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March 31, 2026

Wyandotte Creek Groundwater Sustainability Agency
308 Nelson Avenue
Oroville, CA 95965

Subject: Draft Periodic Evaluation

The Wyandotte Creek Groundwater Sustainability Plan (GSP) was submitted to the Department of Water Resources (DWR) in January 2022 and approved by DWR in July 2023. In the GSP, the GSA notes data gaps that would need to be filled to sustainably manage groundwater in the Wyandotte Creek Subbasin. In their determination letter, DWR provided recommended corrective actions (or RCAs). DWR strongly encouraged the GSA to address the RCAs and data gaps. The GSA received funding through DWR's Sustainable Groundwater Management (SGM) Round 2 Grant Program to address these data gaps and to complete the GSP Five-Year Periodic Evaluation required under Water Code § 10728.2 and GSP Updates.

In April 2024, Larry Walker Associates (LWA or Consultant) was hired by the GSA to prepare the 2027 Periodic Evaluation (PE) and GSP Amendments using the SGM Grant funds. As of March 31, 2026, a draft of the PE and draft amended GSP are complete and available for public review and comment. The due date to submit the PE to DWR is January 31, 2027. The remaining steps that need to be completed this year include:

- Incorporate additional data through Water Year 2026 as feasible.
- Incorporate sites and data from newly installed monitoring wells and stream gages as feasible.
- Incorporate DWR guidance on ISW and inter-basin coordination as needed.
- Conduct additional stakeholder outreach meeting(s) as requested.
- Respond to public and stakeholder comments and incorporate feedback as needed.
- Ensure that the PE aligns with information presented in the 2025 Water Year Annual Report and finalized Plan Amendments.
- Submit to DWR by January 2027.

The draft 2027 Periodic Evaluation and accompanying draft amended GSP (redline and clean) are available on the Wyandotte Creek GSA's website at https://www.wyandottecreekgsa.com/.

Sincerely,

Dillon McGregor

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GSA Program Manager

Wyandotte Creek
GROUNDWATER SUSTAINABILITY AGENCY

LARRY WALKER ASSOCIATES

DRAFT Amended

GROUNDWATER SUSTAINABILITY PLAN

WYANDOTTE CREEK GROUNDWATER SUBBASIN

Prepared by

Wyandotte Creek Groundwater Sustainability Agency
308 Nelson Avenue
Oroville, CA, 95965

In Consultation with

Larry Walker Associates, Inc.
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Davis, California 95618

March 31, 2026

Groundwater Sustainability Plan

Wyandotte Creek Groundwater Subbasin

Prepared by

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March 31, 2026

ACKNOWLEDGEMENTS

Wyandotte Creek Groundwater Sustainability Agency
Member Agencies
City of Oroville, County of Butte, Thermalito Water and Sewer District

Wyandotte Creek Advisory Committee

Wyandotte Creek Management Committee

Cooperating Agencies

South Feather Water and Power Agency

Consultant Teams

2022 GSP
Geosyntec Consultants / Davids Engineering

2027 Amended GSP
Larry Walker Associates

Luhdorff & Scalmanini, Consulting Engineers

Projects and Management Actions

Larry Walker Associates

GEI Consultants

West Yost

In Remembrance of Byron Alan Clark, PE
(February 4, 1976 - April 3, 2021)
With thanks for his excellent leadership and foundational work
on the Basin Setting Project for the Wyandotte Creek Subbasin GSP

PREFACE

Development of the Wyandotte Creek Subbasin Groundwater Sustainability Plan (GSP), like many others throughout California, has coincided with one of the most severe and extensive droughts that has ever gripped the western United States. As of this writing in December 2021, as the final Wyandotte Creek Subbasin GSP is being assembled, drought conditions throughout most of California, including the Wyandotte Creek Subbasin (Subbasin), are classified as "exceptional", the most extreme classification defined by the U.S. Drought Monitor (USDM).[1] Historically, observed impacts during exceptional drought generally include: widespread water shortages, depleted surface water supplies, extremely low federal and state surface water deliveries, curtailment of water rights, extremely high surface water prices, increased groundwater pumping to satisfy water demands, dry groundwater wells, increased well drilling and deepening, increased pumping costs, wildfire, decreased recreational opportunities, and poor water quality, among other potential impacts reported by the USDM. All of these conditions are currently being experienced to some degree across California and, some of them within the Subbasin.

As of November 29, 2021, the County of Butte had received 44 reports of dry wells through the My Dry Water Supply Reporting System, and another approximately 20 from residents calling the Butte County Department of Water and Resource Conservation. While a number of the reported dry wells are in the foothills outside of the Subbasin, a handful lie within the Wyandotte Creek Subbasin. Most reported dry wells are used for domestic water supply. Counts of dry wells are likely to be low because some landowners choose not to report well problems to the county.

At the State level and as a result of the unprecedented dry conditions, Governor Gavin Newsom declared a drought emergency on April 21, 2021, which was subsequently expanded on May 10 to include new drought-impacted areas including the Sacramento-San Joaquin Delta Watershed. Most recently, on October 19, Governor Newsom issued a proclamation extending the drought emergency statewide. On August 20, the State Water Resources Control Board (SWRCB) issued surface water curtailment orders to approximately 4,500 water right holders in the Sacramento-San Joaquin Delta Watershed to protect drinking water supplies, prevent salinity intrusion into fresh water supplies, and minimize impacts to fisheries and the environment. Given the recent curtailments and an already bleak surface water supply condition, there is an increased reliance on groundwater in the region. Currently, all of California's 58 counties have declared drought emergencies, including Butte County.

The reported numbers of dry wells discussed above prompted mitigation and response actions by the county. The county is tracking the well water shortage reporting to identify localized areas where wells are going dry and/or where other groundwater issues may exist. The county is also supporting the public through local and regional programs offered through the county, such as providing an emergency potable water filling station. The county has also applied for drought

[1] The U.S. Drought Monitor (https://droughtmonitor.unl.edu/) is produced through a partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Center. Information for the State of California is available online at: https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?CA.

relief funding through the Department of Water Resources (DWR or Department). At this time, prior to completion and adoption of the GSP, drought response efforts in the Subbasin are the responsibility of the county, cities, and other local agencies. At some point following adoption of the GSP, those responsibilities may be coordinated more closely with the GSA. Additional coordination with the county, cities, and local agencies would ensure preservation of public health and safety (the purview of the counties and cities) and groundwater sustainability for all beneficial users and uses (the purview of the GSA).

Technical work and related public involvement processes supporting development of the Wyandotte Creek Subbasin GSP began in earnest in 2018 and are nearing completion as of December 2021. Development of the GSP has utilized the best available science and tools, with the most sufficient and credible information and data available for the decisions being made and the time frame available for making those decisions. Current and historical groundwater conditions and water budgets have been evaluated for the Subbasin in alignment with the GSP regulations. The technical work is based primarily on historical records of surface water and groundwater conditions from 1970 through 2018 which includes the prior drought conditions from approximately 2007 to 2015, but not the current drought in 2020 to 2021.

Unfortunately, drought conditions in 2020 and 2021 have coincided with development of the GSP, a timing that has not permitted complete evaluation and inclusion of data from these years in the GSP at this time. Due to the schedule mandated by the Sustainable Groundwater Management Act (SGMA) for completion of GSPs by January 31, 2022, it has not been possible to include conditions that have manifested due to the current drought in development of the GSP. Records of drought-related conditions in 2020 to 2021 will not be systematically compiled, quality-controlled, and made publicly available until after the Wyandotte Creek Subbasin GSP has been adopted. However, those conditions will be factored into the required GSP annual reports and particularly the periodic (five-year) evaluations as they become available.

Ongoing management of the Subbasin under the GSP will follow an "adaptive management" strategy that involves active monitoring of Subbasin conditions and addressing any challenges related to maintaining groundwater sustainability by scaling and implementing projects and management actions (PMAs) in a targeted and proportional manner in accordance with the needs of the Subbasin. Notwithstanding the information noted above regarding the challenges with GSP preparation and the current drought, some of the planned projects contained within this GSP could be fast tracked to address impacts associated with the current drought. GSP annual reports provide an opportunity each year to review current Subbasin conditions. Using annual reporting information, the Wyandotte Creek GSA Board can assess the need for further PMAs. During the periodic five-year evaluations, the GSP will also be reviewed and revised, as needed and as more is known about the effects of current and future conditions.

The Wyandotte Creek GSA and the stakeholders within the Subbasin recognize that this GSP is not the finish line; it is the starting line for sustainable management of the Subbasin. As conditions within the Subbasin change, the GSA is committed to an open, transparent, and all-inclusive adaptive management strategy aimed at tackling the important local issues that they face. At the heart of SGMA is the power for locals to solve local problems with local resources. All parties in the Subbasin are committed to doing just that.

The GSP was approved by the DWR in July 2023. DWR provided recommended corrective actions (or RCAs) that the Department believes will enhance the original GSP. The Department strongly encouraged completion of the recommended corrective actions and suggested incorporating all resulting changes to the GSP in future updates. During the development of the GSP, the Wyandotte Creek GSA identified data gaps and DWR suggested resolving these data gaps as part of the corrective actions. Wyandotte Creek GSA received funding through DWR's Sustainable Groundwater Management (SGM) Round 2 Grant Program (2024-2026) to address these data gaps and to complete the accompanying 2027 GSP Periodic Evaluation required under Water Code § 10728.2 and Plan Amendments (as applicable). This amended GSP includes updates to address DWR's RCAs.

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ACRONYMS AND ABBREVIATIONS

µS/cm	microsiemens per centimeter
AB	Assembly Bill
ACS	American Community Survey
AEM	aerial electromagnetic
AFY	acre-feet per year
Agreement	Joint Powers Agreement
amsl	above mean sea level
BBGM	Butte Basin Groundwater Model
BCDWRC	Butte County Department of Water and Resource Conservation
bgs	below ground surface
BMOs	Basin Management Objectives
BMPs	Best Management Practices
C&E Plan	Communication and Engagement Plan
Cal Water	California Water Service
CASGEM	California Statewide Groundwater Elevation Monitoring
CCR	California Code of Regulations
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
CECs	Chemicals of Emerging Concern
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CNRA	California Natural Resources Agency
CRC	California Rice Commission
CVRWQCB	Central Valley Regional Water Quality Control Board
DACs	Disadvantaged Communities
DMS	data management system
Drought Plan	Butte County Drought Preparedness and Mitigation Plan
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
EPA	Environmental Protection Agency

GAMA	Groundwater Ambient Monitoring and Assessment
GDEs	Groundwater Dependent Ecosystems
GIS	geographical information systems
GQTMWP	Groundwater Quality Trend Monitoring Work Plan
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	Hydrogeologic Conceptual Model
HVA	High Vulnerability Area
iGDEs	potential groundwater dependent ecosystems
ILRP	Irrigated Lands Regulatory Program
IM	interim milestones
InSAR	Interferometric Synthetic Aperture Radar
IRWM	Integrated Regional Water Management
JPL	Jet Propulsion Laboratory
LID	Low Impact Development
MA	Management Area
MAF	million acre-feet
MCL	maximum contaminant level
mg/L	milligrams per liter
MGD	million gallons per day
MHI	median household income
MO	measurable objective
MT	minimum threshold
NASA	National Aeronautics and Space Administration
NCCAG	Natural Communities Commonly Associated with Groundwater
NEPA	National Environmental Policy Act
NR	Not yet reported
NRCS	Natural Resources Conservation Service (
OSWCR	Online System for Well Completion Reports
RMS	representative monitoring sites
SAGBI	Soil Agricultural Groundwater Banking Index

SB	Senate Bill
SBFCA	Sutter Butte Flood Control Agency
SDACs	Severely Disadvantaged Communities
SFWPA	South Feather Water and Power Agency
SGMA	Sustainable Groundwater Management Act
SI	Sustainability Indicators
SMC	sustainable management criteria
SOI	Sphere of Influence
SVWQC	Sacramento Valley Water Quality Coalition
SWRCB	State Water Resources Control Board
TAF	thousands of acre-feet
TAF/year	thousand acre-feet per year
TBD	to be decided
TDS	total dissolved solids
TNC	The Nature Conservancy
TSS	Technical Support Services
TWSD	Thermalito Water and Sewer District
URCs	Underrepresented Communities
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
WAC	Wyandotte Creek Advisory Committee
WDL	Water Data Library
Wyandotte Creek Subbasin	Wyandotte Creek Groundwater Subbasin

EXECUTIVE SUMMARY

Sustainability Goal:

To ensure that groundwater is managed to provide a water supply of adequate quantity and quality to support beneficial users of groundwater including but not limited to rural areas and other communities, the agricultural economic base of the region, and environmental resource uses in the Subbasin now and in the future.

Introduction

In 2014, the California legislature enacted the Sustainable Groundwater Management Act (SGMA) in response to continued overdraft of California's groundwater resources. SGMA provides for local control of groundwater resources while requiring sustainable management of the state's groundwater basins. Under the provisions of SGMA, local agencies must establish governance of their subbasins by forming Groundwater Sustainability Agencies (GSAs) within the authority to develop, adopt, and implement a Groundwater Sustainability Plan (GSP or Plan) for the subbasin. Under the GSP, GSAs must adequately define and monitor groundwater conditions in the subbasin and establish criteria to maintain or achieve sustainable groundwater management within 20 years of GSP adoption. Within the framework of SGMA, sustainability is generally defined as long-term reliability of the groundwater supply and the absence of undesirable results.

Critical Dates for the Wyandotte Creek Groundwater Subbasin	
2022	By January 31, submit GSP to Department of Water Resources (DWR)
2027	Evaluate GSP and amend, if warranted
2032	Evaluate GSP and amend, if warranted
2037	Evaluate GSP and amend, if warranted
2042	Achieve sustainability for the Wyandotte Creek Subbasin

The Wyandotte Creek Groundwater Subbasin (Wyandotte Creek Subbasin) is identified by DWR as being in a medium priority subbasin. For medium priority basins, SGMA required preparation of the GSP by January 31, 2022. The Wyandotte Creek GSA is the only GSA in the Wyandotte Creek Subbasin. The Wyandotte Creek GSA was formed through the execution of a Joint Powers Agreement (Agreement) by the County of Butte, City of Oroville, and the Thermalito Water and Sewer District (TWSD). The GSA Board is composed of five seats, each with equal and full voting rights, including Butte County, City of Oroville, TWSD, an agricultural groundwater user, and a domestic well user (non-agricultural).

The purpose of the Agreement was to create the Wyandotte Creek GSA to 1) to develop, adopt, and implement a GSP for the Wyandotte Creek subbasin to implement SGMA requirements and achieve the sustainability goals; and 2) involve the public and subbasin stakeholders through outreach and engagement in developing and implementing the GSP. The focus of the Agreement is to maximize local input and decision-making and address the different water demands and sustainability considerations in the urban and rural areas of the Wyandotte Creek Subbasin.

The agreement also defines two Management Areas (MAs) within the Wyandotte Creek Subbasin: Wyandotte Creek Oroville and Wyandotte Creek South. MA refers to an area within a subbasin for which a GSP may identify different minimum thresholds (MTs), measurable objectives (MOs), monitoring, and projects and management actions based on unique local conditions or other circumstances as described in the GSP regulations. The interests and vulnerability of stakeholders and groundwater uses in these MAs vary based on the nature of the water demand (agricultural, domestic, municipal), numbers and characteristics of wells supplying groundwater, and to some degree the hydrogeology and mix of recharge sources.

SGMA requires development of a GSP that achieves groundwater sustainability in the Wyandotte Creek Subbasin by 2042. A pragmatic approach to achieving sustainable groundwater management requires an understanding of 1) historical trends and current groundwater conditions in the subbasin, based on evaluating six sustainability indicators (SIs) that include groundwater levels, groundwater storage, groundwater quality, land subsidence, depletion of interconnected streams, and seawater intrusion and 2) what must change in the future to ensure sustainability without causing undesirable results (described and defined in Chapter 3) or negatively impacting beneficial uses and users of groundwater, including groundwater dependent ecosystems (GDEs).

The GSP is organized as follows and the various components of each chapter are summarized further below:

1. Chapter 1: Plan Area. This chapter includes agency information, description of the Plan Area, and applicable programs and data sources used to prepare the GSP as well as a description of beneficial users and uses within the Basin and a summary of stakeholder communications and engagement.
2. Chapter 2: Basin Setting. This chapter discusses the Hydrogeologic Conceptual Model (HCM), groundwater conditions and water budget.
3. Chapter 3: Sustainable Management Criteria. This chapter discusses undesirable results, identifies the minimum thresholds, and measurable objectives for each of the six SIs.
4. Chapter 4: Monitoring Network. This chapter describes the methods used to monitor the SIs.
5. Chapter 5: Project Management Actions. This chapter describes projects and management actions that will achieve sustainability within the Subbasin.
6. Chapter 6: Plan Implementation. This chapter describes how the GSA will partner with other groundwater users to implement the GSP to achieve groundwater sustainability.

The GSP outlines the need to address overdraft and related conditions and has identified 15 projects for potential development that either replace groundwater use (offset) or supplement groundwater supplies (recharge) to meet current and future water demands. During the 2022-2027 implementation period, several projects received funding and were completed or began feasibility studies including the Regional Conjunctive Use Project and the Thermalito Water Treatment Plant Capacity Upgrade. In addition, the GSP also identifies five management actions that can be implemented to focus on reduction of groundwater demand. During the 2022-2027 implementation period, several management actions have completed work or begun activities. Although current analysis indicates that groundwater pumping offsets and/or recharge on the order of 1,000 acre-feet per year (AFY) may be required to achieve sustainability, additional efforts are needed to confirm the level of pumping offsets and/or recharge required to achieve sustainability. These efforts include collecting additional data and a review of the Wyandotte Creek Subbasin groundwater model, along with other efforts as outlined in the GSP.

In 2027, this amended GSP was submitted to DWR in response to the Recommended Corrective Actions (RCAs) provided in DWR's Determination Letter.[2] This amended GSP incorporates DWR's RCAs as summarized in Table ES-1. The Amended GSP updates SMCs and networks for nearly all sustainability indicators (SI). SI that previously used the groundwater level SI as a proxy have their own established networks and SMCs, including for land subsidence and stream depletions. This GSP updated key sections with new data and analysis, including interconnected surface water and groundwater dependent ecosystems. The sustainable yield has been updated to reflect updated data collection for groundwater pumping and groundwater levels through Water Year 2025. Projects and management actions have been updated based on recent efforts that have occurred since the initial adoption of the GSP in 2021.

[2] Wyandotte Creek Subbasin Determination Letter is available for download here: https://sgma.water.ca.gov/portal/gsp/preview/99

Table ES-1. Summary of DWR Recommended Corrective Actions and Amendments.

Determination Letter Page No.	GSP Section No.	GSP Section	Recommended Corrective Action (RCA)	Amendment Description
39	2.2.4.2	Basin Setting - Groundwater Quality	**RCA 1a:** Provide additional information in the GSP outlining the location and extent of contamination plumes, identifying which constituents are being monitored under various programs, and thoroughly describing ongoing remediation efforts within the Subbasin.	Explicitly listed and described all existing contamination sites and the corresponding responsible agency and/or mitigation program.
40	2.2.4.1	Basin Setting - Groundwater Quality	**RCA 1b:** Evaluate whether groundwater management actions, including production and/or replenishment under the jurisdiction of the GSA, may influence the migration of contaminant plumes.	Evaluation of water quality data did not reveal significant impacts from pumping; the GSA is currently working on a handout to give to project partners that highlights locations in the Subbasin with water quality problems that could impact project feasibility.
40	2.2.4.1	Basin Setting - Groundwater Quality	**RCA 1c:** Investigate if groundwater quality issues are adversely impacting groundwater supply and beneficial uses and provide information if there are any mitigation programs in place and the effectiveness of such programs.	Evaluation of water quality data did not reveal significant impacts from pumping; existing contamination sites with corresponding mitigation program were listed and described.
40	2.2.4.1	Basin Setting - Groundwater Quality	**RCA 1d:** Coordinate with the lead agencies overseeing these remediation sites regularly and update the Plan stating how existing groundwater quality conditions and/or remediation efforts may impact the GSA's ability to manage groundwater.	Updated description of coordination efforts regarding water quality.
40	3.3.1	Sustainable Management Criteria - Groundwater Levels - Undesirable Result	**RCA 2a:** Revise the definition of undesirable results and language pertaining to significant and unreasonable lowering of groundwater level to remove the non-dry year condition or discuss how extractions and recharge will be managed as necessary to ensure that reductions in groundwater levels or storage during dry years are offset by increases in groundwater levels or storage during other years within the sustainable management criteria for the chronic lowering of groundwater levels.	The definition of undesirable results was updated to remove the non-dry year condition; PMAs were also updated (5.2.4) to describe benefits from recent water supply reliability and recharge projects benefits.

Determination Letter Page No.	GSP Section No.	GSP Section	Recommended Corrective Action (RCA)	Amendment Description
40	3.3.2	Sustainable Management Criteria - Groundwater Levels - Minimum Thresholds	**RCA 2b:** Provide information on impacts to domestic wells during projected conditions where minimum thresholds are exceeded but undesirable results do not occur and quantify domestic wells that will be impacted by the proposed minimum threshold. Furthermore, the GSA should evaluate the impacts of proposed minimum thresholds on other beneficial uses and users, such as public and small water systems and environmental users and users as the GSP does not evaluate those impacts.	Expanded data collection efforts on GDEs (2.2.7.6) and ISW monitoring (4.6); quantified impacts to domestic wells (Appendix 3-B).
40	3.3.2	Sustainable Management Criteria - Groundwater Levels - Minimum Thresholds	**RCA 2c:** Provide a description of the relationship between established minimum thresholds for the chronic lowering of groundwater levels and how they avoid undesirable results for each of the other sustainability indicators.	Changed MT approach for lowering groundwater levels to be more reflective of undesirable result definition.
40	3.5.1	Sustainable Management Criteria - Water Quality - Undesirable Result	**RCA 3:** Revise the definition of undesirable results to remove the non-dry year condition or discuss how degradation during dry period will be managed as necessary to ensure that adverse water quality conditions are offset during other periods.	The definition of undesirable results was updated.
41	3.7.1	Sustainable Management Criteria - Land Subsidence - Undesirable Result & MT	**RCA 4a:** Provide a clear, quantitative definition of when undesirable results for land subsidence may occur in the Subbasin, as required by the GSP Regulations, to support the selection of land subsidence minimum thresholds that demonstrate avoidance of undesirable results.	The definition of undesirable results was updated.
41	3.7.1	Sustainable Management Criteria - Land Subsidence -	**RCA 4b:** Establish sustainable management criteria for land subsidence for the Subbasin utilizing a monitoring network that directly measures land	The GSA has established annual monitoring protocol for subsidence using surveyed wells, InSAR data, and local GPS stations for ground-truthing.

Determination Letter Page No.	GSP Section No.	GSP Section	Recommended Corrective Action (RCA)	Amendment Description
		Undesirable Result & MT	elevation change such as remote sensing data, survey monuments, or global positioning system stations.	
41	3.8.1	Sustainable Management Criteria - ISW	**RCA 5a:** Consider utilizing the interconnected surface water guidance, as appropriate, when issued by the Department to establish quantifiable minimum thresholds, measurable objectives, and management actions.	The GSA has reviewed the guidance released to date; the guidance was taken into consideration during the Periodic Evaluation and Plan Amendment process.
41	4.6	Monitoring Networks - ISW	**RCA 5b:** 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.	ISW monitoring network has been overhauled with the classification of existing wells, drilling of new shallow wells, and installation of new stream gages; new monitoring network visualized in Figure 4-4.
41	2.2.6 & 2.2.7	Basin Setting – ISW / GDE	**RCA 5c:** 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.	The GSA has collaborated with The Nature Conservancy on GDE mapping efforts and has coordinated with Northern Sacramento Valley Subbasins to develop a consistent approach to manage inter-connected surface waters. Coordination efforts are further summarized in Sections 2.2.6 and 2.2.7.
41	4.6	Monitoring Networks - ISW	**RCA 5d:** Clarify the groundwater level monitoring sites that will be used for the evaluation of depletions of interconnected surface water and provide site-specific information.	ISW monitoring network has been overhauled with the classification of existing wells, drilling of new shallow wells, and installation of new stream gages; new monitoring network visualized in Figure 4-4.

GSP Area

The Wyandotte Creek Subbasin is in Butte County within the Sacramento Valley, as shown in Figure ES-1. The Wyandotte Creek GSA jurisdictional area is defined by the boundaries of the Wyandotte Creek Subbasin in DWR's 2003 Bulletin 118 as updated in 2016 and 2018. Figure ES-2 shows the boundaries of the Wyandotte Creek Subbasin and the two MAs.

Outreach Efforts

A stakeholder engagement strategy was developed to solicit and discuss the interests of all beneficial users of groundwater in the Wyandotte Creek Subbasin and Plan Area. The strategy included monthly meetings of the Wyandotte Creek GSA Management Committees (made up of staff from the member agencies) and the Wyandotte Creek Advisory Committee (WAC), and a website where all announcements, meeting dates, times, and materials were posted.

The Wyandotte Creek GSA also prepared and implemented a Communication and Engagement Plan (C&E Plan) to encourage involvement from diverse social, cultural, and economic elements of the population of the Wyandotte Creek Subbasin, in addition to meeting SGMA requirements for intrabasin coordination.

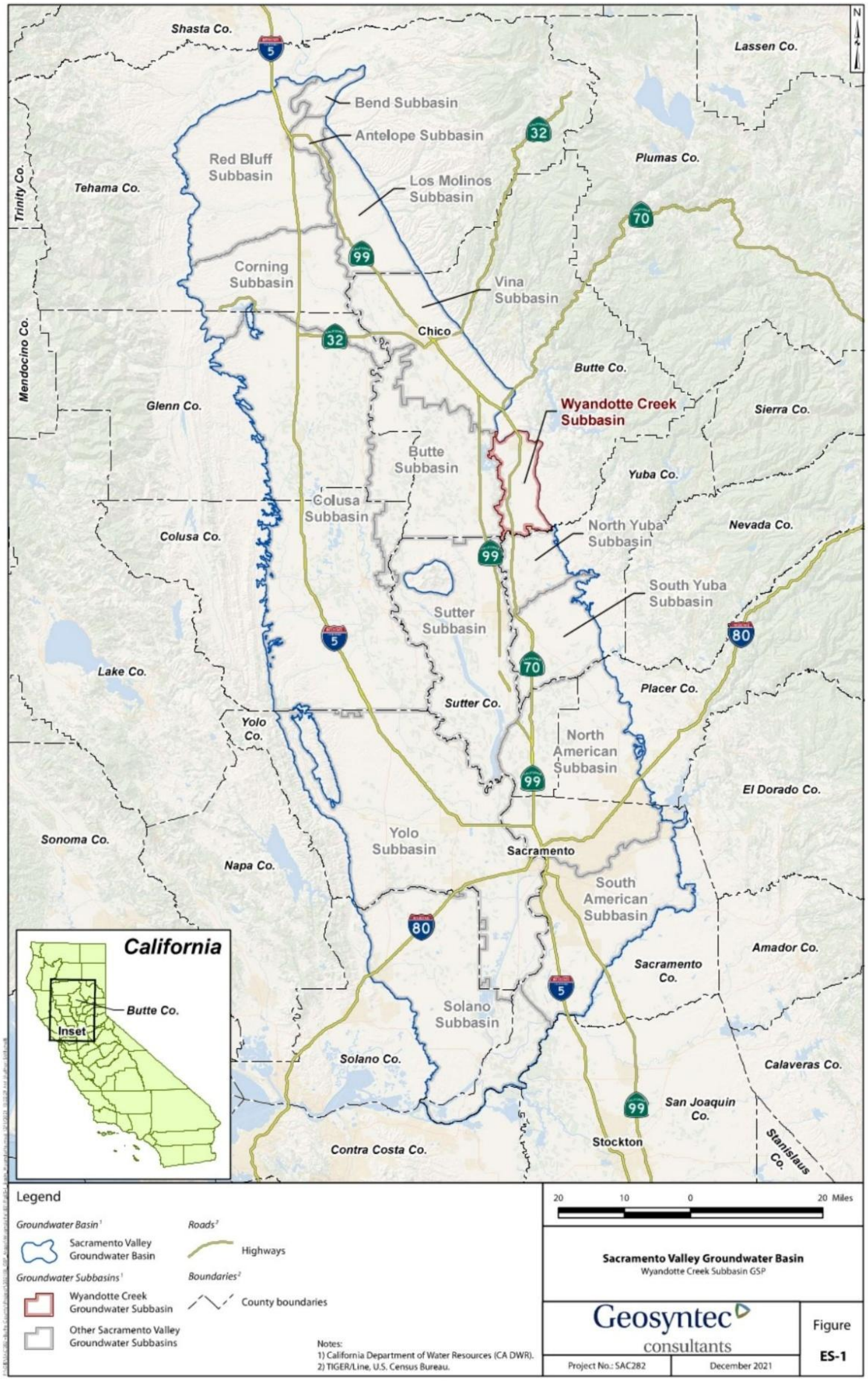
In addition, various chapters of the GSP were available for preliminary review and comment prior to the final draft version released on December 15, 2021. Comments received on preliminary draft chapters were incorporated as deemed appropriate and helped guide and shape the final draft document.

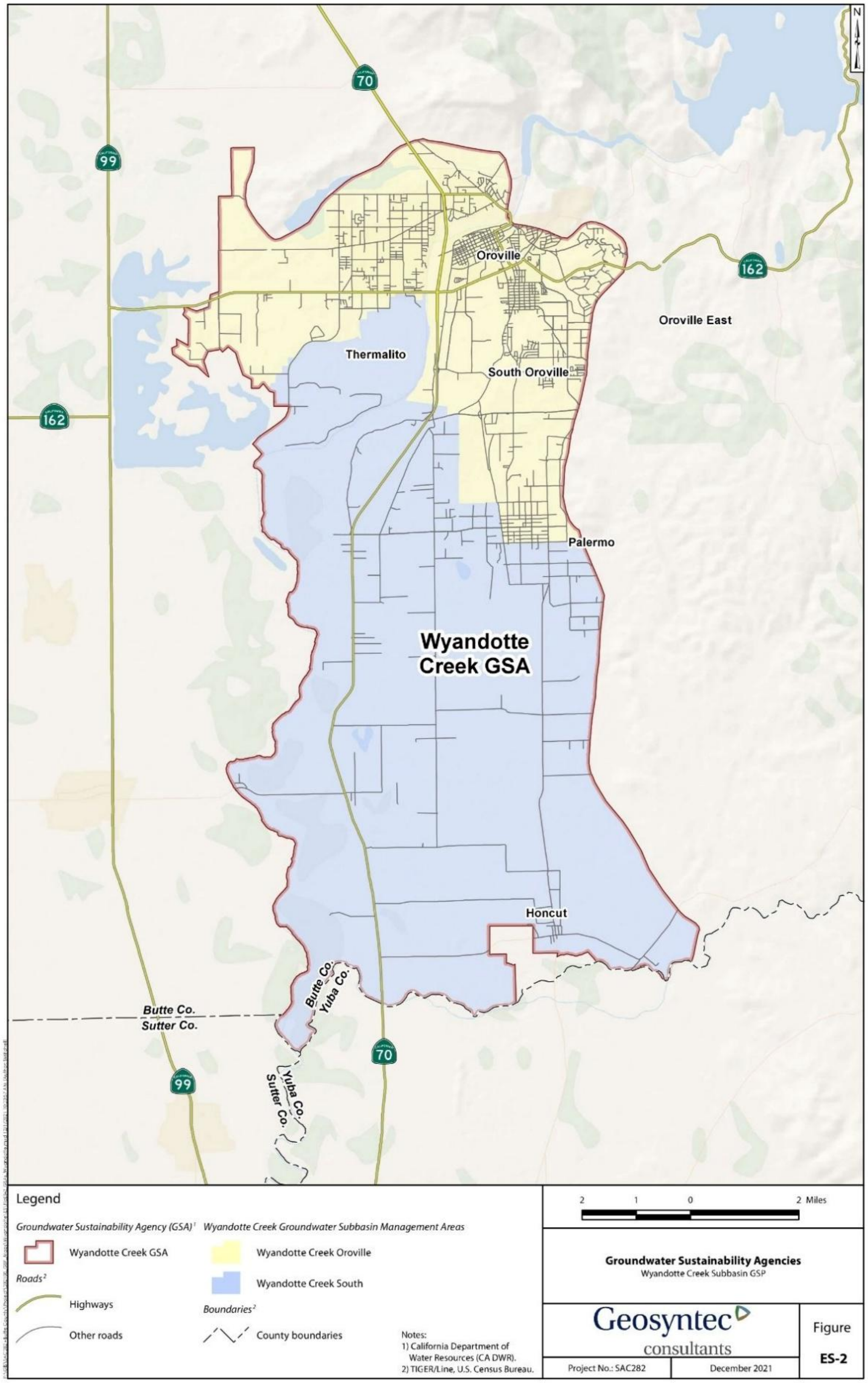
The 2027 Amended GSP followed the same process as the 2022 GSP and was also available for review and comment by the public in 2026.

Basin Setting

The Wyandotte Creek Subbasin lies in the eastern central portion of the Sacramento Groundwater Basin. It is bounded on the west by the Feather River and Thermalito Afterbay; in the south by the Butte-Yuba County line (except for Ramirez Water District which is fully within the North Yuba Subbasin); and on the north and east by the edge of the alluvial basin as defined by DWR Bulletin 118 - Update 2003 (DWR, 2003). It is surrounded by the Butte Subbasin to the west, the Wyandotte Creek Subbasin to the north, the North Yuba Subbasin to the south and the foothills to the east (Figure ES-2). The lateral boundaries of the Wyandotte Creek Subbasin are jurisdictional in nature, and it is recognized that groundwater flows across each of the defined boundaries to some degree.

Continental sediments of the Tuscan and Laguna Formation compose the major fresh groundwater-bearing formations in the Wyandotte Creek Subbasin. The base of these continentally derived formations is generally accepted as the base of fresh water in the northern Sacramento Valley. Locally, the base of fresh groundwater fluctuates depending on local changes in the subsurface geology and geologic formational structure. The base of fresh water is known to be shallower along the eastern portion of the basin.


Shasta Co.
Lassen Co.
Bend Subbasin
Antelope Subbasin
Red Bluff Subbasin
Los Molinos Subbasin
Plumas Co.
Trinity Co.
Tehama Co.
Corning Subbasin
Vina Subbasin
Chico
Mendocino Co.
Butte Co.
Glenn Co.
Wyandotte Creek Subbasin
Sierra Co.
Butte Subbasin
Yuba Co.
Colusa Subbasin
North Yuba Subbasin
Nevada Co.
Colusa Co.
South Yuba Subbasin
Sutter Subbasin
Lake Co.
Sutter Co.
Placer Co.
Yolo Co.
North American Subbasin
El Dorado Co.
Sonoma Co.
Yolo Subbasin
Sacramento
Napa Co.
South American Subbasin
California
Butte Co.
Inset
Amador Co.
Sacramento Co.
Solano Subbasin
Solano Co.
Calaveras Co.
San Joaquin Co.
Stockton
Contra Costa Co.
Stanislaus Co.
Legend
Groundwater Basin[1]
Sacramento Valley Groundwater Basin
Groundwater Subbasins[1]
Wyandotte Creek Groundwater Subbasin
Other Sacramento Valley Groundwater Subbasins
Roads[2]
Highways
Boundaries[2]
County boundaries
Notes:
1) California Department of Water Resources (CA DWR).
2) TIGER/Line, U.S. Census Bureau.
20 10 0 20 Miles
Sacramento Valley Groundwater Basin
Wyandotte Creek Subbasin GSP
Geosyntec consultants
Figure
ES-1
Project No.: SAC282
December 2021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70
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162
Oroville
Oroville East
Thermalito
South Oroville
Palermo
Wyandotte Creek GSA
Honcut
Butte Co.
Sutter Co.
Butte Co.
Yuba Co.
Yuba Co.
Sutter Co.
Legend
Groundwater Sustainability Agency (GSA)[1]
Wyandotte Creek GSA
Wyandotte Creek Groundwater Subbasin Management Areas
Wyandotte Creek Oroville
Wyandotte Creek South
Roads[2]
Highways
Other roads
Boundaries[2]
County boundaries
Notes:
1) California Department of Water Resources (CA DWR).
2) TIGER/Line, U.S. Census Bureau.
2 1 0 2 Miles
Groundwater Sustainability Agencies
Wyandotte Creek Subbasin GSP
Geosyntec
consultants
Project No.: SAC282
December 2021
Figure
ES-2

Groundwater flows from the north and from foothill recharge areas in the east toward the subbasin's southeastern corner. Because of the influence of Thermalito Afterbay and the Feather River, groundwater elevations in the north are generally stable between the spring and fall observation periods, while elevations in the south tend to be lower in the fall than the spring, a pattern typical of valley floor locations distant from major sources of recharge. The location of the Wyandotte Creek Subbasin along with surface water features is shown in Figure ES-3.

Existing Groundwater Conditions

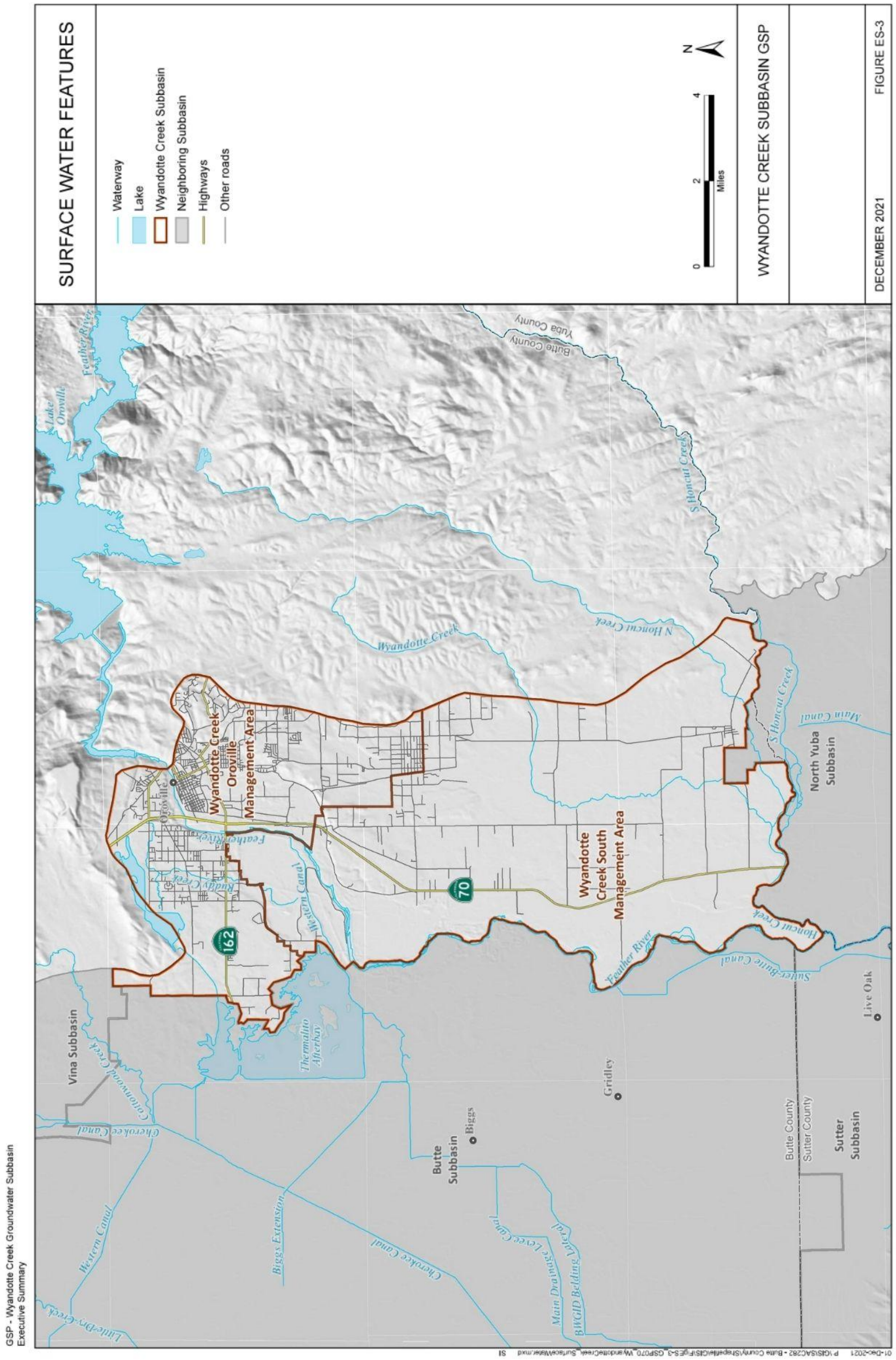
Groundwater conditions in the Wyandotte Creek Subbasin are regularly monitored and are described in reports produced by Butte County since 2001. The Wyandotte Creek GSA submits GSP annual reports to DWR, documenting the state of the groundwater basin. These documents and other reports portray a subbasin that has adequate groundwater resources to meet demands under most hydrologic conditions. However, comparison of the reports illustrates how in the period between their issuance, groundwater conditions have tightened, and as forces ranging from population growth to climate change play out, the value of well-informed water management policies and practices is likely to increase. In short, while groundwater conditions in the Wyandotte Creek Subbasin remain stable, maintaining this posture in the future may become less the result of a state of nature and more the reward for thoughtful management.

Based on historical data and the GSP annual reports, groundwater levels in the Wyandotte Creek Subbasin indicate that groundwater elevations are relatively stable. Groundwater quality in the basin is good except in areas where anthropogenic sources have impacted the groundwater. Figure ES-4 shows the locations of known impacted groundwater from these sources.

Groundwater storage in Wyandotte Creek Subbasin is relatively stable. The Feather River and Thermalito Afterbay stabilize storage volumes by providing recharge to the Wyandotte Creek Subbasin. The total fresh groundwater in storage was estimated at about 2.1 million-acre-feet (MAF) in 2018. The amount of groundwater in storage has decreased by approximately 0.14 percent per year between 2000 and 2018. Between 2020 to 2022, the Subbasin experienced a severe drought followed by several wet and above normal years. Groundwater storage decreased during the critically dry years and recovered during the wet and above normal years (2023-2025). As such, it is highly unlikely the Wyandotte Creek Subbasin will experience conditions under which the volume of stored groundwater poses a concern. However, the depth to access that groundwater across the Wyandotte Creek Subbasin may pose a concern.

Land subsidence has not historically been an area of concern in the Wyandotte Creek Subbasin and there are no records of land subsidence caused by groundwater pumping in the Wyandotte Creek Subbasin. Seawater intrusion is not applicable to the Wyandotte Creek Subbasin due to distance from the Delta and Pacific Ocean.

Surface waters can be hydraulically interconnected with the groundwater system, where the stream baseflow is either derived from the aquifer (gaining stream) or recharged to the aquifer (losing stream). If the water table beneath the stream lowers as a result of groundwater pumping, the stream may disconnect entirely from the underlying aquifer. Within the floodplain of the Feather River there is a continuous saturated zone that connects the shallowest aquifer to the river. The connectivity between shallow and deeper aquifer zones will dictate the overall connectivity to the river.


GSP - Wyandotte Creek Groundwater Subbasin
Executive Summary
SURFACE WATER FEATURES
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE ES-3
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Lake Oroville
Feather River
Wyandotte Creek
N Honcut Creek
S Honcut Creek
Honcut Creek
Main Canal
North Yuba Subbasin
Butte County
Yuba County
Sutter County
Oroville
Thermalito Afterbay
Western Canal
Sutter-Butte Canal
Live Oak
Gridley
Biggs
Butte Subbasin
Sutter Subbasin
Vina Subbasin
Cherokee Canal
Biggs Extension
Little Dry Creek
70
162
Page ES-7

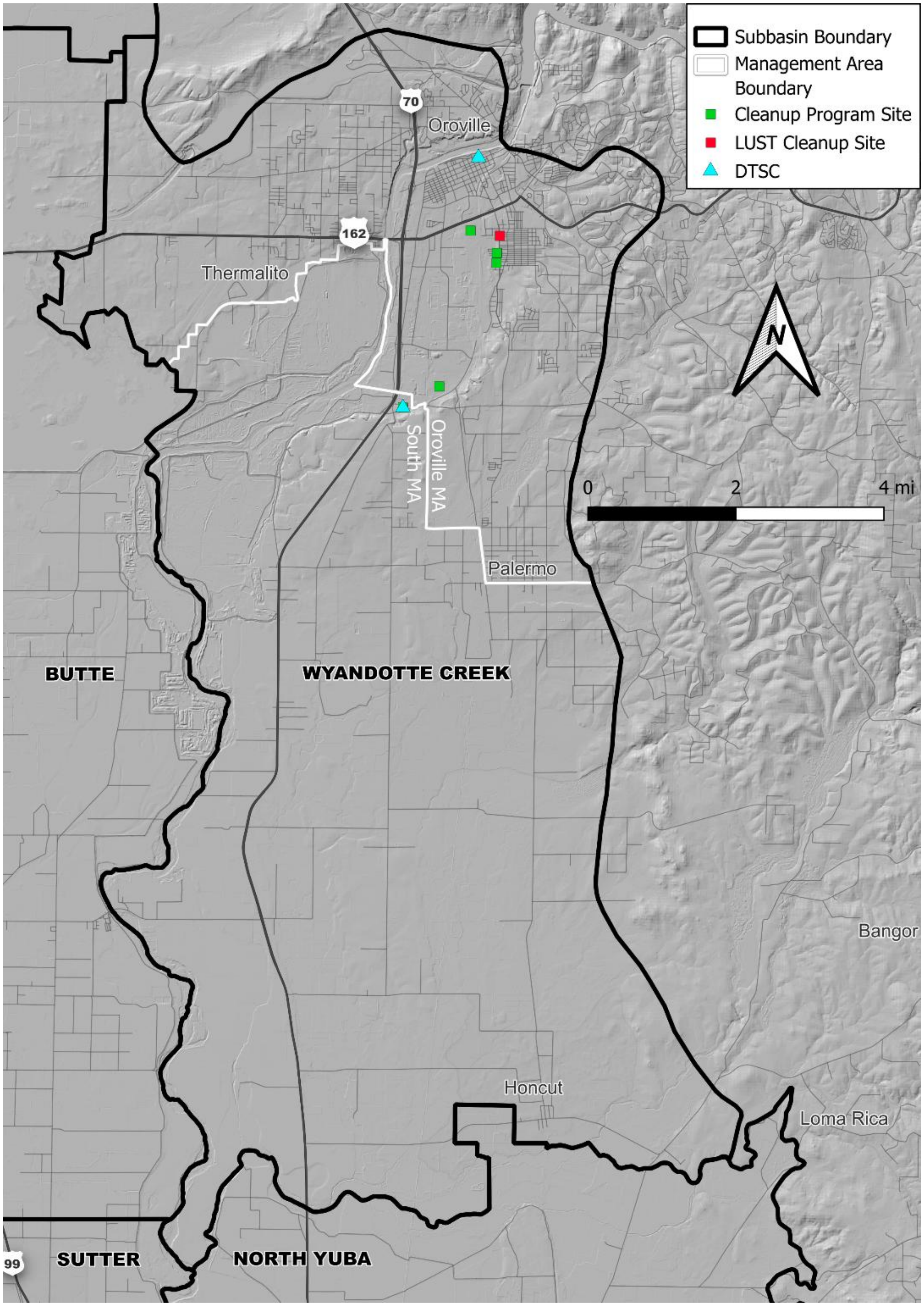


Figure ES-4: Active Contamination Remediation Sites

In the upland areas outside of the Feather River floodplain, there are creeks that flow seasonally and dry up in late summer or are dry for an entire year during dry conditions. In this case, the upland creeks may not be influenced by "high groundwater connectivity" and the presence of an undesirable result is not clear cut with respect to surface water depletion. The streams dry up regardless of the groundwater condition, and streams that are already dry are not considered interconnected surface water. However, the upland streams are an important source of recharge to the aquifer, so the health of these stream channels and their adjacent riparian zones is important to groundwater sustainability. This has been identified as a data gap and will be addressed as part of the GSP implementation.

Potential impacts of the depletion of interconnected surface water were discussed by stakeholders during technical discussions covering the fundamentals of groundwater-surface water interactions and mapping analysis of potential groundwater dependent ecosystems. Potential impacts identified by stakeholders were:

- Disruption to GDEs
- Reduced flows in rivers and streams supporting aquatic ecosystems and water right holders
- Streamflow changes in upper watershed areas outside of the Wyandotte Creek GSA boundary
- Water table depth dropping below the maximum rooting depth of Valley Oak (*Quercus lobata*) or other deep-rooted tree species
- Cumulative groundwater flow moving toward the Feather River from both the Wyandotte Creek Subbasin and surrounding GSAs on both the east and west side of the river

The Wyandotte Creek Subbasin acknowledges that overall function of the riparian zone and floodplain is dependent on multiple components of the hydrologic cycle that may or may not have relationships to groundwater levels in the principal aquifer. For example, hydrologic impacts outside of the Wyandotte Creek Subbasin, such as upper watershed development or fire-related changes in run-off, could result in impacts to streamflow, riparian areas, or GDEs that are completely independent of any connection to groundwater use or conditions within the Wyandotte Creek Subbasin.

Sustainable Management Criteria

SGMA introduces several terms to measure sustainability. The sustainability goal is the culmination of conditions resulting in a sustainable condition (absence of undesirable results) within 20 years. The sustainability goal for the Wyandotte Creek Subbasin is:

> *to ensure that groundwater is managed to provide a water supply of adequate quantity and quality to support beneficial users of groundwater including but not limited to rural areas and other communities, the agricultural economic base of the region, and environmental resource uses in the Subbasin now and in the future.*

SIs refer to any of the effects caused by groundwater conditions occurring throughout the Wyandotte Creek Subbasin that, when significant and unreasonable, cause undesirable results. The six SIs identified by DWR are:

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon
2. Significant and unreasonable reduction of groundwater storage
3. Significant and unreasonable seawater intrusion
4. Significant and unreasonable degraded water quality
5. Significant and unreasonable land subsidence that substantially interferes with surface land uses
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

Undesirable results are the significant and unreasonable occurrence of conditions that adversely affect groundwater use in the Wyandotte Creek Subbasin, including reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses of the Wyandotte Creek Subbasin's groundwater. Categories of undesirable results are defined through the SIs.

MT are numeric values for each SI and are used to define when undesirable results occur. Undesirable results occur if MTs are exceeded in an established percentage of sites in the Wyandotte Creek Subbasin's representative monitoring network. MO are a specific set of quantifiable goals for the maintenance or improvement of groundwater conditions. The margin of operational flexibility is the range of active management between the MT and the MO. Interim milestones (IM) are targets set in 5-year increments over the implementation period of the GSP offering a path to sustainability. Figure ES-5 illustrates these terms using the groundwater level SI.

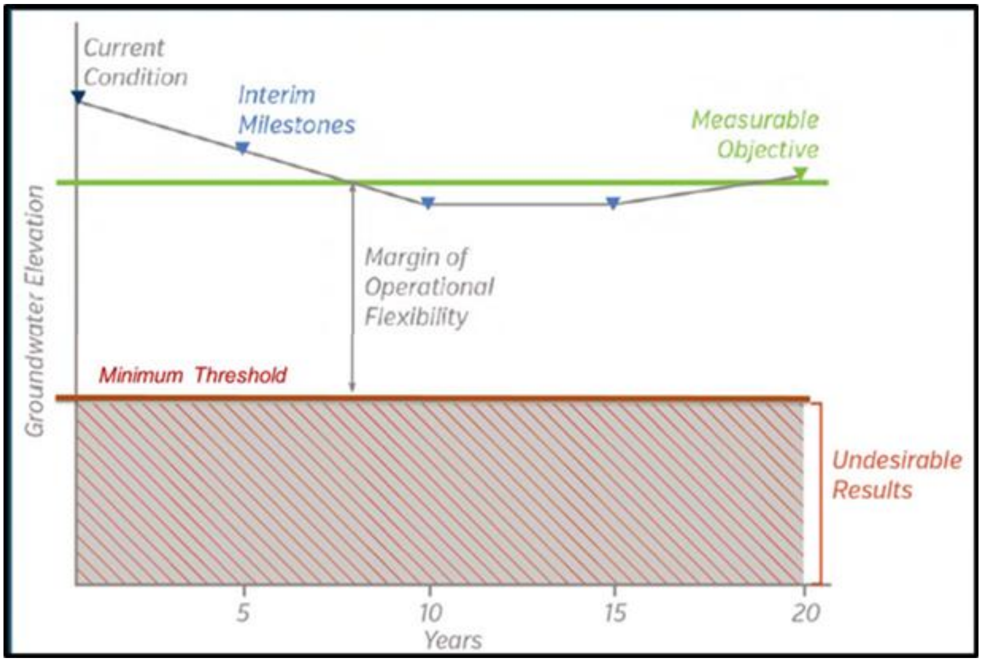


Figure ES-5: Illustration of Terms Used for Describing Sustainable Management Criteria Using the Groundwater Level Sustainability Indicator

A total of ten representative monitoring site (RMS) wells were identified for measurement of groundwater levels in the Wyandotte Creek Subbasin and six representative wells were identified for groundwater quality monitoring. The GSP uses groundwater quality data as a basis for evaluating conditions from saline water below the fresh water and uses groundwater level data as the basis for evaluating conditions for groundwater levels, groundwater storage, and subsidence. The GSP has identified a data gap for development of sustainable management criteria (SMC) for depletion of interconnected surface waters and has provided a framework for evaluation of this SI. For this GSP, the SMC developed for interconnected surface water is preliminary until data gaps are further addressed.

MTs and MOs were developed for each of the representative wells. Figure ES-6 shows a typical relationship of the MTs, MOs, and historical groundwater level data for a sample groundwater level representative monitoring well.

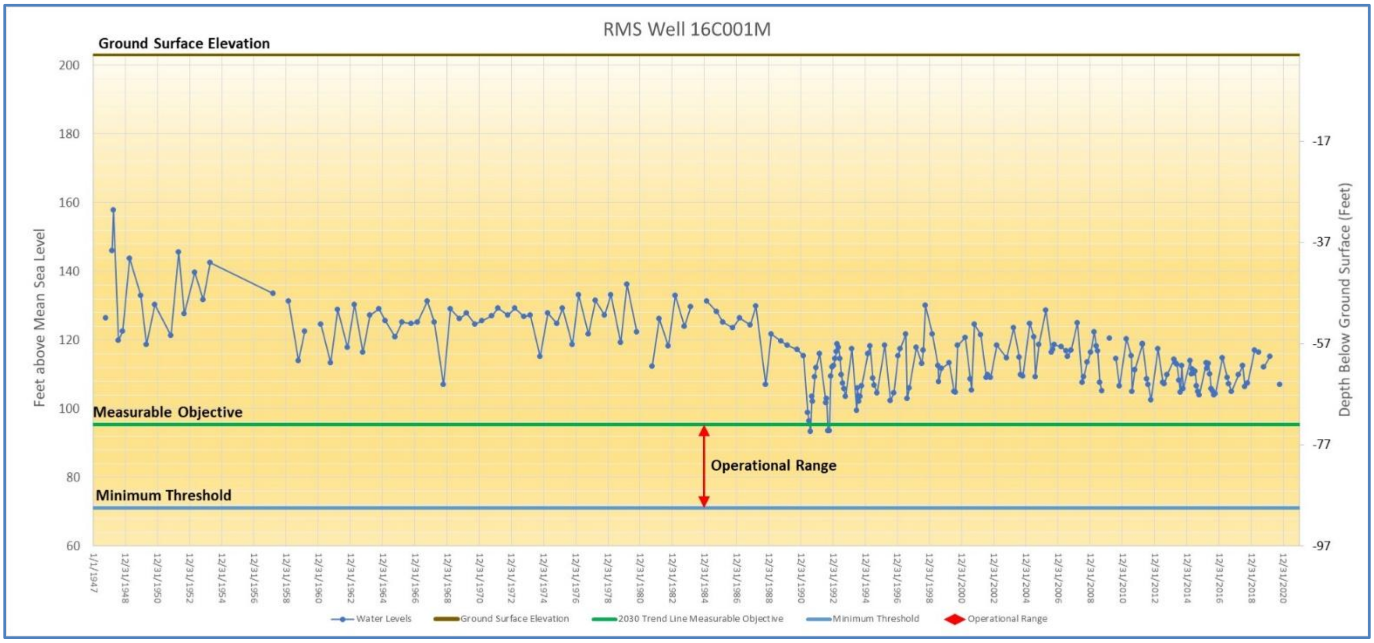


Figure ES-6: Representative Monitoring Site for Groundwater Levels with Relationship of Measurable Objectives, Minimum Thresholds, and Operational Range

MTs for groundwater levels were developed to protect shallow domestic wells within the Subbasin. Representative monitoring site (RMS) wells were selected to be representative of groundwater conditions for domestic wells. The MT for all RMS wells was set to the deeper value of two criteria:

- Criterion 1: Set to protect 95 percent of all shallow domestic wells within each RMS Zone, and
- Criterion 2: Set to a specified buffer distance below the historic low; the buffer is either the range of historically measured groundwater levels or 20 feet, whichever is shallower.

Criterion 2 ensures adequate operational flexibility in periods of drought. During the 2022-2027 implementation period, the domestic well inventory was enhanced and the new dataset was used to update the domestic well risk assessment and SMCs. At the updated MTs, approximately 38 of the 360 (or 11%) active domestic wells in the Subbasin are at risk of going dry. The GSA is working closely with Butte County's Drought Resilience Planning efforts to mitigate against wells going dry due to declining groundwater levels. Additionally, the GSA has identified a PMA, as discussed in Section 5.3.2, to mitigate against dry wells as needed.

The MO was set equal to the average groundwater level recorded from October 1st, 2015, through September 30th, 2025.

IM for groundwater levels are set at five-year intervals between 2022 and 2042. Since the MO for groundwater levels reflect current conditions and is set as a target for future conditions, all IM for groundwater levels are equal to the MO.

Table ES-1: Groundwater Levels Sustainable Management Criteria by Representative Monitoring Site in Feet Above Mean Sea Level

RMS Well ID	Domestic Well Count	Well Type	MT	MO	IM		
					2027	2032	2037
Wyandotte Creek Subbasin – Oroville Management Area							
16Q001M [3]	41	Shallow	108	139	139	139	139
32P001M[2]	64	Shallow	88.8	128	128	128	128
PWS-03[1, 2]	1	Shallow	94	131	131	131	131
Wyandotte Creek Subbasin – South Management Area							
13B002M[3]	14	Deep	11	58	58	58	58
22B001M[2]	32	Shallow	29.8	89	89	89	89
25N001M[3]	23	Shallow	25	61	61	61	61
19D003M[2]	59	Shallow	33.2	72	72	72	72
08M001M[2]	74	Deep	56.1	105	105	105	105
16C001M[3]	74	Both	70	106	106	106	106
31F001M[2]	48	Shallow	88.1	124	124	124	124

Notes:

1) The MT for RMS PWS-03 will be set using criterion 2 due to only having one domestic well in the RMS zone.

2) RMS well uses criterion 2 for setting the MT.

3) RMS well uses criterion 1 for setting the MT.

MTs and MOs for water quality were defined by considering two primary beneficial uses at risk of undesirable results related to salinity: drinking water and agriculture uses. There are several water quality standards for irrigated agriculture, which all recognize that total salt is an important criterion to determine the suitability of water for irrigation. Salinity can affect plant water availability and yield. Typical ranges for irrigation water for EC are 0 to 3,000 µS/cm. The California Department of Health Services has established the preferred agricultural water quality level of specific conductance less than 700 µS/cm. Therefore, the MO is set to 700 µs/cm to maintain irrigated agriculture sensitivity level for salinity to protect agricultural usage.[3] This is consistent with the Butte County Basin Management Objectives (BMO) defined in the Butte County Code of Ordinances. The Butte County BMO Program expired upon the adoption of the 2022 GSP. The MT is set to the recommended secondary maximum contaminant level of 900 µs/cm, or the measured historical high, to ensure safe drinking water (State Water Resources Control Board, 2017).

Data needed to develop the SMC for interconnected surface waters includes definition of stream reaches and associated priority habitat, streamflow measurements to develop profiles at multiple time periods, measurements of groundwater levels directly adjacent to stream channels, first water bearing aquifer zone, and deeper aquifer zones, and estimates of volumes, location and timing of surface water depletion. These data are only partially available and are still a data gap for the GSP. Between 2022 and 2027, new groundwater wells and stream gages have been installed to address the data gap. Further evaluation of this SMC is needed to avoid undesirable results to aquatic ecosystems and GDEs as applicable. To that end, an Interconnected Surface

[3] Artiola, Janick F., Ian L. Pepper, Mark Brusseau. Environmental Monitoring and Characterization. Table 9.4, pg 148

Water SMC framework has been developed for the GSP. Preliminary SMCs have been drafted for the current 2027 Amended GSP, with the goal of collecting additional data for five more years to fill remaining data gaps. RMS wells were selected using existing wells considered representative of ISW connected to the upper (or shallow) aquifer system. Preliminary ISW SMCs were set to a specified buffer distance below the historic low; the buffer is either the range of historically measured groundwater levels or 20 feet, whichever is shallower. Finalized SMCs are scheduled to be developed for the 2032 periodic evaluation, or as guidance is issued, to account for the rate of stream depletion.

The MTs and MOs for groundwater levels are also used for groundwater storage SIs. The groundwater levels MTs are found to be protective of groundwater storage.

The MT and MOs for subsidence are based on historical subsidence trends calculated from InSAR satellite-based subsidence monitoring data. The subsidence analysis in Section 2.2.5.2 showed that the Subbasin experienced minimal subsidence historically (elastic), with a maximum value of 0.11 feet of subsidence over five years. The MT is set to double the historical trend at 0.5 feet of subsidence over five years (or 2 feet over 20 years), and is meant to represent inelastic, or irreversible, subsidence solely due to lowering groundwater levels and may lead to undesirable results. The subsidence MO is equal to the observed maximum subsidence from InSAR data. The MO is one foot over 20 years (e.g., 0.25 feet over a 5-year period) for each of the selected InSAR pixels.

Water Budgets

The groundwater evaluations conducted as a part of GSP development have provided estimates of the historical, current, and projected groundwater budget conditions. The current analysis was prepared using the best available information and through use of the Butte Basin Groundwater Model (BBGM). The BBGM began in 1992 and has been updated over time to simulate historical conditions through 2024. To prepare water budges for the 2022 GSP, historical BBGM results for water years 2000 to 2018 have been relied upon and four additional baseline scenarios were developed to represent current and projected conditions utilizing 50 years of hydrology. It is anticipated that as additional information becomes available, the model will be updated, and more refined estimates of annual pumping and overdraft can be developed.

The projected Wyandotte Creek Subbasin water budget was also evaluated under climate change conditions, which simulate higher demand requiring increased groundwater pumping despite more precipitation and streamflows. The climate change scenario used for the analysis was based on the 2030 and 2070 central tendency climate change datasets provided by DWR to support GSP development. The overdraft modeled under climate change conditions is simulated to increase above projected conditions without climate change up to 3,700 AFY. Figure ES-8 illustrates the cumulative change in groundwater storage for current and future conditions. The model will be updated and calibrated periodically to assess long-term future conditions.

The GSA will annually evaluate and report changes in groundwater storage (i.e., assess overdraft) based on groundwater level measurements collected in the field. The ten-year (WY 2016 – 2025) average annual change in groundwater storage is +4,600 AF per year. This suggests the Subbasin is currently sustainable and will remain sustainable in the short term.

Long-term projections of up to 3,700 AF of overdraft using the model are reasonable based on our current understanding and guidance from DWR. The GSA will develop PMAs to implement as necessary to maintain sustainability.

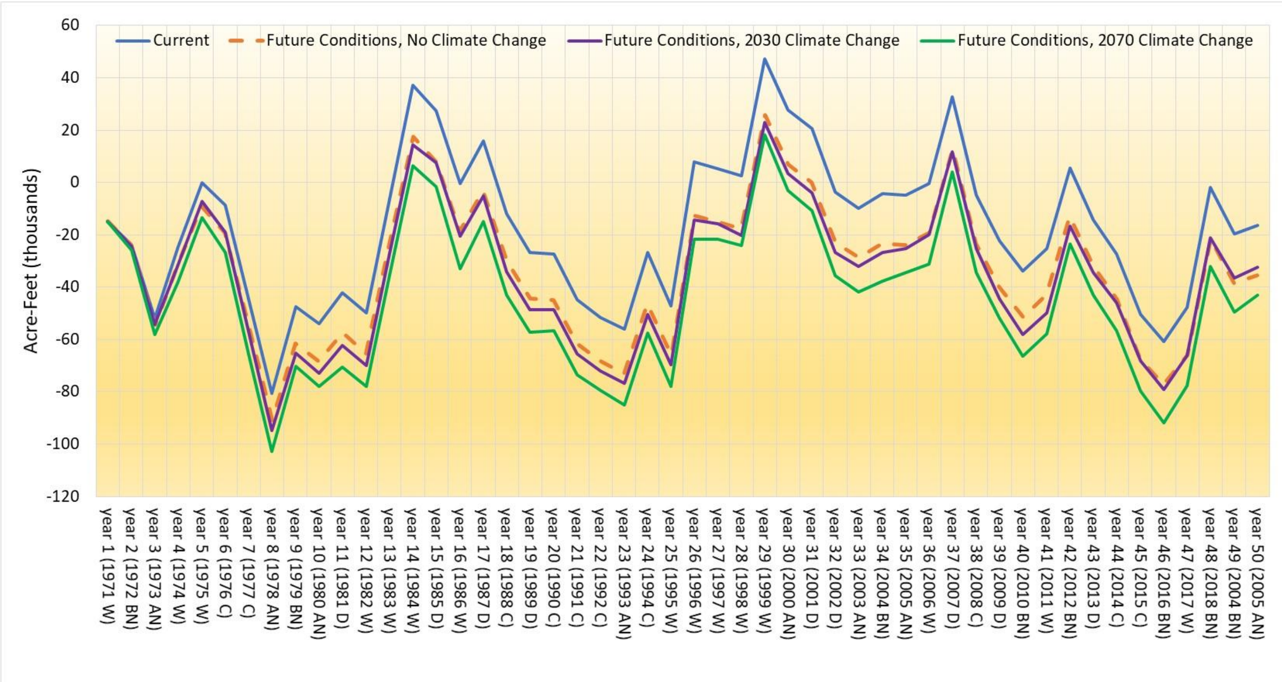


Figure ES-8: Cumulative Change in Groundwater Storage for Current and Future Conditions Baseline Scenarios (BBGM v. 1.0)

Monitoring Networks

The GSP outlines the monitoring networks for the six SIs. The objective of these monitoring networks is to monitor conditions across the Wyandotte Creek Subbasin and to detect trends toward undesirable results. Specifically, the monitoring network was developed to do the following:

- Monitor impacts to the beneficial uses or users of groundwater
- Monitor changes in groundwater conditions relative to MOs and MTs
- Demonstrate progress toward achieving MOs described in the GSP

There are four representative monitoring networks in the Wyandotte Creek Subbasin including a representative network for groundwater levels, water quality, land subsidence, and interconnected surface water. Representative networks are used to determine compliance with the MTs. These sites are selected from broader networks administered by DWR, Butte County, and other outside agencies. These broad networks collect data for informational purposes to identify trends and fill data gaps across the entire Subbasin / State. Sites from the broader network will be re-evaluated, as needed, to assess whether or not to include as a RMS.

The monitoring networks were designed by evaluating data from Butte County's former Basin Management Objective (BMO) program, the United States Geological Survey (USGS), and participating GSAs. The monitoring network consists largely of wells that are already being used for monitoring in the Wyandotte Creek Subbasin. Figure ES-9 shows the location of groundwater monitoring wells for the representative monitoring networks.

Wells in the monitoring networks will be measured at least on a semi-annual schedule. Historical measurements will be entered into the Wyandotte Creek Subbasin Data Management System (DMS), and future data will also be stored in the DMS. A summary of the wells in the monitoring networks is shown in the table below. There are also seven stream gages monitored within the Wyandotte Creek Subbasin.

Summary of Monitoring Network Wells	
Representative Networks	**Well Count**
Groundwater Level	10
Groundwater Quality	8
Interconnected Surface Waters	3

Data Management System

The DMS that will be used is a geographical relational database that will include information on water levels, land elevation measurements, and water quality testing. The DMS will allow the GSA to share data and store the necessary information for annual reporting.

The DMS will be on local servers and data will be transmitted annually to form a single repository for data analysis for the Wyandotte Creek Subbasin's groundwater, as well as to allow for preparation of annual reports. The DMS currently includes the necessary elements required by the regulations, including:

- Well location and construction information for the representative monitoring points (where available)
- Water level readings and hydrographs including water year type
- Land based measurements
- Water quality testing results
- Estimate of groundwater storage change, including map and tables of estimation
- Graphs with Water Year type, Groundwater Use, Annual Cumulative Storage Change

Additional items may be added to the DMS in the future as required. Data will be entered into the DMS by the GSA.

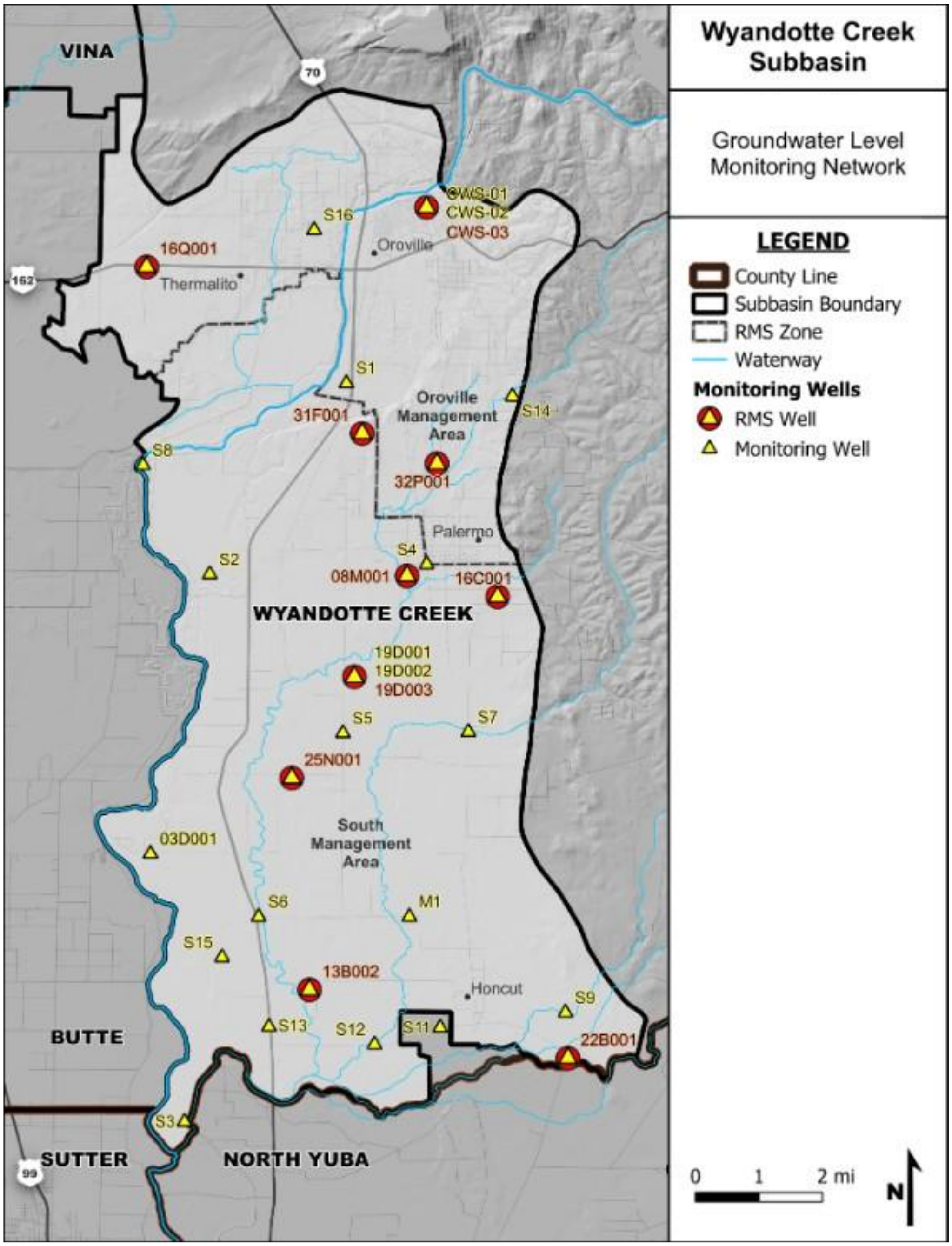


Figure ES-9: Groundwater Level Monitoring Network

Projects and Management Actions

Each of the projects are in various stages of development ranging from ongoing to planned to those still in the conceptual phase. Thus, each of the projects have a different level of development. The GSA will maintain a list of proposed projects and track their development status. The GSA will use this list to help secure funding as opportunities become available. Projects presented in this Plan will remain a part of the potential projects that the GSA may choose to implement, however as other projects are identified, those will be added to the list. The projects currently being considered are sorted into the following categories: Completed, In-Progress, Potential, and Other Projects as described in GSP Sections 5.2.4, 5.2.5, and 5.2.6; respectively.

Completed:

- TWSD Water Treatment Plant Capacity Upgrade

In-Progress Projects:

- Residential Water Conservation
- Palermo Clean Water Consolidation Project
- Agricultural Irrigation Efficiency
- Regional Conjunctive Use Project

Potential Projects:

- Extend Orchard Replacement

These Projects have been prioritized by the GSA for implementation. Other projects are listed in Section 5.2.7 that may be prioritized and implemented by the GSA as needed.

Management Actions

GSAs have a variety of tools to use to achieve sustainable groundwater management. Projects focus primarily on capture, use, and recharge of surface water supplies while management actions focus on groundwater demand.

Section 5.3 presents several management actions that the GSA may consider during GSP implementation. It is expected that the GSA will further develop and modify management actions in response to stakeholder input and available information. The management actions identified in this GSP include:

- General Plans Updates
- Domestic Well Mitigation
- Well Permitting Ordinance
- Landscape Ordinance
- Expansion of Water Purveyors' Service Area

The GSA has prioritized domestic well mitigation to implement as needed. Other management actions may be prioritized and implemented as needed.

Plan Implementation

The Wyandotte Creek Subbasin GSP is being implemented by the GSA since its submission in 2022. In 2023, the GSA successfully passed a Proposition 218 process to assess landowners based on three user classes: non-irrigated, irrigated with surface water, and irrigated with groundwater. These fees fund administrative, legal, and SGMA-compliance costs. The GSA will consider alternative funding structures based on feedback from constituent members as needed.

The GSA applied and received grant funding to further support the GSP implementation through new data collection and projects and management actions. The Regional Conjunctive Use Project, consisting of Intra-Basin Water Transfer and Agricultural Surface Water Supplies planning and feasibility studies, and Thermalito Water Treatment Plant Capacity Upgrade were completed. The GSA will continue their public outreach efforts and work to secure funding to implement projects and management actions. The estimated budgets and implementation schedule for the proposed projects and management actions are presented in Chapter 6.

Implementing the Wyandotte Creek Subbasin GSP will require numerous management activities that will be undertaken by the GSA, including:

- Monitoring conditions relative to applicable SIs at specified frequency and timing
- Entering updated monitoring data into the Wyandotte Creek Subbasin DMS
- Refining the Wyandotte Creek Subbasin model and water budget planning estimates
- Preparing annual reports summarizing the conditions of the Wyandotte Creek Subbasin and progress towards sustainability and submitting them to DWR
- Completing Periodic Evaluations of the GSP every five years and submitting them to DWR
- Overseeing and monitoring projects, management actions, and collection of data identified as “data gaps” within the GSP
- Identify funding sources
- Coordinating with neighboring subbasins

1. AGENCY INFORMATION, PLAN AREA, COMMUNICATION

1.1 Introduction and Agency Information

1.1.1 Purpose of the Groundwater Sustainability Plan

The purpose of this Groundwater Sustainability Plan (GSP) is to meet the regulatory requirements set forth in the three-bill legislative package consisting of Assembly Bill (AB) 1739 (Dickinson), Senate Bill (SB) 1168 (Pavley), and SB 1319 (Pavley), collectively known as the Sustainable Groundwater Management Act (SGMA). SGMA defines sustainable groundwater management as "management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results," which are defined by SGMA as any of the following effects caused by groundwater conditions occurring throughout the basin (Department of Water Resources [DWR], 2018a):

- 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
- Significant and unreasonable land subsidence that substantially interferes with surface land uses
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

The Wyandotte Creek Groundwater Subbasin (Wyandotte Creek Subbasin) has been identified by DWR as a medium priority basin. The Wyandotte Creek GSP was developed to meet SGMA regulatory requirements by the January 31, 2022, deadline for high and medium priority basins while reflecting local needs and preserving local control over water resources. Requirements for the GSP are provided in California Code of Regulations Title 23, Division 2, Chapter 1.5, Subchapter 2, Article 5. Appendix 1-A provides a checklist of where to find the information required by these regulations.

The Wyandotte Creek GSP provides a path to achieve and document sustainable groundwater management within 20 years following GSP adoption, promoting the long-term sustainability of locally managed groundwater resources now and into the future. In 2027, an Amended GSP and Periodic Evaluation was submitted to DWR. The Amended GSP updated SMCs and networks for nearly all applicable sustainability indicators. Stream depletions and subsidence, that previously used the groundwater level SI as a proxy, have their own established networks and SMCs. The 2027 GSP also updated key sections with new data and analysis, including interconnected surface water and groundwater dependent ecosystems. The sustainable yield has been updated to reflect updated data collection for groundwater pumping and groundwater levels. Water budget results including estimates of groundwater pumping and change in storage, and sustainable yield will be updated in annual reporting.

While the Wyandotte Creek GSP offers a new and significant approach to groundwater resource protection, it was developed within an existing framework of comprehensive planning efforts. Throughout the Wyandotte Creek Subbasin, several separate yet related planning efforts have occurred previously or are concurrently proceeding. In November 1996, the voters in Butte County approved "An Ordinance to Protect the Groundwater Resources in Butte County." One of the stated purposes of the ordinance was that "the groundwater underlying Butte County is a significant water resource which must be reasonably and beneficially used and conserved for the benefit of the overlying land by avoiding extractions which harm the Butte basin aquifers (includes the Wyandotte Creek Subbasin), causing exceedance of the safe yield or a condition of overdraft." Other significant reports prepared in the Wyandotte Creek Subbasin include integrated regional water management (IRWM), urban water management, habitat conservation, basin assessment, and general planning. The Wyandotte Creek GSP fits in with these prior planning efforts, building on existing local management and basin characterization. A description of prior planning efforts can be found in Section 1.2.1 of this document.

1.1.2 Sustainability Goal

A sustainability goal is the culmination of conditions resulting in a sustainable condition (absence of undesirable results) within 20 years. The sustainability goal reflects this requirement and succinctly states the GSP's objectives and desired conditions of the Wyandotte Creek Subbasin.

The sustainability goal for the Wyandotte Creek Subbasin is "to ensure that groundwater is managed to provide a water supply of adequate quantity and quality to support beneficial users of groundwater including but not limited to rural areas and other communities, the agricultural economic base of the region, and environmental resource uses in the Subbasin now and in the future."

Additional discussion of the sustainability goal can be found in Section 3: Sustainable Management Criteria.

1.1.3 Contact Information

The Wyandotte Creek Groundwater Sustainability Agency (GSA) has been tasked with submitting a single, jointly composed GSP to DWR on behalf of the entire Wyandotte Creek Subbasin. Contact information for the submitting agency and Plan Manager is provided below:

Submitting Agency:	Wyandotte Creek Groundwater Sustainability Agency 308 Nelson Avenue Oroville, California 95965 (530) 552-3591
Plan Manager:	Dillon McGregor, GSA Program Manager 308 Nelson Avenue Oroville, California 95965 530.552.3595 WyandotteGSA@gmail.com

The Plan Manager is subject to change. Updated contact will be available on the GSA's website: https://www.wyandottecreekgsa.com/.

1.1.4 Agency Information

The Wyandotte Creek GSA was formed through the execution of a Joint Powers Agreement (Agreement; Appendix 1-B) by the County of Butte, City of Oroville and Thermalito Water and Sewer District (TWSD; Figure 1-1).

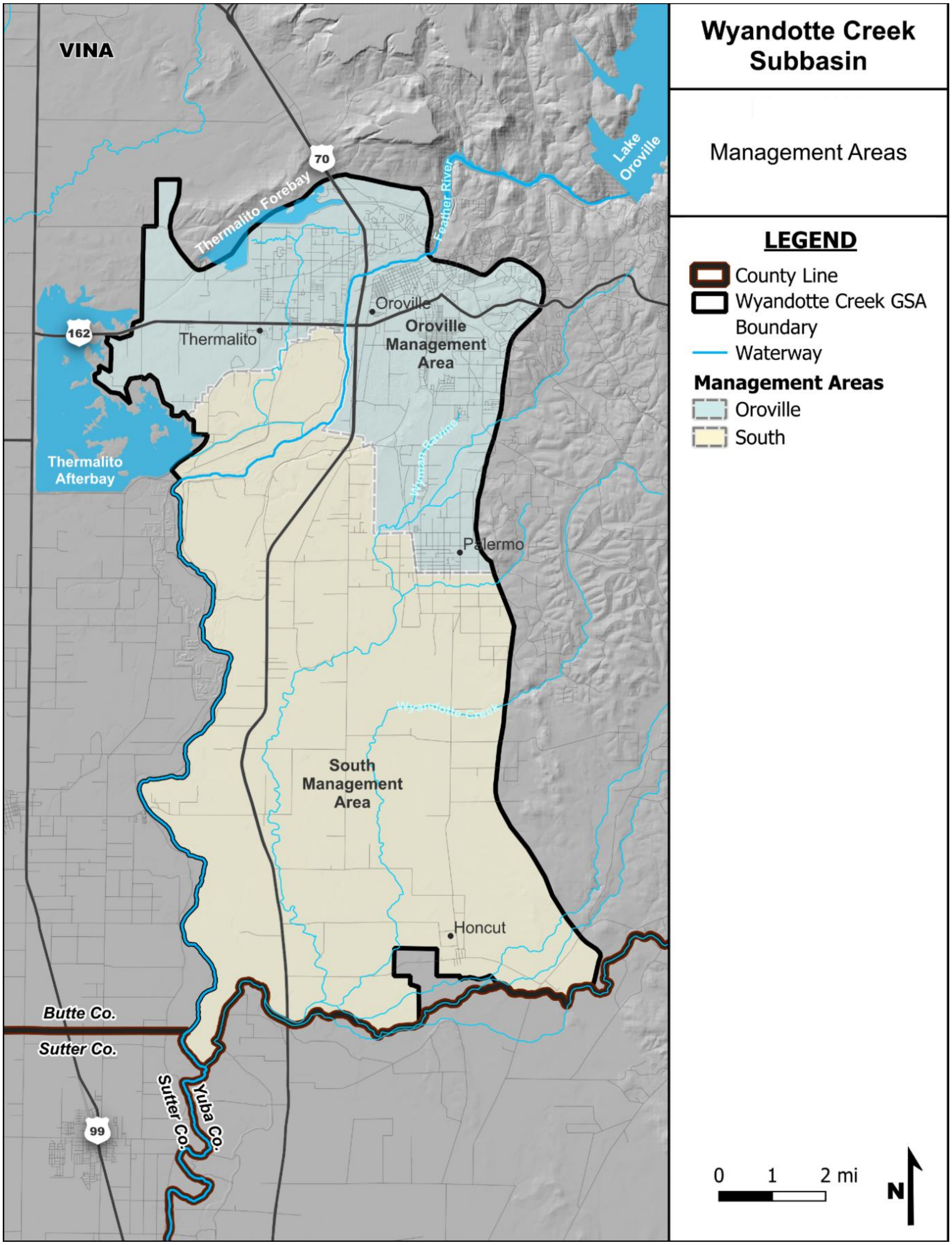


Figure 1-1: Groundwater Sustainability Agency with Management Areas.

The Wyandotte Creek GSA filed to be a GSA on October 24, 2018. The purpose of the Agreement was to create the Wyandotte Creek GSA to 1) to develop, adopt, and implement a GSP for the Wyandotte Creek Subbasin to implement SGMA requirements and achieve the sustainability goals; and 2) involve the public and subbasin stakeholders through outreach and engagement in developing and implementing the GSP. At the heart of the Agreement is the focus to maximize local input and decision-making and address the different water demands and sustainability considerations in the municipal and rural areas of the Wyandotte Creek subbasin.

The Wyandotte Creek GSA Board serves as the policy-making role for SGMA implementation in the Wyandotte Creek subbasin. All GSA Board meetings are subject to the Brown Act and are noticed and open to the public. The GSA Board is composed of five seats, each with equal and full voting rights, including:

1. Butte County – one seat (Member Agency)
2. City of Oroville – one seat (Member Agency)
3. TWSD – one seat (Member Agency)
4. Agricultural groundwater user – one seat (At-large Butte County Appointed Stakeholder)
5. Domestic well user (non-agricultural) – one seat (At large Butte County Board Appointed Stakeholder)

The Wyandotte Creek GSA Board as stated in the Agreement possesses the ability to exercise those powers specifically granted by the Joint Powers Act and SGMA. Additionally, the GSA has the ability to exercise the common powers of its Members related to the purposes of the GSA, including, but not limited to, the following:

- To designate itself as the exclusive GSA for the Wyandotte Creek Subbasin pursuant to SGMA.
- To develop, adopt and implement a GSP for the Wyandotte Creek Subbasin pursuant to SGMA.
- To adopt rules, regulations, policies, bylaws, and procedures governing the operation of the GSA and adoption and implementation of a GSP for the Wyandotte Creek Subbasin.
- To adopt ordinances within the Wyandotte Creek Subbasin consistent with the purpose of the GSA as necessary to implement the GSP and otherwise meeting the requirements of the SGMA.
- To obtain legal, financial, accounting, technical, engineering, and other services needed to carry out the purposes of this Agreement.
- To perform periodic reviews of the GSP including submittal of annual reports.
- To require the registration and monitoring of wells within the Wyandotte Creek Subbasin.
- To issue revenue bonds or other appropriate public or private debt and incur debts, liabilities, or obligations.

- To exercise the powers permitted under Government Code section 6504 or any successor statute.
- To levy taxes, assessments, charges, and fees as provided in SGMA or otherwise provided by law.
- To regulate and monitor groundwater extractions within the Wyandotte Creek Subbasin as permitted by SGMA, provided that this Agreement does not extend to a Member's operation of its systems to distribute water once extracted or otherwise obtained, unless and to the extent required by other laws now in existence or as may otherwise be adopted.
- To establish and administer projects and programs for the benefit of the Wyandotte Creek Subbasin.
- To cooperate, act in conjunction and contract with the United States, the State of California, or any agency thereof, counties, municipalities, special districts, GSAs, public and private corporations of any kind (including without limitation, Public Utilities Commission regulated utilities and mutual water companies), and individuals, or any of them, for any and all purposes necessary or convenient for the full exercise of powers of the GSA.
- To accumulate operating and reserve funds and invest the same as allowed by law for the purposes of the GSA and to invest funds pursuant to California Government Code section 6509.5 or other applicable State Law.
- To apply for and accept grants, contributions, donations, and loans under any federal, state, or local programs for assistance in development or implementing any of its projects or programs for the purposes of the GSA.
- To acquire by negotiation, lease, purchase, construct, hold, manage, maintain, operate, and dispose of any buildings, property, water rights, works or improvements within and without the respective boundaries of the Members necessary to accomplish the purposes described herein.
- To sue and be sued in the GSA's own name.
- To exercise the common powers of its Members to develop, collect, provide, and disseminate information that furthers the purposes of the GSA, including but not limited to the operation of the GSA and adoption and implementation of a GSP for the Wyandotte Creek Subbasin, to the Members' legislative, administrative, and judicial bodies, as well as the public generally.
- To perform all other acts necessary or proper to carry out fully the purposes of this Agreement.

The Wyandotte Creek GSA Board aspires to seek consensus. If the Wyandotte Creek GSA Board cannot reach consensus, the Wyandotte Creek GSA Board defaults to the following voting structure.

- Quorum: A majority of the members of the Wyandotte Creek GSA Board members shall constitute a quorum for purposes of transacting business.

- Director Votes: Each member of the Wyandotte Creek GSA Board shall have one vote.
- Supermajority Voting Requirement (four affirmative votes) for the following:
  1. Bylaws adoption, modification or alteration
  2. GSP adoption, modification, alteration
  3. Adoption of assessment, charges and fees
  4. Adoptions of regulations and ordinances
  5. Adoption or modification of annual budget, including capital projects
  6. Property acquisition (excepting rights of way)
  7. Removal of Advisory Committee Members
  8. Modifications to the composition and number of Advisory Committee Members
  9. Removal of stakeholder board seats as is consistent with the Agreement

The Wyandotte Creek GSA Board does not have the authority to limit or interfere with the respective Member Agency's rights and authorities over their own internal matters, including, but not limited to, legal rights to surface water supplies and assets, groundwater supplies and assets, facilities, operations, water management and water supply matters. The Member Agencies made no commitments by entering into the Agreement to share or otherwise contribute their water supply assets as part of the development or implementation of a GSP. Nothing in the Agreement modifies or limits a Member Agency's police powers, land use authorities, or any other authority. The Member Agencies cooperate to obtain consulting, administrative and management services needed to efficiently develop a GSP and to identify mechanisms for the management and funding commitments reasonably anticipated to be necessary for the purposes of this Agreement.

Each Member Agency (Butte County, City of Oroville and TWSD) designates a staff person (in-kind support) to participate on the Wyandotte Creek GSA Management Committee. The Management Committee receives direction from the Wyandotte Creek GSA Board, makes recommendations and generates staff reports and proposals to the Wyandotte Creek GSA Board. The Management Committee staffs the Advisory Committee and reports to the Wyandotte Creek GSA Board. The Management Committee assures that staff and other resources are provided to prepare the GSP and administer the governance for the Wyandotte Creek GSA.

The Wyandotte Creek GSA does not and will not have any employees. However, the Wyandotte Creek GSA has the power to employ consultants to fulfill the objectives and purposes of SGMA and complete a GSP. Butte County provides technical and staff support in coordination with the Management Committee and the Wyandotte Creek GSA Board. The Management Committee may form ad hoc technical working groups to provide input on technical matters pertaining to the GSP. Preparation of the Wyandotte Creek GSP and carrying out governance requires various administrative activities such as meeting management, website development and maintenance, public outreach and communication.

The Wyandotte Creek Advisory Committee (WAC) provides input and recommendations to Wyandotte Creek GSA Board on GSP development and implementation as well as other items outlined in their Charter. At the time of GSP submittal, the Advisory Committee members included:

- California Water Service (Cal Water) – One representative
- Tribal representative(s)
- South Feather Water and Power Agency (SFWPA) – One representative
- At-large agricultural groundwater users – Three representatives
- At-large domestic well users – Two representatives
- At-large environmental – One representative
- At-large business – One representative

The Wyandotte Creek GSA Board appointed at-large members to fill Advisory Committee seats. Interested individuals from the community or organizations may apply to the Wyandotte Creek GSA. At-large members must live, farm or be employed by a firm operating in the Wyandotte Creek subbasin. To inform the Wyandotte Creek GSA Board and assist in decision-making, the Advisory Committee provides recommendations that are included in Management Committee reports. The recommendations identify areas of agreement and disagreement. The Advisory Committee strives for consensus when possible, but reaching consensus is not necessary. Consensus means that everyone can at least "live with" the recommendation. When unable to reach consensus on recommendations, the Advisory Committee outlines the areas in which it does not agree, providing some explanation to inform the Wyandotte Creek GSA Board decision-making. The Wyandotte Creek GSA Board considers Advisory Committee recommendations when making decisions. If that Board does not agree with the recommendations of the Advisory Committee, the Wyandotte Creek GSA Board states the reasons for its decision. The Advisory Committee is staffed by one member of each of the Member Agencies. All Advisory Committee meetings are subject to the Brown Act and are noticed and open to the public.

Updates to the Board and Committee members will be posted to the GSA's website.

1.2 Groundwater Sustainability Plan Area

This section provides a detailed description of the Wyandotte Creek Subbasin, including major streams and creeks, institutional entities, agricultural and urban land uses, locations of groundwater wells, and locations of state lands. The GSP Area document also describes existing surface water and groundwater monitoring programs, existing water management programs, and general plans in the GSP Area.

1.2.1 Summary of Jurisdictional Areas and Other Features

The Wyandotte Creek Subbasin falls within the larger Sacramento Valley Groundwater Basin (Figure 1-2). Basin designations by DWR were first published in 1952 in Water Quality Investigations Report No. 3, Ground Water Basins in California, and subsequently updated in Bulletin 118 in 1975, 1980, 2003 and draft update in 2020. As shown in Figure 1-3, the

Wyandotte Creek Subbasin (Bulletin 118 Basin Number 5-021.69) is bordered to the north by the Vina Subbasin (Bulletin 118 Basin Number 5-021.57), the Butte Subbasin (Bulletin 118 Basin Number 5-021.70) to the west; to the south by the North Yuba Subbasin (Bulletin 118 Basin Number 5-021.60) and Sutter Subbasin (Bulletin 118 Basin Number 5-021.62; and to the east by the Sierra Nevada geomorphic province.

The Wyandotte Creek Subbasin is located within Butte County. Geologic units in the Wyandotte Creek Subbasin consist of consolidated rocks and unconsolidated deposits as discussed in detail in Section 2. No adjudicated areas or areas covered by an alternative to a GSP exist within the Wyandotte Creek Subbasin.

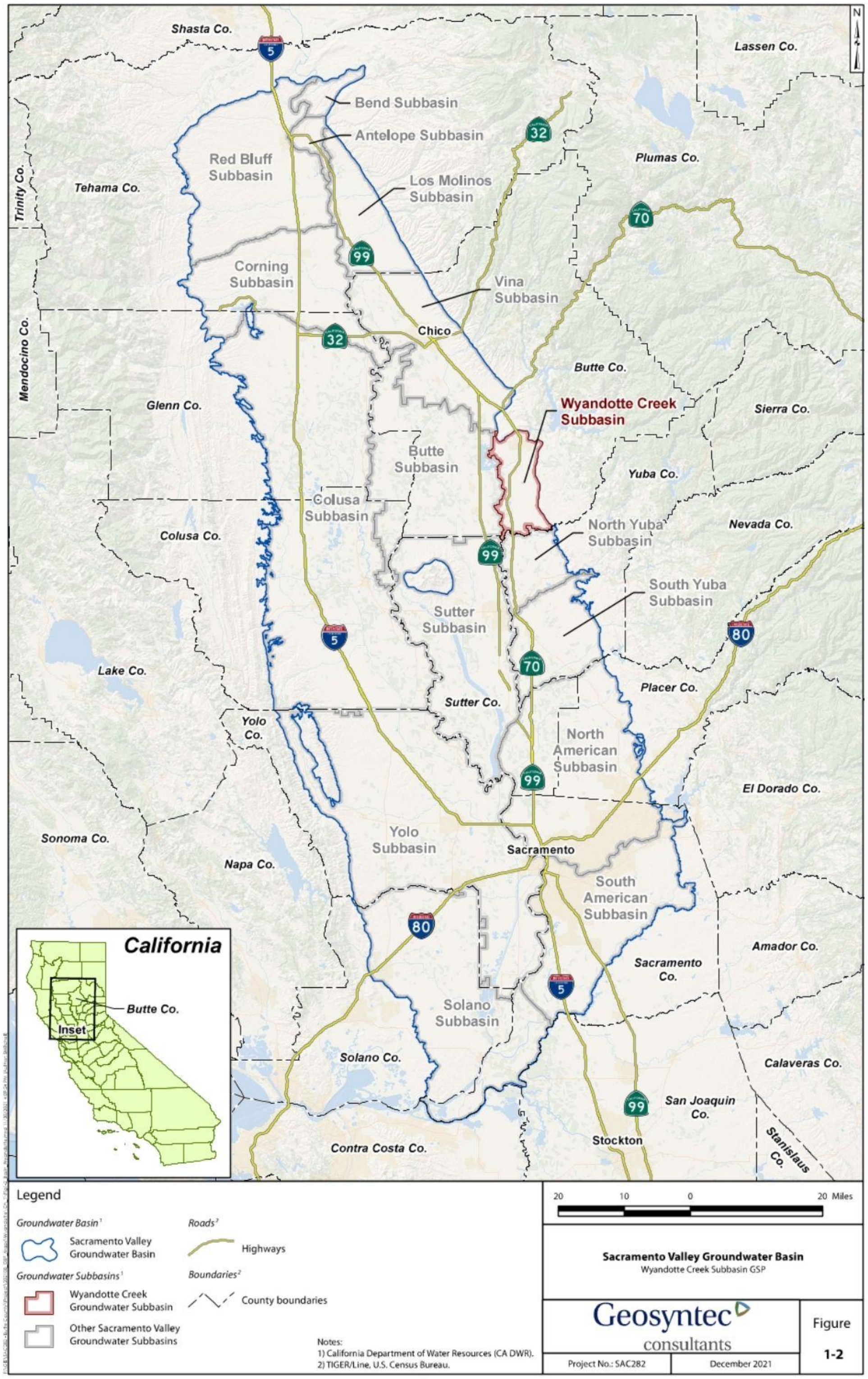
Figure 1-4 shows the Wyandotte Creek Subbasin's key geographic features. The Wyandotte Creek Subbasin encompasses an area of about 59,382 acres. There are two entities within the Wyandotte Creek Subbasin with land use jurisdiction: Butte County and the City of Oroville.

Figure 1-5 shows the tribal areas within the Wyandotte Creek Subbasin that includes portions of the Berry Creek Off-Reservation Trust Land, Mooretown Off-Reservation Trust Land, and Mooretown Rancheria. Figure 1-6 shows the spatial extent of Disadvantaged Communities (DACs) and Severely Disadvantaged Communities (SDACs) in the Wyandotte Creek Subbasin. DWR defines DACs as census geographies (census tracts, census block groups, and census-designated places) with an annual median household income (MHI) that is less than 80% of the statewide annual MHI. SDACs are defined as census geographies with an MHI less than 60% of the statewide annual MHI. DWR uses the most recently available 5-year American Community Survey (ACS) dataset to identify these areas. For this GSP, the 2012-2016 ACS dataset was used, establishing statewide MHI as $63,783 (CA DWR, Mapping Tools).

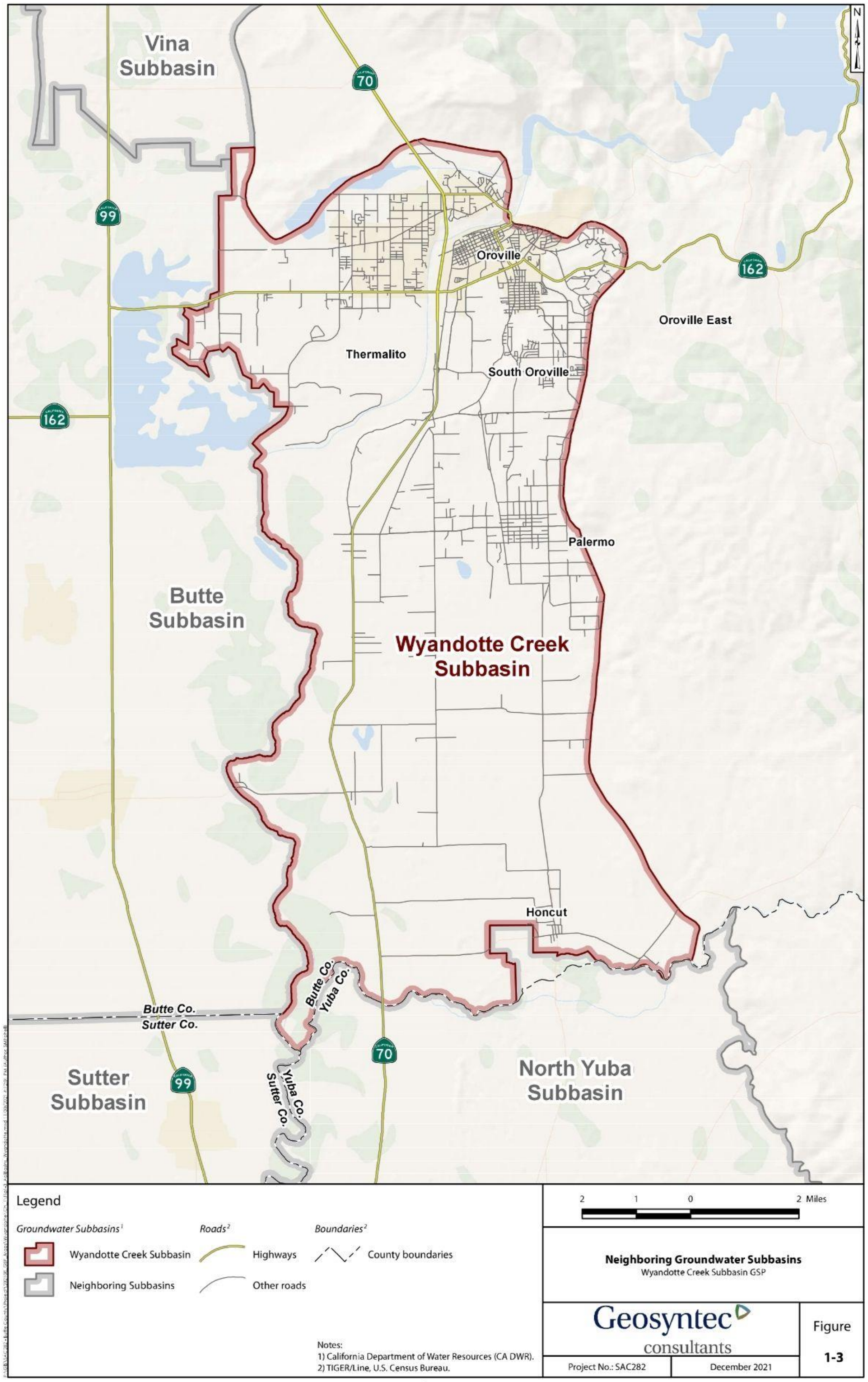
Figure 1-7 shows a map of land use in the Wyandotte Creek Subbasin across four general categories: cropland, industrial, undeveloped, and urban. These categories were mapped based on categories provided by 2015 land use from the United States Department of Agriculture's (USDA) CropScape 2015 dataset.

Land use patterns in the Wyandotte Creek Subbasin are dominated by agricultural uses, including nut and fruit trees, vineyards, row crops, grazing, and forage. Throughout the Wyandotte Creek Subbasin both agricultural and urban land use rely on a combination of surface water and groundwater. Land use is primarily controlled by local agencies. Land use patterns in the low foothills to the east are dominated by native vegetation and unirrigated pasture lands (USDA, 2020).

Crop type varies by region, with fruit and nut trees and rice fields comprising the majority of agriculture in the Wyandotte Creek Subbasin (Figure 1-8). Figure 1-9 shows a map with boundaries of federal and state public lands within the region that includes the Wyandotte Creek Subbasin.


Shasta Co.
Lassen Co.
Trinity Co.
Tehama Co.
Plumas Co.
Mendocino Co.
Glenn Co.
Butte Co.
Sierra Co.
Yuba Co.
Nevada Co.
Colusa Co.
Lake Co.
Sutter Co.
Placer Co.
Yolo Co.
El Dorado Co.
Sonoma Co.
Napa Co.
Amador Co.
Sacramento Co.
Solano Co.
Calaveras Co.
San Joaquin Co.
Contra Costa Co.
Stanislaus Co.
Bend Subbasin
Antelope Subbasin
Red Bluff Subbasin
Los Molinos Subbasin
Corning Subbasin
Vina Subbasin
Wyandotte Creek Subbasin
Butte Subbasin
Colusa Subbasin
North Yuba Subbasin
South Yuba Subbasin
Sutter Subbasin
North American Subbasin
Yolo Subbasin
South American Subbasin
Solano Subbasin
Chico
Sacramento
Stockton
5
32
70
99
80
California
Butte Co.
Inset
Legend
Groundwater Basin 1
Sacramento Valley Groundwater Basin
Groundwater Subbasins 1
Wyandotte Creek Groundwater Subbasin
Other Sacramento Valley Groundwater Subbasins
Roads 2
Highways
Boundaries 2
County boundaries
Notes:
1) California Department of Water Resources (CA DWR).
2) TIGER/Line, U.S. Census Bureau.
20 10 0 20 Miles
Sacramento Valley Groundwater Basin
Wyandotte Creek Subbasin GSP
Geosyntec consultants
Figure 1-2
Project No.: SAC282
December 2021

GSP - Wyandotte Creek Groundwater Subbasin
Section 1



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GSP - Wyandotte Creek Groundwater Subbasin
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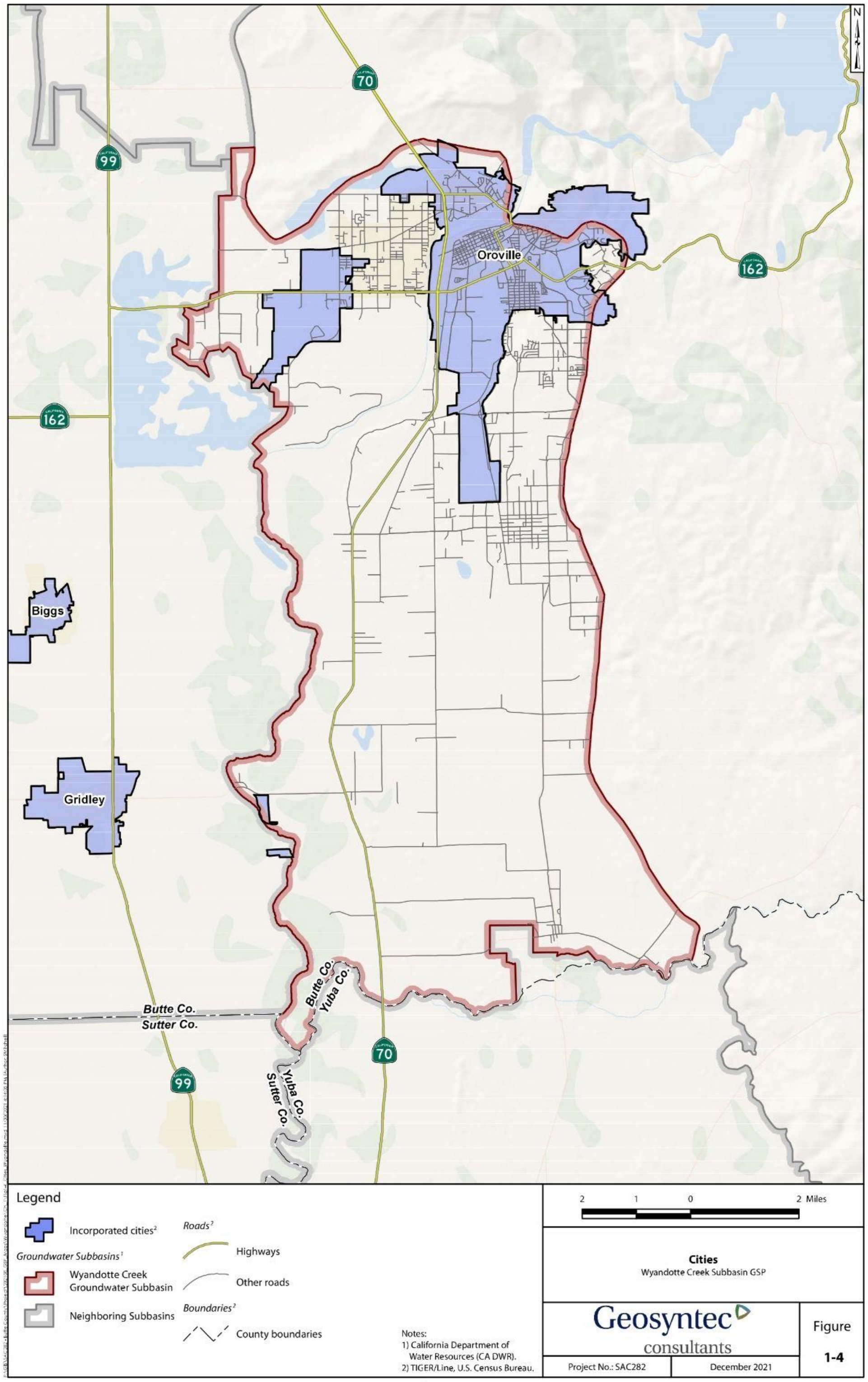

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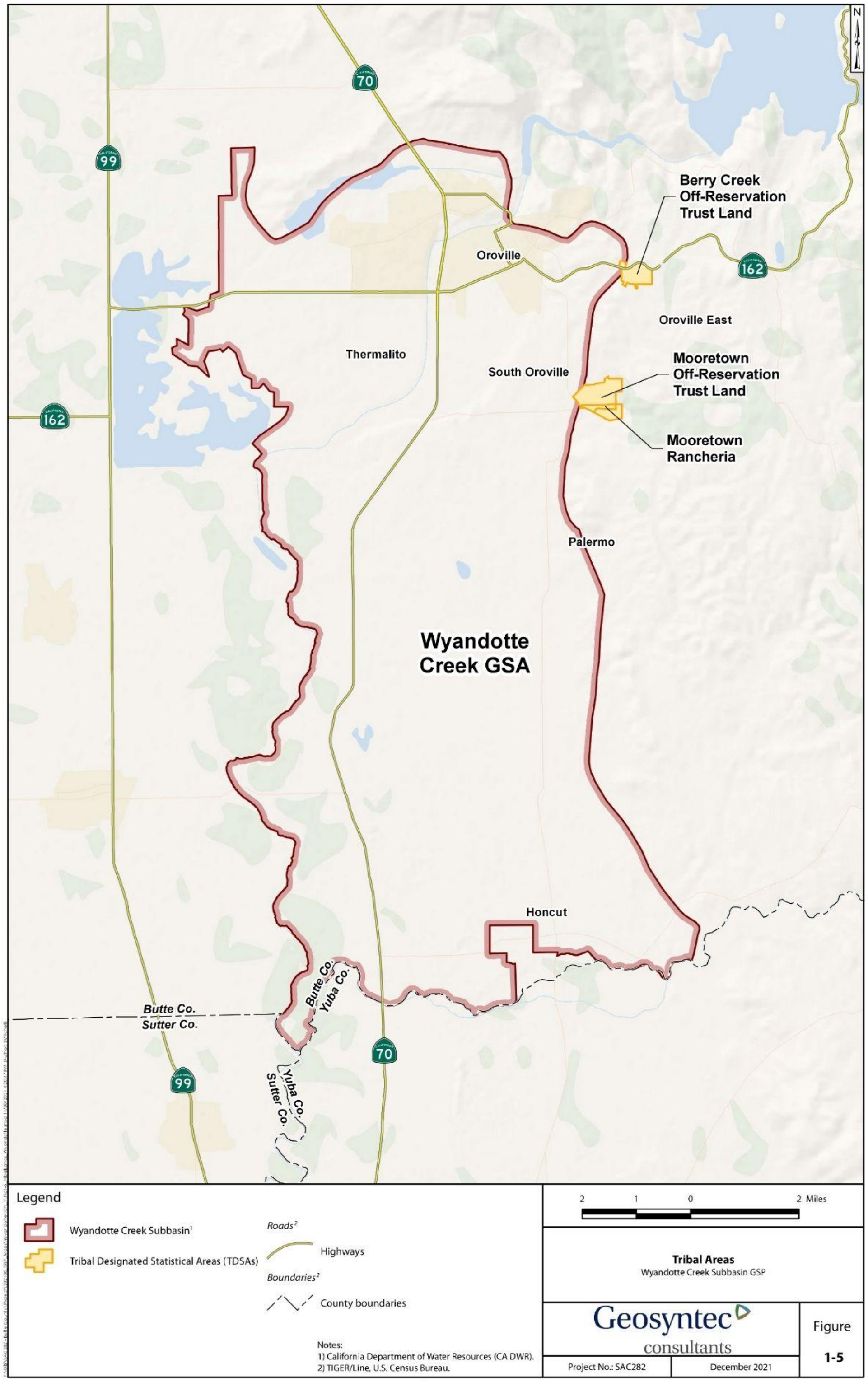
GSP - Wyandotte Creek Groundwater Subbasin
Section 1



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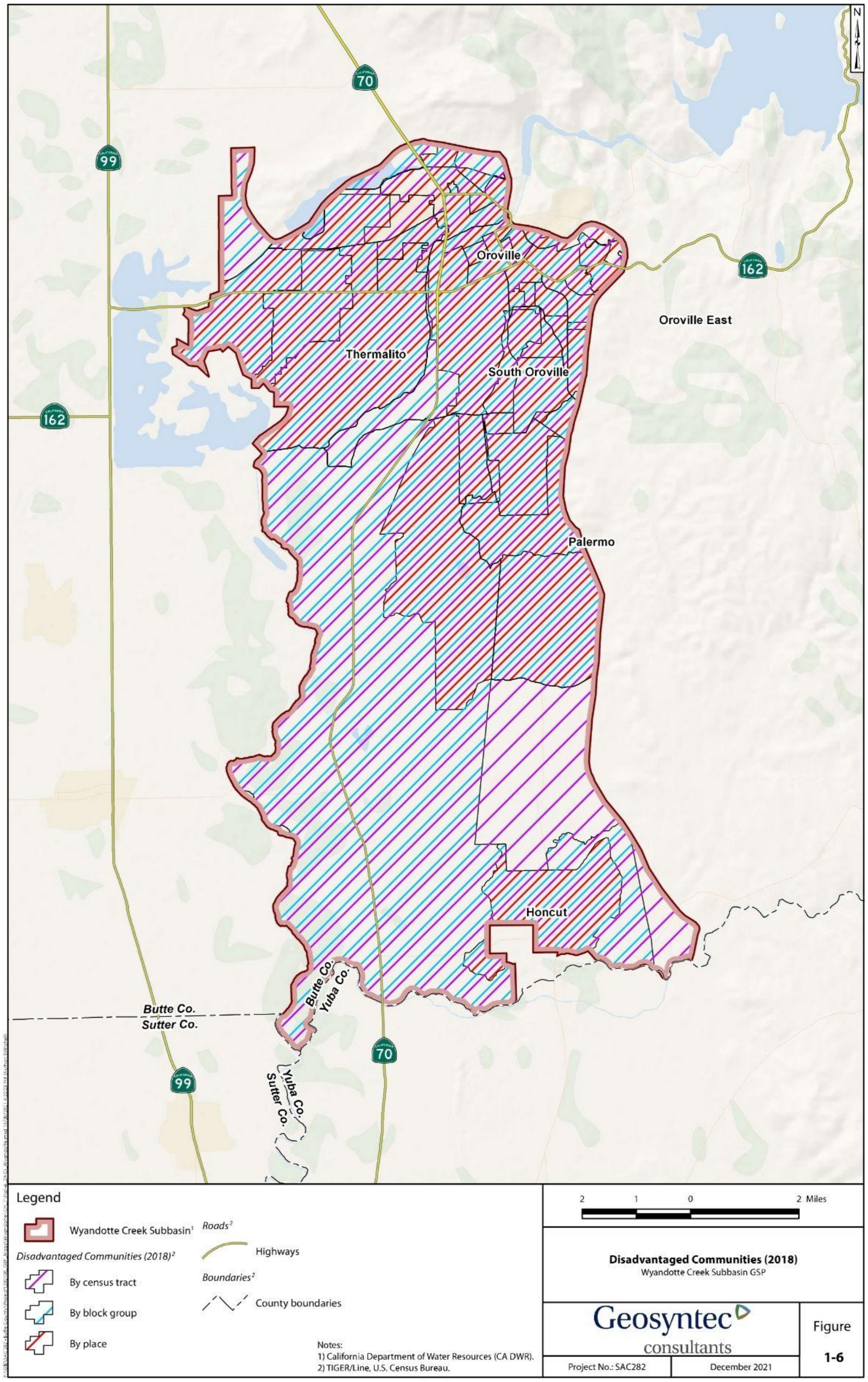
GSP - Wyandotte Creek Groundwater Subbasin
Section 1



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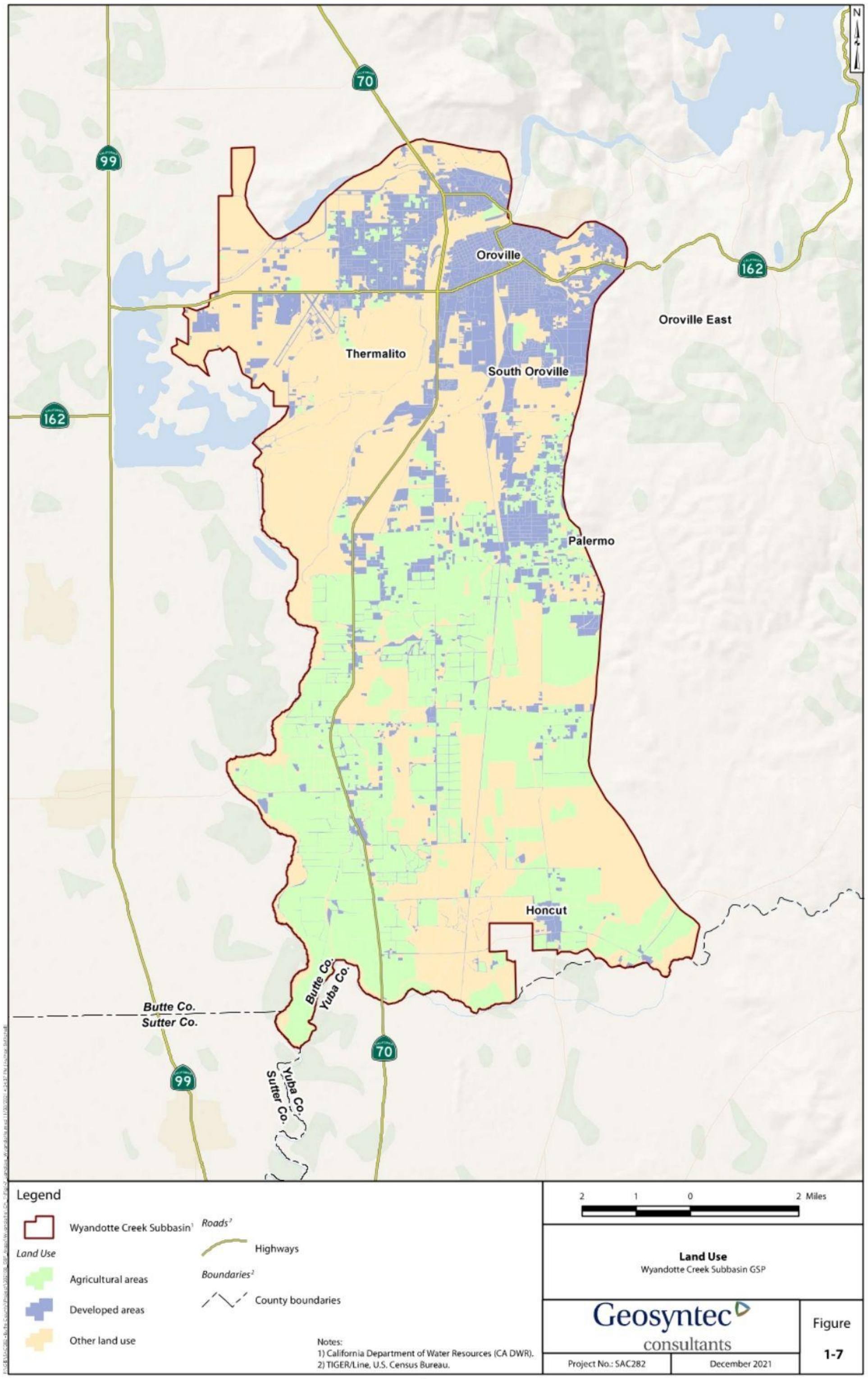
GSP - Wyandotte Creek Groundwater Subbasin
Section 1



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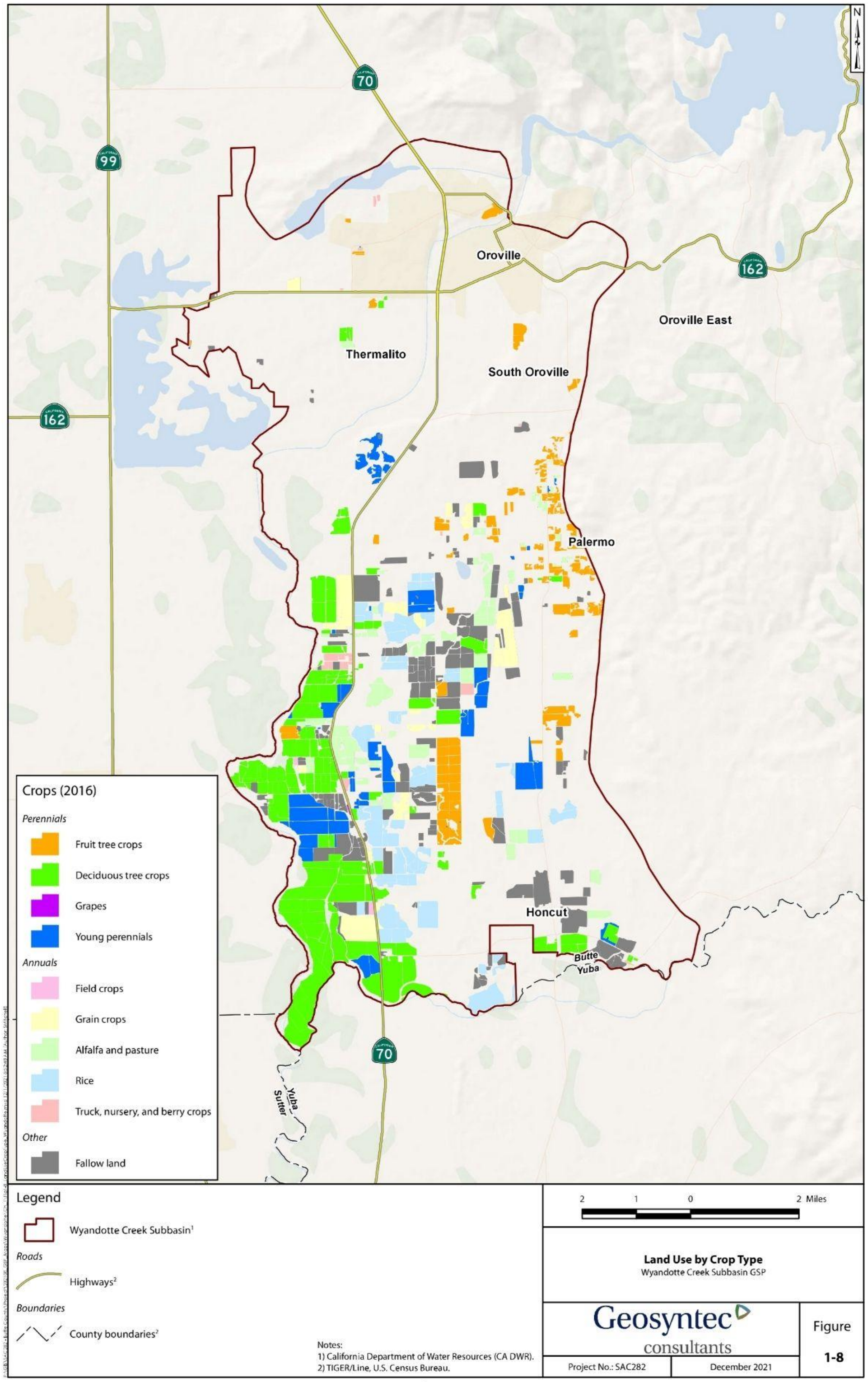
GSP - Wyandotte Creek Groundwater Subbasin
Section 1



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GSP - Wyandotte Creek Groundwater Subbasin
Section 1

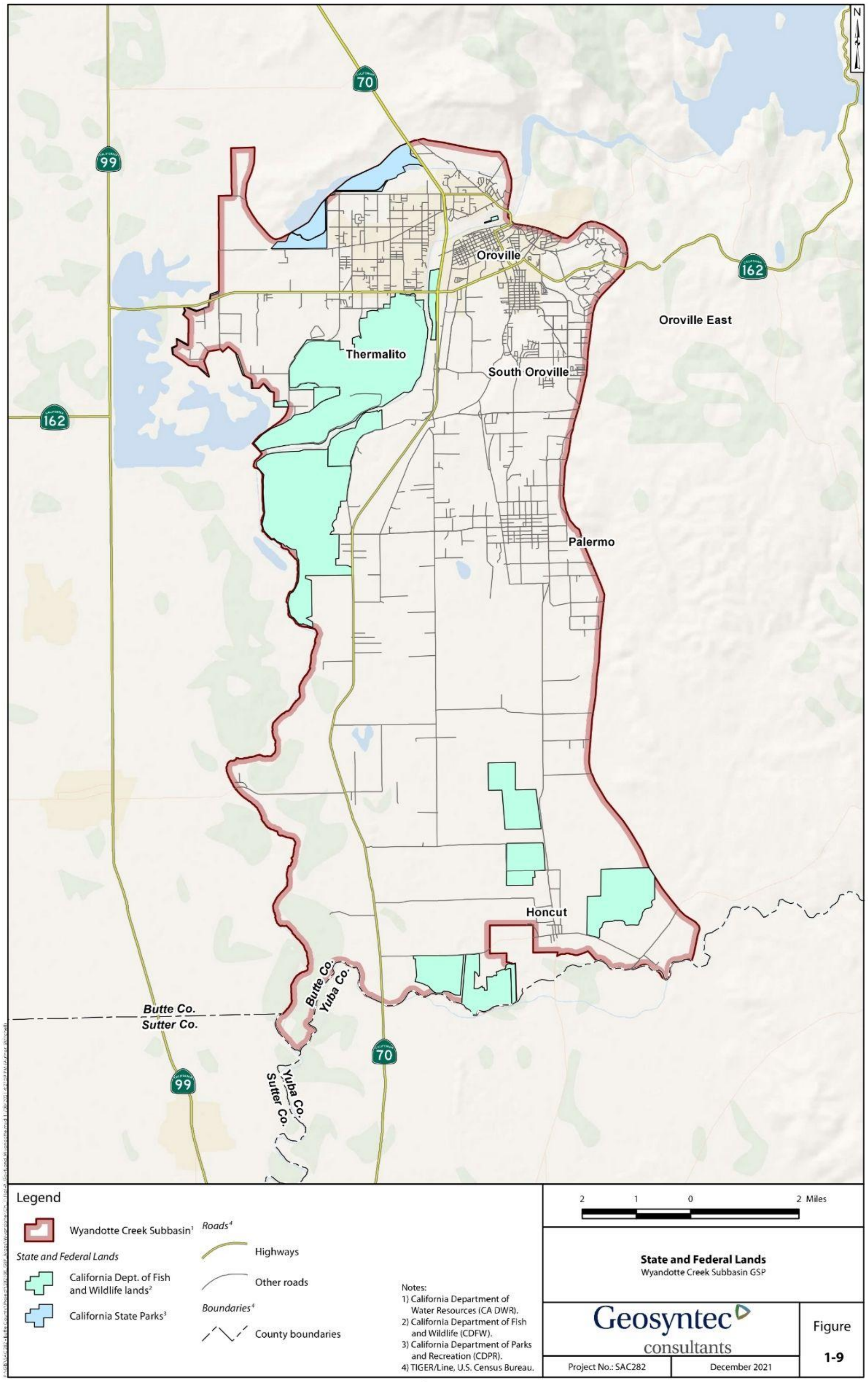

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Figure 1-10 to Figure 1-13 shows the density of domestic, public, industrial, and irrigation wells per square mile in the Wyandotte Creek Subbasin, as classified by the DWR Online System for

Well Completion Reports (OSWCR), which is discussed in Section 1.3.5. Though there are overlaps and discrepancies in the designation of wells, domestic wells are largely private residential wells, public wells are municipal operated wells, and production wells are for irrigation, municipal, public, and industrial purposes (DWR, 2019b). Areas with few wells exist in the Wyandotte Creek Subbasin as shown in Figures 1-10 through 1-13. Wells containing groundwater level data are described further in Section 1.3.5. Community water systems, as defined by the State Water Resources Control Board (SWRCB), are wells serving 15 or more connections or more than 25 people per day.

Figure 1-14 shows locations of major rivers, streams, and creeks within the Wyandotte Creek Subbasin. The Feather River enters the subbasin in the northeast and then borders the subbasin on its western side. Other large surface water bodies bordering the subbasin include components of the Oroville Reservoir Complex including the Forebay and Thermalito Afterbay. The North, Middle, West, and South Forks of the Feather River originate outside the subbasin and together supply water to Lake Oroville with a portion of flow routed through the Thermalito Forebay and Afterbay facilities to generate hydropower and deliver irrigation water supply to the Butte Subbasin, with the remaining water returning to the Feather River. The Feather River serves as a source of municipal and irrigation supply in the subbasin through diversions by the TWSD and SFWPA.

Smaller local or ephemeral streams entering and traversing the subbasin include North Honcut Creek, Wyandotte Creek, Wyman Ravine and numerous unnamed waterways.

1.2.2 Management Areas

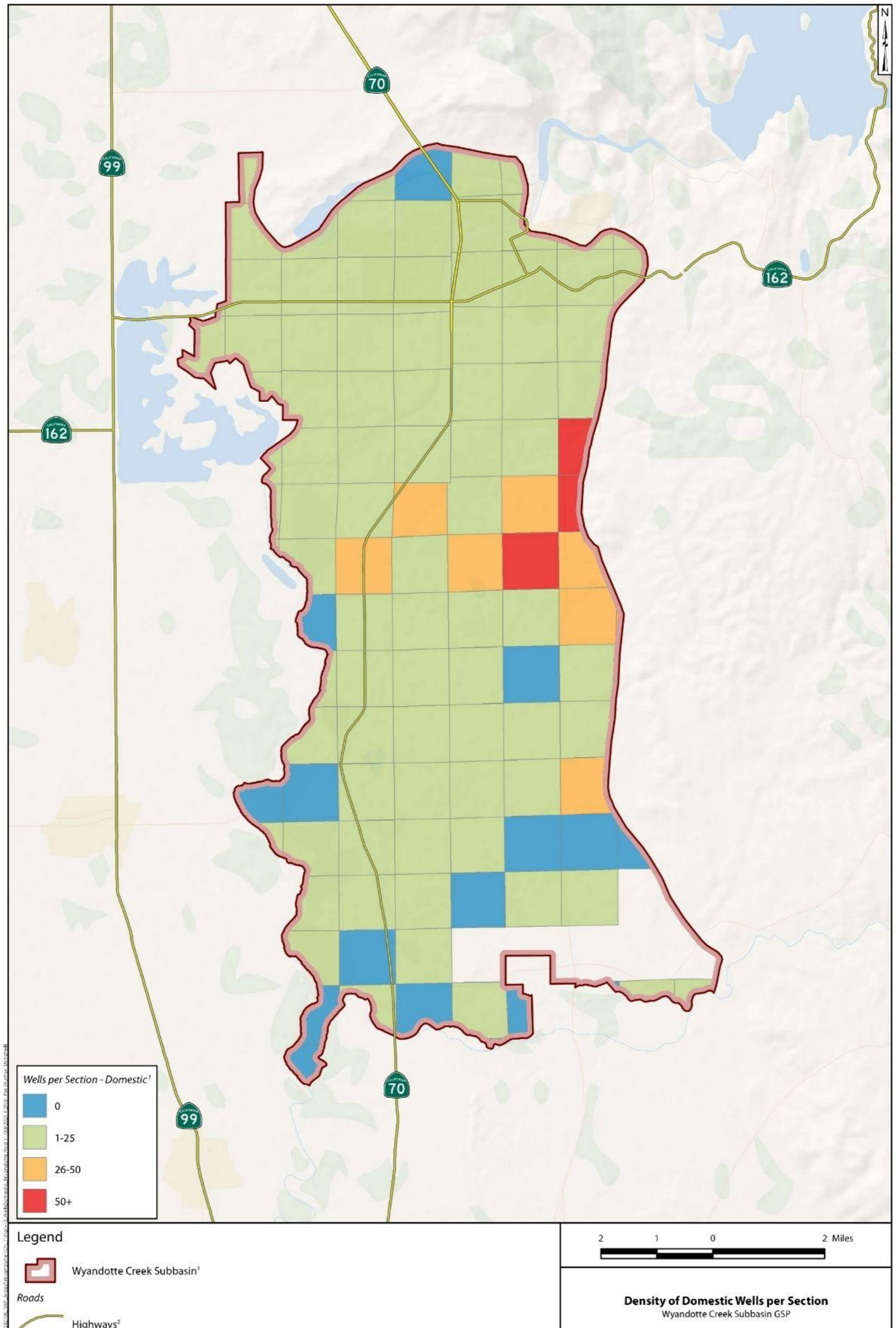
A Management Area (MA) refers to an area within a basin for which a GSP may identify different minimum thresholds (MTs), measurable objectives (MOs), monitoring, and projects and actions based on unique local conditions or other circumstances as described in the GSP regulations. The GSP must describe each MA, including rationale for approach and demonstrate it can be managed without causing undesirable results within or outside the MA. Two MAs, Wyandotte Creek Oroville and Wyandotte Creek South (Figure 1-1) are defined in the Wyandotte Creek Subbasin by the joint powers agreement forming the Wyandotte Creek GSA.

1.2.2.1 Definition and Reason for Creation

The Wyandotte Creek Oroville MA encompasses the area that overlies the municipal area within and adjacent to the City of Oroville. The Wyandotte Creek South MA overlies the areas of the Wyandotte Creek Subbasin south of the City of Oroville. The Wyandotte Creek GSA is the exclusive GSA for these two MAs.

Although all stakeholders have a shared interest in sustainable management of groundwater in this predominantly groundwater dependent subbasin, the landscape of beneficial users varies between MAs. Wyandotte Creek Oroville is predominantly an urban area with Cal Water providing groundwater supplies for residential and municipal use. To a very limited extent, private domestic wells provide the primary source of water to households or in some cases provide a secondary supply for outdoor water use. The Feather River enters the subbasin in the northeast and crosses this MA through the central portion.

GSP - Wyandotte Creek Groundwater Subbasin
Section 1



Notes:
1) California Department of Water Resources (CA DWR).
2) TIGER/Line, U.S. Census Bureau.

Density of Domestic Wells per Section
Wyandotte Creek Subbasin GSP

Geosyntec consultants

Figure 1-10

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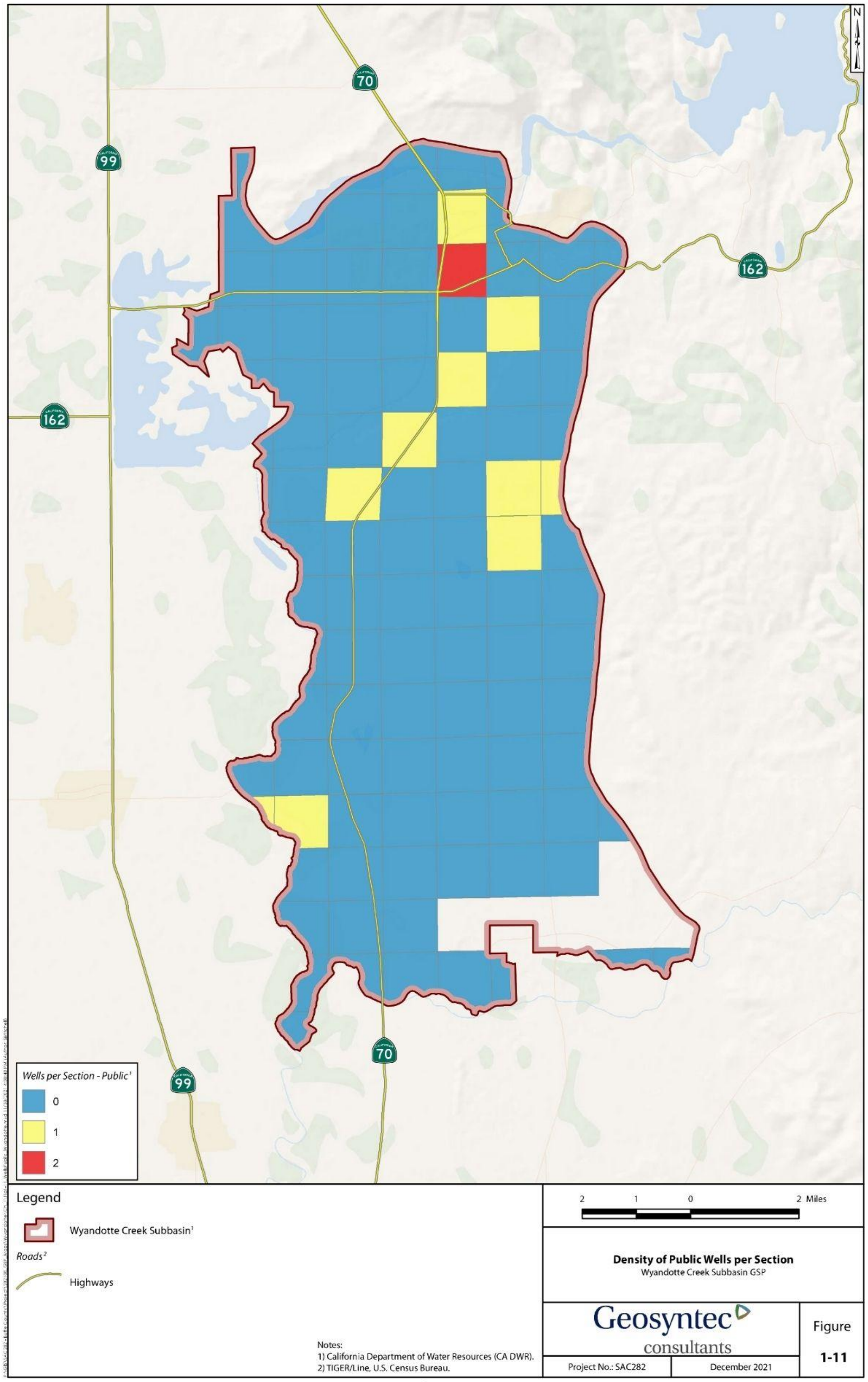
GSP - Wyandotte Creek Groundwater Subbasin
Section 1



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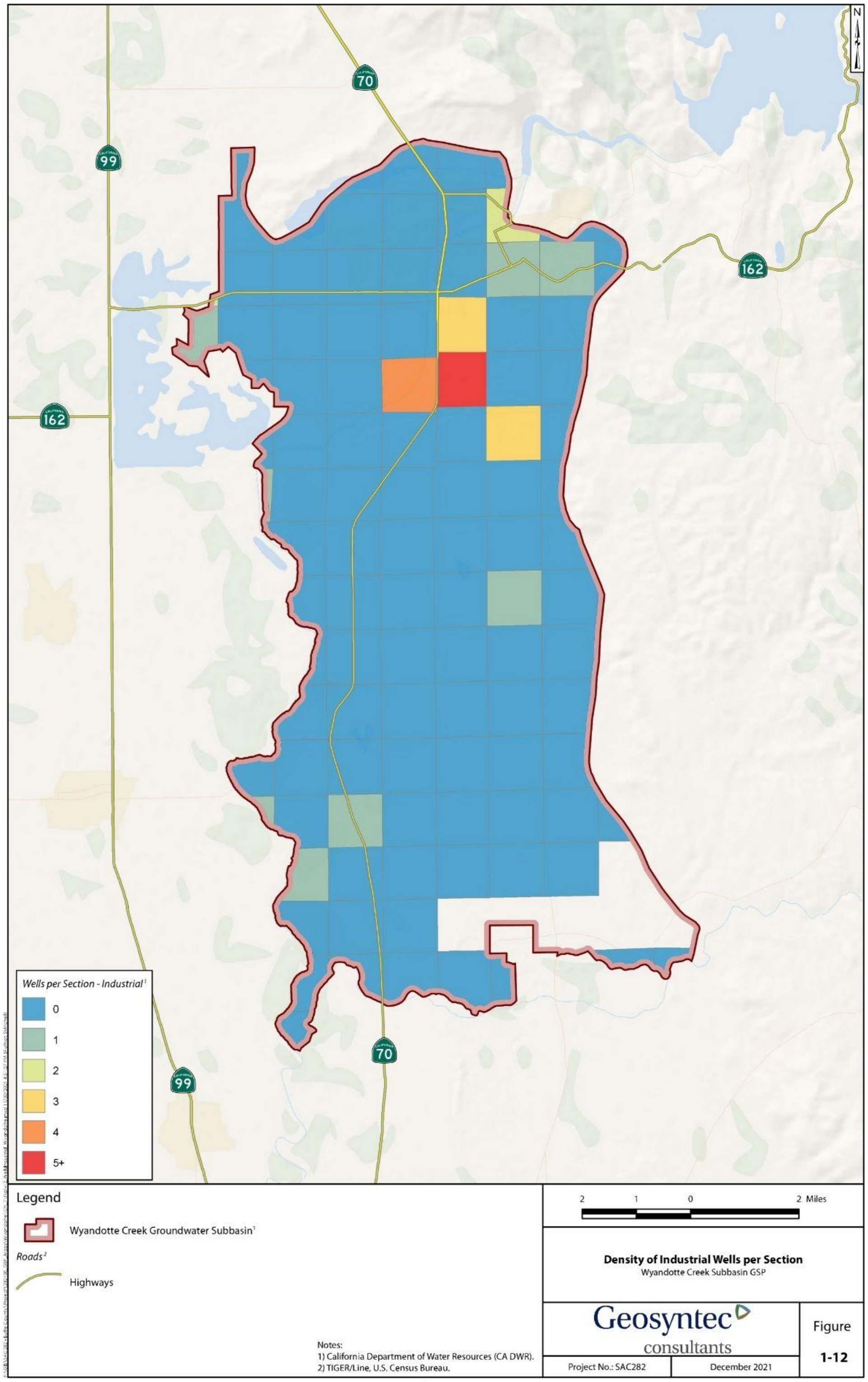
GSP - Wyandotte Creek Groundwater Subbasin
Section 1



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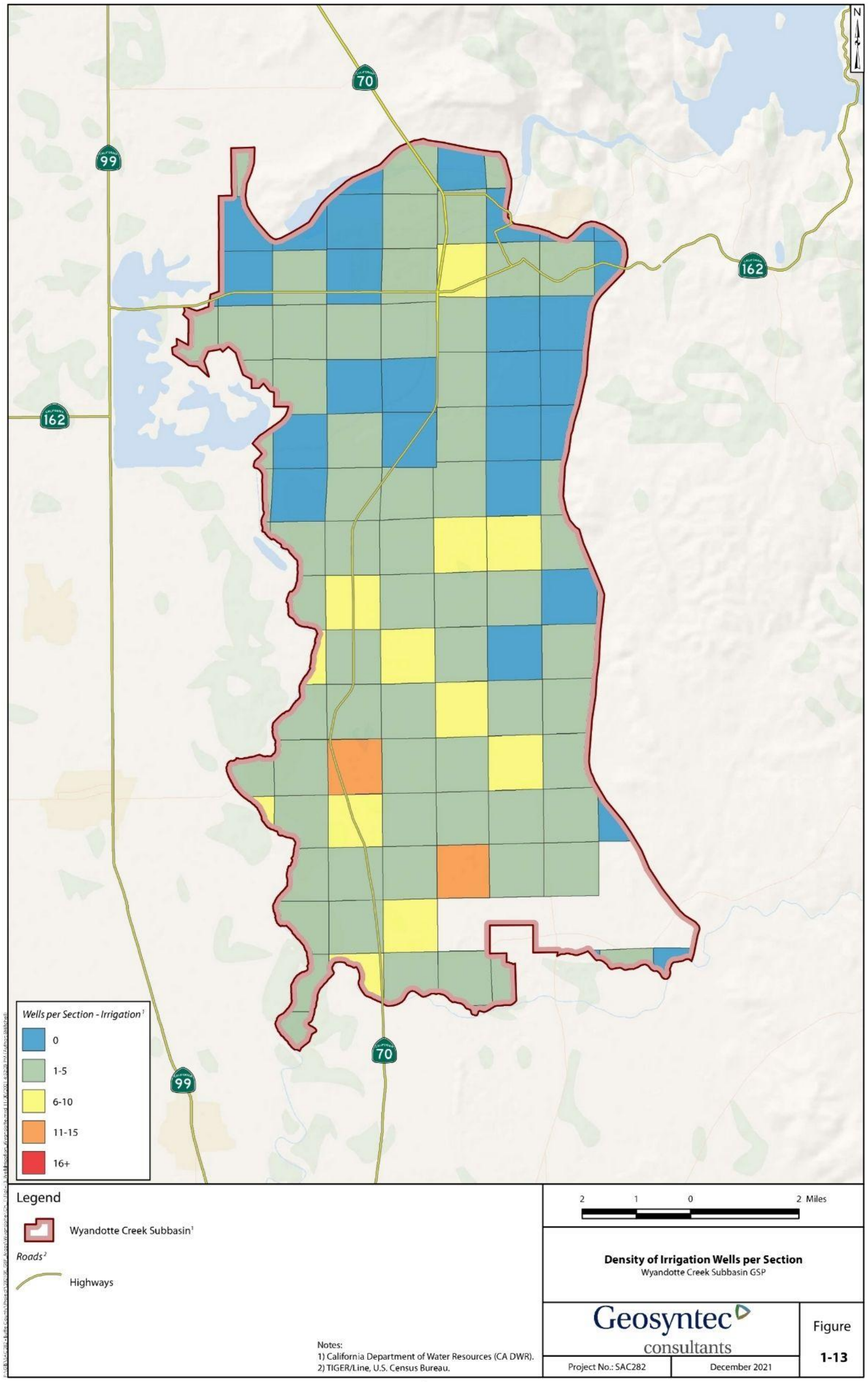

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GSP - Wyandotte Creek Groundwater Subbasin
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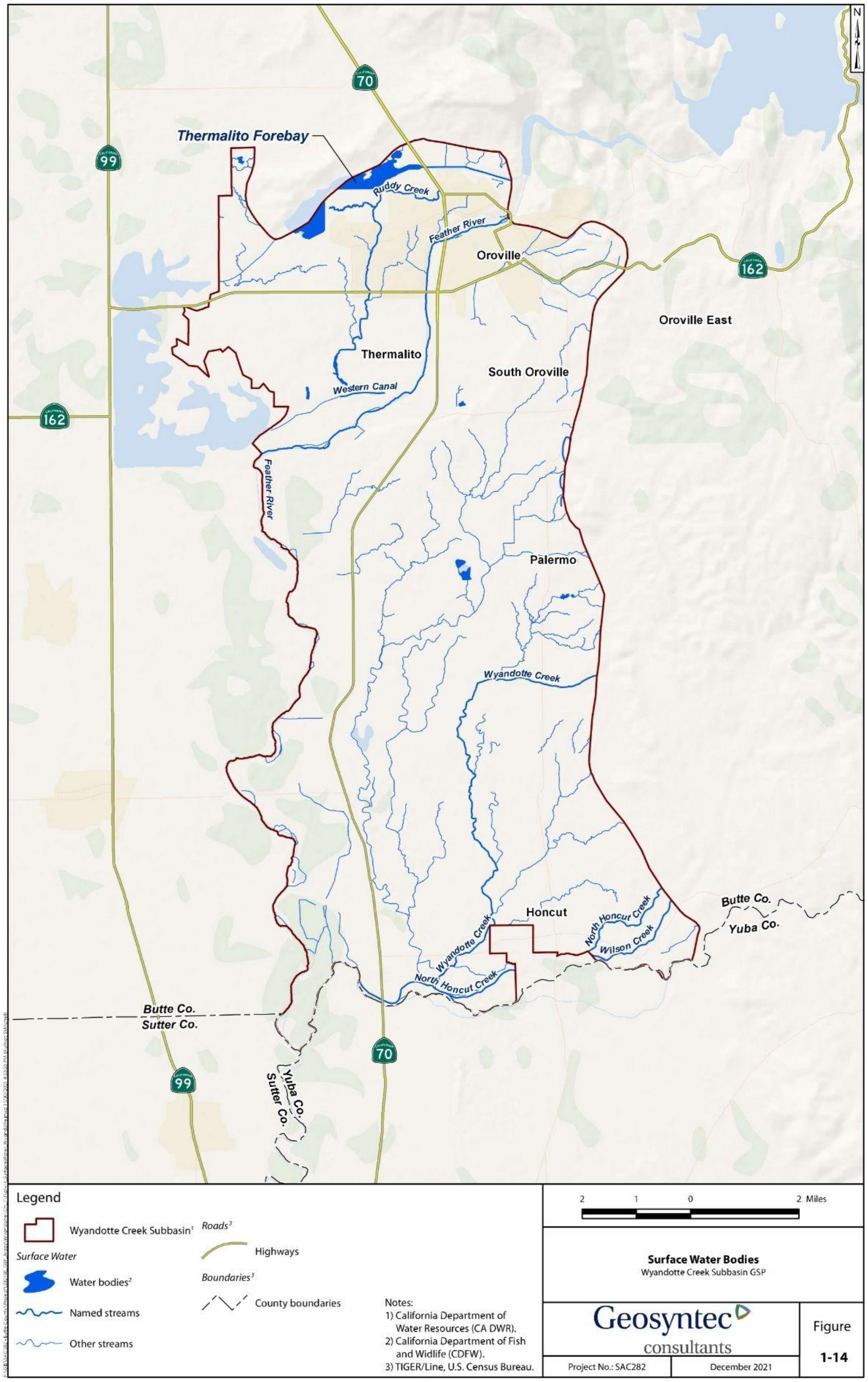

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The Oroville Reservoir Complex including the Forebay and Thermalito Afterbay border this MA (Figure 1-13). The Feather River serves as a source of municipal and irrigation supply in the subbasin through diversions by the TWSD and SFWPA.

Wyandotte Creek South is dominated by irrigated agriculture dependent on groundwater and surface water diversions from the Feather River. Significant numbers of rural residents and ranchettes depend on groundwater typically from relatively shallow domestic wells interspersed with agricultural land uses. The Feather River enters this MA in the northeast then flows along the western boundary (Figure 1-14). Both perennial and ephemeral streams traverse Wyandotte Creek South including Honcut Creek and Wyandotte Creek.

The interests and vulnerability of stakeholders and groundwater uses in these MAs vary based on the nature of the water demand (agricultural, domestic, municipal), numbers and characteristics (i.e., depth) of wells supplying groundwater, and to some degree the hydrogeology and mix of recharge sources. The reason for creating these MAs in the Wyandotte Creek subbasin is to focus development of MTs, MOs, monitoring, and projects and actions in a way that best meets the mix of needs of the uses and users of groundwater unique to the MA. The defined MAs also allow Member Agencies to focus efforts and staff resources on development of portions of the GSP most relevant to stakeholders within their jurisdiction. These established MAs facilitate successful development and long-term implementation of the GSP by effectively targeting the needs, vulnerabilities, and opportunities of local conditions in these areas.

1.3 Management Programs

Existing management programs within the Wyandotte Creek Subbasin are described below.

1.3.1 Groundwater Management Plan

The County of Butte has a Groundwater Management Plan that covers the entire County except for areas covered by Urban Water Management Plans (UWMPs). The Butte County Groundwater Management Plan can be found at http://www.buttecounty.net/waterresourceconservation/groundwatermanagementplan

1.3.2 Urban Water Management Plans

TWSD, Cal Water, and SFWPA have prepared UWMPs.

1.3.2.1 Northern Sacramento Valley Integrated Regional Water Management Plan

Six counties, including Butte, Shasta, Tehama, Glenn, Colusa, and Sutter counties (Figure 1-15), of the Northern Sacramento Valley have been working together for over 10 years to lay the foundation for an integrated regional plan to address water-related issues such as economic health and vitality; water supply reliability; flood, stormwater, and flood management; water quality improvements; and ecosystem protection and enhancement. The counties have completed the development of a valley-wide IRWM Plan and have committed to continuing the efforts of regional water management through this plan. IRWM is a collaborative effort to enhance coordination of the water resources in a region. IRWM involves multiple agencies, stakeholders, tribes, individuals and groups to address water-related issues and offer solutions which can provide multiple benefits to the region.

GSP - Wyandotte Creek Groundwater Subbasin
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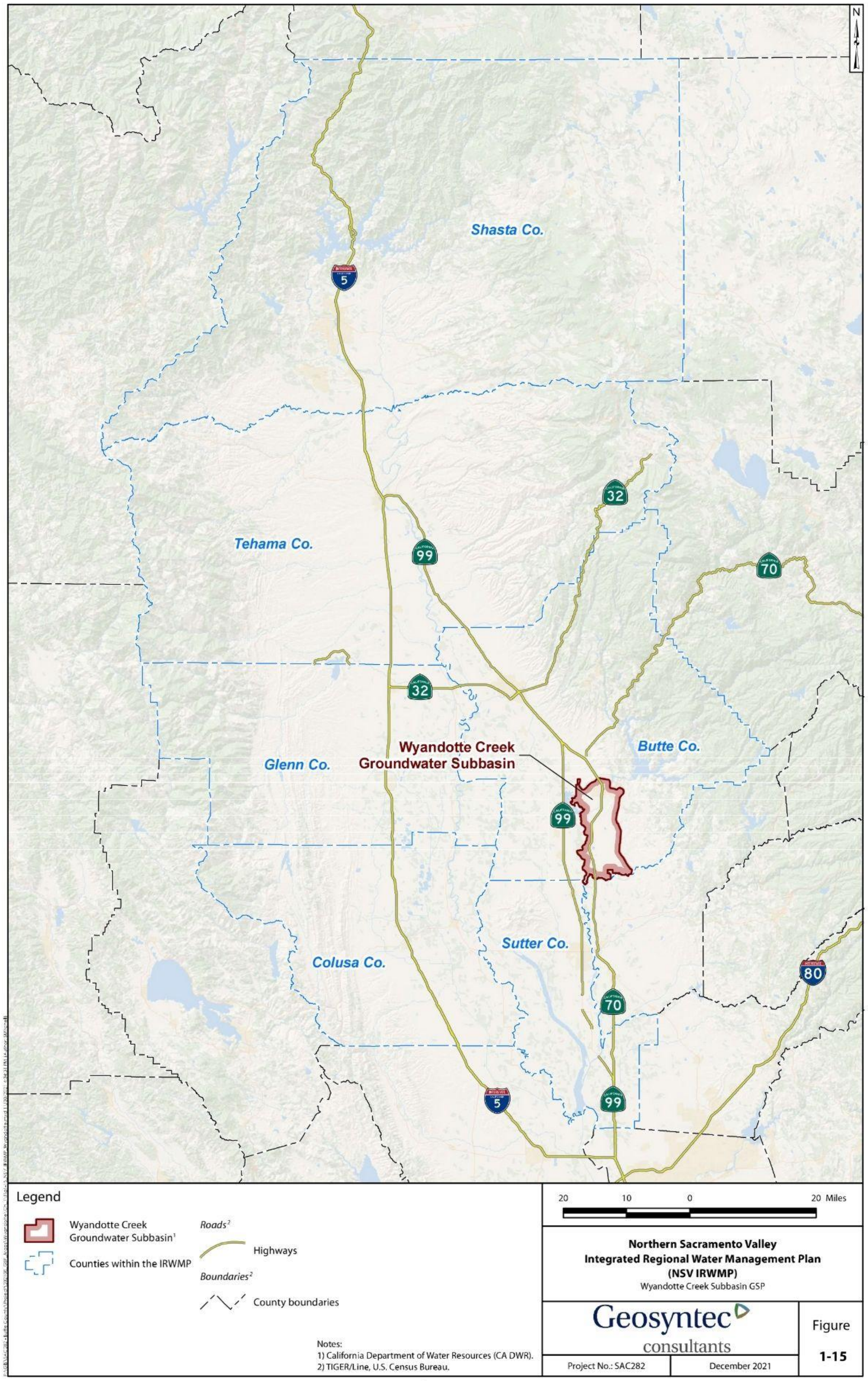

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Representatives of the six counties are working in partnership with community stakeholders, tribes and the public to identify the water-related needs of the region. This information was used to develop goals and objectives of the IRWM Plan, and the identification of projects and programs to be included in the IRWM Plan. The IRWM Plan was adopted in April 2014 and updated in 2020 and better positions the region and local partners to receive funding for high-priority projects.

1.3.3 Drought Management Plans

The Butte County Drought Preparedness and Mitigation Plan (Drought Plan) was adopted in 2004 and was developed to protect the County from the effects of a drought. The Drought Plan includes: an overview of Butte County's drought background; institutional framework to approach drought; a monitoring plan; a response and mitigation plan; and a discussion of water transfers during a drought. The purpose of the Drought Plan is to provide an efficient and systematic process for Butte County that results in a short- and long-term reduction in drought impacts to the citizens, economy, and environment.

1.3.4 Conjunctive Use Programs

The Wyandotte Creek GSA is actively working with South Feather Water and Power Agency, Thermalito Water and Sewer District, Butte County's Palermo Master Drainage Planning efforts, and local stakeholders to implement a Regional Conjunctive Use Program. The Program is further described in Section 5: Projects and Management Actions.

1.3.5 General Plans in the Plan Area

The Wyandotte Creek Subbasin is subject to the Butte County General Plan 2030 and the City of Oroville General Plan. In 2018, the Camp Fire destroyed 18,000 structures in Butte County displacing over 27,000 residents. In 2020, the North Complex Fire destroyed homes in Berry Creek, Feather Falls and other areas. While the Town of Paradise, Concow, Berry Creek and other impacted areas rebuild, many residents have relocated to other parts of Butte County. The existing General Plans may not fully account for the relocation of Camp Fire survivors. A focused accounting of changes to residential land use as a result of the Camp Fire should be conducted.

1.3.5.1 Butte County General Plan 2030

The Butte County General Plan 2030 was adopted by the Butte County Board of Supervisors in October 2010. The General Plan 2030 identifies the goals, policies and actions governing land use in the unincorporated portions of Butte County. The General Plan 2030 reflects the community desire to conserve and enhance the legacy of their forebears, namely, sustainable development. To this end, the General Plan 2030 envisions and supports a Butte County in 2030 where:

- Urban development will be primarily centralized within and adjacent to the existing municipal limits and larger unincorporated communities. Urban development will have efficient, reliable public facilities and infrastructure. Employment centers and a range of services will be located near residential areas so that people spend less time in their cars. Residential communities will be walkable, bicycle facilities will be provided, and there will be access to public transit.

- Small unincorporated areas will be well-planned through community-driven planning processes so that community character is preserved, and adequate public services and facilities are provided. Rural residential development will be limited and will strive to be compatible with agricultural and environmental uses and will address wildfire risks and public service's needs.
- Agriculture and open space will continue to dominate Butte County's landscape and be an important part of the County's culture and economy. Existing agricultural areas will be maintained, and an array of agricultural services will support agriculture while providing new jobs to Butte County residents.

The General Plan 2030 includes an optional Water Resources Element in addition to the mandatory elements of Land Use, Housing, Economic Development, Agriculture, Circulation, Conservation and Open-space, Health and Safety and Public Facilities and Services. In adopting the Water Resources Element, the General Plan 2030 recognized the importance and interrelationship between land use and water resources management. The General Plan 2030 Water Resources Element has six goals:

- Maintain and enhance water quality.
- Ensure an abundant and sustainable water supply to support all uses in Butte County.
- Effectively manage groundwater resources to ensure a long-term water supply for Butte County.
- Promote water conservation as an important part of a long-term and sustainable water supply.
- Protect water quality through effective storm water management.
- Improve stream bank stability and protect riparian resources.

Key Water Resources Element policies include:

- W-P1.4: Where appropriate, new development shall be Low Impact Development (LID) that minimizes impervious area, minimizes runoff and pollution and incorporates best management practices (BMPs).
- W-P2.1: The County supports solutions to ensure the sustainability of community water supplies.
- W-P2.3: Water resources shall be planned and managed in a way that relies on sound science and public participation.
- W-P2.5: The expansion of public water systems to areas identified for future development on the General Plan land use map is encouraged.
- W-P2.6: The County supports water development projects that are needed to supply local demands.
- W-P2.8: The County supports Area of Origin water rights, the existing water right priority system and the authority to make water management decisions locally to meet

the county's current and future needs, thereby protecting Butte County's communities, economy and environment.

- W-P2.9: Applicants for new major development projects, as determined by the Department of Development Services, shall demonstrate adequate water supply to meet the needs of the project, including an evaluation of potential cumulative impacts to surrounding groundwater users and the environment.
- W-P3.1: The County shall continue to ensure the sustainability of groundwater resources, including groundwater levels, groundwater quality and avoidance of land subsidence, through a basin management objective program that relies on management at the local level, utilizes sound scientific data and assures compliance.
- W-P3.2: Groundwater transfers and substitution programs shall be regulated to protect the sustainability of the County's economy, communities and ecosystem, pursuant to Chapter 33 of the Butte County Code.
- W-P3.3: The County shall protect groundwater recharge and groundwater quality when considering new development projects.
- W-P4.1: Agricultural and urban water use efficiency shall be promoted.
- W-P4.2: Water conservation efforts of local Resource Conservation Districts, the Natural Resource Conservation Service and irrigation districts should be coordinated.
- W-P4.3: The County shall work with municipal and industrial water purveyors to implement water conservation policies and measures.
- W-P4.4: Opportunities to recover and utilize wastewater for beneficial purposes shall be promoted and encouraged.
- W-P4.5: The use of reclaimed wastewater for non-potable uses shall be encouraged, as well as dual plumbing that allows graywater from showers, sinks and washers to be reused for landscape irrigation in new developments.
- W-P4.6: New development projects shall adopt BMPs for water use efficiency and demonstrate specific water conservation measures.
- W-P5.2: New development projects shall identify and adequately mitigate their water quality impacts from stormwater runoff.
- W-P5.3: Pervious pavements shall be allowed and encouraged where their use will not hinder mobility.

Implementation of the Wyandotte Creek GSP will provide sustainable groundwater management and is not anticipated to affect water supply assumptions in the General Plans. Information on the Butte County General Plan 2030 and related documents can be found at www.buttegeneralplan.net.

1.3.5.2 City of Oroville

The Oroville City Council adopted the Oroville 2030 General Plan in June 2009. In March 2015, the City Council adopted a targeted update to the 2030 General Plan referred to as the "Oroville Sustainable Code Updates," which included an expansion of Mixed-Use zoning within the city, resource-efficient design to the City's Design Guidelines, and a new Climate Action Plan. This targeted update sought to strengthen the environmental, community, and economic sustainability of the community. The Oroville General Plan's goals, policies and actions are intended to work together to achieve the long-term vision for the city.

The Oroville General Plan seeks to promote high quality residential and commercial growth, support infill development, preserve and provide access to nature, create an appropriate transition between the urban and rural environment, and create a place people are proud to call home. To achieve the implementation of the Oroville General Plan, eight guiding principles have been adopted: livability; enhanced mobility; a vibrant local economy; natural resources and the environment; recreation; community infrastructure; health and safety; and an involved citizenry.

The State General Plan Guidelines call for the Oroville General Plan to address all land within the City limits, land within the City's designated Sphere of Influence (SOI), and other land in unincorporated Butte County which relates to the City's planning efforts.

Oroville General Plan Organization

State law requires the General Plan to address the subjects of land use, circulation, housing, noise, safety, conservation, and open space. Additional topics (or "elements") may be covered at the discretion of the jurisdiction, provided that they are consistent with one another. Oroville's General Plan includes the following optional elements: community design; economic development; and public facilities and services.

Parks, Public Facilities, and Services Element

The Oroville 2030 General Plan Public Facilities and Services Element mentions that:

"The City of Oroville does not provide water service directly. Oroville is served by three local domestic water providers: Cal Water, South Feather Power and Water, and the Thermalito Water and Sewer." The service breakdown in the General Plan for each water provider is as follows:

- "Cal Water Oroville supplies water to a large extent of Oroville south of the Feather River, including the Historic Downtown, the closest portion of the eastern foothills and South Oroville. Currently, Cal Water Oroville has a production potential of 10.7 million gallons per day (MGD), an amount more than adequate to meet the current maximum daily water demand of 6.3 MGD for the Cal Water Oroville area. Approximately 30 percent of their water supply is drawn from groundwater pumped from four wells, with the rest coming from surface water sources including the west fork of the Feather River."
- "South Feather Water and Power Agency supplies water to the eastern and southern portions of the City and SOI." The agency has approximately 171,500-thousand-acre feet (TAF) of storage capacity "sourced from the South Fork of the Feather River and from the Yuba River system, and is stored in reservoirs at Little Grass Valley, Sly Creek, Lost Creek, Ponderosa, Miner's Ranch, and Lake Wyandotte. South Feather Water and Power Agency delivers approximately 28,000 TAF of water annually and has the capacity to treat approximately 14.5 MGD."
- "Thermalito Water and Sewer District (TWSD) serves areas of the City of Oroville to the north and west of the Feather River as well as adjacent unincorporated areas of Butte County. TWSD has rights to approximately 8,200-acre feet of surface water

from Concow Lake/Wilnore Reservoir with a 3.0 MGD backup supply coming from four wells, as needed. Total water consumption is currently 2.5 MGD annually for the TWSD and is expected to grow to just over 5.0 MGD by 2025. The District's water supply is sufficient to meet this future demand as it has secured water rights to 7.3 MGD annually."

Relevant Goals, Policies, Actions relating to water supply is provided below:

- Goal PUB-6: Provide sufficient supplies of high-quality water to City residents and businesses to serve the City in the most efficient and financially-sound manner.
- Policy P6.1: Ensure that Oroville's potable water distribution and storage system is adequately sized to serve development allowed by the General Plan, without providing excess capacity.
- Policy P6.9: Support water conservation measures by working with the water districts and water companies to implement water conservation policies and measures.
- Policy P6.10: Encourage the use of drought-resistant landscaping and the use of reclaimed wastewater for agriculture and landscape irrigation supply water. Ensure that all reclaimed wastewater complies with State wastewater treatment and reclamation regulations and standards.
- Policy P6.11: Support all efforts to encourage water conservation by Oroville residents and businesses, and public agencies, including working with water providers, to implement water conservation programs and incentives that facilitate conservation efforts.
- Policy P6.12: Continue to participate in regional groundwater basin planning efforts to determine the carrying capacity of the groundwater aquifer and ensure that future demand for water does not overdraft the groundwater supply.
- Action A6.1: Conduct a study of using reclaimed wastewater for irrigation of public landscaping and for agriculture.
- Policy P8.6: Implement all necessary measures to regulate runoff from urban uses to protect the quality of surface and groundwater.
- Action A8.6: Prepare a stormwater management plan for the City to improve the quality of surface and groundwater. The Plan should include, but not be limited to, well-defined goals, policies, and actions to:
- ▪ Create effective partnerships with special districts, County, State and federal agencies, as well as non-profit organizations, in all aspects of plan development and implementation.
- ▪ Ensure the long-term financial viability of the plan through appropriate budgeting and allocation of financial and staff resources towards implementation of the plan.
- ▪ Identify clear criteria and an effective process to periodically review and evaluate the achievements of the plan and make amendments to it as needed.

Oroville Open Space, Natural Resources, and Conservation Element
The Oroville 2030 General Plan Open Space, Natural Resources, and Conservation Element acknowledges:

"Water quality is intimately tied to water supply, since adequate uncontaminated flows significantly mitigate the presence of contaminated flows, through dilution, flushing and general availability of alternate sources." Water quality is more greatly discussed in the Public Safety and Services Element of the General Plan, however, there are still relevant goals, policies, and actions discussed in this element relevant to surface and groundwater.

Relevant Goals, Policies, Actions relating to water quality is provided below:

- Goal OPS-11: Protect water quality and quantity in creeks, lakes, natural drainages, and groundwater basins.
- Policy P11.1: Maintain the natural condition of waterways and flood plains to ensure adequate groundwater recharge and water supply where feasible, given flood control requirements.
- Policy P11.2: Minimize impermeable paving that negatively impacts surface water runoff and groundwater recharge rates.
- Policy P11.3: Protect surface and groundwater resources from contamination from runoff containing pollutants and sediment, through implementation of the Central Valley Regional Water Quality Control Board's (CVRWQCB) BMPs.
- Action A11.1: Create a comprehensive mapping of groundwater resources in the Planning Area based on existing groundwater management studies and maps and, where necessary, new groundwater mapping studies to result in comprehensive coverage of the Planning Area.

Information on the City of Oroville 2030 General Plan and related documents can be found at

https://www.cityoforoville.org/services/planning-development-services-department/planning-division/planning-documents

1.3.6 Permitting of New Wells

The construction, repair or destruction of wells is subject to permitting by the Butte County Division of Environmental Health pursuant to Chapter 23B of the Butte County Code, Water Wells. The chapter provides minimum procedures for the proper construction of water wells and for the proper destruction of abandoned wells in order to ensure that water obtained from wells within the County of Butte will be suitable for the purposes for which used and that wells constructed or abandoned pursuant to this chapter will not cause pollution or impairment of the quality of the groundwater within the county. An additional purpose is to reduce potential well interference problems to existing wells and potential adverse impacts to the environment which could be caused by the construction of new wells or the repair or deepening of existing wells where a permit is required. Important provisions of the chapter include:

- The construction, repair, reconstruction, deepening, abandonment and destruction of wells in Butte County must follow the standards in Bulletin 74-81 and its supplement bulletin 74-90, Water Well Standards, State of California.

- After July 25, 1996, the pumping capacity of a new well cannot be greater than 50 gallons per minute per acre to reasonably serve the overlying land, including contiguous parcels of land under the same ownership as the land upon which the well is located.
- Wells can only be drilled by a person licensed to drill water wells pursuant to the provisions of Business and Professions Code section 7000 et seq. possessing a C-57 water well contractor's license required by section 13750.5 of the California Water Code.
- Domestic well owners are required to ensure that a new well will operate properly assuming a repeat of the groundwater conditions experienced during the period 1987 through 1994 in the area in which the new well is located.
- Well drillers reports must be filed with Butte County as well as with DWR.
- Notification of well permit applications are required in specific instances to adjoining landowners and/or local agencies with an adopted groundwater management plan pursuant to part 2.75 of division 6 of the California Water Code (commencing at section 10750). Landowners and/or local agencies are provided 30 days to provide comments prior to permit issuance.
- Wells with a casing diameter greater than 8 inches are required to be drilled at specific distances away from existing wells.
- In addition to well sealing requirements specified within state well standards bulletin 74-81 and bulletin 74-90, the seal shall be extended 5 feet into the first consolidated formation encountered below 15 feet to a maximum required sealing depth of 50 feet.

1.3.7 Land Use Plans Outside of the Wyandotte Creek Subbasin

The Yuba County General Plan and zoning ordinance is the only land use plan adjacent to the Wyandotte Creek subbasin. The Yuba County General Plan will not have any impact on the Wyandotte Creek GSP to achieve sustainable groundwater management. The Wyandotte Creek GSA will continue to monitor amendments to the Yuba County General Plan.

1.4 Groundwater Level Monitoring and Data Sources

Groundwater level programs predominantly used for development of the GSP include Butte County Department of Water and Resource Conservation (BCDWRC), Cal Water, California Statewide Groundwater Elevation Monitoring (CASGEM), and the California Department of DWR Water Data Library (WDL). Each of these programs are discussed below.

1.4.1 Butte County Department of Water and Resource Conservation

As discussed above, in November 1996, the voters in Butte County approved "AN ORDINANCE TO PROTECT THE GROUNDWATER RESOURCES IN BUTTE COUNTY." The ordinance is now codified as Chapter 33 of the Butte County Code relating to groundwater conservation. Section 3.01 of this code, Groundwater Planning Process, requires the preparation of a groundwater status report based upon the data gathered and analyzed pursuant to Section 3.02, Groundwater Monitoring. In 2000, the Butte County Board of Supervisors amended Chapter 33, the Groundwater Conservation Ordinance, to require the delivery of the

Groundwater Status Report by February of each year. In 2010, the Water Commission designated the BCDWRC as the entity responsible for creating and submitting the annual report.

In February 2004, the Butte County Board of Supervisors adopted the Groundwater Management Ordinance, which was codified as Chapter 33A of the Butte County Code. Chapter 33A calls for the establishment of a monitoring network and Basin Management Objectives (BMOs) for groundwater elevation, groundwater quality related to saline intrusion and land subsidence. The BMO concept was incorporated into California Water Code §10750 et. seq., as a component of AB 3030 Groundwater Management Plans. On September 28, 2004, the Butte County Board of Supervisors formally approved Resolution 04-181 adopting the countywide AB 3030 Groundwater Management Plan that includes components of the BMO program. In 2011, Chapter 33A was amended and retitled to "Basin Management Objectives" requiring a report each February describing conditions in the basin relative to established BMOs. The foregoing actions by the Board allow the consolidation of reporting of groundwater conditions from both Chapter 33 and 33A into a single report submitted by the Department on an annual basis in February. Considering new requirements of SGMA, revisions to Chapter 33A were approved in 2019 to continue the transition of groundwater management in Butte County from the BMO program to implementation of SGMA in each of the three subbasins in Butte County, including the Wyandotte Creek Subbasin. Groundwater level measurements occur 4 times per year following this program. Appendix 1-C provides the Groundwater Status Report for the 2020 Water Year following this program.

1.4.2 California Statewide Groundwater Elevation Monitoring

DWR maintains several groundwater level monitoring programs, tools, and resources covering California. The CASGEM Program is DWR's primary resource for groundwater level data and has been used extensively in the development of this GSP. The CASGEM Program was authorized in 2009 by SB X7-6 to establish collaboration between local monitoring parties and DWR to collect and make public statewide groundwater elevation data. The program provides the framework for local agencies or other organizations to "assume responsibility for monitoring and reporting groundwater elevations in all or part of a basin or subbasin" (Water Code §10927). The BCDWRC is the CASGEM monitoring entity for the Wyandotte Creek Subbasin. The groundwater monitoring program discussed above for BCDWRC complies with the reporting requirements of the CASGEM program.

1.4.3 Water Data Library

DWR's WDL contains measurements of groundwater elevations from water supply and monitoring wells monitored by numerous entities, such as DWR and local agencies. Groundwater level measurements available from the WDL are either continuously or periodically measured. Continuous measurements are provided by automatic water level measuring devices that take readings at wells; periodic measurements are manual recordings typically occurring at monthly or semi-annual time intervals. Measurements displayed through the WDL are taken through other programs, such as CASGEM. The WDL lists the organization responsible for collecting each water level measurement. The WDL water level measurements are available through the California Natural Resources Agency (CNRA) Open Data website as a bulk download, or through the WDL website on a per station basis.

1.4.4 Online System for Well Completion Reports

The OSWCR is a DWR program used to document and compile boring or well completion records throughout California. There are as many as 2 million domestic, irrigation, and monitoring water wells in California included in this dataset, including more than 4,000 domestic wells located in the Wyandotte Creek Subbasin. However, as discussed in Section 3, Sustainable Management Criteria, the well characteristics in this database are not always accurate or precise, and, unfortunately, it is not known which of the wells in the database are in use or have been abandoned or replaced. When a well is constructed, modified, or destroyed, drilling contractors are required to submit a Well Completion Report to DWR for upload to the interactive OSWCR web site. OSWCR is used as a data source for wells identified for monitoring. In this GSP, the OSWCR database was used to describe the GSP area and identify sustainable management criteria (SMC).

1.5 Groundwater Quality Monitoring and Data Sources

Groundwater quality programs predominantly used for development of the GSP include BCDWRC, Sacramento Valley Water Quality Coalition (SVWQC), SWRCB Geotracker/ Groundwater Ambient Monitoring and Assessment Program (GAMA) and the DWR WDL. Each of these programs are discussed below.

1.5.1 Butte County Department of Water and Resource Conservation

As discussed in Section 1.3.4, the former BMO program (Chapter 33A) implemented by Butte County included groundwater quality monitoring. Although the ordinance sunset, the Butte County Department of Water and Resource Conservation continues to conduct groundwater quality trend monitoring and provides the data to GSAs within Butte County.

1.5.2 Sacramento Valley Water Quality Coalition

Because irrigated agriculture is the predominant land use in the Wyandotte Creek Subbasin, monitoring of the groundwater quality data developed through the Groundwater Quality Trend Monitoring Work Plan (GQTMWP) being implemented by the SVWQC for compliance with the Central Valley Regional Board's Irrigated Lands Regulatory Program (ILRP) is an important source of information to the GSA in the Wyandotte Creek Subbasin. This program is implemented by California Rice Commission (CRC) that submits annual reports on groundwater quality throughout the region.

1.5.3 Geotracker/Groundwater Ambient Monitoring and Assessment

GeoTracker, operated by the SWRCB, contains records for sites that require cleanup, such as leaking underground storage tank sites, Department of Defense sites, and cleanup program sites. GeoTracker also contains records for various unregulated projects as well as permitted facilities including: ILRP, future CV-SALTS, oil and gas production, operating permitted underground storage tanks, and land disposal sites. GeoTracker receives records and data from SWRCB programs and other monitoring agencies.

The Geotracker System also contains links to GAMA. The GAMA Program is California's comprehensive groundwater quality monitoring program that was created by the SWRCB in 2000. It was later expanded by AB 599 - the Groundwater Quality Monitoring Act of 2001. AB 599 required the State Water Board, in coordination with an Interagency Task Force (ITF) and

Public Advisory Committee (PAC) to integrate existing monitoring programs and design new program elements as necessary, resulting in a publicly accepted plan to monitor and assess groundwater quality in basins that account for 95% of the state's groundwater use. The GAMA Program is based on interagency collaboration with the State and Regional Water Boards, DWR, Department of Pesticide Regulations, United States Geological Survey (USGS), and Lawrence Livermore National Laboratory, and cooperation with local water agencies and well owners.

1.5.4 Water Data Library

DWR's WDL contains groundwater quality data in addition to the groundwater level records described previously. This information includes data from discrete groundwater quality samples collected by DWR and other cooperating entities. These water quality data list the entity responsible for taking the sample but do not specify what program the sample was taken under. The WDL water quality measurements are available through the CNRA Open Data website as a bulk download, or through the WDL website on a per-station basis. WDL water quality measurements in this GSP are utilized for basin characterization but are acquired from the other programs.

1.6 Land Subsidence

To determine whether subsidence is occurring, a land subsidence monitoring network was established throughout Butte County consisting of observation stations and extensometers managed by DWR. Within the Wyandotte Creek Subbasin this network of monuments existed between 2008 to 2017 and has been replaced by data from satellite- and aircraft-based Interferometric Synthetic Aperture Radar (InSAR) from DWR. As of 2025, one GPS station continues to record vertical displacement within the Subbasin.

A summary of the historic information within the Wyandotte Creek Subbasin obtained from these networks is presented in Section 2, Basin Setting, and the monitoring network for implementation of the GSP is discussed in Section 4, Monitoring Networks.

1.6.1 DWR Subsidence Network

The historic observation stations were a result of DWR's efforts to establish a subsidence monitoring network across the valley to capture changes in the ground surface elevation. The observation stations were established monuments with precisely surveyed land surface elevations. They were distributed throughout the valley such that the entire county is well represented. In 2008, DWR along with numerous partners performed the initial GPS survey of the observation stations to establish a baseline measurement for future comparisons. The network was resurveyed in 2017 using similar methods and equipment as those used in the 2008 survey and results were analyzed to depict the change in elevation at each station between those years. Results of the survey are available here,

https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub

Extensometers within Butte County but outside the Subbasin remain active. They are installed in wells or boreholes and are a more site-specific method of measuring land subsidence as they can detect changes in the thickness of the sediment surrounding the well due to compaction or expansion. These instruments can detect very slight changes in land surface elevation on a continuous basis with an accuracy of +/- 0.01 feet or approximately 3 millimeters. The three extensometers in Butte County have a period of record beginning in 2005 and were chosen by

DWR based on a high likelihood of seeing subsidence in these areas if it were to occur, based on the presence of known clay and other fine-grained deposits in these areas. Data are available through July 2020 from the DWR WDL.

1.6.2 Interferometric Synthetic Aperture Radar (InSAR) Satellite Data

DWR provides Interferometric Synthetic Aperture Radar (InSAR) satellite data available on their SGMA Data Viewer web map[4] and DWR WDL, including downloadable raster datasets to estimate subsidence (DWR contracted TRE Altamira to make this data available). The dataset is generated from two satellites operated by the Sentinel mission, which is part of the European Radar Observatory for the Copernicus joint initiative of the European Commission and the European Space Agency (ESA). Data calibration uses Global Navigation Satellite System (GNSS) stations within California and one GNSS station resides within Butte County near Lake Oroville. The dataset nearly covers the entire Subbasin, with some gaps in the southwest. The TRE Altamira InSAR dataset provides estimates of total vertical displacement from June 2015 to Present.

1.7 Interconnection of Databases

Several of the databases discussed above utilize the same water level or water quality data. These records often specify the monitoring entity responsible for the measurement. Although these data overlap between databases, the correlation between databases is not specified. For example, water level data in the WDL are also in CASGEM, but this link is not mentioned in WDL records. This lack of connection poses problems for gathering water level and quality data throughout California. Efforts have been made in the development of this GSP to overcome the issue related to overlap and poor correlation between databases, but the issue remains. It is recommended that agencies work together to utilize a common unique identifier to ease use of multiple datasets.

1.8 Notice and Communication (23 California Code of Regulations § 354.10)

1.8.1 Notice of Intent to Adopt GSP

A notice of intent (NOI) to adopt the 2022 GSP and amended GSP were signed by the GSA and distributed on June 28, 2021 and February XX, 2026; respectively. The hard copies of the NOIs were mailed to cities and counties within the Wyandotte Creek Subbasin including the following:

- Butte County
- City of Oroville

Copies of the NOIs are provided in Appendix 1-B.

1.8.2 Overview

California's SGMA of 2014 requires broad and diverse stakeholder involvement in GSA activities and during the development and implementation of GSPs for groundwater basins around the state, including the Wyandotte Creek Subbasin. The intent of SGMA is to ensure successful, sustainable management of groundwater resources at the local level, success of GSP

[4] https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub

development and implementation will require cooperation by all beneficial users (defined below). Therefore, coordinated communication and consistent messaging of valid information and facilitation of opportunities for the involvement of beneficial users will guide the path forward.

To facilitate stakeholder involvement in the GSA process, a Communication and Engagement Plan (C&E Plan) (Appendix 1-D) was created for the Wyandotte Creek GSA. The desired outcomes and goals of the C&E Plan were to achieve understanding and support for GSP adoption and implementation in consideration of the people, economy, and environment within the subbasin and in coordination with adjacent subbasins.

Plan Goals:

1. Enhance understanding and inform the public about water and groundwater resources in the Wyandotte Creek Subbasin, the purpose and need for sustainable groundwater management, the benefits of sustainable groundwater management, and the need for a GSP.
2. Engage diverse interested parties and stakeholders and promote informed feedback from stakeholders, the community, and groundwater-dependent users throughout the GSP preparation and implementation process.
3. Coordinate communication and involvement between the GSA (Board, Stakeholder Advisory Committee and Management Committee), and other local agencies, elected and appointed officials, and the public.
4. Rely on the WAC to facilitate a comprehensive public engagement process.
5. Employ a variety of outreach methods that make public participation accessible and that encourage broad participation.
6. Respond to public concerns.
7. Provide accurate and up-to-date information.
8. Create public value and use GSA resources wisely by managing communications and engagement in a manner that is resourceful and efficient.

1.8.3 Description of Beneficial Uses and Users in the Wyandotte Creek Subbasin

SGMA calls for consideration of all interested parties that the GSA must consider when developing and implementing the GSP. GSAs must encourage the active involvement of diverse social, cultural, and economic elements of the population. Therefore, stakeholders or beneficial users are any stakeholders who have an interest in groundwater use and management in the Wyandotte Creek Subbasin. Their interest may be related to GSA activities, GSP development and implementation, and/or water access and management in general.

To assist in identifying categories of beneficial users in the Wyandotte Creek Subbasin, the C&E Plan listed broad categories of interested parties to be considered during development and implementation of the GSP. These include, but are not limited to:

- General public
- Agricultural users of water

- Domestic well owners
- Municipal well operators
- Public water systems
- Land use planning agencies
- Environmental users of groundwater
- Surface water users
- The federal government
- California Native American tribes
- DACs and historically underrepresented groundwater users (including those served by private domestic wells or small community water systems)

Table 1-1 further identifies potential stakeholder groups and engagement purpose.

Table 1-1: Stakeholder Engagement Chart for Groundwater Sustainability Plan Development

Category of Interest	Examples of Stakeholder Groups	Engagement purpose
General Public	• Citizens groups • Community leaders • Service clubs and professional organizations	Inform to improve public awareness of sustainable groundwater management
Private/Other users	• Private pumpers • Domestic users • School/College systems • Hospitals: Oroville Hospital	Inform and involve to minimize negative impact to these users
Urban/Agriculture users	• Water agencies: Cal Water • Colleges/Universities • Water associations • Commissions: SC-OR Sewerage Commission - Oroville Region • Water districts: TWSD; SFWPA • Mutual water companies • Resource conservation districts • Farm Bureau: Butte County Farm Bureau • Parks: Feather River Recreation and Park District	Collaborate to ensure sustainable management of groundwater
Industrial users	• Commercial and industrial self-supplier • Local trade association or group	Inform and involve to avoid negative impact to these users
Land Use Planning Agencies	• Municipalities (City, County planning departments): City of Oroville, Butte County • Regional land use agencies	Consult and involve to ensure land use policies are supporting GSPs
Environmental and Ecosystem	• Regional agencies: Butte County Resource Conservation District • Federal and State agencies: California Department of Fish and Wildlife (CDFW)	Inform and involve to sustain a vital ecosystem

Category of Interest	Examples of Stakeholder Groups	Engagement purpose
	• Environmental groups: Butte Environmental Council, The Nature Conservancy (TNC)	
Economic Development	• Chambers of commerce: City of Oroville • Business groups/associations • Elected officials (Board of Supervisors, City Council) • State Assembly members • State Senators	Inform and involve to support a stable economy
Human right to water	• DACs • Small community systems • Environmental Justice Groups: Leadership Council for Justice and Accountability, Self-Help Enterprises, Community Water Center	Inform and involve to provide a safe and secure groundwater supplies to all communities reliant on groundwater. The Butte County OEM Drought Assistance Program assists the public with dry domestic wells by providing water deliveries and/or water storage tanks.
Tribes	• Federally Recognized Tribes and non-federally recognized Tribes with Lands or potential interests in Wyandotte Creek Subbasin: Concow-Maidu Tribe of the Mooretown Rancheria, Tyme Maidu Tribe of the Berry Creek Rancheria	Inform, involve and consult with tribal government
Federal lands	• United States Bureau of Reclamation (USBR) • Bureau of Land Management	Inform, involve and collaborate to ensure basin sustainability
Integrated Water Management	• Regional water management groups (IRWM regions); Upper Feather River IRWM and the North Sacramento Valley (NSV) IRWM group • Flood agencies	Inform, involve and collaborate to improve regional sustainability

1.8.4 Communications

1.8.4.1 Decision-making Processes

As noted above, the Wyandotte Creek Subbasin consists of one GSA for GSP implementation, the Wyandotte Creek GSA.

The Wyandotte Creek GSA Board is the final decision-maker for the Wyandotte Creek Subbasin. To assist in GSP development, the Wyandotte Creek GSA convened a WAC in 2020. The composition of the WAC is intended to represent the beneficial uses and users of groundwater in the Wyandotte Creek GSA. The WAC was originally organized to comprise seven at-large members appointed by the GSA Board and one member representing Cal Water Oroville, one member representing SFWPA, and tribal representatives. The at-large positions include three agricultural groundwater users, two domestic well users, and one environmental and one business association representative. During the 2022 GSP preparation there were three agricultural members, one member from Cal Water and one member from SFWPA on the WAC. The WAC is charged with actively engaging with the public for input and feedback.

The representatives attending the GSA Management Committee meetings are designated staff from the member agencies; City of Oroville, Butte County, and TWSD. In addition to coordinating the WAC and GSA Board business, the GSA Management Committee assists the WAC in identifying and clarifying recommendations for GSP development and implementation which were presented to the GSA Board in public meetings as well as at subbasin-wide public meetings.

1.8.4.2 Public Engagement Opportunities

There were a number of different meetings at which the public had the opportunity to engage during the GSP development and amendment process:

- GSA Board meetings: The Wyandotte Creek GSA Board held regular public meetings, including joint meetings, to facilitate public input.
- WAC meetings.
- Public Workshops.
- Subbasin-wide Technical Advisory Committee meetings.
- Farm Bureau Water Forum meetings.
- City of Oroville.
- Regional Water Management Group.

1.8.4.3 Encouraging Active Involvement

The GSA carried out community engagement during the development of the GSP, which included meetings and presentation materials to inform the public. The GSP has been revised to incorporate public feedback. There were also activities related to encouraging involvement and building capacity for engagement. The GSA Management Committee used a variety of tools to solicit input, including maintaining an up-to-date website with announcements, calendar of events and meetings, and links to draft chapters of the GSP; establishing an interested parties list; email newsletters; and public notices. These documents encouraged and prepared community members to participate in GSP development by providing technical information as well as information about opportunities for engagement.

As part of the 40-day public review period initiated on September 9, 2021, the GSA Management Committee worked with the numerous entities to inform them about the plan and encourage their involvement. Appendix 1-D lists the SGMA public meetings that were held throughout the GSA formation and GSP preparation process.

1.8.4.4 Soliciting Written Comments

In addition to soliciting feedback at GSA meetings, opportunities were provided to offer written comments on the various chapters of the GSP as draft versions became available. Stakeholders could provide comments via an online comment form, letter, or email. An informal comment period began when the draft of the first chapter of the GSP was released in April 2019, and another public comment period began on the date the full draft of the GSP was released, in September 2021. In addition, a Public Workshop was held on October 20, 2021, to solicit written comments. All comments received via the comment form, letter, or email were provided to the WAC and Wyandotte Creek GSA Board in agenda packets for review.

The written comments and responses can be found in Appendix 1-E.

1.8.5 Informing the Public about Groundwater Sustainability Plan Development Progress

1.8.5.1 Interested Parties List

An email distribution list of subbasin-wide stakeholders and beneficial users was developed for outreach throughout the GSP planning process. The list was maintained and updated by the Wyandotte Creek GSA Management Committee. Any interested member of the public could request to be signed up via this link: Contact Us - Wyandotte Creek GSA (wyandottecreekgsa.com)

1.8.5.2 Distribution of Flyers

Typically, before a public meeting in the Wyandotte Creek Subbasin, an email flyer was created with key information provided. The flyer was emailed out to the Interested Party list as well as posted on Member Agency websites and various places throughout the subbasin.

1.8.5.3 Press Outreach

Press releases were issued at key junctures and decision-making points for the Wyandotte Creek Subbasin.

1.8.5.4 A Centralized Wyandotte Creek GSA Website

Throughout the planning process (and beyond) the Wyandotte Creek GSA has maintained a website with information about subbasin-wide planning efforts related to SGMA.

The Wyandotte Creek Subbasin website contains:

- Homepage with links to key pages within the site including a link to draft copies of the GSP
- About Us with an overview of the Wyandotte Creek GSA and SGMA
- Governance that describes the structure of the GSA, Board Members, WAC Members, Meeting Dates and Agendas, and Transparency Documents
- SGMA Overview
- Calendar of Board and WAC Meetings and Workshops
- Contact Us page for email correspondence and to register for the email list

1.8.5.5 Stakeholder Input and Responses

The engagement opportunities described above provided various avenues for stakeholders to provide input on GSP development. The matrix in Appendix 1-E summarizes the public comments received, organized by commenter, organization, chapter/section/line of comment location, comment, and location of where the comment was addressed or changed within the final draft document, as applicable.

1.9 Human Right to Water

Not formerly included in DWR's GSP checklist, but still important to address, is human right to clean water. California Water Code Section 106.3, Human Right to Water, states that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." Private domestic well groundwater pumper representation on the Advisory Committee and community engagement via public workshops and outreach are venues through which those potentially most vulnerable to loss of clean drinking water can share information and concerns throughout the GSP development and implementation. During preparation of this GSP public meetings were held at times, locations, and in a manner both in-person and remotely online that supported and allowed for effective engagement of all stakeholders.

2. BASIN SETTING

2.1 Hydrogeologic Conceptual Model

A Hydrogeologic Conceptual Model (HCM) identifies the major factors contributing to groundwater flow and movement and how different physical features and characteristics affect conditions within a subbasin. This section describes the HCM for the Wyandotte Creek Subbasin. The HCM serves as an important component of the basin setting, providing the framework for understanding groundwater conditions and water budgets.

Much of the information in this section is from existing reports detailing the hydrogeology of the Sacramento Valley and the formations making up the aquifer systems in the groundwater basin. These reports by DWR include the Geology of the Northern Sacramento Valley, 2014 (DWR, 2014), the Butte County Groundwater Inventory Analysis, 2005 (DWR, 2005), and work by Blair et al. (1991). Better understanding the hydrogeology, aquifer dynamics, and recharge paths of the aquifer systems in the Northern Sacramento Valley region is an area of active research by local agencies, DWR, and others.

2.1.1 Basin Boundaries

2.1.1.1 Lateral Boundaries

The Wyandotte Creek Subbasin lies in the eastern central portion of the Sacramento Groundwater Basin. It is bounded on the west by the Feather River and Thermalito Afterbay; in the south by the Butte-Yuba County line (except for Ramirez Water District which is fully within the North Yuba Subbasin); and on the north and east by the edge of the alluvial basin as defined by DWR Bulletin 118 - Update 2003 (DWR, 2003). It is surrounded by the Butte Subbasin to the west, the Vina Subbasin to the north, the North Yuba Subbasin to the south and the foothills to the east.

2.1.1.2 Bottom of Basin

The definable bottom of the basin is described in Bulletin 118 subbasin report (DWR, 2006) as part of the North Yuba Subbasin (which at that time included what is now the Wyandotte Creek Subbasin) as follows:

> *The [Wyandotte Creek] Subbasin aquifer system is comprised of continental deposits of Quaternary to Late Tertiary (Pliocene) age. The cumulative thickness of these deposits increases from a few hundred feet near the Sierra Nevada foothills on the east to over 1,000 feet along the western margin of the basin.*

Groundwater occurs in the heterogeneous gravel and sand layers and the base of the Laguna Formation is generally accepted as the base of fresh water (Olmsted and Davis, 1961, as cited in DWR, 2014). However non-saline water has been observed in the underlying Ione formation (Dames and Moore, 1994) and Blair and others (1991) identified the base of the Mehrten Formation as the base of fresh water in portions of the Wyandotte Creek Subbasin.

Locally, the base of fresh groundwater fluctuates depending on local changes in the subsurface geology and geologic formational structure (DWR, 2005). In the DWR 2005 report, 600 feet was used as the average base of fresh water. In contrast, in an unpublished study by Bookman -Edmonston Engineering, Inc (1992) a thickness of 200 feet was assumed for estimating groundwater storage capacity (as cited in DWR, 2006). Because of the inconclusive data on the location of the base of fresh groundwater, this remains an area requiring additional data to improve characterization of the aquifer system.

2.1.2 Topography, Surface Water and Recharge

2.1.2.1 Terrain and Topography

The Wyandotte Creek Subbasin lies southwest of Lake Oroville. The northeastern area of the subbasin has steeper and more varied terrain. Land surface elevation varies from approximately 90-100 feet above mean sea level (amsl) along the western edge near the Feather River and the southern edge along Honcut Creek, to over 200 feet amsl at the edge of the foothills on the eastern side. In general, the area slopes in a southwesterly direction toward the Feather River.

Figure 2-1 shows the surface topography of the Wyandotte Creek Subbasin.

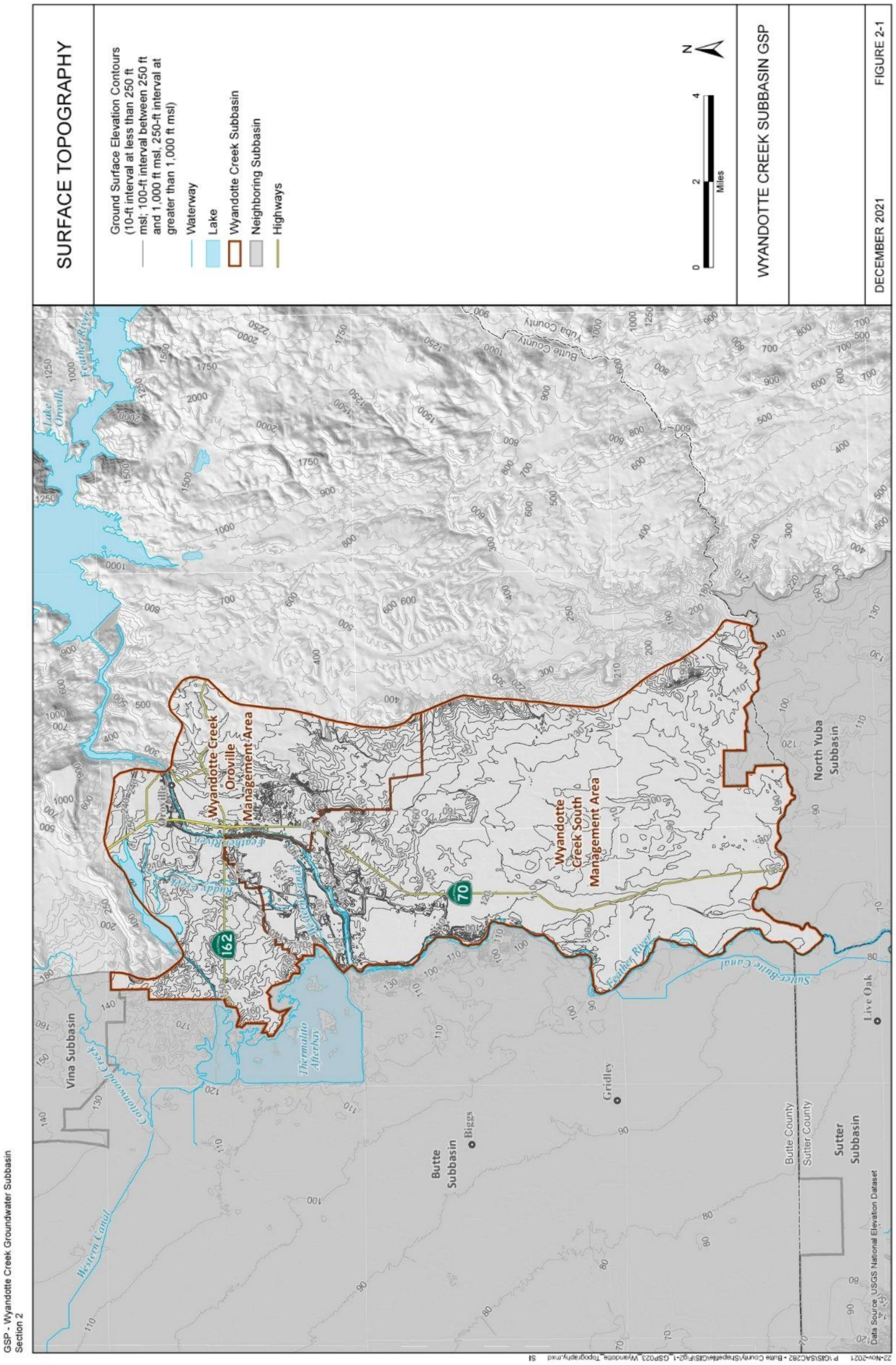
2.1.2.2 Soils

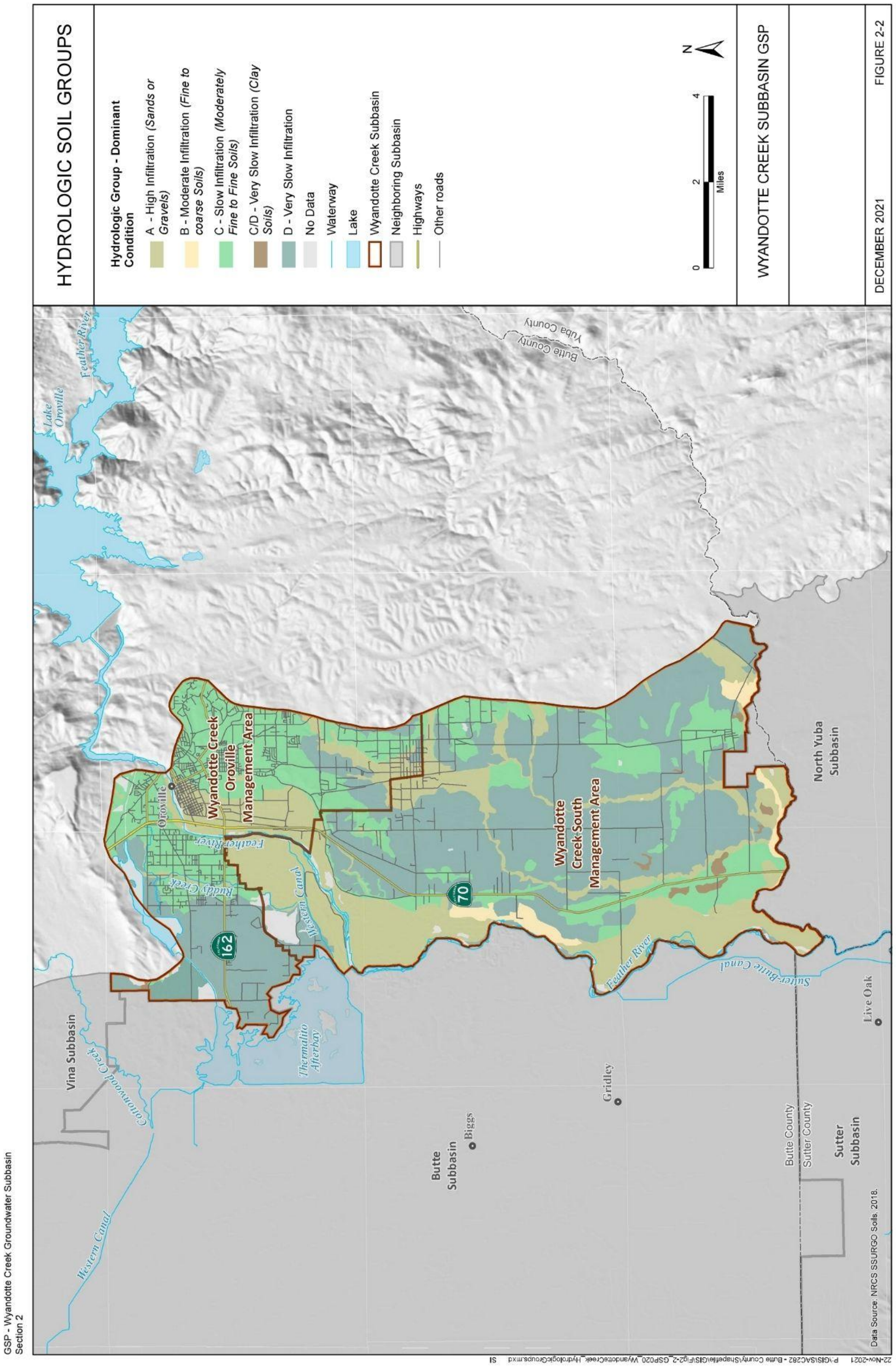
The area along the Feather River is underlain by lighter textured soils characterized by high infiltration rates. These areas correspond to land uses dominated by irrigated orchards. Most remaining areas of the subbasin has soils with slow to very slow infiltration rates. Soils with slow infiltration rates or a restrictive layer are well suited for growing rice. Figure 2-2 shows the distribution of Hydrologic Soil Groups for the Wyandotte Creek Subbasin. Soils designated as C/D are lands having soils that would have been classified as having very low infiltration (Group D) but have characteristics such as natural slope or management improvements that improved their drainage relative to that of similar soils.

Based on the Digital General Soil Map of the United States, or STATSGO2, soil data for the Wyandotte Creek Subbasin, the dominant soil mapping unit within the area is Redding-Corning, which is moderately well drained and represents approximately 64.3% of the subbasin. Other prominent soils within the subbasin include Riverwash-Dumps-Cortina (13.1% of area), and Tisdale-Kilaga-Conejo (13.6% of area). Characteristics of these soils are summarized in Table 2-1. The distribution of prominent soils (e.g., "map units") in the subbasin is shown in Figure 2-3.

Table 2-1: STATSGO2 Soil Table for Wyandotte Creek Subbasin

Soil Map Unit	Percent of Area	Sum of Acres	Slope Range	Drainage
Wyandotte Creek Subbasin	100%	59,382		
Goulding-Auburn (s646)	0.7%	420	27.8	Well drained
Redding-Corning (s821)	64.3%	38,175	5.3	Moderately well drained
Riverwash-Dumps-Cortina (s648)	13.1%	7,783	2.6	Well drained
Stockton-Clear Lake-Capay (s824)	0.2%	108	1	Poorly drained
Sycamore-Shanghai-Nueva-Columbia (s855)	8.1%	4,822	1	Somewhat poorly drained
Tisdale-Kilaga-Conejo (s870)	13.6%	8,047	1	Well drained


GSP - Wyandotte Creek Groundwater Subbasin
Section 2
SURFACE TOPOGRAPHY
Ground Surface Elevation Contours (10-ft interval at less than 250 ft msl; 100-ft interval between 250 ft and 1,000 ft msl, 250-ft interval at greater than 1,000 ft msl)
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Miles
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-1
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
North Yuba Subbasin
Vina Subbasin
Butte Subbasin
Sutter Subbasin
Lake Oroville
Feather River
Thermalito Afterbay
Western Canal
Sutter-Butte Canal
Butte County
Sutter County
Yuba County
Gridley
Biggs
Live Oak
Data Source: USGS National Elevation Dataset
Page 43


GSP - Wyandotte Creek Groundwater Subbasin
Section 2
HYDROLOGIC SOIL GROUPS
Hydrologic Group - Dominant Condition
A - High Infiltration (Sands or Gravels)
B - Moderate Infiltration (Fine to coarse Soils)
C - Slow Infiltration (Moderately Fine to Fine Soils)
C/D - Very Slow Infiltration (Clay Soils)
D - Very Slow Infiltration
No Data
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-2
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Oroville
Lake Oroville
Feather River
Ruddy Creek
Western Canal
Thermalito Afterbay
Sutter-Butte Canal
Cottonwood Creek
Vina Subbasin
Butte Subbasin
North Yuba Subbasin
Sutter Subbasin
Biggs
Gridley
Live Oak
Butte County
Yuba County
Sutter County
162
70
Data Source: NRCS SSURGO Soils, 2018.

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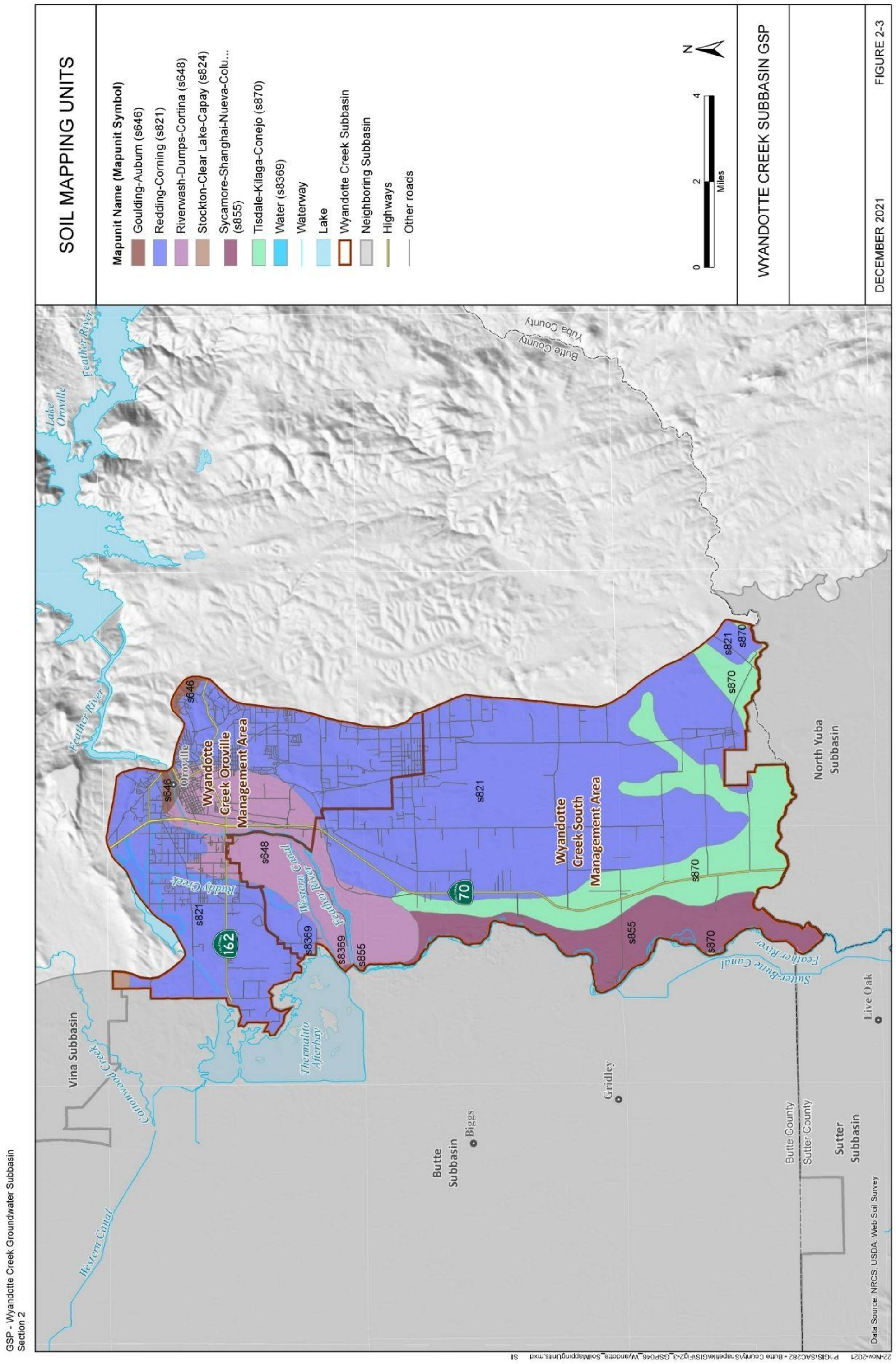

SOIL MAPPING UNITS
Mapunit Name (Mapunit Symbol)
Goulding-Auburn (s646)
Redding-Corning (s821)
Riverwash-Dumps-Cortina (s648)
Stockton-Clear Lake-Capay (s824)
Sycamore-Shanghai-Nueva-Colu... (s855)
Tisdale-Kilaga-Conejo (s870)
Water (s8369)
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-3
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
North Yuba Subbasin
Vina Subbasin
Butte Subbasin
Sutter Subbasin
Butte County
Sutter County
Yuba County
Lake Oroville
Feather River
Oroville
Biggs
Gridley
Live Oak
Thermalito Afterbay
Western Canal
Sutter-Butte Canal
Cottonwood Creek
Ruddy Creek
s646
s648
s821
s855
s870
s8369
162
70
GSP - Wyandotte Creek Groundwater Subbasin
Section 2
Data Source: NRCS, USDA, Web Soil Survey
Page 45

2.1.2.3 Surface Water

The Feather River enters the subbasin in the northeast and then borders the subbasin on its western side. Other large surface water bodies bordering the subbasin include components of the Oroville Reservoir Complex including the Forebay and Thermalito Afterbay. The North, Middle, West and South Forks of the Feather River originate outside the subbasin and together supply water to Lake Oroville with a portion of flow routed through the Thermalito Forebay and Afterbay facilities to generate hydropower and deliver irrigation water supply to the Butte Subbasin, with the remaining water returning to the Feather River. The Feather River serves as a source of municipal and irrigation supply in the subbasin through diversions by the TWSD and SFWPA.

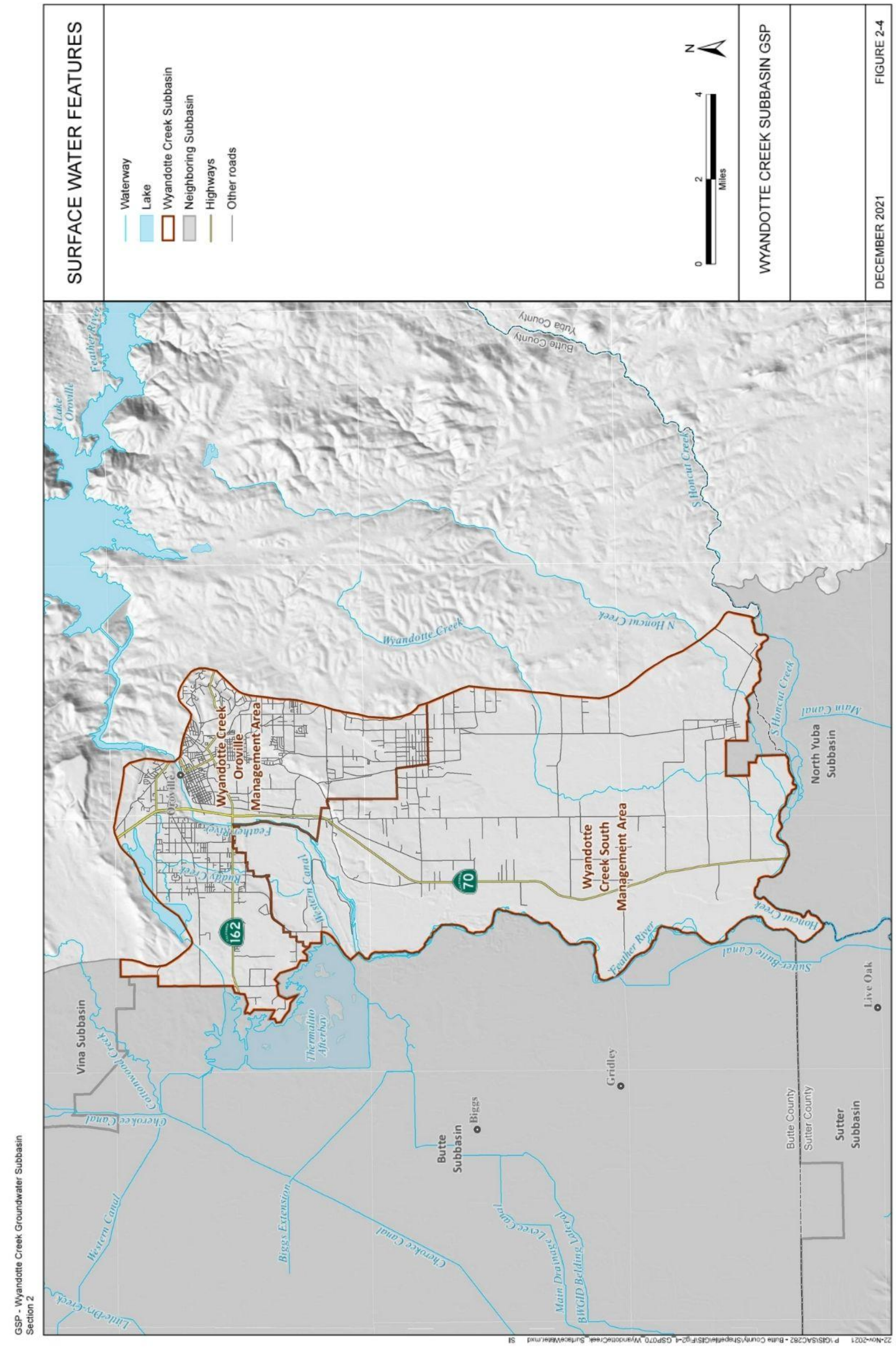
Smaller local or ephemeral streams entering and traversing the subbasin include North Honcut Creek, Wyandotte Creek, Wyman Ravine, Ruddy Creek, canals, and numerous unnamed waterways. Figure 2-4 shows prominent surface water features in the Wyandotte Creek Subbasin.

2.1.2.4 Groundwater Recharge Areas

Groundwater recharge is the downward movement of water from the surface to the groundwater system. Several water sources and mechanisms recharge the groundwater system in the Wyandotte Creek Subbasin. This includes percolation of water from rainfall, irrigation, or water bodies like the Feather River, streams and canals.

Figure 2-5 shows the relative rates of recharge as estimated by the Butte Basin Groundwater Model (BBGM v. 1.0) for the 2018 water year across the model elements (triangular areas) (BCDWRC, 2021). The model has been updated, but 2018 rates can still be considered representative for the subbasin. This is included as an indication of the variation in recharge in different areas due to the cumulative effects of varying factors including: soil characteristics, land use and irrigation water source, and precipitation. Areas with higher rates of recharge correspond in part to areas with soils having higher infiltration rates and areas receiving applied water for irrigation.

There is potential for additional recharge through management activities of flood flows or irrigation practices in the Wyandotte Creek Subbasin. The Soil Agricultural Groundwater Banking Index (SAGBI) is a suitability index for groundwater recharge on agricultural land based on five major factors: deep percolation, root zone residence time, topography, chemical limitations, and soil surface condition. This dataset can serve as a starting point indication for areas conducive to natural or managed recharge. Large portions of the subbasin in its southern half received a moderately good to excellent rating in terms of being suitable for recharge (Figure 2-6). Additional considerations will be important for specific evaluation of any proposed recharge project. SAGBI data can be accessed at https:\\casoilresource.lawr.ucdavis.edu/sagbi.


GSP - Wyandotte Creek Groundwater Subbasin
Section 2
SURFACE WATER FEATURES
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-4
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
North Yuba Subbasin
Vina Subbasin
Butte Subbasin
Sutter Subbasin
Lake Oroville
Feather River
Wyandotte Creek
N Honcut Creek
S Honcut Creek
Honcut Creek
Main Canal
Sutter-Butte Canal
Western Canal
Thermalito Afterbay
Cherokee Canal
Biggs Extension
Oroville
Biggs
Gridley
Live Oak
Butte County
Sutter County
Yuba County
70
162
Page 47

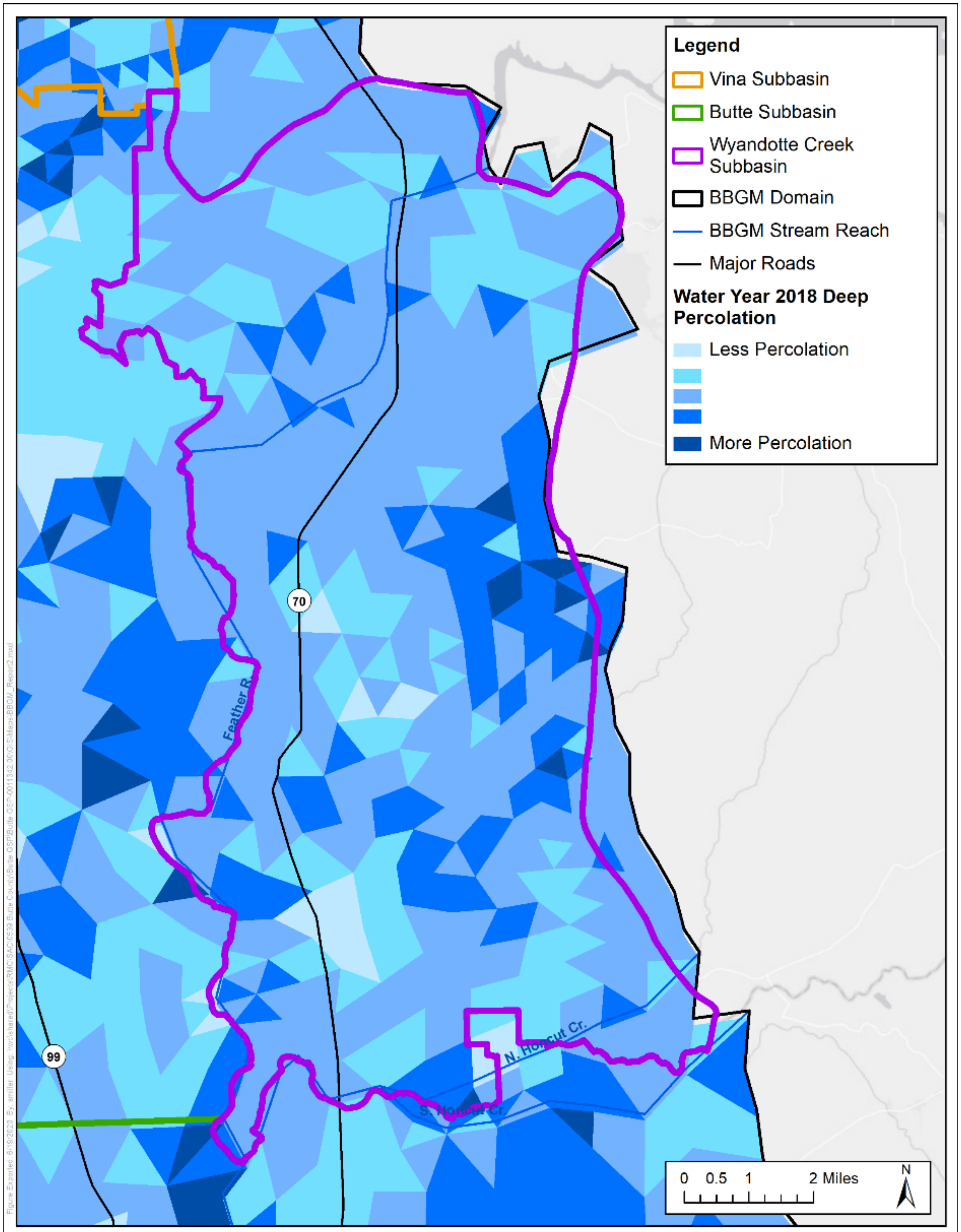
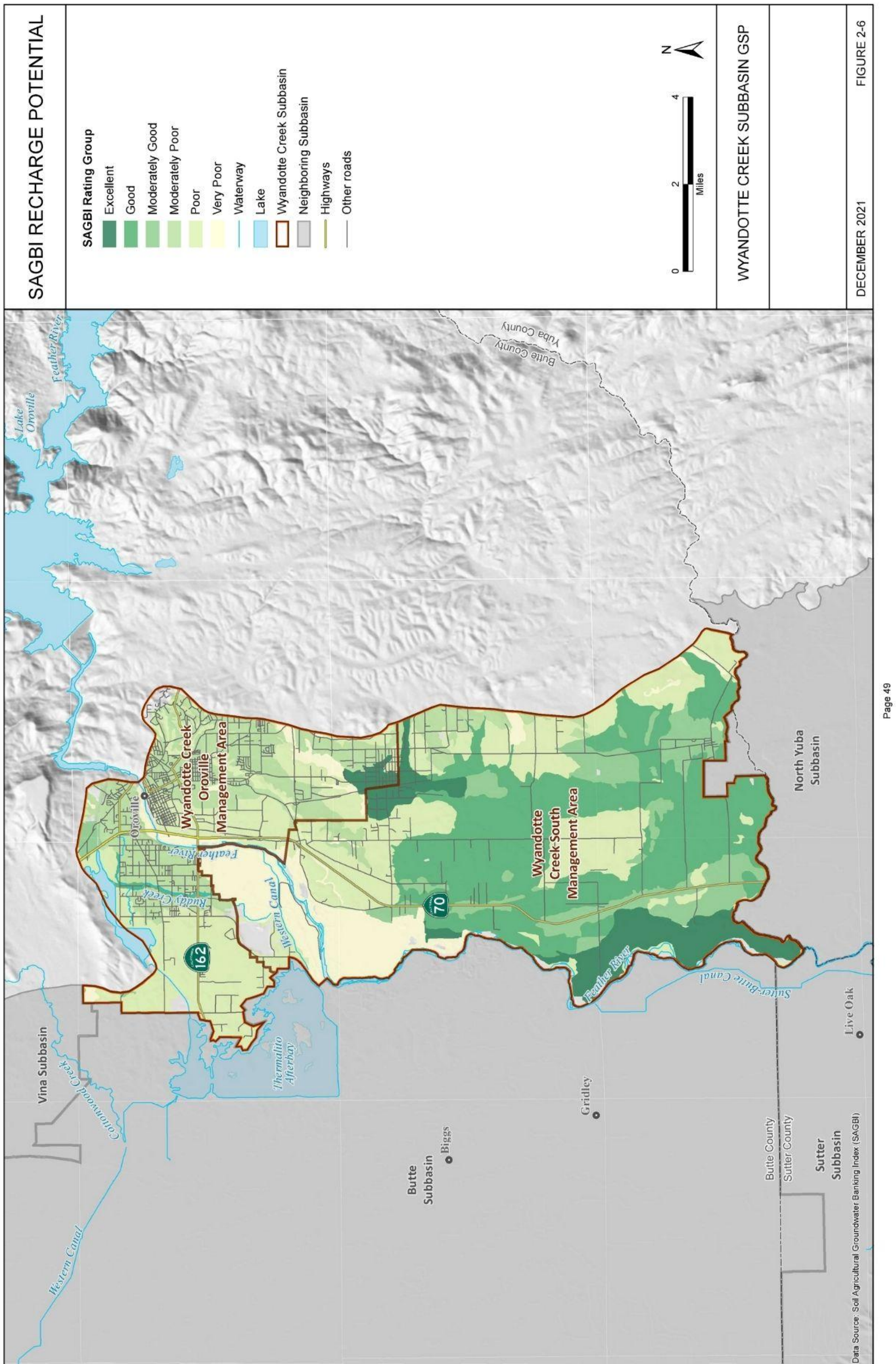


Figure 2-5: Relative Rates of Deep Percolation throughout the Wyandotte Creek Subbasin as Estimated by the Butte Basin Groundwater Model (BBGM v.1.0)

GSP - Wyandotte Creek Groundwater Subbasin
Section 2



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2.1.3 Regional Geologic and Structural Setting

An inconsistent stratigraphic nomenclature has been established for the Cenozoic deposits in the Wyandotte Creek Subbasin (Blair et al., 1991). Many of these units are defined on the basis of gold content, buried soils, and geomorphic relationships or by the introduction of distant formation names without local verification. The stratigraphy of the Wyandotte Creek Subbasin, despite being finely divided, is further complicated by a lack of continuous exposure and by the fact that many of the units have inset relationships with older formations rather than superposed, layered relationships, owing to the sedimentologic behavior of the Feather River system. Using the nomenclature developed by Blair et al. (1991) and by adhering to the stratigraphic code (North American Commission on Stratigraphic Nomenclature, 2005), three formal stratigraphic units have been differentiated in the subbasin. These include, in ascending order, the Ione Formation, Mehrten Formation (designated by others as the Tuscan Formation), and Laguna Formation (designated by others as a combination of the Alluvium, Modesto, and Riverbank Formations).

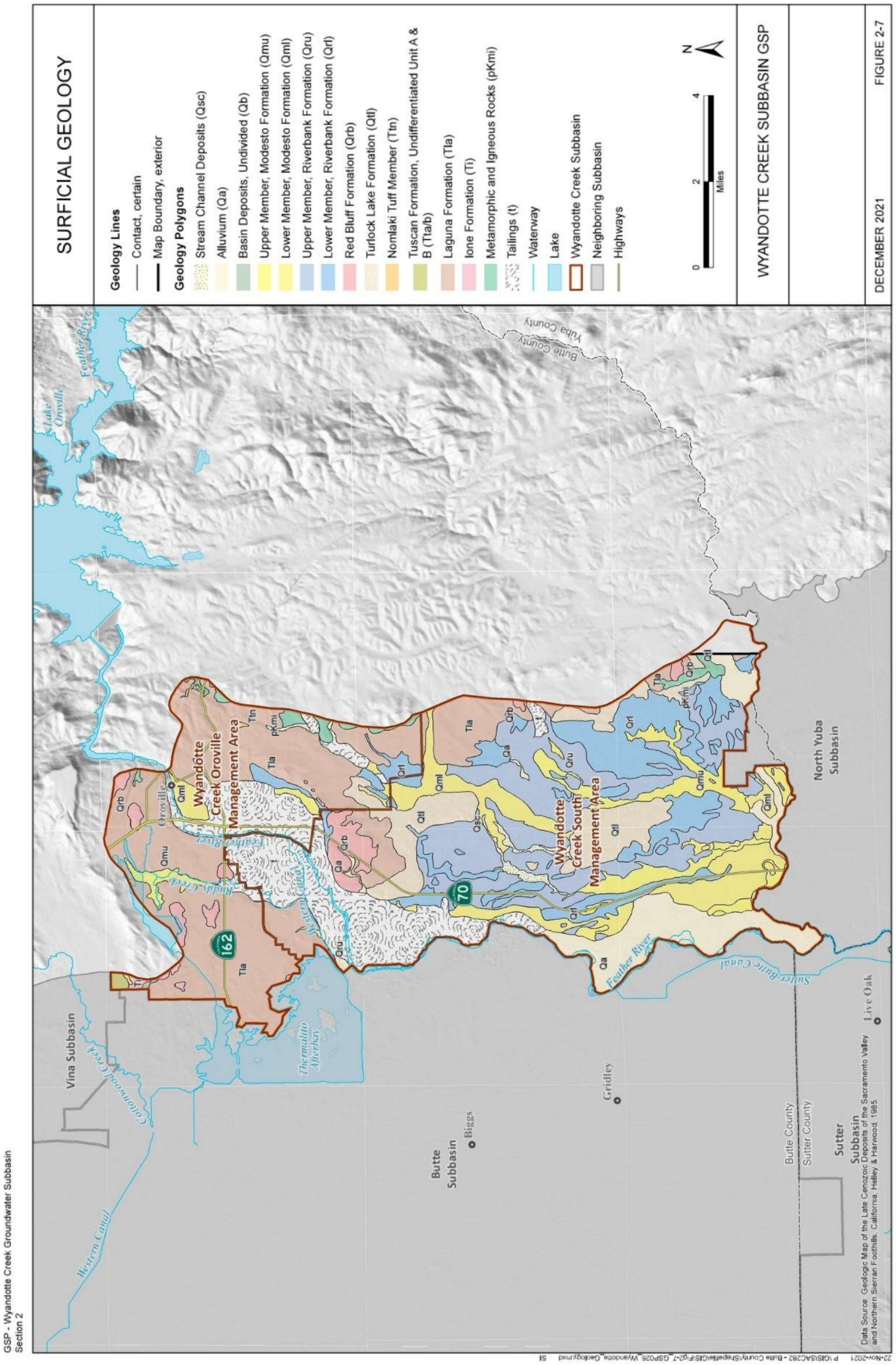
In the Oroville area, bedrock has been encountered as shallow as 283 feet below ground surface (bgs) and has been observed in outcrop adjacent to the Memorial Park Cemetery (Dames and Moore, 1994). Moving east from these areas, bedrock has been reported to occur at depths greater than 1,000 feet.

The regional structure of the Sacramento Valley groundwater basin consists of an asymmetrical trough tilting to the southwest with a steeply dipping western limb and a gently dipping eastern limb (Page, 1986). Older granitic and metamorphic rocks underlie the valley forming the basement bedrock on which younger marine and continentally derived sediments and volcanic rock have been deposited. Along the valley axis and west of the present-day Sacramento River, basement rock is at considerable depth, ranging from 12,000 to 19,000 feet bgs. Overlying marine and continentally derived sediments have been deposited almost continuously from the Late Jurassic period to the present. Of these deposits, older sediments in the basin were emplaced in a marine environment and usually contain saline or brackish groundwater. Younger sediments were deposited under continental conditions and generally contain fresh groundwater. Sediments thin near the margins of the basin, exposing older metamorphic and granitic rocks underlying and bounding the Sacramento Valley sediments (DWR, 2005).

2.1.4 Geologic Formations

Groundwater occurs under both unconfined and confined conditions. Unconfined conditions are generally present in the surficial Quaternary deposits and in the Pliocene deposits that are exposed at the surface. Confined conditions exist where one or more confining layers rests above the underlying aquifer deposits.

Figure 2-7 is the Surficial Geologic Map for the Wyandotte Creek Subbasin, produced by DWR, which shows the surface distribution of geologic units. The surface geology is composed of the Laguna Formation in the north and eastern area, alluvium along the Feather River and predominantly Riverbank and Modesto Formations in the southern half of the subbasin. Tailings are mapped along the Feather River where it traverses the subbasin. These surficial deposits together are referred to as the Laguna Formation using the nomenclature of Blair et al. (1991).


SURFICIAL GEOLOGY
Geology Lines
Contact, certain
Map Boundary, exterior
Geology Polygons
Stream Channel Deposits (Qsc)
Alluvium (Qa)
Basin Deposits, Undivided (Qb)
Upper Member, Modesto Formation (Qmu)
Lower Member, Modesto Formation (Qml)
Upper Member, Riverbank Formation (Qru)
Lower Member, Riverbank Formation (Qrl)
Red Bluff Formation (Qrb)
Turlock Lake Formation (Qtl)
Nomlaki Tuff Member (Ttn)
Tuscan Formation, Undifferentiated Unit A & B (Tta/b)
Laguna Formation (Tla)
Ione Formation (Ti)
Metamorphic and Igneous Rocks (pKmi)
Tailings (t)
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Miles
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-7
GSP - Wyandotte Creek Groundwater Subbasin
Section 2
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Lake Oroville
Feather River
Oroville
Thermalito Afterbay
Vina Subbasin
Butte Subbasin
Biggs
Gridley
Live Oak
North Yuba Subbasin
Sutter Subbasin
Butte County
Sutter County
Yuba County
Western Canal
Sutter-Butte Canal
Data Source: Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California. Helley & Harwood. 1985.
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The following is a discussion of groundwater producing geologic units found within the subbasin and region.

2.1.5 Groundwater Producing Formations

The majority of groundwater resources in the subbasin exist in spaces between gravel, sand, and clay particles of various formations that store and transmit water in the aquifer systems. Principal water bearing formations in the Wyandotte Creek Subbasin include the Ione, Mehrten, and Laguna Formations. These formations are discussed below.

2.1.5.1 Ione Formation

The Ione Formation is discontinuously exposed on the east side of the Sacramento Valley from near Deer Creek north of Chico to around Friant in the San Joaquin Valley (Creely, 1965 as cited in DWR, 2014). It is present in the subsurface in the Wyandotte Creek Subbasin and extends to the west toward the axis of the northern Sacramento Valley.

The Ione Formation consists of variably cemented, fine to coarse sandstone, siltstone, lignite, and claystone with variegated colors including red, yellow, white, blue, gray, orange, and black. Interbedded lenticular pebble-and-cobble “auriferous” or “greenstone” gravels are locally present and become more abundant eastwardly (Blair et al., 1991). In drill cuttings, the Ione Formation is easily identified from the overlying Mehrten Formation by its multicolored nature and volcanic-free composition.

2.1.5.2 Mehrten Formation

The Mehrten Formation includes a sequence of variably cemented, interbedded clay, sand, and gravel. This formation consists predominantly of purple volcanic debris flow deposits and interbedded water-lain fluvial deposits rich in volcanic detritus, but in many areas containing crystalline basement-derived clasts and rare tuff beds. The base of the Laguna Formation can easily be distinguished in drill cuttings where pumiceous materials of the tuff members are encountered. The reported occurrence of both channel-lain, clast supported, pebble- and cobble-gravel facies and interbedded volcanic-rich debris-flow facies in this formation suggests that debris flows related to volcanic events episodically choked the ancestral stream/river systems of the area. Blair et al. (1991) described the gravel and sand fractions, as well as many intervals of the Mehrten Formation in the Oroville area encountered in the subsurface consisting of porphyritic-dacite rock fragments and disaggregated quartz and plagioclase phenocrysts. The sand fraction of this area comprised a mixture of porphyritic-dacite rock fragments (36% to 37%), granitic rock fragments (32% to 49%), metamorphic rock fragments (4% to 7%), Quartz (10% to 19%), and feldspar (0% to 3%). This composition indicates that in the Wyandotte Creek Subbasin that the Mehrten Formation originated from the erosion of both Sierra Nevada crystalline rocks and a Mount Lassen-derived volcanic sequence.

2.1.5.3 Laguna Formation

The Laguna Formation consists of sandy gravel channel, sandy channel facies, and sandy clay to clay floodplain facies and ranges in thickness in the northern part of the subbasin from 120 feet to 220 feet. The gravel deposits occur above sharp, scoured facies and are comprised of poorly to moderately sorted, sandy, clast-supported pebbles and cobbles. In the Oroville area, the Nomlaki Tuff Member, a white, pumice-rich, water-lain vitric tuff has been placed at the base of the Laguna Formation (Blair et al., 1991). If encountered, directly underlying this member is the

Mehrten Formation. Where the Nomlaki Tuff Member is not encountered, the base of the Laguna Formation is identified by the presence of gravel clasts and/or sand grains consisting of a composition greater than 50% andesite, andesitic basalt, and/or dacite.

The Laguna Formation was deposited by the ancestral Feather, and outside the subbasin by the Yuba, Bear, and American rivers to the south (Helley and Harwood, 1985). During the Pliocene and Pleistocene epochs, uplift of the Sierra Nevada increased the erosion of the plutonic and metamorphic rocks on the eastern side of the valley. Rivers and streams carried the eroded material westward to the valley floor, and as the water overtopped the banks, it spread out across the broad floodplains of the valley, depositing the sediments into broad alluvial fans (DWR, 2014).

2.1.6 Geologic Cross Sections

Figure 2-8A shows Airborne Electromagnetic (AEM) data profiles from the Department of Water Resources (DWR) W07 survey. It is a key which shows the orientation of geologic cross sections developed for the Wyandotte Creek Subbasin. Figure 2-8B is the north-south geologic cross sections (labeled A-A’ on the map) for the Wyandotte Creek Subbasin, developed for this amended GSP. The cross-section shows three different stratigraphic units, from oldest to youngest: Ione Formation, Mehrten Formation (including the Nomlaki Tuff), and the Laguna Formation. The Laguna Formation is representative of the shallow (or upper) aquifer zone and the Ione Formation is considered the deeper aquifer zone.

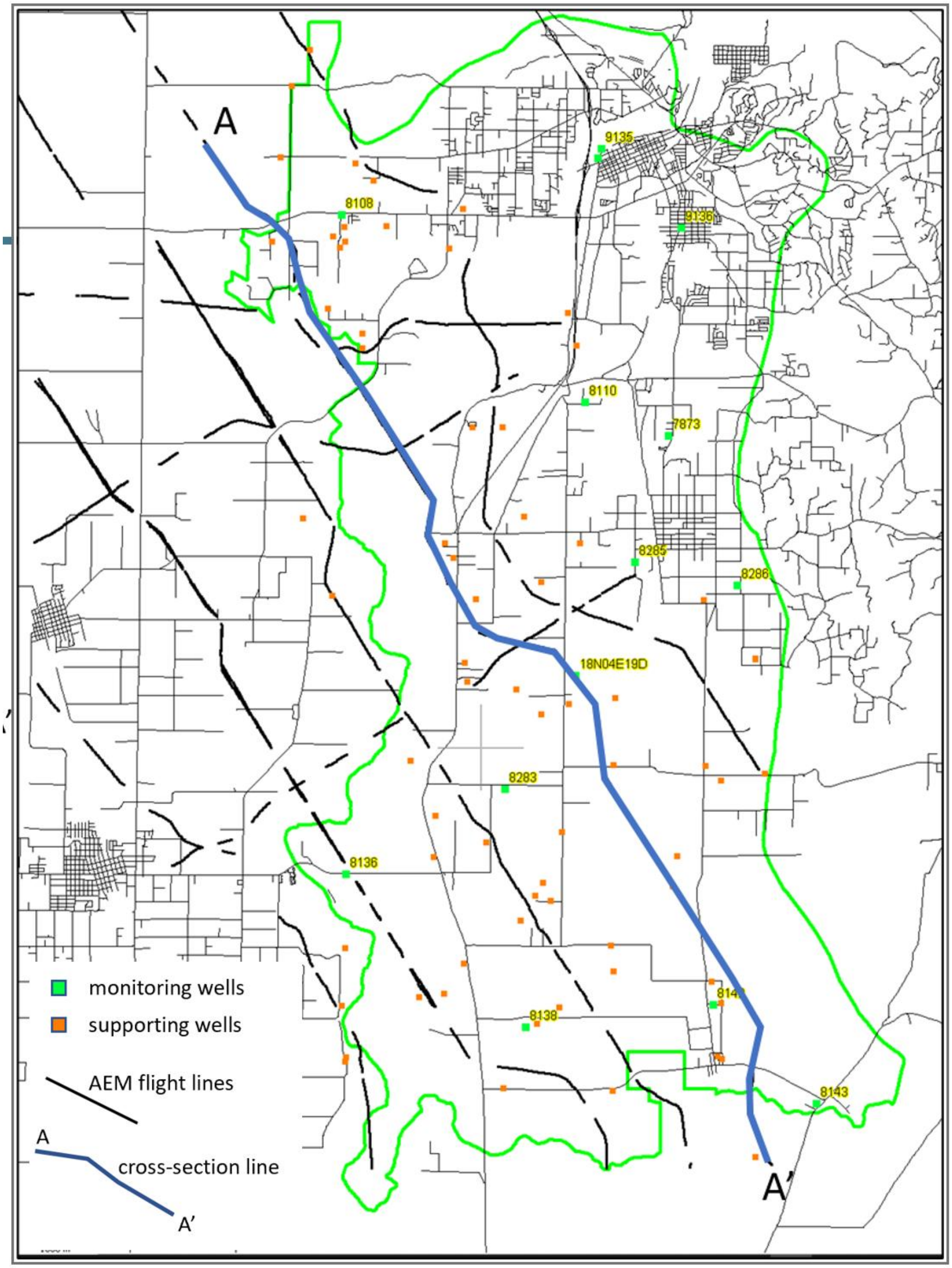


Figure 2-8A. Wyandotte Creek Subbasin AEM Flightlines

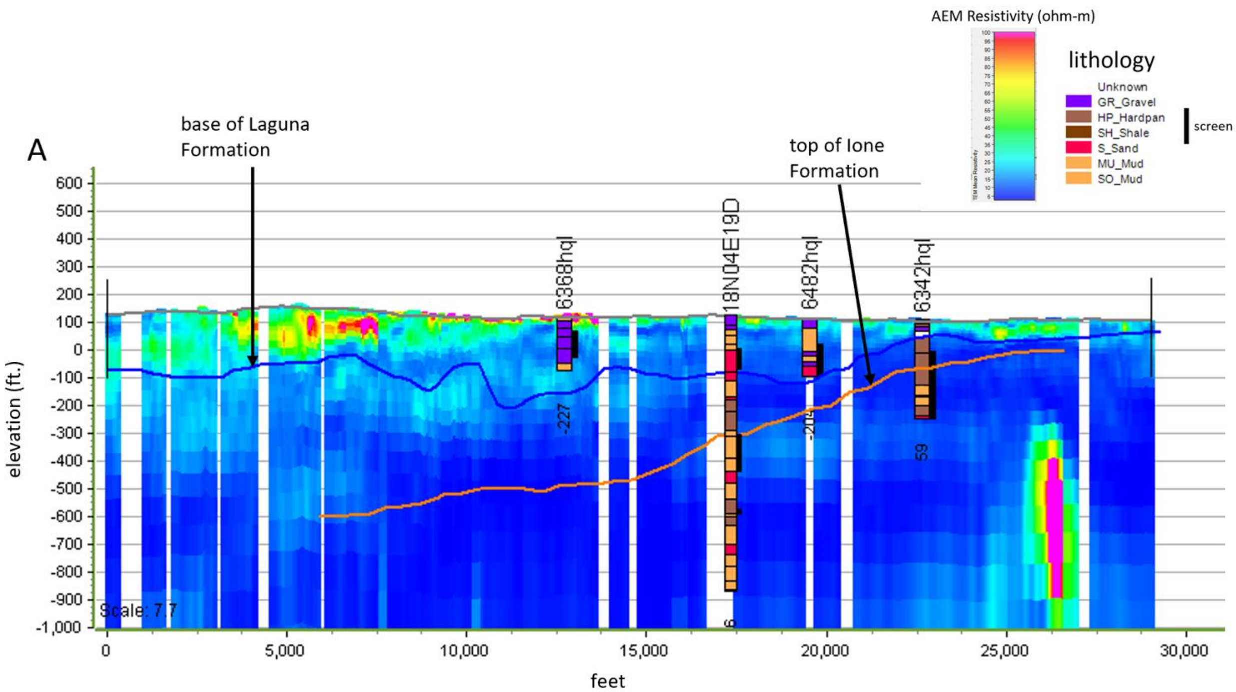


Figure 2-8B: Wyandotte Creek Subbasin Groundwater Aquifer Representative Cross-Section from DWR's AEM Survey.

2.1.7 Principal Aquifers and Aquitards

DWR defines principal aquifers under SGMA as the "aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems" (California Code of Regulations [CCR], Title 23, § 351(aa)). A single principal aquifer in the subbasin consists predominantly of Ione, Mehrten, and Laguna Formations. There are no known structural properties that significantly restrict groundwater flow within the subbasin within the portion of the aquifer that stores, transmits, and yields significant quantities of water.

2.1.7.1 Primary Uses

Water produced from the principal aquifer is primarily used to meet irrigation, domestic and municipal water demand. Domestic supply is used to meet rural residential demands. Municipal supply is largely used to meet demand from the City of Oroville.

2.1.7.2 Specific Yield

Specific Yield or storativity quantifies the ability of the aquifer to hold or store water. Quantitative water-bearing data for the Laguna Formation is limited, especially in the area of the Wyandotte Creek Subbasin. Although the occurrence of thin sand and gravel zones is common, many of them have reduced permeability due to cementation. This, coupled with its fine-grained character, leads to an overall low permeability for the Laguna Formation. An unpublished study by Bookman-Edmonston Engineering, Inc. (1992) estimated groundwater storage based on an average specific yield of 6.9% and assumed thickness of 200 feet (DWR, 2006). The 2005 DWR report assumed a specific yield of 8.8%. Values for specific yield and storativity used in the calibrated BBGM v.1.0 throughout the Wyandotte Creek Subbasin are 10% and 0.00001, respectively (BCDWRC, 2021). Specific Yield will be refined as additional information becomes available.

2.1.7.3 Transmissivity

Transmissivity (T) quantifies the ability of water to move through aquifer materials. The aquifer hydraulic conductivity (K) quantifies the rate of groundwater flow and is related to the transmissivity and aquifer thickness (b) by the following formula: $T = K \times b$. Limited hydraulic conductivity data is available for the subbasin. The BBGM calibrated hydraulic conductivity ranges from 20-250 feet per day depending upon the location and depth within the subbasin (BCDWRC, 2021).

2.1.8 Opportunities for Hydrogeologic Conceptual Model Improvements

2.1.8.1 Identify Areas Where Additional Monitoring Would Help Increase Understanding of the Aquifer

Determine the best approach for increasing monitoring in these areas, such as installation of new wells or increased monitoring at existing wells.

2.1.8.2 Expand Isotopic Analysis to Further Assess Groundwater Recharge

Future recharge and aquifer studies should include the collection and interpretation of stable isotope data. Methodology considerations include: 1) Seasonal sampling should be performed as part of future surface water and groundwater isotope studies for purposes of assessing groundwater recharge; 2) Monitoring wells with multiple screened intervals (multi-completion monitoring wells) are recommended to assess stable isotope data at different depths. Sampling locations with a single well-screen interval do not provide nearly as much insight as sampling locations with wells screened at multiple depths; and 3) Monitoring wells with relatively short screened zones (20 feet or less) are preferred to minimize mixing between aquifer zones or between aquifer zones and residual water retained within the aquitard zones between aquifers.

2.1.8.3 Characterize Recharge Source With General Water Quality

Conduct general mineral analysis on groundwater samples to evaluate whether elevated specific conductivity values observed during sampling are due to irrigation influences (e.g., elevated nitrate, calcium, sulfate) or due to proximity to the Ione Formation (e.g., elevated sodium, chloride, and boron).

2.1.8.4 Recharge rate

Most monitoring well locations and depths should be sampled and analyzed for presence of tritium to help distinguish whether recharge to individual aquifer zones is occurring over periods shorter than about 60 years, or whether recharge is occurring over longer timeframes.

2.1.8.5 Field Testing and Monitoring Equipment Installation to Understand the Recharge Rates and Stream Losses in the Recharge Zone

Expansion of stream gauging locations to document changes in stream-aquifer interactions should be conducted. In addition to the stream gauging, a series of shallow dedicated monitoring wells with temperature sensors installed along stream courses in the recharge corridor may help identify what sections of streams are losing or gaining.

2.2 Groundwater Conditions

2.2.1 Description of Current and Historical Conditions

Groundwater conditions in the Wyandotte Creek Subbasin are continually monitored and are comprehensively described in the 2001 and 2016 Water Resource Inventory and Analysis Reports and Annual Groundwater Status reports produced by Butte County. These documents and other reports portray a subbasin that has adequate groundwater resources to meet demands under most hydrologic conditions. However, comparison of the reports illustrates how in the period between their issuance demand for groundwater has grown relative to the available supply. This trend, quantified below in the water budget section of this document, suggests that as forces ranging from population growth to climate change play out, the value of well-informed water management policies and practices is likely to increase. In short, as shown below, while groundwater conditions in the subbasin remain relatively stable, maintaining this posture in the future may become less the result of a state of nature and more the reward for thoughtful management. The water budget analysis presented in this section provides a quantitative assessment of how conditions have changed in the Wyandotte Creek Subbasin at the time of GSP development and an indication of how conditions may change in the future. The GSA will provide updated groundwater condition assessments in GSP Annual Reports and Five-Year Periodic Evaluations.

2.2.2 Groundwater Trends

2.2.2.1 Elevation and Flow Directions

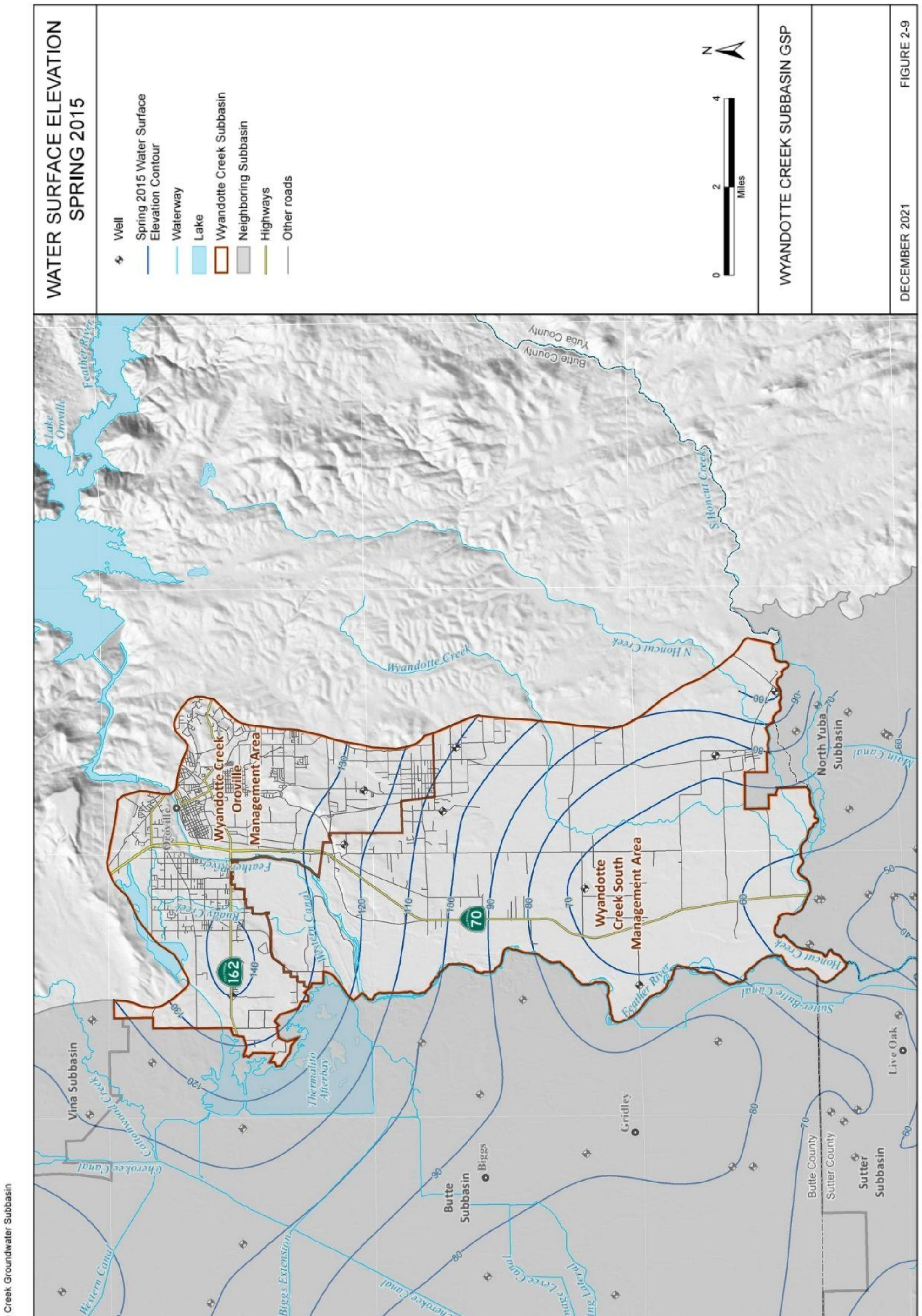
Figures 2-9 and 2-10 show groundwater elevation contours in the Wyandotte Creek Subbasin for the spring and fall of 2015 and Figures 2-11 and 2-12 show elevation contours for the spring and fall of 2019.

Contours plotted on these maps show first encountered groundwater as reported through the CASGEM Program. The data were processed as follows:

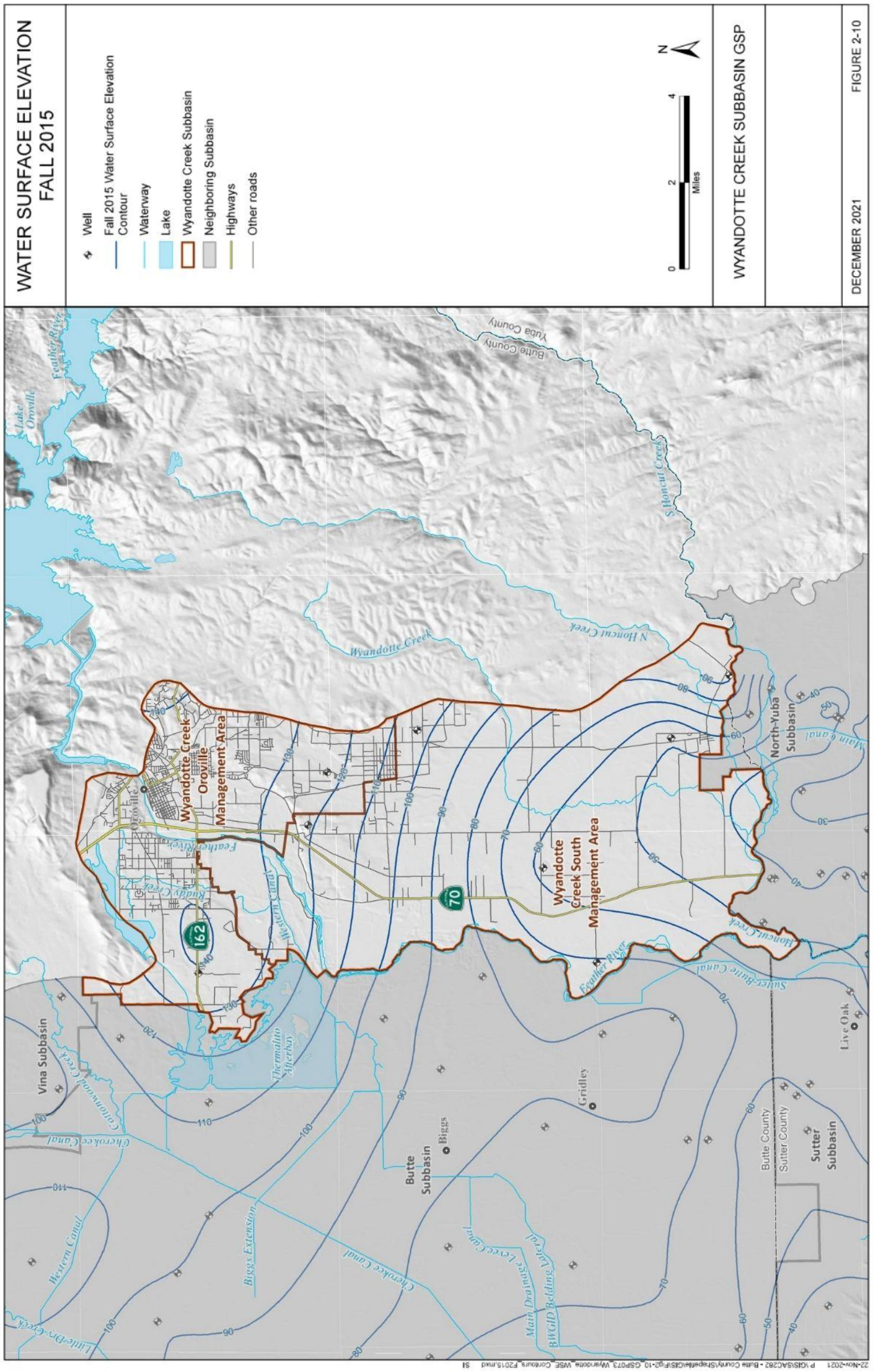
- Data from CASGEM were used to identify wells in the Wyandotte Creek Subbasin plus supplemental sites used to extend the contours to the west.
- Water level readings for 2015 and 2019 were then filtered for measurements taken between September 20th and October 30th for the fall contours and between March 20th and April 30th for the spring contours.
- Wells showing depths to first encountered groundwater deeper than 500 feet were eliminated from the data set. The remaining readings were sorted by well depth.

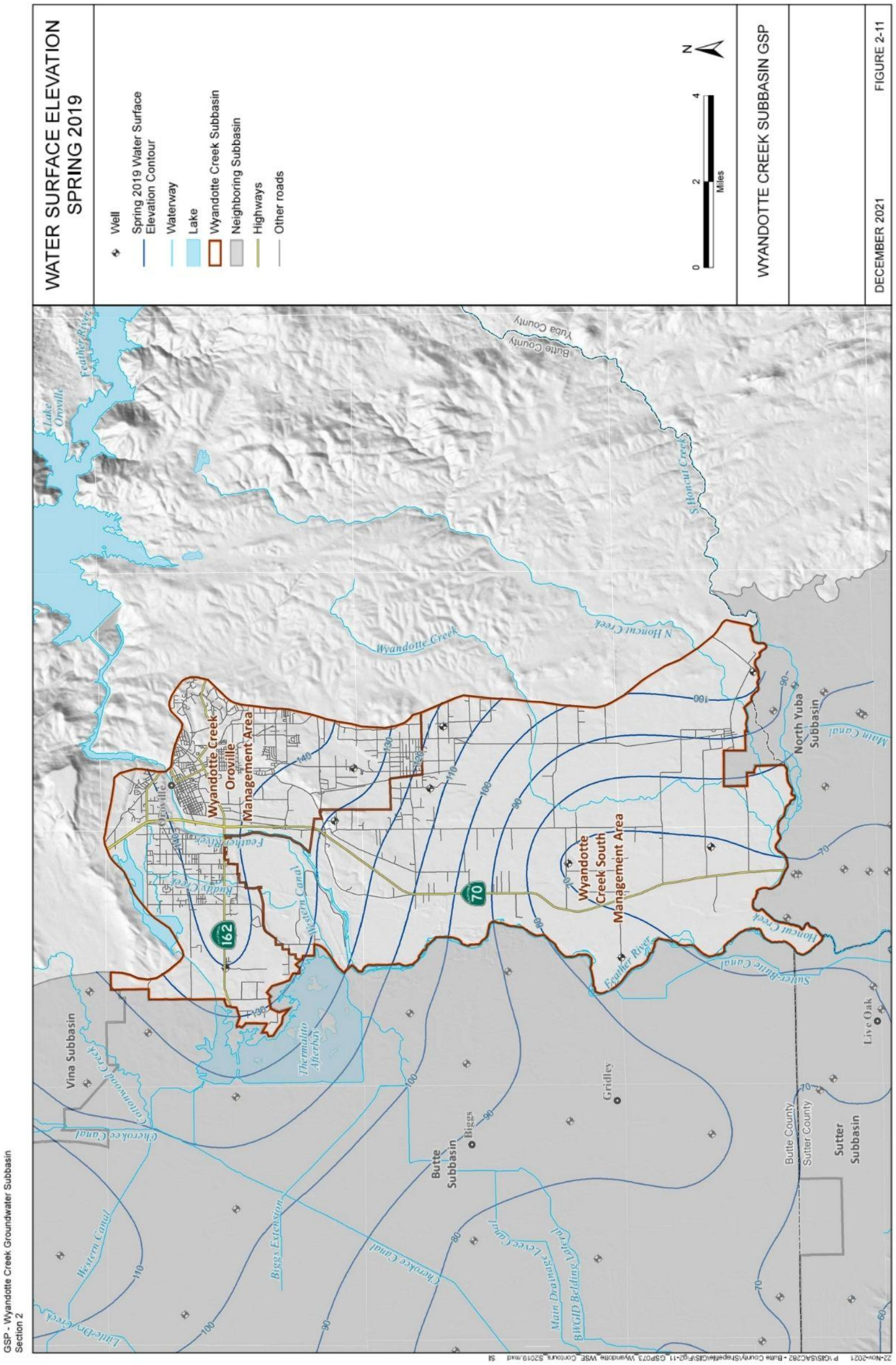
The four contour maps display groundwater elevations that are higher in the north of the subbasin than in the south indicating a general gradient that causes water to flow from north and from foothill recharge areas in the east toward the subbasin's southeastern corner. Because of the influence of Thermalito Afterbay and the Feather River, groundwater elevations in the north are generally stable between the spring and fall observation periods, while elevations in the south tend to be lower in the fall than the spring, a pattern typical of valley floor locations distant from major sources of recharge.

When comparing elevations reported in 2015 with those reported in 2019, the influence of stable water elevations in Thermalito Afterbay has resulted in a corresponding stability in neighboring groundwater elevations. However, elevations in the spring of 2015 observed in the south tend to be higher than those reported for the spring of 2019. Fall elevations in the north continue to show the stabilizing influence of Thermalito Afterbay. However, elevations to the south for 2015 are slightly lower than those observed in 2019. This may be an indication of an increase in the volume of water recharged from upland areas flowing into the subbasin's principal aquifer.

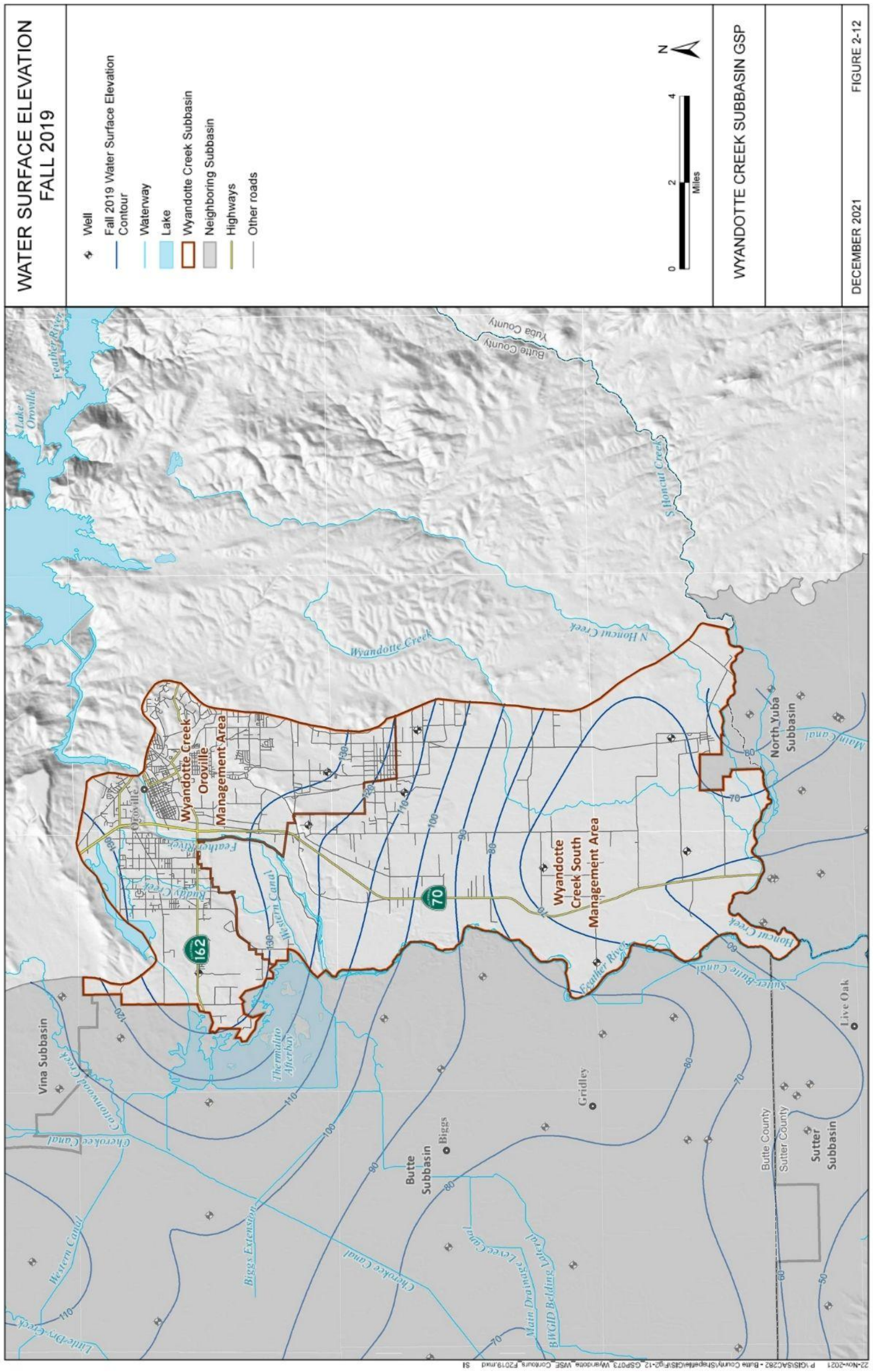

WATER SURFACE ELEVATION SPRING 2015
Well
Spring 2015 Water Surface Elevation Contour
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-9
GSP - Wyandotte Creek Groundwater Subbasin
Section 2
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Vina Subbasin
Butte Subbasin
North Yuba Subbasin
Sutter Subbasin
Oroville
Gridley
Biggs
Live Oak
Lake Oroville
Feather River
Wyandotte Creek
N Honcut Creek
S Honcut Creek
Honcut Creek
Thermalito Afterbay
Western Canal
Cherokee Canal
Biggs Extension
Sutter-Butte Canal
Main Canal
Butte County
Sutter County
Yuba County
Page 60

GSP - Wyandotte Creek Groundwater Subbasin
Section 2




WATER SURFACE ELEVATION
SPRING 2019
Well
Spring 2019 Water Surface Elevation Contour
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-11
GSP - Wyandotte Creek Groundwater Subbasin
Section 2
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Vina Subbasin
Butte Subbasin
North Yuba Subbasin
Sutter Subbasin
Butte County
Sutter County
Yuba County
Lake Oroville
Feather River
Wyandotte Creek
N Honcut Creek
S Honcut Creek
Honcut Creek
Thermalito Afterbay
Oroville
Biggs
Gridley
Live Oak
Western Canal
Cherokee Canal
Sutter-Butte Canal
Main Canal
Biggs Extension
Little Dry Creek
Cottonwood Creek
Main Drainage Canal
BWGID Belding Lateral
Lateral Levee Canal
70
162
Page 62

GSP - Wyandotte Creek Groundwater Subbasin
Section 2



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2.2.2.2 Lateral/vertical Gradients

Lateral groundwater gradients generally reflect ground surface topography. In the foothills east of the Wyandotte Creek Subbasin the gradient is steep, as high as 60 feet per mile. However, in most of the subbasin itself, the gradient is gradual at approximately 3 feet per mile, with the gradient influenced both by the terrain and by the groundwater mound fed by seepage from Thermalito Afterbay.

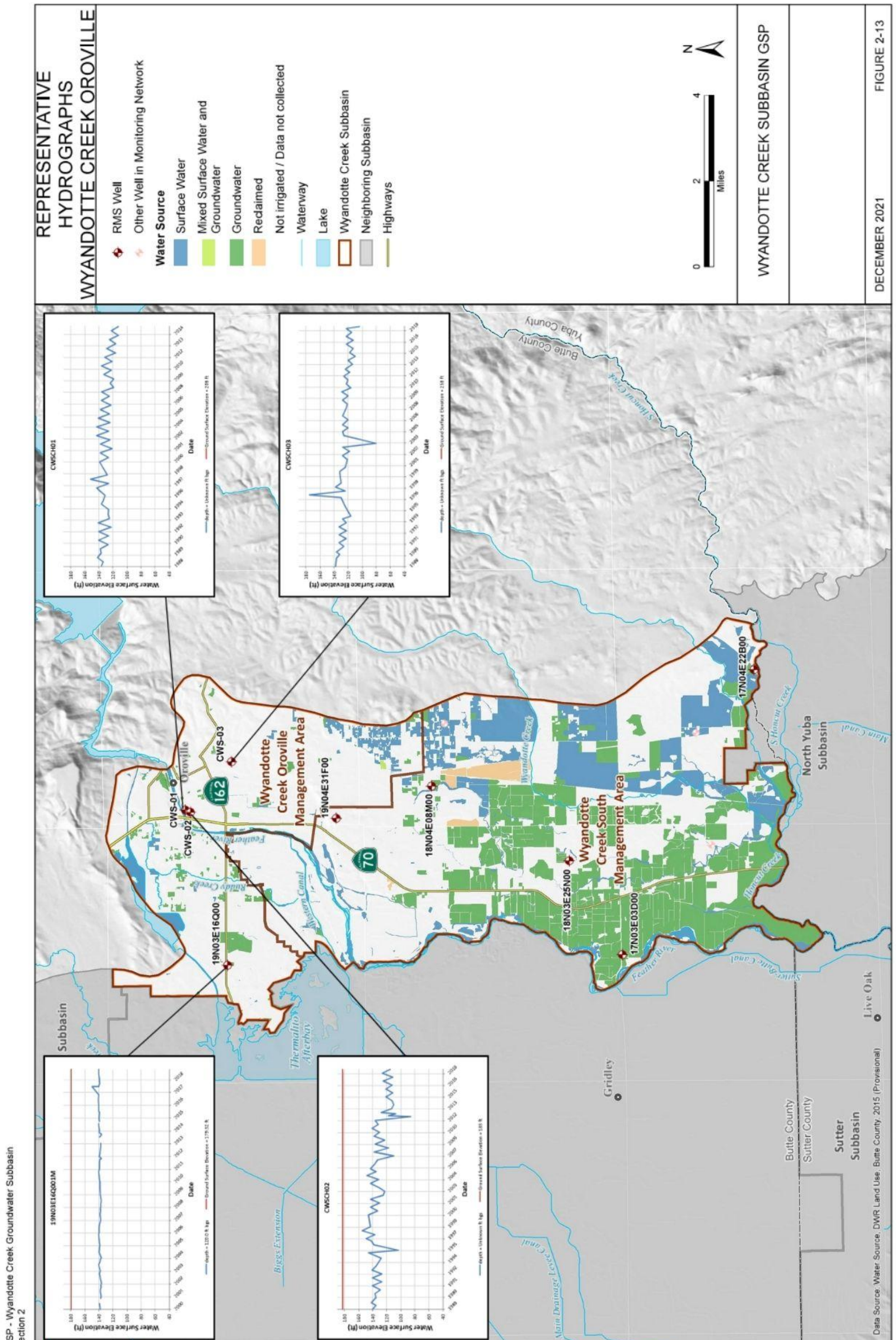
Figure 2-13 is a map of the Wyandotte Creek Subbasin's Oroville MA that displays hydrographs of selected monitoring wells, and Figure 2-14 is a similar map of the subbasin's South MA. Just as comparison of the spring and fall contours indicated the shift in groundwater elevations that typically occurs between the seasons, the hydrographs display annual oscillations in elevations as well as trends over the monitoring period, snapshots of which are captured in comparison between the 2015 and 2019 contours. Each of the hydrographs displays water surface elevations in feet amsl and also gives the depth of the bottom of the well which indicates the location of the zone being measured.

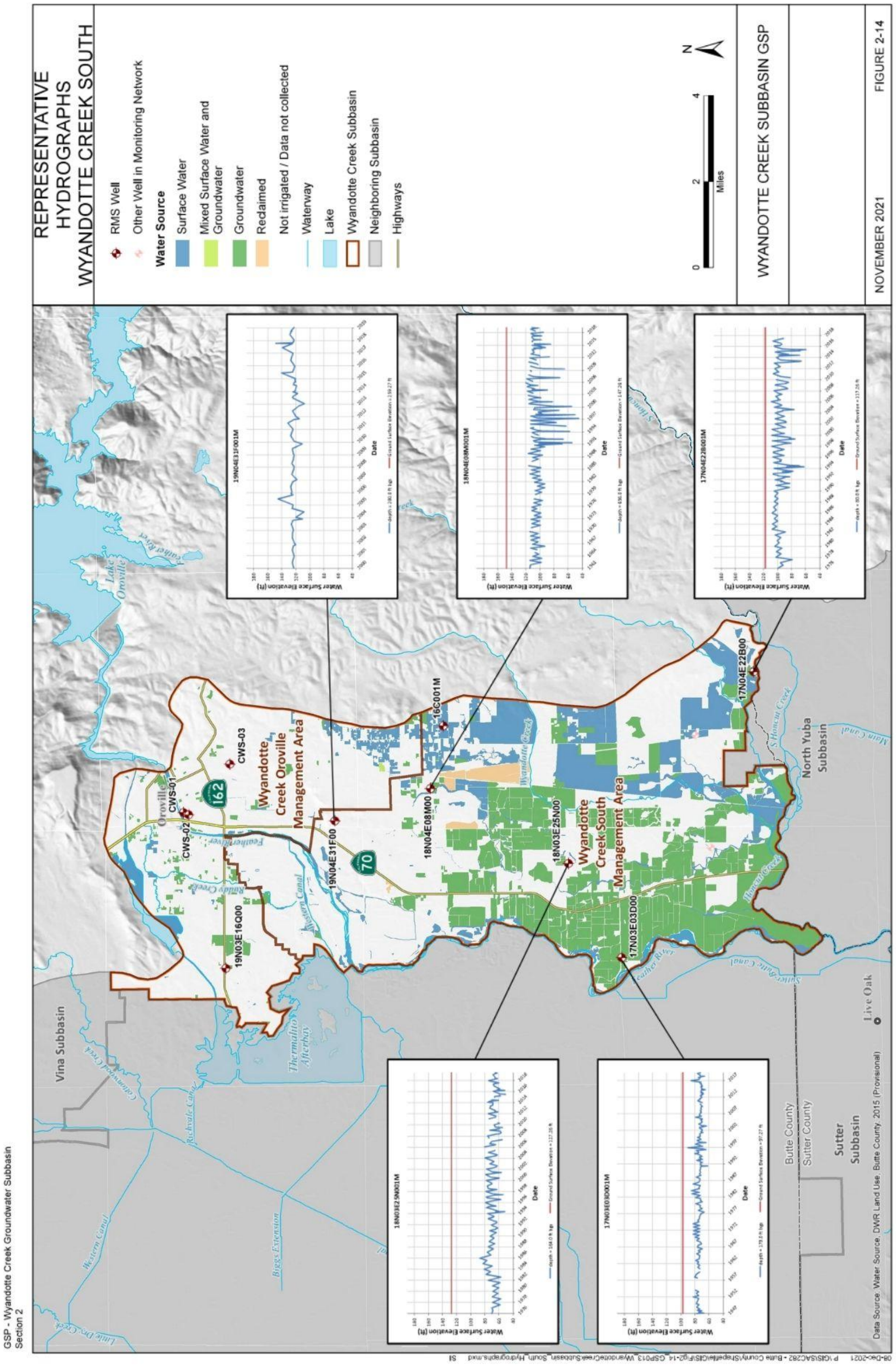
All of the hydrographs are taken from single completion wells where only one aquifer zone is screened. As discussed in Chapter 4, as part of the Technical Support Services program (TSS), DWR completed installation of a nested monitoring well (Figure 4-6). However, no water levels were collected from this well for inclusion into the 2022 GSP.

Hydrographs for the selected wells in the Wyandotte Creek Subbasin are similar to the seasonal fluctuations illustrated in the contour maps with depths to groundwater at all locations being shallower in the winter and spring than in the summer and fall. Wells in the vicinity of Oroville tend to have higher groundwater elevations than those to the south and west because of higher ground surface elevations at those locations and because of recharge from the foothills. While wells in the eastern portion of the subbasin show periods when high levels of pumping cause water levels to drop during the summer, groundwater elevations tend to rebound to consistent elevations over the winter.

As would be expected, wells located near major water bodies such as the Thermalito Afterbay and the Feather River display stable groundwater elevations due to their proximity to these features. These hydrographs also display the strong gradient that exists between spring groundwater elevations observed in the northeastern quadrant of the subbasin, where elevations between 140 and 160 feet amsl are typical, and those observed in the southwestern quadrant, where groundwater elevations are near or shallower than 90 feet amsl.

Vertical groundwater gradients are typically measured by comparing groundwater elevations using multi-completion or nested wells that are designed to measure elevations from different aquifer zones. If groundwater levels in the shallower zone are higher than in the deeper ones, the gradient allows downward movement of groundwater. In locations where groundwater levels in the shallower zone are lower than in the deeper zones, the gradient encourages upward movement of groundwater. In locations where groundwater levels are similar in elevation and track each other in fluctuations across two or more zones, there is no vertical gradient and no vertical movement of groundwater. One of the data gaps observed in the Wyandotte Creek Subbasin is the lack of nested monitoring wells needed to observe and interpret vertical groundwater gradients in the subbasin. Installation of shallow wells (with multiple completions) in 2026 funded by the SGM grant program help to address this data gap.


GSP - Wyandotte Creek Groundwater Subbasin
Section 2
REPRESENTATIVE HYDROGRAPHS
WYANDOTTE CREEK OROVILLE
RMS Well
Other Well in Monitoring Network
Water Source
Surface Water
Mixed Surface Water and Groundwater
Groundwater
Reclaimed
Not irrigated / Data not collected
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Miles
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-13
CWSCH01
CWSCH03
CWSCH02
19N03E16Q001M
CWS-01
CWS-02
CWS-03
Oroville
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
19N04E31F00
18N04E08M00
18N03E25N00
17N03E03D00
17N04E22B00
19N03E16Q00
North Yuba Subbasin
Sutter Subbasin
Butte County
Sutter County
Gridley
Live Oak
Yuba County
Thermalito Afterbay
Feather River
Data Source: Water Source, DWR Land Use: Butte County, 2015 (Provisional)
Page 65


GSP - Wyandotte Creek Groundwater Subbasin
Section 2
REPRESENTATIVE HYDROGRAPHS
WYANDOTTE CREEK SOUTH
RMS Well
Other Well in Monitoring Network
Water Source
Surface Water
Mixed Surface Water and Groundwater
Groundwater
Reclaimed
Not irrigated / Data not collected
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Miles
WYANDOTTE CREEK SUBBASIN GSP
NOVEMBER 2021
FIGURE 2-14
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
CWS-01
CWS-02
CWS-03
19N03E16Q00
19N04E31F00
18N04E08M00
16C001M
18N03E25N00
17N03E03D00
17N04E22B00
19N04E31F001M
18N04E08M001M
17N04E22B001M
18N03E25N001M
17N03E03D001M
Vina Subbasin
North Yuba Subbasin
Sutter Subbasin
Butte County
Sutter County
Oroville
Lake Oroville
Live Oak
Thermalito Afterbay
Data Source: Water Source, DWR Land Use: Butte County, 2015 (Provisional)
Page 66

2.2.2.3 Regional Patterns

The series of contour maps and hydrographs presented above complement each other in showing how groundwater levels respond to seasonal variations in demand and recharge and are affected by long-term events such as the recent drought. The patterns in groundwater conditions observed in the Wyandotte Creek Subbasin resemble those found throughout the region and are driven by similar forces. However, groundwater conditions in the Wyandotte Creek Subbasin tend to be moderated by recharge from precipitation, canal seepage and the proximity of Thermalito Afterbay and the foothills. Although the Wyandotte Creek Subbasin receives little groundwater inflow from the north, the subbasin does contribute groundwater to areas to its south.

2.2.2.4 Change in Storage

Change in groundwater storage is the product of the volume of aquifer material lying between groundwater elevations at the beginning and end of the period over which the change takes place and 'storage' values representing the storage capacity of a unit of aquifer material. The heterogeneity of the lithology of the shallow, unconfined, and confined zones results in a wide range of values for storage: specific yield for unconfined zones and coefficient of storage for confined zones.

Groundwater storage in the Wyandotte Creek Subbasin follows a pattern typical of much of the Sacramento Valley where during normal to wet years, water stored in the aquifer system is withdrawn over the summer when demand is high, and the main pathways for recharge are deep percolation of precipitation and irrigation applications, canal seepage, and seepage from Thermalito Afterbay. As illustrated in the water budget, in many years, reductions in storage during the summer are replenished by precipitation over the winter allowing storage to rebound by the following spring.

Review of the hydrographs from monitoring wells in the Wyandotte Creek Subbasin demonstrates the influence of the Wyandotte Creek Subbasin's location with the foothills to the east, the Feather River to the west and Thermalito Afterbay to the northwest as factors that stabilize both groundwater elevations and groundwater storage. While the Afterbay, canal seepage and the foothills are important sources of recharge, the prevailing groundwater gradients allow groundwater to flow to the river and to subbasins to the south. Outflows to the river and to the south increase when inflows to the Wyandotte Creek Subbasin increase causing gradients to the south and to the river to steepen. The dynamics of the interaction between inflows, outflows, changes in groundwater elevations and changes in storage are captured in the water budget described later in the Basin Setting and by the BBGM.

A graph depicting estimates of the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type based on the Sacramento Valley Water Year Index[5] is provided in Figure 2-15.

The change in groundwater storage is estimated based on the change in measured spring-to-spring groundwater levels at each GWL RMS well, multiplied by the area of a Thiessen polygon

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[5] Additional details describing the Sacramento Valley Water Year Index are available from the California Data Exchange Center (https://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST).

surrounding that RMS well (defining a representative area for each RMS well) and a representative storage coefficient of 0.1 for the subbasin. The groundwater pumping is estimated through measurements (agricultural, municipal/industrial), calculations (rural residential), and estimates (municipal/industrial). and is shown on a water year basis.[6]

As indicated in the figure, groundwater storage has generally decreased in dry and critical years and increased in wet years. In above normal and below normal years, changes in storage are smaller and less predictable, with increases in some years and decreases in others. For the recent historical period, which was marked by relatively dry conditions from 2007 to 2016 (with the exception of the wet year of 2011) and 2020-2022, there has generally been a decline in groundwater storage within the subbasin. Historical and projected changes in storage are discussed in greater detail in Section 2.3, Water Budget.

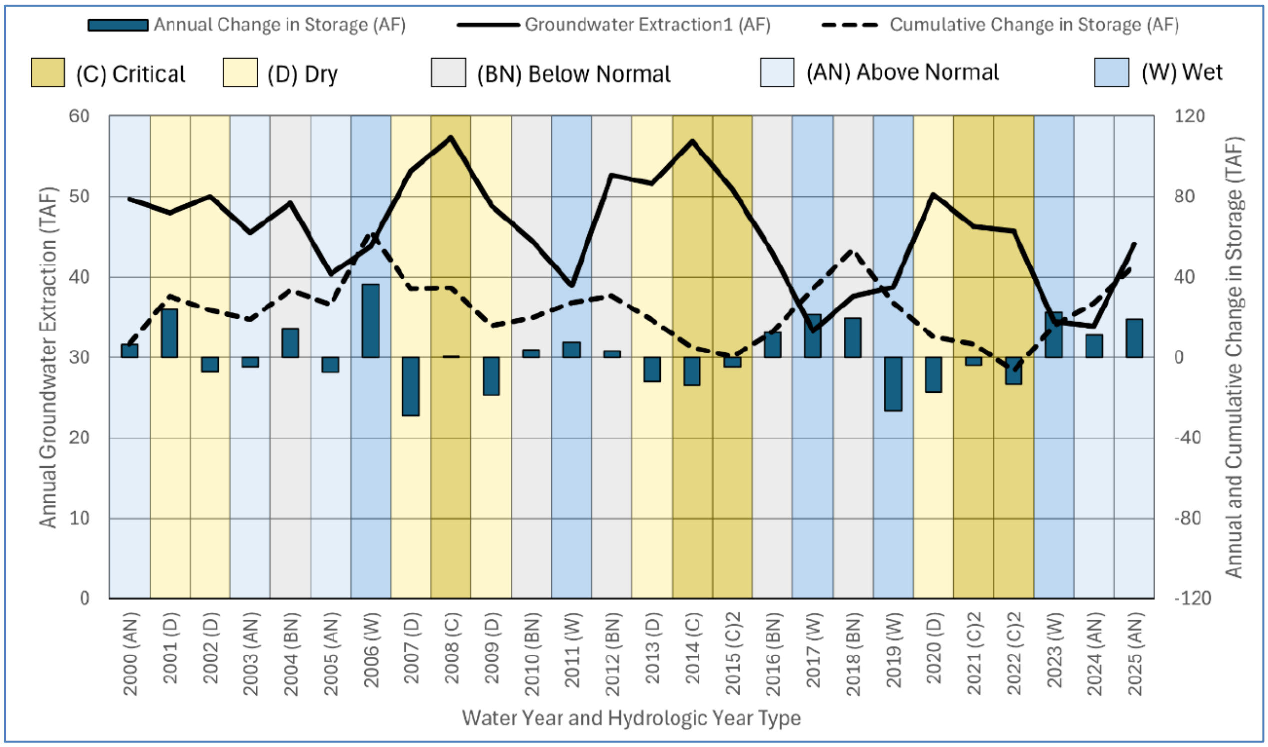


Figure 2-15: Change in Storage and Groundwater Pumping by Water Year Type. TAF = thousand acre-feet

2.2.3 Seawater Intrusion

Intrusion of seawater is not a consideration in the Wyandotte Creek Subbasin because of the subbasin's location. For this reason, no monitoring of seawater intrusion is required nor is there a need for projects and management actions to mitigate seawater intrusion.

[6] A water year is defined as the period from October 1 of the prior year to September 30 of the current year. For example, water year 2000 refers to the period from October 1, 1999, to September 30, 2000.

2.2.4 Groundwater Quality

2.2.4.1 Current Conditions

The primary water chemistry in the area indicates calcium magnesium bicarbonate or magnesium calcium bicarbonate groundwater. Some magnesium bicarbonate can be found in the northwest portion of the subbasin (DWR, 2006). The generally good water quality characteristics of the subbasin are apparent in the overall salinity of groundwater. In general, total dissolved solids (TDS) concentrations in the study area are below 500 milligrams per liter (mg/L) throughout the subbasin (Bookman-Edmonston Engineering, Inc. 1992). Data collected from DWR water quality wells indicate a TDS range of 149 to 655 mg/L and a median of 277 mg/L (DWR, 2006). Butte County's water quality trend monitoring program measures specific conductance in monitoring wells in the subbasin. Data collected annually from 2002 through 2025 indicate a range of 132 to 374 microsiemens per centimeter (µS/cm) for most wells, well below the secondary water quality threshold for drinking water of 900 µS/cm. There are a few isolated instances where specific conductance exceeded drinking water standards in the deeper aquifer zone. The County is monitoring these locations and will report to the GSA if high saline water moves.

In the northern part of the subbasin, groundwater occurrence is saline to brackish except locally on the margins of the valley where the formational water has been flushed with newer fresh water. Non-saline water was also observed in deeper portions of the Ione Formation in the vicinity of Oroville (Dames and Moore, 1994). Sediments that were continentally derived contain fresh to brackish water and are poorly to moderately permeable (Olmsted and Davis, 1961). In the southern part of the subbasin, numerous wells appear to be completed within the Ione Formation (boring logs identify "blue clays" believed to be indicative of the Ione Formation) that produce fresh water.

Flooding during heavy rain is causing many domestic wells in Palermo to be cross contaminated with septic effluent. This contamination has moved into the upper groundwater aquifer. Well samples taken in 2007 and in 2021 show that up to 25% of the sampled wells in Palermo have coliform contamination above safe levels to consume. The GSA, in partnership with Butte County, is actively addressing the flooding.

2.2.4.2 Additional Water Quality Programs

The goal of groundwater quality management under SGMA is to supplement information available from other sources with data targeted to assist the GSA in the Wyandotte Creek Subbasin comply with the requirements of SGMA. Development of groundwater quality-related SMC for the Wyandotte Creek Subbasin is not intended to duplicate or supplant the goals and objectives of ongoing programs including Butte County, the SVWQC (SVWQC, 2016), the CRC (2019), and the State Drinking Water Information System (SDWIS).

Because irrigated agriculture is the predominant land use in the subbasin, monitoring of the groundwater quality data developed through the GQTMWP being implemented by the SVWQC and by the CRC for compliance with the CVRWQCB's ILRP will be an important source of information to the GSA in the Wyandotte Creek Subbasin. The SVWQC has identified one low priority High Vulnerability Area (HVA) in the South MA of Wyandotte Creek Subbasin (SVWQC, 2016). However, this area has been classified as an HVA because of conditions that make it susceptible to contamination and not due to contaminant levels observed in the area.

Additional information on the ILRP is presented in the section describing the monitoring network.

Among the contaminants that may affect groundwater conditions in the future are Chemicals of Emerging Concern (CECs). These are contaminants having toxicities not previously recognized, which may have the potential to cause adverse effects to public health or the environment and are found to be building up in the environment or to be accumulating in humans or wildlife.

The Butte County Department of Water and Resource Conservation (WRC) manages the Groundwater Quality Trend Monitoring Program to provide information on groundwater quality for GSAs. Annual data collected by the program is reported in the GSP annual reports. Program goals include establishing a baseline of water quality data to document any water quality temporal trends, and ensure that groundwater resources are well managed by documenting groundwater water quality.

Water quality samples will be collected and evaluated (as needed) to determine concentrations of other potential constituents of concern including nitrate, perfluorooctanoic acid (PFOA), and perfluorooctanoic sulfonate (PFOS) per State Water Resources Control Board recommendations[7]. All constituents currently being monitored by other agencies have been kept at reasonable levels within the Subbasin and are not impacted by groundwater pumping. Additionally, the GSA plans to develop a handout that highlights key water quality issues in the subbasin to provide to project partners to ensure projects take water quality into consideration during feasibility and design.

GSA staff and members of the consulting team stay informed regarding groundwater quality issues and mitigation programs in the Subbasin. Staff have participated in CV-SALTS webinars and have responded to CV-SALTS requests for GSA input. Additionally, point-source contaminants are managed and regulated through a variety of other programs by the Regional Water Quality Control Board, DTSC, and the EPA. Through coordination with existing agencies, the Wyandotte Creek GSA will know if existing regulations are being met or groundwater pumping activities in the Wyandotte Creek Subbasin are contributing to significant and unreasonable undesirable effects related to degraded water quality. The GSA will continue to stay engaged with these other regulatory programs.

2.2.4.3 Description and Map of Known Sites and Plumes

The SGMA regulations require that GSPs describe locations, identified by regulatory agencies, where groundwater quality has been degraded due to industrial and commercial activity. Locations of impacted groundwater were identified by reviewing information available on the SWRCB Geotracker/GAMA website, the California Department of Toxic Substances Control (DTSC) EnviroStor website, and the Environmental Protection Agency's (EPA) National Priorities List (NPL). Cases that have been closed by the supervisory agency are not considered.

[7] Groundwater Quality Considerations for High and Medium Priority Groundwater Basins. State Water Resources Control Board. November 22, 2022.

To identify known plumes and contamination within the Basin, SWRCB GeoTracker[8] and DTSC program[9],was reviewed for active clean-up sites of all types within the subbasin. The GeoTracker database shows one open Leaking Underground Storage Tank (LUST) site and five open cleanup program sites with potential or actual groundwater contamination located within the subbasin. Underground storage tanks (UST) are containers and tanks, including piping, that are completely or significantly below ground and are used to store petroleum or other hazardous substances. Soil, groundwater and surface water near the site can all be affected by releases from USTs. The DTSC program listed two open cases, with one potential overlap with GeoTracker. A summary of each active site is listed below.

[8] Information on these and other sites is available at https://geotracker.waterboards.ca.gov/map/?CMD=runreport&myaddress=Sacramento

[9] Information on these and other sites is available at www.envirostor.dtsc.ca.gov.

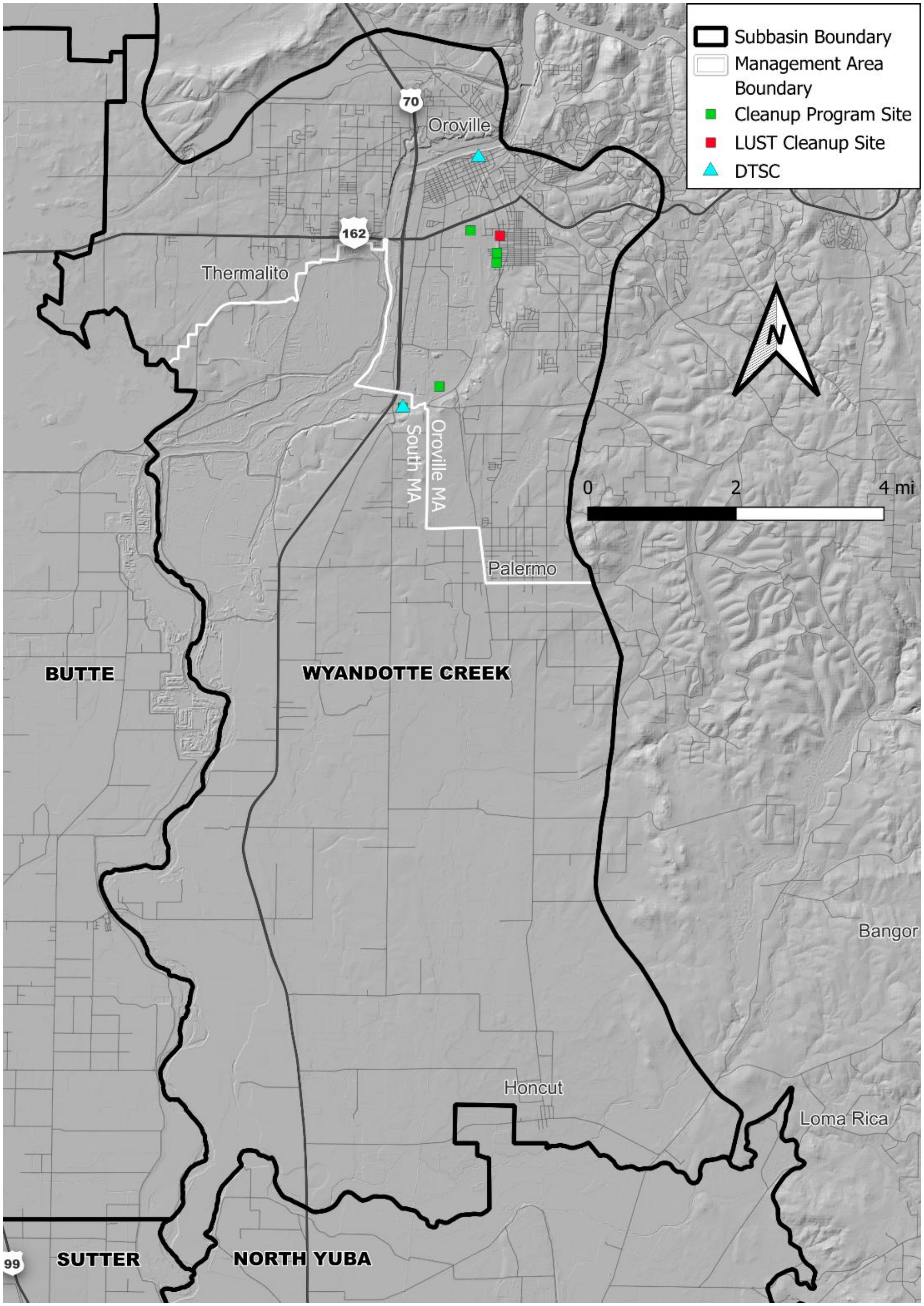


Figure 2-16. Active Contamination Remediation Sites

Active clean-up sites in the Wyandotte Creek Subbasin include the following:

LUST Cleanup Site

- No. T0600766902 – ATWALS:
  - Past use that caused contamination: gasoline service station
  - Potential contaminants of concern: gasoline
  - Potential Media affected: aquifer used for drinking water supply

GeoTracker Cleanup Program Sites

- No. T10000013302 – Former Mill Property:
  - Past use that caused contamination: former mill site
  - Potential contaminants of concern: Arsenic, Dioxin / Furans, Lead, Pentachlorophenol (PCP)
  - Potential Media affected: none specified
- No. SL0600770982 - Chlorinated Solvents, Unknown Rp (Oroville)
  - Past and current use that caused contamination: Potentially Responsible Party (PRP) Search Report by Partner Engineering Science, Inc.
  - Potential contaminants of concern: Chlorinated Solvents - PCE, Tetrachloroethylene (PCE)
  - Potential Media affected: Well Used For Drinking Water Supply
- No. T10000013678 - Delallo Italian Foods, Inc
  - Past and current use that caused contamination: Olive processing and packing companies
  - Potential contaminants of concern: Tetrachloroethylene (PCE)
  - Potential Media affected: Under Investigation
- No. T10000012642 - Koppers Co. Inc. (Oroville Plant) Superfund Site
  - Past and current use that caused contamination: wood treating facility
  - Potential contaminants of concern: Arsenic, Boron, Chromium, Copper, Dioxin / Furans, Pentachlorophenol (PCP), Polynuclear Aromatic Hydrocarbons (PAHS)
  - Potential Media affected: Soil, Well Used For Drinking Water Supply
- No. T10000000611 - Chico Scrap Metal - Ophir Road Facility
  - Past and current use that caused contamination: accumulation of materials related to salvage and metal recycling
  - Potential contaminants of concern: Arsenic, Chromium, Copper, Lead, Polychlorinated Biphenyls (PCBS), Silver
  - Potential Media affected: Soil

DTSC Cleanup Program Sites

- No. 60000689 – Ophir Road Property:
  - Past use that caused contamination: junkyard, recycling, sand blasting
  - Potential contaminants of concern: metals, polychlorinated biphenyls (PCBs)
  - Potential Media affected: soil
- No. 60001282 – Pacific Gas and Electric Company (PG&E) Former Oroville Manufactured Gas Plant Site:
  - Past use that caused contamination: manufactured gas plant
  - Potential contaminants of concern: arsenic, cyanide, lead, polynuclear aromatic hydrocarbons (PAHs); total petroleum hydrocarbons (TPH)-diesel
  - Potential media affected: aquifer used for drinking water supply, soils, soil vapor

Active and Inactive Contamination Remediation Sites are shown in Figure 2-16, presenting the locations of known impacted groundwater or potentially impacted groundwater in the Wyandotte Creek Subbasin. The sites were divided into the following categories based on regulatory designation:

- Leaking Underground Storage Tank (LUST) Cleanup Sites (Active or Inactive)
- Cleanup Program Sites (Active or Inactive)
- Military Cleanup Sites (Active or Inactive)
- DTSC (Active or Inactive)

The GSA may periodically review all contamination plumes within the Subbasin to monitor the potential impact to groundwater. In coordination with state agencies, potential constituents of concern will also be monitored to track potential transport into new areas of the subbasin.

2.2.5 Land Subsidence

2.2.5.1 Rates and Locations

The SGMA regulations define the MT for significant and unreasonable land subsidence to be the “rate and the extent of land subsidence.” Unlike other sustainability indicators (SIs), the harmful effects of subsidence result from the damage it may cause to critical infrastructure and the costs of repairing or mitigating those damages. Critical infrastructure in the Wyandotte Creek Subbasin that could be affected by subsidence includes county, and state highways, power transmission lines and water conveyance and distribution facilities.

Land subsidence is a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials often caused by groundwater or oil extraction. The potential effects of land subsidence include differential changes in elevation and gradients of stream channels, drain and water transport structures, failure of water well casings due to compressive stresses generated by compaction of aquifer system, and compressional strain in engineering structures and houses. Inelastic land subsidence is a major concern in areas of active groundwater extraction due to infrastructure damage, permanent reduction in the groundwater storage capacity of the aquifer, well casing collapse, and increased flood risk in low lying areas. To date, no inelastic land subsidence has been recorded in Wyandotte Creek Subbasin or surrounding subbasins.

Processes that can contribute to land subsidence include aquifer compaction by overdraft, hydrocompaction (shallow or near-surface subsidence) of moisture deficient deposits above the water table that are wetted for the first time since deposition, and subsidence caused by tectonic forces (Ireland et al., 1984). Land subsidence in the Wyandotte Creek Subbasin would most likely occur as a result of aquitard consolidation. An aquitard is a saturated geologic unit that is incapable of transmitting significant quantities of water. As the pressure created by the height of water (i.e., head) declines in response to groundwater withdrawals, aquitards between production zones are exposed to increased vertical loads. These loads can cause materials in aquitards to rearrange and consolidate, leading to land subsidence. Factors that influence the rate and magnitude of consolidation in aquitards include mineral composition, the amount of prior consolidation, cementation, the degree of aquifer confinement and aquitard thickness.

Subsidence has elastic and inelastic deformation components. As the head lowers in the aquifer, the load that was supported by the hydrostatic pressure is transferred to the granular skeletal framework of the formation. As long as the increased load on the formation does not exceed the pre-consolidation pressure, the formation will remain elastic. Under elastic conditions, the formation will rebound to its original volume as hydrostatic pressure is restored. However, when the head of the formation is lowered to a point where the load exceeds pre-consolidation pressure, inelastic deformation may occur. Under inelastic consolidation, the formation will undergo a permanent volumetric reduction as water is expelled from aquitards.

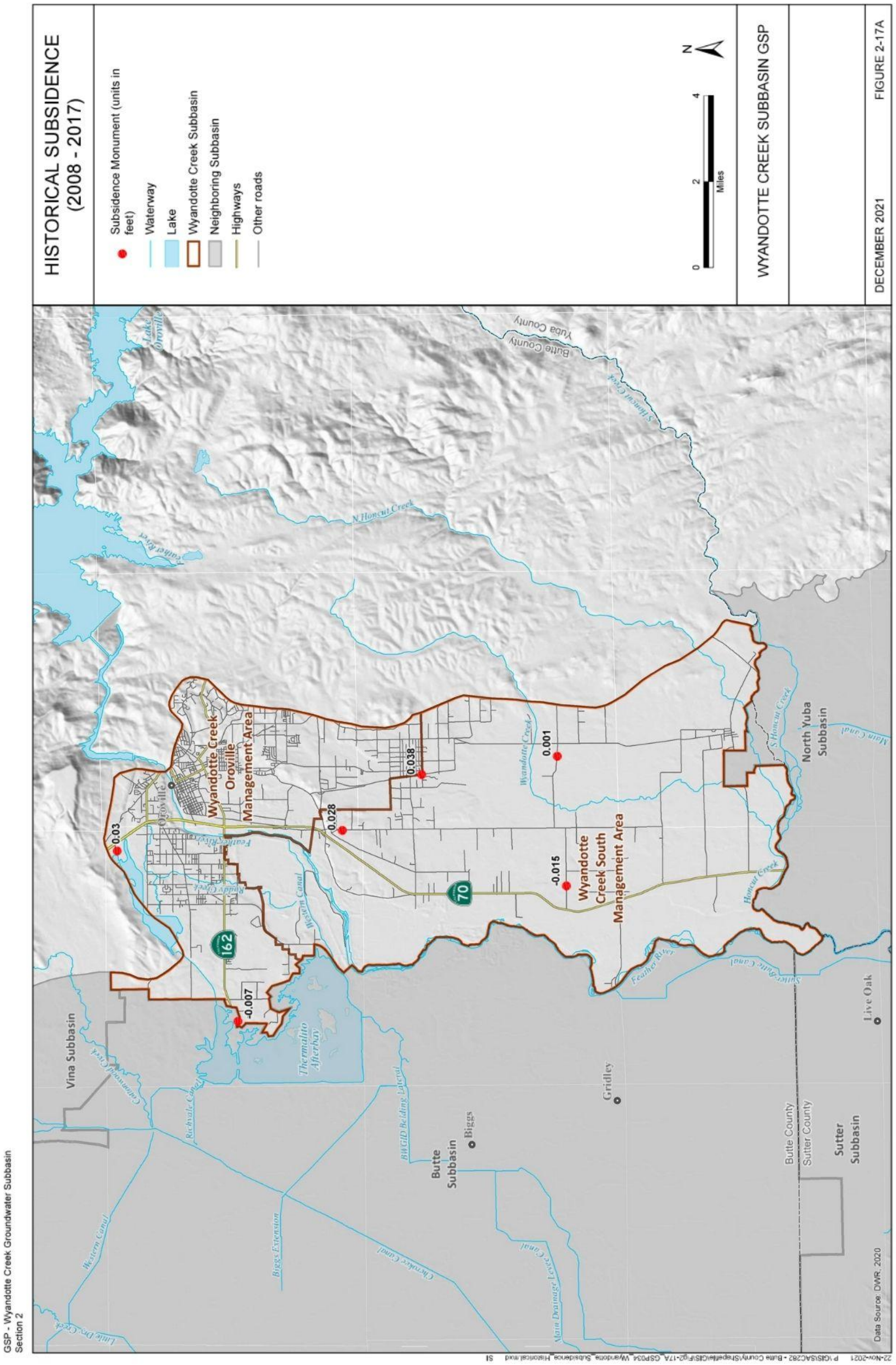
2.2.5.2 Historical and Recent Cumulative Subsidence and Rates of Subsidence

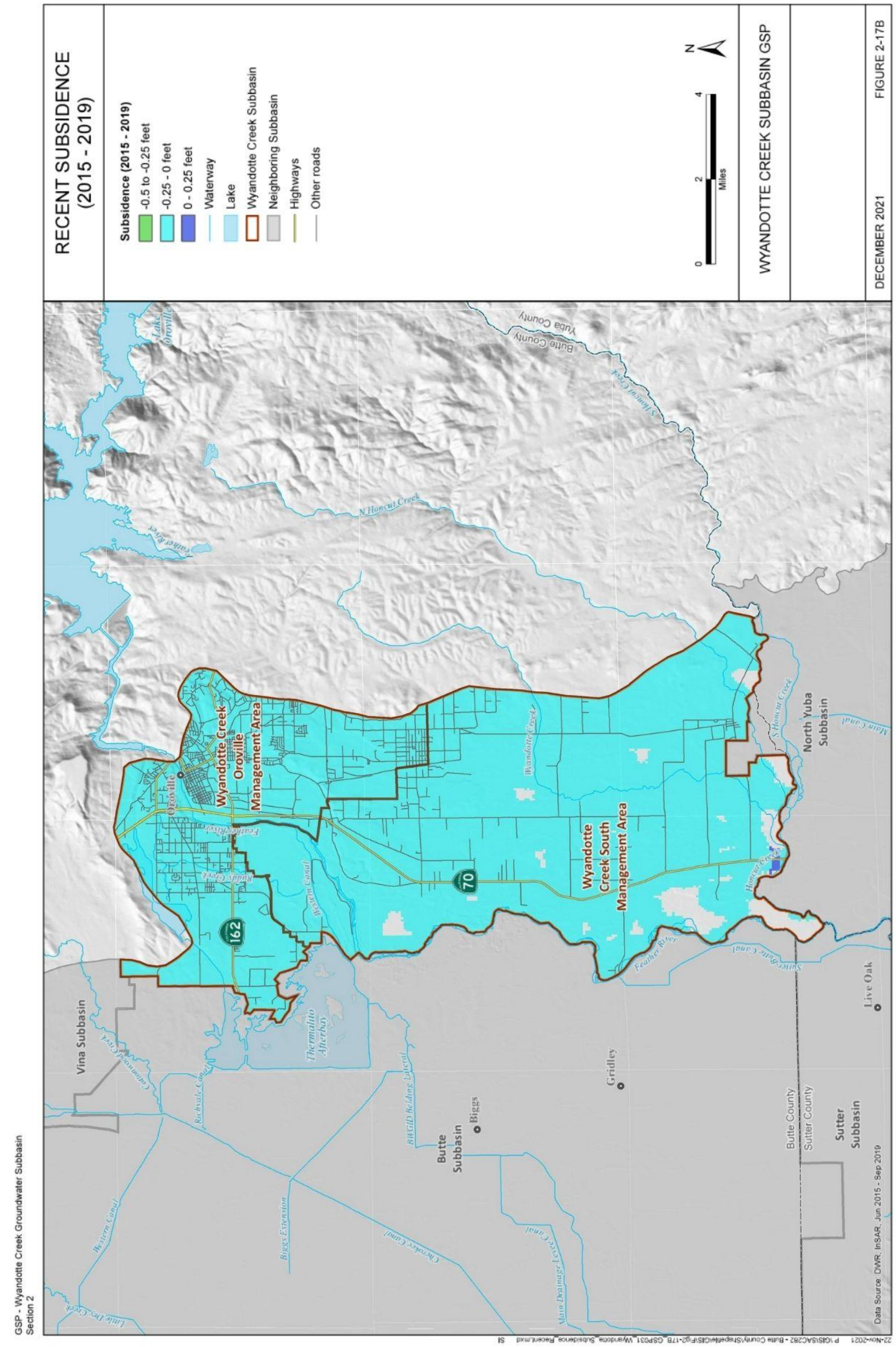
Historical data from monuments in the Sacramento Valley Global Positioning System (GPS) Subsidence Monitoring Network were used to track cumulative subsidence from 2008 to 2017 and InSAR data is used from 2015 to present. The data shown in Table 2-2 includes the range of cumulative subsidence observed within the Wyandotte Creek Subbasin over the period between 2008 and 2017 as reported by Sacramento Valley GPS Subsidence Monitoring stations included in the Wyandotte Creek Subbasin Monitoring Network and a range of annual subsidence rates calculated from the cumulative totals. The range of recent cumulative subsidence and rates of subsidence over the period from June 2015 through September 2019 and 2020 to 2025 is also presented in the table and are based on InSAR data. As both the Sacramento Valley GPS monuments and InSAR monitor changes in land surface elevations, the data do not distinguish between elastic and inelastic subsidence, however the cumulative subsidence values observed by both sources indicate that inelastic subsidence is not significant in the Wyandotte Creek Subbasin.

Table 2-2: Cumulative Subsidence and Approximate Annual Rate of Subsidence

Subbasin Area (square miles)	Date Range	Cumulative Subsidence (feet)	Calculated Annual Rate of Subsidence (feet/year)	Source
93	2008-2017	0.038 to -0.015	0.004 to -0.002	Sac Valley
93	2015-2019	0.25 to -0.25	0.063 to -0.063	InSAR
93	2020-2025	-0.015 to -0.072	-0.003 to -0.0144	InSAR

Figures 2-17A and 2-17B show historical and recent levels of subsidence within the Wyandotte Creek Subbasin. Historical levels for the period comparing 2008 to 2017 are shown in Figure 2-17A – Historical Subsidence and are the locations of subsidence monitoring network monuments used to measure subsidence. Recent levels for the period from 2015 through 2019 are presented in Figure 2-17B – Recent Subsidence. The values presented in Table 2-2 and in Figures 2-17A and 2-17B support the observation that inelastic land subsidence due to groundwater withdrawal is unlikely to result in an Undesirable Result in the Wyandotte Creek Subbasin, and both figures show subsidence to be uniform over the subbasin.


GSP - Wyandotte Creek Groundwater Subbasin
Section 2
HISTORICAL SUBSIDENCE
(2008 - 2017)
Subsidence Monument (units in feet)
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-17A
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Oroville
0.03
-0.007
0.028
0.038
0.001
-0.015
162
70
Thermalito Afterbay
Vina Subbasin
Butte Subbasin
North Yuba Subbasin
Sutter Subbasin
Biggs
Gridley
Live Oak
Butte County
Sutter County
Yuba County
N Honcut Creek
Honcut Creek
Feather River
Data Source: DWR, 2020
Page 74


GSP - Wyandotte Creek Groundwater Subbasin
Section 2
RECENT SUBSIDENCE (2015 - 2019)
Subsidence (2015 - 2019)
-0.5 to -0.25 feet
-0.25 - 0 feet
0 - 0.25 feet
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-17B
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Oroville
North Yuba Subbasin
Vina Subbasin
Butte Subbasin
Sutter Subbasin
Biggs
Gridley
Live Oak
Butte County
Sutter County
Yuba County
Thermalito Afterbay
162
70
Data Source: DWR, InSAR, Jun 2015 - Sep 2019
Page 75

2.2.6 Interconnected Surface Water Systems

This section describes ISW interactions and presents preliminary results identifying where ISW exist, using multiple lines of evidence (model results, groundwater elevations, water quality isotopes); the location, timing, and quantity of depletions; and remaining data gaps. ISW were identified using the BBGM, measured groundwater elevation data representative of the shallow aquifer, and an isotope study. Results from each method are presented in the following sections.

2.2.6.1 Streamflow Depletion and Accretion

The term interconnected surface water systems describes surface water features that are hydraulically connected by a continuous saturated zone to an underlying aquifer such that changes in elevations of either the aquifer or the surface water features propagate throughout the interconnected system. Within the Wyandotte Creek Subbasin, it is likely that surface water features, specifically the Feather River, are interconnected with shallow groundwater.

Interconnected surface waters are classified as either gaining or losing with respect to the condition of the surface water feature with gaining reaches gaining thorough accretion of groundwater and losing reaches losing through depletion to groundwater. It is important to recognize that these interconnections are dynamic and are affected by factors including variations in local geology, hydrology and water use.

Thus, at a single point in time, a stream may have both gaining and losing reaches and reaches that are gaining under certain seasonal, or long-term hydrologic and water use conditions may become losing under others. Moreover, changes in water use or hydrology may cause interconnected surface water features to decouple from the groundwater system.

Direct measurement of interactions between groundwater systems and surface water features is difficult because of the need for a monitoring system that tracks both stream stage and groundwater elevations at nearby locations. Therefore, the interaction between groundwater systems and surface water features within the Wyandotte Creek Subbasin is analyzed through use of the BBGM which, absent the presence of a monitoring system dedicated to assessing interactions at selected locations, integrates information from groundwater monitoring wells and stream stages to model gradients that control flow between surface water and groundwater.

The difference between gaining and losing reaches is illustrated in Figure 2-18. For gaining reaches, the water table adjacent to the stream is above the elevation of water in the stream, resulting in flow of water from the groundwater system to the stream (gains or accretions). For losing reaches, the water table adjacent to the stream is below the elevation of water in the stream, resulting flow of water from the stream to the groundwater systems (losses or seepage). In both cases, flows in the stream are directly connected to the groundwater system, with no unsaturated zone present beneath the streambed.

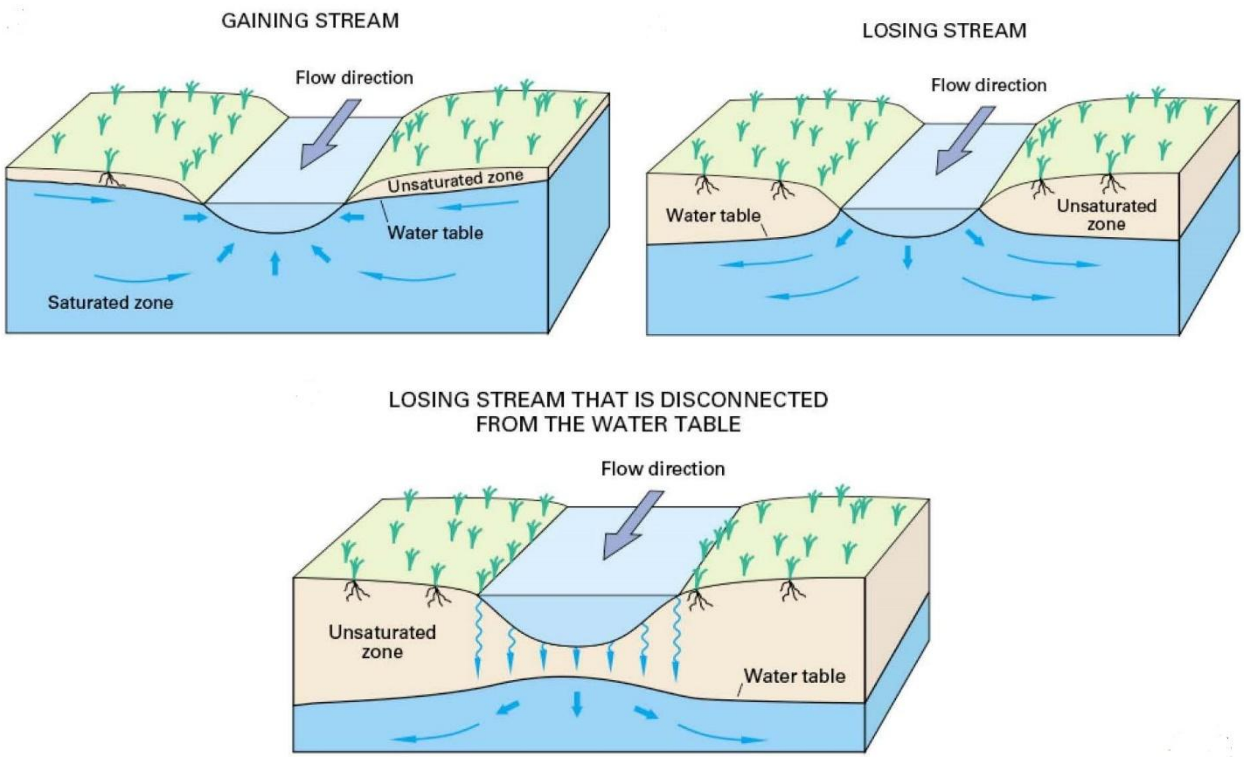


Figure 2-18: Illustration of Gaining and Losing Interconnected and Disconnected Stream Reaches (Source: USGS)

Butte Basin Groundwater Model

BBGM version 1.3 was utilized to evaluate stream segments of the Feather River and Honcut Creek along the border of the Subbasin and to classify segments as being primarily gaining or losing over the historical period from water year 2000 to 2024. A total of seven stream segments traversing or bounding the Subbasin with a total length of approximately 42 miles were defined. Characteristics of the stream segments (cross section, parameters etc.) are described in Butte Basin Groundwater Model Documentation v 1.0 (Butte County, 2021). The segments range in length from 3.4 to 7.3 miles with an average length of 5.3 miles and are shown in Figure 2-19. The results of this analysis are shown in Figure 2-20. The figure shows the percentage of months for the period from water year 2000 to 2024 with gaining conditions and classifies streams as primarily gaining (gaining conditions more than 80% of the time), primarily losing (losing conditions more than 80% of the time), or mixed. As indicated in Figure 3, stream segments representing the Feather River appear to be gaining more than 80% of the time. North Honcut Creek and South Honcut Creek both appear to experience gaining conditions less than 50% of the time transitioning from gaining to losing depending on time of year.

Based on consideration of the frequency with which stream segments are gaining based on BBGM results and on consideration of the spring depth to groundwater below the estimated streambed depth along each primary stream, it is likely that all streams traversing or bounding the subbasin are connected to the groundwater system.

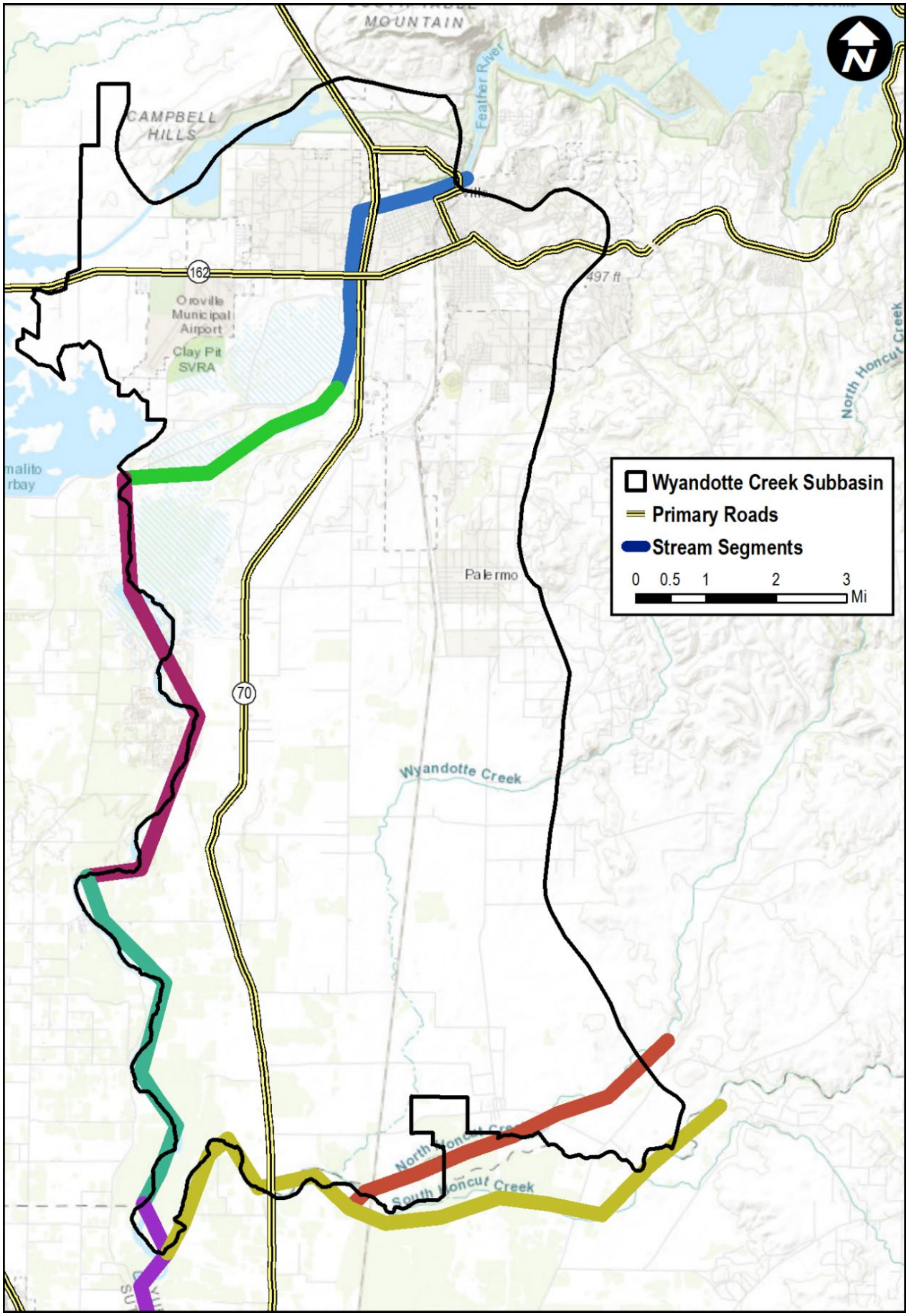


Figure 2-19: Wyandotte Creek Subbasin Stream Segments

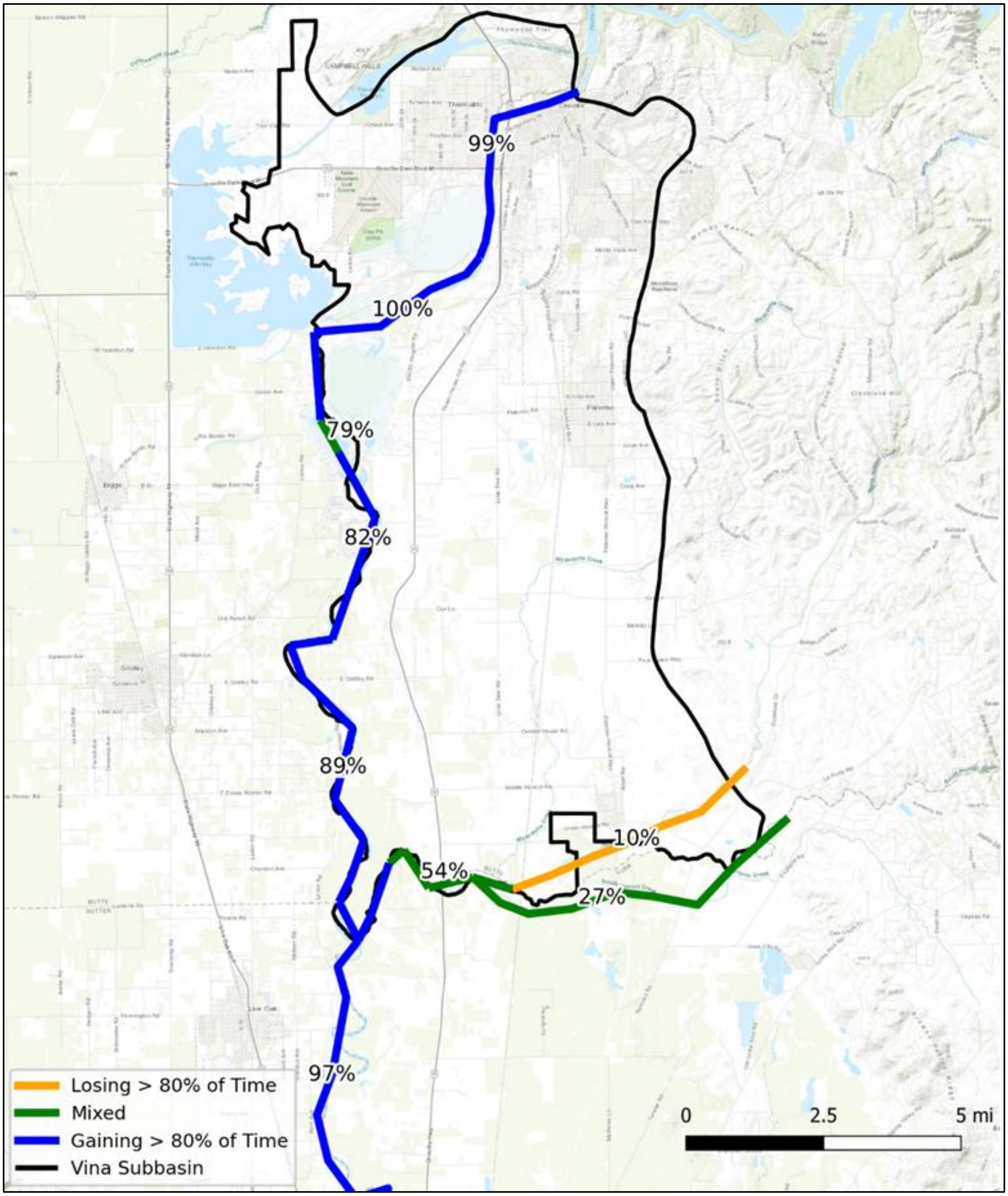


Figure 2-20: Wyandotte Creek Subbasin Gaining and Losing Stream Reaches Based on the BBGM v.1.3, Water Years 2000 to 2024.

Timing and Amount of Surface Water – Groundwater Interaction

The timing and amount of surface water–groundwater interaction was estimated using the BBGM v.1.3 for the primary streams in the Subbasin including the Feather River, North Honcut Creek, and South Honcut Creek. Wyandotte Creek and Wyman Ravine are not modeled in the BBGM. Monthly net gains to streamflow from groundwater were estimated monthly for the historical period from water year 2000 to 2024 and are summarized in Tables 2-3 and 2-4. Average monthly gains to streamflow are expressed in cubic feet per second (cfs) and acre-feet, respectively. Negative values denote average losses from streamflow to groundwater (i.e., seepage).

Table 2-3: Average Monthly Gains to Streamflow from Groundwater, Water Years 2000 to 2024 (cfs)

Stream	Month												Average
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Feather River	32	37	53	70	53	64	53	46	28	17	20	22	41
North Honcut Creek	-1	-1	-2	-1	-1	0	0	0	0	0	0	-1	-1
South Honcut Creek	0	0	0	2	2	3	3	2	0	0	-1	0	1
Total	31	36	51	71	54	66	56	48	28	17	19	21	41

Table 2-3: Average Monthly Gains to Streamflow from Groundwater, Water Years 2000 to 2024 (TAF)

Stream	Month												Annual Total
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Feather River	2.0	2.2	3.3	4.3	2.9	3.9	3.1	2.8	1.7	1.0	1.2	1.3	29.6
North Honcut Creek	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.7
South Honcut Creek	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.1	0.0	0.0	-0.1	0.0	0.7
Total	1.9	2.1	3.1	4.4	3.0	4.1	3.3	2.9	1.7	1.0	1.2	1.2	29.6

Average monthly gains from groundwater are greatest for the Feather River, at approximately 41 cfs. Gains are least between June and November, potentially due to relatively low groundwater elevations resulting from summer pumping. Gains tend to be greatest between late winter and spring (approximately December to May), potentially due to higher groundwater elevations relative to river stage. On average, streams traversing or bounding the subbasin are currently estimated to gain approximately 41 cfs on average, or approximately 30 TAF annually. It is estimated that the Feather River is losing approximately 30 CFS (or 11 TAF per year) between

June through November on average due to pumping within Wyandotte Creek and adjacent subbasins. This additional depletion is less than 1% of the total flow of approximately 4,800,000 AFY on the Feather River. Based on the relatively small volume of additional depletions, the relatively low level of depletions as a percentage of the total streamflow, and based on the managed nature of the Feather River, the risk of additional depletions from the Feather River are not considered to have the potential to have significant and unreasonable impacts on beneficial uses of the river.

ISW Identification using Groundwater Elevation Data

To identify the location of ISW reaches within the basin and ground truth BBGM modeled results we used seasonally interpolated shallow groundwater elevations, created from monitoring well data, in conjunction with LiDAR extracted surface water elevations. There are nine (9) existing shallow groundwater monitoring wells across the Subbasin. Well hydrographs are provided in Appendix B. Groundwater elevations were interpolated between monitoring wells to develop spatial datasets across the entire Subbasin. Groundwater elevation rasters were developed for the spring and fall from 2000 through 2025. LiDAR, or Light Detection and Ranging, is a technology that allows for precise measuring of ground surface elevations by using laser light pulses from aircraft. Longer pulse return times indicate distances farther from the aircraft, and thus lower elevations. Due to the wavelength of light used for LiDAR surveys in the Wyandotte Subbasin, water penetration was limited and it is assumed that the returned elevations of surface water bodies reflect their stage rather than their bottom elevations. To account for this uncertainty as well as uncertainty related to capillary effects below losing streams, a conservative threshold of 20 feet was used to determine connectivity (DWR, 2024). Whether inaccuracies in LiDAR measurements would change connectivity determinations is then done by comparing results generated by manual survey measurement at select locations on North Honcut Creek and Wyman Ravine. Ultimately, the above method yields the following two categories for determining surface water connectivity:

1. Likely Disconnected: Interpolated groundwater levels are greater than 20 feet below the extracted surface water elevation
2. Likely Connected: Interpolated groundwater levels are less than 20 feet below the extracted surface water elevation

Streams were gaining if the interpolated groundwater elevation is greater than the LiDAR extracted reach elevation. The exception to this is the Feather River, which in contrast to the seasonal streams in the rest of the Subbasin, has a consistent stage of many feet. To account for this, we conservatively only consider the reach gaining on the Feather River if the groundwater elevation is greater than 10 feet below the LiDAR returned elevation. This approach allows for uncertainty related to LiDAR returns off water surfaces on the Feather River, and removes the margin allocated to connected but losing streams elsewhere. We then use this classification in a similar way to the BBGM model results, and define three categories of Gaining, Mixed, and Losing.

1. Gaining: Reach is likely gaining greater than 80% of the time
2. Mixed: Reach is likely gaining between 80 and 20% of the time
3. Losing: Reach is likely losing greater than 80% of the time

Results indicate that most streams in the subbasin have groundwater elevations within 20 feet of extracted surface water elevations, with the exceptions to this being the upper reaches of Wyman Ravine and its tributary. For visualization of this result - years 2000, 2015, 2022, and 2025 were selected as being reflective of the start of the modeled period (2000), two drought years (2015 and 2022), and current conditions (2025) as shown on Figures 2-21 through 2-24, respectively. Of these, the modeled low points in groundwater storage (i.e., 2015 and 2022) correlate to the smallest extent of interconnected reaches. By 2025 the extent of interconnected reaches rebounds to that displayed at the beginning of the modeled period. It should be noted that there is only one well available in the southeast with sufficient data to be used in the interpolation. As a result, there may be inaccuracies in this region on North Honcut, Wilson, and South Honcut creeks. However, this method produces results that align with isotope tracers explained further in the next section.

Expanding the LiDAR analysis to all spring and fall measurements between 2000 and 2025 and applying the BBGM categories as detailed in the methods section, the Feather River and Honcut Creek are determined to be gaining, with the lower reaches of other smaller streams considered mixed (Figure 2-25). The upper reaches of these mixed streams (Wyman Ravine, Wyandotte Creek, North Honcut Creek, South Honcut Creek, and Wilson Creek) are considered losing. Furthermore, surveyed results indicate that while LiDAR elevations can be up to 5 feet higher at channel bottom, indicating erosive action since LiDAR acquisition, classification into connected and disconnected categories would remain unchanged due to both our use of wide bin intervals and groundwater elevations that remain far below streambeds (Appendix C).

Overall, the categorization of interconnected surface waters and their status as gaining or losing by use of both LiDAR extracted surface water elevations and interpolated groundwater elevations match the general spatial pattern of the BBGM v1.3 results. Due to this, despite Wyandotte Creek, Wyman Ravine, and Wilson Creek not being simulated in BBGM, estimates on these reaches are reasonable. In general, we conclude that aside from the Feather River, the likelihood of streams gaining within the subbasin increases as they traverse westward towards the Feather River, with reaches towards the outer margins often connected but losing.

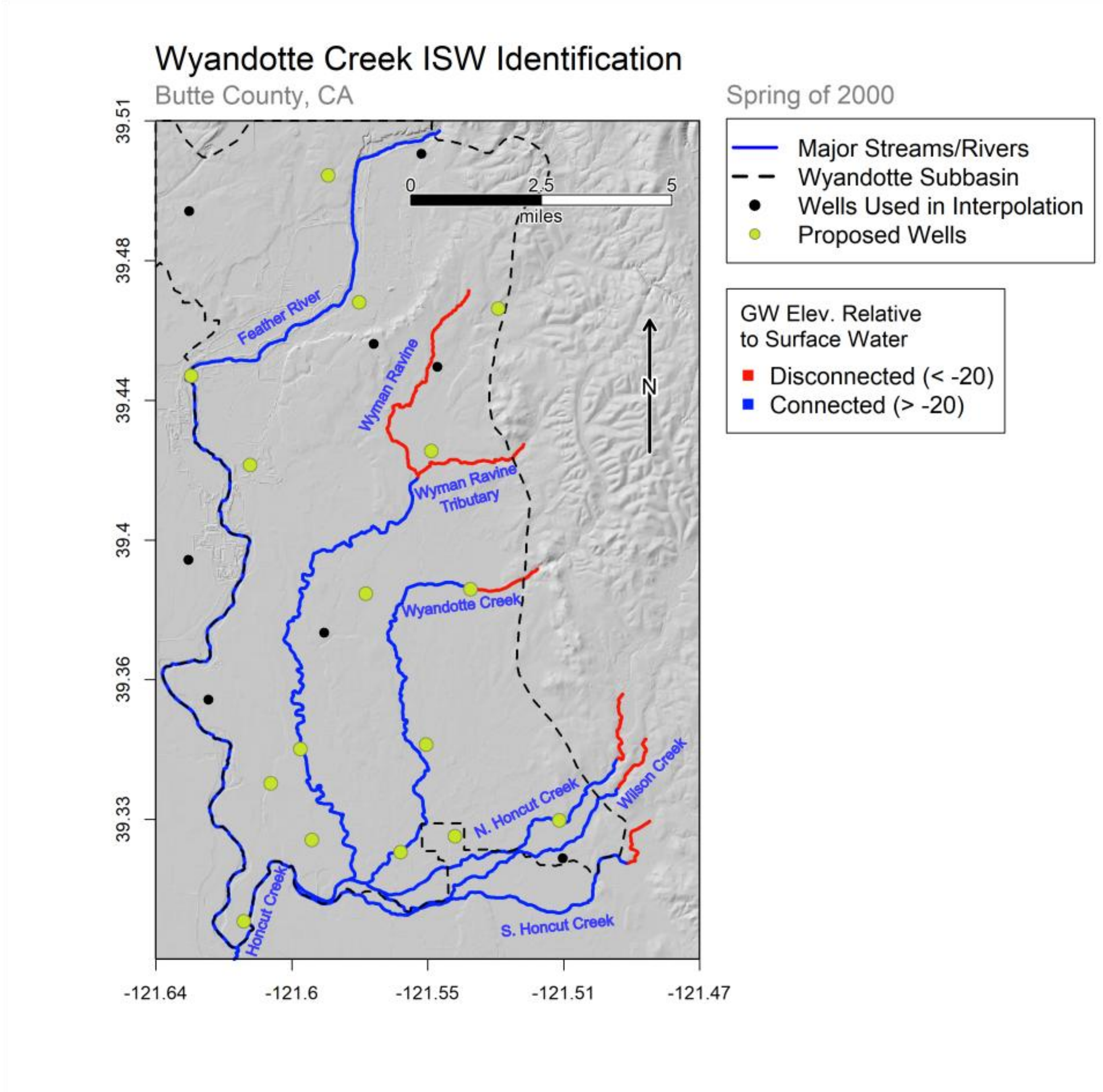


Figure 2-21: Comparison between shallow interpolated water surface elevations and LiDAR extracted streambed elevations in the spring of 2000.

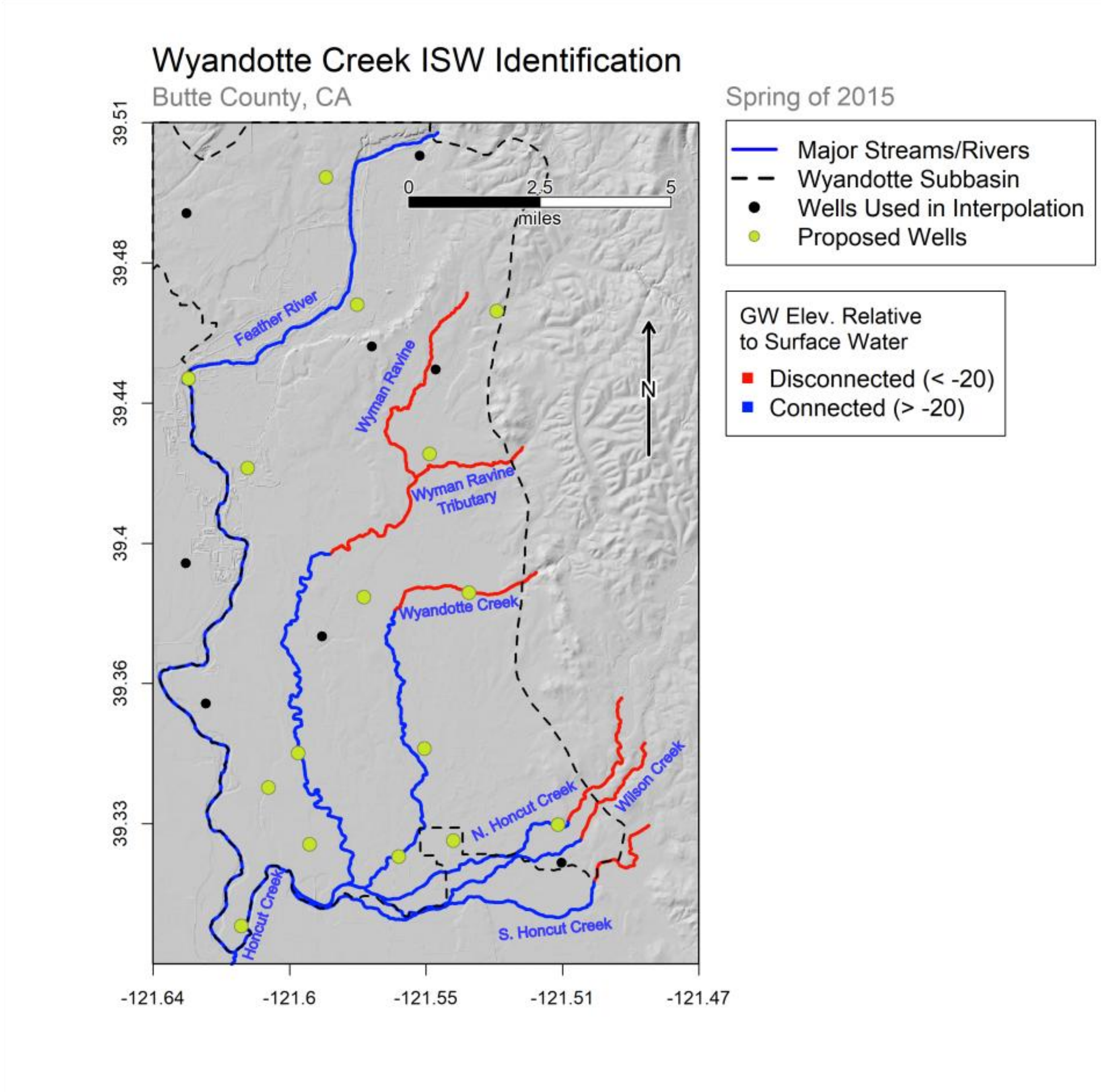


Figure 2-22: Comparison between shallow interpolated water surface elevations and LiDAR extracted streambed elevations in the spring of 2015.

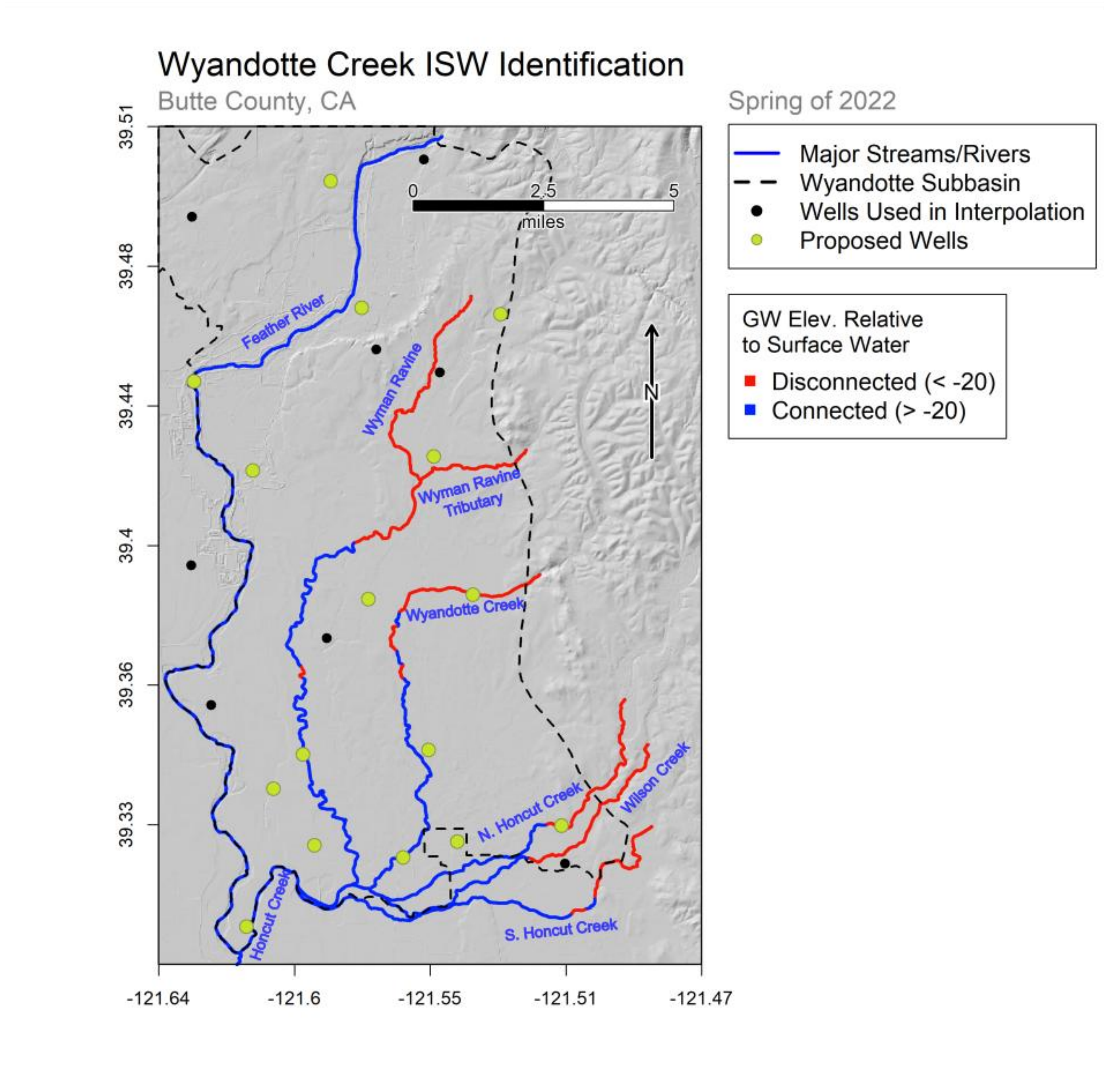


Figure 2-23: Comparison between shallow interpolated water surface elevations and LiDAR extracted streambed elevations in the spring of 2022.

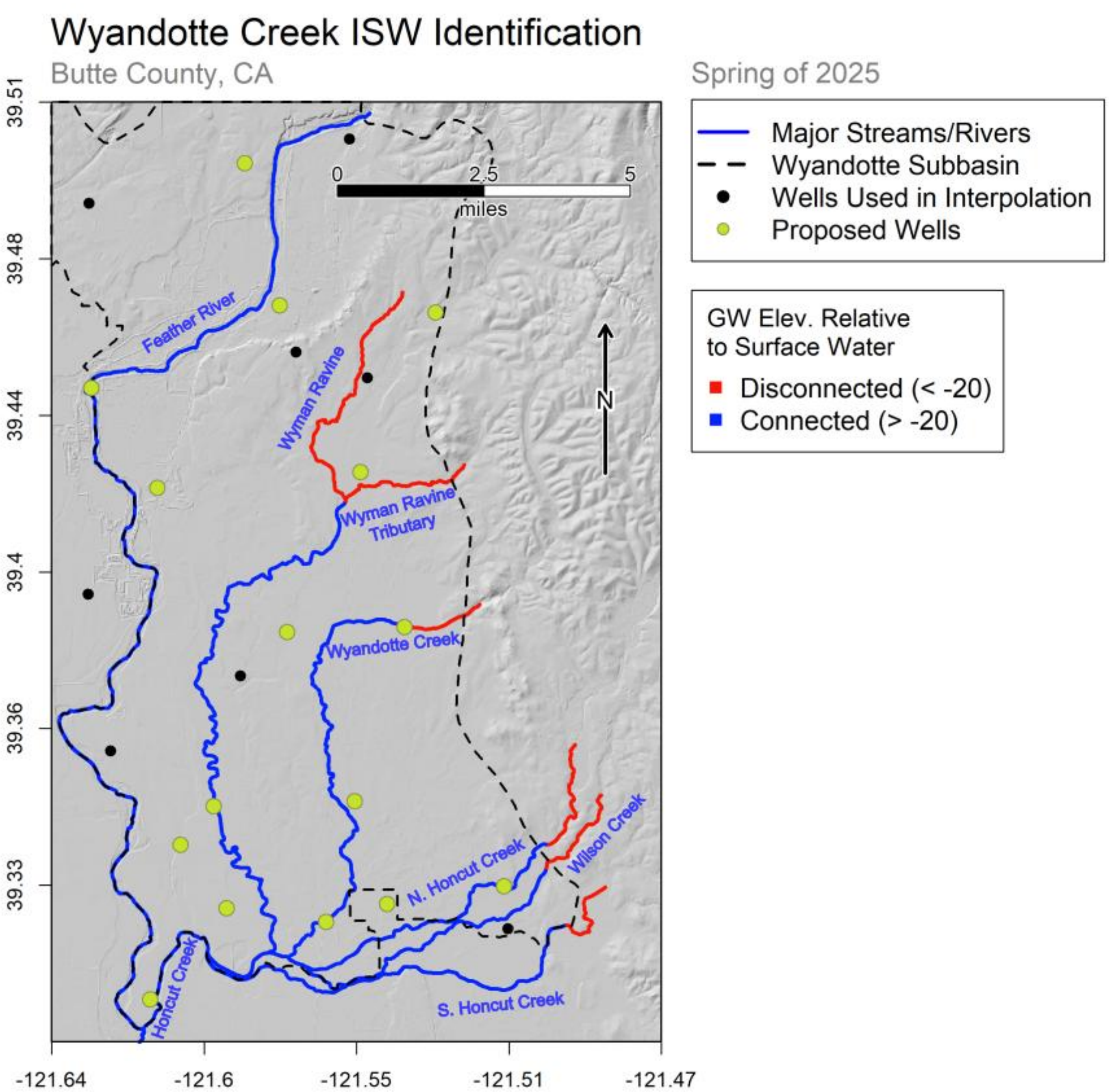


Figure 2-24: Comparison between shallow interpolated water surface elevations and LiDAR extracted streambed elevations in the spring of 2025.

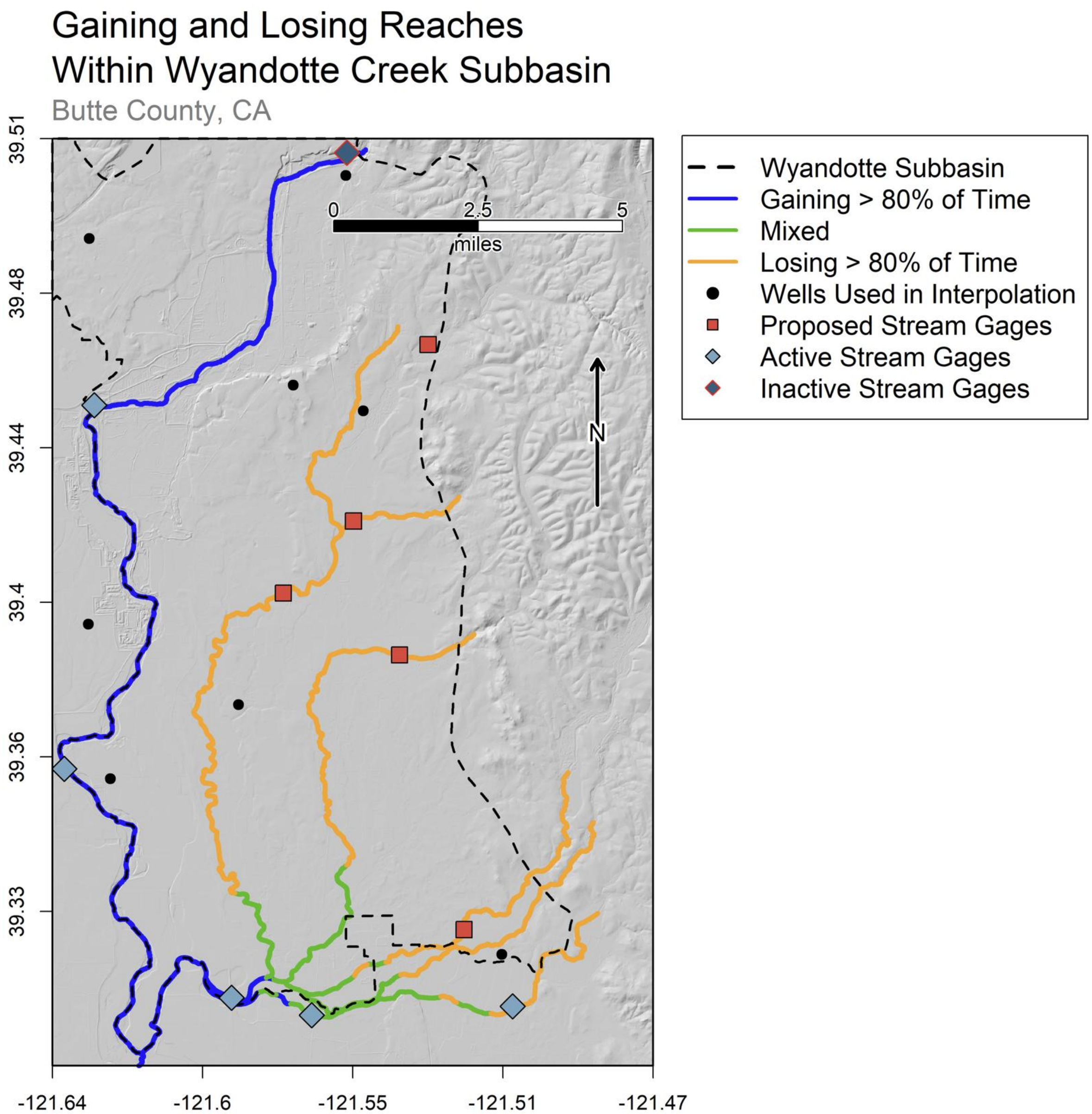


Figure 2-25: Use of Interpolated water surface elevations and LiDAR extracted water surface elevations over the period from 2000 through 2025 to determine the percentage of time in which a given reach is gaining.

ISW Identification through Isotope Sampling

To understand ISW interactions on a finer timescale than seasonal groundwater interpolations can provide, radon-222 and stable isotopes of the water molecule along Wyman Ravine, Wilson Creek, and the tributaries to Honcut Creek were sampled monthly June through October of 2025. Firstly, radon-222 is a naturally occurring short-lived radioactive noble gas that is produced in geologic material and accumulates in groundwater. As groundwater discharges to the surface, radon-222 quickly degasses, and its presence therefore indicates a localized groundwater contribution to surface water flows. In a 2005 USGS study of the South Sacramento Valley, groundwater radon-222 was measured at between 200-700 pCi/L (USGS, 2005). Therefore, it would be expected that surface water in the Wyandotte Subbasin receiving groundwater inputs (i.e. gaining) should contain elevated levels of radon-222. Secondly, as the ratio of stable isotopes of the water molecule (16O,18O,1H,2H) varies due to natural hydrologic processes such as evaporative fractionation and precipitation altitude, sampled water bodies with different source areas should be detected as having distinct isotopic fingerprints (Jameel et al., 2019; Visser et al., 2016). The combination of radon-222 and isotopes of the water molecule allow us to detect seasonal and local groundwater inputs, source area elevation, and evaporative signatures (Castaldo et al., 2021).

In terms of radon-222, low activities (< 7 pCi/L) were observed compared to the 200-700 pCi/L expected from a groundwater signal in all but the upper reach of South Honcut Creek (Figures 2-26 through 28). When combined with the results discussed in the previous section, it is confirmed that the upper reaches of Wyman Ravine, Wilson Creek, and North Honcut Creek are losing while South Honcut Creek may retain small local groundwater contributions in the summer. This again matches BBGM modeled results regarding the status of South and North Honcut Creeks (WGSA, 2021; Figure 3). In terms of stable water isotopes, samples on North and South Honcut Creek are depleted in heavy isotopes relative to Wyman Ravine and Wilson Creek, signaling a higher elevation source area (Figure 12, Castaldo et al., 2021). Samples along North and South Honcut Creek are furthermore generally close to the Global Meteoric Water Line (GMWL) implying limited impact of evaporative fractionation (Figure. 29). These results agree with the potential local groundwater contributions described above as well as the ‘mixed’ status of much of South Honcut Creek. This is in contrast to samples along Wyman Ravine and Wilson Creek, which show consistent evidence of evaporative fractionation as measured by a deuterium excess consistently below that of the GMWL (Figure 30). This is consistent with radon activities describing a lack of groundwater contribution in the summer months. Given the general agreement between the results of groundwater elevations, radon, and stable water isotopes we can conclude three things:

1. South and North Honcut Creek source water originates on average from higher in elevation than that of Wyman Ravine and Wilson Creek. This may be due to Honcut Creek is used to convey agricultural drainage and irrigation water during the irrigation season with the water originating in the upper Feather River or Yuba River watersheds.

2. South Honcut Creek may receive seasonal and local groundwater contributions, which is corroborated by fluctuations in radon-222 activity, though these contributions appear to be limited.

3. Wyman Ravine and Wilson Creek are likely either disconnected or losing along much of their length, though disagreement between LiDAR and radon results on their lower reaches may indicate that sampling in a different year would have yielded higher radon activities.

The isotope study represents a snapshot in time and may not capture transitions from gaining to losing or vice versa that occur over time. The isotope study may be continued as funding allows to assess seasonal trends and impacts from groundwater level fluctuations.

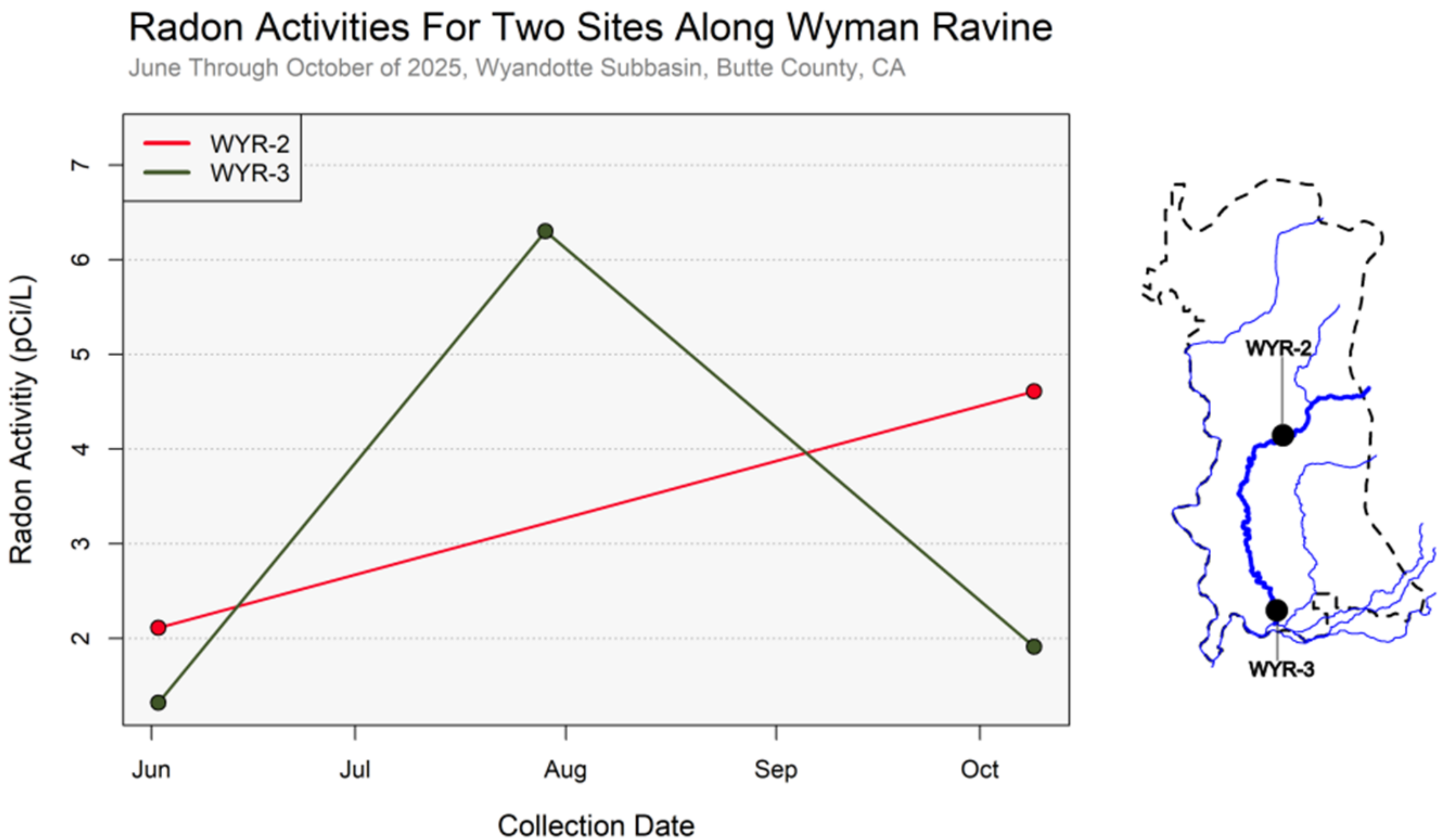


Figure 2-26: Radon activity for sampled sites along Wyman Ravine in June through October of 2025

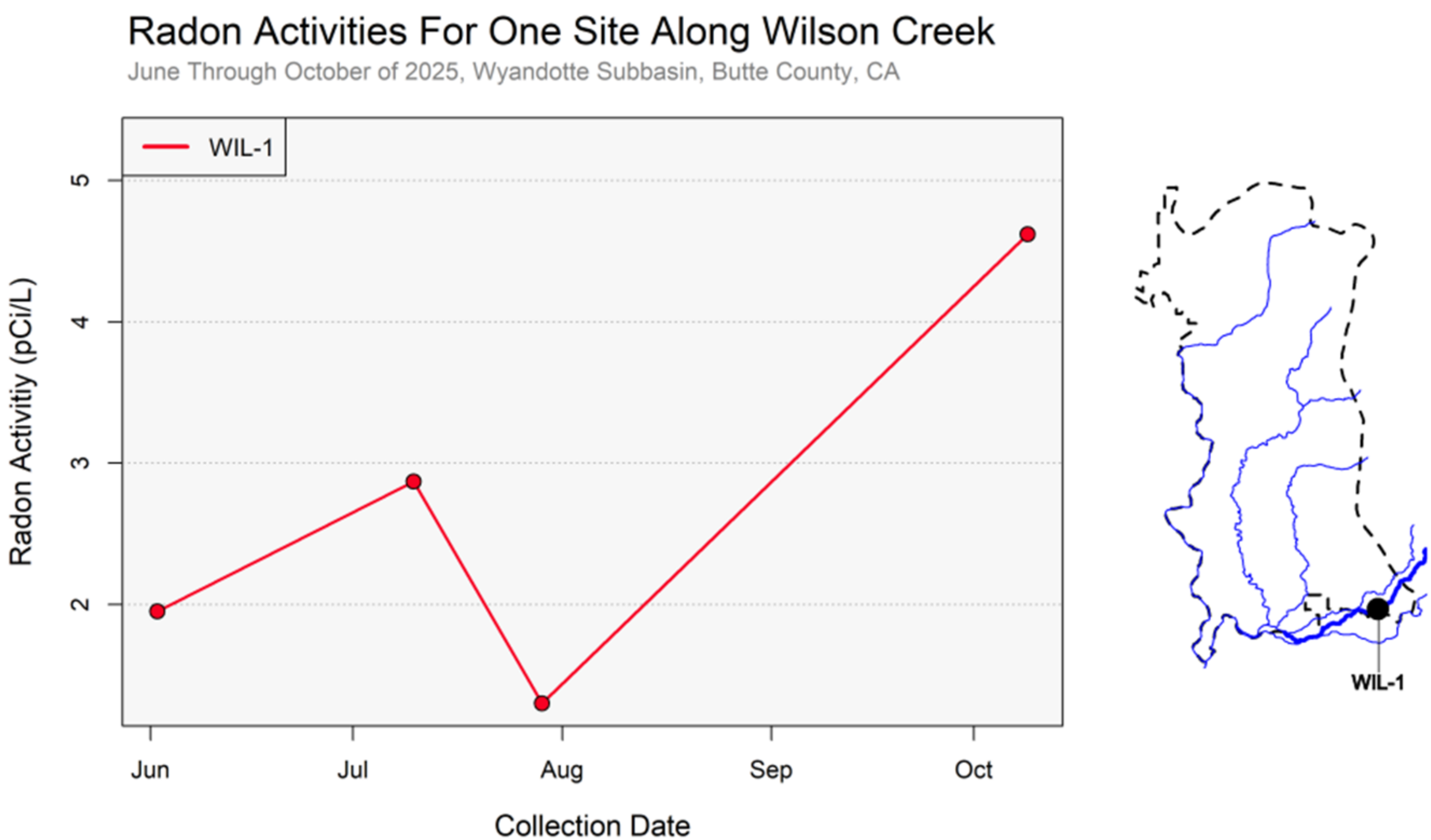


Figure 2-27: Radon activity for sampled sites along Wilson Creek in June through October of 2025

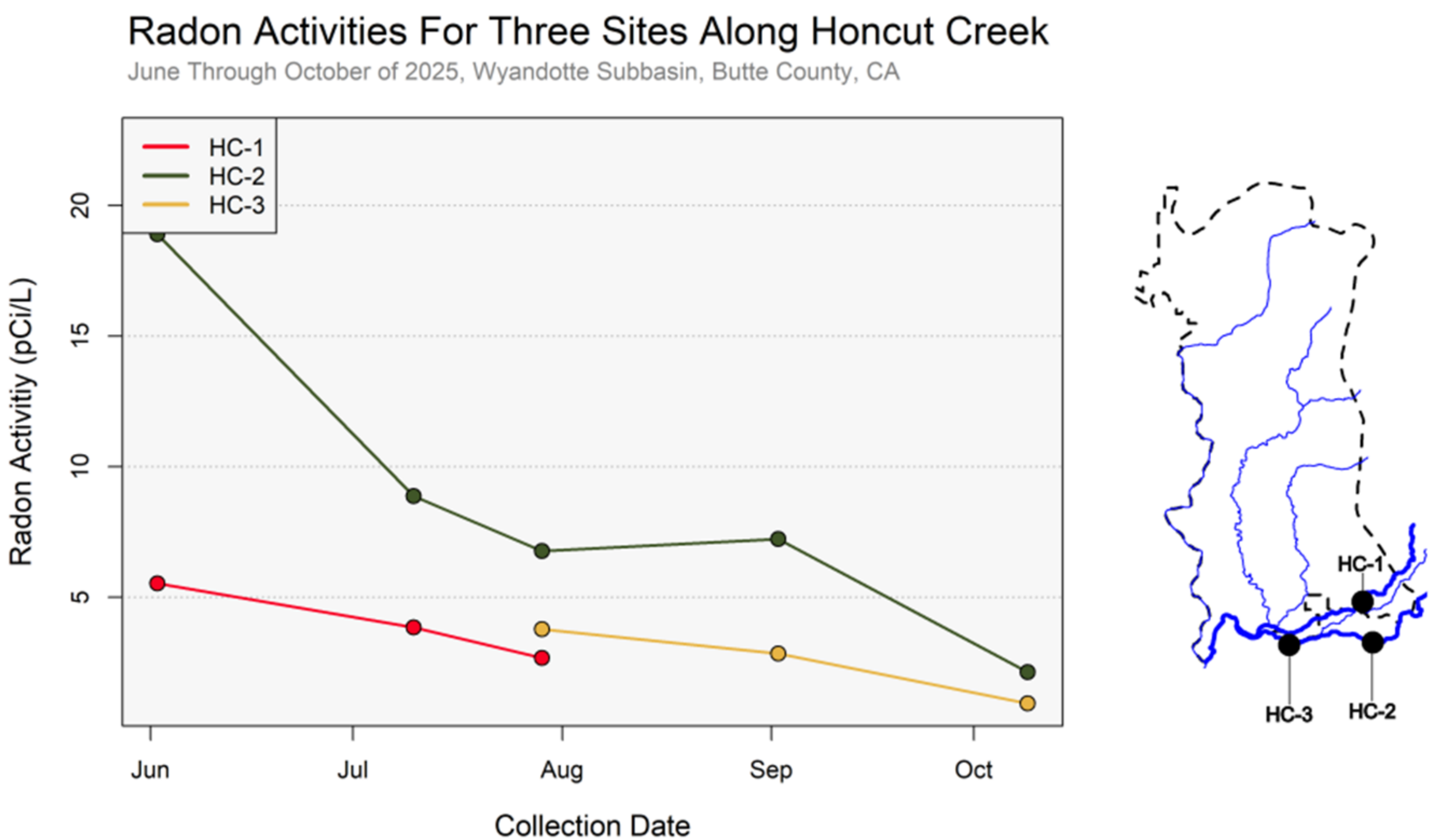


Figure 2-28: Radon activity for sampled sites along Honcut Creek in June through October of 2025

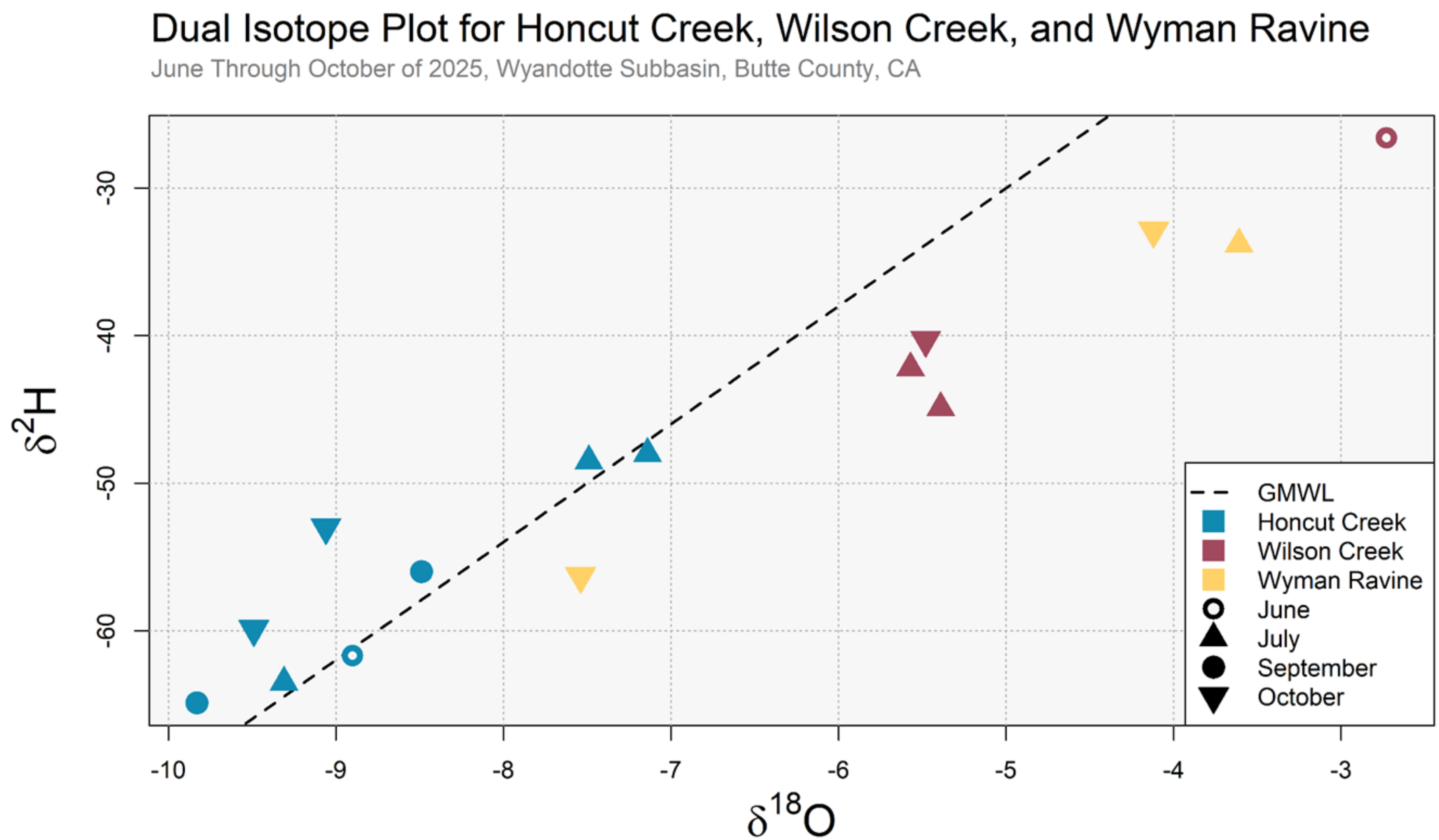


Figure 2-29: Dual isotope plot for isotopes of the water molecule at sampled sites along Honcut Creek, Wilson Creek, and Wyman Ravine in June through October of 2025. Delta notation is relative to Vienna Standard Mean Ocean Water (VSMOW). Global Meteoric Water Line (GMWL) is defined by the equation δD = (8 * δ18O) + 10 ‰.

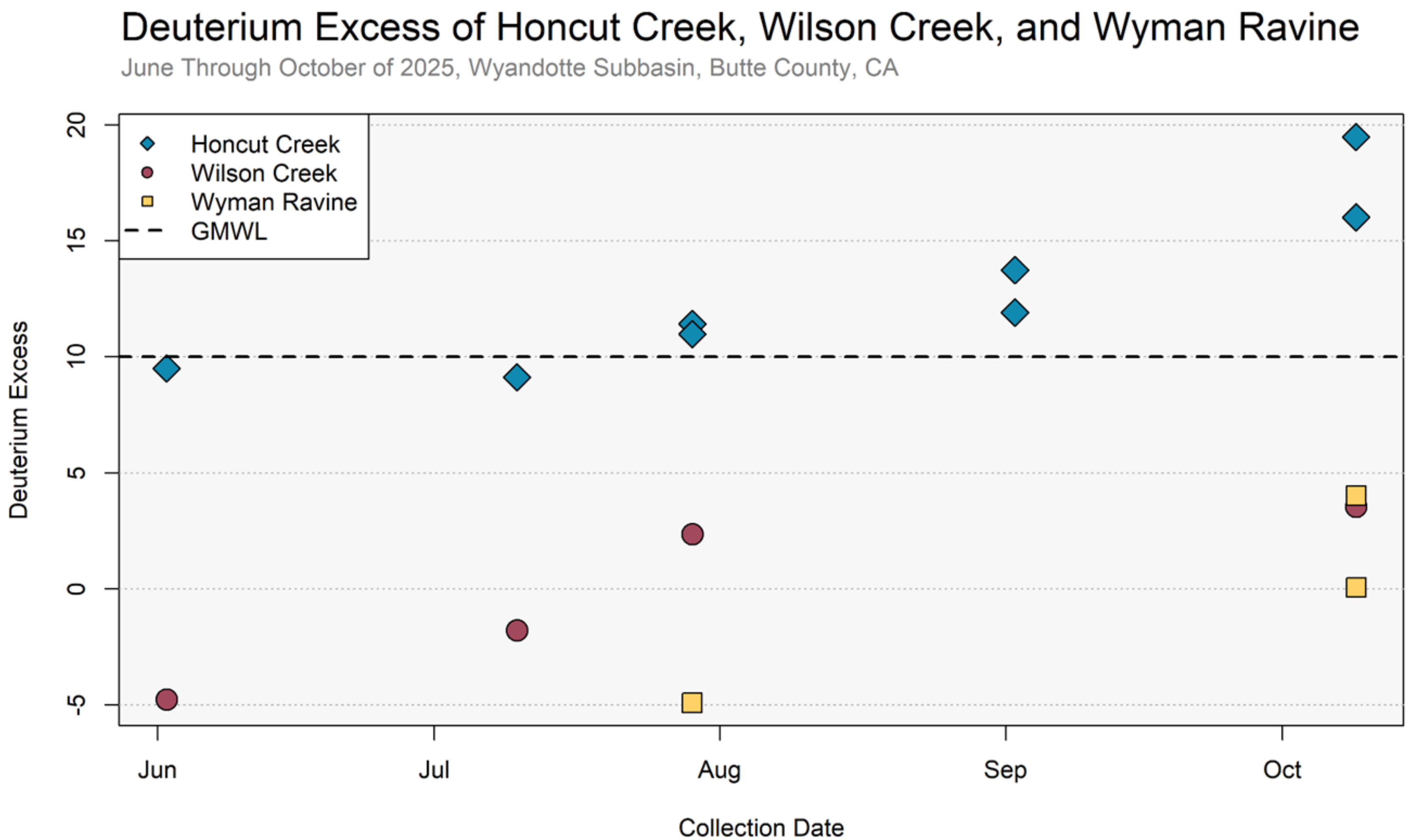


Figure 2-30: Deuterium excess of Honcut Creek, Wilson Creek, and Wyman Ravine samples. Samples taken in June through October of 2025. Deuterium excess defined by the equation Excess = $\delta D - 8*\delta 18O$.

The sections above details efforts in the Wyandotte Creek Subbasin to identify Interconnected Surface Water (ISW) locations using the updated BBGM (v.1.3), LiDAR extracted surface water elevations in conjunction with interpolated groundwater elevations, and stable and radioactive isotope tracers. Groundwater level monitoring wells and stream gages installed in 2026 will help address data gaps. Key findings include:

- The Feather River is primarily a gaining stream and is subject to depletions from groundwater pumping. Depletions from the Feather River are not considered to have the potential to have significant and unreasonable impacts on beneficial uses and users of the river.
- North Honcut Creek likely transitions from a gaining and losing stream depending on time of year and groundwater demands. The stream is ephemeral. Depletions from pumping are limited to when the stream is flowing, the stream is connected to the aquifer, and pumping is occurring. This limited timeframe typically ends by June and leads to a small amount of potential gains / losses in the spring as pumping starts for the irrigation season.
- Groundwater level data gaps exist along Wyman Ravine and Wyandotte Creek, ephemeral creeks. Additional monitoring wells and stream gages may be warranted before establishing SMCs in these areas.

2.2.7 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are defined in the SGMA regulations as “ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface” (CCR, Title 23, § 351(m)). GDEs exist within the Wyandotte Creek subbasin largely where vegetation accesses shallow groundwater for survival; and in areas with streams and creeks where a connection to groundwater exists. Without access to shallow groundwater, these plants and the ecosystems supported by the hydrology would die.

GDEs are incredibly diverse (e.g., riparian forests, rivers, and oak woodlands) and often host rare and endemic species, such as the giant garter snake or green sturgeon to name characteristic species known to occur in the Subbasin. Many of these species are protected under state and federal endangered species act. Moreover, a key goal of SGMA is to prevent depletion of interconnected surface water (ISW) that have significant and unreasonable reductions on beneficial uses and users of surface water (e.g., insufficient water for aquatic species, GDEs). For example, GDEs are closely tied to ISW because many ecosystems depend on groundwater-fed streams and rivers. If pumping reduces streamflows, it can harm fish, wildlife, and other species that make up GDEs.

Surface water depletion and GDEs were identified by the GSA in the 2022 GSP and by the DWR RCAs as having data gaps, including:

- Limited data to analyze how pumping and streamflows interact within the primary aquifer system and the impacts on GDEs,

- Limited groundwater level data for the shallow aquifer, and therefore higher uncertainty on the actual depth to groundwater throughout the subbasin,
- Uncertainty about the location and distribution of GDEs and shallow groundwater conditions in the Subbasin,
- Limited information on the baseline condition and ecological value of GDEs in the Subbasin, and,
- Uncertainty about how sensitive GDEs are to changes in groundwater levels.

To address the data gaps and DWR's RCA, a desktop analysis has been performed. This analysis brings together hydrologic, hydrogeologic, physical, and ecological datasets to better understand the baseline condition and ecological value of the subbasin's GDEs and how sensitive they may be to changes in the groundwater levels. The goals are to create more accurate maps of potential GDEs. Ultimately, the GSA may select representative GDEs for future long term GDE monitoring. These monitoring sites would support the refinement of Sustainable Management Criteria (SMCs) and help ensure that management actions avoid significant and unreasonable impacts on GDEs.

2.2.7.1 NCCAG Database

The initial identification of GDEs was performed by using the Natural Communities Commonly Associated with Groundwater (NCCAG) database to identify and map potential groundwater dependent ecosystems (iGDEs) in the Wyandotte Creek Subbasin. The NCCAG database was developed by a working group comprised of DWR, CDFW, and TNC by reviewing publicly available state and federal agency datasets that have mapped California vegetation, wetlands, springs and seeps and by conducting a screening process to retain types and locations of ecosystems commonly associated with groundwater. The results were compiled into the NCCAG database with two habitat classes defined. The first class includes wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions. The second class includes vegetation types commonly associated with the sub-surface presence of groundwater (phreatophytes). Figure 2-22 shows the locations of iGDEs identified by the NCCAG database within the Wyandotte Creek Subbasin. The primary vegetation types within the Subbasin include Valley Oaks, Cottonwoods, Riparian Vegetation (including Bulrush, Cattail, and Reeds), and Willows accounting for 2,435 acres, 2,227 acres, 1,930 acres, and 1,663 acres; respectively.

The NCCAG dataset is based on 48 layers of publicly available data developed by state or federal agencies that map vegetation, wetlands, springs, and seeps in California (DWR, 2019a). A NCCAG technical working group with representatives from DWR, CDFW, and TNC reviewed the datasets compiled to assemble the NCCAG dataset. The NCCAG dataset attempts to extract mapped vegetation and wetland features that have indicators suggesting dependence on groundwater. The data presented in NCCAG dataset display vegetation polygons that have indicators of GDEs based on published and/or field observations of phreatophytic vegetation defined as a "deep-rooted plant that obtains water that it needs from the phreatic zone (zone of saturation) or the capillary fringe above the phreatic zone" (Rohde et al., 2018). The dominance of phreatophytic plant species in a mapped vegetation type is a primary indicator of GDEs. A list of plant species considered to be phreatophytes based on peer-reviewed scientific literature on rooting depths, published lists of phreatophytes, expert field observations, and vegetation alliance descriptions is publicly available (Klausmeyer et al., 2018; DWR, 2018a).

While developing the NCCAG dataset of areas with indicators of GDEs, the technical working group attempted to exclude vegetation and wetland types and polygons that are less likely to be associated with groundwater (Klausmeyer et al., 2018). The NCCAG working group attempted to remove any polygons that are not likely to be GDEs where they occurred in areas where they are likely to be supported by alternate artificial water sources (e.g. local seepage from agricultural irrigation canals), or where appropriate available data indicated the shallow groundwater depth is located well below the rooting zone (Klausmeyer et al., 2018).

The vegetation data presented in the NCCAG dataset is a starting point for the identification of GDEs as the dataset includes the best available public datasets and has been screened to include only areas that have indicators of groundwater dependent vegetation. DWR has stated that use of the NCCAG dataset is not mandatory and does not represent DWR's determination of a GDE (DWR, 2018a). Rather, the NCCAG dataset can provide a starting point for the identification of GDEs within a groundwater basin.

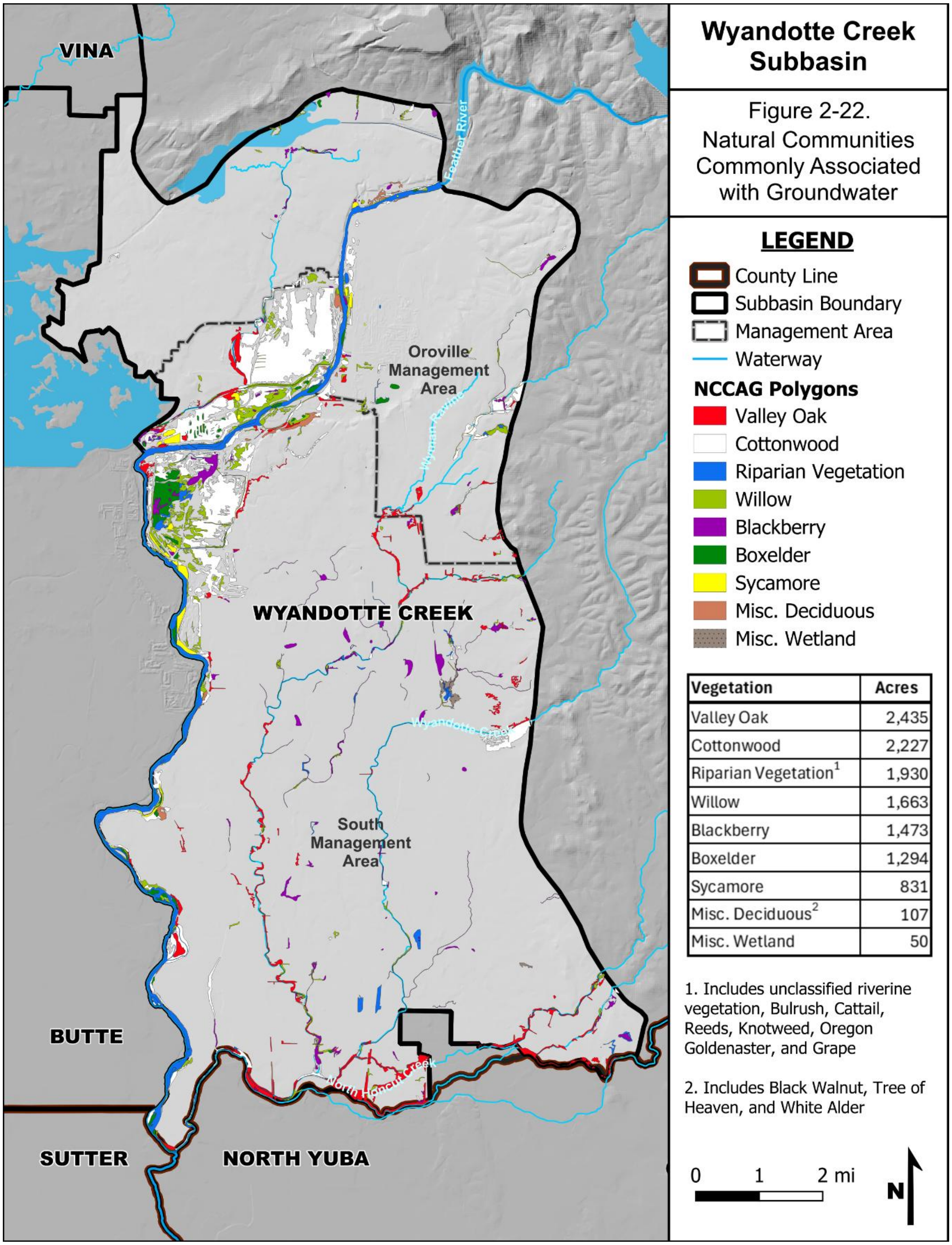


Figure 2-22: All Potential Groundwater Dependent Ecosystems in the Wyandotte Creek Subbasin as Identified in the Natural Communities Commonly Associated with Groundwater Database Hosted by The Nature Conservancy

2.2.7.2 Updated GDE Classification

Characterize Groundwater Conditions in the Shallow Aquifer Zone
Detailed maps were created showing groundwater levels across the region using data from monitoring wells collected between 2000 and 2025. The seasonal maps show depth to the groundwater table during spring and fall of each year, creating a comprehensive picture of how these levels change over time. By combining this groundwater information with precise land surface elevation data from 2018 LiDAR surveys, the depth to groundwater (DTG) was calculated – essentially how deep water is below the ground surface – for each season across 25 years. This resulted in a detailed map showing DTG patterns throughout the subbasin, which were then used to analyze how close groundwater comes to the surface in areas where GDEs might exist.

Refine GDE Mapping
Central locations of potential GDE areas were identified within the Wyandotte Subbasin using an existing database of natural plant communities that typically rely on groundwater. The GDEs were overlaid onto the DTG maps to track how groundwater depths varied over time at each potential GDE site.

Together, these two steps link groundwater data with ecological information. By first developing a detailed picture of groundwater conditions in the shallow aquifer and then overlaying that information with the mapped locations of potential GDEs, the analysis shows where ecosystems are likely to rely on groundwater, where they are not, and where uncertainty remains based on estimated rooting depths for each vegetation type. This connection is critical for deciding which areas should be prioritized for further study and monitoring.

To test this connection, the analysis evaluated rooting depths of groundwater-dependent vegetation from the Nature Conservancy's "Plant Rooting Depth Database." Groundwater levels were compared against rooting depths to determine whether vegetation could reliably access groundwater. GDEs with evidence supporting that groundwater levels are always outside the range accessible to vegetation were preliminarily identified as "Not likely a GDE" (no access to groundwater and would not require consideration under SGMA as part of groundwater management; i.e. not a beneficial user of groundwater), while polygons with evidence supporting that groundwater levels are within the range accessible to vegetation were preliminarily identified as "Potential GDE."[10]

Separately, a second analysis was conducted using a proposed depth to groundwater threshold of 13 feet derived from Rhode et al. (2024)[11], who developed a relationship between DTG and vegetation health to establish a protective threshold. This analysis compared groundwater levels

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[10] Thresholds of certainty will be defined in coordination with the GSA but is envisioned to include situations where 1:1 vegetations mapping to rooting depth relationships are not available or otherwise unclear, where groundwater depths are close to maximum rooting depths (e.g., within 10 percent), and where uncertainty in interpolated groundwater depths with within or close to maximum rooting depths.

[11] Rhode, M.M. et al. (2024). Establishing ecological thresholds and targets for groundwater management. Nature Water. https://doi.org/10.1038/s44221-024-00221-w

to the 13-foot threshold to distinguish between GDEs with persistent groundwater levels that theoretically maintain healthy conditions versus those where groundwater levels may lead to more stressful conditions.

Together, these two methods provide complementary perspectives.

The rooting depth analysis focuses on whether groundwater levels fall within the range that specific plant species can access, while the 13-foot threshold offers a broader, protective benchmark across vegetation types. Comparing results from both approaches helps identify areas that are clearly groundwater dependent, areas that are clearly not, and areas where uncertainty remains.

As a basis of comparison DTG was evaluated for the 90th percentile groundwater elevation (the elevation met or exceeded 90 percent of the time at each GDE during the period of record), the fall season for 2015 (the year SGMA came into effect), and 2021 (recent historical low groundwater levels).[12] These groundwater elevations were selected as basis for comparison because they represent typical, dry, and extremely dry conditions, respectively. GDEs where DTG was greater than or equal to rooting depths are likely potential GDEs whereas those where DTG is greater than rooting depth are not likely GDEs.

Updated GDE Map

As shown on Figure 2-23, potential GDEs were identified along the Feather River, Honcut Creek, lower Wyman Ravine, and lower Wyandotte Creek. The red areas in the middle of the Subbasin and further east correspond to areas that are not likely a GDE as vegetation rooting depths are above historical water table elevations used in the analysis described above. These areas may rely on stored precipitation in the rootzone, perennial or supplemental surface water supplies, or access to water from adjacent irrigated agricultural fields.

Existing and proposed groundwater monitoring wells tracking water table conditions are shown using yellow and blue triangles on Figure 2-23, respectively. There are seven existing wells and fourteen proposed wells across the Subbasin. The proposed wells will improve understanding of geological and water table conditions near streams and potential GDEs. The updated GDE map is preliminary and subject to change as new data becomes available.

Additional information on the updated GDE classifications and field surveys are available in Attachment X.

[12] The 90th percentile represents an estimate for the frequency of a given groundwater levels being observed.

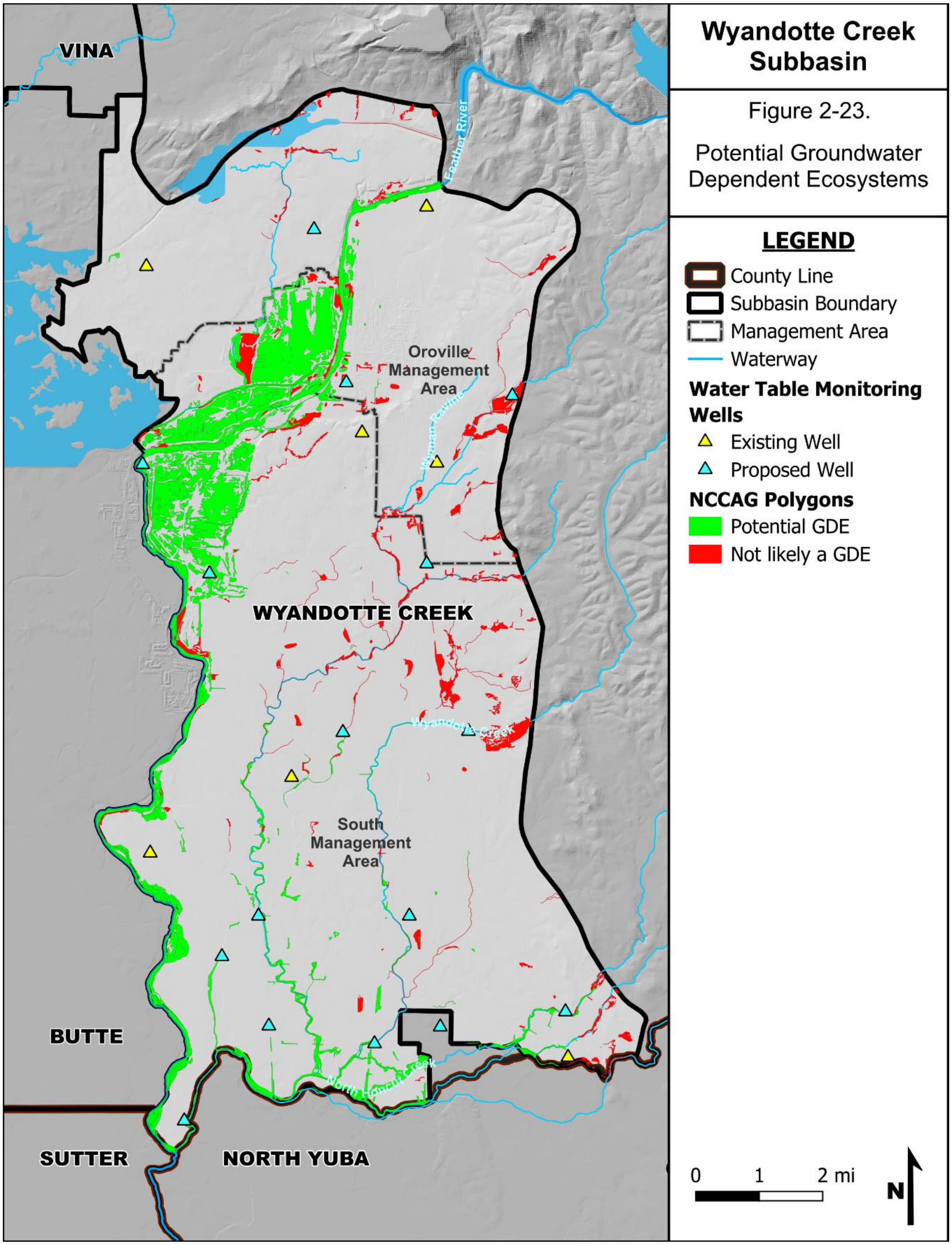

Figure 2-23: Potential Groundwater Dependent Ecosystems in the Wyandotte Creek Subbasin

2.3 Water Budget

This section describes historical, current, and projected water budgets in accordance with §354.18 of the GSP Emergency Regulations, including quantitative estimates of inflows to and outflows from the basin over time and annual changes in water storage within the basin. Components of the water budgets are depicted in Figure 2-24.

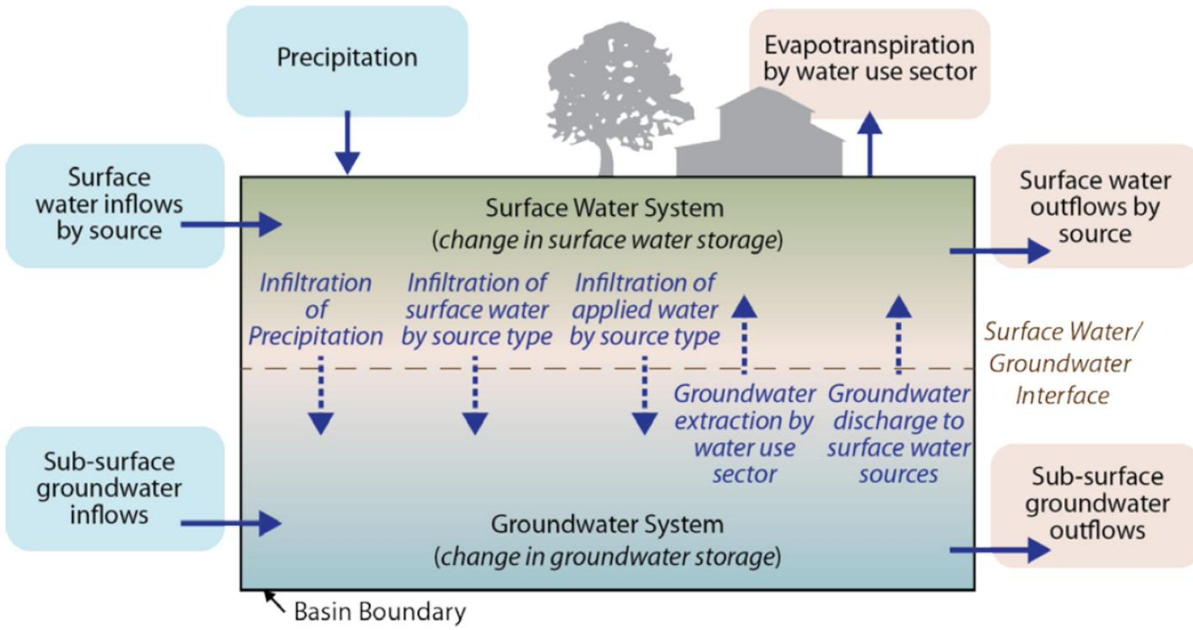

Figure 2-24: Water Budget Components (DWR, 2016)

Water budgets were developed considering hydrology, water demand, water supply, land use, population, climate change, surface water – groundwater interaction, and subsurface groundwater inflows and outflows to and from neighboring basins. Water budget results are reported on a water year basis spanning from October 1 of the prior year to September 30 of the current year. The water budget presented in this section is based on the Butte Basin Groundwater Model (version BBGM v.1.0) used during the 2022 GSP development. Current conditions are based on data through 2018.

2.3.1 Selection of Hydrologic Periods

The GSP Emergency Regulations require evaluation of water budgets over a minimum of 10 years for the historical water budget, using the most recent hydrology for the current water budget, and 50 years of hydrology for the projected water budget. Hydrologic periods were selected, as described below, for each water budget category based on consideration of the best available information and science to support water budget development and based on consideration of the ability of the selected periods to provide a representative range of wet and dry conditions.

- Historical – The 19-year period from water years[13] 2000 to 2018 was selected based on the level of confidence in historical information to support water budget development considering land use, surface water availability, hydrology, and other factors.
- Current Conditions – Historical water budget information for 2018 represents the most recent hydrology. To provide a broader basis for understanding current water budget conditions, a water budget scenario combining current land use and urban demands with 50 years of hydrology was selected. The period selected was 1971 to 2018 (48 years) with 2004–2005 (two relatively normal years) repeated at the end of the scenario. An advantage of evaluating the current conditions water budget over a representative 50-year period is that the results provide a baseline for evaluation of the projected water budgets. Results for 2018, the most recent available information, are provided in Appendix 2-A.
- Future Conditions – Consistent with the current conditions water budget, the period selected for the projected water budgets was 1971 to 2018 (48 years) with 2004–2005 repeated at the end of the scenarios to provide a full 50-year period as required by the GSP Emergency Regulations.
- Selection of the 50-year hydrologic period for the current and projected water budget scenarios was based primarily on three considerations:
- ▪ The BBGM, the primary tool used to develop the water budgets, has a simulation period from water years 1971 to 2018.
- ▪ The Sacramento Valley Water Year Index[14] over the period from 1971 to 2018 has an average of 8.0, as compared to 8.1 for the 103-year period from 1906 to 2018 (1906 is the first year for which the index is available) (Figure 2-25).
- ▪ The selected period includes a combination of wet and dry cycles, including relatively wet periods in the early 1970s, mid 1980s, and late 1990s and dry periods in the late 1970s, early 1990s, and from approximately 2007 to 2015.
- Additionally, annual precipitation for the 1971 to 2018 period averaged approximately 26.3 inches per year, as compared to 24.8 inches for the 1906 to 2018 period indicating slightly drier conditions than the full period of record for the Sacramento Valley Index.

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[13] A water year is defined as the period from October 1 of the prior year to September 30 of the current year. For example, water year 2000 refers to the period from October 1, 1999, to September 30, 2000.
[14] The Sacramento Valley Water Year Index classifies water years as wet, above normal, below normal, dry, or critical based on Sacramento River unimpaired flows. Additional details describing the Sacramento Valley Water Year Index are available from the California Data Exchange Center (https://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST).

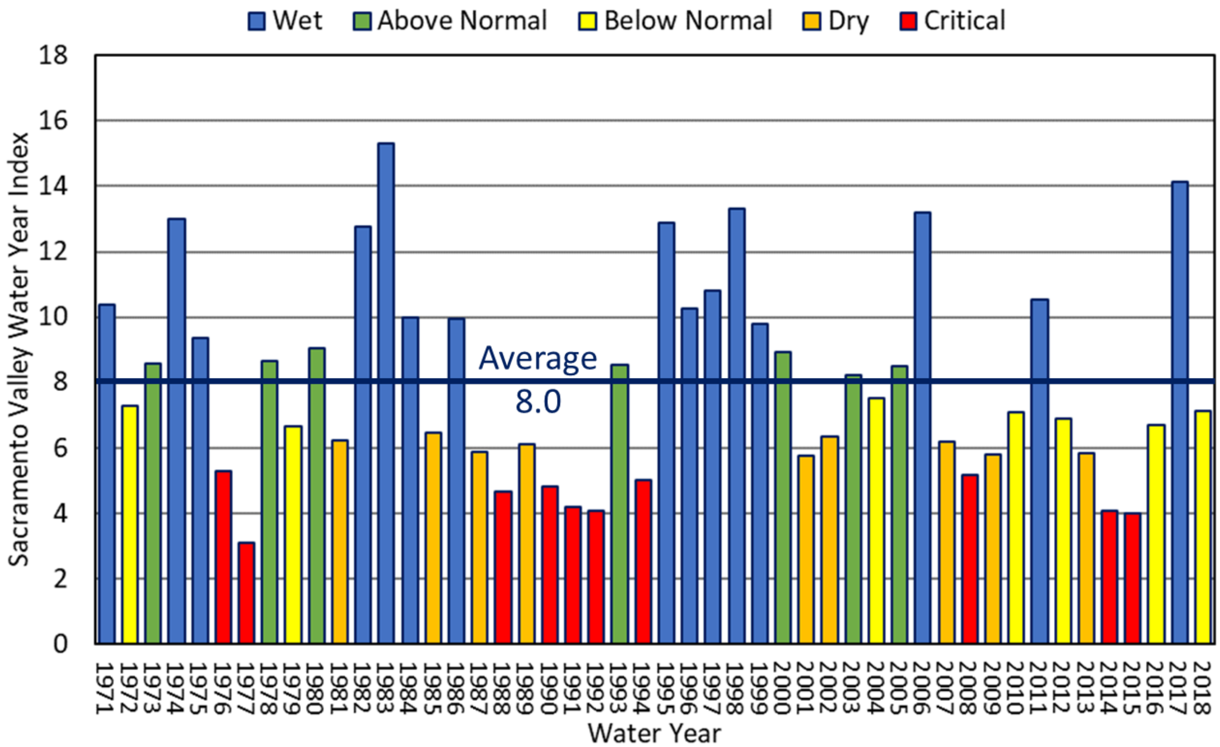

Figure 2-25: 1971 – 2018 Sacramento Valley Water Year Index and Water Year Types

2.3.2 Usage of the Butte Basin Groundwater Model

Development of the original BBGM began in 1992 under the direction and funding of the Butte Basin Water Users Association. The model has been updated over time to simulate historical conditions through water year 2018. The model performs calculations on a daily time step with some daily input (i.e., precipitation, stream inflow), some monthly input data (i.e., surface water diversions) and some annual input data (i.e., land use). Refinements to the model over time include additional crop types to better represent ponded crops (i.e., rice and wetlands), recalibrated soil parameters, and elemental land use. The development of the BBGM is described in more detail in BCDWRC, 2021. The BBGM was updated to version 1.3 and extended through water year 2024. Further information on model updates is available in Woodard & Curran, January 2026. This section did not use the updated BBGM v1.3 as additional model calibration is recommended before its application in the Wyandotte Creek subbasin.

To prepare water budgets, historical BBGM results for water years 2000 to 2018 have been relied upon, and four additional baseline scenarios have been developed to represent current and projected conditions utilizing 50 years of hydrology (described previously). Specific assumptions associated with these scenarios are described in the following section.

2.3.3 Water Budget Assumptions

Assumptions utilized to develop the historical, current, and projected water budgets are described below and summarized in Table 2-4.

Table 2-4: Summary of Water Budget Assumptions

Water Budget	Analysis Period	Hydrology	Land Use	Water Supplies
Historical Simulation	2000 – 2018	Historical	Historical	Historical
Current Conditions Baseline	1971 – 2018	Historical	Current (2015 and 2016)	Current (2015 and 2016 surface water diversions, 2016-2018 average urban demands)
Future Conditions, No Climate Change Baseline	1971 – 2018	Historical	Current, adjusted based on Butte County 2030 General Plan	Current (2015 and 2016 Surface water diversions and 2050 projected urban demands)
Future Conditions, 2030 Climate Change Baseline	1971 – 2018	Historical, adjusted based on 2030 climate change	Current, adjusted based on General Plan	Current, adjusted based on climate change
Future Conditions, 2070 Climate Change Baseline	1971 – 2018	Historical, adjusted based on 2070 climate change	Current, adjusted based on General Plan	Current, adjusted based on climate change

2.3.3.1 Historical

A historical water budget was developed to support understanding of past aquifer conditions, considering surface water and groundwater supplies utilized to meet demands. The historical water budget was developed using the BBGM and incorporates the best available science and information. Historical water supplies and aquifer response have been characterized by water year type based on DWR's Sacramento Valley Water Year Index, which classifies water years as wet, above normal, below normal, dry, or critical based on Sacramento River unimpaired flows.

As described previously, water years 2000 to 2018 were selected to provide a minimum of 10 years across a range of hydrologic conditions. This period includes relatively wet years in 2006, 2011, and 2017 as well as dry conditions between 2007 and 2009 and between 2013 and 2015.

Information utilized to develop the historical water budget include:

- Analysis Period – Water years 2000 to 2018.
- Stream Inflows – Inflows of surface water into the basin were estimated based on stream gage data from USGS and DWR where available (e.g., Feather River and South Honcut Creek). For un-gaged streams, inflows were estimated using the Natural Resources Conservation Service (NRCS) rainfall runoff method applied at the watershed scale, considering precipitation timing and amount, soil characteristics, and other factors. Additional detail describing stream inflows is described in the BBGM model report (BCDWRC, 2021).
- Land Use – Land use characteristics for agricultural, native, and urban (including rural residential) lands were estimated annually based on a combination of DWR land

use surveys and county agricultural commissioner cropping reports. DWR land use data were available for 1994, 1999, 2004, 2011, 2014, 2015, and 2016. Additional detail describing the development of land use estimates can be found in the BBGM model report (BCDWRC, 2021).

- Agricultural Water Demand – Agricultural irrigation demands were estimated using the BBGM, which simulates crop growth and water use on a daily basis, considering crop type, evapotranspiration, root depth, soil characteristics, and irrigation practices. For ponded land uses (rice and managed wetlands), pond depths and pond drainage are also considered to simulate demands.
- Urban and Industrial Water Demand[15] – Urban and industrial demands were estimated based on a combination of pumping data provided directly by water suppliers (e.g., Cal Water) and estimates of population and per capita water use over time. Additional detail describing the development of urban demand estimates can be found in the BBGM model report (BCDWRC, 2021).
- Surface Water Diversions – Surface water diversions were estimated based on a combination of reported diversions by water suppliers (e.g., SFWPA) and, in some cases, agricultural water demand estimates for areas known to receive surface water but for which reported diversion data were not available.
- Groundwater Pumping – For urban water suppliers, historical pumping was estimated from reported pumping volumes over time. Pumping to meet agricultural and managed wetlands demands was estimated within the BBGM by first estimating the total demand and then subtracting surface water deliveries to calculate estimated groundwater pumping required to meet the remaining demand.

2.3.3.2 Current Conditions

The current conditions water budget was developed as a baseline to evaluate projected water budgets considering future conditions and is based on 50 years of hydrology along with the most recent information describing land use, urban demands, and surface water supplies. The 50-year hydrologic period was selected rather than the most recent year for which historical water budget information is available to allow for direct comparison of potential future conditions to current conditions. The use of a representative hydrologic period containing wet and dry cycles supports the understanding of uncertainty in groundwater conditions over time, establishment of SMC, and development of projects and management actions to avoid undesirable results.

The current water budget estimates current inflows, outflows, and change in storage for the basin using 50 years of representative hydrology and the most recent water supply, water demand, and land use information.

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[15] Current estimates of industrial water use not supplied by urban water suppliers have not been explicitly included at this time and are identified as a data gap that could be filled as part of future GSP updates. These water uses are small relative to other water uses (i.e., agricultural and urban) and tend to be non-consumptive in nature. Additionally, future refinements of the BBGM to incorporate rural residential demands may also be made; these demands were estimated as part of the 2016 Water Inventory and Analysis and are also small relative to other uses.

Information utilized to develop the current conditions baseline water budget include:

- Analysis Period – 50-years of hydrology were utilized representing the period from 1971 to 2018, with 2004 and 2005 repeated following 2018.
- Stream Inflows – Inflows of surface water into the basin were estimated utilizing the same information as for the historical water budget.
- Land Use – Land use for agricultural, native, and urban (including rural residential) lands was estimated annually using the most recent land use information. Specifically, 2015 and 2016 land use were mapped to the 50-year analysis period, with 2015 land use applied to extreme dry years and 2016 land use applied to all other years. Extreme dry years were identified based on April to July inflows of the Feather River to Lake Oroville. April to July runoff to the Feather River is believed to be a reasonable indicator of surface water supplies within the basin, which are primarily associated with the Feather River.
- Agricultural Water Demand – Agricultural irrigation demands were estimated using the BBGM, in the same manner as the historical water budget.
- Urban and Industrial Water Demand – Urban and industrial demands were estimated based on recent demands. Specifically, average demands for the period 2016 to 2018 were assumed.
- Surface Water Diversions – Similar to land use, surface water diversions were estimated based on 2015 and 2016 conditions, with 2015 diversion assumed for extreme dry years as discussed above.
- Groundwater Pumping – Pumping to meet urban demands was estimated based on average 2016 to 2018 demands, as described above. Pumping to meet agricultural and managed wetlands demands was estimated using the BBGM as described previously for the historical water budget.

2.3.3.3 Future Conditions

Three projected baseline water budget scenarios were developed considering a range of future conditions that may occur. The scenarios consider future planned land use changes (i.e., development) based on the Butte County 2030 General Plan, along with changes in climate, including precipitation, surface water inflows, and evapotranspiration. These baselines provide information regarding changes in basin conditions (e.g., groundwater storage) that may occur in the future over a series of wet and dry cycles.

The projected water budget estimates potential future inflows, outflows, and change in storage for the basin using 50-years of representative hydrology (including modifications based on climate change projections), the most recent water supply and water demand, and planned future land use information.

Information utilized to develop the future conditions baseline water budgets includes:

- Analysis Period – 50-years of hydrology were utilized representing the period from 1971 to 2018, with 2004 and 2005 repeated following 2018.
- Stream Inflows:
- Future Conditions, No Climate Change – Inflows of surface water into the basin were estimated utilizing the same information as for the historical water budget.
- Future Conditions, 2030 Climate Change – Precipitation, evapotranspiration, and surface water supplies were adjusted to reflect climate change based on the 2030 Central Tendency climate change datasets provided by DWR to support GSP development.
  - For precipitation and evapotranspiration, monthly change factors were applied to historical values to estimate potential future conditions.
- For streamflows, DWR estimates of stream inflows were utilized where available; for streams without direct estimates of inflows, inflows were estimated using streamflow change factors applied at the watershed scale.
- Future Conditions, 2070 Climate Change – Precipitation, evapotranspiration, and surface water supplies were adjusted to reflect climate change based on the 2070 Central Tendency climate change datasets provided by DWR to support GSP development:
  - For precipitation and evapotranspiration, monthly change factors were applied to historical values to estimate potential future conditions.
  - For streamflows, DWR estimates of stream inflows were utilized where available; for streams without direct estimates of inflows, inflows were estimated using streamflow change factors applied at the watershed scale.
- Land Use – Land use for agricultural, native, and urban (including rural residential) lands was estimated annually using the most recent land use information and modified based on planned development according to the Butte County 2030 General Plan. Specifically, 2015 and 2016 land use were mapped to the 50-year analysis period, with 2015 land use applied to extreme dry years and 2016 land use applied to all other years. 2015 and 2016 land use data were modified to reflect planned development, generally resulting in an increase in urban land through development of previously undeveloped (i.e., native) lands:
- Future Conditions, No Climate Change – Land use was assumed to be similar to the current conditions water budget scenario.
- Future Conditions, 2030 Climate Change – 2015 and 2016 land use data were mapped to the 50-year analysis period considering 2030 central tendency climate change projections, with 2015 land use used for extreme dry years and 2016 land use used for all other years.
- Future Conditions, 2070 Climate Change – 2015 and 2016 land use data were mapped to the 50-year analysis period considering 2070 central tendency climate change

projections, with 2015 land use used for extreme dry years and 2016 land use used for all other years.

- Agricultural Water Demand – Agricultural irrigation demands were estimated using the BBGM, in the same manner as the historical water budget.
- Urban and Industrial Water Demand – Urban and industrial demands were estimated based projected urban demands. Specifically, future urban demands were estimated based on preliminary draft demand estimates provided by Cal Water, a primary urban supplier in the basin, as part of 2020 UWMP development.
- Surface Water Diversions – Similar to land use, surface water diversions were estimated based on 2015 and 2016 conditions, with 2015 diversions assumed for extreme dry years and 2016 diversions assumed for other years. Extreme dry years are identified based on April to July unimpaired Feather River inflows into Lake Oroville.
- Groundwater Pumping – Pumping to meet urban demands was estimated based on draft projections from UWMPs currently under development, as described above. Pumping to meet agricultural and managed wetlands demands was estimated using the BBGM as described previously for the historical water budget.

2.3.4 Water Budget Estimates

As described previously, water budget estimates were developed using the BBGM. Primary components of the land and surface water system water budget include the following:

- Inflows:
- ▪ Surface Water Inflows – Inflows at the land surface through streams, canals, or other waterways. These inflows may also include overland flow from upslope areas outside of the basin. Although interactions with streams along the boundary of the basin (i.e., diversions and stream-aquifer interaction) are accounted for, the flow in the stream is not considered an inflow to the basin. Inflows from the Feather River, which traverses the basin, are accounted for explicitly.
- ▪ Precipitation – Rainfall intercepting the ground surface within the basin boundary.
- ▪ Groundwater pumping – Extraction of groundwater to meet agricultural, urban, managed wetlands, or other beneficial uses.
- ▪ Stream Accretions – Gains in streamflow from shallow groundwater occurring when the water level in the aquifer adjacent to the stream is greater than the water level in the stream.
- Outflows:
- ▪ Surface Water Outflows – Outflows at the land surface through streams, canals, or other waterways. These outflows may also include overland flow to downslope areas outside of the basin.

- Evapotranspiration – Consumptive use of water including both evaporation and transpiration components from all land uses.
- Deep Percolation – Recharge of the groundwater system through the vertical movement of precipitation and applied irrigation water below the root zone.
- Seepage (Also referred to as Losses or Leakage) – Recharge of the groundwater system from streams, canals, or other water bodies.
- Change in Storage – Changes in soil moisture storage within the upper several feet of soil in the root zone, as well as changes in storage in surface water bodies within the basin. These changes are generally negligible on an annual basis but vary over the course of a year based on precipitation patterns and other factors.

Primary components of the groundwater system water budget include the following:

- Inflows:
- Deep Percolation – Described above.
- Subsurface Inflows – Groundwater inflows from adjacent basins or from the foothill area north of the Wyandotte Creek Subbasin.
- Seepage – Described above.
- Outflows:
- Groundwater Pumping – Described above.
- Subsurface Outflows – Groundwater outflows to adjacent basins.
- Stream Accretions – Described above.
- Change in Storage – Changes in water storage in the aquifer system. These changes tend to be large compared to changes in root zone soil moisture storage and can vary substantially from year to year.

Many components of the water budget can be estimated based on measured data (e.g., precipitation, diversions, evapotranspiration, etc.) and are used to develop inputs to the BBGM to support water budget development. Other components are more difficult to measure or do not have measured values readily available (e.g., deep percolation, subsurface flows, groundwater pumping, surface water-groundwater interaction, etc.) and are estimated using the BBGM. Additional detail describing the BBGM is available in (BCDWRC, 2021).

Average annual water budget estimates for the historical water budgets and for the current and projected water budget scenarios are summarized in Table 2-5 for the land and surface water system and in Table 2-6 for the groundwater system. Additional information and discussion regarding the water budgets is provided in the following subsections. It is anticipated that the water budgets will be refined and updated over time as part of GSP implementation in the basin.

Table 2-5: Water Budget Summary: Land and Surface Water System

Component	Historical (AFY)	Current (AFY)	Future, No Climate Change (AFY)	Future, 2030 Climate Change (AFY)	Future, 2070 Climate Change (AFY)
Inflows					
Surface Water Inflows	**1,067,300**	**923,900**	**924,000**	**986,500**	**1,036,300**
Outside Diversions	5,700	5,600	5,700	5,700	5,700
Feather River	*1,019,200*	*874,500*	*874,500*	*933,800*	*981,400*
North Honcut Creek	*41,800*	*43,100*	*43,100*	*46,200*	*48,400*
Precipitation Runoff from Upslope Lands	*500*	*600*	*600*	*700*	*700*
Applied Water Return Flows from Upslope Lands	*100*	*100*	*100*	*100*	*100*
Precipitation	**130,800**	**136,100**	**136,100**	**141,500**	**144,900**
Groundwater Pumping	**47,100**	**43,100**	**45,000**	**46,600**	**48,700**
Agricultural	*39,300*	*36,200*	*35,800*	*37,400*	*39,300*
Urban and Industrial	700	500	2,800	2,700	2,700
Managed Wetlands	*7,100*	*6,400*	*6,400*	*6,500*	*6,700*
Stream Gains from Groundwater	**36,300**	**32,000**	**29,500**	**28,500**	**26,600**
Total Inflow	***1,281,500***	***1,135,100***	***1,134,600***	***1,203,100***	***1,256,500***
Outflows					
Evapotranspiration	**87,100**	**82,500**	**81,500**	**84,100**	**86,500**
Agricultural	*43,800*	*41,300*	*40,800*	*42,200*	*44,000*
Urban and Industrial	*8,600*	*8,700*	*11,800*	*12,000*	*12,200*
Managed Wetlands	*5,400*	*4,500*	*4,500*	*4,700*	*4,800*
Native Vegetation	*29,300*	*28,000*	*24,400*	*25,200*	*25,500*
Canal Evaporation	*0*	*0*	*0*	*0*	*0*
Deep Percolation	**70,700**	**69,600**	**67,300**	**69,900**	**70,700**
Precipitation	*47,000*	*48,800*	*45,300*	*49,100*	*47,000*
Applied Surface Water	*6,200*	*4,800*	*4,500*	*4,800*	*4,800*
Applied Groundwater	*17,500*	*16,000*	*17,500*	*16,000*	*18,900*
Seepage	**10,000**	**9,700**	**9,900**	**10,700**	**11,900**
Streams	*4,100*	*4,900*	*5,100*	*5,900*	*7,100*
Lakes	*3,600*	*3,600*	*3,600*	*3,600*	*3,600*
Canals and Drains	*2,300*	*1,200*	*1,200*	*1,200*	*1,200*
Surface Water Outflows	**1,113,500**	**973,200**	**975,600**	**1,038,600**	**1,087,400**
Precipitation Runoff	*17,800*	*19,200*	*21,600*	*23,200*	*24,800*
Applied Surface Water Return Flows	*1,700*	*1,200*	*1,300*	*1,300*	*2,600*

Component	Historical (AFY)	Current (AFY)	Future, No Climate Change (AFY)	Future, 2030 Climate Change (AFY)	Future, 2070 Climate Change (AFY)
Applied Groundwater Return Flows	*3,300*	*2,700*	*3,100*	*3,100*	*4,100*
Streams	*1,090,700*	*950,100*	*949,600*	*1,011,000*	*1,055,900*
Total Outflow	***1,281,300***	***1,135,000***	***1,134,300***	***1,203,300***	***1,256,500***
Change in Storage (Inflow - Outflow)	***200***	***100***	***300***	***-200***	***0***

Note: AFY = acre-feet per year
Totals are the sum of numbers in bold.

Table 2-6: Water Budget Summary: Groundwater System

Component	Historical (AFY)	Current (AFY)	Future, No Climate Change (AFY)	Future, 2030 Climate Change (AFY)	Future, 2070 Climate Change (AFY)
Inflows					
Subsurface Inflows	**24,900**	**22,500**	**22,500**	**22,100**	**22,200**
Butte Subbasin	*15,200*	*13,300*	*13,300*	*12,900*	*13,000*
North Yuba Subbasin	*2,700*	*2,500*	*2,500*	*2,300*	*2,100*
Sutter Subbasin	*700*	*500*	*500*	*600*	*800*
Vina Subbasin	*0*	*0*	*0*	*0*	*0*
Foothill Area	*6,300*	*6,200*	*6,100*	*6,300*	*6,300*
Deep Percolation	**70,800**	**69,600**	**67,300**	**69,900**	**70,700**
Precipitation	*47,000*	*48,800*	*45,300*	*46,900*	*47,000*
Applied Surface Water	*6,200*	*4,800*	*4,500*	*4,700*	*4,800*
Applied Groundwater	*17,500*	*16,000*	*17,500*	*18,300*	*18,900*
Seepage	**10,000**	**9,700**	**9,900**	**10,700**	**11,900**
Streams[1]	*4,100*	*4,900*	*5,100*	*5,900*	*7,100*
Lakes[2]	*3,600*	*3,600*	*3,600*	*3,600*	*3,600*
Canals and Drains[3]	*2,300*	*1,200*	*1,200*	*1,200*	*1,200*
Total Inflow	***105,700***	***101,800***	***99,700***	***102,700***	***104,800***
Outflows					
Subsurface Outflows	**26,000**	**26,700**	**25,600**	**27,600**	**29,900**
Butte Subbasin	*14,000*	*14,800*	*13,700*	*14,400*	*14,900*
North Yuba Subbasin	*10,500*	*10,500*	*10,700*	*11,800*	*13,600*
Sutter Subbasin	*400*	*300*	*300*	*300*	*200*
Vina Subbasin	*200*	*300*	*200*	*300*	*300*

Component	Historical (AFY)	Current (AFY)	Future, No Climate Change (AFY)	Future, 2030 Climate Change (AFY)	Future, 2070 Climate Change (AFY)
Foothill Area	*900*	*800*	*700*	*800*	*900*
Groundwater Pumping	**47,100**	**43,000**	**44,900**	**46,600**	**48,700**
Agricultural	*39,300*	*36,200*	*35,800*	*37,400*	*39,300*
Urban and Industrial	*700*	*500*	*2,800*	*2,700*	*2,700*
Managed Wetlands	*7,100*	*6,400*	*6,400*	*6,500*	*6,700*
Stream Gains from Groundwater	**36,300**	**32,000**	**29,500**	**28,500**	**26,600**
Total Outflow	***109,400***	***101,700***	***100,000***	***102,700***	***105,200***
Change in Storage (Inflow - Outflow)	***-3,700***	***100***	***-300***	***0***	***-400***

Note:
[1] Feather River and North Honcut Creek
[2] Thermalito Afterbay
[3] SFWPA
Totals are the sum of numbers in bold.

2.3.4.1 Historical

The historical water budget provides a foundation for how the basin has behaved historically, including insight into historical groundwater conditions (e.g., observed water levels). Also, in accordance with the GSP Regulations, the historical water budget covers a period of at least 10 years (19-year period from 2000 to 2018), is used to evaluate the availability and reliability of historical surface water supplies, and provides insight into the ability to operate the basin within the sustainable yield. The historical analysis period experienced somewhat less precipitation than the long-term average and included historic drought conditions from approximately 2007 to 2015.[16]

Average annual inflows to and outflows from the basin for the historical land and surface water system water budget were estimated to be 1.28 million acre-feet (MAF) per year. Average annual values were presented previously in Table 2-5 and are shown graphically in Figure 2-26.

Primary inflows to the land and surface water system include surface water inflows (1,067 thousand acre-feet per year [TAF/year]), precipitation (131 TAF/year), stream gains from groundwater (i.e., accretions) (36 TAF/year), and groundwater pumping (47 TAF/year). Surface water inflows consist primarily of the Feather River, which traverses the basin, as well as inflows from Honcut Creek and overland runoff of precipitation and applied water from upslope lands.

Primary outflows from the land and surface water system include surface water outflows (1,113 TAF/year), evapotranspiration (87 TAF/year), deep percolation (71 TAF/year), and stream losses (also referred to as seepage) (10 TAF/year). Surface water outflows include outflows through the Feather River and Honcut Creek, as well as overland runoff of precipitation and applied water to downslope lands. Evapotranspiration is primarily from agricultural lands but also from native vegetation, urban and industrial lands, and managed wetlands. Deep percolation is primarily from precipitation, but also from applied water. Stream losses include a combination of seepage from canals and drains, stream seepage, and seepage from Thermalito Afterbay.

The average annual change in storage in the land and surface water system is negligible due to similar soil moisture content in the root zone, on average, across water years, and limited storage capacity exists in surface water bodies within the basin.

Additional details describing the historical land and surface water system water budget are provided in Appendix 2-A.

[16] For the 2000 to 2018 period, mean annual precipitation was 26.7 inches, compared to 23.1 inches for the 2007 to 2015 period.

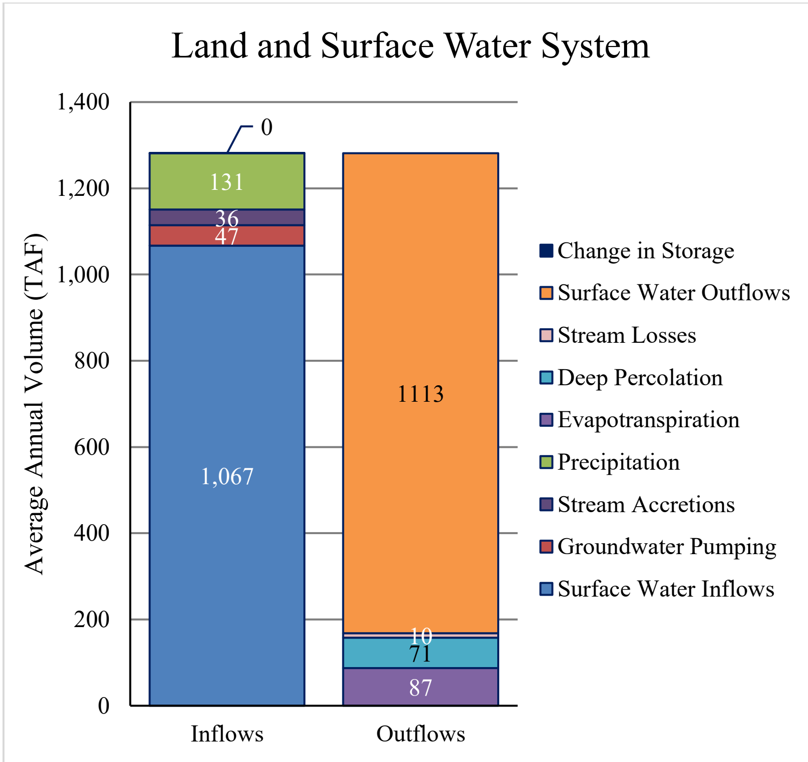


Figure 2-26: Average Annual Historical Land and Surface Water System Water Budget

Average annual inflows to and outflows from the groundwater system were estimated to be 106 TAF and 109 TAF, respectively, with an average decrease in groundwater storage of 4 TAF per year during the historical simulation period. Average annual values were presented previously in Table 2-6 and are shown graphically in Figure 2-27.

Inflows to the groundwater system include deep percolation (71 TAF/year); subsurface inflows from the Butte, North Yuba, Sutter, and Vina subbasins and from the foothill area (25 TAF/year); and stream losses (10 TAF/year). Outflows from the groundwater system include groundwater pumping (47 TAF/year); subsurface outflows to the Butte, North Yuba, Sutter, and Vina subbasins and to the foothill area (26 TAF/year); and stream gains from groundwater (36 TAF/year).

Additional details describing the historical groundwater system water budget are provided in Appendix 2-A.

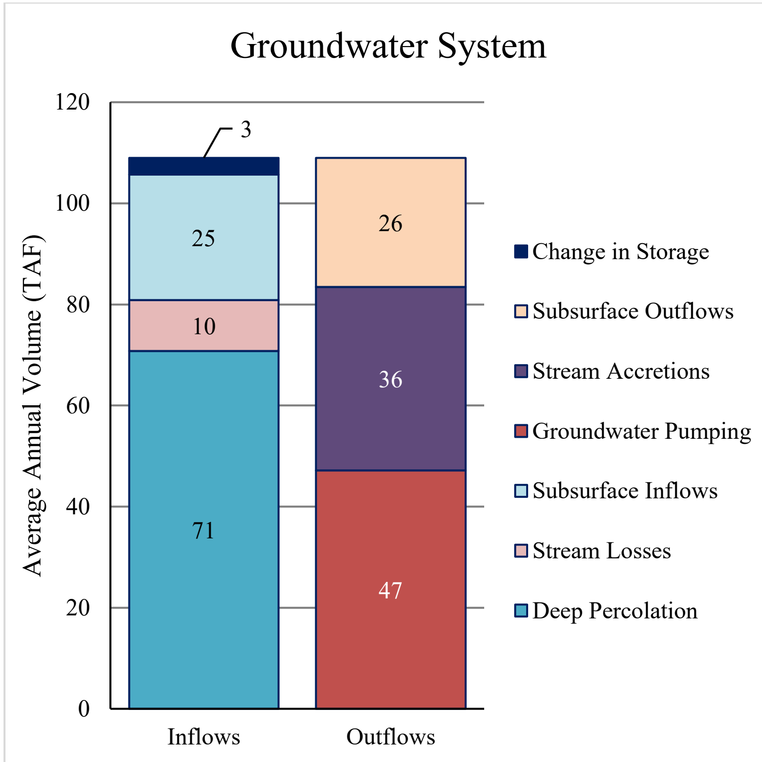


Figure 2-27: Average Annual Historical Groundwater System Water Budget

Historical water supplies and change in groundwater storage are summarized by water year type in Table 2-7 based on the Sacramento Valley Water Year Index. Between 2000 and 2018, there were three wet years, three above normal years, five below normal years, five dry years, and three critical years. Historical surface water deliveries were similar across year types, while groundwater pumping was greatest in critical years and least in wet years. Historically, groundwater storage in the basin has tended to increase in wet years and to decrease in above normal, below normal, dry, and critical years, with reductions in storage in above normal and below normal years less than reductions in dry and critical years. Surface water supplies are relatively reliable in the basin but currently represent only about 20% of total water supplies.

Table 2-7: Historical Water Supplies and Change in Groundwater Storage by Hydrologic Water Year Type

Water Year Type	Surface Water Deliveries (AFY)	Groundwater Pumping (AFY)	Total Supply (AFY)	Change in Groundwater Storage (AFY)
Wet	10,500	38,700	49,200	37,300
Above Normal	12,500	45,200	57,700	-2,000
Below Normal	11,100	45,400	56,500	-3,500
Dry	13,300	50,300	63,600	-20,300
Critical	9,900	55,000	64,900	-18,900

Availability or Reliability of Historical Surface Water Supplies

As indicated in Table 2-7, historical surface water supplies vary somewhat based on water year type with the primary water supply in the basin being groundwater. The primary source of surface water in the basin is the Feather River. Surface water supplies are relatively reliable in the basin and represent approximately 20% of total water supplies. Potential effects of climate change on surface water reliability are further evaluated as part of the projected water budgets in the following sections.

Suitability of Tools and Methods for Planning

The water budgets presented herein have been developed using the best available information and best available science and structured in a manner consistent with the HCM of the basin. The BBGM, which is used to organize information for the water budgets, develop water budget scenarios, and perform water budget calculations, is currently the best available tool and is suitable for GSP development for the Wyandotte Creek Subbasin. The BBGM has been developed over the past several decades and updated over time to use updated model code, updated datasets, and updated input parameters through a series of efforts. Refinements to the BBGM have been made through extensive engagement with local stakeholders as part of several past efforts. It is anticipated that the BBGM may be updated and refined in the future as part of GSP implementation.

2.3.4.2 Current Conditions

The current conditions baseline water budget provides a foundation to understand the behavior of the basin considering current land use and urban demands over a broad range of hydrologic conditions as well as a basis for evaluating how groundwater conditions may change in the future based on comparison of water budget results to projected water budgets presented in the following section. A 50-year hydrologic period was selected, rather than a single, recent year to improve the basis for estimation of sustainable yield under current conditions.

Average annual inflows to and outflows from the basin for the current conditions land and surface water system baseline water budget were estimated to be 1.14 MAF per year. Average annual values were presented previously in Table 2-5 and are shown graphically in Figure 2-28.

Primary inflows to the land and surface water system include surface water inflows (924 TAF/year), precipitation (136 TAF/year), stream gains from groundwater (i.e., accretions) (32

TAF/year), and groundwater pumping (43 TAF/year). Surface water inflows consist primarily of the Feather River, which traverses the basin, as well as inflows from Honcut Creek and overland runoff of precipitation and applied water from upslope lands.

Primary outflows from the land and surface water system include surface water outflows (973 TAF/year), evapotranspiration (83 TAF/year), deep percolation (70 TAF/year), and stream losses (also referred to as seepage) (10 TAF/year). Surface water outflows include outflows through the Feather River and Honcut Creek, as well as overland runoff of precipitation and applied water to downslope lands. Evapotranspiration is primarily from agricultural lands but also from native vegetation, urban and industrial lands, and managed wetlands. Deep percolation is primarily from precipitation, but also from applied water. Stream losses include a combination of seepage from canals and drains, stream seepage, and seepage from Thermalito Afterbay.

The average annual change in storage in the land and surface water system is negligible due to similar soil moisture content in the root zone, on average, across water years, and limited storage capacity exists in surface water bodies within the basin.

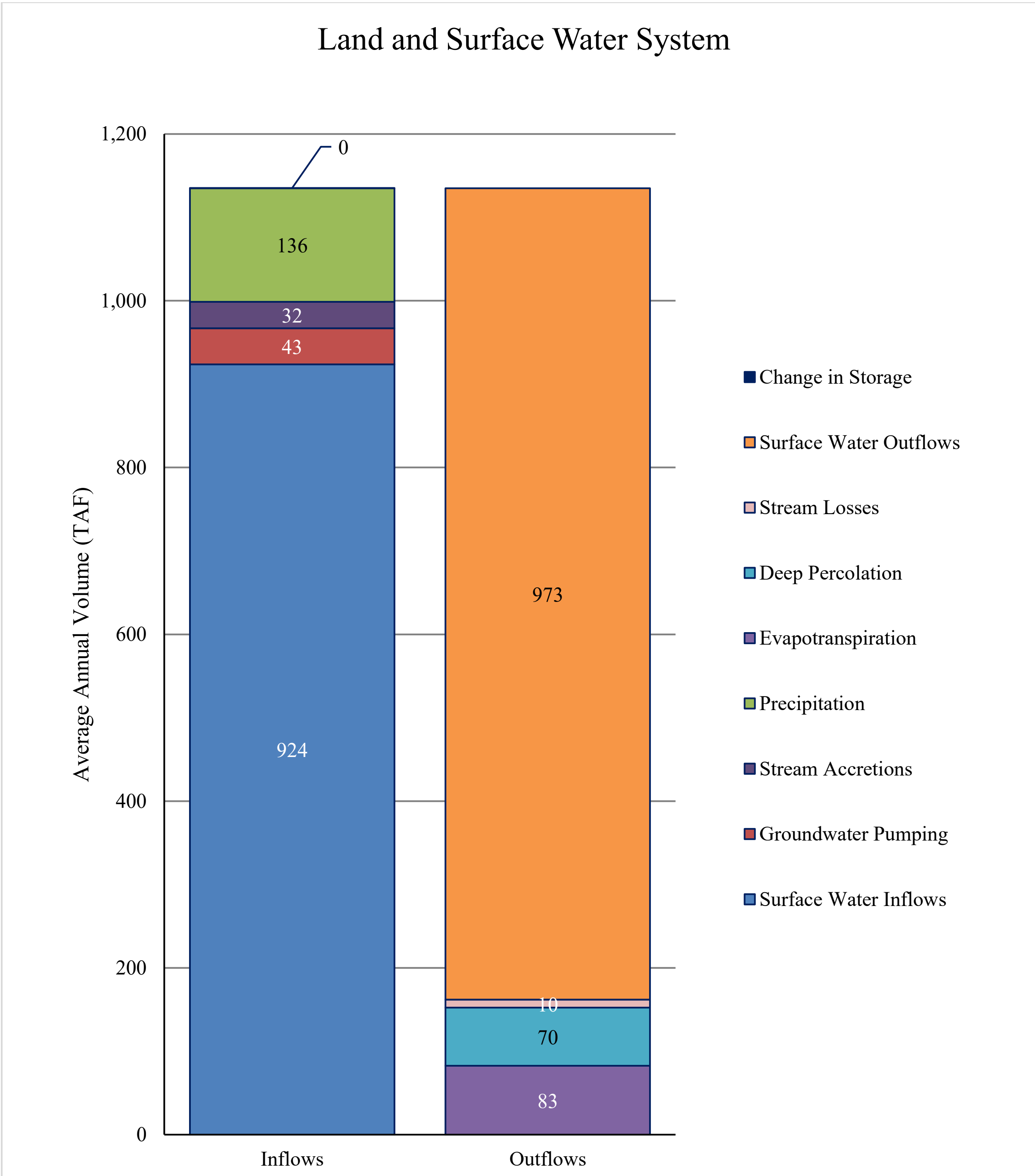


Figure 2-28: Average Annual Current Conditions Land and Surface Water System Water Budget

Average annual inflows to and outflows from the groundwater system were estimated to be 102 TAF, with limited average change in groundwater storage during the current conditions baseline simulation period. Average annual values were presented previously in Table 2-6 and are shown graphically in Figure 2-29.

Inflows to the groundwater system include deep percolation (70 TAF/year); subsurface inflows from the Butte, North Yuba, Sutter, and Vina subbasins and from the foothill area (22 TAF/year); and stream losses (10 TAF/year). Outflows from the groundwater system include groundwater pumping (43 TAF/year); subsurface outflows to the Butte, North Yuba, Sutter, and Vina subbasins and to the foothill area (26 TAF/year); and stream gains from groundwater (32 TAF/year).

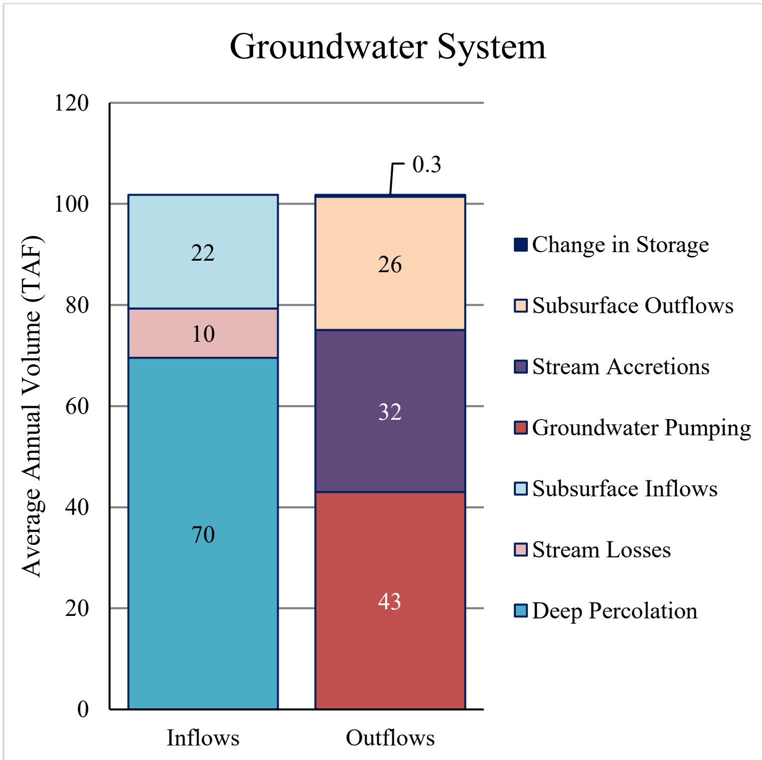


Figure 2-29: Average Annual Current Conditions Groundwater System Water Budget

2.3.4.3 Future Conditions

Three projected water budgets were developed for the basin to provide baseline scenarios representing potential future conditions considering planned development under the Butte County 2030 General Plan and climate change centered around 2030 and 2070 based on central tendency climate change datasets provided by DWR. The projected water budget scenarios provide a foundation to understand the behavior of the basin considering potential land use and urban demands over a broad range of hydrologic conditions, modified based on climate change projections). Use of a 50-year hydrologic period provides a basis for estimation of sustainable yield under potential future conditions.

Future Conditions, no Climate Change

Average annual inflows to and outflows from the basin for the future conditions without climate change projected land and surface water system baseline water budget were estimated to be 1.13 MAF per year. Average annual values were presented previously in Table 2-5 and are shown graphically in Figure 2-30.

Primary inflows to the land and surface water system include surface water inflows (924 TAF/year), precipitation (136 TAF/year), stream gains from groundwater (i.e., accretions) (29 TAF/year), and groundwater pumping (45 TAF/year). Surface water inflows consist primarily of the Feather River, which traverses the basin, as well as inflows from Honcut Creek and overland runoff of precipitation and applied water from upslope lands.

Primary outflows from the land and surface water system include surface water outflows (976 TAF/year), evapotranspiration (82 TAF/year), deep percolation (67 TAF/year), and stream losses (also referred to as seepage) (10 TAF/year). Surface water outflows include outflows through the Feather River and Honcut Creek, as well as overland runoff of precipitation and applied water to downslope lands. Evapotranspiration is primarily from agricultural lands but also from native vegetation, urban and industrial lands, and managed wetlands. Deep percolation is primarily from precipitation, but also from applied water. Stream losses include a combination of seepage from canals and drains, stream seepage, and seepage from Thermalito Afterbay.

The average annual change in storage in the land and surface water system is negligible due to similar soil moisture content in the root zone, on average, across water years, and limited storage capacity exists in surface water bodies within the basin.

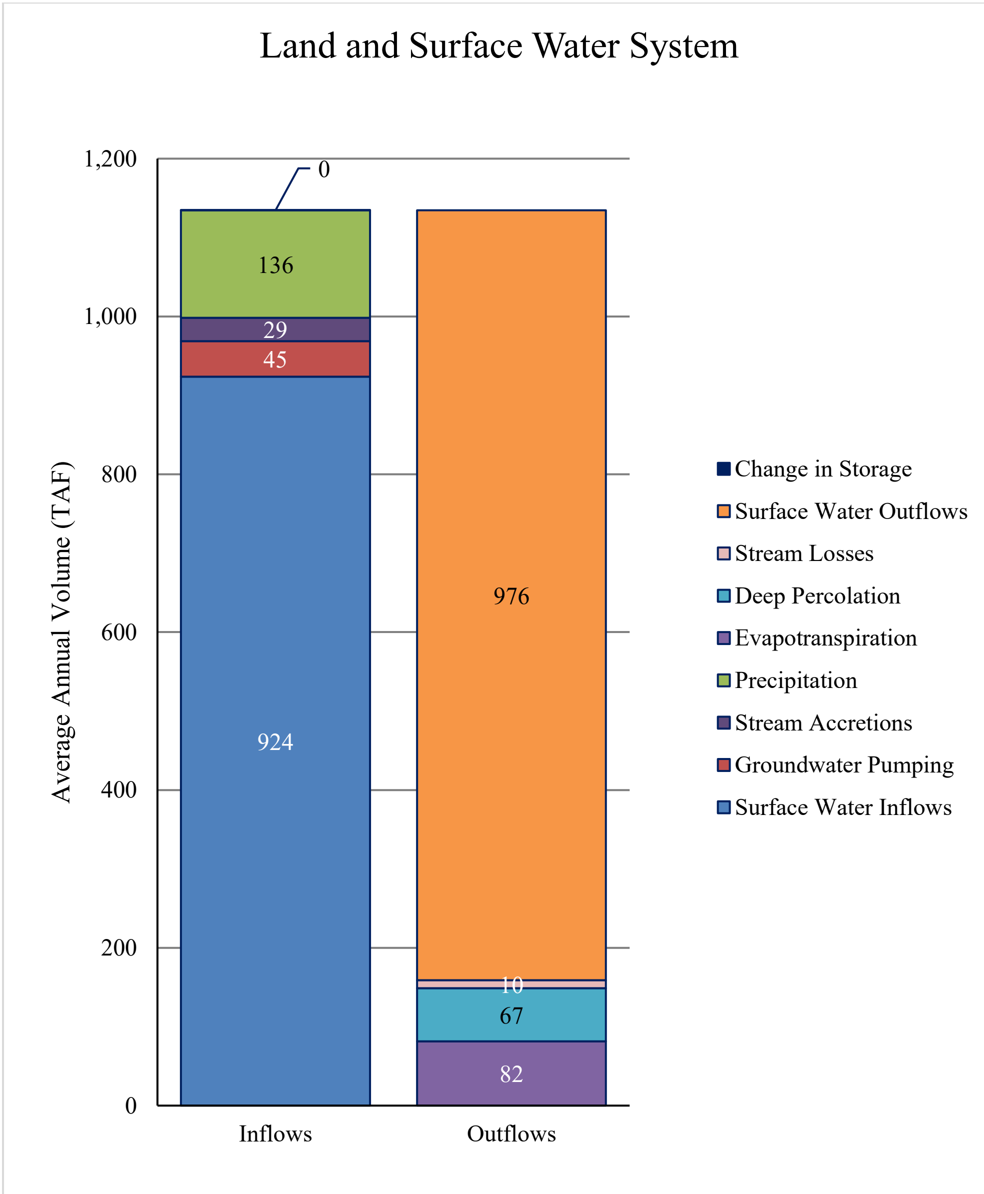


Figure 2-30: Average Annual Future Conditions without Climate Change Land and Surface Water System Water Budget

Average annual inflows to and outflows from the groundwater system were estimated to be 100 TAF, with limited average change in groundwater storage during the future conditions without climate change baseline simulation period. Average annual values were presented previously in Table 2-6 and are shown graphically in Figure 2-31.

Inflows to the groundwater system include deep percolation (67 TAF/year); subsurface inflows from the Butte, North Yuba, Sutter, and Vina subbasins and from the foothill area (22 TAF/year); and stream losses (10 TAF/year). Outflows from the groundwater system include groundwater pumping (45 TAF/year); subsurface outflows to the Butte, North Yuba, Sutter, and

Vina subbasins and to the foothill area (25 TAF/year); and stream gains from groundwater (29 TAF/year).

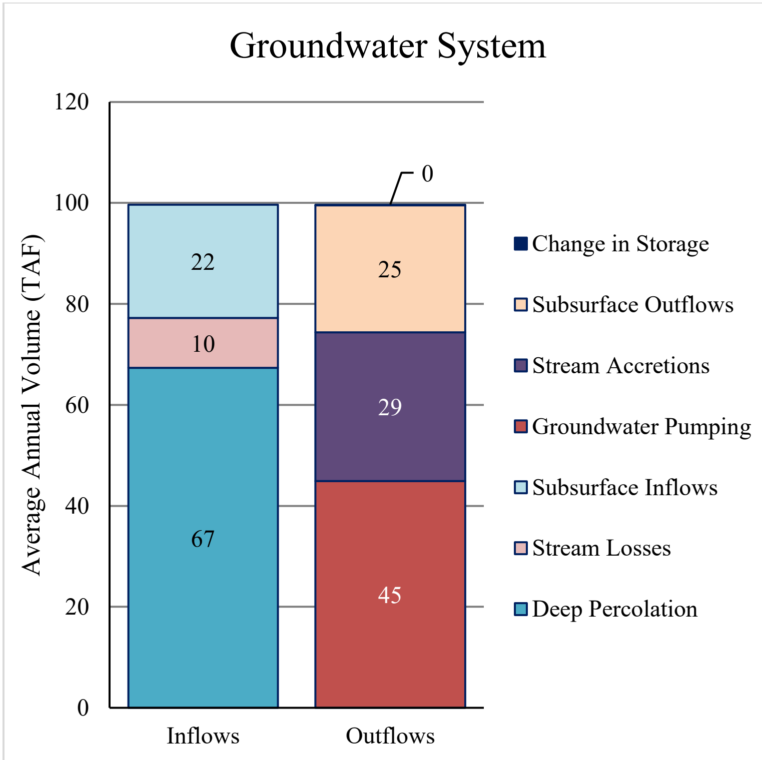


Figure 2-31: Average Annual Future Conditions without Climate Change Groundwater System Water Budget

Future Conditions, 2030 Climate Change

Average annual inflows to and outflows from the basin for the future conditions with 2030 climate change projected land and surface water system baseline water budget were estimated to be 1.20 MAF per year. Average annual values were presented previously in Table 2-5 and are shown graphically in Figure 2-32.

Primary inflows to the land and surface water system include surface water inflows (986 TAF/year), precipitation (142 TAF/year), stream gains from groundwater (i.e. accretions) (29 TAF/year), and groundwater pumping (47 TAF/year). Surface water inflows consist primarily of the Feather River, which traverses the basin, as well as inflows from Honcut Creek and overland runoff of precipitation and applied water from upslope lands.

Primary outflows from the land and surface water system include surface water outflows (1,039 TAF/year), evapotranspiration (84 TAF/year), deep percolation (70 TAF/year), and stream losses (also referred to as seepage) (11 TAF/year). Surface water outflows include outflows through the Feather River and Honcut Creek, as well as overland runoff of precipitation and applied water to downslope lands. Evapotranspiration is primarily from agricultural lands but also from native vegetation, urban and industrial lands, and managed wetlands. Deep percolation is primarily from precipitation, but also from applied water. Stream losses include a combination of seepage from canals and drains, stream seepage, and seepage from Thermalito Afterbay.

The average annual change in storage in the land and surface water system is negligible due to similar soil moisture content in the root zone, on average, across water years, and limited storage capacity exists in surface water bodies within the basin.

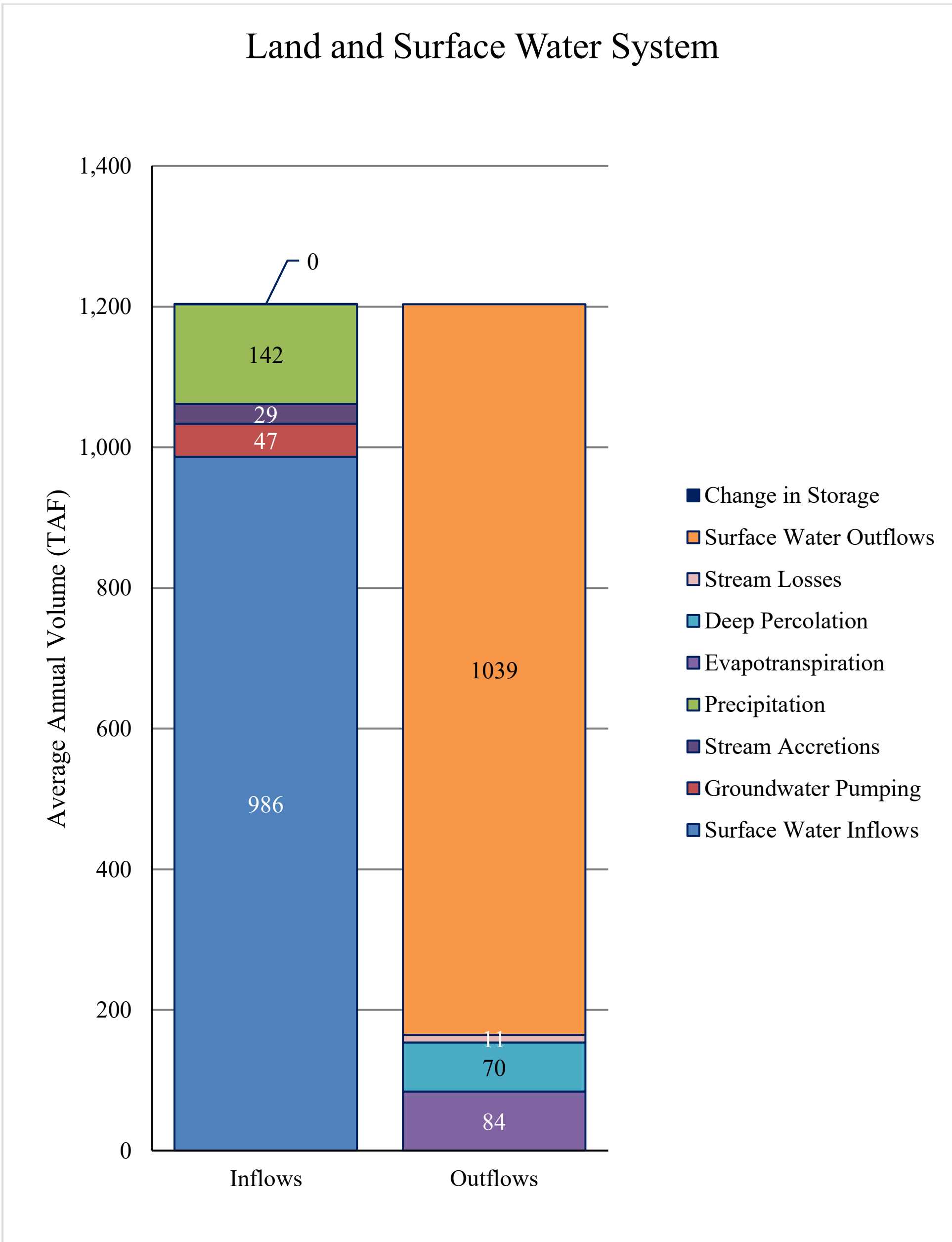


Figure 2-32: Average Annual Future Conditions with 2030 Climate Change Land and Surface Water System Water Budget

Average annual inflows to and outflows from the groundwater system were estimated to be 103 TAF, with limited average change in groundwater storage during the future conditions with 2030 central tendency climate change baseline simulation period. Average annual values were presented previously in Table 2-6 and are shown graphically in Figure 2-33.

Inflows to the groundwater system include deep percolation (70 TAF/year); subsurface inflows from the Butte, North Yuba, Sutter, and Vina subbasins and from the foothill area (22 TAF/year); and stream losses (11 TAF/year). Outflows from the groundwater system include groundwater pumping (47 TAF/year); subsurface outflows to the Butte, North Yuba, Sutter, and Vina subbasins and to the foothill area (27 TAF/year); and stream gains from groundwater (29 TAF/year).

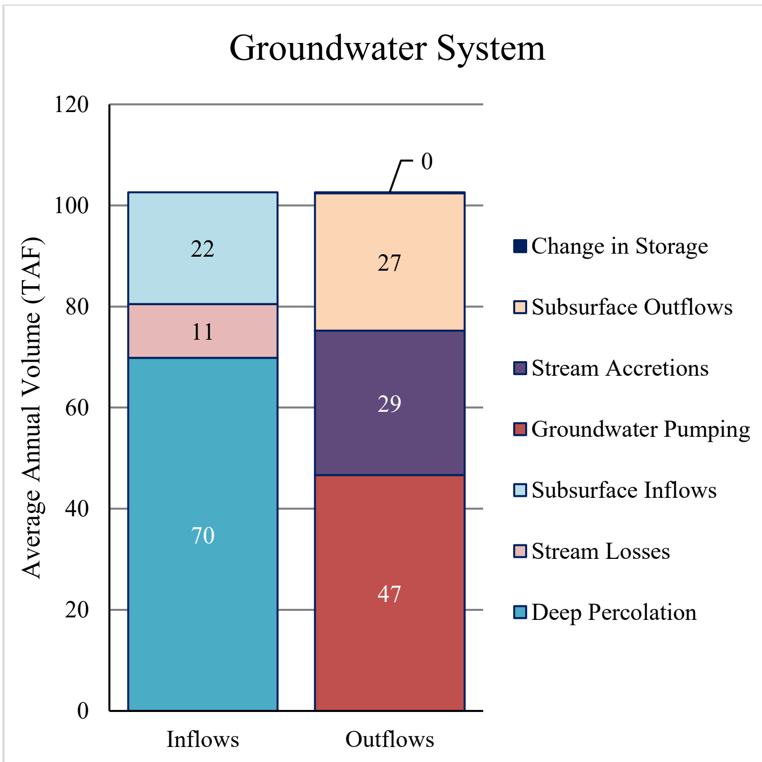


Figure 2-33: Average Annual Future Conditions with 2030 Climate Change Groundwater System Water Budget

Future Conditions, 2070 Climate Change

Average annual inflows to and outflows from the basin for the future conditions with 2070 climate change projected land and surface water system baseline water budget were estimated to be 1.26 MAF per year. Average annual values were presented previously in Table 2-5 and are shown graphically in Figure 2-34.

Primary inflows to the land and surface water system include surface water inflows (1,036 TAF/year), precipitation (145 TAF/year), stream gains from groundwater (i.e. accretions) (27 TAF/year), and groundwater pumping (49 TAF/year). Surface water inflows consist primarily of the Feather River, which traverses the basin, as well as inflows from Honcut Creek and overland runoff of precipitation and applied water from upslope lands.

Primary outflows from the land and surface water system include surface water outflows (1,087 TAF/year), evapotranspiration (87 TAF/year), deep percolation (71 TAF/year), and stream losses (also referred to as seepage) (12 TAF/year). Surface water outflows include outflows through the Feather River and Honcut Creek, as well as overland runoff of precipitation and applied water to downslope lands. Evapotranspiration is primarily from agricultural lands but also from native vegetation, urban and industrial lands, and managed wetlands. Deep percolation is primarily from precipitation, but also from applied water. Stream losses include a combination of seepage from canals and drains, stream seepage, and seepage from Thermalito Afterbay.

The average annual change in storage in the land and surface water system is negligible due to similar soil moisture content in the root zone, on average, across water years, and limited storage capacity exists in surface water bodies within the basin.

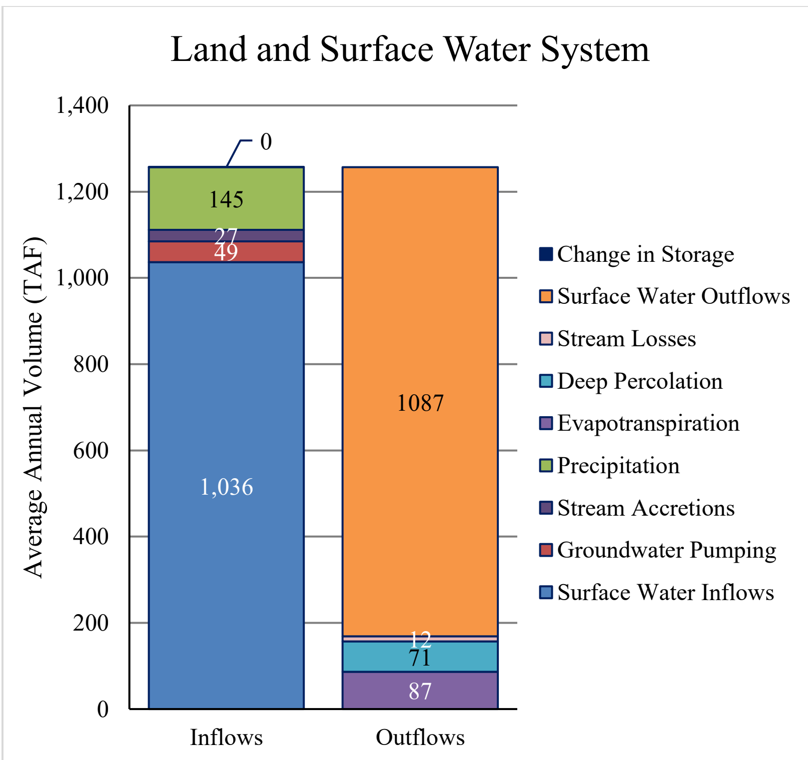


Figure 2-34: Average Annual Future Conditions with 2070 Climate Change Land and Surface Water System Water Budget

Average annual inflows to and outflows from the groundwater system were estimated to be 103 TAF, with limited average change in groundwater storage during the future conditions with 2030 central tendency climate change baseline simulation period. Average annual values were presented previously in Table 2-6 and are shown graphically in Figure 2-35.

Inflows to the groundwater system include deep percolation (71 TAF/year); subsurface inflows from the Butte, North Yuba, Sutter, and Vina subbasins and from the foothill area (22

TAF/year); and stream losses (12 TAF/year). Outflows from the groundwater system include groundwater pumping (49 TAF/year); subsurface outflows to the Butte, North Yuba, Sutter, and Vina subbasins and to the foothill area (29 TAF/year); and stream gains from groundwater (27 TAF/year).

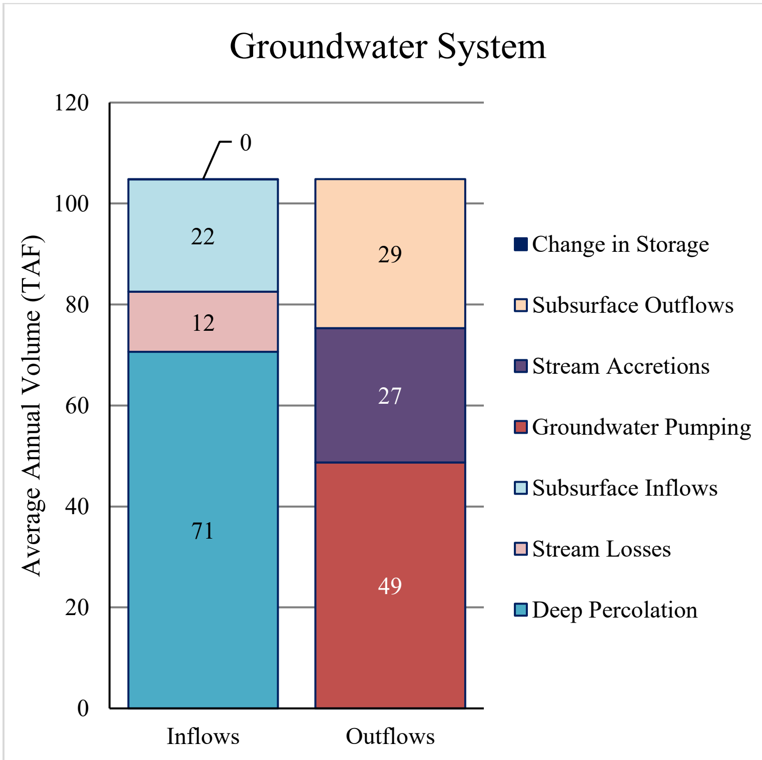


Figure 2-35: Average Annual Future Conditions with 2070 Climate Change Groundwater System Water Budget

Comparison of Water Budget Scenarios

A figure depicting cumulative change in storage for the current conditions and three future conditions baseline scenarios is provided on the following page (Figure 2-36). In the figure, the cumulative change in groundwater storage is shown for the 50-year hydrologic period. The x-axis (horizontal axis) is labeled with the historical reference year along with the corresponding water year type based on the Sacramento Valley Water Year Index. Years are identified as wet (W), above normal (AN), below normal (BN), dry (D), or critical (C).

There is a projected decrease in groundwater in storage for the future conditions scenarios relative to the current conditions scenarios likely resulting from a combination of increased urban and rural residential demands that may be met by groundwater and reduced recharge due to increased runoff on developed lands. Climate change may lead to additional reductions in storage due to increased temperatures and potential reductions in surface water availability.

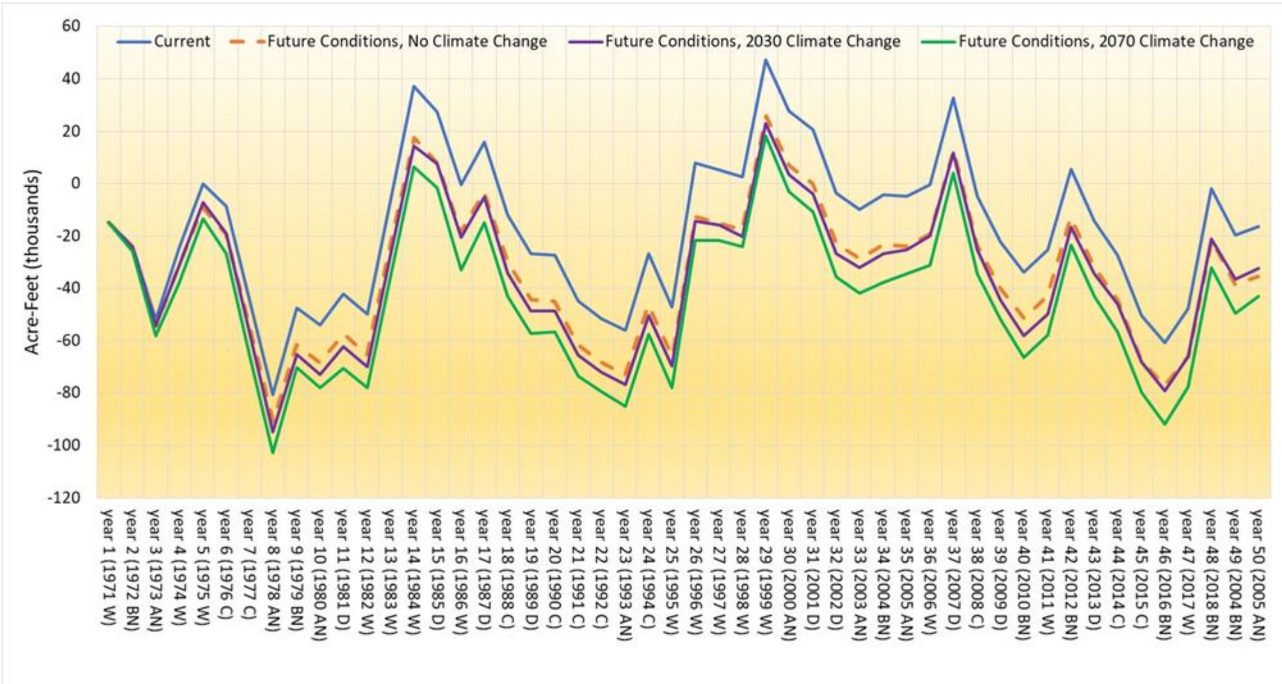


Figure 2-36: Cumulative Change in Groundwater Storage for Current and Future Conditions Baseline Scenarios (BBGM v.1.0)

2.3.5 Water Budget Uncertainty

Uncertainty refers to a lack of understanding of the basin setting that significantly affects an Agency's ability to develop SMC and appropriate projects and management actions in a GSP, or to evaluate the efficacy of plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed. Uncertainty exists in all components of each water budget and in the assumptions used to project potential future conditions related to planned development and associated urban demands as well as projections of climate change. These uncertainties are not expected to substantially limit the ability to develop and implement a GSP for the basin including the ability to develop SMC and appropriate projects and management actions, nor the ability to assess whether the basin is being sustainably managed over time. It is anticipated that these uncertainties will be reduced over time through monitoring and additional data collection, refinements to the BBGM and other tools, and coordination with neighboring basins.

2.3.6 Sustainable Yield Estimate

SGMA defines sustainable yield as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result (CWC 10721(w))."

2.3.6.1 Current Conditions

The current sustainable yield is estimated based on 10-year rolling average using measured and estimated groundwater extraction and annual change in storage calculated from observed groundwater level measurements. The change in groundwater storage is estimated based on the change in measured spring-to-spring groundwater levels at each RMS well, multiplied by the area of a Thiessen polygon surrounding that RMS well (defining a representative area for each RMS well) and a representative storage coefficient of 0.1 for the subbasin. The GSP annual reports estimate the groundwater pumping through measurements (agricultural, municipal/industrial), calculations (rural residential), and estimates (municipal/industrial). In WY 2025, the 10-year rolling average sustainable yield and overdraft are 45,310 AFY and +4,600 AFY, respectively. Currently, the Subbasin is operating within its sustainable yield. The sustainable yield and overdraft estimate may be updated periodically to account for climate change.

2.3.6.2 Future Conditions

The BBGM v.1.0 was used to estimate sustainable yieldunder different climate scenarios. Historical water budget estimates indicate an average annual decrease in storage of up to 3,700 AFY. In general, decreased precipitation and increased groundwater pumping in dry years leads to decreases in groundwater levels and storage and may pose challenges to operating within the sustainable yield over multiple dry years. Operation of the basin within the sustainable yield may require implementation of projects and management actions.

Draft estimates have been developed for the basin for each scenario as the long-term annual groundwater pumping, minus the average annual decrease in groundwater storage, as summarized in Table 2-8.

Table 2-8: Estimated Groundwater Pumping, Decrease in Storage, and Change in Sustainable Yield

Baseline Scenario	Groundwater Pumping (AFY)	Decrease in Groundwater Storage (AFY)	Difference (AFY)
Current	43,000	-100	43,100
Future, No Climate Change	44,900	300	44,600
Future, 2030 Climate Change	46,700	200	46,500
Future, 2070 Climate Change	48,700	400	48,300

However, as discussed in Section 2.3.4, the decrease in groundwater storage is sensitive to the period used to calculate this value. All of the scenarios presented in Table 2-8 are based on 50 years of data. As discussed in Section 2.3.1, a fifth scenario was used called historical that covers the period from 2000 to 2018 or 18 years. The groundwater pumping and decrease in storage for this scenario are 47,100 AFY and 3,700 AFY, respectively. Using these values, a sustainable yield of 43,400 AFY would be calculated similar to the Current scenario.

These projected sustainable yield estimates using the BBGM v.1.0 are preliminary and subject to change. The GSA may periodically update sustainable yield to reflect current conditions using the methodology described in Section 2.3.6.1 until further model calibration is complete.

2.3.7 Opportunities for Improvement to the Water Budget

2.3.7.1 Refine Surface Water Diversion Estimates

While many of the large diversions are continuously monitored and recorded, limited information is available for others. It is recommended that the GSA in the basin work with local stakeholders to better document surface water diversions. Diversion estimates developed as part of the water budgets provide a good basis to support discussion with diverters.

2.3.7.2 Refine Groundwater Pumping Estimates

Groundwater pumping for irrigation has generally been estimated based on estimates of crop irrigation requirements in areas known to rely on groundwater. It is recommended that the GSA look for opportunities to verify and refine groundwater pumping estimates to support water budget validation and refinements by obtaining pumping data from cooperative landowners.

2.3.7.3 Refine Deep Percolation Estimates

Deep percolation in some areas may return to the surface layer through accretion in drains and natural waterways or may be consumed by phreatophytic vegetation. It is recommended that the GSA look for opportunities to further understand and investigate the ultimate fate of deep percolation from agricultural lands. Through modeling of specific waterways and shallow groundwater, the BBGM can help support these investigations.

2.3.7.4 Refine Urban Lands Water Budgets

The relative proportion of non-consumed water returning as deep percolation or surface runoff does not explicitly account for percolation from stormwater retention ponds or releases from wastewater treatment plants to local waterways. There is an opportunity to refine water budgets for developed lands to verify and refine estimates of non-consumed water. Additionally, there is an opportunity to evaluate and develop refined water use estimates for industrial uses.

2.3.7.5 Refine Characterization of Interbasin Flows

Interbasin flows are dependent on conditions in adjacent basins. It is recommended that the GSA refine estimates of subsurface groundwater flows from and to neighboring basins through coordination with GSAs in neighboring basins during GSP implementation and through review of modeling tools that cover the Sacramento Valley region, including the C2VSim and SVSim integrated hydrologic model applications developed by DWR.

2.3.7.6 Land Use Changes Due to the Camp Fire

In 2018, the Camp Fire destroyed 18,000 structures in Butte County displacing over 27,000 residents. While the Town of Paradise, Concow and other areas destroyed by the Camp Fire rebuild, many residents have relocated to the City of Oroville and other portions of the Wyandotte Creek Subbasin. The existing General Plans may not fully account for the relocation of Camp Fire survivors. A focused accounting of changes to residential land use as a result of the Camp Fire should be conducted.

3. SUSTAINABLE MANAGEMENT CRITERIA

SMC offer guideposts and guardrails for groundwater managers seeking to achieve sustainable groundwater management. SGMA defines sustainable groundwater management as "the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results," where the planning and implementation horizon is 50 years with the first 20 years spent working toward achieving sustainable groundwater management and the following 30 years (and beyond) spent maintaining it (California Water Code §10721). For the Wyandotte Creek Subbasin, SMC were formulated by working with the Wyandotte Creek Subbasin GSA and WAC, and members of the public. During development of the 2022 GSP, this stakeholder outreach process was facilitated by the Consensus Building Institute (CBI) with sessions documented on the Wyandotte Creek GSA website. Outreach included a robust discussion and broad agreement on the Wyandotte Creek Subbasin sustainability goal as well as what constitutes locally defined undesirable results. The sustainability goal is meant to reflect the GSA's desired condition, maintained over time, for the groundwater basin. Similarly, public engagement supported the development of amendments to the GSP.

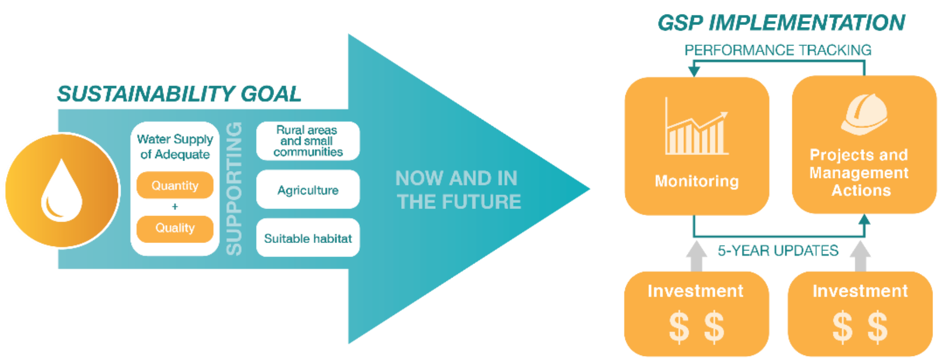


Figure 3-1: Flow Chart for Sustainability

Undesirable results are associated with up to six SIs that include chronic lowering of groundwater levels, reduction in groundwater storage, land subsidence, degraded groundwater quality, depletion of interconnected surface waters, and sea water intrusion. SGMA defines undesirable results as those having significant and unreasonable negative impacts to these six SIs. Failure to avoid undesirable results on the part of the GSA may lead to intervention by the State. Once the sustainability goal and undesirable results have been locally identified, projects and management actions are formulated to achieve the sustainability goal and avoid undesirable results.

The Wyandotte Creek Subbasin is divided into two MAs: Oroville and South (Figure 1-1). The associated undesirable results for each SI have been defined similarly across the two MAs. In turn, the rationale and approach for determining MT and MO for each SI are the same across the two MAs.

The terminology for describing SMC are defined as follows:

- Undesirable Results – Significant and unreasonable negative impacts associated with each SI.
- MT – Quantitative threshold for each SI used to define the point at which undesirable results may begin to occur.
- MO – Quantitative target that establishes a point above the MT that allows for a range of active management to prevent undesirable results.
- Margin of Operational Flexibility – The range of active management between the MT and the MO.
- Interim Milestones (IM) – Targets set in increments of 5 years over the implementation period of the GSP offering a path to sustainability.

Figure 3-2 illustrates these terms for the groundwater level SI.

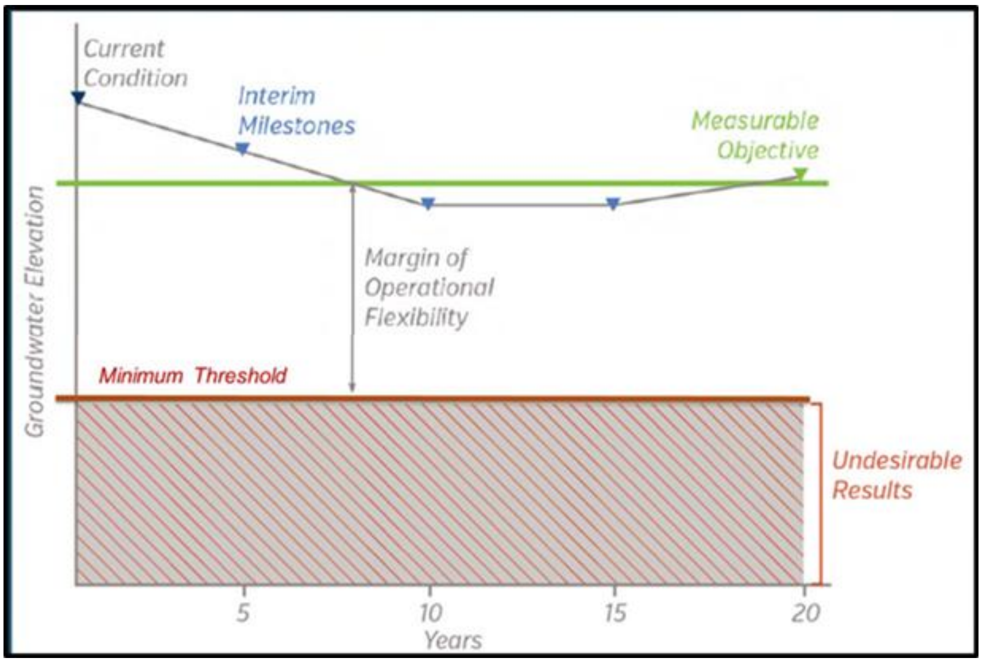


Figure 3-2: Illustration of Terms Used for Describing Sustainable Management Criteria Using the Groundwater Level SI

SIs are intended to be measured and compared against quantifiable SMC throughout a monitoring framework of RMS (Section 4). Ongoing monitoring of SIs can:

- Determine compliance with the adopted GSP
- Offer a means to evaluate the effectiveness of projects and management actions over time
- Allow for course correction and adaptation in 5-year periodic evaluations
- Facilitate understanding among diverse stakeholders

- Support decision-making on the part of the GSA into the future

To quantify SMC for the Wyandotte Creek Subbasin, information from the HCM, descriptions of current and historical groundwater conditions, and input from stakeholders have been considered.

3.1 Sustainability Goal

The sustainability goal for the Wyandotte Creek Subbasin is:

> *to ensure that groundwater is managed to provide a water supply of adequate quantity and quality to support beneficial users of groundwater including but not limited to rural areas and other communities, the agricultural economic base of the region, and environmental resource uses in the Subbasin now and in the future.*

Implementation of the Wyandotte Creek GSP may achieve sustainability before 2042, however, groundwater levels in the Wyandotte Creek subbasin may continue to decline during the implementation period. As projects are implemented and basin operations are modified, sustainable groundwater management will be achieved within its sustainable yield. The Wyandotte Creek Subbasin will be managed to prevent undesirable results throughout the implementation period, despite the possible decline of groundwater elevations. This sustainability goal is supported by locally defined MTs that will avoid undesirable results. Demonstration of stable groundwater levels on a long-term average basis combined with the absence of undesirable results will ensure the Wyandotte Creek Subbasin is operating within its sustainable yield and the sustainability goal will be achieved.

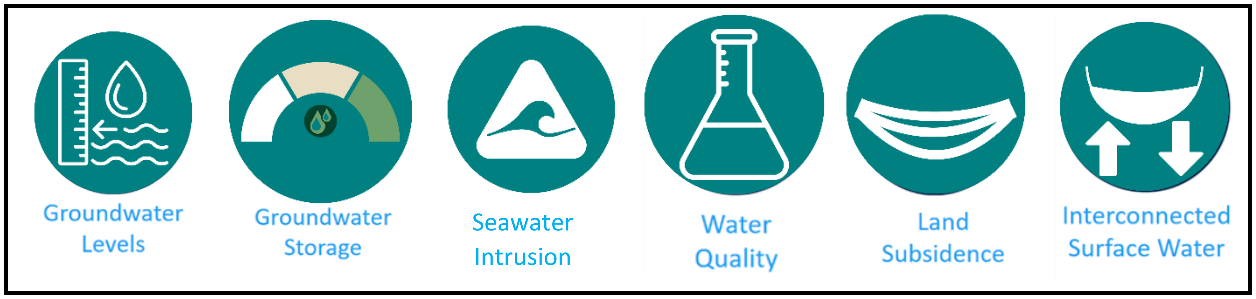
SMC within the Wyandotte Creek Subbasin emphasize management objectives related to domestic, municipal, and agricultural wells as well as suitable habitat. Groundwater management has already been occurring throughout Butte County. The Wyandotte Creek Subbasin will be managed within its sustainable yield by adapting existing management objectives and strategies to address current and future conditions, or by developing new ones. Sustainable yield means the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result. The Wyandotte Creek Subbasin intends to achieve its sustainability goal by implementing GSP projects and management actions that both augment water supply and increase efficiency of water application (see Section 5 for proposed projects and management actions and Section 6 for the implementation plan to achieve sustainability).

The BCDWRC has been participating in groundwater management activities for many years, including within the Wyandotte Creek Subbasin. In the last several years, the BCDWRC has increased groundwater level and water quality monitoring and has worked with other entities to collect and disseminate water data. In addition, the BCDWRC assists with other locally driven groundwater management activities. The Wyandotte Creek Subbasin intends to build on this ongoing county-wide process and broadly shares the objective of long-term maintenance of high-quality groundwater resources within the region for domestic, agricultural, and environmental uses.

3.2 Sustainability Indicators, Minimum Thresholds, and Measurable Objectives

3.2.1 Sustainability Indicators

Six SIs are defined by SGMA and are used to characterize groundwater conditions throughout a basin or subbasin. SGMA requires development of locally defined SMC for each SI and allows for identification of SIs that are not applicable. For example, sea water intrusion is not applicable in the Wyandotte Creek Subbasin due to its distal location from the Pacific Ocean.



Sustainability Indicators and associated undesirable results, if significant and unreasonable

3.2.2 Minimum Thresholds

As noted earlier, MT are those quantitative thresholds for each SI used to define the point at which undesirable results may begin to occur. Undesirable results are those having significant and unreasonable negative impacts, avoidance of which is required by SGMA. Potential impacts and the extent to which they are considered "significant and unreasonable" were determined by the GSA Board of Directors with input from the WAC and members of the public. The GSA established MTs intended to prevent such significant and unreasonable negative impacts from occurring. If observed data trend toward the locally defined MTs, this will trigger action on part of the GSA to reverse this trend before reaching the MT. Actions to reverse a trend toward reaching a MT could be taken at any time during implementation. For this reason, MTs are like guardrails.

3.2.3 Measurable Objectives / Interim Milestones

MO are those quantitative targets that establish a point above the MT that allows for a range of active management to achieve the sustainability goal and prevent undesirable results. This range of active management between the MT and the MO is referred to as the margin of operational flexibility.

MO were determined by the GSA Board of Directors with input from the WAC and members of the public. The GSA established MO intended to preserve the desired condition throughout the Wyandotte Creek Subbasin while offering flexibility in GSP implementation. IM are targets set in increments of 5 years over the implementation period of the GSP offering a path to sustainability. For this reason, the MO and IM are like guideposts.

3.3 Groundwater Levels Sustainable Management Criteria

Groundwater Level SMC are those meant to address the chronic lowering of groundwater levels and avoid the depletion of supply at a given location that may lead to undesirable results caused by groundwater pumping. The locally defined undesirable result, MT, and MO are discussed in the next sections.

3.3.1 Undesirable Result

An undesirable result caused by the chronic lowering of groundwater levels is experienced if:

> *sustained groundwater levels are too low to provide a water supply of adequate quantity and quality to achieve the Sustainability Goal. Two (or 25%, whichever is greater) RMS wells within a management area reach their MT for two consecutive years.*

3.3.2 Minimum Thresholds

The Groundwater Level MT represent quantitative thresholds used to define the point at which undesirable results may begin to occur, avoidance of which is required under SGMA. To establish locally defined MT, the Wyandotte Creek GSA, WAC, and members of the public explored and analyzed potential impacts of declining groundwater levels.

Potential impacts identified by stakeholders from declining groundwater levels included:

- Wells going dry, particularly nearby shallow domestic wells,
- Reduced pumping capacity of existing wells
- Need for deeper well installations and/or lowering of pumps
- Increased pumping costs due to greater lift
- Groundwater dependent ecosystem vegetative habitat loss

Data collection will continue to help further characterize groundwater dependent ecosystems (GDE), with the potential to reconsider the groundwater level SMCs in relation to GDEs during the next Periodic Evaluation Period ending in 2032.

In the most recent drought years (2020-2022), Butte County has documented a number of domestic wells that have “gone dry,” meaning groundwater levels have fallen below the depth of the well installation and/or pump throughout the County. This occurred during summer months of recent drought years and heightened concern among some stakeholders. As a result, domestic well reliability and protection are the focus of the Groundwater Level MT. From a policy perspective, sustainably constructed domestic wells going dry would be a “significant and unreasonable” result of groundwater management. The quantitative Wyandotte Creek Subbasin Undesirable Result for the Chronic Lowering of Groundwater Levels occurs when:

> *Two RMS wells (or 25%, whichever is greater) within a management area reach their MT for two consecutive years.*

As shown in the figures presented in Appendix 3-A showing the average depth of domestic, irrigation, and public supply wells, domestic wells are generally shallower than other wells throughout the Wyandotte Creek Subbasin. These figures were constructed using data from DWR OSWRC and the completed Wyandotte Creek domestic well inventory. Protection of domestic wells was therefore deemed to be additionally protective of other well types, such as agricultural wells. The Wyandotte Creek Subbasin SMC for Chronic Lowering of Groundwater Levels is based on groundwater levels throughout the subbasin that would support sustainably constructed domestic wells. Exceeding the MT may lead to significant and unreasonable effects. Impacts to domestic wells and other groundwater uses may occur and would not constitute an Undesirable Result. Local and state drought responses play a role in addressing dry year impacts. However, once a drought period ends, it is anticipated that groundwater conditions should return to the MO levels. Year-type is defined according to the Sacramento Valley Water Year Hydrologic Classification and groundwater level is defined based on groundwater elevation.

The MT is set to the deeper value of two criteria:

- Criterion 1: Set to protect the 5th percentile of nearby shallow domestic wells; AND
- Criterion 2: Set to a specified distance below the historic low: the distance is either the range of historically measured groundwater levels or 20 feet, whichever is shallower.

Criterion 1 is based on an updated domestic well risk assessment. In order to establish appropriate MT levels protective of sustainably constructed domestic wells, a representative zone (RMS zone) is established for each RMS well. 10 RMS zones, three in the Oroville MA and seven in the South MA, were created using the RMS wells as points as inputs into a Voronoi Diagram (see Appendix 3-C). The Criterion 1 depth is then calculated by finding the 5th percentile of well depths of all domestic wells in the RMS Zone. DWR's OSWCR database provides information on all submitted well completion reports when a well is drilled. This database contains information on characteristics of the wells, including well location, well use, and total well depth. These well characteristics, however, are not always accurate or precise, and, unfortunately, it is not known which of the wells in the database are in use or have been abandoned or replaced. OSWCR indicates that there are 785 domestic wells in the Subbasin. The final domestic well dataset used for Criterion 1 was refined from 785 wells down to 345 wells using the following steps:

- Removed 237 wells installed before 1980. This removes the oldest wells and wells likely to have been replaced as a result of historically low groundwater conditions that occurred during the 1976-1977 drought. Wells that remain are more likely to be consistent with current well standards and currently serving domestic water needs. Still, there is much information that remains to be gathered to further refine the dataset given the unknowns previously identified, as well as relationships to changes in surface elevation.
- Removed 35 domestic wells with estimated bottom elevations above observed historical low groundwater levels based on monitoring data.
- Excluded all domestic wells within public water supplier service areas. Eight domestic wells from California Water Company – Oroville, 25 wells from TWSD, and 135 wells from SGWPA were excluded.

A narrative description of Criterion 1 is as follows: a MT of 50 feet amsl at an RMS having 100 domestic wells within its RMS zone means that 5 wells within that zone have a reported total well depth such that the bottom of the well is at or above 50 feet amsl (and are therefore potentially vulnerable to going dry) and 95 wells have been completed at an elevation below 50 feet amsl (and are therefore not vulnerable to going dry). The fifth-percentile MT assigned to the RMS well is protective of ~~8~~95% of all domestic wells within the RMS zone. Though an attempt was made to remove wells that are no longer in use due to age, as discussed above, there still may be several wells in the dataset used that are not in operation or may go dry due to poor maintenance issues of the well not related to groundwater levels. Typically, domestic wells are shallower than other wells throughout the Wyandotte Creek Subbasin and therefore analyses of this well type yields MT that are largely protective of other well types such as agricultural wells. In addition, the lowering of groundwater levels during a single year is not considered significant and unreasonable and therefore not considered an undesirable result, as long as the groundwater levels rebound to values greater than the MT in the following years.

Criterion 2 was included as an alternative option for calculating MTs to allow for operational flexibility for agricultural and municipal supply wells in cases where the historical minimum groundwater level measured at a given RMS well, minus a buffer, was lower than the depth calculated using Criterion 1. The buffer distance is either the range of historically measured groundwater levels or 20 feet, whichever is shallower.

Water levels calculated following Criterion 1 and Criterion 2 are summarized in Table 3-1.

Table 3-1. Water surface elevations calculated following Criterion 1 and Criterion 2.

RMS Well ID	Criterion 1 WSE (ft AMSL)	Minimum WSE Measurement (ft AMSL) (Measurement Date)	WSE Range (ft)	Criterion 2 WSE (ft AMSL)[1]	Criterion Used for MT
Wyandotte Creek Subbasin – Oroville Management Area					
16Q001M	108	131.3 (07/2022)	9.1	122.2	1
32P001M	103	108.8 (09/2016)	44.0	88.8	2
PWS-03	-83	114.0 (10/2014)	25.0	94.0	2
Wyandotte Creek Subbasin – South Management Area					
13B002M	11	42.2 (07/2021)	26.9	22.2	1
22B001M	48	49.8 (07/2021)	59.0	29.8	2
25N001M	25	46.3 (07/2024)	34.0	26.3	1
19D003M	44	53.2 (08/2022)	35.0	33.2	2
08M001M	69	76.1 (07/2024)	38.8	56.1	2
16C001M	70	94.4 (08/2021)	35.7	74.4	1
31F001M	98	108.1 (03/2005)	42.0	88.1	2

[1]The buffer was set to 20 feet except for RMS well 16Q001M which used the historical WSE range.

3.3.3 Measurable Objectives / Interim Milestones

The Groundwater Levels MO represent quantitative targets that establish a point above the MT allowing for a range of active management to prevent undesirable results and reflect the desired state for groundwater levels in the year 2042. To establish the MO, the historic record of observed groundwater levels at each RMS was evaluated.

The MO was set equal to the average groundwater level recorded from October 1st, 2015, through September 30th, 2025.

IM for groundwater levels are set at regular intervals between 2022 and 2042. Since the MO for groundwater levels reflect current conditions and is set as a target for future conditions, all IMs for groundwater levels are set to the MO.

3.3.4 Minimum Threshold Effects on Beneficial Uses and Users

Groundwater level MT would primarily impact beneficial uses and users reliant on groundwater and environmental users. To better understand the effect on beneficial uses and users, specifically domestic well users, a domestic well risk assessment was performed, which is presented in Appendix 3-B. The analysis provides an estimate of the undesirable result that would occur if water levels declined to the MT.

The following provides greater detail regarding the potential impact of lowering groundwater levels on several major classes of beneficial users:

1. **Rural and/or Agricultural Residential Drinking Water Users** - Falling groundwater levels can cause shallow domestic and stock wells to go dry, which may require well owners to drill deeper wells. The well outage analysis shows, at the minimum threshold, 11% of domestic/shallow wells in the subbasin would be susceptible to well outages. Additionally, the lowering of the water table may lead to decreased groundwater quality in drinking water wells.
2. **Municipal Drinking Water Users** - Declining groundwater levels can adversely affect current and projected municipal users, causing increased costs for potable water supplies.
3. **Agricultural Users** - Continued lowering of groundwater levels increases costs to agricultural operations; this could necessitate changes in irrigation practices and crops grown and could cause adverse effects to property values and the regional economy.
4. **Environmental Uses** - Reduced groundwater levels may result in significant and unreasonable reduction of groundwater flow toward ISWs and availability of shallow groundwater to vegetative GDEs, which may adversely impact ecological habitat and resident species, resulting in reduced spatial coverage and/or health. Currently, in the Subbasin the location of ISWs and GDEs is a data gap the GSA is addressing through installation of new monitoring wells (installed March 2026).

To avoid undesirable results to the first three beneficial user groups, should they occur at water levels above the MT, the GSA includes a well mitigation program as a management action (Chapter 5). To avoid undesirable results to the fourth group of beneficial uses, the GSA may expand upon historic monitoring and assessment efforts to fill data gaps, then develop mitigation programs to avoid significant and unreasonable impacts. In addition, adjustment of the MTs at relevant RMS locations and/or mitigation triggers could be incorporated in future periodic evaluations or amendments to the GSP as needed. The MO is already protective of GDEs, where they exist, as it preserves baseline water levels.

3.3.5 Summary

To achieve the sustainability goal and therefore preserve the desired condition for the groundwater basin over time, the GSA, in setting Groundwater Levels SMC, will implement appropriate projects and/or management actions as necessary to maintain groundwater levels within operational flexibility to limit the decline in groundwater levels to certain values and manage groundwater levels within established ranges at each RMS shown in Table 3-2. (See Section 4, Figure 4-5, and Table 4-6 for relevant information on the RMS for groundwater levels.)

Table 3-2: Groundwater Levels Sustainable Management Criteria by Representative Monitoring Site in Feet Above Mean Sea Level

RMS Well ID	Domestic Well Count	Well Type	MT	MO	IM		
					2027	2032	2037
Wyandotte Creek Subbasin – Oroville Management Area							
16Q001M [3]	41	Shallow	108	139	139	139	139
32P001M[2]	64	Shallow	88.8	128	128	128	128
PWS-03[1, 2]	1	Shallow	94	131	131	131	131
Wyandotte Creek Subbasin – South Management Area							
13B002M[3]	14	Deep	11	58	58	58	58
22B001M[2]	32	Shallow	29.8	89	89	89	89
25N001M[3]	23	Shallow	25	61	61	61	61
19D003M[2]	59	Shallow	33.2	72	72	72	72
08M001M[2]	74	Deep	56.1	105	105	105	105
16C001M[3]	74	Both	70	106	106	106	106
31F001M[2]	48	Shallow	88.1	124	124	124	124

Notes:
1) The MT for RMS PWS-03 will be set using criterion 2 due to only having 1 domestic well in the RMS zone.
2) RMS well uses criterion 2 for setting the MT.
3) RMS well uses criterion 1 for setting the MT.

3.4 Groundwater Storage Sustainable Management Criteria

Groundwater Storage SMC are those meant to address the reduction of groundwater storage caused by groundwater pumping. The locally defined undesirable result, MT, and MO are discussed in the next sections.

3.4.1 Undesirable Result

An undesirable result coming from the reduction of groundwater storage is experienced if:

> *sustained groundwater storage volumes are insufficient to achieve the Sustainability Goal.*

This undesirable result is closely related to that associated with groundwater levels. Because groundwater levels and groundwater storage are closely related, measured changes in groundwater levels can serve as a proxy for changes in groundwater storage. For this reason, the

SMC developed for groundwater levels are used for groundwater storage to ensure avoidance of the undesirable result.

3.4.2 Minimum Thresholds

As Groundwater Levels SMC are used by proxy, the Undesirable Result for groundwater storage is the same as for groundwater levels:

> *Two RMS wells (or 25%, whichever is greater) within a management area reach their MT for two consecutive years.*

In the historical record and recent years, there are incidences of shallow wells going dry in Butte County during summer months of critically dry years. This was noted in the earlier section addressing the development of Groundwater Levels SMC. MT intended to prevent significant and unreasonable negative impacts related to the chronic lowering of groundwater levels are assumed adequate to protect against significant and unreasonable reductions of groundwater storage. Section 3.3.4 Minimum Threshold Effects on Beneficial Uses and Users also applies to the groundwater storage SI.

3.4.3 Measurable Objectives

As Groundwater Levels SMC are used by proxy, the MO for groundwater storage is the same as for groundwater levels:

> *the groundwater level based on the groundwater trend line for the dry periods of observed short-term climatic cycles extended to 2030.*

The aquifer system in the Wyandotte Creek Subbasin generally has sufficient groundwater storage capacity to take additional groundwater recharge during wet periods and remain saturated during dry periods, allowing for a range of active management reflecting the desired state for groundwater storage at the year 2042.

3.5 Water Quality Sustainable Management Criteria

Water Quality SMC are those meant to address degraded water quality caused by groundwater pumping. The locally defined undesirable result, MT, and MO are discussed in the next sections.

3.5.1 Undesirable Result

An undesirable result coming from degraded water quality is experienced if:

> *Two or 25% (whichever is higher) of measured RMS wells across the entire Wyandotte Creek Subbasin exceed their Maximum Threshold (MT) for two consecutive years.*

Salinity is the only water quality constituent for which MTs are established in the Wyandotte Creek Subbasin based on the potential for movement of underlying brackish water from greater depths into the freshwater pool where groundwater pumping for beneficial uses occurs. Other constituents, as discussed in Section 2.2.4, are managed through existing management and regulatory programs within the Wyandotte Creek Subbasin, such as the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) and the ILRP, which focus on improving water quality by managing septic and agricultural sources of salinity and nutrients. Additionally, point-source contaminants are managed and regulated through a variety of programs by the Regional Water Quality Control Board, DTSC, and the EPA. Through coordination with existing agencies, the Wyandotte Creek GSA will know if existing regulations are being met or groundwater pumping activities in the Wyandotte Creek Subbasin are contributing to significant and unreasonable undesirable effects related to degraded water quality from these constituents.

3.5.2 Maximum Threshold

The Water Quality Maximum Threshold (MT) for water quality represents a quantitative threshold used to define the point at which undesirable results may begin to occur, avoidance of which is required under SGMA. The MT is established based on the potential for movement of underlying brackish water from greater depths into the freshwater pool where groundwater pumping for beneficial uses occurs.

To establish a locally defined MT, the Wyandotte Creek GSA Boards, WAC, and members of the public explored and analyzed potential impacts of degraded water quality.

Potential impacts identified by stakeholders were:

- Aesthetic concerns for drinking water
- Reduced crop yield and quality
- Increased reliance on surface water for "blending"

To address the potential impacts of concern related to degraded water quality, the GSA, in setting a MT, commits to avoiding a decline in water quality as it relates to specific conductance, a measure of the water's saltiness, which can impact the suitability of the water as a source for agricultural irrigation or domestic drinking water. Title 22 of CCR recommended secondary drinking water maximum contaminant level (MCL) for specific conductance is 900 µS/cm with an upper secondary MCL of 1,600 µS/cm and short-term secondary MCL of 2,200 µS/cm. Constituent concentrations lower than the recommended secondary contaminant level (900 µS/cm) are desirable for a higher degree of consumer acceptance. Constituent concentrations ranging to the Upper secondary contaminant level are acceptable if it is neither reasonable nor feasible to provide more suitable waters. Constituent concentrations ranging to the short-term secondary contaminant level are acceptable only for existing community water systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources. Water quality standards for irrigated agriculture aim to manage water salinity, which affects plant water availability and crop yield.

The maximum threshold for specific conductance in water quality representative monitoring wells is set to 900 µs/cm or the measured historical high, whichever is greater, to ensure safe drinking water (Title 22 CCR §64449-B). This maximum threshold was set based on best available data, limits that are protective of both irrigated agriculture and drinking water. Salinity thresholds for irrigation are more restrictive than the State Drinking Water Standards. Therefore, the MTs are protective of both irrigation and drinking water.

In Wyandotte Creek, undesirable results have not been reported historically, are not currently occurring, and are not expected to occur in the future. The current sampling schedule for these wells has provided the data by the first 5-year Periodic Evaluation to assess if undesirable results occur in this area, as well as developing SMCs for new RMS wells.

3.5.3 Measurable Objective / Interim Milestones

The Water Quality MO represents a quantitative target that establishes a point below the maximum threshold allowing for a range of active management to prevent undesirable results and reflect the desired state for groundwater quality at the year 2042. To address the potential impacts of concern related to degraded water quality, the MO was established for specific conductance at 700 µs/cm. This is protective of sensitive crops per California Department of Health Services established agricultural water quality limits.[17] Additionally, it is below State Drinking Water Standards. This is consistent with the Butte County Basin Management Objectives (BMO) defined in the Butte County Code of Ordinances. The Butte County BMO Program expired upon the adoption of the 2022 GSP.

Water quality monitoring implemented for compliance with SGMA will build upon Butte County's existing groundwater quality monitoring program. Additional monitoring by DWR and other agencies will continue to track constituents not managed by the GSA, including minerals, metals, pesticides, and herbicides.

Since groundwater quality is already at or near MOs, it is reasonable to set the interim milestones equal to the MOs to provide numerical metrics for the GSA to track conditions so the basin remains sustainable.

3.5.4 Summary

To achieve the sustainability goal and therefore preserve the desired condition for the groundwater basin over time, the GSA, in setting the Water Quality SMC, commits to managing groundwater quality in line with the State Secondary Drinking Water Standards and California Department of Health Services' recommended limits for irrigation water at each RMS shown in Table 3-2. (See Section 4, Figure 4-6)

Table 3-2: Water Quality Sustainable Management Criteria by Representative Monitoring Site in µS/cm

GSP Well ID	Depth	MT	MO	IM		
				2027	2032	2037
Wyandotte Creek Subbasin – Oroville Management Area						
06E002M	Shallow	900	700	700	700	700
Wyandotte Creek Subbasin – South Management Area						
08M001M	Deep	900	700	700	700	700
09N002M	Deep	900	700	700	700	700
New Well #3						

[17] Artiola, Janick F., Ian L. Pepper, Mark Brusseau. Environmental Monitoring and Characterization. Table 9.4, pg 148

New Well #4						
19D003M[1]	Shallow	900	700	700	700	700
New Well #1	Shallow	900	700	700	700	700
New Well #2	Shallow	900	700	700	700	700
Note: 1. New nested well (wells completed in same borehole) installed by DWR under TSS Grant. 2. If access cannot be obtained for this well, new well will be obtained.						

3.6 Seawater Intrusion Sustainable Management Criteria

Seawater intrusion is not applicable to the Wyandotte Creek Subbasin due to its distal location from the Pacific Ocean.

3.7 Land Subsidence Sustainable Management Criteria

Land Subsidence SMC are those meant to address land subsidence that substantially interferes with surface land uses caused by groundwater pumping. The locally defined undesirable result, MT, and MO are discussed in the next sections.

3.7.1 Undesirable Result and Minimum Thresholds

An undesirable result coming from land subsidence is experienced if:

> *groundwater pumping leads to changes in the ground surface elevation severe enough to cause disruptions to critical infrastructure, development and operations of projects that enhance the viability of rural areas, communities, and the agricultural economic base of the region. Undesirable results will occur when the ground surface elevation of at least 12% of monitoring sites (or at least 4 of 31 sites) declines a distance that exceeds the subsidence MT.*

The locations of the monitoring sites are shown in Figure 4-3 and 4-7.

The undesirable results from subsidence due to groundwater pumping are disruptions to critical infrastructure, development of projects that enhance the viability of rural areas, communities, and the agricultural economic base of the region. According to the DWR Subsidence BMP this may include disruptions and damage such as reduced capacity to convey water to beneficial users and damage to pipelines and other utilities.

While elastic subsidence is recoverable deformation, inelastic subsidence is permanent irreversible sinking of the ground surface. The minimum threshold is meant to represent inelastic, or irreversible, subsidence solely due to lowering groundwater levels and may lead to undesirable results. According to the DWR Land Subsidence Best Management Practices[18]

[18] https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Land_Subsidence_BMP.pdf

(DWR Subsidence BMP) in groundwater basins where land subsidence has occurred, the MT should be the amount of subsidence that does not substantially interfere with surface land uses and infrastructure. Since the Subbasin has not experienced substantial disruption to infrastructure, the MT is based on historically observed vertical displacement.

Undesirable results related to land subsidence in the Wyandotte Creek Subbasin have not occurred historically, are not currently occurring, and are not likely to occur in the future. Elastic subsidence on the east side of the Sacramento Valley, including the Wyandotte Creek Subbasin, has historically not been a concern, with cumulative subsidence rarely greater than 0.1 feet. To assess land subsidence in the Sacramento Valley, a subsidence monitoring network was established consisting of observation stations and extensometers managed jointly by the USBR and DWR. This network of observation stations is no longer monitored within the Subbasin as of 2017. This subsidence monitoring network included six GPS monuments located within the Wyandotte Creek Subbasin. The subsidence monitoring network also included three extensometers in Butte County with a period of record beginning in 2005, which are still active (there are no extensometers in the Wyandotte Creek Subbasin). By 2019, a review of the data showed that changes in ground surface elevations were slight and remained at or above baseline levels, indicating that inelastic land subsidence has not been an observed in the Wyandotte Creek Subbasin. From 2020 to 2025, InSAR data does not detect any substantial subsidence (all displacement is within the -0.1 to 0.1 ft range of measurement uncertainty). This is likely due to relatively stable groundwater levels historically and subsurface materials that are not especially conducive to compaction. For this reason, inelastic land subsidence due to groundwater pumping is unlikely to produce an undesirable result in the Wyandotte Creek Subbasin.

3.7.2 Measurable Objectives / Interim Milestones

Undesirable results from subsidence are not currently observed in the Subbasin and the historical trends were used to set the subsidence MO, which is equal to the observed maximum subsidence from InSAR data (Table 2-2). The MO is one foot over 20 years (e.g., 0.25 feet over a 5-year period) for each InSAR pixel (Table 3-3). The interim milestone is 0.25 feet over a 5-year period. This MO and IM are consistent with those of the neighboring groundwater basins.

Table 3-3: Subsidence Sustainable Management Criteria

SMC	Subsidence Extent from 2022 (feet)	Subsidence Rate (feet per 5 years)
IM 2027	0.25	0.25
IM 2032	0.50	0.25
IM 2037	0.75	0.25
MO	1.00	0.25
MT	2.00	0.50

3.8 Interconnected Surface Water Sustainable Management Criteria

Interconnected Surface Water SMC are those meant to address depletions of interconnected surface water caused by groundwater pumping. Relevant context, the Interconnected Surface Water SMC framework, and the locally defined undesirable result, MT and MO are presented in the next sections.

3.8.1 Relevant Context

The objective of the Interconnected Surface Water SMC is to avoid significant and unreasonable adverse impacts on beneficial uses of surface water resources (rivers, creeks and streams). To address this SMC, DWR has provided various forms of guidance, including mapping of potential GDEs. GDEs are a sub-class of aquatic and riparian habitat that depend on groundwater for optimum ecological function. The distinction between an ecosystem's dependence on groundwater versus its dependence on surface water and the associated riparian zone or floodplain is important. In addition, the distinction between the shallow aquifer zone and the deep aquifer zone, or principal aquifer, is important. The principal aquifer only influences surface water to the extent that it affects water levels in the shallow aquifer zone which then influences the shallow aquifer zone's connection to the stream. The Feather River and its floodplain are affected by large and cumulative hydrologic processes, including operation of multiple reservoirs.

Potential impacts of the depletion of interconnected surface water were discussed by stakeholders during technical discussions covering the fundamentals of groundwater-surface water interactions. Potential impacts identified by stakeholders were:

- Reduced flows in rivers and streams supporting aquatic ecosystems (in-stream GDEs) and water right holders
- Streamflow changes in upper watershed areas outside of the Wyandotte Creek GSA boundary
- Cumulative groundwater flow moving toward the Feather River from both the Wyandotte Creek Subbasin and surrounding GSAs on both the east and west side of the river

The Wyandotte Creek Subbasin acknowledges that overall function of the riparian zone and floodplain is dependent on multiple components of the hydrologic cycle that may or may not have relationships to groundwater levels in the principal aquifer. For example, hydrologic impacts outside of the Wyandotte Creek Subbasin, such as upper watershed development or fire-related changes in run-off, could result in impacts to streamflow, riparian areas, or GDEs that are completely independent of any connection to groundwater use or conditions within the Wyandotte Creek Subbasin.

Data needed to develop this SMC as required by Section 354.28 (c)(6)(B) of the GSP regulations includes: definition of stream reaches and associated priority habitat, streamflow measurements to develop profiles at multiple time periods, and measurements of groundwater levels directly adjacent to stream channels, first water bearing aquifer zone, and deeper aquifer zones. The GSA has expanded its network of stream gages and groundwater wells near tributaries but needs additional time collecting data to further fill this data gap. The GSA intends to further evaluate this SMC for the next periodic evaluation to avoid undesirable results to aquatic GDEs. Preliminary SMCs are presented below with the goal of collecting additional data for five more years to address remaining data gaps. Finalized SMCs are expected to be developed for the 2032 periodic evaluation to manage stream depletions as needed. To that end, an Interconnected Surface Water SMC framework has been developed for the GSP as described below. This framework will guide future data collection efforts to fill data gaps as part of GSP plan implementation. As additional data are collected and evaluated, the GSA will evaluate the development of additional SMC, as appropriate, for specific stream reaches and associated habitat where there is a clear connection to groundwater pumping in the principal aquifer.

3.8.2 Interconnected Surface Water SMC Framework

To evaluate the potential for depletion of interconnected streams, an integrated assessment of both surface water and groundwater is required that includes:

- Collect additional data from 2027 to 2032, with the aim of filling data gaps and developing finalized ISW SMCs for the 2032 periodic evaluation. This includes collecting data from newly installed wells and stream gages, and calibrating stream depletion estimates.
- Definition of stream reaches and associated priority habitat. This is typically developed using a combination of geomorphic classification of the stream channel and ecological classification of the associated habitat.
- Multiple streamflow measurements in each stream reach to develop a profile of streamflow at multiple time periods over at least one year. Comparison of flow rates in each reach defines whether the reach is gaining (water moving from the groundwater system to the stream/river) or losing (water moving from the stream/river to the groundwater system). A reach can be both gaining and losing, depending on the time of year (i.e., losing during high flow periods and gaining during low flow periods). Five new stream gages have been installed, growing the ISW network and filling data gaps.
- Measurement of groundwater levels directly adjacent to the stream channel in the adjacent riparian zone or floodplain. Groundwater measurement of this type is typically done with piezometers, or “mini-piezos,” which may be very shallow (less than 15 feet deep) and hand-driven (i.e., not requiring a drill rig). Groundwater levels are collected simultaneous to streamflow profiles. New wells near stream channels have been installed in 2026, growing the ISW network and filling data gaps.
- Measurement of groundwater levels in the first water bearing aquifer zone. This is the first regional or sub-regional aquifer zone that interacts with the stream by either discharging water to the stream or gaining water from the stream. These wells are typically between 20 and 100 feet deep and require a drill rig for installation. It is important to complete these wells across the water table. Groundwater levels are collected simultaneous to streamflow profiles. Water level differences between the shallow aquifer and the water surface elevation of the nearest stream reach are

evaluated. New wells for the shallow aquifer have been installed in 2026, growing the ISW network and filling data gaps.

- Measurement of groundwater levels in deeper aquifer zones. These are typically regional or sub-regional aquifers that are used for regional supply. Water levels in these aquifers can be higher or lower than water levels in the overlying aquifer. The degree of connectivity to the nearest stream reach depends on how stratigraphically isolated the deeper zone is from the shallow zone. These wells are typically greater than 100 feet deep and require a drill rig for installation. It is important to conduct a pumping test of the deeper aquifer and measure water levels in the overlying aquifer to determine how hydraulically connected it is to the overlying aquifer. It is important to complete wells in the shallow aquifer across the water table. Groundwater levels are collected simultaneous to streamflow profiles. Additional Airborne Electromagnetic (geophysical) data would be valuable in further understanding the structure and potential interconnection of the aquifers in different zones.

This information is then integrated to define which surface water reaches are connected to the shallow aquifer zones and where those shallow aquifer zones are influenced by pumping of the deeper aquifer zones. Butte County is leading an effort, in coordination with the NCWA to work with DWR to better characterize ISW across the Sacramento Valley. It is anticipated that a regional model such C2VSimFG will be needed to effectively characterize stream depletions. The framework outlined above will need to be modified as needed to align with regional coordination efforts.

3.8.3 Undesirable Result

The undesirable result for this SMC is focused on connectivity where there is a measurable connection between groundwater levels in the principal aquifer and streamflow or associated aquatic habitat viability. The Wyandotte Creek Subbasin specifically recognizes deep-rooted tree species, such as Valley Oak, that are common along riparian corridors in the Feather River. This connectivity is not well measured or understood in the Wyandotte Creek Subbasin at this time and data gaps remain, although the GSA has installed new shallow wells to help address this data gap. For now, undesirable result coming from the depletion of interconnected surface water is simply defined as:

> *depletion of surface water flows caused by groundwater pumping significantly and unreasonably impacts beneficial uses of surface water. Two shallow RMS wells (or 25%, whichever is greater) within the entire Subbasin reach their MT for two consecutive years.*

The SMC for ISW are set for ISW RMS wells using groundwater levels as a proxy for interconnected surface water.

3.8.4 Minimum Thresholds

The potential impact of groundwater levels on aquatic habitat or GDEs is typically specific to a certain stream reach or geographic area. Groundwater modeling conducted in association with the HCM (Section 2) incorporates the interaction of surface water and groundwater at a regional scale, including all the GSAs in Butte County. While the model is a useful tool for evaluating regional behavior of the groundwater system overall, there are significant data gaps that limit calibration of the groundwater response in the uppermost layer of the model, where the dynamics and “interconnectedness” between surface water and groundwater actually occur. During the next evaluation period (2027 – 2032), the GSA will continue to collect data on ISWs with the goal of revisiting ISW SMCs in the next periodic evaluation.

MT for interconnected surface water is set to the following:

> *The MT is set within 20 feet of the historical low, as follows: The MT is set to the historical low minus the range of observed groundwater surface elevations. If the calculated range is greater than 20 feet, then the MT is set to the historical low minus 20.*

Table 3-4 summarizes the historical low groundwater elevation, range from high to low groundwater elevation, and the proposed minimum thresholds. All MTs are set 20 feet below the historical low. Additional RMS wells may be added as data becomes available.

Table 3-4: Interconnected Surface Water Sustainable Management Criteria by Representative Monitoring Site in Feet Above Mean Sea Level

RMS Well ID	Historical low (ft AMSL) (Measurement Date)	WSE Range (ft)	MT[1]
PWS-03	114 (10/2014)	26	94
03D001M	64 (8/1998)	26	44
22B001M	50 (7/2021)	59	30

[1]All MTs are based 20 feet below the historical minimum elevation.

This MT is protective of interconnected surface water to minimize impacts to stream depletions (Table 3-4).

3.8.5 Measurable Objectives / Interim Milestones

The ISW MO represents quantitative targets that establish a point above the MT allowing for a range of active management to prevent undesirable results and reflect the desired state for stream depletions in the year 2042. To establish the MO, the historic record of observed groundwater levels at each RMS was evaluated.

The MO was set equal to the average groundwater level recorded from October 1st, 2015, through September 30th, 2025.

IM for stream depletions are set at five-year intervals between 2022 and 2042. Since the MO reflect current conditions and is set as a target for future conditions, all IM will be set to the MO. Table 3-5 summarizes ISW SMCs.

Table 3-5: Interconnected Surface Water Sustainable Management Criteria by Representative Monitoring Site in Feet Above Mean Sea Level

RMS Well ID	Well Type	MT	MO	IM		
				2027	2032	2037
PWS-03	Shallow	94	131	131	131	131

03D001M	Deep	44	72	72	72	72
22B001M	Shallow	30	89	89	89	89

4. MONITORING NETWORKS

4.1 Monitoring Network Objectives

The objective of the existing monitoring networks is to observe and record data on groundwater levels, quality, and related conditions, such as the interconnection of surface water and groundwater and land subsidence. Wells included in the existing monitoring networks were selected based on spatial density, quality and frequency of historically collected data to detect short-term, seasonal, and long-term trends and evaluate conditions related to the effectiveness of the GSP. Parameters that have been monitored provide historic baseline information for establishing the current status of relevant SI that will be useful in tracking these SI as the GSP is being implemented. The complete list of SI is presented below:

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued
2. Significant and unreasonable reduction of groundwater storage
3. Significant and unreasonable seawater intrusion
4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies
5. Significant and unreasonable land subsidence that substantially interferes with surface land uses
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

The existing monitoring networks form a pool of monitoring locations that will serve as the backbone of the representative monitoring network used to assess SGMA compliance as discussed in Section 3. The existing network will support improved understanding of conditions in the Wyandotte Creek Subbasin, inform ongoing management of the subbasin, and contribute to future Periodic Evaluations of the GSP. These objectives will be implemented in a manner that will:

- Demonstrate progress toward achieving MO, MT, and IM
- Monitor impacts to the beneficial uses or users of groundwater
- Monitor changes in groundwater conditions
- Quantify annual changes in water budget components, such as change in storage

Data collected from the monitoring networks will be used to track changes in groundwater elevations, water quality constituent concentrations, groundwater and surface water interactions and rates of subsidence at monitoring locations throughout the Wyandotte Creek Subbasin and will be compared to established SMC for each SI in annual reports and Periodic Evaluations.

In addition to being central to SGMA compliance by enabling tracking of SI, data collected through the monitoring network will be used to update inputs to the water budget and to guide interpretation of water budget results. Monitoring data will also be used to assess impacts of groundwater management on various categories of beneficial uses and users and to monitor overall groundwater conditions from local and subbasin-wide perspectives.

The monitoring networks for each of the following sustainability indicators are described below: groundwater levels, groundwater storage, water quality, land subsidence, and depletions of interconnected surface water. Seawater intrusion is not considered to be an SI relevant to the Wyandotte Creek Subbasin as seawater intrusion is not present and is not likely to occur in the Wyandotte Creek Subbasin due to the distance from the Pacific Ocean, bays, deltas, or inlets. However, there is some evidence that connate groundwater of a quality characteristic of its ancient marine origins is present in the Wyandotte Creek Subbasin and that this water has the potential to affect beneficial uses due to brackish characteristics. Ancient marine layers pose a water quality (saline) risk by contaminating groundwater from groundwater pumping. This GSP addresses this risk through the water quality SI.

The location of existing sites and the frequency of monitoring at each site are presented below as is the spatial density of locations in each of the monitoring networks. Data gaps and plans to fill these gaps are also discussed as part of the program for defining the representative monitoring network to be used in monitoring SI to ensure SGMA compliance. Explanations of how gaps identified in the monitoring network will be filled are provided in Section 4.10.

The goal of defining the existing monitoring networks, identifying gaps in the networks, and developing and implementing a program to fill those gaps is to develop a representative monitoring network capable of collecting information needed to address:

- Short-term trends in groundwater and related surface water conditions
- Seasonal trends in groundwater and related surface water conditions
- Long-term trends in groundwater and related surface water conditions
- Provide adequate coverage by establishing sufficient density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends listed above

4.2 Groundwater Level Monitoring

Groundwater level monitoring in the Wyandotte Creek Subbasin is conducted through a network of monitoring wells used for observation of groundwater levels and computation of hydraulic gradients and flow directions in the principal aquifer. The network also allows for characterization of the groundwater table or potentiometric surface of the principal aquifer.

The thirty-two (32) wells included in the network were selected based on the degree to which data from these wells represents conditions in the area, use in existing monitoring programs, permission of the well owner to access the well, and the length and continuity of the monitoring record. Of the 32 wells, 8 are located in the Oroville MA and 24 are in the South MA. Table 4-1 lists wells now used for monitoring in each MA and Figure 4-1 shows the locations of these wells in their respective MAs. Multi-completion wells are sites where more than one monitoring well has been installed at a single location. The wells are drilled and screened at different depths with each well designed to measure groundwater elevations at a selected zone in the underlying aquifer. Section 2.1.6 and Figures 4-1 and 2-8C discuss and show AEM flightlines and representative aquifer cross-section.

Groundwater level monitoring sites were analyzed and then classified to provide stratigraphic context for the well screened intervals to identify which aquifer zone each monitoring well is representative of. A previous investigation (Blair et al., 1991) provided the initial framework for placing screens of the monitoring wells into three different stratigraphic units, from oldest to youngest: Ione Formation, Mehrten Formation (including the Nomlaki Tuff), and the Laguna Formation.[19] Additionally, 72 boreholes and 8 Airborne Electromagnetic (AEM) data profiles from the Department of Water Resources (DWR) W07 region were used to guide interpretations as discussed in Section 2.1.6. In general, monitoring wells screened in the Laguna Formation are representative of the shallow (or upper) aquifer zone and wells screened in the Ione Formation are representative of the deeper aquifer zone. Table 4-1 identifies which aquifer zone each monitoring well is screened within (e.g., Shallow, Deep, or Both). RMS wells were selected based on proximity to domestic wells, aquifer zone representative of domestic wells, and having at least five years of high-quality measurements (further discussed in Section 4.9.1). Typically, domestic wells are screened in the shallow zone and upper portion of the deep aquifer zones. Both shallow and deep wells were used as RMS wells as these wells are intended to monitor conditions for domestic wells.

[19] Blair, T.C., Baker, F., and Turner, J., 1991, Cenozoic fluvial facies architecture and aquifer heterogeneity, Oroville, California, Superfund site and vicinity, in Tyler, N., and Miall, A.D., editors, Three-dimensional facies architecture of terrigenous clastic sediments and its implications for hydrocarbon discovery and recovery: SEPM Concepts in Sedimentology and Paleontology, No. 3, p. 147-159.

Table 4-1: Wyandotte Creek Subbasin Groundwater Level Broad Monitoring Network Wells

Well ID	State Well Number[1]	Monitoring Frequency	Multi-Completion (number of wells at site)	Well Type	Aquifer Zone Category	Drill Depth	Date of First Meas.	RMS?
Wyandotte Creek – Oroville Management Area								
16Q001M	19N03E**16Q001M**	Quarterly	No	Residential	Shallow	120	10/3/2000	Yes
32P001M	19N04E**32P001M**	Quarterly	No	Residential	Shallow	150	8/29/1959	Yes
PWS-01		Quarterly	No	Municipal	Shallow	186	2/1/1978	No
PWS-02		Quarterly	No	Municipal	Both	340	2/1/1978	No
PWS-03		Quarterly	No	Municipal	Shallow	150	2/1/1978	Yes
S1[2]		Quarterly	No	Observation	Shallow			No
S14[2]		Quarterly	No	Observation	Shallow			No
S16[2]		Quarterly	No	Observation	Shallow			No
Wyandotte Creek – South Management Area								
03D001M	17N03E**03D001M**	Quarterly	No	Irrigation	Shallow	179	4/10/1947	No
13B002M	17N03E**13B002M**	Quarterly	No	Irrigation	Deep	320	3/20/2001	Yes
09N002M	17N04E**09N002M**	Quarterly	No	Irrigation	Deep	325	3/20/2001	No
22B001M	17N04E**22B001M**	Quarterly	No	Residential	Shallow	80	3/8/1976	Yes
25N001M	18N03E**25N001M**	Quarterly	No	Irrigation	Shallow	164	3/9/1976	Yes
08M001M	18N04E**08M001M**	Quarterly	No	Irrigation	Deep	656	5/2/1961	Yes
16C001M	18N04E**16C001M**	Quarterly	No	Irrigation	Both	165	10/20/1947	Yes
19D001M	18N04E**19D001M**	Quarterly	Yes	Observation	Deep	720	6/14/2021	No
19D002M	18N04E**19D002M**	Quarterly	Yes	Observation	Deep	570	6/14/2021	No
19D003M	18N04E**19D003M**	Quarterly	Yes	Observation	Shallow	200	6/14/2021	Yes
31F001M	19N04E**31F001M**	Quarterly	No	Residential	Shallow	200	10/3/2000	Yes
M1[2]		Quarterly	Yes	Observation	Shallow			No
S11[2]		Quarterly	Yes	Observation	Shallow			No
S12[2]		Quarterly	Yes	Observation	Shallow			No
S13[2]		Quarterly	Yes	Observation	Shallow			No

Well ID	State Well Number[1]	Monitoring Frequency	Multi-Completion (number of wells at site)	Well Type	Aquifer Zone Category	Drill Depth	Date of First Meas.	RMS?
S15[2]		Quarterly	Yes	Observation	Shallow			No
S2[2]		Quarterly	Yes	Observation	Shallow			No
S3[2]		Quarterly	Yes	Observation	Shallow			No
S4[2]		Quarterly	Yes	Observation	Shallow			No
S5[2]		Quarterly	Yes	Observation	Shallow			No
S6[2]		Quarterly	Yes	Observation	Shallow			No
S7[2]		Quarterly	Yes	Observation	Shallow			No
S8[2]		Quarterly	Yes	Observation	Shallow			No
S9[2]		Quarterly	Yes	Observation	Shallow			No

1) The portion of the State Well Number shown in bold underlined text is the Well ID.

2) Planned well to be installed February / March 2026.

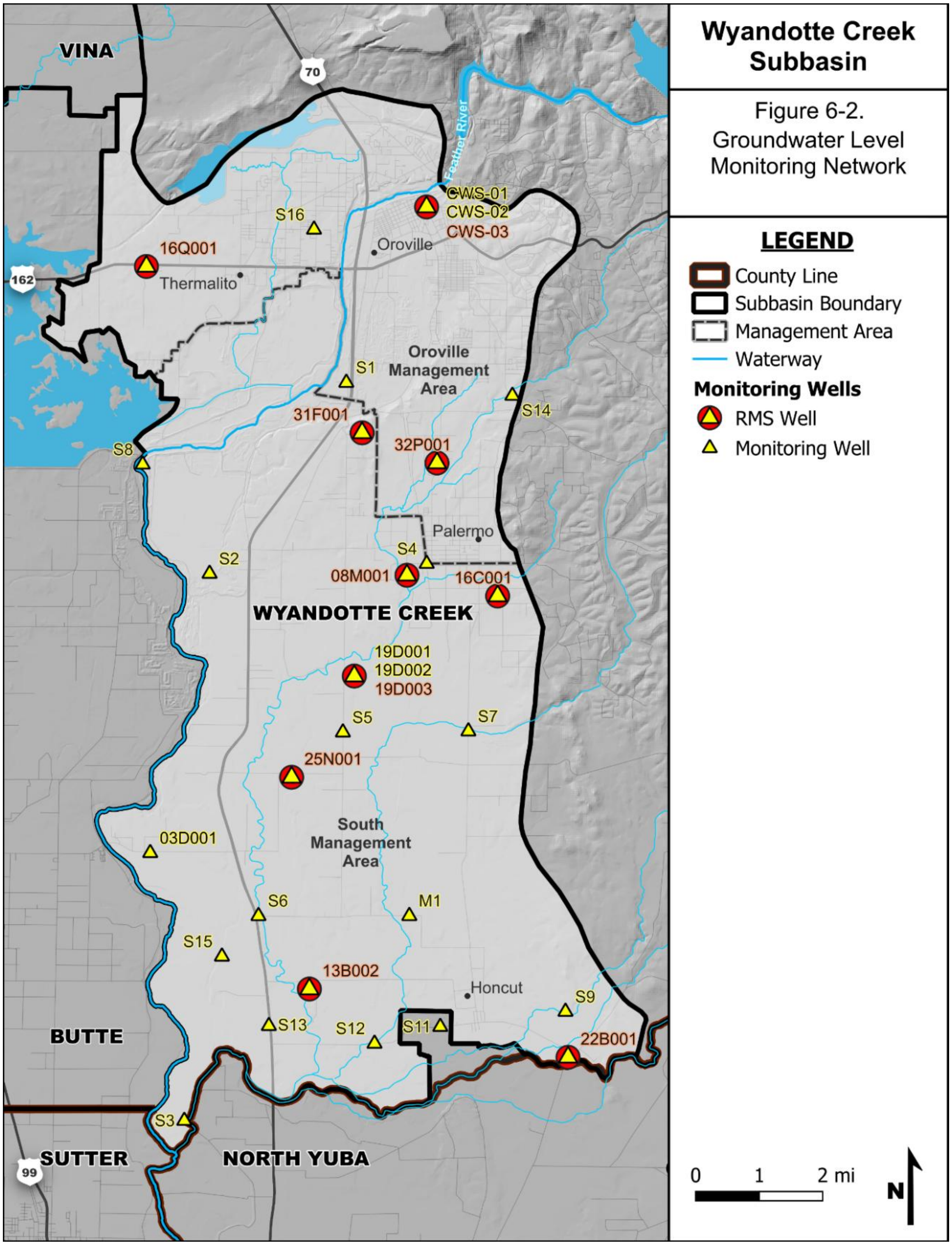


Figure 4-1 Groundwater Level Representative Monitoring Network

4.2.1 Density of Monitoring Sites and Frequency of Measurement

Each of the wells in the existing network is monitored either by Cal Water, Butte County, DWR, or the associated CASGEM collaborators in the subbasin. Each of the wells are reported quarterly.

For the purpose of SGMA compliance, water levels in the RMS network (Section 4.9) in the Wyandotte Creek Subbasin will be monitored at least biannually by the GSA, County or DWR within 14 days of one another.

Groundwater pumping typically peaks during the summer growing season and slows in the fall and winter. Therefore, spring levels represent an annual high prior to summer irrigation demands while fall levels represent an annual low for static (non-pumping) conditions. For wells that cannot be observed on the regular monitoring schedule or for which readings are questionable, it will be noted in the standard data sheet that the well was unable to be measured.

Groundwater elevation data will be used to observe seasonal and annual changes and for analysis of short-term and long-term trends. Analysis of trends in groundwater levels together with data on surface water deliveries and groundwater extraction will be important tools for tracking the Wyandotte Creek Subbasin's progress in meeting its MO and in determining the need for additional projects and management actions or modifications to projects and management actions to meet the MO.

A total of 32 wells are included in the network for monitoring groundwater levels. These wells are distributed over the 93 square- mile area of the Wyandotte Creek Subbasin with a distribution equivalent to a spatial density of 34 wells per 100 square miles, a network density that significantly exceeds those presented in the BMP Monitoring Networks and Identification of Data Gaps. Table 4-2 is taken from the BMP and shows a range of recommended monitoring network densities.

Table 4-2: Monitoring Well Density Considerations

Reference	Well Density (wells per 100 miles)
Heath (1976)	0.2 – 10
Sophocleous (1983)	6.3
Basins pumping more than 10,000 acre-feet/year per 100 miles	4.0
Basins pumping between 1,000 and 10,000 acre-feet/year per 100 miles	2.0
Basins pumping between 250 and 1,000 acre-feet/year per 100 miles	1.0
Basins pumping between 100 and 250 acre-feet/year per 100 miles	0.7

Annual groundwater pumping presented in the water balance section of the GSP shows a historical rate of pumping in the Wyandotte Creek Subbasin of 47,100 AFY (50,645 AFY per 100 square miles) and a current condition pumping rate of 43,000 AFY (46,237AFY per 100 square miles).

Each monitoring site is located in one of the Wyandotte Creek Subbasin's two MAs:

- Wyandotte Creek – Oroville: 8 wells in an area of 29 square miles, spatial density of 27.6 wells per 100 square miles.
- Wyandotte Creek – South: 24 wells in an area of 64 square miles, spatial density of 37.5wells per 100 square miles.

4.3 Groundwater Storage Monitoring

4.3.1 Background

The BMP for Groundwater Monitoring (DWR, 2016) notes:

> *While change in groundwater storage is not directly measurable, change in storage can be estimated based on measured changes in groundwater levels… and a clear understanding of the Hydrogeologic Conceptual Model…. The HCM describes discrete aquifer units and the specific yield values associated with these units. These data, together with information on aquifer thickness and connectivity, can be used to calculate changes in the volume of groundwater storage associated with observed changes in groundwater elevation.*

As suggested in the preceding passage from DWR's BMP on Groundwater Monitoring, measured changes in groundwater levels can serve as a proxy for changes in storage. For this reason, the network for monitoring changes in groundwater storage is the same as that used for monitoring changes in groundwater levels. The groundwater level RMS network is a proxy for the groundwater storage RMS network. Monitoring sites and wells included in this network are presented above in Table 4-1 with well locations shown in Figure 4-3. It is anticipated that the methodology described in Section 2.3.6 will be utilized to calculate annual change in groundwater storage for the Annual Reports.

4.3.2 Frequency of Measurement

The data from the bi-annual frequency of monitoring groundwater levels described above will enable observed changes in levels to serve as a proxy to indicate changes in groundwater storage. Data presented in the HCM on parameters such as aquifer layer composition and thickness and the specific yield and hydraulic conductivity of these layers are integrated in the BBGM, and allow the model to be used to estimate changes in groundwater storage that result from observed changes in groundwater elevations. As data on aquifer characteristics and modeling capabilities improve, the methodologies used to relate changes in groundwater elevations with corresponding changes in storage will be updated.

4.4 Groundwater Quality

4.4.1 Background

Assessment of groundwater quality in the Wyandotte Creek Subbasin focuses on annual observation of salinity (through monitoring of specific conductance) and temperature in the principal aquifer. Each of these parameters is influenced by ambient conditions and the parent material of the principal aquifer. Specific conductance and pH are also influenced by human activity. While only salinity will be used to monitor attainment of MO and avoidance of breaches in MT, changes in pH and temperature may indicate shifting groundwater conditions that trigger additional investigation.

The groundwater quality monitoring network implemented for representative monitoring under SGMA will build upon the County's existing program. Additional monitoring will continue to be conducted by other agencies to track constituents not managed under this GSP including a variety of minerals, metals, pesticides, and herbicides. Data from the ongoing monitoring by various state and federal agencies will be available to the GSA to augment local understanding of water quality in the Wyandotte Creek Subbasin and can be found on the State Board's GAMA program at https://www.waterboards.ca.gov/gama/. Water quality programs conducted by other agencies are summarized in section 1.5.

Table 4-3 presents information on each of the wells monitored by Butte County in the Wyandotte Creek Subbasin groundwater quality monitoring network. Figure 4-2 shows the locations of the wells.

Table 4-3: Butte County Groundwater Quality Monitoring Program Sites

State Well ID Number	Local Name	Well Type
Wyandotte Creek – Oroville Management Area		
19N04E06E002M	Thermalito	Municipal and Industrial
N/A	Thermalito domestic	Domestic

4.4.2 Density of Monitoring Sites and Frequency of Measurement

The County's ongoing water quality monitoring program, collects data annually in July which is near the peak season for groundwater demand. The groundwater quality monitoring sites are distributed over the 93 square-mile area of the Wyandotte Creek Subbasin resulting in a monitoring network with a spatial density of 2.1 sites per 100 square miles.

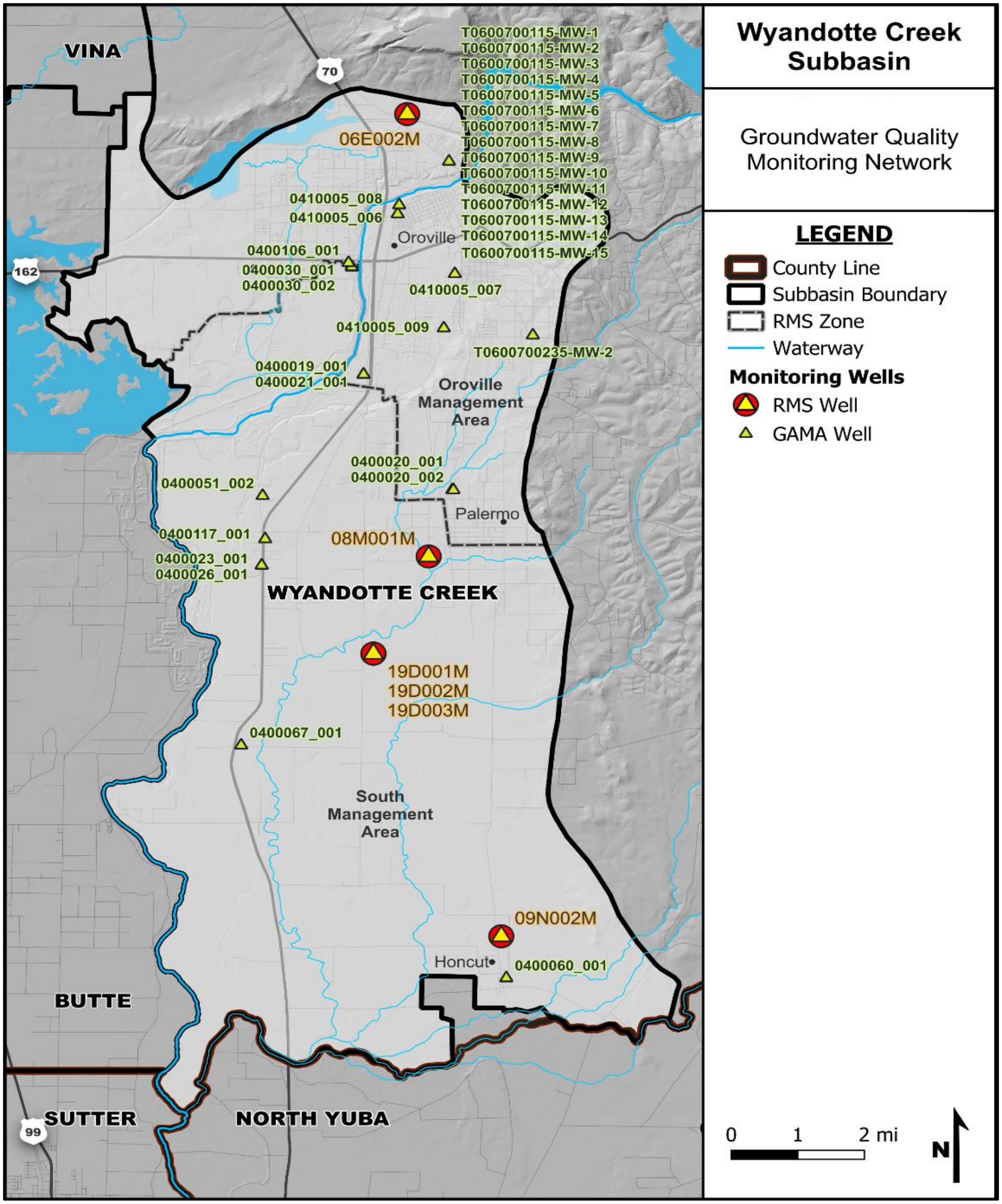


Figure 4-2 Groundwater Quality Monitoring Network

4.5 Land Subsidence

4.5.1 Background

Inelastic land subsidence has the potential to be of major concern in areas of active groundwater extraction due to infrastructure damage, permanent reduction in the storage capacity of an aquifer, well casing collapse, and increased flood risk in low lying areas. Inelastic subsidence typically occurs in the clay layers within aquifers and aquitards due to the withdrawal of water from storage within these layers. Water supports the structure of the clay layers, and dewatering permanently rearranges or collapses this structure, a process that cannot be reversed as groundwater cannot re-enter the clay structure after collapse.

To determine whether subsidence is occurring, a subsidence monitoring network has been established throughout the Sacramento Valley, the Sacramento Valley GPS Subsidence Monitoring Network. This system consists of observation stations and extensometers managed jointly by Reclamation and DWR. The observation stations are a result of DWR's efforts to establish a subsidence monitoring network to capture changes in subsidence across the Sacramento Valley. The observation stations are established monuments with precisely surveyed land surface elevations, which are distributed throughout the County such that the entire county is well represented. In 2008, DWR along with numerous partners performed the initial GPS survey of the observation stations to establish a baseline measurement for future comparisons. The network was resurveyed again in 2017 (DWR, 2018b) using similar methods and equipment as those used in the 2008 survey and results were analyzed to depict the change in elevation at each station between those two years.

Extensometers are installed in wells or boreholes and are a more site-specific method of measuring land subsidence as they can detect changes in the thickness of the sediment surrounding the well due to compaction or expansion. These instruments can detect very slight changes in land surface elevation on a continuous basis with an accuracy of +/- 0.01 feet or approximately 3 millimeters. The three extensometers in Butte County are all located outside of the Wyandotte Creek Subbasin.

Recent subsidence studies in the Central Valley have utilized satellite- and aircraft-based Interferometric Synthetic Aperture Radar (InSAR). Much of the InSAR work has been led by the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL). However, because JPL InSAR data is limited to a period from 2015 through 2017, TRE ALTIMIRA InSAR available through DWR was used for this analysis as data from this source is available for a period starting June 2015 through present.

The Wyandotte Creek Subbasin monitoring network is shown on Figure 4-3. Available data indicate that inelastic land subsidence due to groundwater withdrawal has not occurred in the Wyandotte Creek Subbasin. This is likely due to relatively stable groundwater levels and subsurface materials that are not conducive to compaction.

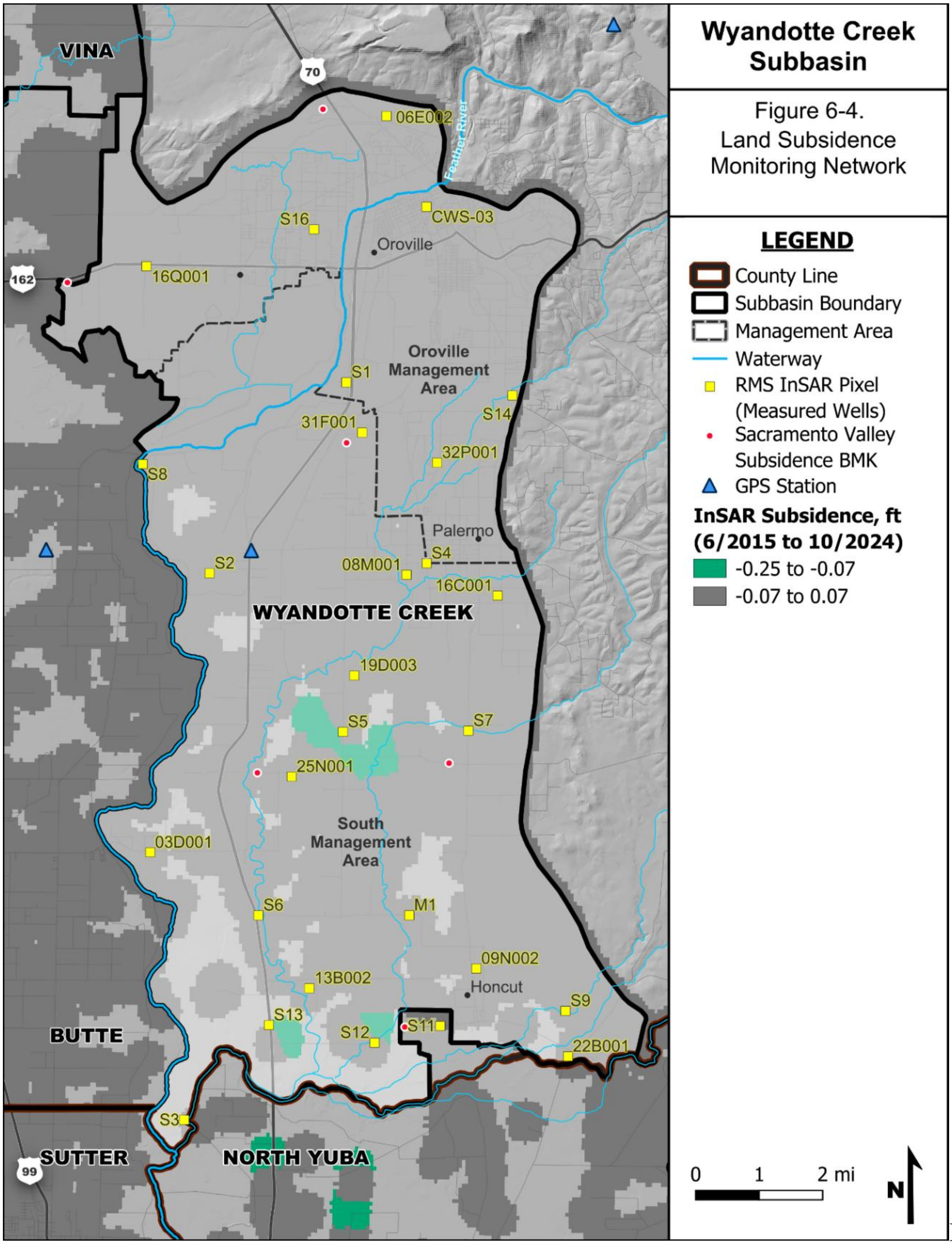


Figure 4-3. Subsidence Monitoring Network showing total subsidence from June 2015 through October 2024.

4.5.2 Location and Density of Monitoring Sites and Frequency of Measurement

The Sacramento Valley GPS Monitoring Network includes monuments that were measured in 2008 and 2017, while the InSAR program monitors subsidence on a continual basis. The GPS Monitoring Network is no longer active within the Subbasin, though one GPS Station in the subbasin continues to report vertical displacement. Data collected from both sources requires post processing and analysis, therefore the frequency of reporting is dependent on the work performed by DWR and TRE ALTAMIRA Inc. (TRE), under contract with the California Department of Water Resources (DWR). No extensometers exist in the Wyandotte Creek Subbasin.

4.6 Interconnected Surface Waters

4.6.1 Background

Monitoring depletions of interconnected surface water is conducted by monitoring water levels (stage) in streams and groundwater levels to characterize spatial and temporal exchanges between surface water and groundwater and to calibrate and apply the tools and methods necessary to estimate depletions. The existing monitoring network incorporates data from active stream gages reported to the California Data Exchange Center (CDEC), the California WDL, Yuba Water Agency, and the USGS National Water Information System and groundwater level monitoring, utilizing a subset of the locations described under the Wyandotte Creek Subbasin's groundwater level monitoring network.

The monitoring network for the Wyandotte Creek Subbasin includes stream gages listed in Table 4-4A and shown in Figure 4-4, as well as shallow groundwater quality monitoring sites in Table 4-4BX and Figure 4-4X. Groundwater level monitoring sites selected to observe groundwater–surface water interactions consist of the entire set of shallow wells in the monitoring network described in Section 4.2, which serves as the pool of potential RMS sites for assessing these interactions. The original eight shallow wells have been supplemented with 5 new shallow wells installed in 2026.

The stream gage network has also been expanded to a total of 12 stations. One USGS station stopped reporting daily streamflow in 2024. Two CDEC/WDL stations were added—one (ORF) located directly across the Feather River from the inactive USGS station 11406930, and another (NHC) on Honcut Creek. Two stations operated by Yuba Water Agency on Honcut Creek have been incorporated. Five new stream gages were installed in 2026 to further strengthen the network.

As discussed in Section 4.1, the GSA in the Wyandotte Creek Subbasin intends to further evaluate the SMC for interconnected surface waters to avoid undesirable results to aquatic ecosystems and GDEs. As additional data are collected and evaluated, the Wyandotte Creek Subbasin commits to developing additional SMC and installation of monitoring points, as appropriate, for specific stream reaches and associated habitat where there is a clear connection to groundwater pumping in the principal aquifer.

As with locations used for monitoring of other SIs, the network of stream gages and wells used to monitor interactions between groundwater and streamflow includes sites selected for their period of record, the quality of data reported and subject to permission of the landowner to monitor the well. The locations of the newly installed wells and gages were selected to:

- Better monitor surface bodies with known connections to the water table, such as the Feather River and Honcut Creek,
- Observe interactions between the water table and groundwater dependent ecosystems (in-stream GDEs),
- Support project planning and implementation and,
    7. Assess benefits of SGMA project implementation in specific watersheds, such as Wyman Ravine.

A total of 25 monitoring wells and 12 stream gages are included in the Wyandotte Creek Subbasin’s network for monitoring groundwater and streamflow interactions.

Table 4-4A: Wyandotte Creek Subbasin Surface Water Stream Gages

Stream Monitored	Gage ID	Well Network	Measurement Frequency	Status	Start Date	End Date
Oroville Management Area						
Feather River	11406930	USGS	Daily	Inactive	10/1/1973	9/30/2024
Feather River	ORF	CDEC	Daily	Active	12/26/2019	Present
South Management Area						
Feather River	11406920	USGS	Daily	Active	11/16/1967	9/30/2024
Feather River	GRL/ A05165	CDEC/WDL	Hourly/Continuous	Active	01/01/1984	Present
Honcut Creek	NHC/ A05189	CDEC/WDL	Continuous	Active	01/25/2018	Present
Honcut Creek	Honcut Creek Inflow	Yuba Water Agency	Continuous	Active		Present
Honcut Creek	Honcut Creek Outflow	Yuba Water Agency	Continuous	Active		Present
Wyman Ravine	SG5	GSA	Continuous	Proposed		Present
Wyman Ravine	SG6	GSA	Continuous	Proposed		Present
Wyandotte Creek	SG7	GSA	Continuous	Proposed		Present
North Honcut Creek	SG8	GSA	Continuous	Proposed		Present
Wyman Ravine	SG9	GSA	Continuous	Proposed		Present

Table 4-4B: Wyandotte Creek Subbasin ISW Monitoring Network Wells

Well ID	State Well Number[1]	Monitoring Frequency	Multi-Completion (number of wells at site)	Well Type	Aquifer Category	Drill Depth	Date of First Meas.	RMS?
Wyandotte Creek – Oroville Management Area								
16Q001M	19N03E**16Q001M**	Quarterly	No	Residential	Shallow	120	10/3/2000	No
32P001M	19N04E**32P001M**	Quarterly	No	Residential	Shallow	150	8/29/1959	No
CWS-01		Quarterly	No	Municipal	Shallow	186	2/1/1978	No
CWS-03		Quarterly	No	Municipal	Shallow	150	2/1/1978	Yes
S1[2]		Quarterly	No	Observation	Shallow			No
S14[2]		Quarterly	No	Observation	Shallow			No
S16[2]		Quarterly	No	Observation	Shallow			No
Wyandotte Creek – South Management Area								
03D001M	17N03E**03D001M**	Quarterly	No	Irrigation	Shallow	179	4/10/1947	Yes
22B001M	17N04E**22B001M**	Quarterly	No	Residential	Shallow	80	3/8/1976	Yes
25N001M	18N03E**25N001M**	Quarterly	No	Irrigation	Shallow	164	3/9/1976	No
19D003M	18N04E**19D003M**	Quarterly	Yes	Observation	Shallow	200	6/14/2021	No
31F001M	19N04E**31F001M**	Quarterly	No	Residential	Shallow	200	10/3/2000	No
M1[2]		Quarterly	Yes	Observation	Shallow			No
S11[2]		Quarterly	Yes	Observation	Shallow			No
S12[2]		Quarterly	Yes	Observation	Shallow			No
S13[2]		Quarterly	Yes	Observation	Shallow			No
S15[2]		Quarterly	Yes	Observation	Shallow			No
S2[2]		Quarterly	Yes	Observation	Shallow			No
S3[2]		Quarterly	Yes	Observation	Shallow			No
S4[2]		Quarterly	Yes	Observation	Shallow			No
S5[2]		Quarterly	Yes	Observation	Shallow			No
S6[2]		Quarterly	Yes	Observation	Shallow			No
S7[2]		Quarterly	Yes	Observation	Shallow			No
S8[2]		Quarterly	Yes	Observation	Shallow			No
S9[2]		Quarterly	Yes	Observation	Shallow			No

1) The portion of the State Well Number shown in bold underlined text is the RMS ID.

2) Planned well for 2026

4.7 Monitoring Protocols for Data Collection

4.7.1 Monitoring Protocols and Frequency for Groundwater Levels

Each of the wells in the monitoring network is monitored either by the GSA, Cal Water, Butte County, DWR, or the associated CASGEM entity. Access agreements, including written description of each site location, access instructions, and point of contact, will be arranged prior to initiation of field data collection.

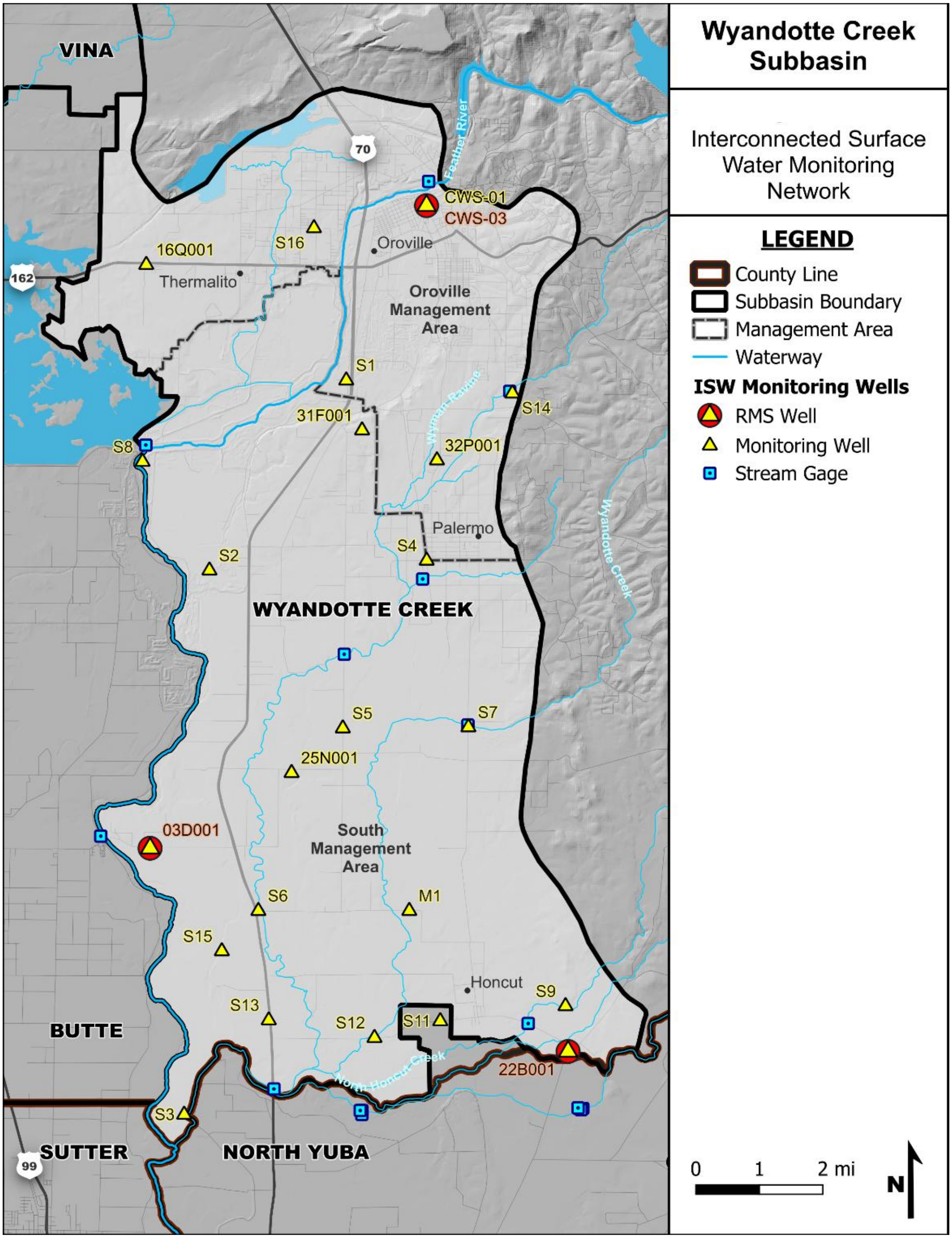


Figure 4-4. Interconnected Surface Water Monitoring Network.

Monitoring for purposes of the GSP will be conducted in accordance with DWR guidelines (DWR, 2016) to ensure groundwater level data are:

- Taken from the correct location, well ID, and screen interval depth
- Accurate and reproducible
- Representative of conditions that inform appropriate basin management data quality objectives
- Recorded with all salient information to correct, if necessary, and compare data
- Handled in a way that ensures data integrity
- Taken using a CASGEM-approved water-level measurement method to ensure consistency across measurements

Methods include:

- Establishing a reference point
- Using one of four approved methods (steel tape, electric sounding tape, sonic water-level meter, or pressure transducer) to measure groundwater levels

Groundwater level data will include at a minimum the well identification number, measurement date, depth to water (to the nearest 0.01 or .1 foot depending on equipment) from the established reference point, measurement method, measurement quality descriptors (for no measurement or questionable measurement), and observations of well and/or site conditions (including modifications to the well). The equipment used to collect groundwater level data will be recorded to include the equipment manufacturer, model, and serial number, as applicable. Equipment used for data collection will be operated and maintained according the manufacturer's recommendations.

Each well in the network has an established reference point in North American Vertical Datum 1988.

The general procedure for groundwater level monitoring is as follows:

- The well port (cap, plug, or lid) for access will be removed. Pressure inside the well casing will be allowed to equalize to ambient conditions prior to data collection.
- Non-dedicated equipment will be decontaminated by washing with a non-phosphate soap solution and triple rinse of distilled water.
- Groundwater level data (described above) will be recorded.
- Groundwater elevation will be recorded (groundwater elevation = reference point elevation – depth to water).
- The well port (and lock, if applicable) will be replaced.

Groundwater level data will be entered into the data management system (DMS) as soon as possible following collection.

Monitoring frequency for each well will occur at a minimum of bi-annually. Monitoring will be conducted in the Spring (March) and Fall (October). Select wells are monitored more frequently via dataloggers, at an hourly basis, but will only be reported bi-annually. Each RMS will be monitored within the same calendar month to ensure consistency for comparability over time. This monitoring frequency will achieve the goal of obtaining sufficient data to evaluate the seasonal, short-, and long-term trends in groundwater.

4.7.2 Monitoring Protocols and Frequency for Water Quality

Each of the wells in the existing network is monitored for water quality by DWR and other agencies, both private and public, including Butte County.

Monitoring for purposes of the GSP will be conducted in accordance with DWR guidelines (BMP 1) to ensure water quality data:

- Are taken from the correct location
- Are accurate and reproducible
- Represent conditions that inform appropriate basin management and are consistent with the data quality objectives
- Are handled in a way that ensures data integrity
- Include pertinent information that is recorded to normalize, if necessary, and compare data

Water quality will be measured for compliance through monitoring of specific conductance. However, pH and temperature may also be recorded for informational purposes. Water quality samples will be assessed in the field and will not require laboratory analysis.

Groundwater quality data will include at a minimum the well identification number, sample time and date, groundwater elevation data if available (as described in Section 4.2), water quality values for pH, specific conductance, and temperature, sample quality descriptors (for no measurement or questionable measurement), and observations of well and/or site conditions (including modifications to the well). The equipment used to collect groundwater quality data will be recorded to include the equipment manufacturer, model and serial number, as applicable. Equipment used for data collection will be calibrated, operated and maintained according to the manufacturer's recommendations.

The general procedures for groundwater quality sampling include:

- For wells with dedicated pumps, the sample will be collected near the wellhead.
- The sampling port and/or sampling equipment will be decontaminated by washing with a non-phosphate soap solution and triple rinse of distilled water prior to sample collection.

- With the exception of observation wells, the well will be purged of three well casing volumes prior to sampling (if not equipped with dedicated low-flow or passive equipment).
- Samples will be collected under laminar flow conditions.
- Equipment will be field calibrated to assess drift.

Monitoring for water quality for each well will occur annually in July or August. Select wells may be monitored more frequently but will only be reported annually. Each RMS will be monitored within one calendar month to ensure consistency for comparability over time. This monitoring frequency will achieve the goal of obtaining sufficient data to evaluate the seasonal, short-, and long-term trends in groundwater.

Representative Monitoring Sites

Representative monitoring sites (RMS) are a subset of monitoring sites chosen by the GSA to characterize conditions in the Subbasin. RMS sites have defined minimum thresholds, measurable objectives, and interim milestones, to monitor sustainability indicators. The data gathered from the RMS will be used to quantify the groundwater conditions for the five SIs and evaluate GSP implementation.

RMS wells were selected using the following criteria:

1. Adequate Spatial Distribution – RMS were selected from the monitoring network to maximize the geographical coverage across each of the two MAs and avoid overlapping or redundant coverage.
2. Existing Data – RMS with a longer period of record and a greater number of historical measurements were selected to provide insight into long-term trends that can provide information about groundwater conditions through varying climatic periods such a droughts and wet periods. Historical data may also show changes in groundwater conditions through anthropogenic effects as well. While some sites chosen may not have extensive historical data, they may still be selected because there are no wells nearby with longer records.
3. Increased Density in Heavily Pumped Areas – Selection of additional wells in heavily pumped areas such as within urban residential areas in the city of Oroville will provide additional data where higher groundwater use occurs.
4. Multi-Completion Wells – The utilization of wells with different screen intervals is important to collect data on the groundwater conditions at different elevations within the aquifer. This can be achieved by using wells with different screen depths that are close to one another, or by using multi-completion wells.
5. Consistency with BMPs – The BMPs provided by DWR encourage consistency across subbasins and compliance with established regulations.
6. Well Construction Data – Well data such as perforation depths, construction date, and well depth was considered for selection.

7. Accessibility – Consideration for accessibility to the physical well location and to the existing data was incorporated into the selection of RMS wells. RMS in the network include residential, municipal, agricultural, and governmental wells that are owned and operated by various private and public entities.
8. Beneficial Uses/Users – RMS wells were selected if its location and/or screening interval represented local beneficial users such as domestic wells and interconnected surface water.
9. Professional Judgement – Professional judgement was used to make the final decision about each well, particularly when more than one suitable well exists in an area of interest.

4.8 Representative Monitoring Sites for Sustainability Indicators

Each of the associated SMC for each SI described in Section 3 have RMS wells identified for monitoring and evaluation with the exception of seawater intrusion as it is not applicable to the Wyandotte Creek Subbasin. The selected RMS wells for each SI are discussed in the following sections.

4.8.1 Groundwater Levels and Groundwater Storage

The RMS wells will be used as compliance points to record groundwater elevations for the evaluation of chronic lowering of groundwater levels and groundwater storage. SGMA allows groundwater elevations to be used as proxy for monitoring other SI if a significant correlation exists between groundwater elevations and the other SI and if the MO for groundwater elevation include a reasonable margin of operational flexibility to avoid undesirable results.

Groundwater storage is directly connected to groundwater elevation, and therefore the same RMS network is used for both SIs.

A total of ten RMS wells were selected as compliance points for monitoring of groundwater levels and groundwater storage (Figure 4-5). They will be monitored for the SMC listed in Section 3.9. RMS wells were selected to be representative of domestic wells and upper and lower aquifer conditions (similar to irrigation wells) and includes shallow wells relevant to vegetative GDEs. Table 4-5 summarizes the RMS well construction details and Table 4-6 summarizes the RMS well location details.

Table 4-5: Groundwater Levels Representative Monitoring Site Well Construction Details

RMS Well ID	State Well Number (Site Name)	Total Depth (feet bgs)	Screened Interval (feet bgs)	Reference Point Elevation[1] (feet)	Reference Point Description	Ground Surface Elevation[1] (feet)
Wyandotte Creek Subbasin – Oroville Management Area						
16Q001M	19N03E**16Q001M**	120	100-120	180.32	Top of casing	179.32
32P001M	19N04E**32P001M**	150	N/A	188	Between plate and casing on west side	187
PWS-03	PWS-03	150	---	161	---	---
Wyandotte Creek Subbasin – South Management Area						
13B002M	17N03E**13B002M**	320	120-320	89.57	Top of casing	89.27
22B001M	17N04E**22B001M**	80	55-80	118.26	Top of casing	117.26
25N001M	18N03E**25N001M**	164	81-164	128.26	Top of casing	127.26
08M001M	18N04E**08M001M**	350	168-244	147.56	Between metal plate and top of casing	147.26
16C001M	18N04E**16C001M**	165	65-165	204.46	Top of casing	203.26
19D003M	18N04E**19D003M**	944	120-200	124	N/A	124
31F001M	19N04E**31F001M**	200	160-200	260.97	Top of casing	259.27

Note:
1 – North American Vertical Datum 1988.
N/A – Not available
--- Details of public supply wells not disclosed

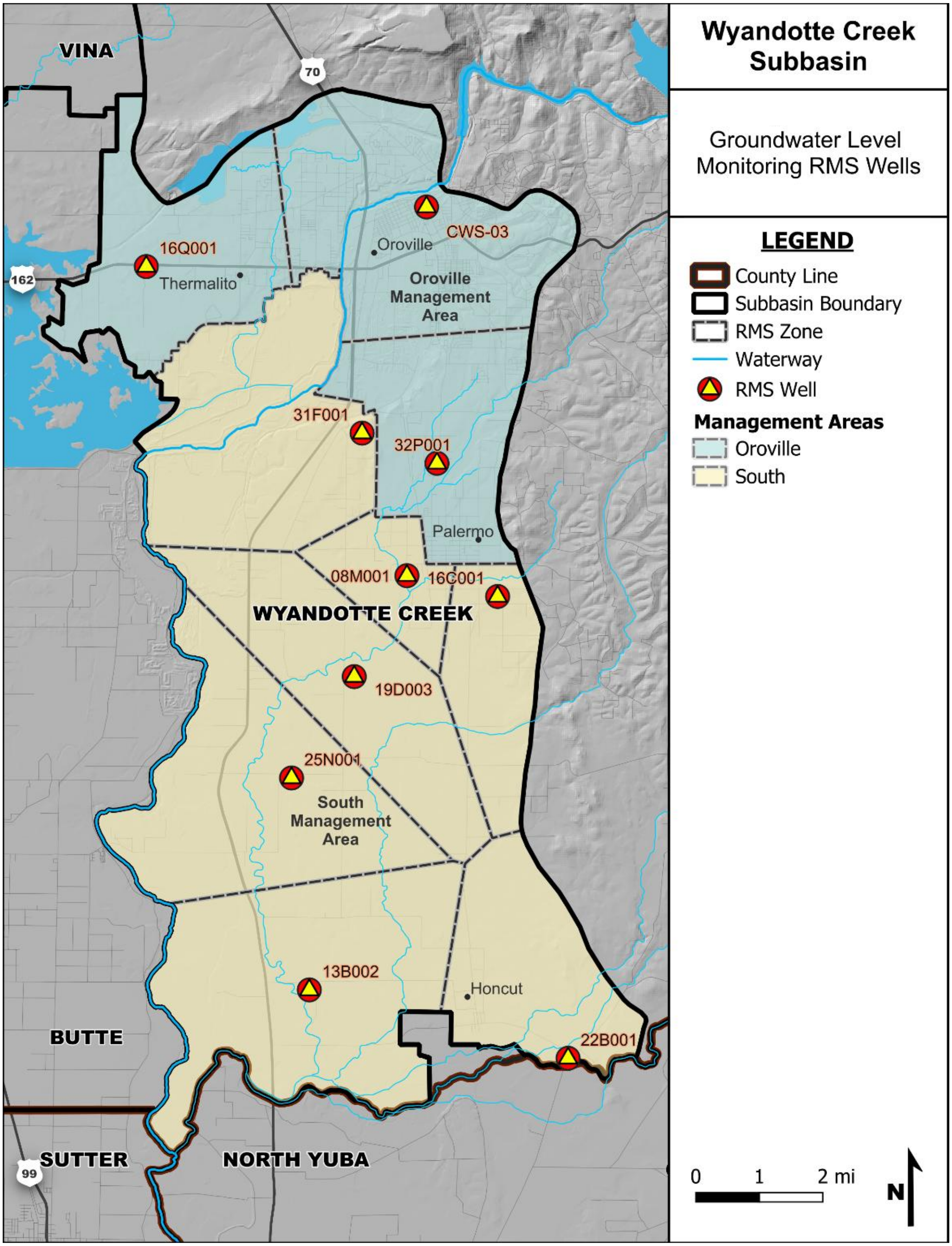


Figure 4-5. Groundwater Level Monitoring RMS Wells.

Table 4-6: Groundwater Levels Representative Monitoring Site Well Location Details

RMS Well ID	State Well Number (Site Name)	Latitude[1]	Longitude[1]
Wyandotte Creek Subbasin – Oroville Management Area			
16Q001M	19N03E**16Q001M**	39.4977	-121.6369
32P001M	19N04E**32P001M**	39.4540	-121.5503
PWS-03	PWS-03	---	---
Wyandotte Creek Subbasin – South Management Area			
13B002M	17N03E**13B002M**	39.3336	-121.5853
22B001M	17N04E**22B001M**	39.319	-121.5089
25N001M	18N03E**25N001M**	39.3818	-121.59156
16C001M	18N04E**16C001M**	39.4239	-121.5318
08M001M	18N04E**08M001M**	39.4283	-121.5586
19D003M	18N04E**19D003M**	39.40512	-121.57362
31F001M	19N04E**31F001M**	39.4606	-121.5725

Note:
1 – North American Datum 1983 (NAD83).
--- Location of public supply wells not disclosed

4.8.2 Water Quality

The revised monitoring network includes four of the eight original RMS sites identified in the 2022 GSP. Four original RMS wells identified in the GSP were removed from the monitoring network for the following reasons:

- Two RMS wells were removed from the network per the request of the landowners, 28L001M in 2022 and 16Q001M in 2023.
- RMS well 13B002M was removed from the monitoring network in 2022 due to an inoperable pump.
- Well CWS-02 was removed in 2023 due to water quality issues at the well.

Well 06E002M was added in 2022. This well was historically measured for groundwater quality as part of the former Butte County Basin Management Objective (BMO) program. One more additional well, 09N002M was added into the monitoring network in 2023. This well also serves as an existing RMS well for groundwater level monitoring in the Subbasin. As of 2025, there were six (6) locations being monitored within Wyandotte Creek GSA.

Two additional wells will be added to the RMS network in Spring 2026. Several wells will be added to the water quality network on the west and south areas of the Subbasin. Of those new wells, two will be chosen for the RMS network.

The revised RMS network currently has six wells, with plans to expand to eight wells in 2026, were selected as compliance points for monitoring of water quality (Figure 4-6). They will be monitored for the SMC listed in Section 3.9. Each well was selected independently of the wells discussed in Section 4.4 and thus not all wells are listed in Table 4-3. Table 4-8 summarizes the well construction details and Table 4-9 summarizes the well location details. As discussed in Section 4.2, one of these wells, designated as 19D001M, 19D002M, and 19D003M, was currently installed, as shown in Figure 4-6 by DWR under the TSS program.

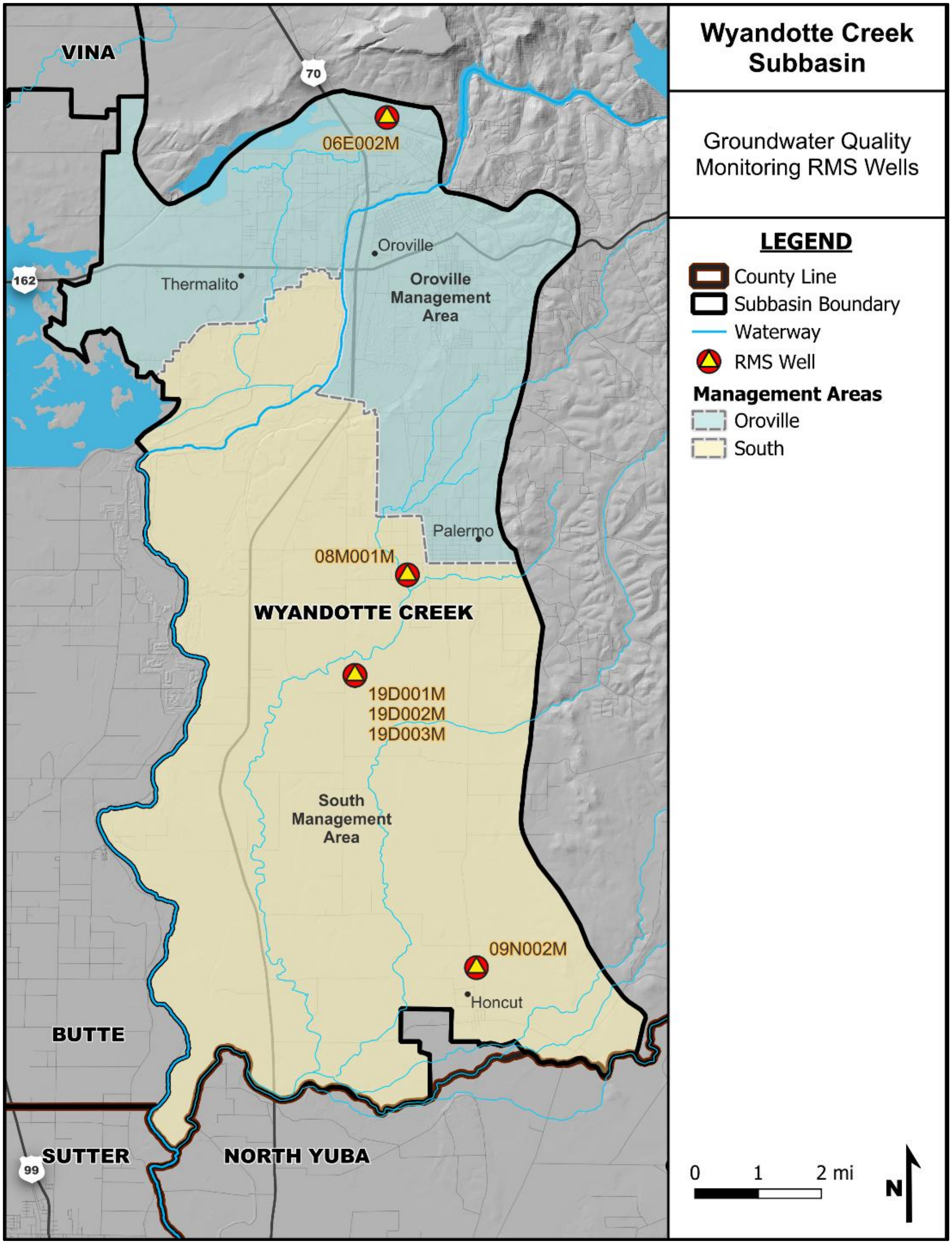


Figure 4-6. Groundwater Quality Monitoring RMS Wells.

Table 4-8: Water Quality Representative Monitoring Site Well Construction Details

RMS Well ID	State Well Number (Site Name)	Total Depth (feet bgs)	Screen Interval (feet bgs)	Reference Point Elevation[1] (feet)	Reference Point Description	Ground Surface Elevation[1] (feet)
Wyandotte Creek Subbasin – Oroville Management Area						
06E002M	19N04E06E002M	196	110 – 130, 164 – 174	N/A	N/A	N/A
Wyandotte Creek Subbasin – South Management Area						
09N002M	17N04E09N002M	325	100 – 112	103.26	N/A	102.26
08M001M	18N04E08M001M	656	168-244	147.56	Between metal plate and top of casing	147.26
19D003M	18N04E19D003M[2]	220	120-130, 190-200	124	NR	124
New Well #1	TBA	TBA	TBA	TBA	TBA	TBA
New Well #2	TBA	TBA	TBA	TBA	TBA	TBA
New Well #3						
New Well #4						

Notes:
1. North American Datum 1983 (NAD83).
2. Nested well installed by DWR under TSS Program.
3. If access cannot be obtained for this well, a new well will be obtained.
--- Details of public supply wells not disclosed
N/A – Not available
NR – Not yet reported by DWR

Table 4-9: Water Quality Representative Monitoring Site Well Location Details

RMS Well ID	State Well Number (Site Name)	Latitude[1]	Longitude[1]
Wyandotte Creek Subbasin – Oroville Management Area			
06E002M	19N04E**06E002M**		
Wyandotte Creek Subbasin – South Management Area			
08M001M	18N04E**08M001M**	39.4283	-121.5586
09N002M	17N04E**09N002M**	39.3387	-121.5363
19D003M	18N04E**19D003M**	39.40512	-121.57363
New Well #1	TBA	TBA	TBA
New Well #2	TBA	TBA	TBA

Note:
1. North American Datum 1983 (NAD83).
3. If access cannot be obtained for this well, a new well will be obtained.
N/A – Not available

4.8.3 Land Subsidence

The subsidence RMS network consists of 32 monitoring well and InSAR pixel pairs, ground-truthed with available GPS subsidence station(s). InSAR pixels are chosen near selected groundwater level monitoring site in the RMS network. If subsidence should occur, the GSA will check the groundwater levels of the paired groundwater well to determine if the subsidence is natural or from declining groundwater levels. InSAR pixels and GPS subsidence stations are shown in Table 4-10 and Figure 4-7.

The quantitative metric for assessment of subsidence SMCs will use the average value of InSAR pixels around each RMS well. InSAR data will be downloaded, plotted, and analyzed annually as part of the GSP Annual Report. Both rates and cumulative extents of subsidence at each RMS site will be assessed to determine compliance with the MT described above.

Table 4-10: Land Subsidence RMS Monitoring Network

Site ID	Site Type	Paired RMS Well – Well ID	Years of Record	Measurement Type	Basis of Selection
Wyandotte Creek – Oroville Management Area					
	InSAR pixel	16Q001M	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	32P001M	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	PWS-01	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	PWS-02	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	PWS-03	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S1[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S14[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S16[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
Wyandotte Creek – South Management Area					
	InSAR pixel	03D001M	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	13B002M	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	09N002M	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	22B001M	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	25N001M[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	08M001M	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	16C001M	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	19D001M[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	19D002M[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	19D003M[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	31F001M	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	M1[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well

Site ID	Site Type	Paired RMS Well – Well ID	Years of Record	Measurement Type	Basis of Selection
	InSAR pixel	S11[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S12[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S13[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S15[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S2[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S3[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S4[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S5[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S6[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S7[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S8[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	InSAR pixel	S9[2]	2015-Present	Vertical Ground Surface Displacement	Proximity to GWL well
	GPS Station				

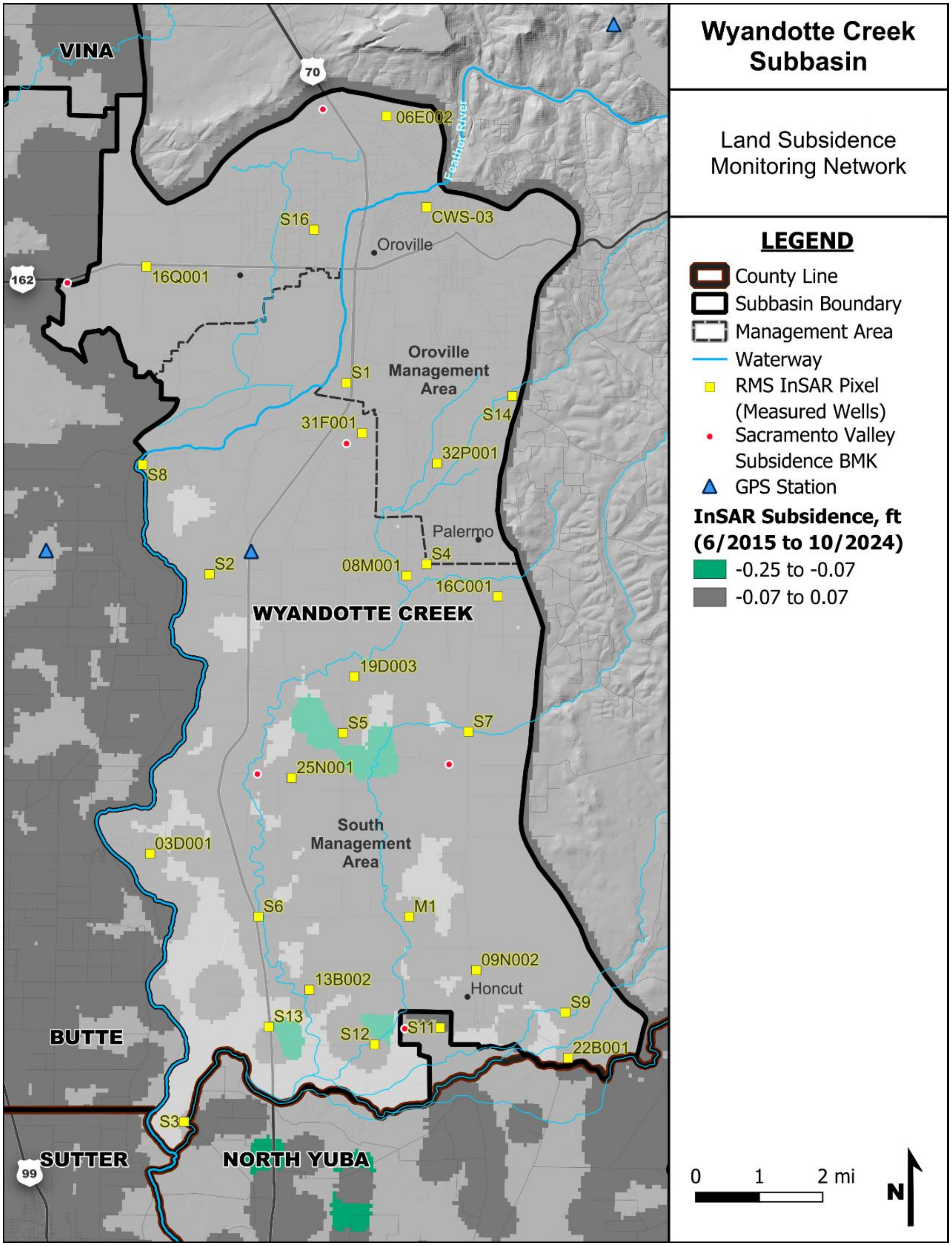


Figure 4-7. Land Subsidence Monitoring Network

4.8.4 Interconnected Surface Waters

The preliminary ISW RMS network consists of three (3) monitoring wells, selected due to their proximity to existing stream gages and ISWs. RMS wells are shown in Table 4-11 and Figure 4-8. The finalized ISW SMCs are still in development and may be reconsidered in the 2032 periodic evaluation.

The RMS selection process includes the following:

1. Compile a comprehensive list of possible monitoring wells representative of groundwater table conditions in relation to surface water features.
2. Classify monitoring wells based on well lithology and screening intervals.
3. Review data quality and condition of all possible monitoring wells (e.g., presence of oil).
4. Consistent, high-quality spring and fall measurements for at least the past 5 years.
5. Map beneficial users (ISWs).
6. Select RMS based on proximity to sensitive beneficial uses/users of groundwater:
    a. ISW: within 0.5 miles of an identified ISW

Table 4-11: Interconnected Surface Waters Representative Monitoring Site Well Construction Details

RMS Well ID	State Well Number (Site Name)	Total Depth (feet bgs)	Screened Interval (feet bgs)	Reference Point Elevation[1] (feet)	Reference Point Description	Ground Surface Elevation[1] (feet)
Wyandotte Creek Subbasin – Oroville Management Area						
PWS-03	PWS-03	150	---	161	---	---
Wyandotte Creek Subbasin – South Management Area						
03D001M	17N03E**03D001M**	179	35-105	99.27	One inch pipe east side of pump base.	97.27
22B001M	17N04E**22B001M**	80	55-80	118.26	Top of casing	117.26

Note:
1 – North American Vertical Datum 1988.
N/A – Not available
--- Details of public supply wells not disclosed

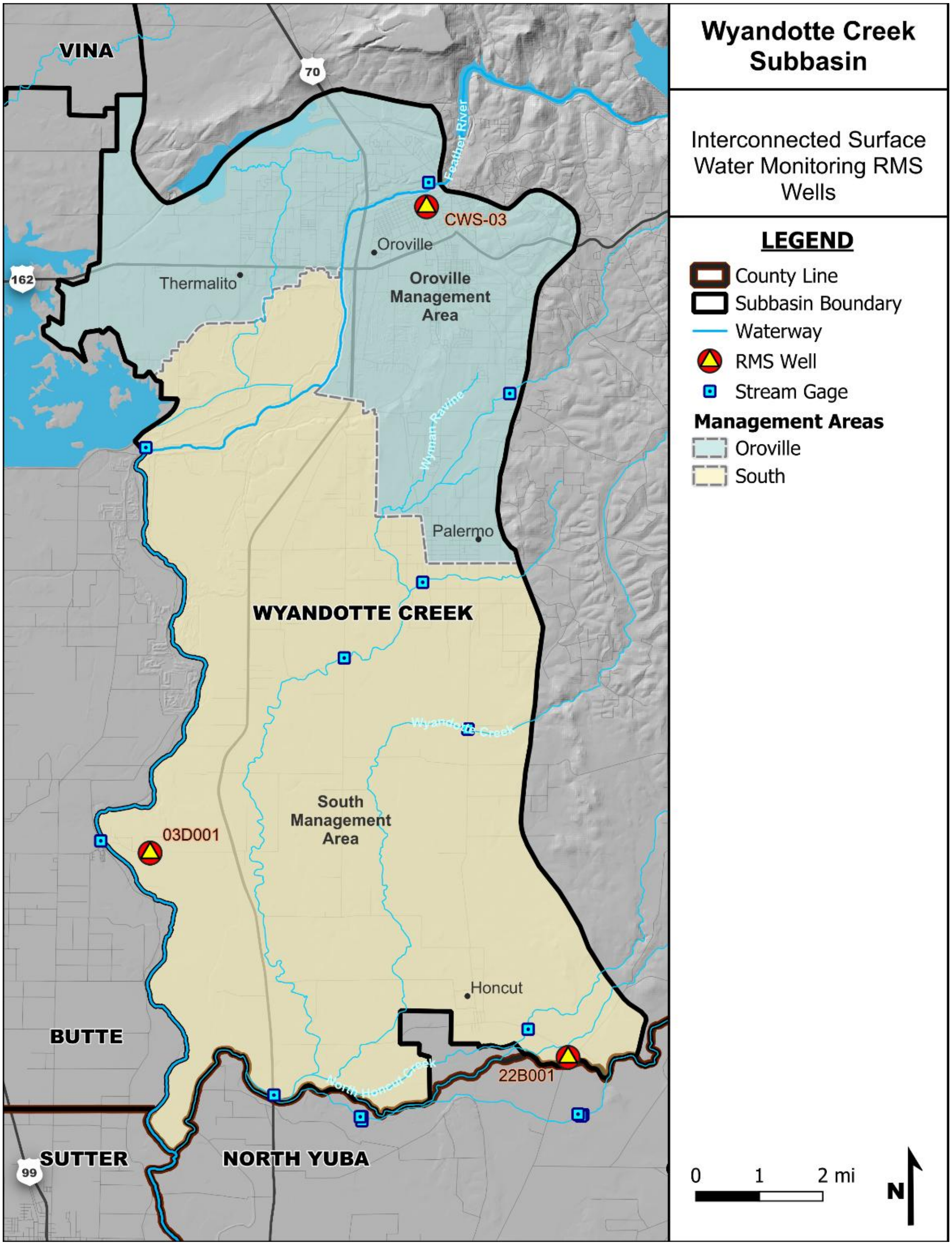


Figure 4-8. ISW Preliminary RMS Monitoring Network.

4.9 Network Assessment and Improvements

An assessment of the monitoring network is required to determine uncertainty and identify data gaps that could affect the achievement of sustainability goals. Improvements to the network to address data gaps will be planned and implemented to manage, focus, and prioritize monitoring.

Data gaps can result from monitoring information that is not of sufficient quantity or quality. Monitoring network data gaps can influence the development and understanding of the basin setting, including the HCM, groundwater conditions, and water budget; and proposed MTs and MOs. Updates to the data gaps will be included in the Periodic Evaluations of the GSP.

The following data gaps and proposed resolutions have been identified in the Wyandotte Creek Subbasin:

- Interconnected Surface Water and GDEs – There is limited data to analyze interaction of streams and pumping within the primary aquifer system. There is also limited data to assess groundwater level conditions in relation to GDEs. Additional wells and stream gages have been installed, as appropriate, following the framework discussed in Section 3.8. Within the 2027-2032 evaluation period, data will continue to be collected from the groundwater level and ISW networks to address this data gap.

5. PROJECT AND MANAGEMENT ACTIONS

This section includes relevant information about projects and management actions to satisfy CCR Title 23 § 354.42 and 354.44. The projects and management actions described in this section will help achieve the Wyandotte Creek Subbasin's sustainability goal.

5.1 Projects, Management Actions, and Adaptive Management Strategies

The sustainability goal of the Wyandotte Creek Subbasin is to maintain a sufficient groundwater supply and quality that can be used by rural areas, communities, and agricultural users. Therefore, the overall approach will focus on investigating additional water sources to supplement groundwater and implementing various conservation programs. The projects described below were selected with this approach in mind.

5.2 Projects

5.2.1 Project Identification

Projects were identified through an outreach effort involving the WAC and the Wyandotte Creek GSA. The process included soliciting input from governmental agencies, water purveyors, local organizations, and local landowners. The GSA website allowed project proponents to input the available information on each project.

The majority of projects submitted were proposed by the Wyandotte Creek GSA. Some of the projects also include other proponents, such as the TWSD and SFWPA. The list of proponents and other potential entities involved in the projects is included in Tables 5-1, 5-2, and 5-3 below.

The provided project information was compiled into an initial draft list with similar and overlapping projects combined as appropriate. The draft list was presented to the WAC and to the GSA Boards. The projects were evaluated based on the following priorities:

- Project addresses one or more of the Undesirable Results
- Project is implementable with respect to technical complexity, regulatory complexity, institutional consideration, and public acceptance
- Project is implementable within the SGMA timeframe
- Project benefits Underrepresented Communities (URCs)
- Project is in an area where water quality is suitable for use

5.2.2 Project Implementation

Projects will be implemented through the individual project proponent(s) with the Wyandotte Creek GSA providing oversight. The GSA oversight may vary from acknowledging the implementation of the project to actively participating in the design and construction of the project or being the project proponent for some projects. The GSA will track the estimated effect on the water budget from projects annually.

5.2.3 List of Projects

Several projects to achieve the Wyandotte Creek Subbasin's sustainability goal were identified. The initial set of projects was reviewed by the WAC. A final list of 15 possible projects is included in this GSP and they are categorized into four project types: direct recharge, water supply/conjunctive use, intra-basin water transfers, and demand conservation. Projects are further classified into four categories based on project status: Completed, In-Progress, Potential, and Other as defined below.

- Completed – Projects in this category are finished and benefits have been reported
- In-Progress Projects – Projects in this category are in the planning, design, or implementation phase and may require funding to proceed
- Potential Projects – Projects in this category have been developed and are ready to be implemented as needed/funded
- Other Projects – Projects in this category are potentially led by other agencies and not critical to achieving sustainability. Status will be tracked by the GSA as feasible (not subject to annual tracking and reporting).

Completed, In-Progress, and Potential Projects have been prioritized by the GSA. Projects may be moved between categories as prioritized and implementation status advances.

This subsection of the GSP satisfies the requirements of CCR Title 23 § 354.44. Consistent with SGMA requirements, the project descriptions contain information regarding:

- The MO benefitted by the project
- Permitting and regulatory processes
- Timetable for initiation and completion
- Expected benefits
- How the project will be accomplished
- Legal authority
- Estimated costs and plans to meet costs
- Implementation circumstances
- Public noticing

Tables 5-1, 5-2, 5-3, and 5-4 provide a summary of the 15 projects. Full descriptions are included below.

Table 5-1: List of Completed Projects.

Project Name	Project Type	Project Proponent(s)/ Potential Participating Entities	Measurable Objective Expected to Benefit	Estimated Costs	Required Permitting and Regulatory Process	Observed Groundwater Demand Reduction (Acre-Feet/Year)
5.2.4.1 TWSD Water Treatment Plant Capacity Upgrade	Conservation	TWSD, DWR, Division of Drinking Water	Groundwater Levels, Groundwater Storage, Water Quality, Land Subsidence	$1.5 million-$3 million	Completed	300

Table 5-2: List of In-Progress Projects.

Project Name	Project Type	Project Proponent(s)/ Potential Participating Entities	Measurable Objective Expected to Benefit	Current Status	Timetable (initiation and completion)	Estimated Costs	Required Permitting and Regulatory Process	Expected Groundwater Demand Reduction (Acre-Feet/Year)
5.2.5.1 Residential Water Conservation	Conservation	Wyandotte Creek GSA, municipal water providers	Groundwater Levels, Groundwater Storage	Ongoing	2022-2025	To be decided (TBD)	N/A	100 – 200
5.2.5.2 Palermo Clean Water Consolidation Project	Water Supply/Conjunctive Use	Butte County Department Water and Resource Conservation, SFWPA, Palermo Community Council	Groundwater Levels, Groundwater Storage	Implementation	Expected 2026	$12.4 million	Permitting completed.	500+
5.2.5.3 Agricultural Irrigation Efficiency	Conservation	Wyandotte Creek GSA Vina GSA, Agricultural Groundwater Users of Butte County, Butte County Farm Bureau	Groundwater Levels, Groundwater Storage	Planning (seeking landowner participation)	TBD; dependent upon landowner participation	TBD	N/A	Up to 4,000
5.2.5.4 Regional Conjunctive Use Project	Direct Recharge, Water Supply/Conjunctive Use	Wyandotte Creek GSA, Agricultural Groundwater Users of Butte County, Farm Bureau, SFWPA, DWR	Groundwater Levels, Groundwater Storage, Water Quality, Land Subsidence	Planning and Design	Expected 2032	$3 million	SWRCB Water Right Permit, California Environmental Quality Act (CEQA)	Up to 3,000

Table 5-3: List of Potential Projects.

Project Name	Project Type	Project Proponent/ Potential Participating Entities	Measurable Objective Expected to Benefit	Current Status	Timetable (initiation and completion)	Estimated Costs	Required Permitting and Regulatory Process	Expected Groundwater Demand Reduction (AFY)
5.2.7.2 Extend Orchard Replacement	Conservation	Wyandotte Creek GSA, Butte County	Groundwater Levels	Planning Stage	Dependent upon availability of financial incentives and willingness of growers to participate	TBD	N/A	TBD

Table 5-4: List of Other Projects.

Project Name	Project Type	Project Proponent/ Potential Participating Entities	Measurable Objective Expected to Benefit	Current Status	Timetable (initiation and completion)	Estimated Costs	Required Permitting and Regulatory Process	Expected Groundwater Demand Reduction (AFY)
5.2.5.3 Oroville Wildlife Area Robinson's Riffle Project	Direct Recharge	Sutter Butte Flood Control Agency, Golden State Salmon Association	Groundwater Levels, Groundwater Storage, Water Quality, Land Subsidence	Planning Stage	TBD; Sutter Butte Flood Control Agency (SBFCA) is currently seeking funding	$1.7 million (planning, design, environmental, permitting)	CEQA/National Environmental Policy Act (NEPA), United States Army Corps of Engineers (USACE) 408, USACE 404, CDFW ITP, CDFW 1600 LSAA, State Lands Commission Lease, CVRWQCB 401, CVFPB Encroachment Permit, DWR Encroachment Permit	TBD
5.2.5.4 Streamflow Augmentation	Direct Recharge, Water Supply/Conju nctive Use	Wyandotte Creek GSA, PG&E, surface water rights holders	Groundwater Levels, Surface Water Depletion	Planning Stage	2027-2042	$50-100 per acre-foot	SWRCB Water Right Permit, CEQA	1,000-5,000
5.2.5.5 Water Loss Monitoring	Conservation	Wyandotte Creek GSA /SFWPA, Butte County	Surface Water Depletion	Planning Stage	2027-2042	$800,000	TBD	Unknown
5.2.6.1 Well Upgrades	Conservation	TWSD, DWR, Butte County,	Groundwater Levels, Groundwater	Planning Stage	2027-2042	TBD	TBD	TBD

		Wyandotte Creek GSA	Storage, Water Quality, Land Subsidence					
5.2.6.2 Fuel Management for Watershed Health	Conservation	Wyandotte Creek GSA, Butte County Fire Safe Council, Butte County Resource Conservation District, NRCS	Groundwater Levels, Groundwater Storage, Water Quality, Surface Water Depletion	Planning Stage	2027-2042	TBD	CEQA	TBD
5.2.6.3 Removal of Invasive Species	Conservation	Wyandotte Creek GSA; other local, state, federal organizations and agencies	Groundwater Levels	Planning Stage	2027-2042	TBD	CEQA and/or NEPA (depending on project location and impact)	TBD
5.2.7.1 Recharge Well (Injection Well)	Direct Recharge	TWSD, DWR, Butte County, Wyandotte Creek GSA	Groundwater Levels, Groundwater Storage, Water Quality, Land Subsidence	Planning Stage	2027-2042	TBD	TBD	TBD

5.2.4 Completed Projects

Projects categorized as Completed Projects have been completed by the Wyandotte Creek GSA or partner agency. Completed Projects are summarized in Table 5-1.

5.2.4.1 TWSD Water Treatment Plant Capacity Upgrade

The TWSD has increased the capacity of the water treatment plant serving the city of Oroville and surrounding area. By treating a greater volume of water for the area, the amount of groundwater pumped for drinking water has decreased.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA / TWSD, Division of Drinking Water, DWR
Project Type:	Conservation
Groundwater Offset and/or Recharge:	300 acre-feet/year

Measurable Objective Expected to Benefit: Groundwater Levels, Groundwater Storage, Water Quality, Land Subsidence

Project Status: This project was completed in 2024.

Required Permitting and Regulatory Process: Division of Drinking Water, DWR.

Expected Benefits and Evaluation: Since groundwater is a significant contributor to drinking water in the city of Oroville and the Wyandotte Creek Subbasin, increasing the capacity of the treatment plant will reduce the impact of groundwater pumping.

How Project Will Be Accomplished/Evaluation of Water Source: This project is a demand-side conservation project by TWSD. No additional water source will be utilized for this project.

Legal Authority: The project was conducted by the TWSD and Wyandotte Creek GSA.

Actual Costs and Method to Meet Costs: $1.5-$3 million; funding source DWR SGM Round 2 grant funds.

Trigger for Implementation and Termination: Increased groundwater pumping for drinking water.

Process for Determining Conditions Requiring the Project to have Occurred: This is completed due to securing DWR funding.

5.2.5 In-Progress Projects

Projects categorized as In-Progress Projects are ongoing or currently in the pilot, design, or implementation phase under the Wyandotte Creek GSA or partner agency. In-Progress Projects are summarized in Table 5-2.

5.2.5.1 Residential Water Conservation

Municipal water providers, who currently supply water to the City of Oroville and others throughout Butte County, are planning to implement water conservation practices in accordance with their 2020 UWMP. Some of these conservation projects include the installation of low flow fixtures, toilet replacements, urinal valve and bowl replacements, clothes washer replacements, residential conservation kits, smart controllers, and high efficiency irrigation nozzles. Other projects include water waste prevention ordinances, metering, conservation pricing, public education and outreach, programs to assess and manage distribution system real loss, water conservation program coordination and staffing support, and other demand management measures.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA / Municipal water providers (including Cal Water Oroville, TWSD)
Project Type:	Conservation
Estimated Groundwater Offset and/or Recharge:	100 – 200 AFY

Measurable Objective Expected to Benefit: Groundwater Levels, Groundwater Storage

Project Status: This project is currently in the planning stages.

Required Permitting and Regulatory Process: N/A

Timetable for Initiation and Completion: 2022-2025

Expected Benefits and Evaluation: As groundwater is the primary source of water for the region, these various conservation projects will reduce groundwater demand, allowing groundwater levels and overall storage to recover.

How Project Will Be Accomplished/Evaluation of Water Source: This project is a demand-side conservation project conducted by municipal water service providers. No additional water source will be utilized for this project.

Legal Authority: The project would be conducted by municipal water service providers in the City of Oroville and other municipalities in the Wyandotte Creek Subbasin.

Estimated Costs and Plans to Meet Costs: TBD; funding via grants and local entities.

Circumstances for Implementation: This project is a Planned Project that is anticipated to move forward.

Trigger for Implementation and Termination: Increased water demand from planned developments in the City of Oroville and Butte County General Plans.

Process for Determining Conditions Requiring the Project to have Occurred: Not applicable; this is a Planned Project that is anticipated to move forward.

5.2.5.2 Palermo Clean Water Consolidation Project

The water quality in the unincorporated community of Palermo is currently a public health concern for its nearly 2,000 residents. Most of the population obtain their potable water from individual water wells and use septic systems for wastewater treatment and disposal. The area's predominant soil type prevents surface water from properly percolating and draining, causing frequent flooding and the surfacing of untreated wastewater effluent. This, in turn, leads to septic system failures, plumbing back-ups into homes, and possible cross-contamination of pathogens in untreated wastewater with drinking water sources in the aquifer. Under this project, the SFWPA would expand its service areas and water delivery capabilities to provide treated drinking water to Palermo residents.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA, Butte County Department Water and Resource Conservation, SFWPA, Palermo Community Council
Project Type:	Water Supply/Conjunctive Use
Estimated Groundwater Offset and/or Recharge:	500+ acre-feet/year

Measurable Objective Expected to Benefit: Groundwater Levels, Groundwater Storage, Water Quality

Project Status: The first phase, the Dry Well Consolidation Project, is in progress focusing on installing pipelines and connecting properties. It's a multi-year effort, with construction progressing as funding allows, aiming to serve hundreds of parcels. Funding is being sought from multiple grant sources to fully fund the project.

Required Permitting and Regulatory Process: LAFCO and Butte County.

Timetable for Initiation and Completion: Project design is completed, funding is secured, and implementation is underway and is expected to be completed in 2026.

Expected Benefits and Evaluation: Expanding the SFWPA service areas in Palermo would provide more residents with clean and safe drinking water using a surface water source and will reduce dependence on groundwater pumping wells that may be contaminated. This would also allow groundwater levels and water quality in the region to recover. This project will improve the resilience of drinking water supplies to households in Palermo.

How Project Will Be Accomplished/Evaluation of Water Source: This project is a supply side conjunctive use project conducted by the BCDWRC in partnership with SFWPA. Water will be supplied by surface water from SFWPA.

Legal Authority: The project would be under the authority of BCDWRC, SFWPA, and Wyandotte Creek GSA.

Estimated Costs and Plans to Meet Costs: $12.4 million met through multiple grant sources

Circumstances for Implementation: Implementation is currently underway with expected completion date within 2026.

Trigger for Implementation and Termination: Dependence on individual groundwater pumping wells for drinking water and frequent issues such as flooding, plumbing problems, and possible cross contamination.

Process for Determining Conditions Requiring the Project to have Occurred: Implementation is currently underway. This is a high priority project for the Wyandotte Creek GSA and partnering agencies.

5.2.5.3 Agricultural Irrigation Efficiency

A survey is currently being conducted in North and South Vina by the Vina GSA, Agricultural Groundwater Users of Butte County, and Butte County Farm Bureau in order to evaluate current irrigation methods and practices, identify opportunities and methods to improve irrigation efficiency, determine potential issues preventing the adoption of efficiency practices, and provide recommendations for increasing participation in these practices. The results of this survey are expected to be available in September 2022, with implementation of the project expected to be initiated between 2024 and 2030. Recommendations from the survey will be made available to the local agricultural community, and implementation of the practices will be voluntary. The Wyandotte Creek GSA along with participating partners will pursue grant funds to help implement these practices. It is estimated that the adoption of more efficient practices could reduce groundwater demand by up to 2%, which translates to a reduction in groundwater demand of up to 4,000 AFY.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA, Vina GSA, Agricultural Groundwater Users of Butte County, Butte County Farm Bureau
Project Type:	Conservation
Estimated Groundwater Offset and/or Recharge:	4,000 AFY

Measurable Objective Expected to Benefit: This project will address declining water levels and the declining volume of groundwater stored in the aquifer. The main objective of the project is to reduce groundwater demand by modifying irrigation practices.

Project Status: This project is in the planning stages.

Required Permitting and Regulatory Process: None

Timetable for Initiation and Completion: Project will be initiated in 2024

Expected Benefits and Evaluation: A survey that consolidates data on the adoption of irrigation methods and practices by agricultural groundwater users will identify where more efficient practices can be implemented. This can help focus efforts and finances on areas where a reduction in overall groundwater demand is needed and feasible.

How Project Will Be Accomplished/Evaluation of Water Source: This project is a demand-side conservation project. No additional water source will be utilized for this project.

Legal Authority: The project would be under the authority of Vina GSA and potential future participating partners.

Estimated Costs and Plans to Meet Costs: To be determined, funding via Proposition 1, Proposition 68, USDA, Drought Resiliency Grants

Circumstances for Implementation: This project is a Planned Project that is anticipated to move forward.

Trigger for Implementation and Termination: The project will be initiated after the recommendations from the initial survey results are available.

Process for Determining Conditions Requiring the Project to Occur: As mentioned above, the survey is already underway and once analysis is complete, recommendations based off the results will be made available for voluntary implementation.

5.2.5.4 Regional Conjunctive Use Project

In the 2018 "Evaluation of Restoration and Recharge Within Butte County Basins," Butte County identified surface water sources that could be diverted to fields, recharge basins, and/or recharge ponds in both the Vina and Wyandotte Creek Subbasins. For Wyandotte Creek, the main source of surface water would come from Lake Oroville, while other sources are owned by water right holders in the Wyandotte Creek Subbasin and upper watershed. Under this project, excess surface water supplies would be used in place of groundwater in both agricultural and Flood MAR applications to allow groundwater levels in the Wyandotte Creek Subbasin to recover. Agricultural users may need a dual irrigation system that allows them to use surface water and switch to groundwater when surface water is not available. Feasible Flood MAR projects that have already identified include the Wyandotte Creek, Wyman Ravine, Wilson Creek, North Honcut Creek, Feather River, and Ruddy Creek, and will utilize water from the seasonal high flows from these creeks and streams for rice fields that have historically relied on groundwater, managed habitat, recharge ponds, and recharge basins. Recharge along Wyman Ravine, conducted in coordination with SFWPA and the Palermo Master Drainage Plan, has been determined to be most feasible. Work is currently underway to advance project concepts and designs.

The Regional Conjunctive combines the scopes of the Flood MAR, Intra-Basin Water Transfer, and Agricultural Surface Water Supplies projects that were described in the 2022 GSP.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA / TWSD, Butte County, agricultural users
Project Type:	Water supply/Conjunctive Use
Estimated Groundwater Offset and/or Recharge:	up to 3,000 AFY

Measurable Objective Expected to Benefit: Groundwater Levels, Groundwater Storage, Water Quality, Land Subsidence

Project Status: This project is an ongoing project and the feasibility and 60% designs completed.

Required Permitting and Regulatory Process: DWR, Butte Count, California SWRCB Water Right Permit, CEQA

Timetable for Initiation and Completion: 2024-2032

Expected Benefits and Evaluation: Utilization of flood waters and intra-basin water transfers to increase the surface water supply in the basin will offset groundwater pumping and allow groundwater levels and volume to recover.

How Project Will Be Accomplished/Evaluation of Water Source: This project is a direct recharge and water supply/conjunctive use project. The water would be supplied by surface water from SFWPA and floodwater that has historically accumulated in Palermo.

Legal Authority: The project would be under the authority of SFWPA and the Wyandotte Creek GSA. Additional evaluation of water rights may be necessary as projects move forward.

Estimated Costs and Plans to Meet Costs: TBD; likely funding via Proposition 4 or privately funded by willing landowners.

Circumstances for Implementation: This project is an Ongoing Project, meaning it is currently being worked on. The project will be implemented once additional grant funds have been secured.

Trigger for Implementation and Termination: Availability of water sources and negotiations with water suppliers and landowners.

Process for Determining Conditions Requiring the Project to have Occurred: This is an Ongoing Project that is anticipated to move forward due to strong stakeholder support.

5.2.6 Potential Projects

Projects categorized as Potential Projects are currently in the planning stages and may move forward if funding becomes available or if they become necessary to achieve sustainability. The Potential Projects are presented in Table 5-3.

5.2.6.1 Extend Orchard Replacement

Under this project, various funding sources would incentivize local growers to increase the duration of their current fallowing practice between orchard removal and replanting by one growing season. The extra time would allow the soil to fallow and decrease the overall demand on groundwater and other water sources. Additionally, this program may also reduce the need for soil treatments such as fumigation and expand recycling options for the previous orchard. This project has the potential to fallow many acres although it is not determined at this time. As envisioned, this project would be dependent on the availability of financial incentives and willingness of landowners to participate. Participation in the program would be voluntary.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA / Butte County
Project Type:	Conservation
Estimated Groundwater Offset and/or Recharge:	TBD

Measurable Objective Expected to Benefit: Groundwater Levels

Project Status: This project is still in the early conceptual planning stages.

Required Permitting and Regulatory Process: None

Timetable for Initiation and Completion: To be determined. The timetable would be dependent on the availability of financial incentives and willingness of farmers to participate.

Expected Benefits and Evaluation: By increasing the time between orchard removal and replanting, the soil may be allowed to fallow, restoring its fertility, and decreasing its water demand. This would decrease the overall use of groundwater in the Subbasin.

How Project Will Be Accomplished/Evaluation of Water Source: This project is a demand-side conservation project. No additional water source will be utilized for this project.

Legal Authority: The project would be under the Wyandotte Creek GSA, local landowners and other entities To be determined.

Estimated Costs and Plans to Meet Costs: To be determined; funding via Proposition 1, Proposition 68, USDA, National Resource Conservation Service (NRCS)

Circumstances for Implementation: This project is a Conceptual project in the early conceptual planning stages and would require significant additional work to move forward.

Trigger for Implementation and Termination: None

Process for Determining Conditions Requiring the Project to Occur: The project proponents are in the process of determining the feasibility of this project including the possibility of securing the necessary finances to move forward.

5.2.7 Other Projects

Projects categorized as Other Projects may have benefits to groundwater conditions but are not part of the GSA's strategy to maintain/achieve sustainability. Other Projects are not being led by the GSA, but will still be tracked, as feasible. These Other Projects are presented in Table 5-4.

5.2.7.1 Oroville Wildlife Area Robinson's Riffle Project

The Robinson's Riffle Project is a major restoration project for the Oroville Wildlife Area, a 12,000-acre area located in Butte County and managed by DWR and the CDFW. Under this project, the Feather River would undergo major grading improvements that would lower the floodplain surface to a more naturalized condition by excavating tailing piles, reconnect the overbank areas to the main channel, and create new side-channel and floodplain habitat. This work would increase the overall area of riverine habitat, thereby improving the flow and quality of the water, removing invasive species along the banks, and increasing the surface available for recharge into the aquifer during flood events. Additionally, increasing the overall streamflow in the river will benefit several local species. Necessary permits will be obtained by the SBFCA, in partnership with DWR and CDFW. SBFCA is in the process of conducting a series of workshops, during which they will share details of the project with potential stakeholders and resource agencies and obtain the necessary funding to move forward.

Project Summary

Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA / SBFCA, Golden State Salmon Association
Project Type:	Direct Recharge
Estimated Groundwater Offset and/or Recharge:	TBD

5.2.7.2 Streamflow Augmentation

Under this project, flood waters from water right holders in the region would be diverted to certain creeks or streams in the Wyandotte Creek Subbasin. This flood waters would be used for direct and water supply/conjunctive use to restore groundwater levels in the basin, as well as increase stream flows. The Wyandotte Creek GSA would head the project and initially conduct an investigation and feasibility study.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA / PG&E, surface water right holders
Project Type:	Direct Recharge, Water Supply/Conjunctive Use
Estimated Groundwater Offset and/or Recharge:	1,000-5,000 acre-feet/year

5.2.7.3 Water Loss Monitoring

The water providers across the Wyandotte Creek subbasin recognize that water loss across their systems due to unpermitted use. SFWPA, which provides service to cities such as Oroville and Palermo, has recognized that fire hydrants, which are primarily used for fire suppression, are being used for other unmonitored purposes. The extended use of fire hydrants is negatively affecting the amount of available surface water in the service area. The hydrants do not have meters on them, making it difficult to monitor usage when used by those without portable meters. Under this project, water providers would evaluate and implement procedures to track usage and water loss more accurately from their systems. This evaluation could include implementation of new practices to reduce unregulated use or even installation of meters on hydrants.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA/ SFWPA, Butte County
Project Type:	Conservation
Estimated Groundwater Offset and/or Recharge:	Unknown

5.2.7.4 Well Upgrades

Under this project, TWSD would install variable frequency drives and telemetry on its groundwater wells to better utilize groundwater and to document groundwater pumping.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA, TWSD, Butte County, DWR
Project Type:	Conservation

Estimated Groundwater Offset and/or Recharge:	TBD

5.2.7.5 Fuel Management for Watershed Health

Numerous fuel management projects would be implemented to protect various water sources in the Wyandotte Creek Subbasin and in the upper watershed of the Wyandotte Creek Subbasin and to better maintain overall watershed health. The implementation of fuel management projects in the Wyandotte Creek Subbasin will help with the protection of water bodies, maintaining quality and ensuring that those bodies can continue to be water sources for communities and agriculture.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA, Butte County Fire Safe Council, Butte County Resource Conservation District, NRCS
Project Type:	Conservation
Estimated Groundwater Offset and/or Recharge:	TBD

5.2.7.6 Removal of Invasive Species

Invasive species are a threat to the Wyandotte Creek Subbasin's ecosystem and water resources since they are known to consume water and hamper recharge. Under this project, invasive species and native grasses would be mapped to help track the effects these species have on water supplies and to help plan out future groundwater management actions. Following this initial mapping, management plans would be developed to establish groundwater management goals and propose actions towards the removal of invasive species. Appropriate funding mechanisms would be identified and secured to move the project forward.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA, local, state, and federal organizations and agencies
Project Type:	Conservation
Estimated Groundwater Offset and/or Recharge:	TBD

5.2.7.7 Recharge Well (Injection Well)

Under this project, the TWSD treatment plant would install an injection well that would inject raw and backwash water from its operations into the basin.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA /TWSD, Butte County, DWR
Project Type:	Direct Recharge
Estimated Groundwater Offset and/or Recharge:	TBD

5.2.8 Notification Process

The GSA will continue to conduct public outreach and will be responsible for notification of the projects. Regular updates will be provided to the GSA Boards and presented on the website (www.wyandottecreekgsa.com) as projects are implemented. Outreach is likely to be provided via public notices, meetings, website, social media, and email lists.

5.3 Management Actions

In order to achieve sustainable groundwater management, management actions can be implemented to focus on reduction of groundwater demand. The management actions can include increased data collection, education and outreach, regulatory policies, incentive programs, and enforcement actions. The GSA has prioritized the management actions by splitting them into two categories: potential management actions and other management actions.

The following sections will present management action options that the GSA may consider during GSP implementation. The GSA will monitor, participate, and coordinate with respective agencies for each of the Management Actions that may be considered. The schedule to implement the management actions is likely to vary depending upon Wyandotte Creek Subbasin conditions and the expected benefits may also vary year to year.

5.3.1 Potential Management Actions

Management Actions categorized as Potential Management Actions are currently in the planning stages and may move forward if funding becomes available or if they become necessary to prevent the occurrence of undesirable results.

5.3.1.1 Domestic Well Mitigation

In order to protect domestic water supplies in the region, the Wyandotte Creek GSA would conduct the following under this management action:

1. Establish a voluntary registry for domestic wells.
2. Compile domestic well logs, screen depths, and locations.
3. Improve and deepen domestic wells so that well screens are at or below the MTs established for the Wyandotte Creek Subbasin.
4. Provide emergency supplies, such as bottled drinking water or potable water for sanitation, to communities with dry domestic wells. Priority would be given to DACs who are dependent on groundwater.

Creating a registry of domestic wells in the region, with information on well location and screen depths, would help the GSA compile important data into a centralized location. This would allow the GSA to determine which wells need to be updated to the current standards and which may need to be deepened, as well as to help them prioritize certain communities for emergency response.

Development of the mitigation program started in 2023, and the program will be implemented if groundwater conditions decline below historical lows or as domestic wells are being significantly impacted by declining groundwater levels. Local agencies are actively working to connect vulnerable residents with domestic wells to public water supply systems, such as the Palermo Clean Water Consolidation Project.

5.3.2 Other Management Actions

Management Actions categorized as Other Management Actions may have benefits to groundwater conditions but are not part of the GSA's strategy to maintain/achieve sustainability.

5.3.2.1 General Plan Updates

Under this management action, the Wyandotte Creek GSA would monitor, participate, and coordinate with the City of Oroville and Butte County, who are currently updating their General Plans, to make necessary amendments so that the plans recognize important components of the Wyandotte Creek Subbasin's GSP.

5.3.2.2 Well Permitting Ordinance

According to current Butte County Code, wells are required to be screened below groundwater levels measured during the 1989 to 1994 drought. With water levels continuing to decline in the Wyandotte Creek Subbasin, several domestic wells are becoming dry. Wyandotte Creek GSA in coordination with Butte County would work to update the current well permitting ordinance to require all domestic wells in the Representative Monitoring Network area to be screened below the MT depths established for the Wyandotte Creek Subbasin.

5.3.2.3 Landscape Ordinance

Wyandotte Creek GSA will coordinate with Butte County and the City of Oroville to update the landscape ordinance to encourage new residential, commercial, and industrial developments to use drought-resistant species and to limit the size of grass turf lawns. This ordinance would also promote xeriscaping and focus efforts and funds on reducing landscape irrigation and water use for swimming pools. The implementation of this ordinance would require a period of planning, public discussion, and code enforcement for each new building permit.

5.3.2.4 Expansion of Water Purveyors' Service Area

Under this management action, water purveyors would expand their service areas and provide drinking water to residential areas that are currently using private domestic groundwater wells. Groundwater levels in the Wyandotte Creek Subbasin would be allowed to recover with the overall decrease in groundwater demand. This action would require approval from the Butte Local Agency Formation Commission and the California Public Utilities Commission.

5.4 Data Collection and Analysis

5.4.1 County Contour Mapping

As part of the efforts to collect the information necessary to fill the information needs and data gaps identified in Section 3, this project proposes to expand the existing monitoring program to include Butte, Glenn, Colusa, and Tehama counties and conduct these groundwater elevation surveys in the spring, summer, and fall. The monitoring program would gather data used to produce groundwater contours and estimates of lateral and vertical flow direction and volume.

Producing this data for the four counties will help to identify interbasin flow patterns and influences on surface water flows and replenishment locations, thereby improving coordination between counties and water management decision-making.

Routine water table monitoring programs will track overall water table trends in the region and provide important, up-to-date data for making decisions on water management. Establishing these programs amongst the four counties will aid in the exchange of data and improve regional coordination on various water projects. The expanded water monitoring programs will be established by the Wyandotte Creek GSA, with assistance from the four counties.

5.4.2 Project: Update the Butte Basin Groundwater Model

The existing BBGM covers the Vina, Butte, and Wyandotte Creek Subbasins. This project will help fill the identified information needs and data gaps and will consist of 1) updating the BBGM with newly acquired data; and 2) using the updated version of the model to run simulations and better establish the basin's SMC as needed.

Some of the new data to be added is the AEM data and data on the different hydraulic conductivities of each layer of the aquifer. The AEM data will be used, among other things, to adjust the various surfaces in the model to better present the aquifer's hydrogeologic layers.

Once the model has been updated with the new data, it will be better suited for running simulations of different water or land management scenarios as well as predictions for climate and precipitation fluctuations. Lateral and vertical connectivity between aquifer layers and connections to surface water features will be more accurate and help identify areas of the basin where groundwater recharge may be needed. Overall, this will help shape management actions by focusing their efforts on those particular areas. Ongoing updates to the model will emphasize the importance of accurate and up-to-date data and help continue monitoring efforts such as measuring water levels and stream flows.

An updated groundwater model is vital for running accurate simulations that may be used to make important decisions regarding groundwater allocation, pumping, recharge, and other activities. The model should contain the most up-to-date data to represent the basin realistically and accurately. Two updates to the model are currently planned during SGMA implementation.

5.4.3 Community Monitoring Program

As discussed in Section 3.3, the MT for groundwater levels is based on the depths of domestic wells. The dataset used for this assessment is limited and likely includes wells no longer in use or poorly maintained. To resolve this data gap, the GSA will conduct surveys of domestic wells within the Wyandotte Creek Subbasin to assess if the wells are still active and well construction details. As domestic well construction information may be limited, selected wells may be video logged to obtain additional information.

The GSA will also maintain a record of verifiable domestic wells that go dry during the implementation period that will include depth of these wells, screen intervals, and available maintenance records. These data will be used to modify the MT over the implementation period, as appropriate. New groundwater level monitoring sites will be added to the community monitoring program pending stakeholder interest and funding.

5.4.4 Interconnected Surface Water/Associated Impacts on Groundwater Dependent Ecosystems

As presented Section 4.10, there is limited data to analyze interaction of streams and pumping within the primary aquifer system. Additional wells and other monitoring networks have been installed and may be expanded, as appropriate, and data is being collected at newly installed monitoring sites. The GSA may re-evaluate ISW/ GDE following the framework discussed in Section 3.8.

5.5 Adaptive Management Strategies

The Wyandotte Creek GSA will be requesting annual reports from the project proponents to evaluate progress on implementation. If the projects are not progressing or if monitoring efforts demonstrate that those projects are not achieving their targets, the GSA will evaluate the need for additional or modified projects and begin implementation of management actions.

5.6 Potential Available Funding Mechanisms

As listed above in the individual project descriptions, several funding mechanisms have been identified to help with the planning and implementation of the GSP projects. The following is an abbreviated list of some of the funding mechanisms proposed:

Project Type	Funding Type	Program	Dates
IRWM (projects included in an adopted IRWMP)	Implementation grant	TBD	Proposition 4 funds expected 2027
Recharge Projects	Planning, design, and construction grants	TBD	Proposition 4 funds expected 2027
Wastewater Treatment for URC Projects	Planning and construction grants	Small Community Grant Fund	Applications accepted continuously
Public Water Systems Improvement	Planning and construction grants	Drinking water grants	Applications accepted continuously
Land Conservation	USDA Farm Service Agency	Conservation Reserve Program	Applications accepted continuously

6. PLAN IMPLEMENTATION

The SGMA requires the GSA to partner with groundwater users to develop and implement GSPs to achieve groundwater sustainability. SGMA requires the Wyandotte Creek Subbasin to be sustainable by 2042. The GSP includes provisions to evaluate current conditions in the Wyandotte Creek Subbasin (Section 2), establish the SMC (Section 3), gather and analyze groundwater data (Section 4), and report findings. The provisions in the GSP will be evaluated every 5 years and updated as necessary. The Wyandotte Creek Subbasin GSA is required to submit the amended GSP to DWR by January 31, 2027. DWR will evaluate the GSP within 24 months of submittal. Upon submittal of this GSP to DWR, GSP implementation will begin in the Wyandotte Creek Subbasin. The GSA will continue their efforts with public engagement and to secure funding to monitor and manage groundwater resources. This section presents the manner in which the GSA will execute the GSP consistent with the requirements in CCR Title 23 § 354.6(e).

The GSP includes provisions for:

- Gathering data at RMS locations
- Evaluation of SMC
- Report of findings and analysis
- PMAs

Each of these will require funding and schedule coordination to help achieve Wyandotte Creek Subbasin sustainability goals. The following sections describe the funding mechanisms and timetable for the GSP implementation.

6.1 Estimate of Groundwater Sustainability Plan Implementation Costs

Where feasible, the GSA will use existing funding and/or programs for use in the GSP implementation. The GSA, member agencies, and water purveyors will coordinate to implement the actions outlined in this GSP. The GSA will fund the implementation of the GSP where other sources are not available. The cost of implementation of the GSP by activity is presented below.

6.1.1 Administrative Costs

These include the cost of annually operating the GSA, including staff expenses, audit, outreach, legal and other administrative costs. This does not include agency specific project implementation costs. Costs are estimated to be in the range of approximately $100,000 to $300,000 annually.

Table 6-1: Estimated Administrative Costs

GSP Implementation	Estimated Annual Costs
Public Outreach	$15,000
Staff	$100,00
Legal	$20,000
Total Estimate	$135,000

6.1.2 Monitoring

Monitoring for compliance with SGMA regulations will include periodic (e.g., biannual / monthly) collection of groundwater levels RMS wells and annual collection of groundwater quality measurements. The GSA will maintain sites including all continuous measurement equipment at groundwater level sites and stream gages as conditions dictate and funding allows. The GSA will assess the value and need for added monitoring data annually and adjust their monitoring plan as needed. Monitoring activity costs will include labor (field data collection, surveying, laboratory analysis, data quality control / assurance, and project management) and equipment (vehicles, meters, pumps, field tools/supplies).

Table 6-2: Monitoring Activities and Estimated Cost

Monitoring Activity	Frequency	Estimated Annual Cost
Groundwater Levels (minimum required)	Biannual, 2 events	$30,000
Groundwater Quality (minimum required)	Annual, 1 event	$6,000
Groundwater Levels & Stream Gages (as conditions dictate and funding allows)	Continuous sensors / telemetry	Up to $61,500

Some monitoring locations include wells that are monitored and funded under other existing programs.

6.1.3 Data Analysis

The data gathered from the monitoring will be analyzed to assess trends for determination of undesirable results. Analysis of the data may lead to modifications in the RMS network, the HCM, and the priority of PMAs. Data gaps that arise from analysis may require installation of new RMS locations.

Table 6-3: Data Analysis Activities and Estimated Cost

Data Analysis Activity	Frequency	Estimated Annual Cost
DMS	Annual	$5,000
Review of Groundwater Data	Annual	$5,000

6.1.4 Reporting and Evaluation

Annual reports are required after GSP adoption to provide updates to general GSP information, basin conditions, and plan implementation progress. Section 6.5 discusses the annual reporting plan in more detail. GSA are required to conduct an evaluation of the GSP and prepare a report every 5 years or whenever the GSP is amended. Section 6.6 discusses the evaluation report in more detail.

Table 6-4: Reporting and Evaluation Activities and Estimated Cost

Reporting Activity	Frequency	Estimated Cost
Annual Report	Annual	$30,000
5-year Evaluation Report	5 Years	$100,000

6.1.5 Data Collection

A discussion of the data needed to improve groundwater management and address data gaps is presented in Section 5 and the estimated costs are presented below.

Table 6-5: Estimated Costs for Implementing Data Improvements to address Data Gaps

Data Collection	Estimated Costs
Contour Mapping	$15,000 - $40,000
Interconnected Surface Water/GDEs	$100,000 - $200,000
Butte Basin Model Update 1	$25,000 - $75,000
Butte Basin Model Update 2	$25,000 - $75.,000

6.1.6 Project and Management Actions

The PMAs and anticipated costs are presented in Section 5. The PMAs with a planned initiation date in or before 2042 are presented below.

Table 6-6: Estimated Project Costs

Project Name	Capital Costs	Expected Groundwater Demand Reduction (AFY)
TWSD Water Treatment Plant Capacity Upgrade	$1.5 -$3M	500+
Palermo Clean Water Improvement Project	$12.4M	500+
Flood MAR	TBD	500+
Intra-Basin Water Transfer	TBD	Up to 4,000
Agricultural Surface Water Supplies	TBD	Up to 4,000
Residential Water Conservation	TBD	100 - 200
Agricultural Irrigation Efficiency	TBD	TBD
Oroville Wildlife Area Robinson's Riffle Project	$1.7M	TBD
Streamflow Augmentation	TBD	1,000 – 5,000
Water Loss Monitoring	$800,000	TBD
Well Upgrades	TBD	TBD
Fuel Management for Watershed Health	TBD	TBD
Removal of Invasive Species	TBD	TBD

6.2 Identify Funding Alternatives

The GSA will seek to capitalize on existing funding and programs that overlap with GSP requirements. For example, Butte County, DWR and other entities currently fund groundwater data collection programs at locations within the Wyandotte Creek Subbasin. The GSA will ensure that the existing programs meet the technical requirements of the monitoring and reporting as outlined in the GSP.

In cases where no funding or programs are established, the GSA is responsible for securing funding for the GSP implementation. In 2023, the GSA successfully passed a Proposition 218 process to assess landowners based on three user classes: non-irrigated, irrigated with surface water, and irrigated with groundwater. These fees fund administrative, legal, and SGMA-compliance costs. The GSA will consider alternative funding structures based on feedback from constituent members as needed.

Funding is anticipated to be met from one or a combination of the following sources: direct contributions from the GSA constituent members, State and Federal grant funding, and taxes or assessments levied on landowners and groundwater users in accordance with local and State law.

The GSA successfully applied for funding through the DWR's Sustainable Groundwater Management (SGM) Grant Program to support ongoing operational costs and to fund agency operations. These costs include retaining consulting firms and legal counsel to provide oversight and assist with SGMA compliance. Expenses consist of administrative support, GSP development, and GSP implementation. The GSA will continue to apply for grant funding to support GSP implementation.

6.3 Schedule for Implementation

The monitoring, data analysis and reporting will begin upon submittal of the GSP by DWR. The PMAs listed in Table 6-6 are scheduled to be completed by 2042 or earlier. Each of the PMAs will be completed by priority as funding and resources become available.

6.4 Data Management Systems

In development of this GSP, the GSA developed a groundwater model that was calibrated to estimate future scenarios. The DMS plans to build on existing data inputs in the groundwater model and develop a more formalized approach to collecting and capturing data. As stated in Section 4, Monitoring Network, future data will be gathered to develop annual reports as well as provide necessary information for future and ongoing update to the groundwater models at five-year intervals upon GSP implementation. The DMS that will be used is a geographical relational database that will include information on water levels, land elevation measurements, and water quality testing. The DMS will allow the GSA to store the necessary information for annual reporting.

The DMS will be on local servers and data will be transmitted annually to form a single repository for data analysis for the Wyandotte Creek Subbasin's groundwater, as well as to allow for preparation of annual reports. GSA representatives have access to data and will be able to ask for a copy of the regional DMS. The DMS currently includes the necessary elements required by the regulations, including:

- Well location and construction information for the representative monitoring points (where available)

- Water level readings and hydrographs including water year type
- Land based measurements
- Water quality testing results
- Estimate of groundwater storage change, including map and tables of estimation
- Graph with Water Year type, Groundwater Use, Annual Cumulative Storage Change

Reporting generated from data from the GSA will include but is not limited to:

- Seasonal groundwater elevation contours
- Estimated groundwater extraction by category
- Total water uses by source

Additional items may be added to the DMS in the future as required. Data will be entered into the DMS by each GSA. The majority of the data will then be aggregated to the entity that is responsible for the regional DMS and summarized for reporting to DWR. Groundwater contours will be prepared outside of the DMS because of the need to evaluate the integrity of the data collected and generate a static contour set that has been reviewed and will not change once approved. Groundwater storage calculations will be calculated in accordance with the method described in Section 2, outside of the DMS. Results are uploaded to the DMS for annual reporting and trend monitoring. Since most of the pumping in the Wyandotte Creek Subbasin is not currently measured, the groundwater pumping estimates are also calculated outside of the DMS using the methods developed by GSA and uploaded to the DMS for annual reporting and trend analysis. The GSA may choose to have their own separate system for additional analysis.

The one-time cost of expanding the existing data systems is estimated between $50,000 to $200,000 as the system is still being evaluated. The Board has indicated a desire to make the data transparent and available to the public while respecting the privacy of individual landowners.

6.5 Annual Reporting

Annual reports will be submitted by April 1 for the prior year's activities. The report will include a general update in the form of an executive summary with accompanying map of the Wyandotte Creek Subbasin. The body of the report will include a detailed discussion and graphical representation of the following:

- Groundwater elevation data, including contour maps at seasonal high and low conditions and hydrographs using water year type and historical data from at least 2015.
- Groundwater extraction data divided into volume by water usage sectors with accompanying map, including a description of the methodology and accuracy of the groundwater extraction estimation.
- Surface water volume used or available for use for groundwater recharge or water supply/conjunctive use, including a description of the water sources.

- Total water volume use divided into water use sector and water source type, including a description of the methodology and accuracy of the water use estimation.
- Changes in groundwater storage with accompanying map, including a graph with water year type, groundwater use, annual change in groundwater storage, and cumulative change in groundwater storage using historical data from at least 2015.

The annual report will also include a discussion and update on the plan implementation including the status of IM and the execution of PMAs.

6.6 Periodic Evaluation Report

The GSA will evaluate the GSP and provide a Periodic Evaluation report every 5 years or whenever the GSP is amended for submittal to DWR, as required by SGMA and in consideration of DWR guidance.

6.7 Inter-basin Coordination

Wyandotte Creek GSA intends to coordinate in the following ways with its neighboring subbasins and with subbasins in the Feather River Corridor (Wyandotte Creek, Butte, North Yuba, Sutter Subbasins):

1. Information Sharing

Wyandotte Creek Subbasin will work with GSA staff of Butte and North Yuba subbasins to identify lines of communication and methods for information sharing between subbasins and GSA Boards. This will continue throughout GSP implementation and may include:

1. Inform each other on changing conditions (i.e., surface water cutbacks, land use changes, policy changes that inform groundwater management)
2. Share annual reports and interim progress reports
3. Share data and technical information and work towards building shared data across and/or along basin boundaries (e.g., monitoring data, water budgets, modeling inputs and outputs, and GDEs)

2. Conduct Joint Analysis and Evaluation of GSPs

Wyandotte Creek Subbasin pursued grant funding and collaboratively worked with subbasins in the Feather River Corridor group to:

1. Contract with a consultant to conduct this work
2. Evaluate and compare contents of GSPs with a focus on establishing a common understanding of basin conditions at boundaries
3. Identify significant differences, uncertainties, and potential issues of concern related to groundwater interaction at the boundaries
4. Engage in analysis and evaluation of SMC between GSPs to assess impacts and identify significant differences and possible impacts between subbasins that could potentially lead to undesirable results

This work was completed in 2026.

3. Coordinate on mutually beneficial activities

Wyandotte Creek GSA will work collaboratively with Feather River Corridor subbasins to identify items in our GSPs that are ripe for a coordinated project and pursuit of funding such as Projects and Management Actions, Data Gaps (new monitoring wells, stream gaging etc.)

1. Wyandotte Creek will pursue grant funding to support a consultant to conduct this work
2. Wyandotte Creek will work collaboratively with the Northern California Water Association (NCWA) and others in their efforts to pursue funding and support local and state agency activities to identify and fill regional data gaps

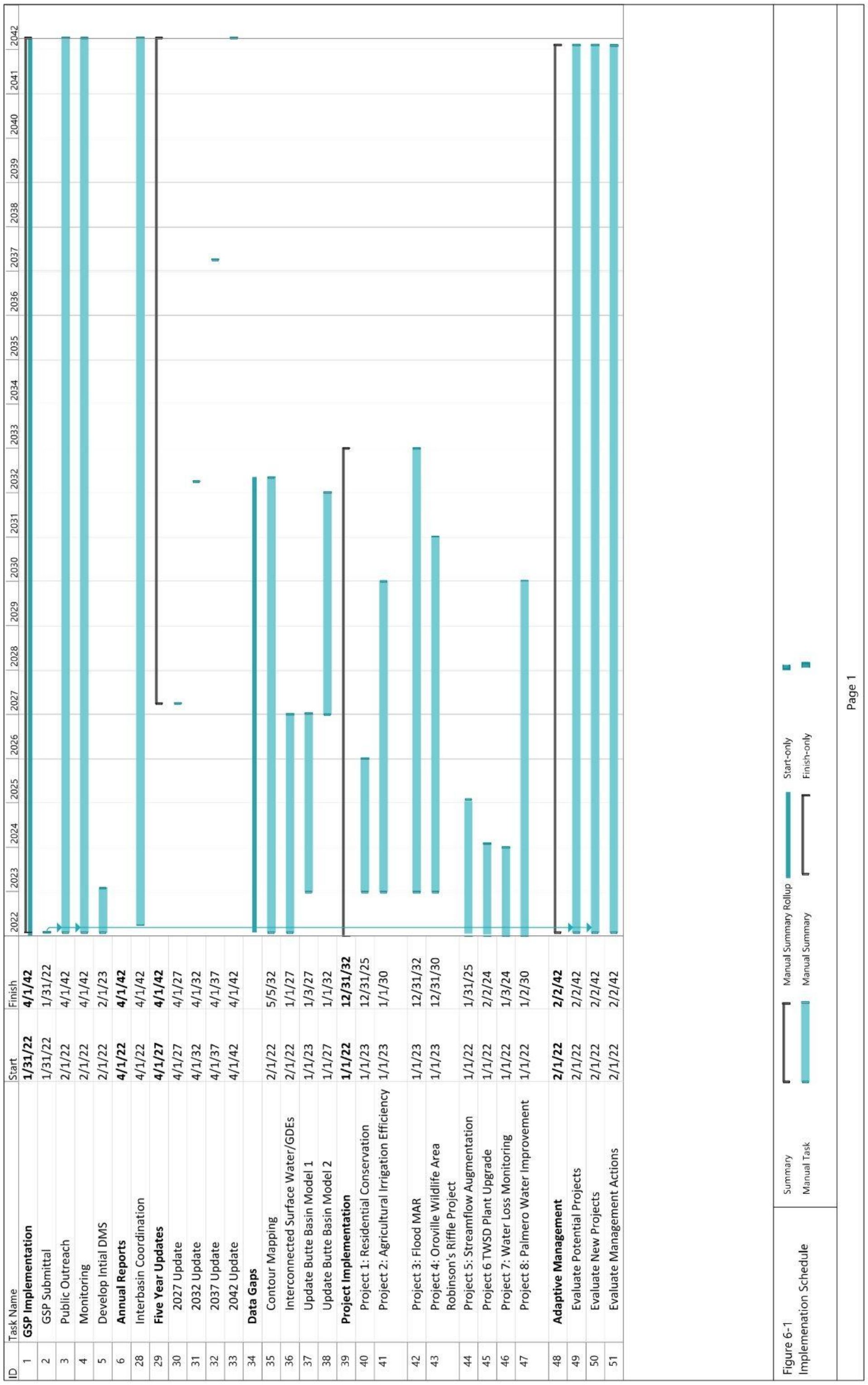
4. Coordinated Communication and Outreach

Wyandotte Creek GSA staff will continue to participate in regional public engagement activities and efforts related to implementation of SGMA in the Northern Sacramento Valley. This may include:

1. Coordinate and collaborate on regional-scale public engagement and communication strategies that promote awareness on groundwater sustainability, enhance public trust, and maintain institutional knowledge
2. Maintain list of GSP/subbasin staff contacts and websites

5. Issue Resolution Process

Wyandotte Creek Subbasin will pursue development of an issue-resolution process with neighboring subbasins in the Feather River Corridor group.



ID
Task Name
Start
Finish
1 GSP Implementation 1/31/22 4/1/42
2 GSP Submittal 1/31/22 1/31/22
3 Public Outreach 2/1/22 4/1/42
4 Monitoring 2/1/22 4/1/42
5 Develop Intial DMS 2/1/22 2/1/23
6 Annual Reports 4/1/22 4/1/42
28 Interbasin Coordination 4/1/22 4/1/42
29 Five Year Updates 4/1/27 4/1/42
30 2027 Update 4/1/27 4/1/27
31 2032 Update 4/1/32 4/1/32
32 2037 Update 4/1/37 4/1/37
33 2042 Update 4/1/42 4/1/42
34 Data Gaps
35 Contour Mapping 2/1/22 5/5/32
36 Interconnected Surface Water/GDEs 2/1/22 1/1/27
37 Update Butte Basin Model 1 1/1/23 1/3/27
38 Update Butte Basin Model 2 1/1/27 1/1/32
39 Project Implementation 1/1/22 12/31/32
40 Project 1: Residential Conservation 1/1/23 12/31/25
41 Project 2: Agricultural Irrigation Efficiency 1/1/23 1/1/30
42 Project 3: Flood MAR 1/1/23 12/31/32
43 Project 4: Oroville Wildlife Area Robinson's Riffle Project 1/1/23 12/31/30
44 Project 5: Streamflow Augmentation 1/1/22 1/31/25
45 Project 6 TWSD Plant Upgrade 1/1/22 2/2/24
46 Project 7: Water Loss Monitoring 1/1/22 1/3/24
47 Project 8: Palmero Water Improvement 1/1/22 1/2/30
48 Adaptive Management 2/1/22 2/2/42
49 Evaluate Potential Projects 2/1/22 2/2/42
50 Evaluate New Projects 2/1/22 2/2/42
51 Evaluate Management Actions 2/1/22 2/2/42
2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042
Figure 6-1
Implemenation Schedule
Summary
Manual Task
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
Page 1

7. REFERENCES

Blair, T.C., F.G. Baker, and J.B. Turner. 1991. "Cenozoic Fluvial-Facies Architecture and Aquifer Heterogeneity, Oroville, California, Superfund Site and Vicinity." The Three-Dimensional Facies Architecture of Terrigenous Clastic Sediments and Its Implication for Hydrocarbon Discovery and Recovery, edited by A.D. Miall and N. Tyler, Society for Sedimentary Geology, pp. 148-159.

Bookman-Edmonston Engineering, Inc. 1992. Ground Water Resources and Management in Yuba County. Unpublished report for Yuba County Water Agency.

Brown and Caldwell. 2013. Lower Tuscan Aquifer Monitoring, Recharge, and Data Management Project. Final Report.

BCDWRC. 2021. Model Documentation v 1.0. Butte Basin Groundwater Model. 30 September.

BCDWRC. 2020. Groundwater Status Report- 2019 Water Year.

California Department of Water Resources (DWR). 2003. California's Groundwater. California Department of Water Resources Bulletin 118-Update 2003. 246 pp.

DWR. 2005. Butte County Groundwater Inventory Analysis: prepared by the California Department of Water Resources Northern Region Office, Division of Planning and Local Assistance. February.

DWR. 2006. California's Groundwater Bulletin 118, Sacramento Valley Groundwater Basin, North Yuba Sub-basin. 20 January.

DWR. 2014. Geology of the Northern Sacramento Valley: prepared by the California Department of Water Resources Northern Region Office, Groundwater and Geologic Investigations, updated September 2014.

DWR. 2016. BMP 1 Monitoring Networks and Identification of Data Gaps.

DWR. 2018a. SGMA Groundwater Management. Retrieved from: https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management

DWR. 2018b. 2017 GPS Survey of the Sacramento Valley Subsidence Network Report.

DWR. 2019a. SGMA Data Viewer, https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels

DWR. 2019b. 2016 Statewide Land Use Mapping. https://data.cnra.ca.gov/dataset/statewide-crop-mapping.

DWR Sustainable Groundwater Management Program. 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer https://gis.water.ca.gov/app/NCDatasetViewer/.

California Rice Commission. 2019. Waste Discharge Requirements for Sacramento Valley Rice Growers – 2018 Annual Monitoring Report.

Creely, R.S. 1965. Geology of the Oroville quadrangle, California. California Division of Mines and Geology Bulletin 184. 86 pp.

Dames & Moore. 1994. Extraction Well Field Report, Initial Phase On-Property Groundwater Remedial Action, Koppers Company, Incorporated Superfund Site (Feather River Plant), Oroville, California. August.

Heath, R.C. 1976. "Design of ground-water level observation-well programs." Groundwater 14:71–77.

Helley, E.J. and D.S. Harwood. 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: 24 pp. 5 sheets, scale 1:62,500.

Ireland, R.L., J.F. Poland, and F.S. Riley, 1984, Land Subsidence in the San Joaquin Valley, California, as of 1980, Studies of Land Subsidence, USGS Professional Paper 437-1.

Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, and A. Lyons. 2018. Mapping Indicators of Groundwater dependent ecosystems in California.

LaHue, G.T., and B.A. Lindquist. 2019. "The Magnitude and Variability of Lateral Seepage in California Rice Fields." Journal of Hydrology, 574, 202-210.

North American Commission on Stratigraphic Nomenclature (NACM). 2005. North American Stragraphic Code, AAPG Bulletin, v. 89, no. 11. November.

Northern California Water Association, Sacramento Valley Water Quality Coalition. 2016. Draft Comprehensive Groundwater Quality Management Plan; Appendix B: Subwatershed Action Plans.

Olmsted, F.H., and G.H. Davis. 1961. Geologic features and ground-water storage capacity of the Sacramento Valley, California. Washington: U.S. Government Printing Office. U.S. Geological Survey Water- Supply Paper 1497. 241 pp.

Page, R.W. 1986. U.S. Geological Survey Professional Paper 1401-C, Geology of the Fresh Ground-Water Basin of the Central Valley, California with Texture Maps and Sections, Regional Aquifer System Analysis.

Rohde, M.M., S. Matsumoto, J. Howard, S. Liu, L. Riege, and E.J. Remson. 2018. Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans. The Nature Conservancy, San Francisco, California.

Sophocleous, M. 1983. Groundwater observation network design for the Kansas groundwater management districts, U.S.A. Journal of Hydrology, 61(4), 371–389.

United States Department of Agriculture (USDA). 2020. CropScape - Cropland Data Layer, https://nassgeodata.gmu.edu/CropScape/.

APPENDIX 1-A
Preparation Checklist for Groundwater Sustainability Plan Submittal

APPENDIX 1-B

Joint Powers Agreement and Notice of Agreement

APPENDIX 1-C
Groundwater Status Report for the 2020 Water Year

APPENDIX 1-D
Communication and Engagement Plan

APPENDIX 1-E

Comments to the Draft Groundwater Sustainability Plan and Responses

APPENDIX 2-A
Historical Annual Water Budget Estimates

APPENDIX 3-A

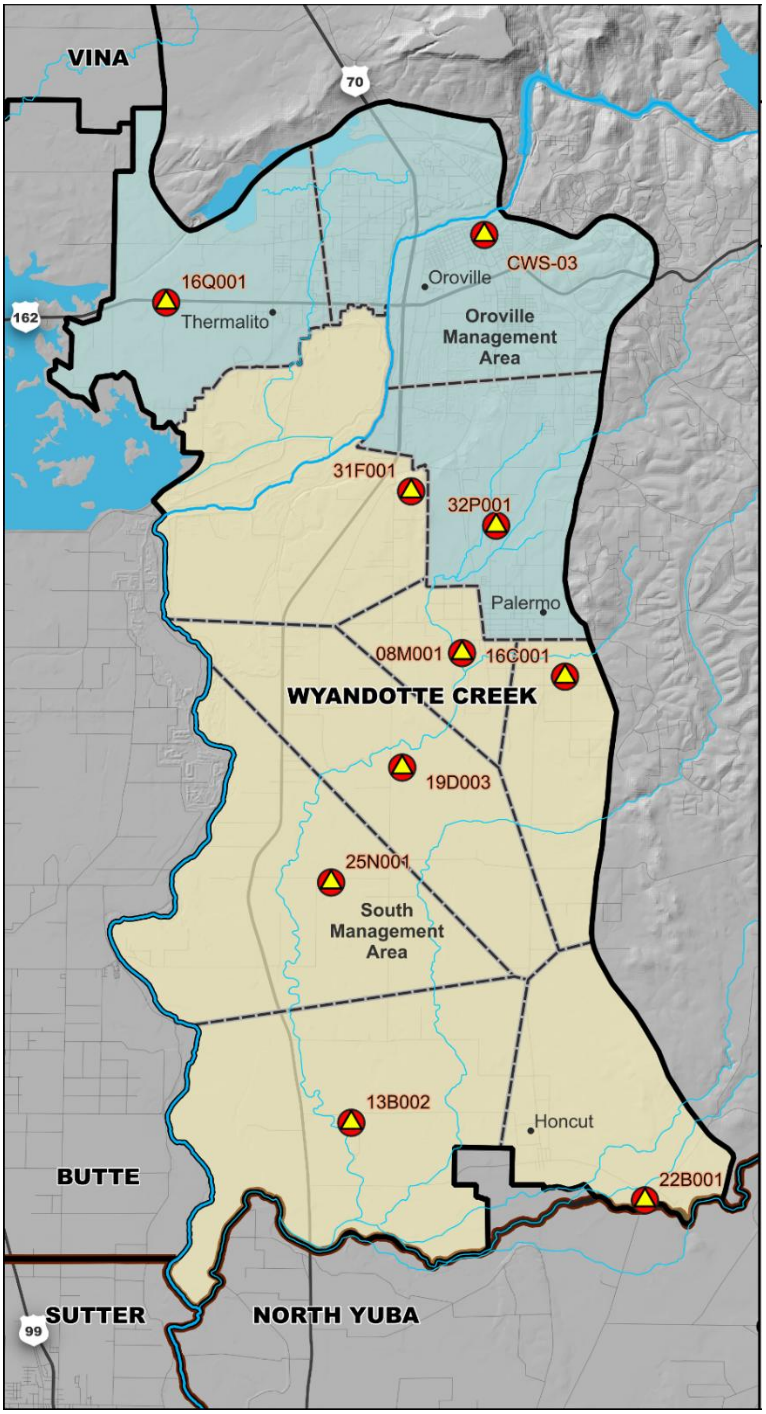
Figures Showing Average Depth of Domestic, Irrigation, and Public Supply Wells

APPENDIX 3-B

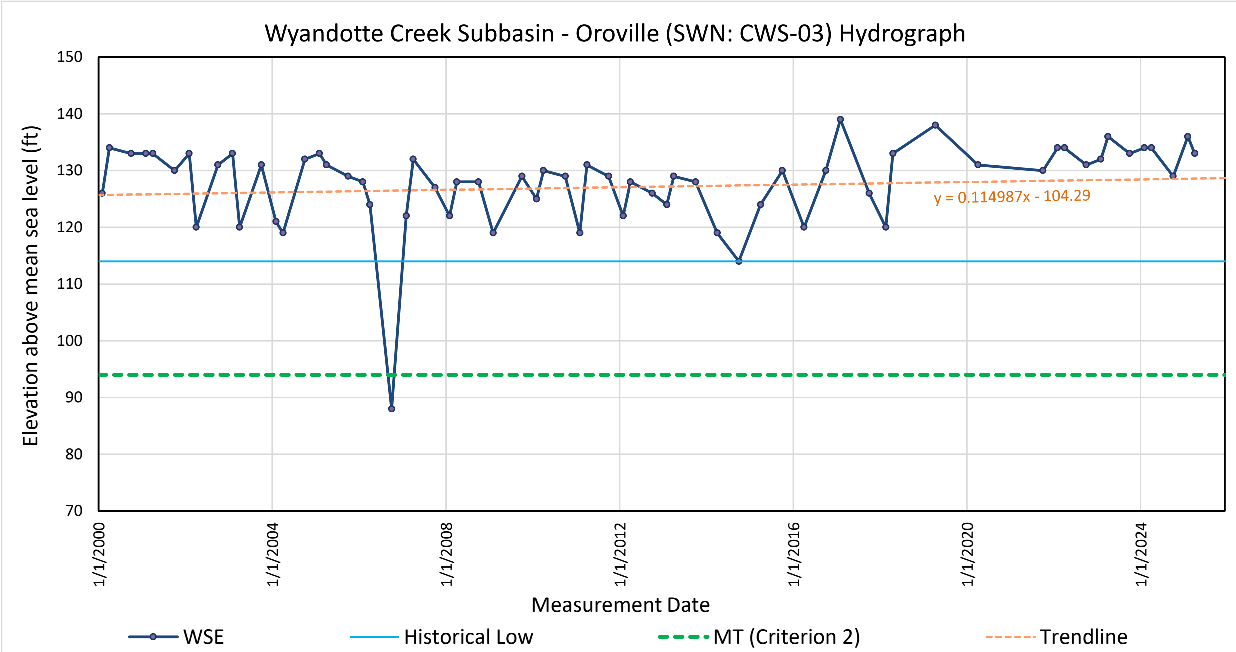
Figures of Representative Monitoring Sites Well Radius and Box and Whisker Plots

APPENDIX 3-C

Representative Monitoring Site Well Hydrographs



The map to the left depicts the 10 RMS wells and the boundaries of their corresponding RMS zones. The following 10 figures display hydrographs for each well along with MTs corresponding to Criterion 1 and Criterion 2 described in Section 3.3.2. If a hydrograph does not show a Criterion 1 MT, then there were not enough domestic wells in the RMS zone.


Wyandotte Creek Subbasin - Oroville (SWN: CWS-03) Hydrograph
Elevation above mean sea level (ft)
150
140
130
120
110
100
90
80
70
1/1/2000
1/1/2004
1/1/2008
1/1/2012
1/1/2016
1/1/2020
1/1/2024
Measurement Date
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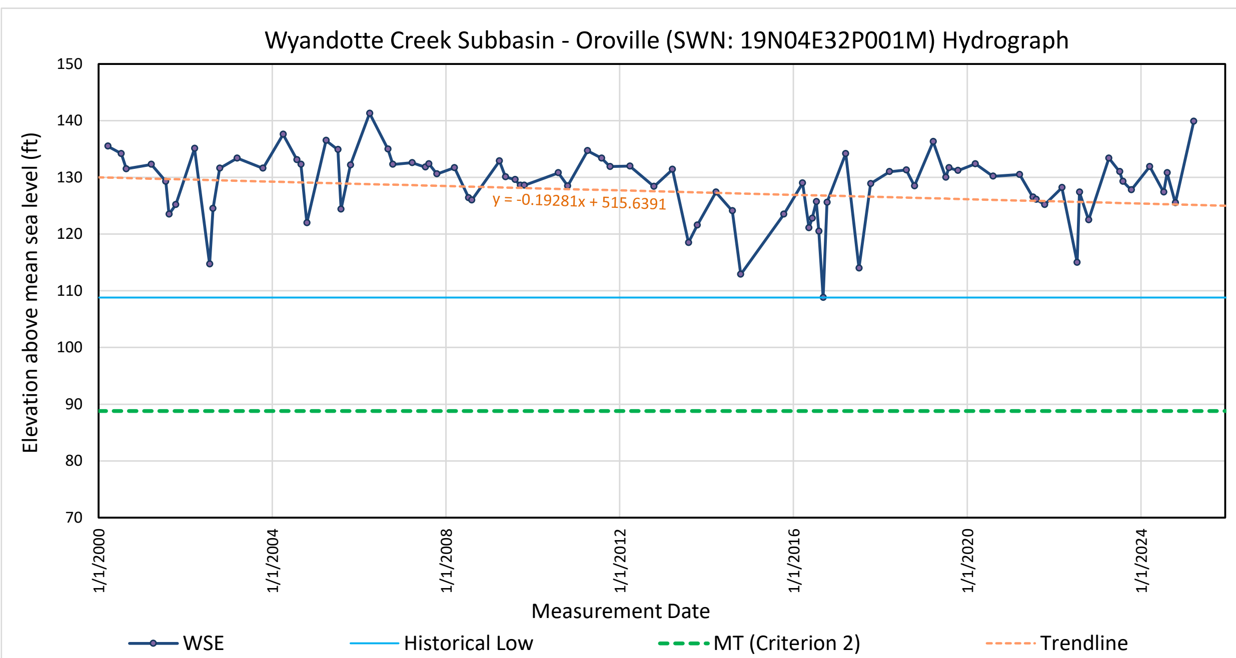
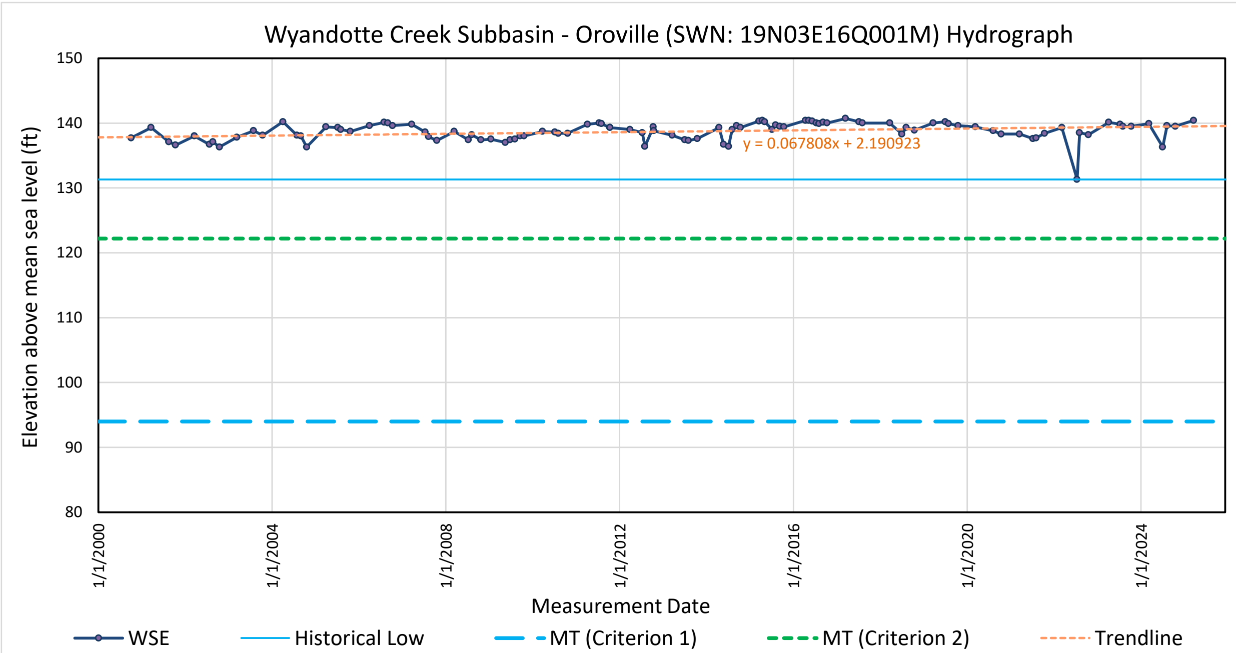
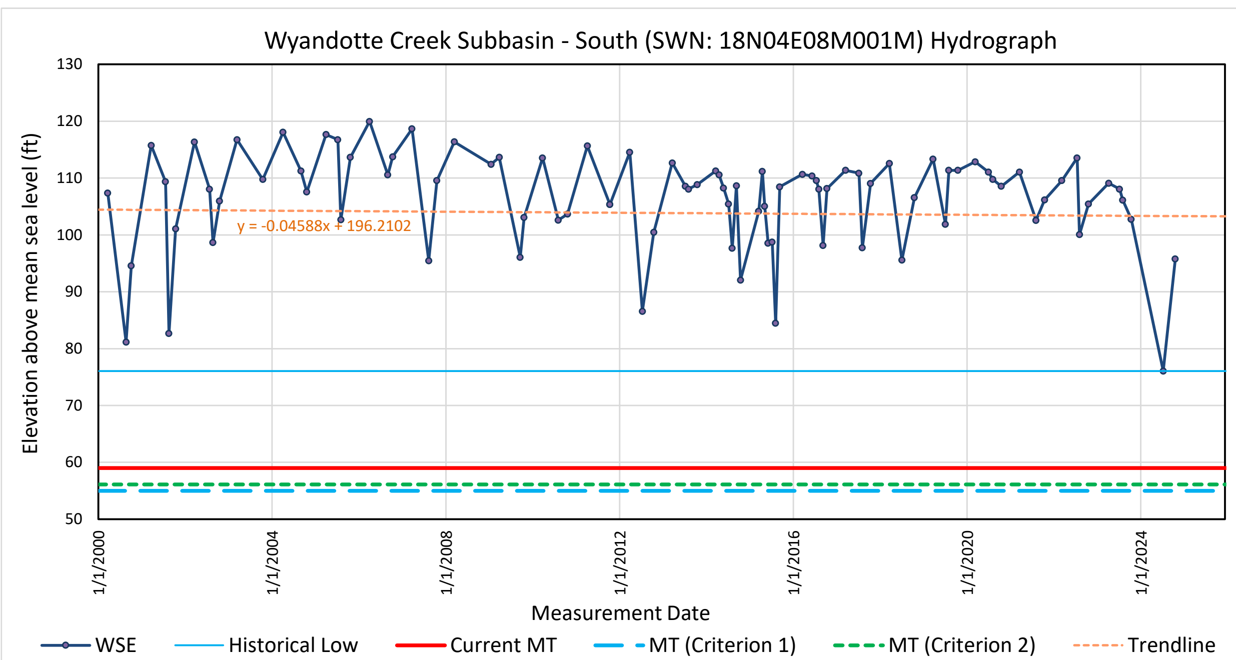
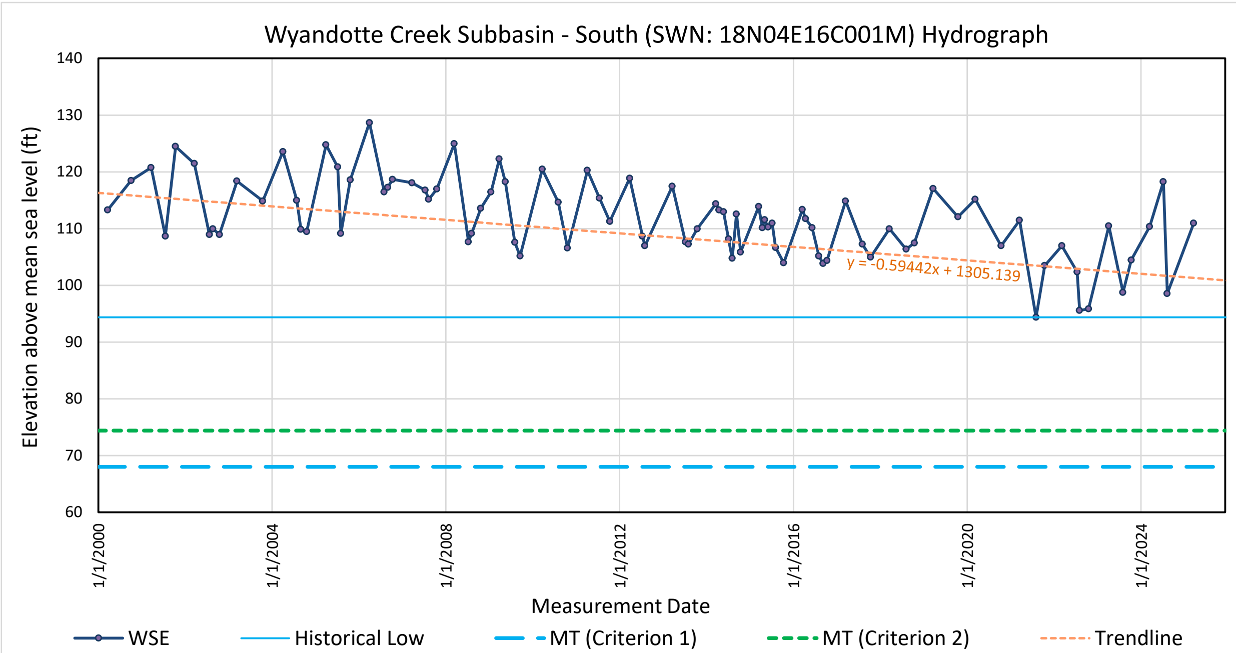
WSE
Historical Low
MT (Criterion 2)
Trendline

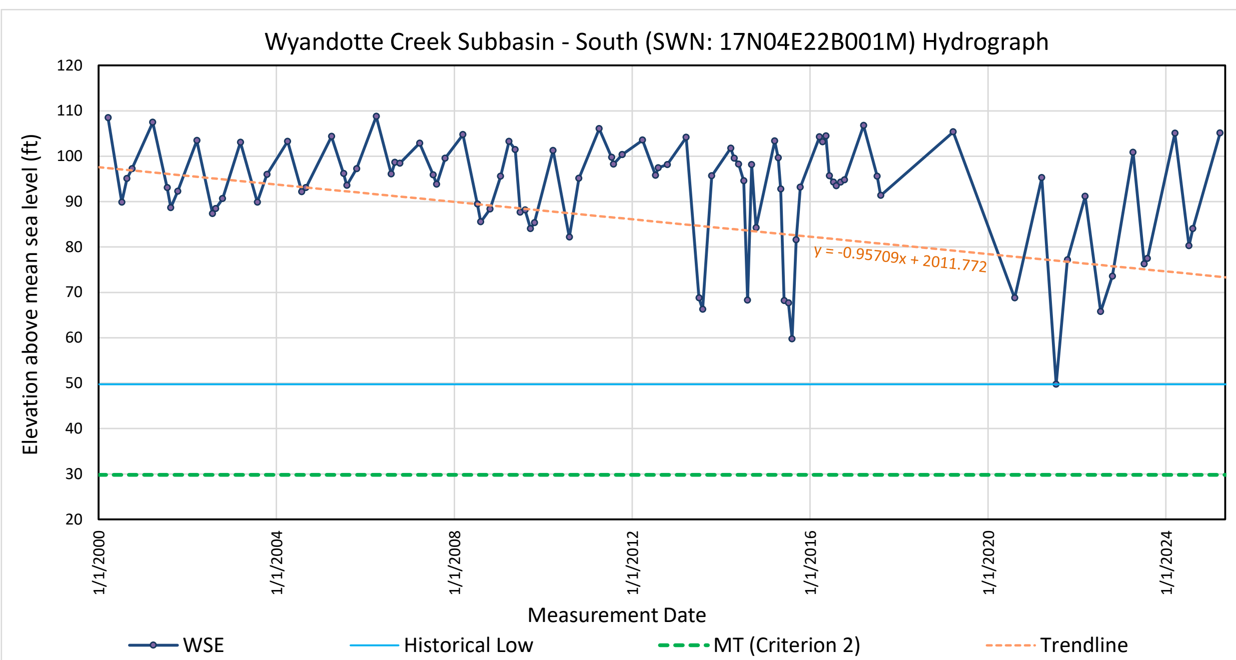

Wyandotte Creek Subbasin - Oroville (SWN: 19N04E32P001M) Hydrograph
Elevation above mean sea level (ft)
150
140
130
120
110
100
90
80
70
1/1/2000
1/1/2004
1/1/2008
1/1/2012
1/1/2016
1/1/2020
1/1/2024
Measurement Date
y = -0.19281x + 515.6391
WSE
Historical Low
MT (Criterion 2)
Trendline


Wyandotte Creek Subbasin - Oroville (SWN: 19N03E16Q001M) Hydrograph
Elevation above mean sea level (ft)
150
140
130
120
110
100
90
80
y = 0.067808x + 2.190923
1/1/2000
1/1/2004
1/1/2008
1/1/2012
1/1/2016
1/1/2020
1/1/2024
Measurement Date
WSE
Historical Low
MT (Criterion 1)
MT (Criterion 2)
Trendline

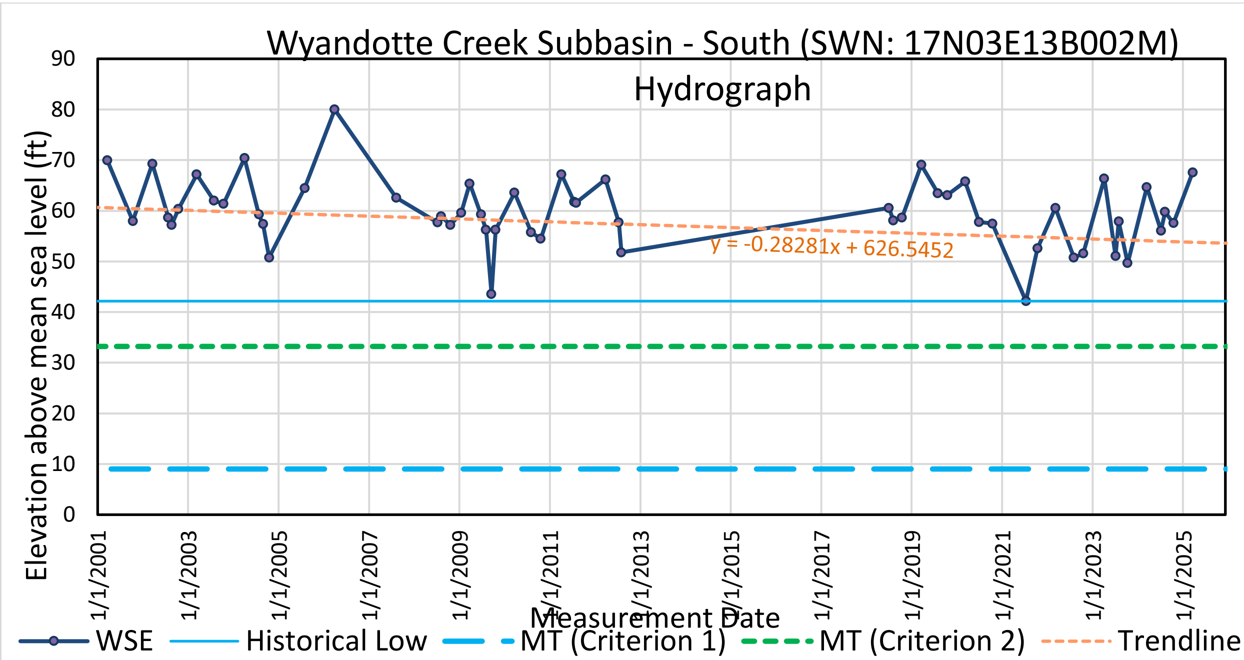

Wyandotte Creek Subbasin - South (SWN: 18N04E08M001M) Hydrograph
Elevation above mean sea level (ft)
130
120
110
100
90
80
70
60
50
y = -0.04588x + 196.2102
1/1/2000
1/1/2004
1/1/2008
1/1/2012
1/1/2016
1/1/2020
1/1/2024
Measurement Date
WSE
Historical Low
Current MT
MT (Criterion 1)
MT (Criterion 2)
Trendline

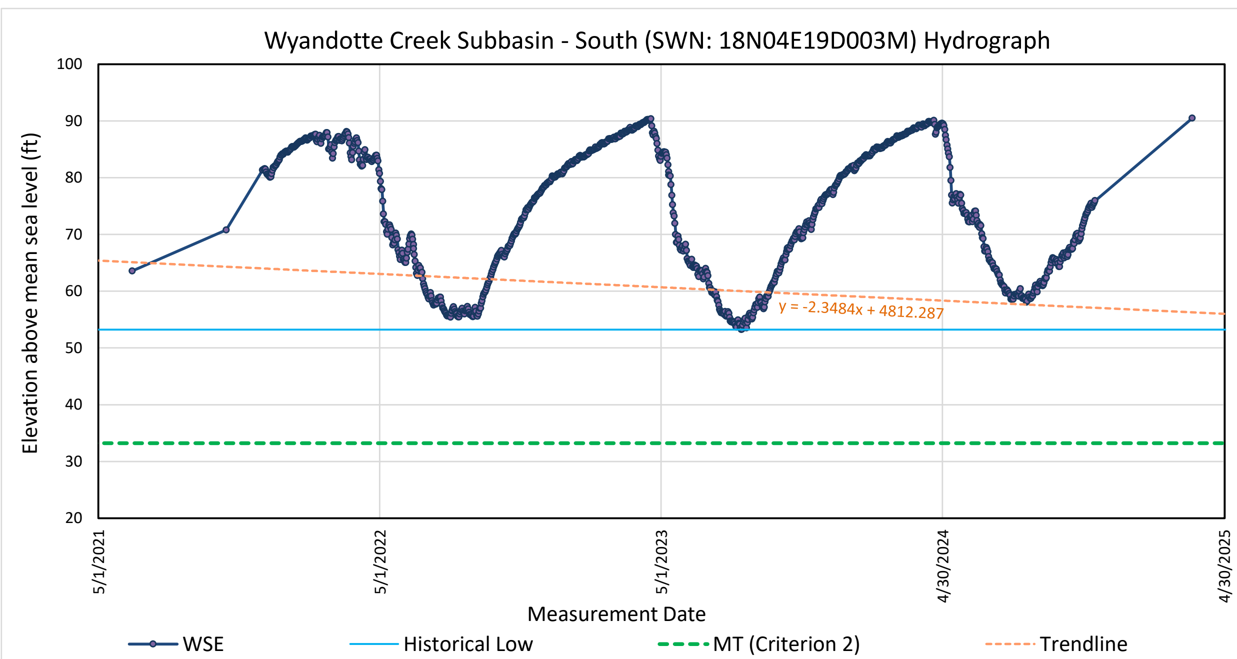


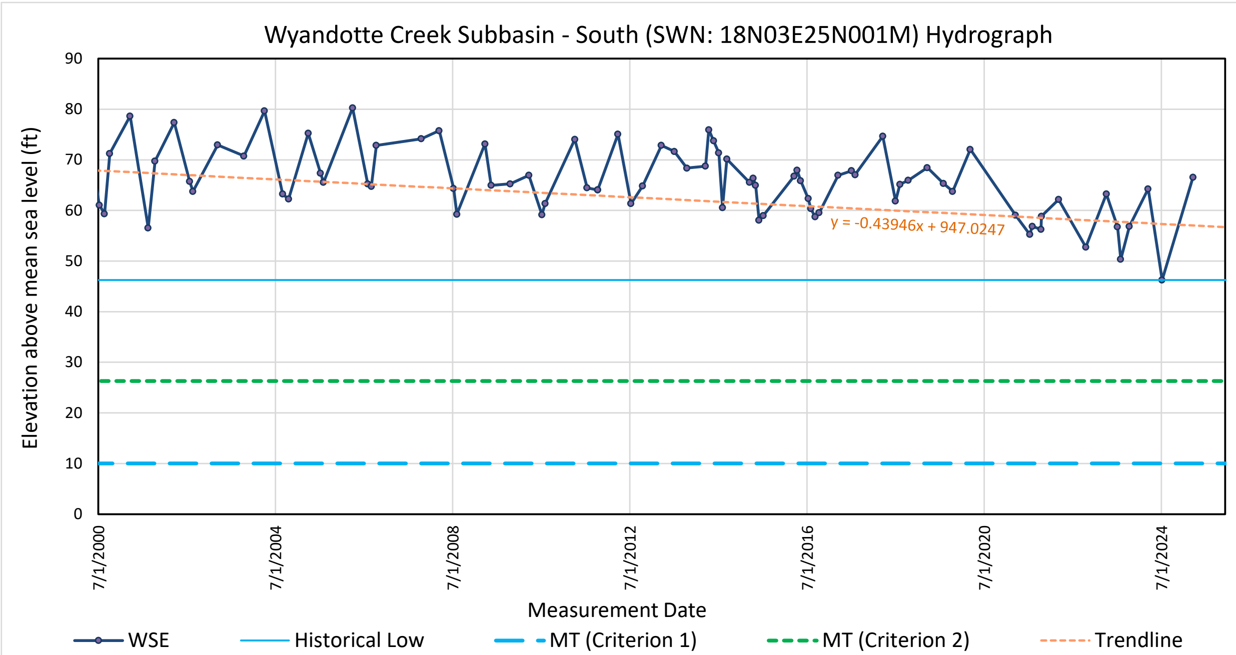
Wyandotte Creek Subbasin - South (SWN: 18N04E16C001M) Hydrograph
Elevation above mean sea level (ft)
140
130
120
110
100
90
80
70
60
1/1/2000
1/1/2004
1/1/2008
1/1/2012
1/1/2016
1/1/2020
1/1/2024
Measurement Date
y = -0.59442x + 1305.139
WSE
Historical Low
MT (Criterion 1)
MT (Criterion 2)
Trendline

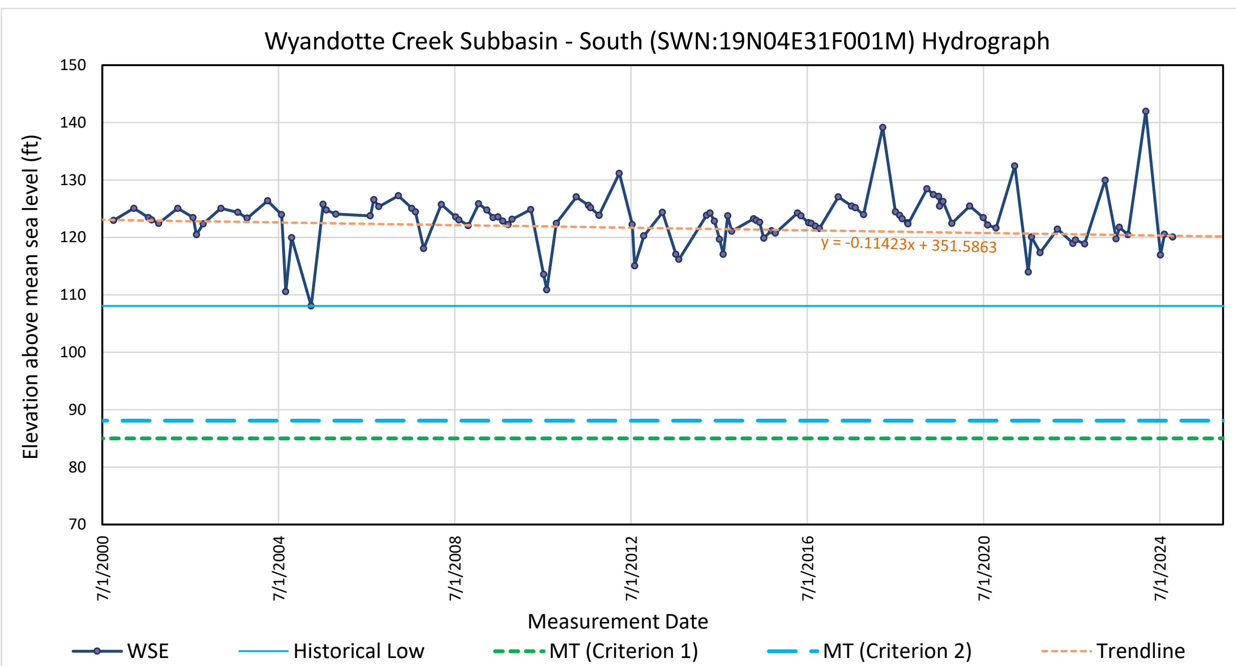


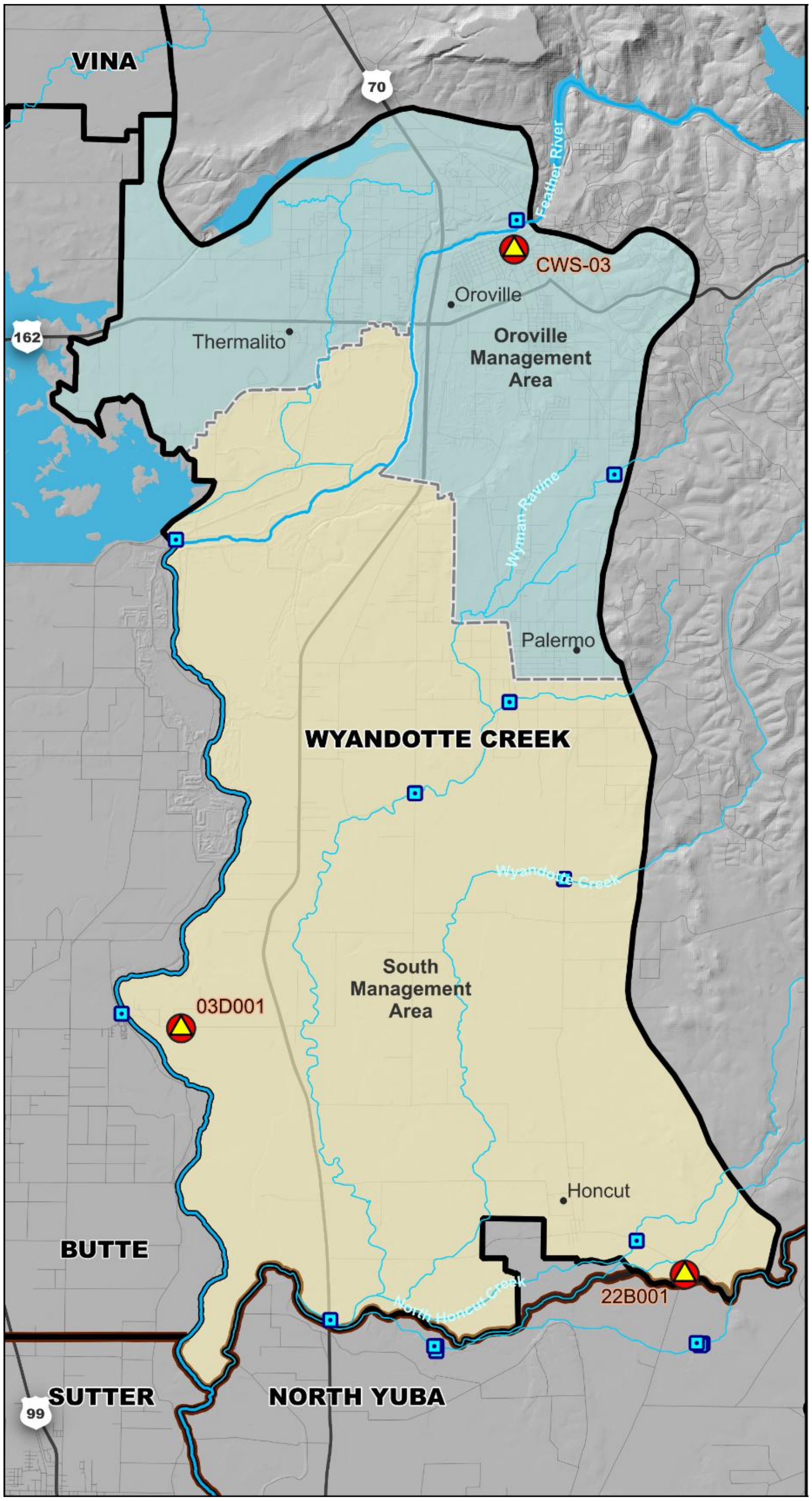
Wyandotte Creek Subbasin - South (SWN: 17N04E22B001M) Hydrograph
Elevation above mean sea level (ft)
120
110
100
90
80
70
60
50
40
30
20
1/1/2000
1/1/2004
1/1/2008
1/1/2012
1/1/2016
1/1/2020
1/1/2024
Measurement Date
y = -0.95709x + 2011.772
WSE
Historical Low
MT (Criterion 2)
Trendline


Wyandotte Creek Subbasin - South (SWN: 17N03E13B002M) Hydrograph
Elevation above mean sea level (ft)
Measurement Date
y = -0.28281x + 626.5452
WSE
Historical Low
MT (Criterion 1)
MT (Criterion 2)
Trendline

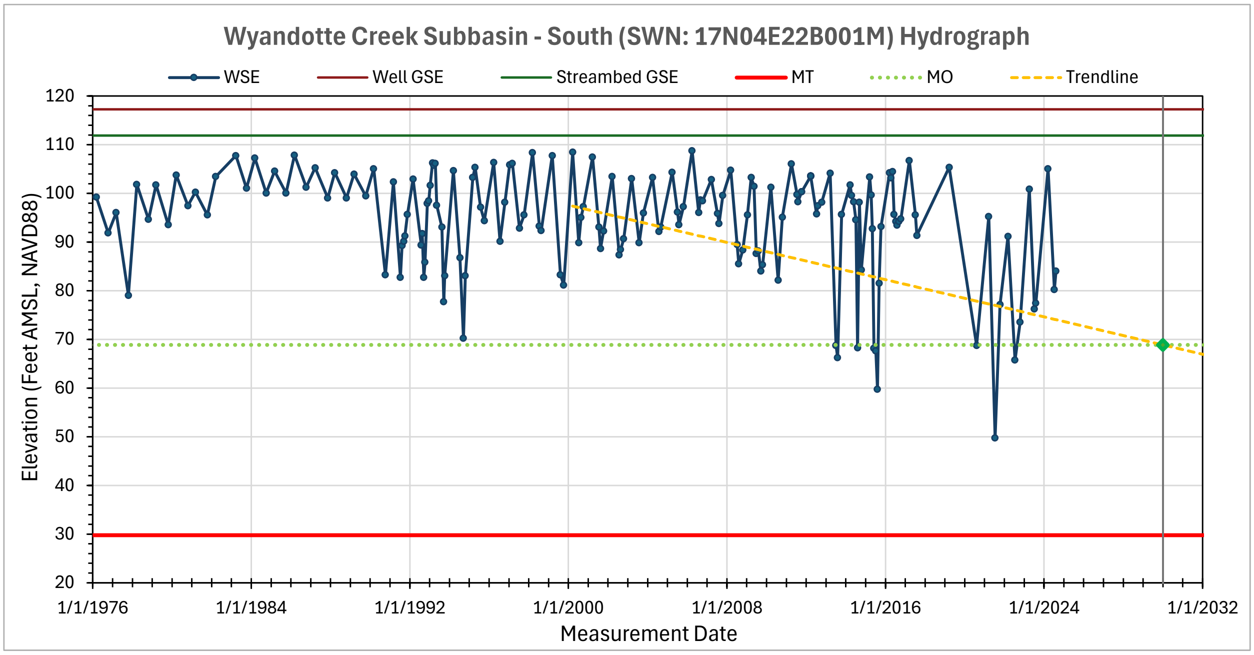

Wyandotte Creek Subbasin - South (SWN: 18N04E19D003M) Hydrograph
Elevation above mean sea level (ft)
Measurement Date
y = -2.3484x + 4812.287
WSE
Historical Low
MT (Criterion 2)
Trendline


Wyandotte Creek Subbasin - South (SWN: 18N03E25N001M) Hydrograph
Elevation above mean sea level (ft)
90
80
70
60
50
40
30
20
10
0
y = -0.43946x + 947.0247
7/1/2000
7/1/2004
7/1/2008
7/1/2012
7/1/2016
7/1/2020
7/1/2024
Measurement Date
WSE
Historical Low
MT (Criterion 1)
MT (Criterion 2)
Trendline

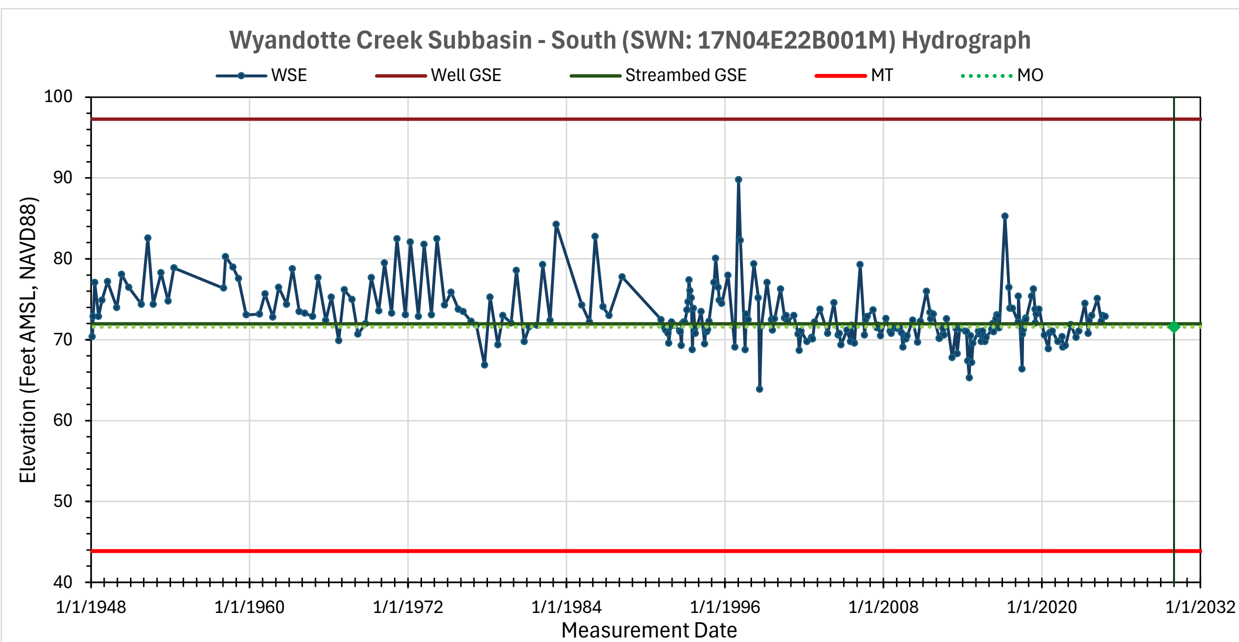

Wyandotte Creek Subbasin - South (SWN:19N04E31F001M) Hydrograph
Elevation above mean sea level (ft)
150
140
130
120
110
100
90
80
70
y = -0.11423x + 351.5863
7/1/2000
7/1/2004
7/1/2008
7/1/2012
7/1/2016
7/1/2020
7/1/2024
Measurement Date
WSE
Historical Low
MT (Criterion 1)
MT (Criterion 2)
Trendline



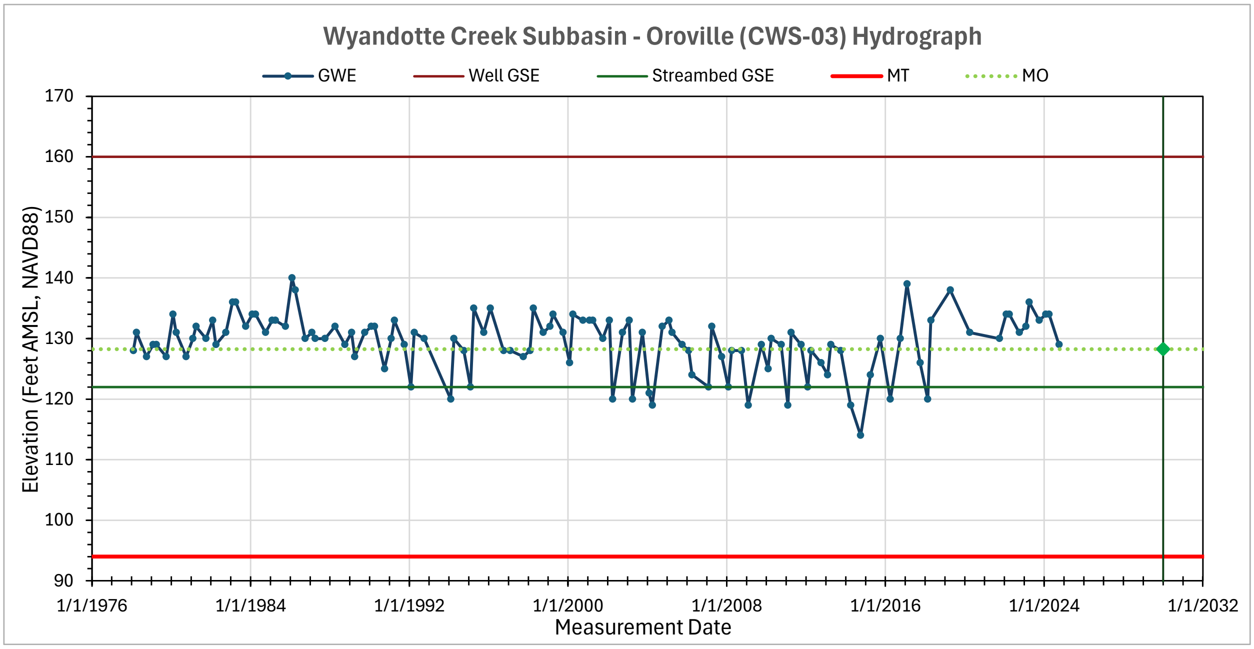
The map to the left shows the three RMS wells included in the ISW monitoring network. The following three hydrographs correspond to the three RMS wells, and display the historical record of the well, the MT, the MO, and the ground surface elevation (GSE) of the well and streambed. If the MO was defined using the trend of fall low measurements, then the trendline is also included.



Nearest stream: Honcut Creek



Nearest Stream: Feather River



Nearest Stream: Feather River

APPENDIX 6-A
Northern Sacramento Valley Inter-basin Coordination Report