 (c) *et seq*.
[143] 23 CCR § 354.18 (b)(7).
[144] Sutter Subbasin GSP, Section 5.3.1, p. 376.

conditions. The model was refined and calibrated specifically for the Sutter Subbasin. The water budget information is provided in tabular and graphical forms for the surface system and groundwater system.[145]

The Plan includes a historical water budget for Water Year (WY) 1996 through WY 2015,[146] a current water budget for WY 2013,[147] and projected water budgets that repeat three times WY 1996 through WY 2015 with[148] and without[149] climate change. The historical groundwater budget reports an average negative change in groundwater storage of about 7,000 acre-feet per year (AFY).[150] The average change in groundwater storage in the current water budget is a negative 19,000 AFY.[151] For the projected water budgets, an average annual increase of 1,300 AFY in groundwater storage is estimated for either scenario.[152]

The GSP estimates that the sustainable yield of the Subbasin is 182,000 AFY based on a simulation of increase in demand (i.e., 20 percent increase in evapotranspiration) that resulted in a change in groundwater storage of almost zero.[153] The estimated sustainable yield is higher than simulated average annual groundwater pumping in all four water budget scenarios – historical, current conditions, projected conditions, and projected conditions with climate change. Therefore, the GSP states that the Subbasin is currently operating under sustainable conditions and is expected to continue to be sustainable if the projected conditions hold true into the future.

Department staff note that net subsurface inflows from adjacent basins (i.e., Butte, North Yuba, South Yuba, North American, and Yolo) increase significantly in the projected water budgets in comparison to the historical and current water budgets,[154] which are not explained in the GSP. The GSP's sustainable yield simulation may have similar increases because it is related to the projected water budget simulation. However, GSPs from the adjacent subbasins do not anticipate such changes in their water budgets.[155] Department staff recommend the Sutter Subbasin GSAs provide further information and justification related to the increases in net subsurface inflows from adjacent subbasins in the projected water budgets and the sustainable yield estimation (see Recommended Corrective Action 2).

[145] Sutter Subbasin GSP, Section 5.3.5, pp. 384-403.
[146] Sutter Subbasin GSP, Section 5.3.5.1, pp. 389-396.
[147] Sutter Subbasin GSP, Section 5.3.5.2, pp. 396-398.
[148] Sutter Subbasin GSP, Section 5.3.5.3, pp. 398-401.
[149] Sutter Subbasin GSP, Section 5.3.5.4, pp. 401-403.
[150] Sutter Subbasin GSP, Section 5.3.5.1, p. 390; Table 5-13, p. 388.
[151] Sutter Subbasin GSP, Section 5.3.5.2, p. 398; Table 5-13, p. 388.
[152] Sutter Subbasin GSP, Section 5.3.5.3, p. 400; Table 5-13, p. 388.
[153] Sutter Subbasin GSP, Section 5.3.6, p. 404.
[154] Sutter Subbasin GSP, Table 5-13, p. 388.
[155] Butte Subbasin GSP, Table 2-8, p. 157; North and South Yuba Subbasins GSP, Table 2-14, p. 212, Table 2-16, p. 214; North American Subbasin GSP, Table 6-13, pp. 206-207; Yolo Subbasin GSP, Table 2-29, p. 259.

The water budget described in the GSP substantially complies with the GSP Regulations and appears to be developed using the best available science. The GSP provides the required historical, current, and future accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the Subbasin including an estimate of the sustainable yield of the Subbasin. Because the Subbasin's groundwater levels are currently stable, the recommended corrective action regarding the projected water budgets and sustainable yield does not preclude plan approval at this time.

4.2.4 Management Areas

The GSP Regulations provide the option for one or more management areas to be defined within a basin if the GSA has determined that the creation of the management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives, provided that undesirable results are defined consistently throughout the basin.[156]

There are no management areas proposed within the Plan area.[157]

4.3 Sustainable Management Criteria

GSP Regulations require each Plan to include a sustainability goal for the basin and to characterize and establish undesirable results, minimum thresholds, and measurable objectives for each applicable sustainability indicator, as appropriate. The GSP Regulations require each Plan to define conditions that constitute sustainable groundwater management for the basin including the process by which the GSA characterizes undesirable results and establishes minimum thresholds and measurable objectives for each applicable sustainability indicator.[158]

4.3.1 Sustainability Goal

GSP Regulations require that GSAs establish a sustainability goal for the basin. The sustainability goal should be based on information provided in the GSP's basin setting and should include an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation.[159]

The GSP describes the Sutter Subbasin's sustainability goal as to "maintain locally managed groundwater resources for existing and future beneficial uses and users that are economically viable and sustainable by managing groundwater use within the sustainable yield, resulting in the avoidance of undesirable results."[160]

The Plan's approach to achieve the sustainability goal is through "implementation of proposed projects and management actions and monitoring activities aiding in reaching

[156] 23 CCR § 354.20.
[157] Sutter Subbasin GSP, Section 5, p. 191.
[158] 23 CCR § 354.22 *et seq*.
[159] 23 CCR § 354.24.
[160] Sutter Subbasin GSP, Section 6.3, p. 413.

or maintaining established interim milestones and measurable objectives culminating in the absence of undesirable results by 2042."[161] The GSP states that the Sutter Subbasin will be sustainable even without projects and management actions, and that projects and management actions will be implemented through an adaptive management approach to ensure undesirable results do not occur and to address data gaps.[162] The GSAs anticipate that the Subbasin will be operated within its sustainable yield and will be absent of undesirable results during the 20-year Plan implementation period, which will support the conclusion that the sustainability goal has been achieved by 2042 and will be maintained beyond 2042.

The GSP's discussion and presentation of information related to the Subbasin's sustainability goal substantially complies with the requirements outlined in the GSP Regulations in an understandable format using appropriate data.

4.3.2 Sustainability Indicators

Sustainability indicators are defined as any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results.[163] Sustainability indicators thus correspond with the six undesirable results – chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon, significant and unreasonable reduction of groundwater storage, significant and unreasonable seawater intrusion, significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies, land subsidence that substantially interferes with surface land uses, and depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water[164] – but refer to groundwater conditions that are not, in and of themselves, significant and unreasonable. Rather, sustainability indicators refer to the effects caused by changing groundwater conditions that are monitored, and for which criteria in the form of minimum thresholds are established by the agency to define when the effect becomes significant and unreasonable, producing an undesirable result.

GSP Regulations require that GSAs provide descriptions of undesirable results including defining what are significant and unreasonable potential effects to beneficial uses and users for each sustainability indicator.[165] GSP Regulations also require GSPs provide the criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.[166]

[161] Sutter Subbasin GSP, Section 6.3, p. 413.
[162] Sutter Subbasin GSP, Section 6.3, p. 414; Section 7.1.2, pp. 477-479.
[163] 23 CCR § 351(ah).
[164] Water Code § 10721(x).
[165] 23 CCR §§ 354.26 (a), 354.26 (b)(c).
[166] 23 CCR § 354.26 (b)(2).

GSP Regulations require that the description of minimum thresholds include the information and criteria relied upon to establish and justify the minimum threshold for each sustainability indicator.[167] GSAs are required to describe how conditions at minimum thresholds may affect beneficial uses and users,[168] and the relationship between the minimum thresholds for each sustainability indicator, including an explanation for how the GSA has determined conditions at each minimum threshold will avoid causing undesirable results for other sustainability indicators.[169]

GSP Regulations require that GSPs include a description of the criteria used to select measurable objectives, including interim milestones, to achieve the sustainability goal within 20 years.[170] GSP Regulations also require that the measurable objectives be established based on the same metrics and monitoring sites as those used to define minimum thresholds.[171]

The following subsections thus consolidate three facets of sustainable management criteria: undesirable results, minimum thresholds, and measurable objectives. Information, as presented in the Plan, pertaining to the processes and criteria relied upon to define undesirable results applicable to the Subbasin, as quantified through the establishment of minimum thresholds, are addressed for each applicable sustainability indicator. A submitting agency is not required to establish criteria for undesirable results that the agency can demonstrate are not present and are not likely to occur in a basin.[172]

4.3.2.1 Chronic Lowering of Groundwater Levels

In addition to components identified in 23 CCR §§ 354.28 (a-b), for the chronic lowering of groundwater, the GSP Regulations require the minimum threshold for chronic lowering of groundwater levels to be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results that is supported by information about groundwater elevation conditions and potential effects on other sustainability indicators.[173]

The Plan states that "[a]n undesirable result for chronic lowering of groundwater levels in the Sutter Subbasin is experienced through groundwater levels dropping to a level at which domestic or irrigation wells go dry or lose functional pumping capacity, result in significantly higher pumping costs, and/or the significant and unreasonable effort is required to maintain or deepen production wells."[174]

The GSP states that "[a]n undesirable result is observed when groundwater elevations drop below the minimum threshold criteria at 25% of representative monitoring locations

[167] 23 CCR § 354.28 (b)(1).
[168] 23 CCR § 354.28 (b)(4).
[169] 23 CCR § 354.28 (b)(2).
[170] 23 CCR § 354.30 (a).
[171] 23 CCR § 354.30 (b).
[172] 23 CCR § 354.26 (d).
[173] 23 CCR § 354.28(c)(1) *et seq*.
[174] Sutter Subbasin GSP, Section 6.4.1.1, p. 415.

(16 out of 63 representative wells) concurrently over two consecutive seasonal high water level measurements."[175] The GSP also states that "[i]mpacts relating to this [sustainable management criteria] will be evaluated both by aquifer zone and for the principal aquifer as a whole."[176] However, it is unclear how undesirable results will be evaluated by aquifer zone. For example, about two-thirds of the 23 representative monitoring sites in the shallow AZ and AZ-1 zones will have their minimum thresholds exceeded if all exceedances occur in the two shallow zones. Department staff encourage the GSAs to provide additional information regarding how the impacts of undesirable results will be evaluated by aquifer zone.

Department staff conclude the decision to set sustainable management criteria based on seasonal high water level measurements may not adequately consider the interests of beneficial uses and users of groundwater in the Subbasin. Based on a review of hydrographs provided in the GSP, groundwater levels in the Subbasin typically decline during the peak irrigation season and hit seasonal lows in the late summer or fall period where potential impacts to beneficial uses and users will be most severe. The GSAs' decision to set sustainable management criteria for the chronic decline of groundwater levels based on the highest anticipated groundwater levels of the season in spring, instead of during the time of most impacts in late summer or fall, is concerning to Department staff as it likely disregards potential impacts to beneficial uses and users from seasonal variations. Under this management decision, even if the GSAs successfully maintain spring groundwater levels within the historical range, impacts to beneficial uses and users that occur during any other times of the year (as groundwater levels typically decline) appear to not be considered. The GSAs should revise the sustainable management criteria to be based on seasonal low groundwater levels to ensure potential impacts to beneficial uses and users are considered (see Recommended Corrective Action 3a).

The GSP establishes minimum thresholds as the deepest of (1) historical low, (2) "90% of the average groundwater elevation from the projected water budget (baseline condition over 60-year period using C2VSimFG-Sutter) at each representative monitoring site with an artificial increase in evapotranspiration (ET) of 50%," or (3) water level corresponding to an average operating range of 8.0 feet for the AZ and AZ-1 zones, and 16.5 feet for the AZ-2 and AZ-3 zones.[177]

The GSP does not present a clear description for Department staff to understand the methodology of the second criterion (i.e., "90% of the average groundwater elevation from…"). It is unclear what "90% of the average groundwater elevation" at each representative monitoring site refers to and how it relates to Appendix 6-B's statement of "assuming a percentage of groundwater levels under sustainable yield estimates

[175] Sutter Subbasin GSP, Section 6.4.1.2, p. 415.
[176] Sutter Subbasin GSP, Section 6.4.1.2, p. 415.
[177] Sutter Subbasin GSP, Section 6.5.1.1, p. 422.

impacting interconnected surface waters."[178] The assumed groundwater conditions associated with this method are not well defined, such as the spatial and temporal aggregations that define "interconnected streams that are gaining become losing."[179] Department staff recommend the GSAs provide detailed information to clarify this method (see Recommended Corrective Action 3b).

The GSP describes the potential impacts of minimum thresholds on beneficial uses and users of groundwater, including domestic, municipal, agricultural, and environmental uses and users (i.e., GDEs).[180] The GSP states that minimum thresholds are established to avoid undesirable results for domestic wells, which are typically screened in the shallow AZ and AZ-1 zones, and to protect groundwater production of municipal and agricultural wells in the deeper aquifer zones. However, the GSP does not present the analysis or information in support of this statement. Department staff recommend the GSAs provide more information about how the proposed minimum thresholds for the chronic lowering of groundwater levels may impact beneficial uses and users. Specifically, consider the impact of the selected minimum threshold levels on supply wells. The consideration should identify the degree/extent of potential impact including the percentage, number, and location of potentially impacted wells at the proposed minimum thresholds for chronic lowering of groundwater levels (see Recommended Corrective Action 3c).

The GSP describes the relationship between the minimum thresholds for groundwater levels and other sustainability indicators.[181] The GSP states that land subsidence has not been observed in the Subbasin and the minimum thresholds are not expected to cause land subsidence. However, because minimum thresholds are deeper than historical lows in some representative monitoring wells, future land subsidence may be possible. Department staff recommend the GSA reevaluate how groundwater level minimum thresholds may impact land subsidence (see Recommended Corrective Action 3d).

Additionally, it is also unknown how much stream depletion is projected along the Sacramento and Feather Rivers, despite the GSA's concern of impacts to the two rivers (i.e., purpose of this method) and the statement that "the rivers went from gaining to losing at a 50% increase in ET."[182] The GSP has not provided justification that stream conditions at the groundwater level minimum thresholds, before gaining streams become losing (i.e., the second criterion), will avoid significant and unreasonable adverse impacts on beneficial uses and users of interconnected surface water. Department staff recommend the GSAs provide estimates of correlated stream depletion and evaluate the potential impacts to beneficial uses and users of interconnected surface water (see Recommended Corrective Action 3e).

[178] Sutter Subbasin GSP Appendices, Appendix 6-B, Section 3.4, pp. 662-665.
[179] Sutter Subbasin GSP, Section 6.5.1.1, p. 422.
[180] Sutter Subbasin GSP, Section 6.5.1.4, pp. 431-432.
[181] Sutter Subbasin GSP, Section 6.5.1.2, pp. 427-428.
[182] Sutter Subbasin GSP Appendices, Appendix 6-B, Section 3.4, p. 662.

The GSP states that the Sutter Subbasin's minimum thresholds for groundwater levels are not anticipated to cause undesirable results or affect the abilities of the adjacent subbasins to achieve their sustainability goals. The GSP explains that the Subbasin's minimum thresholds are generally comparable to those of the adjacent subbasins' and that the Feather and Sacramento Rivers maintain groundwater levels along the borders between Sutter and adjacent subbasins.[183]

The GSP establishes measurable objectives and interim milestones for groundwater levels at the average of historical measurements at each representative monitoring site.[184] The GSP explains that the Subbasin is in a sustainable state and will maintain sustainable conditions. Department staff note that the measurable objectives are generally lower than historical groundwater levels because they are defined with seasonal high groundwater level measurements. Additionally, Department staff note the GSP does not present projected groundwater levels for review. Future groundwater levels are likely to differ to some degree from historical conditions at some locations due to changes in groundwater pumping (e.g., more municipal, and less agricultural groundwater pumping). Department staff recommend that the GSAs include hydrographs of projected groundwater levels to facilitate Department review of groundwater level sustainable management criteria.

The GSP's discussion and presentation of information seems to be comprehensive and generally covers the specific items listed in the GSP Regulations in an understandable format using appropriate data and information. Because the overall groundwater level and storage conditions in the Basin are generally stable based on the information included in the GSP, the recommended corrective actions do not preclude plan approval at this time. However, the GSAs should give due consideration to implementing the recommended corrective actions detailed in this section prior to the first periodic evaluation of the Plan.

4.3.2.2 Reduction of Groundwater Storage

In addition to components identified in 23 CCR §§ 354.28 (a-b), for the reduction of groundwater storage, the GSP Regulations require the minimum threshold for the reduction of groundwater storage to 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.[185]

The GSP describes the potential effects of undesirable results for reduction of groundwater storage as "shallow wells going dry and/or losing production capacity resulting in the need to deepen or replace wells; increased pumping costs as deeper wells

[183] Sutter Subbasin GSP, Section 6.5.1.3, pp. 428-430.
[184] Sutter Subbasin GSP, Section 6.6.1, p. 457.
[185] 23 CCR § 354.28(c)(2).

are required to access groundwater; and an overall reduction in beneficial uses of groundwater."[186] The GSP uses groundwater levels as a proxy and the same sustainable management criteria (i.e., undesirable results,[187] minimum thresholds,[188] measurable objectives,[189] and interim milestones[190]) as those for chronic lowering of groundwater levels.

The GSP justifies using groundwater levels as a proxy by stating that "[l]ong-term reductions in storage are not anticipated as the Sutter Subbasin is already sustainable and due to the large volume of water currently in storage in the Subbasin" and that "as long as groundwater levels are managed above minimum thresholds, changes in storage should not be significant."[191] The Subbasin's storage is estimated at approximately 49 million acre-feet.[192] Department staff generally understand the GSAs' reasoning for using the same sustainable management criteria as groundwater levels and agree that maintaining groundwater levels above minimum thresholds will avoid significant changes in storage and depletions of groundwater supply in the Subbasin.

The GSP's discussion and presentation of information related to the reduction of groundwater storage are generally reasonable and covers the specific items listed in the GSP Regulations. Staff are aware of no significant inconsistencies or contrary information to that presented in the GSP and, therefore, have no significant concerns regarding the discussion of this subject in the GSP.

4.3.2.3 Seawater Intrusion

In addition to components identified in 23 CCR §§ 354.28 (a-b), for seawater intrusion, the GSP Regulations require the minimum threshold for seawater intrusion to be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results.[193]

The GSP states that seawater intrusion is not an applicable sustainability indicator because the Subbasin is far from the Pacific Ocean and is not adjacent to the Sacramento-San Joaquin Delta.[194] Therefore, the GSP does not establish sustainable management criteria for seawater intrusion.

Department staff regard the GSAs' rationale for not setting sustainable management criteria for seawater intrusion to be reasonable given the location of the Subbasin.

[186] Sutter Subbasin GSP, Section 6.4.2.3, p. 417.
[187] Sutter Subbasin GSP, Section 6.4.2.1, p. 416.
[188] Sutter Subbasin GSP, Section 6.5.2, p. 433.
[189] Sutter Subbasin GSP, Section 6.6.2, p. 463.
[190] Sutter Subbasin GSP, Section 6.6.2, p. 463.
[191] Sutter Subbasin GSP, Section 6.4.2.1, p. 416.
[192] Sutter Subbasin GSP, Section 6.5.1.2, p. 427.
[193] 23 CCR § 354.28(c)(3).
[194] Sutter Subbasin GSP, Section 6.4.3, p. 417.

4.3.2.4 Degraded Water Quality

In addition to components identified in 23 CCR §§ 354.28 (a-b), for degraded water quality, the GSP Regulations require the minimum threshold for degraded water quality to be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.[195]

The GSP states that "[a]n undesirable result for degraded water quality in the Sutter Subbasin would be the result stemming from a causal nexus between groundwater-related activities, such as groundwater extraction or recharge, and a degradation in groundwater quality that causes a significant and unreasonable reduction in long-term viability of domestic, agricultural, municipal, or environmental uses over the planning and implementation horizon of this GSP."[196] The GSP describes that "the causal nexus would be related to increased salinity (measured as total dissolved solids [TDS]) and nitrate (measured as nitrate as nitrogen [N]) concentration resulting from groundwater pumping or implementation of projects and/or management actions."[197] The GSAs will consider establishing sustainable management criteria for other constituents of concern with elevated concentrations if groundwater management activities are determined to be the cause.

The GSP states that undesirable results occur "when 50% of representative monitoring wells (14 out of 28 representative wells) across all aquifer zones exceed the minimum threshold for two consecutive measurements at each location during non-drought years and where these minimum threshold exceedances can be tied to a causal nexus between SGMA-related activities and water quality."[198] The GSP explains that such criteria "would provide sufficient data to establish a trend in potential worsening groundwater level as a result of GSP-related activities." However, the GSP does not justify why drought years are excluded from the criteria for undesirable results. In general, in drought years groundwater pumping increases, groundwater levels decline, and groundwater quality tends to degrade. For example, shallow domestic wells tend to experience more water quality issues during drought. Excluding water quality data in drought years is likely to exclude more severe impacts on water quality from either groundwater extraction or the GSAs' projects and management actions. Department staff recommend the GSAs revise the sustainable management criteria for degraded water quality to include water quality monitoring data collected in drought year (see Recommended Corrective Action 4).

[195] 23 CCR § 354.28(c)(4).
[196] Sutter Subbasin GSP, Section 6.4.4.1, pp. 417-418.
[197] Sutter Subbasin GSP, Section 6.4.4.1, p. 418.
[198] Sutter Subbasin GSP, Section 6.4.4.2, p. 417.

The GSP establishes minimum thresholds as "the highest of: (1) the upper Secondary MCL for TDS (1,000 mg/L) and Primary MCL for nitrate as [nitrogen] (10 mg/L) or (2) current water quality conditions for TDS and nitrate as [nitrogen] based on data available from 2000 to the time of GSP development (Summer 2021) at the representative monitoring well or nearby well within the same aquifer zone as described in Section 5.2.5 of the Basin Setting chapter, using maximum concentration detected of each constituent."[199] The minimum thresholds exceed 1,000 mg/L for TDS or 10 mg/L for nitrate as nitrogen in two and one representative monitoring well, respectively.[200] The minimum thresholds are consistent with the State drinking water standards and takes into consideration historical data.

The GSP describes the effects of the minimum thresholds on beneficial uses and users of groundwater in the Subbasin,[201] and how the GSAs determined that conditions at minimum thresholds will avoid undesirable results for other sustainability indicators[202] and will avoid undesirable results for adjacent subbasins or the ability of adjacent subbasins to achieve their sustainability goals.[203]

The GSP sets measurable objectives as "the current water quality conditions for TDS and nitrate as [nitrogen] based on data available from 2000 to the time of GSP development (Summer 2021) at the representative monitoring well or nearby well within the same aquifer zone (as described in Section 5.2.5 of the Basin Setting chapter) using maximum concentration detected of each constituent", or "500 mg/L for TDS (the recommended Secondary MCL) and 7 mg/L for nitrate as [nitrogen]" where such data are not available.[204] The interim milestones are set the same as the measurable objectives.[205] The measurable objectives and interim milestones are consistent with State drinking water standards and are informed by historical data.

The GSP's discussion of the minimum thresholds and measurable objectives for degraded water quality seems to be comprehensive and includes adequate support, justification, and information to understand the GSAs' process, analysis, and rationale. The GSP's discussion and presentation of information covers the specific items listed in the GSP Regulations in an understandable format using appropriate data and assumptions. The recommended corrective action of including drought-year water quality data does not preclude approval of the GSP at this time.

4.3.2.5 Land Subsidence

In addition to components identified in 23 CCR §§ 354.28 (a-b), the GSP Regulations require the minimum threshold for land subsidence to be the rate and extent of

[199] Sutter Subbasin GSP, Section 6.5.4.1, p. 434.
[200] Sutter Subbasin GSP, Table 6-2, pp. 435-436.
[201] Sutter Subbasin GSP, Section 6.5.4.4, pp. 439-441.
[202] Sutter Subbasin GSP, Section 6.5.4.2, p. 437.
[203] Sutter Subbasin GSP, Section 6.5.4.3, pp. 437-440.
[204] Sutter Subbasin GSP, Section 6.6.4, p. 463.
[205] Sutter Subbasin GSP, Table 6-6, pp. 465-466.

subsidence that substantially interferes with surface land uses and may lead to undesirable results.[206] Minimum thresholds for land subsidence shall be supported by 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 maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum thresholds and measurable objectives.[207]

The GSP describes that inelastic land subsidence has not been observed in the Subbasin historically and that potential causes of inelastic land subsidence would be significant increases in groundwater production. The GSP states that "[a]n undesirable result for land subsidence would be a result due to groundwater extraction that causes a significant reduction in the viability of the use of infrastructure for water distribution and flood control, including impacts to laterals from differential settlement that reduces the ability to deliver surface water supplies or inadequate freeboard on levee systems in wet years impacting conveyance of flood waters."[208]

The GSP states that "[u]ndesirable results are considered to occur when at least 25% of representative subsidence monitoring sites (6 out of 22 sites) exceed the minimum threshold for subsidence over the 5-year monitoring period."[209] Department staff note that this definition of land subsidence could result in localized occurrences of land subsidence that are not considered undesirable results and encourage the GSAs to provide more information regarding how the proposed criteria avoid significant and unreasonable conditions in the Subbasin. Department staff also note that identification of vulnerable water conveyance and flood control infrastructure may improve the GSAs' ability to avoid undesirable results during the planning and implementation horizon of the GSP.

The GSP states that the 22 representative subsidence monitoring sites are part of the Sacramento Valley Global Positioning System (GPS) Subsidence Monitoring Network and "is intended to be monitored on a 5-year timeframe."[210] The GSP states that the GSAs will rely on the Department to collect data in the future;[211] however, there is no commitment that this data will be collected on a routine basis. Given the GSAs' definition of undesirable results which allows a certain amount of subsidence over a 5-year period, measurements from the land subsidence monitoring network must be collected at a minimum of every 5-years to evaluate whether undesirable results are occurring in the Subbasin. If data is not collected at a minimum of every 5-years from the network, another

[206] 23 CCR § 354.28(c)(5).
[207] 23 CCR §§ 354.28(c)(5)(A-B).
[208] Sutter Subbasin GSP, Section 6.4.5.1, p. 419.
[209] Sutter Subbasin GSP, Section 6.4.5.2, pp. 419-420.
[210] Sutter Subbasin GSP, Section 6.4.5.2, pp. 419-420; Section 7.2.6.5.3, p. 624; Table 7-51, p. 621.
[211] Sutter Subbasin GSP, Section 7.2.6.5.4, p. 624.

method should likely be utilized to ensure undesirable results are not occurring within the Subbasin (see Recommended Corrective Action 5a).

The GSP states that InSAR data collected by NASA's Jet Propulsion Laboratory and published by DWR "will also be reviewed on an annual basis to ensure subsidence does not become a concern over the 5-year monitoring period."[212] However, it is not clear how the InSAR data will be incorporated into minimum threshold assessment. Department staff recommend the GSAs provide a description of how the InSAR data will be incorporated into identifying undesirable results for land subsidence (see Recommended Corrective Action 5b).

The GSP establishes the minimum threshold as "0.5 feet of subsidence over a 5-year period" at each survey monument site.[213] The GSP explains that water conveyance and levees become sensitive to land subsidence at this subsidence rate.

The GSP states that minimum thresholds are selected to avoid undesirable results for all beneficial uses and users of groundwater.[214] The GSP describes the potential impacts to the interests of beneficial uses and users of groundwater or land uses and property interests if minimum thresholds are exceeded. The impacts generally involve well repair or replacement, disturbance of gravity-fed water conveyance systems, and reduced ability to divert or convey flood water, and changes in streambed slope.

The GSP states land subsidence minimum thresholds do not cause undesirable results for other sustainability indicators and are selected to avoid causing undesirable results in adjacent subbasins.[215] The GSP describes minimum thresholds for subsidence in GSPs of adjacent subbasins. The Butte, North Yuba, and South Yuba Subbasins have similar minimum thresholds for subsidence as the Sutter Subbasin, while the Yolo and Colusa subbasins allow higher rates of subsidence as their minimum thresholds. The GSP states that the GSAs will coordinate with GSAs in the Yolo and Colusa Subbasins to ensure their minimum thresholds do not cause undesirable results in the Sutter Subbasin.

The GSP establishes the measurable objectives as "0.25 feet of subsidence per 5-year period at each site."[216] The GSP explains that this rate is comparable to the accuracy of the subsidence monitoring network (i.e., 0.17 feet). Interim milestones are set at the measurable objectives because inelastic land subsidence has not been observed historically.

Department staff note that the GSAs have not established what amount of subsidence would be considered "significant and unreasonable" in the Subbasin but conclude that the

[212] Sutter Subbasin GSP, Section 6.4.5.2, p. 420; Section 7.2.6.5.3, p. 624.
[213] Sutter Subbasin GSP, Section 6.5.5.1, pp. 441-442.
[214] Sutter Subbasin GSP, Section 6.5.5.1, pp. 441-442.
[215] Sutter Subbasin GSP, Sections 6.5.5.2-6.5.5.3, pp. 442-445.
[216] Sutter Subbasin GSP, Section 6.6.5, p. 467.

GSP's sustainable management criteria for subsidence are reasonable in light of the lack of currently observed land subsidence in the Subbasin.

The GSP's discussion of land subsidence is comprehensive and includes adequate support, justification, and information to understand the GSAs' process, analysis, and rationale. Although a recommend corrective action was identified, which requires the GSAs to provide more information about how an undesirable result will be detected, this does not preclude plan approval as it appears that the Subbasin has not experienced land subsidence based on information presented in the GSP. Department staff are aware of no significant inconsistencies or contrary information to that presented in the GSP and, therefore, have no significant concerns regarding the discussion of this subject in the GSP.

4.3.2.6 Depletions of Interconnected Surface Water

SGMA defines undesirable results for the depletion of interconnected surface water as those that have significant and unreasonable adverse impacts on beneficial uses of surface water and are caused by groundwater conditions occurring throughout the basin.[217] The GSP Regulations require that a Plan identify the presence of interconnected surface water systems in the basin and estimate the quantity and timing of depletions of those systems.[218] The GSP Regulations further require that minimum thresholds be set based on the rate or volume of surface water depletions caused by groundwater use, supported by information including the location, quantity, and timing of depletions, that adversely impact beneficial uses of the surface water and may lead to undesirable results.[219]

The Plan acknowledges the presence of interconnected surface waters in the Subbasin and identifies their locations by evaluating the differences in elevations between the groundwater and surface water at the stream node scale through modeling of historical conditions for the Sacramento and Feather Rivers and the Sutter Bypass.[220] Department staff are satisfied that the GSA has adopted a reasonable approach to identify the location of interconnected surface waters in the Basin.

The GSP does not quantify the rate or volume of surface water depletions due to groundwater pumping as required by the GSP Regulations.[221] Instead, the GSP proposes to use groundwater elevations as a proxy metric to manage depletions of interconnected surface water.[222] The GSP indicates that groundwater levels associated with gaining streams turning into losing streams are considered undesirable results. Department staff note the GSP does not demonstrate, with adequate evidence, that the use of groundwater

[217] Water Code § 10721(x)(6).
[218] 23 CCR § 354.16 (f).
[219] 23 CCR § 354.28 (c)(6).
[220] Sutter Subbasin GSP, Section 5.2.7, pp. 359-362.
[221] 23 CCR § 354.28 (c)(6).
[222] Sutter Subbasin GSP, Section 6.4.6.2, p. 421.

elevations as a proxy for depletions of interconnected surface water is sufficient to quantify the location, quantity, and timing of depletions.

The GSP states that "[t]he undesirable result for depletions of interconnected surface water is a result that causes significant and unreasonable adverse effects on beneficial uses and users of interconnected surface water within the Sutter Subbasin over the GSP planning and implementation horizon,"[223] and that "the adverse effects could potentially include reduced ability of surface water flows to meet instream flow requirements or to deliver surface water supplies to users in the Subbasin."[224] The GSP describes potentially impacted beneficial uses and users, including fisheries, riparian habitat, recreation, and agriculture. Department staff note that the GSP has not described the potential impacts of stream depletion on downstream beneficial uses and users of surface water, including water rights holders and environmental uses and users.

The GSP describes that undesirable results occur when "[g]roundwater elevations [drop] below the minimum threshold criteria at 25% of representative monitoring locations (6 out of 23 representative wells) concurrently over two consecutive seasonal high water level measurements resulting in a significant loss of aquifer contribution to the interconnected water course (if currently a gaining stream) and/or a reversal of stream connection from gaining to losing streams."[225]

Department staff generally understand that the GSP's definition of undesirable results emphasizes the long-term effects of Subbasin-wide groundwater level decline on interconnected surface waters, such as turning gaining streams into losing streams. However, the GSP has not explained how the GSAs decided the conditions of gaining streams becoming losing streams correspond to the significant and unreasonable effects, such as "reduced ability of surface water flows to meet instream flow requirements or to deliver surface water supplies to users in the Subbasin." Specifically, the GSP has not quantified stream depletions that are considered significant and unreasonable. Additionally, it is unclear whether the GSAs have considered the seasonality of stream depletion and determined that increased pumping and stream depletions in irrigation seasons (e.g., seasonal low water levels) during Plan implementation do not cause significant and unreasonable adverse effects. Department staff recommend the GSAs present justification for its criteria of when and where undesirable results occur for depletions of interconnected surface water (see Recommended Corrective Action 6a).

The minimum thresholds for interconnected surface water were established using the same methodology as for the chronic lowering of groundwater levels (see Section 4.3.2.1).[226] The minimum thresholds are set as the deepest of (1) historical low, (2) "90% of the average groundwater elevation from the projected water budget (baseline condition over 60-year period using C2VSimFG-Sutter) at each representative monitoring site with

[223] Sutter Subbasin GSP, Section 6.4.6.1, p. 420.
[224] Sutter Subbasin GSP, Section 6.4.6.4, p. 421.
[225] Sutter Subbasin GSP, Section 6.4.6.2, p. 421.
[226] Sutter Subbasin GSP, Section 6.5.6.1, p. 446.

an artificial increase in evapotranspiration (ET) of 50%," or (3) water level corresponding to an average operating range of 8.0 feet for the AZ and AZ-1 zones, and 16.5 feet for the AZ-2 and AZ-3 zones.[227] As noted in the GSP, minimum thresholds will be modified during Plan implementation if it is determined that applying the minimum operating range will lead to a reversal of stream connection from gaining to losing streams.[228] As discussed in Section 4.3.2.1, Department staff recommend the GSAs provide clarification related to the methodology of the second criterion.

The GSP describes the impacts of minimum thresholds on beneficial uses and users of groundwater, including environmental uses and users. The GSP states that "[i]f an undesirable result for depletions of interconnected surface water is observed and presently gaining streams become losing streams, this reversal of stream interconnection would affect aquatic systems and potentially GDEs. Overall water supply utilized by environmental beneficial users of water would be reduced, thereby reducing suitable habitat through reduced stream depth, flow velocity, cover, and dissolved oxygen as well as increased temperature."[229] However, while the minimum thresholds are associated with gaining streams turning into losing streams, the GSP has not provided justification that stream conditions at the groundwater level minimum thresholds, before gaining streams become losing (i.e., the second criterion), will avoid significant and unreasonable adverse impacts on surface water uses and users. As discussed in Section 4.3.2.1, Department staff recommend the GSAs provide estimates of correlated stream depletion and present justification why the impacts are not considered significant and unreasonable.

The GSP describes the potential impact of minimum thresholds on other sustainability indicators and adjacent subbasins. The GSAs anticipate the minimum thresholds will not prevent neighboring subbasins from achieving their sustainability goals and explain that the minimum thresholds are comparable to those of the adjacent subbasins, and the Sacramento and Feather rivers serve as "regulating reservoirs" to maintain groundwater levels in the region. Department staff note that the GSAs have not provided depletion estimates at minimum thresholds or discussed how depletions may impact water quality or water availability for water rights holders and environmental users.

The measurable objectives and interim milestones were also set the same as those for chronic lowering of groundwater levels, at the average groundwater level of the available historical records at each representative monitoring site.[230] The GSP explains that maintaining current, sustainable conditions will avoid undesirable results. Department staff note that depletions at the measurable objectives will be generally higher than historical depletions because the measurable objectives are defined with seasonal high groundwater level measurements.

[227] Sutter Subbasin GSP, Section 6.5.6.1, p. 446.
[228] Sutter Subbasin GSP, Section 6.5.6.1, p. 451.
[229] Sutter Subbasin GSP, Section 6.5.6.4, p. 456.
[230] Sutter Subbasin GSP, Section 6.5.1.1, p. 427.

Department staff understand that quantifying depletions of surface water from groundwater extractions is a complex task that likely requires developing new, specialized tools, models, and methods to understand local hydrogeologic conditions, interactions, and responses. During the initial review of GSPs, Department staff have observed that most GSAs have struggled with this new requirement of SGMA. However, staff believe that most GSAs will more fully comply with regulatory requirements after several years of Plan implementation that includes projects and management actions to address the data gaps and other issues necessary to understand, quantify, and manage depletions of interconnected surface waters. Accordingly, Department staff believes that affording GSAs adequate time to refine their Plans to address interconnected surface waters is appropriate and remains consistent with SGMA's timelines and local control preferences.

The Department will continue to support GSAs in this regard by providing, as appropriate, financial and technical assistance to GSAs, including the development of guidance describing appropriate methods and approaches to evaluate the rate, timing, and volume of depletions of interconnected surface water caused by groundwater extractions. Once the Department's guidance related to depletions of interconnected surface water is publicly available, the GSA, where applicable, should consider incorporating appropriate guidance approaches into their future periodic updates to the GSP (see Recommended Corrective Action 6b). GSAs should consider availing themselves of the Department's financial or technical assistance, but in any event must continue to fill data gaps, collect additional monitoring data, and implement strategies to better understand and manage depletions of interconnected surface water caused by groundwater extractions and define segments of interconnectivity and timing within their jurisdictional area (see Recommended Corrective Action 6c). Furthermore, GSAs should coordinate with local, state, and federal resources agencies as well as interested parties to better understand the full suite of beneficial uses and users that may be impacted by pumping induced surface water depletion (see Recommended Corrective Action 6d).

4.4 Monitoring Network

The GSP Regulations describe the monitoring network that must be developed for each sustainability indicator including monitoring objectives, monitoring protocols, and data reporting requirements. Collecting monitoring data of a sufficient quality and quantity is necessary for the successful implementation of a groundwater sustainability plan. The GSP Regulations require a monitoring network of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.[231] Specifically, a monitoring network must be able to monitor impacts to beneficial uses and users,[232] monitor changes in groundwater conditions relative to measurable objectives

[231] 23 CCR § 354.32.
[232] 23 CCR § 354.34(b)(2).

and minimum thresholds,[233] capture seasonal low and high conditions,[234] include required information such as location and well construction and include maps and tables clearly showing the monitoring site type, location, and frequency.[235] Department staff encourage GSAs to collect monitoring data as specified in the GSP, follow SGMA data and reporting standards,[236] fill data gaps identified in the GSP prior to the first periodic evaluation,[237] update monitoring network information as needed, follow monitoring best management practices,[238] and submit all monitoring data to the Department's Monitoring Network Module immediately after collection including any additional groundwater monitoring data that is collected within the Plan area that is used for groundwater management decisions. Department staff note that if GSAs do not fill their identified data gaps, the GSA's basin understanding may not represent the best available science for use to monitor basin conditions.

The GSP has identified 62 monitoring wells within the principal aquifer of Subbasin to include in the groundwater level monitoring network.[239] The entire groundwater level monitoring network will be used as representative monitoring points in the Subbasin, according to the GSP. However, there are a total of 59 wells uploaded to DWR's SGMA Portal Monitoring Network Module (MNM) which identifies only 56 wells as being representative monitoring points. The Department's review of the groundwater level monitoring network is based on information provided in the MNM rather than the information provided in the GSP.

The GSP proposes to use the groundwater level monitoring network as a proxy for the groundwater storage monitoring network because changes in groundwater storage are directly dependent on changes in groundwater levels.[240]

The GSP identifies 28 representative wells in its degraded water quality monitoring network.[241] The GSP lists several active groundwater quality monitoring programs within the Subbasin which include the Irrigated Lands Regulatory Program (ILRP), Groundwater Ambient Monitoring and Assessment Program (GAMA), and others.[242] The GSP identifies TDS and nitrate as [nitrogen] as the constituents of concern for the Subbasin[243] and that all wells will be sampled annually during the month of September.[244]

The GSP proposes a dedicated land subsidence monitoring network using 22 monuments from the Department's Sacramento Valley Subsidence Network (SVSN) and

[233] 23 CCR § 354.34(b)(3).
[234] 23 CCR § 354.34(c)(1)(B).
[235] 23 CCR §§ 354.34(g-h).
[236] 23 CCR § 352.4 *et seq*.
[237] 23 CCR § 354.38(d).
[238] Department of Water Resources, 2016, Best Management Practices and Guidance Documents.
[239] Sutter Subbasin GSP, Table 7-48, pp. 595-596.
[240] Sutter Subbasin GSP, Section 6.4.2, pp. 416-417; Section 6.5.2, p. 433; Section 7.2.6.2, p. 606.
[241] Sutter Subbasin GSP, Table 7-50, p. 607.
[242] Sutter Subbasin GSP, Section 2.3.3.1, pp. 126-132.
[243] Sutter Subbasin GSP, Table 7-50, p. 607.
[244] Sutter Subbasin GSP, Section 7.2.6.4.3, p. 614.

Interferometric Synthetic Aperture Radar (InSAR) satellite data.[245] As discussed in Section 4.3.2.5, the GSAs should evaluate the reliability and frequency of the SVSN and explain how InSAR data will be used.

The GSP proposes to use a combination of stream gauges and a subset of wells from the groundwater level monitoring network as a proxy for the depletions of interconnected surface water monitoring network.[246] This network consists of 30 stream gauges and 23 wells; of the 23 wells, 15 are shared with the chronic lowering of groundwater levels monitoring network and 8 are unique to the depletions of interconnected surface water monitoring network.[247] All sites are considered representative monitoring sites for this network.[248] Of the 30 stream gauges, 27 will be monitored every 15 minutes and 3 will be monitored hourly.[249] The GSP states that the wells will be monitored at least semi-annually, following the same monitoring schedule as wells in the chronic lowering of groundwater levels monitoring network.[250]

While the GSP does provide tables and includes maps identifying the location of the representative monitoring sites for the chronic lowering of groundwater levels and depletions of interconnected surface water monitoring networks, Department staff have determined additional information should be provided in the GSP regarding the monitoring network for these sustainability indicators. The GSP did not report, in tabular format, the measurement frequency for groundwater elevation measurements within the chronic lowering of groundwater levels and depletions of interconnected surface water monitoring networks as required by the GSP Regulations.[251] Providing this information will provide the Department additional clarity on how the Subbasin will comply with the requirements of the GSP Regulations and SGMA (see Recommended Corrective Action 7).

Despite the recommended corrective action for additional information, the description of the monitoring network included in the Plan substantially complies with the requirements outlined in the GSP Regulations at this time. Overall, the monitoring network is supported by the best available information and data and is designed to ensure adequate coverage of sustainability indicators.

4.5 Projects and Management Actions

The GSP Regulations require a description of the projects and management actions the submitting Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the

[245] Sutter Subbasin GSP, Section 7.2.6.5, pp. 619 and 624; Table 7-51, p. 621; Figure 7-12, p. 623.
[246] Sutter Subbasin GSP, Section 7.2.6.6, pp. 626-627; Tables 7-52 and 7-53, pp. 629-630; Figures 7-13 through 7-16, pp. 631-634.
[247] Sutter Subbasin GSP, Tables 7-48, 7-52, 7-53, pp. 595, 629-630.
[248] Sutter Subbasin GSP, Section 7.2.3, p. 586.
[249] Sutter Subbasin GSP, Table 7-53, p. 630.
[250] Sutter Subbasin GSP, Section 7.2.6.1.3, pp. 601-602; Section 7.2.6.6.3, p. 635.
[251] 23 CCR § 354.34 (h).

basin.[252] Each Plan's description of projects and management actions must include details such as: how projects and management actions in the GSP will achieve sustainability, the implementation process and expected benefits, and prioritization and criteria used to initiate projects and management actions.[253]

The Plan states that the Sutter Subbasin is expected to achieve its sustainability goal by 2042 and maintain sustainability through 2072 even without projects and management actions.[254] The GSAs plan to maintain sustainability through an adaptive management strategy, implementing projects and management actions as needed to ensure undesirable results do not occur. The GSAs also propose to address data gaps to improve the understanding of groundwater conditions and inform adaptive management of the Subbasin.

The GSP groups projects and management actions into three categories based on their status and purpose.[255] Category 1 includes six ongoing and planned projects and management actions that are intended to help the Subbasin achieve the sustainability goal, meet interim milestones and measurable objectives, and avoid minimum threshold exceedances.[256] These projects and management actions focus on improved water management, in-lieu or direct recharge, and improved shallow groundwater monitoring. Category 2 comprises 17 other projects and management actions that will be implemented as needed to support sustainability and adapt to changing conditions when measurable objectives cannot be maintained, or minimum thresholds are exceeded.[257] Category 3 contains 16 potential projects and management actions that address data gaps and will be implemented on an as-needed basis.[258] Department staff recommend the GSAs prioritize projects and management actions that address the identified data gaps and specify when they will be initiated.

The GSP includes a table that summarizes these projects and management actions into eight general types and depicts whether each type would directly benefit each of the applicable sustainability indicators.[259] Projects and management actions related to improved water management, in-lieu or direct recharge, and groundwater demand reduction are expected to directly improve conditions of groundwater levels, groundwater storage, and interconnected surface water depletion. Projects and management actions specifically scoped for water quality enhancement are also included.

The Plan adequately describes proposed projects and management actions in a manner that is generally consistent and substantially complies with the GSP Regulations. The adaptive management approach and the projects and management actions, which focus

[252] 23 CCR § 354.44 (a).
[253] 23 CCR § 354.44 (b) *et seq.*
[254] Sutter Subbasin GSP, Section 7.1.2, pp. 477-479.
[255] Sutter Subbasin GSP, Section 7.1.3, pp. 479-481; Table 7-2, pp. 483-491.
[256] Sutter Subbasin GSP, Section 7.1.4, pp. 495-535.
[257] Sutter Subbasin GSP, Section 7.1.5, pp. 535-553.
[258] Sutter Subbasin GSP, Section 7.1.6, pp. 553-575.
[259] Sutter Subbasin GSP, Table 7-3, pp. 492-493.

largely on supply augmentation and conservation, present a generally feasible approach to achieve the Subbasin's sustainability goals. As projects and management actions are implemented, the Department expects that progress be included in annual reports and any addition or removal of project and management actions be documented in periodic updates.

4.6 Consideration of Adjacent Basins/Subbasins

SGMA requires the Department to "…evaluate whether a groundwater sustainability plan adversely affects the ability of an adjacent basin to implement their groundwater sustainability plan or impedes achievement of sustainability goals in an adjacent basin."[260] Furthermore, the GSP Regulations state that minimum thresholds defined in each GSP be designed to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.[261]

The Sutter Subbasin has seven adjacent subbasins - Butte, Colusa, North American, North Yuba, South Yuba, Wyandotte Creek, and Yolo.[262] Each of them is required to be managed under a GSP.

The GSP describes that the Sutter Subbasin's minimum thresholds and measurable objectives were developed in a coordinated way with the adjacent subbasins by reviewing their respective sustainable management criteria chapters and through discussions with consulting staff in the Sacramento Valley.[263] The GSP describes how the Sutter Subbasin GSAs determined that conditions at minimum thresholds would avoid causing undesirable results for adjacent subbasins or affecting the ability of adjacent subbasins to achieve their sustainability goals.[264] The GSP explains that the Subbasin's minimum thresholds are generally comparable to those of the adjacent subbasins'. The GSP also states that "[t]he Sutter Subbasin GSAs will continue to coordinate with adjacent subbasins regarding [Sustainable Management Criteria] and related monitoring and ensure that subbasin management activities do not cause undesirable results in either the Sutter Subbasin or for adjacent subbasins."[265]

Based on information available, Department staff have no reason to believe that groundwater management under the Plan in the Sutter Basin will adversely affect the ability of local agencies in the adjacent basins at this time. Department staff will review this issue during periodic updates to the Plan.

[260] Water Code § 10733(c).
[261] 23 CCR § 354.28(b)(3).
[262] Sutter Subbasin GSP, Table 4-1, p. 165.
[263] Sutter Subbasin GSP, Section 6.3, p. 414.
[264] Sutter Subbasin GSP, Section 6.5.1.3, pp. 428-430; Section 6.5.4.3, pp. 437-440; Section 6.5.5.3, pp. 443-445; Section 6.5.6.3, pp. 452-455.
[265] Sutter Subbasin GSP, Sections 6, p. 411.

4.7 Consideration of Climate Change and Future Conditions

The GSP Regulations require a GSA to consider future conditions and project how future water use may change due to multiple factors including climate change.[266]

Since the GSP was adopted and submitted, climate change conditions have advanced faster and more dramatically. It is anticipated that the hotter, drier conditions will result in a loss of 10% of California's water supply. As California adapts to a hotter, drier climate, GSAs should be preparing for these changing conditions as they work to sustainably manage groundwater within their jurisdictional areas. Specifically, the Department encourages GSAs to:

1. Explore how their proposed groundwater level thresholds have been established in consideration of groundwater level conditions in the basin based on current and future drought conditions.
2. Explore how groundwater level data from the existing monitoring network will be used to make progress towards sustainable management of the basin given increasing aridification and effects of climate change, such as prolonged drought.
3. Take into consideration changes to surface water reliability and that impact on groundwater conditions.
4. Evaluate updated watershed studies that may modify assumed frequency and magnitude of recharge projects, if applicable, and
5. Continually coordinate with the appropriate groundwater users, including but not limited to domestic well owners and state small water systems, and the appropriate overlying county jurisdictions developing drought plans and establishing local drought task forces to evaluate how their Plan's groundwater management strategy aligns with drought planning, response, and mitigation efforts within the basin.

[266] 23 CCR § 354.18.

5 STAFF RECOMMENDATION

Department staff recommend approval of the GSP with the recommended corrective actions listed below. The Sutter Subbasin GSP conforms with Water Code Sections 10727.2 and 10727.4 of SGMA and substantially complies with the GSP Regulations. Implementation of the GSP will likely achieve the sustainability goal for the Sutter Subbasin. The GSAs have identified several areas for improvement of their Plan and Department staff concur that those items are important and should be addressed as soon as possible. Department staff have also identified additional recommended corrective actions that should be considered by the GSAs for the first periodic assessment of the GSP. Addressing these recommended corrective actions will be important to demonstrate that implementation of the Plan is likely to achieve the sustainability goal.

The recommended corrective actions include:

RECOMMENDED CORRECTIVE ACTION 1

Provide clarification regarding the various zones of the principal aquifer system, geologic formations comprising the principal aquifer, and the vertical extent of the Subbasin. Consistent descriptions and naming of the aquifer zones should be present throughout the GSP, including in the hydrogeologic conceptual model and the monitoring network.

RECOMMENDED CORRECTIVE ACTION 2

Provide further information and justification related to the increases in net subsurface inflows from adjacent subbasins in the projected water budgets and the sustainable yield estimation.

RECOMMENDED CORRECTIVE ACTION 3

Revise the sustainable management criteria for the chronic lowering of groundwater levels as follows:

a. Revise the sustainable management criteria to be based on seasonal low groundwater levels to ensure potential impacts to beneficial uses and users are considered.

b. Provide clarification and detailed information related to the methodology of the second criterion for minimum thresholds (i.e., associated with the projected water budget simulation with a 50 percent increase in ET). Clearly describe the processes and terms involved, and the spatial and temporal aggregations that define “interconnected streams that are gaining become losing.”

c. Provide more information about how the proposed minimum thresholds for the chronic lowering of groundwater levels may impact beneficial uses and users. Specifically, consider the impact of the selected minimum threshold levels on

supply wells. The consideration should identify the degree/extent of potential impact including the percentage, number, and location of potentially impacted wells at the proposed minimum thresholds for chronic lowering of groundwater levels.

d. Reevaluate how groundwater level minimum thresholds may impact land subsidence.

e. Provide estimates of stream depletions when groundwater levels are at the minimum thresholds and evaluate the potential impacts to beneficial uses and users of interconnected surface water.

RECOMMENDED CORRECTIVE ACTION 4

Revise the sustainable management criteria for degraded water quality to use water quality monitoring data collected in all water year types including drought years.

RECOMMENDED CORRECTIVE ACTION 5

Revise the sustainable management criteria for land subsidence as follows:

a. Describe how undesirable results will be evaluated since it is unclear at what frequency data will be collected from the Sacramento Valley GPS Subsidence Monitoring Network. If data is not collected at a minimum of every 5-years from the network, another method should be utilized to ensure undesirable results are not occurring within the Subbasin.

b. Provide a description of how the InSAR data will be incorporated into identifying undesirable results for land subsidence.

RECOMMENDED CORRECTIVE ACTION 6

Department staff understand that estimating the location, quantity, and timing of stream depletion due to ongoing, Subbasin-wide pumping is a complex task and that developing suitable tools may take additional time; however, it is critical for the Department's ongoing and future evaluations of whether GSP implementation is on track to achieve sustainable groundwater management. The Department plans to provide guidance on methods and approaches to evaluate the rate, timing, and volume of depletions of interconnected surface water and support for establishing specific sustainable management criteria in the near future. This guidance is intended to assist GSAs to sustainably manage depletions of interconnected surface water.

In addition, the GSA should work to address the following items by the first periodic update:

a. Provide justification for the criteria of when and where undesirable results occur. Explain how the GSAs have determined that significant and unreasonable effects

will not occur before gaining streams become losing, and how the GSAs have considered the seasonality of stream depletions.

b. Consider utilizing the interconnected surface water guidance, as appropriate, when issued by the Department to establish quantifiable minimum thresholds, measurable objectives, and management actions.

c. Continue to fill data gaps, collect additional monitoring data, and implement the current strategy to manage depletions of interconnected surface water and define segments of interconnectivity and timing.

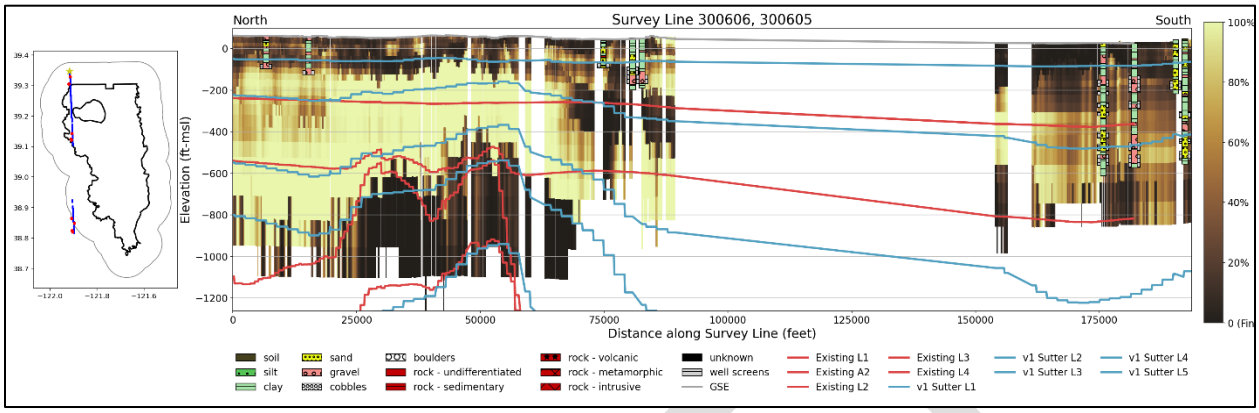
d. Prioritize collaborating and coordinating with local, state, and federal regulatory agencies as well as interested parties to better understand the full suite of beneficial uses and users that may be impacted by pumping induced surface water depletion within the GSA's jurisdictional area.

RECOMMENDED CORRECTIVE ACTION 7

Define the data collection frequency in tabular format for groundwater monitoring sites within the chronic lowering of groundwater levels and depletions of interconnected surface water monitoring networks in the GSP.

ATTACHMENT 2 – AEM Profiles

DRAFT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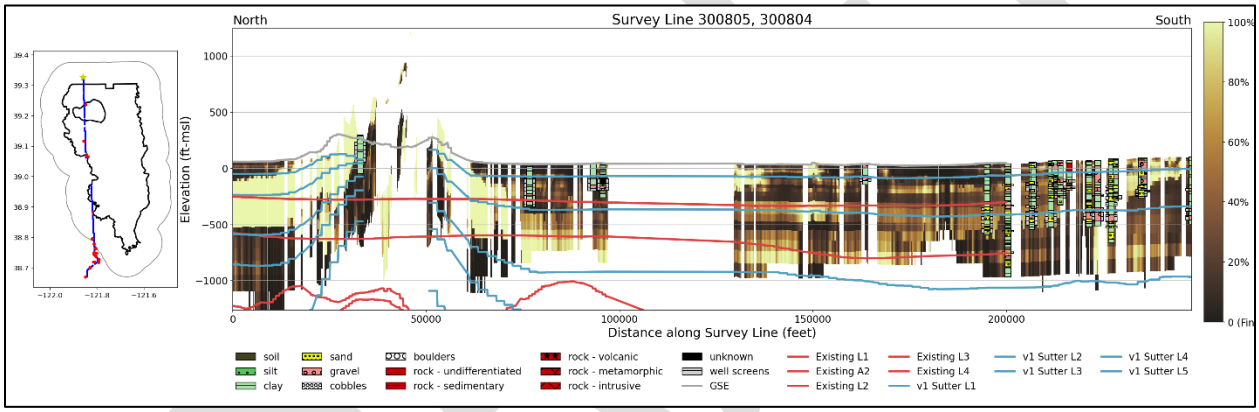
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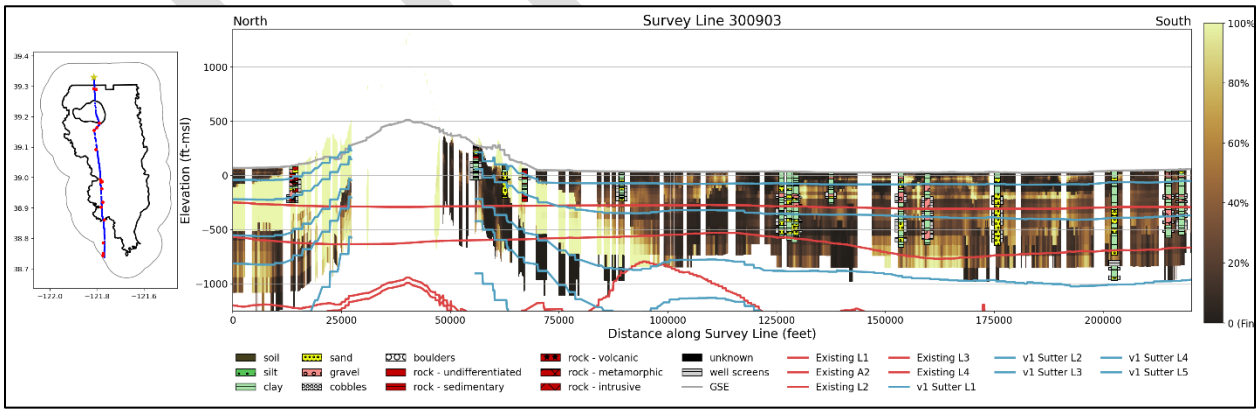
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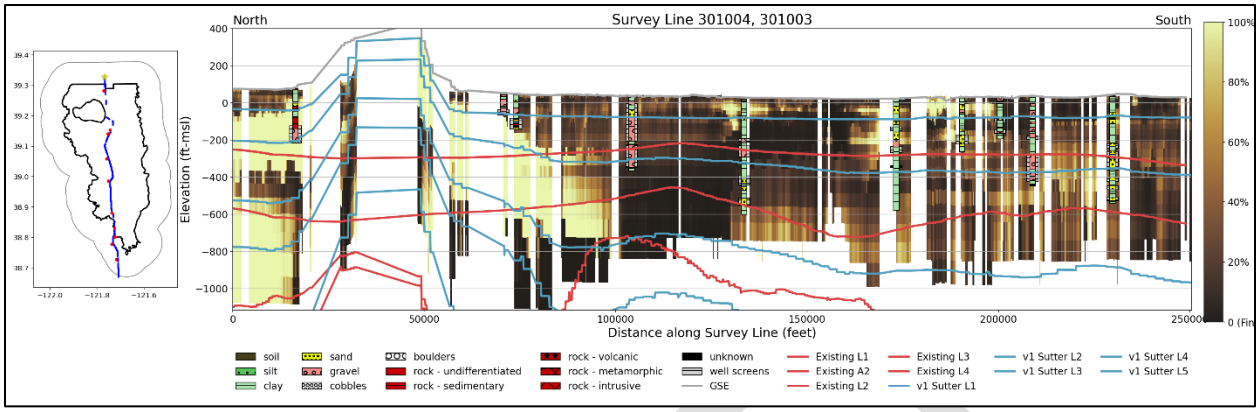
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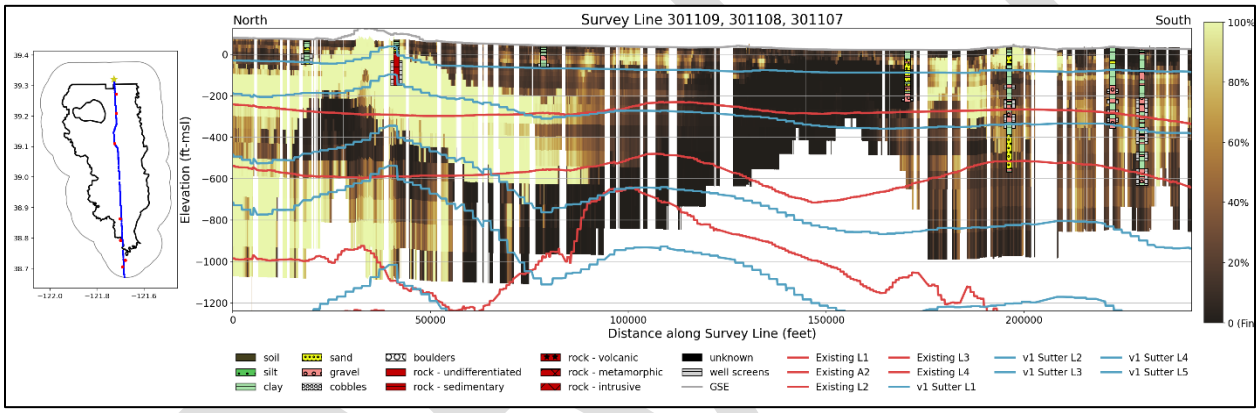
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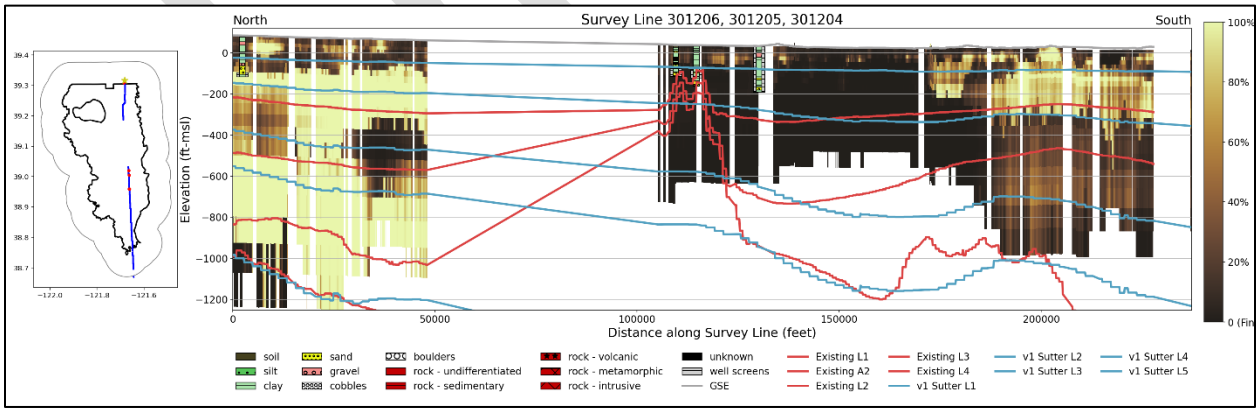
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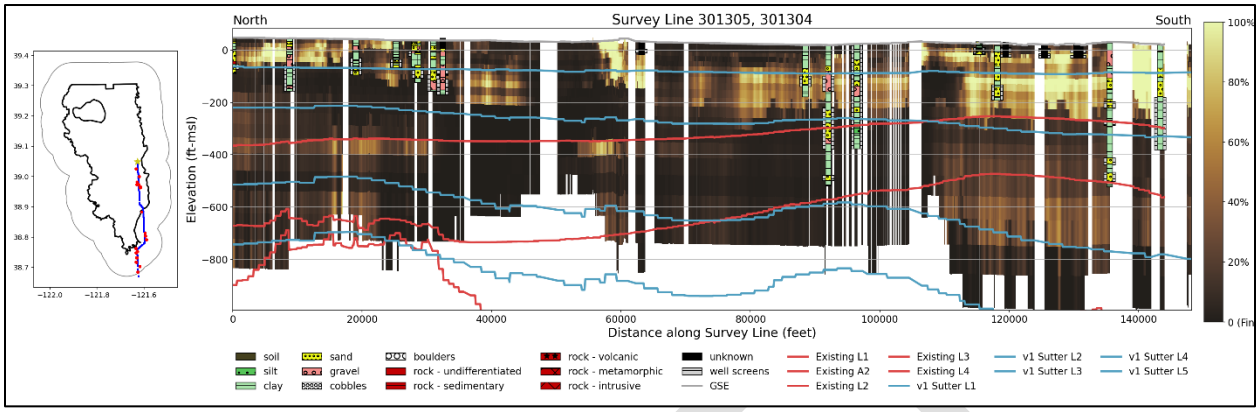
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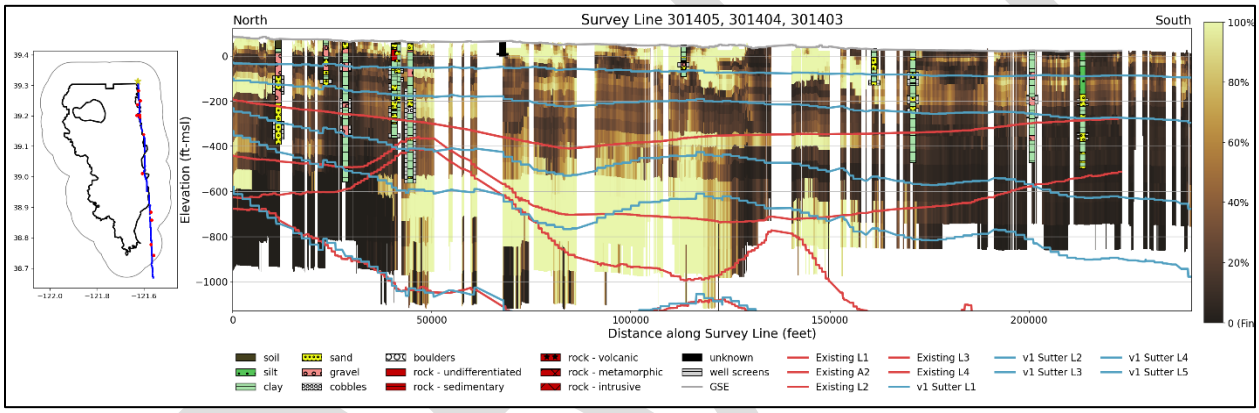
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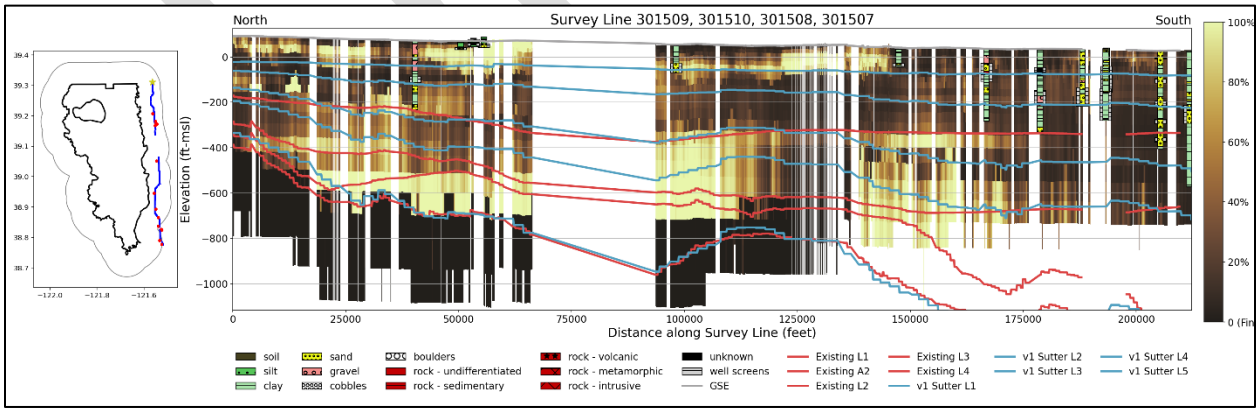
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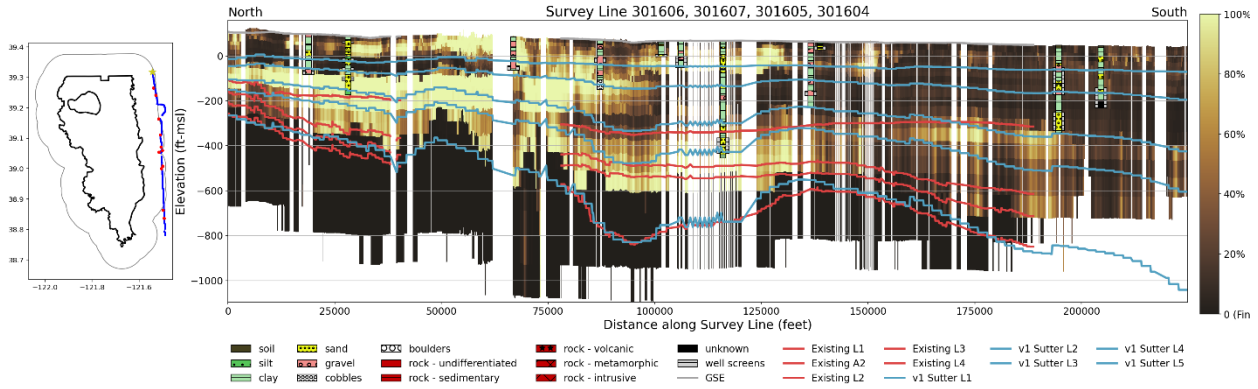
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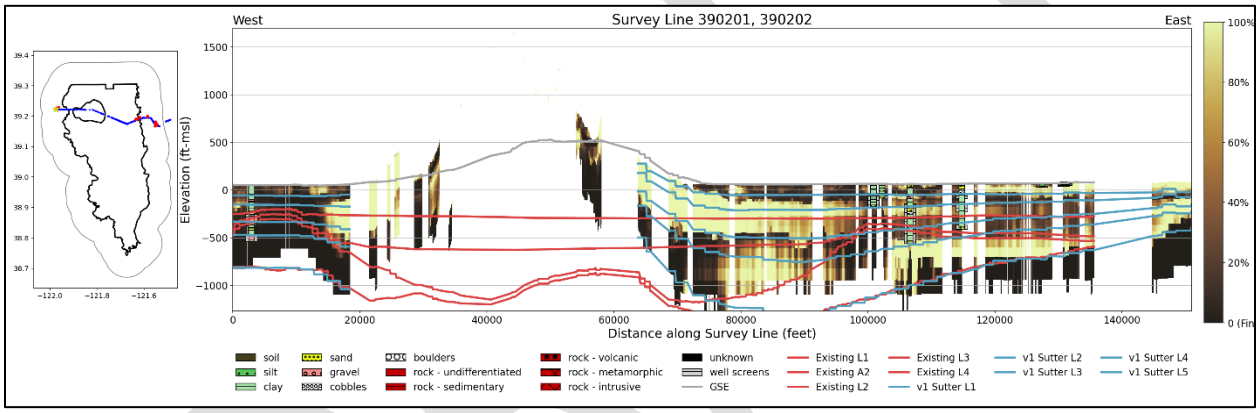
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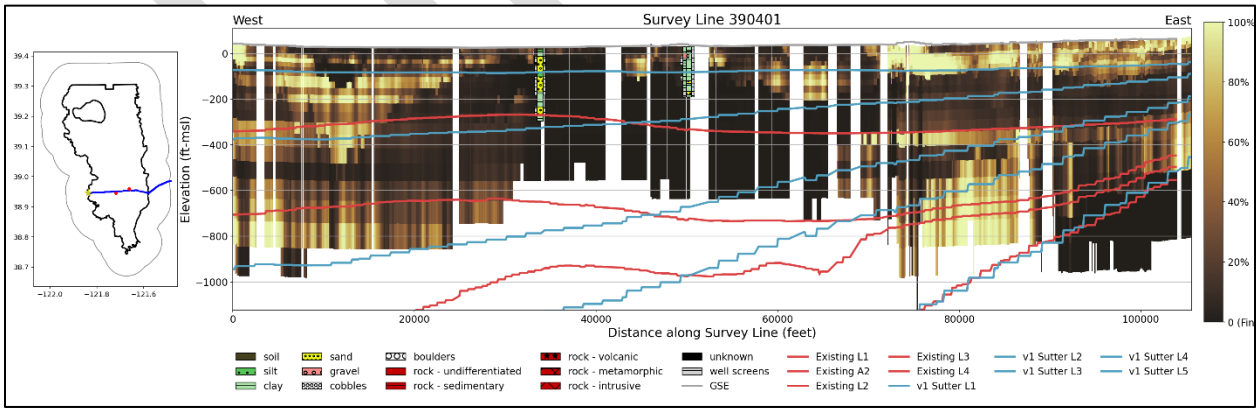
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rock - sedimentary
rock - volcanic
rock - metamorphic
rock - intrusive
unknown
well screens
GSE
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Existing A2
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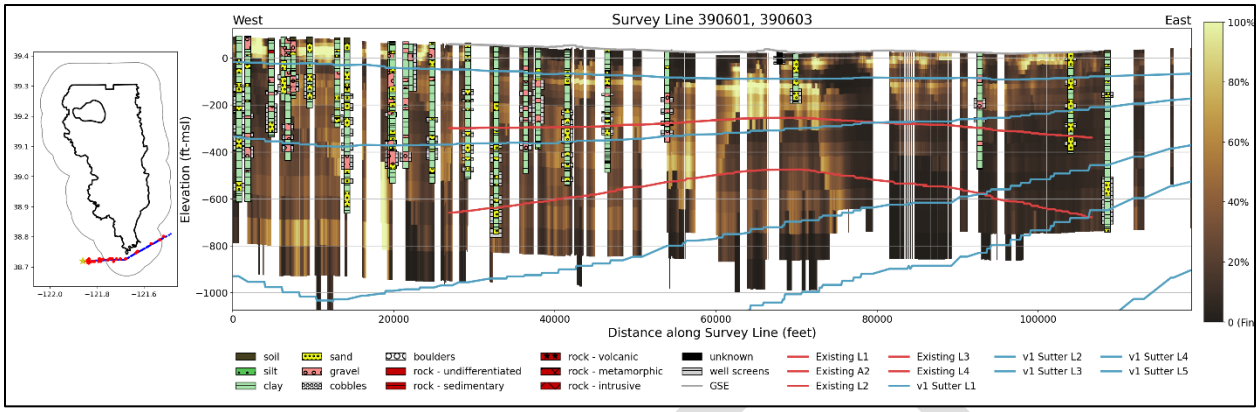
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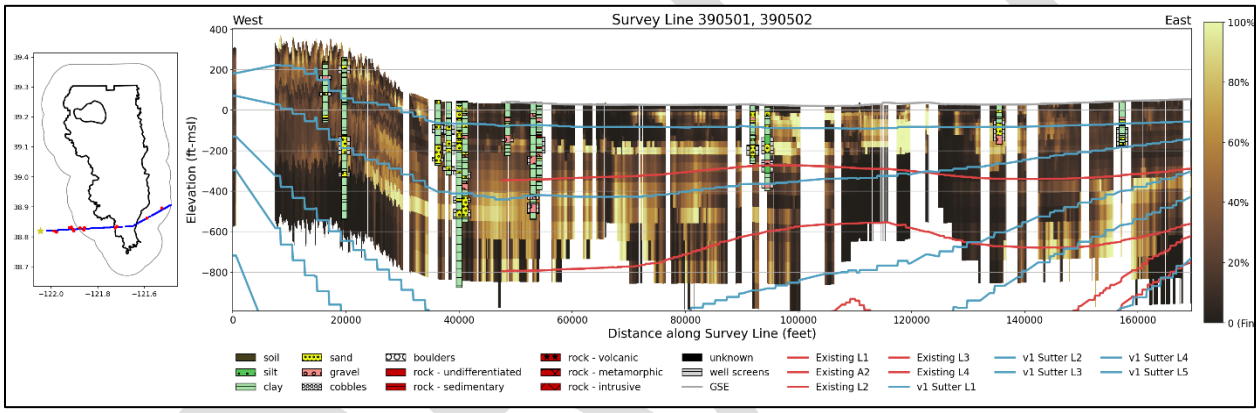
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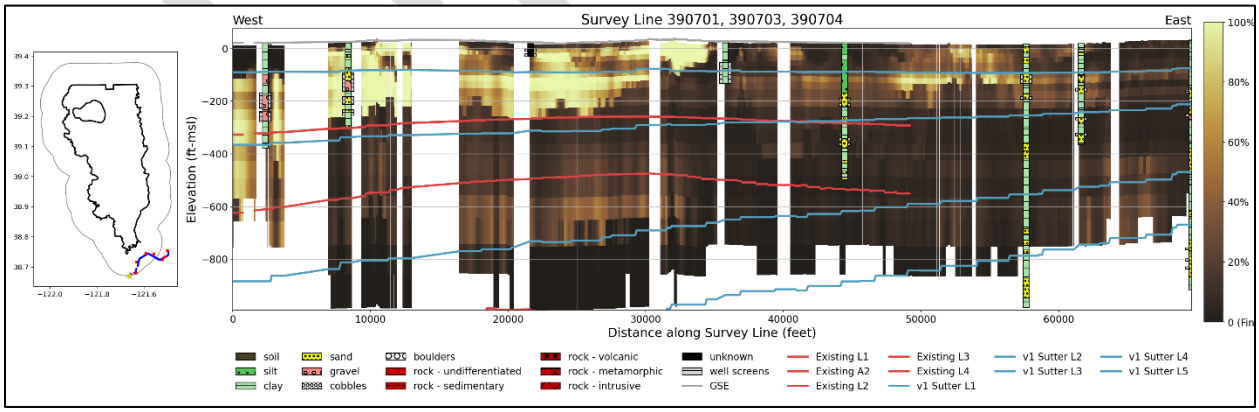
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ATTACHMENT 3 – Beneficial Uses and Users Analysis for Chronic Lowering of Groundwater Levels

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TECHNICAL MEMORANDUM

TO:	Guadalupe Rivera, on behalf of the Sutter Subbasin
CC:	Sutter Subbasin Groundwater Sustainability Agencies
PREPARED BY:	Emily Honn and Leah Makler, Woodard & Curran
REVIEWED BY:	Leslie Dumas, Woodard & Curran
DATE:	October 16, 2026
RE:	Beneficial Uses and Users Analysis For Chronic Lowering of Groundwater Levels – Response to DWR Recommended Corrective Action No. 3c

The California Department of Water Resources' (DWR's) Recommended Corrective Action (RCA) No. 3 includes several recommendations regarding the basis for Sutter Subbasin's sustainable management criteria (SMC) for the chronic lowering of groundwater levels sustainability indicator. Specifically, RCA No. 3c states:

> *Provide more information about how the proposed minimum thresholds for the chronic lowering of groundwater levels may impact beneficial uses and users. Specifically, consider the impact of the selected minimum threshold levels on supply wells. The consideration should identify the degree/extent of potential impact including the percentage, number, and location of potentially impacted wells at the proposed minimum thresholds for chronic lowering of groundwater levels.*

This technical memorandum (TM) responds specifically to RCA No. 3c. This analysis provides a Subbasin-scale evaluation of the potential impacts of the established groundwater level SMC on beneficial uses and users of groundwater as part of the 2027 GSP Amendment. The beneficial uses and users considered in this analysis are the following:

- Domestic Wells
- Public Water Systems and Community Water Systems
- Groundwater Dependent Ecosystems (GDEs)

The 2022 GSP included a similar assessment of impacts on domestic wells, included in Appendix 6-B of the document. This analysis revises and expands that work to include the additional beneficial users listed above. Additionally, to assess the sensitivity of the results, the updated well and potential GDE impact analyses were also evaluated under a range in the number of wells at their minimum threshold.

Since the publication of the 2022 GSP, minor changes have been made to the chronic lowering of groundwater levels representative monitoring network (RMN) and SMC, as described in the 2027 Periodic Evaluation, broader RCA No. 3 TM, and the 2027 GSP Amendment.

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The undesirable result for the chronic lowering of groundwater levels sustainability criterion is defined in the 2027 GSP Amendment as at least 25% of representative monitoring wells (RMW) reaching their minimum threshold (MT) over two consecutive seasonal low groundwater level measurements.

As defined by the 2027 GSP Amendment, each RMW's MT is determined as the deeper of the following criteria:

1. The historic low for the available record
2. The average operating range (difference between measurable objective [MO] and MT) for all representative monitoring sites using the above criterion for the following aquifer zones (AZs), applied based on available screen interval or well depth information for each RMW:
    a. Shallow AZ and AZ-1 = 8.0 feet
    b. AZ-2 and AZ-3 = 16.5 feet

1. Well Impacts Analysis

a. Methods

An inventory of all wells within the Sutter Subbasin was compiled by their use, type, and depth using the DWR Online System for Well Completion Reports (OSWCR) database (California Department of Water Resources, 2026a). This list was then filtered by the following attributes:

- Active status;
- Known coordinates;[1]
- Known depths; and
- Construction dates during or after 1976 (a production well's usable lifespan is assumed to be approximately 50 years).

The remaining wells were then sorted into each of the following type categories:

- Domestic Wells
- Public Supply Wells
- Public Supply Wells that are within a Community Water System (CWS)

[1] In the OSWCR database, wells lacking precise location data are assigned the centroid coordinates of their associated PLSS section. Including these wells may have resulted in inaccurate impact assessments if assigned to the incorrect Impact Zone.

State small water systems (SSWS) are defined as systems that serve 5 to 14 service connections and do not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year (California State Water Resources Control Board, 2021). A public water system is classified as a community water system (CWS) when it serves at least 25 permanent residents or 15 service connections for the majority of a calendar year (United States Environmental Protection Agency, 2026). SSWS have fewer connections and serve fewer permanent residents than CWS. However, since the location and depth of production wells within SSWS are not readily available, this analysis conservatively assesses the impacts to wells within CWS service areas in the Subbasin. It is assumed that impacts on CWS would be correlated with impacts on SSWS.

To capture wells that may be impacted by declines in groundwater levels at RMWs, an "Impact Zone" was delineated by a 3-mile radius around each well. **Figure 1** displays the Subbasin's 52 RMWs from the 2027 GSP Amendment and their Impact Zones. Well IDs for multi-completion wells whose impact zones overlap are highlighted in yellow and indicated by "#" to represent all depth intervals present. **Table 1** summarizes the RMN for groundwater levels and displays each RMW's Impact Zone number and MT.

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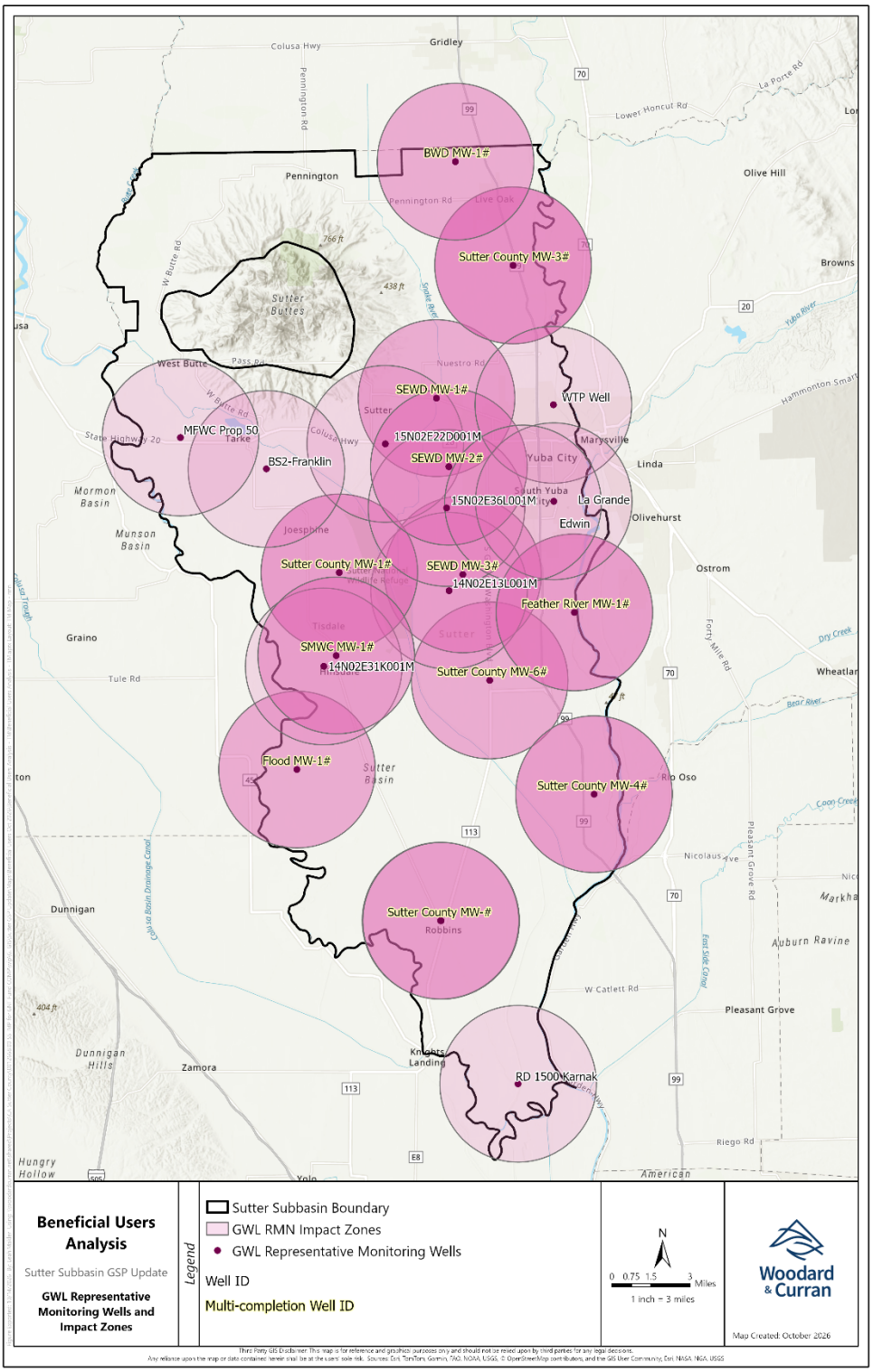

FIGURE 1: SUTTER SUBBASIN GROUNDWATER LEVEL REPRESENTATIVE MONITORING NETWORK AND IMPACT ZONES

TABLE 1: MINIMUM THRESHOLDS AT REPRESENTATIVE MONITORING WELLS

Impact Zone #	State Well Number	Well ID	Minimum Thresholds (feet AMSL, NAVD88)
1	11N03E20H003M	RD 1500 Karnak	10.51
2	12N02E23H001M	Sutter County MW-2A	7.58
3	12N02E23H002M	Sutter County MW-2B	-0.08
4	12N02E23H003M	Sutter County MW-2C	-0.12
5	12N02E23H004M	Sutter County MW-2D	-0.41
6	13N01E24G002M	Flood MW-1A (deep)	7.20
7	13N01E24G003M	Flood MW-1B (int)	-7.90
8	13N01E24G004M	Flood MW-1C	13.00
9	13N03E06A001M	Sutter County MW-6A	21.13
10	13N03E06A002M	Sutter County MW-6B	10.21
11	13N03E06A003M	Sutter County MW-6C	9.91
12	13N03E26J002M	Sutter County MW-4A	5.09
13	13N03E26J003M	Sutter County MW-4B	4.12
14	13N03E26J004M	Sutter County MW-4C	2.82
15	13N03E26J005M	Sutter County MW-4D	0.34
16	14N02E13A003M	SEWD MW-3A	37.37
17	14N02E13A004M	SEWD MW-3B	21.16
18	14N02E13A005M	SEWD MW-3C	18.52
19	14N02E13L001M	-	15.93
20	14N02E17C001M	Sutter County MW-1A	21.50
21	14N02E17C002M	Sutter County MW-1B	12.33
22	14N02E17C003M	Sutter County MW-1C	5.77
23	14N02E17C004M	Sutter County MW-1D	11.91
24	14N02E31K001M	-	19.08
25	14N02E32D001M	SMWC MW-1A	18.34
26	14N02E32D002M	SMWC MW-1B	10.01
27	14N02E32D003M	SMWC MW-1C	8.85
28	14N03E23D003M	Feather River MW-1A	15.78
29	14N03E23D004M	Feather River MW-1B	-30.19
30	14N03E23D005M	Feather River MW-1C	11.05
31	14N03E23D006M	Feather River MW-1D	9.49
32	15N02E12E001M	SEWD MW-1A	15.66
33	15N02E12E002M	SEWD MW-1B	23.14
34	15N02E12E003M	SEWD MW-1C	22.91
35	15N02E22D001M	-	24.00
36	15N02E36L001M	-	33.09
37	16N03E17J001M	Sutter County MW-3A	59.82
38	16N03E17J002M	Sutter County MW-3B	36.89
39	16N03E17J003M	Sutter County MW-3C	34.68

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Impact Zone #	State Well Number	Well ID	Minimum Thresholds (feet AMSL, NAVD88)
40	16N03E17J004M	Sutter County MW-3D	31.78
41	16N03E17J005M	Sutter County MW-3E	31.21
42	17N02E25J001M	BWD MW-1A	10.10
43	17N02E25J002M	BWD MW-1B	3.90
44	17N02E25J003M	BWD MW-1C	60.03
45	-	BS2-Franklin	16.77
46	-	MFWC Prop 50	27.72
47	15N02E24P001M	SEWD MW-2A	24.51
48	15N02E24P002M	SEWD MW-2B	-16.30
49	15N02E24P003M	SEWD MW-2C	-13.80
50	-	WTP Well #1	21.51
51	-	La Grande	17.34
52	-	Edwin	14.35

Table 2 shows the total number of wells, by type, within the RMWs' Impact Zones. The range in well depths, as well as the average well depth, are also shown by well type. The supply wells within the Impact Zones represent 94% and 91% of the domestic and public supply wells within the Subbasin, respectively; thus, this analysis captures potential impacts on a majority of well users within the Subbasin.

Figure 2 and **Figure 3** show the locations of the domestic wells and public supply wells, respectively, within the RMW Impact Zones. **Figure 4** shows the same information but highlights public supply wells located within CWS.

TABLE 2: DETAIL BY WELL TYPE

Well Type	Total Number in Sutter Subbasin[2]	Within 3-mile Radius Impact Zone of RMWs			
		Total Number of Wells	*% of Total Wells Analyzed*	*Well Depth Range (ft bgs)[1]*	*Well Depth Average (ft bgs)*
Domestic Wells	863	809	94%	14 to 457	123
Public Supply Wells	34	31	91%	75 to 720	231
Public Supply Wells – Community Water System	8	8	100%	114 to 535	292

1. ft bgs = feet below the ground surface
2. Excludes wells constructed prior to 1976 and wells lacking depth data.

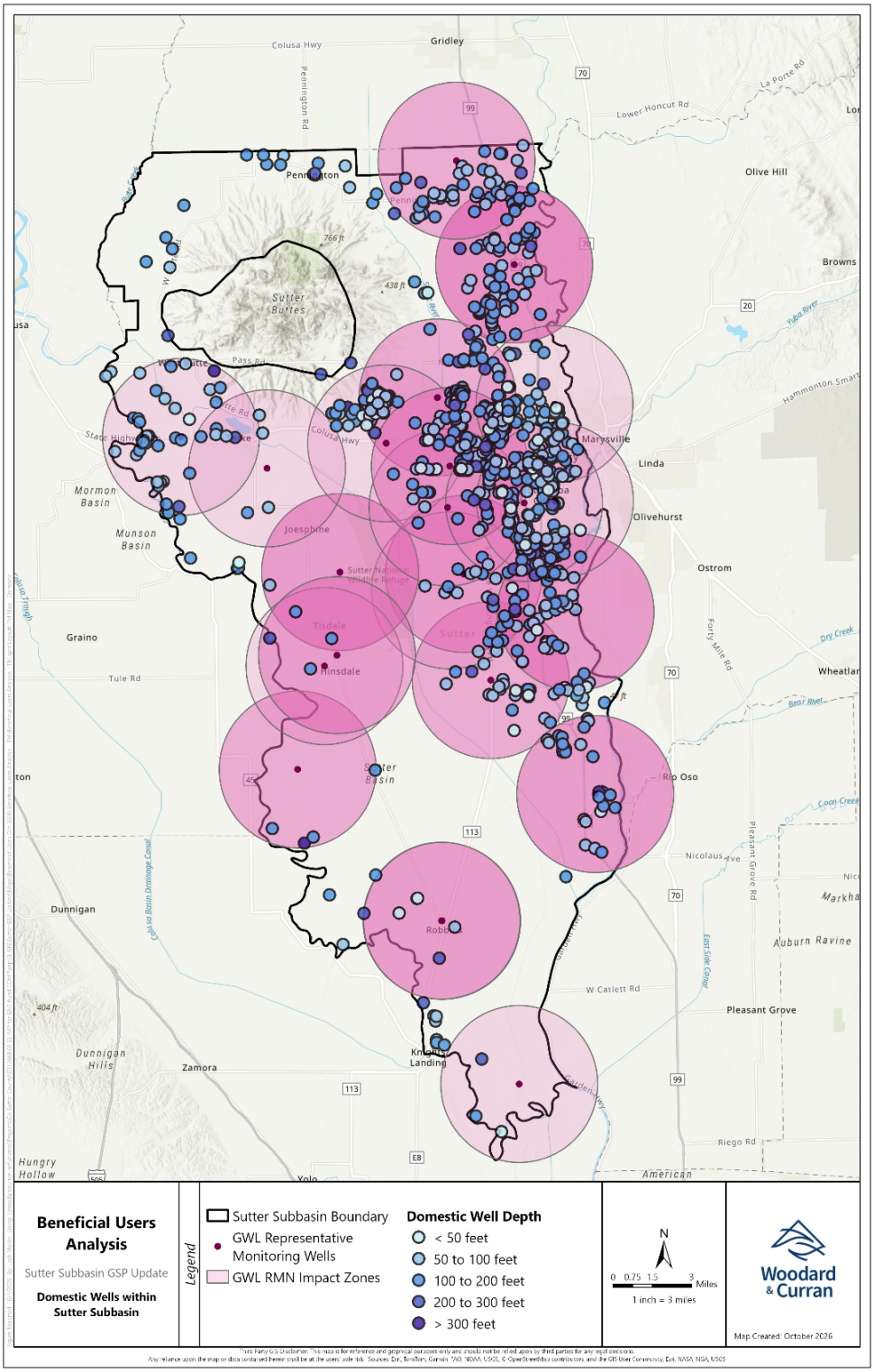

FIGURE 2: INVENTORY OF DOMESTIC WELLS AND GROUNDWATER LEVEL RMN IMPACT ZONES

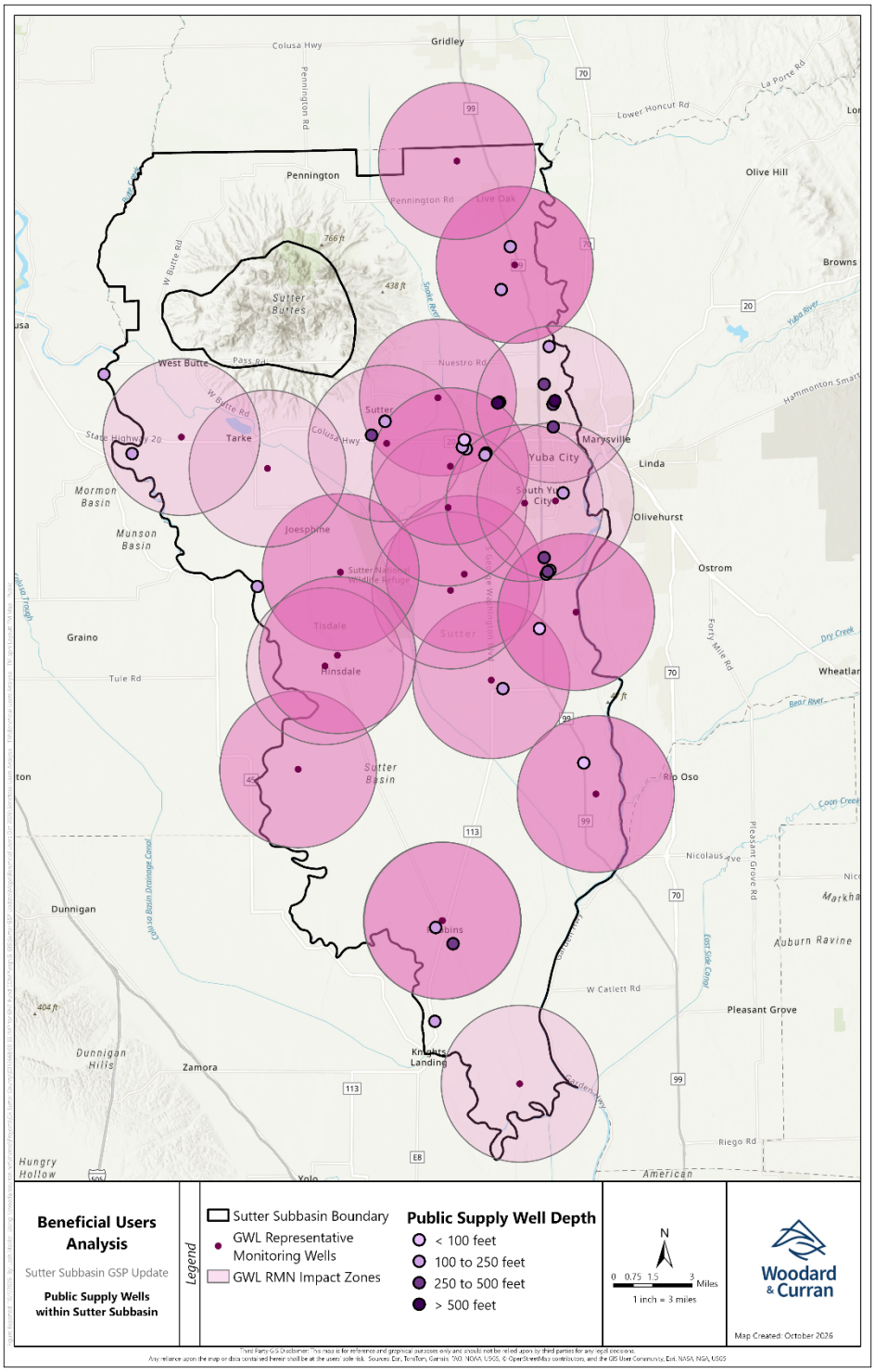

FIGURE 3: INVENTORY OF PUBLIC SUPPLY WELLS AND GROUNDWATER LEVEL RMN IMPACT ZONES

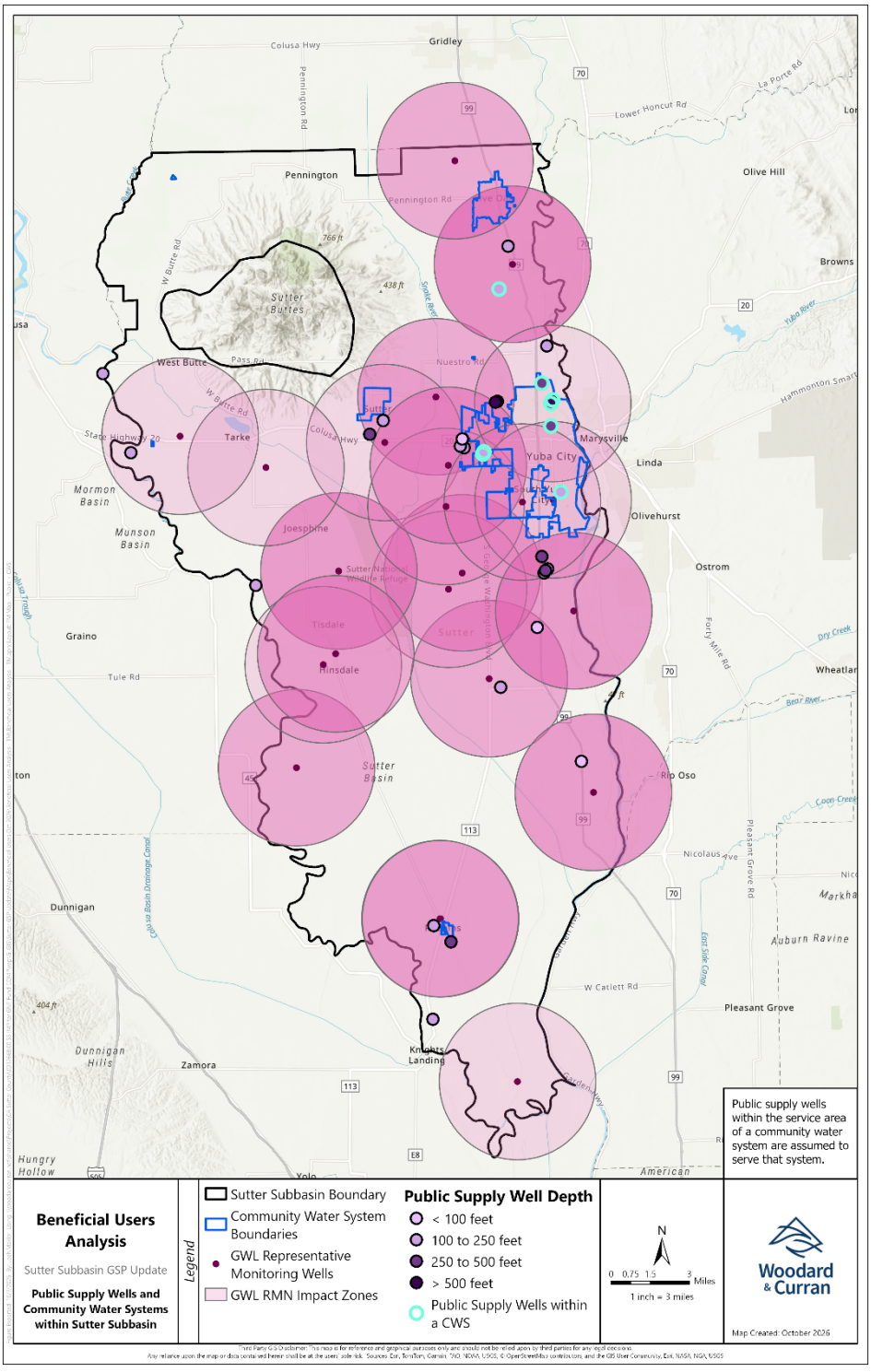

FIGURE 4: INVENTORY OF PUBLIC SUPPLY WELLS WITHIN COMMUNITY WATER SYSTEMS AND GROUNDWATER LEVEL RMN IMPACT ZONES

To identify which RMWs were most vulnerable to reaching their respective MTs during extended dry periods, each RMW's MT was compared to a critical-year low water level, defined as the lowest groundwater elevation observed during WY 2021 or WY 2022 (the most recent drought period). Wells were ranked by this comparison with the assumption that wells closer to their MT during these critical years are more at risk of a MT exceedance.

The undesirable result for the chronic lowering of groundwater levels is defined as when at least 25% of the RMN reaches their respective MT during two consecutive seasonal low groundwater level measurements. With the current RMN, an undesirable result requires at least 13 wells to meet this criterion. To replicate an undesirable result scenario, the 13 RMWs closest to their MT during the WY 2021-2022 critical low years were assumed to have groundwater levels drop to their MT values. For those wells, the MT groundwater level was then compared to the total well depths within the associated Impact Zone to determine whether any supply wells may potentially go dry. For simplicity, it was assumed that groundwater levels, and therefore their impacts on beneficial users, are uniform within the RMW's Impact Zone. For example, in this analysis, a domestic well that is 2 miles away from the RMW location is assumed to be impacted to the same degree as a well that is 0.5 miles from the RMW location.

The same analysis was repeated using differing numbers of RMWs with groundwater levels at their minimum thresholds to serve as a sensitivity analysis. The impacts were calculated when 8%, 15%, 40%, and 100% RMWs reached their respective MT groundwater levels.

b. Results

Of the 809 domestic wells analyzed, approximately three wells could be potentially impacted if the Subbasin experiences an undesirable result for the chronic lowering of groundwater levels as defined in the 2027 GSP Amendment. This represents less than 1% of the total number of domestic wells across the Subbasin, as shown in **Table 3**. The three potentially impacted domestic wells are highlighted in **Figure 5**. Additionally, this analysis shows that public supply wells are likely sufficiently deep to not experience impacts under an undesirable result scenario, as shown in **Table 4**.

TABLE 3: SUMMARY OF POTENTIAL DOMESTIC WELL IMPACTS

Undesirable Result Definition	Number of RMWs at MT	Total Number of Domestic Wells Analyzed	Number of Potentially Impacted Domestic Wells	Percentage of Total Domestic Wells
25%	13	809	3	0.4%

TABLE 4: SUMMARY OF POTENTIAL PUBLIC SUPPLY WELL IMPACTS

Undesirable Result Definition	Number of RMWs at MT	Total Number of Public Supply Wells Analyzed	Number of Potentially Impacted Public Supply Wells	Percentage of Total Public Supply Wells
25%	13	31	0	0%

The sensitivity analysis indicated that the number of wells potentially impacted is not sensitive to the number of representative monitoring wells at their minimum threshold groundwater levels. The 8%, 15%, and 40% scenarios still showed less than 1% of domestic wells may potentially be impacted. In the most extreme case, in which all RMWs reach their MT for groundwater levels, less than 2% of domestic wells were shown to potentially be impacted. These results are summarized in **Table 5**.

There were no impacts to public supply wells under all scenarios, including the extreme case in which all RMWs drop to their MT groundwater levels, as shown in **Table 6**.

TABLE 5: SENSITIVITY ANALYSIS OF UNDESIRABLE RESULT SCENARIOS – DOMESTIC WELLS

Percent RMWs at MT for Groundwater Levels	Number of RMWs dropped to MT	Total Number of Domestic Wells Analyzed	Number of Potentially Impacted Domestic Wells	Percentage of Total Domestic Wells Analyzed
8%	4	809	2	0.2%
15%	8	809	3	0.4%
40%	21	809	3	0.4%
100%	52	809	15	1.9%

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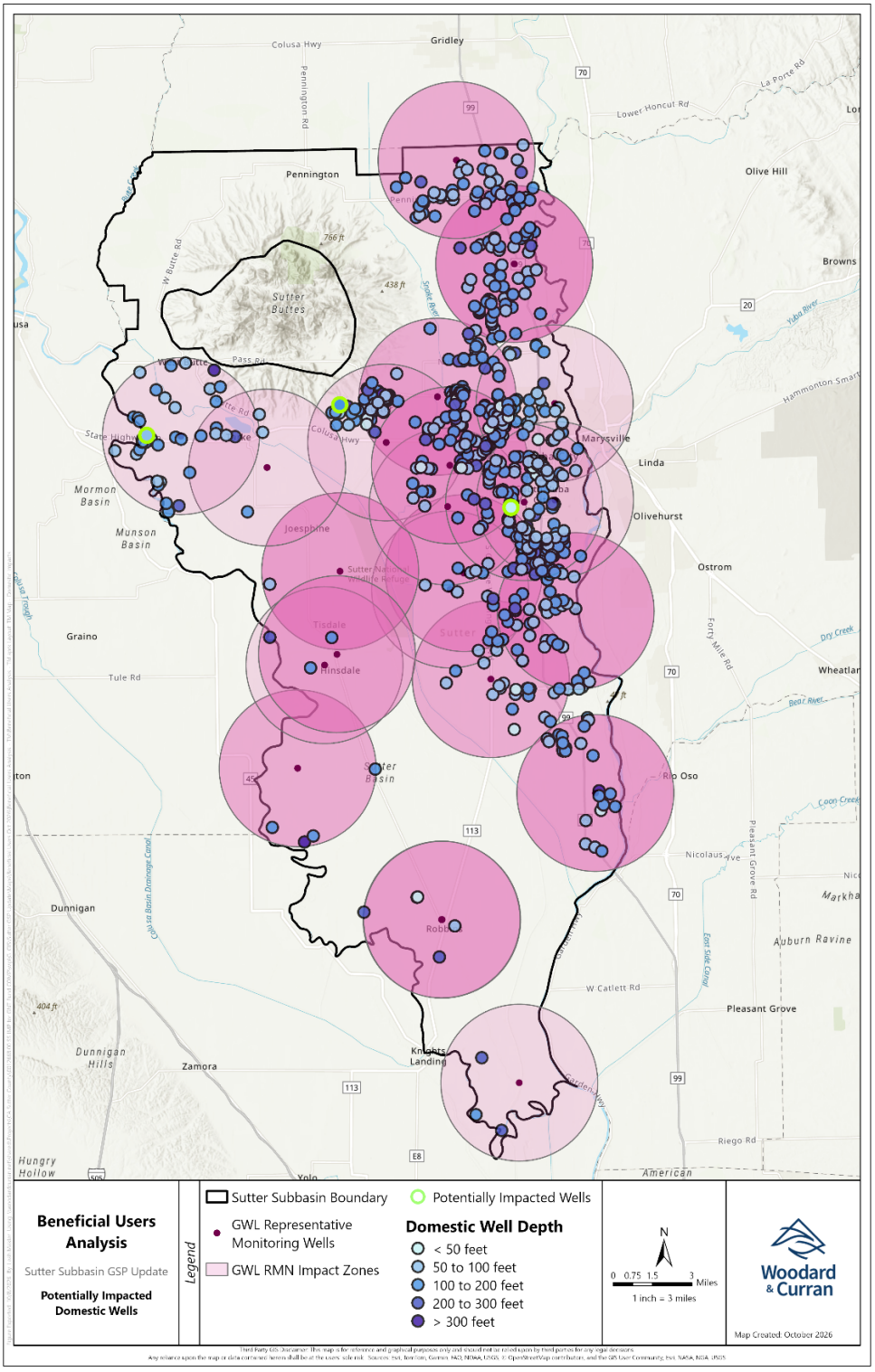

FIGURE 5: DOMESTIC WELLS AT RISK OF IMPACT UNDER GROUNDWATER LEVEL UNDESIRABLE RESULTS

TABLE 6: SENSITIVITY ANALYSIS OF UNDESIRABLE RESULT SCENARIOS – PUBLIC SUPPLY WELLS

Percent RMWs at MT for Groundwater Levels	Number of RMWs dropped to MT	Total Number of Public Supply Wells Analyzed	Number of Potentially Impacted Public Supply Wells	Percentage of Total Public Supply Wells Analyzed
8%	4	31	0	0%
15%	8	31	0	0%
40%	21	31	0	0%
100%	52	31	0	0%

DWR has developed a tool and mapping portal to identify areas which may be at risk of groundwater supply shortages (California Department of Water Resources, 2026b). The tool scores Public Land Survey System (PLSS) sections by percentiles of Dry Well Susceptibility. Within the Sutter Subbasin, PLSS sections range in scores from the 10th to 30th percentile, as shown in **Figure 6**. Only a small number of PLSS sections have been scored by the tool within Sutter Subbasin. The three potentially impacted domestic wells are not in or adjacent to PLSS sections with percentile scores, and thus, the results cannot be directly compared to the results of the analysis contained in this TM. However, the majority of PLSS sections are within the 10th percentile across the Subbasin. This is more generally comparable to the results of the analysis contained herein – potential domestic well impacts are expected to be limited to less than 10% of the Subbasin's domestic, small system and public supply wells.

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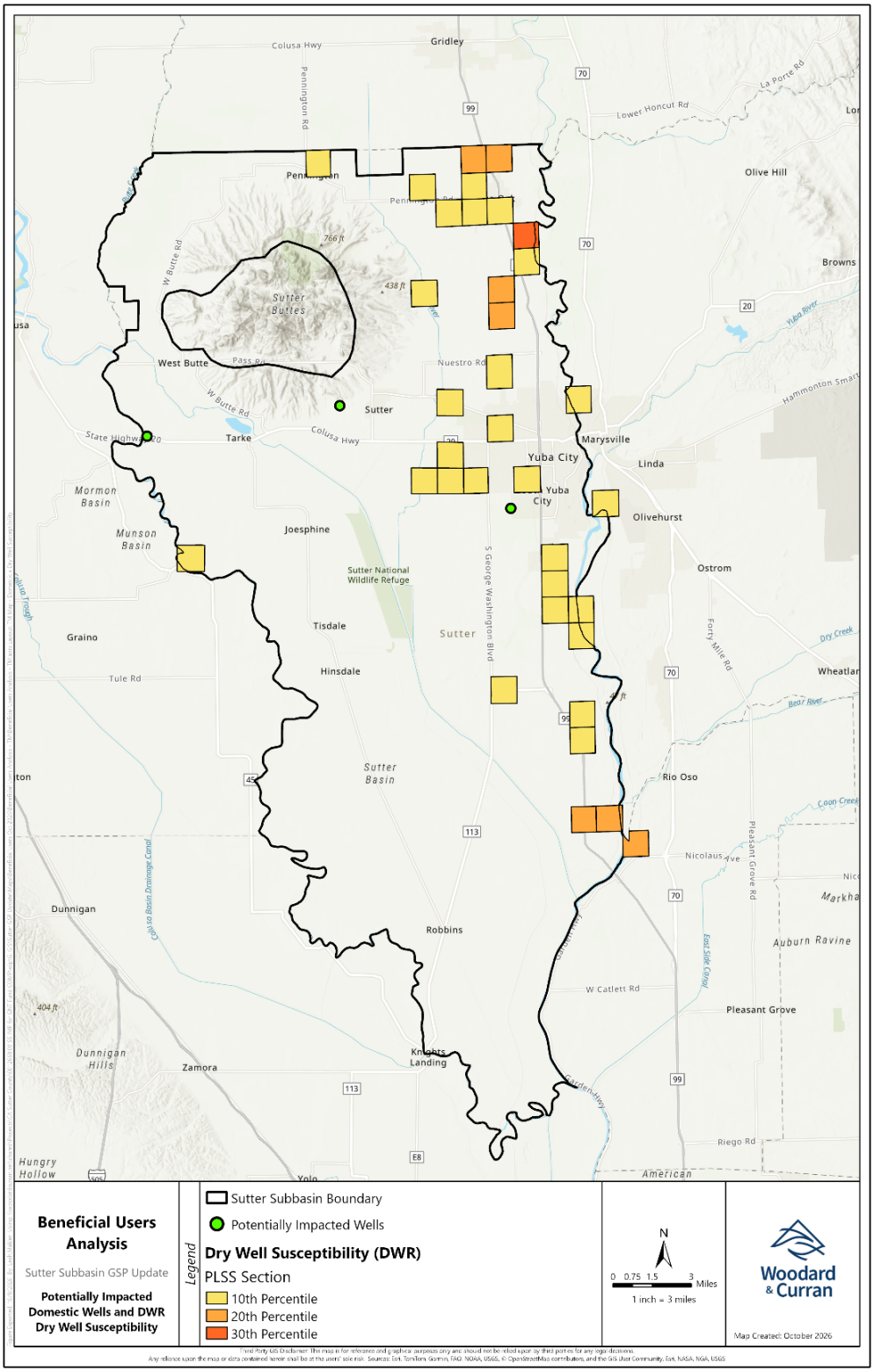

FIGURE 6: POTENTIALLY IMPACTED WELLS COMPARED TO DWR WELL SUSCEPTIBILITY METRICS

c. Limitations of Analysis

The following limitations should be considered in the interpretation of the presented results presented herein:

- The relationship between shallow aquifers and deeper aquifers is still poorly understood and varies considerably across the Subbasin. The majority of data available in the Sutter Subbasin is from its deeper aquifer zones (AZ-1 and deeper) where groundwater is being actively produced for domestic or public supplies. This analysis assumes that the groundwater levels measured in the deeper aquifers at the RMN wells are representative of conditions in all areas of the Impact Zones (including the Shallow Aquifer Zone). That said, the analysis does cover the large majority (more than 90%) of supply wells in the Subbasin and is therefore considered a representative assessment.

- The scenarios analyzed only represent one possible combination of monitoring wells dropping to their MT groundwater levels. The scenarios presented in this analysis utilize lists of RMWs as ranked by the relationship between their observed critical year groundwater levels and their established minimum thresholds. Groundwater levels other than critical-year water levels could be used to rank the vulnerability of the RMWs, such as most recent or model-simulated groundwater levels. The analysis is intended to assess the robustness of the current monitoring network's minimum thresholds and potential impacts. It is not intended to predict the actual circumstances under which an undesirable result may occur.

- The analysis relies on the assumption that groundwater levels within an Impact Zone would drop uniformly to the MT of the representative monitoring well. In reality, groundwater conditions vary spatially due to a variety of factors and can differ within a 3-mile Impact Zone. The assumption was applied as a baseline to simplify the evaluation of MTs across the Subbasin.

- The analysis assumes that impacts on wells would only occur when groundwater levels drop below the total well depth. Wells may fail at shallower depths and due to other circumstances. As discussed above, this assumption was used in order to prepare a Subbasin-scale analysis and align with the data available at that scale.

2. GDE Impacts Analysis

In the Sutter Subbasin, groundwater dependent ecosystems (GDEs) are an environmental beneficial user of groundwater. GDEs are defined in the GSP Emergency Regulations as the following based on the California Code of Regulations (CCR) Title 23 § 351 (m):

> *"Groundwater dependent ecosystem" refers to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface."*

Sufficiently high groundwater levels are required to maintain connection between the root zones of these ecosystems and the groundwater supply they rely on for survival. The 2022 GSP and 2027 GSP Amendment identified GDEs to assess whether groundwater management could affect these beneficial users of groundwater. The following analysis builds on the desktop GDE identification included in the 2027 GSP Amendment to investigate impacts to GDEs as a beneficial user, if the Subbasin were to experience undesirable results.

a. Methods

For the purposes of this analysis, GDEs were identified and screened using the same methods as described in the 2027 GSP Amendment, starting with DWR's Natural Communities Commonly Associated with Groundwater (NCCAG) dataset, which includes vegetation communities and wetlands commonly associated with groundwater (California Department of Water Resources, 2022). NCCAG areas were screened out as potential areas of GDEs if they: (1) occurred where groundwater depths exceeded vegetation rooting depths (30 feet below the ground surface), (2) were located within 150 feet of losing streams or rivers that provide surface water recharge, or (3) were adjacent to irrigated lands, within 50 feet for most irrigated lands and 150 feet for irrigated rice fields.

In the 2027 GSP Amendment, the presence of GDEs was evaluated across a range of hydrologic conditions using average groundwater depths from normal (2013), dry (2015), and wet (2017) years. This analysis evaluates impacts to potential GDEs identified in 2015, a dry year, in order to assess impacts on the largest identified GDE footprint. Impacts to potential GDEs were assessed in a manner consistent with the analysis completed for well impacts (previously described).

The delineated polygons in the NCCAG dataset represent mapping of vegetation, wetlands, springs, and seeps across California compiled from 48 publicly available State and federal agency datasets. The size of the polygon is determined for each ecological grouping using databases that gather information through aerial imagery, remote sensing, and field inspection. For this analysis, the total number of potential GDE polygons identified in the NCCAG dataset within each Impact Zone radii was counted. Both a count and an area of GDE impact are reported due to concerns about the reliability of the exact acreages of the polygon delineations in the NCCAG dataset.

The rooting depth threshold plays a similar role as the well depth in the well impacts analysis by defining at what groundwater level there is an impact or not. It is assumed that if the groundwater levels fall below the MT in an Impact Zone, all identified potential GDEs within the Impact Zone would be impacted. Like in the well impact analysis, the groundwater levels in the Impact Zone are assumed to be level across the zone, and therefore, the impacts are assumed to be uniform throughout the full Impact Zone. If a potential GDE falls anywhere within an Impact Zone, it is designated as either potentially "impacted" or "not impacted," depending on where the groundwater level falls in relation to the rooting depth threshold (30 feet below ground surface).

It should be noted that the analysis presented herein is based on desktop work only. Field study beyond this analysis will be required to determine the presence, extent, and status of potential GDEs in the Subbasin to further inform future assessment.

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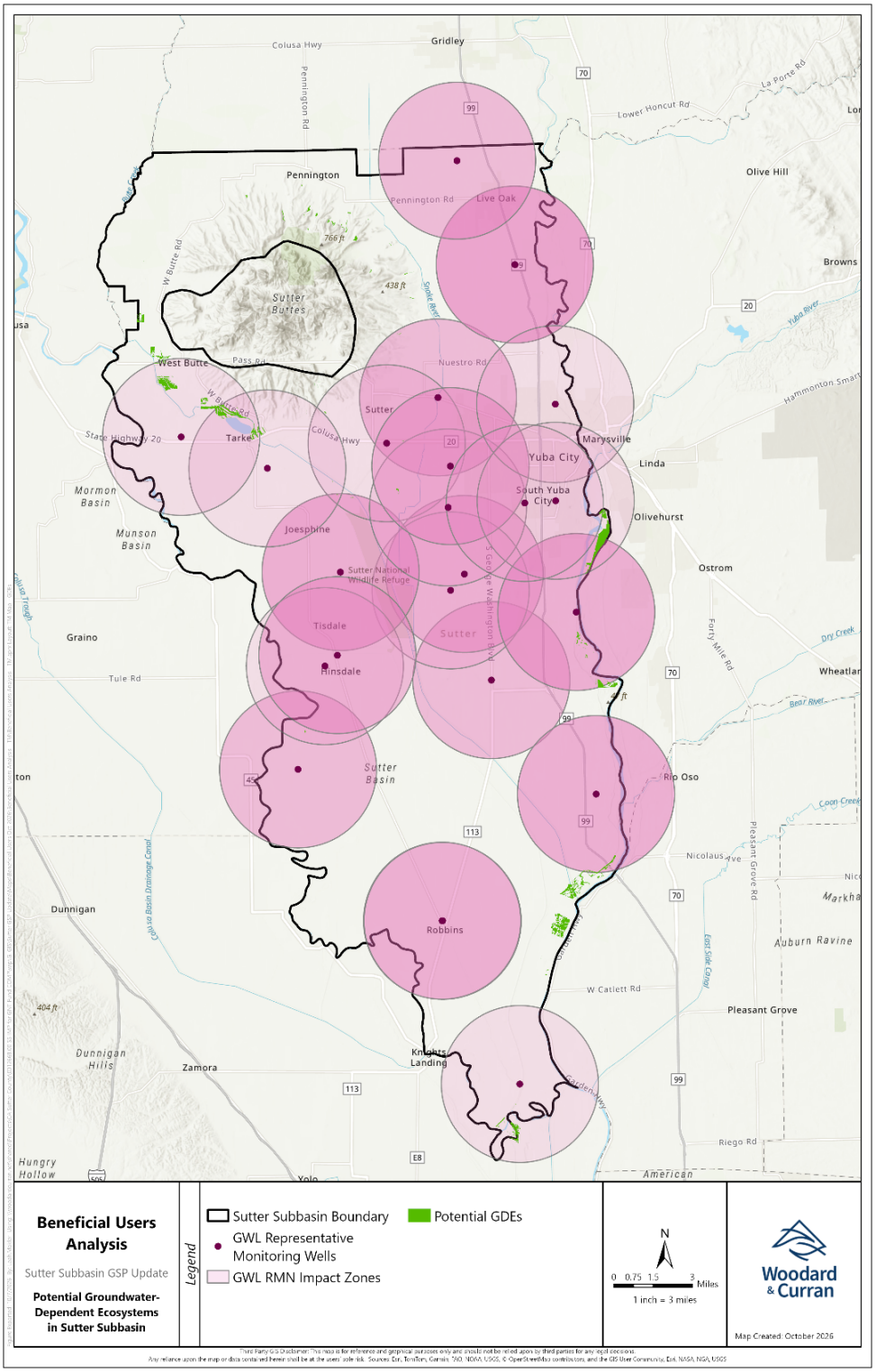

FIGURE 7: INVENTORY OF GDES AND REPRESENTATIVE MONITORING WELL IMPACT ZONES

b. Results

There are 285 potential GDE polygons identified across the Subbasin totaling an area of approximately 2.5 square miles.

Under undesirable results conditions, as defined in the 2027 GSP Amendment, this analysis found no impacts to GDE polygons as shown in **Table 7**. Only under the most extreme scenario, in which 100% of the RMWs reach their MT groundwater levels, are impacts to GDE polygons recorded. These results are shown in **Table 8**. Under this extreme scenario, the impacts to GDEs are substantial. In terms of a count, 22% of the GDE polygons are impacted and in terms of area, 33% of the total GDE area (or approximately 0.83 square miles) is potentially impacted.

TABLE 7: SUMMARY OF POTENTIAL GDE IMPACTS

Undesirable Result Definition for Groundwater Levels	Total Count of GDE Polygons in Sutter Subbasin	Total Area of GDEs in Sutter Subbasin (sq miles)	Number of Potentially Impacted GDE Polygons	Percentage of Total GDE Polygons
25%	285	2.5	0	0%

TABLE 8: SENSITIVITY ANALYSIS OF UNDESIRABLE RESULT SCENARIOS - GDES

Percent RMWs at MT for Groundwater Levels	Total Count of GDE Polygons in Sutter Subbasin	Total Area of GDEs in Sutter Subbasin (sq miles)	Number of Potentially Impacted GDE Polygons	Area of Potentially Impacted GDE polygons (sq miles)	Percentage of Total GDE Polygons	Percentage of Total Area
8%	285	2.5	0	0	0%	0%
15%	285	2.5	0	0	0%	0%
40%	285	2.5	0	0	0%	0%
100%	285	2.5	64	0.8	22%	33%

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c. Limitations of Analysis

The following limitations and outstanding data gaps should be considered in the interpretation of the results presented above. The GDE analysis is subject to most limitations discussed in the well impact analysis, in addition to the following:

- The impact analysis included in this TM is a desktop only analysis. No field survey has been completed to ground-truth the presence or extent of GDEs. Field surveys to verify the locations and extent of GDEs should be completed to verify both the mapping used in this analysis and the findings of this analysis.

- The definition of what an ecosystem is in the NCCAG dataset carries a number of assumptions. The size of the polygons in NCCAG is based on how an ecosystem is defined within the dataset, and this incorporates a variety of assumptions regarding the identification of a potential GDE. For example, two stretches of stream may have similar densities of potential GDEs in the field, but if one reach has more individual species than the other, the two reaches may be classified as more individual GDE polygons despite their similar densities. Therefore, the size of the NCCAG polygons as well as the actual count of GDE polygons should be interpreted cautiously.

Additionally, while the groundwater level RMN does overlap with more than half of potential GDE locations mapped in the Subbasin (60%), there is generally a lack of overlap between groundwater level monitoring well locations and locations of potential GDEs. To assess impacts on a greater number of GDEs, additional monitoring locations would need to be established near the Sutter Buttes, in the northwest portion of the Subbasin, and north of the southern tip of the Subbasin. Monitoring in these areas would increase understanding of groundwater level impacts on GDEs, while also providing information on interconnected surface water dynamics. Since the publication of the 2022 GSP, the groundwater levels RMN described in the 2027 GSP Amendment has replaced an interconnected surface water (ISW)-specific RMN as proxy due to various monitoring limitations in the ISW-specific RMN. The Subbasin GSAs are in the process of filling data gaps to monitor for depletions of ISW conditions and potential GDEs for future reporting.

3. Conclusion

Under undesirable results conditions (as defined in the 2027 GSP Amendment), this analysis finds that less than 1% of the domestic wells analyzed may be potentially impacted by groundwater levels declining to their MT values. No public supply wells, public supply wells within Community Water Systems, or groundwater dependent ecosystems are expected to be impacted at defined undesirable results conditions for groundwater levels. Therefore, this analysis shows that the undesirable result definition and MTs established for the chronic lowering of groundwater levels are protective of beneficial uses and users of groundwater in the Sutter Subbasin.

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