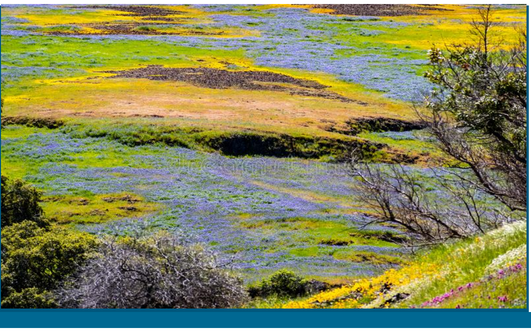
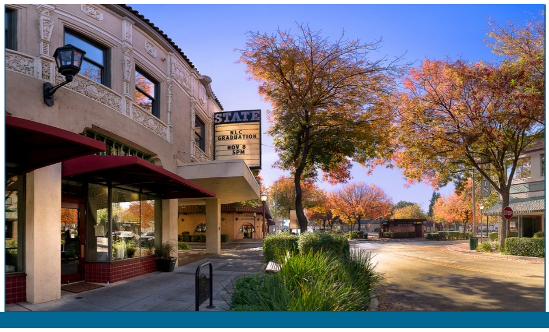
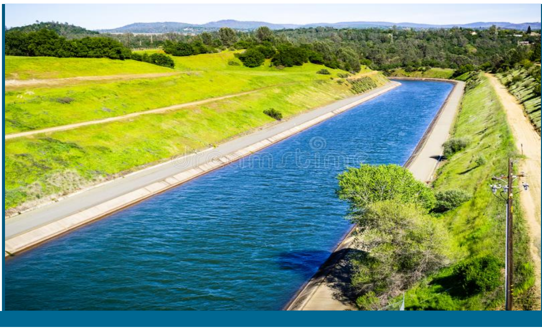
Wyandotte Creek Groundwater Subbasin

Groundwater Sustainability Plan

December 2021







Wyandotte Creek
GROUNDWATER SUSTAINABILITY
AGENCY

PREPARED FOR

WYANDOTTE CREEK GROUNDWATER SUSTAINABILITY AGENCY

Geosyntec consultants

Groundwater Sustainability Plan

Wyandotte Creek Groundwater Subbasin

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Project Number: SAC282

December 15, 2021

Note: Drafts of Section 2, Basin Setting, and portions of Section 4, Monitoring Networks were prepared by Davids Engineering, Inc. These draft sections have been updated during GSP development as additional information became available and modified based on responses to public comment.

Geosyntec consultants

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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

GSP Completion
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Basin Setting Project
Davids Engineering, Inc.
GEI Consultants, Inc.
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Consensus Building Institute

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. 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.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Geosyntec consultants

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 update, if warranted
2032	Evaluate GSP and update, if warranted
2037	Evaluate GSP and update, 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 requires 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. In addition, the GSP also identifies five management actions that can be implemented to focus on reduction of groundwater demand. 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.

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.

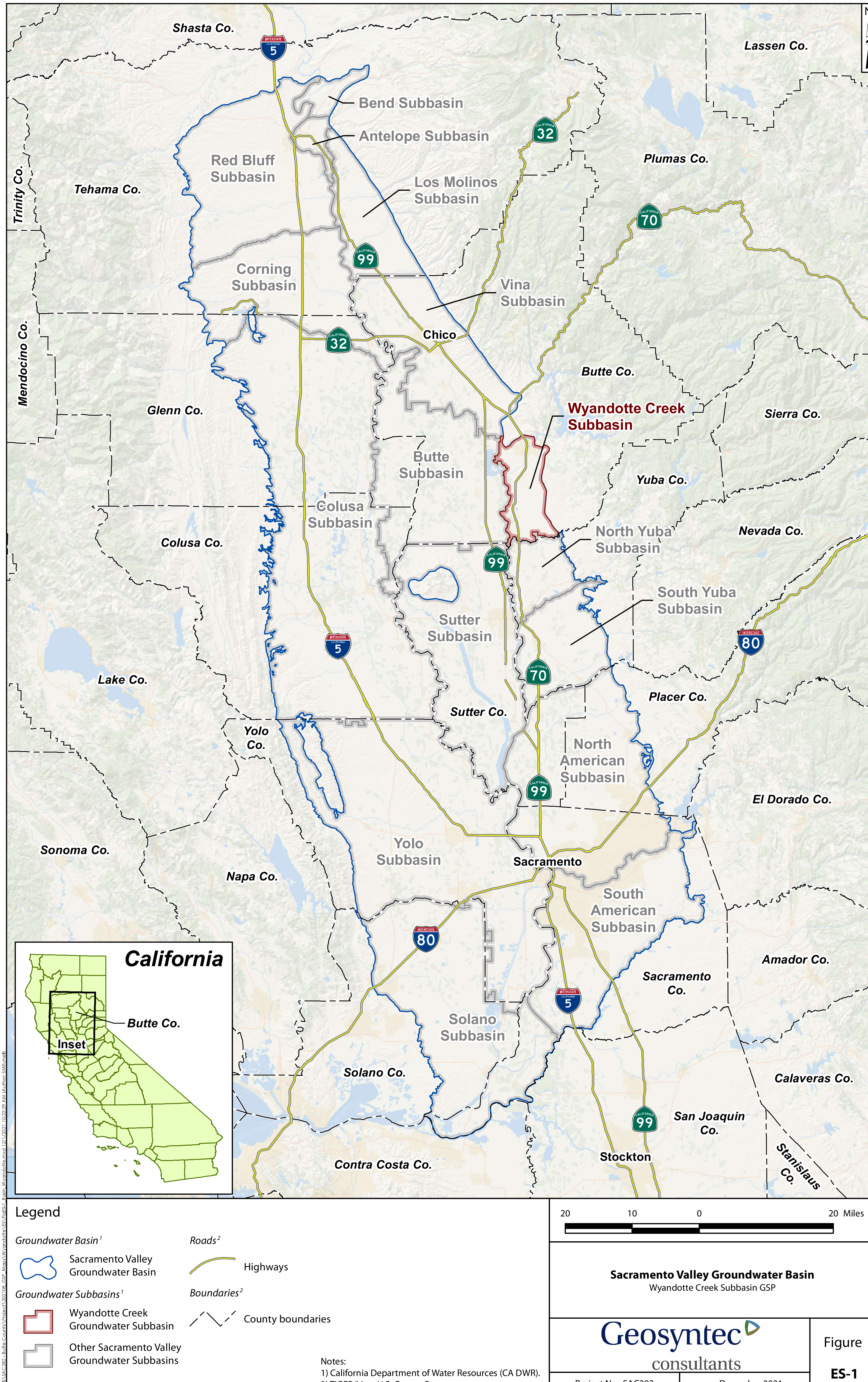
The Wyandotte Creek GSA also prepared and implemented a Communication and Engagement Plan (C&E Plan) to encourage involvement from diverse social, cultural, and economic elements of the population of the Wyandotte Creek Subbasin, in addition to meeting SGMA requirements for intrabasin coordination.

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.

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.

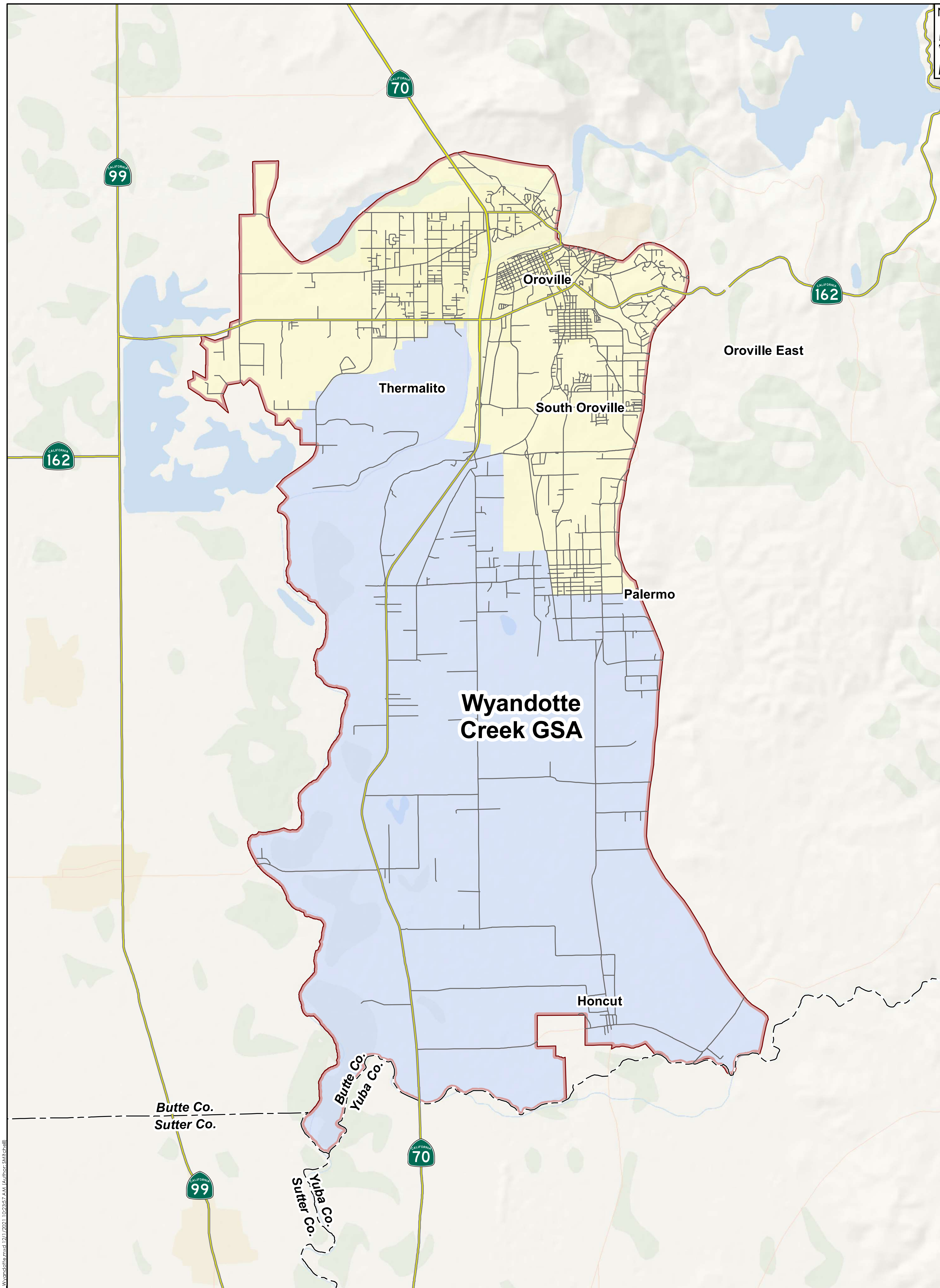


Sacramento Valley Groundwater Basin
Wyandotte Creek Subbasin GSP

Geosyntec consultants

Figure ES-1

Project No.: SAC282 | December 2021



Legend

Groundwater Sustainability Agency (GSA) [1]

Wyandotte Creek GSA

Roads [2]

Highways

Other roads

Wyandotte Creek Groundwater Subbasin Management Areas

Wyandotte Creek Oroville

Wyandotte Creek South

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

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Figure

ES-2

Project No.: SAC282

December 2021

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

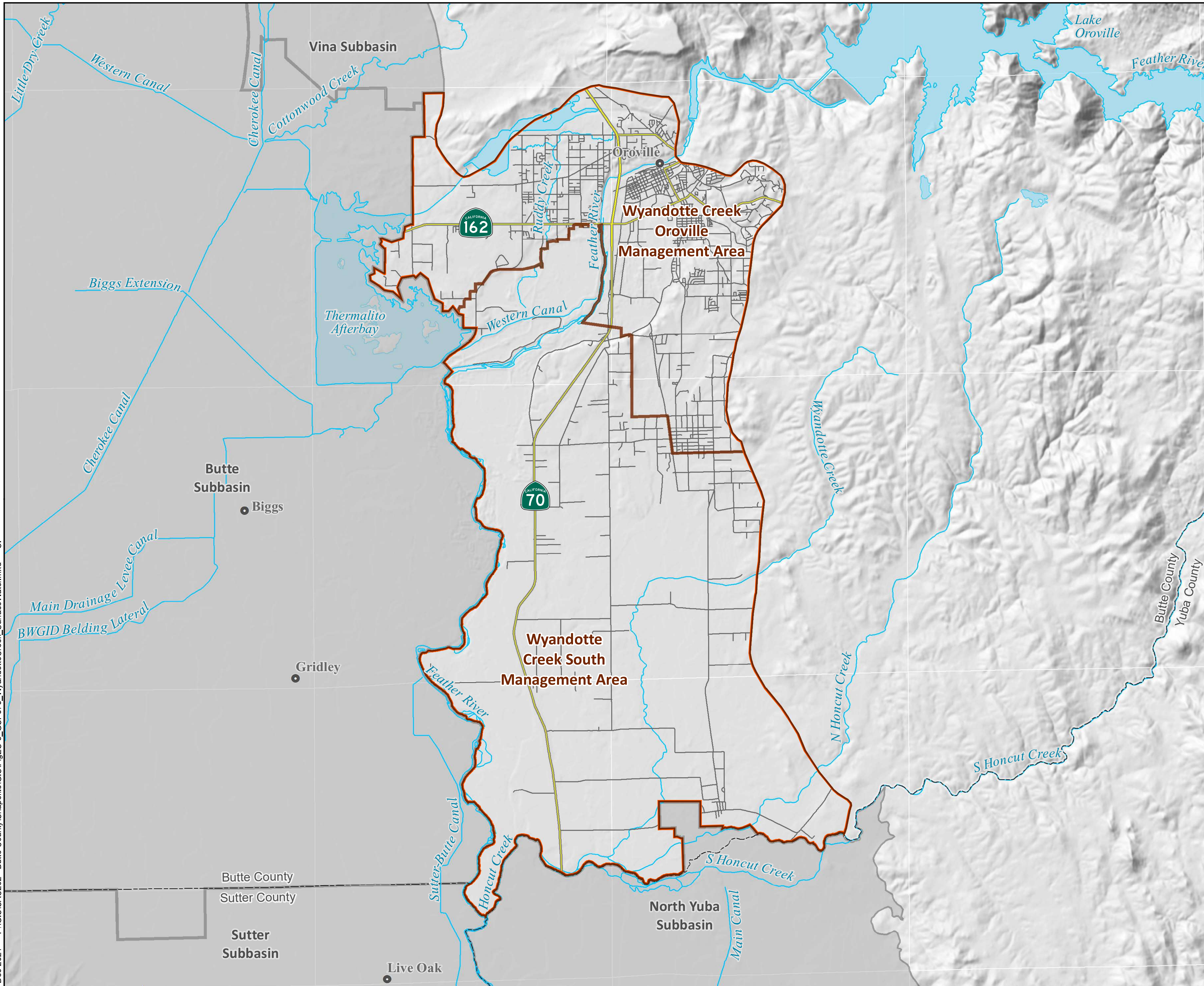
Groundwater conditions in the Wyandotte Creek Subbasin are regularly monitored and are described in reports produced by Butte County since 2001. These documents and other reports portray a subbasin that has adequate groundwater resources to meet demands under most hydrologic conditions. However, comparison 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.

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. 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.



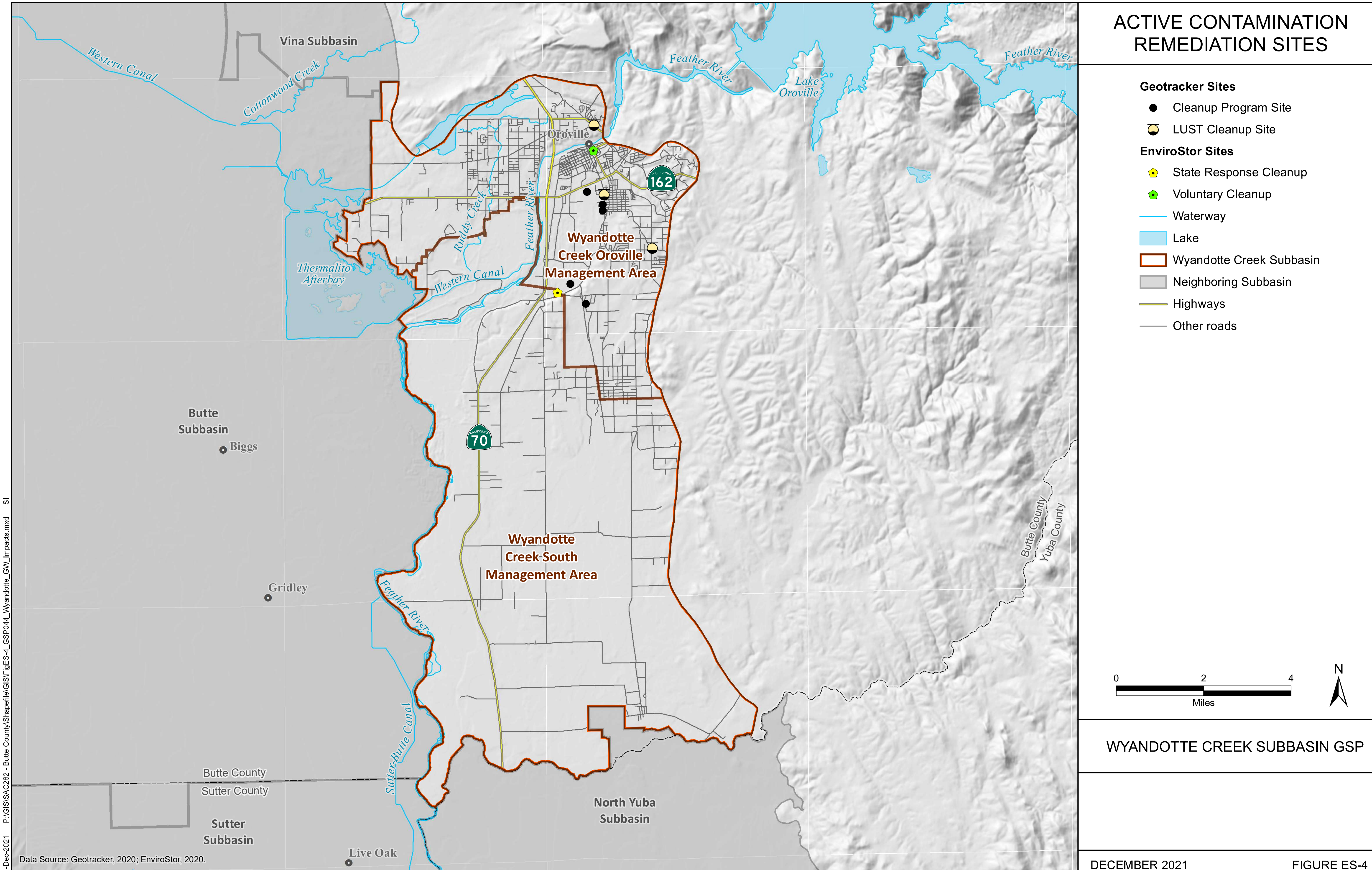
SURFACE WATER FEATURES

- Waterway
- Lake
- Wyandotte Creek Subbasin
- Neighboring Subbasin
- Highways
- Other roads

0 2 4
Miles
N

WYANDOTTE CREEK SUBBASIN GSP

DECEMBER 2021 FIGURE ES-3


ACTIVE CONTAMINATION REMEDIATION SITES
Geotracker Sites
Cleanup Program Site
LUST Cleanup Site
EnviroStor Sites
State Response Cleanup
Voluntary Cleanup
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0 2 4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE ES-4
Vina Subbasin
Western Canal
Cottonwood Creek
Feather River
Lake Oroville
Oroville
162
Thermalito Afterbay
Ruddy Creek
Wyandotte Creek Oroville Management Area
Butte Subbasin
Biggs
70
Wyandotte Creek South Management Area
Gridley
Butte County
Yuba County
Sutter-Butte Canal
Butte County
Sutter County
Sutter Subbasin
North Yuba Subbasin
Live Oak
Data Source: Geotracker, 2020; EnviroStor, 2020.
01-Dec-2021 P:\GIS\SAC282 - Butte County\Shapefile\GIS\FigES-4_GSP044_Wyandotte_GW_Impacts.mxd SI

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 (iGDEs) prepared by Butte County Department of Water and Resource Conservation (BCDWRC). 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.

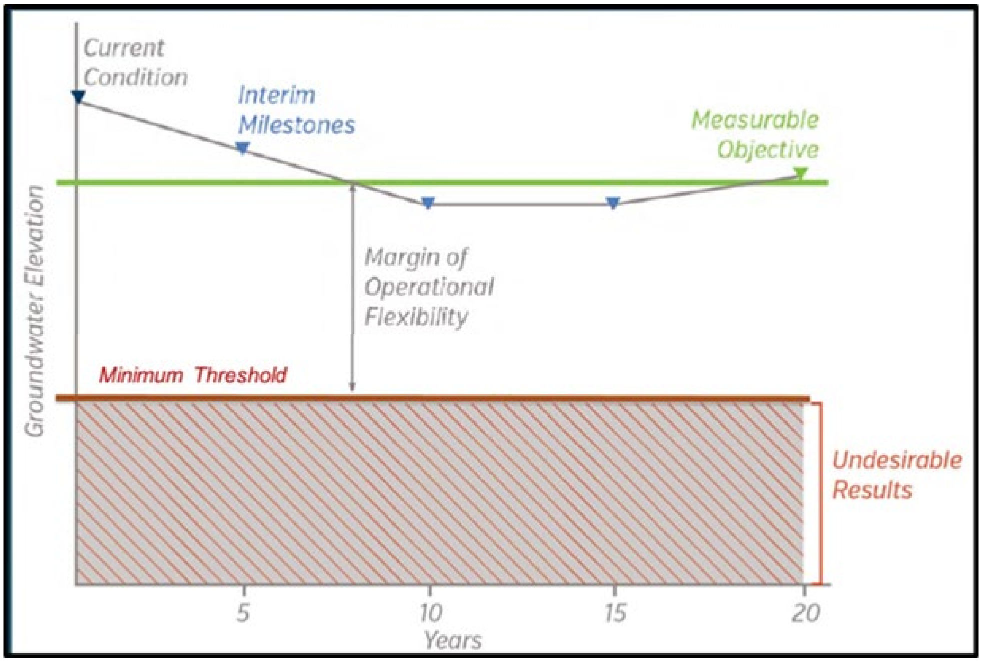


Figure ES-5: Illustration of Terms Used for Describing Sustainable Management Criteria Using the Groundwater Level Sustainability Indicator

A total of nine representative 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. However, for this GSP, the SMC developed for groundwater levels are used as a proxy for interconnected surface water in an interim manner until data gaps are addressed. As such, the representative monitoring wells described above provide the basis for measuring the five relevant SIs across the Wyandotte Creek Subbasin.

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.

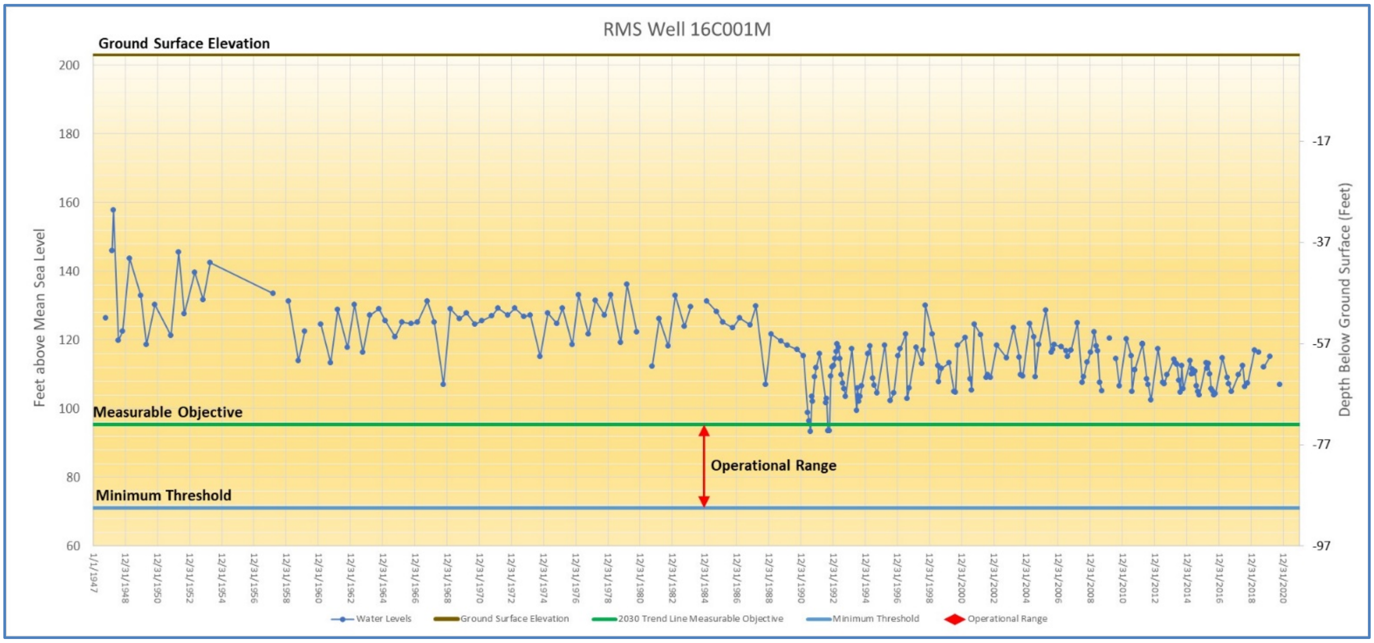


Figure ES-6: Representative Monitoring Site for Groundwater Levels with Relationship of Measurable Objectives, Minimum Thresholds, and Operational Range

MTs for groundwater levels were developed with reference to domestic well depths. The MT for all representative monitoring site (RMS) wells was based on the 15th percentile of total well depth for domestic wells completed after 1980. The DWR database used for information on total depths of the domestic wells is not always accurate or precise, nor is it known which of the wells in the database are in use or have been abandoned or replaced. As such, the GSP has identified these data as a data gap that will be further investigated as part of the GSP implementation.

To establish the MO, the water-level hydrograph of observed groundwater levels at each RMS well was evaluated. The historical record at these locations shows cyclical fluctuations of groundwater level over a four- to seven-year cycle. The MO for groundwater levels at each RMS well was set at the trend line for the dry periods (since 2000) of observed short-term climatic cycles extended to 2030. Figure ES-7 shows an example of this trend line for an RMS well. Table ES-1 shows the MTs and MOs for groundwater levels at each of the RMS wells.

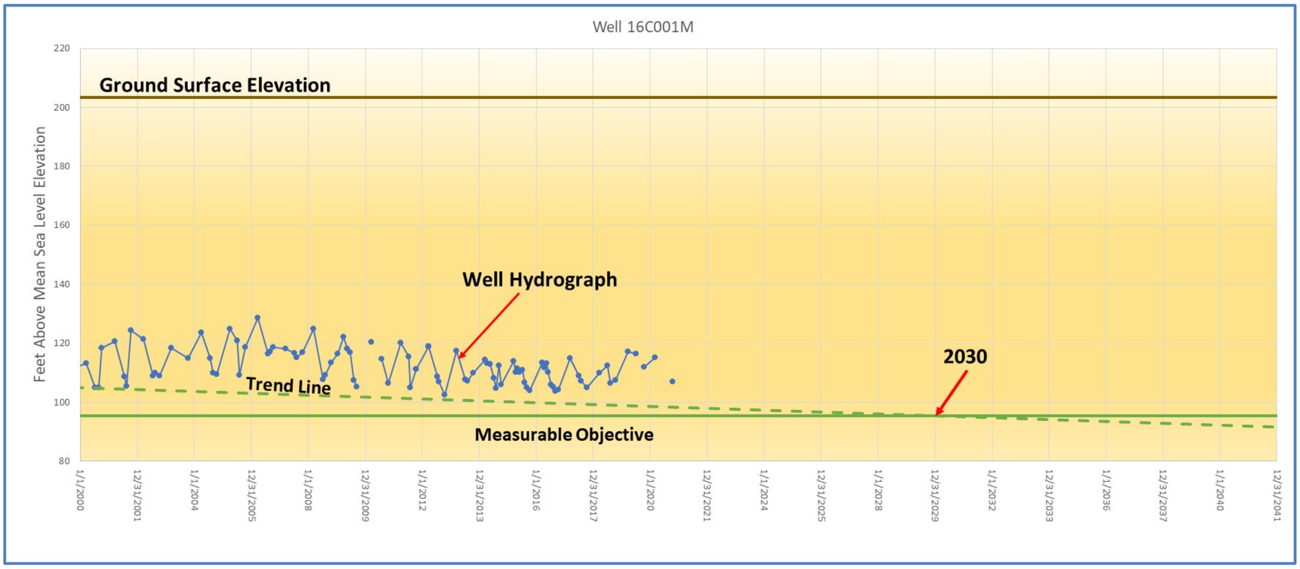


Figure ES-7: Illustration of Long-Term Trend Using Historical Water Levels Extended to 2030 for Development of Measurable Objective

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

RMS Well ID	MT	MO	IM 2027	IM 2032	IM 2037
Wyandotte Creek Subbasin – Oroville Management Area					
16Q001M	85	133	134	133	133
32P001M	78	107	108	106	106
CWS-03	102	133	135	132	132
Wyandotte Creek Subbasin – South Management Area					
13B002M	35	47	48	46	46
09N002M	35	49	51	47	47
25N001M	37	52	53	52	52
08M001M	59	86	87	85	85
16C001M	71	95	96	95	95
31F001M	76	99	101	98	98

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. MTs are 1,600 micro-siemens per centimeter (µS/cm) for each representative monitoring well, consistent with the upper limit of the California Secondary Maximum Contaminant Level (MCL) for electrical conductivity. MOs are 900 µS/cm for each representative monitoring well, consistent with the California Secondary MCL for electrical conductivity.

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, and measurements of groundwater levels directly adjacent to stream channels, first water bearing aquifer zone, and deeper aquifer zones. These data are not available and are a data gap for the GSP. Further evaluation of this SMC is needed to avoid undesirable results to aquatic ecosystems and GDEs. To that end, an Interconnected Surface Water SMC framework has been developed for the GSP. As such, for this GSP the groundwater levels SMC are used by proxy and the MT and MO for interconnected surface water is the same as for groundwater levels.

The MTs and MOs for groundwater levels are also used for the land subsidence and groundwater storage SIs, as both are strongly linked to groundwater levels. The groundwater levels MTs are found to be protective of land subsidence and groundwater storage.

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 2018. To prepare water budges for this GSP, 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. 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.

Based on these analyses, at projected groundwater pumping levels, the long-term groundwater pumping offset and/or recharge required for the Wyandotte Creek Subbasin to achieve sustainability is approximately 1,000 AFY. Groundwater levels are expected to continue to decline based on projections of current land and water uses. Projects that offset groundwater pumping and/or increase recharge will help the Wyandotte Creek Subbasin reach sustainability.

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. Figure ES-8 illustrates the cumulative change in groundwater storage for current and future conditions.

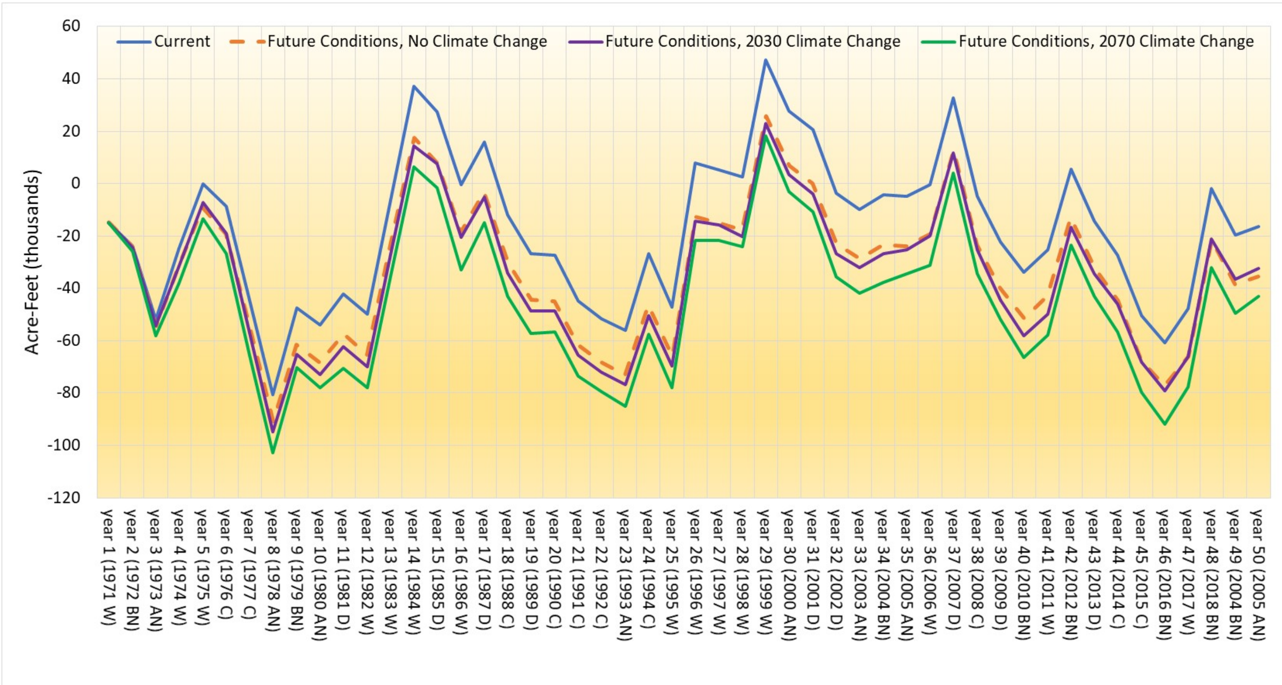


Figure ES-8: Cumulative Change in Groundwater Storage for Current and Future Conditions Baseline Scenarios

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 five monitoring networks in the Wyandotte Creek Subbasin: a representative network for water levels; a broad network for water levels; a representative network for water quality; a broad network for water quality; and a broad network for land subsidence. Representative networks are used to determine compliance with the MTs, while the broad networks collect data for informational purposes to identify trends and fill data gaps. The two monitoring networks for water quality will additionally be used to develop an electrical conductivity isocontour to monitor for potential intrusion for underlying saline waters and water levels data will inform depletions of interconnected surface water.

The monitoring networks were designed by evaluating data from Butte County's existing 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 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 three stream gauges monitored within the Wyandotte Creek Subbasin

Summary of Monitoring Network Wells	
Representative Networks	**Well Count**
Groundwater Level	9
Groundwater Quality	8
Broad Network	
Groundwater Levels	13
Groundwater Quality	2
Subsidence	6

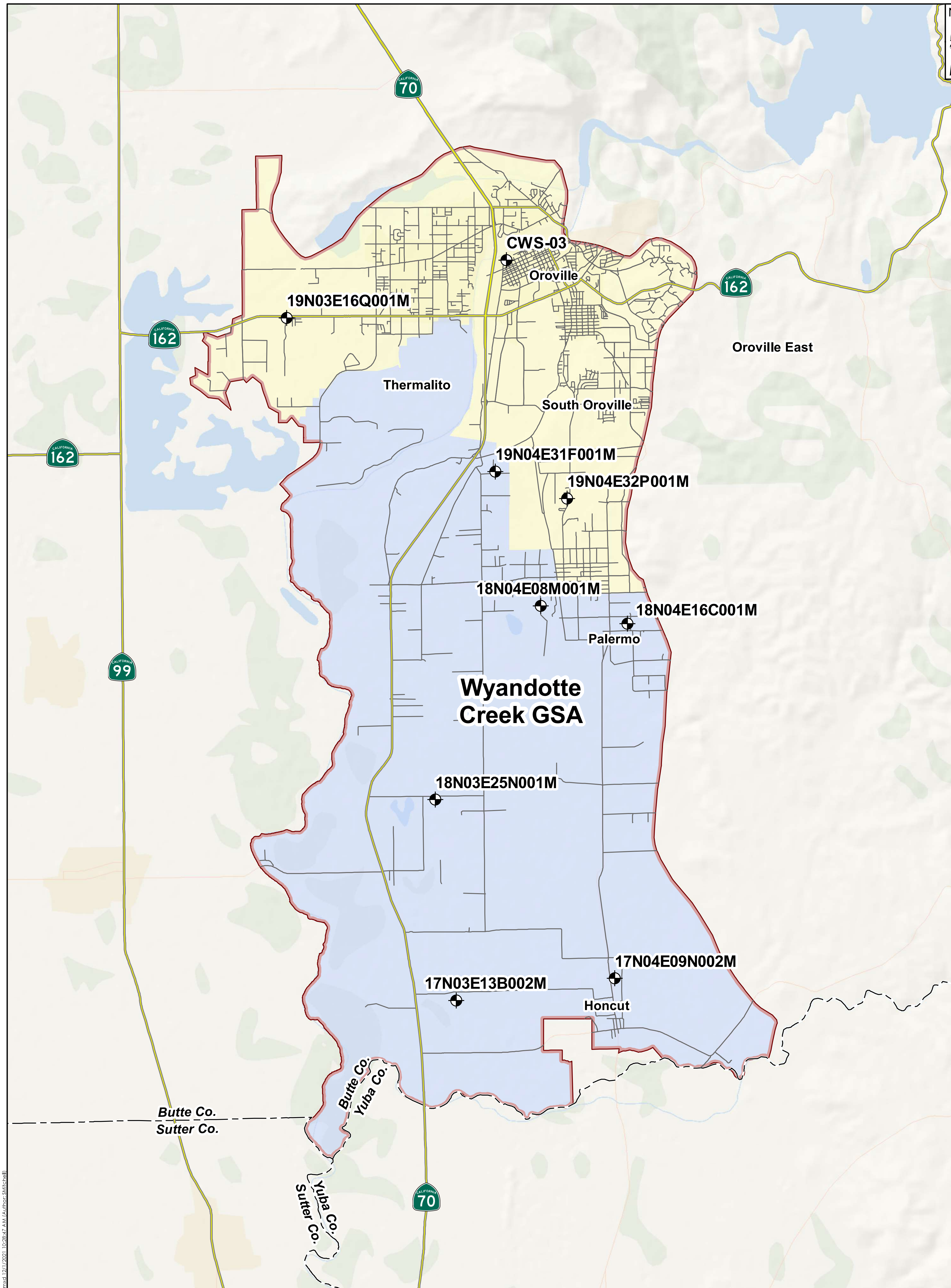
Data Management System

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 GSAs 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. 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
- 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.



Legend

Groundwater Sustainability Agency (GSA)[1]
Wyandotte Creek GSA

RMS GWE Monitoring Wells
Well

Boundaries[2]
County boundaries

Wyandotte Creek Subbasin Management Areas
Wyandotte Creek Oroville
Wyandotte Creek South

Roads[2]
Highways
Other roads

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

2 1 0 2 Miles

Groundwater Level RMS Wells
Wyandotte Creek Subbasin GSP

Geosyntec consultants

Figure ES-9

Project No.: SAC282

December 2021

Projects and Management Actions

Each of the projects are in various stages of development ranging from 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 listed below and are listed from planned to conceptual.

Planned:

- Residential Conservation
- Agricultural Irrigation Efficiency
- FloodMAR
- Oroville Wildlife Area Robinson's Riffle Project
- Streamflow Augmentation
- TWSD Water Treatment Plant Capacity Upgrade
- Water Loss Monitoring
- Palermo Clean Water Consolidation Project

Potential:

- Intra-Basin Water Transfer
- Agricultural Surface Water Supplies
- Well Upgrades
- Fuels Management for Watershed Health
- Removal of Invasive Species

Conceptual:

- Recharge Well (Injection Well)
- Extend Orchard Replacement

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

Plan Implementation

The adoption of the GSP is official start of plan implementation for the Vina Subbasin. The GSAs 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 GSAs, 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
- Updating the GSP once every five years
- 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.

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.

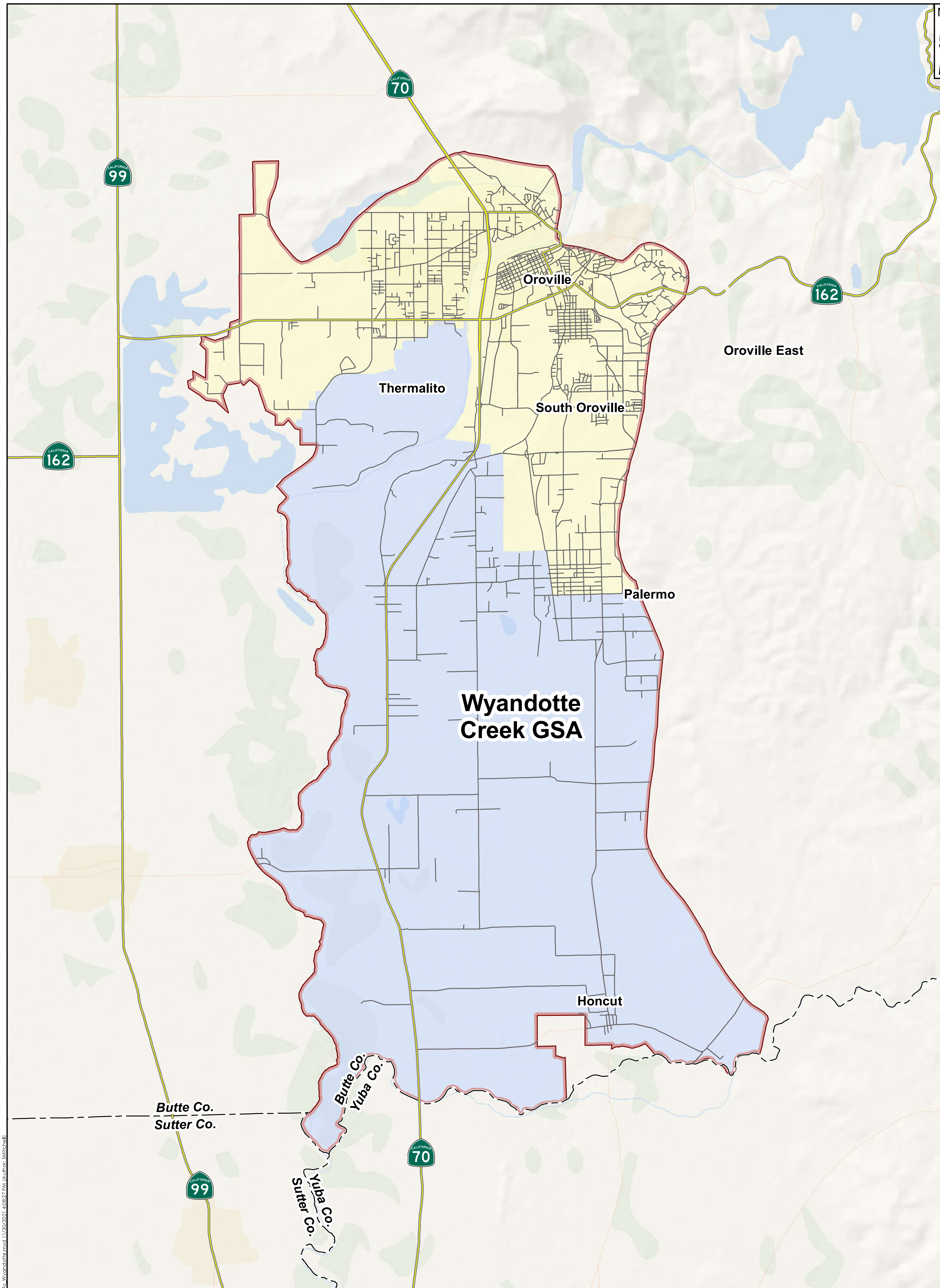
1.1.3 Contact Information

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:	Dr. Christina Buck 308 Nelson Avenue Oroville, California 95965 530.552.3595 cbuck@buttecounty.net

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).



Legend

Groundwater Sustainability Agency (GSA)[1]

Wyandotte Creek GSA

Roads[2]

Highways

Other roads

Wyandotte Creek Groundwater Subbasin Management Areas

Wyandotte Creek Oroville

Wyandotte Creek South

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 **1-1**

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 is leading the development of technical aspects of the GSP including contracting for professional services 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) – Vacant
- South Feather Water and Power Agency(SFWPA) – One representative
- At-large agricultural groundwater users – Three representatives
- At-large domestic well users – Vacant
- At-large environmental – Vacant
- At-large business – Vacant

The Wyandotte Creek GSA Board appointed at-large members to fill Advisory Committee seats. Interested individuals from the community or organizations applied 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 were included in Management Committee reports. The recommendations identified areas of agreement and disagreement. The Advisory Committee strived 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 outlined 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 considered 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.

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.

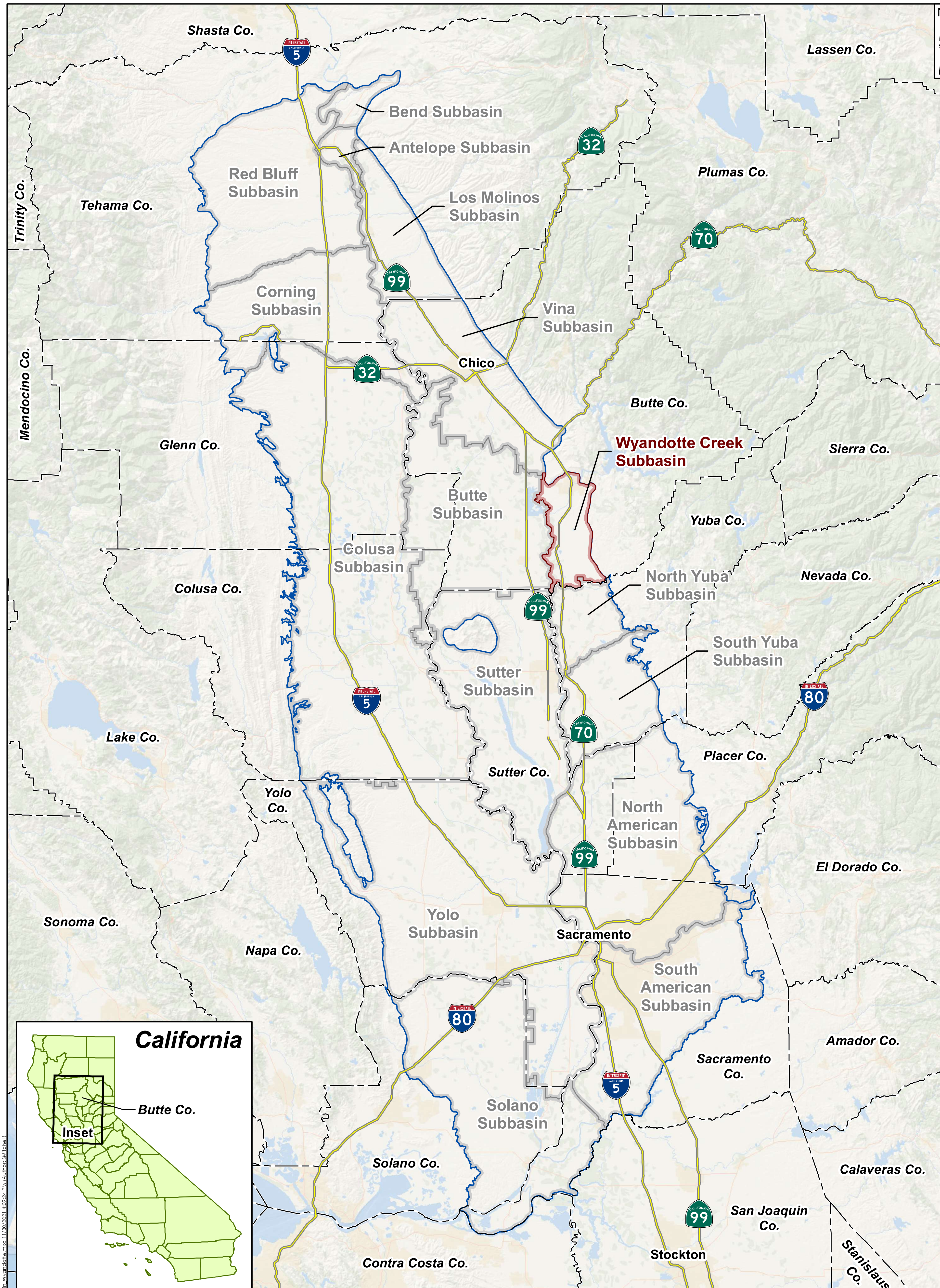
Figure 1-4 shows the Wyandotte Creek Subbasin's key geographic features. The Wyandotte Creek Subbasin encompasses an area of about 59,382 acres. There are two entities within the Wyandotte Creek Subbasin with land use jurisdiction: Butte County and the City of Oroville.

Figure 1-5 shows the tribal areas within in 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.



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.

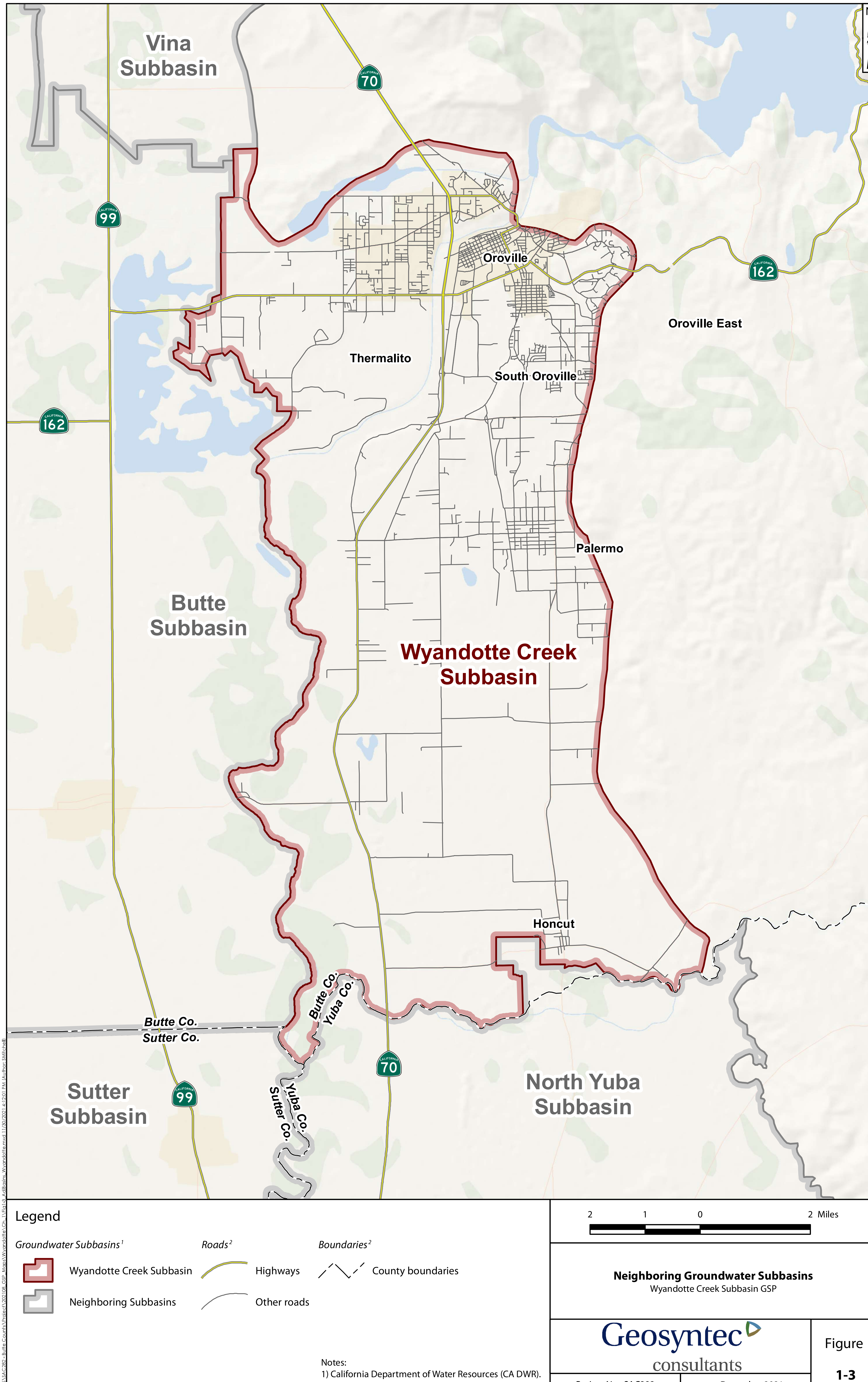
Sacramento Valley Groundwater Basin
Wyandotte Creek Subbasin GSP

Geosyntec consultants

Figure **1-2**

Project No.: SAC282

December 2021

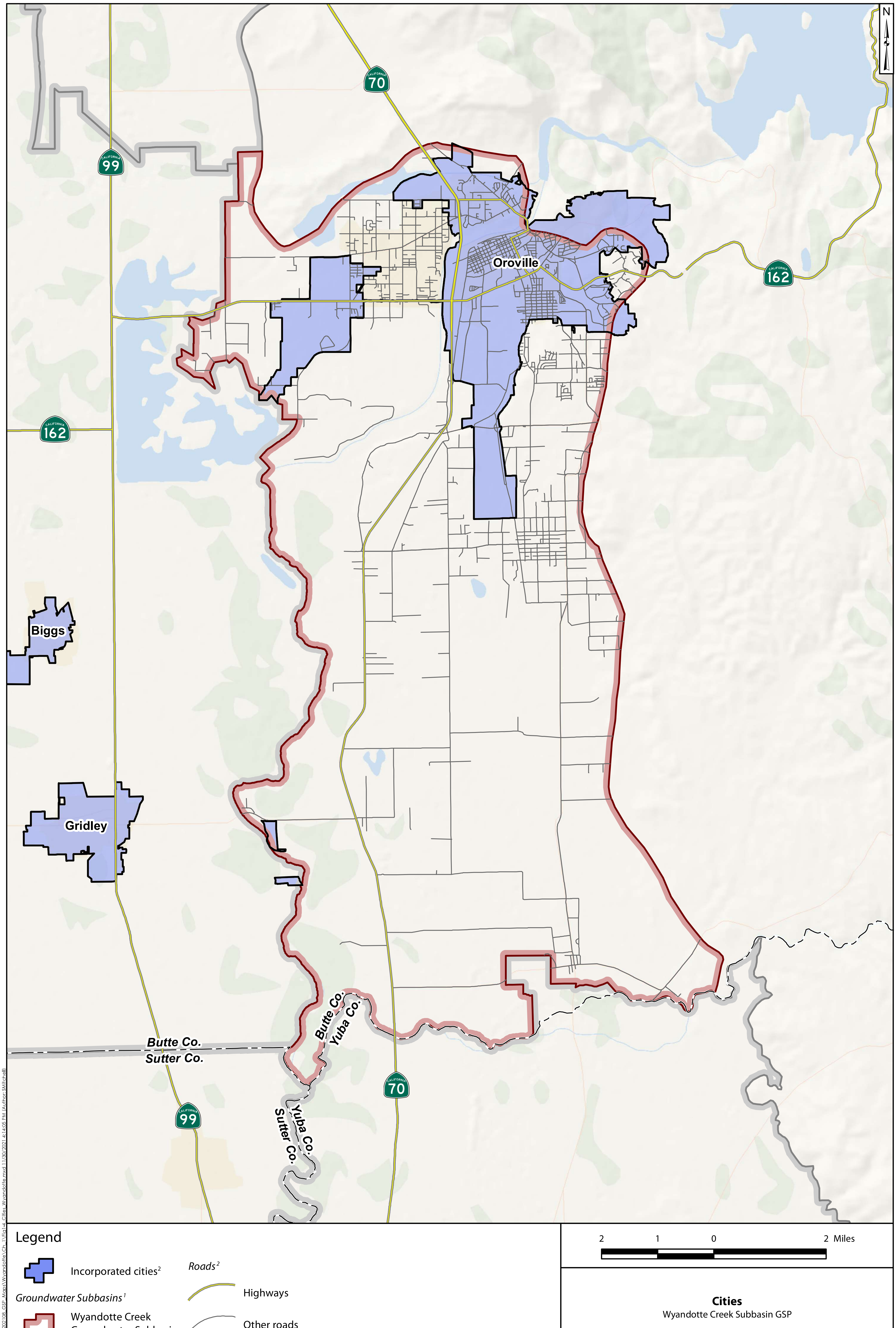


Neighboring Groundwater Subbasins
Wyandotte Creek Subbasin GSP

Geosyntec consultants

Figure 1-3

Project No.: SAC282 | December 2021



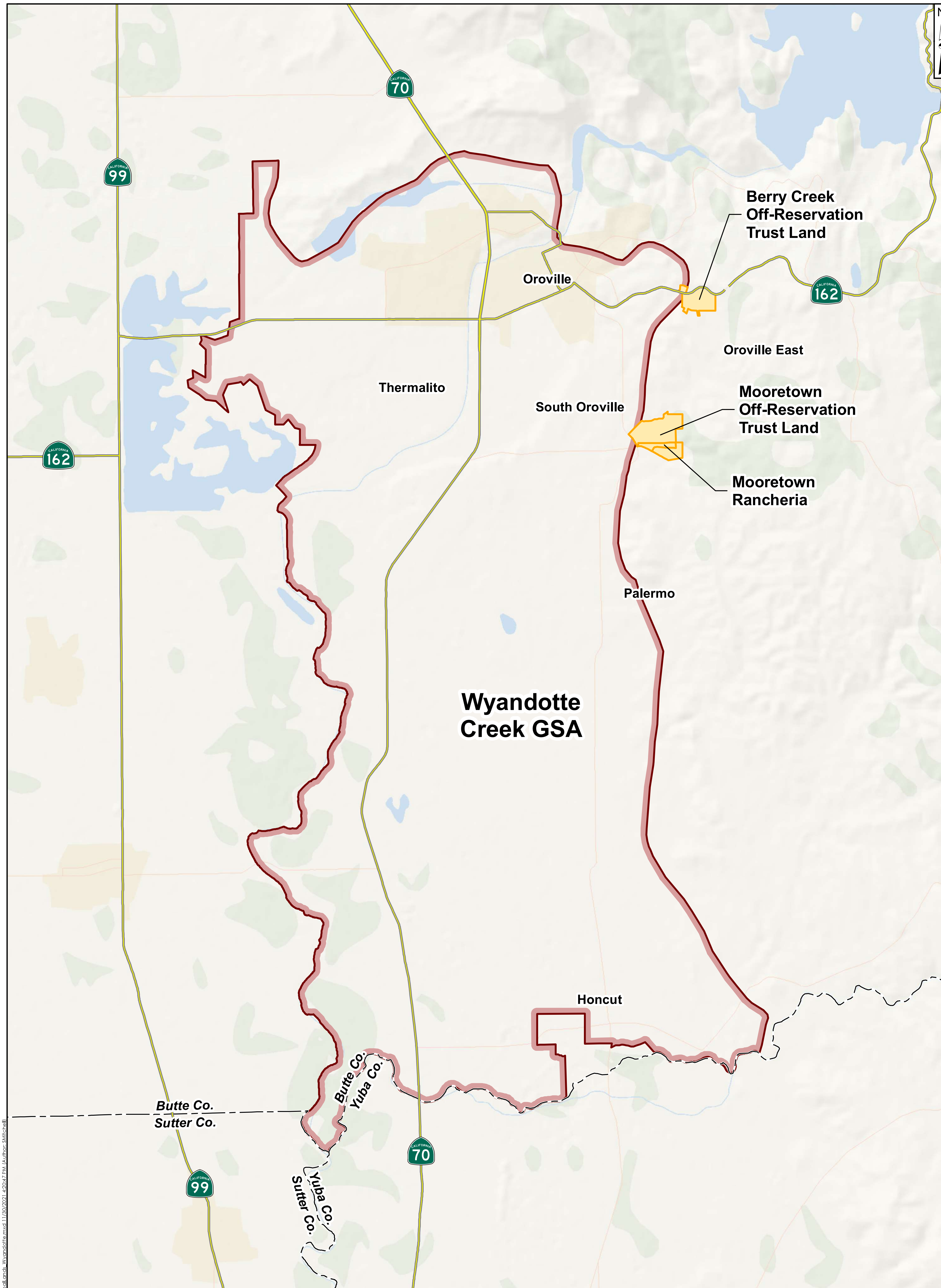
Notes:
1) California Department of Water Resources (CA DWR).
2) TIGER/Line, U.S. Census Bureau.

Cities
Wyandotte Creek Subbasin GSP

Geosyntec consultants

Project No.: SAC282 | December 2021

Figure 1-4



Legend

- Wyandotte Creek Subbasin[1]
- Tribal Designated Statistical Areas (TDSAs)

Roads[2]

- Highways

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

Tribal Areas
Wyandotte Creek Subbasin GSP

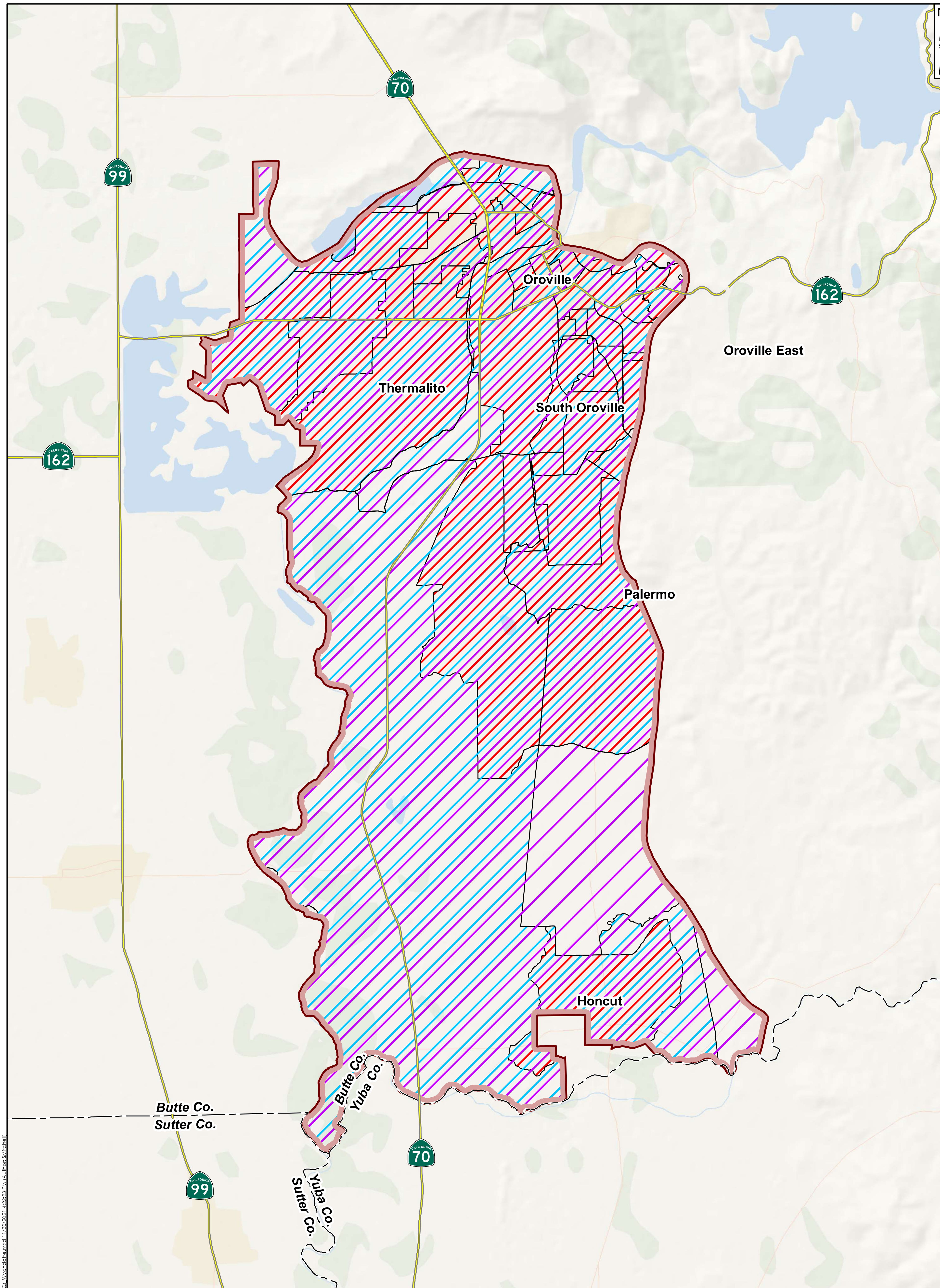
Geosyntec consultants

Project No.: SAC282

December 2021

Figure **1-5**

P:\GIS\SAC282 - Butte County\Project\202108_GSP_Maps\Wyandotte\Ch_1\Fig1-5_TribalLands_Wyandotte.mxd 11/30/2021 4:20:47 PM (Author: SMitchell)



Legend

Wyandotte Creek Subbasin[1]

Disadvantaged Communities (2018)[2]

By census tract

By block group

By place

Roads[2]

Highways

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

Disadvantaged Communities (2018)
Wyandotte Creek Subbasin GSP

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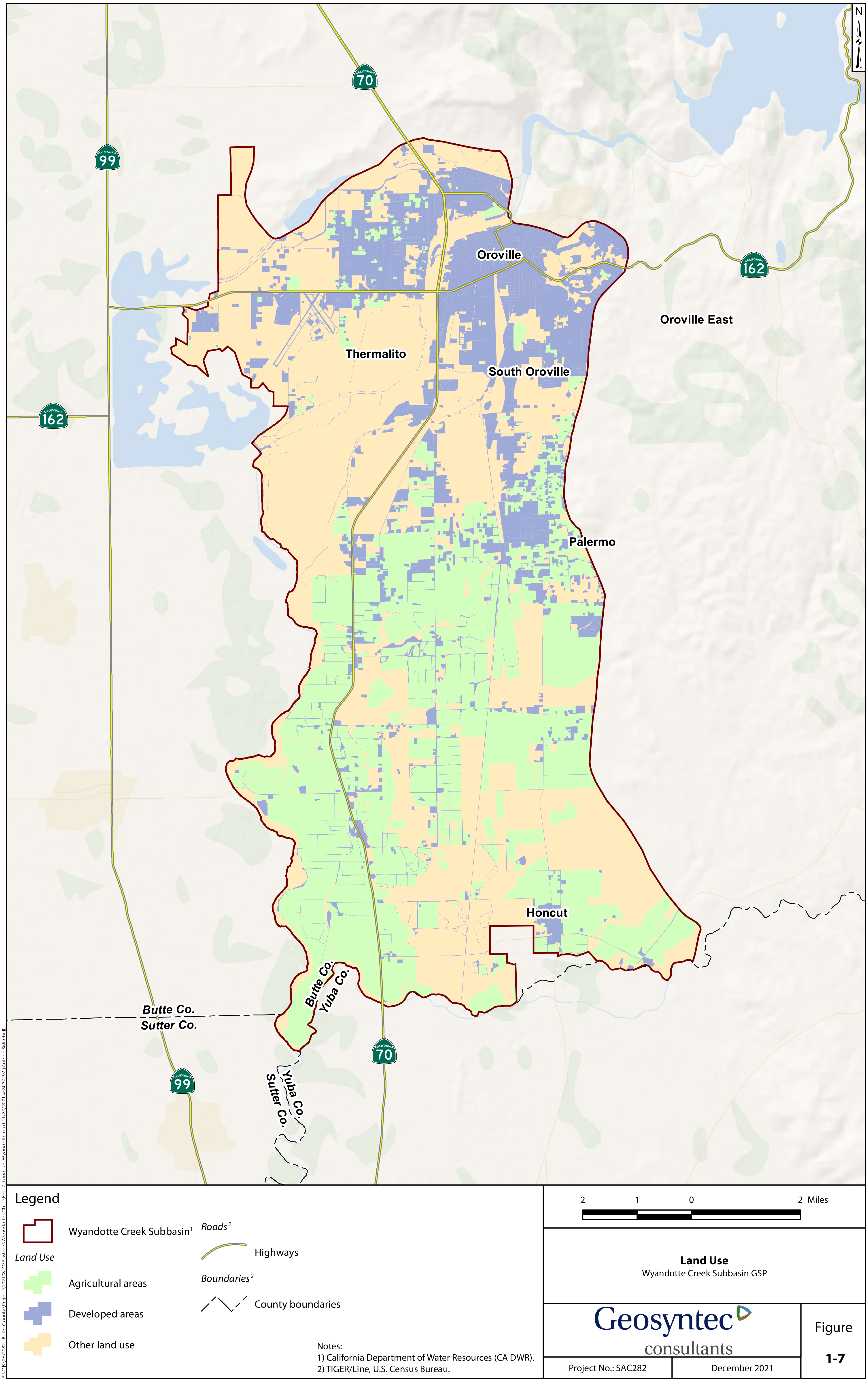
Project No.: SAC282

December 2021

Figure **1-6**



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

Land Use
Wyandotte Creek Subbasin GSP

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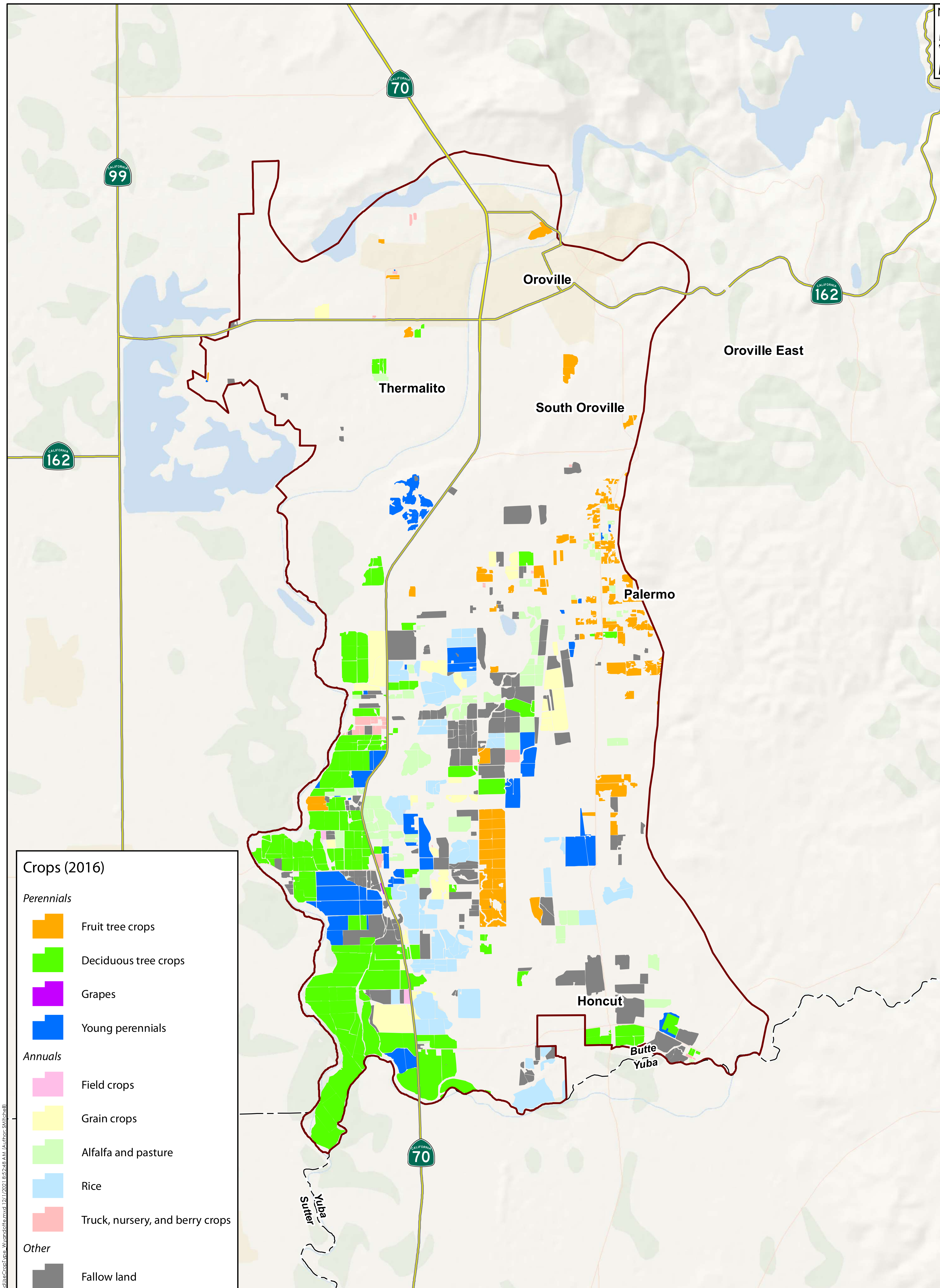
Project No.: SAC282 | December 2021

Figure 1-7



Legend

Wyandotte Creek Subbasin[1]

Roads

Highways[2]

Boundaries

County boundaries[2]

2 1 0 2 Miles

Land Use by Crop Type
Wyandotte Creek Subbasin GSP

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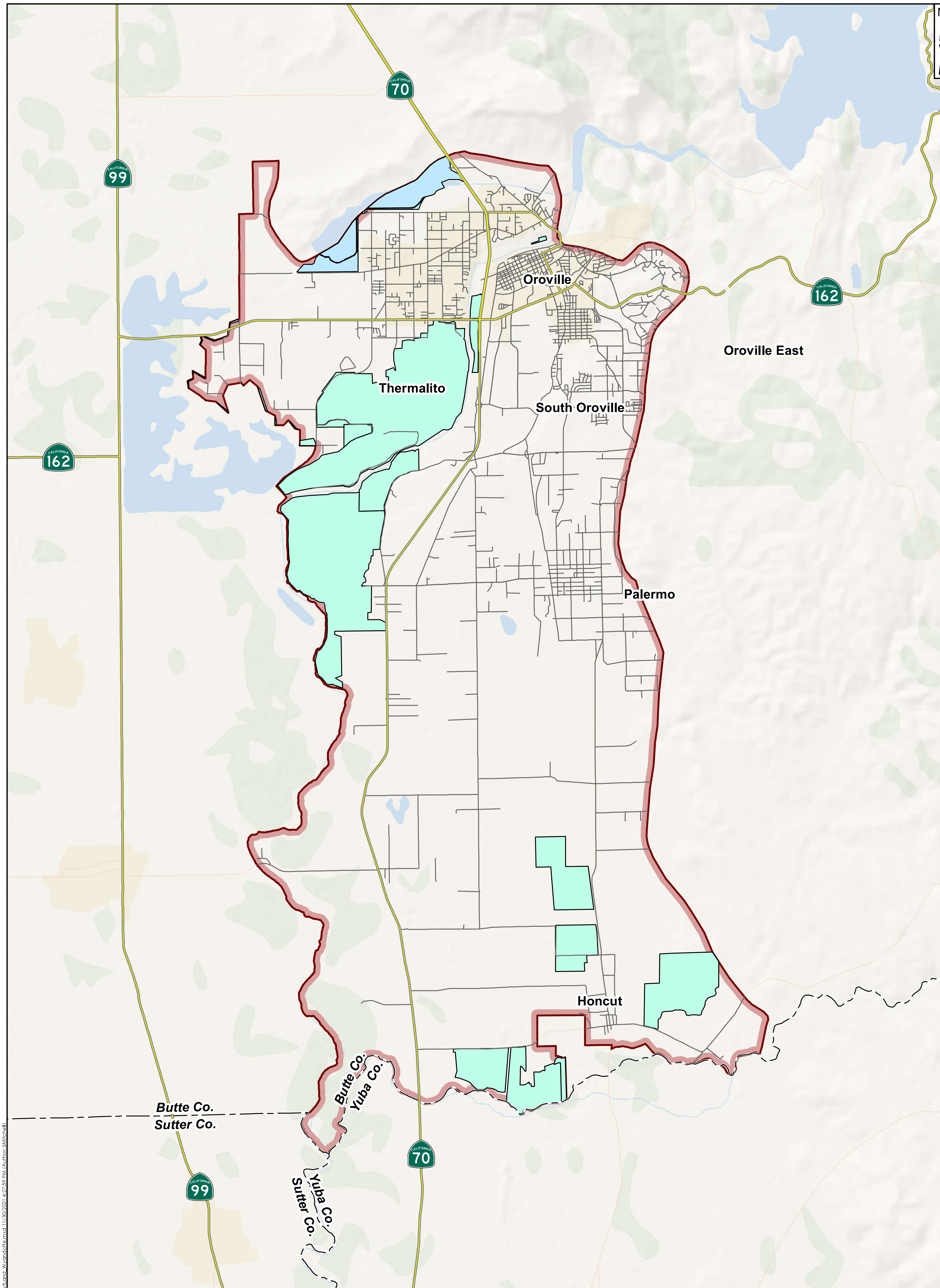
Figure 1-8

Project No.: SAC282 | December 2021

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



Legend

Wyandotte Creek Subbasin[1]

State and Federal Lands

California Dept. of Fish and Wildlife lands[2]

California State Parks[3]

Roads[4]

Highways

Other roads

Boundaries[4]

County boundaries

Notes:
1) California Department of Water Resources (CA DWR).
2) California Department of Fish and Wildlife (CDFW).
3) California Department of Parks and Recreation (CDPR).
4) TIGER/Line, U.S. Census Bureau.

2 1 0 2 Miles

State and Federal Lands
Wyandotte Creek Subbasin GSP

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Figure **1-9**

Project No.: SAC282 | December 2021

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.

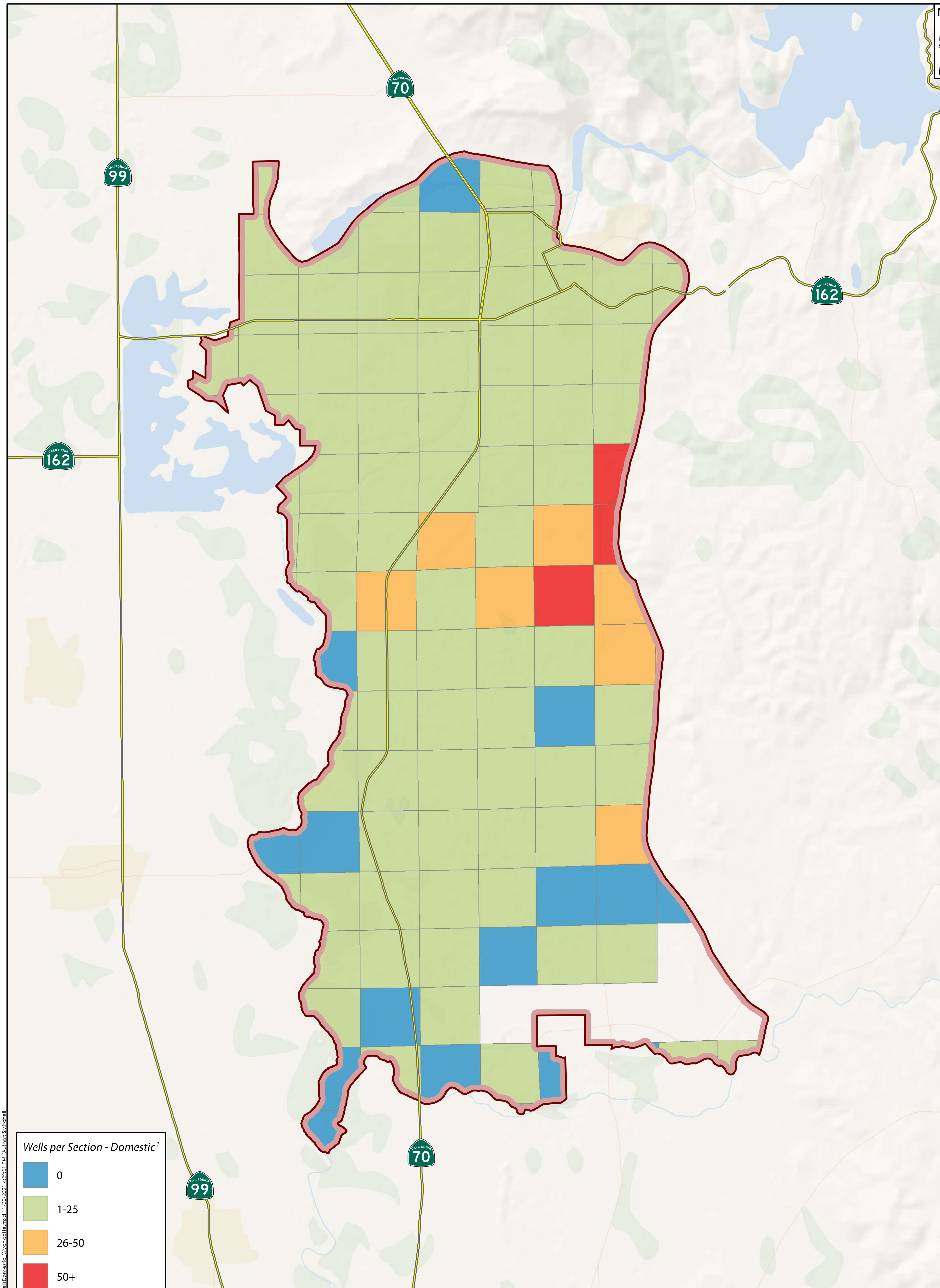
1.2.2 Management Areas

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.



Legend

Wyandotte Creek Subbasin[1]

Roads

Highways[2]

2 1 0 2 Miles

Density of Domestic Wells per Section
Wyandotte Creek Subbasin GSP

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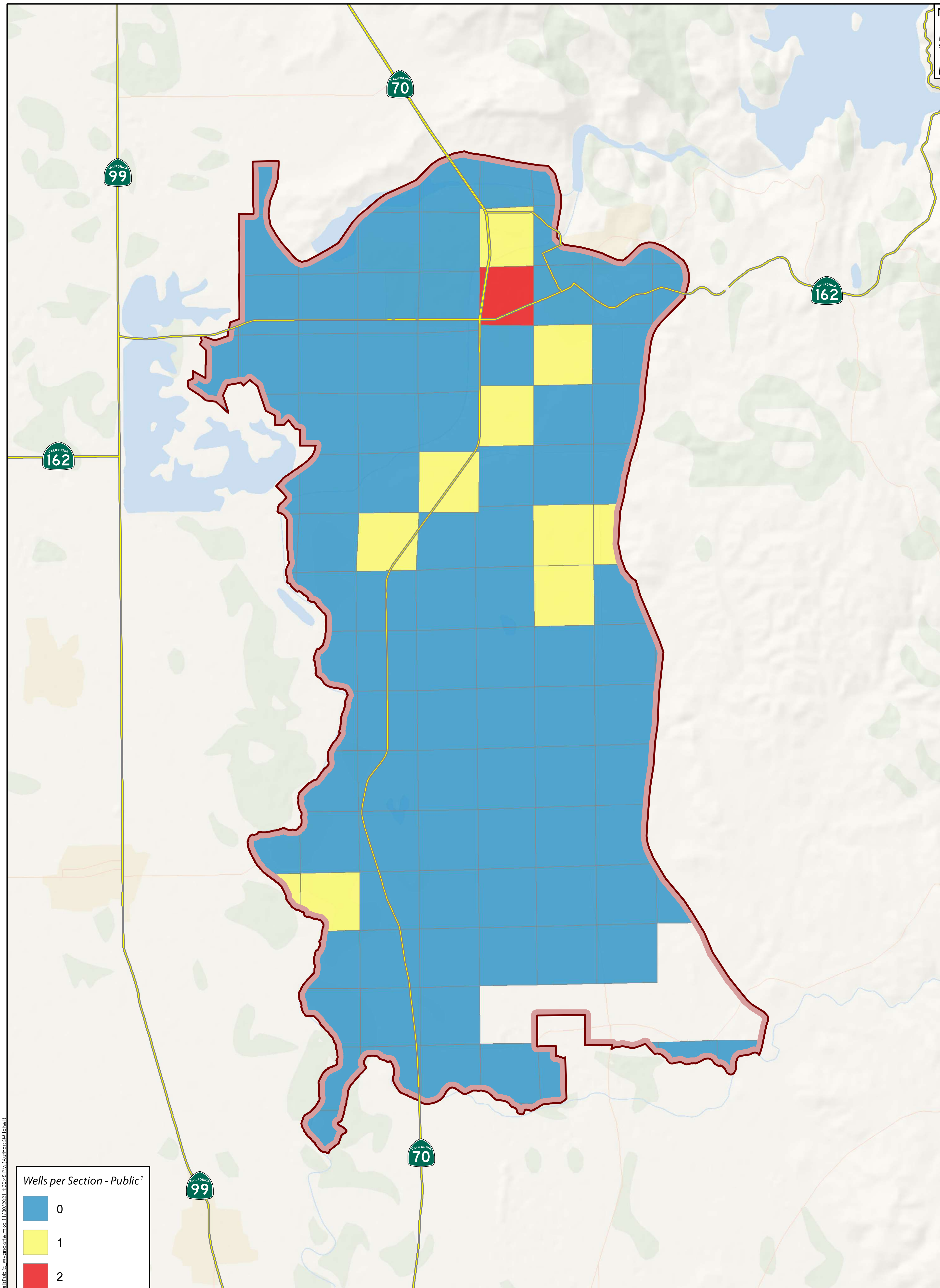
Figure **1-10**

Project No.: SAC282 | December 2021

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



Legend

Wyandotte Creek Subbasin[1]

Roads[2]

Highways

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

2 1 0 2 Miles

Density of Public Wells per Section
Wyandotte Creek Subbasin GSP

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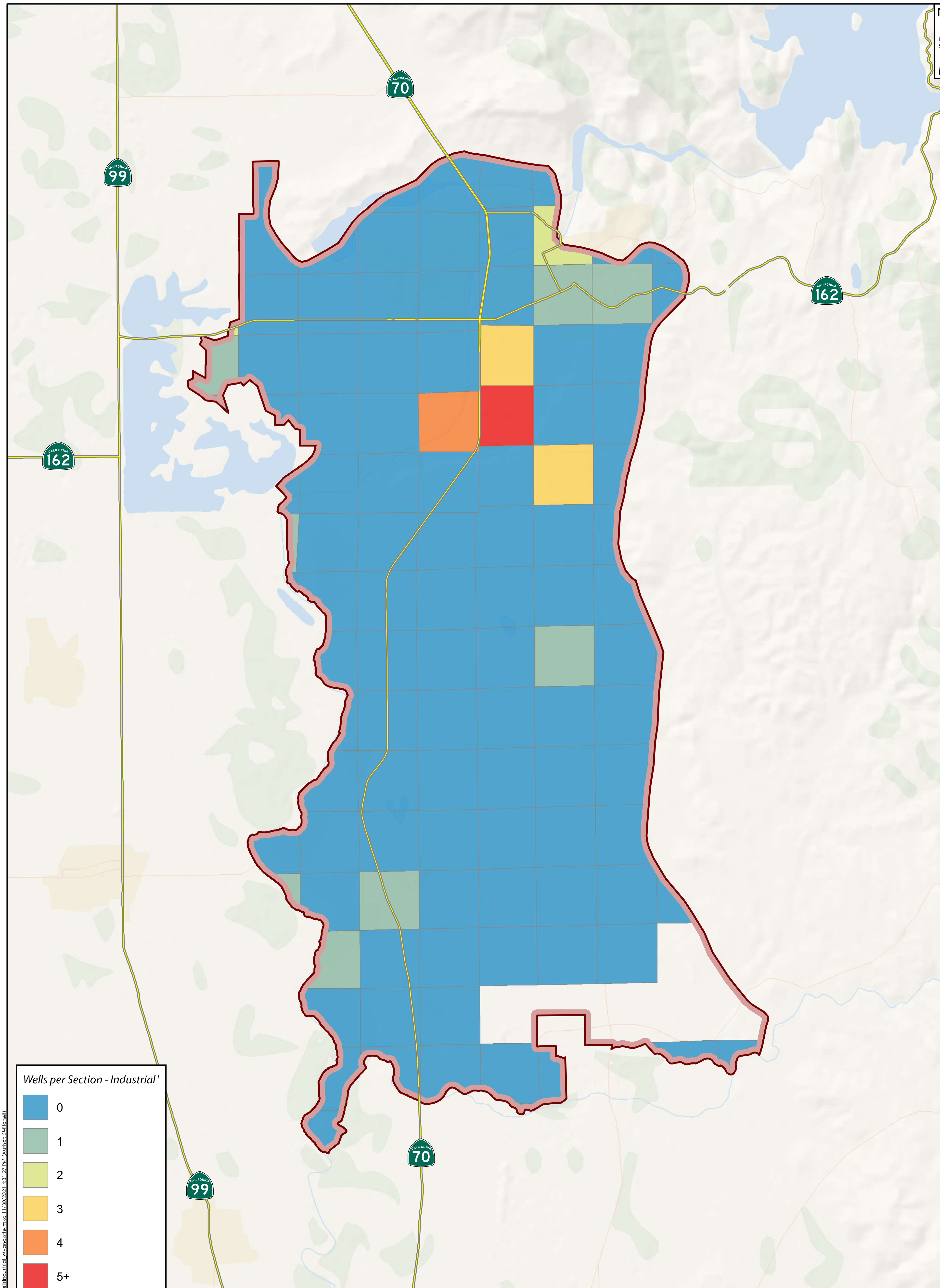
Project No.: SAC282

December 2021

Figure **1-11**



Legend

Wyandotte Creek Groundwater Subbasin[1]

Roads[2]

Highways

2 1 0 2 Miles

Density of Industrial Wells per Section
Wyandotte Creek Subbasin GSP

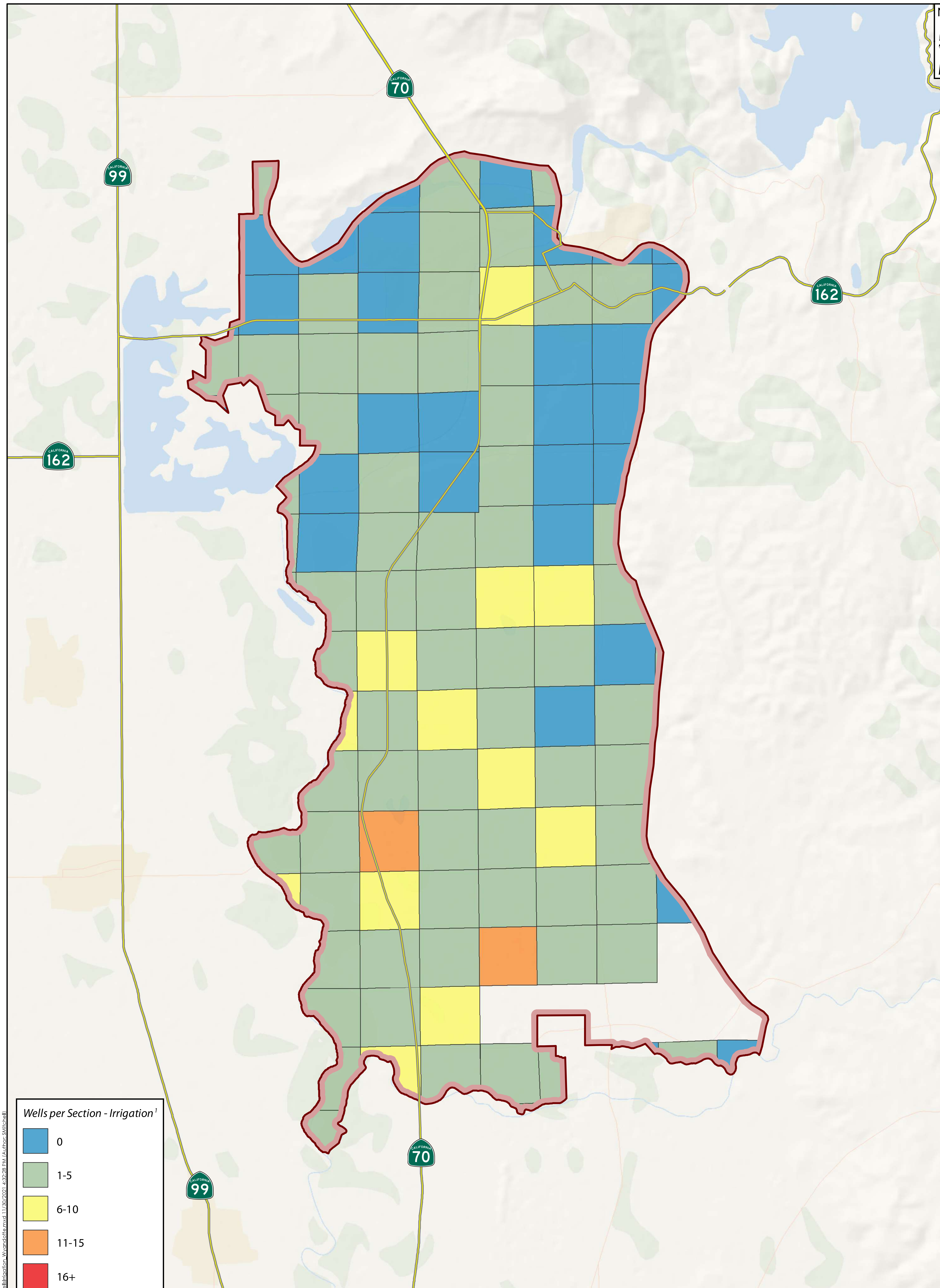
Geosyntec consultants

Figure **1-12**

Project No.: SAC282

December 2021

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



Legend

Wyandotte Creek Subbasin[1]

Roads[2]

Highways

2 1 0 2 Miles

Density of Irrigation Wells per Section
Wyandotte Creek Subbasin GSP

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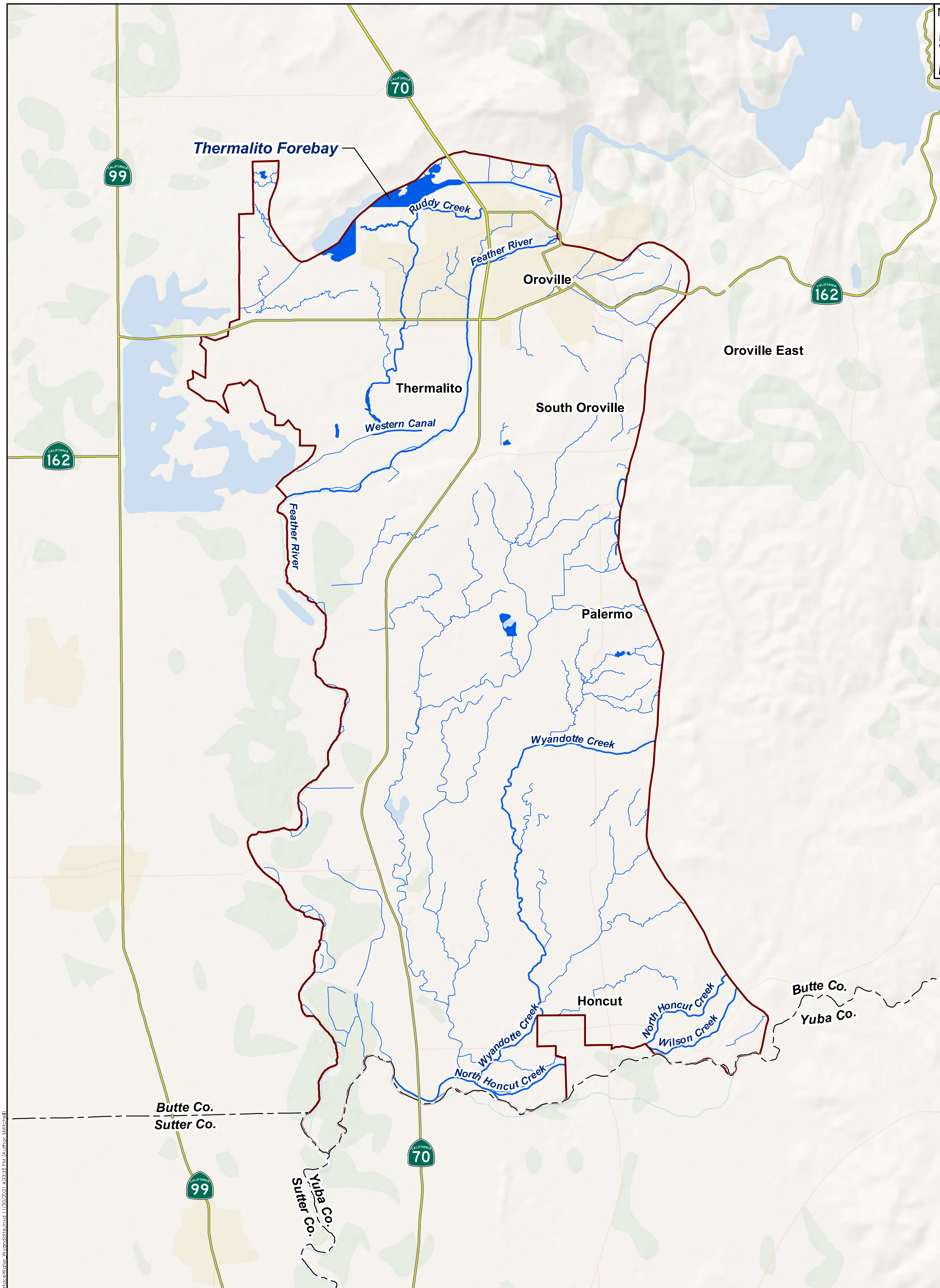
Figure **1-13**

Project No.: SAC282

December 2021

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



Legend

Wyandotte Creek Subbasin[1]

Surface Water

Water bodies[2]

Named streams

Other streams

Roads[3]

Highways

Boundaries[3]

County boundaries

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

2 1 0 2 Miles

Surface Water Bodies
Wyandotte Creek Subbasin GSP

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Project No.: SAC282

December 2021

Figure **1-14**

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

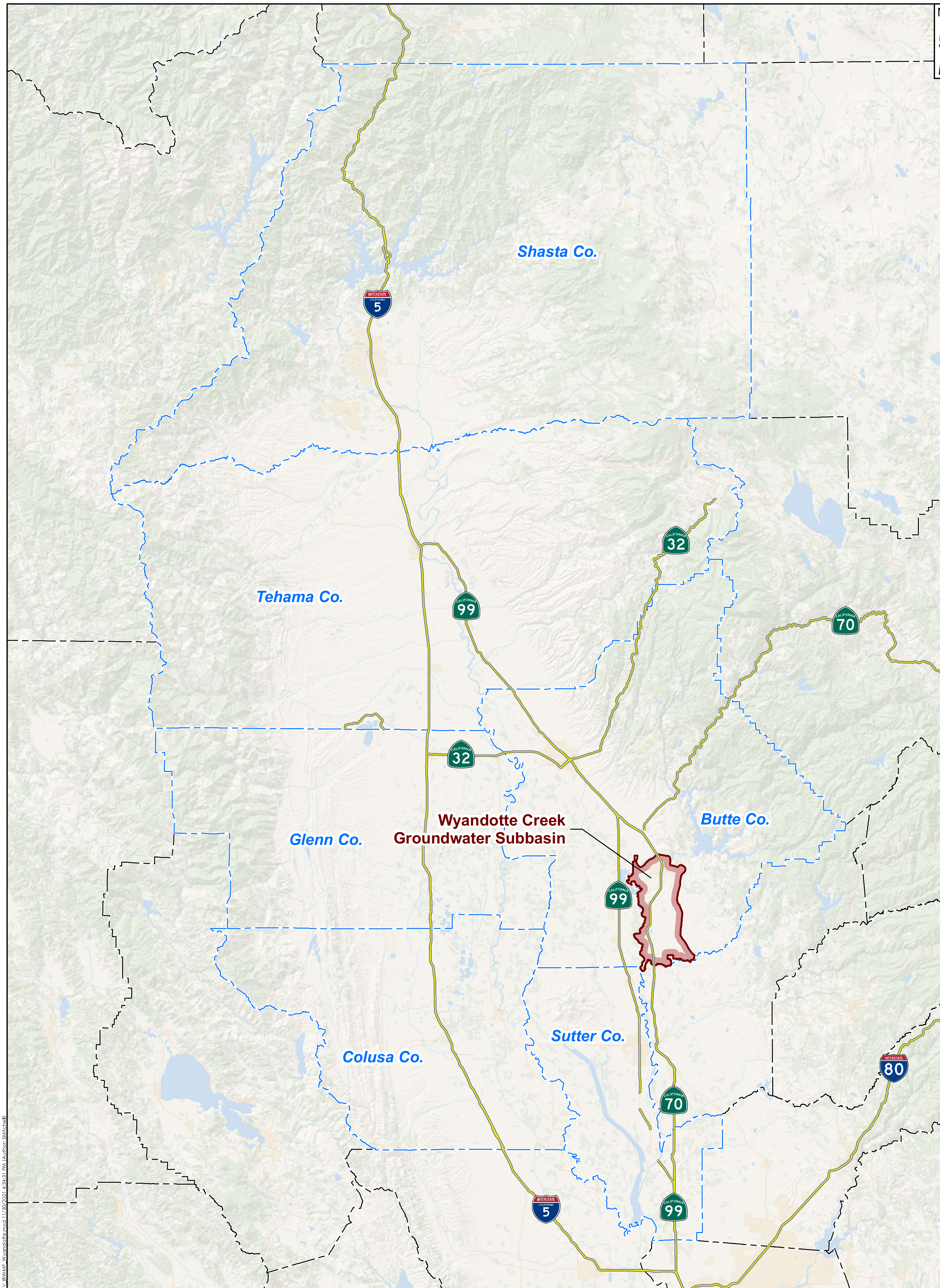
The County of Butte has a Groundwater Management Plan that covers the entire County except for areas covered by Urban Water Management Plans (UWMPs). The Butte County Groundwater Management Plan can be found at http://www.buttecounty.net/waterresourceconservation/groundwatermanagementplan

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.



Legend

Wyandotte Creek Groundwater Subbasin[1]

Counties within the IRWMP

Roads[2]

Highways

Boundaries[2]

County boundaries

20 10 0 20 Miles

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

Northern Sacramento Valley
Integrated Regional Water Management Plan
(NSV IRWMP)
Wyandotte Creek Subbasin GSP

Geosyntec consultants

Project No.: SAC282

December 2021

Figure

1-15

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 will better position 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

There are no conjunctive use programs in the Wyandotte Creek Subbasin.

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 for 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 BMO program developed by Butte County includes groundwater quality monitoring that is presented annually in the Groundwater Status Reports. Appendix 1-C provides the Water Year 2020 Groundwater Status Report summarizing the results of this groundwater quality monitoring.

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 GSAs 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 Subsidence

To determine whether subsidence is occurring, a subsidence monitoring network has been established throughout Butte County consisting of observation stations and extensometers managed by DWR. The observation stations are 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 are established monuments with precisely surveyed land surface elevations. They are 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 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. 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.

1.7 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 a GSP was signed by the GSAs and distributed on June 28, 2021. The hard copies of the NOI were mailed to cities and counties within the Wyandotte Creek Subbasin including the following:

- Butte County
- City of Oroville

Copies of the NOI 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 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) • Environmental groups: Butte Environmental Council, The Nature Conservancy (TNC)	Inform and involve to sustain a vital ecosystem
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

Category of Interest	Examples of Stakeholder Groups	Engagement purpose
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 development, 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 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 WAC has been meeting approximately monthly since its formation in December of 2020.

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 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 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 are able to 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.

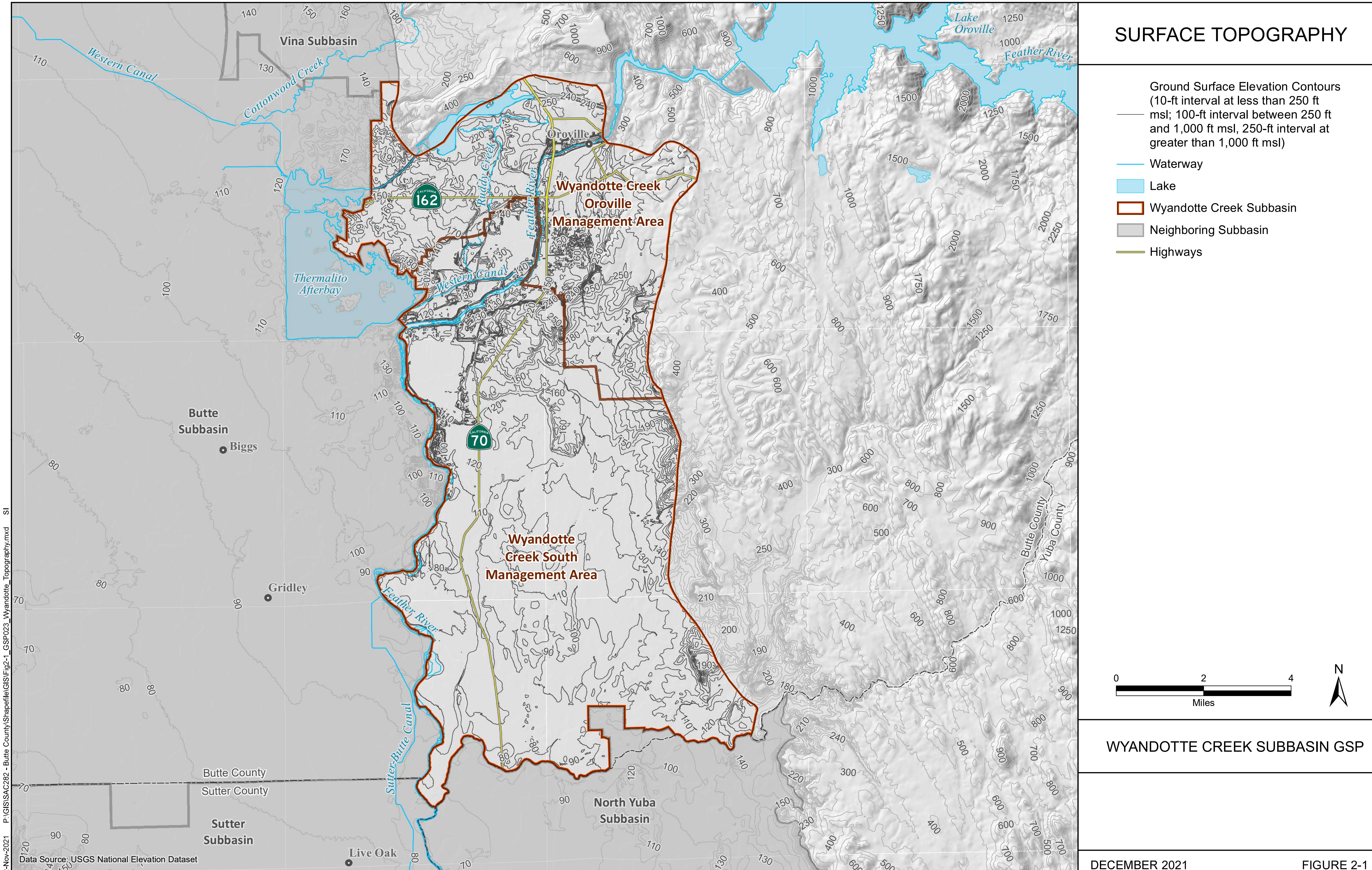
2.1.2.2 Soils

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.

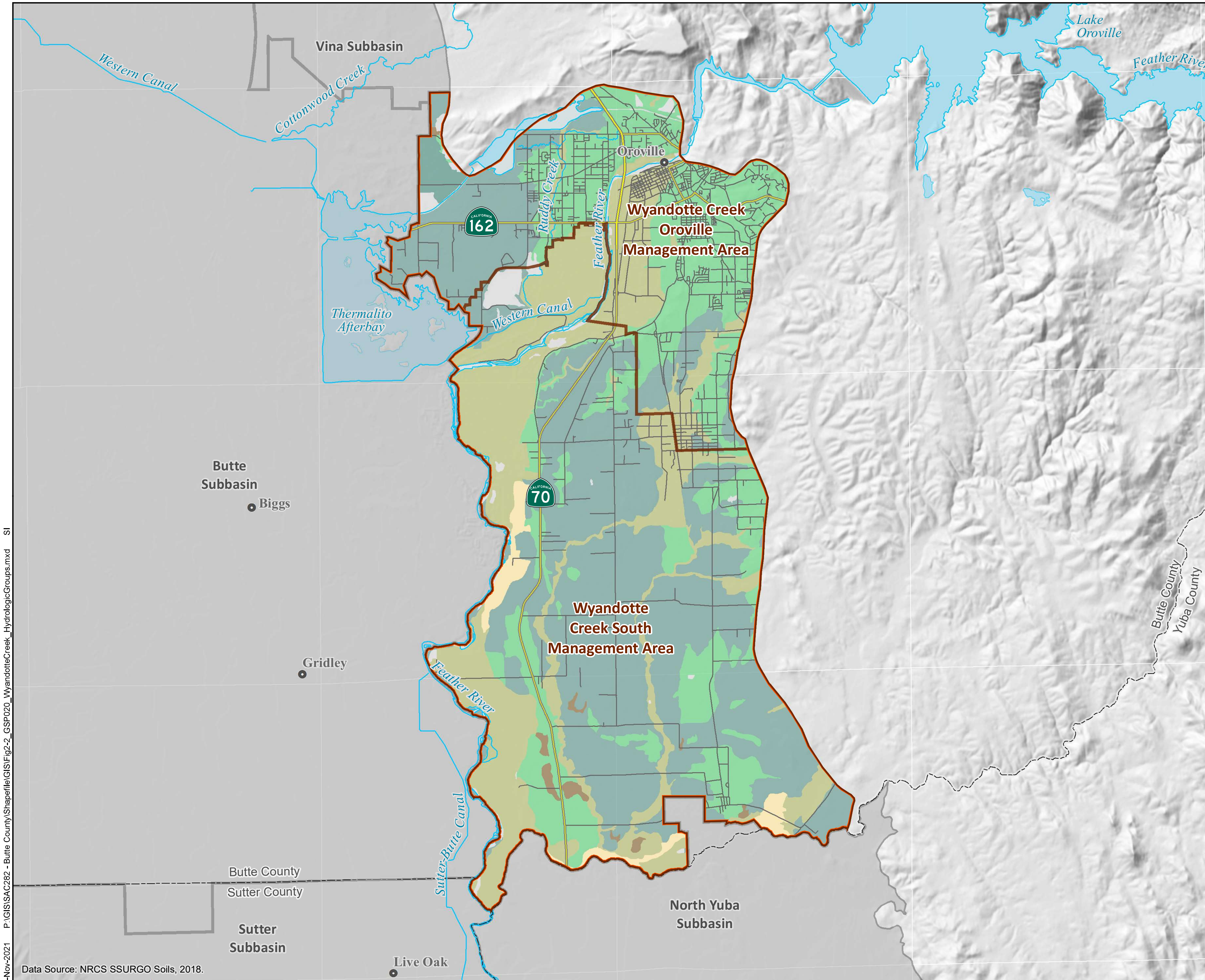
Based on the Digital General Soil Map of the United States, or STATSGO2, soil data for the Wyandotte Creek Subbasin, the dominant soil mapping unit within the area is Redding-Corning, which is moderately well drained and represents approximately 64.3% of the subbasin. Other prominent soils within the 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


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
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-1
Vina Subbasin
Western Canal
Cottonwood Creek
Lake Oroville
Feather River
Oroville
Wyandotte Creek Oroville Management Area
Thermalito Afterbay
Butte Subbasin
Biggs
Gridley
Wyandotte Creek South Management Area
Butte County
Yuba County
Sutter County
Sutter Subbasin
North Yuba Subbasin
Live Oak
Sutter-Butte Canal
162
70
Data Source: USGS National Elevation Dataset
22-Nov-2021 P:\GIS\SAC282 - Butte County\Shapefile\GIS\Fig2-1_GSP023_Wyandotte_Topography.mxd SI

HYDROLOGIC SOIL GROUPS



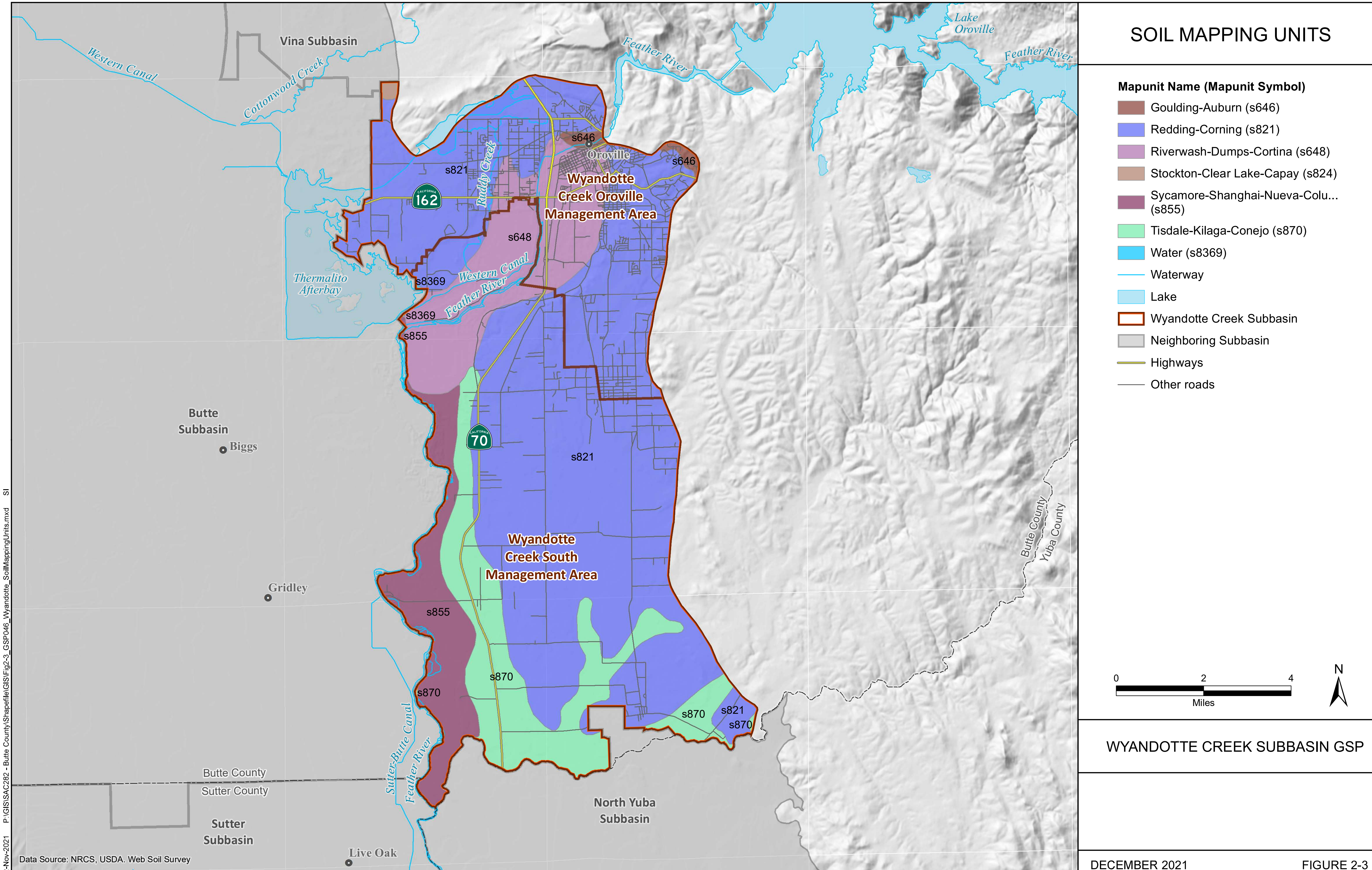
Hydrologic Group - Dominant Condition

- 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


Vina Subbasin
Western Canal
Cottonwood Creek
Feather River
Lake Oroville
Feather River
s646
Oroville
s646
s821
Ruddy Creek
162
Wyandotte Creek Oroville Management Area
s648
Western Canal
Feather River
s8369
Thermalito Afterbay
s8369
s855
Butte Subbasin
Biggs
70
s821
Butte County
Yuba County
Wyandotte Creek South Management Area
Gridley
s855
s870
s870
s870
s821
s870
Butte County
Sutter County
Sutter-Butte Canal
Feather River
North Yuba Subbasin
Sutter Subbasin
Live Oak
Data Source: NRCS, USDA. Web Soil Survey
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
22-Nov-2021 P:\GIS\SAC282 - Butte County\Shapefile\GIS\Fig2-3_GSP046_Wyandotte_SoilMappingUnits.mxd SI

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.

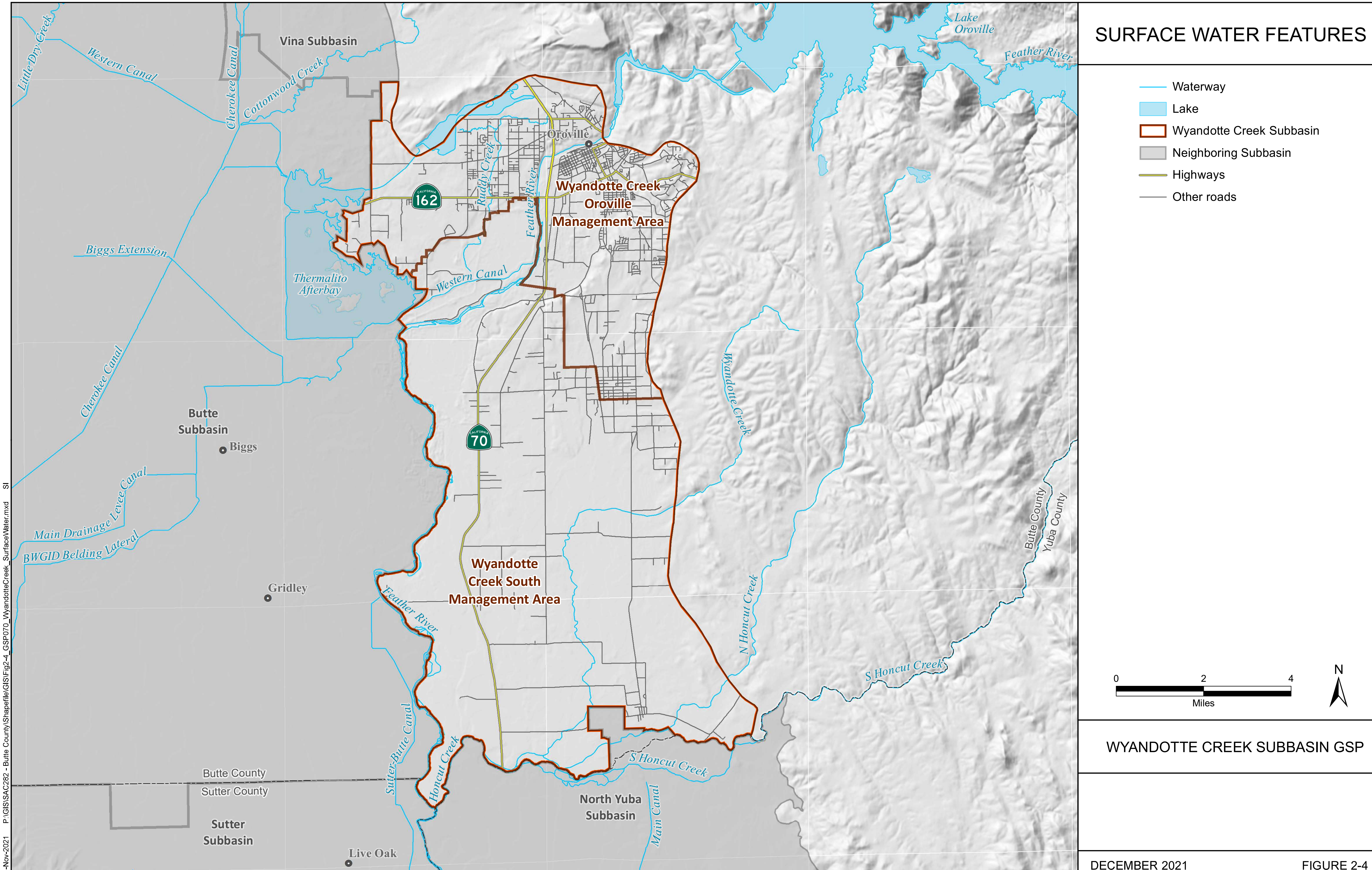
Smaller local or ephemeral streams entering and traversing the subbasin include North Honcut Creek, Wyandotte Creek, Wyman Ravine, Ruddy Creek, canals, and numerous unnamed waterways. Figure 2-4 shows prominent surface water features in the Wyandotte Creek Subbasin.

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) for the 2018 water year across the model elements (triangular areas) (BCDWRC, 2021). 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.



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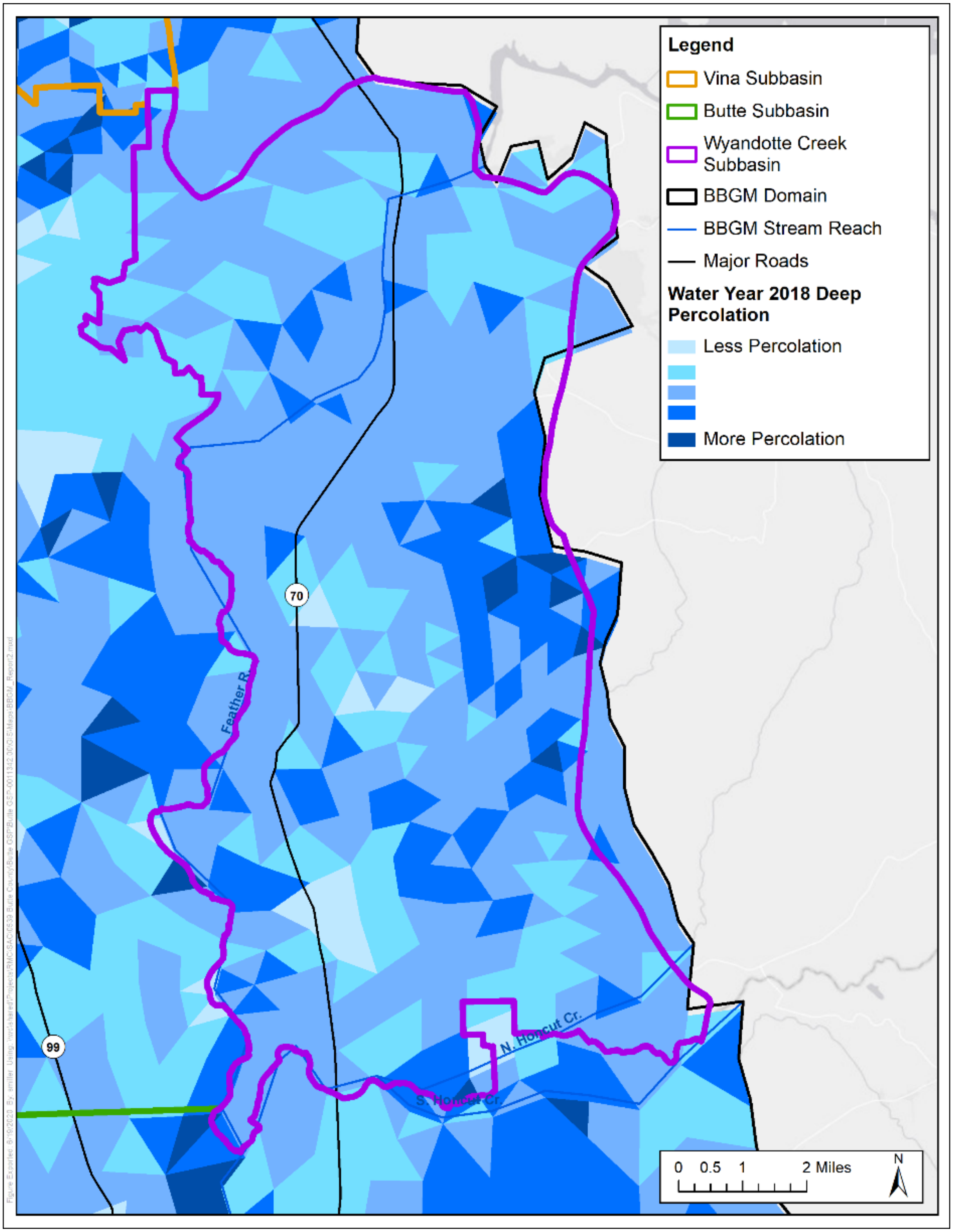
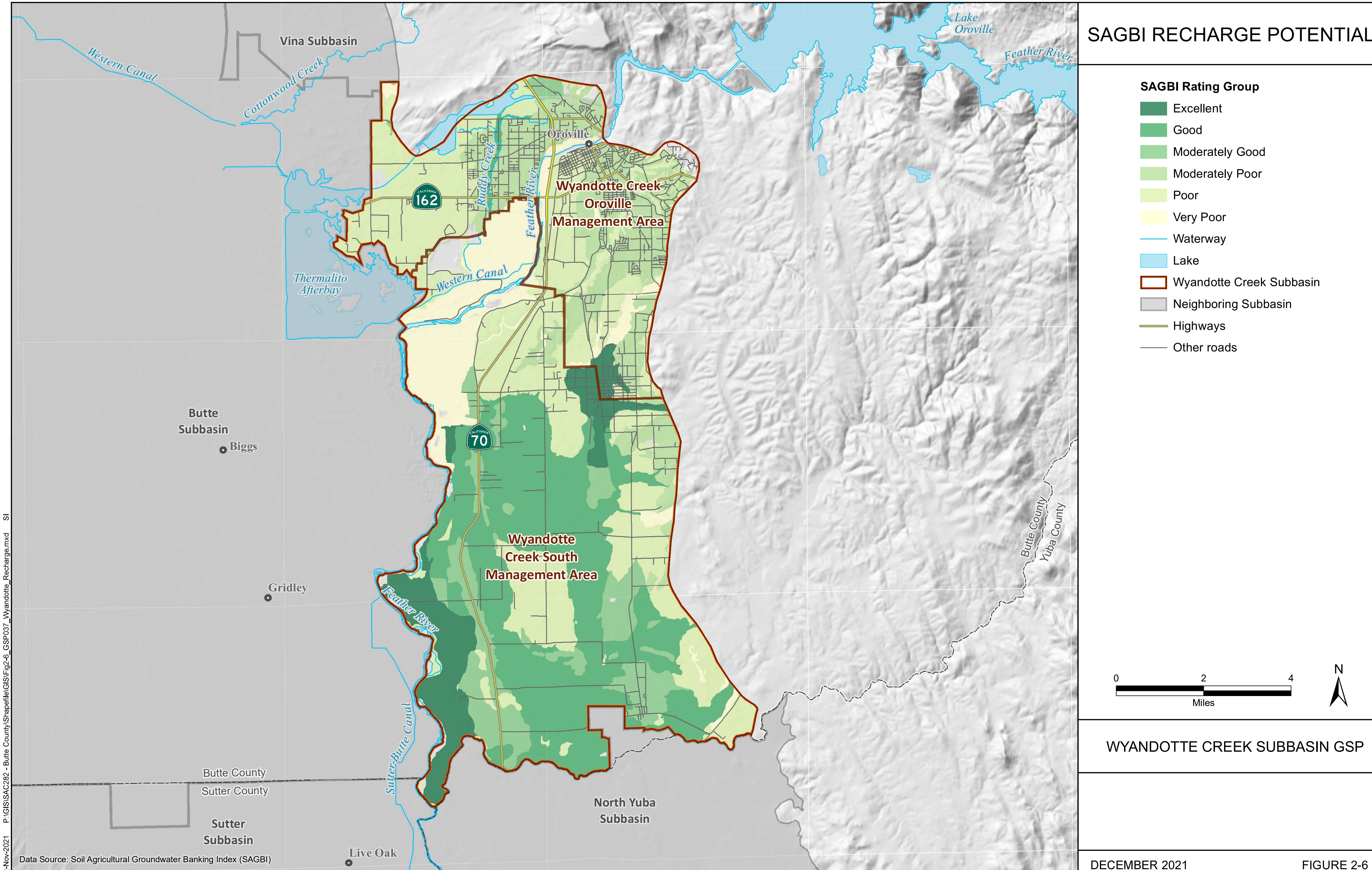


Figure 2-5: Relative Rates of Deep Percolation throughout the Wyandotte Creek Subbasin as Estimated by the Butte Basin Groundwater Model (BBGM)


Vina Subbasin
Western Canal
Cottonwood Creek
Lake Oroville
Feather River
Oroville
Ruddy Creek
162
Feather River
Wyandotte Creek Oroville Management Area
Thermalito Afterbay
Western Canal
70
Butte Subbasin
Biggs
Gridley
Wyandotte Creek South Management Area
Feather River
Butte County
Yuba County
Butte County
Sutter County
Sutter-Butte Canal
North Yuba Subbasin
Sutter Subbasin
Live Oak
Data Source: Soil Agricultural Groundwater Banking Index (SAGBI)
SAGBI RECHARGE POTENTIAL
SAGBI Rating Group
Excellent
Good
Moderately Good
Moderately Poor
Poor
Very Poor
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-6
22-Nov-2021 P:\GIS\SAC282 - Butte County\Shapefile\GIS\Fig2-6_GSP037_Wyandotte_Recharge.mxd SI

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).

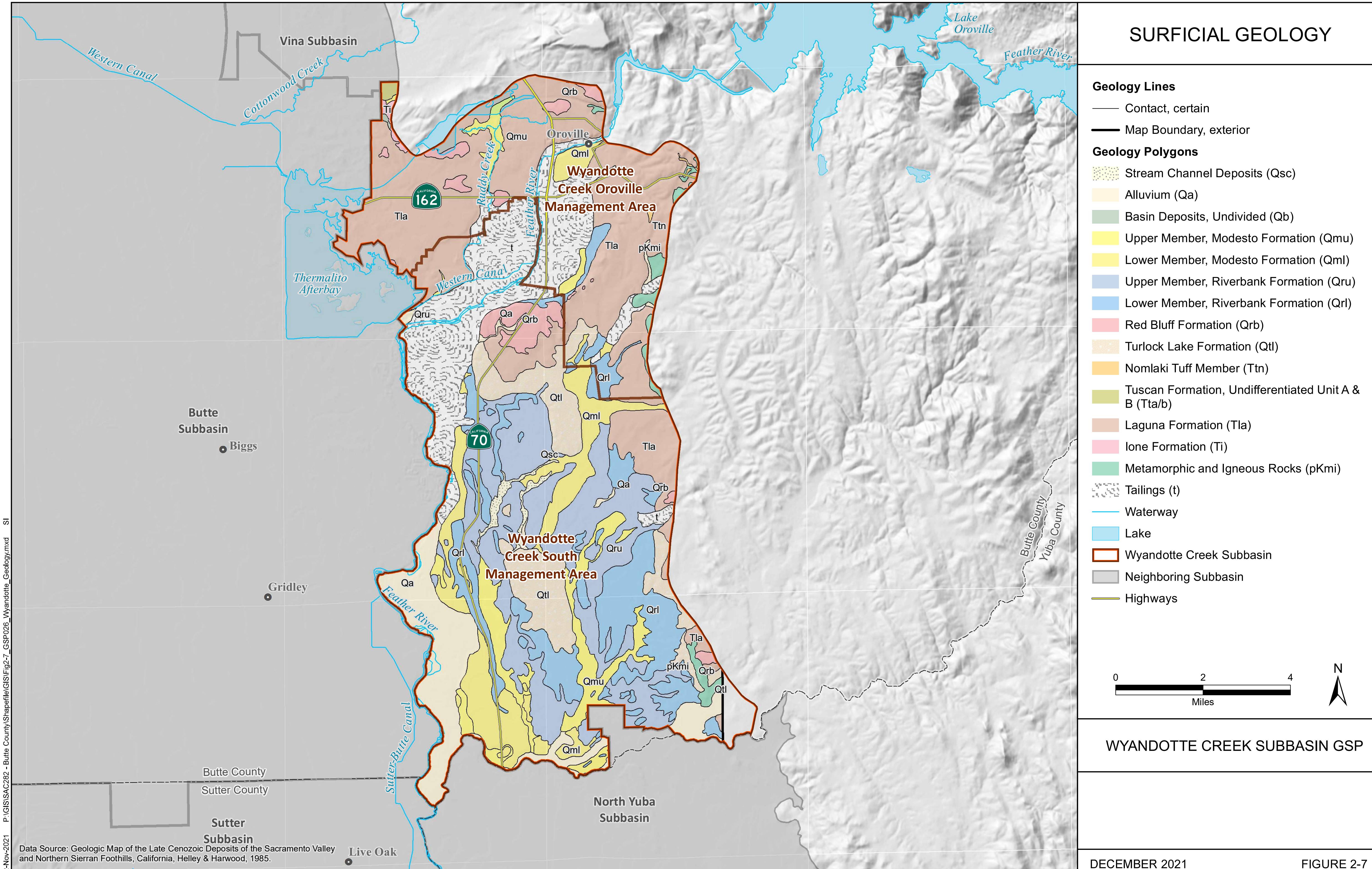
In the Oroville area, bedrock has been encountered as shallow as 283 feet below ground surface (bgs) and has been observed in outcrop adjacent to the Memorial Park Cemetery (Dames and Moore, 1994). Moving east from these areas, bedrock has been reported to occur at depths greater than 1,000 feet.

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
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-7
Vina Subbasin
Western Canal
Cottonwood Creek
Lake Oroville
Feather River
Oroville
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Thermalito Afterbay
Butte Subbasin
Biggs
Gridley
Sutter-Butte Canal
Butte County
Sutter County
Yuba County
Sutter Subbasin
North Yuba Subbasin
Live Oak
162
70
Ruddy Creek
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

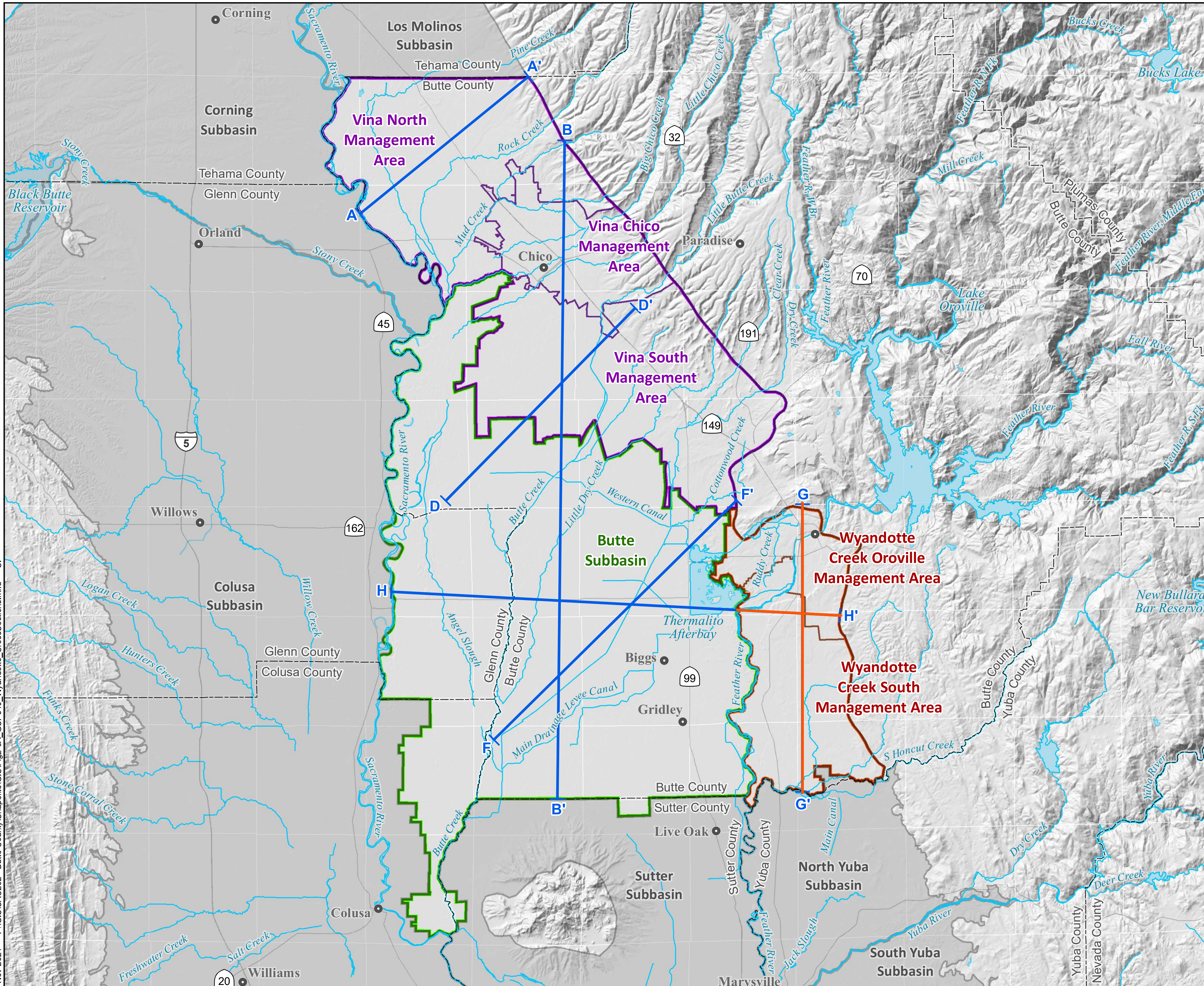
The Laguna Formation consists of sandy gravel channel, sandy channel facies, and sandy clay to clay floodplain facies and ranges in thickness in the northern part of the subbasin from 120 feet to 220 feet. The gravel deposits occur above sharp, scoured facies and are comprised of poorly to moderately 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 is a key which shows the orientation of geologic cross sections developed for the Wyandotte Creek Subbasin and relation of these cross sections to others in the adjacent Vina and Butte subbasins. Figures 2-8B and 2-8C are respectively north-south and east-west geologic cross sections for the Wyandotte Creek Subbasin. The north-south section was developed for this GSP, the east-west section is based on a section presented in the DWR report Geology of the Northern Sacramento Valley, California (DWR, 2014).



CROSS SECTION ALIGNMENTS

Cross Section Alignment
Relevant Cross Section Extent

Subbasins

Butte Subbasin
Vina Subbasin
Wyandotte Creek Subbasin
Neighboring Subbasin

All Other Features

Highway
Waterway
Lake

0 2.5 5 10
Miles

N

WYANDOTTE CREEK SUBBASIN GSP

DECEMBER 2021 FIGURE 2-8A

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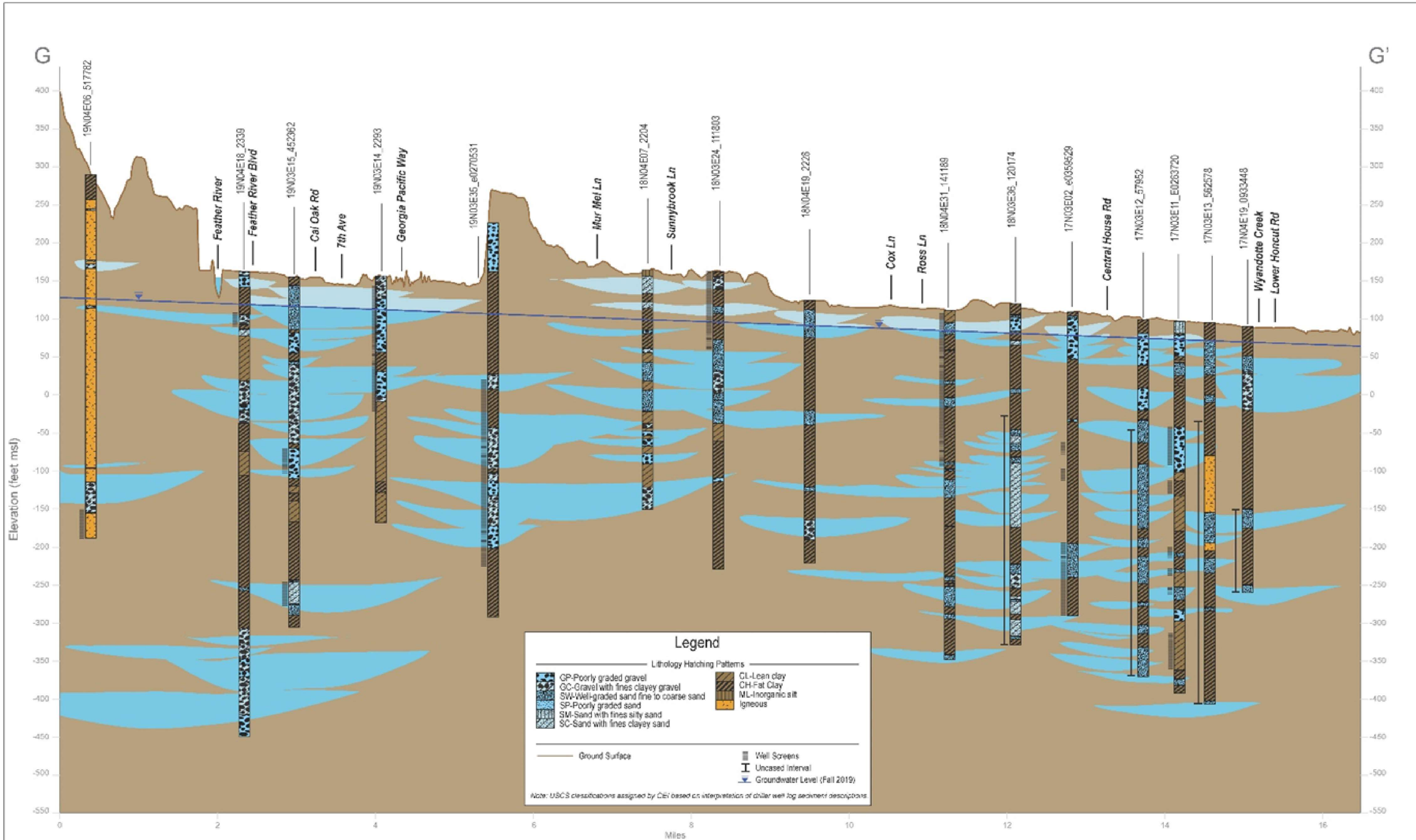


North-South Geologic Cross-Section G-G'
Wyandotte Creek Subbasin GSP

Project No.: SAC282 | December 2021

Figure 2-8B

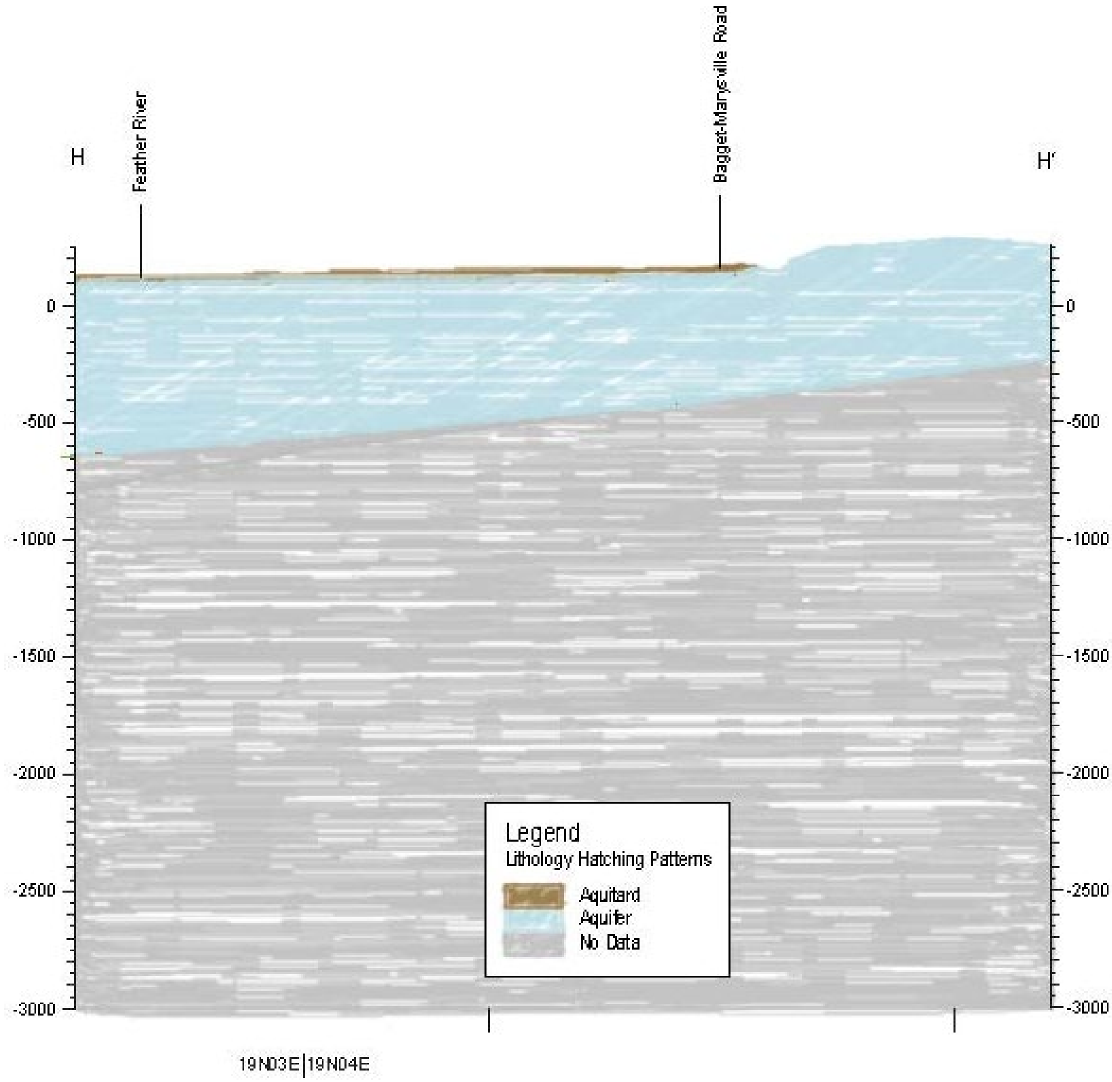


Figure 2-8C: East-West Geologic Cross Section H-H'

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 throughout the Wyandotte Creek Subbasin are 10% and 0.00001, respectively (BCDWRC, 2021).

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).

2.1.7.4 Water Quality

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 electrical conductivity in two wells in the subbasin. Data collected annually from 2002 through 2019 indicate a range of 132 to 374 microsiemens per centimeter (μS/cm), well below the secondary water quality threshold for drinking water of 900 μS/cm.

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.

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 electrical 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.

2.1.8.6 Additional Aerial Electromagnetic Data Collection

Expanding the extent of aerial electromagnetic (AEM) surveys is recommended to support refinement of the 3D HCM of the subsurface. AEM data sets provide valuable insights on the lithology of the subbasin and therefore better understanding of connectivity between aquifer layers and recharge areas.

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 and an indication of how conditions may change in the future.

2.2.2 Groundwater Trends

2.2.2.1 Elevation and Flow Directions

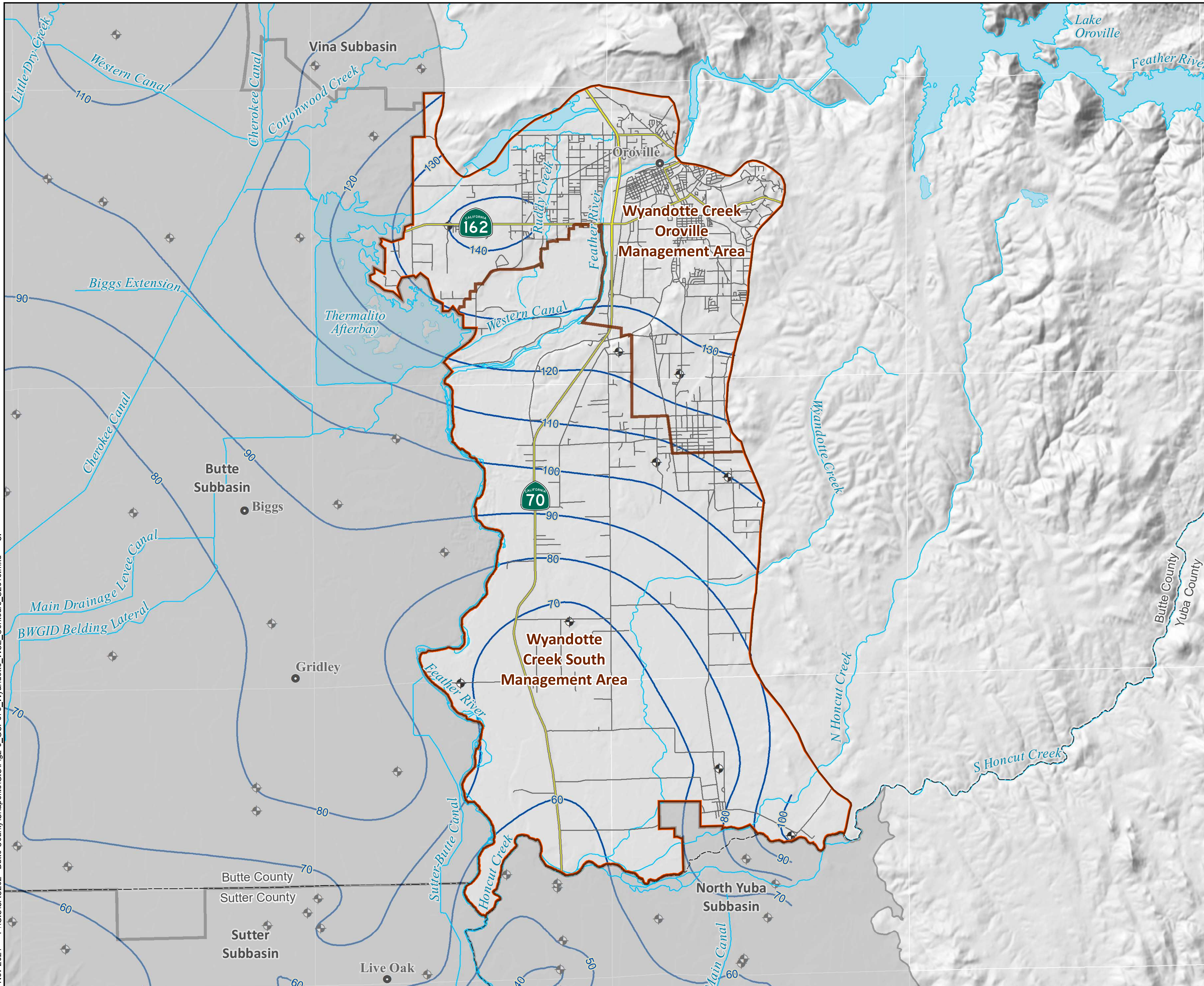
Figures 2-9 and 2-10 show groundwater elevation contours in the Wyandotte Creek Subbasin for the spring and fall of 2015 and Figures 2-11 and 2-12 show elevation contours for the spring and fall of 2019.

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

WYANDOTTE CREEK SUBBASIN GSP

DECEMBER 2021

FIGURE 2-9

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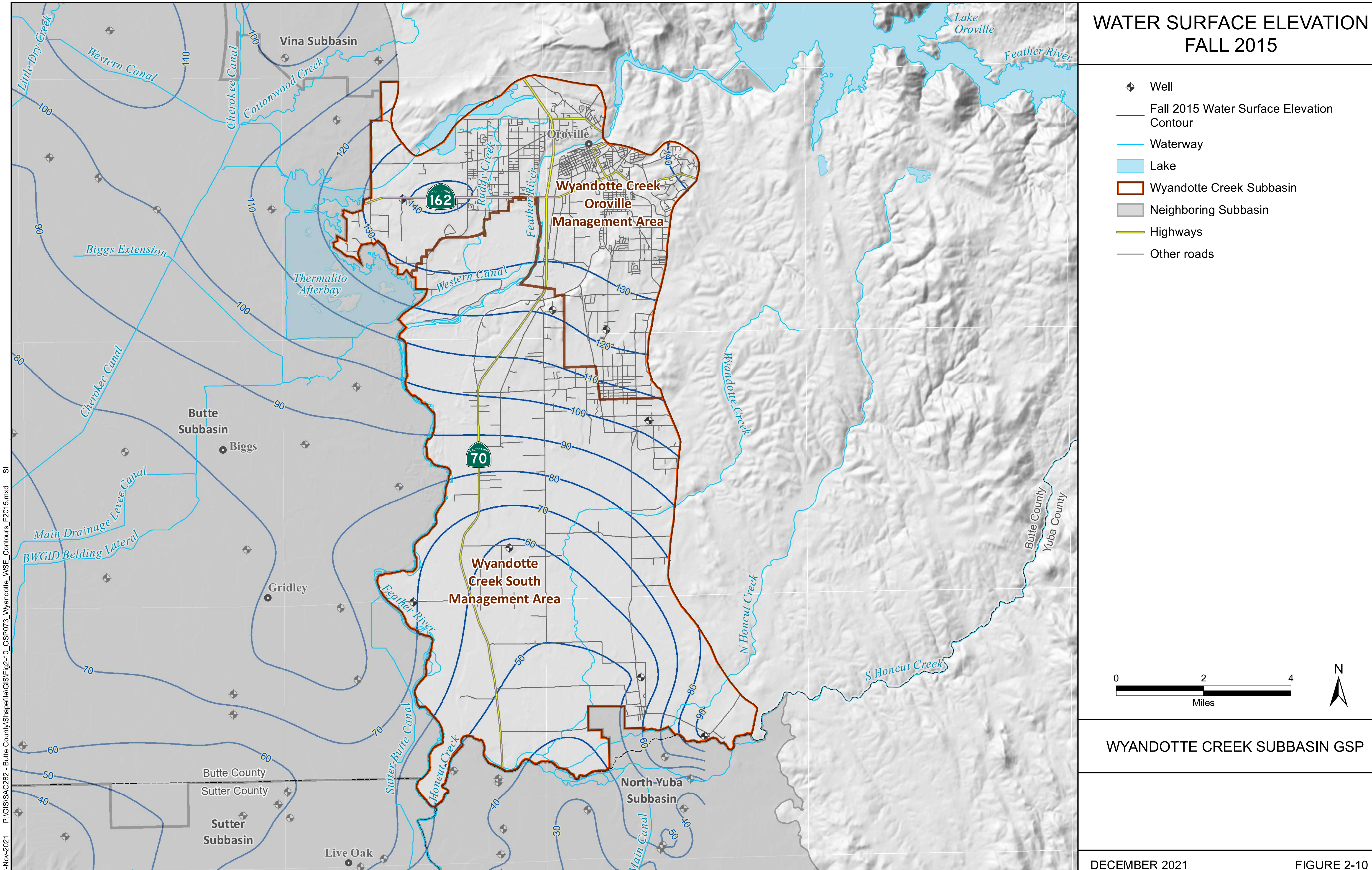
WATER SURFACE ELEVATION
FALL 2015
Well
Fall 2015 Water Surface Elevation Contour
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
Vina Subbasin
Butte Subbasin
Sutter Subbasin
North Yuba Subbasin
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Oroville
Biggs
Gridley
Live Oak
Lake Oroville
Feather River
Thermalito Afterbay
Western Canal
Biggs Extension
Cherokee Canal
Cottonwood Creek
Little Dry Creek
Main Drainage Levee Canal
BWGID Belding Lateral
Sutter-Butte Canal
Honcut Creek
Wyandotte Creek
N Honcut Creek
S Honcut Creek
Ruddy Creek
Main Canal
Butte County
Sutter County
Yuba County
162
70
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 2-10
P:\GIS\SAC282 - Butte County\Shapefile\GIS\Fig2-10_GSP073_Wyandotte_WSE_Contours_F2015.mxd SI
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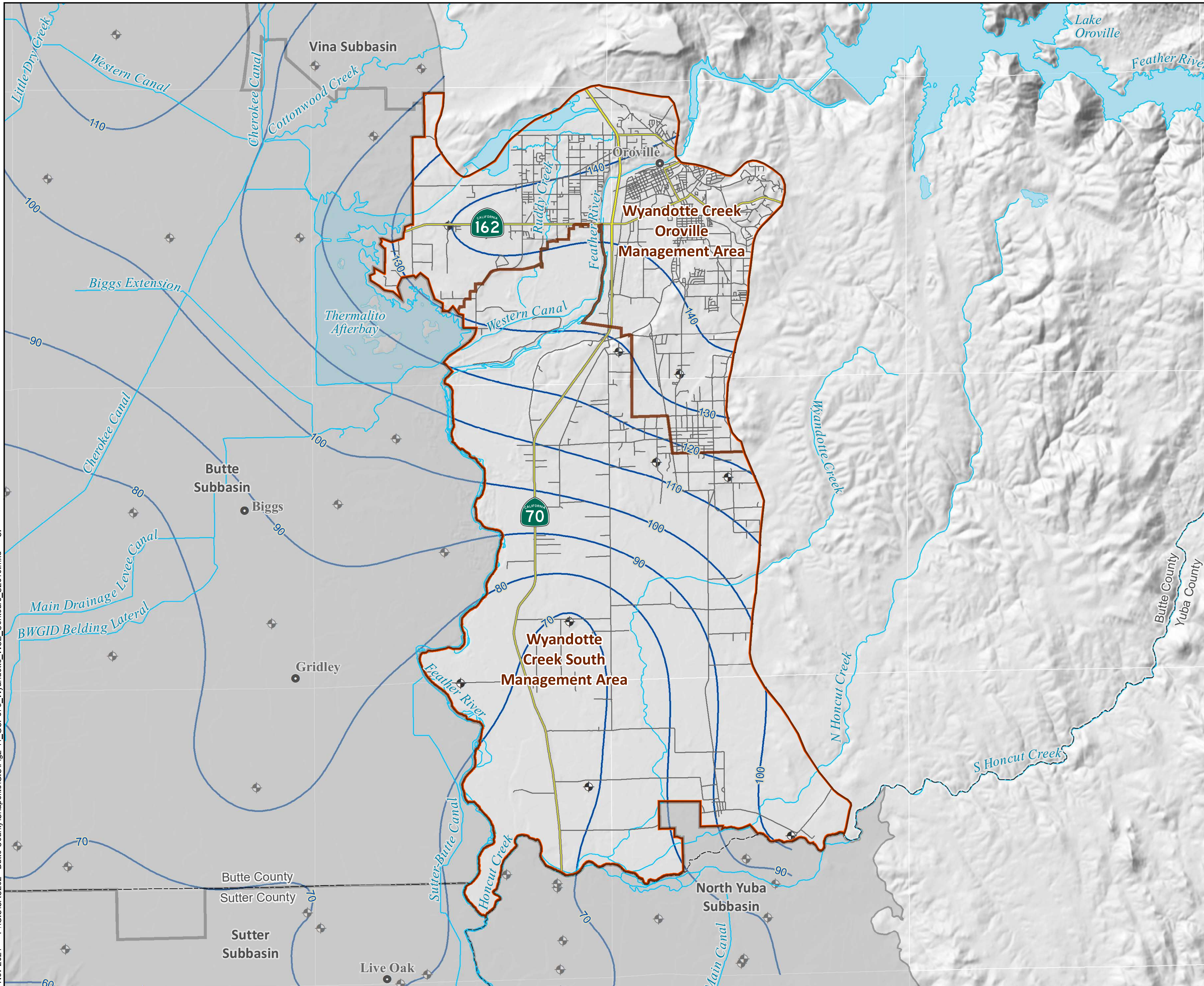
WATER SURFACE ELEVATION SPRING 2019

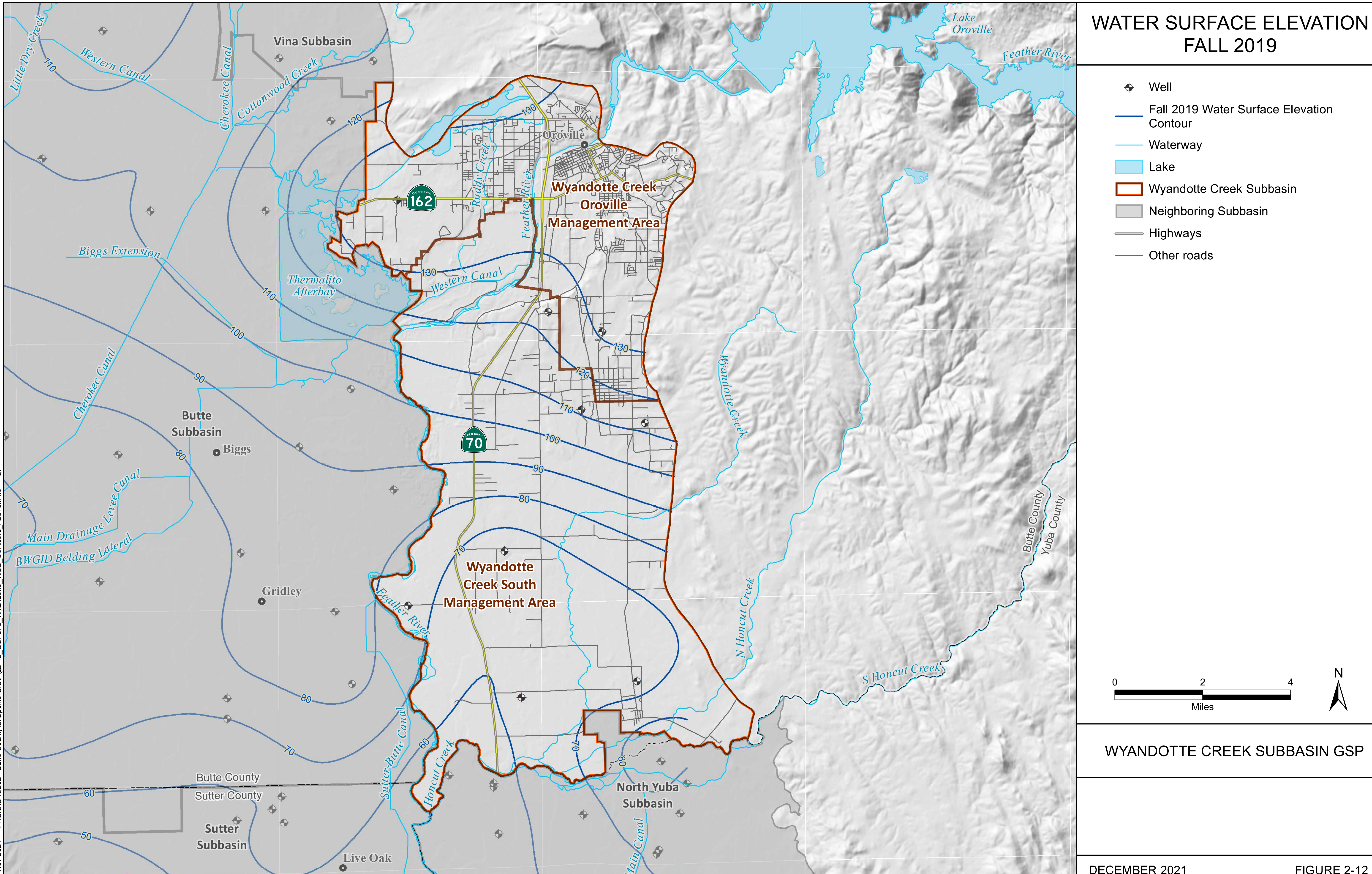


WYANDOTTE CREEK SUBBASIN GSP

DECEMBER 2021

FIGURE 2-11

P:\GIS\SAC282 - Butte County\Shapefile\GIS\Fig2-11_GSP073_Wyandotte_WSE_Contours_S2019.mxd SI 22-Nov-2021


WATER SURFACE ELEVATION
FALL 2019
Well
Fall 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 2-12
Vina Subbasin
Butte Subbasin
Sutter Subbasin
North Yuba Subbasin
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Oroville
Biggs
Gridley
Live Oak
Thermalito Afterbay
Lake Oroville
Feather River
Western Canal
Cherokee Canal
Cottonwood Creek
Little Dry Creek
Biggs Extension
Main Drainage Levee Canal
BWGID Belding Lateral
Sutter-Butte Canal
Honcut Creek
Wyandotte Creek
N Honcut Creek
S Honcut Creek
Ruddy Creek
Main Canal
Butte County
Sutter County
Yuba County
162
70
P:\GIS\SAC282 - Butte County\Shapefile\GIS\Fig2-12_GSP073_Wyandotte_WSE_Contours_F2019.mxd SI
22-Nov-2021

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.

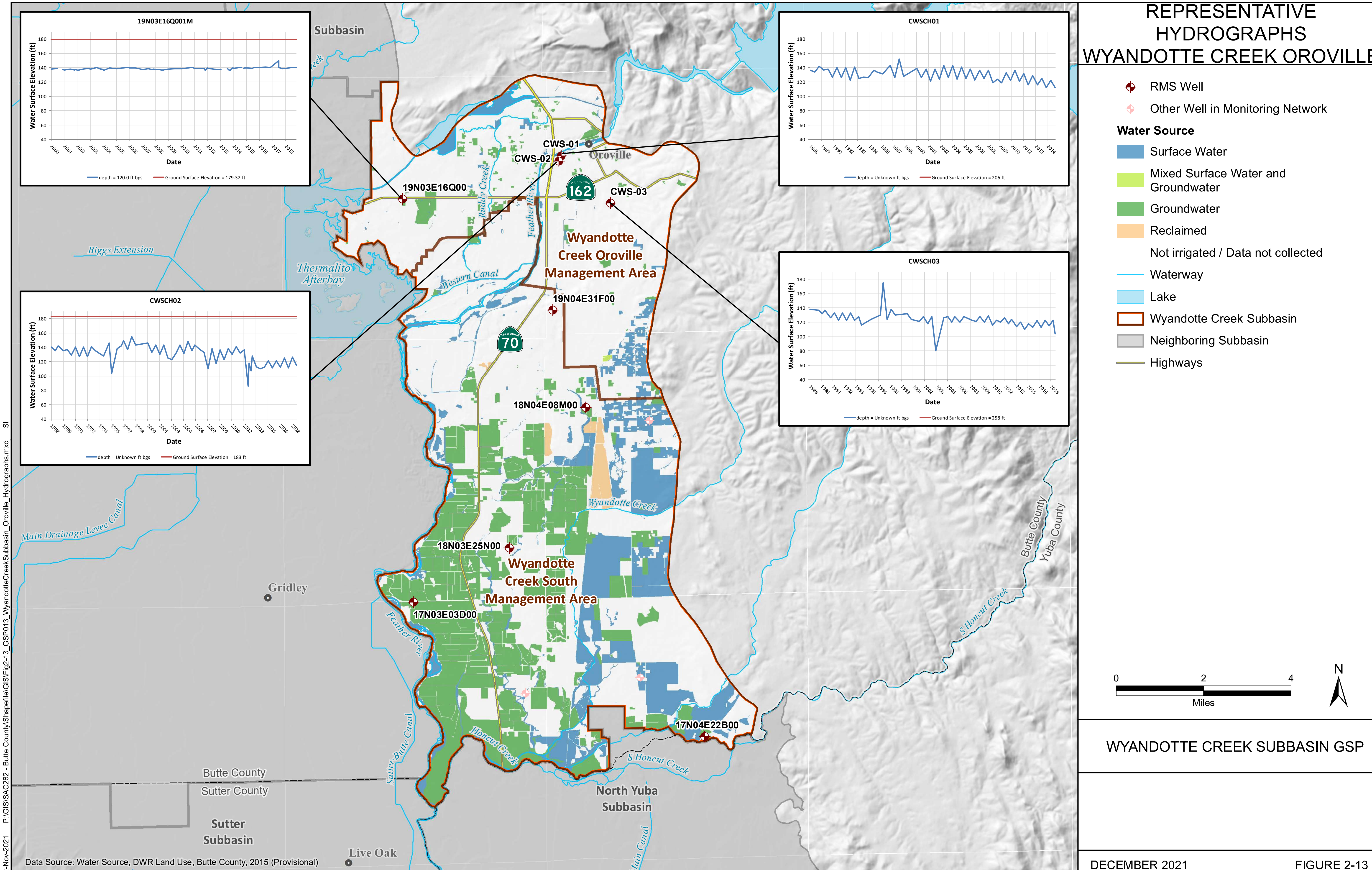
Figure 2-13 is a map of the Wyandotte Creek Subbasin's Oroville MA that displays hydrographs of selected monitoring wells, and Figure 2-14 is a similar map of the subbasin's South MA. Just as comparison of the spring and fall contours indicated the shift in groundwater elevations that typically occurs 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 have been collected from this well for inclusion into the 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.

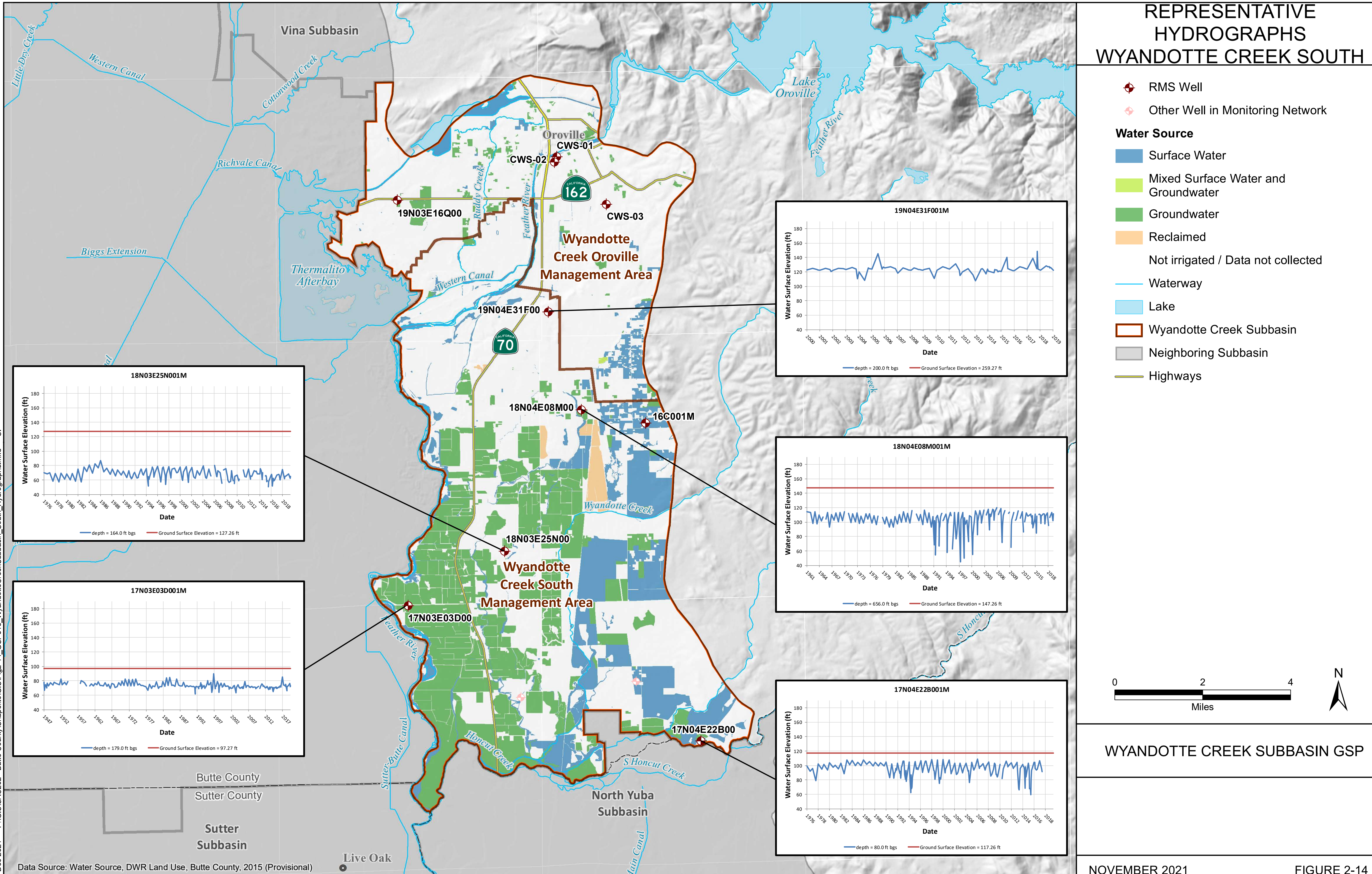
Vertical groundwater gradients are typically measured by comparing groundwater elevations using multi-completion or nested wells that are designed to measure elevations from different aquifer zones. If groundwater levels in the shallower zone are higher than in the deeper ones, the gradient allows downward 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.



WYANDOTTE CREEK SUBBASIN GSP

DECEMBER 2021

FIGURE 2-13



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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 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[2] is provided in Figure 2-15. Water year types are identified as wet (W, shaded blue), above normal (AN, shaded green), below normal (BN, shaded yellow), dry (D, shaded orange), or critical (C, shaded red). Annual change in storage was estimated using the BBGM based on March groundwater storage

[2] 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).

amounts. Groundwater pumping was estimated using the BBGM and is shown on a water year basis.[3] Values are reported in TAF.

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, 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.

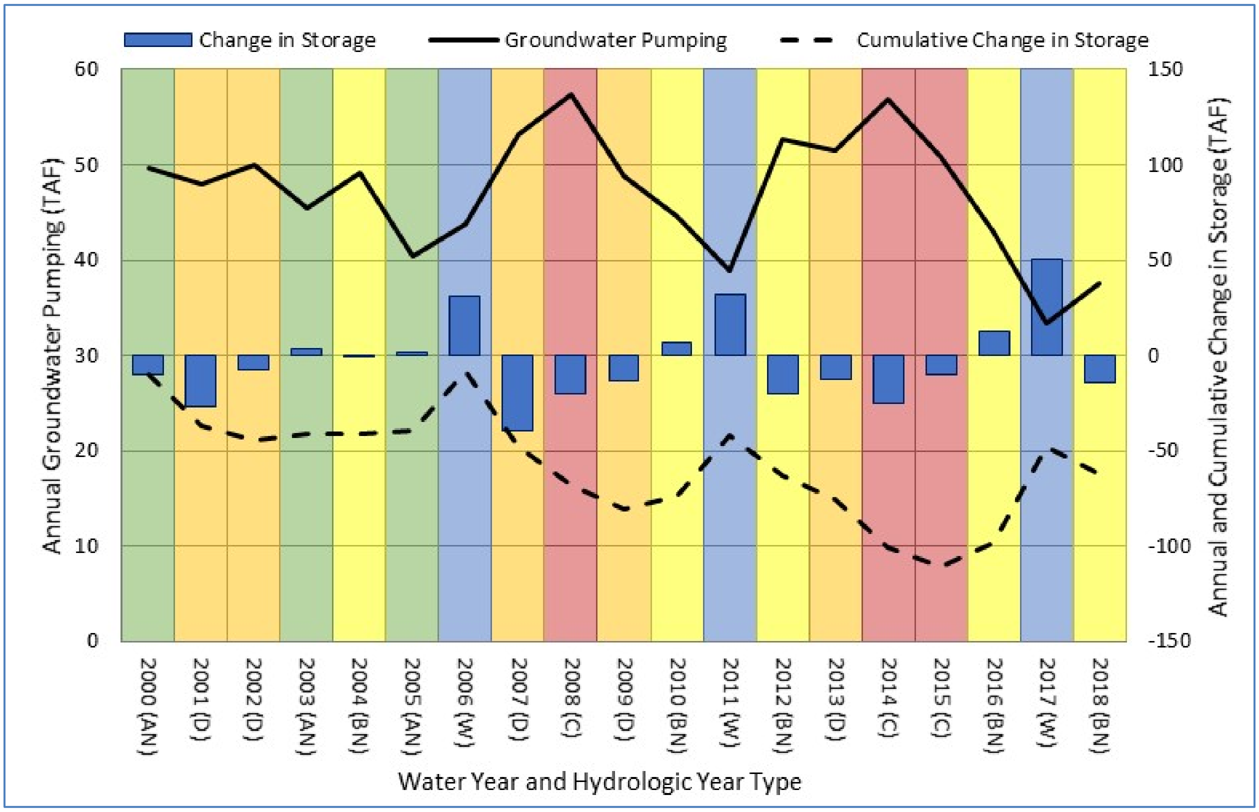

Figure 2-15: Change in Storage and Groundwater Pumping by Water Year Type. AN – above normal, D – dry, BN – below normal, W – wet, C – critical.

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.

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[3] 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 General Water Quality of Principal Aquifers

The goal of groundwater quality management under SGMA is to supplement information available from other sources with data targeted to assist GSAs 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 GSAs 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. CECs such as perfluorooctanesulfonic acid (PFOS) and per- and polyfluoroalkyl substances (PFAS) will not be monitored under the groundwater quality monitoring program established for SGMA. However, GSAs will have access to data on CECs collected by other entities and will be attentive to the presence of CECs that may impact groundwater management in specific locations.

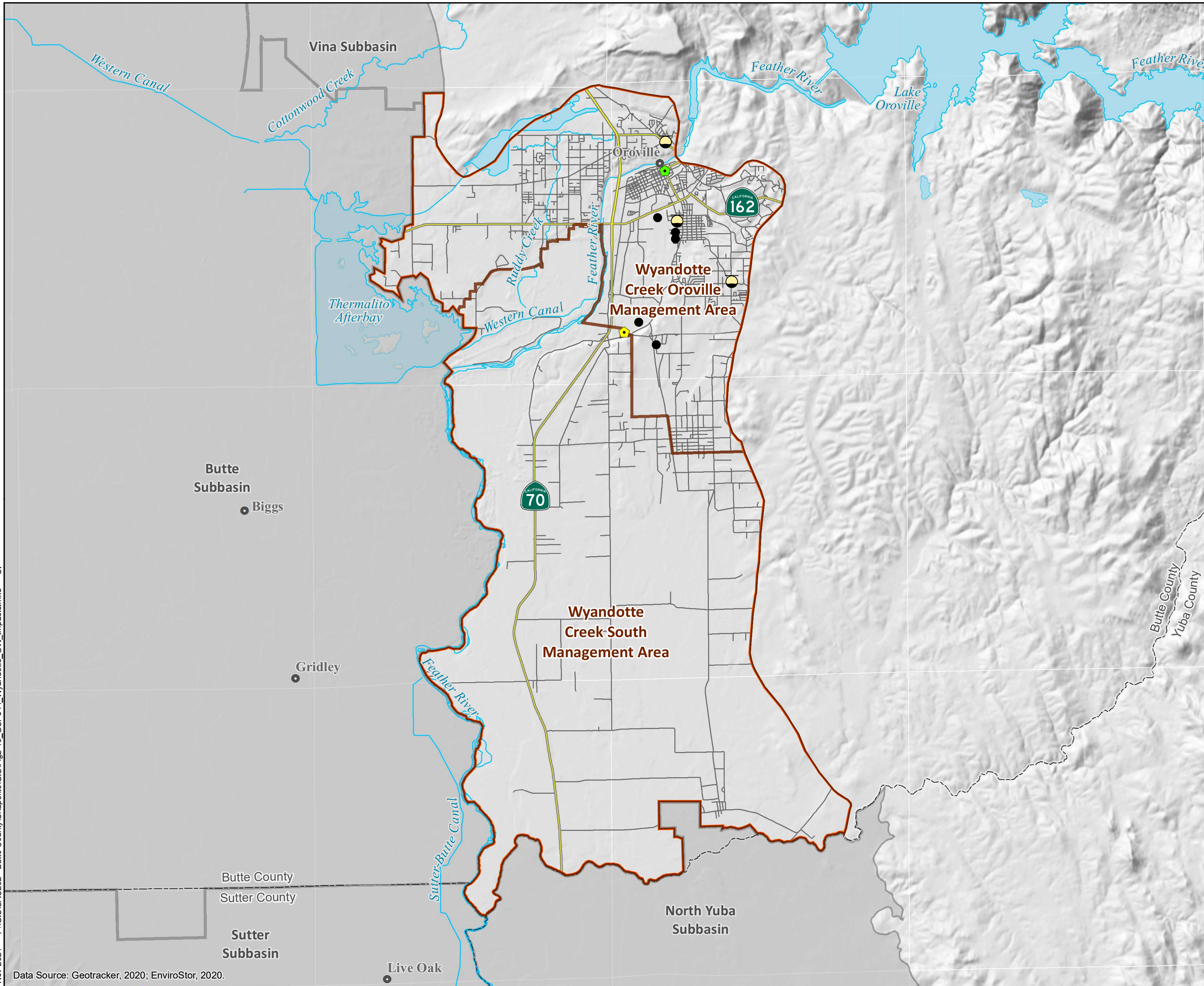
2.2.4.2 Description and Map of Known Sites and Plumes

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.

Figure 2-16, Active Contamination Remediation Sites, presents 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:

- Other Sites with Corrective Action (Current)
- Sites Needing Evaluation (Active or Inactive)
- Federal Superfund-Listed Sites
- Leaking Underground Storage Tank (LUST) Cleanup Sites

ACTIVE CONTAMINATION REMEDIATION SITES



Geotracker Sites
- Cleanup Program Site
- LUST Cleanup Site

EnviroStor Sites
- State Response Cleanup
- Voluntary Cleanup
- Waterway
- Lake
- Wyandotte Creek Subbasin
- Neighboring Subbasin
- Highways
- Other roads

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N

WYANDOTTE CREEK SUBBASIN GSP

DECEMBER 2021 FIGURE 2-16

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Active DTSC Cleanup Program Sites in the Wyandotte Creek Subbasin include the following:

- 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
- No. 60002933 – St. Francis Mine – site under evaluation:
  - Past uses that caused contamination: none specified
  - Contaminants of concern: none specified
  - Potential media affected: none specified

Of the three open cases within the boundaries of the Wyandotte Creek Subbasin, only the former Oroville manufactured gas plant site has been confirmed as impacting groundwater. Information on these and other sites is available at www.envirostor.dtsc.ca.gov.

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 aquitards4.

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 are capable of detecting 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 extending from June 2015 through September 2019.

2.2.5.2 Historical and Recent Cumulative Subsidence and Rates of Subsidence

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 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

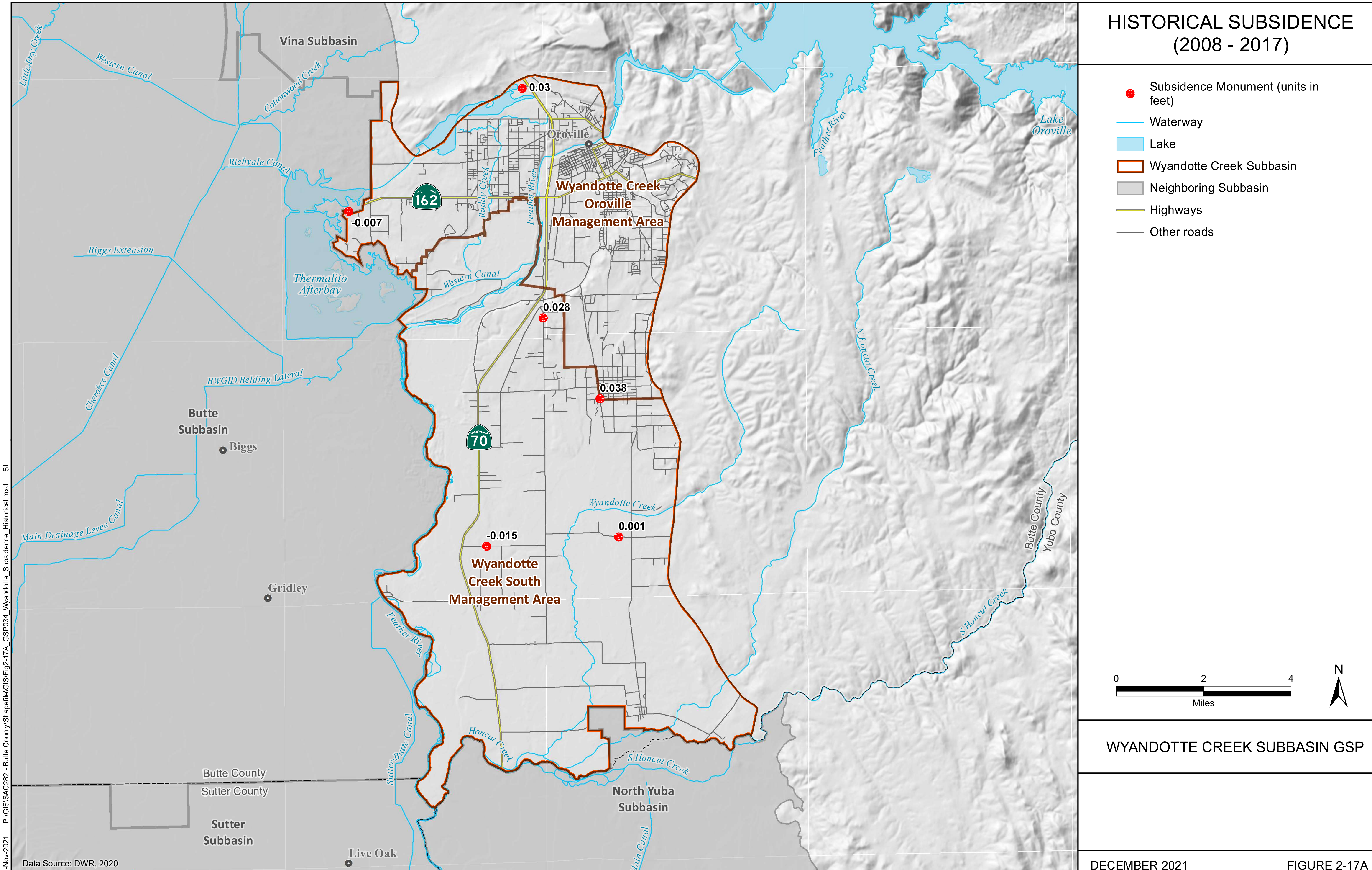
Figures 2-17A and 2-17B show historical and recent levels of subsidence within the Wyandotte Creek Subbasin. Historical levels for the period comparing 2008 to 2017 are shown in Figure 2-17A – Historical Subsidence and are the locations of subsidence monitoring network monuments used to measure subsidence. 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.

2.2.6 Interconnected Surface Water Systems

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 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.



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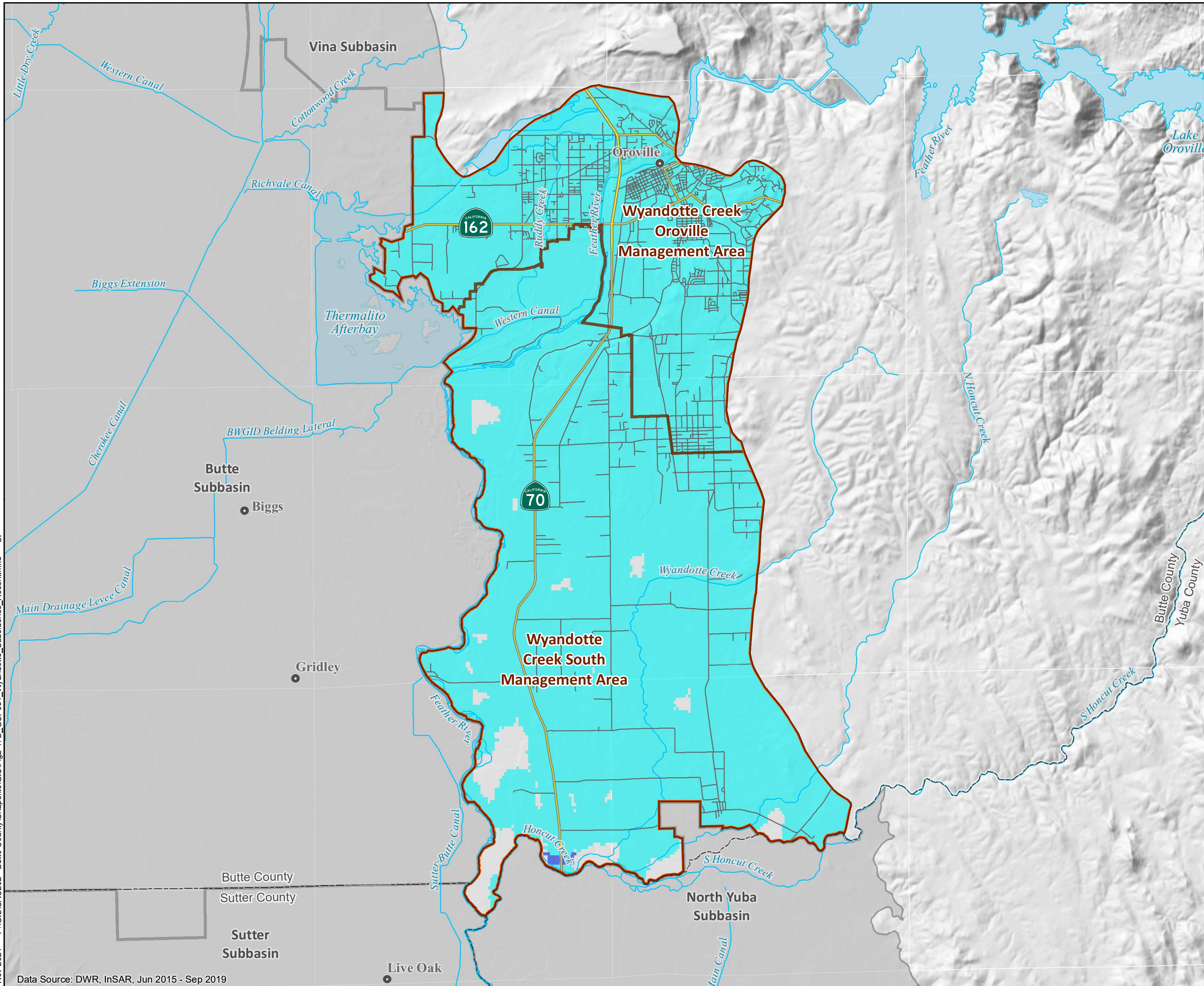
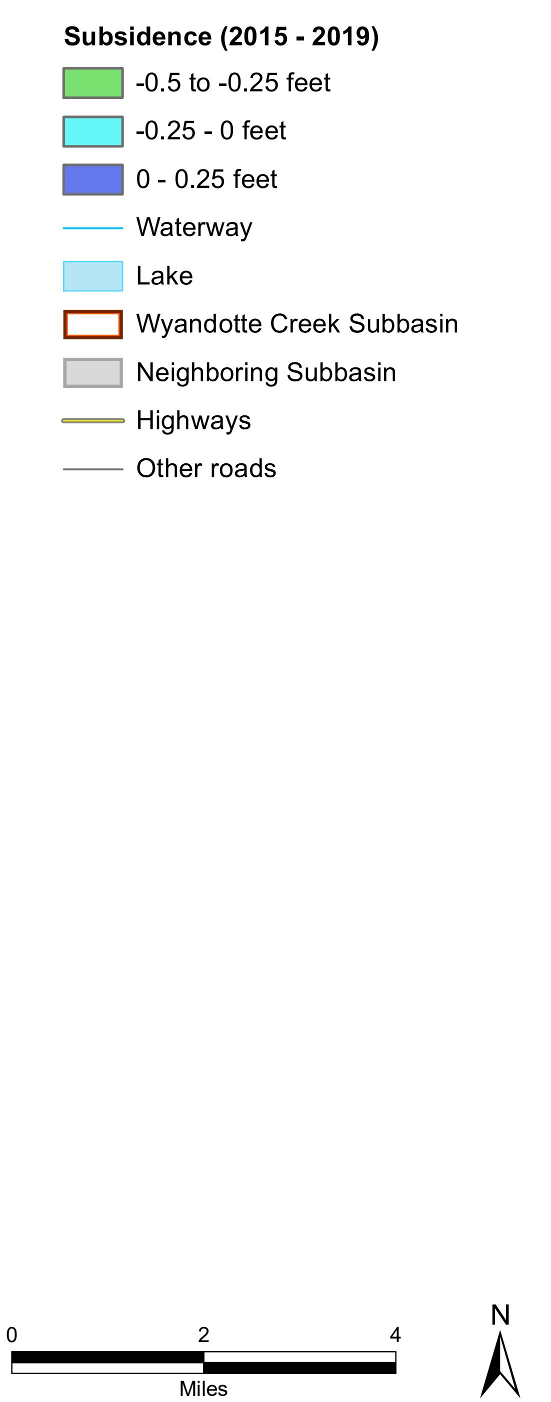


RECENT SUBSIDENCE (2015 - 2019)



WYANDOTTE CREEK SUBBASIN GSP

DECEMBER 2021

FIGURE 2-17B

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.

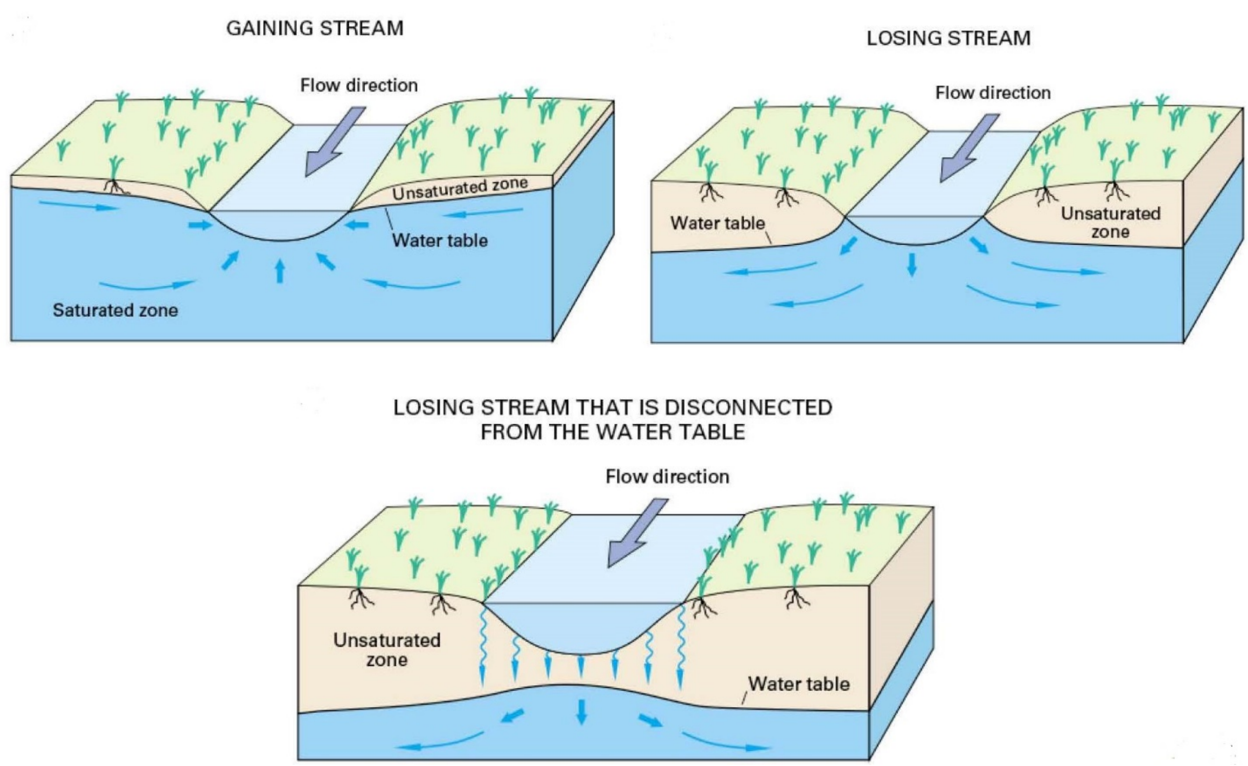


Figure 2-18: Illustration of Gaining and Losing Interconnected and Disconnected Stream Reaches (Source: USGS)

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 (see Section 4.2). Therefore, the interactions between groundwater systems and surface water features within the Butte Subbasin are estimated through use of the BBGM which integrates information from groundwater monitoring wells and stream stages to model gradients that control flow between surface water and groundwater.

The BBGM was utilized to evaluate stream segments within the subbasin and to classify them as being primarily gaining or losing over the historical period from water year 2000 to 2018. A total of seven stream segments traversing or bounding the subbasin with a total length of approximately 42 miles were defined. 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 percent of months for the period from water year 2000 to 2018 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 2-20, 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.

To further evaluate the interconnectedness of streams with the groundwater system in the basin, streambed elevations at individual stream nodes from the BBGM were compared to groundwater elevations from spring groundwater level measurements provided by DWR as part of the SGMA Data Viewer.[4] Spring groundwater levels were available for 2014 to 2018. As indicated in Figure 2-21, the vast majority of stream nodes within the subbasin had spring groundwater levels within 10 feet of the estimated streambed elevation.

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.

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

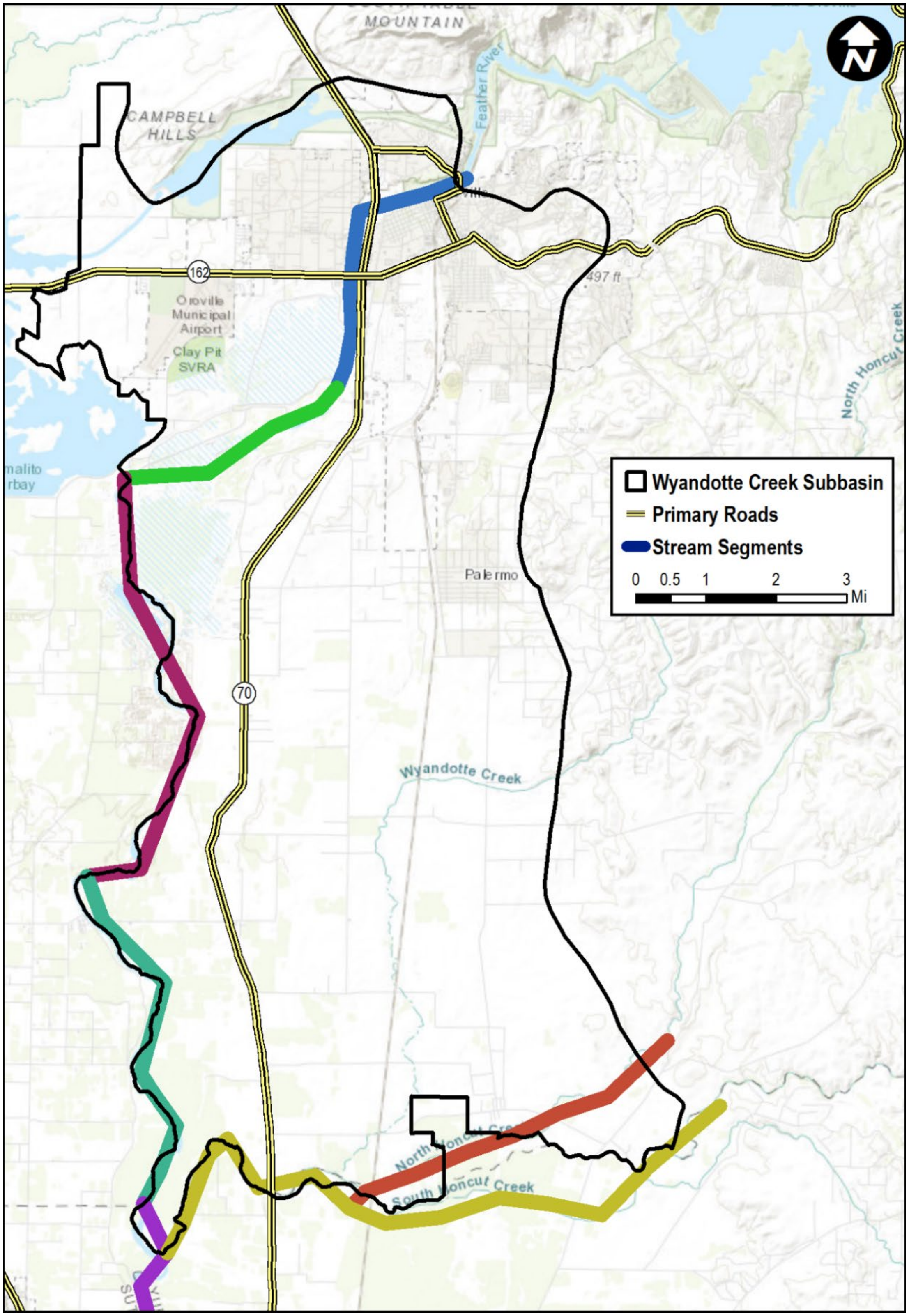


Figure 2-19: Wyandotte Creek Subbasin Stream Segments

Geosyntec consultants

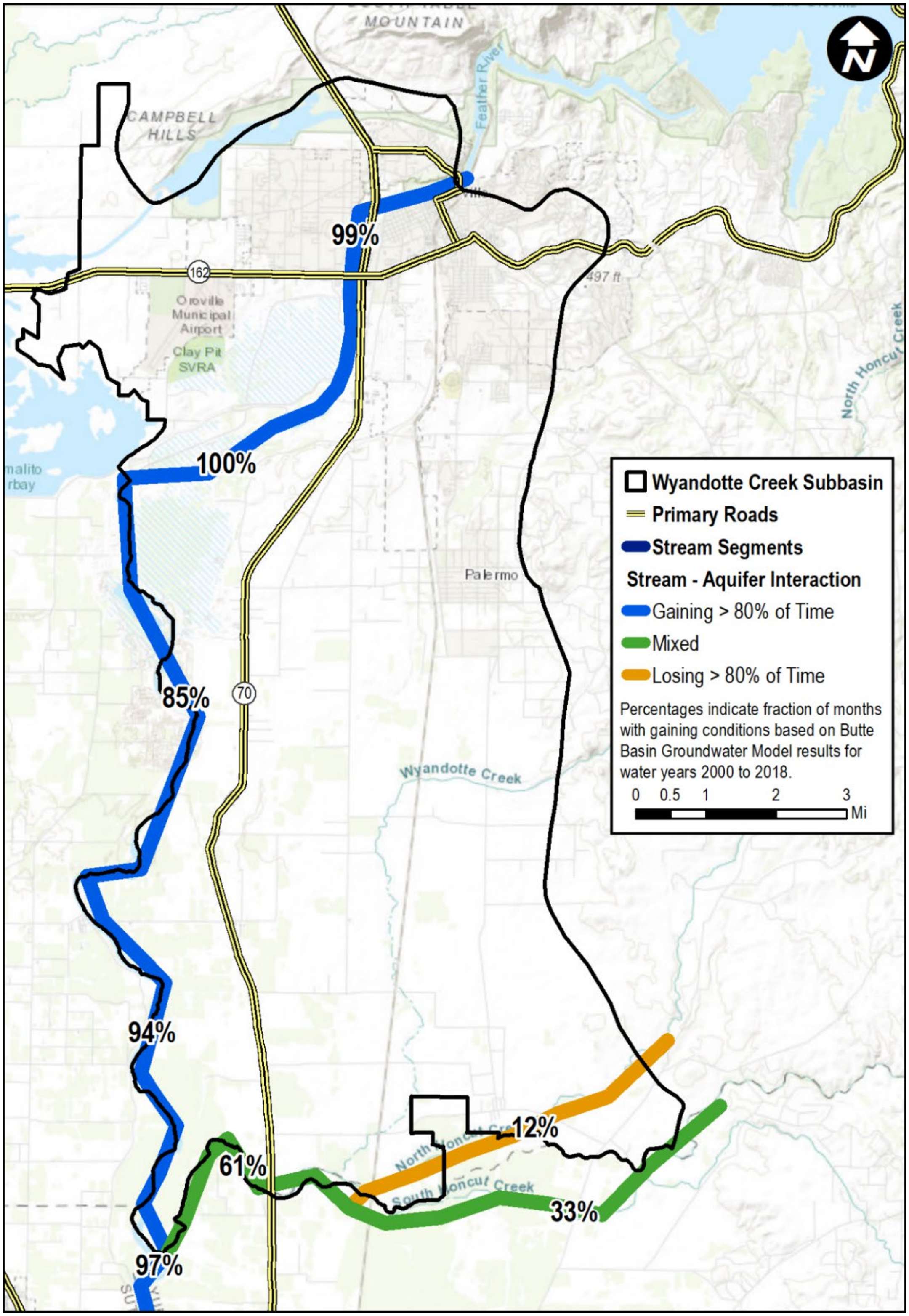


Figure 2-20: Wyandotte Creek Subbasin Gaining and Losing Stream Reaches Based on the BBGM, Water Years 2000 to 2018

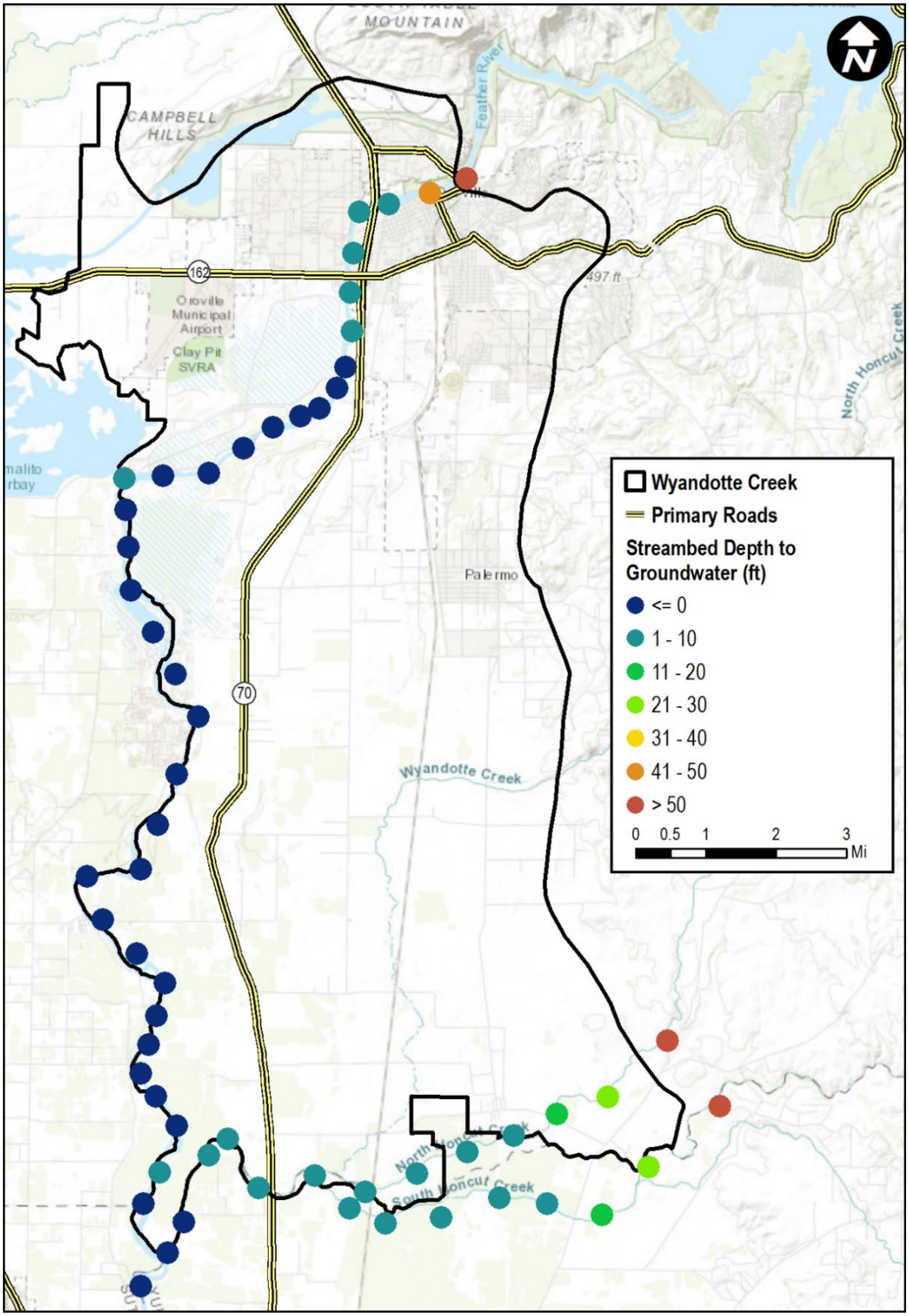


Figure 2-21: Wyandotte Creek Subbasin Average Spring Depth to Groundwater, 2014 to 2018

2.2.6.2 Timing and Amount of Surface Water – Groundwater Interaction

The timing and amount of surface water–groundwater interaction was estimated using the BBGM for the primary streams in the subbasin. Monthly net gains to streamflow from groundwater were estimated on a monthly basis for the historical period from water year 2000 to 2018 and are summarized in Table 2-3. Average monthly gains to streamflow are expressed in cubic feet per second (cfs). Negative values denote average losses from streamflow to groundwater (i.e., seepage or leakage).

Table 2-3: Average Monthly Gains to Streamflow from Groundwater, Water Years 2000 to 2018 (cfs)

Stream	Month												Average
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Feather River	34	41	54	70	56	68	56	49	29	21	23	26	44
North Honcut Creek	-1	-1	-2	-1	-1	0	1	0	0	0	0	0	0
South Honcut Creek	0	0	0	2	2	3	3	2	0	0	0	0	1
Total	34	40	52	71	58	71	60	51	29	20	23	26	45

Average monthly gains from groundwater are greatest for the Feather River, at approximately 44 cfs. Gains are least between June and October, 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 45 cfs on average, or approximately 32 TAF annually.

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.

2.2.7.1 NCCAG Database

The initial identification of GDEs for this GSP 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 these 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.

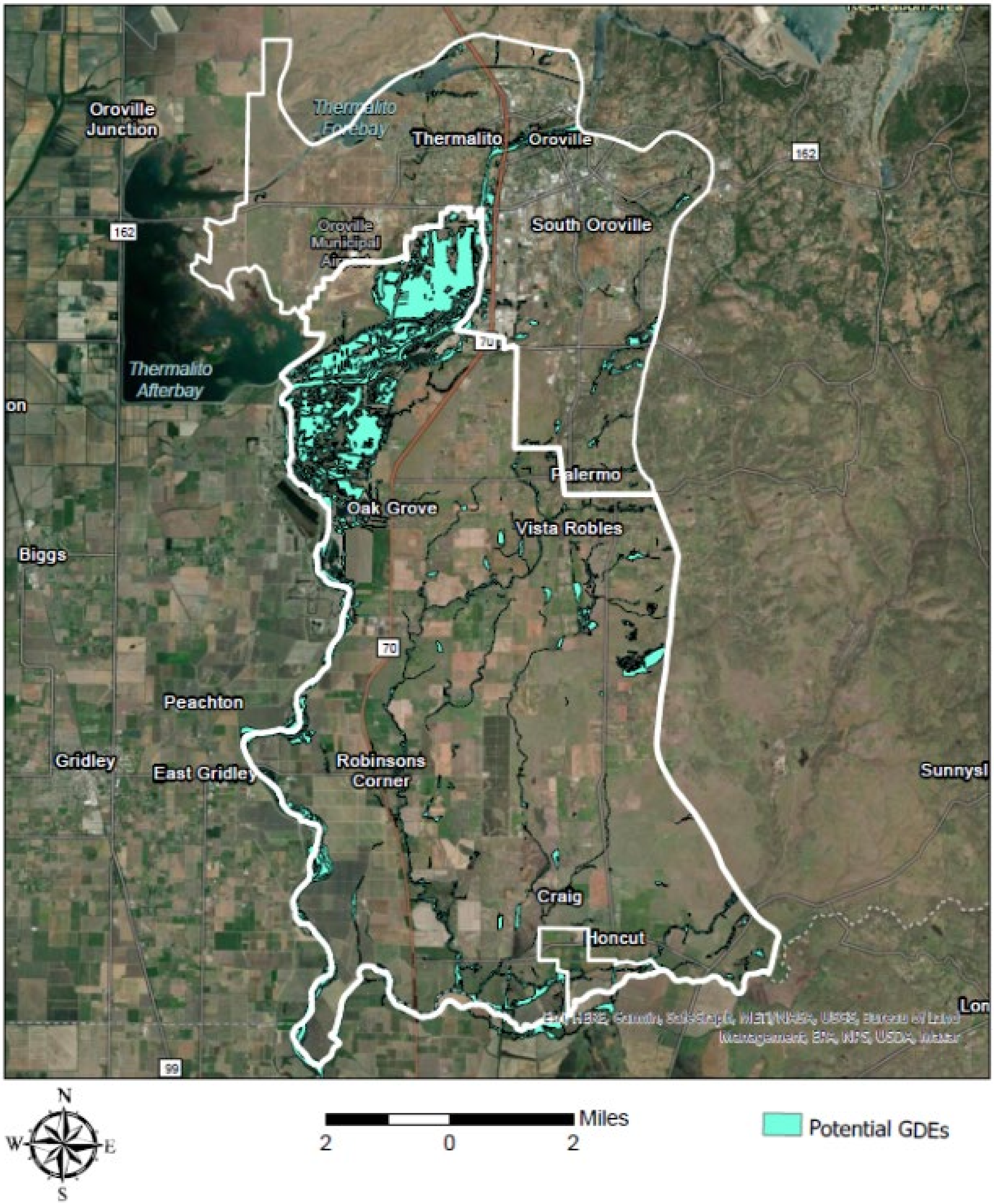


Figure 2-22: All Potential Groundwater Dependent Ecosystems in the Wyandotte Creek Subbasin as Identified in the Natural Communities Commonly Associated with Groundwater Database Hosted by The Nature Conservancy

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 latest available 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.

Additional information, such as near surface groundwater depth obtained from piezometers, information about subsurface stratigraphy and geology on confining layers, and information on local land use and hydrology can be used to confirm whether vegetation in areas identified by the NCCAG as iGDEs is, in fact, reliant on groundwater.

2.2.7.2 Initial iGDE Analysis

GSA Managers from the subbasin used this database as a starting point to analyze a portion of the total iGDEs in the NCCAG database to evaluate local groundwater dependence. Specific criteria to each polygon to answer a series of questions led to an eventual characterization for each iGDE. These iGDEs were designated as either "Likely a GDE," "Not likely a GDE," or "Uncertain" based on evaluations. The criteria aimed at understanding each iGDE's dependence on groundwater including questions about land use changes, proximity to perennial surface water supplies, irrigated agriculture and agricultural dependent surface water, condition of vegetation during drought years and water applications to the iGDEs.

The first phase of the analysis was conducted by thorough review of aerial photographs from Google Earth across multiple years specifically focusing on the 2007, 2009, 2013, and 2015 drought years as well as use Managers' local knowledge of these areas.

2.2.7.3 iGDE Designations

While there were some areas identified as "Not likely a GDE" during this effort, Managers were also able to add any iGDEs into the map that were not captured in the original NCCAG database. NCCAG areas identified as "Not likely a GDE" from the initial analysis by Managers can be categorized as follows.

Not Likely a GDE Due to Significant Land Use Change

Some areas in the NCCAG database may have changed in land use since the database was published. Developed areas where there have been significant land use changes to the iGDE, i.e., land transitioned to cultivated irrigated agricultural lands, industrial or residential development occurred or lands had undergone man-made changes such as golf courses or other obvious anthropogenic changes were labeled as "Not likely a GDE."

Not Likely a GDE Due to Perennial Surface Water Supplies

Areas with perennial water supplies such as those subject to historical hydraulic gold mining runoff and dredging activities or those near reservoirs were labeled as "Not likely a GDE." In some areas historic mining activities have left tailings of cobbles and coarse gravel which rapidly transmit water. To some extent, it is assumed that pooled water in this area is tied to river stage through direct connections with the river with surface water bodies. Likewise, the reservoirs provide water year-round for adjacent ecosystems. If any iGDEs were located within 150 feet of reservoirs or mine tailings, they were assumed to be able to access the nearby surface water bodies and were labeled as "Not likely a GDE."

Not Likely a GDE Due to Supplemental Water Supplies

Irrigated agriculture, irrigated refuge / managed wetlands or irrigated urban areas with supplemental water deliveries were identified by Managers during the initial GDEs analysis effort. These areas are assumed to be accessing supplemental water supplies and not reliant on groundwater and were labeled as "Not likely a GDE."

Not Likely a GDE Due to Adjacency to Irrigated Agricultural Fields

Agricultural lands are dependent on reliable water supplies to ensure a successful harvest. Surface water and / or groundwater pumped from the aquifer is used to irrigate crops in the Wyandotte Creek subbasin. Such irrigation benefits not only the crops, but also surrounding vegetation. Potential GDEs further than 150 feet from irrigated rice fields and areas further than 50 feet from all other irrigated agriculture were assumed to be unable to access irrigation water. These distances are based on professional judgment, including past experience in the region and consideration of the physical characteristics of the Wyandotte Creek subbasin, such as hydraulic conductivity. Rice fields, along with other irrigated agriculture, are known to have percolation and lateral seepage, supplying water to the aquifer and into adjacent areas. Lateral seepage in Sacramento Valley rice areas has been estimated at between 1.0% and 1.9% of the total irrigation volume (LaHue and Lindquist, 2019). A larger distance was used for rice due to the long-term ponding of water and due to restrictive layers in the subsurface that result in the horizontal spreading of irrigation water. Potential GDEs near these irrigated areas are assumed to be accessing irrigation water through lateral movement through the soils, thus, they were labeled as "Not likely a GDE."

Not Likely a GDE Due to Dependence on Agricultural-dependent Surface Water
Similar to areas adjacent to reservoirs, iGDEs adjacent to surface water bodies that are perennial due to agricultural practices and those near drainage canals, are able to access surface water throughout the year. Agricultural water conveyance features, i.e., the Cherokee Canal is included in this definition; however, this does not include the Sacramento River, Butte Creek, or Honcut Creek because these natural waterways also convey non-agricultural water. Potential GDEs within 150 feet of these agricultural-dependent surface water bodies were assumed to be accessing water from them thus, they were labeled as “Not likely a GDE.”

Not Likely a GDE Due to Non-Survival during Drought Conditions
To assess if the iGDE was groundwater dependent, Managers reviewed the condition of the iGDE over multiple dry drought years using aerial photographs from Google Earth. Specifically, the group focused on the drought years of 2007, 2009, 2013, and 2015 in addition to the Managers’ local knowledge of these areas. Green vegetation over multiple drought years during summer months indicated survival of the iGDE as well as an assumed connection to groundwater. Potential GDEs which did not indicate any surviving conditions over multiple drought years were assumed to not be connected to groundwater and were labeled as “Not likely a GDE.”

Uncertain – All Other Areas
The iGDEs analyzed by the Managers in this initial effort, which did not receive a designation as either “Not likely a GDE” or “Likely a GDE” based on the conclusions from the analysis above, were labeled as “Uncertain” and were analyzed as described below.

2.2.7.4 Additional GIS Analysis

Irrigated Agricultural Land Use
After the initial analysis was completed for a selection of the total iGDEs in the NCCAG database as described above, a geographical information systems (GIS) analysis was performed for all remaining iGDEs in this subbasin by Butte County staff to determine each iGDE’s proximity to rice and other irrigated agriculture as described below. The DWR / Land IQ land use and crop mapping data for 2016 (DWR, 2019b) was used to determine the dominant crop type throughout the subbasin.

Land classified as “Rice” for the “Crop Type 2016” in the dataset was identified. Then all polygons in the TNC iGDEs dataset within 150 feet of land classified as rice were identified and designated as “Not likely a GDE near irrigated rice” for the same reasons as described above in the “Not Likely a GDE Due to Adjacency to Irrigated Agricultural Fields” section of this document above.

Land with “Crop Type 2016” classifications other than “Managed Wetland,” “Urban,” “Rice,” and “Mixed Pasture” in the dataset were identified and for this purpose referenced as “Other Irrigated Agriculture” for this GIS analysis, as all other remaining irrigated crop types. All polygons in the NCCAG dataset within 50 feet of land classified as “Other Irrigated Agriculture” were designated as “Not likely a GDE near irrigated agriculture (Non-Rice)” for the same reasons as described above in the “Not Likely a GDE Due to Adjacency to Irrigated Agricultural Fields” section of this document.

Valley Oak Dominated Areas

The dataset provided by TNC indicates the dominant species of vegetation for each polygon, including Valley oak (*Quercus lobata*) in the Wyandotte Creek subbasin. Those polygons were classified as "Likely a GDE" due to feedback from TNC staff that this species can access groundwater over a wide range of depths (M. Rohde personal communication March 2, 2021).

2.2.7.5 Mapping

The map in Figure 2-23 show iGDEs classified as "Likely a GDE" or "Not Likely a GDE" for one of the reasons described above. The iGDEs classified as "Not Likely a GDE" in the Wyandotte Creek subbasin were designated this way due to either their proximity to irrigated agriculture as rice, proximity to irrigated agriculture other than rice, or for another reason as determined during the initial analyses performed by the GSA Managers.

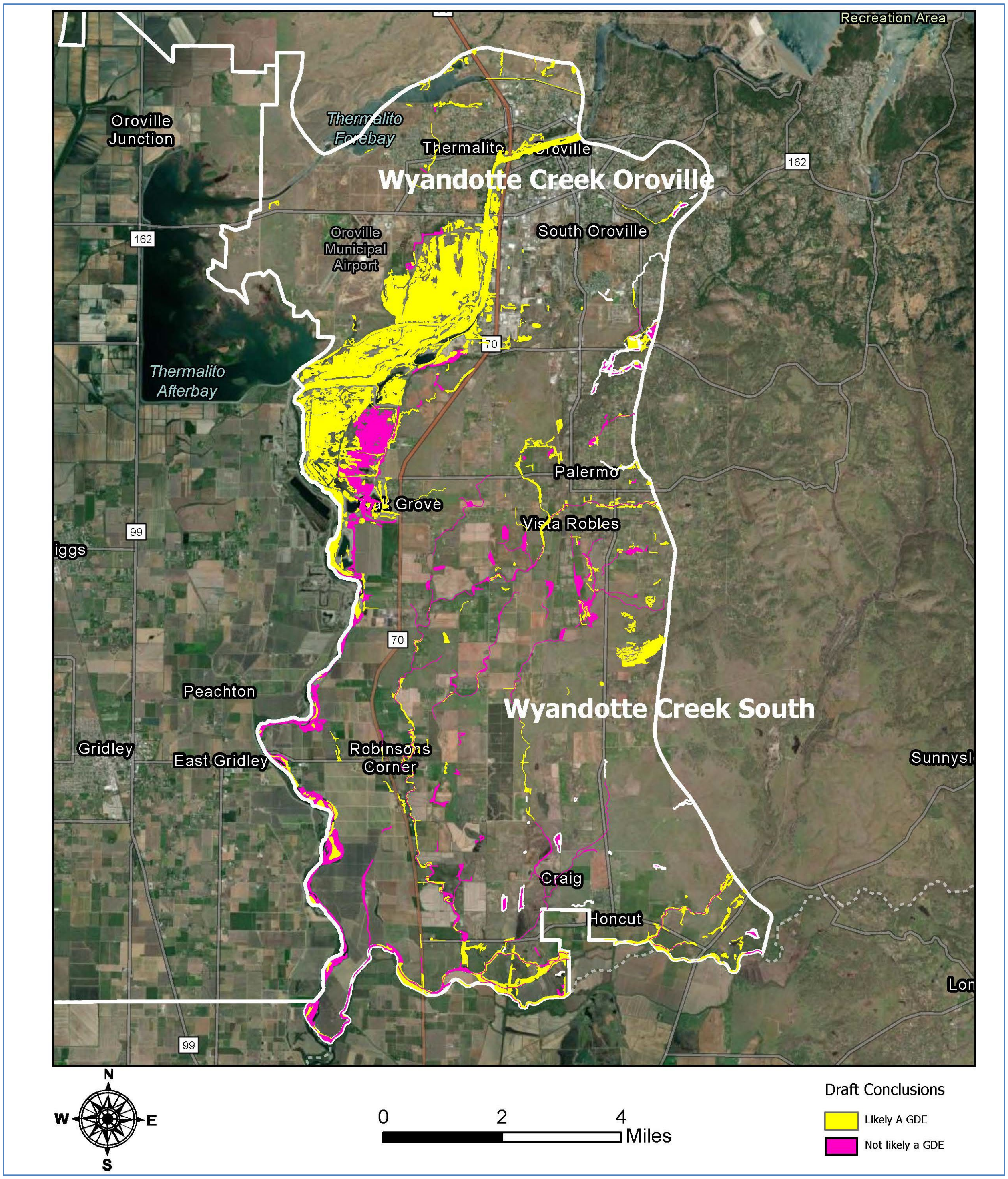


Figure 2-23: Potential Groundwater Dependent Ecosystems (iGDEs) Designations

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.

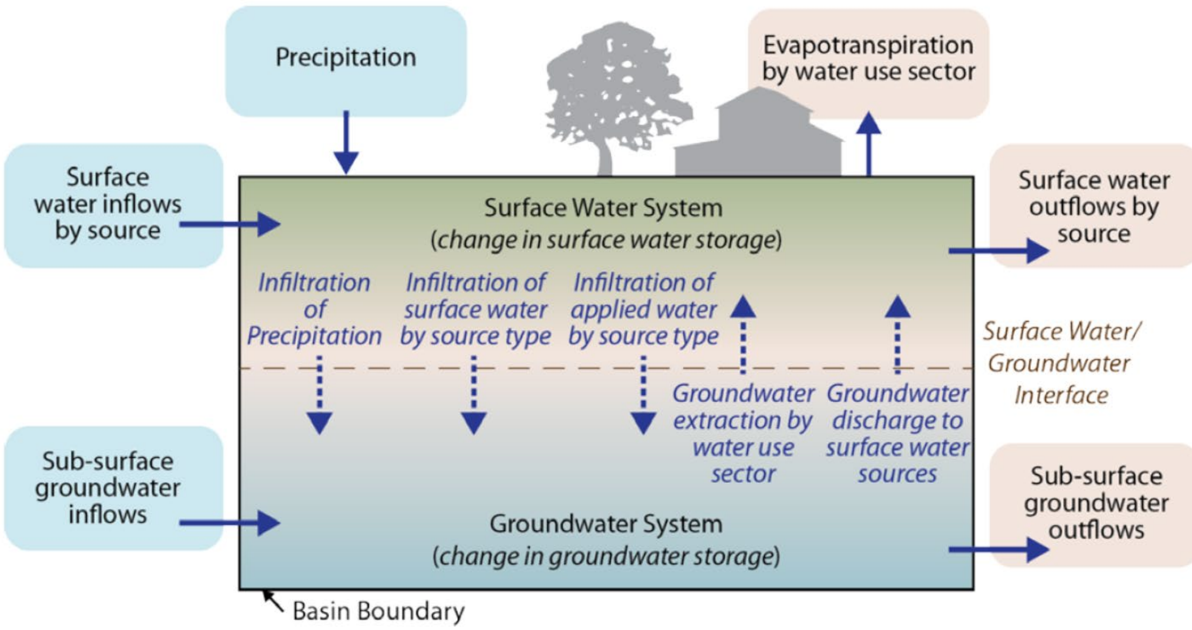


Figure 2-24: Water Budget Components (DWR, 2016)

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.

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[5] 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[6] 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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[5] 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.
[6] 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).

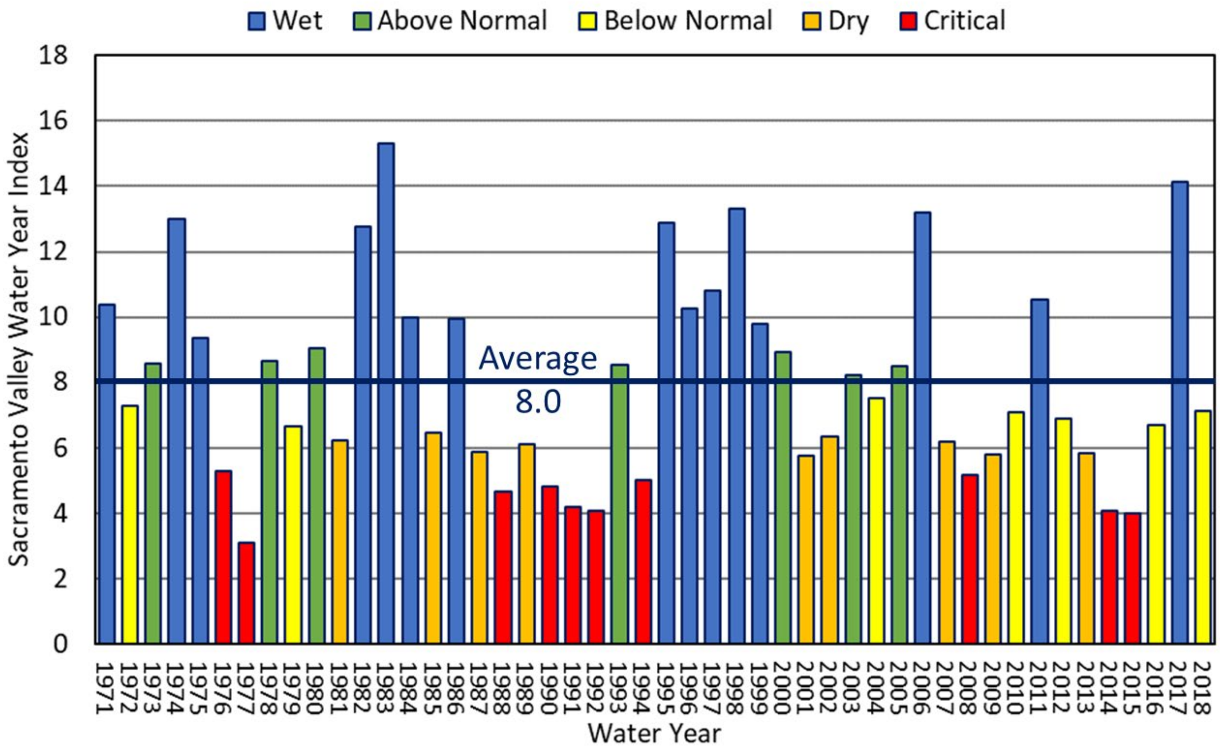

Figure 2-25: 1971 – 2018 Sacramento Valley Water Year Index and Water Year Types

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 are described in more detail in BCDWRC, 2021.

To prepare water budgets for this GSP, 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[7] – 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.

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

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[7] 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.

- 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.[8]

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

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

(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.

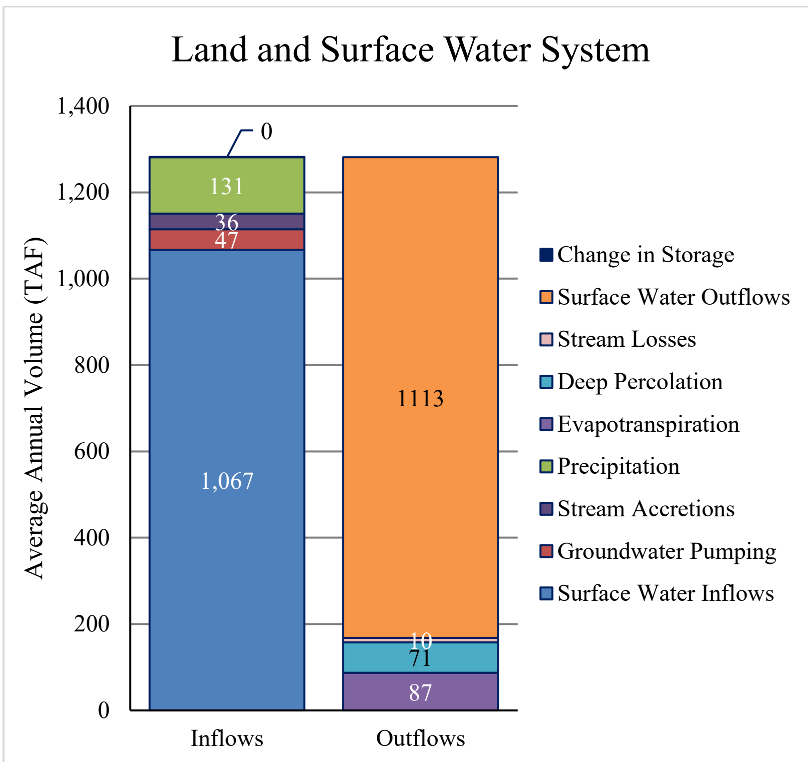


Figure 2-26: Average Annual Historical Land and Surface Water System Water Budget

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.

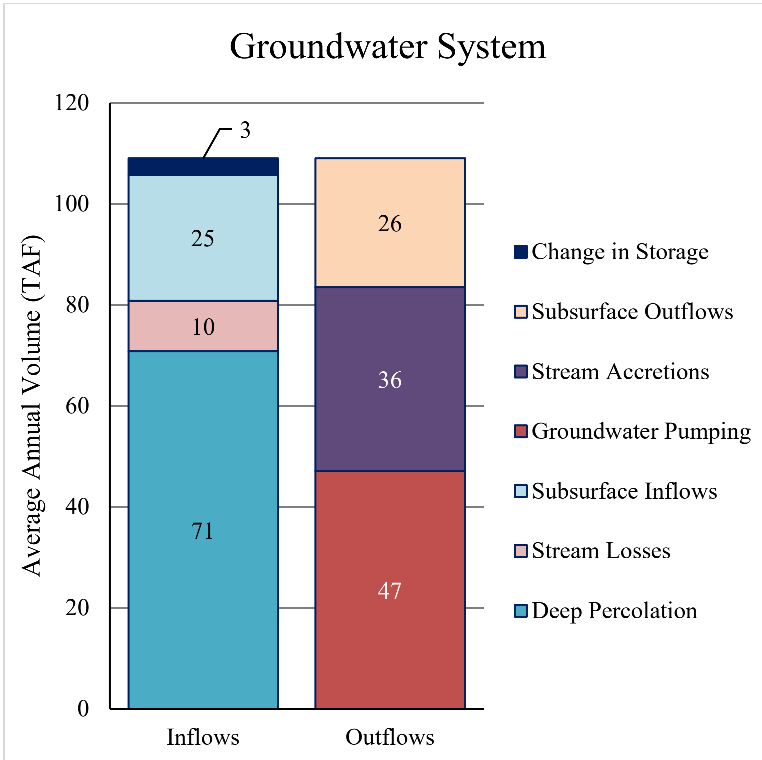


Figure 2-27: Average Annual Historical Groundwater System Water Budget

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.

The water budgets developed using the BBGM support the development of SMC, evaluation of the monitoring network, and development of projects and management actions as part of GSP development. It is anticipated that the BBGM will be updated and refined in the future as part of GSP implementation. Additional information describing the BBGM is available in (BCDWRC, 2021).

Ability to Operate the Basin within the Sustainable Yield

Sustainable yield refers to 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. As a result, determination of sustainable yield requires consideration of SGMA's six SIs. Historical water budget estimates indicate an average annual decrease in storage of 3,700 TAF/year for the period from water year 2000 to 2018. Operation of the basin within the sustainable yield may require incorporation of projects and management actions into the GSP and implementation over the 50-year SGMA planning and implementation horizon. The estimated sustainable yield of the basin is described in greater detail in Section 2.3.5.

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.

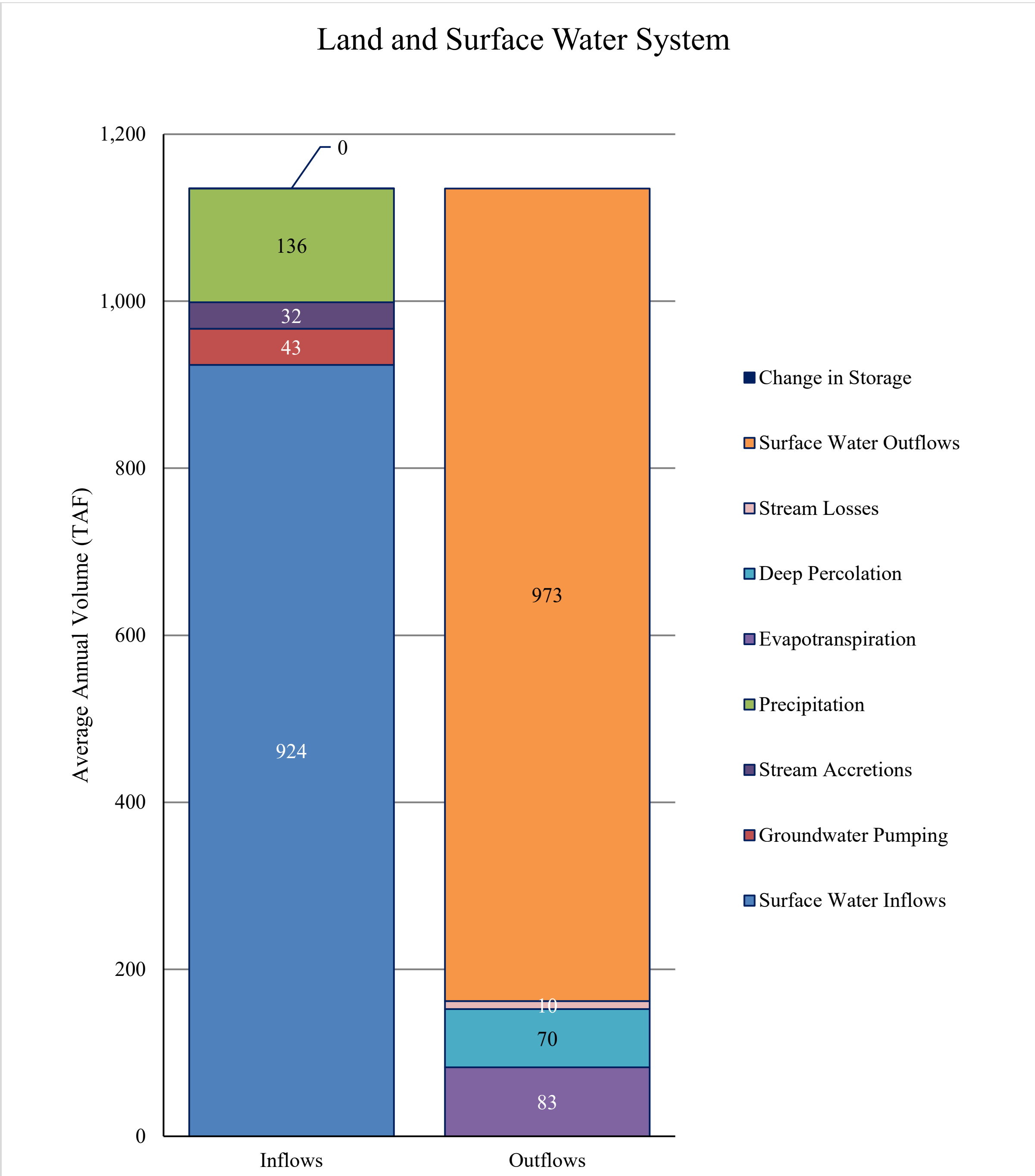


Figure 2-28: Average Annual Current Conditions Land and Surface Water System Water Budget

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).

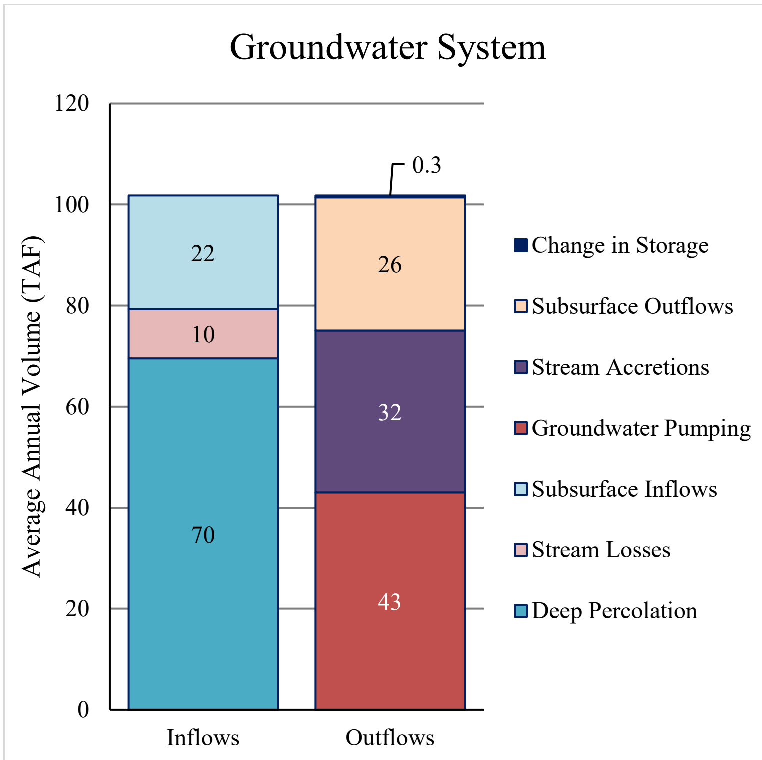


Figure 2-29: Average Annual Current Conditions Groundwater System Water Budget

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.

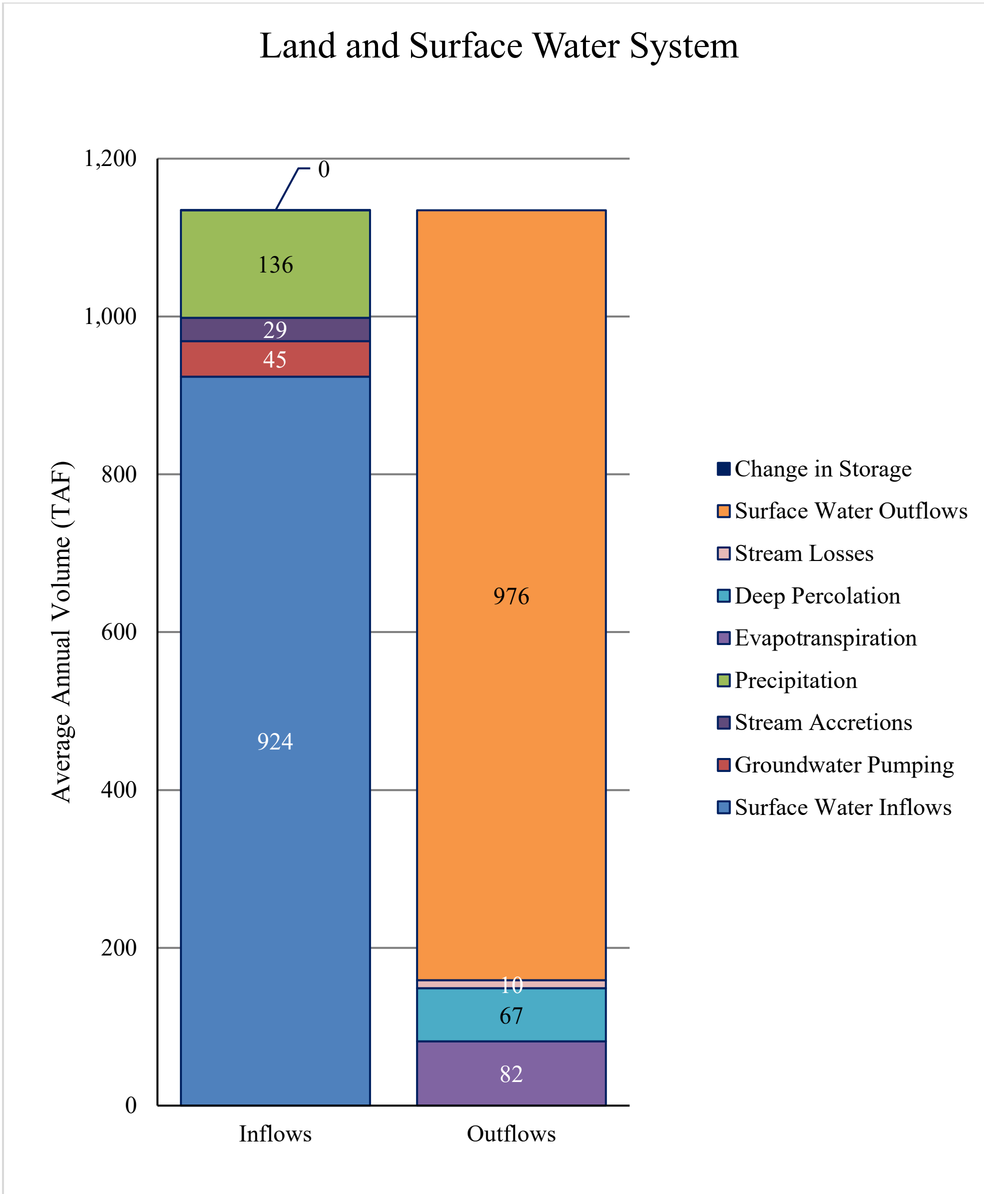


Figure 2-30: Average Annual Future Conditions without Climate Change Land and Surface Water System Water Budget

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).

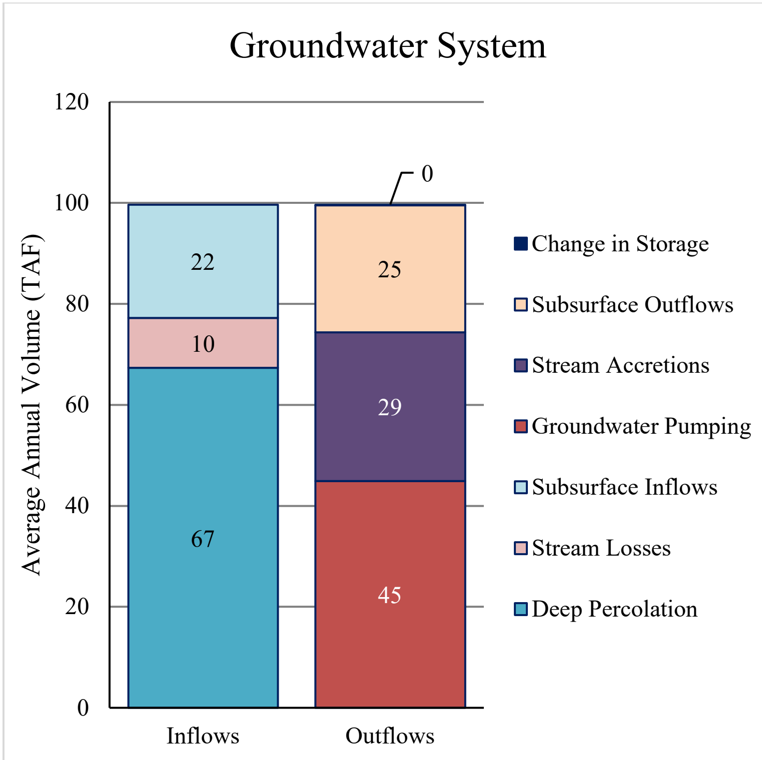


Figure 2-31: Average Annual Future Conditions without Climate Change Groundwater System Water Budget

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.

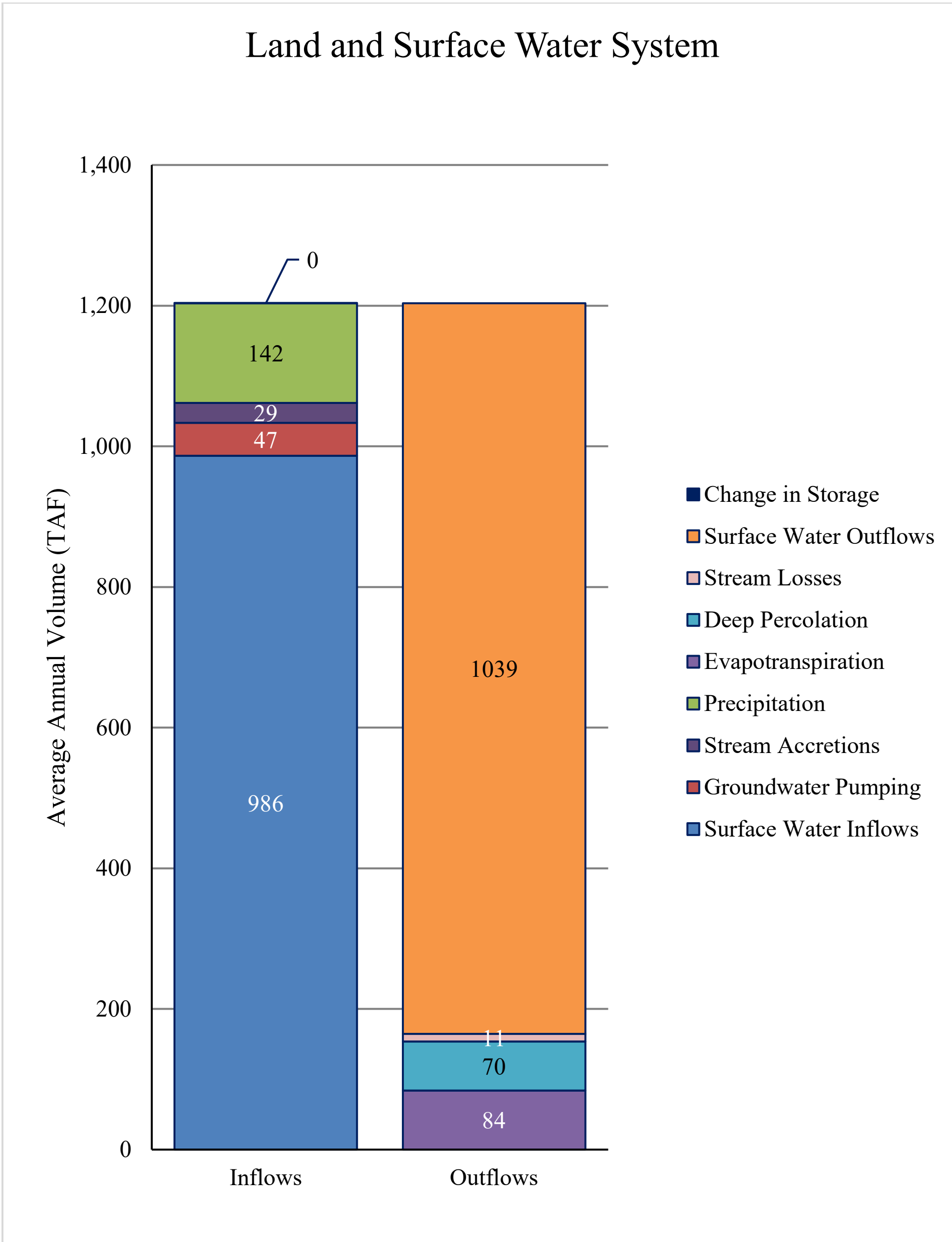


Figure 2-32: Average Annual Future Conditions with 2030 Climate Change Land and Surface Water System Water Budget

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).

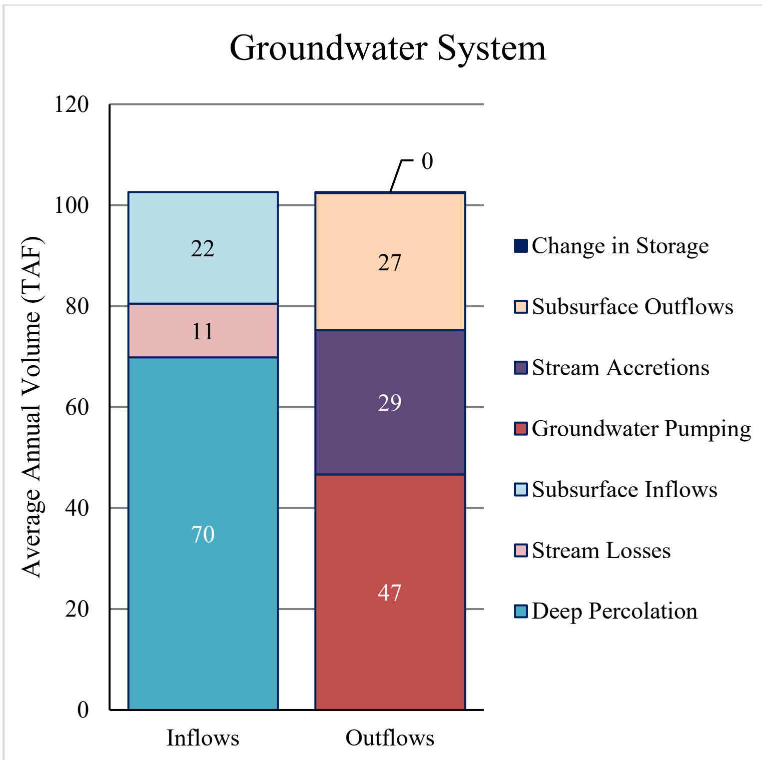


Figure 2-33: Average Annual Future Conditions with 2030 Climate Change Groundwater System Water Budget

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.

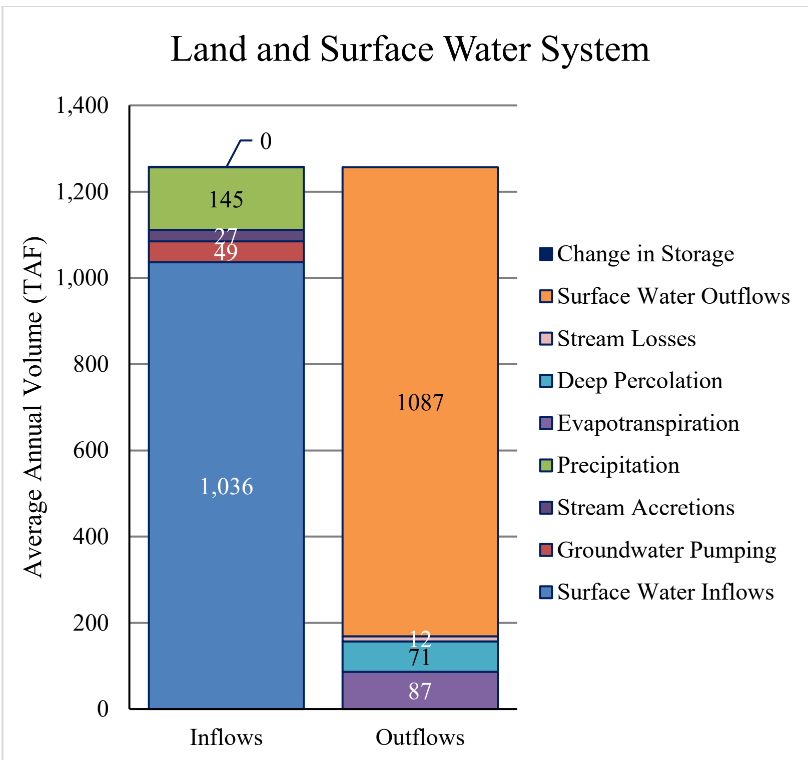


Figure 2-34: Average Annual Future Conditions with 2070 Climate Change Land and Surface Water System Water Budget

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).

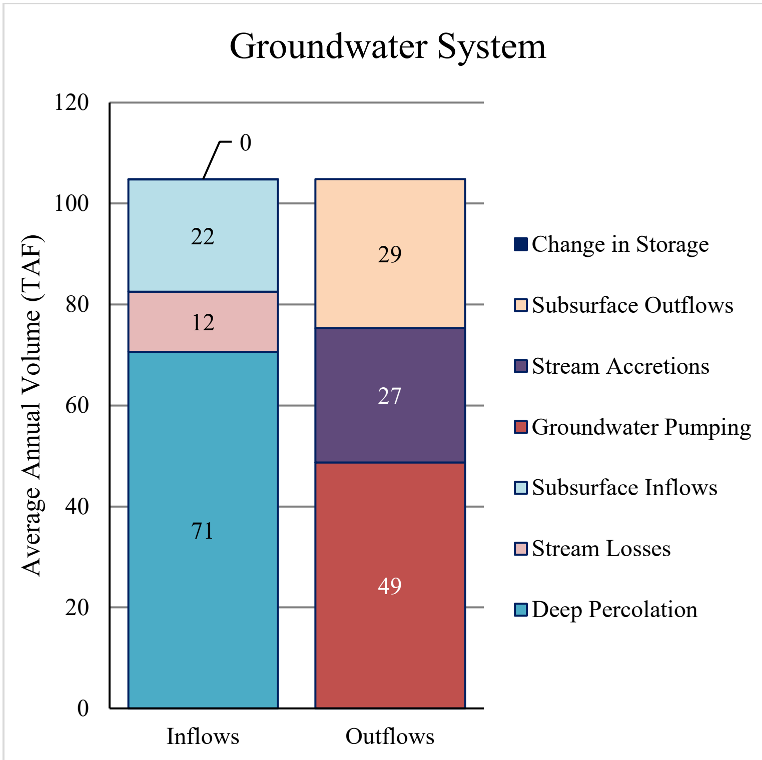
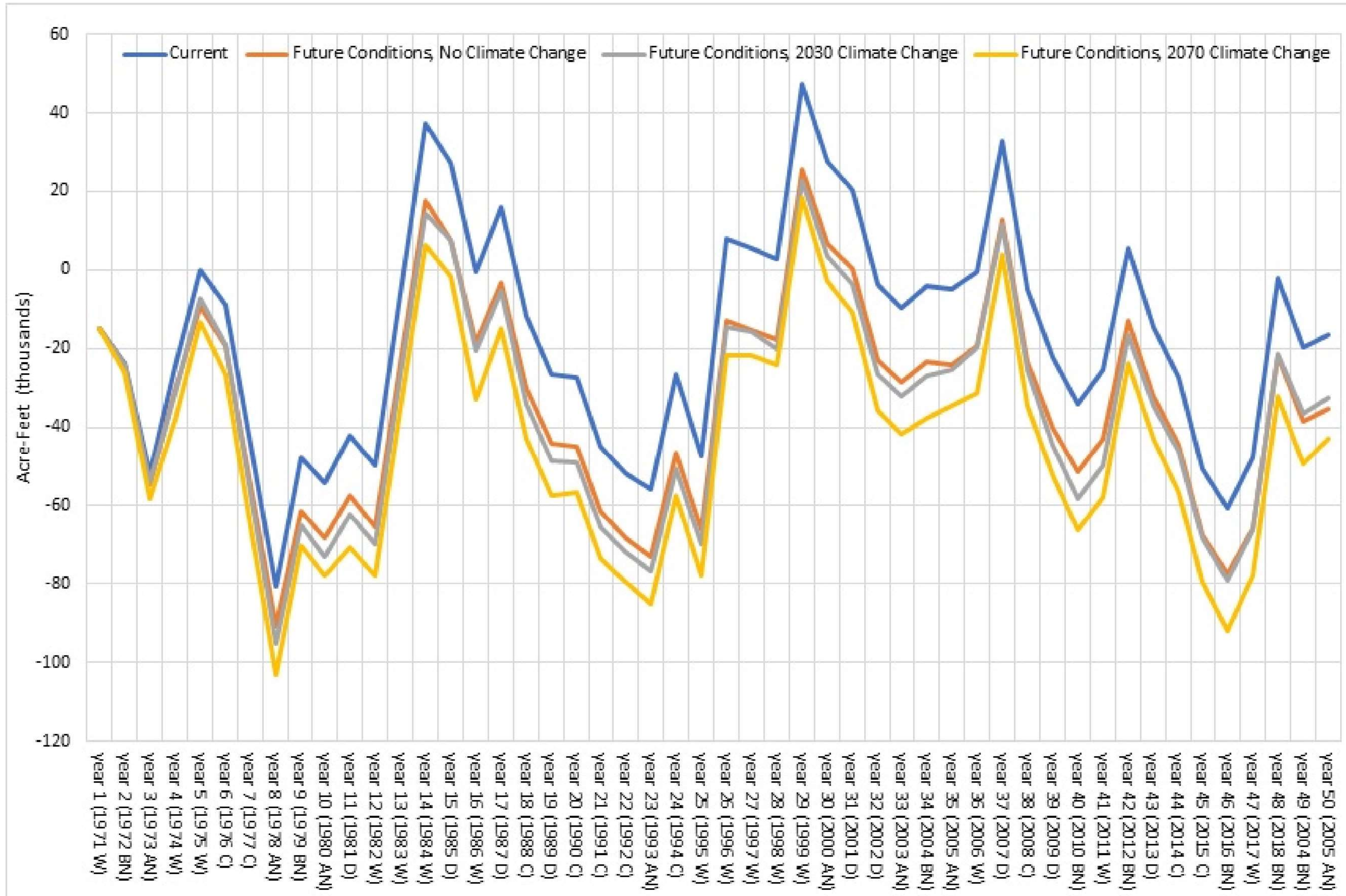


Figure 2-35: Average Annual Future Conditions with 2070 Climate Change Groundwater System Water Budget

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.



Cumulative Change in Groundwater Storage for Current and Future Conditions Baseline Scenarios
Wyandotte Creek Subbasin GSP

		Figure
Project No.: SAC282	December 2021	**2-36**

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

Sustainable yield refers to 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. As a result, determination of sustainable yield requires consideration of SGMA's six SIs. Historical water budget estimates indicate an average annual decrease in storage of about 3,700 AFY for the period from 2000 to 2018. 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 will likely require incorporation of projects and management actions into the GSP and implementation over the 50-year SGMA planning and implementation horizon. The estimated sustainable yield of the basin is described in greater detail in Section 2.3.6.

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. Ultimately, it is anticipated that other factors will be considered in refining these estimates as part of development of SMC for the basin.

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 time 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 2.3.6, 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.

For development of SMC as discussed in Chapter 3, the MO was developed to address the long-term trend of the "peaks and valleys" of the short-term cycles and stop the long-term decline in groundwater levels during dry years. Using this method, the average depth below the MO at compliance points (see Chapter 3 for discussion of representative monitoring sites [RMS]) if no actions are taken before the end of the implementation period in 2042 is about 5 feet. Using this value, a sustainable yield can be estimated based on the reduction in pumping needed to stop the observed decline in water levels across the subbasin. This value is sensitive to the specific storage. Specific storage is the parameter that translates the change in groundwater elevation to an associated change in volume (i.e. change in storage).

As discussed in Section 2.1.8.3, the average specific storage value used in the BBGM is 0.03967. Specific storage values estimated from pumping tests conducted in the Wyandotte Creek Subbasin ranged from 0.0002 to 0.00044 (Brown and Caldwell, 2013). Table 2-9 provides estimates of sustainable yield to maintain the MO in 2042 using this range of storativity values and the average decline in water levels across the subbasin in 2042. The groundwater pumping rate for the historical scenario is used for the calculation of sustainable yield.

Table 2-9: Estimated Sustainable Yield Using Average Depth Below Measurable Objective in 2042 and Range of Storativity Values

Feet Below MO in 2042	Specific Storage	Area of Subbasin (square miles)	Volume Storage Below MO in 2042 (acre-feet)	Average Change in Storage Between 2030 and 2042 (AFY)	Groundwater Pumping[1] (AFY)	Estimated Sustainable Yield (AFY)
5	0.03967	75	9,521	793	47,100	46,307
5	0.002	75	480	40	47,100	47,060
5	0.0002	75	48	4	47,100	47,096
5	0.0005	75	120	10	47,100	47,090

Using the information presented above, this GSP defines the estimate of the sustainable yield as 46,100 AFY based on groundwater pumping of 47,100 AFY and a decrease in storage of 1,000 AFY.

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 or following GSP development 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. 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.

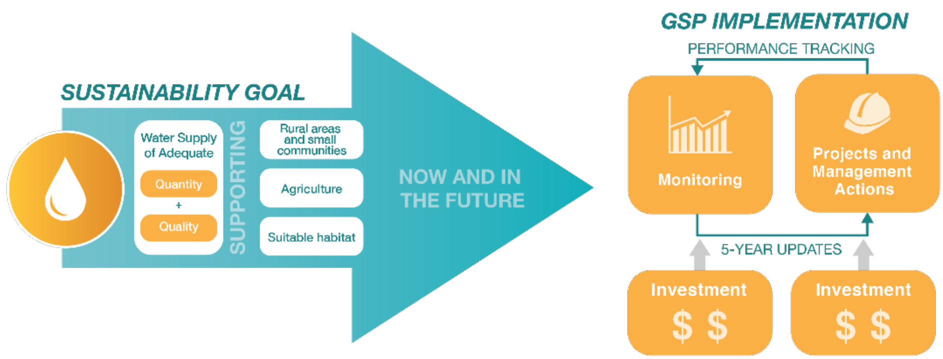


Figure 3-1: Flow Chart for Sustainability

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 within the Wyandotte Creek Subbasin. 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.

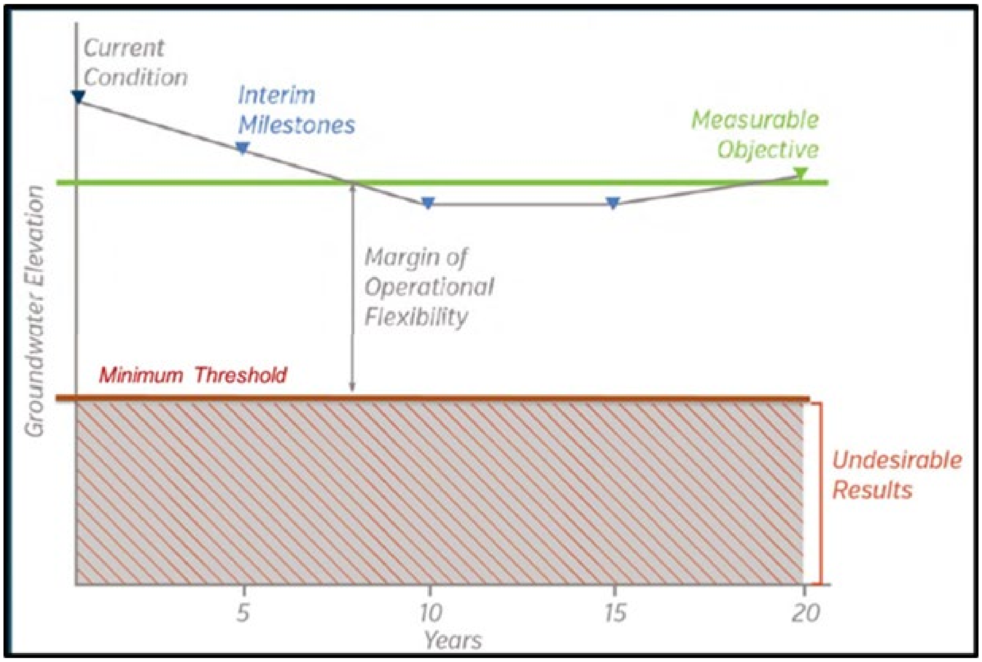


Figure 3-2: Illustration of Terms Used for Describing Sustainable Management Criteria Using the Groundwater Level SI

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 updates
- 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

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.*

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 potential impacts of declining groundwater levels.

Potential impacts identified by stakeholders from declining groundwater levels included:

- Wells going dry
- Reduced pumping capacity of existing wells
- Need for deeper well installations and/or lowering of pumps
- Increased pumping costs due to greater lift
- Reduced flows in rivers and streams supporting aquatic ecosystems

Issues related to reduced flows in rivers and streams and/or water tables that support aquatic ecosystems are addressed in the Interconnected Surface Water SMC (Section 3.8). As stated in this section, data are not available to assess these issues and are a data gap for the GSP. Section 3.8 also provides the framework to provide the data to develop SMC for these components.

In recent years, 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 during non-dry year conditions 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 within a management area reach their MT for two consecutive non-dry year-types.*

Non-dry year types include those with wet, above normal, and below normal classifications as defined by the Sacramento Valley Water Year Index. Dry year types include those with dry and critical classifications. See Section 2.3.1 for more information on the Sacramento Water Year Index.

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 Vina Subbasin. These figures were constructed using data from DWR OSWRC. 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 during drought years. Impacts to domestic wells and other groundwater uses may occur and would not constitute an Undesirable Result. Local and state drought response 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.

In order to establish appropriate MT levels protective of sustainably constructed domestic wells, a representative zone is established for each RMS well. The DWR domestic well 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, groundwater surface elevation of the well, 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.

To refine the dataset, wells installed before 1980 were removed. 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.

The MT was developed using the refined dataset by removing the 15% most shallow wells based on the elevation of the bottom of the wells within a 3-mile radius of the RMS well (see figures in Appendix 3-B). The percentile analysis is based on the statistical calculation of domestic well depths (translated to elevation amsl) in the DWR domestic well database for wells completed after 1980. Box and whisker plots were used to calculate the MT using this method. Box plots are a method for graphically depicting groups of numerical data through their quartiles. Box plots may also have lines extending vertically from the boxes (whiskers) indicating variability outside the upper and lower quartiles, hence the terms box-and-whisker plot. Box plots are non-parametric: they display variation in samples of a statistical population without making any assumptions of the underlying statistical distribution. The spacings between the different parts of the box indicate the degree of dispersion (spread) and skewness in the data. An illustration of the box and whisker plot is provided in Appendix 3-B.

A description of this method is as follows: a MT of 50 feet amsl at an RMS having 100 domestic wells within a 3-mile radius means that 15 wells within that radius 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 85 wells have been completed at an elevation below 50 feet amsl (and are therefore not vulnerable to going dry). The fifteenth-percentile MT assigned to each RMS 3-mile radius is protective of at least 85% of all domestic wells within its 3-mile radius. Some wells that fall above the MT may not "go dry" even if the MT is reached at the RMS well due to differences in groundwater elevation conditions within the RMS zone 3-mile radius. 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 two or more consecutive dry and/or critically dry year types 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 following those consecutive dry and/or critically dry years and should return to MO levels.

Appendix 3-B contains the box and whisker plots for each RMS.

3.3.3 Measurable Objectives

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 at the year 2042. To establish the MO, the water-level hydrograph of observed groundwater levels at each RMS was evaluated. The historical record at these locations shows cyclical fluctuations of groundwater level over a four- to seven-year cycle consistent with variations in water year type according to the Sacramento Valley Water Year Hydrologic Classification. Groundwater levels are typically lower during dry years and higher during wet years. Superimposed on this four- to seven-year short-term cycle is a long-term decline in groundwater levels. In other words, groundwater levels during more recent dry-year cycles are lower than groundwater levels in earlier dry-year cycles.

The wet-dry cycles are climatically induced, and the GSA has no ability to change this cyclical behavior; there will always be short-term cyclical fluctuations in groundwater levels. The MO are therefore intended to address the long-term trend of the "peaks and valleys" of the short-term cycles and stop the long-term decline in groundwater levels during dry years. Because the GSA cannot immediately augment water supply and/or reduce water demand, some continuation of the long-term decline in groundwater levels is expected in the near future. Currently (in 2021), the Wyandotte Creek subbasin appears to be coming out of a wet period (2017 and 2019 being wet years) of a short-term cycle and beginning the next dry period of the short-term cycle starting in 2020. The MO was therefore based on the trend line of observed historical data extended to the year 2030. The year 2030 was chosen as a reasonable time frame in which the GSA could implement projects and management actions to address long-term groundwater level decline while recognizing that groundwater levels may experience another dry period of the short-term cycle in the intervening years. The MO for the Groundwater Levels SMC is (Figure 3-3):

the groundwater level based on the groundwater trend line for the dry periods (over the period of record) of observed short-term climatic cycles extended to 2030.

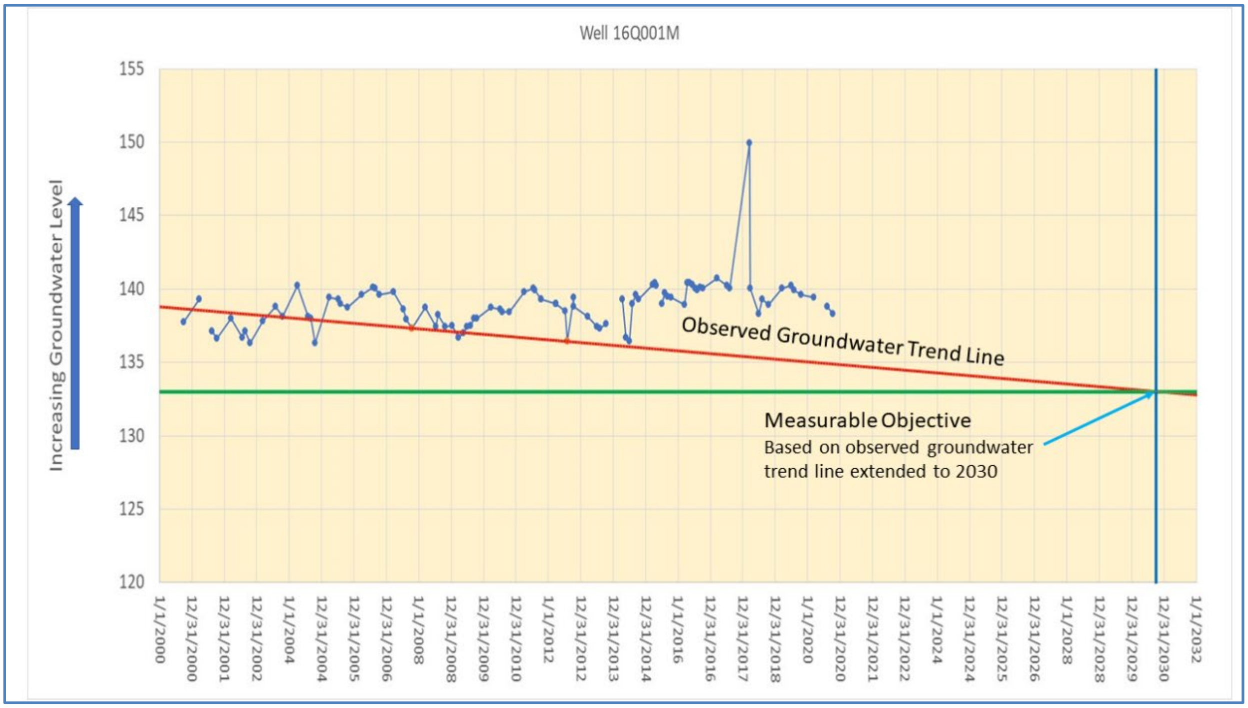


Figure 3-3: Illustration of Long-Term Trend Using Historical Water Levels Extended to 2030 for Development of Measurable Objectives

The projection of groundwater levels for each RMS was based on a simple non-statistical linear projection of the observed data. Generally, the lowest groundwater levels of a given cycle were used for the projection, unless they appeared to be outliers relative to the general long-term trend of the dry years in the cycle.

IM for groundwater levels between 2022 and 2042 were interpolated based on the linear projection of groundwater level at each RMS. Using a projection based on the dry years of the short-term cycle, it will be important to assess IM relative to dry years as they occur, rather than at fixed 5-year intervals. By projecting based on the dry years in the cycle, the observed groundwater levels may be higher than the IM. This will be addressed in the annual reports and interim GSP updates based on what occurs with respect to the short-term cycles in the future. Appendix 3-C contains the hydrographs with projected data used to develop MO and IMs for each RMS.

3.3.4 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 certain ranges at each RMS shown in Table 3-1. (See Section 4, Figure 4-5, and Table 4-6 for relevant information on the RMS for groundwater levels.)

Table 3-1: Groundwater Levels Sustainable Management Criteria by Representative Monitoring Site in Feet Above Mean Sea Level

RMS Well ID	MT	MO	IM		
			2027	2032	2037
Wyandotte Creek Subbasin – Oroville Management Area					
16Q001M	85	133	134	133	133
32P001M	78	107	108	106	106
CWS-03	102	133	135	132	132
Wyandotte Creek Subbasin – South Management Area					
13B002M	35	47	48	46	46
09N002M	35	49	51	47	47
25N001M	37	52	53	52	52
08M001M	59	86	87	85	85
16C001M	71	95	96	95	95
31F001M	76	99	101	98	98

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 within a management area reach their MT for two consecutive non-dry year-types.*

In the historical record, there are isolated incidences of shallow wells going dry in Butte County during summer months of recent 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.

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:

> *groundwater pumping compromises the Subbasin's ability to achieve its Sustainability Goal. This occurs in the Wyandotte Creek subbasin when two RMS wells over the entire Wyandotte Creek Subbasin exceed their MT for two consecutive non-dry 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 Minimum Threshold

The Water Quality MT 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 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.

For the Wyandotte Creek Subbasin undesirable result is considered "significant and unreasonable" if groundwater quality degrades such that the specific conductance exceeds the upper Secondary MCL of 1,600 µS/cm. There are no public health goal or primary MCL goal associated with specific conductance. The MT for the Water Quality Secondary MCL is:

> *the upper Secondary MCL for specific conductance based on the State Secondary Drinking Water Standards.*

In Wyandotte Creek Oroville, undesirable results have not been reported historically, are not currently occurring, and are not expected to occur in the future. Observations of specific conductance at RMS from 2001 through 2019 ranged between 346 and 390 µS/cm and demonstrated no trend. In Wyandotte Creek South undesirable results related to water quality as a result possibly due to groundwater pumping have been reported in one well, 18N04E28L001M (Figure 4-6), with data collected in the 1970s and 1980s. The last reported value of specific conductance was greater than 2,000 µS/cm for a sample collected in 1986. No samples have been collected in this area since that time. These results may also be naturally occurring within this well (total depth 190 feet bgs) and not due to groundwater pumping. If access cannot be obtained for the proposed RMS well in this area, then a new RMS well will be installed. Although there have been no reported undesirable results due to groundwater pumping in this area, other RMS wells in Wyandotte Creek South have not been sampled for specific conductance. The proposed sampling schedule for these wells will provide the data by the first 5-year update to assess if undesirable results occur in this area.

3.5.3 Measurable Objective

The Water Quality MO represents a quantitative target that establishes a point above the MT 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 the recommended Secondary MCL of 900 µS/cm based on State Secondary Drinking Water Standards as discussed above for the MT. The MO for the Water Quality SMC is:

> *the recommended Secondary MCL for specific conductance based on the State Secondary Drinking Water Standards.*

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.

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 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	MT	MO	IM		
			2027	2032	2037
Wyandotte Creek Subbasin – Oroville Management Area					
16Q001M CWS-02	1,600	900	900	900	900
Wyandotte Creek Subbasin – South Management Area					
08M001M 18C001M[1] 18C002M 18C003M 28L001M[2] 13B002M	1,600	900	900	900	900

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 disrupt critical infrastructure or development of projects in a manner that is inconsistent with the Sustainability Goal.*

Land subsidence typically occurs concurrently or shortly after significant declines in groundwater levels, therefore measured changes in groundwater levels can serve as a proxy for potential land subsidence. For this reason, the SMC developed for groundwater levels are used for land subsidence to ensure avoidance of the undesirable result.

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

> *Two RMS wells within a management area reach their MT for two consecutive non-dry year-types.*

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. 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 subsidence monitoring network includes six GSP monuments located within the Wyandotte Creek Subbasin. The subsidence monitoring network also includes three extensometers in Butte County with a period of record beginning in 2005 (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. This is likely due to relatively stable groundwater levels historically and subsurface materials that are not 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

As Groundwater Levels SMC are used by proxy, the MO for land subsidence 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.

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 also 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 and mapping analysis of GDEs prepared by BCDWRC. The GDEs mapping analysis is presented in Section 2.2.7. 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.

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. These data are not available and are a data gap for the GSP. The GSA intends to further evaluate this SMC to avoid undesirable results to aquatic ecosystems and GDEs. 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, either as part of GSP projects and management actions or 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:

- 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).
- 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.
- 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.
- 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.

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. For now, an 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.

For this reason, the SMC developed for groundwater levels are used as a proxy for interconnected surface water in an interim manner until data gaps are addressed. As outlined in Chapter 6, an aggressive schedule has been provided to fill these data gaps and the GSA is committed to addressing these issues and develop appropriate SMC for Wyandotte Creek Subbasin.

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. Therefore, at this time, Groundwater Levels SMC are used by proxy and the MT for interconnected surface water is the same as for groundwater levels:

Two RMS wells within a management area reach their MT for two consecutive non-dry year-types.

This interim MT may be refined as more data are collected to support the SMC framework described above. In the meantime, this MT is protective of interconnected surface water in so far as it is protective of shallow domestic wells, which are more likely to be completed in shallow aquifer zones that have a greater connection to surface water.

3.8.5 Measurable Objectives

As Groundwater Levels SMC are used by proxy, the MO for interconnected surface water 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.*

As described previously, the historical record of groundwater levels shows fluctuations over a four- to seven-year cycle consistent with variations in water year type according to the Sacramento Valley Water Year Hydrologic Classification. It is not known whether streamflow and associated aquatic habitat and GDEs that are connected to groundwater have also experienced a long-term decline. Long-term declines in Feather River streamflow may have been avoided by reservoir releases aimed at maintaining streamflow levels and meeting water supply demands. As described previously, the wet-dry cycles are climatically induced, and the GSA has no ability to change this cyclical behavior; there will always be short-term cyclical fluctuations in surface water availability. The MO are therefore intended to address the long-term trend of the “peaks and valleys” of the short-term cycles. A focus on long-term trends will be maintained as more data are collected to inform future MOs for the shallowest zone of the aquifer system.

3.9 Sustainable Management Criteria Summary Tables

Groundwater Levels SMC and Water Quality SMC for each RMS are shown in Table 3-1 and Table 3-2, respectively. The locations of these wells are shown in Figures 4-5 and 4-6, respectively.

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 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 updates to 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

Data collected from the monitoring network 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. At locations where MO differ substantially from current conditions, the monitoring data from the RMS (Section 4.9) will be used to determine whether local projects and management actions are meeting IM presented in the GSP as indicators of progress toward attainment of MO. MOs will be monitored directly through measurement of groundwater levels and water quality constituents.

Groundwater elevations will be used as a proxy for evaluating reduction in groundwater storage, depletions of interconnected surface waters, and for land subsidence where either of these potential undesirable results is associated with declining groundwater elevations. In each of these instances, "significant and unreasonable" reductions are the guideposts used to warn of unsustainable groundwater conditions. For interconnected surface waters, the GSA in the Wyandotte Creek Subbasin intends to further evaluate this SMC to avoid undesirable results to aquatic ecosystems and GDEs. To that end, an Interconnected Surface Water SMC framework has been developed for the GSP, as described in Section 3.8. This framework will guide future data collection efforts to fill data gaps, either as part of GSP projects and management actions or as plan implementation. As additional data are collected and evaluated, the Wyandotte Creek Subbasin commits to developing additional SMC, as appropriate, for specific stream reaches and associated habitat where there is a clear connection to groundwater pumping in the principal aquifer.

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 groundwater levels, water quality, land subsidence, and depletions of interconnected surface water are described below. The BBGM and / or groundwater level data will be used to estimate changes in groundwater storage based on observed changes in groundwater levels.

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 will address 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 network, identifying gaps in the network, 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

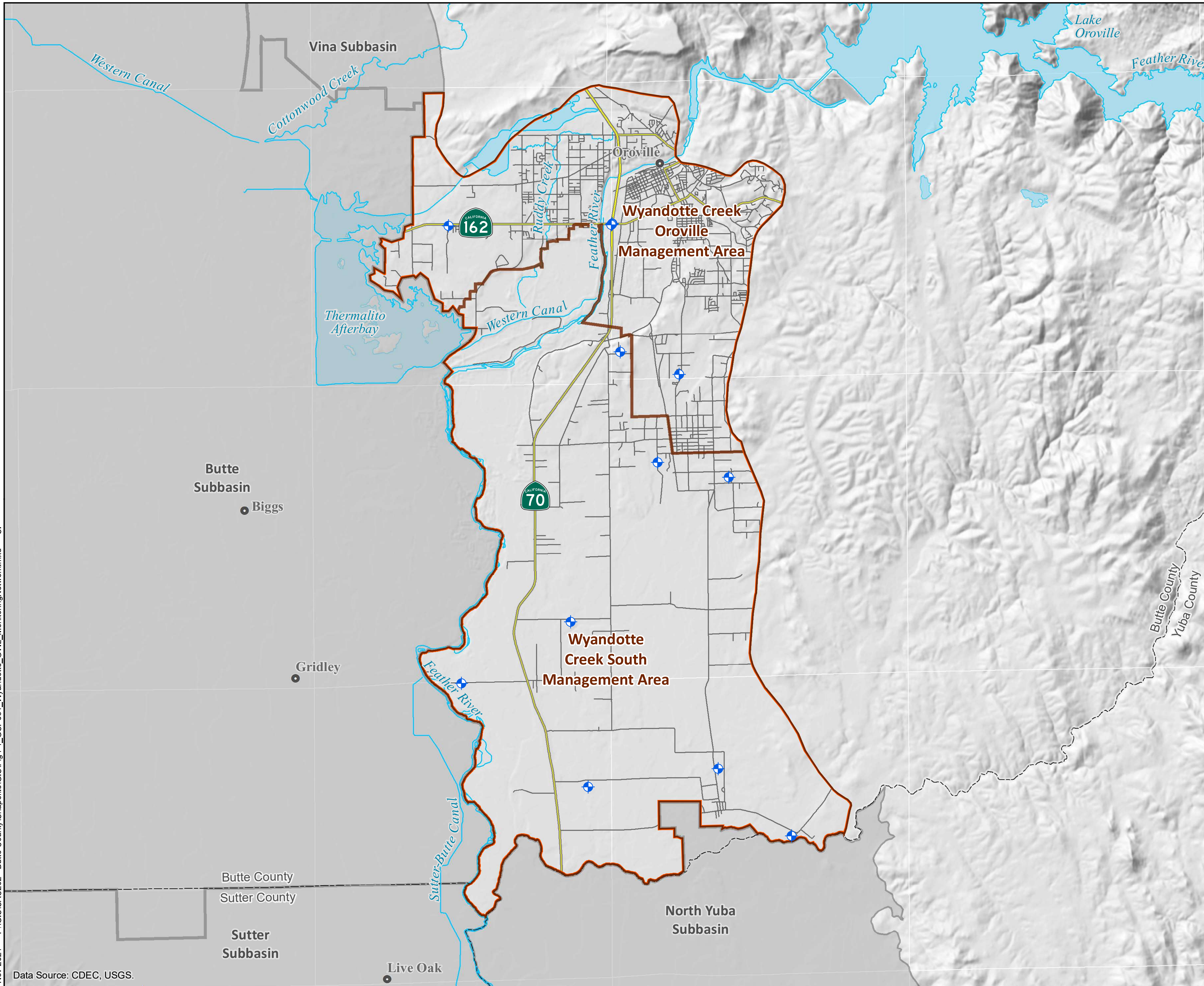
4.2 Groundwater Level Monitoring

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 13 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 13 wells, 5 are located in the Wyandotte Creek - Oroville MA, and 8 in the Wyandotte Creek - South MA. Table 4-1 lists wells now used for monitoring in each MA and Figure 4-1 shows the locations of these wells (except for municipal 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. A multi-completion well was recently installed as shown in Figure 4-6 by DWR under the TSS program and will be used for both groundwater level and water quality assessments (Section 4.9.2). No other multi-completion wells are located within the Wyandotte Creek Subbasin.

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

Well ID	Monitoring Frequency	Multi-Completion (number of wells at site)	Well Type
Wyandotte Creek – Oroville Management Area			
19N03E1600Q	Quarterly	No	Residential
19N04E3200P	Quarterly	No	Residential
CWS-01	Quarterly	No	Municipal
CWS-02	Quarterly	No	Municipal
CWS-03	Quarterly	No	Municipal
Wyandotte Creek – South Management Area			
17N03E0300D	Quarterly	No	Irrigation
17N03E1300B	Quarterly	No	Irrigation
17N04E0900N	Quarterly	No	Irrigation
17N04E2200B	Quarterly	No	Residential
18N03E2500N	Quarterly	No	Irrigation
18N04E0800M	Quarterly	No	Irrigation
18N04E1600C	Quarterly	No	Irrigation
19N04E31F	Quarterly	No	Residential



GROUNDWATER LEVEL MONITORING NETWORK

- Groundwater Level Monitoring Well
- Waterway
- Lake
- Wyandotte Creek Subbasin
- Neighboring Subbasin
- Highways
- Other roads

WYANDOTTE CREEK SUBBASIN GSP

DECEMBER 2021

FIGURE 4-1

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 (Section 4.9) in the Wyandotte Creek Subbasin will be monitored at least biannually by the 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 13 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 14 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: 5 wells in an area of 29 square miles, spatial density of 17 wells per 100 square miles.
- Wyandotte Creek – South: 8 wells in an area of 64 square miles, spatial density of 12.5 wells 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. Monitoring sites and wells included in this network are presented above in Table 4-1 with well locations shown in Figure 4-1.

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), temperature, and pH 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. The locations of all water quality monitoring wells are in Figure 4-2.

A total of two sites are part of the County's ongoing water quality monitoring programs. These wells have been selected based on the existing period of record, depth of well screens, and the quality of data reported and subject to permission of the well owner to monitor the well. Water quality monitoring has historically been conducted by Butte County during the summer. Both of the wells are located in the Oroville MA.

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

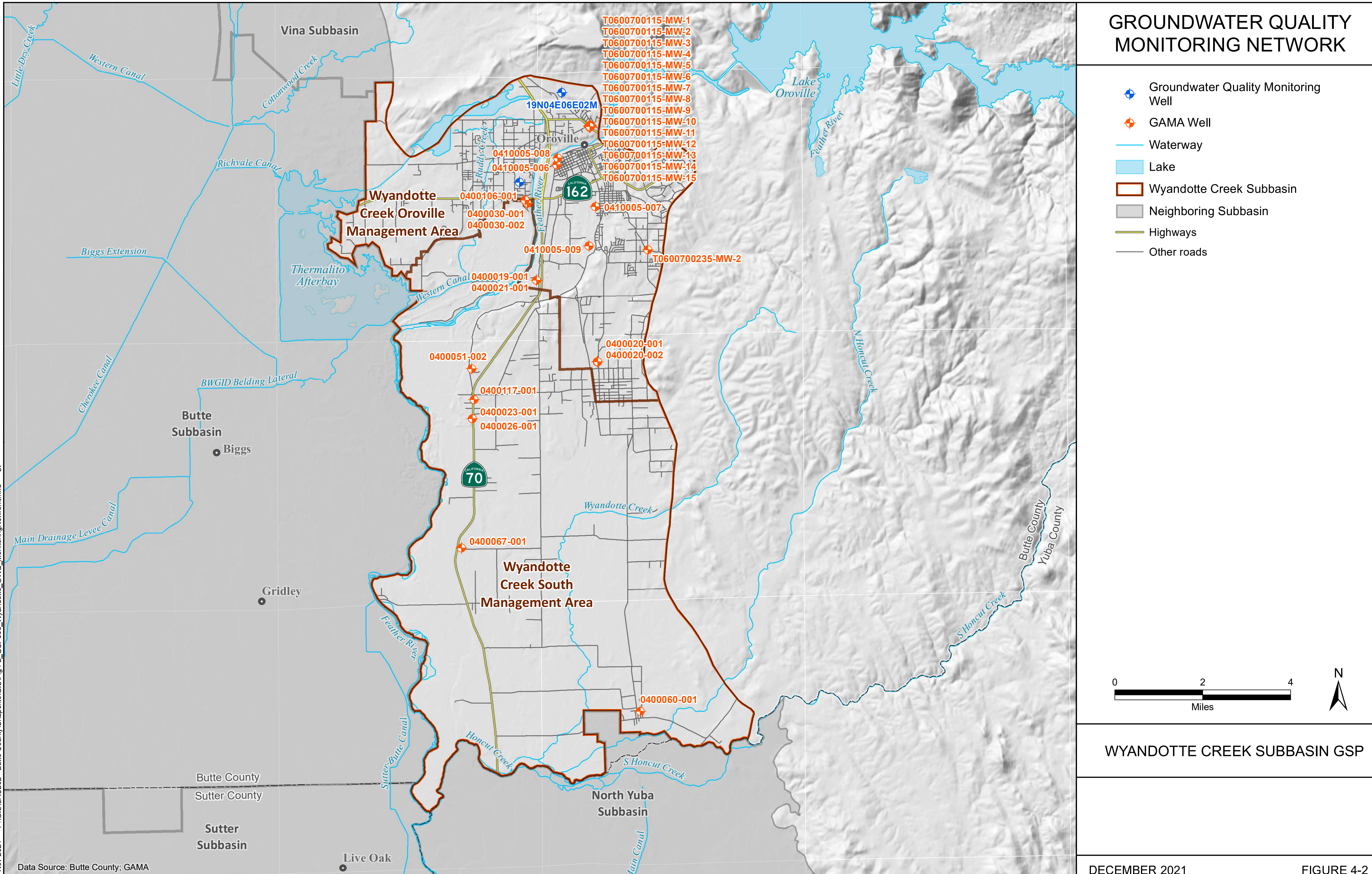
4.4.2 Density of Monitoring Sites and Frequency of Measurement

Following the County's ongoing water quality monitoring program, data will be collected annually for monitoring the groundwater quality sustainability 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.

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. This 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.



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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.

The primary mechanism for subsidence monitoring in the Wyandotte Creek Subbasin is a group of GPS monuments established to create the Sacramento Valley GPS Subsidence Monitoring Network. This program has been developed jointly by DWR and Reclamation with cooperation and assistance from local entities, including Butte County. The locations of these monuments are shown in Figure 4-3. Monuments used to monitor subsidence in the Wyandotte Creek Subbasin network include six monuments located either in the interior of the Wyandotte Creek Subbasin or on the boundary between the Wyandotte Creek and the Butte and Vina subbasins. Data from this monitoring network is collected, analyzed and reported by DWR as the data becomes available.

Data from monuments in the Wyandotte Creek Subbasin portion of the Sacramento Valley GPS Subsidence Monitoring Network have been used to monitor cumulative subsidence in the Wyandotte Creek Subbasin in 2008 and 2017, a period used to satisfy the SGMA requirement to evaluate historical subsidence.

Observations from the GPS Subsidence Monitoring Network will be supplemented by InSAR data released by DWR. This information reports vertical ground surface displacement using data collected by the European Space Agency Sentinel-1A satellite and processed by NASA's JPL. Data released to date from DWR's InSAR program provides cumulative vertical ground surface displacements from June 2015 through September 2019 and is used in the GSP to fulfill the requirement to estimate the rate and extent of recent subsidence.

InSAR data collection and mapping is regional and is not based on a defined network of monitoring locations. Therefore, no InSAR sites are shown in Figure 4-3.

4.5.2 Location and Density of Monitoring Sites and Frequency of Measurement

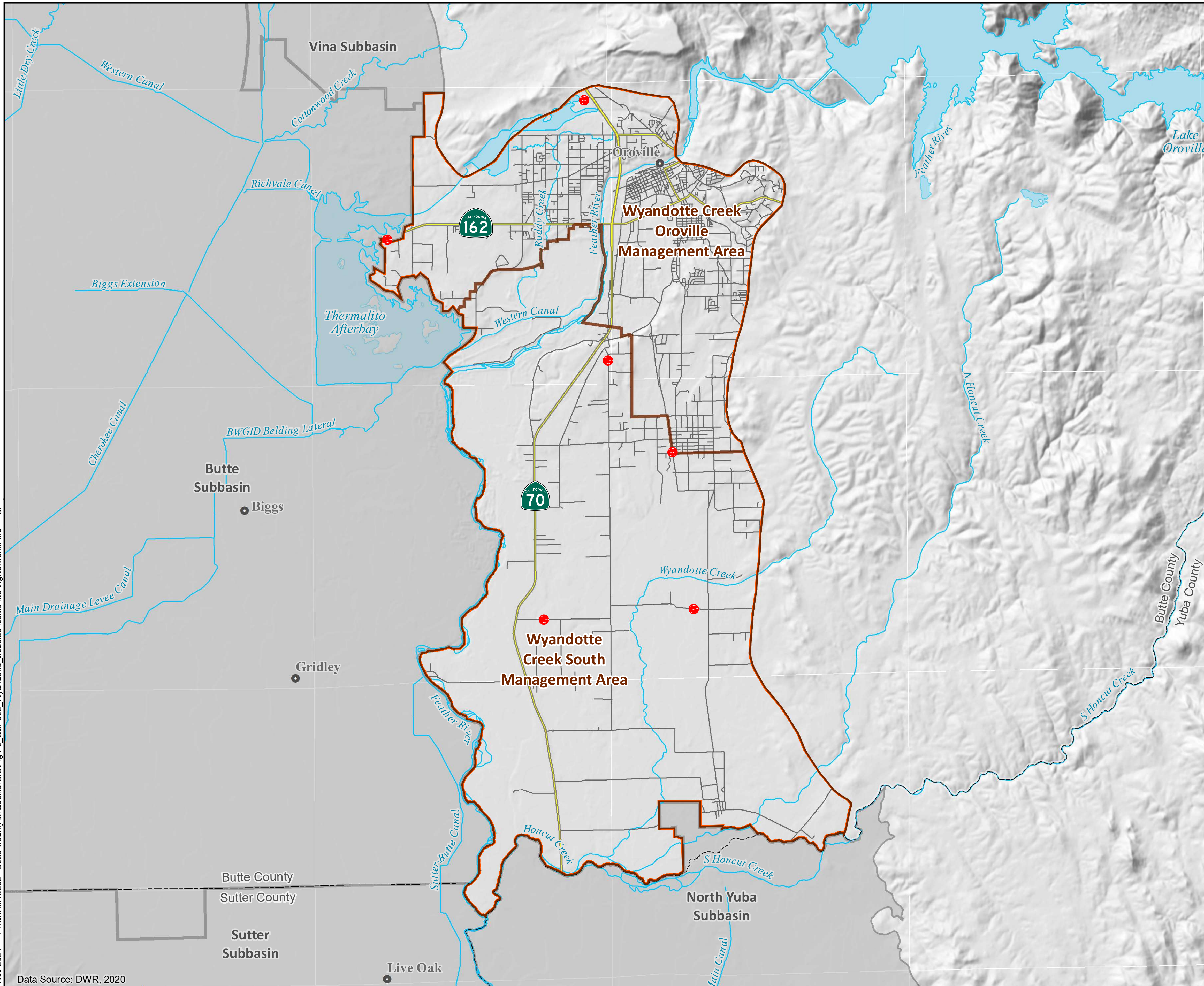
The Sacramento Valley GPS Monitoring Network includes monuments that were measured in 2008 and 2017, while the InSAR program monitors subsidence on a continual basis. Data collected from both sources requires post processing and analysis, therefore the frequency of reporting is dependent on the work performed by DWR and by NASA's JPL. 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, 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.

SUBSIDENCE MONUMENT LOCATIONS



- Subsidence Monument
- Waterway
- Lake
- Wyandotte Creek Subbasin
- Neighboring Subbasin
- Highways
- Other roads

0 2 4
Miles
N

WYANDOTTE CREEK SUBBASIN GSP

DECEMBER 2021

FIGURE 4-3

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The monitoring sites for the Wyandotte Creek Subbasin include the stream gages found in Table 4-4 and Figure 4-4 and the groundwater quality monitoring sites shown above in Table 4-3 and Figure 4-2. The groundwater level monitoring sites selected for observing groundwater and surface water interactions include the entire array of existing wells in the groundwater level monitoring network as described in Section 4.2, above, that form the pool of potential RMS used to assess surface water and groundwater interactions. 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.

In addition to being used to identify relations between groundwater levels and streamflow, data from the network of stream gages and monitoring wells may be used to update and refine the calibration of the BBGM. This model will be used to combine data on groundwater levels and stream flows with data on aquifer parameters and water use to estimate the relation between groundwater conditions and stream flow and to identify instances where groundwater use depletes surface water.

Table 4-4: Wyandotte Creek Subbasin Surface Water Stream Gauges

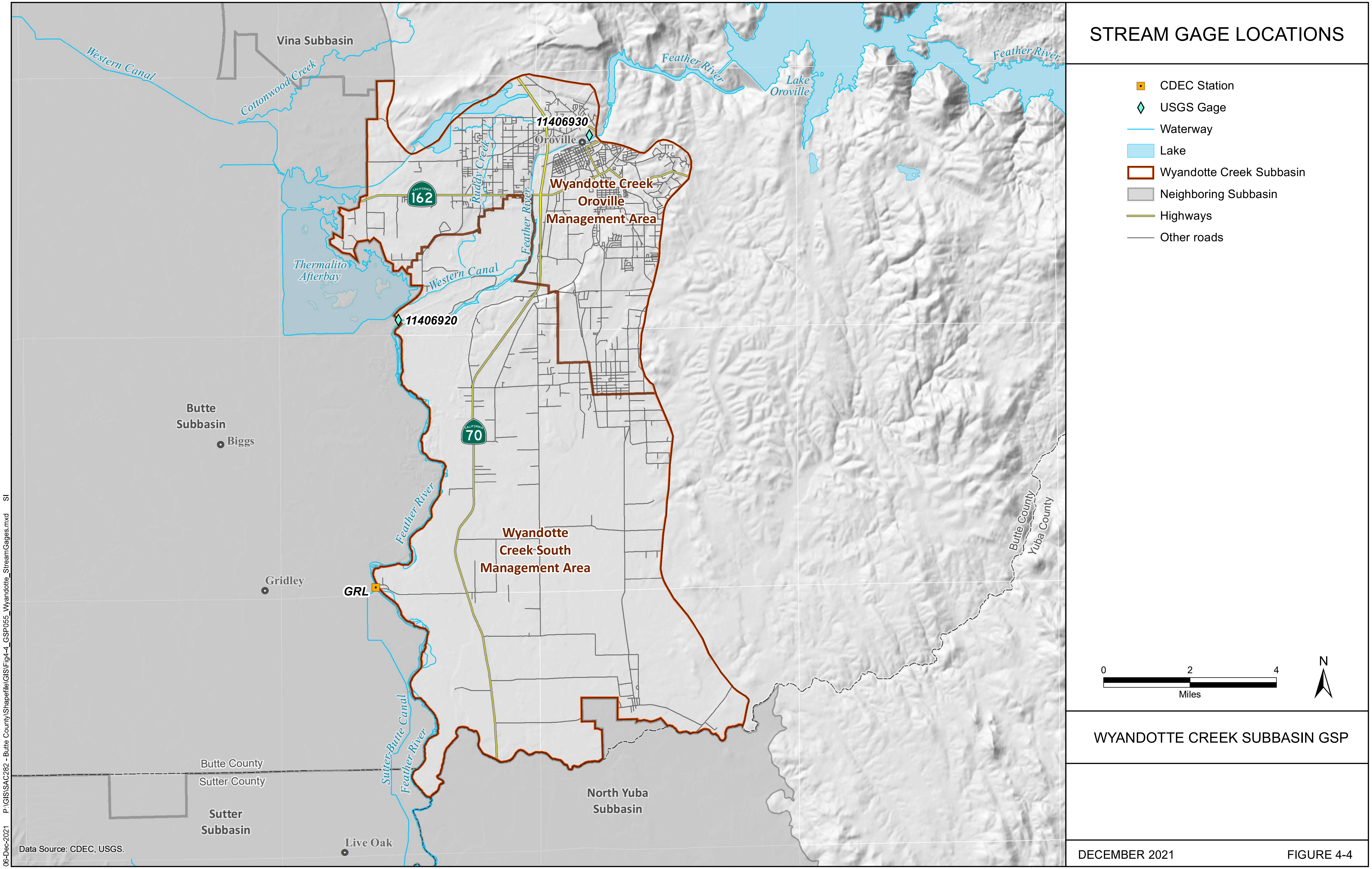
Stream Monitored	Gage ID	Well Network	Measurement Frequency
Oroville Management Area			
Feather River	11406930	USGS	Daily
South Management Area			
Feather River	11406920	USGS	Daily
Feather River	GRL	CDEC	Hourly

A total of 13 monitoring wells and 3 stream gages are included in the Wyandotte Creek Subbasin's network for monitoring groundwater and streamflow interactions.

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 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.


STREAM GAGE LOCATIONS
CDEC Station
USGS Gage
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 4-4
Vina Subbasin
Western Canal
Cottonwood Creek
Feather River
Lake Oroville
11406930
Oroville
Ruddy Creek
162
Wyandotte Creek Oroville Management Area
Thermalito Afterbay
Western Canal
11406920
Butte Subbasin
Biggs
70
Feather River
Wyandotte Creek South Management Area
Gridley
GRL
Butte County
Yuba County
Sutter-Butte Canal
Butte County
Sutter County
Sutter Subbasin
North Yuba Subbasin
Live Oak
Data Source: CDEC, USGS.
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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.

4.8 Representative Monitoring Sites

RMS wells are intended to be representative of general conditions within the area. This approach allows for a focused and specific monitoring location to effectively represent a larger geographical area. The data gathered from the RMS will be used to quantify the MAs 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 three 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 high 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. 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.

4.9 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.

4.9.1 Groundwater Levels

The RMS wells will be used as compliance points to record groundwater elevations for the evaluation of chronic lowering of groundwater levels. 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 MO for groundwater levels will adequately serve as proxy for groundwater storage. Land subsidence occurs when compressible subsurface soils are dewatered. Soil units in the Wyandotte Creek Subbasin have not historically been susceptible to compression during periods of declining groundwater elevations. Therefore, the MO for groundwater levels will adequately serve as proxy for land subsidence.

Surface waters may manifest a depletion in volume if groundwater levels fall below the established MO. Such depletion is not evident in the historical records available, however more information may be required to adequately characterize interactions. See Section 3.8 for a discussion of interconnected surface water assessment. As indicated in this section, an Interconnected Surface Water SMC framework has been developed for the GSP. This framework will guide future data collection efforts to fill data gaps, either as part of GSP projects and management actions or plan implementation. As additional data are collected and evaluated, the Wyandotte Creek Subbasin commits to developing additional SMC and installation of RMS as appropriate, for specific stream reaches and associated habitat where there is a clear connection to groundwater pumping in the principal aquifer.

For the purposes of this GSP, groundwater elevations will be used as a proxy for monitoring of SMC of groundwater storage, land subsidence, and interconnected surface water.

A total of nine RMS wells were selected as compliance points for monitoring of groundwater levels (Figure 4-5). They will be monitored for the SMC listed in Section 3.9. Each well (except CWS-03) was selected independently of the wells discussed in Section 4.2 and are not listed in Table 4-1 (CWS-03 is listed in Table 4-1). 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	19N03E16Q001M	120	100-120	180.32	Top of casing	179.32
32P001M	19N04E32P001M	N/A	N/A	188	Between plate and casing on west side	187
CWS-03	CWS-03	<200	---	195	---	---
Wyandotte Creek Subbasin – South Management Area						
13B002M	17N03E13B002M	320	N/A	89.57	Top of casing	89.27
09N002M	17N04E09N002M	325	N/A	103.26	N/A	102.26
25N001M	18N03E25N001M	164	N/A	128.26	Top of casing	127.26
08M001M	18N04E08M001M	656	168-244	147.56	Between metal plate and top of casing	147.26
16C001M	18N04E16C001M	165	N/A	204.46	Top of casing	203.26
31F001M	19N04E31F001M	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

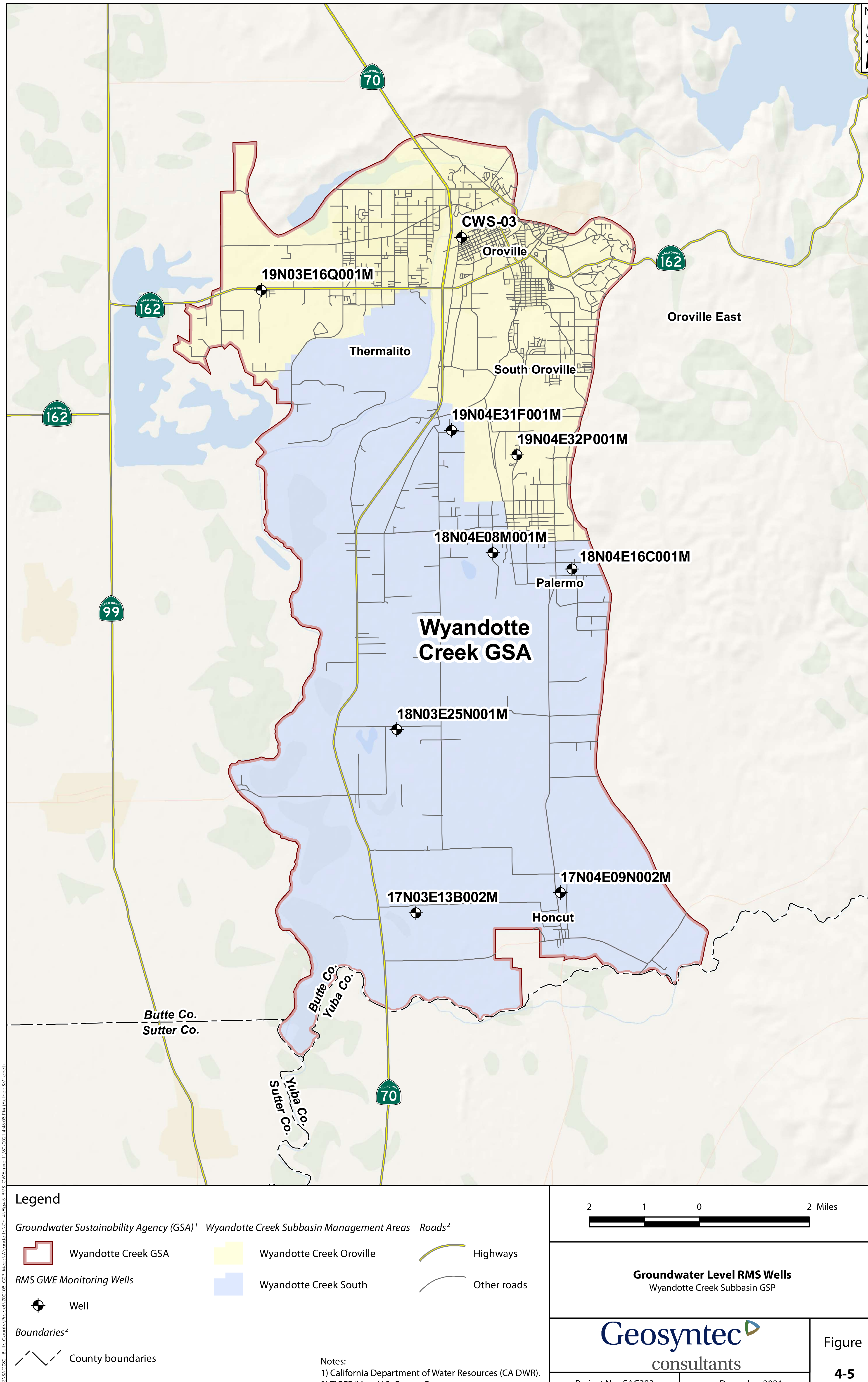

N
70
162
162
162
99
70
CWS-03
Oroville
19N03E16Q001M
Oroville East
Thermalito
South Oroville
19N04E31F001M
19N04E32P001M
18N04E08M001M
18N04E16C001M
Palermo
Wyandotte
Creek GSA
18N03E25N001M
17N04E09N002M
17N03E13B002M
Honcut
Butte Co.
Yuba Co.
Butte Co.
Sutter Co.
Yuba Co.
Sutter Co.
Legend
Groundwater Sustainability Agency (GSA)[1]
Wyandotte Creek GSA
RMS GWE Monitoring Wells
Well
Boundaries[2]
County boundaries
Wyandotte Creek Subbasin Management Areas
Wyandotte Creek Oroville
Wyandotte Creek South
Roads[2]
Highways
Other roads
Notes:
1) California Department of Water Resources (CA DWR).
2) TIGER/Line, U.S. Census Bureau.
2 1 0 2 Miles
Groundwater Level RMS Wells
Wyandotte Creek Subbasin GSP
Geosyntec consultants
Figure
4-5
Project No.: SAC282
December 2021

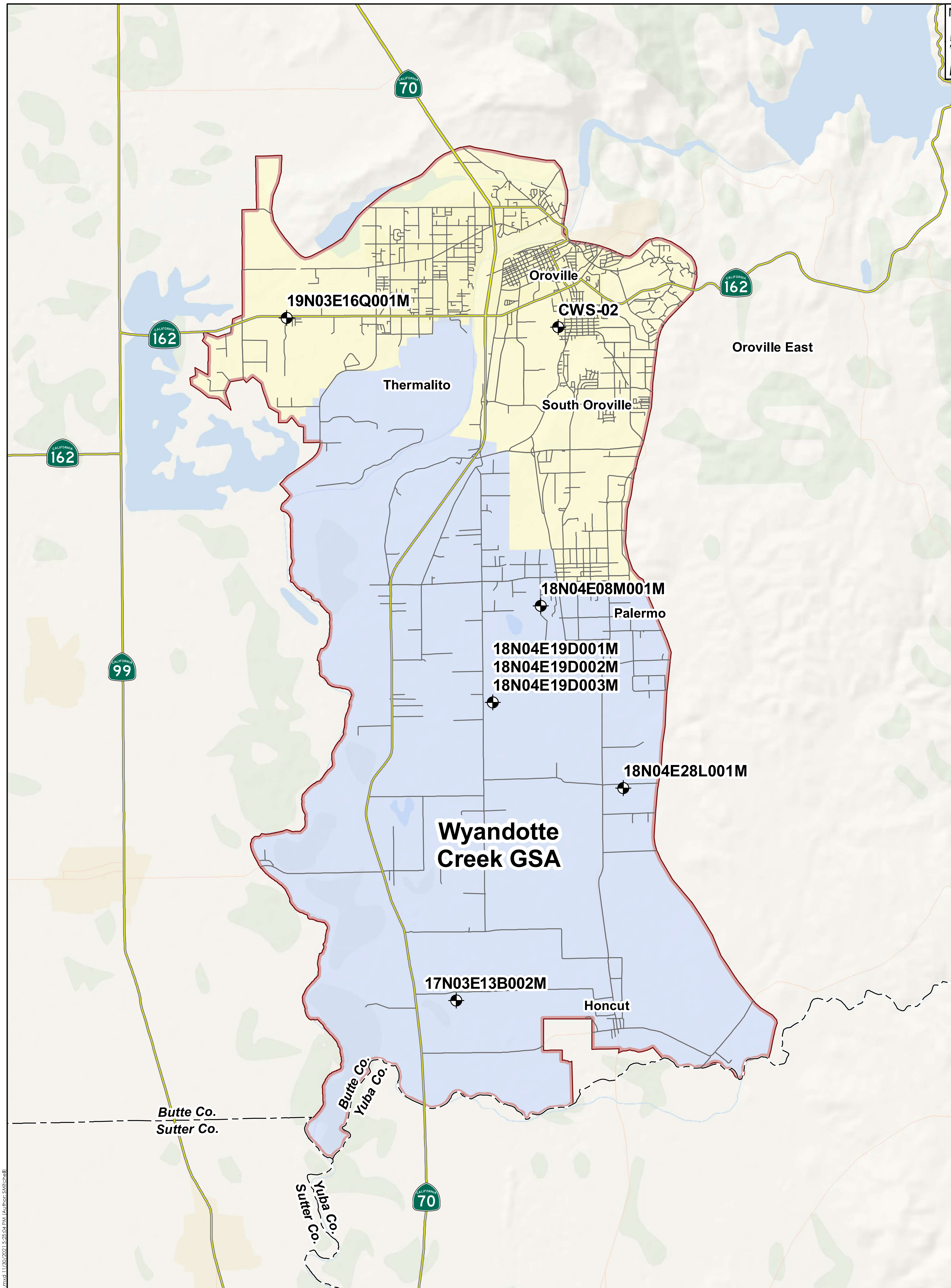
Table 4-6: Groundwater Levels Representative Monitoring Site Well Location Details

RMS Well ID	State Well Number (Site Name)	Latitude[1]	Longitude[1]
Wyandotte Creek Subbasin – Oroville Management Area			
16Q001M	19N03E16Q001M	39.4977	-121.6369
32P001M	19N04E32P001M	39.4540	-121.5503
CWS-03	CWS-03	---	---
Wyandotte Creek Subbasin – South Management Area			
13B002M	17N03E13B002M	39.3336	-121.5853
09N002M	17N04E09N002M	39.3387	-121.5363
25N001M	18N03E25N001M	39.3818	-121.59156
16C001M	18N04E16C001M	39.4239	-121.5318
08M001M	18N04E08M001M	39.4283	-121.5586
31F001M	19N04E31F001M	39.4606	-121.5725

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

4.9.2 Water Quality

A total of eight RMS wells were selected as compliance points for monitoring of water quality (Figure 4-5). 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 4-7 summarizes the well construction details and Table 4-8 summarizes the well location details. As discussed in Section 4.2, one of these wells, designated as 19D001 - 19D003M , was currently installed, as shown in Figure 4-6 by DWR under the TSS program.



Legend

Groundwater Sustainability Agency (GSA) [1]

Wyandotte Creek GSA

RMS WQ Monitoring Wells

Well

Boundaries [2]

County boundaries

Wyandotte Creek Subbasin Management Areas

Wyandotte Creek Oroville

Wyandotte Creek South

Roads [2]

Highways

Other roads

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

2 1 0 2 Miles

Water Quality RMS Wells
Wyandotte Creek Subbasin GSP

Geosyntec consultants

Project No.: SAC282

December 2021

Figure 4-6

Table 4-7: 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						
16Q001M	19N03E16Q001M	120	100-120	180.32	Top of casing	179.32
CWS-02	CWS-02	< 600	---	---	---	---
Wyandotte Creek Subbasin – South Management Area						
13B002M	17N03E13B002M	320	N/A	89.57	Top of casing	89.27
08M001M	18N04E08M001M	656	168-244	147.56	Between metal plate and top of casing	147.26
19D001M 19D002M 19D003M	18N04E19D001M[2] 18N04E19D002M 18N04E19D003M	1000	700-720 430-450, 550-570 120-130, 190-200	NR	NR	NR
28L001M	18N04E28L001M[3]	190	N/A	137.75	N/A	137.25

Notes:
1. North American Datum 1983 (NAD83).
2. New 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 4-8: 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			
16Q001M	19N03E16Q001M	39.4977	-121.6369
CWS-02	CWS-02	---	---
Wyandotte Creek Subbasin – South Management Area			
13B002M	17N03E13B002M	39.3336	-121.5853
08M001M	18N04E08M001M	39.4283	-121.5586
19D001M 19D002M 19D003M	18N04E19D001M[2] 18N04E19D002M 18N04E19D003M	39.40512	-121.57363
28L001M	18N04E28L001M[3]	39.3844	-121.5333

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

4.10 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 with the annual reporting and 5-year assessment of the GSP.

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

- Water Quality – Temporal data gaps exist for water quality samples collected within the Wyandotte Creek – South RMS wells. The frequency of sampling proposed in the GSP is anticipated to provide consistent and comparable data to fill this data gap. In addition, one well in this MA, 18N04E28L001M (28L001M) (Figure 4-6), had reported specific conductance levels above 2,000 micrograms per liter in 1986. No samples have been collected since this time and it is unknown if these levels still exist. Well 28L001M may no longer be accessible. If not, to fill this data gap, a new existing well will be identified with a similar screen interval(s) (total depth of well approximately 200 feet bgs) or a new well may be installed.

- Interconnected Surface Water/Associated impacts on GDEs – There is a lack of sufficient data to analyze interaction of streams and pumping within the primary aquifer system. Additional wells and other monitoring networks will be installed, as appropriate, following the framework discussed in Section 3.8.

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, in-lieu recharge, intra-basin water transfers, and demand conservation. Projects are further classified into three categories based on project status: Planned, Potential, and Longer-term or Conceptual, as defined below.

- Planned Projects – Projects in this category will move forward to help achieve the subbasin's sustainability before 2042.
- Potential Projects – Projects in this category are currently in the planning stages and may move forward if funding becomes available. Potential Projects represent a "menu of options" for the Wyandotte Creek Subbasin to achieve long-term sustainability and offset the remaining imbalance above and beyond implementation of the Planned Projects.
- Longer-term or Conceptual Projects – Projects in this category are in the early conceptual planning stages and will require significant additional work to move forward. Longer term/Conceptual Projects represent potential future projects that could conceptually provide a benefit to the Wyandotte Creek Subbasin in the future, but that would need to be further developed.

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

Table 5-1: List of Planned 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)
5.2.4.1 Residential Water Conservation	Conservation	Wyandotte Creek GSA, municipal water providers	Groundwater Levels, Groundwater Storage	Planning Stage	2022-2025	To be decided (TBD)	N/A	100 – 200
5.2.4.2 Agricultural Irrigation Efficiency	Conservation	Wyandotte Creek GSA Vina GSA, Agricultural Groundwater Users of Butte County, Butte County Farm Bureau	Groundwater Levels, Groundwater Storage	Planning Stage	2024-2030	TBD	N/A	4,000
5.2.4.3 Flood MAR	Direct Recharge, In-Lieu Recharge	Wyandotte Creek GSA	Groundwater Levels	Planning Stage	2022-2032	TBD	SWRCB Water Right Permit, California Environmental Quality Act (CEQA)	TBD
5.2.4.4 Oroville Wildlife Area Robinson's Riffle Project	In-Lieu 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	TBD

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)
							Lease, CVRWQCB 401, CVFPB Encroachment Permit, DWR Encroachment Permit	
5.2.4.5 Streamflow Augmentation	Direct Recharge, In-Lieu Recharge	Wyandotte Creek GSA, PG&E, surface water rights holders	Groundwater Levels, Surface Water Depletion	Planning Stage	2022-2025	$50-100 per acre-foot	SWRCB Water Right Permit, CEQA	1,000-5,000
5.2.4.6 TWSD Water Treatment Plant Capacity Upgrade	Conservation	TWSD, DWR, Division of Drinking Water	Groundwater Levels, Groundwater Storage, Water Quality, Land Subsidence	Planning Stage	6-12 months	$1.5 million-$3 million	Division of Drinking Water, DWR	500+
5.2.4.7 Water Loss Monitoring	Conservation	Wyandotte Creek GSA /SFWPA, Butte County	Surface Water Depletion	Planning Stage	2025	$800,000	TBD	Unknown
5.2.4.8 Palermo Clean Water Consolidation Project	In-Lieu Recharge	Butte County Department Water and Resource Conservation, SFWPA, Palermo Community Council	Groundwater Levels, Groundwater Storage	Planning Stage	Project design and evaluation of funding sources underway, implementation could begin in 2022	$12.4 million	TBD	TBD

Table 5-2: 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)
5.2.5.1 Intra-Basin Water Transfer	Intra-basin water transfer	TWSD, Butte County, DWR, agricultural users	Groundwater Levels, Groundwater Storage, Water Quality, Land Subsidence	Planning Stage	6-12 months	TBD	DWR, Butte County	3,000-5,000
5.2.5.2. Agricultural Surface Water Supplies	Intra-Basin Water Transfer	Wyandotte Creek GSA, Agricultural Groundwater Users of Butte County, Farm Bureau	Groundwater Levels	Planning Stage	2025-2032	TBD	SWRCB Water Right Permit, CEQA, others TBD	2,000-3,000
5.2.5.3 Well Upgrades	Conservation	TWSD, DWR, Butte County, Wyandotte Creek GSA	Groundwater Levels, Groundwater Storage, Water Quality, Land Subsidence	Planning Stage	6-12 months	TBD	TBD	TBD
5.2.5.4 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	2022-2042	TBD	CEQA	TBD
5.2.5.5 Removal of Invasive Species	Conservation	Wyandotte Creek GSA; other local, state, federal organizations and agencies	Groundwater Levels	Planning Stage	2022-2025	TBD	CEQA and/or NEPA (depending on project location and impact)	TBD

Table 5-3: List of Conceptual 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)
5.2.6.1 Recharge Well (Injection Well)	Direct Recharge	TWSD, DWR, Butte County, Wyandotte Creek GSA	Groundwater Levels, Groundwater Storage, Water Quality, Land Subsidence	Planning Stage	12-24 months	TBD	TBD	TBD
5.2.6.2 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

5.2.4 Planned Projects

Projects categorized as Planned Projects are expected to move forward and be completed to achieve the Wyandotte Creek Subbasin's sustainability goal by 2042. The estimated groundwater supply from these projects is expected to offset any potential overdraft.

5.2.4.1 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.

5.2.4.2 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.

5.2.4.3 Flood MAR

DWR originally developed the Flood MAR initiative to promote groundwater recharge programs. Under this project, the Wyandotte Creek GSA would adopt a similar approach to identify opportunities for recharge specific to the Wyandotte Creek Subbasin. Some projects 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 fields, recharge ponds, and recharge basins.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA
Project Type:	Direct Recharge, In-Lieu Recharge
Estimated Groundwater Offset and/or Recharge:	TBD

Measurable Objective Expected to Benefit: Groundwater Levels

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

Required Permitting and Regulatory Process: California SWRCB Water Right Permit, CEQA

Timetable for Initiation and Completion: 2022-2032

Expected Benefits and Evaluation: By identifying specific locations and resources for recharge projects through the Flood MAR initiative, the Wyandotte Creek GSA can focus its efforts and direct water from those locations to recharge areas and increase groundwater levels in the region.

How Project Will Be Accomplished/Evaluation of Water Source: The Wyandotte Creek GSA will identify specific water sources for the recharge projects. Some sources already identified include Wyandotte Creek, Wyman Ravine, Wilson Creek, North Honcut Creek, Feather River, and Ruddy Creek.

Legal Authority: The project is being conducted by the Wyandotte Creek GSA. Additional evaluation of water rights may be necessary as projects move forward.

Estimated Costs and Plans to Meet Costs: TBD; funding via Proposition 1 and Proposition 68.

Circumstances for Implementation: This project is a Planned Project that is anticipated to move forward.

Trigger for Implementation and Termination: Availability of water sources.

Process for Determining Conditions Requiring the Project to have Occurred: This is a Planned Project that is anticipated to move forward.

5.2.4.4 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:	In-Lieu Recharge
Estimated Groundwater Offset and/or Recharge:	TBD

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

Project Status: This project is currently seeking stakeholders who will fund the work. Workshops are being held by SBFCA to present project details.

Required Permitting and Regulatory Process: CEQA/NEPA, USACE 408, USACE 404, CDFW Incidental Take Permit, CDFW 1600 Lake and Streambed Alteration, State Lands Commission Lease, CVRWQCB 401, Central Valley Flood Protection Board Encroachment Permit, DWR Encroachment Permit.

Timetable for Initiation and Completion: Once funding is obtained for the project, planning, design, and permitting will take approximately 18 months.

Expected Benefits and Evaluation: Expanding the overall area of riverine habitat near the Feather River will increase the surface available for water during flood events to recharge groundwater in the Wyandotte Creek Subbasin.

How Project Will Be Accomplished/Evaluation of Water Source: This project will improve streamflow in the Feather River, thereby increasing the area available for water during flood events to recharge groundwater levels and storage in the aquifer.

Legal Authority: The project is being conducted by the SBFCA.

Estimated Costs and Plans to Meet Costs: $1.7 million; funding via Proposition 1, Proposition 68, grants, DWR programs.

Circumstances for Implementation: This project is a Planned Project that is anticipated to move forward.

Trigger for Implementation and Termination: Project implementation is dependent on funding and permitting issues.

Process for Determining Conditions Requiring the Project to have Occurred: This is a Planned Project that is anticipated to move forward.

5.2.4.5 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 in-lieu recharge 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, In-Lieu Recharge
Estimated Groundwater Offset and/or Recharge:	1,000-5,000 acre-feet/year

Measurable Objective Expected to Benefit: Groundwater Levels, Surface Water Depletion

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

Required Permitting and Regulatory Process: SWRCB Water Right Permit, CEQA

Timetable for Initiation and Completion: 2022-2025

Expected Benefits and Evaluation: Diverting flood waters will increase surface water flows and groundwater levels in the basin.

How Project Will Be Accomplished/Evaluation of Water Source: Wyandotte Creek GSA will evaluate which surface water sources will be available in a particular year to divert to creeks, streams, and recharge ponds.

Legal Authority: The project is being conducted by the Wyandotte Creek GSA.

Estimated Costs and Plans to Meet Costs: $50-$100 per acre-foot; funding via Proposition 1 (funds provided by the Stream Flow Enhancement Program through the California Wildlife Conservation Board), Proposition 68, Wyandotte Creek GSA fees, Resource Renewal Institute.

Circumstances for Implementation: This project is a Planned Project that is anticipated to move forward.

Trigger for Implementation and Termination: None

Process for Determining Conditions Requiring the Project to have Occurred: This is a Planned Project that is anticipated to move forward.

5.2.4.6 TWSD Water Treatment Plant Capacity Upgrade

The TWSD is planning to increase 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 can decrease.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA / TWSD, Division of Drinking Water, DWR
Project Type:	Conservation
Estimated Groundwater Offset and/or Recharge:	500+ acre-feet/year

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

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

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

Timetable for Initiation and Completion: 6-12 months

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 is being conducted by the TWSD and Wyandotte Creek GSA.

Estimated Costs and Plans to Meet Costs: $1.5-$3 million; funding sources TBD.

Circumstances for Implementation: This project is a Planned Project that is anticipated to move forward.

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

Process for Determining Conditions Requiring the Project to have Occurred: This is a Planned Project that is anticipated to move forward.

5.2.4.7 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

Measurable Objective Expected to Benefit: Surface Water Depletion

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

Required Permitting and Regulatory Process: N/A

Timetable for Initiation and Completion: To be completed by 2025.

Expected Benefits and Evaluation: An improved monitoring system for unregulated water usage from fire hydrants will give a better indication as to the effect on surface water in the Wyandotte Creek Subbasin. This can prove useful for the Wyandotte Creek GSA when it comes to further water management decisions and strategies.

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

Legal Authority: The project will be conducted by water providers and Wyandotte Creek GSA. The water systems to be evaluated are owned by the water providers.

Estimated Costs and Plans to Meet Costs: $800,000; funding via state and federal water use efficiency grants.

Circumstances for Implementation: This project is a Planned Project that is anticipated to move forward. As scenarios change, the Potential Projects can come online to bring additional resources for adaptive management. Implementation of Potential Projects will be based on long-term management or changing needs of the GSA or Wyandotte Creek Subbasin.

Trigger for Implementation and Termination: The water providers have recognized that this unregulated water loss has been occurring for some time and are committed to proceeding with the evaluation once funding is secured.

Process for Determining Conditions Requiring the Project to have Occurred: This is a Planned Project that is anticipated to move forward.

5.2.4.8 Palermo Clean Water Consolidation Project

The water quality in the l 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:	In-Lieu Recharge
Estimated Groundwater Offset and/or Recharge:	TBD

Measurable Objective Expected to Benefit: Groundwater Levels, Groundwater Storage

Project Status: This project is in the planning stages with 100% project design expected by mid-2022. 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 and evaluation of funding sources underway, implementation could begin in 2022.

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 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 in-lieu recharge 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: This project is a Planned Project that is anticipated to move forward.

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 of Potential Projects will be based on long-term management or changing needs of the GSA or Wyandotte Creek Subbasin.

5.2.5 Potential Projects

Projects categorized as Potential Projects are currently in the planning stages and may move forward if funding becomes available. Potential Projects represent a “menu of options” for the Wyandotte Creek Subbasin to achieve long-term sustainability and offset the remaining imbalance above and beyond implementation of the Planned Projects. The Potential Projects are presented in Table 5-2.

5.2.5.1 Intra-Basin Water Transfer

Under this project, surface water would be supplied to agricultural groundwater users in the Wyandotte Creek Subbasin outside of the subbasin to offset groundwater pumping by with available surface water

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA / TWSD, Butte County, agricultural users
Project Type:	In-Lieu Recharge
Estimated Groundwater Offset and/or Recharge:	3,000 – 5,000 AFY

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

Project Status: This project is a potential project and the feasibility is still being evaluated.

Required Permitting and Regulatory Process: DWR, Butte County

Timetable for Initiation and Completion: 2025-2030

Expected Benefits and Evaluation: Intrabasin water transfers increase the surface water supply in the basin, offsetting groundwater pumping by agricultural or urban users and allowing groundwater levels and volume to recover.

How Project Will Be Accomplished/Evaluation of Water Source: This project is an in-lieu recharge project. The water would be supplied by surface water from entities such as TWSD, Butte County, or SFWPA.

Legal Authority: The project would be under the authority of TWSD.

Estimated Costs and Plans to Meet Costs: TBD

Circumstances for Implementation: This project is a Potential Project, meaning it is currently in the planning stages. Potential Projects represent a “menu of options” for the Wyandotte Creek Subbasin to achieve long-term sustainability and offset the remaining imbalance above and beyond implementation of the Planned Projects. As scenarios change, the Potential Projects can come online to bring additional resources for adaptive management.

Trigger for Implementation and Termination: Availability of water sources and negotiations with water suppliers.

Process for Determining Conditions Requiring the Project to have Occurred: Implementation of Potential Projects will be based on long-term management or changing needs of the GSA or Wyandotte Creek Subbasin.

5.2.5.2 Agricultural Surface Water Supplies

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, surface water would be used in place of groundwater in agricultural settings 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.

Project Summary	
Project Proponent / Other Potential Participating Entities:	Wyandotte Creek GSA / Agricultural Groundwater Users of Butte County, Farm Bureau
Project Type:	Intra-Basin Water Transfer, In-Lieu Recharge
Estimated Groundwater Offset and/or Recharge:	2,000 – 3,000 AFY

Measurable Objective Expected to Benefit: Groundwater Levels, Groundwater Storage

Project Status: This project is a potential project and the feasibility is still being evaluated.

Required Permitting and Regulatory Process: SWRCB Water Right Permit, CEQA, other TBD.

Timetable for Initiation and Completion: 2025-2032

Expected Benefits and Evaluation: By using available surface water in place of groundwater for agricultural purposes, groundwater levels in the region will be allowed to recover.

How Project Will Be Accomplished/Evaluation of Water Source: This project will transfer and utilize available surface water in the region owned by water rights holders. Most of the surface water will come from the Feather River watershed.

Legal Authority: The project would be under the authority of Wyandotte Creek GSA.

Estimated Costs and Plans to Meet Costs: TBD; likely funding via Proposition 1 and Proposition 68.

Circumstances for Implementation: This project is a Potential Project, meaning it is currently in the planning stages. Potential Projects represent a "menu of options" for the Wyandotte Creek Subbasin to achieve long-term sustainability and offset the remaining imbalance above and beyond implementation of the Planned Projects. As scenarios change, the Potential Projects can come online to bring additional resources for adaptive management.

Trigger for Implementation and Termination: Based on discussions with landowners.

Process for Determining Conditions Requiring the Project to have Occurred: Implementation of Potential Projects will be based on long-term management or changing needs of the GSA or Wyandotte Creek Subbasin.

5.2.5.3 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

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

Project Status: This project is a potential project and the feasibility is still being evaluated.

Required Permitting and Regulatory Process: TBD

Timetable for Initiation and Completion: 2025-2030

Expected Benefits and Evaluation: By automating more of its groundwater wells, TWSD will be able to better monitor the amount of groundwater pumped, increasing the efficiency of pumping and allowing groundwater to stabilize in the Wyandotte Creek Subbasin.

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

Legal Authority: The project would be under the authority of TWSD and Wyandotte Creek GSA.

Estimated Costs and Plans to Meet Costs: TBD; funding via Wyandotte Creek GSA, DWR, Butte County.

Circumstances for Implementation: This project is a Potential Project, meaning it is currently in the planning stages. Potential Projects represent a "menu of options" for the Wyandotte Creek Subbasin to achieve long-term sustainability and offset the remaining imbalance above and beyond implementation of the Planned Projects. As scenarios change, the Potential Projects can come online to bring additional resources for adaptive management.

Trigger for Implementation and Termination: Availability of funds.

Process for Determining Conditions Requiring the Project to have Occurred: Implementation of Potential Projects will be based on long-term management or changing needs of the GSA or Wyandotte Creek Subbasin.

5.2.5.4 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

Measurable Objective Expected to Benefit: Groundwater Levels, Groundwater Storage, Water Quality, Surface Water Depletion

Project Status: This project is a potential project and the feasibility is still being evaluated.

Required Permitting and Regulatory Process: CEQA

Timetable for Initiation and Completion: 2022-2042

Expected Benefits and Evaluation: Fuels have the potential to contaminate water sources, affecting water quality and their use for communities and agriculture. Fuel management will help to maintain water quality.

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

Legal Authority: The project would be under the authority of Wyandotte Creek GSA.

Estimated Costs and Plans to Meet Costs: TBD; funding via CAL FIRE, Sierra Nevada Conservancy, California Fire Safe Council, other state/federal funding agencies.

Circumstances for Implementation: This project is a Potential Project, meaning it is currently in the planning stages. Potential Projects represent a "menu of options" for the Wyandotte Creek Subbasin to achieve long-term sustainability and offset the remaining imbalance above and beyond implementation of the Planned Projects. As scenarios change, the Potential Projects can come online to bring additional resources for adaptive management.

Trigger for Implementation and Termination: None.

Process for Determining Conditions Requiring the Project to have Occurred: Implementation of Potential Projects will be based on long-term management or changing needs of the GSA or Wyandotte Creek Subbasin.

5.2.5.5 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

Measurable Objective Expected to Benefit: Groundwater Levels

Project Status: This project is a potential project and the feasibility is still being evaluated.

Required Permitting and Regulatory Process: CEQA and/or NEPA depending on project location and impact.

Timetable for Initiation and Completion: 2022-2025

Expected Benefits and Evaluation: The removal of invasive species would benefit the natural ecosystem and prevent them from negatively affecting the amount of available water and the ability for water to recharge.

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

Legal Authority: The project would be under the authority of Wyandotte Creek GSA.

Estimated Costs and Plans to Meet Costs: TBD; funding via state and federal wildfire resiliency grants and other local, state, and federal organizations and agency programs.

Circumstances for Implementation: This project is a Potential Project, meaning it is currently in the planning stages. Potential Projects represent a "menu of options" for the Wyandotte Creek Subbasin to achieve long-term sustainability and offset the remaining imbalance above and beyond implementation of the Planned Projects. As scenarios change, the Potential Projects can come online to bring additional resources for adaptive management.

Trigger for Implementation and Termination: Increase in the number of invasive species in the region and their negative effect on water supply.

Process for Determining Conditions Requiring the Project to have Occurred: Implementation of Potential Projects will be based on long-term management or changing needs of the GSA or Wyandotte Creek Subbasin.

5.2.6 Longer-term or Conceptual Projects

Projects categorized as Longer-term or Conceptual Projects are in the early conceptual stages and would require significant additional work to move forward. Longer-term/Conceptual Projects represent potential future projects that could conceptually provide a benefit to the Wyandotte Creek Subbasin in the future, but that would need to be further developed.

5.2.6.1 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

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

Project Status: This project is conceptual planning stages.

Required Permitting and Regulatory Process: TBD

Timetable for Initiation and Completion: 12-24 months

Expected Benefits and Evaluation: This project would use raw and backwash water, which would be discharged from the treatment plant anyway, for direct recharge into the aquifer, thereby increasing groundwater levels and volume in the Wyandotte Creek Subbasin.

How Project Will Be Accomplished/Evaluation of Water Source: This project is a direct recharge project. The water would be supplied from the raw and backwash water from operations at the TWSD treatment plant.

Legal Authority: The project would be under the authority of TWSD and Wyandotte Creek GSA.

Estimated Costs and Plans to Meet Costs: TBD; funding via DWR, Butte County, Wyandotte Creek GSA.

Circumstances for Implementation: This project is a Longer-term/Conceptual Project, meaning it is in the early conceptual planning stages and would require significant additional work to move forward. Longer-term/Conceptual Projects represent potential future projects that could conceptually provide a benefit to the Wyandotte Creek Subbasin in the future. As scenarios change, Longer-term/Conceptual Projects can come online to bring additional resources for adaptive management. This project could be implemented when agreements are reached with all federal and state regulatory agencies and when funding is available.

Trigger for Implementation and Termination: None.

Process for Determining Conditions Requiring the Project to have Occurred: Implementation of Longer-term/Conceptual Projects will be based on long-term management or changing needs of the GSA or Wyandotte Creek Subbasin.

5.2.6.2 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 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 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 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 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.

5.3.3 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.

5.3.4 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.

5.3.5 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

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, Glen, 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 current 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 GSAs 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 GSAs 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.

5.4.4 Interconnected Surface Water/Associated Impacts on Groundwater Dependent Ecosystems

As presented Section 4.10, the lack of sufficient data to analyze interaction of streams and pumping within the primary aquifer system. Additional wells and other monitoring networks will be installed, as appropriate, 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 to 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	Proposition 1, Water Quality, Supply, and Infrastructure Improvement Act of 2014	Round 2 solicitation expected in late 2021
Recharge Projects	Planning and construction grants	Proposition 68, California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access for All Act of 2018	Round 2 solicitation to be released early 2022
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 GSP to DWR by January 31, 2022. 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 biannual collection of groundwater levels at 9 RMS locations and annual collection of groundwater quality at 8 RMS locations. Monitoring activity costs will include labor (field data collection, surveying, laboratory analysis, 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	Biannual, 2 events	$15,000
Groundwater Quality	Annual, 1 event	$6,000

Some RMS locations include wells that are monitored and funded under 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 2027 are presented below.

Table 6-6: Estimated Project Costs

Project Name	Capital Costs	Expected Groundwater Demand Reduction (AFY)
Residential Water Conservation	TBD	100 - 200
Agricultural Irrigation Efficiency	TBD	Up to 4,000
Flood MAR	TBD	1000 - 3000
Oroville Wildlife Area Robinson's Riffle Project	$1.7M	TBD
Streamflow Augmentation	TBD	1,000 – 5,000
TWSD Water Treatment Plant Capacity Upgrade	$1.5 -$3M	500+
Water Loss Monitoring	$800,000	TBD
Palermo Clean Water Improvement Project	TBD	TBD
Intra-Basin Water Transfer	TBD	3,000 – 5,000
Agricultural Surface Water Supplies		2,000 – 3,000
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 GSAs 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 will be responsible for securing funding for the GSP implementation. The GSA will coordinate funding with their respective constituent members within the Wyandotte Creek Subbasin. GSAs will fund the GSP through a cost-sharing collaboration to be determined after adoption of GSP.

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 GSAs are evaluating a variety of funding mechanisms including Proposition 218 or Proposition 26 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.

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 6-4 are scheduled to be completed by 2027 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 GSAs 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 in-lieu 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 Evaluation Report

The GSAs will evaluate the GSP and provide an evaluation report every 5 years or whenever the GSP is amended for submittal to DWR.

The assessment will include a detailed discussion of the following:

- Significant new information and whether the information warrants changes to the basin setting, MOs, MTs, and SIs, including completed or planned GSP amendments.
- Current groundwater conditions relating to each MO, MT and IM.
- Implementation of any project and management actions and the resulting effects on groundwater conditions.
- Assessment of the basin setting, MAs, undesirable results, MOs and MTs.
- Evaluation of the basin setting and overdraft conditions to include changes in water use, along with overdraft mitigation measures (if applicable).
- Assessment of the monitoring network with analysis of data collected to date, including identification of data gaps and suggested improvements of the network.
- Program to address data gaps, including timing and incorporation of data into the GSP, with prioritization on the installation of new data collection sites and analysis of new data based on the needs of the basin.
- Relevant actions taken by the GSAs including a summary of regulations, ordinances, legal enforcement or action related to the implementation of the GSP and sustainability goals.

Summary of coordination by GSAs within the basin or within hydrogeologically connected basins and land use agencies.

6.7 Interbasin 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 intends to pursue grant funding and collaboratively work 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

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

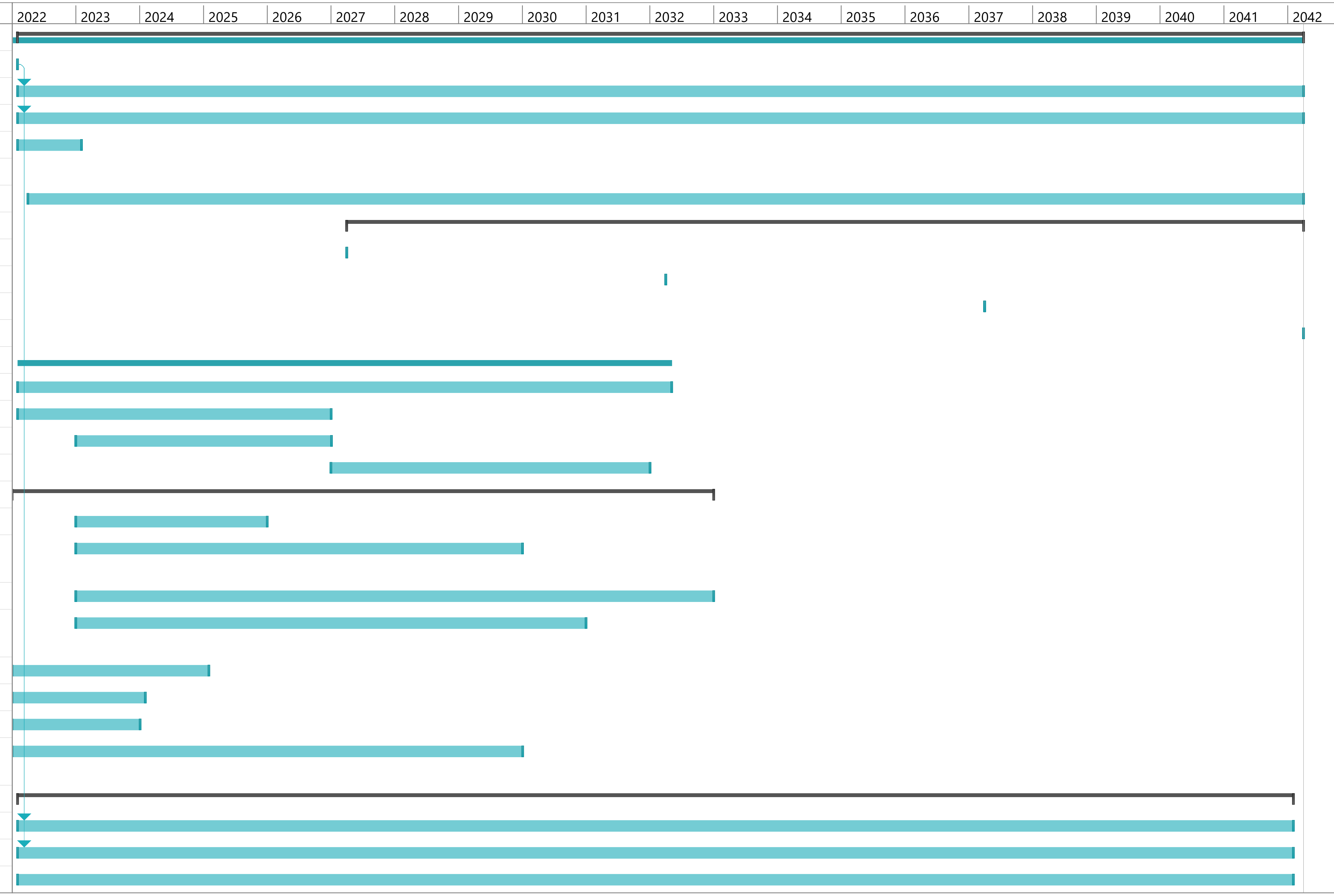


Figure 6-1
Implemenation Schedule

Summary — Manual Summary Rollup — Start-only
Manual Task — Manual Summary — Finish-only

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