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Anderson Subbasin Groundwater Sustainability Plan

Draft

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Enterprise Anderson Groundwater Sustainability Agency

Certification Page

The Anderson Subbasin Groundwater Sustainability Plan was prepared under the direction of a Professional Geologist and Certified Hydrogeologist licensed in the State of California as required per *California Code of Regulations*, Title 23, Section 354.12 consistent with professional standards of practice. This certification is not a guarantee or warranty, either expressed or implied.

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Executive Summary

Introduction

The 2014 California Sustainable Groundwater Management Act (SGMA) requires that medium- and high-priority groundwater basins and subbasins develop Groundwater Sustainability Plans (GSPs) that outline how they will achieve groundwater sustainability within 20 years and maintain sustainability for an additional 30 years. This GSP fulfills that requirement for the Redding Area Groundwater Basin (RAGB) – Anderson Subbasin.

In response to this legislation, -eligible interested entities formed the Enterprise Anderson Groundwater Sustainability Agency (EAGSA) to develop and implement the GSPs for the two subbasins designated as medium priority in Shasta County (the Enterprise and Anderson Subbasins). The EAGSA consists of the City of Anderson (COA), Shasta County, Clear Creek Community Services District (CCCSD), Bella Vista Water District, Anderson-Cottonwood Irrigation District (ACID), and the City of Redding (COR). The EAGSA is governed by a Board of Directors, composed of elected officials representing each agency.

The RAGB consists of five subbasins, of which two qualify as medium-priority basins: the Enterprise Subbasin (Department of Water Resources [DWR] Basin No. 5-6.004) and the Anderson Subbasin (DWR Basin No. 5-6.003). The EAGSA developed this GSP for the Anderson Subbasin in concert with the GSP for the Enterprise Subbasin.

This GSP covers all of the 98,700 acres of the Anderson Subbasin, as shown on Figure ES-1. The GSP describes the current groundwater conditions and hydrogeologic conceptual model, establishes a water budget, outlines local sustainable management criteria (SMC or SMCs), and describes projects and management actions for maintaining sustainability through the GSP planning and implementation period.

This GSP was developed to be protective of both groundwater levels and groundwater quality for all beneficial users including residential well owners, disadvantaged communities, severely disadvantaged communities, and tribal water resources. By addressing all beneficial uses and users of groundwater, the GSP has addressed California's Human Right to Water. Additional information on how the Human Right to Water was incorporated into the GSP through consideration of all beneficial uses and users of groundwater is included in Section 1.5 Notice and Communication and Chapter 6 Sustainable Management Criteria.

Plan Area

The Anderson Subbasin is located in southwestern Shasta County and includes the northern end of the Sacramento River Valley. The subbasin contains the cities of Redding and Anderson, the towns of Centerville and Cottonwood, and the community of Happy Valley. The largest land use category in the subbasin is agriculture (41 percent), which is dominated by pastures and orchards. Following the agriculture land use is residential (26 percent), more than half of which is rural.

The Anderson Subbasin has two water source types: surface water and groundwater. Surface water diverted from the Sacramento River or from Whiskeytown Lake under Central Valley Project contracts with Bureau of Reclamation is the primary water source for most purveyors in the Anderson Subbasin. The primary water source for COA Water Utility and Cottonwood Water District is groundwater. Locations served by COR Water Utility receive a combination of Central Valley Project surface water and groundwater. CCCSD also owns groundwater production wells; however, they are only operated intermittently for contingency supply during periods of surface-water curtailments. The primary water use sector for COR Water Utility, COA Water Utility, Cottonwood Water District, and Centerville Community Services District is urban; and CCCSD and ACID deliver primarily agricultural water.

Several existing groundwater and surface-water monitoring programs that are active in the subbasin will be incorporated into GSP implementation. Ongoing monitoring programs include the following:

- California Statewide Groundwater Elevation Monitoring Program (CASGEM)
- DWR continuous groundwater elevation monitoring
- DWR periodic groundwater elevation monitoring
- U.S. Geological Survey (USGS) groundwater elevation monitoring
- State Water Resources Control Board (SWRCB) Division of Drinking Water's water quality monitoring program
- DWR's Groundwater Ambient Monitoring and Assessment (GAMA) program
- USGS GAMA program
- Environmental compliance monitoring
- USGS stream gauges
- Sacramento Watershed Coordinated Monitoring Program

Basin Setting

Hydrogeologic Conceptual Model

The Anderson Subbasin (5-006.04) is one of five groundwater subbasins within the RAGB of Northern California (Figure ES-1). The roughly east-west oriented subbasin is approximately 5 to 15 miles long and 18 miles wide. The Sacramento River forms the northeastern boundary of the subbasin, the Klamath Mountains form the north/northwestern boundary, the Coast Ranges form the west/southwestern boundary, and Cottonwood Creek forms the southern boundary (DWR, 2004).[1] The Sacramento River is the primary surface-water body in the subbasin. River flows are controlled by releases from Shasta and Keswick Dams and average around 10,000 cubic feet per second.

Tertiary deposition of material sourced from the Coast and Cascade Ranges (the Tuscan and Tehama Formations) created the principal aquifer in the Anderson Subbasin. These formations are up to 2,000 feet thick near the confluence of the Sacramento River and Cottonwood Creek and are interbedded throughout the RAGB, with the Tuscan more prominent to the east and the Tehama more prominent to the west. These formations, together, function as one large, leaky unconfined aquifer with increasing degrees of confinement with depth. Although laterally discontinuous fine-grained zones are present within the subbasin, there is no evidence of a regional aquitard. Groundwater use of the principal aquifer is for urban, industrial, and agricultural purposes.

Hydraulic conductivity describes the rate at which a fluid can move through a porous medium and is dependent on the fluid density, fluid viscosity, and permeability. Groundwater flow in aquifers with smaller hydraulic conductivity values is met with more resistance than groundwater flow in aquifers with larger hydraulic conductivity values. Hydraulic conductivity values in the Anderson Subbasin are generally

[1] California Department of Water Resources. 2004. *Redding Groundwater Basin, Enterprise Subbasin in California's Groundwater, Bulletin 118*. Last Updated February.

moderate to high. Thus, the principal aquifer is capable of transmitting substantial quantities of water in most areas of the Anderson Subbasin.

Natural groundwater recharge within the subbasin occurs through recharge from precipitation, recharge from irrigation, recharge from streams and irrigation channels, and subsurface inflow from adjacent subbasins. Although surface soils in much of the western and central portions of the subbasin have lower infiltration capacities, locations within and along stream channels coincide with soils with greater infiltration capacities. Natural groundwater discharge from the principal aquifer of the Anderson Subbasin occurs through discharge to surface-water bodies, subsurface outflow to adjacent subbasins, and evapotranspiration where the water table is near or within rooting depths of vegetation.

Groundwater Conditions

Groundwater conditions in the subbasin are described for current (water years 2015–2018) and historical conditions (water years 1999–2018), organized by DWR’s six sustainability indicators as follows:

- **Groundwater Elevations –** Historical groundwater-level records for the Anderson Subbasin indicate groundwater levels have been relatively consistent. Although there is seasonal variability in groundwater levels and temporary decreases in groundwater levels during multi-year droughts, available data do not indicate long-term declines in groundwater levels that would be indicative of overdraft conditions.
- **Change in Groundwater Storage –** Over the historical and current periods, groundwater storage fluctuates year to year, decreasing during dry periods and increasing during wet periods. Overall, the annual change in groundwater storage is balanced (that is, there is a roughly equal distribution of positive and negative annual changes in groundwater storage). This balance in storage indicates that overdraft conditions are not present within the subbasin.
- **Seawater Intrusion –** The Anderson Subbasin is not vulnerable to seawater intrusion given its distance from the Pacific Ocean.
- **Groundwater Quality –** Although there may be localized areas of impairment associated with environmental contamination sites (such as gas stations) being cleaned up and regulated by federal, State, or local agencies, the overall quality of groundwater in the Anderson Subbasin is good and suitable for the designated beneficial uses of the subbasin. Chemicals of concern in groundwater were identified as those exceeding federal drinking water standards at municipal or private supply wells. These include naturally occurring (that is, a function of the rock or sediment type that makes up the aquifer) chemicals such as arsenic, iron, and manganese. Beneficial users of groundwater in the subbasin have been managing these constituents, where present (such as through blending of water), and will continue to do so in the future.
- **Subsidence –** Based on datasets made available by DWR, the vertical displacement within the majority of the Anderson Subbasin over a 5- to 10-year period was less than 1 inch (0.08 foot). These datasets provide no indication of land subsidence in the subbasin. The lack of continuous, extensive aquitards in the subbasin indicates that local conditions are not susceptible to groundwater pumping-induced land subsidence.
- **Interconnected Surface Water –** In the Anderson Subbasin, groundwater and surface water are interconnected along the entire lengths of the Sacramento River and Cottonwood Creek, and along the lower portion of Clear Creek, during seasonal high groundwater conditions.

Water Budgets

Water budgets provide an accounting and assessment of the quantity of water entering and leaving the land, surface water, and groundwater systems within the subbasin. Separate historical (1999–2018), current (2015–2018), and projected (2019–2071) water budgets have been developed for these three "systems." The water budgets for these systems have been estimated with the aid of the EAGSA Integrated Groundwater/Surface-water Flow Model (EAGSA Model). This model simulates the major hydrologic processes that affect groundwater and surface-water flow in and surrounding the Anderson Subbasin. Annual water budgets for each time period are presented on Figure ES-2.

Land System Water Budgets – According to the EAGSA Model results, average inflows and outflows to/from the subbasin land system ranged from about 425 to 490 thousand acre-feet per year (TAFY) during the historical, current, and projected periods. Inflows were mostly from precipitation, followed by groundwater discharge to land surface, applied water (both purveyor and non-purveyor supplied), and shallow groundwater uptake by vegetation. The largest outflows from the land system (which were roughly equal to average inflows) were runoff to streams, followed by evapotranspiration of precipitation, groundwater recharge from precipitation, applied water and septic systems, and evapotranspiration of applied water and/or shallow groundwater. The relative order (largest to smallest volumes) of the land system water budget components is similar among the historical, current, and projected periods.

Surface-water System Water Budgets – According to the EAGSA Model, the subbasin received an average of about 8,500 to 8,700 TAFY of surface-water inflows and outflows during the historical, current, and projected periods. Stream inflow from adjacent areas was the largest surface-water inflow component, followed by groundwater discharge to streams (stream gains), runoff to streams, and wastewater treatment plant discharge to streams. The largest outflows from the surface-water system were stream outflow to adjacent areas, followed by groundwater recharge from streams (stream leakage), and surface-water diversions. The relative order (largest to smallest volumes) of the surface-water system water budget components is similar among the historical, current, and projected periods.

Groundwater System Water Budgets – According to the EAGSA Model, the subbasin received an average of about 490 to 510 TAFY of groundwater inflows and outflows during the historical, current, and projected periods. Inflows consist primarily of groundwater recharge from streams (stream leakage), followed by subsurface inflow from adjacent areas, and groundwater recharge from precipitation, applied water, and septic systems. The largest outflow from the groundwater system was groundwater discharge to streams (stream gains), followed by subsurface outflow to adjacent areas, groundwater discharge to land surface, groundwater pumping, and evapotranspiration of shallow groundwater. The relative order of groundwater budget components is generally similar between each water budget period. The historical, current, and projected groundwater system budgets indicate an average change in groundwater storage ranging from a decrease of 2 TAFY under historical conditions up to an increase of 10 TAFY under current conditions.

Sustainable Yield – The sustainable yield of the subbasin is an estimate of the maximum quantity of groundwater that can be pumped on a long-term basis without causing undesirable results. Projections for the historical, current, and projected periods all indicate that undesirable results are unlikely. An additional projection simulation, which incorporates future water demands beyond those that are reasonably anticipated due to population growth and climate change, was performed to aid in estimating a sustainable yield. The average projected groundwater pumping in the Anderson Subbasin under this increased water demand projection is 89 TAFY, as compared to an estimate of 22 TAFY of groundwater pumping needed to accommodate anticipated population growth and current climate change models. Based on the locally defined SMC, this extreme pumping condition is not projected to produce undesirable results in the subbasin. As such, the sustainable yield for the Anderson Subbasin is estimated to be at least 89 TAFY.

Monitoring Networks

Monitoring networks are developed to promote the collection of data of a sufficient quality, frequency, and distribution to characterize groundwater and related surface-water conditions in the subbasin and to evaluate changing conditions as the GSP is implemented. Monitoring networks were developed for each of the applicable sustainability indicators through the use of existing monitoring networks as follows:

- **Seawater Intrusion –** The Anderson Subbasin is not vulnerable to seawater intrusion given its distance from the Pacific Ocean.
- **Groundwater Elevations –** The proposed groundwater elevation network in the Anderson Subbasin consists of 28 wells or well completions (in the case of multi-level wells or well clusters) that are part of ongoing monitoring programs. A subset of 14 wells or well completions was selected to serve as representative monitoring points (RMPs). Quantitative SMC are established at RMPs to facilitate evaluation of whether groundwater levels are trending toward undesirable results.
- **Groundwater Storage –** Groundwater storage is monitored by proxy through the groundwater elevation monitoring network.
- **Interconnected Surface Water –** Interconnected surface water is monitored by proxy through the groundwater elevation monitoring network.
- **Groundwater Quality –** The proposed groundwater quality network incorporates 86 wells currently sampled (between 2010 and 2019) as part of the SWRCB Division of Drinking Water or the DWR/USGS GAMA programs. RMPs include most of the existing monitoring network (72 locations); however, some wells were omitted because they have been sampled fewer than three times throughout the period of record and are considered to have insufficient data with which to reliably characterize groundwater-quality conditions.
- **Land Subsidence –** Existing land subsidence monitoring in the Anderson Subbasin includes periodic surveying of global positioning system monuments and satellite-based (interferometric synthetic aperture radar [InSAR]) data. DWR is coordinating with independent contractors to make InSAR datasets available to GSAs quarterly; therefore, these data have been used to establish SMCs for the subbasin.

The EAGSA has developed a data management system that is used to store, review, and upload data collected as part of the GSP development and implementation. The EAGSA also provides a publicly accessible web-map hosted on ArcGIS Online that gives interested parties access to technical information used in the development of the GSP. This platform will be updated as new information is made available to the EAGSA and can be accessed at https://eagsa-redding.hub.arcgis.com/.

Sustainable Management Criteria

Sustainable management of groundwater, as defined under SGMA, refers to "the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results." SMCs define the conditions that constitute sustainable groundwater management (that is, demonstrate the avoidance of undesirable results). A description of the SMCs for each of the six sustainability indicators is included in Table ES-1. Each sustainability indicator includes the following:

- **Minimum Thresholds –** specific, quantifiable values for each sustainability indicator used to define undesirable results (that is, indicators of unreasonable conditions that should not be exceeded).

- **Measurable Objectives –** specific, quantifiable goals that provide operational flexibility above the minimum thresholds (that is, "desired condition" for the basin).
- **Undesirable Results –** quantitative combinations of minimum thresholds that define the conditions at which a particular sustainability indicator would become significant and unreasonable.

The SMCs described in Table ES-1 define the subbasin's desired future conditions and commit the EAGSA to actions that will maintain sustainability.

Table ES-1. Summary of Sustainable Management Criteria for the Anderson Subbasin

Sustainability Indicator	Measurable Objective	Minimum Threshold	Measurement	Undesirable Result
Seawater Intrusion	Sustainability indicator is not applicable to the Anderson Subbasin.			
Chronic Lowering of Groundwater Levels	Average WY 2015 through WY 2018 groundwater elevation at RMPs.	Lower of either the measured historical minimum groundwater elevation or the projected minimum groundwater elevation under the Increased Groundwater Use Scenario.	Measured at RMP network.	Condition that would occur when 25% of the same RMPs exceed the minimum threshold for three consecutive spring measurements.
Reduction of Groundwater Storage	Sustainability indicator uses groundwater levels as a proxy; SMCs are the same as the SMCs for chronic lowering of groundwater levels.			
Depletions of Interconnected Surface Water	Sustainability indicator uses groundwater levels as a proxy; SMCs are the same as the SMCs for chronic lowering of groundwater levels.			
Degraded Water Quality	No change to the number or distribution of MCL/SMCL exceedances at RMPs through 2018.	Zero new exceedances of MCL/SMCL at a given RMP for any chemical with an MCL or SMCL.	Groundwater quality data for RMPs downloaded annually from the SWRCB GAMA information system.	Condition that would occur when 25% of the same RMPs exceed the MT for two consecutive sampling events.
Land Subsidence	Level of accuracy of the InSAR datasets provided by DWR, 0.71 inch (0.06 foot) over a 5-year period (2015 to 2020).	6 inches (0.5 foot) of groundwater-pumping-induced land subsidence over a 5-year period.	Annual InSAR grid of vertical land displacement data (approximately 300- by 400-foot grid cells).	Condition that would occur when there is an average of 6 inches (0.5 foot) of groundwater-pumping-induced land subsidence over a 5-year period, averaged over the Anderson Subbasin.

Notes:
MCL = maximum contaminant level
MT = minimum threshold
SMCL = secondary maximum contaminant level
WY = water year

Projects and Management Actions

This GSP identifies projects and management actions that the EAGSA has determined will maintain sustainable groundwater conditions and will help the EAGSA respond to changing conditions in the subbasin.

Undesirable results are currently not present in the Anderson Subbasin and are not anticipated to occur based on the EAGSA's best estimate of future conditions (that is, water supply and demand due to future population growth and climate change); therefore, projects and management actions to achieve sustainability or to mitigate overdraft conditions are not required at this time. This GSP identifies projects and management actions that the EAGSA has determined will maintain sustainable groundwater conditions and will help the EAGSA respond to changing conditions in the subbasin. The EAGSA has developed two categories of projects and management actions: (1) ongoing projects and management actions that have already been implemented under past and current operations that have successfully contributed to sustainable groundwater management and (2) potential projects and management actions that could be implemented to respond to unanticipated changing conditions in the subbasins and help avoid undesirable results.

Ongoing projects and management actions include water conservation and demand management strategies (such as public education, voluntary or mandatory water rationing, or tiered billing rates), exercising flexibility in water supplies (such as engaging in in-basin water transfers between local purveyors), and stormwater resources plans (such as low-impact design and construction [porous pavement]; providing information on best management practices on auto maintenance and landscaping; and implementing projects to enhance natural groundwater recharge). If in their annual review of SMCs, the EAGSA determines that local conditions are trending toward undesirable results, the agency would first initiate an investigation to determine if conditions were the result of SGMA-related groundwater management activities. If determined that trends are the result of SGMA-related groundwater management activities and that ongoing projects and management actions are insufficient to mitigate the trend, the EAGSA may consider expanding one or more of the existing programs. This may include actions such as providing financial incentives for water efficiency (such as rebates), increasing flexibility for in-basin water transfers via expanding the use of water system interties, redistributing groundwater pumping within the subbasin, or looking for opportunities for enhanced groundwater recharge (such as using unlined irrigation canals for stormwater recharge during the non-growing season).

The Anderson Subbasin is currently being sustainably managed; therefore, there is not a current need for projects and management actions to bring the subbasins to a sustainable condition. If there is a need to implement additional projects and management actions during GSP implementation, they would be fully developed to address the requirements of GSP regulations (such as full evaluation of financial cost and permit requirements) at that time.

Plan Implementation

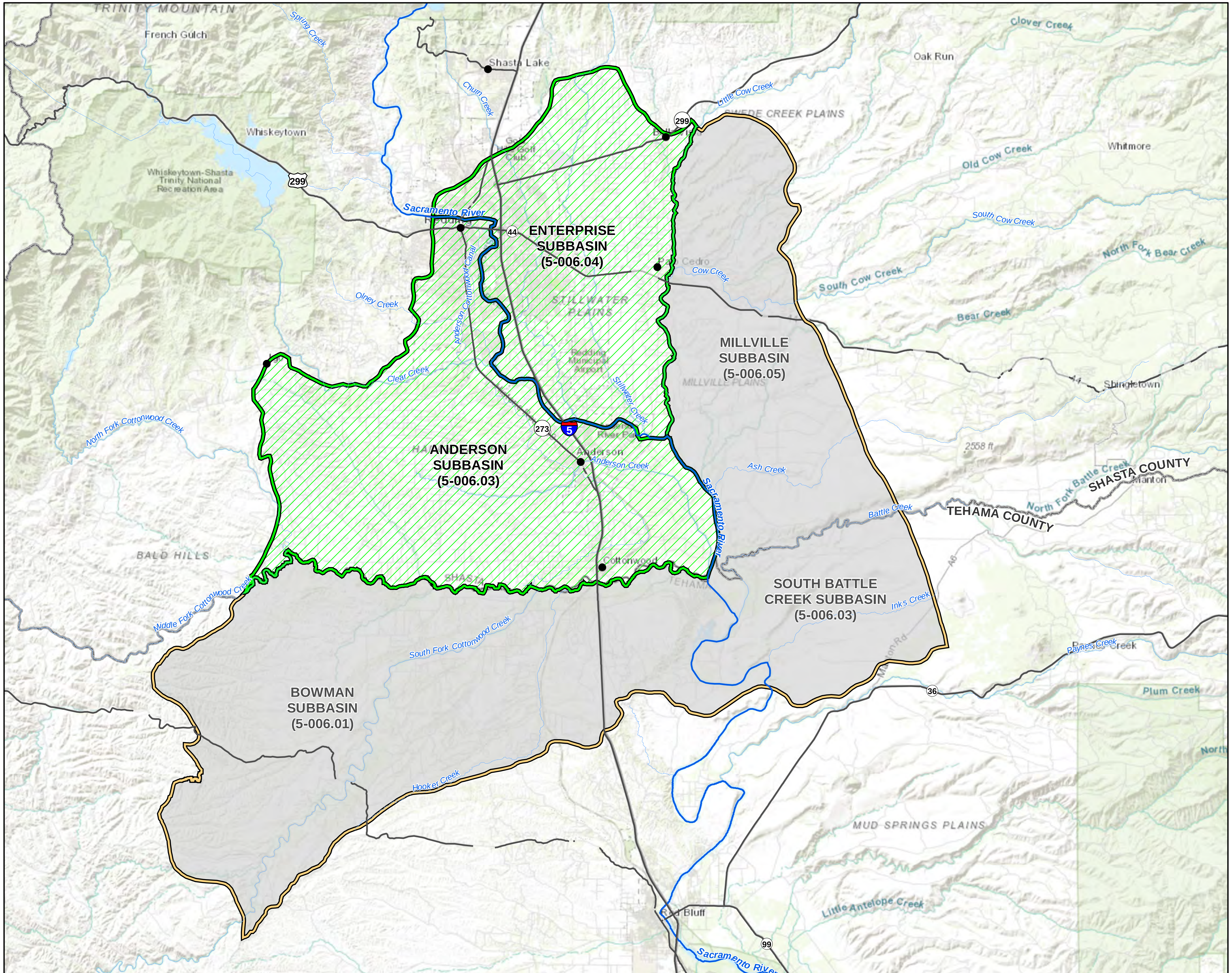
This GSP lays out a roadmap that addresses all of the activities needed for GSP implementation between 2022 and 2042, focusing mainly on the first 5 years. Implementing this GSP requires the following formative actions:

- **GSP Implementation Project Management –** Administration of all activities required to comply with GSP regulations.
- **Monitoring, Reporting, and Outreach –** Following adoption of this GSP, the EAGSA will continue to coordinate with the entities executing monitoring programs to ensure necessary data are collected for each applicable sustainability indicator. These data will be maintained in the data management

system and will be routinely evaluated to assess hydraulic conditions relative to SMCs. The EAGSA will submit to DWR and make publicly available the following: Annual Reports, Five-year GSP Assessment Reports, and GSP Periodic Evaluations and Assessments. The EAGSA will continue public outreach and provide opportunities for engagement during GSP implementation through the EAGSA website, Groundwater Sustainability Agency Board meetings, and GSP-related meeting and workshops.

- **Address Data Gaps –** The EAGSA plans to fill data gaps, as funding resources become available (such as through the DWR technical support services grants). Such activities may include installation of new monitoring wells, video logging of wells with unknown or uncertain well construction, or expansion of the monitoring network by seeking permission to monitor additional private wells in the areas lacking current monitoring infrastructure.
- **Implement Projects and Management Actions –** The Anderson Subbasin is and will continue to be managed sustainably. Local agencies implement a variety of actions, particularly during dry and critically dry water years, to conjunctively manage local water resources. Local entities will continue these management actions during GSP implementation, as appropriate. The need for new projects and management actions will be assessed as part of the 5-year GSP review process.
- **Pursue Work Agreements and Funding Opportunities –** Given the sustainable nature of the subbasin, GSP implementation costs are largely related to administration, monitoring, and reporting. Although GSP implementation costs are relatively low, as compared to higher-priority basins that require projects and management actions to achieve sustainability, the ability of the EAGSA to raise funds beyond those already in the member agencies' operating budgets is limited by constraints in its Memorandum of Understanding and the high percentage of disadvantaged and severely disadvantaged communities in the subbasin. As such, the EAGSA will coordinate with federal and State agencies to the extent practicable to offset as much of the SGMA-related costs as possible.
- **Update the EAGSA Model –** The intent of the EAGSA Model is to serve as a numerical representation of the hydrogeologic conceptual model, to provide detailed water budgets for each 5-year assessment, and to evaluate the effects of implementing potential future management actions, if needed, on sustainability. As such, the EAGSA Model will continue to be periodically updated through implementation of this GSP.

The EAGSA estimates that planned activities will cost approximately $605,000 over the first 5 years of implementation for the Enterprise and Anderson Subbasins combined (with an estimated range of $465,000 to $1,070,000). Estimates of GSP implementation costs will be refined as efficiencies are gained from optimizing and prioritizing activities and as the SGMA program evolves. To bridge the gap between GSP submission in 2022 and the first 5-year assessment report, the EAGSA members will share the SGMA-related cost burden with existing member agency resources and pursue additional grant and technical support services funding, as applicable.



LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- COUNTY BOUNDARY LINE
- INTERSTATE/HIGHWAY
- EAGSA COVERAGE AREA
- REDDING AREA GROUNDWATER BASIN
- COUNTY BOUNDARY LINE

NOTES:

EAGSA = ENTERPRISE ANDERSON GROUNDWATER SUSTAINABILITY AGENCY

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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FIGURE ES-1
LOCATIONS OF THE ENTERPRISE AND ANDERSON SUBBASINS
Anderson Subbasin Groundwater Sustainability Plan

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DATUM: NAD 1983. DATA SOURCE: DWR, 2019; ESRI, 2019; SHASTA COUNTY 2019

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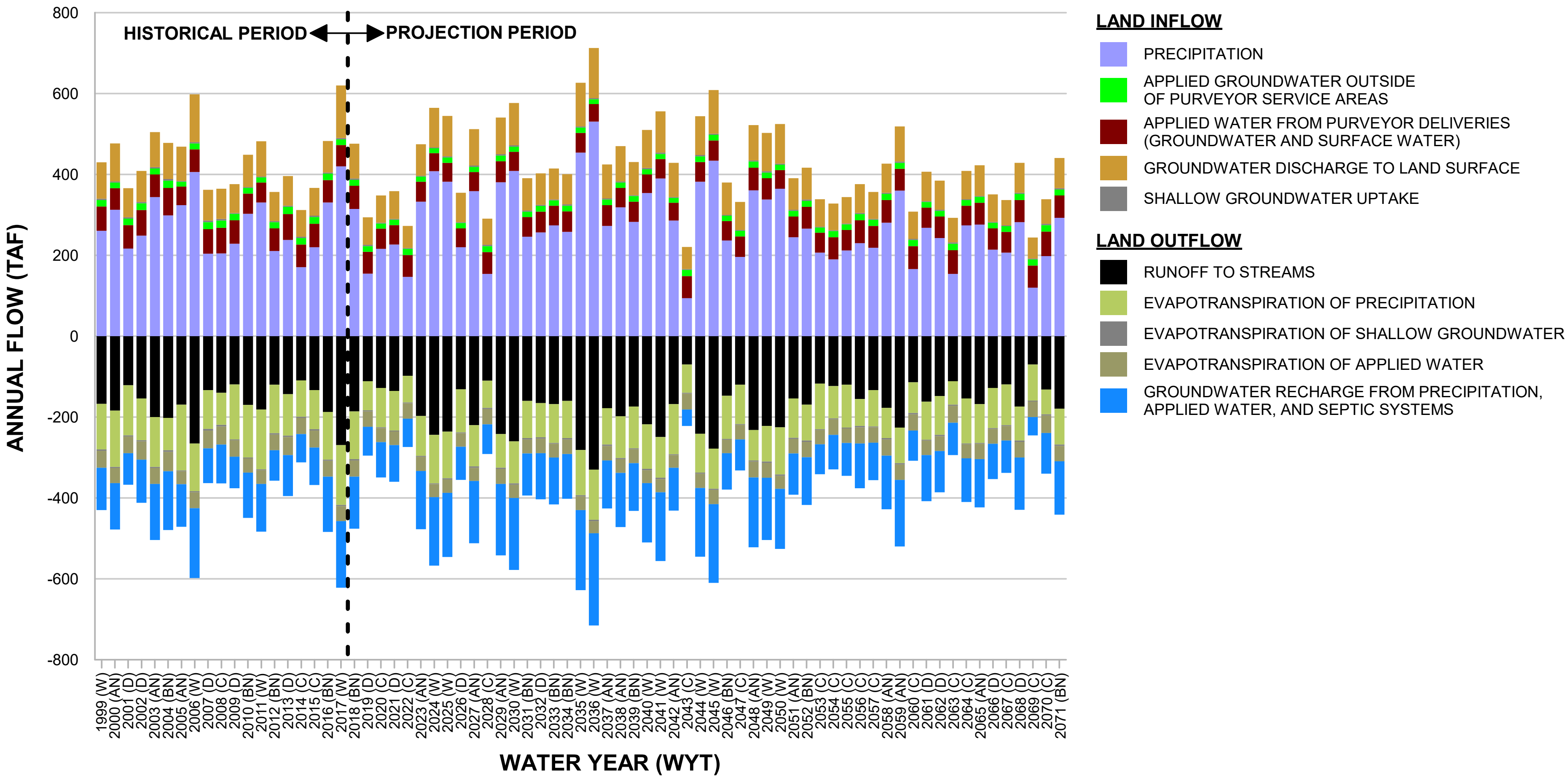
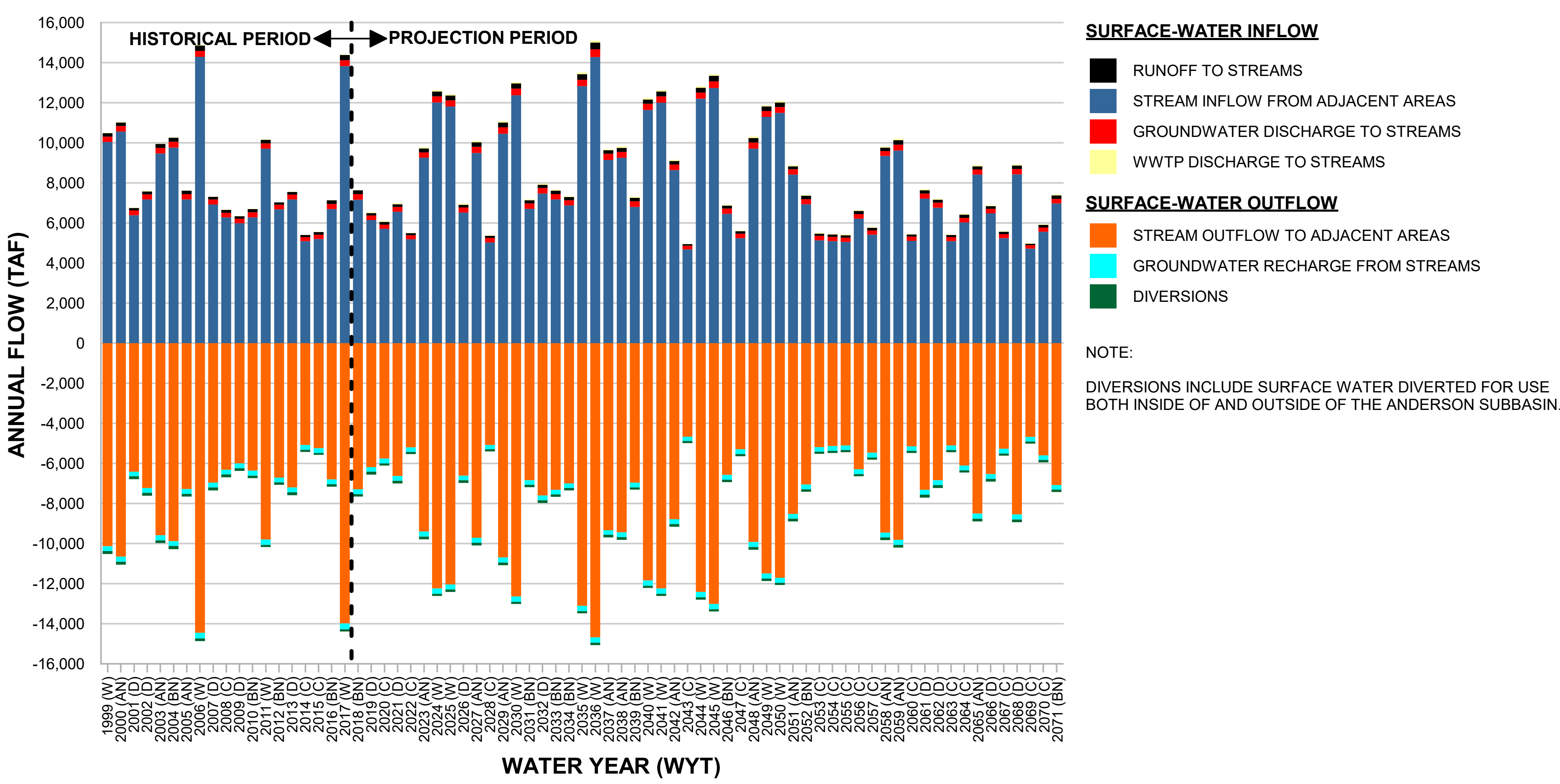




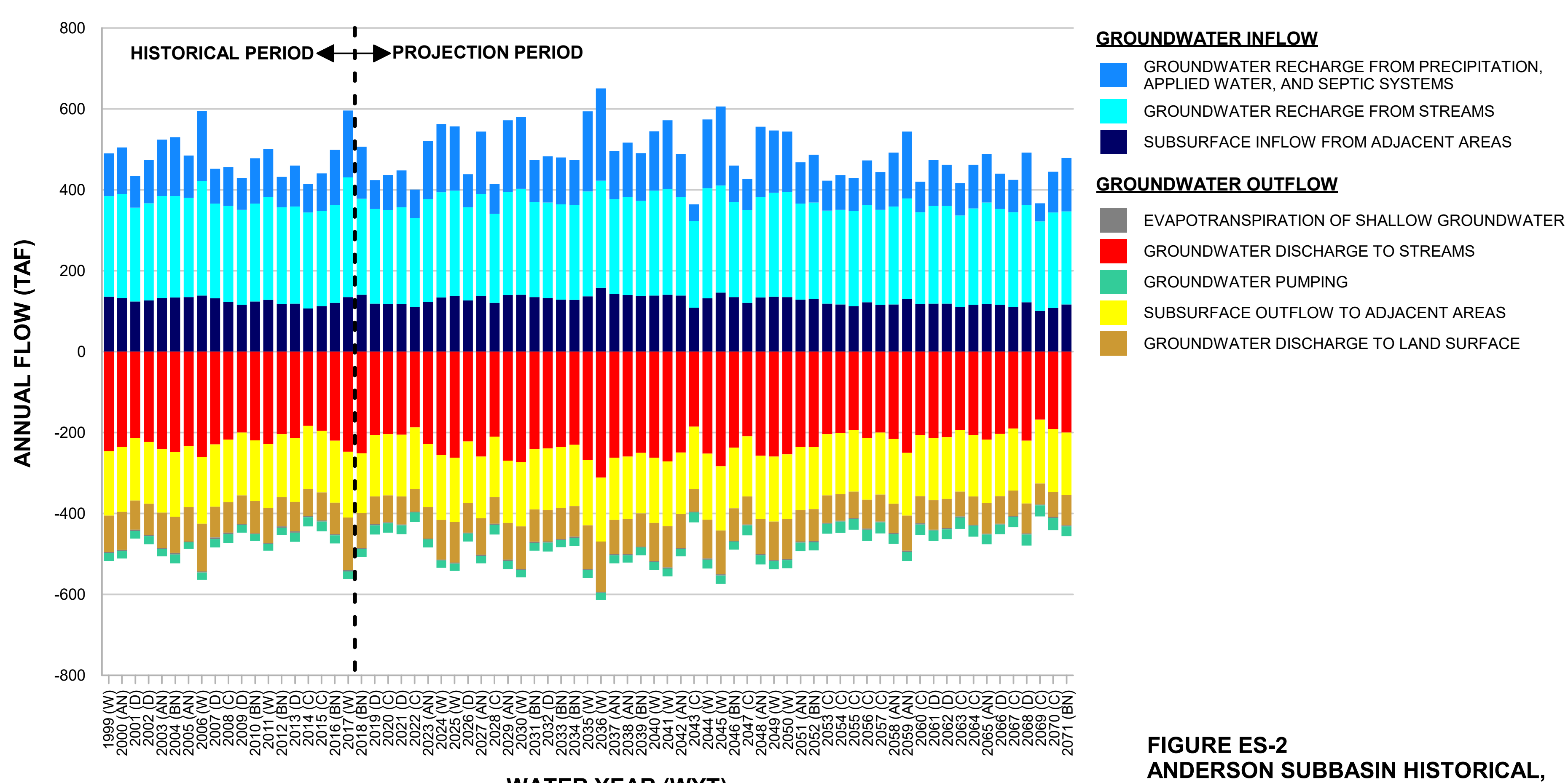


FIGURE ES-2
ANDERSON SUBBASIN HISTORICAL, CURRENT, AND PROJECTED TIME-SERIES ANNUAL WATER BUDGETS
Anderson Subbasin Groundwater Sustainability Plan

Contents

Appendices

Tables

Figures

Exhibits

Acronyms and Abbreviations

§	Section
°F	Fahrenheit
AB	Assembly Bill
ACID	Anderson-Cottonwood Irrigation District
AF	acre-feet
AF/yr	acre-feet per year
AN	above normal
bgs	below ground surface
BMP	best management practice
BN	below normal
Board	Board of Directors
BVWD	Bella Vista Water District
C	critically dry
CalEPA	California Environmental Protection Agency
CASGEM	California Statewide Groundwater Elevation Monitoring Program
CCCSD	Clear Creek Community Services District
CCR	*California Code of Regulations*
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
COA	City of Anderson
COC	chemicals of concern
COR	City of Redding
CSA	County Service Area
CSD	Community Services District
CVP	Central Valley Project
CWA	Clean Water Act
D	dry
DAC	disadvantaged community
DDW	Division of Drinking Water
DMS	Data Management System
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
EAGSA	Enterprise Anderson Groundwater Sustainability Agency

EAGSA Model	EAGSA Integrated Groundwater/Surface-water Flow Model
EPA	U.S. Environmental Protection Agency
ET	evapotranspiration
ET_o	reference evapotranspiration
ft/day	feet per day
ft/ft	foot per foot
ft^2/day	square feet per day
GAMA	Groundwater Ambient Monitoring and Assessment
GCM	global climate model
GDE	groundwater-dependent ecosystem
GIS	Geographic Information System
GMP	Groundwater Management Plan
gpm	gallons per minute
GPS	global positioning system
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	hydrogeological conceptual model
InSAR	Interferometric Synthetic Aperture Radar
IRWM	integrated regional water management
IRWMP	Integrated Regional Water Management Plan
Lidar	light detection and ranging
LUST	leaking underground storage tank
MAF	million acre-feet
MAP	mean annual precipitation
MCL	maximum contaminant level
MGD	million gallons per day
MGP	manufactured gas plant
µg/L	micrograms per liter
mg/L	milligrams per liter
MNM	Monitoring Network Module
MO	measurable objective
MOU	Memorandum of Understanding
MT	minimum threshold
MTBE	methyl-tert-butyl ether
NAVD88	North American Vertical Datum of 1988

NC	Natural Communities
NDMI	Normalized Derived Moisture Index
NDVI	Normalized Derived Vegetation Index
NGO	non-government organization
NSV	Northern Sacramento Valley
PG&E	Pacific Gas & Electric
Porter-Cologne Act	Porter-Cologne Water Quality Control Act
PRISM	Parameter-elevation Regressions on Independent Slopes Model
RAGB	Redding Area Groundwater Basin
RAWC	Redding Area Water Council
RCD	Resource Conservation Districts
Reclamation	U.S. Bureau of Reclamation
REDFEM	Redding Basin Finite Element Model
RMP	representative monitoring point
RWQCB	Regional Water Quality Control Board
SAGBI	Soil Agricultural Groundwater Banking Index
SB	Senate Bill
SDAC	severely disadvantaged community
SGMA	Sustainable Groundwater Management Act
SMC or SMCs	sustainable management criteria
SMCL	secondary maximum contaminant level
SWRCB	State Water Resources Control Board
SWRP	Storm Water Resources Plan
TAF	thousand acre-feet
TAFY	thousand acre-feet per year
TBA	tert-butyl alcohol
TSS	technical support services
USGS	U.S. Geological Survey
UWMP	Urban Water Management Plan
W	wet
WMP	Water Management Plan
WWTP	wastewater treatment plant
WY	water year
WYT	water year type

Definitions

The definitions in the Sustainable Groundwater Management Act, Bulletin 118, and Subchapter 1 of this Chapter, shall apply to these regulations. In the event of conflicting definitions, the definitions in the Act govern the meanings in this Subchapter. In addition, the following terms used in this Subchapter have the following meanings:

(a) "Agency" refers to a groundwater sustainability agency as defined in the Act.

(b) "Agricultural water management plan" refers to a plan adopted pursuant to the Agricultural Water Management Planning Act as described in Part 2.8 of Division 6 of the Water Code, commencing with Section 10800 et seq.

(c) "Alternative" refers to an alternative to a Plan described in Water Code Section 10733.6.

(d) "Annual report" refers to the report required by Water Code Section 10728.

(e) "Baseline" or "baseline conditions" refer to historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin.

(f) "Basin" means a groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Water Code 10722 et seq.

(g) "Basin setting" refers to the information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to Subarticle 2 of Article 5.

(h) "Best available science" refers to the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, that is consistent with scientific and engineering professional standards of practice.

(i) "Best management practice" refers to a practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science.

(j) "Board" refers to the State Water Resources Control Board.

(k) "CASGEM" refers to the California Statewide Groundwater Elevation Monitoring Program developed by the Department pursuant to Water Code Section 10920 et seq., or as amended.

(l) "Data gap" refers to a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation, and could limit the ability to assess whether a basin is being sustainably managed.

(m) "Groundwater dependent ecosystem" refers to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.

(n) "Groundwater flow" refers to the volume and direction of groundwater movement into, out of, or throughout a basin.

(o) "Interconnected surface water" refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted.

(p) "Interested parties" refers to persons and entities on the list of interested persons established by the Agency pursuant to Water Code Section 10723.4.

(q) “Interim milestone” refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.

(r) “Management area” refers to an area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors.

(s) “Measurable objectives” refer to specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin.

(t) “Minimum threshold” refers to a numeric value for each sustainability indicator used to define undesirable results.

(u) “NAD83” refers to the North American Datum of 1983 computed by the National Geodetic Survey, or as modified.

(v) “NAVD88” refers to the North American Vertical Datum of 1988 computed by the National Geodetic Survey, or as modified.

(w) “Plain language” means language that the intended audience can readily understand and use because that language is concise, well-organized, uses simple vocabulary, avoids excessive acronyms and technical language, and follows other best practices of plain language writing.

(x) “Plan” refers to a groundwater sustainability plan as defined in the Act.

(y) “Plan implementation” refers to an Agency’s exercise of the powers and authorities described in the Act, which commences after an Agency adopts and submits a Plan or Alternative to the Department and begins exercising such powers and authorities.

(z) “Plan manager” is an employee or authorized representative of an Agency, or Agencies, appointed through a coordination agreement or other agreement, who has been delegated management authority for submitting the Plan and serving as the point of contact between the Agency and the Department.

(aa) “Principal aquifers” refer to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

(ab) “Reference point” refers to a permanent, stationary and readily identifiable mark or point on a well, such as the top of casing, from which groundwater level measurements are taken, or other monitoring site.

(ac) “Representative monitoring” refers to a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin.

(ad) “Seasonal high” refers to the highest annual static groundwater elevation that is typically measured in the Spring and associated with stable aquifer conditions following a period of lowest annual groundwater demand.

(ae) “Seasonal low” refers to the lowest annual static groundwater elevation that is typically measured in the Summer or Fall, and associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.

(af) “Seawater intrusion” refers to the advancement of seawater into a groundwater supply that results in degradation of water quality in the basin, and includes seawater from any source.

(ag) "Statutory deadline" refers to the date by which an Agency must be managing a basin pursuant to an adopted Plan, as described in Water Code Sections 10720.7 or 10722.4.

(ah) "Sustainability indicator" refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x).

(ai) "Uncertainty" refers to a lack of understanding of the basin setting that significantly affects an Agency's ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.

(aj) "Urban water management plan" refers to a plan adopted pursuant to the Urban Water Management Planning Act as described in Part 2.6 of Division 6 of the Water Code, commencing with Section 10610 et seq.

(ak) "Water source type" represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.

(al) "Water use sector" refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.

(am) "Water year" refers to the period from October 1 through the following September 30, inclusive, as defined in the Act.

(an) "Water year type" refers to the classification provided by the Department to assess the amount of annual precipitation in a basin.

Note: Authority cited: Section 10733.2, Water Code.

Reference: Sections 25, 10720.7, 10721, 10722, 10722.4, 10723, 10727.2, 10728, 10729, 10733.2, 10733.6, and 10924, Water Code.

1. Introduction

The Enterprise Anderson Groundwater Sustainability Agency (EAGSA) has developed this Groundwater Sustainability Plan (GSP) in compliance with the 2014 Sustainable Groundwater Management Act (SGMA) and with the requirements of the GSP Emergency Regulations, *California Code of Regulations* (CCR) Title 23, Water, Division 2 Department of Water Resources, Chapter 1.5 Groundwater Management, Subchapter 2, Groundwater Sustainability Plans, and related guidance documents. See Appendix A – *DWR Preparation Checklist for GSP Submittal* for a crosswalk of compliance requirements and where the required information can be found in the GSP. The following introduces the Anderson GSP, describes the purpose of the plan and the sustainability goal, and provides information about the EAGSA. The Enterprise Subbasin is covered under a separate GSP. Figure 1-1 depicts the locations of the Enterprise and Anderson Subbasins.

1.1 Purpose of the Groundwater Sustainability Plan

SGMA, which comprises a three-bill legislative package, Assembly Bill (AB) 1739, Senate Bill (SB) 1168, and SB 1319, describes the goals and general approach to achieve sustainability. The intent of the legislation is to ensure sustainable, local and regional management of groundwater use and address the issue of overdrafted groundwater basins across the State. GSP regulations developed by the California Department of Water Resources (DWR) subsequent to SGMA describe the specific requirements for developing GSPs. The purpose of this GSP is to describe the approaches to achieve groundwater sustainability goals for the Anderson Subbasin and to meet the GSP regulatory requirements.

SGMA defines sustainable groundwater management as the "management and use of groundwater in a manner that can be maintained without causing undesirable results." Undesirable results may be present when at least one of the following conditions occurs throughout a groundwater basin as a result of groundwater management activities (DWR, 2017).

- *Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.*
- *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.*

SGMA requires groundwater basins designated as high or medium priority to be managed under a GSP by January 31, 2022, and to achieve sustainability within 20 years, allowing until 2042. The State has prioritized 127 basins that must comply with SGMA; failure to locally implement SGMA would cause State Water Resources Control Board (SWRCB) intervention. The Anderson Subbasin is located within the Redding Area Groundwater Basin (RAGB) and was determined by DWR to be a medium-priority groundwater basin.

This GSP is intended to provide a framework to enable local government, groundwater users, and the local community to work together to maintain sustainable use of groundwater resources in the Anderson Subbasin. This GSP was developed to be protective of both groundwater levels and groundwater quality for all beneficial users including residential well owners, disadvantaged communities (DACs), severely disadvantaged communities (SDACs), and tribal water resources. By addressing all beneficial uses and users of groundwater, the GSP has addressed California's Human Right to Water. Additional information on how the Human Right to Water was incorporated into the GSP through consideration of all beneficial uses and users of groundwater is included in Section 1.5 Notice and Communication and Chapter 6 Sustainable Management Criteria.

1.2 Sustainability Goal

Under GSP regulations, specifically, CCR Section (§) 354.24, each Groundwater Sustainability Agency (GSA) is required to establish "a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline." Groundwater conditions in this subbasin are generally considered to meet the needs of all beneficial users, even during drought conditions. Therefore, this GSP is intended to meet the overarching sustainability goal of SGMA by implementing a plan for continued operation of the Anderson Subbasin within its sustainable yield without resulting in undesirable results listed in Section 1.1. The Anderson Subbasin is required to meet its sustainability goal no later than 2042.

1.3 Agency Information

The six EAGSA member agencies include City of Anderson (COA), City of Redding (COR), and County of Shasta, each of which has land-use authority within the Anderson Subbasin and has water-supply and water-management responsibilities within the respective city limits and Shasta County. The EAGSA also includes Clear Creek Community Services District (CCCSD), Bella Vista Water District (BVWD), and Anderson-Cottonwood Irrigation District (ACID), which have water-supply and water-management responsibilities within their respective service areas.

The COR Water Utility Manager has been designated as the Plan Manager for the EAGSA. His contact name and mailing address are as follows:

Josh Watkins, City of Redding Water Utility Manager
Enterprise Anderson Groundwater Sustainability Agency
20055 Viking Way, Building 3
Redding, CA 96003
(530) 224-6068
jwatkins@cityofredding.org

1.3.1 Organization and Management Structure of the Enterprise Anderson Groundwater Sustainability Agency

On May 5, 2017, the above-listed entities entered into a Memorandum of Understanding (MOU) to establish the process and structure for developing this GSP as well as the organization and management structure of the EAGSA (Appendix B – *Memorandum of Understanding*). The EAGSA is governed by a Board of Directors (Board) appointed and/or removed by the legislative body of each member. The Board is composed of one each of the following: COA council member, ACID board member, CCCSD board member, COR council member, BVWD board member, and Shasta County Supervisor. Each of the members may designate one alternative director (who must be a member of the legislative body of the member agency that they represent) to serve when the director is absent or when it is anticipated that the director may have a conflict of interest.

The Board appointed a Management Committee comprising one staff representative from each member agency. The Management Committee takes direction from the Board, recommends agenda items, recommends proposed actions for the Board, and approves staff reports to the Board.

The EAGSA website[2] contains additional information regarding the GSA including the MOU, the staff report from the public hearing to execute the MOU to form the EAGSA, and meeting agendas and minutes from EAGSA meetings.

1.3.2 Legal Authority of the Groundwater Sustainability Agency

Governor Jerry Brown signed into law the legislative packages comprising SGMA on September 16, 2014. Among other powers, SGMA grants local groundwater agencies the legal authority and responsibility necessary to sustainably manage groundwater while also including provisions that provide the technical and financial assistance needed to achieve the objectives outlined within the bills. It was this legislation that resulted in the partnership of the agency members to form the EAGSA and accept the statutory authorities granted to them to manage the subbasin's groundwater supply sustainably and ensure compliance with SGMA.

1.4 Groundwater Sustainability Plan Organization

This GSP is organized as follows:

- The **Executive Summary** is a summary that provides an overview of the GSP and a description of groundwater conditions in the Enterprise Subbasin.
- **Chapter 1, Introduction**, includes the purpose of the GSP, sustainability goals, and agency information, describes the document organization, and provides and overview of notice and communication and public outreach strategies used during development of the GSP.
- **Chapter 2, Plan Area**, provides a general overview of the Plan Area, including agency jurisdiction, relevant water resources monitoring and management plans, a description of land uses and land use policies, and an overview of GSP notice and communication activities.
- **Chapter 3, Basin Setting,** describes the hydrogeologic setting of the Plan Area, including a description of current and historical conditions related to each undesirable result defined under SGMA.
- **Chapter 4, Water Budgets,** provides a summary of the groundwater modeling and water budget components established for the Plan Area.
- **Chapter 5, Monitoring Networks,** describes the existing monitoring networks for each applicable sustainability indicator, including identification of representative monitoring points (RMPs), monitoring frequency and protocols, and data gaps.
- **Chapter 6, Sustainable Management Criteria**, describes sustainable management criteria (SMC or SMCs) by which the EAGSA has defined conditions that constitute sustainable groundwater management for the subbasin, including the process by which the EAGSA has characterized undesirable results and established minimum thresholds (MTs) and measurable objectives (MOs) for each applicable sustainability indicator.

[2] https://www.cityofredding.org/departments/public-works/eagsa

- **Chapter 7, Projects and Management Actions**, consists of a description of the projects and management actions the EAGSA has determined will achieve the sustainability goal for the subbasin, including projects and management actions to respond to changing conditions in the subbasin.
- **Chapter 8, Plan Implementation**, provides an estimate of GSP implementation costs, a schedule for implementation, and a plan for annual reporting and 5-year evaluations.

1.5 Notice and Communication

According to the requirements in GSP Regulations § 354.10 Notice and Communication, this chapter includes information regarding beneficial uses and users of groundwater, summaries of public meetings that occurred, an overview of GSP comments and responses, and a description of the EAGSA communication plan (describing the EAGSA decision-making process, public engagement opportunities, encouragement of active involvement, and informing the public on the GSP implementation program).

As described in the preceding sections, the EAGSA was formed to establish the process and structure for developing the GSPs for the Enterprise and Anderson Subbasins as well as the organization and management structure of the EAGSA. As such, notice and communication for both the Enterprise Subbasin and the Anderson Subbasin has been concurrent, and this section is nearly identical for both the Enterprise and the Anderson GSPs.

Supporting information associated with the EAGSA's notice and outreach are included in Appendix C as follows:

- Appendix C-1, *Communications and Engagement Plan*
- Appendix C-2, *Public Outreach Materials*
- Appendix C-3, *Public Workshop Summaries*
- Appendix C-4, *Public Comments on Draft GSP*
- Appendix C-5, *Freshwater Species Located in the Anderson Subbasin*
- Appendix C-6, *Summary of Targeted Outreach and Interbasin Coordination*

1.5.1 Identification of Beneficial Uses, Users, and User Interests

Consistent with GSP Regulations § 354.10(a), this section describes

> *The beneficial uses and users of groundwater in the Enterprise and Anderson Subbasins and their interests. This includes the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.*

1.5.1.1 Beneficial Uses and Users

The Central Valley Regional Water Quality Control Board (RWQCB) designates:

> *Unless otherwise designated by the Regional Water Board, all ground waters in the Region are considered as suitable or potentially suitable, at a minimum, for municipal and domestic water supply, agricultural supply, industrial service supply, and industrial process supply.* (RWQCB, 2018)

SGMA requires GSAs to consider the interests of all beneficial uses and users of groundwater. These interests include, but are not limited to, the following:

- Holders of overlying groundwater rights, including:
  - Agricultural users
  - Domestic well owners
- Municipal well operators
- Public water systems
- Local land use planning agencies
- Environmental users of groundwater (see Appendix C-5 for an inventory of freshwater species within the Anderson Subbasin)
- Surface-water users, if there is a hydrologic connection between surface-water and groundwater systems
- The federal government including, but not limited to, the military and managers of federal lands
- California Native American Tribes
- DAC or DACs including, but not limited to, those served by private domestic wells or small community water systems
- Entities listed in California Water Code § 10927 that are monitoring and reporting groundwater elevations in all or part of a groundwater subbasin managed by the GSA

1.5.1.2 Interests of Beneficial Users

Groundwater users in the Enterprise and Anderson Subbasins include municipalities, utilities, or other public water systems that provide groundwater as a drinking water supply; agricultural purveyors; individual private supply wells (domestic, agricultural, and/or industrial); and environmental users (plants and animals within the subbasins). Specific interests of entities and individuals on the interested parties list, categorized by beneficial use or user type as listed in California Water Code § 10723.2, are presented in the following sections as follows:

- EAGSA Member Agencies
- Non-participating Agencies
- Area Tribes
- Mutual and Private Water Companies
- Environmental Users of Groundwater
- The full interested parties list, with associated beneficial use/user type, is presented in Appendix C – *Public Outreach Materials*.

1.5.1.3 EAGSA Member Agencies

The EAGSA Board of Directors consists of one elected official from each of the six-member agencies listed in Table 1-1. In turn, each of the member agencies has appointed at least one staff member to serve on the EAGSA Management Committee. EAGSA Management Committee members maintain consistent communications with their agency's board member who serves on the EAGSA board. The EAGSA board members and Management Committee members keep their respective agencies' governing bodies apprised of SGMA implementation activities.

Table 1-1 presents the six-member agencies that formed the EAGSA and their associated overlying subbasin and assumed type and primary beneficial uses. The overlying basins are Enterprise Subbasin (groundwater basin number 5-6.04) and Anderson Subbasin (groundwater basin number 5-6.03).

Table 1-1. EAGSA Member Agencies and Associated Subbasin and Beneficial Uses

GSA Board Members	Subbasin	Assumed Type and Primary Beneficial Uses (If Any)
Anderson-Cottonwood Irrigation District	Enterprise and Anderson Subbasins	Agricultural uses/surface-water users
Bella Vista Water District	Enterprise Subbasin	Agricultural uses/municipal well operator/public water system/surface-water user
City of Anderson	Anderson Subbasin	Municipal well operator/public water system/local land use planning agency/DAC
City of Redding	Enterprise and Anderson Subbasin	Municipal well operator/public water system/local land use planning agency/surface-water user/DAC
Clear Creek Community Services District	Anderson Subbasin	Agricultural uses/municipal well operator/public water system/surface-water user
Shasta County	Enterprise and Anderson Subbasin	Agricultural uses/municipal well operator/public water system/local land use planning agency/surface-water user/DAC

1.5.1.4 Nonparticipating Agencies

Table 1-2 lists agencies that were eligible to form a GSA and chose not to participate in the EAGSA.

Table 1-2. Nonparticipating Agencies

Nonparticipating GSA-eligible Local Agencies	Subbasin	Assumed Type and Primary Beneficial Uses (If Any)
Centerville Community Services District	Anderson Subbasin	Agricultural uses/public water system/surface-water user
Cottonwood Water District	Anderson Subbasin	Agricultural uses/municipal well operator/public water system
Igo/Ono Community Services District	Anderson Subbasin	Agricultural uses/municipal well operator/ public water system
Western Shasta Resource Conservation District	NA	Environmental uses

Note:

NA = not applicable

Centerville Community Services District (CSD), Cottonwood Water District, and Igo/Ono CSD elected not to participate in the EAGSA. SGMA requires that an entire groundwater basin/subbasin be covered by a GSA. For these agencies that chose not to become an EAGSA member agency, Shasta County became the default entity to represent these unmanaged areas.

Resource Conservation Districts (RCDs) have been deemed GSA-eligible agencies by the SWRCB. However, the Western Shasta RCD does not have water supply, water management, or land use responsibilities within the Anderson and Enterprise Subbasins. The RCD collaborates with private landowners and regulatory agencies on a range of watershed planning and implementation efforts.

1.5.1.5 Area Tribes

Consistent with California Water Code § 10720.3, the federal government or any federally recognized Indian tribe may voluntarily agree to participate in the preparation or administration of a GSP through a joint powers authority or other agreement with local agencies in the basin. A participating tribe is eligible to participate fully in planning, financing, and management. Additionally, SGMA identifies California tribes (including those that are not federally recognized) as possible beneficial users of groundwater whose interests should be considered in GSP development and implementation.

Redding Rancheria is the only tribe with public trust lands within the EAGSA's jurisdiction.

The EAGSA reached out to the following tribes in an effort to identify interested parties and points of contact for the interested parties list. None of the following original points of contact nor ensuing referrals from California Indian Environmental Alliance expressed interest in response to phone calls and email outreach.

- Redding Rancheria
- Pit River Tribe of California
- Nor-Rel-Muk Tribe
- Wintu Tribe of Northern California
- Winnemum Wintu Tribe

1.5.1.6 Municipal and Private Water Companies

The EAGSA public outreach and communication included municipal and private water companies located in DWR-identified DAC tracts and blocks. Appendix C-1 – *Communications & Engagement Plan* includes the private water systems and the EAGSA member agency jurisdiction where each resides as well as the associated beneficial use/user type. These water systems are primarily made up of community water systems (residential) and transient water systems (schools and food marts).

1.5.1.7 Environmental Users of Groundwater

Representatives of environmental users of groundwater have interests in the connection between the Enterprise and Anderson Subbasin groundwater and surface water, most notably, the Sacramento River. The following representatives of environmental users of groundwater and groundwater-dependent ecosystems (GDEs) have engaged with the EAGSA:

- The Nature Conservancy
- California Department of Fish and Wildlife
- Western Shasta Resource Conservation District
- Virginia Phelps (member of the public)

An inventory of freshwater species within the Anderson Subbasin is included as Appendix C-5. This list includes State and federal protection status for species potentially present within the subbasin.

1.5.2 Consultation with Beneficial Users

The EAGSA contacted a variety of stakeholders to see if they were interested in receiving targeted briefings or participating in the public workshops. In many cases, the participants declined the offer for a briefing, made referrals for the interested parties list, provided their interests and concerns, and in some cases requested materials. The facilitation team reached out to the following and was able to collect referrals and brief statements of interest to incorporate into the public comment themes:

- Cattleman's Association
- Shasta County Farm Bureau
- University of California Extension
- Anderson High School
- Pacheco Elementary School
- Various municipal and private water systems including:
  - Verde Vale, Private Water System
  - Rio Vista Mobile Home Estates

The EAGSA conducted targeted outreach to select beneficial users, seeking to better understand their interests and concerns and address them in the GSP. These included the following:

- California Department of Fish and Wildlife
- The Nature Conservancy
- Shasta Tehama Watershed Education Coalition
- League of Women Voters
- Municipal and Private Water Companies

The EAGSA had planned to meet with Redding Rancheria representatives in March 2020; however, this meeting was delayed when the COVID-19 shelter-in-place started. The EAGSA has reached out to the contact with Redding Rancheria three times since then, but has not received a response from the Rancheria since canceling that meeting. The EAGSA respectfully understands that the Rancheria may need to respond to more urgent needs during this pandemic and will be available to meet with them when the Rancheria contacts are available.

1.5.3 Interested Parties Database

The EAGSA developed and maintains an interested parties database including the beneficial users identified related to the aforementioned groups (Appendix C). As stakeholder outreach was conducted, the database was updated with the addition of newly identified interested parties and contact information as necessary.

The interested parties database was initially used to identify legislative bodies and tribes to receive formal notices of the GSP development. Informal email notification of development of the GSPs was also sent to all others on the interested parties list.

Out of respect for the community's privacy and awareness of community culture, the EAGSA requested that interested parties respond with a positive request to remain on the interested parties list to continue to receive EAGSA communications. However, in response to a comment made during the October 2019 public workshop that the majority of interested parties were not receiving the communications by default, the EAGSA began to include all interested parties in EAGSA communications by default. An "unsubscribe" option was added for those who wanted to be removed from the list. A number of stakeholders have requested to be unsubscribed. These stakeholders have been removed from the list and further communications. The interested parties database, along with the associated beneficial use/user type, is included in Appendix C-1.

1.5.4 Communications & Engagement Plan Development

The EAGSA developed a Communications & Engagement Plan (Appendix C-1). The Communications & Engagement Plan includes a description of the engagement goals and desired outcomes, SGMA requirements for outreach, beneficial uses and users, interested parties list, participants/potential audiences for GSP development, and a description of interbasin coordination. The Communications & Engagement Plan provides information related to the EAGSA's methods for stakeholder outreach and engagement, including public workshops, targeted stakeholder briefings, EAGSA Board meetings, EAGSA website, and media outreach as well as messages and talking points related to SGMA processes and frequently asked questions for development of outreach materials.

1.5.5 Past Groundwater Planning

Prior to the inception of the GSP process, the members of the EAGSA conducted planning and stakeholder engagement related to groundwater.

In 1998, several local public and private agencies formed the Redding Area Water Council (RAWC), a council interested in water resource planning and management. The members adopted the Redding Basin Groundwater Management Plan (GMP) (AB 3030 Plan) and developed a numerical groundwater flow model to support decision making and planning activities. In May 2007, RAWC updated the AB 3030 Plan to meet requirements of SB 1938.

In 2017, member agencies formed the EAGSA in response to the SGMA of 2014. The EAGSA is responsible for preparing GSPs for the Anderson and Enterprise Subbasins of the RAGB in accordance with SGMA requirements.

The EAGSA applied for and was awarded grant funding under the 2017 Sustainable Groundwater Planning Grant Program. The work funded by the grant includes the following three projects:

- Preparation of a GSP for the Anderson Subbasin
- Preparation of a GSP for the Enterprise Subbasin
- Siting, design, and construction of a multi-completion monitoring well to enhance the monitoring network within the Enterprise or Anderson Subbasin

1.5.5.1 Lessons Learned

When developing the Communications & Engagement Plan and continuing to adaptively manage outreach, the EAGSA considered some key lessons learned from the 2016 GSA formation phase, including the following:

- The public workshop for EAGSA formation, despite being expertly designed and promoted, was poorly attended.
- The nonparticipating eligible EAGSA members expressed that they had little time and money for participation.
- COR had some success reaching out individually to the Redding Rancheria tribe.

In addition, the public outreach team accounted for other relevant situational awareness to inform the Communications & Engagement Plan, as follows:

- Public attendance was high at past annual watershed festivals.
- Certain statewide representatives from The Nature Conservancy and California Department of Fish and Wildlife had commented on many GSPs across the state.
- Municipal and private water companies were typically not organized, and contact information from the County well applications was typically out of date. Some of these well owners are very protective of their private property and their contact information.

- The Latinx community in California was expressing some hesitancy about participating in the U.S. Census and other public processes due to the fear of potential deportation.
- Other community efforts were demanding Redding area stakeholder attention. Redding area residents were still recovering from the Carr Fire. Fire-related outreach and events soliciting participation and community investment continued.

These lessons learned from the GSA formation stage informed the design of outreach to be less focused on convening GSP-centered public workshops and meetings and more focused on connecting public events to existing interested networks of people, targeted outreach and briefings with key stakeholders, and outreach and documentation of a sampling of individuals to represent the key stakeholder groups.

1.5.6 Public Meetings Related to GSP Development

The EAGSA convened a number of public meetings leading up to and related to GSP development. These included the following meetings and objectives:

- Public Workshops – public outreach, solicitation of public comment
- EAGSA Board Meetings – EAGSA formation, hearing public comment, GSP decision making, and decision making on how the GSP will respond to public comment

1.5.6.1 Public Workshops

The public outreach team convened two public workshops: an in-person workshop on October 16, 2019, and a virtual workshop on April 27, 2021.

Table 1-3 lists EAGSA public workshops, outcomes, target audience, and attendance.

Table 1-3. EAGSA Public Workshops

Date	Outcomes	Target Audience	Attendance
December 12, 2016	Presented overview of SGMA and EAGSA formation. Held open house format to answer questions.	EAGSA Board, interested parties list	EAGSA representatives and facilitator Public – 2
October 16, 2019	Presented overview of SGMA, overview of GSA governance and authority, and preliminary assessment of hydrologic conditions. Gathered participants' interests and concerns.	EAGSA Board, interested parties list, municipal and private water companies	EAGSA Board members and consulting team – 9 DWR – 1 Public – 16
April 27, 2021	Presented an overview of SMCs and projects and management actions development. Gathered participants' interests and concerns.	EAGSA Board, interested parties list, municipal and private water companies	EAGSA Board members and consulting team – 13 DWR – Public – 3

For the October 16, 2019, public workshop, the outreach team worked with a local organizer who leads the Redding Watershed Festival and is a well-connected leader with First United Methodist Church. The EAGSA convened the public workshop at the church in Redding for ease of access for members of the public in the DACs of Redding and Anderson. Coordination with the local organizer also supported promotion of the workshop among her list of local media outlets and local civic groups. Exhibit 1-1 shows the EAGSA public workshop in session at the First United Methodist Church in Redding.

Exhibit 1-1. EAGSA Public Workshop October 2019

The EAGSA hosted a second public workshop on April 27, 2021, as part of the Whole Earth Watershed Festival. The EAGSA worked with the festival organizer to promote the public workshop with other festival events through local radio, civic groups, and the internet. Because of COVID-19 restrictions, the festival organizer converted the events from in-person to virtual platforms. To support online collaboration, the EAGSA hosted the workshop on Zoom, which allowed for participants and presenters to have two-way interaction through presentations and a question and answer session.

1.5.6.2 EAGSA Board of Directors Meetings

The EAGSA Board convenes triennially with publicly noticed Board meetings. Table 1-4 presents the EAGSA Board meetings, describes items discussed/addressed, and presents attendance by various affiliations.

Table 1-4. EAGSA Board of Directors Meetings

Date	Items Addressed	Participants in Addition to EAGSA Board Members
April 9, 2019	DWR presentation on SGMA, overview of GSP, update on DWR basin prioritization, communications	DWR, Jacobs, Kearns & West
August 15, 2019	Groundwater sustainability planning update	Sierra Club, League of Women Voters, Verde Vale Water Company, Virginia Phelps, Ellen Sweeney, Bill Palmoymesa, Jacobs, DWR
October 24, 2019	Groundwater sustainability funding	Jacobs, Verde Vale Water Company
December 12, 2019	Groundwater sustainability planning update	COR, Jacobs, Virginia Phelps, Sierra Club
August 11, 2020	Approval of contract amendment with Jacobs for additional grant writing, groundwater sustainability update	DWR, Jacobs, COR, Shasta County, COA, Bella Vista Water District
May 5, 2021	Update on SMCs and projects and management actions development	COR, Shasta County, ACID, DWR, BVWD, Jacobs, David Ledger, John Livingston

1.5.7 Public Comments Received and Responses by GSA

This section outlines the public comments received by the EAGSA, any responses by the EAGSA, and plans for addressing the comments in the GSPs.

1.5.7.1 Public Comment Themes

Throughout development of the GSP, the EAGSA solicited, collected, and documented public input and feedback through the various stakeholder engagement opportunities outlined above as well as through public review of individual GSP chapters and the draft GSP. Similar individual comments were grouped into a general set of themes, which would have a common response.

The EAGSA technical team drafted proposed general responses for review, consideration, and discussion by the Management Committee, which recommended an updated version to the EAGSA Board for approval. The EAGSA Board approved the proposed direction reflected by the proposed EAGSA responses.

The EAGSA responses range from indicating how the GSP would include or address requested information and technical monitoring and modeling approaches. In some cases, the EAGSA found the comments on the GSP to be outside the GSA's planning authority and does not plan to include or address those issues in the GSP.

Table 1-5 presents the general comment themes and the EAGSA's associated general response. The comment themes compile public feedback from the (1) public workshops and/or EAGSA Board meetings, (2) targeted briefings, (3) individual interviews, letters, and emails, and (4) comments on the GSP chapters. A table summarizing individual comments received via the EAGSA comment portal during the formal public review of the draft GSP is included in Appendix C-4 – *Public Comments on Draft GSP*

Public comment themes are summarized as follows:

- Concerns regarding groundwater extraction permitting
- Concerns regarding groundwater export
- Concern regarding the tension between groundwater sustainability and economic development
- Consider analyzing the relationship between the subbasin and the greater Sacramento River system
- Concerns regarding maintaining local control and use of water
- Interest in potential ecosystem benefits associated with substituting groundwater for surface water
- Concerns regarding groundwater contamination
- Consider impacts associated with future growth and climate/land use changes in models
- Concerns regarding the public being sufficiently engaged and informed in the process
- Concern regarding the GSP's enforceability
- Multi-benefit groundwater projects
- EAGSA membership and outreach

1.5.8 GSA Decision-making Process

As laid out in its MOU, the EAGSA is governed by a Board of Directors who will serve without compensation or term of office and will be appointed and/or removed by the legislative body of each member. As described in Section 1.3.1 Organization and Management Structure of the Enterprise Anderson Groundwater Sustainability Agency, the EAGSA Board of Directors is composed of one Board member from each of the following member boards or councils: COA, ACID, CCCSD, COR, BVWD, and Shasta County. Each of the members may designate one Alternate Director who will serve only when the Director is absent or when it is anticipated that the Director may have a conflict of interest.

Table 1-5. Public Comment Themes and EAGSA Proposed Responses

Theme	Example Comments	Response
Concerns regarding groundwater extraction permitting	▪ Proposed new increased GSA basin-wide governance, requirements, transparency, and public involvement for water extraction permitting and water transfer sales.	▪ The EAGSA does not have permitting authority for the issuance of groundwater extraction permits. (See Chapter 2, Section 2.13.1 Groundwater Export Permitting.). Shasta County is the permitting agency for new water wells within the subbasin. ▪ Addressing concerns regarding groundwater extraction permitting is outside the scope of SGMA.
Concerns regarding groundwater export	▪ Consideration of effects on GDEs including Sacramento River and nature of impact of water transfers. ▪ Transparency and public involvement for water transfers and sales.	▪ Shasta County ordinances govern the sale of groundwater and prevent unpermitted out-of-basin transfers. Such sales are only allowed by permit through Shasta County. (See Chapter 2, Section 2.13.1 Groundwater Export Permitting.) ▪ Applicants for groundwater export permits are required to demonstrate compliance with the California Environmental Quality Act and applicable guidelines. Public notice regarding applications for groundwater export permits and associated review periods are posted to the County Public Works Department website. Additionally, interested parties can provide written request to the Commission Director to receive written notice of applications for groundwater export permits. ▪ Addressing concerns regarding groundwater export is outside the scope of SGMA.
Concern regarding the tension between groundwater sustainability and economic development	▪ Prioritize the objective of protecting the environment and GDEs in relation to economic development for sustainable management of the basin. ▪ Land use planning and new well development should consider the cost of sustaining the groundwater and surface-water connections to the Sacramento River. ▪ The GSP should detail sustainable yield of groundwater. ▪ Avoid increasing costs of owning and maintaining wells. ▪ Recommended six best practices for mapping GDEs.	▪ One of the six sustainability indicators as defined by SGMA is depletion of interconnected surface water, which includes GDEs. SMCs, including Sustainability Goal (GSP Regulations § 354.24), Measurable Objectives (GSP Regulations § 354.30), Minimum Thresholds (GSP Regulations § 354.28), and Undesirable Results (GSP Regulations § 354.26) are included in Chapter 6 Sustainable Management Criteria of both GSPs. ▪ Technical analysis and numerical modeling is used to estimate the sustainable yield for the Enterprise and Anderson Subbasins. The sustainable yield for each subbasin is incorporated into the development of the MT for the sustainability indicator for depletion of groundwater storage (Chapter 6 Sustainable Management Criteria). ▪ The EAGSA considered the six best practices recommended for mapping GDEs during its analysis.

Table 1-5. Public Comment Themes and EAGSA Proposed Responses

Theme	Example Comments	Response
Consider analyzing the relationship between the subbasin and the greater Sacramento River system	▪ Sustainable management of subbasin contributions to Sacramento River and downstream. ▪ Avoid commitment of more water to downstream Sacramento River needs. Maintain water use locally in basin. ▪ Land use planning and new well development should account for the cost of sustaining the groundwater and surface-water connections to the Sacramento River.	▪ Although GDEs and interconnected surface-water depletions are an important part of SGMA and are included as one of the six sustainability indicators, managing water availability for downstream use is not a part of GSP regulation nor is it included in the sustainability goal for the EAGSA GSPs. The focus of SGMA is on project uses, a 50-year planning horizon, and sustainability within the Enterprise and Anderson Subbasins. ▪ Although not specified as a sustainability goal, the EAGSA subbasins and contributing catchments provide an average of 2 MAF of water annually to the Sacramento River. This average gain accounts for the periodic occurrence of dry WYs. ▪ The EAGSA does not have authority to determine or manage downstream releases or flow. ▪ Greater scrutiny by local (city and county) regulators is beyond the scope of SGMA.
Concerns regarding maintaining local control and use of water	▪ Avoid commitment of more water to downstream Sacramento River needs. Maintain water use locally in basin. ▪ Maintain local control of groundwater independent of the State. ▪ Independent well owners take action to develop supply redundancies to proactively avoid water quality concerns.	▪ The EAGSA is planning to maintain local control by meeting its own standards for sustainability. The State would only take over groundwater management if those standards are not met. Because the subbasins are currently sustainable, it is unlikely the State would step in.
Interest in potential ecosystem benefits associated with substituting groundwater for surface water	▪ Protect surface water for ecosystems and species. ▪ Explore using more groundwater to substitute for surface water at particular times for salmon fishery.	▪ Management of surface-water resources for the protection of aquatic species is beyond the scope of SGMA. Surface-water releases from Shasta Lake and Keswick Reservoir are managed by Reclamation with consideration of ecological beneficial users. Scheduled releases include consideration of diversions by water purveyors. ▪ As discussed in Section 2.14, several water purveyors use a combination of both groundwater and surface water to meet demands within their service areas. Expansion of groundwater use in lieu of surface-water diversions is not feasible in certain areas of the subbasin due to limited aquifer thickness and/or productivity. The EAGSA will continue to manage groundwater resources to maintain the sustainability goal for the subbasin.

Table 1-5. Public Comment Themes and EAGSA Proposed Responses

Theme	Example Comments	Response
Concerns regarding groundwater contamination	▪ Develop more a widespread monitoring network that tests shallow water quality to indicate early contamination before it deteriorates water quality at deeper levels. ▪ The GSP address contamination of groundwater or management actions with respect to treated water discharge.	▪ Regulatory agencies such as DTSC and RWQCB regulate groundwater contamination. The intent of SGMA is to achieve and maintain groundwater sustainability in the Enterprise and Anderson Subbasins. Degradation of water quality is one of the six sustainability indicators included in SGMA. Although the EAGSA is not charged with improving existing groundwater quality, the GSA will monitor groundwater quality to ensure SGMA-related management activities are not inducing migration of impaired groundwater into previously unimpaired areas. ▪ The EAGSA monitoring network is described in GSP Chapter 5 Monitoring Networks of both GSPs to comply with GSP Regulations § 454.34. The monitoring network objectives include a description of how the network was developed and will be implemented, including monitoring water-quality trends as applicable. Groundwater quality in the Enterprise and Anderson Subbasins is described in the GSPs in Chapter 3, Section 3.2.5 Groundwater Quality. Although there may be localized areas of impairment, the overall quality of groundwater in the subbasins is good and suitable for their designated beneficial uses. ▪ Based on this, SGMA-related treated water discharge impacts are not anticipated.
Consider impacts associated with future growth and climate/land use changes in models	▪ Conduct analysis of projected future land use and increase in population in Enterprise and Anderson Subbasin and the effects on groundwater levels and sustainability of connections to surface water. ▪ Incorporate climate change analysis into evaluation of projected groundwater levels. ▪ Conduct analysis of forest/fire management and impacts on groundwater and its conveyance. Plan for interlinked effects between forest/fire and groundwater availability. ▪ Conduct analysis of ambient temperature increases and effects on open conveyance of water supply. ▪ Assumptions for increased water demand and precipitation trends.	▪ GSP Regulations § 354.18 requires GSAs to establish historical, current, and projected (future) water budgets for the Enterprise and Anderson Subbasins. Numerical modeling was conducted to support water budget development. Details regarding assumptions included in the projected water budget (including future water demand, future water supply, and climate change) are included in Chapter 4 Water Budgets. Details regarding numerical model development, calibration, and application are included in Appendix F – *Numerical Flow Model Documentation*. Numerical modeling of future water demands and supply was used to inform development of MTs for SMCs. Those details are provided in Chapter 6 Sustainable Management Criteria. ▪ Analysis of open conveyance of water supply is beyond the scope of SGMA. ▪ The groundwater model incorporated several factors related to increased water demand and precipitation trends. These projections and models will be updated along with the GSP update every 5 years. ▪ Population growth: UWMPs, where available, specified population growth rates, which generally projected modest growth (less than 1 percent growth per year). ▪ Land use: The model assumes that land use and crop patterns do not change substantially over the next couple of decades (based on historical data).

Table 1-5. Public Comment Themes and EAGSA Proposed Responses

Theme	Example Comments	Response
		▪ Precipitation levels: The global climate model was selected based on applicability to conditions in California and long-term average precipitation. The model includes a variety of wet and dry years as well as a significant drought near the end of the model period.
Concerns regarding the public being sufficiently engaged and informed in the process	▪ Water education on groundwater/surface-water connections. ▪ Distribute education and communication to all mutual and private well owners by default.	▪ The GSA holds workshops and issues written/electronic materials to inform the public about the SGMA process and solicit public input on the GSP content and details. ▪ All interested parties are receiving communication unless they have opted out.
Concern regarding the GSP's enforceability	▪ Revise the EAGSA's self-imposed restrictions on its authority to empower the EAGSA to require management actions and projects to meet its goals. ▪ Concern about limitations to pumping and effects on neighboring wells and adjacent basins.	▪ The EAGSA is incentivized to implement the GSPs because SGMA is a legal requirement, subject to DWR enforcement. All members want to cooperate and stay in compliance and avoid undesirable results. ▪ If there is a holdout member agency, then all members risk losing local control. Changes will occur as needed to meet the sustainability goals. ▪ Chronic lowering of groundwater levels is one of the six sustainability indicators included in SGMA. The EAGSA considered impacts on beneficial groundwater users during the development of the minimum threshold for this sustainability indicator. See Chapter 6 Sustainable Management Criteria for additional information.
Multi-benefit groundwater projects	▪ Use models for multi-benefit groundwater projects (such as the Nature Conservancy's multi-benefit pilot recharge projects) to inform future projects in Redding area subbasins.	▪ The EAGSA is aware of The Nature Conservancy's pilot recharge projects and will consider their results as applicable to the RAGB.
EAGSA Membership and Outreach	▪ Proposed including NGO in EAGSA Board to represent different perspective and gain access to data. ▪ Proposed continued targeted outreach to NGOs.	▪ The EAGSA has engaged with NGOs and individual citizens through targeted outreach and public workshops. The EAGSA has not considered any changes to the Board membership at this point.

Notes:

DTSC = California Department of Toxic Substances Control
MAF = million acre-feet
NGO = non-government organization
Reclamation = U.S. Bureau of Reclamation
UWMP = urban water management plan
WY = water year

The Management Committee consists of one staff representative from each member agency. The Management Committee works directly with consultants preparing the GSPs and DWR, discussing GSP content and providing guidance on GSP development, providing input on technical decisions, issuing notice of meetings and GSP content available for public review, and providing initial review of GSP chapters. The Management Committee coordinates and communicates information on GSP development to the Board of Directors.

Based on its governance authorities and roles, the EAGSA decision-making process is as follows.

- The Brown Act – The EAGSA MOU states that the GSA shall follow the Brown Act: The Board of Directors shall agendize and conduct all meetings in accordance with the Ralph M. Brown Act. The Board of Directors shall set regular meetings on such dates and times and at such locations as the Board of Directors shall fix by resolution.
- Quorum – The EAGSA Board requires a quorum for decision making. As stated in the EAGSA MOU, quorum determinations are dependent on the nature of the action proposed as follows:
  - General Board Action Not Specific to a subbasin: Four (4) of the six (6) Board Members shall constitute a quorum.
  - Action specific to the Enterprise Subbasin: Three (3) of the five (5) Members entitled to vote shall constitute a quorum.
  - Action specific to the Anderson Subbasin: Three (3) of the five (5) Members entitled to vote shall constitute a quorum.
- Voting – The EAGSA Board voting rules are outlined in the MOU as follows:
  - Only Members overlying a basin have decision-making authority on issues within their respective subbasins.
  - For purposes of Board action not specific to a subbasin, each Member shall have one (1) vote and a majority vote shall be a majority of the Board of Directors.
- The authority of the Board of Directors does not extend to or otherwise authorize the following:
  - The exercise of any power or Authority set forth herein on any Member that has withdrawn from this MOU or provided notice of withdrawal of its participation in this MOU in accordance with Section 7 and has elected upon withdrawal to be its own GSA.
  - The imposition of any fees, charges, assessments, taxes, or other exactions related to groundwater management, extraction, monitoring, and the implementation of SGMA or the GSP on any Member or the landowners within the political boundaries of any Member.
  - The exercise of authority set forth in Water Code section 10726.4, subdivisions (a)(2) and (a)(3), including any regulations limiting, suspending, or controlling groundwater extractions.
- Authority – The EAGSA's MOU includes the following authority:
  - The EAGSA shall assume the following authority as set forth in Water Code sections 10725 - 10726.9
  - Unanimous consent of the Members is necessary to expand the authority set forth herein or to add additional limitations on authority.

1.5.9 Public Engagement Process

This section identifies opportunities for public engagement and discusses how public input and response were used in GSP development.

1.5.9.1 Opportunities for Engagement

The EAGSA provided a variety of opportunities for public engagement and involvement including the following:

- Information
  - Outreach materials – project description factsheet, frequently asked questions, EAGSA GSP development and implementation timeline (provided on the website), hardcopies of the project brief and schedule (provided at public workshops and to libraries and Shasta Health Centers), and Rural Community Assistance Corporation training. In addition, the outreach team provided the Spanish and English SGMA brochure to libraries and Health Centers in COA and COR.
  - The EAGSA partnered with organizations to write about the EAGSA and solicit comments and promote meetings in newsletters.
    - Shasta Tehama Watershed Education Coalition
- Solicitation and documentation of comments
  - Public Workshops – solicited verbal comments, comment cards, and invited emails
  - EAGSA Board Meetings – public comment period
  - GSP Chapters – solicitation and documentation of comments via Google form survey
  - Invitation to email comments and letters
  - Targeted Briefings – meetings to present and solicit comments in small groups or one-on-one
  - Individual interviews – outreach interviews and follow-up interviews to clarify comments received in writing
  - GSP Public Comment Portal – solicitation and documentation of comments and responses on individual GSP chapters and the Draft GSP via the web-based tool housed on the EAGSA website

1.5.9.2 Encouragement of Active Involvement

SGMA requires GSAs to consider the interests of all beneficial uses and users of groundwater as a part of GSP development and implementation. Furthermore, as is stated in Water Code § 10727.8:

> The GSA shall encourage the active involvement of diverse social, cultural, and economic elements of the population within the groundwater basin prior to and during the development and implementation of the GSP.

To plan and implement public outreach to meet these requirements, the EAGSA developed a Communications & Engagement Plan (Appendix C). The following sections describe how the EAGSA has encouraged active involvement in GSP development.

1.5.10 Disadvantaged Communities

The COA and COR lying within the Enterprise and Anderson Subbasins are both DACs according to the DWR DAC Mapping Tool.[3]

DWR has developed a web-based application (DAC Mapping Tool) to assist in evaluating DAC status throughout the State. This publicly available mapping tool shows DACs of California in funding areas as recognized pursuant to California Proposition 1 and Proposition 84. DAC Block Groups, Tracts, and Places depict data from the U.S. Census American Community Survey 2010-2018 showing census block groups identified as DACs (less than 80 percent of the state's median household income [$56,982]) or SDACs (less than 60 percent of the state's median household income [$42,737]). Figures 1-2 through 1-4 present DACs and SDACs identified by the DWR DAC Mapping Tool in Places (DWR, 2021a; Figure 1-2), Tracts (DWR, 2021b; Figure 1-3), and Blocks (DWR, 2021c; Figure 1-4) in the greater Redding area. The U.S. Census designations are as follows:

- Census Places – Populated areas that generally include one officially designated but currently unincorporated community, for which the Place is named, plus surrounding inhabited countryside of varying dimensions and, occasionally, other, smaller unincorporated communities as well.
- Census Tracts – subdivisions of county of 4,000 people
- Census Blocks – subdivisions of tracts of 1,500 people

There is a large area of unpopulated open space overlying the Enterprise and Anderson Subbasins (as is presented on Figure 2-4 of each GSP). The total area of DACs (light brown) and SDACs (dark brown)presented on Figures 1-2 through 1-4 represents approximately 18,140 and 15,400 acres for the Enterprise and Anderson Subbasins, respectively. A comparison of these areas with the total populated area of the subbasins (18,600 acres [Enterprise Subbasin] and 15,417 acres [Anderson Subbasins]) suggests that 97.5 percent and 99.9 percent of the populated areas of the Enterprise and Anderson Subbasins, respectively, represent DACs or SDACs, including COR and COA. As such, all components of this GSP (including water supply/use, potential impacts, and EAGSA Board representation) are considered to be reflective of and applicable to DACs and SDACs.

In addition to being identified as DACs, COR and COA both have non-English-speaking Hispanic or Latino populations. The following population data for COR and COA have been retrieved from the U.S. Census Bureau's data from 2015-2019.

1.5.10.1 City of Anderson Spanish Speakers

The U.S. Census reports that COA has 13.2 percent Hispanic or Latino population and that 8.5 percent of the total population speaks a language other than English at home in persons age 5 or older (U.S. Census Bureau, 2019a). Furthermore, census data from 2017 show that of languages spoken at home other than English, Spanish is the largest among persons 5 years and older. Of the COA population, 5.3 percent or 491 people speak Spanish at home, and 0.7 percent of the COA population or 64 people speak English less than very well (U.S. Census Bureau, 2017). This level of detail is not yet available in the U.S. Census 2019 data release; thus, the 2017 and 2019 estimates must be correlated to deduce that the highest population of non-English speakers in COA is Spanish speaking.

[3] https://gis.water.ca.gov/app/dacs/

1.5.10.2 City of Redding Spanish Speakers

The U.S. Census reports that COR has 10.7 percent Hispanic or Latino population and that 9.7 percent of the total population speaks a language other than English at home in persons age 5 or older (U.S. Census Bureau, 2019b). Furthermore, census data from 2017 show that of languages spoken at home other than English, Spanish is the largest among persons 5 years and older. Of the COR population, 4.4 percent or 3,806 people speak Spanish at home, and 1.1 percent of the COR population or 905 people speak English less than very well (U.S. Census Bureau, 2017). This level of detail is not yet available in the U.S. Census 2019 data release; thus, the 2017 and 2019 estimates must be correlated to deduce that the highest population of non-English speakers in COR is Spanish speaking.

1.5.10.3 Mutual and Private Water Companies Serving Disadvantaged Communities

COR and COA are home to a cluster of mutual and private water companies that serve economically disadvantaged populations. The mutual and private water companies are mostly mobile home and recreational vehicle parks that are likely to be serving populations who are economically disadvantaged. A handful of schools in the Enterprise and Anderson Subbasins also manage their own small water systems and appear on the list of the area’s private and mutual water companies. Between the schools and the mobile home and recreational vehicle parks, these mutual and private water companies serve a population of economically disadvantaged citizens in the Enterprise and Anderson Subbasins.

1.5.10.4 Outreach to Spanish Speakers and Mutual and Private Water Companies

To encourage active involvement from the COR and COA DAC populations, including the Spanish-speaking population and the mutual and private water companies, the following steps were taken:

- Developed and distributed Spanish-language notification of the public workshop with the SGMA Spanish brochure.
- Coordinated the display of Spanish-language outreach materials at the Shasta Health Centers in COA and COR. These centers serve people who are economically disadvantaged and also speak Spanish as their first language.
- Coordinated display of Spanish-language outreach materials and public meeting notices at the COA and COR public libraries.
- Conducted outreach calls and left voicemails to municipal and private water companies serving between 101 and 600 people including Anderson High School to offer briefings and opportunities to solicit comments.
- Mailed hardcopy notices to all municipal and private water companies for whom we had neither email nor phone number to solicit responses to be added to the interested parties list.
- Hosted two EAGSA public meetings with one in-person meeting in downtown Redding at First United Methodist Church in October 2019. This church has plenty of parking space and is accessible by car within 13 miles of COA and by foot from parts of COR. The second EAGSA public meeting was held via the internet in May 2021. This second public meeting was not held in-person because of in-person restrictions due to the COVID-19 pandemic.

1.5.10.5 Municipal and Private Water Companies

In the Communications & Engagement Plan (Appendix C-1), municipal and private water companies are identified as key users of the groundwater resources affected by the GSP. Municipal and private water companies meeting the following priority criteria were targeted for focused outreach:

- Population served, with a higher priority on larger populations
- Community water systems that provide water all day to residents
- Schools – Non-transient non-community water systems that are providing water to sensitive populations (schoolchildren) on a daily basis

Eighteen municipal and private water companies in the Enterprise and Anderson Subbasins of RAGB serve 101 to 600 people, and one municipal and private water company serves more than 600 people (Table 1-6). Eight of these water companies are located in the Anderson community. See Appendix C-1: Table of Municipal and Private Water Companies and Connections.

Table 1-6. Outreach Material

Date and Organization	Contact	Target Audience	Outreach Materials
August 2019 Redding and Anderson Libraries	Various contacts	Redding and Anderson residents	Outreach Materials: Project brief, FAQ, timeline, and public meeting announcement for posting on public message board. Spanish/English public meeting announcement and Spanish SGMA brochure
Shasta Health Center August 5, 2019	Suvee Semore, Center Manager	DAC of Anderson Spanish-speaking residents	Outreach Materials: Spanish/English public meeting announcement and Spanish SGMA brochure Project brief, FAQ, timeline, and public meeting announcement for posting at Anderson and Redding Health Centers
August 27, 2019 8:30 a.m.–2:30 p.m. Rural Community Assistance Corporation Small Water Systems Training, Redding	Kathleen Hiott	Municipal and Small Water Systems	Outreach Materials: Project brief, FAQ, timeline, and public meeting announcement handed out to participants in workshop

Note:

FAQ = frequently asked questions

1.5.11 Interbasin Coordination

Interbasin coordination is an important component of GSP development and implementation. Because the groundwater subbasins in the RAGB are hydrologically interconnected, water management decisions and actions in a given subbasin could affect groundwater conditions in adjacent subbasins. Of the five subbasins in the RAGB, the Enterprise and Anderson Subbasins are designated as medium priority; thus, GSPs must be prepared for these subbasins by January 2022 (DWR, 2020c). Although the remaining subbasins (Bowman, Millville, and South Battle Creek) are designated as very low priority (therefore not required to develop GSPs), Tehama County is voluntarily developing a GSP for the Bowman Subbasin.

The EAGSA used the same approach to develop the GSPs for both the Enterprise and Anderson Subbasins; therefore, the SMCs and projects and management actions in one subbasin will not affect the sustainability of the other subbasin.

The EAGSA technical teams have participated in interbasin coordination with the Tehama County GSA technical team regarding the Anderson and Bowman Subbasin GSPs and have participated in the North Sacramento Valley interbasin coordination meetings. Technical teams focused on exchanging technical information, such as approach to numerical model construction and application and estimated water budgets. Interbasin coordination among technical teams has primarily occurred via email, comparative technical analyses, and virtual meetings.

Interbasin coordination will continue, as appropriate, during GSP implementation. Due to their assessment of the state of the subbasins, the technical teams do not foresee a need for frequent interbasin coordination in the next couple years. The technical teams may meet annually during GSP implementation to share monitoring and modeling results and additional data along the boundaries between the Anderson and the Bowman Subbasin. They will continue to assess any potential impacts of planned projects and management actions, although, at this time, they have concluded that the GSP elements in each plan will not impact the sustainability of the other GSA's subbasin.

1.5.12 Notification

1.5.12.1 Formal Notification

In the beginning of the GSP planning stage, the public outreach team sent formal notification of the planning process to the tribes, adjacent basin, and legislative bodies as required by SGMA. The following lists the entities that received formal notifications:

- Tribes
  - Redding Rancheria
  - Pit River Tribe of California
  - Nor-Rel-Muk Tribe
  - Wintu Tribe of Northern California
  - Winnemum Wintu Tribe
- Adjacent GSAs
  - Tehama County GSA

1.5.12.2 Informal Notification

The public outreach team provided informal notifications of the planning process by email and hardcopy mail to the stakeholders on the interested parties list including the eligible but non-participating members, municipal and private water companies, and various other interested parties.

The public outreach team mailed hardcopy informal notifications including a printout of the email, project brief, timeline, and frequently asked questions to the private and mutual water companies without email addresses recorded in the interested parties list.

1.5.13 Outreach

This section describes the method the EAGSA followed to inform the public about progress in developing the GSPs.

Outreach conducted during GSP development included the following:

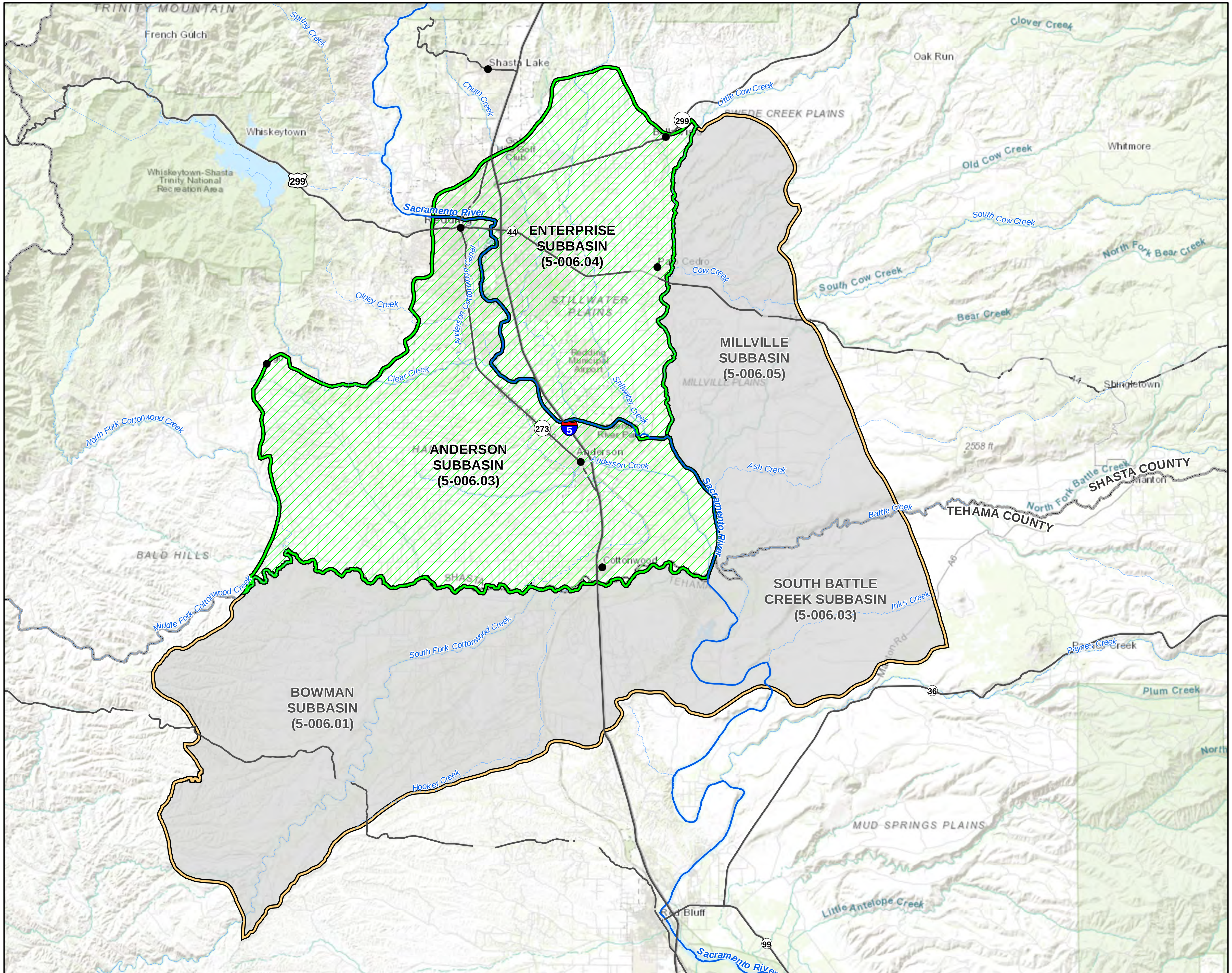
- Formal and informal notifications of start of GSP process to all interested parties, including:
  - Mailed formal notifications to all legislative bodies, tribes, and adjacent basins
  - Mailed notifications to all municipal and private water companies for which the EAGSA had no email or phone contact information
  - Emailed informal notifications to all on the interested parties list including legislative bodies and tribes

- Public notice of upcoming EAGSA Board meetings via the EAGSA website, emails to the interested parties list, and written publications posted in public spaces and/or in local newspapers.
- EAGSA webpage containing GSP-related information and providing access to meeting announcements, materials, and GSP chapters as completed.
- Press releases and targeted calls to promote the public workshops
  - Outreach calls to 18 municipal and private water companies serving the 101 to 600 people each
  - Outreach calls to eligible non-participating agencies
  - Print media – press release provided to the following media outlet:
    - Record Searchlight
  - Web media – press releases provided to the following web media outlets:
    - EAGSA member websites
    - COA Facebook page
    - A News Café
    - East Valley Times
- Outreach calls and emails inviting input
  - Outreach calls to 18 municipal and private water companies serving the 101 to 600 people each
  - Outreach calls to eligible non-participating agencies
    - Groundwater Leadership Forum – Local Government Commission
- Targeted briefings and interviews to solicit interests and concerns to inform GSP development
  - The Nature Conservancy
  - California Department of Fish and Wildlife
  - League of Women's Voters
  - Virginia Phelps, Member of the Public
- Outreach calls to partner agencies to solicit interest, promote the public workshops, and to solicit entities to reach their customers and networks through newsletters, meetings, and/or outreach materials
  - Shasta Health Center to understand how to reach their Latinx customers
  - Rural Community Assistance Corporation to understand how to promote the public workshop with municipal and private water company customers through their Rural Community Assistance Corporation trainings in Redding
  - Manager of the Whole Earth Watershed Festival to reach non-government organization and other distribution networks
  - Livingston Stone Fish Hatchery
  - Shasta Farm Bureau
  - Cattleman's Association
  - Shasta Tehama Watershed Education Coalition
  - University of California Extension
  - United Methodist Church
  - Reviewed existing festivals and community gatherings to assess if public meetings could be held in conjunction with other existing gatherings

- Placed outreach materials in libraries, Health Centers, and trainings serving target populations in Redding and Anderson of DAC residents, Spanish-speaking residents, and municipal and private water companies (Table 1-6).
- Updates to interested parties – The EAGSA provided email updates to the interested parties list with SMC fact sheets, video snips of public workshops, highlights from draft GSP chapters, and invitations to submit comments on draft chapters.

The EAGSA intends to continue public outreach and provide opportunities for engagement during GSP implementation. This will include providing opportunities for public participation, especially from beneficial users, at public EAGSA Board meetings, and providing access to GSP information online.

Public notice of any planned changes/amendments to the GSP (such as plan updates or proposed fees associated with groundwater management), annual GSP reports, and 5-year GSP updates will be provided by posting notice on the EAGSA webpage, by mail to any interested party who files a written request with EAGSA for mailed notice of GSP updates, and by email to the interested parties distribution list. Such notifications will be followed by convening an annual public workshop for presentation of the summary of the annual report content, including any proposed changes to the GSP, and to provide an opportunity for stakeholder engagement and feedback.



LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- COUNTY BOUNDARY LINE
- INTERSTATE/HIGHWAY
- EAGSA COVERAGE AREA
- REDDING AREA GROUNDWATER BASIN
- COUNTY BOUNDARY LINE

NOTES:

EAGSA = ENTERPRISE-ANDERSON GROUNDWATER SUSTAINABILITY AGENCY

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 4 8 Miles

FIGURE 1-1
ENTERPRISE ANDERSON GROUNDWATER SUSTAINABILITY AGENCY LOCATION
Anderson Subbasin Groundwater Sustainability Plan

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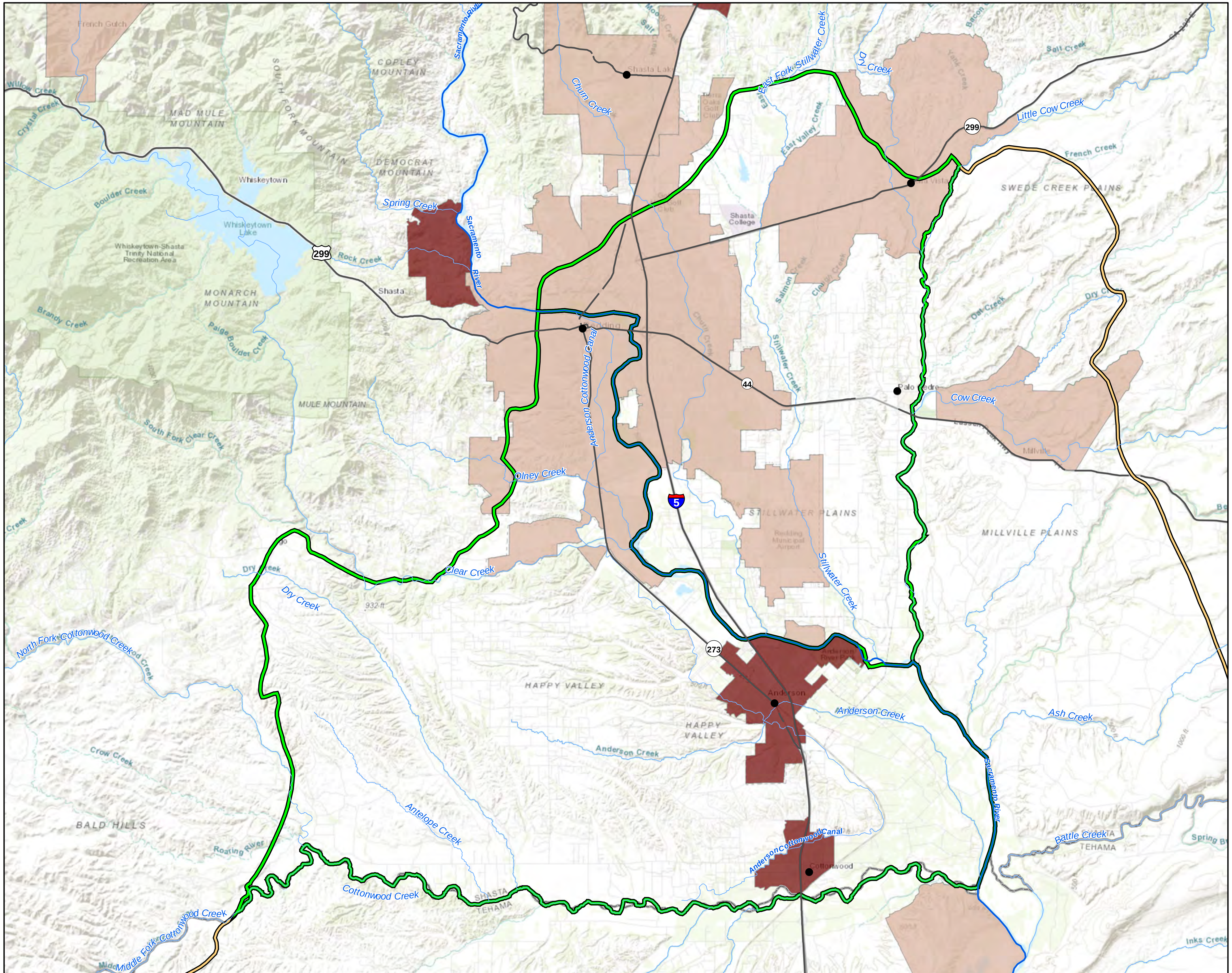
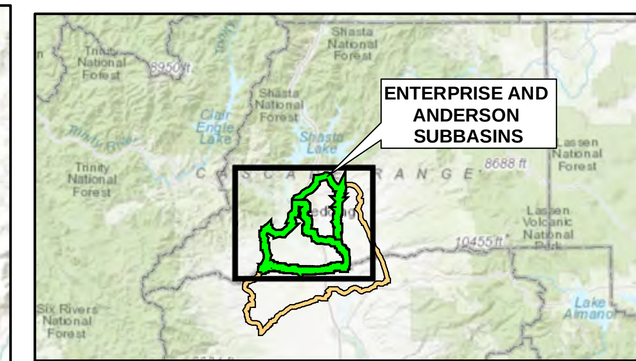
DATUM: NAD 1983. DATA SOURCE: DWR, 2019; ESRI, 2019; SHASTA COUNTY 2019

Jacobs





LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- SEVERELY DISADVANTAGED COMMUNITY
- DISADVANTAGED COMMUNITY
- ENTERPRISE AND ANDERSON SUBBASINS
- REDDING AREA GROUNDWATER BASIN

NOTES:

DATA SOURCE: DWR, 2021a

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2.5 5 Miles

FIGURE 1-2
DISADVANTAGED AND SEVERELY DISADVANTAGED COMMUNITIES BY CENSUS PLACES
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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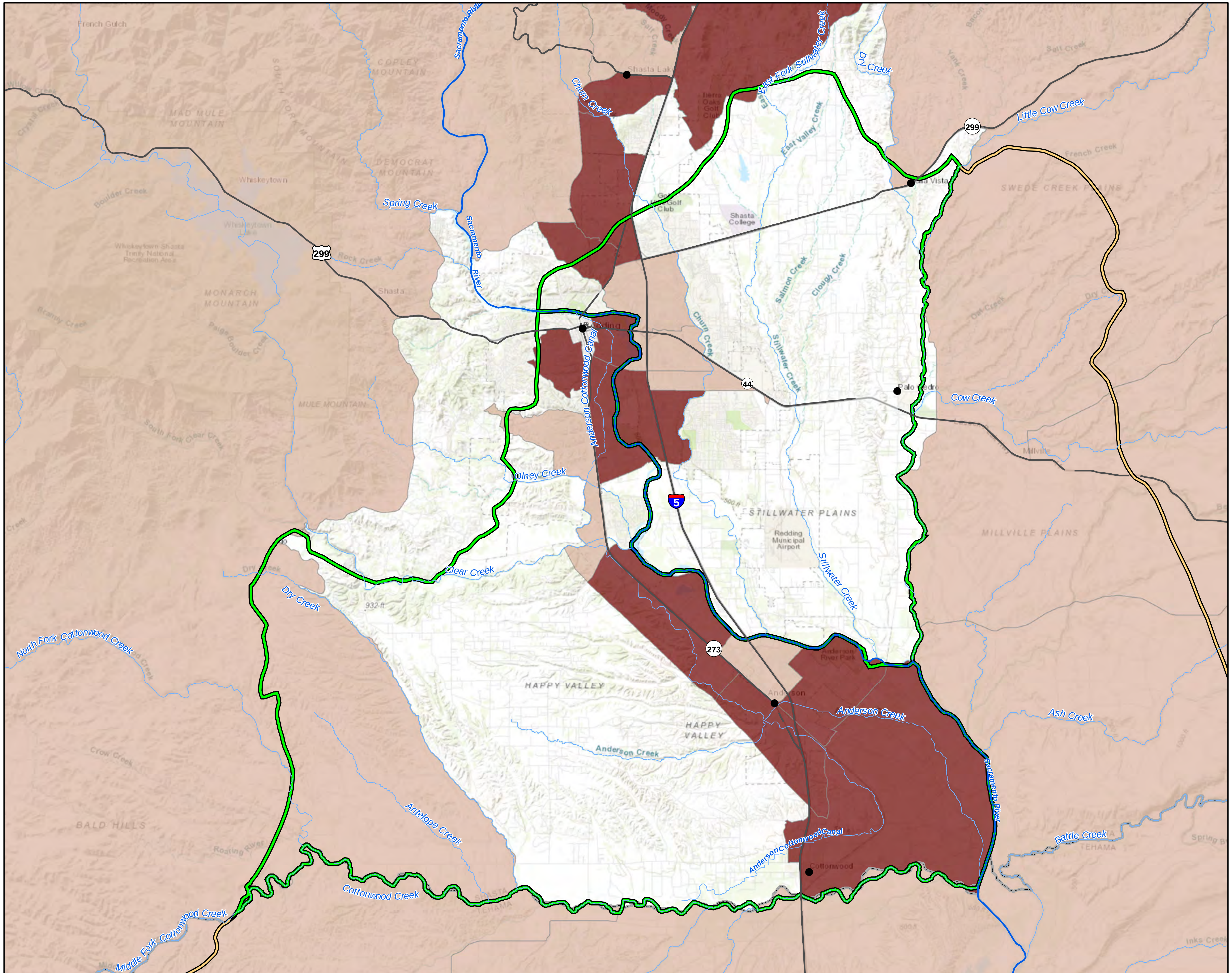

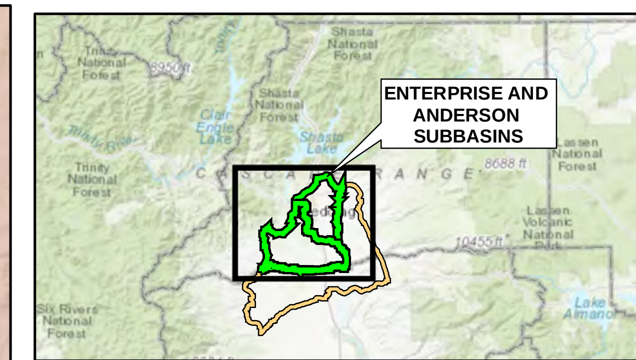

LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- SEVERELY DISADVANTAGED COMMUNITY
- DISADVANTAGED COMMUNITY
- ENTERPRISE AND ANDERSON SUBBASINS
- REDDING AREA GROUNDWATER BASIN

NOTES:

DATA SOURCE: DWR, 2021b

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FIGURE 1-3
DISADVANTAGED AND SEVERELY DISADVANTAGED COMMUNITIES BY CENSUS TRACTS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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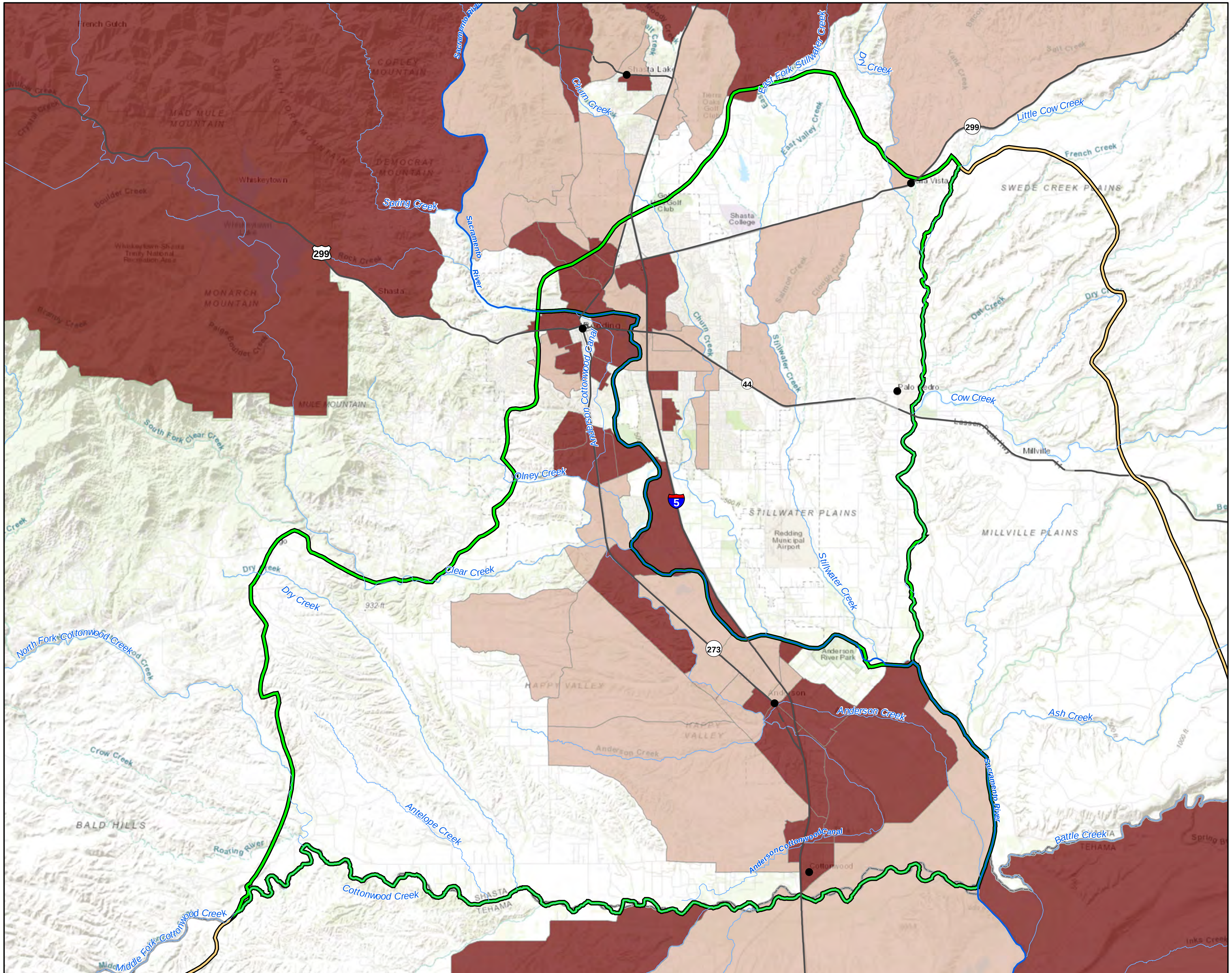

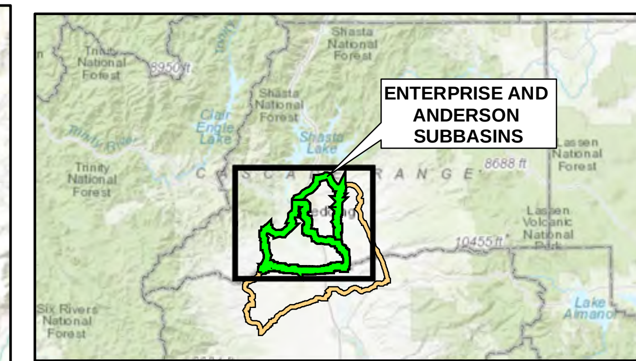

LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- SEVERELY DISADVANTAGED COMMUNITY
- DISADVANTAGED COMMUNITY
- ENTERPRISE AND ANDERSON SUBBASINS
- REDDING AREA GROUNDWATER BASIN

NOTES:

DATA SOURCE: DWR, 2021c

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2.5 5 Miles

FIGURE 1-4
DISADVANTAGED AND SEVERELY DISADVANTAGED COMMUNITIES BY CENSUS BLOCK GROUPS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

2. Plan Area

This GSP covers the Anderson Subbasin, a subbasin of the RAGB, as shown on Figure 2-1. This subbasin is under the jurisdiction of the EAGSA. The Anderson Subbasin lies in southwestern Shasta County and includes the northern end of the Sacramento River Valley. The subbasin covers an area of 98,700 acres, or 154 square miles (DWR, 2004).

The Sacramento River drains the subbasin, flowing southward down the Sacramento River Valley. The cities of Redding and Anderson, the towns of Centerville and Cottonwood, and the community of Happy Valley overlie the Anderson Subbasin. U.S. Interstate 5 runs north-south through the southeastern portion of the subbasin. State Highway 44 crosses the northern portion of the subbasin running east-west, and State Highway 273 runs along the eastern portion of the subbasin running north-south before merging with Interstate 5 in Anderson. Larger streams and major roads are also shown on Figure 2-1.

2.1 Adjudicated Areas, Other GSAs, and Alternatives

An adjudicated basin is one in which, through legal action, the basin has certain requirements placed on it by the court, and those requirements are normally administered by a watermaster who is appointed by the court. The Anderson Subbasin is not adjudicated.

The EAGSA overlies the entirety of the subbasin and is the only GSA overlying it. No alternative plans were submitted within the subbasin.

2.2 Jurisdictional Areas

In accordance with the GSP Regulations § 354.8 (a)(3), the following subsections describe the federal, State, tribal, and local agencies with water management responsibilities in the Anderson Subbasin.

2.2.1 Federal Jurisdiction

Areas under federal jurisdiction are shown on Figure 2-2. The U.S. Bureau of Land Management manages most of the area along Clear Creek within the Anderson Subbasin, an area north of Olney Creek, an area along the western boundary of the subbasin, and an area along the Sacramento River in the southeastern portion of the subbasin.

2.2.2 State Jurisdiction

Areas under State jurisdiction are shown on Figure 2-2. The California Department of Fish and Wildlife manages the Mouth of Cottonwood Creek Wildlife Areas, the Anderson River Park and Bonnyview Road Fishing Accesses, and an area along Clear Creek.

2.2.3 Tribal Lands

The subbasin includes the Redding Rancheria tribal lands.[4] The land that comprises the Redding Rancheria was originally purchased by the Bureau of Indian Affairs in 1922, but in 1959, the Redding Rancheria was terminated by an act of Congress. In 1983, however, it was ruled that the failure of the Bureau of Indian Affairs to comply with its obligations under the California Rancheria Act invalidated the termination, and the Redding Rancheria was restored as a federally recognized tribe. Redding Rancheria

[4] https://www.redding-rancheria.com/tribal-history/

lies within the jurisdiction of COR Water Utility, and in 2000, the two entities entered into an agreement to incorporate some of the COR municipal services in the Redding Rancheria. COR installed a master meter at the Redding Rancheria property line. Excluding water required to maintain sufficient flow for fire protection, the agreement specifies a maximum monthly volume of 7,800 hundred cubic feet monthly and a maximum annual volume of 39,350 hundred cubic feet (Redding Rancheria, 2001). Because this GSP was developed to be protective of groundwater resources within the Anderson Subbasin for all beneficial uses and users, tribal interests will be protected.

2.2.4 County Jurisdiction

The entire subbasin lies within Shasta County and is subject to the land and water management authorities granted to counties. Additionally, Shasta County Department of Public Works manages one sewer district within the Anderson Subbasin, County Service Area (CSA) #17 - Cottonwood Sewage Disposal System, shown on Figure 2-3.

2.2.5 City and Local Jurisdiction

The COR and COA Water and Wastewater Utilities provide water and sewage collection services within their respective jurisdictional areas, which are shown on Figure 2-3. ACID, CCCSD, Cottonwood Water District, Centerville CSD, and Igo-Ono CSD provide water services within their jurisdictional boundaries.

2.3 Land Use

Shasta County, COR, and COA maintain Geographic Information System (GIS) zoning databases, which store land use zoning designations throughout the unincorporated portions of the County and the cities, respectively. These databases were used to develop land use maps for the Anderson Subbasin, shown on Figure 2-4 and summarized by major category in Table 2-1 (Shasta County, 2020, COR, 2020a, and COA, 2020a). The zoning codes included in the County and COR GIS datasets were cross-referenced with those listed in the COR and Shasta County General Ordinances (Municode, 2020a, 2020b) and were generalized into the categories shown on Figure 2-4 and listed in Table 2-1. The COA zoning dataset contained generalized categories. The data presented represent the use for which a given area is zoned and might not be consistent with actual land use. However, the data presented effectively depict general land use patterns.

Table 2-1. Anderson Subbasin Land Zoning Summary

Category	Area in Anderson Subbasin (acres)	Percentage of Anderson Subbasin Area (%)
Agriculture	40,725	41.8
Commercial	2,518	2.6
Floodway	694	0.7
Habitat Protection/Open Space	2,591	2.7
Industrial	4,807	4.9
Mineral Resource	294	0.3
Planned Development	3,820	3.9
Public/Institutional	2,499	2.6
Rural Residential	14,393	14.8
Urban Residential	10,879	11.2
Unclassified	14,164	14.5
Total	**97,384**	

The most significant land use type in the subbasin is agriculture—almost 42 percent of the subbasin—which is dominated by pasture and orchards. Residential land use is also significant at approximately 26 percent. Based on the 2018 agricultural land use mapping made available by DWR, irrigated agriculture (approximately 7,900 acres) comprised the following amounts: approximately 63 percent pasture, 24 percent orchard, 6 percent idle, 4 percent grain and hay crops, 3 percent young perennial, and less than 1 percent miscellaneous truck crops and vineyards (CNRA, 2021).

2.3.1 Water Source Types

According to the GSP Regulations (§ 351. Definitions), "water source type represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface-water sources identified as CVP, the State Water Project, the Colorado River Project, local supplies, and local imported supplies." The Anderson Subbasin has two water source types: surface water and groundwater. Surface water diverted from the Sacramento River or from Whiskeytown Lake under Central Valley Project (CVP) contracts with Reclamation is the primary water source for all water sectors for most purveyors in the Anderson Subbasin. The primary water source for all water use sectors for COA Water Utility and Cottonwood Water District is groundwater (Figure 2-5). Throughout the subbasin, groundwater is primarily used for rural residential areas, small community systems, and small commercial operations, such as golf courses and schools. However, during times of drought, water districts in the subbasin become more reliant on groundwater; and as a result, it is used more broadly. The jurisdictional areas shown on Figure 2-5 were sourced directly from the responsible entities (ACID, 2015; COA, 2019; COR, 2020a; and Shasta County, 2019a).

Locations served by COR Water Utility receive a combination of CVP surface water and groundwater. CVP surface water is diverted from either the Spring Creek Conduit dropping from Whiskeytown Reservoir to Keswick Reservoir or from the Sacramento River at Pump Station 1. The surface-water supply is governed under two separate contracts with Reclamation and ACID (COR, 2015). Groundwater is used to augment the COR surface-water supply and is sourced from the Cascade and Enterprise well fields, consisting of 5 and 12 groundwater wells, respectively. Between 2000 and 2018, surface water represented approximately 65 percent of the COR water supply (an annual average of approximately 18,100 acre-feet [AF]), whereas approximately 35 percent of the COR water supply was sourced from groundwater (an annual average of approximately 10,100 AF) (COR, 2019a). The total COR water supply, as well as the water supplies of ACID, Centerville CSD, and Igo-Ono CSD discussed below, are not distributed solely to areas overlying the Anderson Subbasin, rather to the jurisdictional areas presented on Figure 2-5.

Locations served by COA Water Utility solely receive groundwater. Groundwater is pumped from ten groundwater wells—eight wells in the main city pressure zone and two wells in the Wooded Acres pressure zone—capable of producing approximately 9.6 million gallons per day (MGD) and 1.5 MGD, respectively (COA, 2017). Between 2000 and 2018, COA pumped an annual average of approximately 2,400 AF from its wellfield (COA, 2019).

ACID is contracted with Reclamation to receive a maximum of 125,000 AF of surface water diverted from the Sacramento River. The ACID base supply is 121,000 AF with an additional 4,000 of the CVP supply available for transfers to other districts. Between 2000 and 2018, total annual diversions averaged approximately 102,000 AF. Additionally, ACID owns two groundwater production wells, located in the Anderson Subbasin, that are used to supplement surface-water supply during years when water transfers occur. Transfers of up to 3,700 AF occurred in 2013, 2014, 2015, 2020, and 2021. During these years, groundwater was pumped in lieu of diverting an equivalent volume of surface water.

As previously discussed, Cottonwood Water District water source is solely groundwater, pumped from their five production wells in the southeast portion of the subbasin. These wells range in capacity from

154 gallons per minute (gpm) to 831 gpm (Shasta County, 2019b). Water is temporarily stored in a 0.1-million-gallon tank along Vantage Drive and a 1-million-gallon tank along Rhonda Road. Between 2006 and 2017, the annual average volume of water pumped by Cottonwood Water District was approximately 940 AF (SWRCB, 2019).

CCCSD's primary water source is surface water diverted through a contract with Reclamation for 15,300 AF of CVP water. This water is diverted from the Clair A. Hill Whiskeytown Dam, near which CCCSD has a treatment facility. After being treated, this water flows south to CCCSD through the Muletown Conduit. Reported annual diversion volumes between 2000 and 2018 averaged approximately 4,850 AF (CCCSD, 2019). CCCSD owns three groundwater production wells; however, they are reserved as a contingency for supply and have only been operated intermittently. Annual production during recent drought conditions (2014-2016) ranged from 150 to 425 AF.

The sole water source for Centerville CSD is CVP surface water diverted from Whiskeytown Reservoir at the Clair A. Hill Whiskeytown Dam. Centerville CSD shares approximately 25 percent of the capacity of the CCCSD water treatment plant. Between 2000 and 2018, the average annual volume of water diverted to Centerville CSD was approximately 1,650 AF (Centerville CSD, 2019).

Igo-Ono CSD diverts water from Rainbow Lake and North Fork Cottonwood Creek. Misselbeck Dam impounds the flow of North Fork Cottonwood Creek to form Rainbow Lake, and less than a mile downstream of Misselbeck Dam, Hoover Dam diverts water to the Happy Valley Irrigation Canal through Hoover Canal. Igo-Ono CSD holds a permit from SWRCB to continually divert 16.8 cubic feet per second (cfs) from North Fork Cottonwood during the irrigation season (March 15 to November 1), subject to restriction during periods of shortage. Water is conveyed to customers through a system of canals and ditches, and customers are responsible for treating water for domestic use (Shasta County, 2014). Between 2008 and 2018, average annual volume of water diverted from Rainbow Lake and/or North Fork Cottonwood Creek was approximately 4,000 AF (SWRCB, 2020d).

2.3.2 Water Use Sectors

As defined in § 351 (Definitions) of the GSP Regulations, "'water use sector' refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation." Water use sector data presented in this section represent water deliveries averaged over the period 2000–2018, or the portion of this time period for which data were available/provided. Data used in the water sector analyses were provided by the purveyors or SWRCB (COR, 2019a; COA, 2019; CCCSD, 2019; and SWRCB, 2019). Discussions of COR, ACID, and Centerville deliveries represent their entire service areas respectively, rather than deliveries only to areas overlying the Anderson Subbasin. Further evaluation of current and projected water use by sector will be provided in Chapter 4 Water Budgets. Water use sectors include the following:

- **Urban**. Urban water use is assigned to non-agricultural water uses in the cities and census-designated places (i.e., towns). For the purposes of this analysis, domestic use outside of towns is considered urban use in the rural residential category. COR Water Utility averages 25,000 AF of urban water use annually (single-family, multiple-family, commercial/institutional, and other/unknown uses), nearly 98 percent of its total deliveries. COA averages 1,650 AF of urban water use annually (residential), 78 percent of its total deliveries. The water sector associated with the remaining 22 percent (approximately 460 AF) of the deliveries is unavailable, but is assumed to be commercial/industrial/institutional. CCCSD averages approximately 1,840 AF of urban water use annually, 41 percent of its total deliveries. Between 2014 and 2017, Cottonwood Water District averaged approximately 760 AF of urban water use annually (single-family, multiple-family, and commercial/institutional uses), 98 percent of its total deliveries. Centerville CSD services mostly residential customers, and nearly

100 percent of its deliveries are considered urban, averaging approximately 1,400 AF annually between 2013 and 2018.

- **Industrial**. There is limited industrial use in the subbasin. COR Water Utility averages 500 AF of industrial water use annually, 2 percent of its total deliveries. Cottonwood Water District averages approximately 16 AF of industrial water use annually, 2 percent of its total deliveries. Centerville CSD averages approximately 5.1 AF of industrial deliveries annually, 0.4 percent of its total deliveries.
- **Agricultural**. For the purposes of this analysis, the agricultural water use sector is assumed to cover outdoor water use including irrigated agriculture and landscape irrigation. COR Water Utility averages approximately 30 AF of agricultural water delivery annually (irrigation), which is less than 1 percent of its total deliveries. ACID supplies water solely for agricultural use, representing 100 percent of the district's deliveries. CCCSD averages approximately 2,630 AF of agricultural water use annually, 59 percent of its total deliveries. Cottonwood Water District and Centerville CSD supply approximately 7.5 and 4.5 AF of water on average annually, respectively. This represents less than 1 percent of the deliveries for these districts.
- **Managed wetlands**. 2018 DWR land use records, which included ground-truthing of land use in Shasta County, indicate that there are no managed wetlands in the subbasin (CNRA, 2021).
- **Managed recharge**. There is no managed recharge in the subbasin. Although the temporary clean-water holding reservoirs and some wastewater ponds are unlined, recharge from these sources is considered to be negligible and has not been quantified. The ACID distribution system consists of a series of unlined canals and laterals that contribute to recharge of the underlying groundwater system. Previous work has estimated a volume of 44,000 AF/yr (30,000 AF/yr from the main canal and 14,000 AF/yr from the laterals) (CH2M HILL, 2001).
- **Native vegetation**. Most of the subbasin comprises commercial, industrial, agricultural, or residential land uses, while only approximately 2.7 percent is identified as "Habitat Protection/Open Space." Consumptive use by native vegetation will be refined through numerical modeling being conducted as part of this GSP.

2.4 Existing Well Types, Numbers, and Density

Well density data were obtained from the database of wells that DWR specifically developed for use in GSPs (CNRA, 2020). The well completion dataset represents counts of logs filed with DWR. Upon review of the database, it became apparent that some of the logs must have been input to the DWR database more than once, resulting in an over-estimate of well density. Furthermore, some of the wells included in the DWR database might have been abandoned or otherwise destroyed; therefore, the counts described herein might not be reflective of existing infrastructure. However, the DWR database is considered the best available well log information repository.

DWR's Well Completion Report Map Application classifies wells as domestic, production, and public (municipal). Figures 2-6a, 2-7a, and 2-8a show the density of domestic, public, and production wells, respectively, in the subbasin; and Figures 2-6a, 2-7b, and 2-8b show the average total depth of domestic, public, and production wells, respectively, in the subbasin. Well counts in the subbasin are summarized in Table 2-2. Over 90 percent of the wells in the DWR dataset are domestic wells. Many of the domestic wells identified by DWR may be classified as de minimis extractors, defined as pumping less than 2 AF per year (AF/yr) for domestic purposes. Production wells account for most of the remaining wells, approximately 5.3 percent. The majority of wells classified as production wells are assumed to be used for agricultural irrigation, with some production wells used for industrial purposes. Approximately 1.4 percent of wells in the subbasin are classified as public supply wells. As previously discussed, public (municipal) wells are pumped intermittently to augment surface-water supplies.

Table 2-2. Anderson Subbasin Well Density

Category	Number of Wells	Percentage of Total
Domestic	3,812	93.3
Public Supply	59	1.4
Production	216	5.3
Total	**4,087**	

2.5 Existing Groundwater-level Monitoring Programs

2.5.1 California Statewide Groundwater Elevation Monitoring Program

The California Statewide Groundwater Elevation Monitoring Program (CASGEM) was instituted as a result of the passing of SB X7-6 in 2009. CASGEM is overseen by DWR. CASGEM is intended to facilitate collaboration between State and local entities in support of the collective goal of more sustainably managing groundwater resources, as required under SGMA (DWR, 2019a). CASGEM requires the collection and analysis of groundwater data across the state and requires the collected information be made publicly available. Monitoring and reporting is conducted by local monitoring parties under groundwater monitoring and management programs, as well as DWR. There are nine locations with 20 CASGEM wells in the Anderson Subbasin; they are shown on Figure 2-9. Shasta County is the CASGEM monitoring entity for the Anderson Subbasin. Shasta County gauges well 30N/06W-03M01, whereas DWR gauges the remaining 19 CASGEM wells.

2.5.2 DWR Continuous Groundwater Elevation Monitoring

The DWR continuously collects groundwater elevation data from a network of 20 wells within the Anderson Subbasin, as shown on Figure 2-9. The period of record varies by well location, but monitoring frequency is generally monthly (DWR, 2019b). Eighteen of these wells are also monitored under the CASGEM program. Two of the wells (30N/04W-10H02 and 30N/04W-10H03) are no longer monitored and have been replaced by continuous gauging at replacement wells 30N/04W-10H04 and 30N/04W-10H05.

2.5.3 DWR Periodic Groundwater Elevation Monitoring

DWR has periodically collected groundwater elevation data from a network of up to 20 wells within the Anderson Subbasin, as shown on Figure 2-9. The period of record varies by well location as does the monitoring frequency. Wells have typically been accessed biannually, but as frequently as quarterly (DWR, 2019b).

2.5.4 U.S. Geological Survey Groundwater Elevation Monitoring

As shown on Figure 2-9, U.S. Geological Survey (USGS) has periodically gauged six wells within the Anderson Subbasin (USGS, 2019a). USGS has recently begun monitoring well 30N/06W-35L01, which has historically been monitored by DWR. USGS has monitored each well location once, with measurement dates ranging between January 2018 and April 2019.

2.6 Groundwater Extraction Monitoring Programs

Purveyors in California that supply drinking water to residents (public water systems) are required to submit annual reports regarding water supply and delivery volumes to the SWRCB Division of Drinking

Water (DDW) (Large Water System or Small Water System Reports). The DDW defines a public water system as "a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year."[5] Groundwater-related information reported to the DDW includes the number and location of groundwater production wells and the volume of groundwater pumped from each well per month. COR, COA, Cottonwood Water District, and CCCSD monitor groundwater production from their wellfields for internal use as well as for reporting purposes.

2.7 Groundwater Quality Monitoring Programs

2.7.1 State Water Resources Control Board Division of Drinking Water

The DDW maintains groundwater quality data records for both active and inactive public drinking water wells (systems with at least 15 connections or serving at least 25 people per day) (SWRCB, 2020b). Groundwater quality data reported by purveyors and maintained by DDW generally reflect untreated groundwater and might not be representative of drinking water supplied to customers. The DDW groundwater quality monitoring program in Anderson Subbasin includes 95 groundwater wells sampled between 1951 and 2019; however, the period of record and sampling frequency varies by well. Figure 2-10 presents the location of wells sampled between 2000 and 2019 (80 wells).

2.7.2 California Department of Water Resources

As part of DWR's Groundwater Ambient Monitoring and Assessment Program (GAMA), the department periodically samples wells to evaluate groundwater quality relative to a basin or subbasin's beneficial uses (SWRCB, 2020b). Figure 2-10 presents the location of 14 wells sampled by DWR between 2000 and 2019.

2.7.3 U.S. Geological Survey

USGS has periodically collected groundwater quality data under the GAMA program (SWRCB, 2020b). Figure 2-10 presents the location of 32 wells sampled between 2000 and 2019.

2.7.4 Environmental Compliance Monitoring

As discussed further in Chapter 3 Basin Setting, there are multiple sites at which groundwater quality monitoring is conducted as part of investigation or compliance monitoring programs through RWQCB and/or DTSC. Figure 2-10 presents the location of 295 wells sampled between 2000 and 2019 for environmental compliance purposes (SWRCB, 2020b).

2.7.5 Other Groundwater Quality Monitoring

In addition to the aforementioned groundwater quality monitoring programs, municipal and community water purveyors routinely collect water quality samples for compliance monitoring and reporting. Below are summaries of water purveyors and their monitoring programs.

The COA and COR Public Works Departments, Cottonwood Water District, CCCSD, and Centerville CSD each provide an annual Consumer Confidence Report to their customers (COA, 2020b; COR, 2020b; Cottonwood Water District, 2020; CCCSD, 2020; Centerville CSD, 2020). Consumer Confidence Reports

[5] State Water Resources Control Board, Division of Drinking Water Public Water System Legal Definitions, https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/publicwatersystems.html

are designed to provide their customers with summary information on the purveyor's water supply sources, the levels of any detected contaminants, and compliance with drinking water regulations.

2.8 Surface-water Monitoring Programs

2.8.1 U.S. Geological Survey Stream Gauges

USGS currently operates two streamflow gauges relevant to the Anderson Subbasin (Figure 2-11; USGS, 2019a):

- Clear Creek near Igo (USGS Site #11372000)
- Cottonwood Creek near Cottonwood (USGS Site #11376000)

2.8.2 Sacramento Watershed Coordinated Monitoring Program

The Sacramento Watershed Coordinated Monitoring Program (included in the surface-water ambient monitoring program) is a coordinated effort between DWR and Central Valley RWQCB to monitor ambient surface-water quality at locations on the Sacramento River and at the lower reaches of tributaries to the Sacramento River (SRWP, 2020). The locations extend from north of Lake Shasta to as far south as Verona, California, and include two locations in the Anderson Subbasin: Clear Creek near Redding and Cottonwood Creek near Cottonwood. The program was initiated in November 2008 and has since engaged in quarterly sampling for several chemical, physical, and biological parameters and annual monitoring of water column and sediment toxicity.

2.9 Incorporating Existing Monitoring Programs into the GSP

Incorporation of existing monitoring programs into the GSP is discussed in Chapter 6 Sustainable Management Criteria.

2.10 Limits to Operational Flexibility

The existing monitoring programs are not anticipated to limit the operational flexibility of this GSP.

2.11 Existing Management Plans

2.11.1 Northern Sacramento Valley Integrated Regional Water Management Plan

The Sacramento Valley Integrated Regional Water Management Plan (IRWMP) was published in December 2006 as part of the regional planning process consistent with DWR's Bulletin 160 (California Water Plan), the SWRCB's Strategic Plan, its Watershed Management Initiative, and the basin planning process, and other authorities, such as the Groundwater Management Act of 1992 (AB 3030) and SB 1938 (NCWA, 2006).

In 2014, six counties in the northern Sacramento Valley (i.e., Butte, Colusa, Glenn, Shasta, Sutter, and Tehama) published the Northern Sacramento Valley (NSV) IRWMP (Butte County et al., 2014). The IRWMP is intended to provide a framework and forum to guide the development of water resources policies, programs, and projects with the overarching statement of intent, which reads as follows:

> *To establish a regional collaborative structure with the objective of ensuring an affordable, sustainable water supply that supports agricultural, business, environmental, recreational, and domestic needs of the Northern Sacramento Valley.*

To meet this intent, the NSV IWRMP identifies the following six goals:

- Water supply reliability
- Flood protection and planning
- Water quality protection and enhancement
- Watershed protection and management
- Integrated regional water management (IRWM) sustainability
- Public education and information dissemination

Between four and twelve objectives are associated with each goal. These objectives are ranked as foundational (essential for determining baseline conditions), critical (directly addresses public health and safety), high (addresses economic health), and medium (addresses environmental concerns). The NSV IRWMP further provides a description of the plan development, potential project ranking and selection processes as well as future project solicitation procedures (updated in 2016 to include open solicitation of potential projects at any time), resources management strategies considered during potential project selection, and an overview of plan implementation strategy. The appendixes of the NSV IRWMP include lists of both the over 100 ranked potential projects submitted for consideration (currently housed in an online project database) and unranked projects to track ("*included in the IRWMP to acknowledge projects that may be on the horizon for future consideration but which are not yet developed enough to be ranked according to the criteria of the prioritization process*").

In March 2020, the NSV Board approved updates to the NSV IRWMP.[6] These updates are included as Appendix N to the NSV IRWMP. Updates to the plan are intended to bring the NSV IRWMP into compliance with California Proposition 1 (Water Bond). This includes amendments to:

- Chapter 1: Governance and Region Description
  - If the IRWM region has areas of nitrate, arsenic, perchlorate, or hexavalent chromium contamination, the plan must describe location, extent, and impacts of the contamination; actions undertaken to address the contamination; and any additional actions needed to address the contamination.
  - Describe likely climate change impacts on their region as determined from the vulnerability assessment.
- Chapter 2: Goals and Objectives
  - Address adapting to changes in the amount, intensity, timing, quality, and variability of runoff and recharge.
  - Consider the effects of sea level rise on water supply conditions and identify suitable adaptation measures.
- Chapter 3: Plan Development Process, Schedule, and Phasing
  - Present a public process that provides outreach and opportunity to participate in the IRWMP; and specifically, coordination with Native American Tribes is to be conducted on a government-to-government basis.
  - Identify process to involve and facilitate stakeholders during development and implementation of IRWMP regardless of ability to pay; include description of any barriers to involvement.

[6] https://nsvwaterplan.org/category/nsv-irwmp-news/

- Chapter 4: Resource Management Strategies
  - Consider all 32 California Water Plan resource management strategy criteria listed in the California Water Plan Update 2013. Identify resource management strategies incorporated in the IRWMP.
  - Factor climate change effects on the IRWM region into resource management strategies. Identify and implement, using vulnerability assessments and tools such as those provided in the Climate Change Handbook, resource management and adaptation strategies that address region-specific climate change impacts.
- Chapter 5: Project Selection Process and Procedure
  - Include a set of eight climate change and greenhouse gas emissions considerations in review factors.
  - Discuss how the plan relates to these other planning documents and programs. Water Code § 10562 (b)(7) requires the development of a stormwater resource plan and compliance with these provisions to receive grants for stormwater and dry-weather runoff capture projects. Upon development of the stormwater resource plan, the Regional Water Management Group shall incorporate it into IRWMP. The IRWMP should discuss the processes to incorporate such plans.
  - Demonstrate information sharing and collaboration with regional land use planning to manage multiple water demands throughout the state, adapt water management systems to climate change, and potentially offset climate change impacts to water supply in California.
- Chapter 6: Implementation Strategy
  - Ensure efficient use of available data, access to data, and ensure the data generated by IRWMP implementation activities can be integrated into existing State databases.
- General Amendments Addressing Climate Change
  - Consider the effects of sea level rise on water supply conditions and identify suitable adaptation measures for areas of the State that receive water imported from the Sacramento-San Joaquin River Delta, the area within the Delta, and areas served by coastal aquifers.
  - Contain a plan, program, or methodology for further data gathering and analysis of prioritized vulnerabilities.
  - Address adapting to changes in the amount, intensity, timing, quality, and variability of runoff and recharge.

2.11.2 Redding Basin Water Resources Management

Phase 1 of the Redding Basin Water Resources Management Plan, also referred to as the Shasta County Water Resources Master Plan, was completed in 1997 as a first step toward ensuring the water supply needs of RAGB would be met as population expanded. This study was funded by RAWC, a group of water purveyors, industries, and private interests in an effort to identify current and long-term water supply needs. Although RAGB is bisected by the Sacramento River and has abundant natural water supply, water purveyors have been challenged by severe cutbacks on their annual contracted surface-water supply. Accounting for increasing demand, driven primarily by increasing population, it became clear that water purveyors would have to begin using RAGB to ensure an ample water supply. This master plan provided a regional planning framework, quantifying projected water demand through the year 2030 and identifying objectives for subsequent phases.

Phase 2, completed in 2003, consisted of three documents: Phase 2A, Phase 2B, and Phase 2C (CH2M HILL, 1997; 2001; 2003). Phase 2A identified the main problems facing water purveyors and users, and set relevant goals to develop a comprehensive GMP. Three main purposes for the plan were as follows:

- Avoid or minimize conditions that adversely affect groundwater availability and quality within the basin
- Develop a monitoring and data collection program to help protect local beneficial use of groundwater resources
- Implement the elements of the GMP by achieving basinwide consensus

Phase 2B, initiated in March 1999, sought to implement the now-developed Water Resources Management Plan by investigating a variety of actions aimed at increasing the reliability of water supply. To help achieve this end, Phase 2B included development of an integrated water resources model for the basin and engaged in extensive public outreach in the cities of Redding, Anderson, and Shasta Lake. Phase 2C outlined and evaluated several water resources management alternatives, developed from actions identified in Phase 2B. Two committees, the Policy Advisory Committee and the Technical Advisory Committee, reviewed draft work products and planning assumptions, and made appropriate adjustments to develop three conceptual alternatives. These alternatives included varying degrees of reliance of surface water and groundwater as well as other management actions.

Phase 3, completed in 2007, consists of an Environmental Impact Report, seeking to investigate long-term implementation of each alternative (CH2M HILL, 2007). Each alternative was evaluated, and a recommendation was made to accept the alternative that maximized operational flexibility, making use of both surface-water and groundwater supplies.

2.11.3 Anderson-Cottonwood Irrigation District Groundwater Management Plan

The ACID GMP, released in 2006, describes the ACID system, including information on water supply sources, historical and projected water use through 2030, water quality, and water shortage contingency measures (ACID, 2006). As previously described, ACID relies primarily on surface water from the CVP and augments their surface-water supply with groundwater from their two production wells (although the district wells were installed subsequent to the GMP). The ACID GMP describes that it is a priority for ACID to increase water supply reliability, in part by expanding groundwater use to decrease reliance on CVP water.

ACID established a pre-1914 water right for diversions from Sacramento River and its tributaries and, in 1967, entered into a contracted agreement with Reclamation that quantified their entitlement as a “Base Supply” of 165,000 AF and 10,000 AF of “Project Water” for a total contracted entitlement of 175,000 AF. As of 2006, this contract was renegotiated to a total of 125,000 AF—121,000 AF Base Supply and 4,000 AF Project Water. ACID has two diversion points on the Sacramento River. The main supply is diverted from the Sacramento River at Caldwell Park in the COR, and a supplemental supply is diverted from the Churn Creek Lateral Pump Station on the southern edge of Redding, near the South Bonnyview Bridge.

ACID’s service area encompasses approximately 32,000 acres and directly serves approximately 7,000 acres. This includes areas within the Enterprise, Anderson, and Bowman Subbasins of the RAGB. Approximately 90 percent of the water supplied by ACID is used to irrigate pasture, with the remaining 10 percent supplied to orchards and food crops. No potable water is supplied by ACID.

2.12 Urban and Federal Water Management Plans

2.12.1 City of Anderson Urban Water Management Plan

The COA UWMP was produced in accordance with the Urban Water Management Planning Act of 1983 and released in 2017 (COA, 2017). This UWMP describes the COA water system, including information on water supply sources, historical and projected water use through 2035, water quality, water supply reliability, water shortage contingency planning, and water conservation/demand management measures. COA Water Utility supplies consist solely of groundwater pumped from the RAGB through 10 active groundwater wells. Eight of the city's wells are located in the main City pressure zone, and the other two are in the Wooded Acres pressure zone. The eights wells in the City pressure zone produce 90 percent of COA water supply. The effective capacity of the 10 wells operated by the COA is suitable to meet projected demand through 2035.

2.12.2 City of Redding Urban Water Management Plan

The COR UWMP was produced in accordance with the Urban Water Management Planning Act of 1983 and released in 2015 (COR, 2016a). The UWMP describes the COR water system, including information on water supply sources, historical and projected use through 2035, water quality, and water shortage contingency measures. COR water supplies described in the plan are as follows:

- Surface water from the Sacramento River – 21,000 AF/yr
- Surface water from Whiskeytown Lake – 6,140 AF/yr
- Groundwater pumped from the RAGB – 11,000 to 13,400 AF/yr
- Transfers of up to 4,000 AF/yr from ACID as a supplemental water supply, if needed

Furthermore, the COR UWMP describes demand management measures to meet the conservation requirements established by the Water Conservation Act of 2009 SB X7-7, a 20 percent reduction in water use by 2020. Forecasts indicated that the city's diverse water supply would be more than sufficient, even during multiple dry-year events. Furthermore, the city's water consumption was on a declining trend coming into 2015, helping the city to achieve 20 percent reduction in usage. The city included a Water Use Reduction Plan that sought to combat overuse through education, outreach, aggressive leak detection, and infrastructure updates. It is anticipated that an update to this plan will be released in 2021.

2.12.3 City of Redding Federal Water Management Plan

The City of Redding Federal Water Management Plan (WMP) includes a description of the COR Water Utility, including population, land use and water supply infrastructure, an inventory of water resources, best management practices (BMPs) for agricultural and urban contractors, and water inventory tables (COR, 2016b).

2.12.4 Clear Creek Community Services District Water Management Plan

The CCCSD WMP consists of four sections: description of the district, inventory of water resources, BMPs for agricultural contractors, and BMPs for urban contractors (CCCSD, 2015). Section 1 of the WMP describes the district's history, facilities and infrastructure, physical setting, operating rules, billing structure, and water shortage allocation policies. Section 2 of the WMP provides an overview of the district's surface and groundwater resources, water quality monitoring practices, and water use within the district. Sections 3 and 4 describe BMPs for agricultural and urban water users.

2.13 Existing Groundwater Regulatory Programs

2.13.1 Groundwater Export Permitting

Section 18.08 of the *Codification of the General Ordinances of Shasta County, California* (Municode, 2020a) specifies that:

> *It is unlawful to extract groundwater underlying lands in Shasta County for export of that groundwater, either directly or indirectly, without first obtaining a permit as provided in this chapter. For purposes of this section, the extraction of groundwater to replace a surface water supply which has been, is being, or will be exported for commercial purposes shall be considered an extraction of groundwater that is subject to this chapter.*

The general ordinances further describe exclusions to the permit process (such as to prevent flooding) and the procedures for filing and processing a groundwater export permit (such as conducting environmental review required under the California Environmental Quality Act). The ordinance states that:

> *The permit may only be granted if there is a majority of the total membership of the commission present at the required public meeting and a majority of the total membership of the commission finds that the proposed groundwater extraction will not have significant detrimental impacts on the affected groundwater basin by determining that:*
>
> *A. The proposed extraction will not cause or increase an overdraft of the groundwater underlying the county;*
>
> *B. The proposed extraction will not adversely affect the long-term ability for storage or transmission of groundwater within the aquifer;*
>
> *C. The proposed extraction will not exceed the annual yield of the groundwater underlying the county and will not otherwise operate to the injury of the reasonable and beneficial uses of overlying groundwater users;*
>
> *D. The proposed extraction will not result in an injury to a water replenishment, storage or restoration project operating in accordance with statutory authorization;*
>
> *E. The proposed extraction is in compliance with Water Code Section 1220; and*
>
> *F. The proposed extraction will not be otherwise detrimental to the health, safety and welfare of property owners overlying or in the vicinity of the proposed extraction site(s).*

2.13.2 Title 22 Drinking Water Program

As described in Section 2.7, the DDW regulates public water systems in California to ensure the delivery of safe drinking water to the public. Public water systems are those that provide potable water that has at least 15 service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. Private domestic wells, wells associated with drinking water systems with less than 15 residential service connections, industrial, and irrigation wells are not regulated by the DDW.

The DDW enforces the monitoring requirements established in Title 22 of the CCR for public water system wells. In addition, Title 22 specifies the maximum contaminant levels (MCLs) for various waterborne contaminants.

2.13.3 Clean Water Act

The Federal Water Pollution Control Act was initially adopted in 1948. Modifications to portions of the act in 1972, 1977, and 2002 became known as the Clean Water Act (CWA) (33 United States Code 1251 to 1376). The CWA establishes the basis for regulating discharges of pollutants into surface waters of the United States and regulating water quality standards for stated beneficial uses. Section 303 of the CWA requires states to adopt water quality standards for all surface waters of the United States. As defined by the CWA, water quality standards consist of two elements: (1) designated beneficial uses of the water body in question and (2) criteria that protect the designated uses. Section 304(a) requires the U.S. Environmental Protection Agency (EPA) to publish advisory water quality criteria that accurately reflect the latest scientific knowledge on the kind and extent of all effects on health and welfare that may be expected from the presence of pollutants in water. Where multiple uses exist, water quality standards must protect the most sensitive use.

EPA is generally directly responsible for implementing CWA provisions, although the CWA also authorizes states to implement portions of CWA through a delegation process. Through an agreement between EPA and the State of California, SWRCB has been designated, along with the nine RWQCBs, to develop and enforce water quality objectives and implementation plans in California to identify beneficial uses and water quality criteria to protect those beneficial uses.

2.13.4 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne Act) established surface-water and groundwater quality regulations that set limits on water quality constituents for the purpose of protecting beneficial uses[7] and provided the authority for SWRCB to protect the state's surface water and groundwater. The nine RWQCBs were established to oversee and implement specific water quality activities in their geographic jurisdictions. The Porter-Cologne Act requires the RWQCBs to establish water quality objectives while acknowledging that water quality may change without unreasonably affecting beneficial uses. Therefore, water quality objectives are references, as opposed to rules, for meeting federal and State requirements for water quality control.

The Porter-Cologne Act also requires that each RWQCB develop basin plans that establish and periodically review the beneficial uses and water quality objectives for surface water and groundwater bodies within its jurisdiction. Water quality objectives provide specific water quality guidelines to protect groundwater and surface water to maintain designated beneficial uses. SWRCB, through the RWQCBs, is the permitting authority in California to administer National Pollutant Discharge Elimination System and waste discharge requirements for regulation of waste discharges.

Article 4 of the Porter-Cologne Act (specifically § 13160. Federal Water Pollution Control Act) states that "The state board is designated as the state water pollution control agency for all purposes stated in the Federal Water Pollution Control Act and any other federal act, heretofore or hereafter enacted…" Although EPA has delegated implementation of portions of the CWA to the SWRCB, those portions of state or regional Water Quality Control Plans or amendments to the plans that are consistent with and under the jurisdiction of the CWA require approval by both SWRCB and EPA.

[7] "Beneficial uses" of the waters of the state that may be protected against quality degradation include, but are not limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

2.14 Conjunctive Use Programs

The term conjunctive use "*refers to the coordinated and planned use and management of both surface-water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives*" (DWR, 2016a). COR and CCCSD use a combination of both surface water and groundwater pumped by city or district wells to meet water demands within their administrative areas. Furthermore, ACID has periodically participated in water transfer programs, in which groundwater is pumped from district-owned wells, located in the Anderson Subbasin, in lieu of diverting an agreed-upon volume of surface water from the Sacramento River. ACID's water transfer program has been exercised in 2013, 2014, 2015, 2020, and 2021 with an additional program planned for 2022.

2.15 Land Use Plans

Shasta County has jurisdiction over land use planning for unincorporated portions of the Anderson Subbasin, and COR and COA have jurisdiction over land use planning within their respective city limits. Implementation of the Anderson Subbasin GSP may be affected by the policies and regulations outlined in the Shasta County General Plan, as well as the General Plan for COR and COA, given that the long-term land use planning decisions that would affect the Anderson Subbasin are under the jurisdiction of the County, COR, and COA.

This section describes how implementation of the Shasta County and COR general plans may change water demand in the subbasin and the GSP's ability to achieve sustainability. Due to the presence of Shasta Lake, Whiskeytown Lake, and the Sacramento River in the area, water resources in the RAGB are usually abundant; but the County and incorporated cities recognize that this will not necessarily protect residents from shortages during drought periods or in the event of significant growth. As a result, the general plans have shown dedication to preserving water resources and increasing the sustainability of water systems.

2.15.1 Shasta County General Plan

The current Shasta County General Plan was adopted by the Board of Supervisors in 2004, apart from a Housing Element amendment added in 2018 (Shasta County, 2004). This document outlines a set of objectives, formulated through a broad-based citizen participation effort, that provide the basis for policies within the County. These objectives focus on five major ideas: accommodating growth as a means of preserving quality of life; the relationship between geographic distribution, growth, and public services; recognition of the plan as a decision-making tool that requires periodic revisions; growth accommodation across a variety of living environments; and an interjurisdictional approach to planning issues.

The Shasta County General Plan recognizes that the preservation of natural resources in the County is essential to maintaining the quality of life of its residents; thus, the General Plan encourages growth only in places well suited for development and supply infrastructure. This aids Shasta County in ensuring water is available to its residents. The General Plan explains that water management is made more complicated by the complex state-legal system, which establishes water rights in the Central Valley. The General Plan also cites population growth within Shasta County and overdraft of other California groundwater basins as reasons to conserve water resources. The goals of the Shasta County General Plan, therefore, are consistent with the goals of this GSP.

2.15.2 City of Anderson General Plan

The COA General Plan was adopted in 2007 and outlines the city's vision for Anderson through 2027. Emphasized in the General Plan is preservation of Anderson's "small town" characteristics. That is, prioritizing quality of life of current residents and access to open space above quantitative measures of growth (COA, 2007). Objectives of the COA General Plan are as follows:

1) Land Use: To maintain the orderly growth and stable physical development of the City of Anderson while enhancing the physical, social, economic and environmental characteristics of the community; and ensure the continuance of the City's "small town" atmosphere.
2) Circulation: To maximize the development of a multimodal circulation system that will be both safe and efficient.
3) Conservation: To ensure the planned management of the community's natural resources consistent with community goals and prevention of their misuse.
4) Open Space: To establish open space areas for the following: the preservation of natural resources, the managed production of resources, outdoor recreation, public health and safety, mitigation areas, wetland banking, and to ensure the preservation and maintenance of these spaces consistent with community need.
5) Health and Safety: To provide all City residents with public services for a safe and healthy community.
6) Noise: To mitigate noise, maintaining a livable environment in the City of Anderson.
7) Housing: To ensure that the City of Anderson offers the opportunity for adequate and safe housing in a suitable environment for all economic groups. This consists of the conservation and rehabilitation of existing and older neighborhoods as well as planning of new and innovative residential developments.

2.15.3 City of Redding General Plan

The COR General Plan, adopted in 2000, outlines a vision for Redding's future and provides principles and policies to guide development through 2020 (COR, 2000). The development of the Redding General Plan was a collaborative effort involving the community and the City Planning Commission. The plan recognizes the importance of natural resources to the community and seeks to balance protection and responsible management policies, echoing the objectives of the Shasta County General Plan. Among these objectives are commitments to prevent the discharge of contaminated water into the environment, to prevent excessive pumping and water consumption, and to encourage opportunities for groundwater recharge. A new General Plan or an updated version is anticipated in 2020, but this document is not yet available. Objectives of the COR General Plan are as follows:

1) Continue community/neighborhood planning efforts that will put in place actions geared to the development and redevelopment of key neighborhoods and districts.
2) Increase efforts to attract new industry to the area and to retain existing high-paying jobs.
3) Contribute to the quality of life of Redding's citizens by investing in cultural, recreational, and open-space projects.
4) Focus development efforts on building neighborhoods, rather than just approving subdivisions.
5) Ensure that public and private development is well-designed, functional, complementary to surrounding buildings and lands, and contributes its fair share to providing necessary infrastructure and services that the citizens of Redding have come to expect.
6) Continue to ensure that necessary infrastructure is planned, funded, and constructed so as to maintain the standards expected by the community.

2.15.4 Well Permitting

A valid permit must be obtained from the Shasta County Environmental Health Division to drill, destroy, deepen, or recondition a water well in the Anderson Subbasin. Standards for the construction, repair, reconstruction, abandonment, and destruction of wells in the county include the following:

- Minimum well depth will be 50 feet except in those areas where the only available groundwater is at a depth less than 50 feet. In such cases, wells may be permitted at a depth sufficient to develop an adequate water supply.
- All wells must be at minimum 50 feet from any sewer, septic tank, or pit privy, and 100 feet from any structure designed to allow sewage to percolate into the ground.
- The following regulations apply to prevent saline degradation:

    1. Within the Redding Area Groundwater Basin, the health officer may establish limitations on the depth of any well if, in his opinion, there is the possibility of saline degradation because of proximity to the Chico Formation.

    2. Any well encountering water with a saline taste and a specific electrical conductance above 1,500 micromhos per centimeter will be sealed by grouting to a level where a 4-hour pumping test will produce water of acceptable quality.

    3. Any well penetrating the Chico Formation and pumping water from the aquifers above the Chico Formation will have the annular space surrounding the casing sealed with an acceptable grout seal, including bentonite, to a point 10 feet above the point of contact with the formation.

    4. Any well intended to draw water from the Chico Formation in an area where the water may be of acceptable quality will be caged, and the annular space surrounding the casing will be sealed with a grout seal, including bentonite, to a point 10 feet below the point of contact with the formation.

    5. Any abandoned well containing water with a specific electrical conductance above 1,500 micromhos per centimeter will be sealed so that no such water escapes from the formation.

- An outer casing or conductor casing is not an acceptable substitute for a seal. Temporary casing will be removed before the well is deemed to be completed unless incorporation of the conductor casing in the sealing material is approved by the health officer or his designee prior to the sealing of the well.
- When a well is destroyed in a residential area, in addition to other well destruction requirements, a hole will be excavated around the well casing to a depth of at least 11 feet below the ground surface, and the well casing will be removed to within 6 inches of the bottom of the excavation.

Work shall be performed by a C-57 licensed driller or contractor. Drillers are held to California Water Well Standards set forth by DWR. For more information on well permitting, refer to the Shasta County Municipal Codes Chapter 8.56 – Water Wells.

Wellhead Protection Measures

Identification of wellhead protection areas is a component of the Drinking Water Source Assessment and Protection Program, administered by SWRCB-DDW. The three major components of the source water assessments required by DDW include the following:

- Delineation of capture zones around sources (drinking water supply wells): Delineation of capture zones can be accomplished through the use of numerical models or by using groundwater gradient and aquifer hydraulic conductivity data to evaluate the portion of an aquifer that contributes groundwater to a well within specified groundwater travel times (typically, areas are delineated as 2-, 5-, and 10-year travel times). Under the source water protection program, these water supply well capture areas should be managed to protect the drinking water supply from viral, microbial, and direct chemical contamination.

- Inventory of potential contaminating activities within protection areas: Water purveyors are required to identify potential sources of contamination within the drinking water source and protection areas (water supply well capture areas). Potential sources of contamination may consist of commercial, industrial, agricultural, and residential cleanup sites, or infrastructure sources such as utilities and roads.
- Vulnerability analysis to identify potential contaminating activities to which the source is most vulnerable: The identified potential sources of contamination within the water supply well capture areas are then assigned a risk ranking, ranging from "very high" for such sources as gas stations, dry cleaners, and landfills, to "low" for such sources as schools, lakes, and non-irrigated cropland. This vulnerability analysis includes determining the most likely and significant threats within the drinking water source and protection areas.

The SWRCB is currently developing a public web tool, the "Source Water Protection Webmap[8]", which

> *will provide spatial data for analysis and download, including groundwater source well locations, surface water intakes, vulnerability assessments, nearby potentially contaminating activities, and other data relevant to source water protection. The site will also provide an application to create source water assessments required for drinking water sources*.

2.15.5 Land Use Plans Outside of the Basin

Land use plans outside of the Anderson Subbasin are not expected to affect implementation of this GSP.

2.15.6 Effects of Land Use Plan Implementation on Water Demand

The GSA does not have authority over land use planning. However, the GSA will coordinate with Shasta County, COA, and COR on general plans and land use planning/zoning as needed when implementing the GSP.

2.15.7 Effects of GSP Implementation on Water Supply Assumptions

Implementation of this GSP is not anticipated to affect water supply assumptions of relevant land use plans over the planning and implementation horizon. Further information will be provided as additional components of this GSP are developed.

2.16 Additional GSP Elements, GSP Regulations § 354.8(g)

One or more of the following subjects may be incorporated into a future version of this GSP:

- Control of saline water intrusion – Seawater intrusion is not present or likely within the Anderson Subbasin because of its distance from the Pacific Ocean and its associated surface-water features. However, saline water is present in Anderson Subbasin in the underlying Chico Formation. The Shasta County Municipal Codes Chapter 8.56 – Water Wells includes provisions to prevent saline water

[8] https://www.waterboards.ca.gov/water_issues/programs/gama/online_tools.html

intrusion including depth limitations for completed wells relative to the Chico Formation and limitations on electrical conductance of pumped groundwater.

- Wellhead protection – For details on wellhead protection, refer to Sections 2.15.5 and 2.7 of this GSP.
- Migration of contaminated groundwater – For details on migration of contaminated groundwater, refer Section 3.2.5 and 6.3.5 of this GSP.
- Well abandonment and well destruction program – For details on well abandonment and well destruction, refer to Section 2.15.14 of this GSP and the Shasta County Municipal Codes Chapter 8.56 – Water Wells.
- Replenishment of groundwater extractions – For details on groundwater recharge, refer to Section 3.1.6.5 of this GSP. A discussion on the lack of groundwater overdraft in the subbasins is provided in Sections 3.2.3, 4.5.3, and Chapter 6. Chapter 7 provides further discussion of the fact that projects and management actions are not currently needed to mitigate overdraft conditions.
- Conjunctive use and underground storage – For information regarding conjunctive use in the Anderson Subbasin, refer to Section 2.14 of this GSP.
- Well construction policies – For details on well construction policies, refer to Section 2.15.4 of this GSP and the Shasta County Municipal Codes Chapter 8.56 – Water Wells.
- Groundwater contamination cleanup, recharge, diversions to storage, conservation, water recycling, conveyance, and extraction projects – For information on groundwater contamination and cleanup within the Anderson Subbasin, refer to Section 3.2.5 of this GSP. For information regarding areas of groundwater recharge, refer to Section 3.1.6.5 of this GSP. For information on water conservation and water use efficiency, refer to Sections 2.11 and 2.12 and Chapter 7 Projects and Management Actions of this GSP. The remainder of the listed items are not applicable to the Anderson Subbasin.
- Efficient water management practices - For details on efficient water management practices, refer to Sections 2.11 and 2.12 and Chapter 7 of this GSP.
- Relationships with State and federal regulatory agencies – For details on developing relationships with State and federal regulatory agencies, refer to Section 8.2.3 of this GSP.
- Land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity – For information on land use planning, refer to Section 2.15 of this GSP. For information on groundwater quality and evaluating potential risks to groundwater quality, refer to Sections 3.2.5 and 6.3.5 of this GSP. For information regarding interagency coordination, refer to Chapter 8 of this GSP.
- Impacts on groundwater-dependent ecosystems – For information on GDE identification, refer to Section 3.1.6.6 of this GSP. For evaluation of SMCs relative to potential impacts to GDEs, refer to Chapter 6 of this GSP.

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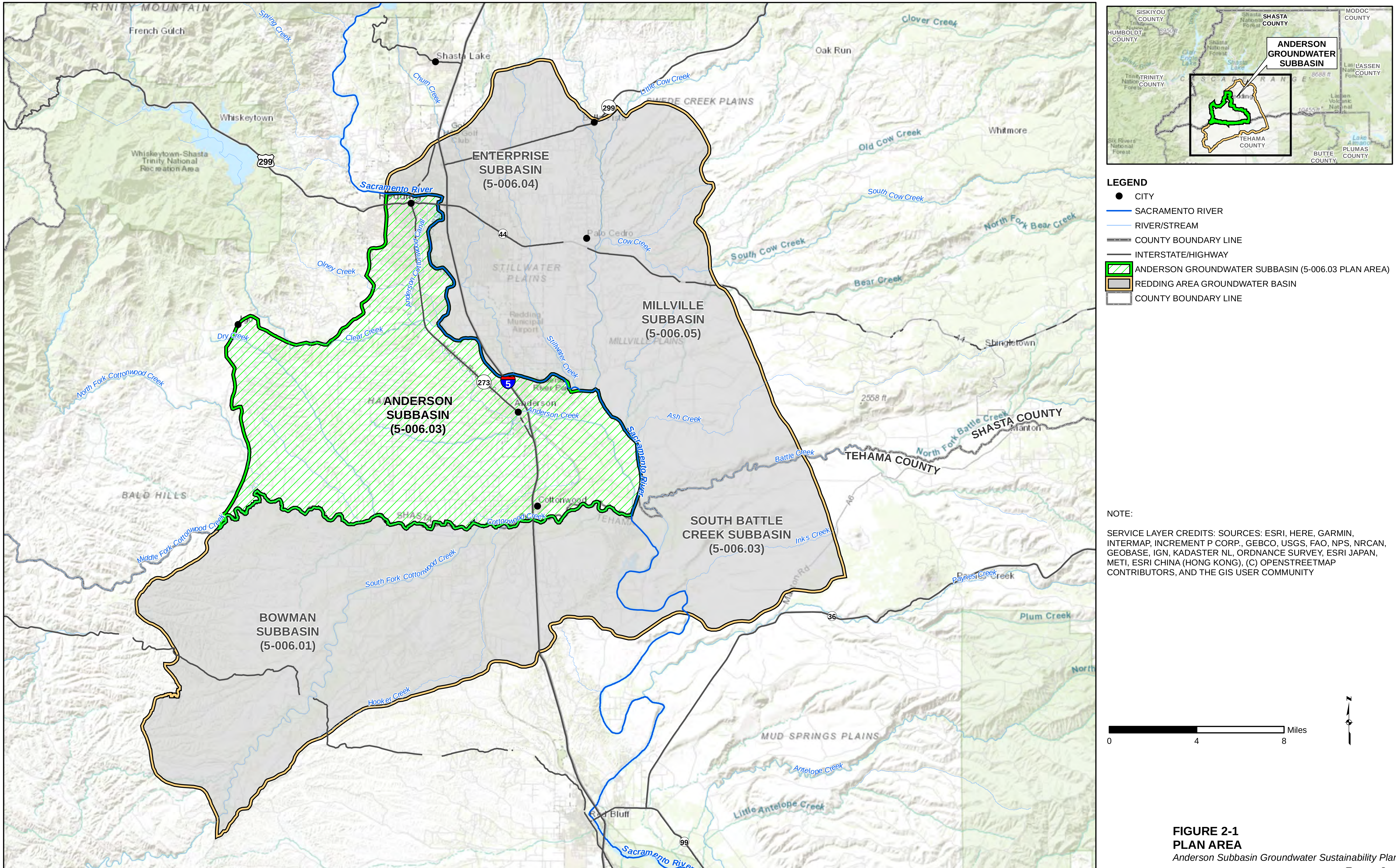
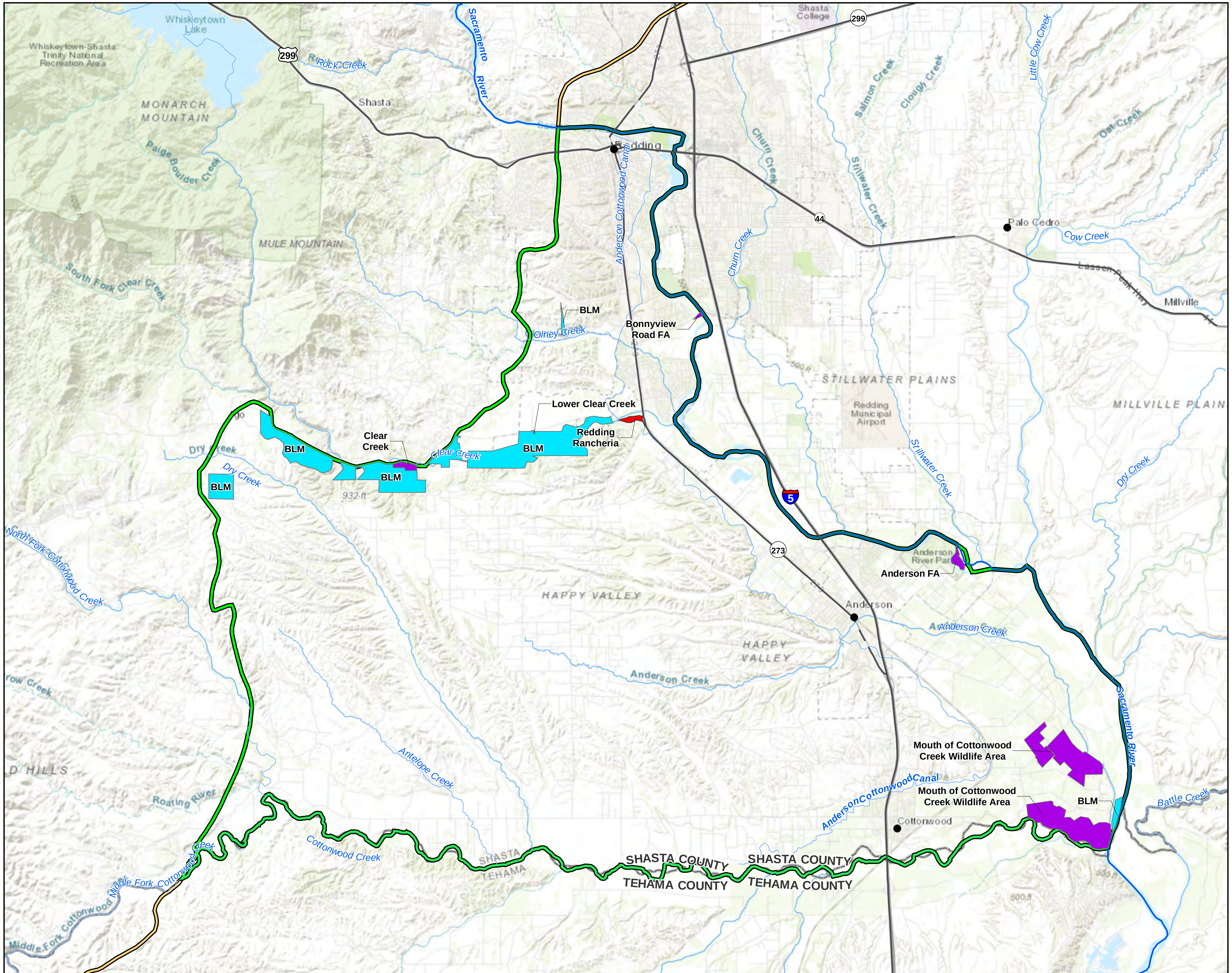
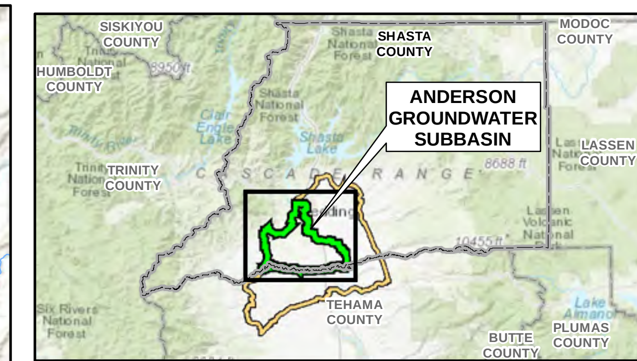


FIGURE 2-1
PLAN AREA
Anderson Subbasin Groundwater Sustainability Plan





LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN
- CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
- US BUREAU OF LAND MANAGEMENT (BLM)
- BUREAU OF INDIAN AFFAIRS LAND AREA REPRESENTATION

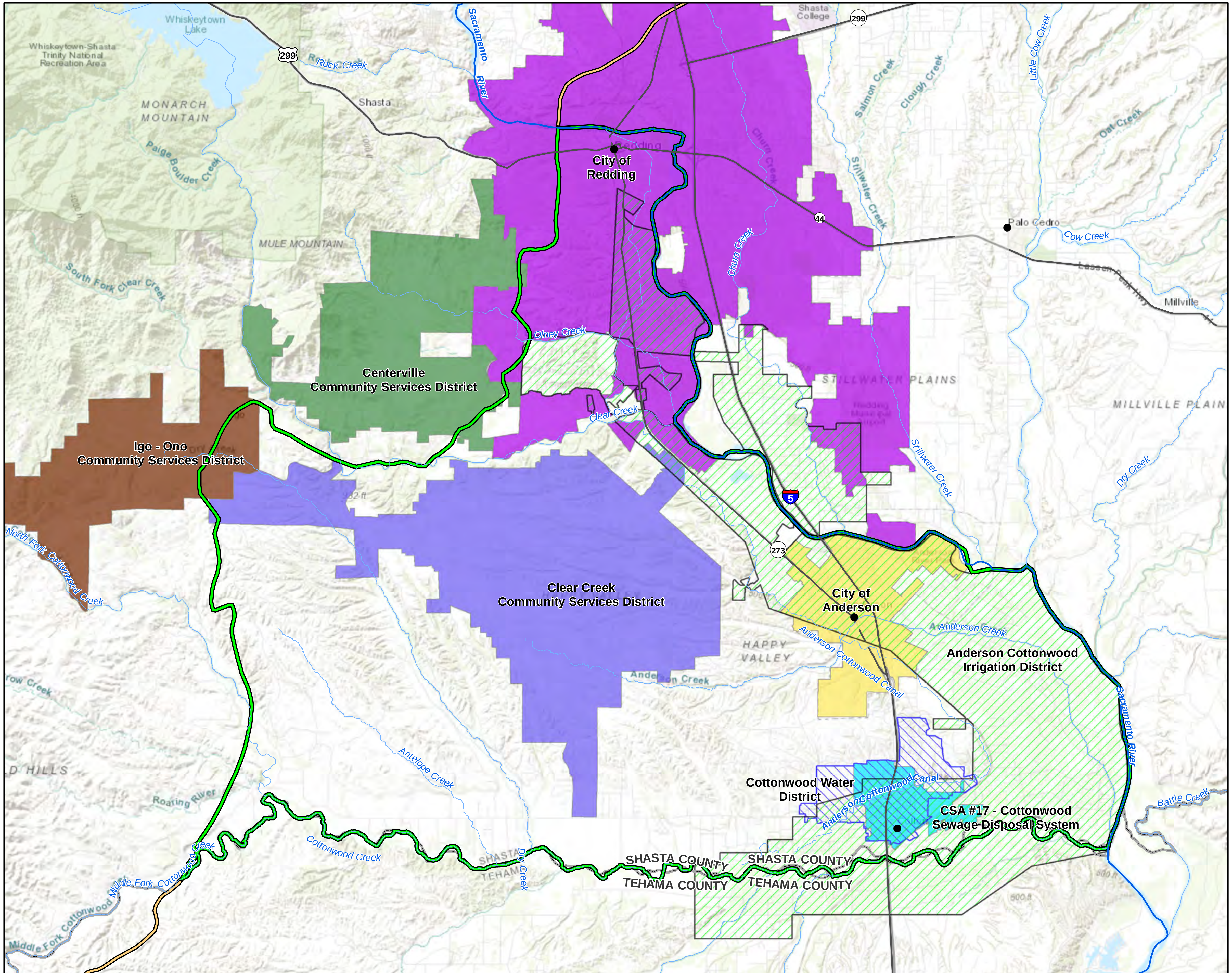
NOTES:

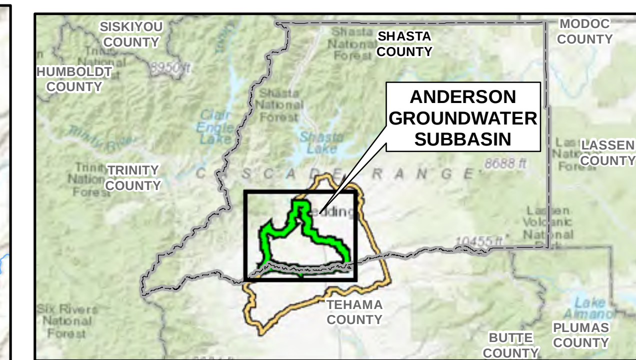
DATA SOURCES: HTTPS://WWW.CALANDS.ORG (CALANDS, 2020) AND BIA, 2020

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FIGURE 2-2
FEDERAL, STATE, AND TRIBAL JURISDICTIONAL AREAS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs





LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER

AGENCY NAME

- ANDERSON COTTONWOOD IRRIGATION DISTRICT
- CITY OF
- CITY OF REDDING
- CENTERVILLE COMMUNITY SERVICES DISTRICT
- CLEAR CREEK COMMUNITY SERVICES DISTRICT
- COTTONWOOD WATER DISTRICT
- COUNTY SERVICE AREA (CSA) #17 - COTTONWOOD SEWAGE DISPOSAL SYSTEM
- IGO - ONO COMMUNITY SERVICES DISTRICT

NOTES:

DATA SOURCES: ACID, 2015; COA, 2019; COR, 2020a; AND SHASTA COUNTY, 2019a

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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FIGURE 2-3
CITY, COUNTY SERVICE AREAS, AND WATER DISTRICT JURISDICTIONAL AREAS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

D:\REDDINGCACITYOFIEAGSA\FIGURES\ARCMAP\MAPFILES\AGSP\2.0\FIG02-03_WATERDISTRICTS.MXD 7/20/2021 8:07:46 AM FELHADID

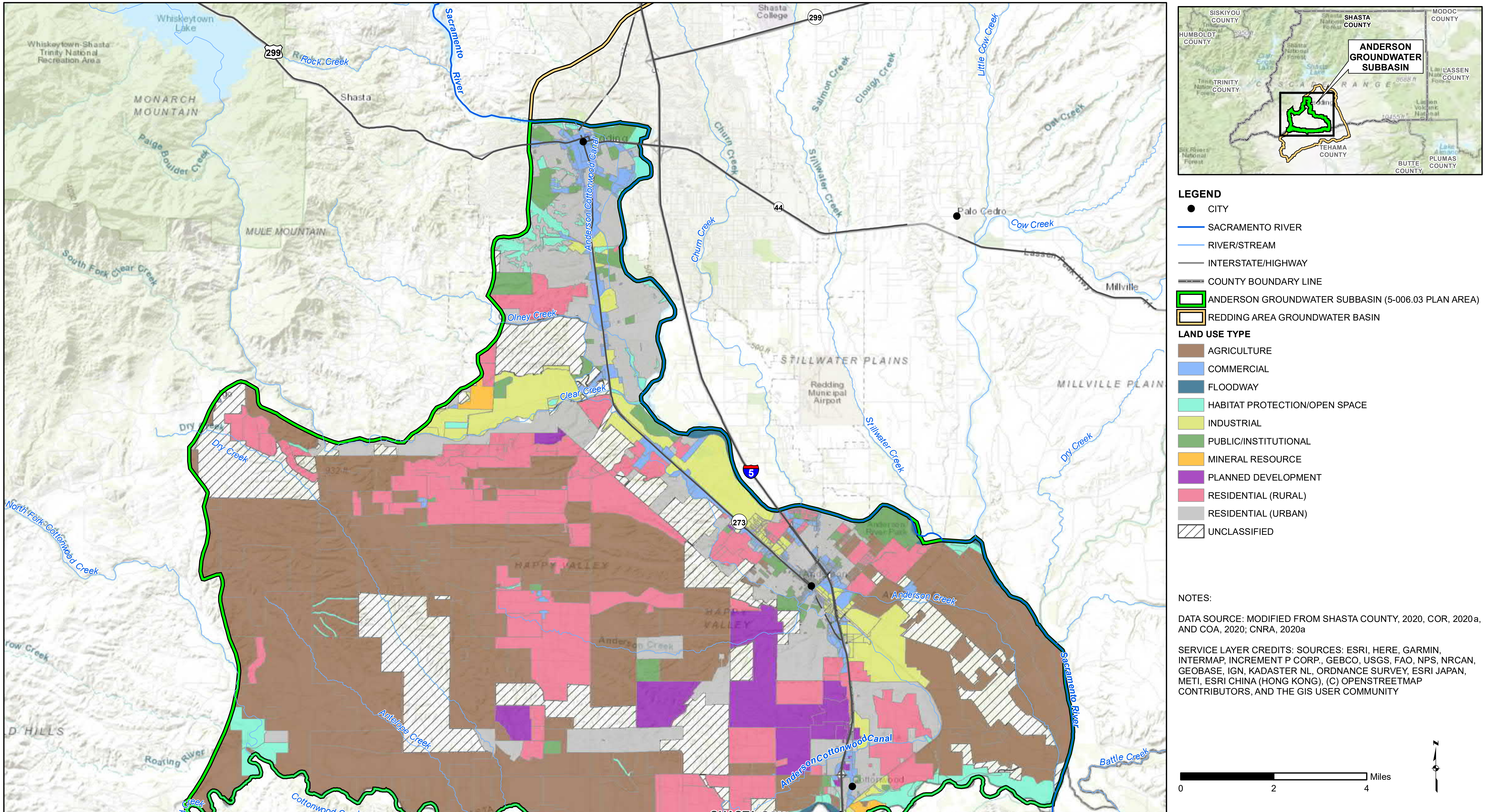

FIGURE 2-4
2019/2020 LAND USE
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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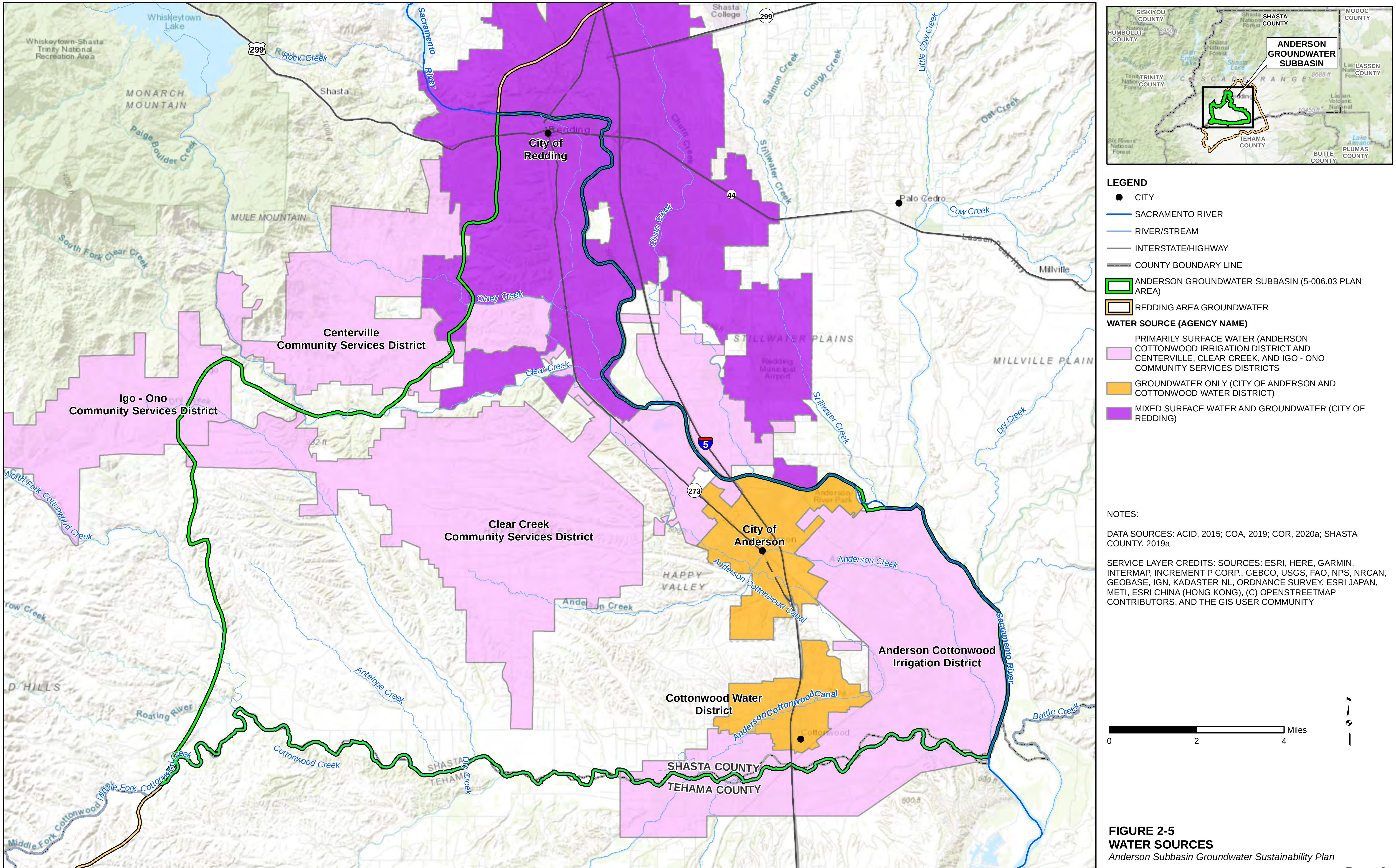

NOTES:

DATA SOURCES: ACID, 2015; COA, 2019; COR, 2020a; SHASTA COUNTY, 2019a

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FIGURE 2-5
WATER SOURCES
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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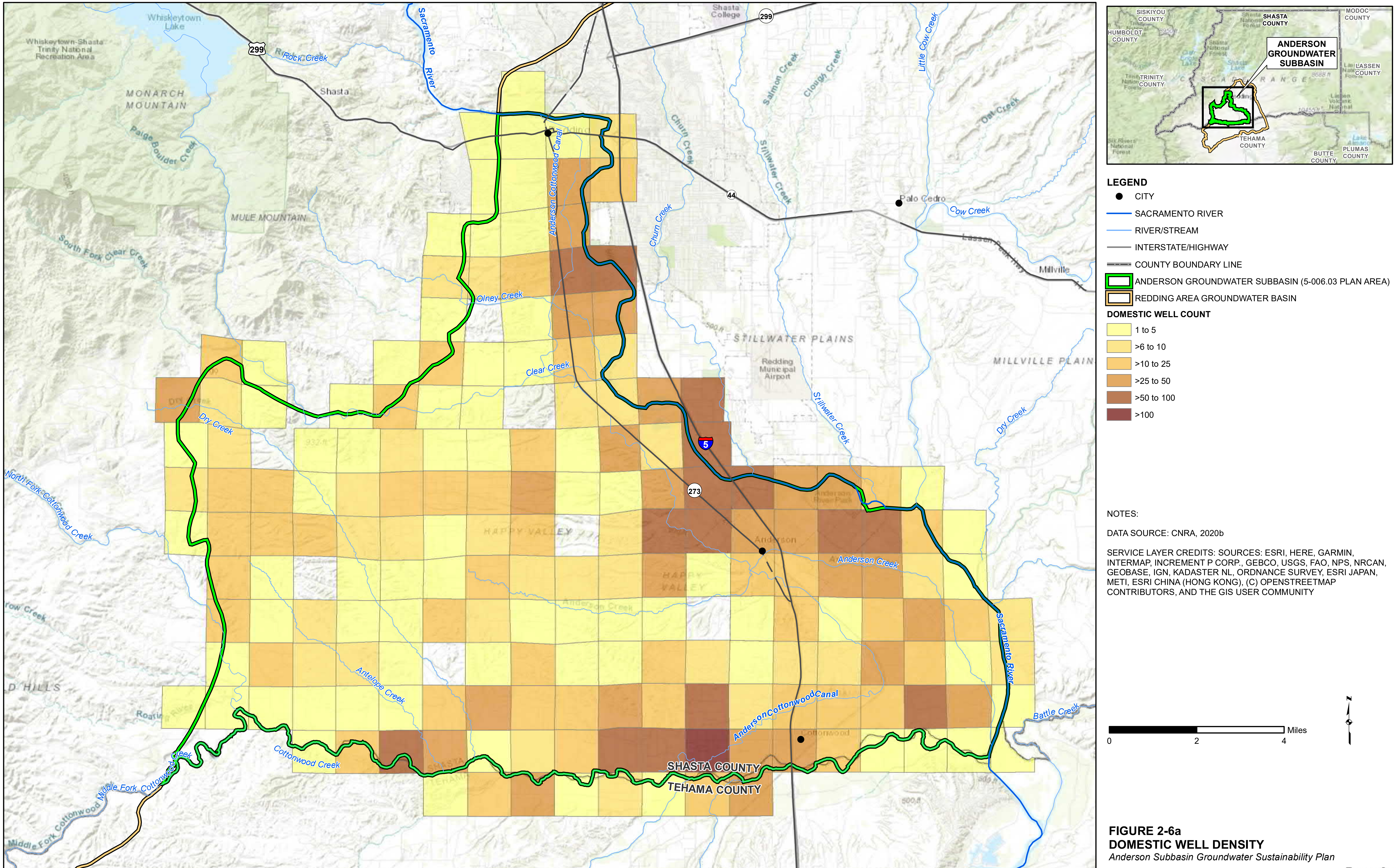


LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

DOMESTIC WELL COUNT

- 1 to 5
- >6 to 10
- >10 to 25
- >25 to 50
- >50 to 100
- >100

NOTES:

DATA SOURCE: CNRA, 2020b

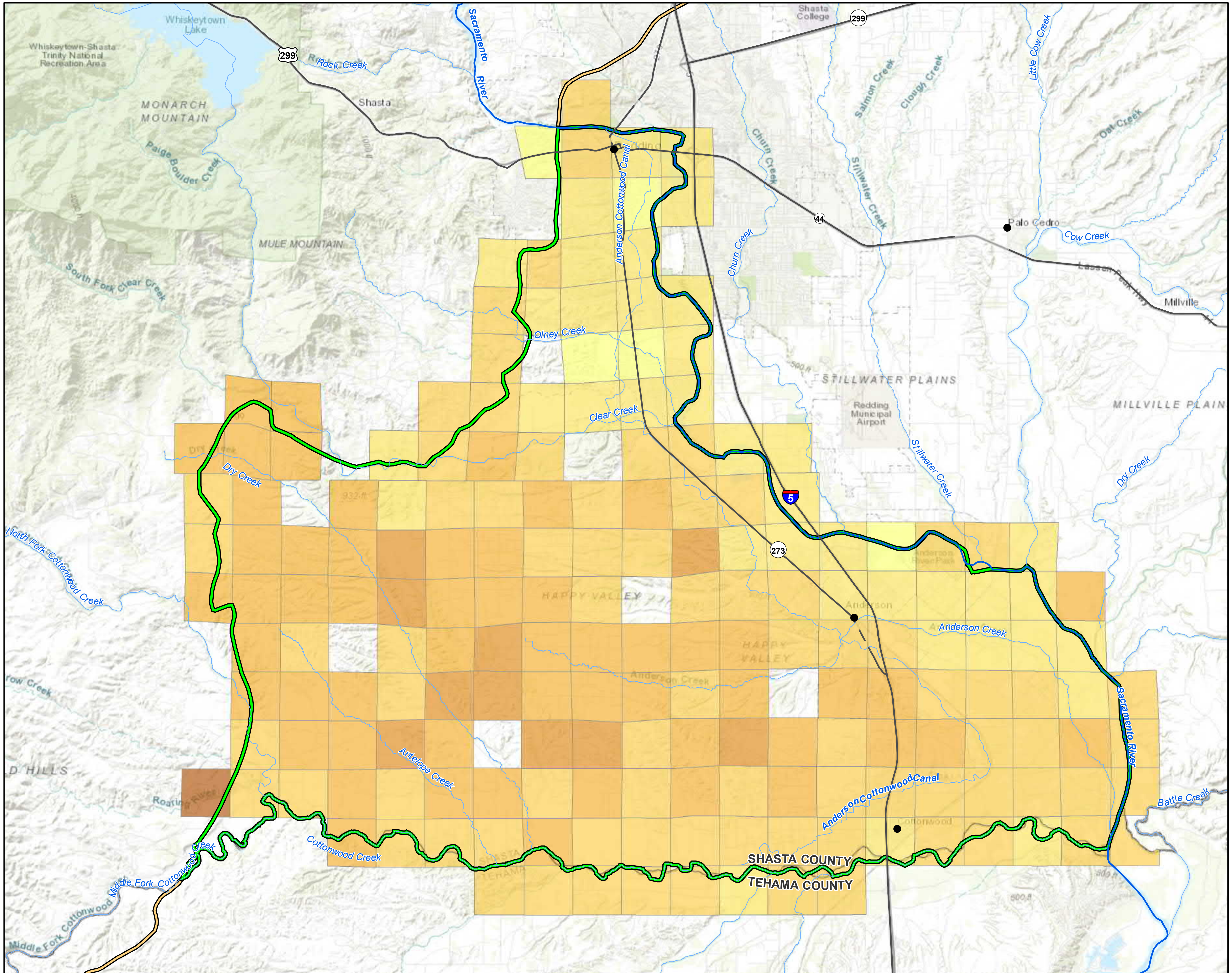
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

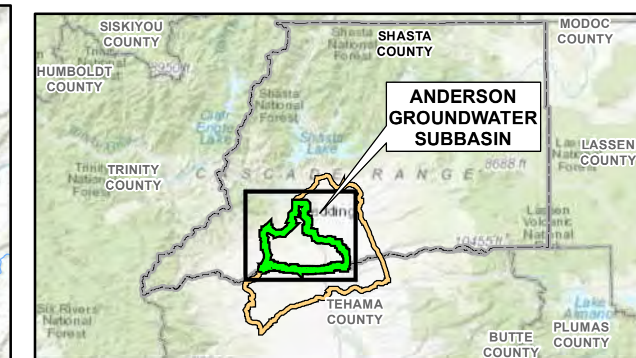
Miles 0 2 4

FIGURE 2-6a
DOMESTIC WELL DENSITY
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

D:\REDDINGCACITYOFIEAGSA\FIGURES\ARCMAP\MAPFILES\AGSP\2.0\FIG02-06A_DOMESTICWELLDENSITY.MXD 12/17/2021 8:51:25 AM FELHADID





LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

AVERAGE DOMESTIC WELL DEPTH (feet BGS)

- <=50
- >50 to 100
- >100 to 200
- >200 to 300
- >300 to 400
- >400 to 500
- >500 to 600
- >600 to 700

NOTES:

BGS = BELOW GROUND SURFACE

DATA SOURCE: CNRA, 2020b

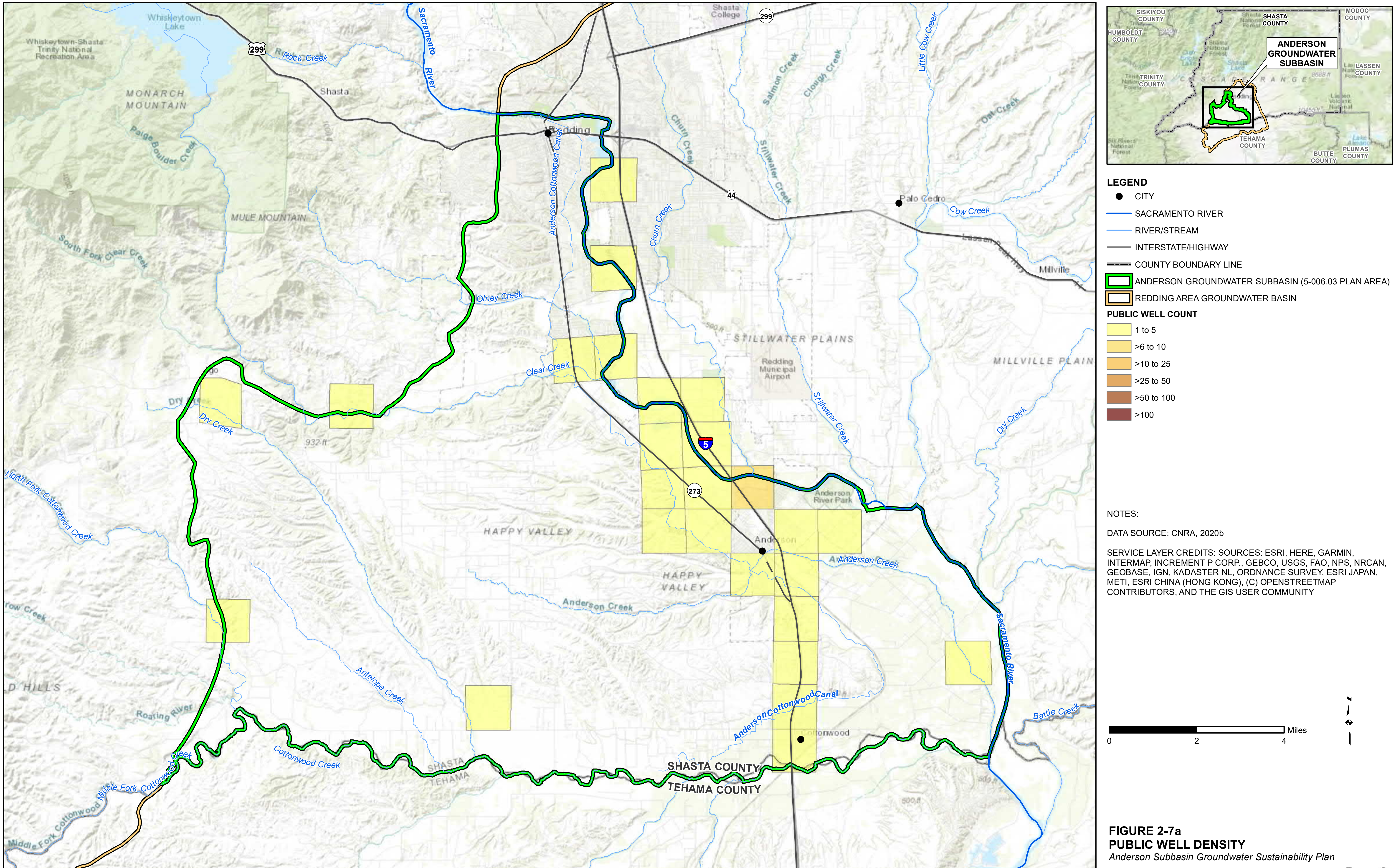
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP

0 2 4 Miles

FIGURE 2-6b
AVERAGE DOMESTIC WELL DEPTH
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

D:\REDDINGCACITYOF\EAGSA\FIGURES\ARCMAP\MAPFILES\AGSP\2.0\FIG02-06B_DOMESTICWELLDEPTH.MXD 12/17/2021 9:47:34 AM FELHADID



LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

PUBLIC WELL COUNT

- 1 to 5
- >6 to 10
- >10 to 25
- >25 to 50
- >50 to 100
- >100

NOTES:

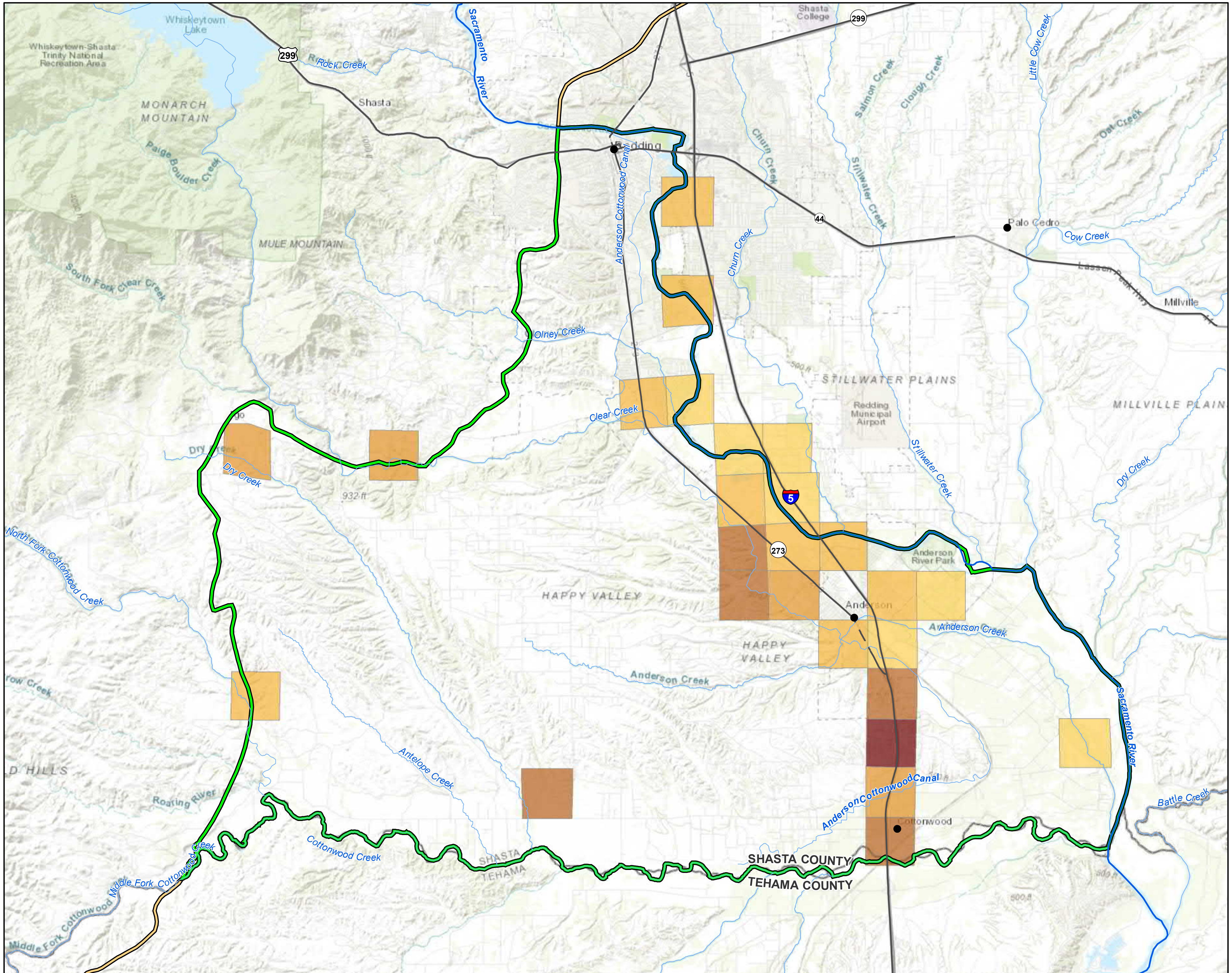
DATA SOURCE: CNRA, 2020b

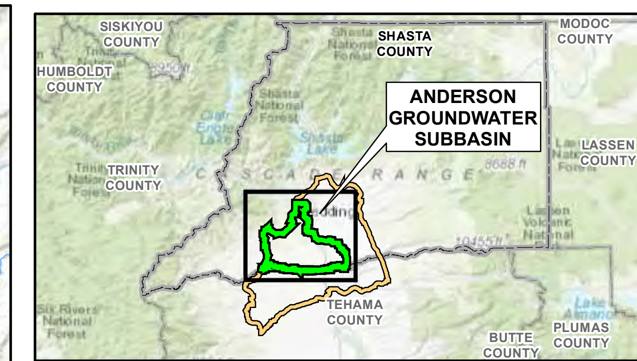
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FIGURE 2-7a
PUBLIC WELL DENSITY
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

D:\REDDINGCACITYOFEAGSA\FIGURES\ARCMAP\MAPFILES\AGSP\2.0\FIG02-07A_PUBLICWELLDENSITY.MXD 12/17/2021 9:52:39 AM FELHADID





LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

AVERAGE PUBLIC WELL DEPTH (feet BGS)

- <=50
- >50 to 100
- >100 to 200
- >200 to 300
- >300 to 400
- >400 to 500
- >500 to 600
- >600 to 700

NOTES:

BGS = BELOW GROUND SURFACE

DATA SOURCE: CNRA, 2020b

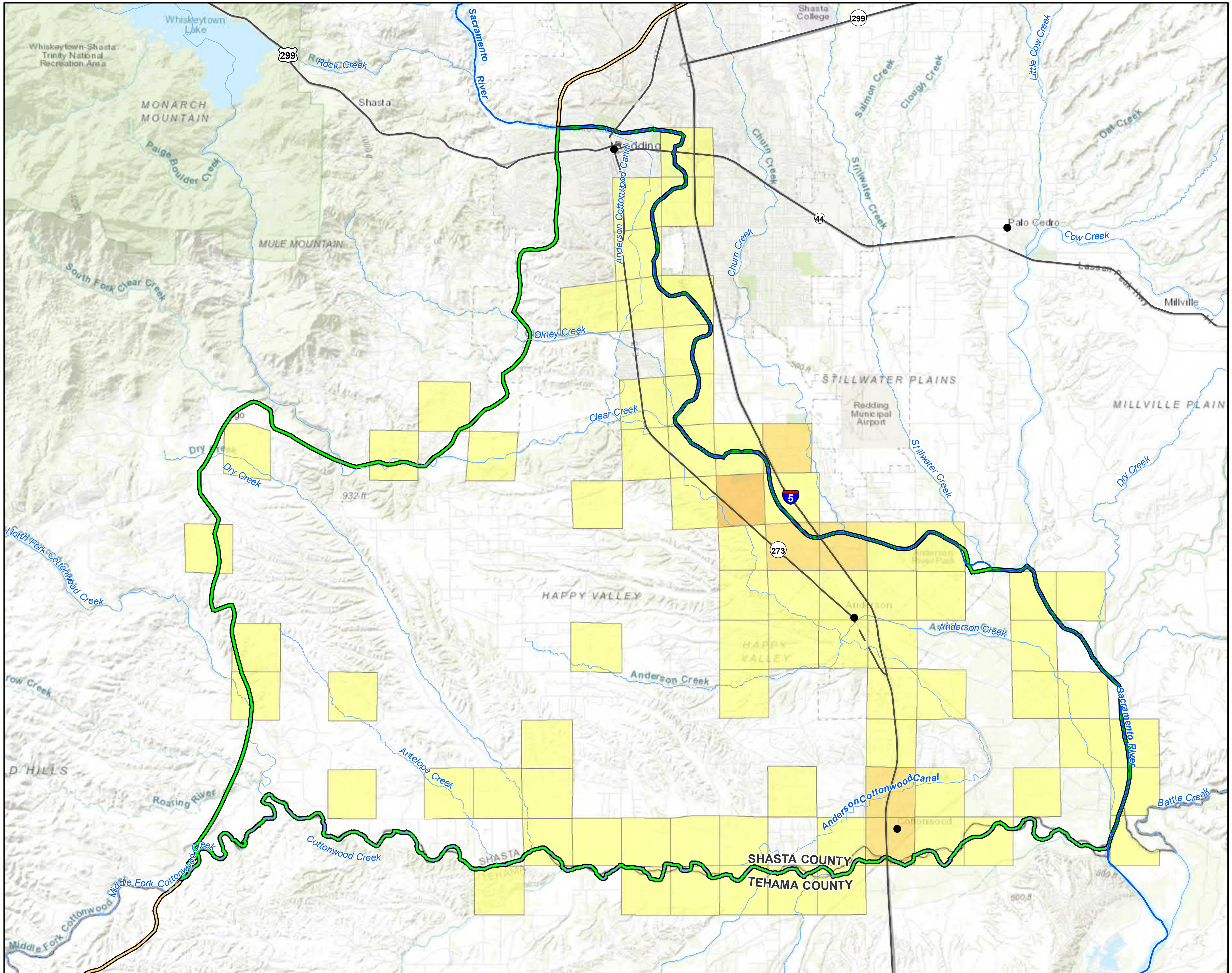
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 2-7b
AVERAGE PUBLIC WELL DEPTH
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

D:\REDDINGCACITYOF\EAGSA\FIGURES\ARCMAP\MAPFILES\AGSP\2.0\FIG02-07B_PUBLICWELLDEPTH.MXD 12/17/2021 9:55:59 AM FELHADID



LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

PRODUCTION WELL COUNT

- 1 to 5
- >6 to 10
- >10 to 25
- >25 to 50
- >50 to 100
- >100

NOTES:

DATA SOURCE: CNRA, 2020b

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 2-8a
PRODUCTION WELL DENSITY
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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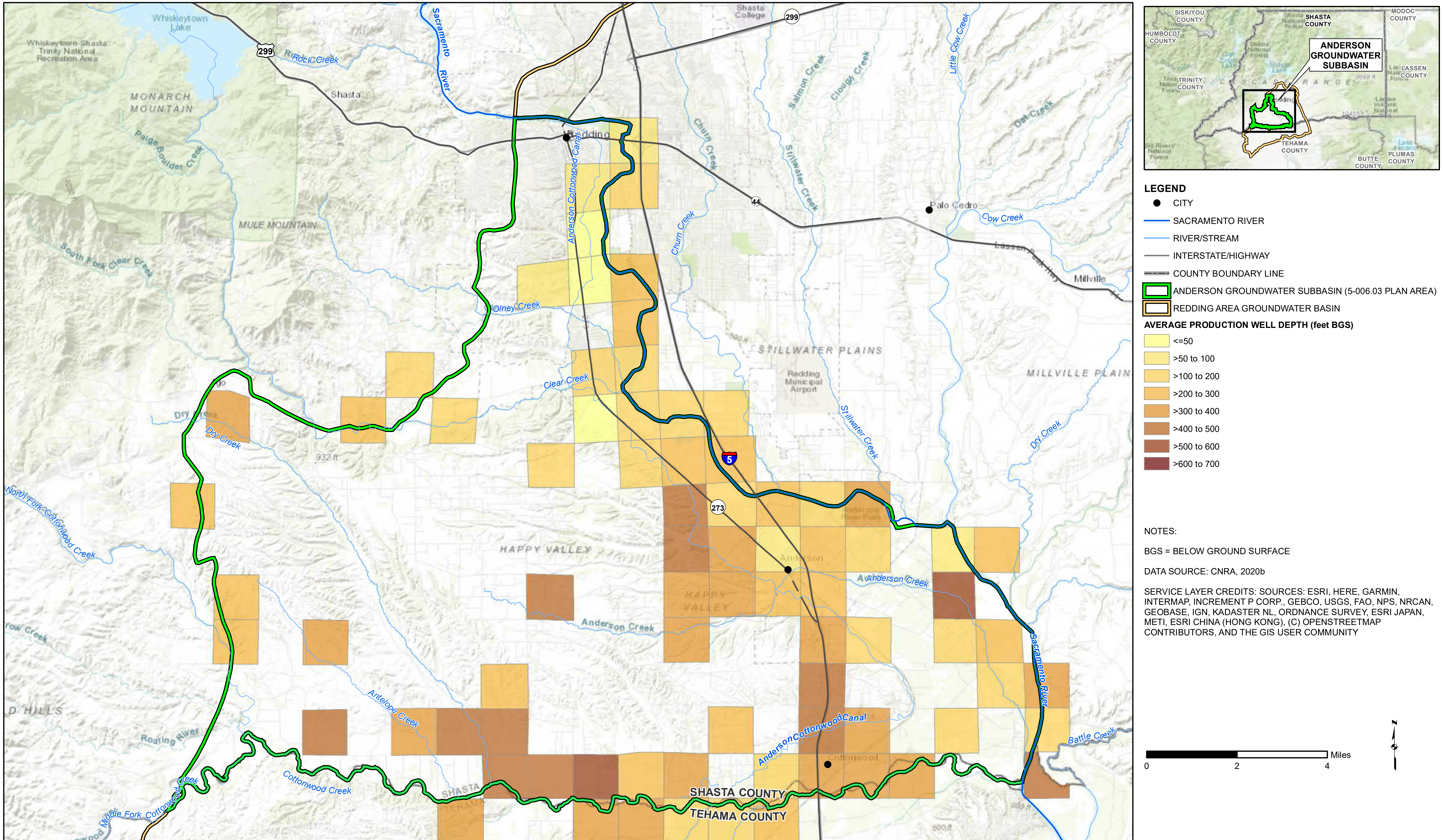

FIGURE 2-8b
AVERAGE PRODUCTION WELL DEPTH
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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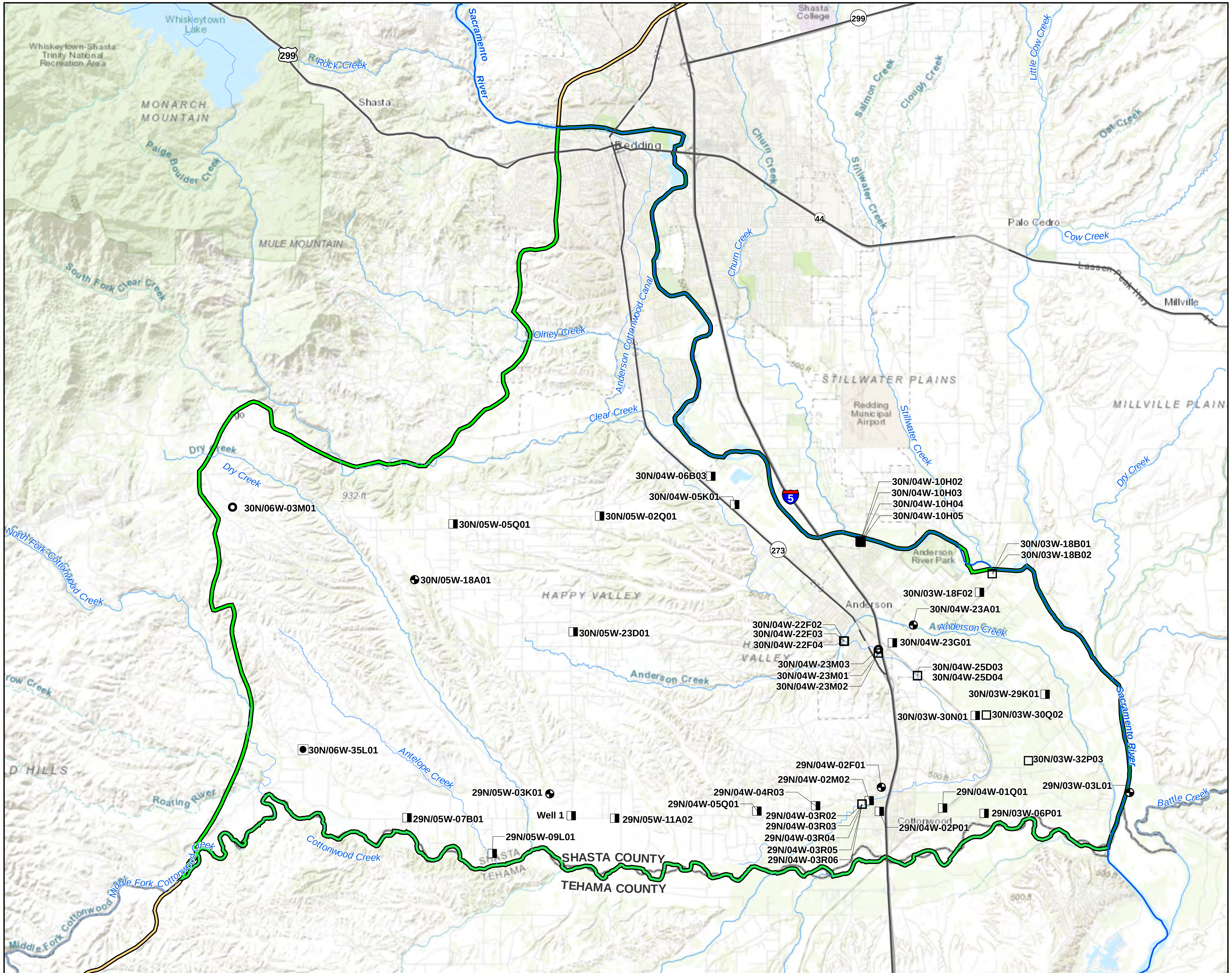
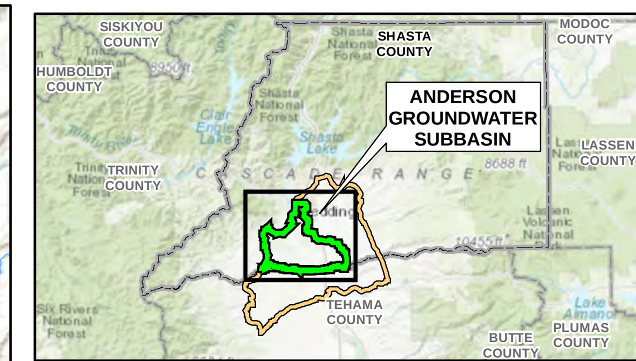




LEGEND

PROGRAM (SAMPLING FREQUENCY)

- DWR WELL (CONTINUOUS)
- DWR WELL (PERIODIC)
- DWR AND USGS WELL (PERIODIC)
- CASGEM (PERIODIC)
- CASGEM (PERIODIC) AND DWR WELL (CONTINUOUS)
- USGS WELL (PERIODIC)
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

DATA SOURCES: DWR, 2019a; DWR, 2019b; USGS, 2019a

CASGEM = CALIFORNIA STATEWIDE GROUNDWATER ELEVATION MONITORING PROGRAM

DWR = DEPARTMENT OF WATER RESOURCES

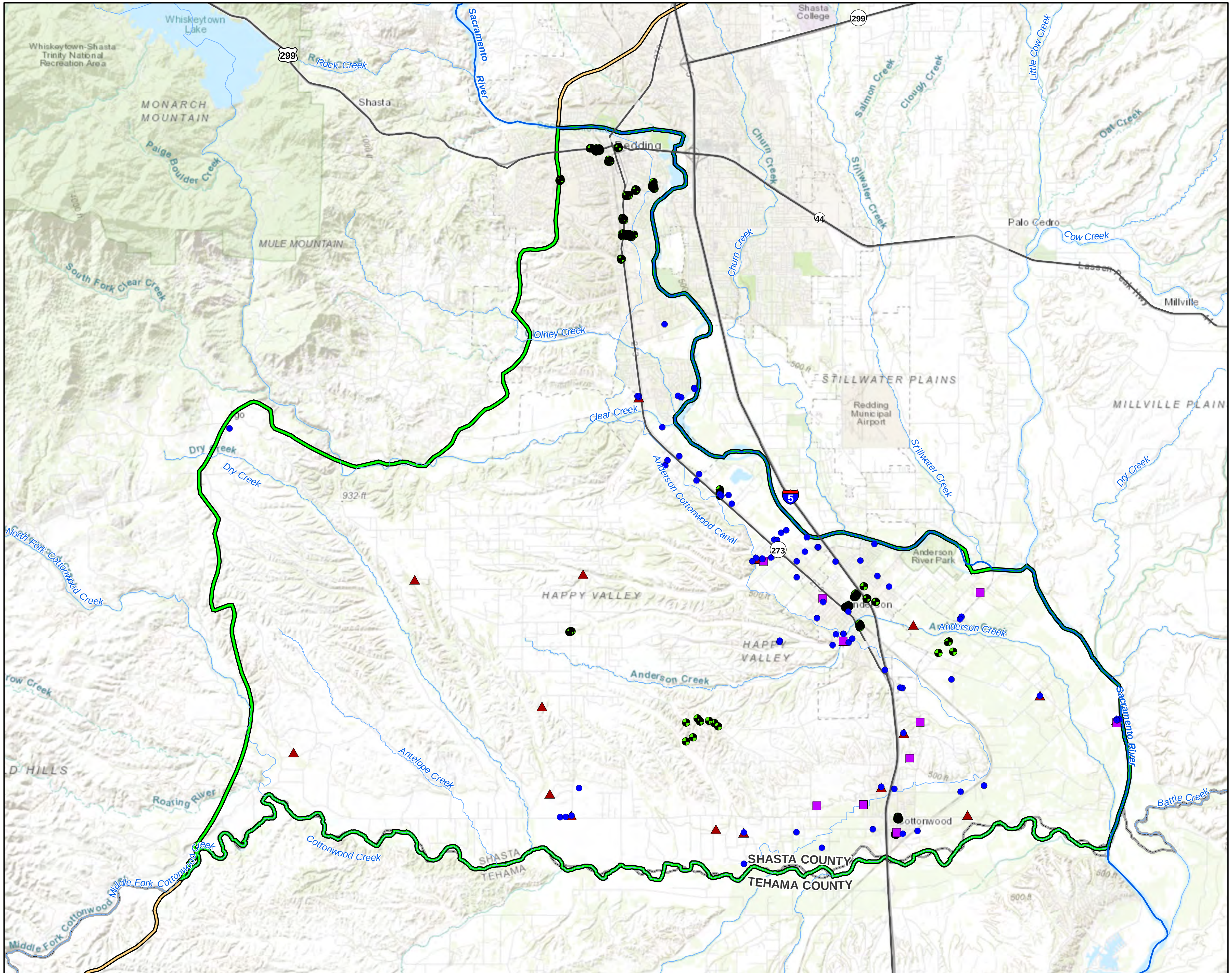
USGS = UNITED STATES GEOLOGICAL SURVEY

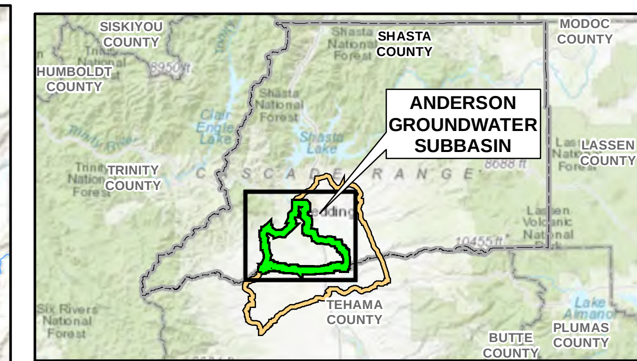
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FIGURE 2-9
ANDERSON SUBBASIN GROUNDWATER LEVEL MONITORING NETWORK
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

D:\REDDINGCACITYOFEAGSA\FIGURES\ARCMAP\MAPFILES\AGSP\2.0\FIG02-09_GWMONNETWORK.MXD 7/20/2021 8:29:15 AM FELHADID





LEGEND

GROUNDWATER QUALITY NETWORK SOURCE

- SWRCB – DDW
- GAMA – DWR
- GAMA – USGS
- REGULATED SITE ENVIRONMENTAL MONITORING
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

LOCATIONS SAMPLED BETWEEN 2000 AND 2019.

DATA SOURCE: SWRCB, 2020b

DDW = DIVISION OF DRINKING WATER

DWR = CALIFORNIA DEPARTMENT OF WATER RESOURCES

GAMA = GROUNDWATER AMBIENT MONITORING AND ASSESSMENT PROGRAM

SWRCB = STATE WATER RESOURCES CONTROL BOARD

USGS = UNITED STATES GEOLOGICAL SURVEY

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 2-10
ANDERSON SUBBASIN GROUNDWATER QUALITY WELL NETWORK
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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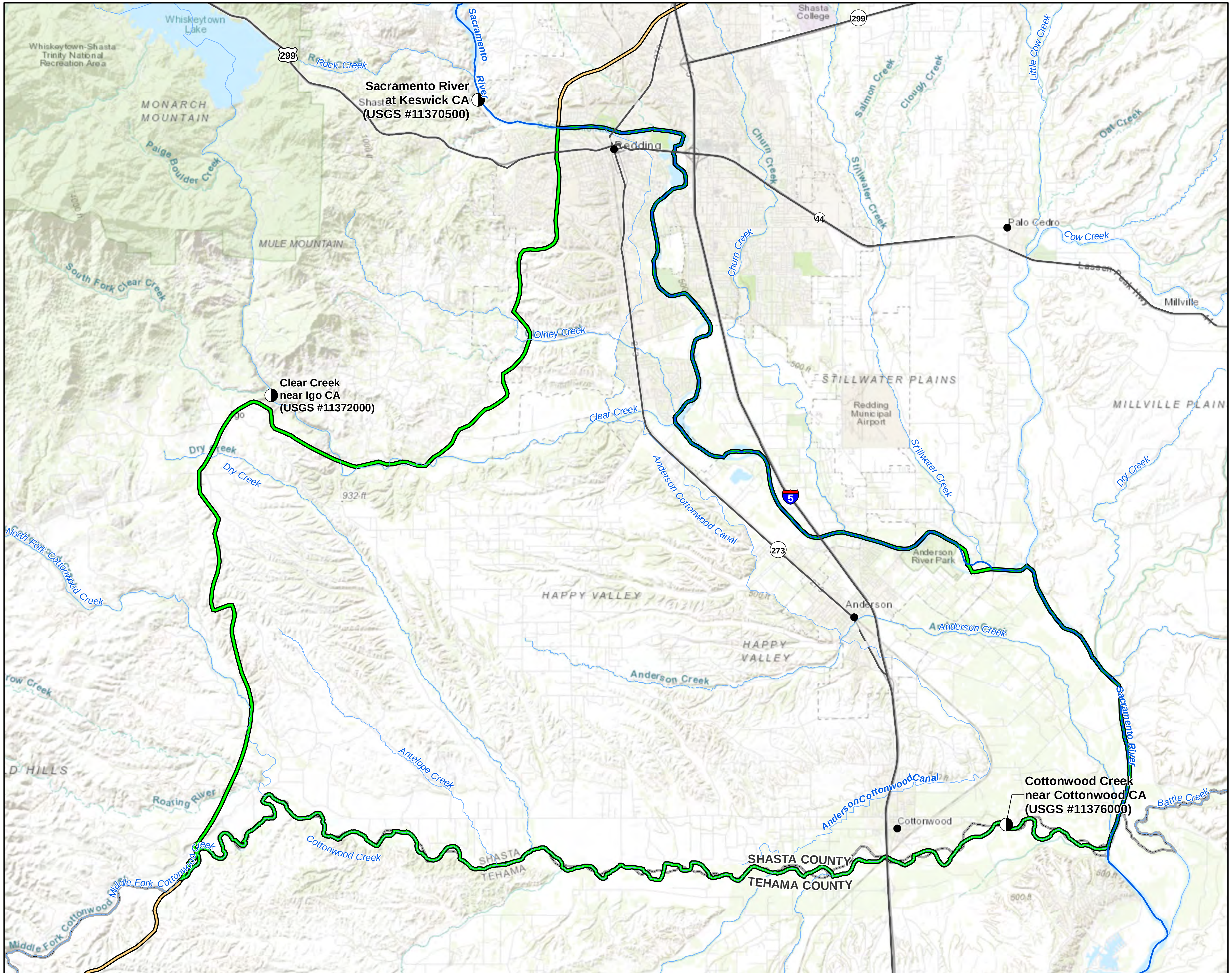

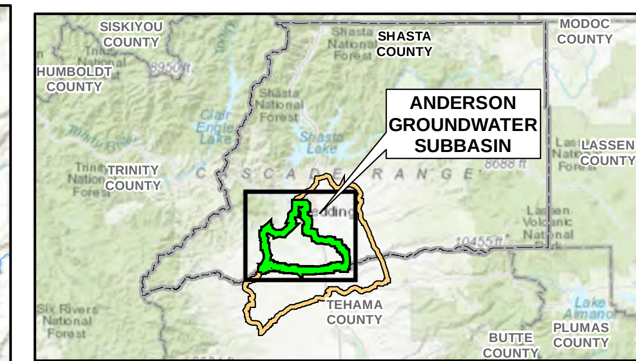

LEGEND

- STREAM GAUGE LOCATION
- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

DATA SOURCE: USGS, 2019a

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 2-11
ANDERSON SUBBASIN STREAM GAUGE LOCATIONS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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3. Basin Setting

3.1 Hydrogeological Conceptual Model

A hydrogeological conceptual model (HCM) is a description of the physical system within a basin, including (but not limited to) topography, geology and structure, three-dimensional geometry of water-bearing units (aquifers) and aquitards, land and water use, hydrology, and groundwater quality. The HCM provides a framework for understanding the interrelationships among these components and their influence on occurrence and movement of groundwater. The HCM can be used to develop numerical models and water budgets and to help inform decision making with respect to selection of SMC, monitoring networks, and potential management actions. An HCM should be periodically reviewed and revised as new data become available. The following sections describe the HCM of the Anderson Subbasin.

The Anderson Subbasin (5-006.03) is one of five groundwater subbasins within the RAGB of Northern California (Figure 2-1). The roughly east-west-oriented subbasin is approximately 5 to 15 miles long and 18 miles wide. The Sacramento River forms the northeastern boundary of the subbasin, the Klamath Mountains form the north/northwestern boundary, the Coast Ranges form the west/southwestern boundary, and Cottonwood Creek forms the southern boundary (DWR, 1968; DWR, 2004).

3.1.1 Topography

Figure 3-1 presents the topography of the Anderson Subbasin. The data presented on Figure 3-1 represent topographic data from a number of sources that were compiled into a single dataset. These data sources include the following:

- USGS 1/3-arcsecond (approximately 30-foot) digital elevation model data (USGS, 2019b)
- Light detection and ranging (Lidar) data collected as part of a Federal Emergency Management Agency study of the Cow Creek drainage area; 2-foot resolution (USGS, 2018)
- High-resolution (3-foot) Lidar data collected as part of a collaborative effort between COR and Shasta County (COR, 2019b)

Ground surface elevations across the Anderson Subbasin vary by as much as 750 feet as the foothills of the Klamath Mountains in the north/northwest and the Coast Ranges to the west/southwest descend to the trough of the Sacramento Valley in the southeast. The maximum ground surface elevation in the Anderson Subbasin, nearly 1,100 feet above the North American Vertical Datum of 1988 (NAVD88), is in the foothills of the Klamath Mountains to the north/northwest. Where the foothills of the Klamath Mountains and Coast Ranges have been deeply incised by Clear Creek, there is local relief in excess of 100 feet at high grades. Topographic relief generally decreases toward the Sacramento River, with a minimum ground surface elevation of approximately 350 feet NAVD88 in the southeasternmost portion of the Anderson Subbasin.

3.1.2 Climate

3.1.2.1 Precipitation

Figure 3-2 presents an isohyetal map of 1981–2010 mean annual precipitation for the Anderson Subbasin (PRISM Climate Group, 2012), showing that precipitation varies along a primarily northwest-southeast trend in the Anderson Subbasin. Based on these 30-year averages from Parameter-elevation Regressions on Independent Slopes Model (PRISM) datasets, the foothills of the Klamath Mountains on the north/northwestern periphery of the subbasin receive a mean annual precipitation of approximately

44 inches, and portions of the valley floor to the south receive approximately 31 to 34 inches per year (Figure 3-2). Mean annual precipitation is greater outside the Anderson Subbasin in the mountains to the north and west. The Redding area receives about 84 percent of its precipitation in the autumn and winter, with only about 16 percent falling in the spring and summer (UCC, 2019a; Station USR0000CREA).

Figure 3-3 presents a chart of water year type (WYT) based on the Sacramento Valley Water Year Index[9] (an accounting of the volume and timing of unimpaired runoff at specific stream gauges in the Sacramento, Feather, Yuba, and American Rivers) (DWR, 2020a). The WY index is computed as follows:

Sacramento Valley Water Year Index = 0.4 * Current April-July Runoff Forecast (in MAF) + 0.3 * Current October-March Runoff (in MAF) + 0.3 * Previous Water Year's Index

If the previous WY's index exceeds 10, then a value of 10 is used for that component of the equation. The computed WY index is used to classify the WY as one of the following:

Year Type	Water Year Index
Wet	Equal to or greater than 9.2
Above Normal	Greater than 7.8, and less than 9.2
Below Normal	Greater than 6.5, and equal to or less than 7.8
Dry	Greater than 5.4, and equal to or less than 6.5
Critical	Equal to or less than 5.4

The Redding area (included in the Sacramento Valley Water Year Index) had several notable wet years in the early 1980s and in the late 1990s, interspersed by several critical WYs in the late 1980s and early 1990s. Prior to 1986, wet years were more frequent, and critical years were scarce. In the decades since 1986, precipitation has become more inconsistent, with periods of drought interrupted by one or a few very wet years. Furthermore, a recent increase in atmospheric river events is bringing more intense storms to California, with total annual precipitation falling in fewer total storms (Swain et al., 2018).

Of particular importance to note is that the Sacramento Valley Water Year Index is a regional planning tool. WYTs have not been established by DWR for local conditions in the RAGB; thus, WYTs presented in this GSP were obtained from DWR for the entire Sacramento Valley. As such, some Sacramento Valley WYTs do not necessarily correlate well with local precipitation conditions in the RAGB. The need to develop WYTs specific to the RAGB will be assessed during GSP implementation.

3.1.2.2 Temperature

Within the Anderson Subbasin, summers are hot and arid, and winters are cool and typically wet. Based on data from weather stations at Shasta Dam and Whiskeytown Reservoir, the average annual high temperature is approximately 73 degrees Fahrenheit (°F), ranging from a low of 53°F in January to a high of 96°F in July. The average annual low temperature is approximately 51°F, ranging from a low of 38° in January to a high of 66° in July (UCC, 2019b, 2019c; Stations USC00048135 and USC00049621).

3.1.2.3 Evapotranspiration

Reference evapotranspiration (ET_o) in the Anderson Subbasin has been calculated based on data collected at California Irrigation Management Information System (CIMIS) Station 224 at Shasta College between January 2013 and October 2019. The average annual ET_o measured over the period of record is 55 inches per year, or 4.6 feet per year. The ET_o values calculated from the CIMIS data indicate the amount of water that could be transpired from a reference crop, such as grass or alfalfa, if supplied by irrigation. To

[9] http://cdec.water.ca.gov/reportapp/javareports?name=wsihist

calculate a specific crop evapotranspiration (ET_c) rate, the ET_o is multiplied by a crop coefficient that adjusts the water consumption for each specific crop relative to the water consumption of the reference crop. CIMIS Station 224 is located within the neighboring Enterprise Subbasin of the RAGB and it is the closest CIMIS station to the Anderson Subbasin.

According to the State of California Reference Evapotranspiration Map developed by CIMIS, the Anderson Subbasin is located within Zone 14, with an annual average ET_o of 57 inches, or 4.8 feet (CIMIS, 2012). This regional average annual ET_o is similar to the ET_o measured at CIMIS Station 224.

3.1.3 Hydrology

Many streams cross the Anderson Subbasin, generally flowing down from the foothills of the Klamath Mountains in the north/northwest and the Coast Ranges in the west/southwest, eastward to confluences with the Sacramento River. The Sacramento River is the largest and most significant hydrological feature in the subbasin (Figure 3-4). Data referenced in this section were sourced from USGS and the Sacramento River Watershed Program (SRWP, 2020).

The Sacramento River is the largest river and watershed system in California, carrying 31 percent of the state's total surface-water runoff. Around 6,500 square miles of the 27,000-square-mile Sacramento River watershed drain into the RAGB. Sourced from volcanic plateaus approximately 45 miles north of the Anderson Subbasin, its headwaters comprise the Upper Sacramento, McCloud, and Pit Rivers. After flowing through Shasta Lake and Keswick Reservoir, the Sacramento River flows south, making up the northeastern and eastern boundary of the Anderson Subbasin. The Sacramento River is gauged at Keswick Reservoir, where the flow is controlled by releases from Shasta and Keswick Dams. Based on data from this gauge (USGS #11370500, see Figure 2-11, USGS, 2019a) extending back to 1938, the annual average flow in the Sacramento River at this location is approximately 10,000 cfs, with peaks as high as 50,000 to 70,000 cfs in wet years and lows around 5,000 cfs during drought periods.

Water from the Trinity River is imported to the Sacramento River watershed through diversions from Lewiston Lake in Trinity County. Water from Lewiston Lake is conveyed via the Clear Creek Tunnel to the Carr Powerhouse on Whiskeytown Lake in Shasta County. Several purveyors in Shasta County divert water from Whiskeytown Lake through contracts with Reclamation.

The southern boundary of the Anderson Subbasin coincides with Cottonwood Creek. Drainage in this watershed comes from the east slope of the Klamath Mountains and the Coast Ranges, entering the Sacramento River near the town of Cottonwood. Including its three main tributaries (North Fork, Middle Fork, and South Fork) with more than 500,000 AF in annual runoff, this is the third largest watershed on the western side of the Sacramento River Basin at 938 square miles. Typical of westside watersheds, headwaters are from relatively low-elevation, rainfall-dominated areas that produce a flashy hydrology (short-term peak runoff events in winter and low baseflow in summer). Cottonwood Creek is the largest undammed tributary in the Sacramento River Basin and is a major source of sediment and gravel input to the Sacramento River (SRWP, 2020). Cottonwood Creek streamflow is monitored by USGS near the town of Cottonwood with a record extending back to 1940 (USGS #11376000, see Figure 2-11, USGS, 2019a). Average annual flow in Cottonwood Creek at this stream gauge between 1940 and 2019 is approximately 850 cfs, increasing to nearly 3,000 cfs during the wet years (such as 1983) and decreasing to less than 100 cfs during dry/critical years (such as 1977). Cottonwood Creek is known to produce peak flood flows of 20,000 to over 80,000 cfs during heavy storms.

Lower Clear Creek flows west to east though the northern portion of the Anderson Subbasin before reaching a confluence with the Sacramento River between Redding and Anderson. Water in Lower Clear Creek is released from Clair A. Hill Whiskeytown Dam, and the Whiskeytown Reservoir forms the boundary between Upper Clear Creek and Lower Clear Creek. With the exception of some minor accretion flows from side tributaries, flows in Lower Clear Creek are controlled by the releases through Clair A. Hill Whiskeytown Dam. The current release schedule is 50 cfs (January through October) and 100 cfs (November and December) (SRWP, 2020). Lower Clear Creek streamflow is monitored by USGS near the town of Igo with a record extending back to 1940 (USGS #11372000, see Figure 2-11, USGS, 2019a). Average annual flow in Clear Creek between 1965 and 2019 is approximately 190 cfs, ranging from nearly 570 cfs during the wet years (such as 1983) to less than 60 cfs during dry/critical years (such as 1977). Peak flows in Clear Creek range from less than 5,000 cfs to as much as nearly 25,000 cfs.

3.1.4 Regional Geologic Setting

The RAGB consists of 510 square miles in the northern Central Valley of California. It is bounded by the foothills of the Cascade Range in the east, the Klamath Mountains in the north/northwest, the Coast Ranges in the west/southwest, and the Red Bluff Arch in the south (Pierce, 1983). The Red Bluff Arch, a subsurface structural feature, defines the boundary between the RAGB and the Sacramento Groundwater Basin to the south. The area of the RAGB is an interior dissected plain, consisting of a sediment-filled, southward-plunging, symmetrical trough, crossed by the valleys of the Sacramento River and of Churn Creek, Clear Creek, Cottonwood Creek, and Stillwater Creek.

Tertiary deposition of material sourced from the Coast and Cascade Ranges created the principal freshwater-bearing formations in the basin: the Tuscan and Tehama Formations. These formations are up to 2,000 feet thick near the confluence of the Sacramento River and Cottonwood Creek and are interbedded throughout the RAGB, with the Tuscan more prominent to the east and the Tehama more prominent to the west. The Tuscan Formation is generally more permeable and productive than the Tehama Formation (DWR, 2004).

3.1.5 Local Geologic Setting

3.1.5.1 Surface Soils

Figure 3-5 presents the distribution of surface soils within the Anderson Subbasin (USDA, 2019). Soils are derived from the weathering of underlying geological units and are influenced by lithology as well as climate, biological factors (vegetation, biota, human influences), topography, and hydrologic conditions. The United States Department of Agriculture's Natural Resources Conservation Service developed a hierarchical classification system consisting of Order, Suborder, Great Group, Subgroup, Family, and Series. This classification system (or taxonomy) is based on quantitative soil properties such as depth, moisture, temperature, texture, structure, cation exchange capacity, base saturation, clay mineralogy, organic matter content, and salt content. The soil distribution presented on Figure 3-5 categorizes surface soils based on taxonomic order. As shown on Figure 3-5, 5 of the 12 Natural Resources Conservation Service taxonomic orders are present in the Anderson Subbasin, as follows:

- Alfisols are present across approximately 77 percent of the subbasin. Alfisols are naturally fertile soils, high in aluminum and iron, have clay-rich horizons, and form in semi-arid to humid regions with at least several months of vegetation grown throughout the year (sufficient moisture and warmth).
- Entisols are present over approximately 12 percent of the subbasin, primarily present adjacent to surface streams and within stream floodplains. Entisols are young soils with no profile development (that is, they have not been significantly altered from the parent material).
- Ultisols are present over approximately 2 percent of the subbasin within stream channels. Ultisols are highly weathered, acidic, clay-rich mineral soils with little base nutrients.

- Inceptisols are present over approximately 0.5 percent of the subbasin. Inceptisols are generally young soils with limited soil profile development (more developed than entisols).
- Aridisols are present over approximately 0.02 percent of the subbasin. Aridisols have a very low concentration of organic matter and are often associated with arid climates.

Regions of the subbasin classified as “other” (8.48 percent of the subbasin) on Figure 3-5 are primarily areas that have been mapped as water.

3.1.5.2 Geologic Units

Figure 3-6a,b presents a geologic map of the RAGB, derived from the *Digital Geologic Map of The Redding 1° X 2° Degree Quadrangle, Shasta, Tehama, Humboldt, And Trinity Counties, California* (USGS, 2012). Northwest-southeast and east-west trending cross sections are presented on Figures 3-7 and 3-8, respectively. Geologic cross sections were developed based on available lithologic information with the primary objective of displaying the water-bearing units within the subbasin. Because the level of detail and consistency of historical lithologic logging varied greatly, units are presented on the cross section as dominated by either finer- or coarser-grained materials. Lack of detailed lithologic information precludes differentiating major geologic units in section view. Major geologic units underlying the Anderson Subbasin include (from oldest to youngest) the following:

Basement Complex (Various Units, including Kqd and Dcg, on Figure 3-6a,b)

The pre-Tertiary igneous and metamorphic basement complex is the oldest geologic unit underling the Central Valley. The formations that make up the basement complex formed throughout the Devonian and terminated during the Cretaceous with the inception of the Chico Formation. The basement complex crops out along the steep slopes surrounding the RAGB, forming a nearly impermeable boundary for groundwater. The basement complex is considered non-water bearing, yet scarce water is stored in joints and fractures, permitting small well yields.

Chico Formation (Kc on Figure 3-6a,b)

Unconformably overlying the basement complex is the Cretaceous Chico Formation. The Chico Formation was deposited in a marine and shore zone environment, consisting of a variety of sedimentary rocks—conglomerate, siltstone, sandstone, and shale. This formation is generally of low permeability, with some zones yielding small amounts of saline, connate water. In certain places, this water may be under artesian pressures, especially where shale beds are extensive. The thickness of the Chico Formation ranges from zero feet in the northern RAGB to 6,000 feet to the south, forming the base of the southerly tilt of the Central Valley. Because the Chico Formation contains saline, connate water, the top of the Chico Formation defines the base of fresh water in the RAGB.

Sedimentary Rocks (Ks on Figure-3-6a,b)

Lower Cretaceous marine sedimentary rocks generally outcrop west of the Anderson Subbasin; however, small areas of outcrop are located within the subbasin near the confluence of the North Fork Cottonwood Creek and Cottonwood Creek. This formation consists of “*well indurated, buff-weathering sandstone, mudstone, and conglomerate*” (USGS, 2012). The unit contains ammonites and other marine fossils; rocks are similar to those of equivalent age in the Great Valley sequence.

Tehama Formation (Tte on Figure 3-6a,b)

The Pliocene-age Tehama Formation consists of fluviatile silt, sand, gravel, and clay originating in the Klamath Mountains and Coast Ranges (DWR, 2004). Sourced from the west, the Tehama Formation is most prominent in the western portion of the RAGB and is interbedded with the Tuscan Formation in the central portion of the RAGB. This unit crops out throughout the central portion of the Anderson Subbasin. The thickness of the Tehama Formation is variable, from around 1,000 feet in the northern portion of the Anderson Subbasin to around 4,000 feet at the confluence of Cottonwood Creek and the Sacramento River; however, the formation is generally approximately 500 feet thick over most of the subbasin west of Anderson (DWR, 2004). Permeability is generally moderate to high with yields of 100 to 1,000 gpm, making the Tehama Formation one of the principal water-bearing formations in the RAGB (Pierce, 1983).

Tuscan Formation (Tt on Figure 3-6a,b)

The Pliocene-age Tuscan Formation consists of volcanic breccia, tuff-breccia, volcanic sandstone and conglomerate, coarse- to fine-grained tuff, and tuffaceous silt and clay predominately derived from andesitic and basaltic sources. As shown on Figure 3-6b, the Tuscan Formation generally crops out east and south of the Anderson Subbasin; and much of the formation lies east of the Sacramento Valley under a volcanic plateau of the Cascade Range. The Tuscan Formation dips to the southwest and thins from east to west. The maximum thickness of the Tuscan Formation is 1,600 feet in the Cascade Range, thinning to around 300 feet where it interfingers with the Tehama Formation in the central portion of the RAGB (Pierce, 1983). Fresh water is found throughout the Tuscan Formation, with a thick and low-permeability basalt flow separating it from the underlying and saline Chico Formation. It contains moderately permeable beds at a range of depths, with lenticular clay beds resulting in locally confined conditions. Yields are similar to that of the Tehama Formation—100 to 1,000 gpm (Pierce, 1983).

Red Bluff Formation (Qrb on Figure 3-6a,b)

Unconformably overlying the Tehama and Tuscan Formation is the Pleistocene-age Red Bluff Formation. It is composed of coarse gravels and boulders in a matrix of reddish sand, silt, and clay. This formation is discontinuous, with thicknesses ranging from 1 foot to 100 feet. The Red Bluff Formation typically lies above the zone of saturation, but there are areas of perched water. Permeability generally ranges from poor to moderate, and yields are small to moderate and sufficient for domestic wells (Pierce, 1983).

Riverbank Formation (Qr on Figure 3-6a,b)

The Pleistocene-age Riverbank Formation is present as alluvial fan and terrace deposits along streams in the RAGB. The unit consists of weathered reddish gravel, sand, and silt (USGS, 2012). The Riverbank Formation reaches thicknesses of up to 50 feet in the Anderson Subbasin (DWR, 2004).

Modesto Formation (Qm on Figure 3-6a,b)

The Pleistocene-age alluvial deposits of the Modesto Formation are primarily present along the Sacramento River, Cottonwood Creek, and tributary floodplains in the RAGB. The unit consists of tan and light-gray gravely sand, silt, and clay, except where derived from volcanic rocks of the Tuscan Formation, where it is distinctly red and black with minor brown clasts (USGS, 2012). The Modesto Formation reaches thicknesses of up to 50 feet in the Anderson Subbasin (DWR, 2004).

Alluvium and Overbank Deposits (Qa, Qao, Qo on Figure 3-6a,b)

Alluvium is found in channels and floodplains along the Sacramento River and its tributaries, and has been described by Pierce (1983) as unconsolidated, interbedded, gravel, sand, silt, and clay. Permeability is generally moderate but may be quite high in regions dominated by gravels. Some wells in the alluvium have produced as much as 2,000 gpm, but many others produce only enough for domestic use.

3.1.5.3 Geologic Structures

Red Bluff Arch

A series of northeastward-trending anticlines and synclines located north of Red Bluff, the Red Bluff Arch, distinguishes the RAGB from the Sacramento Groundwater Basin. Data are insufficient to determine the groundwater and surface-water relationship in the vicinity of the Red Bluff Arch; however, the effect of the arch is hypothesized to force groundwater toward the surface to induce gaining streams (Pierce, 1983).

3.1.6 Local Hydrogeology

3.1.6.1 Lateral Basin Boundary

The RAGB is bounded by the foothills of the Cascade Range to the east, the Klamath Mountains to the north/northwest, the Coast Range to the west/southwest, and the Red Bluff Arch to the south (Pierce, 1983). Unlike the RAGB, much of the Anderson Subbasin is bounded by hydrologic features: the Sacramento River to the east and northeast and Cottonwood Creek to the south. Because some of the lateral subbasin boundaries are defined by surface streams, there is likely hydraulic communication between adjacent subbasins. That is, there may be subsurface flow into the Anderson Subbasin from adjacent subbasins and from the Anderson Subbasin into adjacent subbasins.

3.1.6.2 Definable Bottom of Basin

The base of fresh water defines the bottom of the basin. In the RAGB, this is the top of the Chico Formation (Figure 3-9). Although water-bearing formations exist below this depth, the saline nature of the groundwater and the depth to formation prevent the Chico Formation from being a viable aquifer. The top of the Chico Formation in the Anderson Subbasin ranges from a depth of less than 100 feet in the northwest to a depth of greater than 2,000 feet in the southeast (DWR, 1968).

3.1.6.3 Principal Aquifers and Aquitards

Much of the water supply in the Anderson Subbasin, and in the greater RAGB, is stored in surface reservoirs; and as a result, the communities in the region are less dependent on groundwater. This may contribute to the fact that groundwater elevations in the RAGB do not show evidence of continuous decline (as will be discussed further in subsequent sections). In the portions of the Anderson Subbasin near either Sacramento River, Clear Creek, or Cottonwood Creek, depths to groundwater are shallow, within 25 feet of land surface. However, depth to groundwater generally increases to the west, with increasing distance from the streams. In areas outside of large drainages, depths to groundwater can range from 150 to 250 feet below land surface. Shallow, alluvial deposits have moderate to high permeabilities in the subbasin, but deposits are not significant sources for groundwater use in the subbasin because of the limited lateral and vertical extents. The Red Bluff Formation is generally present above the regional water table; however, local perched zones may yield small quantities of water to domestic wells (DWR, 1968, Pierce, 1983). The principal water-bearing formations in the Anderson Subbasin, the Tuscan and Tehama Formations, together function as one large, leaky unconfined aquifer with increasing degrees of confinement with depth. Groundwater use of the principal aquifer is for urban, industrial, and agricultural purposes, and is described in greater detail in Chapter 2. Due to the reliability of surface water storage and the readily available groundwater supply within the Tuscan and Tehama aquifers, few resources have been dedicated to describing other aquifers within the RAGB. As shown on Figures 3-7 and

3-8, although laterally discontinuous fine-grained zones are present within the subbasin, there is no evidence of a regional aquitard.

3.1.6.4 Aquifer Properties

Aquifer systems function as a combination of subsurface reservoirs for storage of groundwater and conduits for the transmission of groundwater. The following sections describe the aquifer system properties in the Anderson Subbasin. The magnitude and distribution of hydrogeologic properties of the principal aquifers in the subbasin have not been well characterized or documented. The scarcity of available quantitative estimates of the aquifer properties of the subbasin's principal aquifers results in uncertainties that will be further refined during implementation of this GSP. This will be accomplished through evaluation of hydraulic data collected during development of the new monitoring well and through calibration of the numerical model being developed as part of this GSP.

Transmissivity and Hydraulic Conductivity

There are two general terms that are used to describe the capacity of an aquifer to transmit water: hydraulic conductivity and transmissivity. Hydraulic conductivity is defined as the coefficient of proportionality describing the rate at which a fluid can move through a porous medium and is dependent on the fluid density, fluid viscosity, and the intrinsic permeability. Transmissivity is defined as the capacity of an aquifer to transmit groundwater through a unit width of the aquifer under a unit hydraulic gradient. Transmissivity is equal to the product of the hydraulic conductivity (which is reported in units of feet per day [ft/day]) and saturated thickness, and is generally reported in units of gallons per day per foot or square feet per day (ft^2/day).

Numerous well completion logs filed with DWR include information that can be used to estimate the specific capacity of the associated well, which can then be used to approximate the transmissivity (CNRA, 2020). Additionally, specific capacity estimates are available from short-duration (45- to 176-minute) hydraulic testing performed at the end of development of 13 ACID groundwater monitoring wells (CH2M HILL, 2004). In general, estimated transmissivity values are lower in the west/southwestern portion of the Anderson Subbasin and increase to the east/northeast, where the thickness of unconsolidated deposits increases. Estimated transmissivities based on reported specific capacity values on well logs by well type are as follows for the Anderson Subbasin:

- Domestic Wells (80 logs): 6 to 9,000 ft^2/day with a geometric mean of 230 ft^2/day
- Public Wells (8 logs): 120 to 13,750 ft^2/day with a geometric mean of 2,400 ft^2/day
- Industrial and Irrigation Wells (11 logs): 600 to 35,000 ft^2/day with a geometric mean of 3,300 ft^2/day
- Monitoring Wells, Test Wells, and Unknown Well Type (15 logs): 80 to 22,000 ft^2/day with a geometric mean of 1,325 ft^2/day

Hydraulic conductivity was estimated from specific capacity data by dividing the estimated transmissivity by the well screen length, where available. Estimated hydraulic conductivity values for the Anderson Subbasin are as follows:

- Domestic Wells (57 logs): 0.2 to 500 ft/day with a geometric mean of 11 ft/day
- Public Wells (4 logs): 42 to 230 ft/day with a geometric mean of 87 ft/day
- Industrial and Irrigation Wells (9 logs): 5.5 to 113 ft/day with a geometric mean of 19 ft/day
- Monitoring Wells, Test Wells, and Unknown Well Type (14 logs): 2.5 to 735 ft/day with a geometric mean of 43 ft/day

Excluding lower-yield wells (those with reported pumping rates less than 50 gpm) and relatively shallow wells (those with depths less than 150 feet below ground surface [bgs]), transmissivity ranges from 150 to

35,000 ft^2/day (hydraulic conductivity of 2.5 to 230 ft/day) with a geometric mean of 1,700 ft^2/day (hydraulic conductivity of 20 ft/day).

In addition to estimating transmissivity based on specific capacity measurements, aquifer properties have been estimated through the process of numerical model calibration, which is a process of adjusting model inputs (such as transmissivity) to achieve a reasonable match to field observations of interest. The most recent version of the Redding Basin Finite Element Model (REDFEM) included transmissivity estimates of less than 1,000 ft^2/day (hydraulic conductivity of 5 ft/day) in the northern portion of the subbasin to more than 200,000 ft^2/day (hydraulic conductivity of 300 ft/day) in the southern portion of the subbasin (CH2M HILL, 2011). These values represent the estimated transmissivity for the entire thickness of unconsolidated materials of the principal aquifers overlying the Chico Formation (Figure 3-9) as opposed to aquifer thickness associated with a well screen (as is the case for specific capacity estimates). Estimates of transmissivity and hydraulic conductivity will be further refined in the numerical groundwater flow model development effort being performed to support this GSP.

Storativity

Storativity (or storage coefficient) is the volume of water released from (or taken into) storage in the aquifer system per unit area per unit change in head (i.e., groundwater elevation). In general, unconfined aquifer systems have relatively higher storativity values (typically known as specific yield), whereas confined aquifer systems have lower storativity values. Point estimates of aquifer storage from hydraulic testing within the Anderson Subbasin are currently unavailable. Values incorporated into REDFEM include a specific yield of 10 percent for shallow portions of the basin aquifer and a specific storage of 2×10^{-6} per foot for the deeper portions of the aquifer. Storativity values are computed by multiplying the specific storage value by the aquifer thickness. The assumed resulting storativity values for the deeper model layers in REDFEM range from 1×10^{-4} to 4×10^{-3} (CH2M HILL, 2011). Similar to transmissivity, storage properties will be further refined in the numerical groundwater flow model that is being developed as part of this GSP.

3.1.6.5 Natural Recharge Areas

Recharge to the principal aquifers (i.e., Tuscan and Tehama Formations) in the Anderson Subbasin and the shallower, overlying water-bearing units occurs through a combination of the following (DWR, 1968; Pierce, 1983):

- Groundwater recharge from precipitation
- Groundwater recharge from applied water
- Groundwater recharge from streams and irrigation canals
- Subsurface inflow from adjacent subbasins

Recharge to aquifer systems is influenced by a number of parameters including (but not limited to) the following: surface soil infiltration capacity; land use/vegetative cover; topography; lithology; and the frequency, intensity, duration, and volume of precipitation. Figure 3-10 presents the distribution of the Soil Agricultural Groundwater Banking Index (SAGBI) for the Anderson Subbasin. The SAGBI was developed by the University of California–Davis as part of a study of the potential to bank groundwater, while maintaining healthy crops as a drought management strategy (O'Geen et al., 2015). The SAGBI data presented on Figure 3-10 are based on the following factors: infiltration capacity of soils, the duration that the root zone would be anticipated to remain saturated, topography, potential for leaching of high-salinity soils to degrade groundwater quality, and the susceptibility of soils to compact and erode. As shown on Figure 3-10, the SAGBI indicates that much of the western (foothills of the Klamath Mountains and Coast Ranges) and central portions of the subbasin overlie areas with a moderately poor to very poor potential for groundwater recharge. Areas within and along stream channels, especially those of the Sacramento

River and Cottonwood Creek, represent areas of good to excellent potential for groundwater recharge; however, groundwater levels in these areas are often shallow, limiting the quantity of recharge that can enter the shallow aquifer. This distribution provides one source of information on where natural recharge to the groundwater system likely occurs. Quantitative estimates of natural and anthropogenic recharge are discussed further in Chapter 4 Water Budgets.

3.1.6.6 Natural Discharge Areas

Natural groundwater discharge areas within the Anderson Subbasin include groundwater discharge to surface-water bodies (streams, ponds, wetlands), subsurface outflow to adjacent subbasins, and shallow groundwater ET by phreatophytes. Although groundwater discharge to streams has not been mapped, previous numerical modeling efforts indicate that the Sacramento River and at least the lower portions of primary tributaries are gaining streams. REDFEM output indicates that the Sacramento River gains approximately 700,000 AF/yr (on average) from groundwater as it flows through the RAGB. Updated estimates of the location and magnitude of natural groundwater discharge are discussed further in Chapter 4 Water Budgets.

Figure 3-11 presents the distribution of potential GDEs within the Anderson Subbasin contained in the DWR Natural Communities (NC) dataset (DWR, 2020b). The NC dataset is the product of a collaborative effort among DWR, California Department of Fish and Wildlife, and The Nature Conservancy. These agencies compiled and screened information from 48 datasets (such as the National Hydrography Dataset, National Wetlands Inventory, Vegetation Classification and Mapping Program, and Classification and Assessment with Landsat Of Visible Ecological Groupings) to produce the NC dataset. As defined in the NC dataset, the two classifications of GDEs are (1) wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions (NC wetland) and (2) vegetation types commonly associated with the subsurface presence of groundwater (NC vegetation or phreatophytes).

The top pane of Figure 3-11 presents the nearly 5,000 acres of potential GDEs mapped within the Anderson Subbasin. These data indicate that NC wetlands typically occur within and immediately adjacent to stream channels (primarily the Sacramento River and Cottonwood Creek), whereas NC vegetation areas are typically present in floodplain areas associated with streams. The NC vegetation in the subbasin is dominated by Fremont cottonwood (30 percent), valley oak (29 percent), and riparian mixed hardwood and shrubs (22 percent). Of the NC wetlands mapped in the Anderson Subbasin, approximately 65 percent are categorized as riverine, and approximately 35 percent are categorized as palustrine. Of the riverine wetlands in the Anderson Subbasin, approximately 65 percent of the area is permanently or semi-permanently flooded, and 35 percent of the area is seasonally flooded. Approximately 10 percent of the palustrine wetlands are permanently or semi-permanently flooded, and 90 percent are seasonally flooded.

The Nature Conservancy has published guidance documents aimed at helping GSAs evaluate GDEs under SGMA. The document *Identifying GDEs under SGMA, Best Practices for using the NC Dataset* (TNC, 2019) includes five BMPs to consider: (1) establishing a connection to groundwater, (2) characterizing seasonal and interannual groundwater conditions, (3) understanding ecosystems often rely on both groundwater and surface water, (4) selecting representative groundwater wells, and (5) contouring groundwater elevations. As was discussed in the preceding sections, the primary aquifer in the Anderson Subbasin is a heterogeneous, leaky system (that is, there are not defined "layers" of aquifers separated by aquitards). When considering whether the mapped potential GDEs have a connection to groundwater, the EAGSA selected a depth to groundwater threshold of up to 30 feet bgs. This threshold was deemed to provide a conservative buffer when considering the rooting depths of the mapped species described in the preceding paragraph (for example, the Fremont Cottonwood rooting depth is estimated at approximately

10 to 17 feet).[10] The second pane on Figure 3-11 presents potential GDEs overlying areas of shallow groundwater within 30 feet of land surface within the Anderson Subbasin based on April 2018 groundwater conditions. As will be discussed further in Section 3.2, groundwater levels in the Anderson Subbasin are generally highest in the winter and spring, and lowest in the summer and fall. As such, the period of seasonal high groundwater levels was considered appropriate when evaluating potential GDEs in the subbasin. Depth to groundwater was computed by subtracting the April 2018 groundwater elevation contours (plotted on Figure 3-12) from the digital ground surface elevation distribution (Figure 3-1). As shown on the second pane of Figure 3-11, approximately 4,000 acres of potential GDEs overlie areas of shallow groundwater within the Anderson Subbasin. It should be noted that there has been no independent verification that the locations shown on this map constitute actual GDEs; therefore, Figure 3-11 shows only potential GDEs. Additional field reconnaissance may be necessary to further inform the potential existence of these GDEs.

In addition to publishing guidance documents to support GSAs, the Nature Conservancy has developed the GDE Pulse dataset.[11] This online mapping tool provides an overview of GDE changes (growth or decline) between defined time periods using satellite-based remote sensing data. These methods "take advantage of different patterns of reflectance related to the level of surface moisture and/or photosynthetic chlorophyll present in vegetation." The two datasets published on the GDE pulse online interactive mapping tool include (1) Normalized Derived Vegetation Index (NDVI), which is an estimate of vegetation greenness and (2) Normalized Derived Moisture Index (NDMI), which is an estimate of vegetation moisture. Both the NDVI and NDMI datasets for the 1985 through 2018 timeframe indicate that the majority of the potential GDEs in the Anderson Subbasin showed little to no change to moderate increase. Available data for the 2014 through 2018 period (which includes the recent drought) shows a more variable pattern ranging from large increase to large decrease; however, a majority of the subbasin remained in the little to no change to moderate increase category.

3.2 Groundwater Conditions

This section describes current and historical groundwater conditions in the Anderson Subbasin. Unless otherwise specified, current conditions will refer to conditions occurring after January 1, 2015, and historical conditions will refer to those occurring prior to January 1, 2015. The groundwater conditions described in the following sections present the current and historical variability of groundwater levels and groundwater quality.

3.2.1 Groundwater Elevations

The assessment of groundwater elevation conditions in the Anderson Subbasin is largely based on data collected by DWR from March 16, 1954 to April 11, 2019. The groundwater-level monitoring network in the Anderson Subbasin comprises 47 groundwater wells gauged by DWR, Clear Creek CSD, Shasta County, and USGS (DWR, 2019a; DWR, 2019b; USGS, 2019a). Groundwater wells in the monitoring network have various uses including residential, irrigation, industrial, and observation, as well as two groundwater wells with the designation of other, one groundwater well with a designation of unknown, and five groundwater wells without a designation for well usage. The location and type of monitoring program are shown on Figure 2-9 and listed in Table 3-1. Data collected by Clear Creek CSD and Shasta County are maintained under the DWR groundwater elevation dataset.

[10] https://www.fs.fed.us/database/feis/plants/tree/popfre/all.html#:~:text=Fremont%20cottonwood%20is%20vulnerable%20to,)%20%5B26%2C166%5D.
[11] https://gde.codefornature.org/#/map

Groundwater elevation data have been routinely collected in the subbasin to provide data to better understand seasonal changes and to monitor longer-term trends in groundwater levels. A general summary of the historical groundwater-level monitoring activities conducted within the Anderson Subbasin since 1954 is described below:

- Between 1954 and 1969, DWR gauged up to 11 groundwater wells monthly to triennially
- Between 1970 and 1999, DWR gauged up to 16 groundwater wells monthly to semiannually
- Between 2000 and 2009, DWR gauged up to 25 groundwater wells triennially to semiannually
- Between 2010 and 2019, DWR gauged up to 27 groundwater wells weekly to semiannually
- Between 2004 and 2018, DWR used transducers to gauge up to 20 groundwater wells monthly
- Between 2016 and 2019, Shasta County gauged 1 groundwater well semiannually
- Between 2016 and 2017, CCCSD gauged 1 groundwater well three times
- Between January 2018 and April 2019, USGS gauged 6 groundwater wells one time

The amount of available groundwater-level data for a given well varies from 1 measurement at the USGS-monitored wells to over 400 data points at a DWR-monitored location. The period of record for wells included in the DWR dataset ranges from 1 year at Well 1, to 63 years of groundwater-level monitoring at 30N/04W-05K01 and 30N/04W-23G01, with an average period of record of nearly 22 years.

Due to the various regional and local influences on groundwater elevations, characterization of subbasin groundwater elevation conditions was completed using three methodologies: groundwater elevation contour maps, hydrographs, and vertical hydraulic gradients, as follows:

- Groundwater elevation contour maps show the geographic distribution of groundwater elevations at a specific time. Contours and posted groundwater elevations represent the elevation of the water table in elevation units of feet NAVD88.
- Hydrographs show variations in groundwater elevations at an individual well over time. A review of hydrographs can provide insight to both seasonal and longer-term temporal trends in groundwater elevations.
- Vertical hydraulic gradients provide information on the potential for vertical groundwater flow at a given location.

A summary of current and historical groundwater elevations and evaluations of vertical and horizontal flow directions are included herein.

3.2.1.1 Groundwater Elevation Contours and Horizontal Groundwater Gradients

Because the Anderson Subbasin comprises a portion of the larger RAGB and groundwater flow is not affected by jurisdictional boundaries (such as subbasin boundaries), a regional review of groundwater-level data is important for understanding groundwater flow on a basinwide scale. Consistent with GSP requirements, groundwater-level data for two recent timeframes, March 19 through April 3, 2018 (spring) and October 16 through October 26, 2018 (fall), were used to create groundwater elevation contour maps for the RAGB. Groundwater levels in wells within the Anderson Subbasin were measured between March 19 and March 30, 2018 (spring) and October 16 and October 26, 2018 (fall). These groundwater measurements represent the most recent groundwater-level data as of the time of this evaluation.

The first step in the process of groundwater elevation contouring was to identify wells representative of groundwater conditions across the RAGB (that is, completed at consistent depths within the primary aquifer units). With some exceptions, wells included in the contouring were generally completed between depths of 50 and 150 feet bgs. A limited number of wells completed shallower (between 30 and 60 feet bgs) and deeper (between 150 to 880 feet bgs) were considered outlier data and were not included in the contouring.

As mentioned in Section 2.2.1.3, Sacramento River serves as a northern and eastern boundary, and Cottonwood Creek serves as a southern boundary for the Anderson Subbasin. These surface-water bodies are inferred to be gaining streams, or streams in which the stream stage is at a lower elevation than the underlying water table. Thus, groundwater moves from the aquifer into the stream channel. A gaining stream is hydraulically connected to the water table; and as a result, surface-water elevations in perennial streams that are coupled with the underlying aquifer must be considered when generating water table elevation contours. Because the Sacramento River is perennial and coupled with the groundwater system, the river surface elevation was included in groundwater contouring. The river gauge below Keswick Reservoir (11370500) and the river gauge at Bend Bridge in Red Bluff (11377100) served as upper and lower extents for consideration of Sacramento River stages in groundwater elevation contouring (USGS, 2019a). The topographic data (discussed in Section 3.1.1) were used to help inform Sacramento River stage between Keswick Reservoir and Bend Bridge. The average surface-water elevations between March 19 through April 3, 2018 (spring) and October 16 through October 26, 2018 (fall) at the Keswick Reservoir and Bend Bridge river gauges were computed. The average surface-water elevations at the two river gauges during the dates above were compared to the surface-water elevations in the digital elevation model near these two locations. The average spring surface-water elevation was more similar to the topographic elevation measured in the digital elevation model; thus, the topographic elevations along the Sacramento River were extracted from the digital elevation model to represent spring 2018 surface-water elevations. The fall 2018 Sacramento River surface-water elevations were interpolated from the previously extracted elevations from the digital elevation model and the difference between the spring 2018 and fall 2018 surface-water elevations at the river gauges. Because there is a lack of measured groundwater-level data in the northern and western portions of the Anderson Subbasin, groundwater elevation output from REDFEM (CH2M HILL, 2011) were used to augment the dataset used in the contouring in these sections of the Anderson Subbasin. Groundwater elevation contours for the Anderson Subbasin for spring and fall 2018 are shown on Figures 3-12 and 3-13, respectively.

During spring and fall 2018, groundwater flow in the Anderson Subbasin was generally east toward the Sacramento River. Groundwater flow directions and variations in groundwater elevation generally mimic a muted version of ground surface topography. Horizontal hydraulic gradients are estimated to be steeper in the western portion of the Anderson Subbasin, where transmissivity is lower, and flatter in the eastern portion of the subbasin, near the Sacramento River, where transmissivity is higher. The steepest horizontal hydraulic gradient is near 30N/06W-03M01, with both a spring and fall 2018 hydraulic gradient of approximately 0.027 foot per foot (ft/ft). The shallower horizontal gradients in the east near 30N/03W-32P03 are approximately 0.0016 ft/ft in spring 2018 and 0.0014 ft/ft in fall 2018. Measured spring and fall 2018 groundwater elevations considered in the contouring ranged from a high of approximately 990 feet NAVD88 at 30N/06W-03M01 in the western portion of the subbasin to a low of approximately 387 feet NAVD88 at 30N/03W-32P03 in the farthest eastern portion.

A comparison of Figures 3-12 and 3-13 shows that wells with groundwater levels measured in both spring and fall 2018 generally exhibit a decrease in groundwater levels between spring and fall. Generally, most groundwater recharge occurs from increased precipitation and less groundwater pumping in winter and spring. Conversely, groundwater recharge decreases during summer and fall when there is less precipitation and more groundwater pumping. Twenty-one of the twenty-eight wells with measurements in both spring and fall demonstrated declining groundwater levels, ranging from a decline of 0.29 foot at well 30N/06W-03M01 to a maximum decline of 4.1 feet at well 29N/05W-11A2. Groundwater levels in seven wells have increasing groundwater levels between spring and fall 2018, ranging from a rise of 1.45 foot at well 30N/03W-18B02 to a maximum rise of 8.6 feet at well 29N/04W-03R06.

3.2.1.2 Hydrographs

As mentioned above, the Anderson Subbasin groundwater monitoring network consists of groundwater wells monitored by multiple agencies, with data maintained by either USGS or DWR. Each of the six USGS-monitored groundwater wells has only one groundwater-level measurement, whereas the DWR dataset is more robust, with an average of approximately 145 datapoints per groundwater well. With the USGS and DWR datasets combined, temporal groundwater-level data for the Anderson Subbasin date as far back as March 16, 1954, with some locations continuing to be updated annually.

Temporal trends in groundwater elevations can be assessed with hydrographs that plot changes in groundwater elevations over time. Figure 3-14 depicts locations and hydrographs of representative wells in the Anderson Subbasin. The points on the plots represent groundwater elevation measurements, whereas the color-coded bars on the hydrographs represent the Sacramento Valley Water Year Index (as discussed in Section 3.1.2.1). Representative wells were chosen based on their distribution across the subbasin, and the timeframe and continuity of their monitoring record. A complete set of hydrographs is included in Appendix D – *Anderson Subbasin Hydrographs*.

Historical groundwater-level records for the Anderson Subbasin indicate groundwater levels have been relatively consistent, generally without long-term trends of increasing or decreasing groundwater levels, as indicated by the hydrographs for wells 29N/04W-02P01 and 30N/05W-02Q01 (Figure 3-14). However, some well locations in the Anderson Subbasin exhibit spatial and temporal variability with groundwater levels generally increasing at location 30N/04W-23G01 and decreasing groundwater levels at 29N/04W-04R03. Groundwater levels in 30N/04W-23G01 have generally increased from approximately 385 feet elevation during the 1976-1977 drought to nearly 400 feet elevation in 2011. Recent groundwater levels (since 2013) show declines during the recent dry and critical WYs. Conversely, groundwater levels at location 29N/04W-04R03 indicate longer-term declining groundwater levels. Groundwater levels at 29N/04W-04R03 have generally decreased from approximately 450 feet elevation in 1970 to approximately 440 feet elevation in 2004. Groundwater levels in 29N/05W-11A02 have been more variable over time, increasing from approximately 450 feet elevation in the early 1970s to approximately 465 feet elevation in 1985, at which point groundwater levels remained relatively consistent until the two droughts between 2007 and 2015, when groundwater levels decreased to approximately 455 feet elevation.

Although there have been relatively few long-term changes in groundwater levels, there are seasonal variations in groundwater levels that are evident in hydrographs. Figure 3-14 shows that groundwater levels in many wells can fluctuate between 0 and 10 feet within a year. In general, groundwater levels increase during the rainy season only to decrease during the dry season. As discussed in Section 3.1.2.1, precipitation has been variable in the RAGB, with multi-year droughts (critical and dry WYs) occurring between 1976 and 1977, 1987 to 1992, 2007 to 2009, and 2013 to 2015, and wet years occurring between 1970 to 1975, 1982 to 1984, and 1995 to 2000.

Groundwater levels in most of the wells shown on Figure 3-14 depict some influence from droughts and wet periods. Groundwater levels in groundwater wells 29N/04W-02P01, 29N/05W-11A02, 30N/04W-23G01, and 30N/05W-02Q01 are responsive to multi-year wet and dry periods. The intermittent droughts between 2007 and 2015 had a large impact on groundwater levels in 29N/05W-11A02, 30N/04W-23G01, and 30N/05W-02Q01, with groundwater levels decreasing by approximately 10 to 20 feet during droughts. Conversely, even brief wet periods have resulted in increasing groundwater levels at these locations. Wet and dry climatic periods are similarly pronounced in the groundwater-level records of many other wells in the Anderson Subbasin.

3.2.1.3 Vertical Hydraulic Gradients

The potential for groundwater to move vertically within an aquifer system is evaluated by comparing groundwater elevations in wells screened at different depths. Because groundwater elevations change spatially, the potential for vertical movement is computed between wells of differing depths that are in proximity to each other (that is, a well cluster or a multiple completion well). For the purposes of this analysis, the vertical hydraulic gradient is computed as the groundwater elevation at the shallower well minus the groundwater elevation at the deeper well divided by the vertical distance between the well screen midpoints. Based on this calculation method, a positive vertical hydraulic gradient represents the potential for downward groundwater flow, and a negative vertical hydraulic gradient represents the potential for upward groundwater flow. The larger the value of the vertical hydraulic gradient (either positive or negative), the stronger the potential for upward or downward groundwater flow. When comparing groundwater elevations over time (hydrographs) measured in well clusters (such as presented on Figures 3-15a through 3-15f), there is the potential for some groundwater from the well completion with higher groundwater elevation to flow vertically toward the well completion with the lower groundwater elevation. If the well with the higher groundwater elevation is shallower than the well with the lower groundwater elevation, then the potential for downward vertical groundwater flow exists. If the well with the higher groundwater elevation is deeper than the well with the lower groundwater elevation, the potential for upward vertical groundwater flow exists.

There are six clusters of wells in the Anderson Subbasin, wherein each well in the cluster is within 80 feet of the other (Figures 3-15a through 3-15f). These well pairs/clusters include the 29N/04W-03R, 30N/03W-18B, 30N/04W-10H, 30N/04W-22F, 30N/04W-23M, and 30N/04W-25D wells. Because it appears that well pair 30N/04W-10H04 and 30N/04W-10H05 is a replacement for well pair 30N/04W-10H02 and 30N/04W-10H03 (based on the similarity in well construction and the periods of measurements), data for these locations are plotted on the same figure. General observations with respect to potential vertical groundwater flow is as follows:

- Well clusters/pairs 29N/04W-03R, 30N/04W-22F, 30N/04W-23M, and 30N/04W-25D are located along the ACID canal and show generally downward vertical gradients (Figures 3-15a, and Figures 3-15d through 3-15f).
  - The potential for vertical groundwater flow is small at the 30N/04W-22F and 30N/04W-25D clusters (Figures 3-15d and 3-15f) as indicated by the very small to no difference in groundwater elevations between the well completions.
  - Although there is generally the potential for downward vertical flow near the 29N/04W-03R well cluster, the second shallowest completion (29N/04W-03R05) has the lowest groundwater elevation in the well cluster. This suggests that groundwater is converging on this depth interval (the potential for upward flow from the deeper three completions and downward flow from the shallower completion exists).
  - The drawdown in groundwater levels at deeper well 30N/04W-23M02 during 2013 through 2015 is likely related to pumping at the ACID Barney Road well, approximately 400 feet away (Figure 3-15e).
- Vertical groundwater flow directions in well pairs near the Sacramento River vary spatially. The 30N/03W-18B well pair indicate generally upward groundwater flow over the period of record (Figure 3-15b). Upward vertical groundwater flow near the Sacramento River is consistent with the river being a regional groundwater discharge area. The 30N/04W-10H well pairs, located nearly 3 miles upstream of the 30N/03W-18B well pair, show more seasonal variability in vertical groundwater flow directions (Figure 3-15c). During the wet months, vertical flow directions are generally upward, and during the dry months when groundwater usage is generally greater, vertical hydraulic gradients are generally downward.

Vertical hydraulic gradients calculated from groundwater well data measured in spring, summer, and fall 2018 are summarized in Table 3-2. As described above, vertical hydraulic gradients vary spatially, with depth and with the seasons. As previously discussed, vertical hydraulic gradients are generally downward, but can be upward near the Sacramento River and at greater depths near the ACID canal. Vertical hydraulic gradients range between -0.06 ft/ft to 0.38 ft/ft.

3.2.2 Interconnected Surface Water and Groundwater

GSP regulations § 351 define interconnected surface water as "*surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted.*" Figure 3-16 provides examples of stream and aquifer systems that are and are not interconnected. In the upper-left graphic, groundwater in the aquifer is in direct contact with the bottom of the stream. Because the water table is higher than the stream stage, groundwater discharges into the stream (the stream is gaining). In the upper-right graphic, groundwater is in direct contact with the stream bottom; however, the stream stage is higher than the water table, and the stream is "losing" water to the aquifer. Because the groundwater and stream bottom are in direct contact, both of the upper graphics on Figure 3-16 are examples of interconnected surface water. If the groundwater level were to decrease (such as due to increased groundwater pumping), there could be depletions in interconnected surface water by either the aquifer discharging less water to the stream or by increased leakage from the stream to the aquifer. In the lower graphic of Figure 3-16, the water table is below the bottom of the stream; therefore, this is an example of a stream and aquifer system that are not interconnected. Because the stream stage and stream bottom are higher than the water table, the stream leaks water to the aquifer. If the water table in the lower graphic were to decrease further, it would not increase the rate of stream leakage from the disconnected stream.

As previously discussed, the RAGB is bounded on the east by the Cascade Range, on the north/northwest by the Klamath Mountains, and on the west/southwest by the Coast Range. Following rain and snowmelt events, the resulting discharge to surface-water channels and infiltration to the aquifer system produces flow within the tributaries to the perennial Sacramento River and recharges the aquifer within the RAGB. To identify areas where interconnected surface water and groundwater may be present, an analysis was performed based on reviewing depth-to-groundwater data. The underlying assumption of this analysis is that the shallower the depth to groundwater, the more likely that area is in hydraulic connection with nearby stream channels.

To document this relationship, the simulated April water-table elevations in WYs 1999 through 2018 (from the EAGSA Integrated Groundwater/Surface-water Flow Model [EAGSA Model], see Appendix F) were averaged to develop a seasonal high-water-table distribution. The month of April was selected because it represents a period of seasonal high groundwater levels that would be anticipated to result in greater connection between groundwater and surface-water features in the Anderson Subbasin. The average water-table elevations were then compared to the stream bottom elevations, estimated from available topographic information (USGS, 2019b; USGS, 2018; COR, 2019b) to evaluate where modeled streams and the water table were in direct connection (that is, the water table at a given point is above the stream bottom elevation). Figure 3-17 presents the results of that analysis. Portions of the streams that are symbolized as blue lines represent interconnected surface water, whereas portions of the streams that are symbolized as orange lines are streams that are not interconnected (that is, the water table is below the bottom of the stream bed). As shown on Figure 3-17, the entire lengths of the Sacramento River and Cottonwood Creek are interconnected under seasonal high-water-table conditions, which is to be expected because these streams are perennial. The analysis further indicates that the lower portion of Clear Creek is interconnected during seasonal high groundwater conditions.

3.2.3 Groundwater Storage

Groundwater in storage represents the volume of water that exists in the pore spaces between grains of soil (sand, silt, gravel) or within fractures in bedrock in an aquifer. The amount of groundwater in storage varies over time, increasing or decreasing in response to changes in recharge to the aquifer (such as infiltration of precipitation or applied water) and discharge from the aquifer (such as through pumping of groundwater). The volume of groundwater in storage beneath the Anderson Subbasin was estimated through the EAGSA Model. Figure 3-18 presents plots illustrating the estimated total groundwater in storage within the subbasin (solid blue line), the annual change in groundwater storage (yellow bars), and the cumulative change in groundwater storage (dashed red line) between WYs 1999 and 2018. These data indicate that the estimated volume of groundwater in storage during this time fluctuated between approximately 6,300 and 6,400 thousand acre-feet (TAF). Groundwater pumping associated with these groundwater storage estimates average of 22 TAF per year (TAFY). The annual change in storage presented on Figure 3-18 show that groundwater in storage varies year to year, decreasing during drier periods and increasing during wetter periods. Overall, the annual change in groundwater storage is balanced through WY 2018 (that is, there is a roughly equal distribution of positive and negative annual changes in groundwater storage). This balance in storage indicates that overdraft conditions are not present within the subbasin.

3.2.4 Seawater Intrusion

The RAGB is not vulnerable to seawater intrusion, given its distance from the Pacific Ocean.

3.2.5 Groundwater Quality

This section presents a summary of current groundwater quality conditions within the Anderson Subbasin. The EAGSA does not have regulatory authority over groundwater quality and is not charged with improving groundwater quality in the Anderson Subbasin under SGMA. Although there may be localized areas of impairment, the overall quality of groundwater in the Anderson Subbasin is good and suitable for the designated beneficial uses of the subbasin. Although projects and actions implemented by the EAGSA are not required to improve groundwater quality under SGMA, the management actions and projects recommended must not further degrade groundwater quality, as compared with baseline (i.e., January 2015) conditions.

SWRCB monitors and regulates activities and discharges that can contribute to constituents that are released to groundwater over large areas. The SWRCB's GAMA program compiles groundwater quality data from a variety of sources and makes these data available to the public for download by county (SWRCB, 2020b). Groundwater quality monitoring programs incorporated into the dataset include the following:

- Data from a GAMA domestic well sampling program
- USGS GAMA program
- Lawrence Livermore National Laboratory GAMA program
- Data from the Department of Pesticides Regulation groundwater sampling program
- Data from groundwater sampling programs conducted by DWR
- Data from the California Department of Public Health's sampling of public water supply wells
- Data from sampling of environmental monitoring wells at regulated sites

The Shasta County dataset was downloaded, and a compiled dataset of publicly available groundwater quality results from the Anderson Subbasin was used for establishing baseline groundwater quality in the subbasin. Groundwater quality data were then compared to an applicable regulatory standard including the following:

- Primary MCLs established by either EPA or the California EPA (CalEPA), whichever was more strict
- Secondary maximum contaminant levels (SMCLs) established by either EPA or CalEPA, whichever was more strict
- Federal Action Level established by EPA
- Cancer or non-cancer Health Based Screening Level established by USGS
- Chronic non-cancer Human Health Benchmark for Pesticides established by EPA
- Federal Health Advisory Level established by EPA
- Reference Dose as a drinking water level
- National Academy of Science Health Advisory Level
- California Cancer Potency Factor
- California Proposition 65 Safe Harbor Levels as a drinking water level
- SWRCB notification levels

The following analyses used analytical data collected between 2000 and 2019 to compare to State or federal groundwater limits. Detected concentrations of constituents based on groundwater analytical data were compared to the associated regulatory limit to evaluate whether the concentration was higher (an exceedance) or lower (a non-exceedance) than the limit. Most tested constituents were either nondetect or detected at concentrations below regulatory limits. Constituents with low detection frequencies do not represent pervasive groundwater quality issues throughout the Anderson Subbasin; these constituents will not be considered further in this GSP.

Figures 3-19 and 3-20 present the distribution of sampled locations and locations of exceedances for each constituent that exceeded the applicable regulatory limit at 10 percent or more of the sampled locations. The locations are symbolized as either non-exceedance (indicating that the constituent has not exceeded the applicable limit in any of the samples at a given well) or symbolized by the number of exceedances over time at a given location. Groundwater quality data included in the analysis of recent subbasin groundwater quality are presented in Appendix E – *Anderson Subbasin Groundwater Quality Dataset*.

In the Anderson Subbasin, the following water quality constituents were identified to have exceedances in 10 percent or more of tested groundwater wells: chromium, iron, manganese, benzene, gasoline, kerosene, tert-butyl alcohol (TBA), and methyl-tert-butyl ether (MTBE). Naturally occurring water quality constituents may include the metals chromium, iron, and manganese; whereas groundwater quality constituents related to human activity include the fuel-related compounds, such as benzene, gasoline, and kerosene, and the non-hydrocarbon solvents TBA and MTBE. Table 3-3 summarizes the analytical results for each of the above water quality constituents. Although available data show localized areas of potential groundwater impairments, the overall quality of groundwater in the Anderson Subbasin is good and suitable for the designated beneficial uses of the subbasin.

3.2.5.1 Point-source Contamination

Point-source contamination data collection activities take place in the Anderson Subbasin in response to known or potential sources of groundwater contamination. These sources include leaking underground storage tank (LUST) sites and various other state cleanup sites.

SWRCB and DTSC have the responsibility for cleanup and monitoring of point-source pollutants. Both entities make all related materials available to the public through two public portals: GeoTracker managed by SWRCB (SWRCB, 2020c) and EnviroStor managed by DTSC (DTSC, 2020). Figure 3-21 presents a map with locations of active remediation sites within the Anderson Subbasin, and Table 3-4 summarizes the active remediation sites.

The SWRCB's GeoTracker database identifies five open LUST remediation sites, five other sites linked to fuel storage areas or spills at a gas station, a former dry cleaner location, the Winemucca Trading Co/former Shasta Paper Treatment Lagoons, the former Branstetter Mill, Redding Lumber Transport, Northstate Recycling, and a Pacific Gas & Electric (PG&E) manufactured gas plant (MGP) as sites with potential or actual groundwater contamination within the Anderson Subbasin. DTSC's EnviroStor database also identifies the former Branstetter Mill (but with differing constituents of concern than the GeoTracker listing) and the Winemucca Trading Co/former Shasta Paper Treatment Lagoons, but lists the former Shasta Paper site as two separate open sites under different site names (Simpson Paper Company and Plainwell Paper). The EnviroStor database redirects the user to the GeoTracker database for more information on the former Shasta Paper sites. The DTSC EnviroStor database identifies the PG&E MGP site (formerly the Redding Gas Company) as a location with potential or actual groundwater contamination. The GeoTracker database also has a listing for the PG&E MGP, but the site is recognized as completed, the case is closed, and the site only has continued operation and maintenance. DTSC's EnviroStor database identifies the J H Baxter & Company site and the Roseburg Lumber Company site as locations that may be open with potential or actual groundwater contamination within the Anderson Subbasin. The EnviroStor database redirects the user to "Other Agency" for more information on the J H Baxter & Company site and redirects the user to the GeoTracker database for more information on the Roseburg Lumber Company site; however, attempts to locate these sites have been unsuccessful as the GeoTracker database does not contain an entry for either remediation site. Resolution of the status of these potentially open remediation sites remains a data gap that will be filled via additional communication with DTSC and/or SWRCB.

As indicated in Table 3-4, point-source contaminants include gasoline, metals, petroleum and petroleum based constituents, dioxins, insecticides and pesticides and other pest related chemicals, solvents or non-petroleum hydrocarbons, and halogenated organic compounds or organic compounds with halogen. Although these constituents are of concern, only fuel-related compounds and metals were detected in more than 10 percent of sampled wells within the Anderson Subbasin to warrant inclusion in the GSP monitoring program.

3.2.5.2 Connate Water

In addition to the above potential constituents of concern, there exists a potential source of saline water intrusion from the Chico Formation. The Chico Formation, which underlies the primary aquifer units of the RAGB, contains saline, connate water under artesian pressure (Pierce, 1983). The Chico Formation is composed of marine deposits of sandstone, conglomerates, and shale, most of which are of low permeability with a few exceptions. Pumping at depths near the top of the Chico Formation could potentially induce upward migration of the saline water into the principal aquifers. No historical evidence indicates widespread migration of saline water from the Chico Formation into the principal aquifers as a result of groundwater use.

3.2.6 Land Subsidence

Land subsidence is the gradual settlement of ground surface due to the removal of subsurface materials. Such settlement can be the result of natural processes, such as decomposition of buried organic materials or earthquake activity, or the result of human activities, such as groundwater pumping or mining. Land subsidence was recently measured across the Sacramento Valley by DWR, and results were published in the report *2017 GPS Survey of the Sacramento Valley Subsidence Network* (DWR, 2018). Figure 3-22 presents the distribution of global positioning system (GPS) monuments in the Anderson Subbasin. These data indicate that there was less than 1.5 inches (0.125 foot) of vertical displacement of the survey monuments in the subbasin between 2008 and 2017. In addition to the periodic GPS survey, DWR has published land subsidence information using satellite-based data collection, Interferometric Synthetic Aperture Radar (InSAR). This method involves estimating the difference in ground surface elevation between successive satellite passes over a specific area. Figure 3-22 presents the InSAR total vertical displacement grid between June 2015 and October 2020. These data indicate that estimated total vertical displacement in the Anderson Subbasin ranged from an increase of 0.023 inch (0.002 foot) to a decrease of 2.8 inches (0.23 foot), averaging a decrease of 0.25 inches (0.02 foot) across the subbasin. It should be noted that the margin of accuracy of the InSAR dataset is 18 millimeters (0.71 inch, 0.06 foot) (Towill, 2021). As shown on Figure 3-22, the total vertical displacement estimates over the vast majority of the subbasin are within the range of uncertainty. Additionally, the area in the central portion of the subbasin with estimated total vertical displacement of up to 2.8 inches (0.23 foot) is the Anderson Landfill; therefore, this is not considered to be representative of land subsidence.

The DWR GPS document and InSAR datasets provide no indication of land subsidence to have occurred in the Anderson Subbasin. Furthermore, the distribution of unconsolidated deposits without extensive low-permeability aquitards in the subbasin indicates that the subbasin is also not particularly vulnerable to groundwater pumping-induced land subsidence (i.e., there are no extensive aquitards [clay layers]). As such, land subsidence from groundwater extraction in the Anderson Subbasin is not considered an issue of concern.

Table 3-1. Anderson Subbasin Groundwater Monitoring Network

State Well Name	EAGSA Well Name	Easting	Northing	Well Type	Monitoring Agency	Ground Surface Elevation (feet NAVD88)	Reference Point Elevation (feet NAVD88)	Total Well Depth (feet bgs)	Top of Well Screen (feet bgs)	Bottom of Well Screen (feet bgs)
29N03W03L001M	29N/03W-03L01	6508501.448	2027822.572	--	USGS	366	--	80	--	--
29N03W06P001M	29N/03W-06P01	6492811.675	2025599.187	Residential well	DWR	412.24	412.54	69	--	--
29N04W01Q001M	29N/04W-01Q01	6488356.696	2026158.589	Residential well	DWR	418.52	419.52	100	--	--
29N04W02F001M	29N/04W-02F01	6481719.452	2028411.688	--	USGS	479	--	492	--	--
29N04W02M002M	29N/04W-02M02	6480411.608	2026950.932	Irrigation well	DWR	462	464.2	270	160	255
29N04W02P001M	29N/04W-02P01	6481522.479	2025796.118	Other	DWR	447.49	447.99	425	165	425
29N04W03R002M	29N/04W-03R02	6479654.939	2026562.585	Observation well	DWR	457.84	460.49	917	740	880
29N04W03R003M	29N/04W-03R03	6479654.939	2026562.585	Observation well	DWR	457.84	460.33	696	515	660
29N04W03R004M	29N/04W-03R04	6479654.939	2026562.585	Observation well	DWR	457.84	460.15	438	380	390
29N04W03R005M	29N/04W-03R05	6479654.939	2026562.585	Observation well	DWR	457.84	460.03	254	128	188
29N04W03R006M	29N/04W-03R06	6479651.04	2026562.598	Observation well	DWR	457.84	459.81	76	40	60
29N04W04R003M	29N/04W-04R03	6474653.559	2026385.74	Residential well	DWR	507.48	507.48	96	--	--
29N04W05Q001M	29N/04W-05Q01	6468328.704	2025826.251	Residential well	DWR	512.5	513	152	--	--
29N05W03K001M	29N/05W-03K01	6445973.827	2027704.965	--	USGS	574	--	157	--	--
29N05W07B001M	29N/05W-07B01	6430582.47	2025125.502	Irrigation well	DWR	551.56	555.66	450	--	--
29N05W09L001M	29N/05W-09L01	6439772.048	2021251.763	Residential well	DWR	517.55	517.55	140	100	140
29N05W11A002M	29N/05W-11A02	6452974.047	2025057.407	Irrigation well	DWR	514.54	514.54	360	110	356
30N03W18B001M	30N/03W-18B01	6493690.642	2051435.115	Observation well	DWR	400.12	399.49	55	30	55
30N03W18B002M	30N/03W-18B02	6493701.217	2051435.814	Observation well	DWR	400.1	399.47	164	110	164
30N03W18F002M	30N/03W-18F02	6492322.353	2049424.831	Residential well	DWR	397.56	398.56	52	--	--
30N03W29K001M	30N/03W-29K01	6499390.17	2038440.766	Residential well	DWR	422.14	422.54	72	--	--
30N03W30N001M	30N/03W-30N01	6491866.91	2036129.707	Unknown	DWR	452.44	453.54	150	--	--
30N03W30Q002M	30N/03W-30Q02	6493079.327	2036191.111	Observation well	DWR	445.09	444.37	103	70	103
30N03W32P003M	30N/03W-32P03	6497602.699	2031267.524	Observation well	DWR	434.07	433.74	101	60	101
30N04W05K001M	30N/04W-05K01	6465919.666	2058882.962	Industrial well	DWR	457.59	459.09	300	45	300
30N04W06B003M	30N/04W-06B03	6463349.279	2061946.658	Residential well	DWR	452.6	455.6	312	--	--
30N04W10H002M	30N/04W-10H02	6479484.728	2054892.592	Observation well	DWR	410.47	409.88	40	20	40
30N04W10H003M	30N/04W-10H03	6479484.728	2054892.592	Observation well	DWR	410.57	410.02	150	100	150

Table 3-1. Anderson Subbasin Groundwater Monitoring Network

State Well Name	EAGSA Well Name	Easting	Northing	Well Type	Monitoring Agency	Ground Surface Elevation (feet NAVD88)	Reference Point Elevation (feet NAVD88)	Total Well Depth (feet bgs)	Top of Well Screen (feet bgs)	Bottom of Well Screen (feet bgs)
30N04W10H004M	30N/04W-10H04	6479557.953	2054826.774	Observation well	DWR	418.8	421.3	62	35	62
30N04W10H005M	30N/04W-10H05	6479552.615	2054811.492	Observation well	DWR	418.7	421.2	161	110	161
30N04W22F002M	30N/04W-22F02	6477735.921	2044142.988	Observation well	DWR	447.86	447.36	113	70	113
30N04W22F003M	30N/04W-22F03	6477740.031	2044124.031	Observation well	DWR	447.64	447.09	202	170	202
30N04W22F004M	30N/04W-22F04	6477673.925	2044163.966	Observation well	DWR	447.8	449.96	540	480	540
30N04W23A001M	30N/04W-23A01	6485186.031	2045896.406	--	USGS	404	--	80	--	--
30N04W23G001M	30N/04W-23G01	6482927.12	2043989.068	Industrial well	DWR	452.55	452.35	345	324	345
30N04W23M001M	30N/04W-23M01	6481410.172	2042877.84	Observation well	DWR	472.33	471.72	114	80	114
30N04W23M002M	30N/04W-23M02	6481425.501	2042883.983	Observation well	DWR	472.67	472.11	201	140	201
30N04W23M003M	30N/04W-23M03	6481421.746	2043265.403	Irrigation well	DWR	467	469.3	465	150	455
30N04W25D003M	30N/04W-25D03	6485633.332	2040414.851	Observation well	DWR	472.47	471.19	122	100	122
30N04W25D004M	30N/04W-25D04	6485625.589	2040431.633	Observation well	DWR	472.07	471.16	201	150	201
30N05W02Q001M	30N/05W-02Q01	6451349.47	2057661.165	Residential well	DWR	712.61	713.11	180	116	176
30N05W05Q001M	30N/05W-05Q01	6435537.424	2056792.526	Irrigation well	DWR	822.62	823.12	264	224	244
30N05W18A001M	30N/05W-18A01	6431397.446	2050799.469	--	USGS	865	--	255	--	--
30N05W23D001M	30N/05W-23D01	6448502.646	2045144.513	Residential well	DWR	757.58	757.58	234	--	--
30N06W03M001M	30N/06W-03M01	6411766.217	2058602.862	Observation well	Shasta County	1062.5	1062.5	130	--	--
30N06W35L001M	30N/06W-35L01	6419356.268	2032439.926	Residential well	DWR USGS	678 661	679 --	180 --	178 --	180 --
Well 1	Well 1	6448299.647	2025348.972	Other	CCCSD	519	509	450	216	444

Notes:

-- = information not available

The horizontal datum for well coordinates is North American Datum 1983, State Plane California Zone I in feet.

Table 3-2. Anderson Subbasin Vertical Head Differences During Spring, Summer, and Fall 2018

Location ID of Shallow Well	Location ID of Deep Well	Distance Between Wells (feet)	Measured Groundwater Elevation in Shallow Well (feet NAVD88)	Measured Groundwater Elevation in Deep Well (feet NAVD88)	Difference in Groundwater Elevation (feet)	Measurement Date of Groundwater Levels	Screen Elevation of Shallow Well (feet NAVD88)	Screen Elevation of Deep Well (feet NAVD88)	Calculated Vertical Hydraulic Gradient (foot/foot)
29N/04W-03R06	29N/04W-03R05	3.90	418.31	387.83	30.48	3/19/2018	417.84-397.84	329.84-269.84	0.282
29N/04W-03R06	29N/04W-03R05	3.90	425.91	384.53	41.38	8/7/2018	417.84-397.84	329.84-269.84	0.383
29N/04W-03R06	29N/04W-03R05	3.90	426.91	385.68	41.23	10/17/2018	417.84-397.84	329.84-269.84	0.382
29N/04W-03R06	29N/04W-03R04	3.90	418.31	394.15	24.16	3/19/2018	417.84-397.84	77.84-67.84	0.072
29N/04W-03R06	29N/04W-03R04	3.90	425.91	391.65	34.26	8/7/2018	417.84-397.84	77.84-67.84	0.102
29N/04W-03R06	29N/04W-03R04	3.90	426.91	391.75	35.16	10/17/2018	417.84-397.84	77.84-67.84	0.105
29N/04W-03R06	29N/04W-03R03	3.90	418.31	392.95	25.36	3/19/2018	417.84-397.84	-57.16--202.16	0.047
29N/04W-03R06	29N/04W-03R03	3.90	425.91	390.03	35.88	8/7/2018	417.84-397.84	-57.16--202.16	0.067
29N/04W-03R06	29N/04W-03R03	3.90	426.91	390.03	36.88	10/17/2018	417.84-397.84	-57.16--202.16	0.069
29N/04W-03R06	29N/04W-03R02	3.90	418.31	392.09	26.22	3/19/2018	417.84-397.84	-282.16--422.16	0.035
29N/04W-03R06	29N/04W-03R02	3.90	425.91	389.09	36.82	8/7/2018	417.84-397.84	-282.16--422.16	0.048
29N/04W-03R06	29N/04W-03R02	3.90	426.91	389.07	37.84	10/17/2018	417.84-397.84	-282.16--422.16	0.050
29N/04W-03R05	29N/04W-03R04	0	387.83	394.15	-6.32	3/19/2018	329.84-269.84	77.84-67.84	-0.028
29N/04W-03R05	29N/04W-03R04	0	384.53	391.65	-7.12	8/7/2018	329.84-269.84	77.84-67.84	-0.031
29N/04W-03R05	29N/04W-03R04	0	385.68	391.75	-6.07	10/17/2018	329.84-269.84	77.84-67.84	-0.027
29N/04W-03R05	29N/04W-03R03	0	387.83	392.95	-5.12	3/19/2018	329.84-269.84	-57.16--202.16	-0.012
29N/04W-03R05	29N/04W-03R03	0	384.53	390.03	-5.5	8/7/2018	329.84-269.84	-57.16--202.16	-0.013
29N/04W-03R05	29N/04W-03R03	0	385.68	390.03	-4.35	10/17/2018	329.84-269.84	-57.16--202.16	-0.010
29N/04W-03R05	29N/04W-03R02	0	387.83	392.09	-4.26	3/19/2018	329.84-269.84	-282.16--422.16	-0.0065
29N/04W-03R05	29N/04W-03R02	0	384.53	389.09	-4.56	8/7/2018	329.84-269.84	-282.16--422.16	-0.007
29N/04W-03R05	29N/04W-03R02	0	385.68	389.07	-3.39	10/17/2018	329.84-269.84	-282.16--422.16	-0.005
29N/04W-03R04	29N/04W-03R03	0	394.15	392.95	1.2	3/19/2018	77.84-67.84	-57.16--202.16	0.006
29N/04W-03R04	29N/04W-03R03	0	391.65	390.03	1.62	8/7/2018	77.84-67.84	-57.16--202.16	0.008
29N/04W-03R04	29N/04W-03R03	0	391.75	390.03	1.72	10/17/2018	77.84-67.84	-57.16--202.16	0.008
29N/04W-03R04	29N/04W-03R02	0	394.15	392.09	2.06	3/19/2018	77.84-67.84	-282.16--422.16	0.005
29N/04W-03R04	29N/04W-03R02	0	391.65	389.09	2.56	8/7/2018	77.84-67.84	-282.16--422.16	0.006
29N/04W-03R04	29N/04W-03R02	0	391.75	389.07	2.68	10/17/2018	77.84-67.84	-282.16--422.16	0.006
29N/04W-03R03	29N/04W-03R02	0	392.95	392.09	0.86	3/19/2018	-57.16--202.16	-282.16--422.16	0.004

Table 3-2. Anderson Subbasin Vertical Head Differences During Spring, Summer, and Fall 2018

Location ID of Shallow Well	Location ID of Deep Well	Distance Between Wells (feet)	Measured Groundwater Elevation in Shallow Well (feet NAVD88)	Measured Groundwater Elevation in Deep Well (feet NAVD88)	Difference in Groundwater Elevation (feet)	Measurement Date of Groundwater Levels	Screen Elevation of Shallow Well (feet NAVD88)	Screen Elevation of Deep Well (feet NAVD88)	Calculated Vertical Hydraulic Gradient (foot/foot)
29N/04W-03R03	29N/04W-03R02	0	390.03	389.09	0.94	8/7/2018	-57.16--202.16	-282.16--422.16	0.004
29N/04W-03R03	29N/04W-03R02	0	390.03	389.07	0.96	10/17/2018	-57.16--202.16	-282.16--422.16	0.004
30N/03W-18B01	30N/03W-18B02	10.60	381.39	384.67	-3.28	3/19/2018	370.12-345.12	290.1-236.1	-0.035
30N/03W-18B01	30N/03W-18B02	10.60	384.19	386.87	-2.68	8/6/2018	370.12-345.12	290.1-236.1	-0.028
30N/03W-18B01	30N/03W-18B02	10.60	383.09	386.12	-3.03	10/16/2018	370.12-345.12	290.1-236.1	-0.032
30N/04W-10H04	30N/04W-10H05	16.19	395.5	400.4	-4.9	3/19/2018	383.8-356.8	308.7-257.7	-0.056
30N/04W-10H04	30N/04W-10H05	16.19	397.2	396.6	0.6	8/6/2018	383.8-356.8	308.7-257.7	0.007
30N/04W-10H04	30N/04W-10H05	16.19	395.8	398.7	-2.9	10/16/2018	383.8-356.8	308.7-257.7	-0.033
30N/04W-22F02	30N/04W-22F03	19.40	402.76	402.29	0.47	3/19/2018	377.86-334.86	277.64-245.64	0.005
30N/04W-22F02	30N/04W-22F03	19.40	399.51	398.69	0.82	8/6/2018	377.86-334.86	277.64-245.64	0.009
30N/04W-22F02	30N/04W-22F03	19.40	400.36	399.79	0.57	10/17/2018	377.86-334.86	277.64-245.64	0.006
30N/04W-22F02	30N/04W-22F04	65.45	402.76	401.96	0.8	3/19/2018	377.86-334.86	-32.2--92.2	0.002
30N/04W-22F02	30N/04W-22F04	65.45	399.51	398.86	0.65	8/6/2018	377.86-334.86	-32.2--92.2	0.0015
30N/04W-22F02	30N/04W-22F04	65.45	400.36	399.26	1.1	10/17/2018	377.86-334.86	-32.2--92.2	0.0026
30N/04W-22F03	30N/04W-22F04	77.23	402.29	401.96	0.33	3/19/2018	277.64-245.64	-32.2--92.2	0.001
30N/04W-22F03	30N/04W-22F04	77.23	398.69	398.86	-0.17	8/6/2018	277.64-245.64	-32.2--92.2	-0.0005
30N/04W-22F03	30N/04W-22F04	77.23	399.79	399.26	0.53	10/17/2018	277.64-245.64	-32.2--92.2	0.0016
30N/04W-23M01	30N/04W-23M02	16.51	402.72	400.01	2.71	3/19/2018	392.33-358.33	332.67-271.67	0.037
30N/04W-23M01	30N/04W-23M02	16.51	401.32	397.91	3.41	8/6/2018	392.33-358.33	332.67-271.67	0.047
30N/04W-23M01	30N/04W-23M02	16.51	400.92	397.81	3.11	10/17/2018	392.33-358.33	332.67-271.67	0.043
30N/04W-25D03	30N/04W-25D04	18.48	398.29	398.26	0.03	3/19/2018	372.47-350.47	322.07-271.07	0.000
30N/04W-25D03	30N/04W-25D04	18.48	396.19	396.26	-0.07	8/6/2018	372.47-350.47	322.07-271.07	-0.001
30N/04W-25D03	30N/04W-25D04	18.48	395.99	395.96	0.03	10/17/2018	372.47-350.47	322.07-271.07	0.000

Note:

Positive vertical hydraulic gradient indicates downward flow.

Table 3-3. Summary of Analytes Exceeding Regulatory Limits in the Anderson Subbasin Analytical, 2000–2019

Analyte	Limit Type	Regulatory Limit (µg/L)	Number of Wells Sampled	Number of Samples Collected	Number of Wells with Exceedances
Chromium	Federal EPA MCL	50	147	565	17
Iron	EPA SMCL	300	184	966	74
Manganese	SMCL	50	205	776	84
Benzene	CalEPA MCL	1	392	6,191	89
Gasoline	Federal Health Advisory Level	5	130	721	79
Kerosene	Federal Health Advisory Level	100	27	249	13
Methyl-Tert-Butyl Ether	CalEPA MCL	13	394	6,413	140
Tert-Butyl Alcohol	Federal Notification Level	12	343	5,988	81

Note:

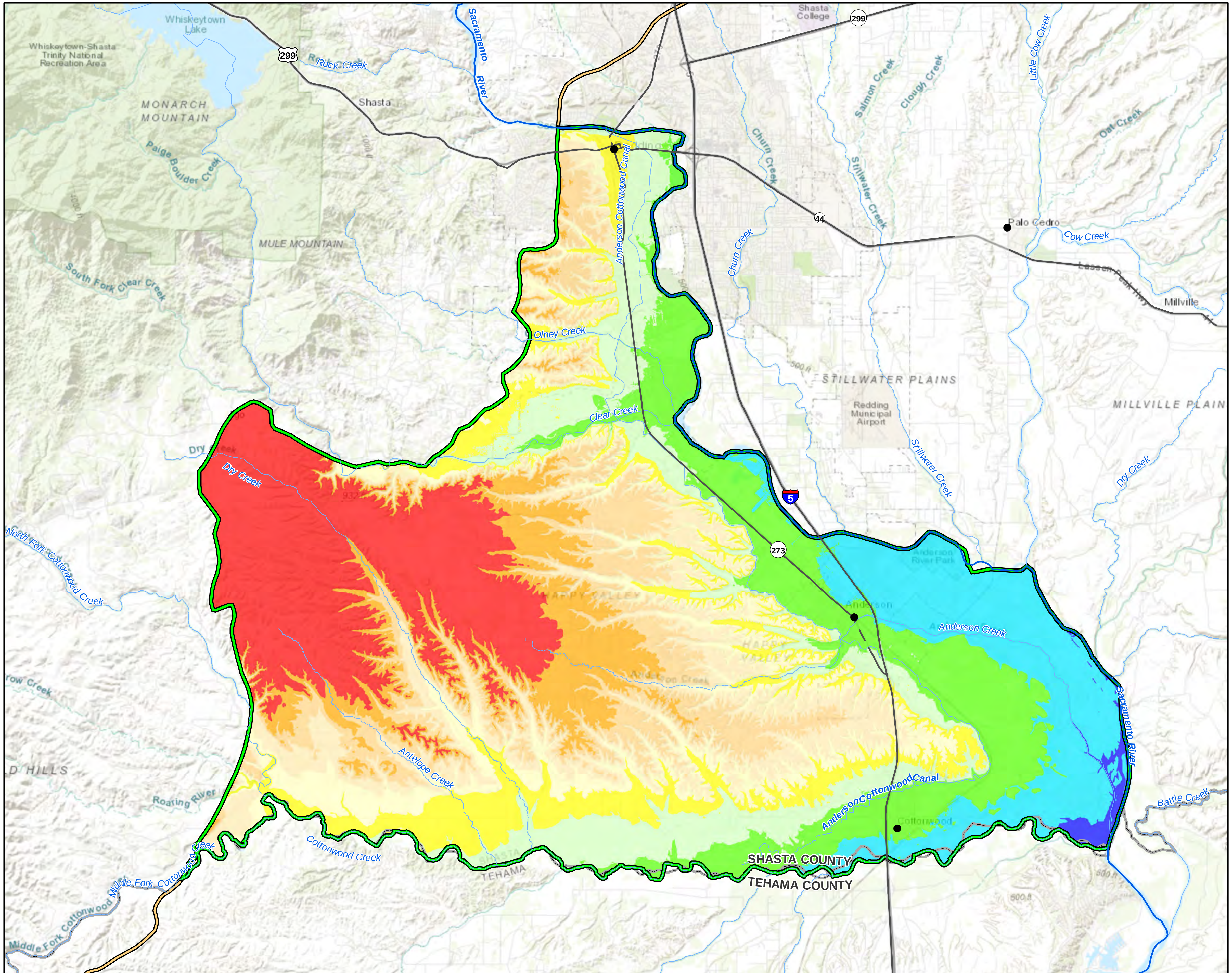
µg/L = micrograms per liter

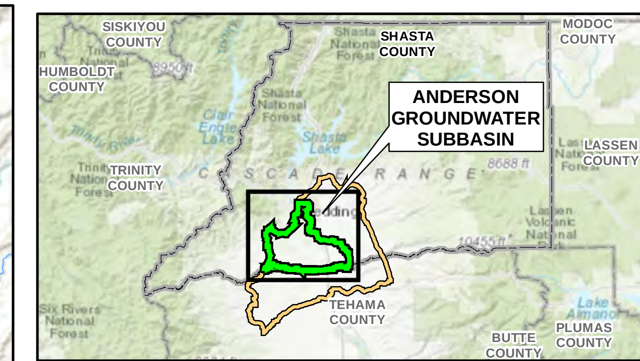
Table 3-4. Anderson Subbasin Active Remediation Sites

Site Name	Site Type	Status	Constituents of Concern	Address	City	Source Database (Site ID)
Anderson Chevron	LUST Cleanup Site	Open - Verification Monitoring	Gasoline	2298 North Street	Anderson	GeoTracker (T0608900318)
Branstetter Mill	Voluntary Cleanup	Active	Arsenic, Dioxin (as 2,3,7,8-TCDD TEQ), Furan, Pentachlorophenol	1535 Branstetter Lane	Redding	EnviroStor (60000855)
Branstetter Mill Site (Former)	Cleanup Program Site	Open - Site Assessment	Gasoline, Metals, Other Insecticides/Pesticide/Fumigants/Herbicides	1535 Branstetter Lane	Redding	GeoTracker (SL0608916110)
ConocoPhillips Bulk Plant #0629 - Redding	Cleanup Program Site	Open – Remediation	Gasoline, MTBE/TBA/Other Fuel Oxygenates, Petroleum/Fuels/Oils	2340 Wyndham Lane	Redding	GeoTracker (SL375322881)
Dotzenrod Shell Anderson	Cleanup Program Site	Open – Remediation	None Specified	2030 North Street	Anderson	GeoTracker (T10000009265)
Flyers Energy (Former Valero #266)	Cleanup Program Site	Open - Site Assessment	Benzene, Ethylbenzene, Gasoline, Naphthalene, Toluene, Xylene	2470 Balls Ferry Road	Anderson	GeoTracker (T10000013643)
Former Attainable Auto	LUST Cleanup Site	Open – Remediation	Diesel, Waste Oil/Motor/Hydraulic/Lubricating	1893 Eureka Way	Redding	GeoTracker (T0608993531)
J H Baxter & Company	Evaluation	Refer: Other Agency	None Specified	1115 Court Street	Redding	EnviroStor (45240010)
McGee's Corner Saloon	LUST Cleanup Site	Open - Assessment and Interim Remedial Action	Diesel, Gasoline, Lead	5533 Deschutes Road	Anderson	GeoTracker (T10000004977)
Northstate Recycling	Cleanup Program Site	Open – Remediation	Copper, Diesel, Lead, other Metal, Waste Oil/Motor/Hydraulic/Lubricating	2041 Girvan Road	Redding	GeoTracker (T10000003519)
Payless Gas & Food Mart	LUST Cleanup Site	Open - Verification Monitoring	Gasoline	3440 South Market Street	Redding	GeoTracker (T0608900234)
PG&E MGP, Redding	State Response ERAP	Certified O&M - Land Use Restrictions Only	Arsenic, Contaminated Soil, Polynuclear Aromatic Hydrocarbons, TPH-Diesel, TPH-Gas	California, Gold, Oregon, and South Streets	Redding	EnviroStor (45490001)
PG&E Former Manufactured Gas Plant	Cleanup Program Site	Completed - Case Closed - Land Use Restrictions	Crude Oil, Other Solvent or Non-Petroleum Hydrocarbon, Petroleum	Bounded by South Street, Center Street, California Street, Gold Street	Redding	GeoTracker (SL0606723378)
RAM Auto Sales	LUST Cleanup Site	Open - Site Assessment	Gasoline	3270 South Market Street	Redding	GeoTracker (T10000003476)
Redding Lumber Transport	Cleanup Program Site	Open - Assessment and Interim Remedial Action	Diesel	4301 Eastside Road	Redding	GeoTracker (T10000010253)
Roseburg Lumber Company	Evaluation	Refer: RWQCB	Halogenated Organic Compounds, Organic Liquids (Nonsolvents) with Halogens, Unspecified Sludge Waste, Waste Potentially Containing Dioxins	Locust and Deschutes Road	Anderson	EnviroStor (45240002)
San Francisco Deli (previously a gas station and automotive service center)	Cleanup Program Site	Open - Assessment and Interim Remedial Action	None Specified	2395 Athens Avenue	Redding	GeoTracker (T10000011100)
SST Oil Inc.	Cleanup Program Site	Open - Verification Monitoring	Diesel, Gasoline, MTBE/TBA/Other Fuel Oxygenates, Petroleum/Fuels/Oils	2341 Wyndham Lane	Redding	GeoTracker (SL375312880)
Village Plaza Cleaners	Cleanup Program Site	Open - Site Assessment	Tetrachloroethylene	2325 Athens Avenue	Redding	GeoTracker (SL0608997819)
Winemucca Trading Co/Former Shasta Paper Treatment Lagoons	Cleanup Program Site	Open - Assessment and Interim Remedial Action	Dioxin/Furans, Dioxins, Other Inorganic/Salt	21091 Hawes Road	Anderson	GeoTracker (SL0608923324)
Plainwell Paper	Tiered Permit	Refer: RWQCB	None Specified	21091 Hawes Road	Anderson	EnviroStor (71002477)
Simpson Paper Company	Evaluation	Refer: RWQCB	None Specified	21091 Hawes Road	Anderson	EnviroStor (45260001)

Notes:

2,3,7,8-TCDD TEQ = 2,3,7,8-Tetrachlorodibenzo-P-dioxin toxic equivalency
ERAP = Expedited Remedial Action Program
O&M = operations and maintenance
TPH = total petroleum hydrocarbons





LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

GROUND SURFACE ELEVATION (feet NAVD88)

- 772 to 819.21
- 722 to 772
- 672 to 722
- 622 to 672
- 572 to 622
- 522 to 572
- 472 to 522
- 422 to 472
- 372.48 to 422
- 372.48

0 2 4 Miles

NOTES:

DATA SOURCE: SURFACE DATA REPRESENTS TOPOGRAPIC DATA FROM MULTIPLE SOURCES THAT WERE COMPILED INTO A SINGLE SURFACE (USGS, 2018; USGS, 2019b; AND COR, 2019)

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FIGURE 3-1
TOPOGRAPHIC SETTING
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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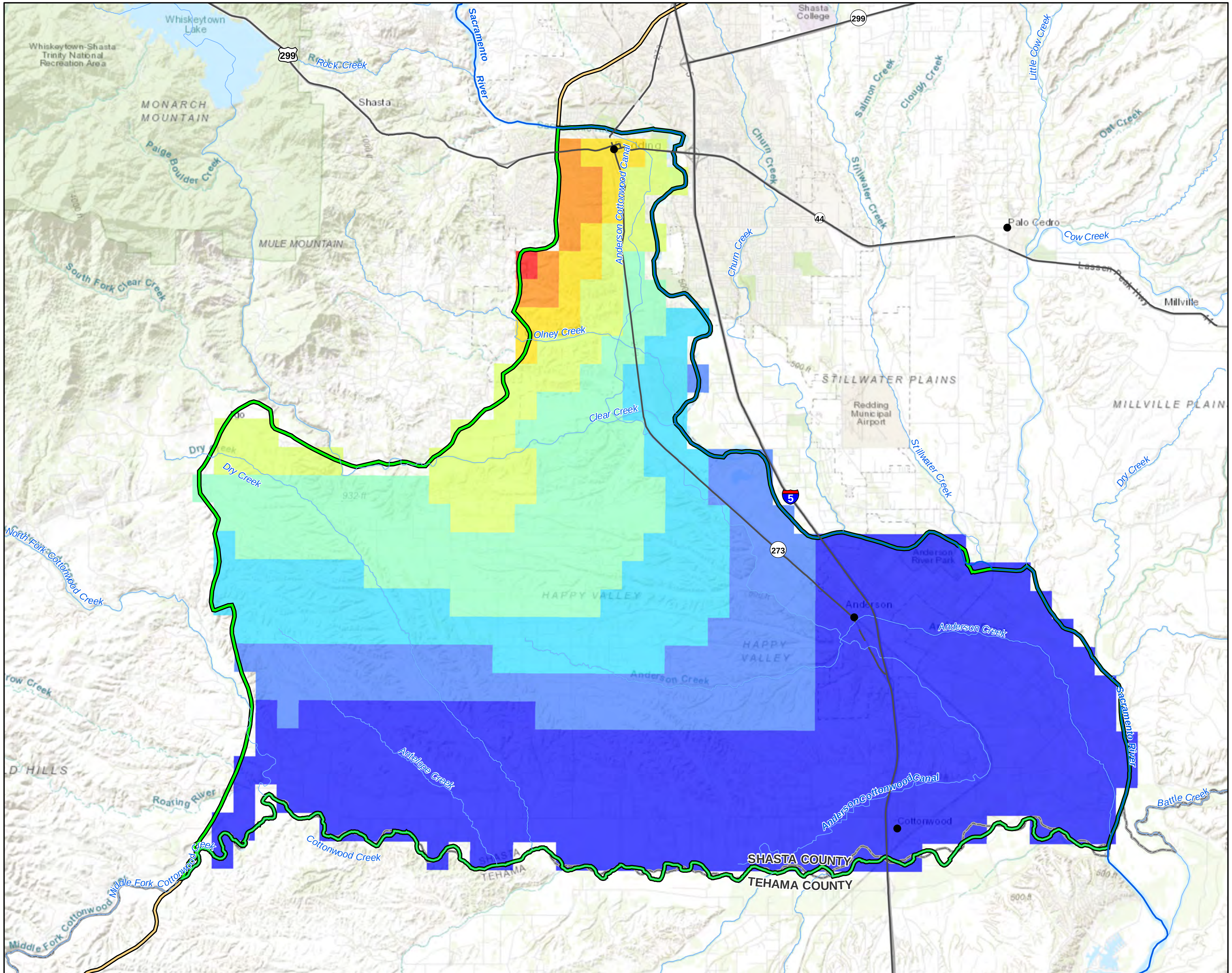

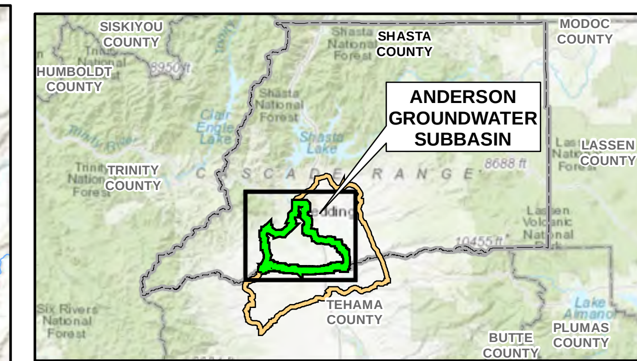

LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

MEAN ANNUAL PRECIPITATION (inches)

- 31.25 to 34
- 34 to 36
- 36 to 38
- 38 to 40
- 40 to 42
- 42 to 44
- 44 to 46
- 46 to 48.63

NOTES:

DATA SOURCE: PRISM CLIMATE GROUP, OREGON STATE UNIVERSITY, HTTP://PRISM.OREGONSTATE.EDU. ACCESSED MARCH 2020 (PRISM CLIMATE GROUP, 2012)

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP

0 2 4 Miles

FIGURE 3-2
MEAN ANNUAL PRECIPITATION
Anderson Subbasin Groundwater Sustainability Plan

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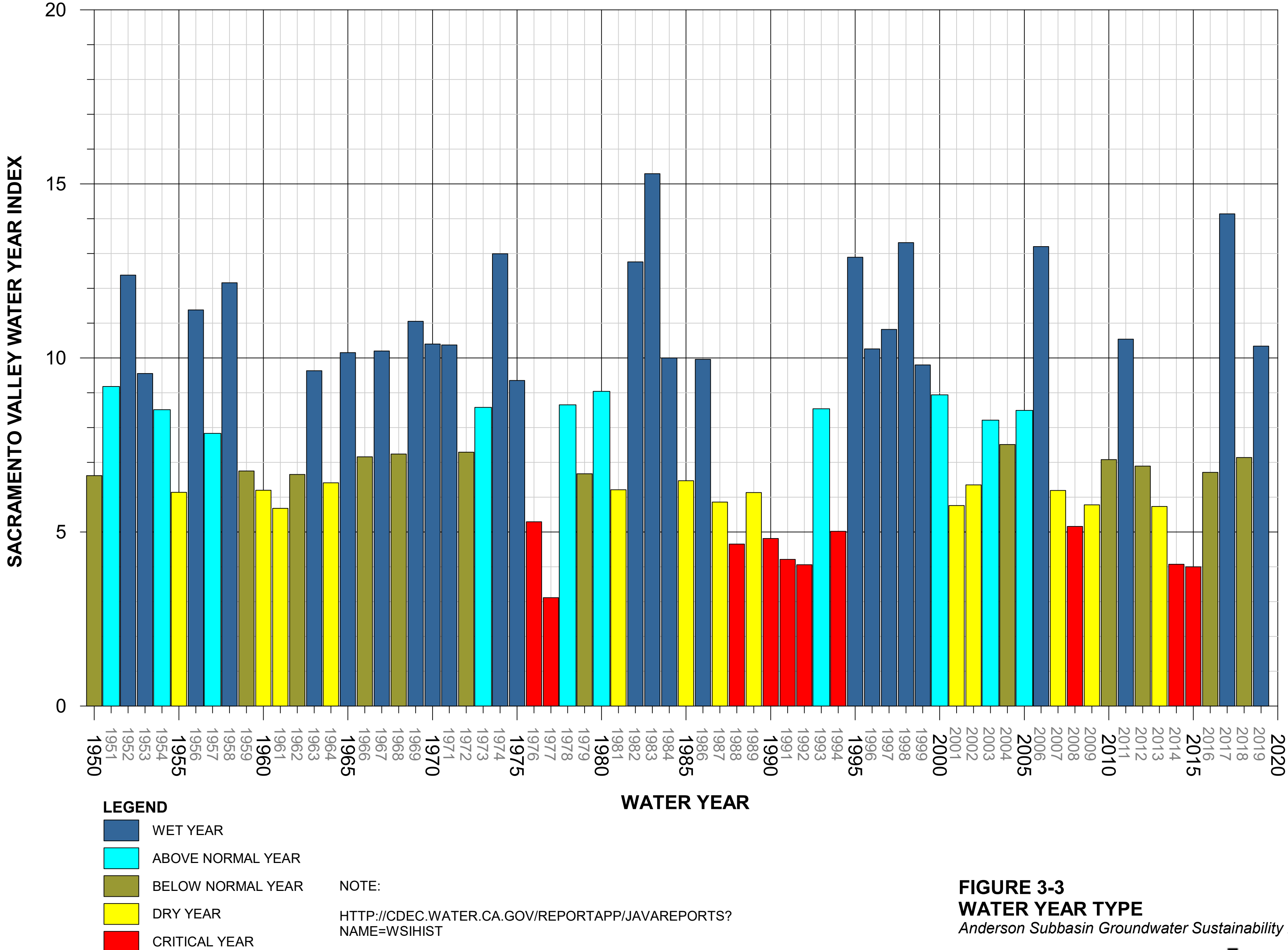
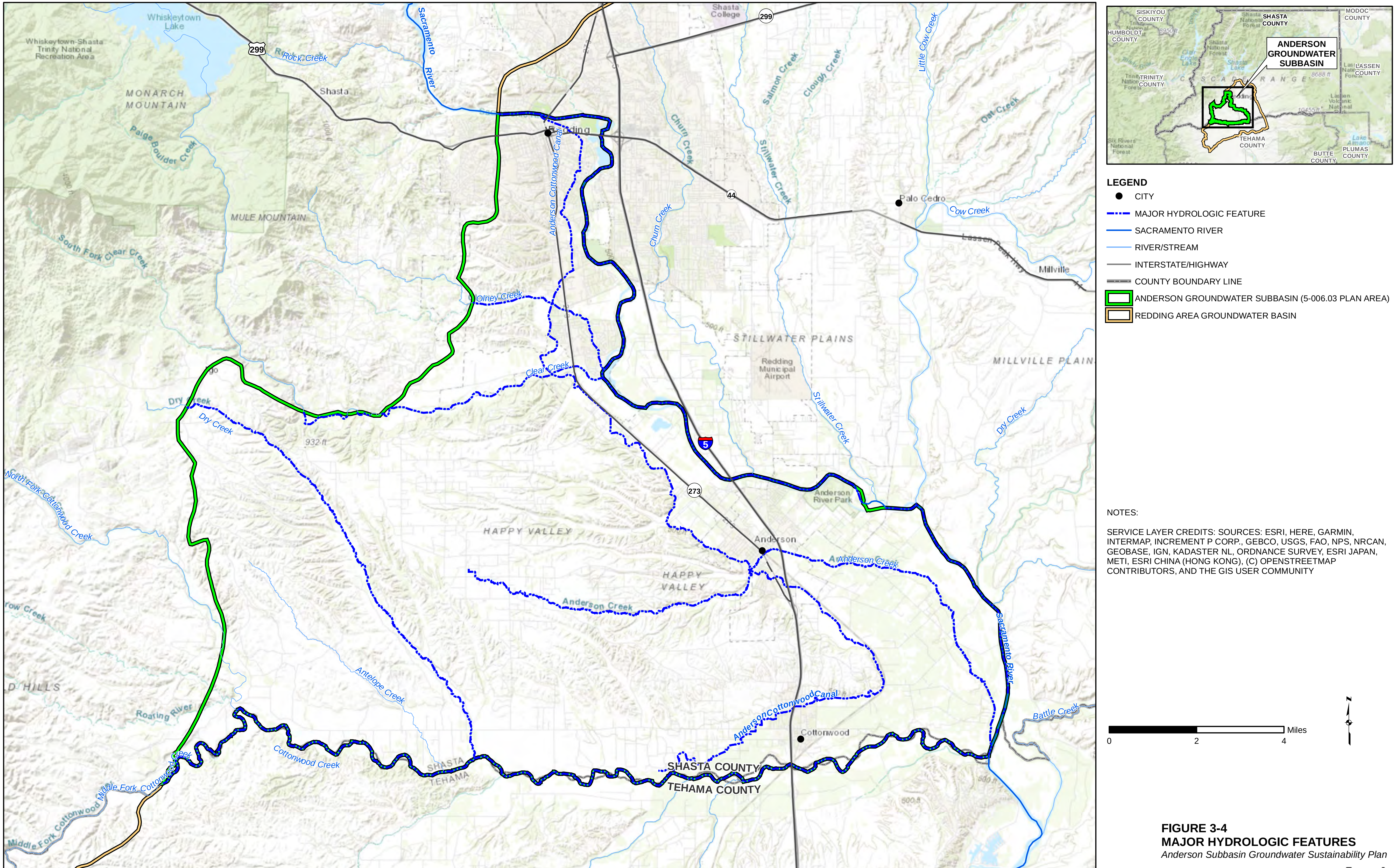


NOTE:

HTTP://CDEC.WATER.CA.GOV/REPORTAPP/JAVAREPORTS?NAME=WSIHIST

FIGURE 3-3
WATER YEAR TYPE
Anderson Subbasin Groundwater Sustainability Plan



NOTES:

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FIGURE 3-4
MAJOR HYDROLOGIC FEATURES
Anderson Subbasin Groundwater Sustainability Plan

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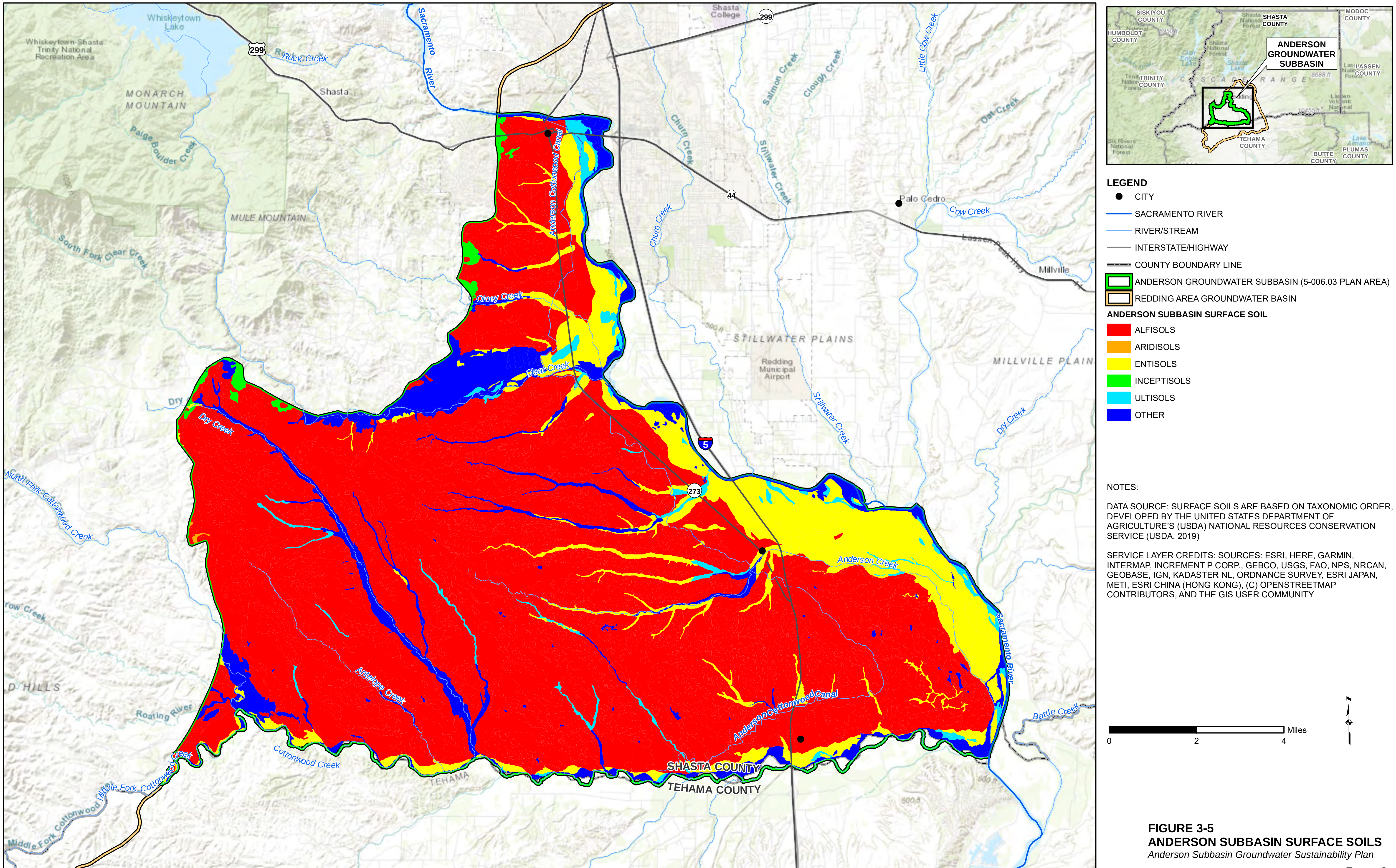

FIGURE 3-5
ANDERSON SUBBASIN SURFACE SOILS
Anderson Subbasin Groundwater Sustainability Plan

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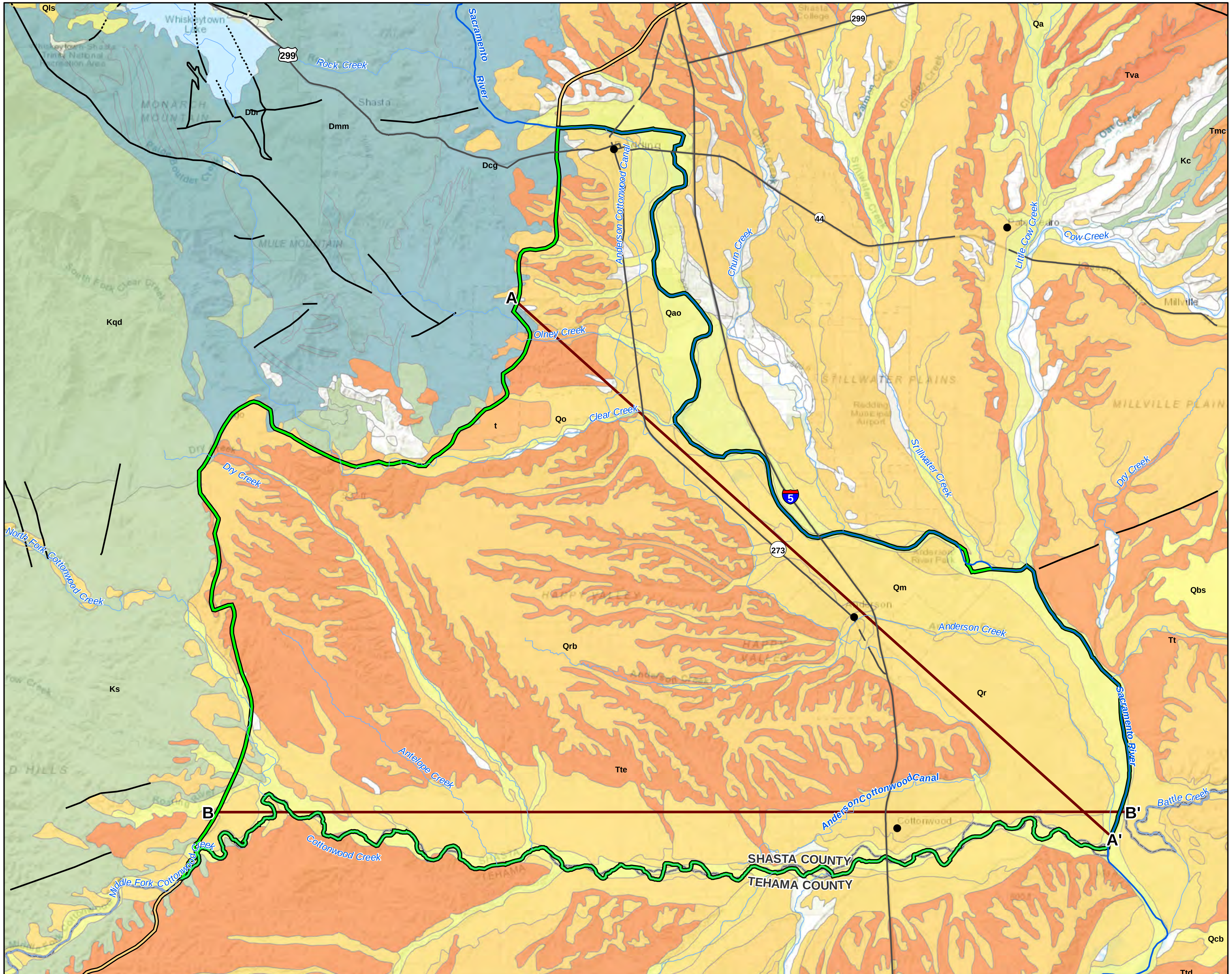

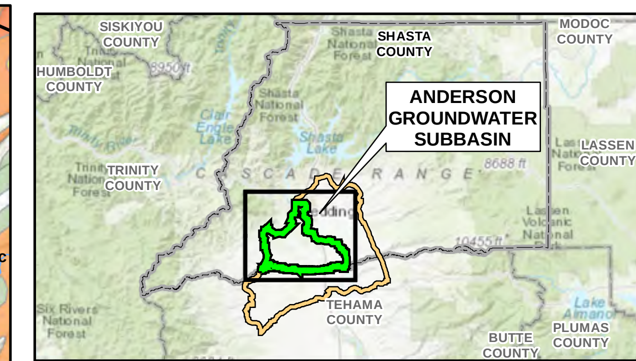

LEGEND

- ● CITY
- LOCATION OF CROSS SECTION
- FAULT LINE
- FAULT LINE (CONCEALED)
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

GEOLOGY DERIVED FROM THE DIGITAL GEOLOGIC MAP OF THE REDDING 1° X 2° DEGREE QUADRANGLE, SHASTA, TEHAMA, HUMBOLDT, AND TRINITY COUNTIES, CALIFORNIA (USGS, 2012). FIGURE 3-6b PRESENTS EXPLANATION OF MAP UNITS.

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

N

FIGURE 3-6a
ANDERSON SUBBASIN GEOLOGY
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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FIGURE 3-6a MAP UNIT EXPLANATION

SURFICIAL DEPOSITS

t	Man-made materials (Holocene)
Qa	Alluvium and colluvium (Holocene)
Qo	Overbank deposits (Holocene)
Qao	Alluvial and overbank deposits, undivided (Holocene)
Qls	Landslide deposits (Holocene)
Qm	Modesto formation of Davis and Hall (1959) (Pleistocene)
Qr	Riverbank Formation (Pleistocene)
Qrb	Red Bluff formation of Diller (1894) (Pleistocene)

VOLCANIC ROCKS

Qbs	Basalt of Shingletown Ridge (Pleistocene)
Qcb	Basalt of Coleman Forebay (Pleistocene)
Tva	Andesitic breccia (Pliocene)

SEDIMENTARY ROCKS

Tte	Tehama Formation (Pliocene)
Tt	Tuscan Formation, undivided (Pliocene)
Ttd	Fragmental Deposits
Tmc	Montgomery Creek Formation (Eocene)
Kc	Chico Formation (Upper Cretaceous)
Ks	Sedimentary Rocks (Lower Cretaceous)

EASTERN KLAMATH TERRANE

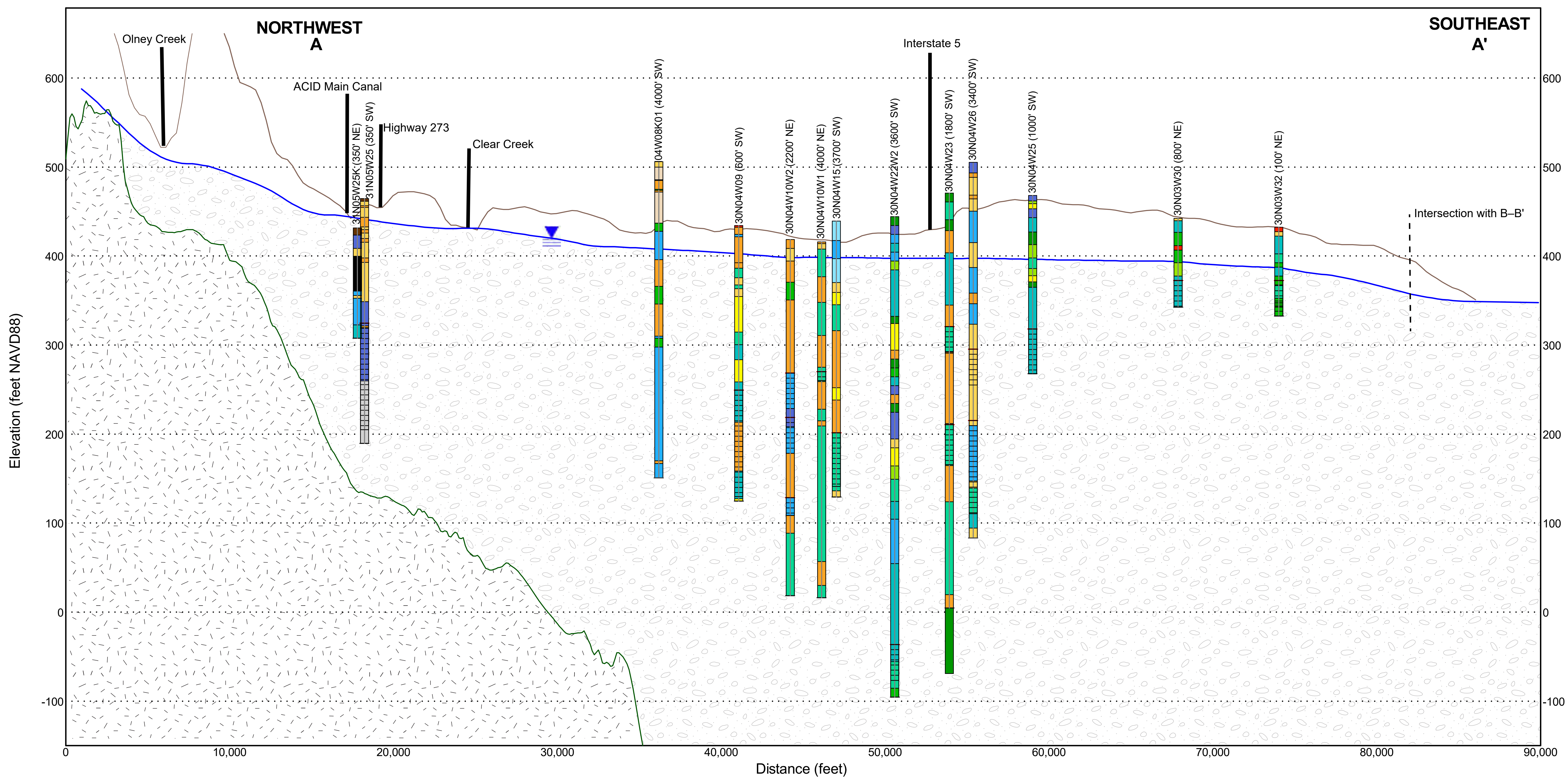
Dmm	Mule Mountain stock (Devonian)
Dbr	Balaklala Rhyolite (Devonian(?))
Dcg	Copley Greenstone (Devonian(?))

NOTES:

GEOLOGY DERIVED FROM THE DIGITAL GEOLOGIC MAP OF THE REDDING 1° X 2° DEGREE QUADRANGLE, SHASTA, TEHAMA, HUMBOLDT, AND TRINITY COUNTIES, CALIFORNIA (USGS, 2012).

MAP UNIT (Ttm) LABELED ON THE MAP IS OF UNKNOWN IDENTITY AND AGE; UNLABELED AREAS ARE OF UNKNOWN IDENTITY AND AGE. BOTH ARE UNFILLED ON THIS MAP.

FIGURE 3-6b
LIST OF MAP UNITS
Anderson Subbasin Groundwater Sustainability Plan



GROUND SURFACE ELEVATION (feet NAVD88)

TOP OF CHICO FORMATION

GROUNDWATER ELEVATION (feet NAVD88)

SCREEN INTERVAL

SOIL AND LITHOLOGY

SAND	GRAVEL	CLAY	BASALT	PRINCIPAL AQUIFER
CLAYEY SAND	CLAYEY GRAVEL	SANDY CLAY	HARD PAN	BEDROCK
GRAVELLEY SAND	SANDY GRAVEL	GRAVELLEY CLAY	SHALE	
SILTY SAND	SILTY GRAVEL	SILT	UNDIFFERENTIATED ROCK	
SANDSTONE	TUFF	SILTSTONE	UNDIFFERENTIATED SOIL	

SCALE EXAGGERATION – 54:1 (H:V)

NOTES:

LOCATION OF CROSS SECTION SHOWN ON FIGURE 3-6a.

30N04W08K01 (4000' SW) = LOCATION (DISTANCE/DIRECTION) FROM SECTION LINE (SEE FIGURE 3-6a).

GROUNDWATER ELEVATION IS ESTIMATED FROM GROUNDWATER LEVELS MEASURED BETWEEN OCTOBER 16 AND OCTOBER 26, 2018 (DWR, 2019b) (SEE FIGURE 3-13).

TOP OF CASING (AND GROUND SURFACE) ELEVATION OF SOME WELLS DIFFER FROM THE ELEVATION OF THE PROFILE BECAUSE THOSE WELLS WERE PROJECTED ONTO THE PLANE OF THE CROSS SECTION FROM VARYING DISTANCES.

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988.

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FIGURE 3-7
GEOLOGIC CROSS SECTION A-A'
Anderson Subbasin Groundwater Sustainability Plan

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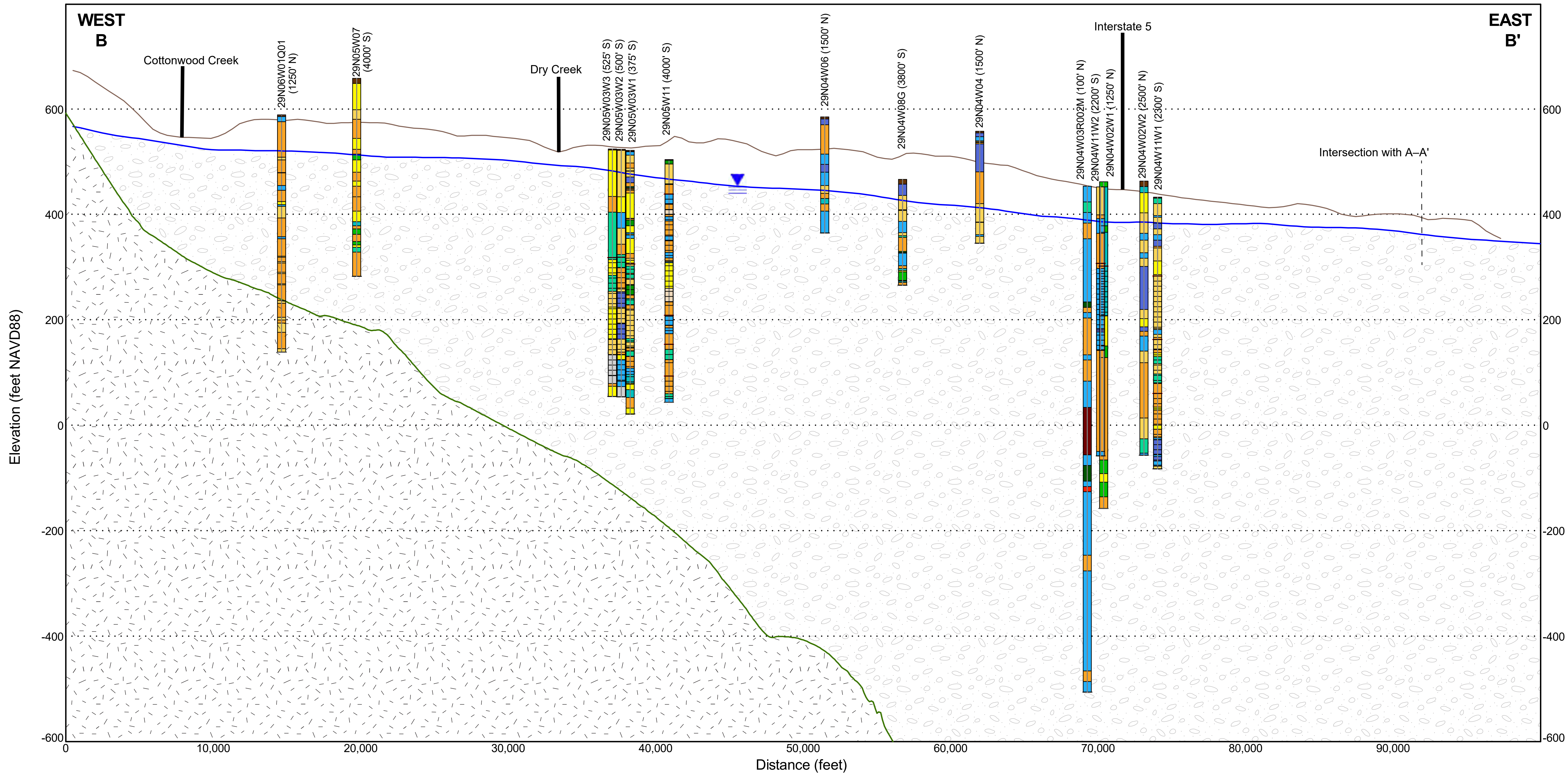

GROUND SURFACE ELEVATION (feet NAVD88)
TOP OF CHICO FORMATION (DASHED WHERE UNCERTAIN)
GROUNDWATER ELEVATION (feet NAVD88)
SCREEN INTERVAL

SCALE EXAGGERATION – 36:1 (H:V)

SOIL AND LITHOLOGY

SAND	GRAVEL	CLAY	BASALT
CLAYEY SAND	CLAYEY GRAVEL	SANDY CLAY	HARD PAN
GRAVELLEY SAND	SANDY GRAVEL	GRAVELLEY CLAY	SHALE
SILTY SAND	SILTY GRAVEL	SILT	UNDIFFERENTIATED ROCK
SANDSTONE	TUFF	SILTSTONE	UNDIFFERENTIATED SOIL

PRINCIPAL AQUIFER
BEDROCK

NOTES:

LOCATION OF CROSS SECTION SHOWN ON FIGURE 3-6a.

30N04W08K01 (4000' SW) = LOCATION (DISTANCE/DIRECTION) FROM SECTION LINE (SEE FIGURE 3-6a).

GROUNDWATER ELEVATION IS ESTIMATED FROM GROUNDWATER LEVELS MEASURED BETWEEN OCTOBER 16 AND OCTOBER 26, 2018 (DWR, 2019b) (SEE FIGURE 3-13).

TOP OF CASING (AND GROUND SURFACE) ELEVATION OF SOME WELLS DIFFER FROM THE ELEVATION OF THE PROFILE BECAUSE THOSE WELLS WERE PROJECTED ONTO THE PLANE OF THE CROSS SECTION FROM VARYING DISTANCES.

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988.

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FIGURE 3-8
GEOLOGIC CROSS SECTION B-B'
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

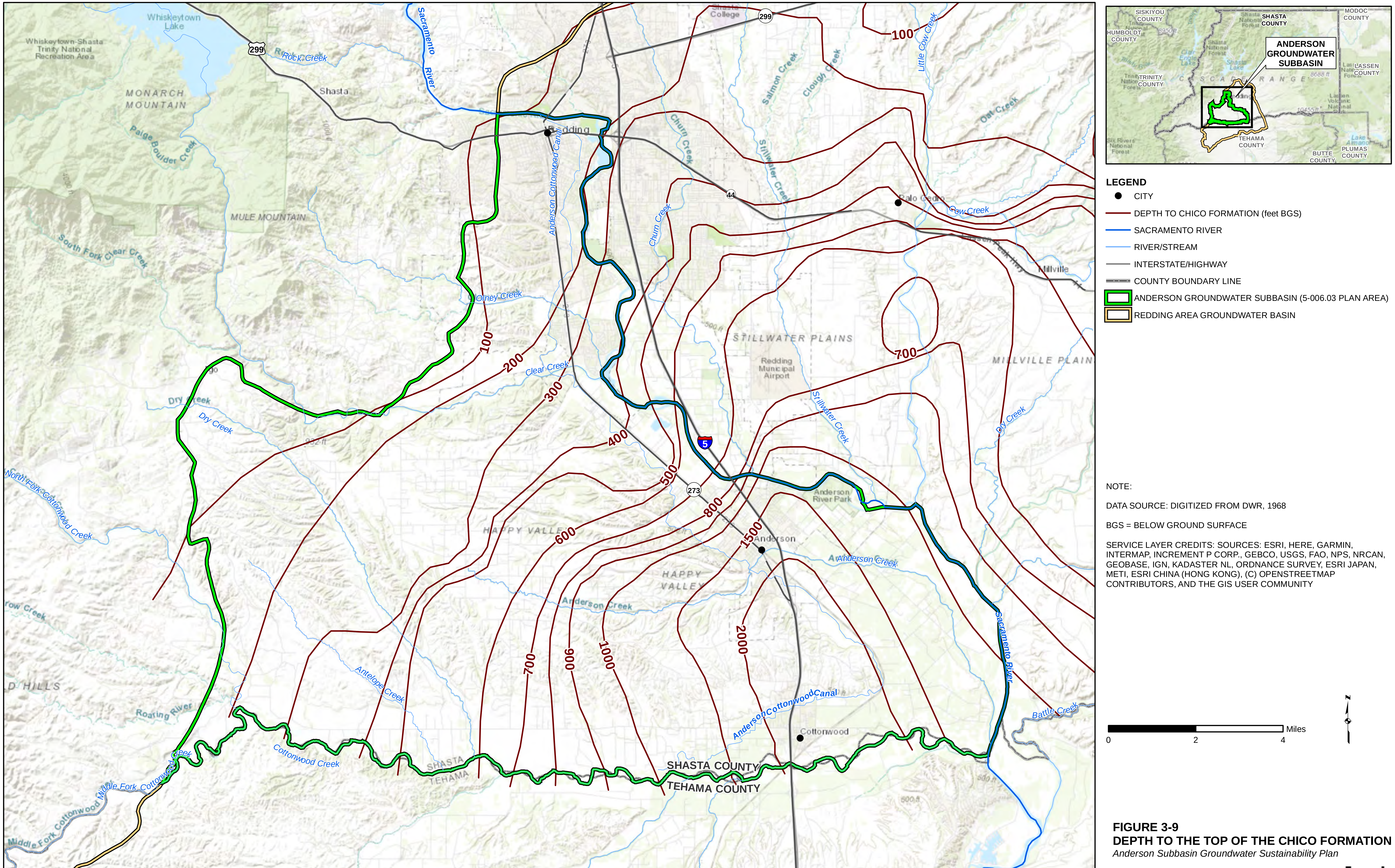

FIGURE 3-9
DEPTH TO THE TOP OF THE CHICO FORMATION
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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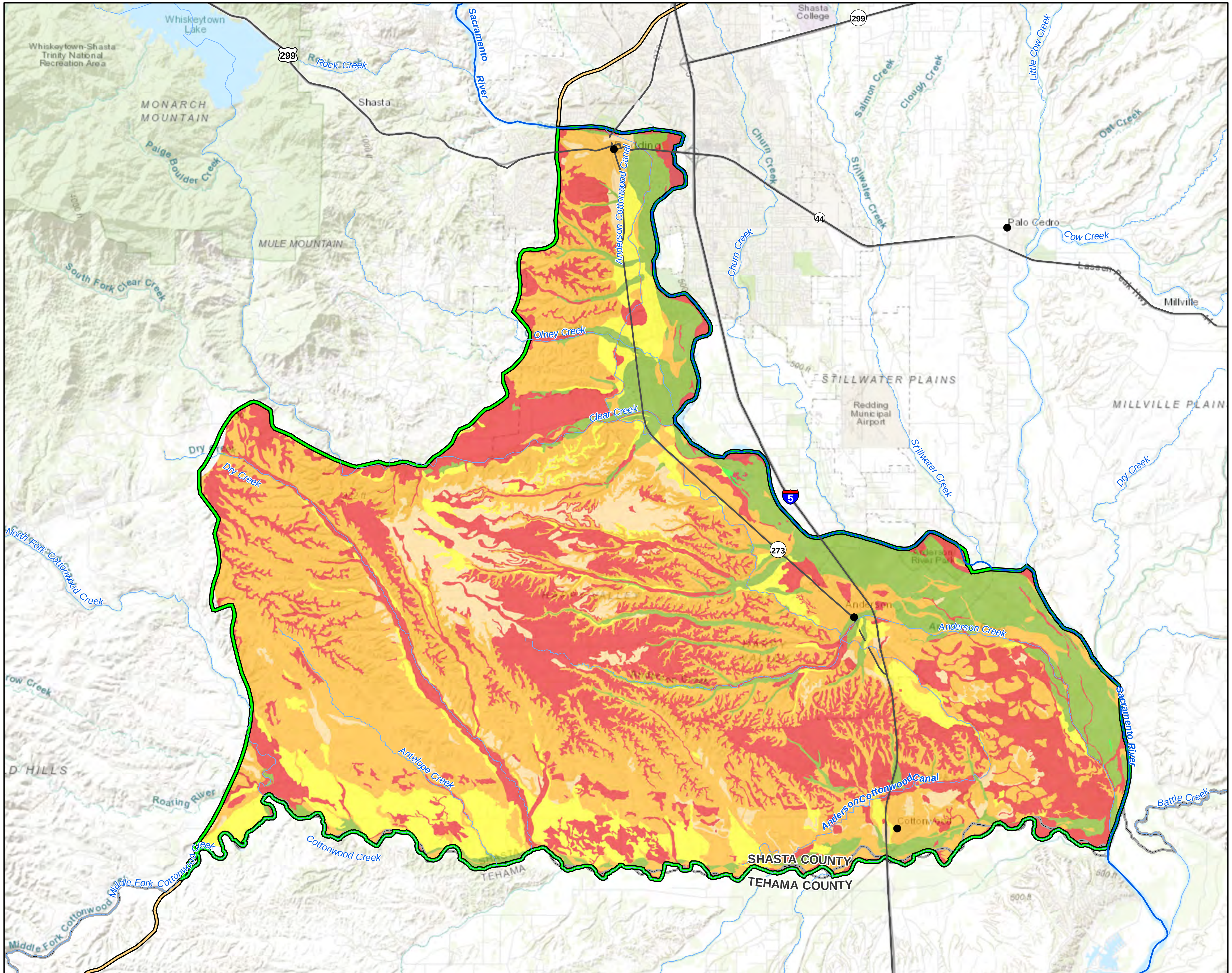
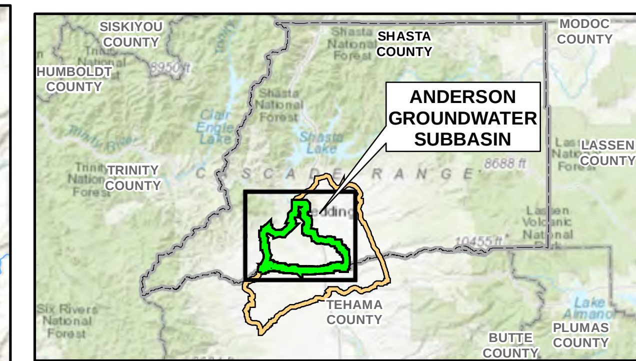




LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

SAGBI RATING (RATING CLASS)

- 85 to 100 (EXCELLENT)
- 69 to 85 (GOOD)
- 49 to 69 (MODERATELY GOOD)
- 29 to 49 (MODERATELY POOR)
- 15 to 29 (POOR)
- 0 to 15 (VERY POOR)

NOTES:

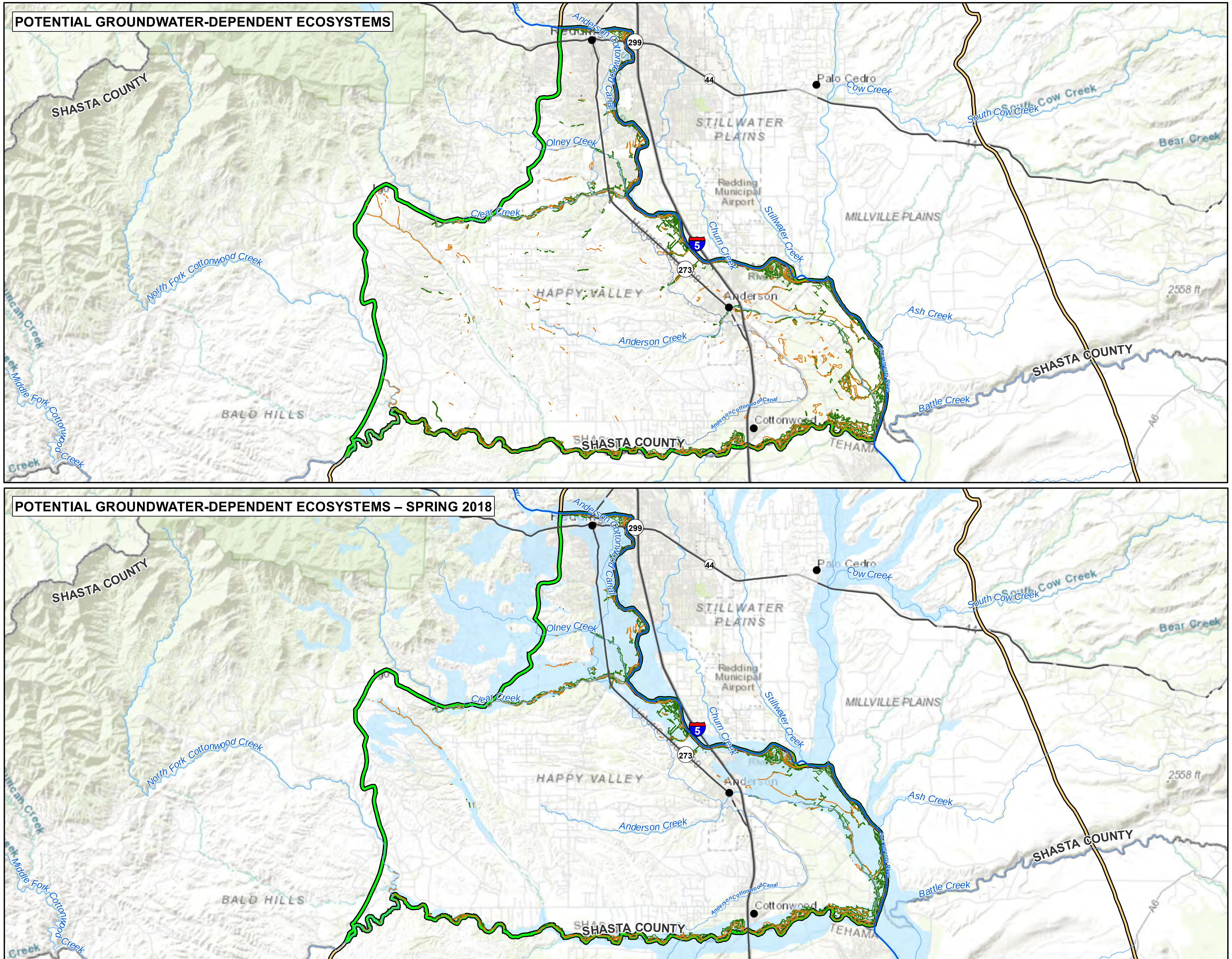
DATA SOURCE: SOIL AGRICULTURAL GROUNDWATER BANKING INDEX (SAGBI) (O'GEEN ET AL., 2015)

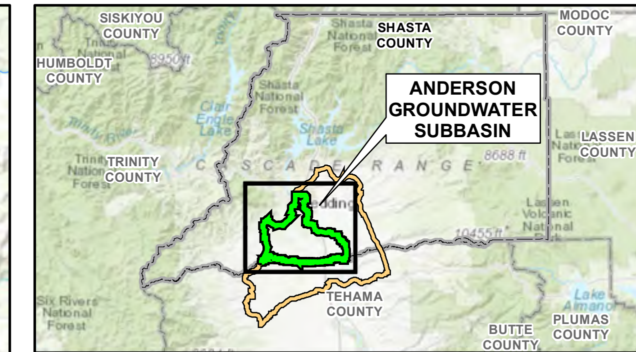
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 3-10
SOIL AGRICULTURAL GROUNDWATER BANKING INDEX MAP
Anderson Subbasin Groundwater Sustainability Plan

Jacobs





LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN
- GROUNDWATER LEVELS WITHIN 30 FEET OF GROUND SURFACE (feet BGS)

POTENTIAL GROUNDWATER-DEPENDENT ECOSYSTEMS

- NATURAL COMMUNITIES COMMONLY ASSOCIATED WITH GROUNDWATER VEGETATION
- NATURAL COMMUNITIES COMMONLY ASSOCIATED WITH GROUNDWATER WETLANDS

NOTES:

DATA SOURCES:

HTTPS://GIS.WATER.CA.GOV/APP/NCDATASETVIEWER/#. ACCESSED MARCH 2020 (DWR, 2020c)

BGS = BELOW GROUND SURFACE

DWR = DEPARTMENT OF WATER RESOURCES

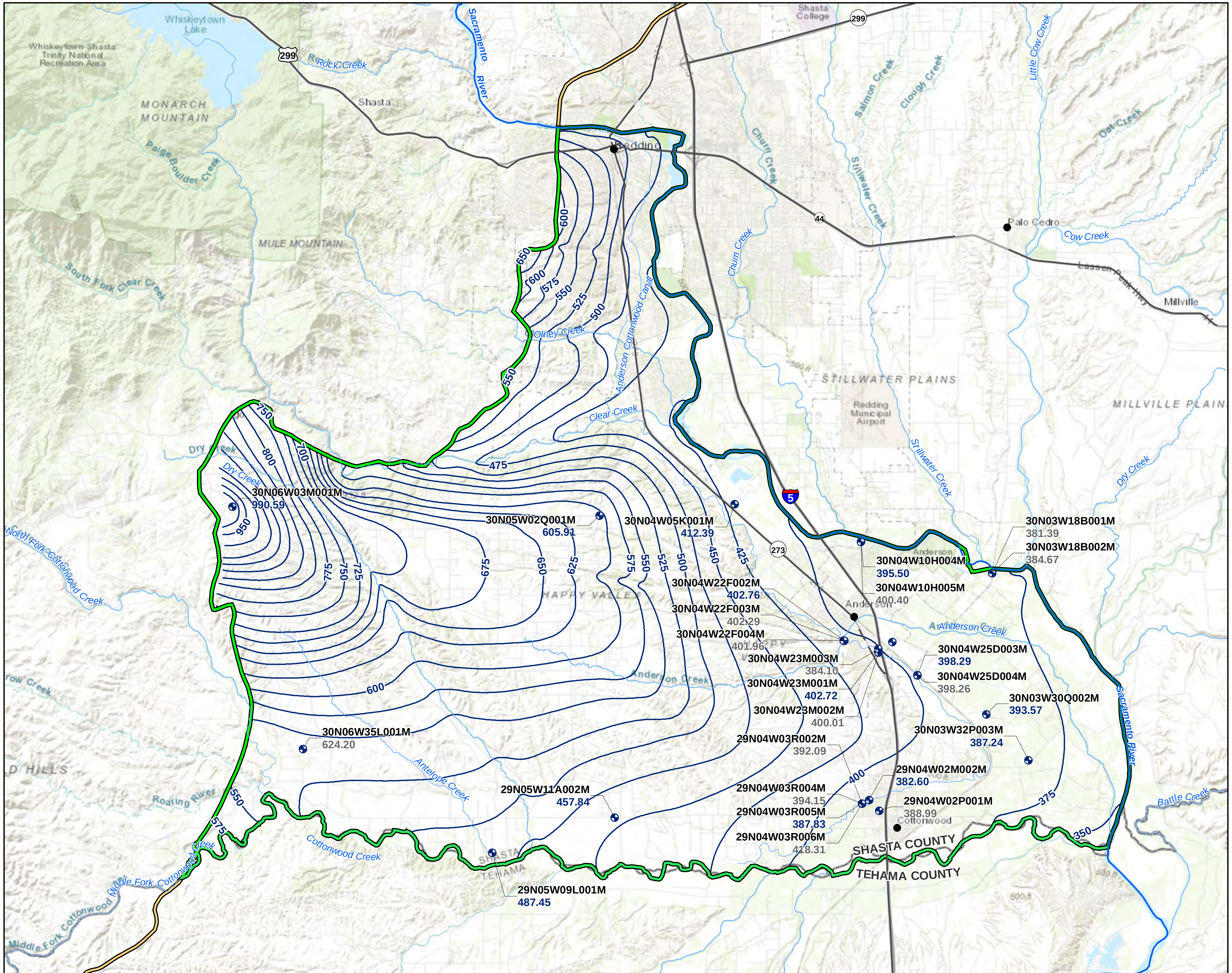
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

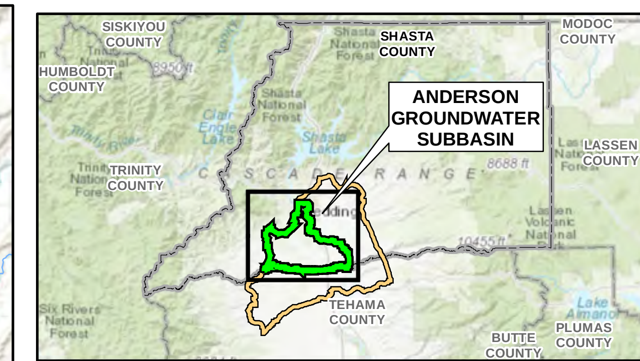
0 3.5 7 Miles

N

FIGURE 3-11
POTENTIAL GROUNDWATER-DEPENDENT ECOSYSTEMS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs





LEGEND

- GROUNDWATER ELEVATION LOCATION
- 395.50 MEASURED GROUNDWATER ELEVATION (feet NAVD88) (GRAY TEXT INDICATES ELEVATION NOT USED IN CONTOURING)
- CITY
- SPRING 2018 GROUNDWATER ELEVATION CONTOUR (feet NAVD88)
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

GROUNDWATER LEVELS WERE MEASURED BETWEEN MARCH 19 AND APRIL 3, 2018 (DWR, 2019b).

WELLS SCREENED IN SHALLOW GROUNDWATER, POINT LOCATIONS ALONG SACRAMENTO RIVER WITH INTERPOLATED SURFACE WATER ELEVATIONS, AND RIVER GAGES BELOW KESWICK RESERVOIR (11370500) AND AT BEND BRIDGE IN RED BLUFF (11377100) WERE USED IN CONTOURING SHALLOW GROUNDWATER. REDFEM OUTPUTS WERE USED TO SUPPLEMENT AREAS WITHOUT CURRENT GROUNDWATER ELEVATION DATA (CH2M HILL, 2011 AND USGS, 2019a).

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 3-12
SPRING 2018 GROUNDWATER ELEVATION CONTOURS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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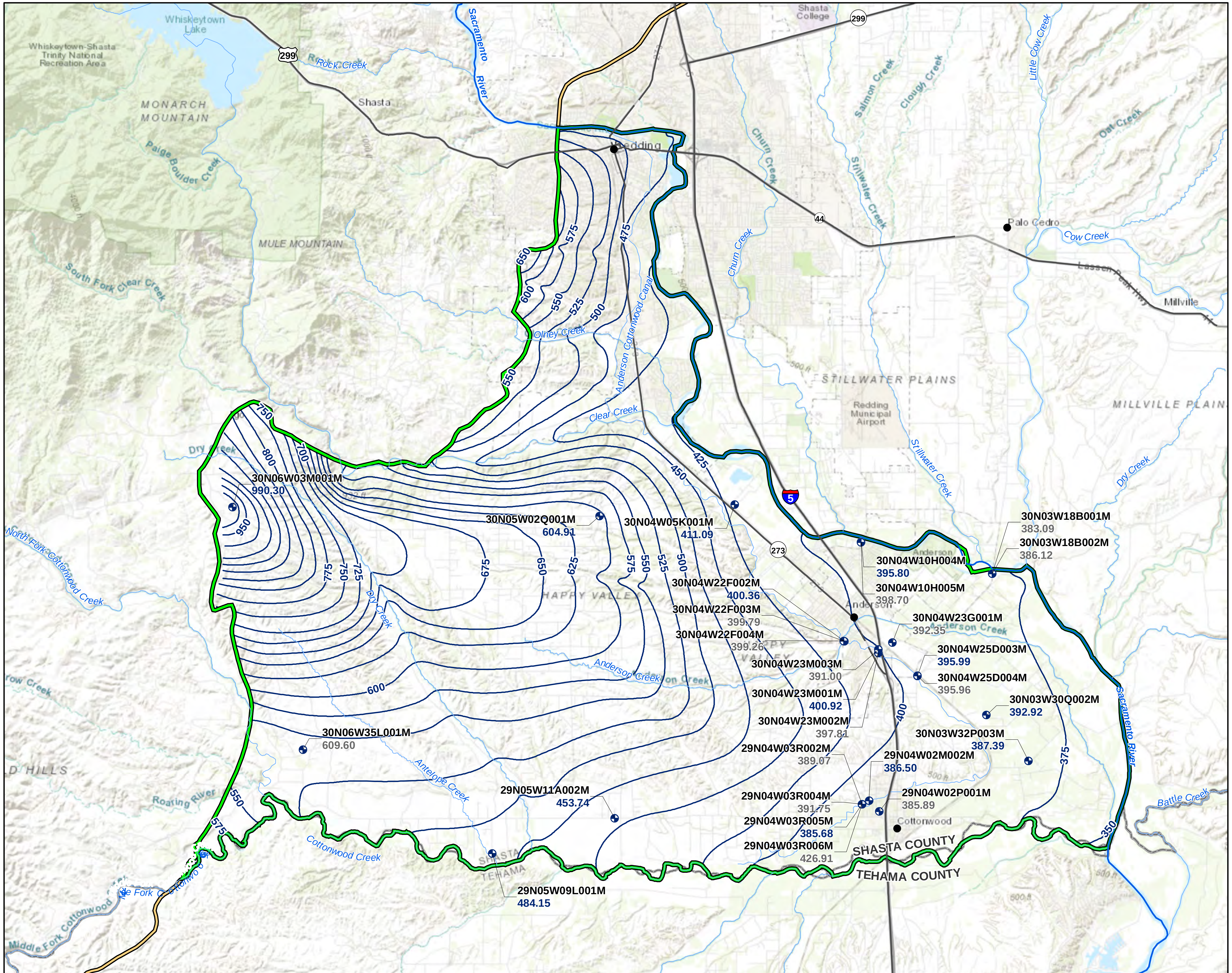

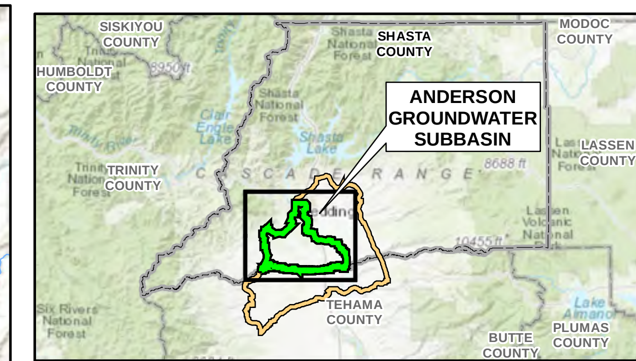

LEGEND

- GROUNDWATER ELEVATION LOCATION
- 395.50 MEASURED GROUNDWATER ELEVATION (feet NAVD88) (GRAY TEXT INDICATES ELEVATION NOT USED IN CONTOURING)
- CITY
- FALL 2018 GROUNDWATER ELEVATION CONTOUR (feet NAVD88)
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

GROUNDWATER LEVELS WERE MEASURED BETWEEN OCTOBER 16 AND 26, 2018 (DWR, 2019b).

WELLS SCREENED IN SHALLOW GROUNDWATER, POINT LOCATIONS ALONG SACRAMENTO RIVER WITH INTERPOLATED SURFACE WATER ELEVATIONS, AND RIVER GAGES BELOW KESWICK RESERVOIR (11370500) AND AT BEND BRIDGE IN RED BLUFF (11377100) WERE USED IN CONTOURING SHALLOW GROUNDWATER. REDFEM OUTPUTS WERE USED TO SUPPLEMENT AREAS WITHOUT CURRENT GROUNDWATER ELEVATION DATA (CH2M HILL, 2011 AND USGS, 2019a).

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FIGURE 3-13
FALL 2018 GROUNDWATER ELEVATION CONTOURS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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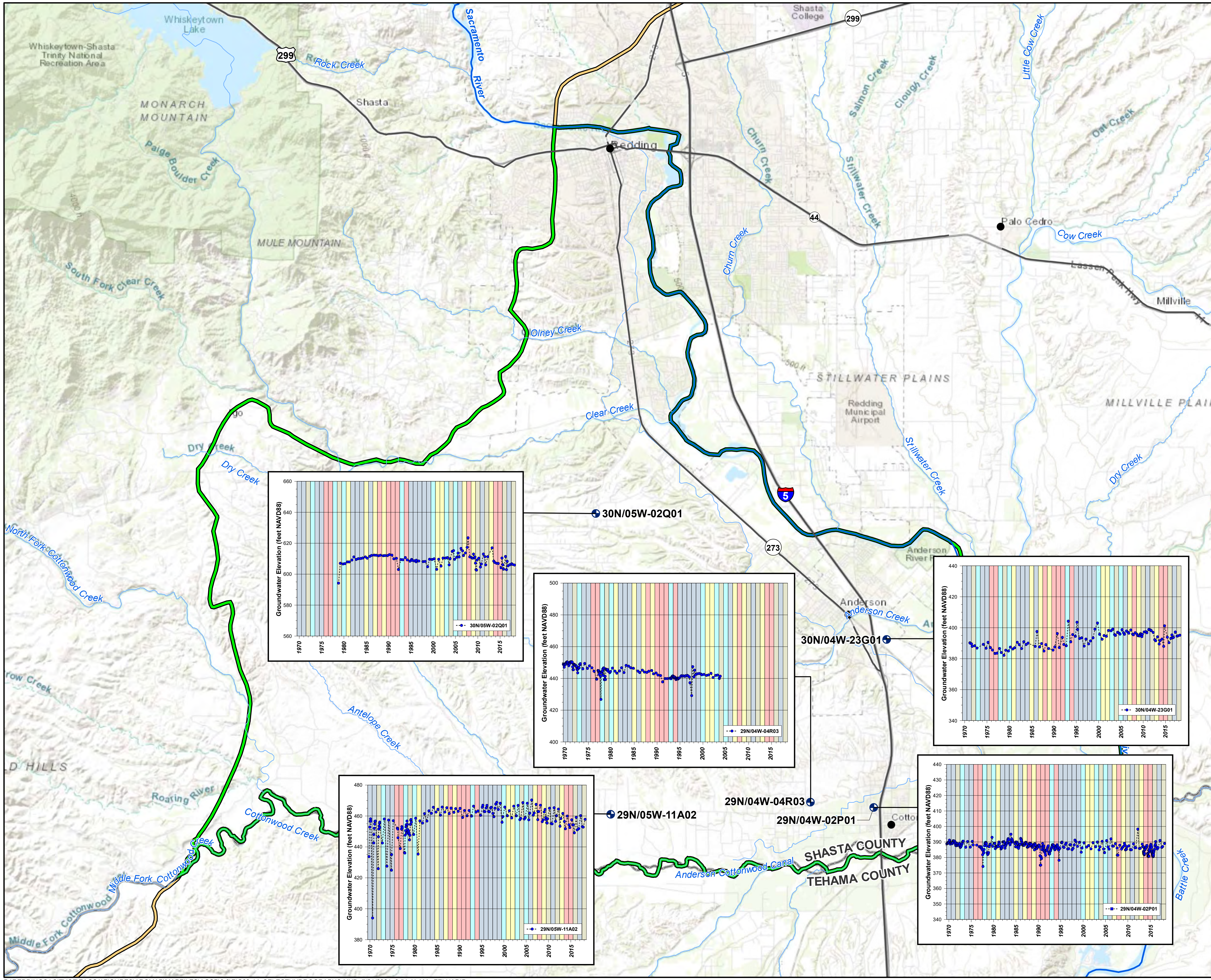

MAP LEGEND

- GROUNDWATER ELEVATION LOCATION
- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

GRAPH LEGEND

- GROUNDWATER ELEVATION (feet NAVD88)

SACRAMENTO VALLEY HYDROLOGIC REGION WATER YEAR CLASSIFICATION

- WET YEAR
- ABOVE NORMAL YEAR
- BELOW NORMAL YEAR
- DRY YEAR
- CRITICAL YEAR

NOTES:

DATA SOURCES: DWR, 2019b

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FIGURE 3-14
SELECT HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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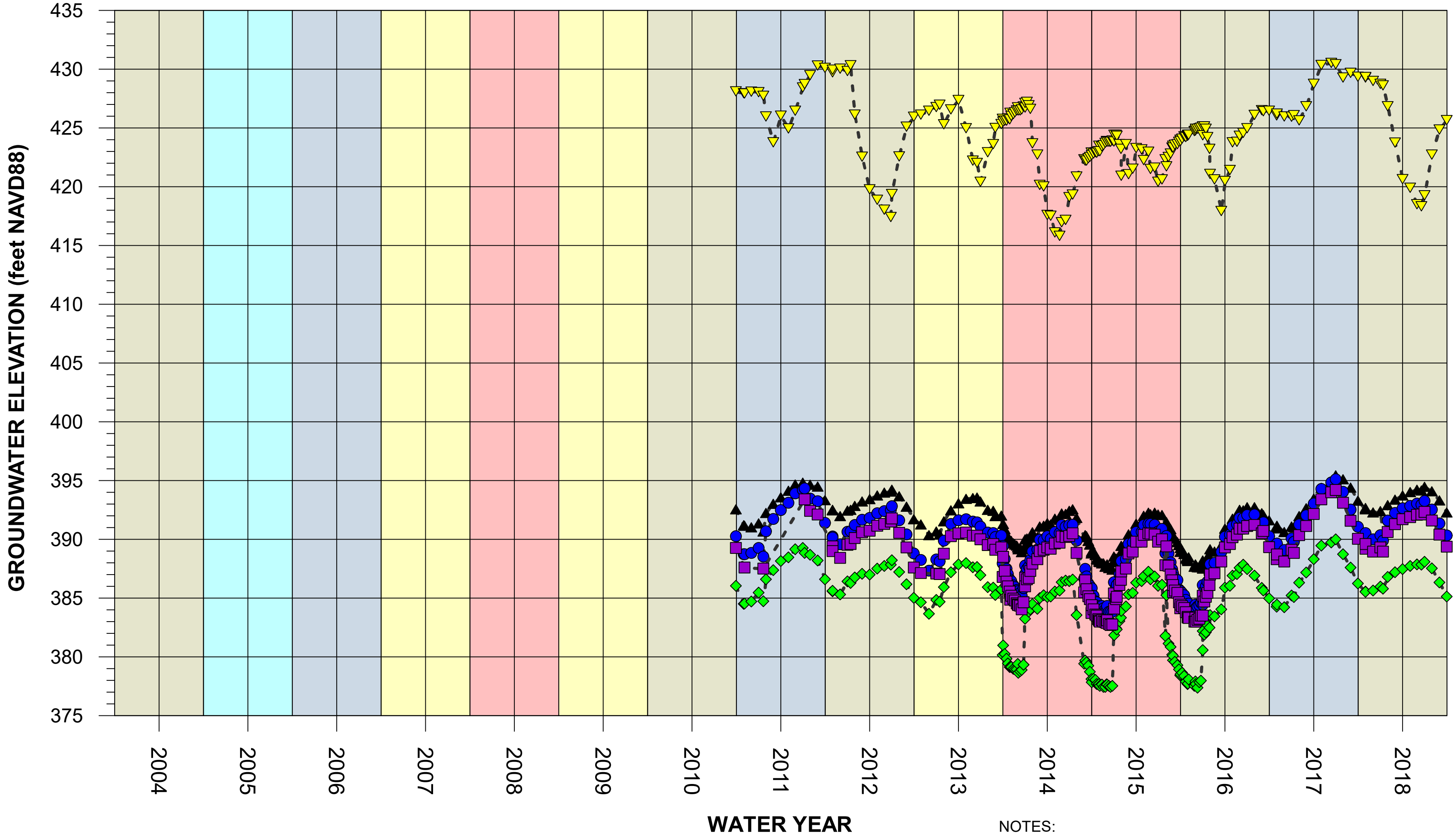

LEGEND

- 29N/04W-03R06 (417.84 to 397.84)
- 29N/04W-03R05 (329.84 to 269.84)
- 29N/04W-03R04 (77.84 to 67.84)
- 29N/04W-03R03 (-57.16 to -202.16)
- 29N/04W-03R02 (-282.16 to -422.16)

- WET YEAR
- ABOVE NORMAL YEAR
- BELOW NORMAL YEAR
- DRY YEAR
- CRITICAL YEAR

NOTES:

(200.6 to 119.6) = WELL SCREEN ELEVATION (feet NAVD88)

DATA SOURCES: DWR, 2019a and 2020a

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988

FIGURE 3-15a
ANDERSON SUBBASIN WELL CLUSTER HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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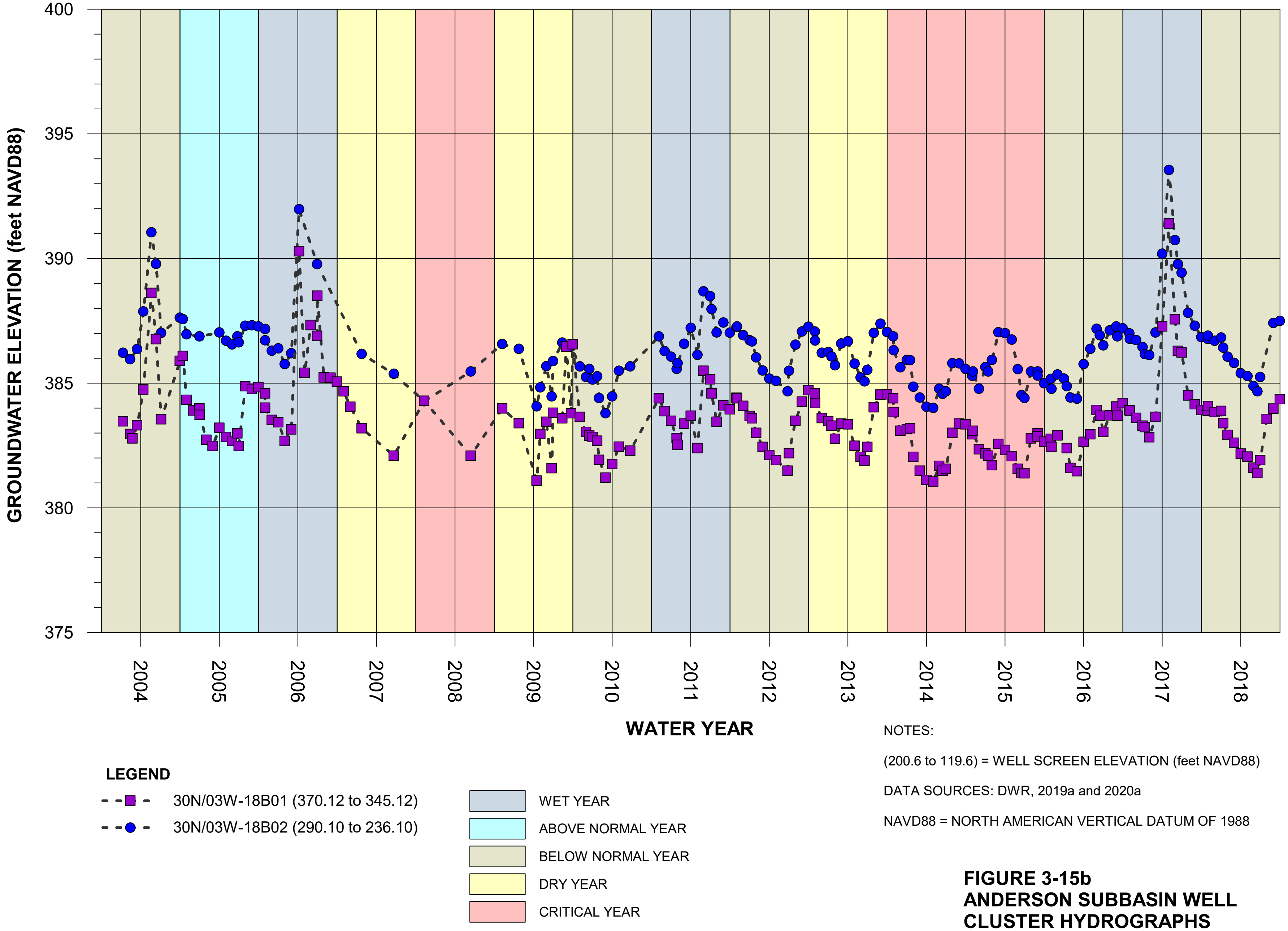


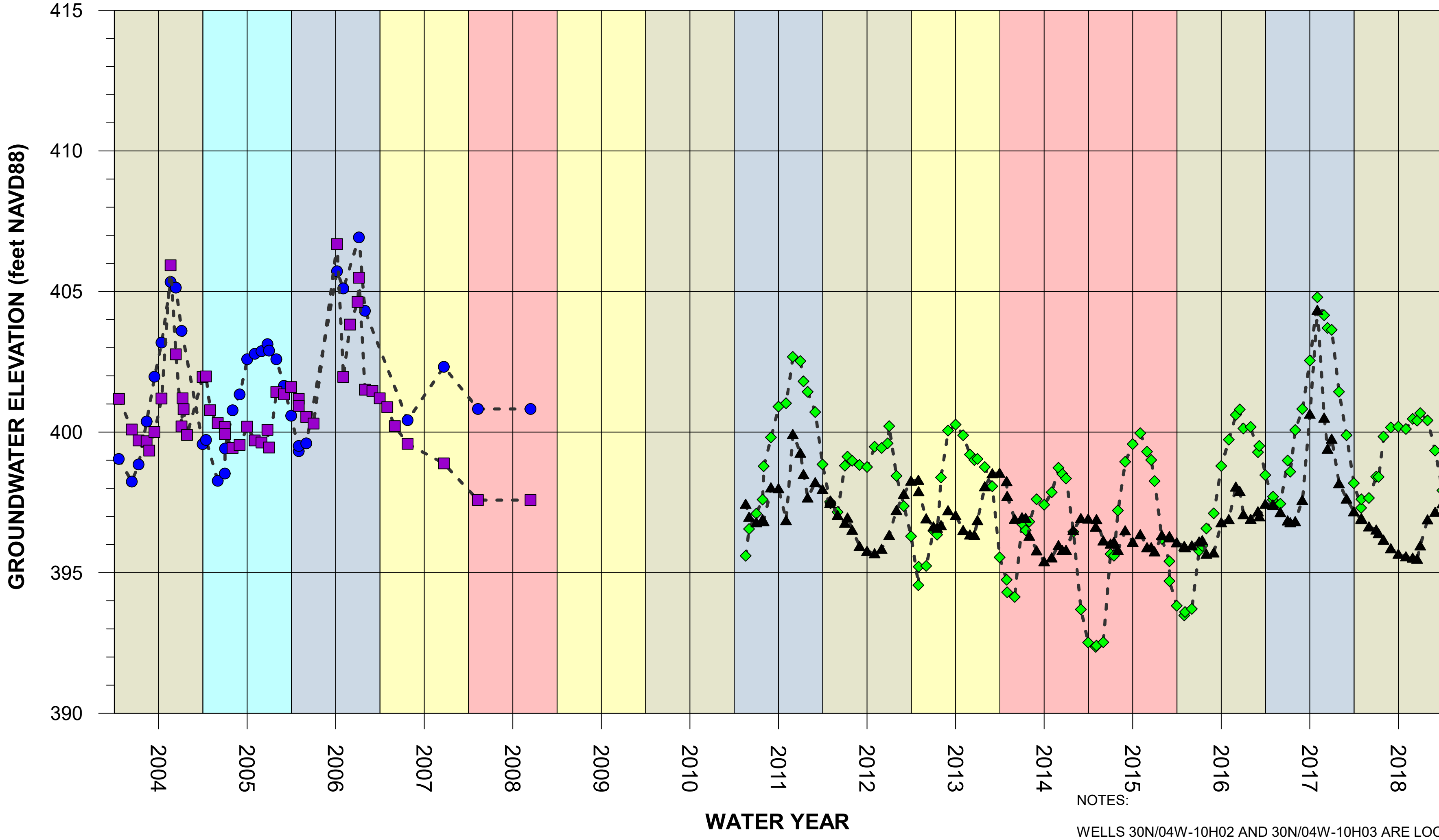
NOTES:

(200.6 to 119.6) = WELL SCREEN ELEVATION (feet NAVD88)

DATA SOURCES: DWR, 2019a and 2020a

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988

FIGURE 3-15b
ANDERSON SUBBASIN WELL CLUSTER HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan



LEGEND

- 30N/04W-10H02 (390.47 to 370.47)
- 30N/04W-10H03 (310.57 to 260.57)
- 30N/04W-10H04 (383.80 to 356.80)
- 30N/04W-10H05 (308.70 to 257.70)

- WET YEAR
- ABOVE NORMAL YEAR
- BELOW NORMAL YEAR
- DRY YEAR
- CRITICAL YEAR

NOTES:

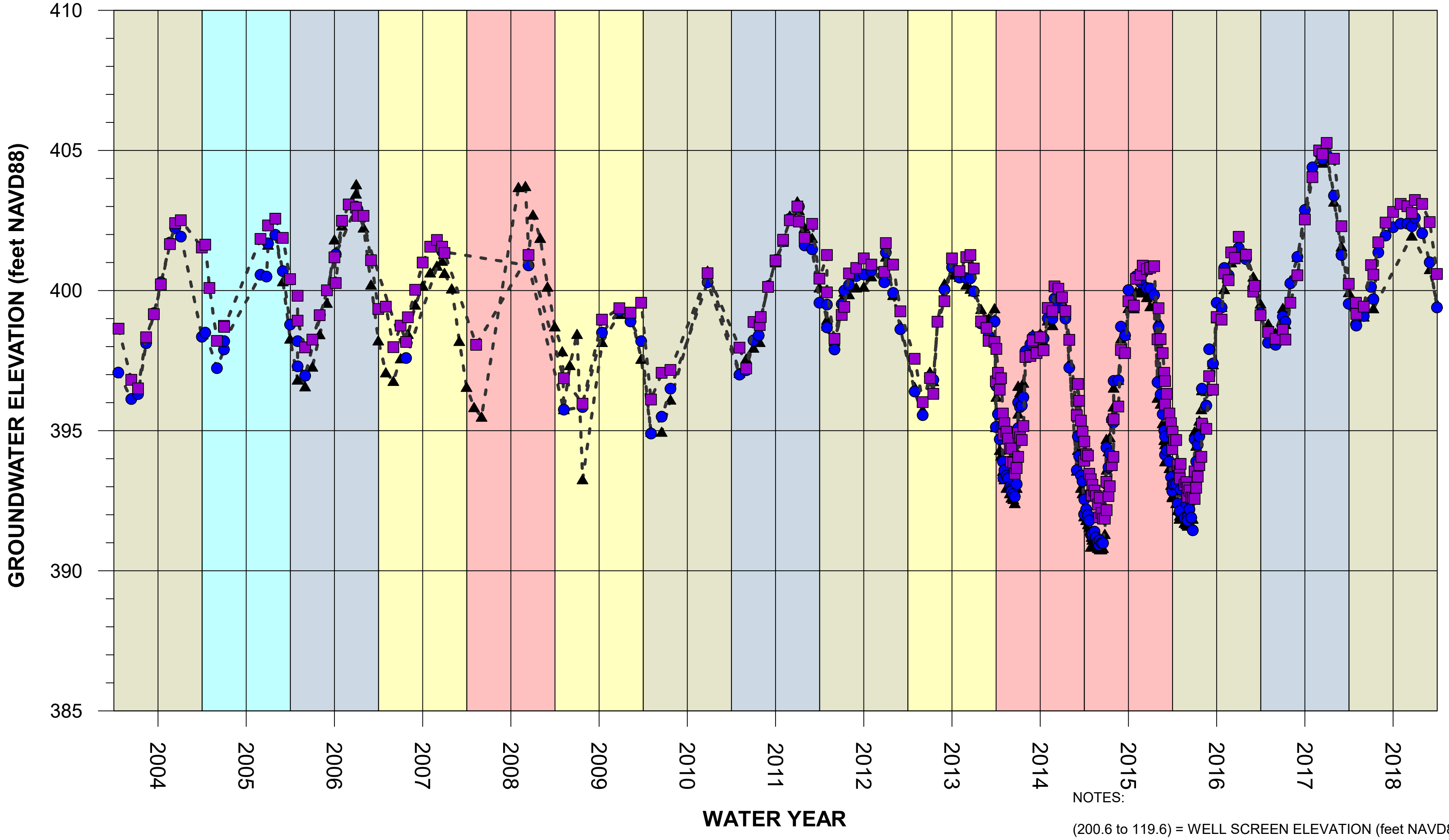
WELLS 30N/04W-10H02 AND 30N/04W-10H03 ARE LOCATED APPROXIMATELY 98 FEET FROM WELLS 30N/04W-10H04 AND 30N/04W-10H05.

(200.6 to 119.6) = WELL SCREEN ELEVATION (feet NAVD88)

DATA SOURCES: DWR, 2019a and 2020a

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988

FIGURE 3-15c
ANDERSON SUBBASIN WELL CLUSTER HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan



LEGEND

- 30N/04W-22F02 (377.86 to 334.86)
- 30N/04W-22F03 (277.64 to 245.64)
- 30N/04W-22F04 (-32.20 to -92.20)

- WET YEAR
- ABOVE NORMAL YEAR
- BELOW NORMAL YEAR
- DRY YEAR
- CRITICAL YEAR

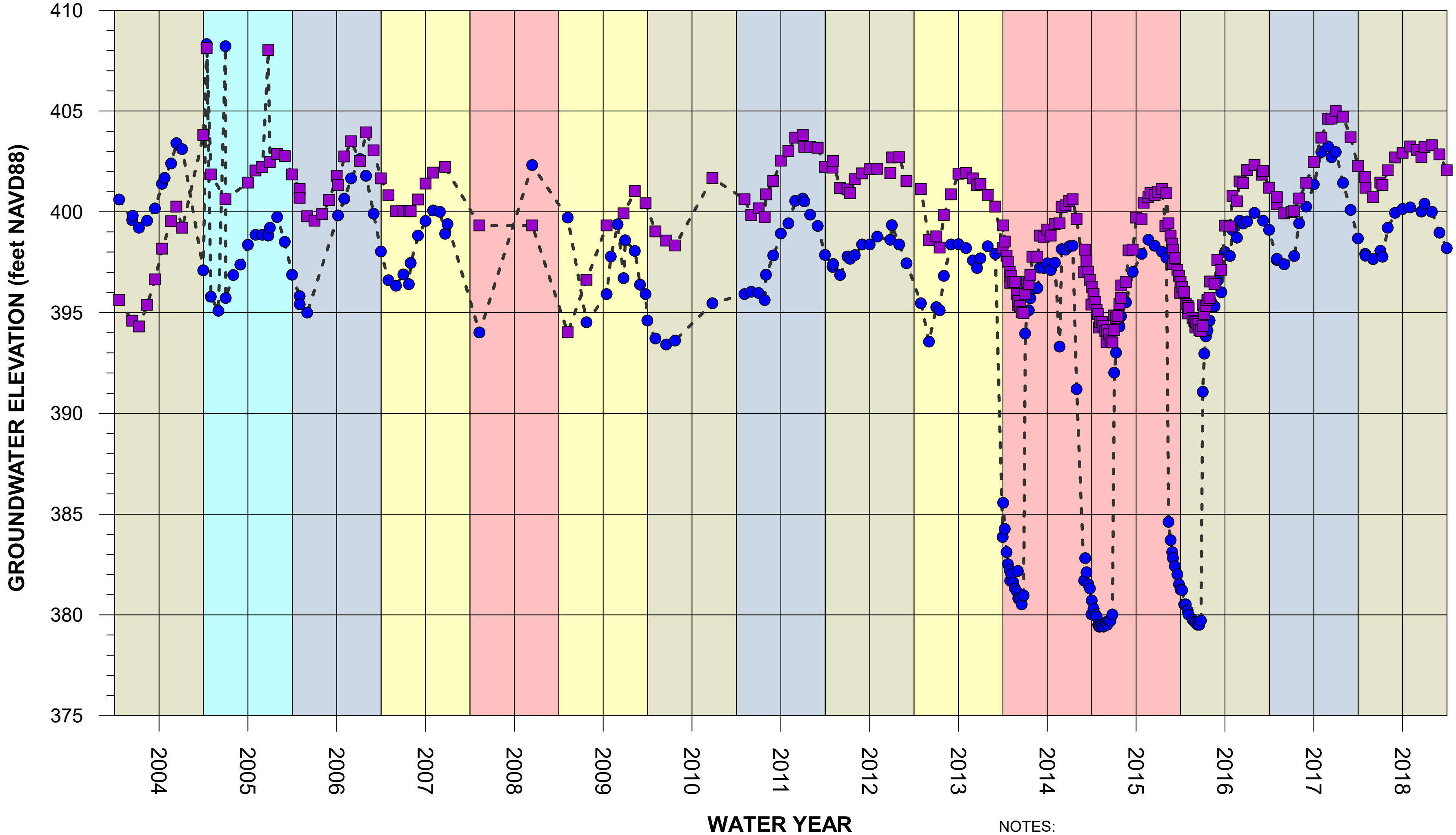
NOTES:

(200.6 to 119.6) = WELL SCREEN ELEVATION (feet NAVD88)

DATA SOURCES: DWR, 2019a and 2020a

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988

FIGURE 3-15d
ANDERSON SUBBASIN WELL CLUSTER HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan



LEGEND

- 30N/04W-23M01 (392.33 to 358.33)
- 30N/04W-23M02 (332.67 to 271.67)

- WET YEAR
- ABOVE NORMAL YEAR
- BELOW NORMAL YEAR
- DRY YEAR
- CRITICAL YEAR

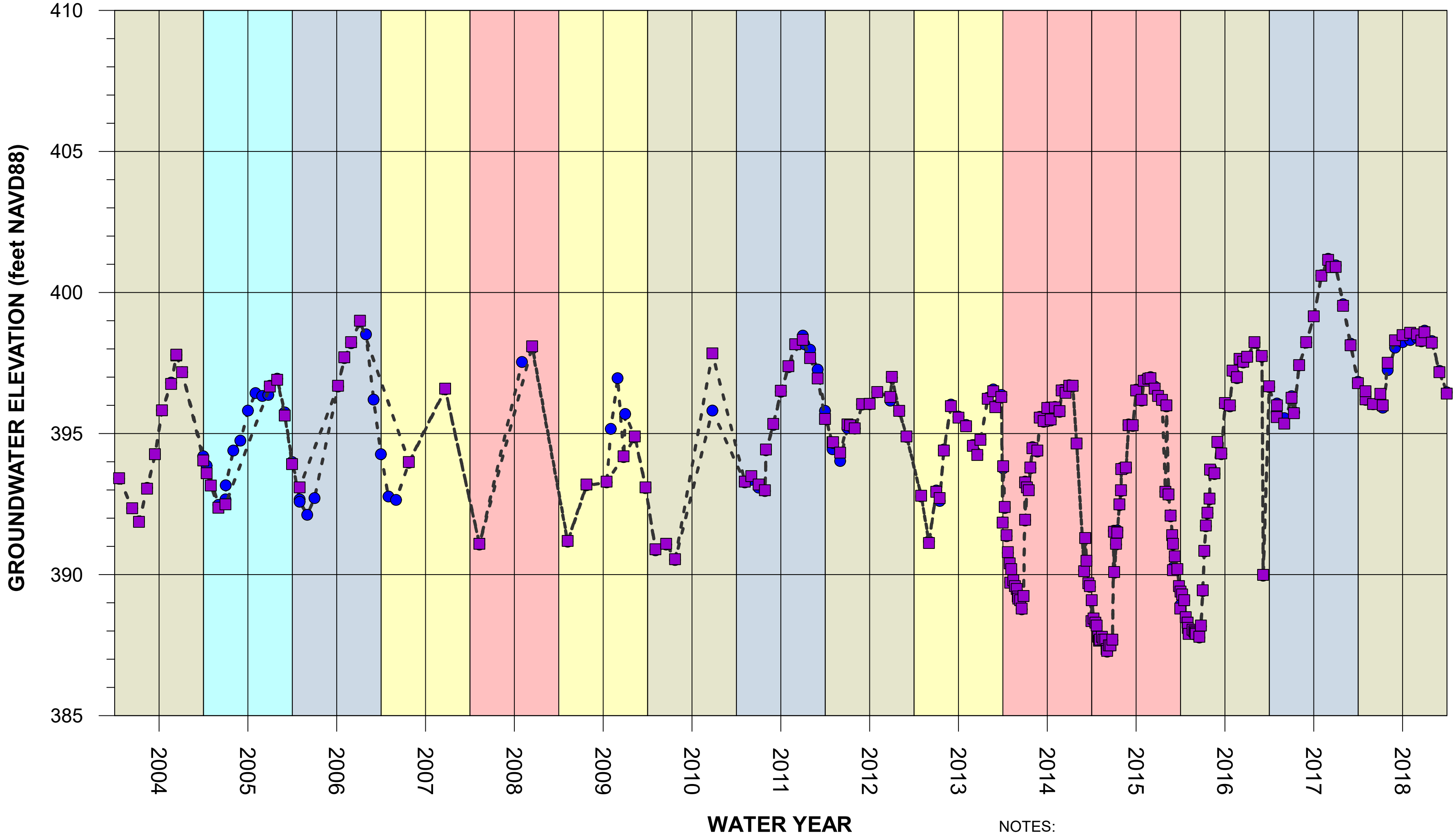
NOTES:

(200.6 to 119.6) = WELL SCREEN ELEVATION (feet NAVD88)

DATA SOURCES: DWR, 2019a and 2020a

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988

FIGURE 3-15e
ANDERSON SUBBASIN WELL CLUSTER HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan



LEGEND

30N/04W-25D03 (372.47 to 350.47)

30N/04W-25D04 (322.07 to 271.07)

WET YEAR

ABOVE NORMAL YEAR

BELOW NORMAL YEAR

DRY YEAR

CRITICAL YEAR

NOTES:

(200.6 to 119.6) = WELL SCREEN ELEVATION (feet NAVD88)

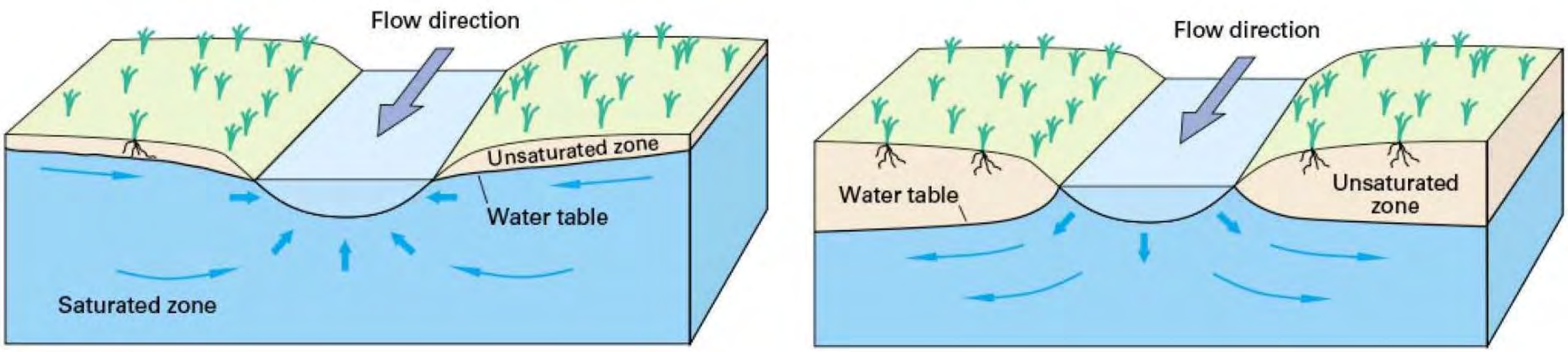
DATA SOURCES: DWR, 2019a and 2020a

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988

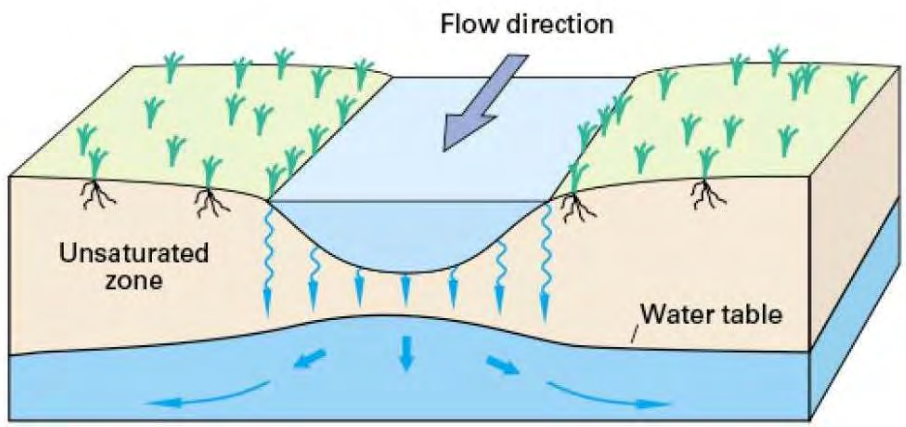
FIGURE 3-15f
ANDERSON SUBBASIN WELL CLUSTER HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan

D:\ReddingCACityof\EAGSA\Figures\Grapher\AGSP\FIG03-15f_ClusterHydrographs.grf

Jacobs



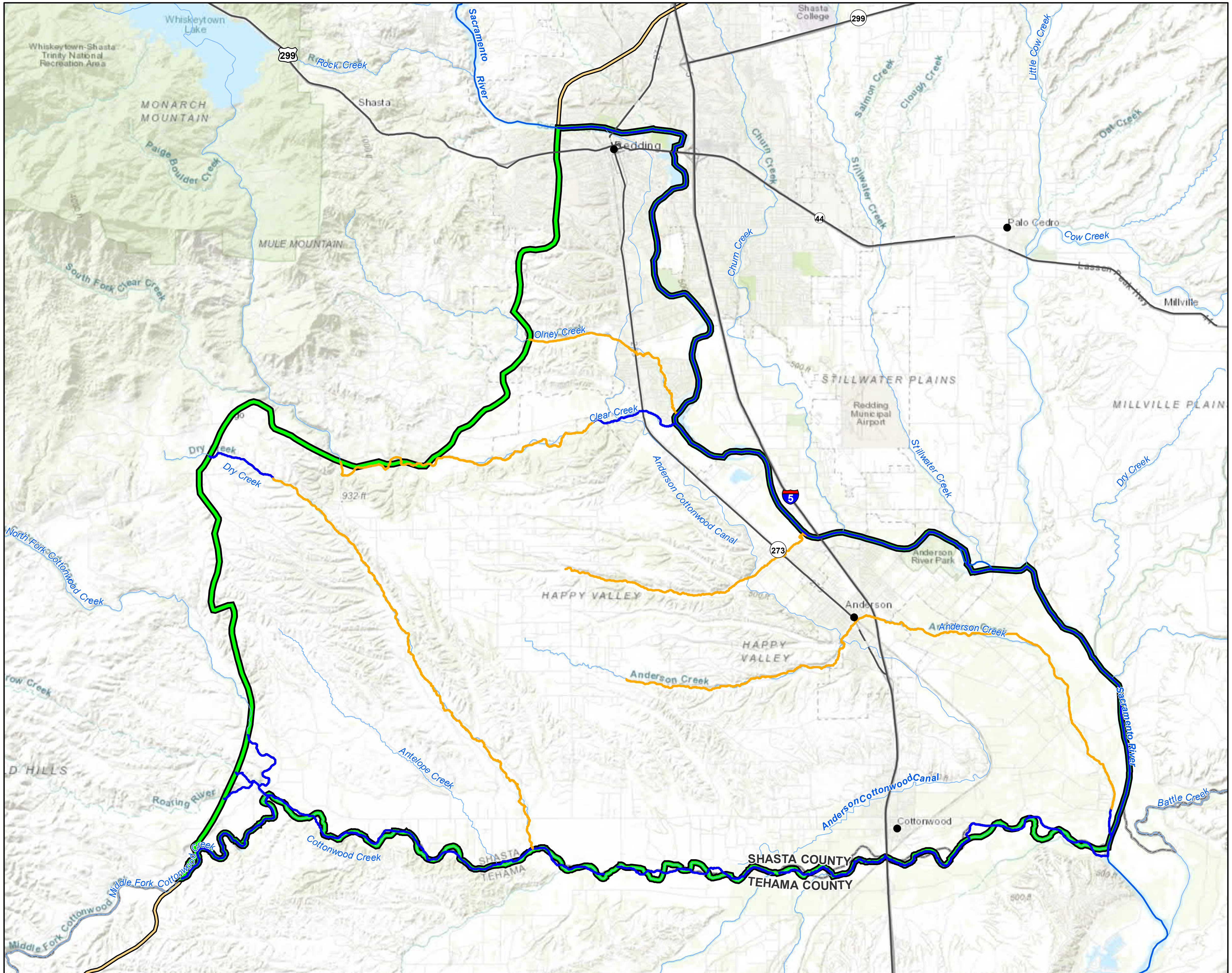
INTERCONNECTED SURFACE WATER

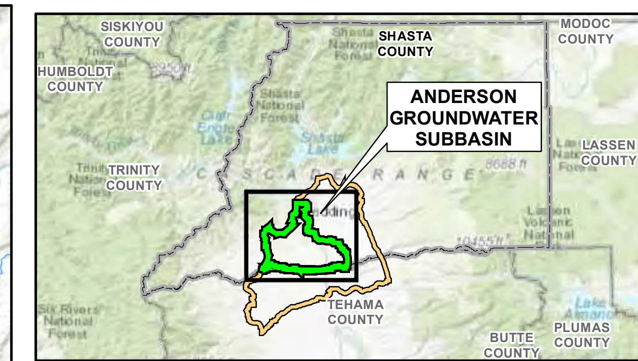


NOT INTERCONNECTED SURFACE WATER

Image Source:
https://groundwaterexchange.org/interconnected-surface-water-depletions/

FIGURE 3-16
EXAMPLES OF INTERCONNECTED AND
NOT INTERCONNECTED SURFACE WATER
Anderson Subbasin Groundwater Sustainability Plan





LEGEND

- CITY
- INTERCONNECTED STREAM REACH
- NOT INTERCONNECTED STREAM REACH
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTE:

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

Miles
0 2 4

FIGURE 3-17
DISTRIBUTION OF INTERCONNECTED SURFACE WATER; AVERAGE SPRING CONDITIONS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

D:\REDDINGCACITYOF\EAGSA\FIGURES\ARCMAP\MAPFILES\AGSP\3.0\FIG03-17_INTERCONNECTEDSW_SPRING.MXD 12/17/2021 12:24:24 PM FELHADID

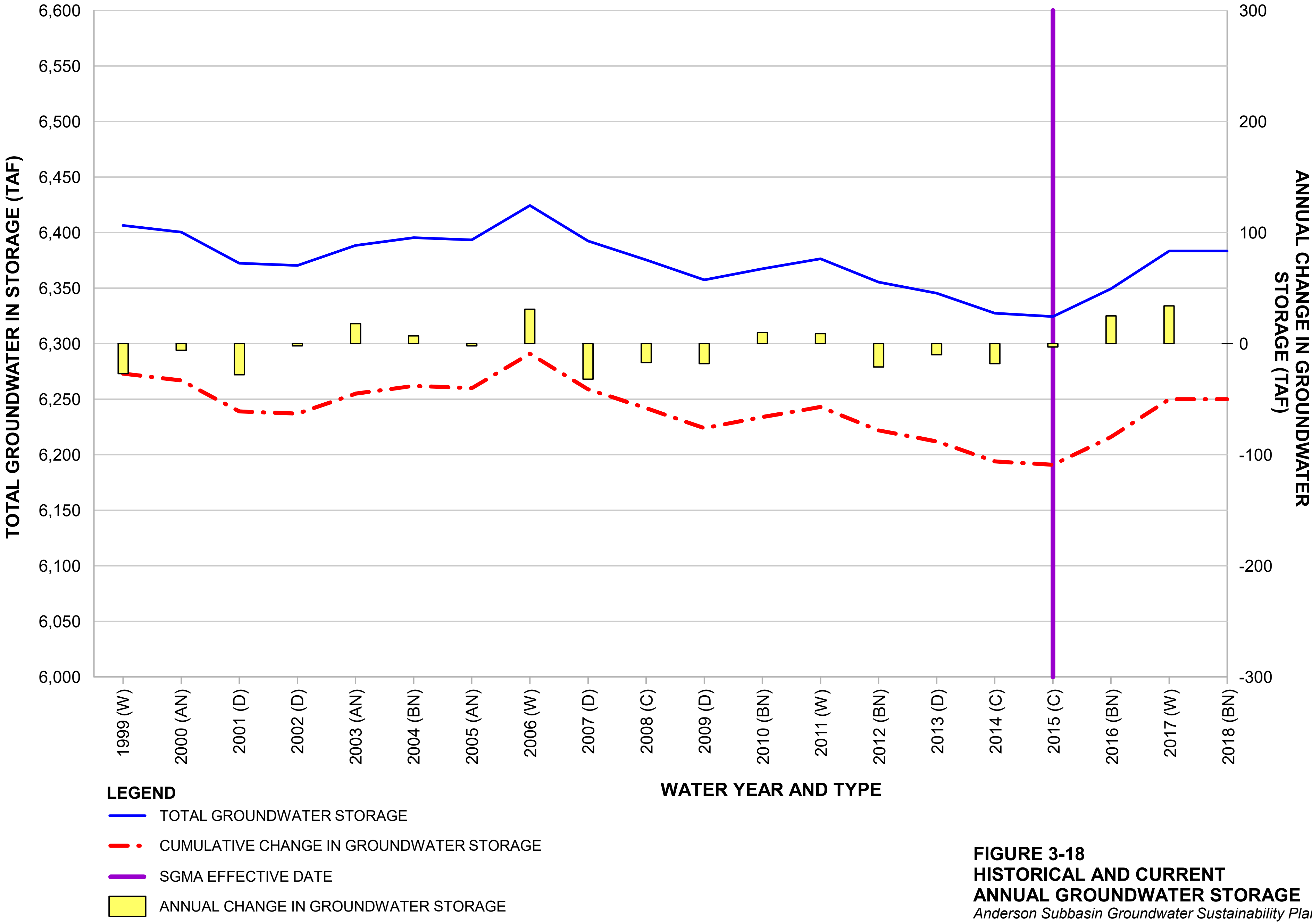
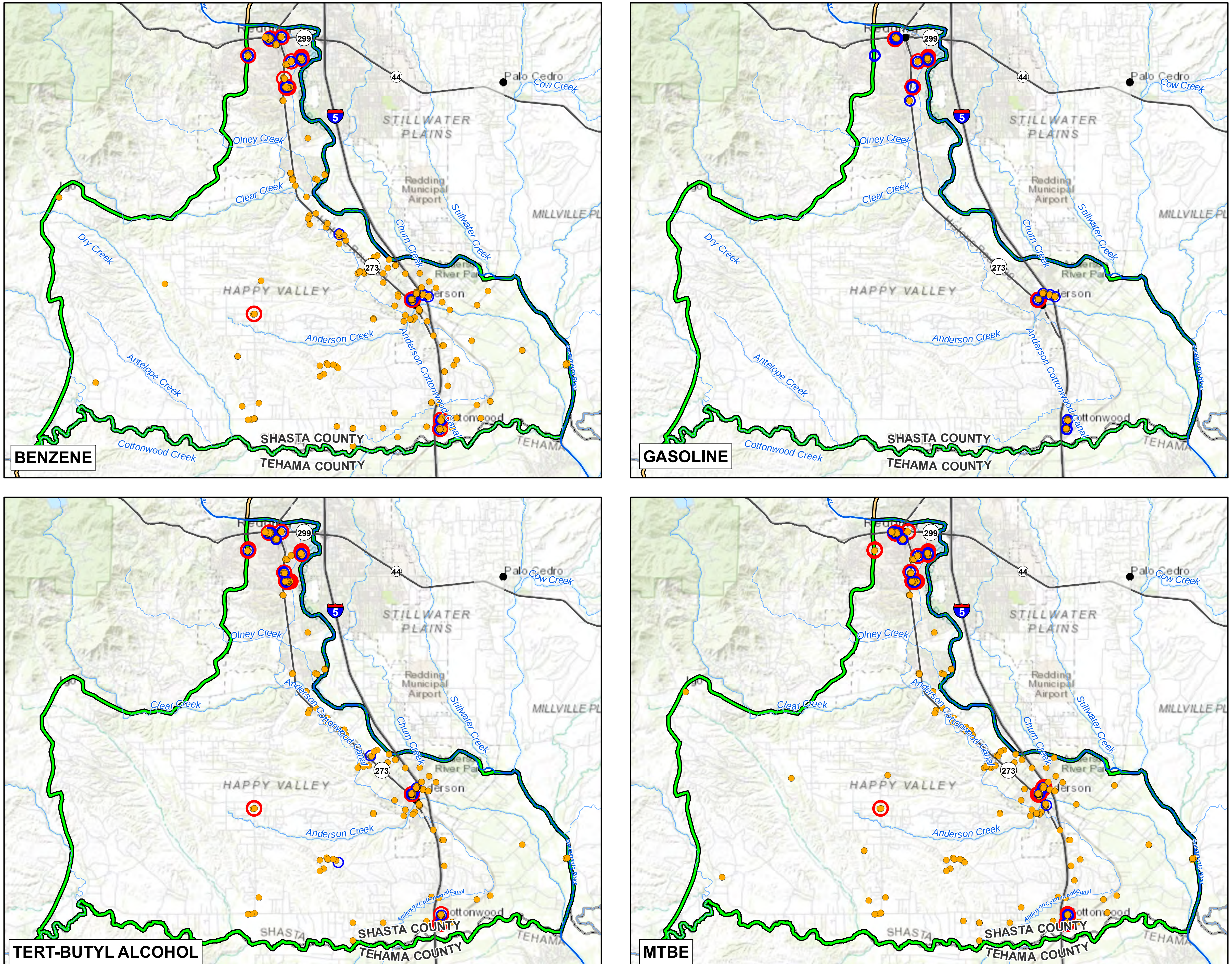
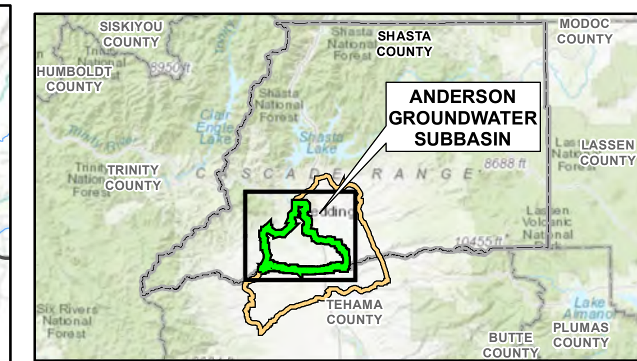


FIGURE 3-18
HISTORICAL AND CURRENT ANNUAL GROUNDWATER STORAGE
Anderson Subbasin Groundwater Sustainability Plan





LEGEND

- SAMPLING LOCATION (NO EXCEEDANCES)
- SAMPLING LOCATION (1 to 5 EXCEEDANCES)
- SAMPLING LOCATION (> 5 EXCEEDANCES)
- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

DATA USED TO ASSESS AREAS OF AFFECTED GROUNDWATER ARE FROM 2000 THROUGH 2019 (SWRCB, 2020b).

BENZENE CalEPA MAXIMUM CONTAMINANT LEVEL = 1 µg/L

GASOLINE US FEDERAL HEALTH ADVISORY LEVEL = 5 µg/L

TERT-BUTYL ALCOHOL FEDERAL NOTIFICATION LEVEL = 12 µg/L

METHYL-TERT-BUTYL ETHER (MTBE) CA EPA MAXIMUM CONTAMINANT LEVEL = 13 µg/L

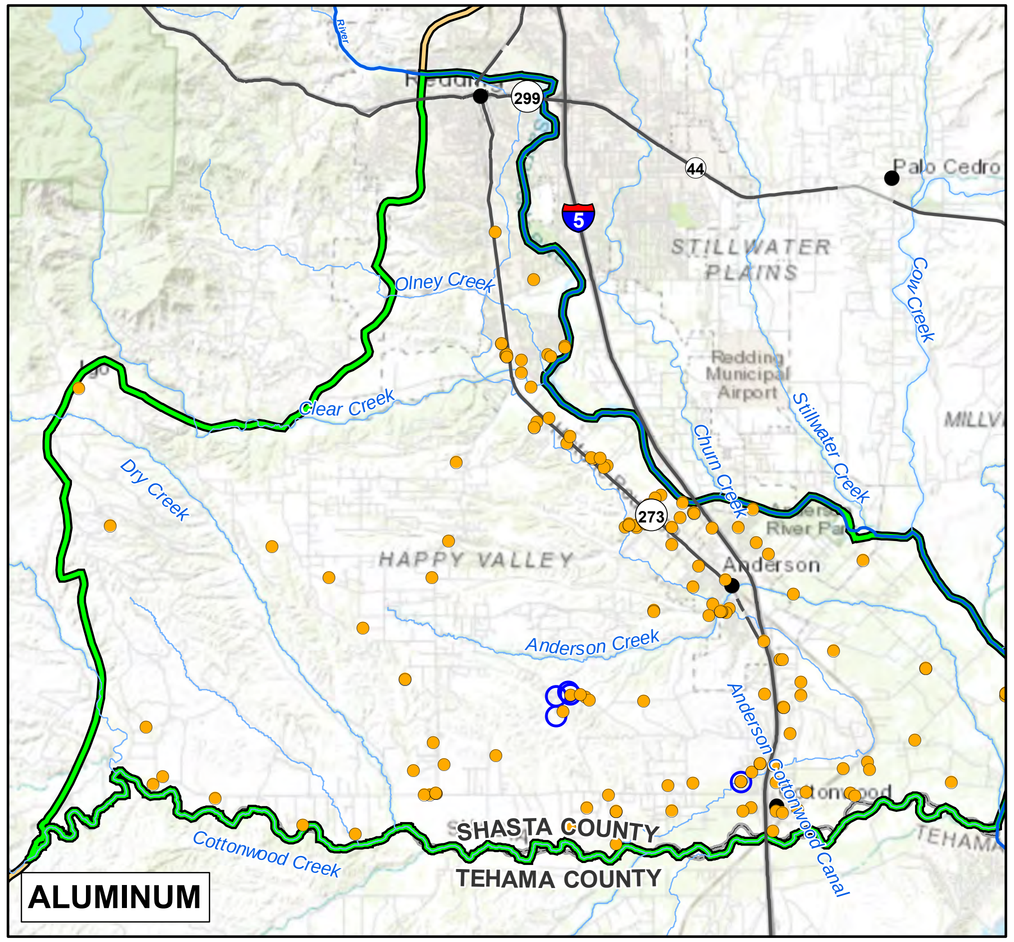
µg/L = MICROGRAMS PER LITER

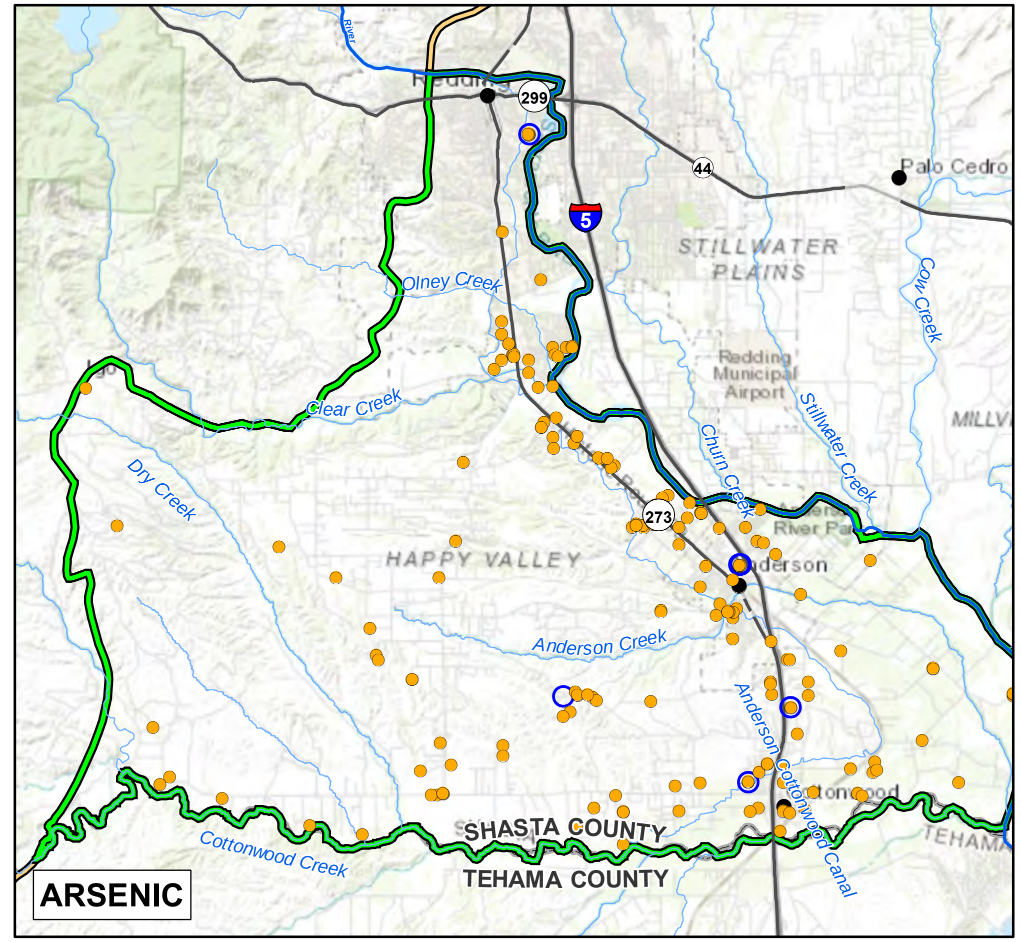
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

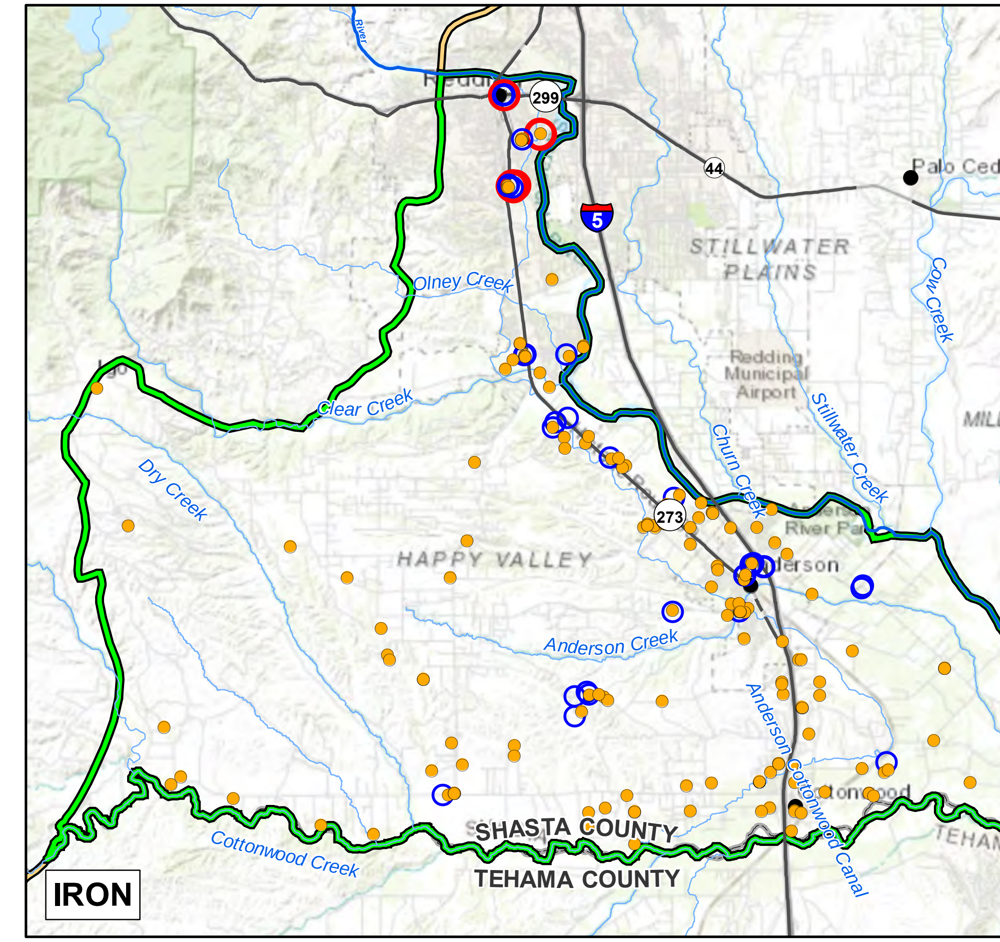
0 3.5 7 Miles

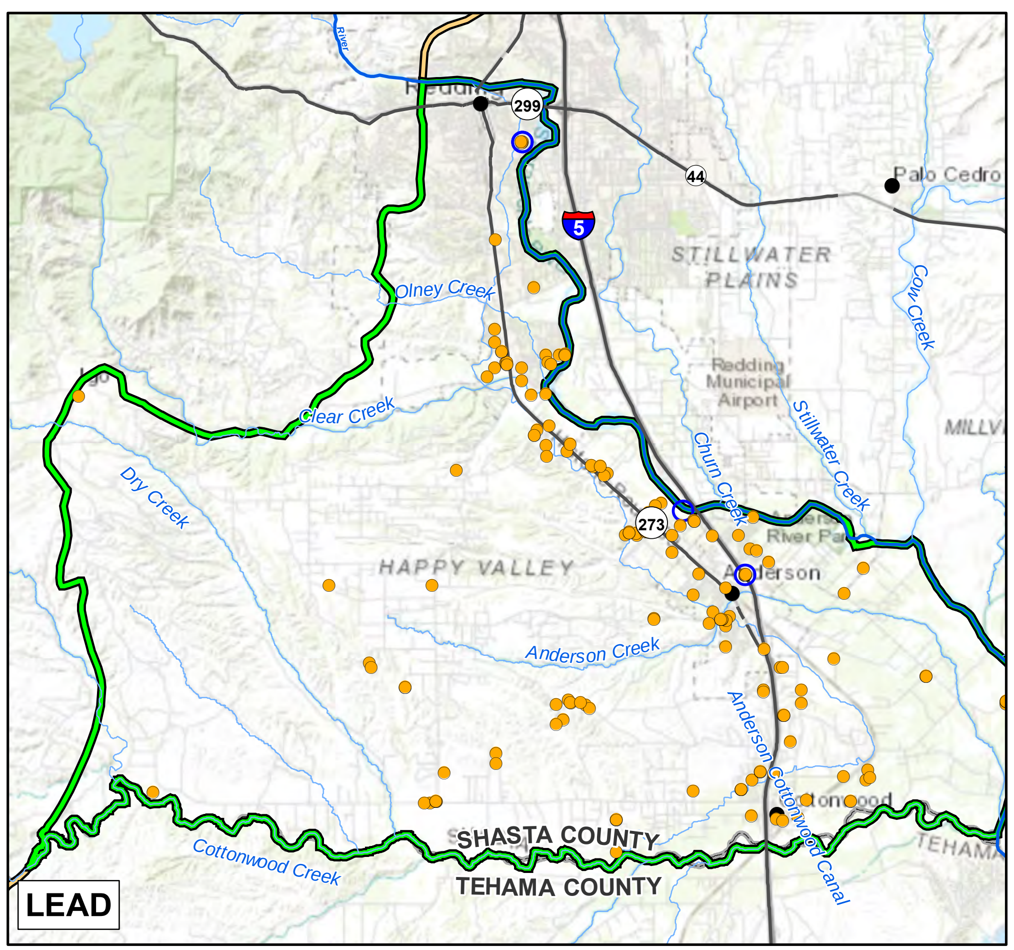
FIGURE 3-19
GROUNDWATER SAMPLING LOCATIONS – ORGANICS
Anderson Subbasin Groundwater Sustainability Plan

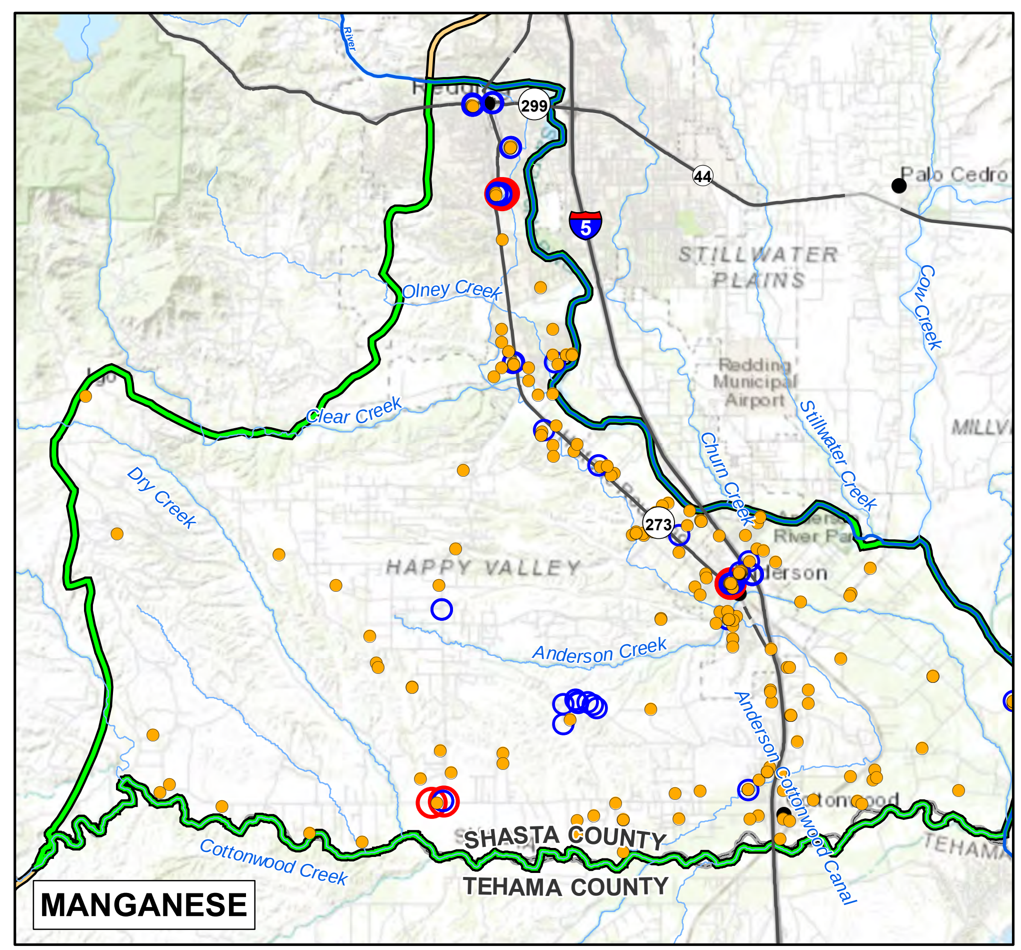
Jacobs











NOTES:

DATA USED TO ASSESS AREAS OF AFFECTED GROUNDWATER ARE FROM 2000 THROUGH 2019 (SWRCB, 2020b).

ALUMINUM CalEPA MCL = 1,000 µg/L

ARSENIC CalEPA MCL = 10 µg/L

IRON SECONDARY MCL = 300 µg/L

LEAD US FEDERAL ACTION LEVEL= 15 µg/L

MANGANESE US HEALTH ADVISORY LEVEL = 50 µg/L

µg/L = MICROGRAMS PER LITER

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

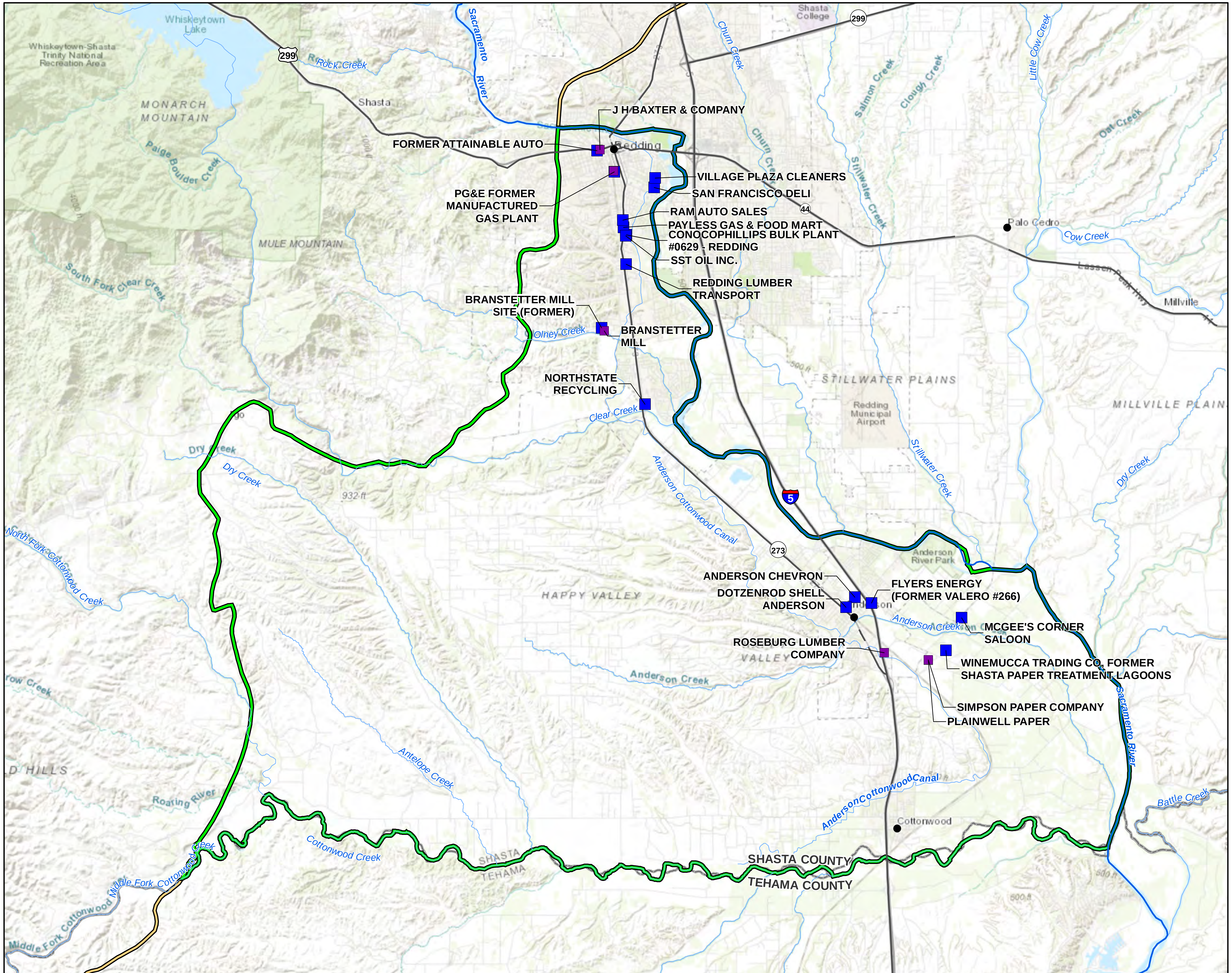
LEGEND

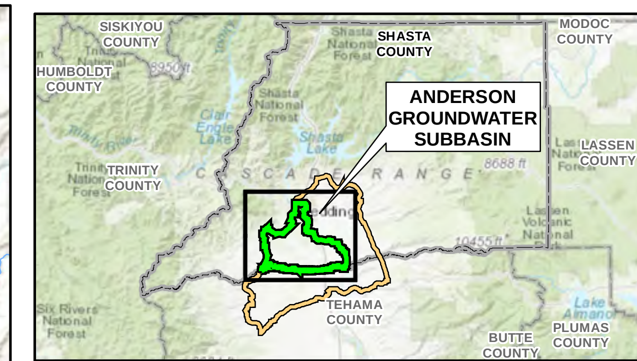
- SAMPLING LOCATION (NO EXEEDANCES)
- SAMPLING LOCATION (1 to 5 EXCEEDANCES)
- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

0 4 8 Miles

FIGURE 3-20
GROUNDWATER SAMPLING LOCATIONS – INORGANICS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs





LEGEND

ACTIVE REMEDIATION SITE

- CALIFORNIA STATE DEPARTMENT OF TOXIC SUBSTANCES CONTROL
- STATE WATER RESOURCES CONTROL BOARD
- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

DATA SOURCES: DTSC, 2020 AND SWRCB, 2020b

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 3-21
ACTIVE REMEDIATION SITES
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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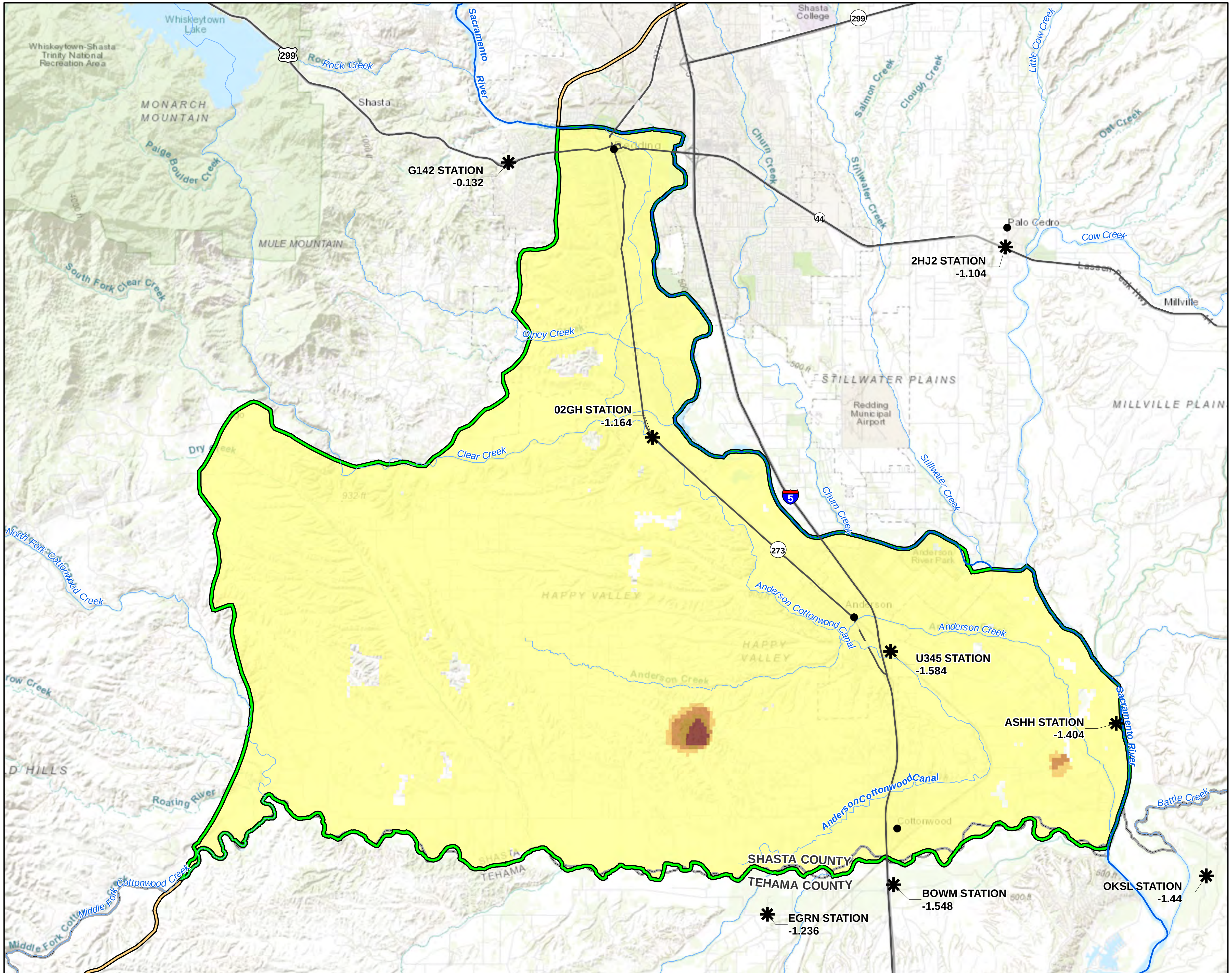

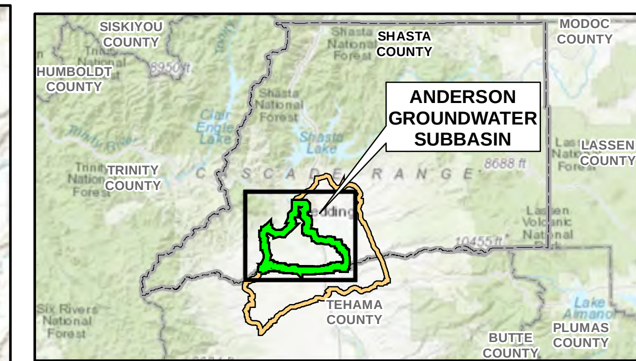

LEGEND

- GPS SURVEY MONUMENT TOTAL VERTICAL DISPLACEMENT (inches) 2008 to 2017
- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBSASIN (5-006.04, PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

INSAR TOTAL VERTICAL DISPLACEMENT (inches)
JUNE 2015 THROUGH OCTOBER 2020

- 0 to -0.71
- -0.71 to -1
- -1 to -1.5
- -1.5 to -2
- -2 to -3

NOTES:

DATA SOURCE: DWR, 2018 and DWR, 2021d

GPS = GLOBAL POSITIONING SYSTEM

INSAR = INTERFEROMETRIC SYNTHETIC APERTURE RADAR

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 3-22
EXISTING SUBSIDENCE MONITORING DATA
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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4. Water Budgets

This section describes the historical, current, and projected water budgets for the Anderson Subbasin. As defined by GSP regulations § 354.18, this section quantifies the following:

- Total surface water entering and leaving the subbasin by water source type
- Inflow to the groundwater system by water source type
- Outflows from the groundwater system by water use sector
- Change in the annual volume of groundwater in storage between seasonal-high conditions
- If overdraft conditions occur, a quantification of overdraft over a period of years during which WY and water supply conditions approximate average conditions
- WYT associated with the annual supply, demand, and change in groundwater stored
- An estimate of sustainable yield for the subbasin

The water budgets described in this section have been developed in accordance with the guidelines provided in DWR's *Water Budget Best Management Practices* (DWR, 2016b) to help quantify the volumetric rate of water entering and leaving the land, surface-water, and groundwater systems of the subbasin. Water enters and leaves the Anderson Subbasin naturally, such as through precipitation and streamflow, and through human activities, such as pumping and groundwater recharge from irrigation.

Separate historical, current, and projected water budgets have been developed for three different subbasin "systems": a land system, a surface-water system, and a groundwater system. Figure 4-1 illustrates how these different systems relate to each other; Table 4-1 lists the water budget components for each of these systems.

- The land system accounts for processes occurring on the land surface and between the land surface and the water table. For example, precipitation falls onto the land surface and is an inflow to the land system water budget. The portion of precipitation that percolates downward through the soil and reaches the water table (i.e., groundwater recharge from precipitation) becomes an outflow from the land system budget and an inflow to the groundwater system budget.
- The surface-water budget accounts for water flowing into and out of streams and canals. For example, precipitation that does not percolate into the soil, flows over the land surface, and enters a stream as runoff, is an outflow from the land system budget and an inflow to the surface-water budget. Water that is pumped from a stream for beneficial uses becomes an outflow from the surface-water system, whereas water that is diverted from a river into a canal remains in the surface-water system, because rivers and canals are both part of the surface-water system.
- The groundwater budget accounts for water flowing into and out of the aquifer beneath the Anderson Subbasin. For example, groundwater that leaves the aquifer as it discharges into a stream (groundwater discharge to streams) is an outflow from the groundwater budget and an inflow to the surface-water budget. When groundwater wells are pumped, they remove groundwater from the aquifer system; therefore, groundwater pumping is an outflow from the groundwater system.

Thus, as shown on Figure 4-1 and in Table 4-1, an outflow from one system can be an inflow to another system.

Table 4-1. Land, Surface-water, and Groundwater Systems Water Budget Components

Land System Inflow Components	Land System Outflow Components
Precipitation	Runoff to Streams/Canals
Applied Water from Purveyor Deliveries (Groundwater and Surface Water)	ET of Precipitation
Applied Groundwater Outside of Purveyor Service Areas	ET of Shallow Groundwater
Shallow Groundwater Uptake	ET of Applied Water
Groundwater Discharge to Land Surface	Groundwater Recharge from Precipitation, Applied Water, and Septic Systems
Surface-water System Inflow Components	**Surface-water System Outflow Components**
Runoff to Streams/Canals	Stream/Canal Outflow to Adjacent Areas
Stream/Canal Inflow from Adjacent Areas	Groundwater Recharge from Streams/Canals
Groundwater Discharge to Streams/Canals	Diversions for Use Inside the Subbasin
WWTP Discharge to Streams	Diversions for Use Outside of the Subbasin
Groundwater System Inflow Components	**Groundwater System Outflow Components**
Groundwater Recharge from Precipitation, Applied Water, and Septic Systems	Shallow Groundwater Uptake (ET of Shallow Groundwater)
Groundwater Recharge from Streams/Canals	Groundwater Discharge to Streams/Canals
Subsurface Inflow from Adjacent Areas	Groundwater Pumping
	Subsurface Outflow to Adjacent Areas
	Groundwater Discharge to Land Surface

Note:

WWTP = wastewater treatment plant

The water budgets discussed in this chapter focus on the full WY.[12] This information can be used to help manage the Anderson Subbasin by revealing the largest and smallest components of the water budget and identifying potential opportunities to maintain or improve water supply conditions. The water budgets for these systems have been estimated with the aid of the EAGSA Model. This model simulates the major hydrologic processes that affect groundwater and surface-water flow in and surrounding the Anderson Subbasin. There is unavoidable uncertainty associated with these water budget estimates; uncertainty is always present to various degrees in water budget calculations. Furthermore, these estimates are subject to change as the understanding of subbasin conditions evolves as monitoring data are collected and analyzed during GSP implementation.

The following subsections provide an overview of the approach and results of the water budget analysis. As will be discussed in this chapter, the Anderson Subbasin has been managed sustainably in the past and is projected to continue to be managed sustainably in the future. Appendix F provides additional details

[12] A water year includes October 1st of one calendar year through September 30th of the following calendar year.

regarding the development of these water budgets as well as the EAGSA Model, which was used to develop these water budgets.

4.1 Approach for Selecting Hydrologic Periods

GSP regulations § 354.18 requires the EAGSA to develop historical, current, and projected water budgets for the Anderson Subbasin. Pursuant to the regulations, the historical water budget must include information from at least the last 10 years. A 20-year period including WYs 1999 through 2018 (i.e., October 1998 through September 2018) was selected for the historical model calibration and water budget period. This period was selected because there was a range in climatic conditions (that is, a variety of wet, above/below normal, dry, and critically dry years) during this time, as well as an adequate amount of land and water use data. The last 4 years of this historical period, including WYs 2015 through 2018, were used to establish an averaging period (that is, the timeframe over which water budget components are averaged) to develop the current water budget. Section 4.2.1 describes modeled climate conditions that occurred during the historical and current periods.

GSP regulations § 354.18 requires projected water budgets to span 50 years from 2022, which is the year by which a GSA of a medium-priority groundwater basin must submit its first GSP to DWR. A 53-year period, including WYs 2019 through 2071, was established to develop projected water budgets for the land, surface-water, and groundwater systems.

GSP regulations § 354.18 requires projected water budgets to incorporate assumptions regarding climate change. However, these regulations do not require any particular climate-change approach, as long as the chosen approach is based on the best available science and is technically defensible. The selected approach involved using precipitation and air temperature projections from a global climate model (GCM) along with a rainfall-runoff model to establish projected precipitation and ET_0 datasets. A rainfall-runoff model estimates how much precipitation falling on watersheds surrounding (outside of) the EAGSA Model domain infiltrates the land surface and how much runs off to streams. This water can then enter the EAGSA Model domain as stream inflow or groundwater inflow from the surrounding watersheds. Available GCMs include projected climate conditions out to the year 2100 under a variety of climatic and greenhouse-gas-emission assumptions made by atmospheric scientists (CCTAG, 2015; Pierce et al., 2018). Section 4.2.2 describes modeled climate conditions for the projection period. EAGSA Model documentation in Appendix F provides additional details regarding the approach for incorporating climate change with model projections used to develop the projected water budget.

4.2 Modeled Climate Conditions

4.2.1 Historical and Current Climate Conditions

Figure 4-2 presents the annual precipitation totals (gray bars) for the subbasin for a 20-year period, including WYs 1999 through 2018. Data sets from the PRISM Climate Group (2020) were used to represent the spatial pattern of precipitation and ET_0 in the RAGB and surrounding vicinity. The annual precipitation data presented on Figure 4-2 represent the spatial averages of precipitation values in the EAGSA Model domain. The mean annual precipitation (MAP) over the 20-year historical period is 37.55 inches (dashed blue line). The MAP of 42.40 inches (dashed black line) over the current period (WYs 2015 through 2018) is about 13 percent higher than the WYs 1999 through 2018 MAP of 37.55 inches. Although WY 2015 represents the end of a multi-year drought, the higher MAP during the current period is the result of wet climatic conditions in WY 2017.

Annual departures from the WYs 1999 through 2018 MAP are displayed as yellow bars on Figure 4-2. The annual departure from the MAP is the difference between the precipitation amount in a given year and the

MAP, and is calculated by subtracting the MAP value of 37.55 inches from each annual precipitation value. Above normal (AN) and wet (W) WYs generally have positive annual departure values above the dashed line (higher than average precipitation), while dry (D) and critically dry (C) years generally have negative annual departure values below the dashed line (lower than average precipitation). The cumulative departure from the WYs 1999 through 2018 MAP is also provided on Figure 4-2 (shown as the black solid line) and is calculated by summing the positive and negative annual departures (i.e., the yellow bars) from WY 1999 forward in time. The cumulative departure from MAP can be used to evaluate longer-term climatic trends. Periods when the cumulative departure is increasing represent wetter conditions, while periods when the cumulative departure is decreasing represent drier conditions. Precipitation data are commonly evaluated in this manner to provide a sense of cumulative effects of precipitation through time. The annual departures and cumulative departure data indicate a reasonable balance of wet, above normal, below normal (BN), dry, and critically dry conditions to help develop the EAGSA Model to simulate conditions during the 20-year historic period.

4.2.2 Projected Climate Conditions

An appropriate GCM was selected and used to develop projected water budgets for the GSP planning period (see Appendix F for additional details). The selected GCM assumes "business as usual" greenhouse-gas emissions and climatic conditions that plot within the range, but on the drier side of four California-specific GCMs identified by Pierce et al. (2018). Figure 4-3 presents the annual precipitation totals for the subbasin for the 53-year projection period, including WYs 2019 through 2071, along with annual and cumulative departures from the MAP of the historical period of WYs 1999 through 2018. Projected precipitation for the selected GCM includes several multi-year droughts, with a prolonged dry period beginning in the early- to mid-2050s through the end of the projection period. More substantial wet years are projected to occur five to six times every 10 to 20 years, according to the selected GCM. The projected precipitation and departure data indicate a variety of wet, normal, and dry conditions that are suitable for aiding the GSP planning process.

4.3 Model Use and Associated Data for Water Budget Development

The EAGSA Model, which was used to estimate the water budgets, was developed in consultation with members of the EAGSA Management Committee. The committee includes representatives from each of the EAGSA member agencies. This committee hosted 13 meetings in 2019 through 2021 during the development of the GSP and EAGSA Model. The meetings provided opportunities for committee members to review and comment on major aspects of model and GSP development.

The EAGSA Model integrates the three-dimensional groundwater and surface-water systems, land surface processes, and operations. The EAGSA Model simulates hydrologic and operational conditions for the 20-year hydrologic period, including WYs 1999 through 2018, as well as potential future conditions for the 53-year hydrologic period, including WYs 2019 through 2071. This projection simulation is referred to as the Future Baseline simulation. This projection simulation assumes a gradual increase in future population in the subbasin. The per capita water demands are assumed to decrease from current water-use rates based on state water conservation targets (refer to Appendix F for more details). The EAGSA Model simulates monthly hydrologic and operational conditions over the 20-year historical period and 53-year projection period.

Development of this model included the integration of information on land use, water infrastructure, hydrogeologic conditions, water demands and supplies, and population. The EAGSA Model was built using information from an existing numerical groundwater flow model (i.e., REDFEM), which was developed as part of previous groundwater planning and management efforts in the RAGB (CH2M HILL, 2011). The EAGSA Model is based on the best available data and information as of January 2021. It is expected that this model will be updated as additional data are collected and analyzed and as knowledge of the HCM evolves during GSP implementation. Future model updates could result in changes to the estimated water budgets described in this section. Additional information on the development and use of the EAGSA Model is included in Appendix F.

4.4 Water Budget Assumptions

This section defines water budget components and the assumptions used during the water budget development.

4.4.1 Historical and Current Water Budget Assumptions

The historical water budget evaluates the availability and reliability of past surface-water supplies and water demands relative to WYT. The 20-year hydrologic period of WYs 1999 through 2018 was selected for developing the historical water budget. This period includes a sequence of representative hydrology while capturing recent subbasin operation conditions. Table 4-2 lists the assumptions for information incorporated into the EAGSA Model for the development of historical and current water budgets.

Table 4-2. Water Budget Assumptions

Water Budget Item	Assumption/Basis for Historical and Current Water Budget	Assumption/Basis for Projected Water Budgets
Hydrologic Period	▪ Historical: WYs 1999 through 2018. ▪ Current: WYs 2015 through 2018. ▪ Monthly time intervals.	▪ WYs 2019 through 2071. ▪ Monthly time intervals.
Precipitation	▪ Precipitation data from the PRISM Climate Group (2020) were used and processed with modeling software (Boyce et al., 2020; Flint et al., 2013) to compute the recharge and runoff of precipitation.	▪ Precipitation data from the selected GCM that incorporates climate change (IPCC, 2013) were used and processed with modeling software (Boyce et al, 2020; Flint et al., 2013) to compute future recharge and runoff of precipitation.
Reference Evapotranspiration[a]	▪ Air temperature data from the PRISM Climate Group (2020) were processed with modeling software (Flint et al., 2013) to compute ET0.	▪ Air temperature projections from the GCM that incorporate climate change (IPCC, 2013) were used and processed with modeling software (Flint et al., 2013) to compute future ET0.
Evapotranspiration	▪ Crop coefficients are based on Cal-SIMETAW (Orang et al., 2013) for land use/cropping distribution multiplied by historical ET0 as computed by the modeling software (Flint et al., 2013).	▪ Crop coefficients are based on Cal-SIMETAW (Orang et al., 2013) for land use/cropping distribution multiplied by projected ET0 as computed by the modeling software (Flint et al., 2013).
Stream Inflows	▪ Sacramento River releases from Keswick Reservoir (KES [DWR, 2019c]). ▪ Clear Creek releases from Clair A. Hill Whiskeytown Dam (WHI [DWR, 2019d]). ▪ Inflows for ungauged streams are based on runoff estimates computed by the modeling software (Flint et al., 2013).	▪ Monthly reservoir releases by WYT based on average historical data. ▪ Runoff projections computed by the modeling software (Flint et al., 2013) are based on the selected GCM (IPCC, 2013).

Table 4-2. Water Budget Assumptions

Water Budget Item	Assumption/Basis for Historical and Current Water Budget	Assumption/Basis for Projected Water Budgets
Land Use/Cropping	▪ 2012 Shasta County DWR land use survey. ▪ 1999 Tehama County DWR land use survey. ▪ 2014 LandIQ data from DWR for irrigated agriculture.	▪ 2012 Shasta County DWR land use survey. ▪ 1999 Tehama County DWR land use survey. ▪ 2014 LandIQ data from DWR for irrigated agriculture.
Purveyor Well Infrastructure, Pumping, Surface-water Diversions, Deliveries, WWTP Discharges	▪ Information provided by purveyors for WYs 1999 through 2018.	▪ Purveyor pumping projected based on future population growth (estimated at an annual rate of 0.6 to 0.7 percent) and target per capita water use from UWMPs (where available). ▪ Surface-water diversions, purveyor deliveries, and WWTP discharges by WYT based on average historical data.
Domestic Water Use (non-purveyor areas)	▪ Per capita water use and census data.	▪ Per capita water use and census data with projected population growth.

[a] The crop associated with the ET_0 is grass.

See Appendix F for more details.

The current water budget evaluates the availability and reliability of more recent surface-water supplies and water demands relative to WYT. The 4-year hydrologic period of WYs 2015 through 2018 was selected for developing the current water budget. This period includes recent hydrology and subbasin operation conditions since 2015, which is the WY coinciding with the January 1, 2015, effective date of GSP regulations. Appendix F contains additional information about the development and use of the EAGSA Model as it relates to historical and current water budgets.

4.4.2 Projected Water Budget Assumptions

The projected water budget forecasts the availability and reliability of recent land use and future population and water use over a 53-year period that includes the effects of climate change. The 53-year hydrologic period of WYs 2019 through 2071 was selected for developing the projected water budget. This period captures recent subbasin operations at current land use conditions with projected population growth and target water use. Within purveyor areas, it was assumed that future indoor and outdoor water uses will equal the per capita target rates listed in UWMPs (where available). For purveyor areas without target per capita water use rates, future water use rates were assumed to be equal to that in purveyor service areas with similar water use characteristics. For non-purveyor areas, outdoor water use is based on crop type (i.e., pasture, orchards, and lawns), and indoor water use is assumed at a rate of 55 gallons per capita per day (based on the provisional standard in California Water Code 10608.20). Table 4-2 lists the assumptions for projected water budget information incorporated into the EAGSA Model. Appendix F contains additional information about the development and use of the EAGSA Model.

4.5 Historical, Current, and Projected Water Budgets

Figures 4-4 through 4-6 present sets of charts showing average annual historical, current, and projected water budgets for the land system, surface-water system, and groundwater system water budget, respectively. Figures 4-7 through 4-9 present charts, one for each component, with the annual time series of the historical, current, and projected water budgets. The colors of the water budget components on Figures 4-4 through 4-9 have been standardized to make comparing water budget components across figures easier. Water budget estimates are described below; these budgets are likely to change in future GSP updates as the understanding of subbasin conditions evolves as more monitoring data are collected during GSP implementation.

4.5.1 Land System Water Budgets

Table 4-3 and Figure 4-4 present averages of the components of the historical, current, and projected land system budgets for the Anderson Subbasin, while Figure 4-7 presents the total of each component of the historical, current, and projected land system budgets for each year. According to the EAGSA Model results (see Appendix F for more details), the subbasin received an average of about 440 TAFY of land system inflows and outflows during the 20-year historical period. The fact that the inflows equal the outflows means that the land system is in balance. During this period, inflows were mostly from precipitation (280 TAFY), followed by applied water (both purveyor and non-purveyor supplied), groundwater discharge to land surface, and shallow groundwater uptake. ACID deliveries in the Anderson Subbasin average approximately 50, 50, and 46 TAF for the historical, current, and projection periods, respectively. Application of this water for irrigation is not only beneficial for sustaining agriculture, but also for providing an additional source of groundwater recharge in the Anderson Subbasin. The largest outflows from the land system were runoff to streams (168 TAFY) followed by ET of precipitation and groundwater recharge from precipitation, applied water, and septic systems (which were roughly equal), followed by ET of applied water and ET of shallow groundwater.

Table 4-3. Average Annual Land System Water Budgets

Land System Budget Component	Historical Average Water Volume (TAF) WYs 1999–2018	Current Average Water Volume (TAF) WYs 2015–2018	Projected Average Water Volume (TAF) WYs 2019–2071
Inflows			
Precipitation	280	321	276
Applied Water from Purveyor Deliveries (Groundwater and Surface Water)[a]	57	56	51
Applied Groundwater Outside of Purveyor Service Areas	16	16	14
Shallow Groundwater Uptake	3	3	3
Groundwater Discharge to Land Surface	84	91	79
Total Inflow	**440**	**487**	**423**

Table 4-3. Average Annual Land System Water Budgets

Land System Budget Component	Historical Average Water Volume (TAF) WYs 1999–2018	Current Average Water Volume (TAF) WYs 2015–2018	Projected Average Water Volume (TAF) WYs 2019–2071
Outflows			
Runoff to Streams/Canals	167	193	172
ET of Precipitation	117	120	94
Non-native Vegetation	50	52	40
Native Vegetation	67	69	53
ET of Shallow Groundwater	3	3	3
Non-native Vegetation	2	2	2
Native Vegetation	1	1	1
ET of Applied Water	40	40	36
Groundwater Recharge from Precipitation, Applied Water, and Septic Systems	111	131	119
Total Outflow	**438**	**487**	**424**

[a] ACID deliveries in the Anderson Subbasin average approximately 50 TAF for the historical and current periods, and,46 TAF for the projection period.

The relative order (largest to smallest volumes) of the land system water budget components is similar between the 20-year historical and the 4-year current averaging periods. However, the total inflows and outflows under current conditions (approximately 480 TAF) are about 10 percent higher than the total inflows and outflows under historical conditions (approximately 440 TAF). The larger amount of water moving through the land system is largely driven by the higher magnitude of precipitation in WY 2017, which was designated as a wet WYT.

As previously discussed, the Future Baseline simulation assumes a gradual increase in future population in the subbasin, and per capita water use rates are assumed to decrease based on state water conservation targets. As such, the land system water budget for the projected period is smaller in magnitude compared to the historical (4 percent) and current (14 percent) land system estimates.

As discussed above, the total land system budget inflows generally equal the land system budget outflows for the historical, current, and projection periods. This means that the land system water budget is in balance.

4.5.2 Surface-water System Water Budgets

Table 4-4 and Figure 4-5 present averages of the individual components of the historical, current, and projected surface-water system budgets for the Anderson Subbasin, whereas Figure 4-8 presents the total of each subbasin component of the historical, current, and projected surface-water system budgets for each year. As discussed in Chapter 2, water source types in the Anderson Subbasin come from a combination of CVP (that is, releases from Keswick and Clair A. Hill Whiskeytown Dams) and local supplies (that is, smaller tributaries). According to the EAGSA Model (see Appendix F for more details), the subbasin received an average of about 8,500 TAFY of surface-water inflows during the 20-year historical period. During this period, stream inflow from adjacent areas (8,100 TAFY) was the largest surface-water inflow component, followed by groundwater discharge to streams (stream gains), runoff to streams, and WWTP discharge to streams. Outflow from the surface-water system also averaged approximately 8,500 TAFY during the historical period. The fact that the inflows equal the outflows means that the surface-water system water budget is in balance. The largest outflows from the system were stream outflow to adjacent areas (8,200 TAFY), followed by groundwater recharge from streams (stream leakage), and surface-water diversions.

Table 4-4. Average Annual Surface-water System Water Budgets

Surface-water System Budget Component	Historical Average Water Volume (TAF) WYs 1999–2018	Current Average Water Volume (TAF) WYs 2015–2018	Projected Average Water Volume (TAF) WYs 2019–2071
Inflows			
Stream/Canal Inflow from Adjacent Areas	8,097	8,229	8,182
Groundwater Discharge to Streams/Canals	221	232	231
Runoff to Streams/Canals	167	193	175
WWTP Discharge to Streams	14	14	14
Total Inflow	**8,499**	**8,668**	**8,602**
Outflows			
Stream/Canal Outflow to Adjacent Areas[a]	8,165	8,326	8,271
Groundwater Recharge from Streams/Canals[b]	244	252	242
Diversions for use Inside the Anderson Subbasin	88	79	86
Diversions to Areas Outside the Anderson Subbasin[c]	42	32	40
Total Outflow	**8,539**	**8,690**	**8,634**

[a] Includes approximately 2 to 4 TAF of exports during ACID water transfer years.

[b] Leakage from the ACID main canal contributes approximately 20 to 43 TAF of groundwater recharge to the aquifer system under historical and projected conditions.

[c] Average annual diversion values represent the volume of water removed from streams for uses outside of the Anderson Subbasin. The 2010–2019 ACID Churn Creek diversion from the Sacramento River averaged 14.5 TAFY (SWRCB, 2021). Additional details regarding the EAGSA Model are included in Appendix F.

Because the Sacramento River forms the boundary between the Enterprise and Anderson Subbasins, the diversion volumes presented in Table 4-4 and Figures 4-5 and 4-8 represent water that is diverted by users in both subbasins. Surface water diverted by purveyors such as COR and BVWD exits the surface-water system and is conveyed through pipelines (largely within the Enterprise Subbasin). These diversion rates are included in Table 4-4 as diversions to areas outside the Anderson Subbasin. Surface water diverted by ACID is conveyed through open canals and laterals, with approximately 85 percent of the water diverted for use in the Anderson Subbasin and 15 percent diverted for use in the Enterprise Subbasin. Because ACID's main canal is simulated as a stream in the EAGSA Model, the water diverted from the Sacramento River into the ACID main canal remains part of the surface-water system in the Anderson Subbasin. Thus, although the ACID Sacramento River diversion at Caldwell Park in Redding is incorporated into the model, ACID's diversion rates for out-of-basin use included in Table 4-4 represent the modeled volume of water delivered to customers in the Enterprise Subbasin (that is, surface water that is diverted from the Sacramento River that is no longer available for use in the Anderson Subbasin). The diversion rates listed in Table 4-4 for use in the Anderson Subbasin represent deliveries from the ACID main canal to farms in the subbasin.

Model projections for the current period (WYs 2015 through 2018) indicate slightly larger average stream inflows and outflows than the historical period (approximately 2 percent), while water budget estimates for the projected period (WYs 2019 through 2071) indicate slightly lower inflows and outflows (approximately 1 percent). The total surface-water system inflows generally equal the surface-water system outflows for the historical, current, and projection periods. This means that the surface-water system is in balance.

4.5.3 Groundwater System Budgets

Table 4-5 and Figure 4-6 present averages of the individual components of the historical, current, and projected groundwater system budgets for the Anderson Subbasin, whereas Figure 4-9 presents the total of each subbasin component of the historical, current, and projected groundwater system budgets for each year. According to the EAGSA Model (see Appendix F for more details), the subbasin received an average of about 490 TAFY of groundwater inflows during the 20-year historical period. These inflows consist primarily of groundwater recharge from streams and canals (stream leakage) (248 TAFY), followed by subsurface inflow from adjacent areas, and groundwater recharge from precipitation, applied water, and septic systems. Leakage from the ACID main canal contributes approximately 20 to 45 TAF of groundwater recharge to the aquifer system in the Anderson Subbasin. During this same period the total outflow from the groundwater was approximately equal to the inflow. The fact that the inflows equal the outflows means that the groundwater system is in balance. The largest outflow from the groundwater system was groundwater discharge to streams (stream gains) (225 TAFY), followed by subsurface outflow to adjacent areas, groundwater pumping, groundwater discharge to land surface, and ET of shallow groundwater.

Table 4-5. Average Annual Groundwater System Water Budgets

Groundwater System Budget Component	Historical Average Water Volume (TAF) WYs 1999–2018	Current Average Water Volume (TAF) WYs 2015–2018	Projected Average Water Volume (TAF) WYs 2019–2071
Inflows			
Groundwater Recharge from Precipitation, Applied Water, and Septic Systems	111	131	119
Groundwater Recharge from Streams/Canals[a]	247	252	242
Subsurface Inflow from Adjacent Areas	128	130	127
Total Inflow	**486**	**513**	**488**

Table 4-5. Average Annual Groundwater System Water Budgets

Groundwater System Budget Component	Historical Average Water Volume (TAF) WYs 1999–2018	Current Average Water Volume (TAF) WYs 2015–2018	Projected Average Water Volume (TAF) WYs 2019–2071
Outflows			
Shallow Groundwater Uptake (ET of Shallow Groundwater)	3	3	3
Groundwater Discharge to Streams/Canals	225	228	229
Groundwater Pumping	20	21	23
Municipal Groundwater Pumping	4	5	9
Private Agricultural Groundwater Pumping	14	14	12
Private Residential Groundwater Pumping	2	2	2
Subsurface Outflow to Adjacent Areas	156	155	155
Groundwater Discharge to Land Surface	84	91	79
Total Outflow	**488**	**498**	**489**
Average of Total Inflows and Outflows	487	506	489
Change in Groundwater Storage	-2	15	-1
Change in Groundwater Storage as a Percent of the Average of Total Inflows and Outflows	-0.41%	2.97%	-0.20%

[a] Leakage from the ACID main canal contributes approximately 20 to 43 TAFY of groundwater recharge to the aquifer system in the Anderson Subbasin under historical and projected conditions.

The total inflows and outflow to the groundwater system under current conditions are slightly higher (2 to 4 percent) than historical conditions with similar order of largest to smallest water budget component volumes. Increased inflows to the groundwater system under current conditions primarily result from the approximate 15 percent higher groundwater recharge from precipitation, applied water, and septic systems. Increases in total outflows from the groundwater system during the current period is mostly due to increased groundwater discharge to land surface.

As is discussed further in Appendix F, the Future Baseline simulation conservatively assumes that additional future water demand due to population growth will be met by increased groundwater pumping; however, the per capita water use is assumed to be reduced in the future to meet state conservation water use targets. As such, the overall projected groundwater system budget is similar to historical conditions (that is, rates of inflows to and outflows from the groundwater system in the future are projected to be similar to past rates of groundwater inflows and outflows).

The average change in groundwater in storage in the Anderson Subbasin is computed by subtracting the average total outflows from the groundwater system from the average total inflows to the groundwater system. The historical, current, and projected groundwater system budgets indicate an average change in groundwater storage ranging from a decrease of 2 TAFY under historical conditions and an increase of 1 TAFY under Future Baseline conditions up to an increase of 10 TAFY under current conditions (Table 4-5). The increase in groundwater storage under current conditions results primarily from increased groundwater recharge from precipitation, applied water, and septic systems (likely a result of wet climatic conditions in WY 2017) and only slight increase in the groundwater outflow components. Because of the modest projected future population growth in the Anderson Subbasin (as compared to the Enterprise Subbasin), groundwater pumping is projected to increase by only 1 to 2 TAFY to meet future water demands in the Future Baseline simulation. EAGSA Model results indicate that this will not create overdraft conditions, given the average decrease in groundwater storage of only 1 TAFY. The total groundwater system inflows generally equal or are larger than the groundwater system outflows for the historical, current, and projection periods. This means that the groundwater system has been and is projected to continue to be managed sustainably.

4.6 Water Supply and Demand

Table 4-6 summarizes the annual average supply and demand by WYT in the Anderson Subbasin for the historical, current, and projected water budgets. Total supply is equal to the total surface water diverted for in-basin use (excluding conveyance losses) and groundwater pumped within the subbasin. Because water purveyors in the Anderson Subbasin only divert surface water or pump groundwater in response to a demand (that is, an indoor or outdoor water need), the total demands listed in Table 4-6 are equal to the total supply. The data listed in Table 4-6 indicate that total water supplies have been, and will continue to be, sufficient to meet total water demands in the subbasin.

Table 4-6. Average Annual Supply and Demand by Water Year Type

Water Budget Component	Wet (TAF)	Above Normal (TAF)	Below Normal (TAF)	Dry (TAF)	Critically Dry (TAF)
Historical Period (WYs 1999–2018)					
Annual Groundwater Supply	17	20	18	20	22
COR	*2*	*2*	*2*	*2*	*2*
ACID	*0*	*0*	*0*	*0.5*	*2*
COA	*2*	*2*	*2*	*3*	*2*
Cottonwood Water District	*1*	*1*	*1*	*1*	*1*
CCCSD	*0*	*0*	*0*	*0*	*0*
Private	*12*	*15*	*13*	*14*	*15*
Annual Surface-water Supply	68	77	71	88	67
COR	*4*	*5*	*4*	*5*	*4*
ACID	*59*	*66*	*63*	*77*	*59*
CCCSD	*5*	*6*	*4*	*6*	*4*
Annual Total Supply	85	97	89	108	89
Annual Total Demand	85	97	89	108	89
Change in Stored Groundwater	12	3	4	-18	-13

Table 4-6. Average Annual Supply and Demand by Water Year Type

Water Budget Component	Wet (TAF)	Above Normal (TAF)	Below Normal (TAF)	Dry (TAF)	Critically Dry (TAF)
Current Period (WYs 2015–2018)					
Annual Groundwater Supply	20	NA	20	NA	23
COR	2	NA	2	NA	2
ACID	*0*	*NA*	*0*	*NA*	*4*
COA	*2*	*NA*	*2*	*NA*	*2*
Cottonwood Water District	*2*	*NA*	*2*	*NA*	*1*
CCCSD	*0*	*NA*	*0*	*NA*	*0*
Private	14	NA	14	NA	14
Annual Surface-water Supply	59	NA	68	NA	55
COR	4	NA	4	NA	3
ACID	*52*	*NA*	*61*	*NA*	*51*
CCCSD	*3*	*NA*	*3*	*NA*	*1*
Annual Total Supply	79	NA	88	NA	78
Annual Total Demand	79	NA	88	NA	78
Change in Stored Groundwater	34	NA	13	NA	-3
Projected Period (WYs 2019–2071)					
Annual Groundwater Supply	22	22	22	24	26
COR	*3*	*3*	*3*	*3*	*3*
ACID	*0*	*0*	*0*	*2*	*4*
COA	*3*	*3*	*3*	*3*	*3*
Cottonwood Water District	*3*	*3*	*3*	*3*	*3*
CCCSD	*1*	*1*	*1*	*1*	*1*
Private	*12*	*12*	*12*	*12*	*12*
Annual Surface-water Supply	66	73	69	83	62
COR	*3*	*4*	*4*	*4*	*3*
ACID	*59*	*65*	*61*	*75*	*55*
CCCSD	*4*	*4*	*4*	*4*	*4*
Annual Total Supply	88	95	91	107	88
Annual Total Demand	88	95	91	107	88
Change in Stored Groundwater	23	10	-7	-8	-19

Notes:

NA = not applicable because no above normal or dry year occurred during the current period

Total Subbasin Groundwater Supply = Sum of purveyor and private groundwater supply.

- City of Redding Groundwater Supply: Approximately 25 percent of total COR groundwater supply is assumed to serve Anderson Subbasin.
- ACID, COA, Cottonwood Water District, CCCSD Groundwater Supply = Total groundwater pumping reported by each respective purveyor.

Table 4-6. Average Annual Supply and Demand by Water Year Type

Water Budget Component	Wet (TAF)	Above Normal (TAF)	Below Normal (TAF)	Dry (TAF)	Critically Dry (TAF)

- Private Groundwater Supply = EAGSA Model estimate of private groundwater pumping in the Anderson Subbasin.

Total Subbasin Surface-water Supply = Sum of COR, ACID, and CCCSD surface-water diversions.

- City of Redding Surface-water Supply: Approximately 25 percent of total COR Sacramento River and Whiskeytown diversions is assumed to serve Anderson Subbasin.
- ACID Surface-water Supply = Total ACID Sacramento River diversion at Caldwell Park (estimated to be 85 percent of the total ACID diversion on average [SWRCB, 2021]) minus the simulated 34 to 40 TAFY of ACID main canal leakage.
- CCCSD Surface-water Supply = Total CCCSD Whiskeytown diversions minus the Centerville CSD Whiskeytown allocation.

Total Subbasin Supply = Sum of total groundwater and surface-water supply.

Total Subbasin Demand = Total groundwater pumping and surface-water supply (i.e., diversions) to reflect total indoor and outdoor water use demands and associated conveyance losses.

Change in Stored Groundwater = Total inflows minus total outflows from the EAGSA Model groundwater system budget.

As discussed in Chapter 2, major purveyors in the subbasin rely on surface water, groundwater, or a combination to meet water demands. Although portions of Igo-Ono CSD and Centerville CSD overlie the Anderson Subbasin (Figure 2-5), these areas represent small fractions of their respective service areas; therefore, the water supplies and demands associated with these two CSDs in the subbasin are considered negligible. ACID and CCCSD rely primarily on surface-water supplies, COA and Cottonwood Water District rely solely on groundwater, and COR uses a combination of surface water and groundwater. COR diverts CVP water under two separate contracts with Reclamation. The larger contract (up to 21 TAFY) represents a senior water right (pre-1914). During April through October of critically dry years, this contract may be reduced by up to 25 percent of the volume that COR diverted during the previous 3 non-critical WYs (COR, 2015). The smaller contract (up to 6,140 AF/year) represents a more junior water right. During critically dry or less severe WYs, this contract may be reduced by up to 75 percent of the volume that COR diverted during the previous 3 non-constrained (that is, full allocation) WYs. ACID diverts CVP water from the Sacramento River under a contract with Reclamation of up to 125 TAFY (121 TAFY of base supply and 4 TAFY of project supply). Similar to COR, ACID's April through October water rights are subject to reduction of up to 25 percent during critically dry years (based on diversions during the 3 previous non-critical WYs). CCCSD diverts up to 15,300 AF/year of CVP water at Clair A. Hill Whiskeytown Dam under a contract with Reclamation. Because CCCSD holds a more junior water right, the district is subject to the Reclamation water shortage policy and may experience reductions to a public health and safety volume during drought years (CCCSD, 2015; Reclamation, 2017). Although there is a measure of uncertainty with respect to the reliability of surface-water supplies for the more junior contracts, purveyors have the ability to meet water demand through groundwater pumping, intrabasin water transfers, and conservation measures.

As shown in Table 4-6, surface water made up approximately 70 to 80 percent of the total water supplies in the subbasin during the historical period, with increased demand on groundwater resources (up to nearly 30 percent of total water supplies) under critically dry WYs due to less precipitation and reduced surface-water supplies during these WYTs. Annual total water demands among the WYTs varied by less than 30 percent, which is to be expected given that population growth has been modest, and there have not been substantial changes in land use during this period. Changes in groundwater storage listed in Table 4-6 are estimated from the EAGSA Model based on the difference between average simulated inflows to and outflows from the groundwater system for the different WYTs. Because change in storage is related to the groundwater system budget, a positive or negative value does not necessarily mean that there was a surplus or deficit in total supplies (that is, change in storage is not directly related to total water supply or demand). Changes in groundwater storage vary between WYTs with increases in groundwater storage during wet, above normal, and below normal years and decreases in groundwater storage during dry and critically dry years. Water supplies met water demands during the historical period.

Observations of the current supply and demand are similar to those of the 20-year historical period, except that neither an above normal nor dry WY occurred in WYs 2015 through 2018 (Table 4-6). Additionally, surface-water supplies were reduced under recent critically dry WYs, creating a smaller difference between surface and groundwater supplies in the subbasin during the 2015 critically dry year. Despite the surface-water reductions during the current period, purveyors in the subbasin were able to compensate for the reduced surface-water allocations through increased groundwater pumping. As discussed in Section 4.7, this magnitude of groundwater pumping was less than the sustainable yield of the subbasin. Water supplies met water demands during the current period.

As previously discussed, the Future Baseline simulation assumes that water purveyors will have similar access to surface water in the future as under historical and current conditions (that is, the reliability of surface-water supplies in the future is assumed to be the same as in the past, on average); therefore, increased water demand due to population growth in the subbasin will be met by increased groundwater pumping. Because the projected per capita water use is assumed to be reduced in the future to meet state conservation water use targets, the overall projected groundwater pumping is similar in annual volume to the historical and current periods. As such, the projected supply and demand are similar to those of the historical and current periods, with surface water comprising approximately 70 to 80 percent and groundwater comprising 20 to 30 percent of total supplies (Table 4-6). Changes in groundwater storage vary between WYTs with increases in groundwater storage during wet and above normal years and decreases in groundwater storage during below normal, dry, and critically dry years. Water supplies are projected to meet future water demands.

4.7 Estimate of Sustainable Yield

Sustainable yield is defined in SGMA as follows:

> *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.*

Based on the locally defined SMCs (discussed in detail in Chapter 6), the Anderson Subbasin has been and is currently operating within its sustainable yield. That is, the historical and current levels of groundwater pumping within the subbasin have not produced undesirable results (the local definitions of undesirable results are discussed further in Chapter 6). Figure 4-10 presents plots illustrating the estimated total groundwater in storage within the subbasin (solid blue lines), the annual change in groundwater storage (yellow bars), and the cumulative change in groundwater storage (dashed red lines) over the historical, current, and projected periods (top chart). Groundwater pumping associated with these groundwater storage estimates range from an average of 20 TAFY during the historical period (based on the historical version of the EAGSA Model) to an average of 22 TAFY during the projected period (based on the Future Baseline simulation) (Table 4-5). The groundwater storage plots presented on Figure 4-10 show that groundwater in storage varies year to year, decreasing during drier periods and increasing during wetter periods. Overall, the annual change in groundwater storage is balanced through about 2050 (that is, there is a roughly equal distribution of positive and negative annual changes in groundwater storage). After approximately 2050, the selected GCM includes a nearly 20-year drought, during which the groundwater outflows in the Future Baseline simulation exceed the groundwater inflows, resulting in a downward trend in the total groundwater storage. Having groundwater outflows exceed groundwater inflows during droughts is normal and not itself an indicator of overdraft conditions. Regardless, the amount of groundwater in storage at the end of WY 2071 is nearly the same as the groundwater storage at the beginning of the projection period starting in WY 2019. As such, groundwater pumping at these levels, according to the EAGSA Model and the definitions of SMCs discussed in Chapter 6, will not produce undesirable results.

Because the historical, current, and Future Baseline projections indicate that undesirable results will not occur, an additional projection simulation was performed to help inform selection of SMCs and aid in estimating a sustainable yield for the subbasin. This simulation, discussed further in Appendix F, is referred to as the Increased Groundwater Use Scenario. This scenario involved increasing the outdoor water demand in irrigated parcels by roughly two-fold, which would increase future water demands beyond what has been estimated by local water purveyors. Similar to the Future Baseline simulation, the Increased Groundwater Use Scenario conservatively assumed that increased future water demand would be met through increased groundwater pumping in the subbasin. This involved expanding both the "footprints" of wellfields and magnitude of pumping within purveyor service areas and increasing the magnitude of pumping outside of purveyor service areas. The average projected pumping in the Anderson Subbasin under the Increased Groundwater Use Scenario is 89 TAFY. Figure 4-10 presents the results from this projection scenario (bottom chart). Although the estimated volume of groundwater in storage is lower than the Future Baseline simulation, the annual change in storage pattern is similar. That is, groundwater storage decreases during drier periods but recovers during wetter periods. Although the cumulative change in storage declines beginning in the mid-century, there is still annual recovery during some years. As will be discussed further in Chapter 6, these future conditions are unlikely to create undesirable results. As such, the sustainable yield for the Anderson Subbasin is estimated to be at least 89 TAFY, which represents the long-term average groundwater pumping under the Increased Groundwater Use Scenario.

As defined above, the sustainable yield of the subbasin is the long-term level of groundwater pumping that can be removed from the aquifer system without causing undesirable results. Groundwater levels, groundwater pumping, and total water supplies will be reported, and SMCs will be evaluated to assess whether undesirable results are present (or may be present in the future given observed trends) as part of SGMA annual reporting and 5-year GSP assessments. As such, the estimate of sustainable yield for the Anderson Subbasin will be further evaluated and refined during GSP implementation. The Anderson Subbasin has historically been operating within its sustainable yield. According to the EAGSA Model and the definitions of undesirable results discussed in Chapter 6, if future groundwater pumping locations are similar to past pumping locations, pumping rates could quadruple, and the subbasin would still potentially remain sustainable. This finding will be reassessed as additional monitoring data are collected and knowledge of the HCM evolves during GSP implementation.

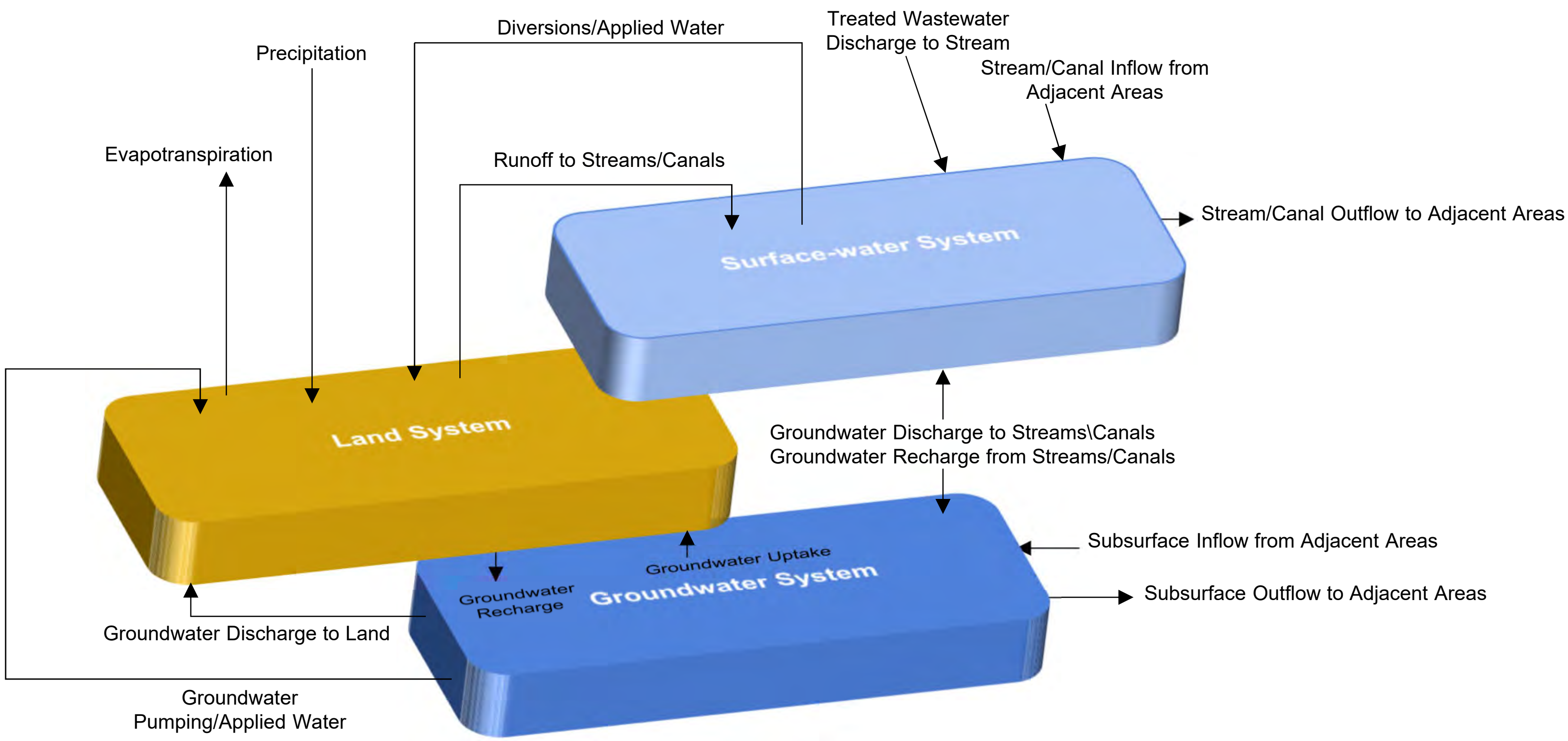
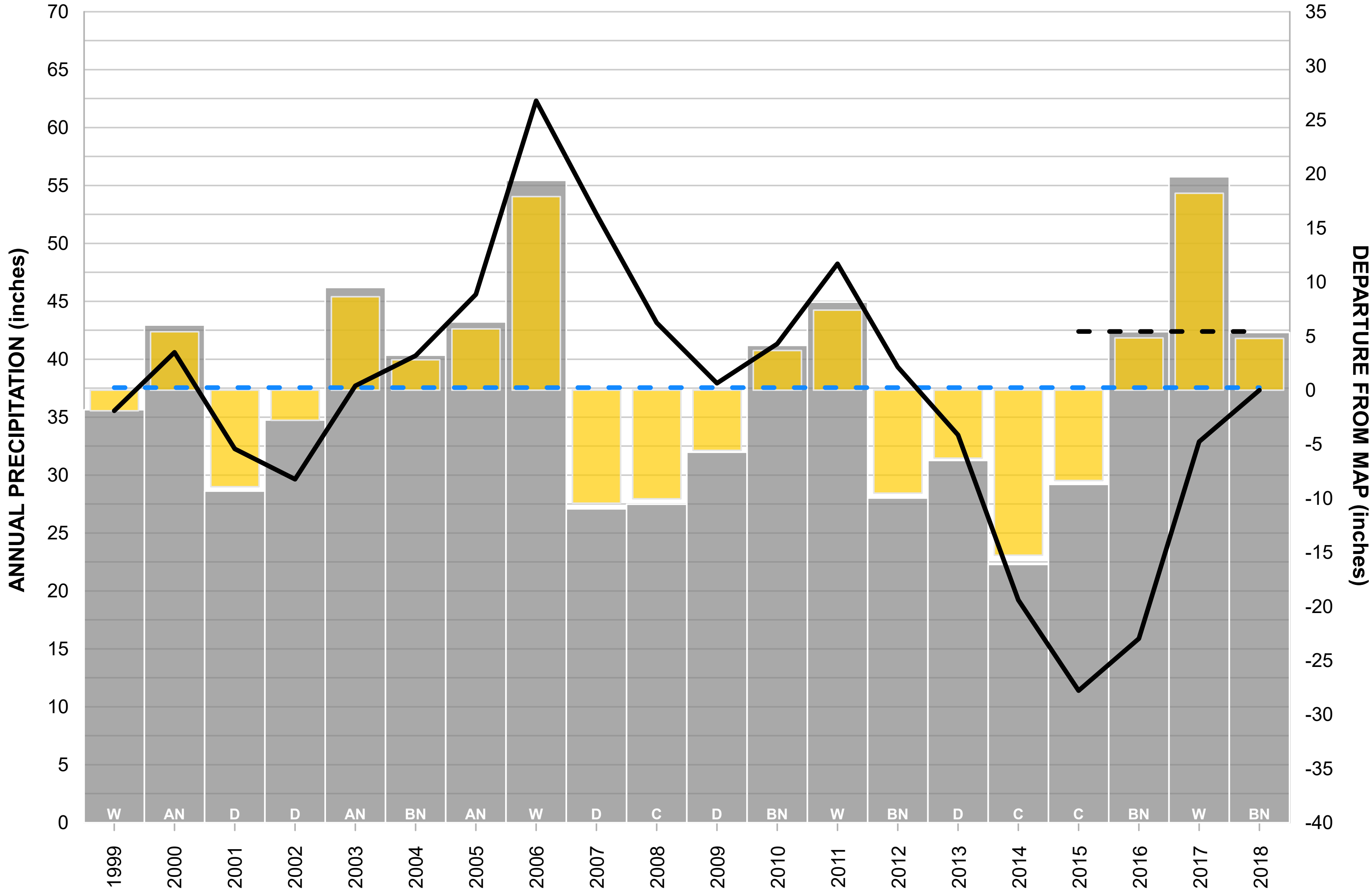


FIGURE 4-1
GENERALIZED WATER BUDGET DIAGRAM
Anderson Subbasin Groundwater Sustainability Plan

Jacobs



LEGEND

- HISTORICAL ANNUAL PRECIPITATION
- 1999–2018 MEAN ANNUAL PRECIPITATION (MAP) (37.55 inches)
- 2015–2018 MAP (42.40 inches)
- CUMULATIVE DEPARTURE FROM 1999-2018 MAP (right axis)
- DEPARTURE FROM MAP (right axis)

FIGURE 4-2
HISTORICAL ANNUAL PRECIPITATION
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

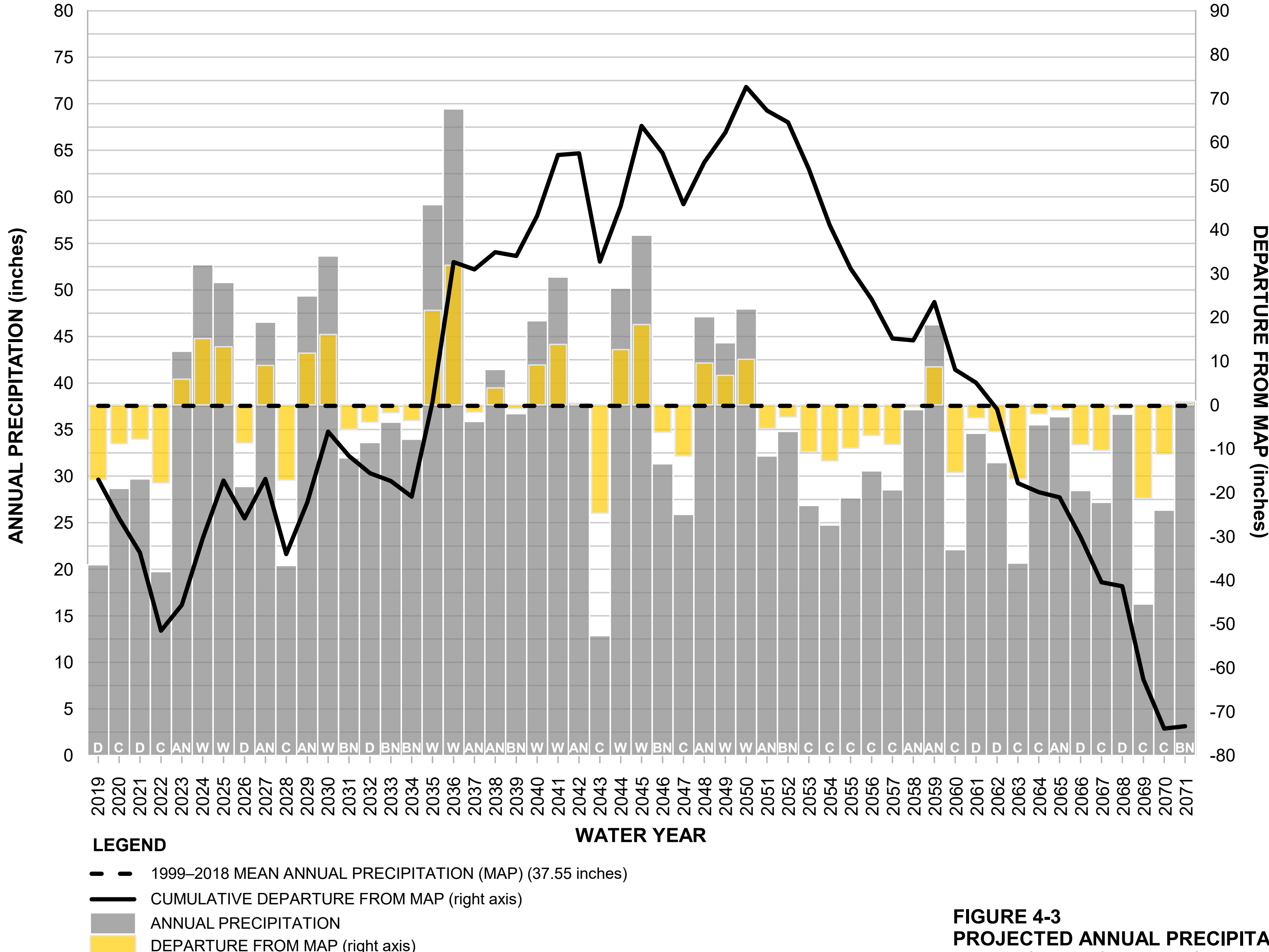


FIGURE 4-3
PROJECTED ANNUAL PRECIPITATION
Anderson Subbasin Groundwater Sustainability Plan

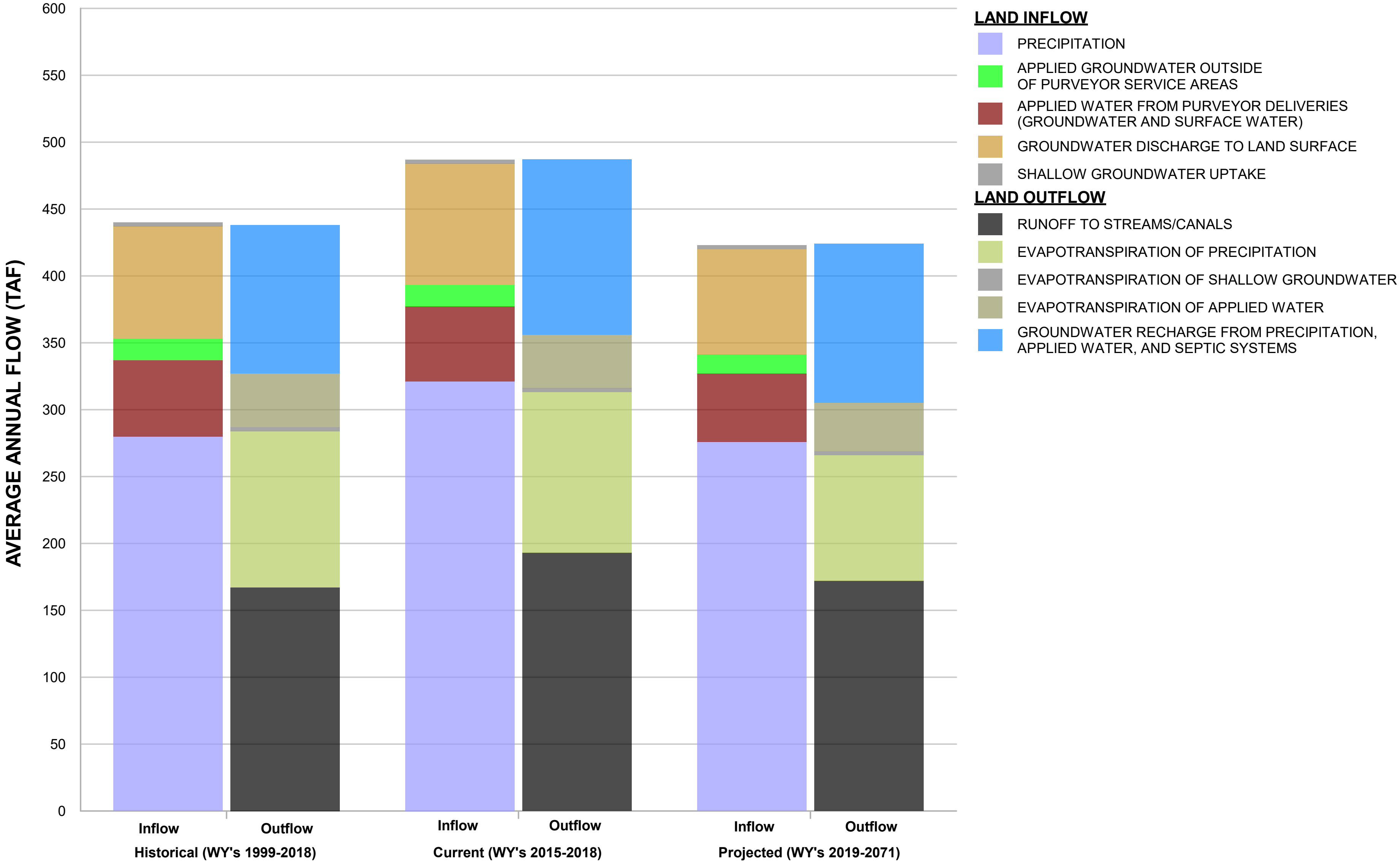


FIGURE 4-4
AVERAGE ANNUAL LAND SYSTEM BUDGET
Anderson Subbasin Groundwater Sustainability Plan

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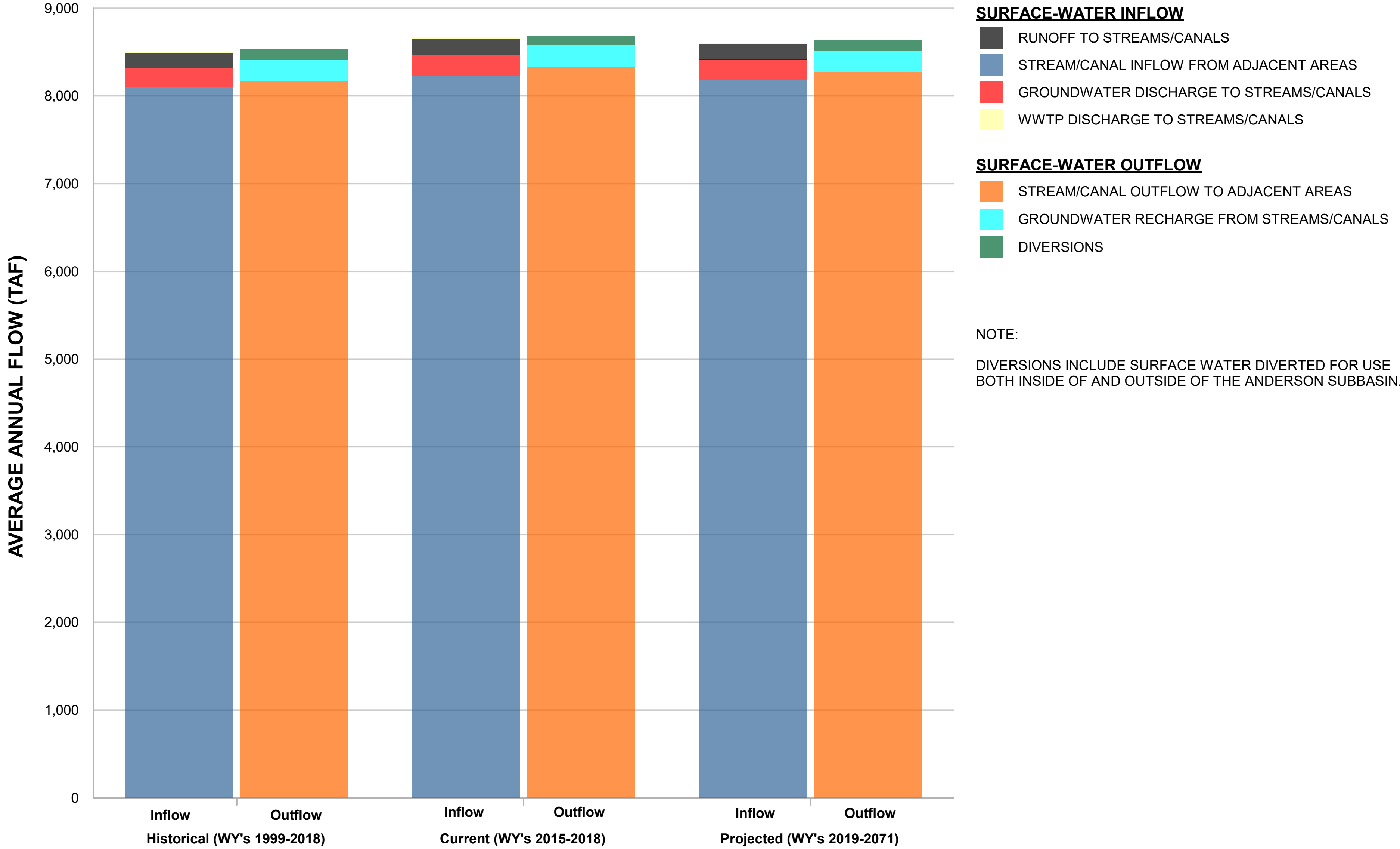


NOTE:

DIVERSIONS INCLUDE SURFACE WATER DIVERTED FOR USE BOTH INSIDE OF AND OUTSIDE OF THE ANDERSON SUBBASIN.

FIGURE 4-5
AVERAGE ANNUAL SURFACE-WATER SYSTEM BUDGET
Anderson Subbasin Groundwater Sustainability Plan

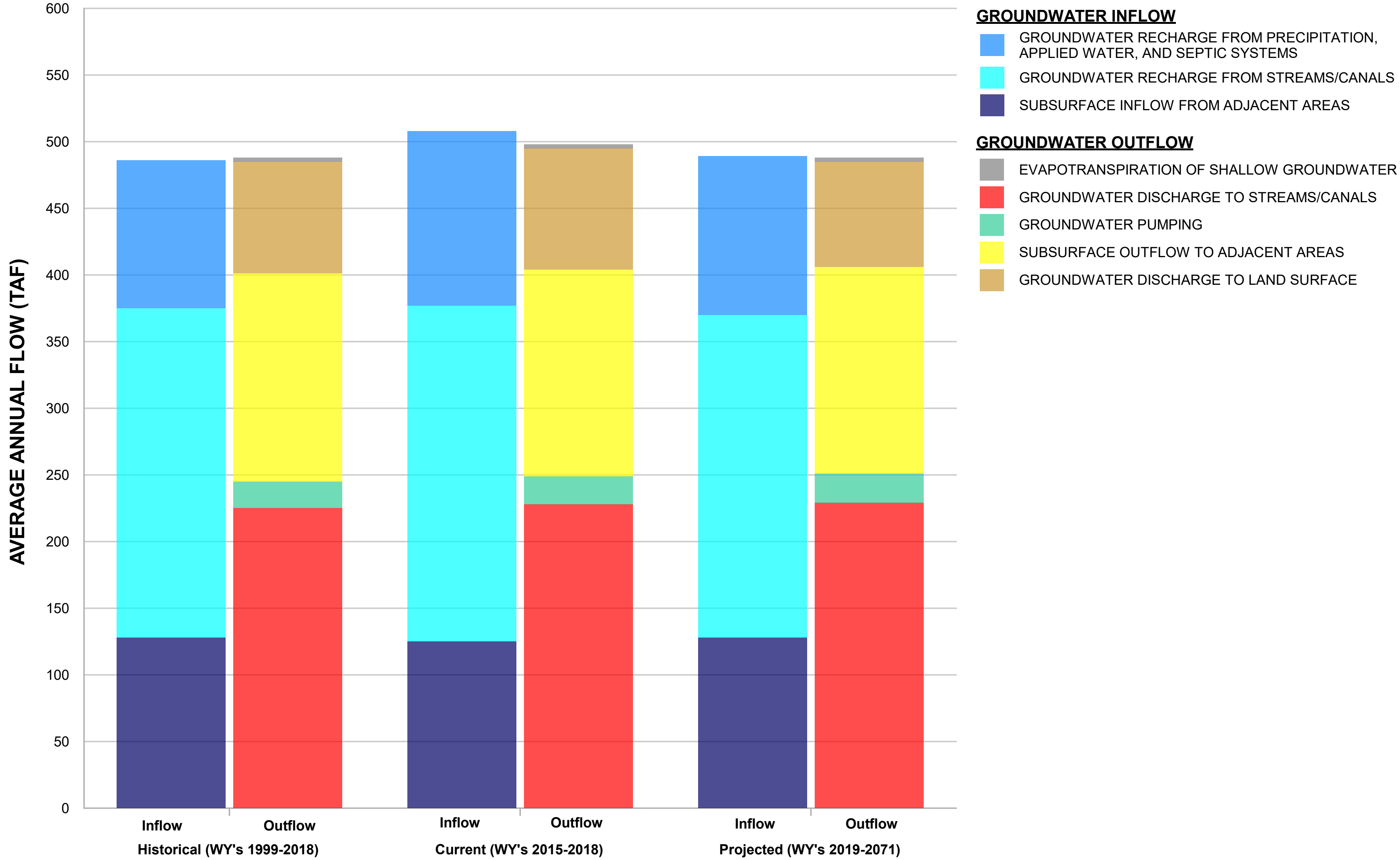
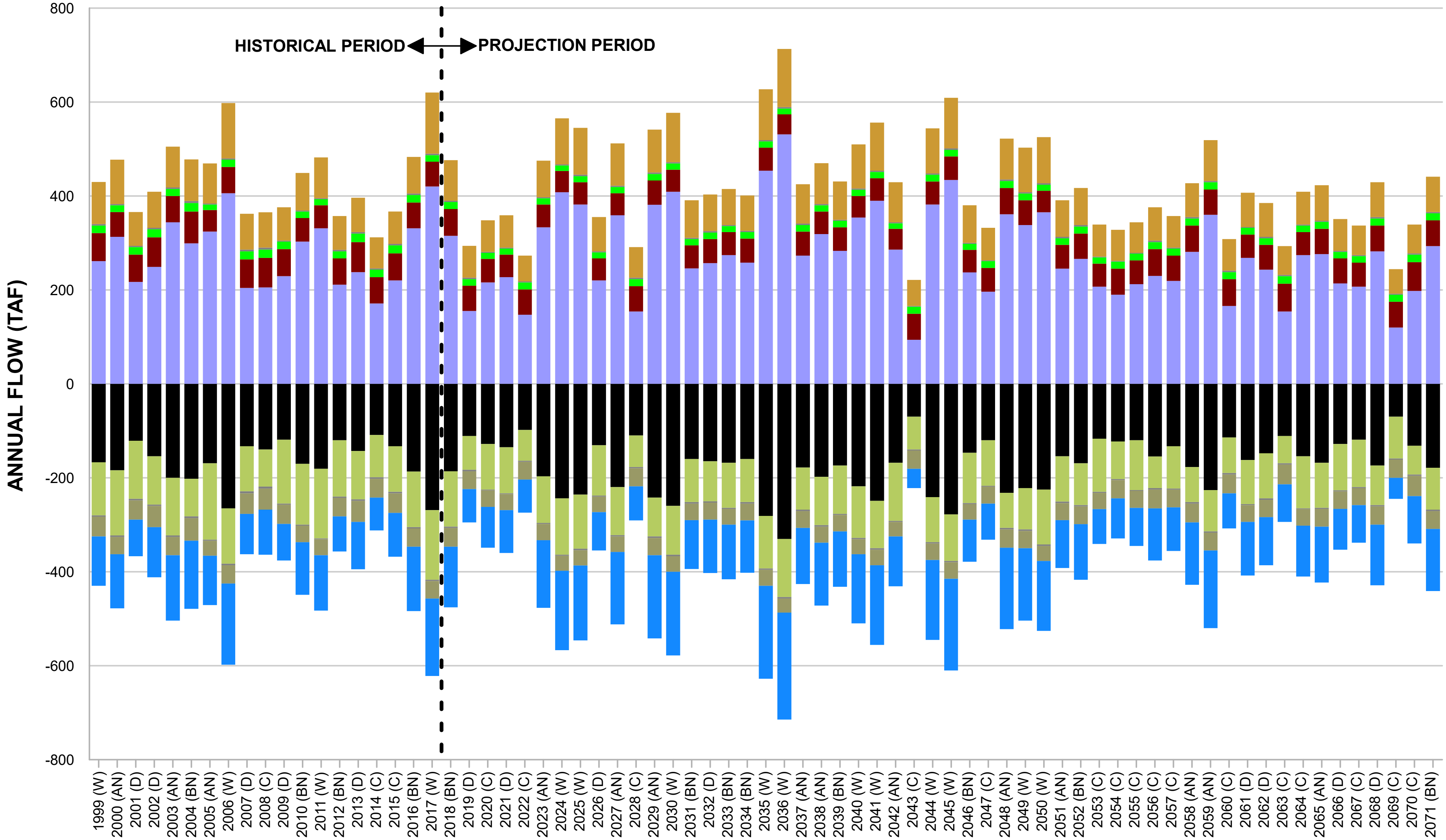


FIGURE 4-6
AVERAGE ANNUAL GROUNDWATER SYSTEM BUDGET
Anderson Subbasin Groundwater Sustainability Plan



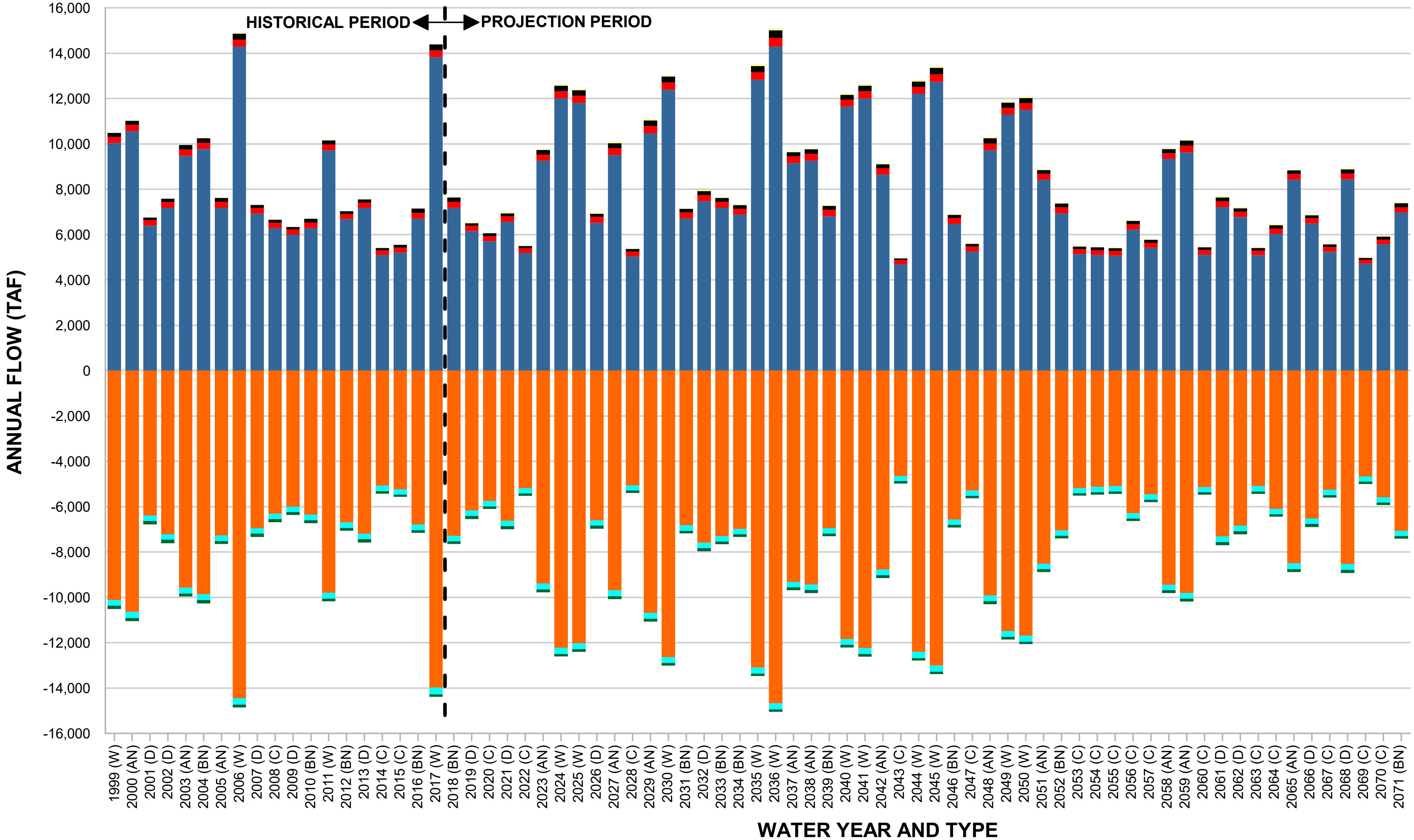
LAND INFLOW

- PRECIPITATION
- APPLIED GROUNDWATER OUTSIDE OF PURVEYOR SERVICE AREAS
- APPLIED WATER FROM PURVEYOR DELIVERIES (GROUNDWATER AND SURFACE WATER)
- GROUNDWATER DISCHARGE TO LAND SURFACE
- SHALLOW GROUNDWATER UPTAKE

LAND OUTFLOW

- RUNOFF TO STREAMS/CANALS
- EVAPOTRANSPIRATION OF PRECIPITATION
- EVAPOTRANSPIRATION OF SHALLOW GROUNDWATER
- EVAPOTRANSPIRATION OF APPLIED WATER
- GROUNDWATER RECHARGE FROM PRECIPITATION, APPLIED WATER, AND SEPTIC SYSTEMS

FIGURE 4-7
TIME-SERIES ANNUAL LAND SYSTEM BUDGET
Anderson Subbasin Groundwater Sustainability Plan



SURFACE-WATER INFLOW

- RUNOFF TO STREAMS/CANALS
- STREAM/CANAL INFLOW FROM ADJACENT AREAS
- GROUNDWATER DISCHARGE TO STREAMS/CANALS
- WWTP DISCHARGE TO STREAMS

SURFACE-WATER OUTFLOW

- STREAM/CANAL OUTFLOW TO ADJACENT AREAS
- GROUNDWATER RECHARGE FROM STREAMS/CANALS
- DIVERSIONS

NOTE:

DIVERSIONS INCLUDE SURFACE WATER DIVERTED FOR USE BOTH INSIDE OF AND OUTSIDE OF THE ANDERSON SUBBASIN.

FIGURE 4-8
TIME-SERIES ANNUAL SURFACE-WATER SYSTEM BUDGET
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

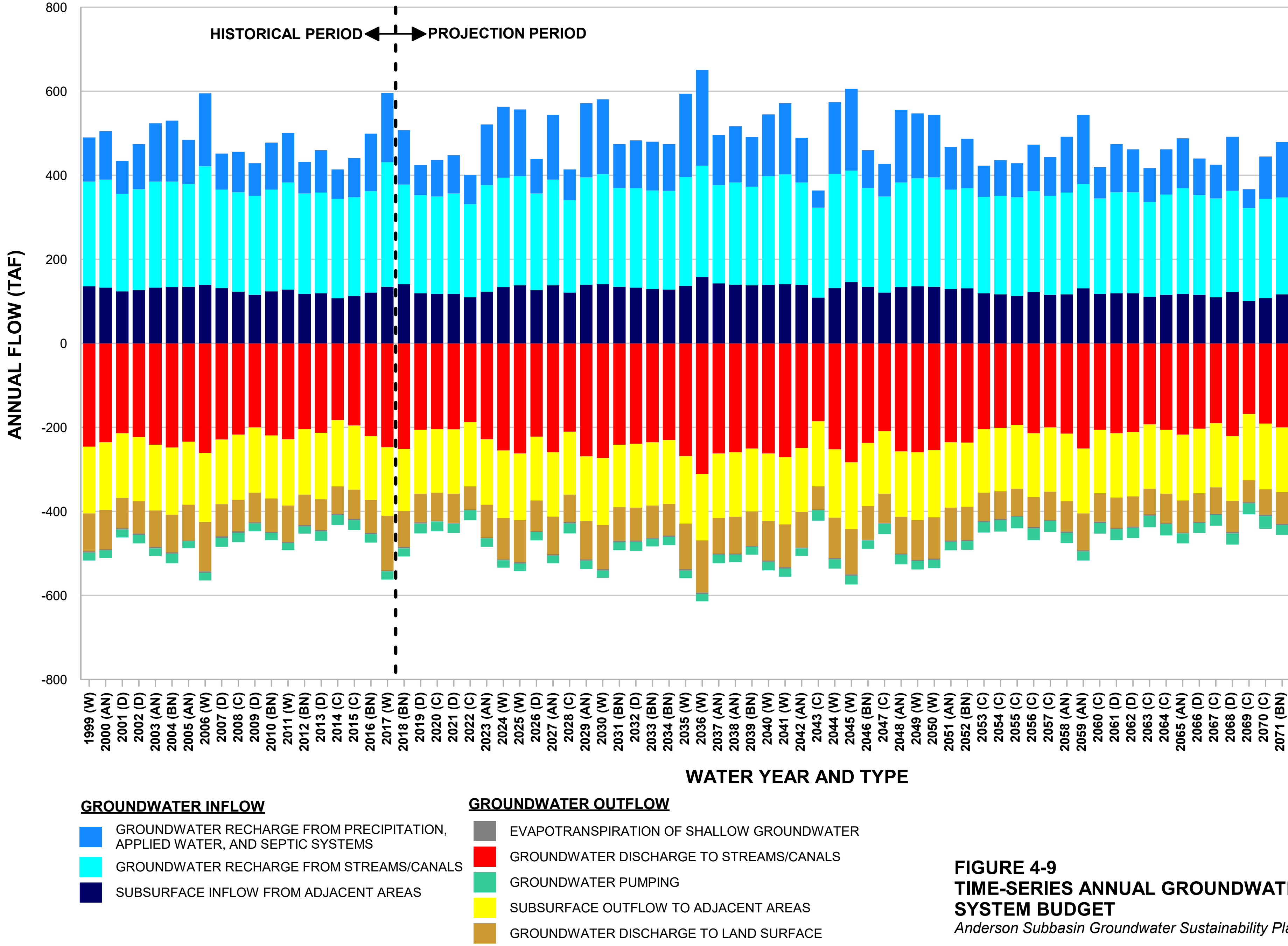


FIGURE 4-9
TIME-SERIES ANNUAL GROUNDWATER SYSTEM BUDGET
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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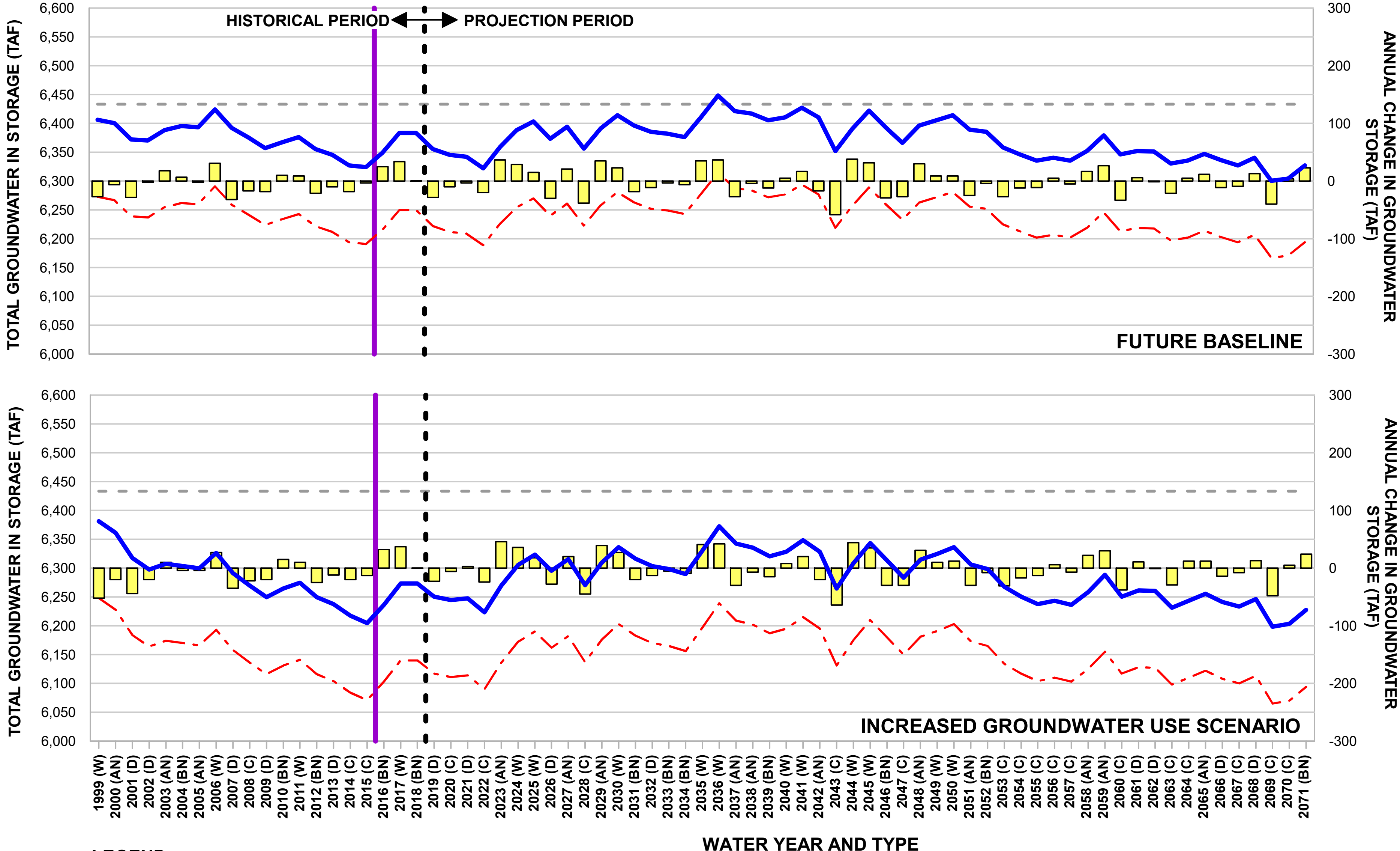


LEGEND

- TOTAL GROUNDWATER STORAGE AT BEGINNING OF WATER YEAR 1999
- TOTAL GROUNDWATER STORAGE
- CUMULATIVE CHANGE IN GROUNDWATER STORAGE
- SGMA EFFECTIVE DATE
- ANNUAL CHANGE IN GROUNDWATER STORAGE

FIGURE 4-10
ANNUAL GROUNDWATER STORAGE
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

5. Monitoring Networks

Pursuant to GSP Regulations Subarticle 4 (Monitoring Networks), this chapter describes the monitoring networks that will be used to monitor hydrologic conditions to aid in the evaluation of SMCs for the Anderson Subbasin. SMC development is discussed in Chapter 6, Sustainable Management Criteria, based on the monitoring network described herein. The following sections describe the existing monitoring network and the development of representative monitoring networks associated with the six sustainability indicators including seawater intrusion, chronic lowering of groundwater levels, reduction of groundwater storage, depletions of interconnected surface water, degraded groundwater quality, and land subsidence. This chapter also includes a discussion on the data management system and reporting of measurements associated with the monitoring network.

5.1 Monitoring Network Objectives

As defined by GSP Regulations § 354.34, the EAGSA is required to develop a monitoring network at which sufficient groundwater and surface-water measurements will be recorded to meet the following objectives:

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

In addition to the objectives above, the EAGSA has developed monitoring networks that will facilitate evaluation of potential effects of groundwater management activities on adjacent subbasins.

5.2 Seawater Intrusion Monitoring Network

The Anderson Subbasin is geographically isolated from the Pacific Ocean. Therefore, undesirable results related to seawater intrusion are not present and will not occur in the Anderson Subbasin. Pursuant to § 354.34(j), development of a seawater intrusion monitoring network is not warranted.

5.3 Groundwater-level Monitoring Network

5.3.1 Existing Monitoring

Section 2.5 of the GSP provides information on existing groundwater-level monitoring programs in the Anderson Subbasin including the CASGEM semiannual monitoring program, the DWR periodic groundwater elevation monitoring program (e.g., CASGEM voluntary wells), and the USGS periodic groundwater elevation monitoring program. As part of SGMA, the CASGEM program (including voluntary wells) will ultimately be transitioned into the SGMA Portal's Monitoring Network Module (MNM). As described in Section 2.5, with the exception of location 30N/06W-35L01, wells previously monitored by USGS include only one measurement at each location collected between 2018 and 2019. As such, these well locations are not considered to be part of ongoing, active monitoring programs in the Anderson Subbasin. If these locations are transitioned into a more routine monitoring program, the wells may be incorporated into the EAGSA's groundwater-level monitoring network. Wells currently monitored by DWR or USGS will continue to be monitored by these entities, and the data will be transitioned into the MNM. One new multi-completion well (location and number of completions to be determined) is being installed in 2022 as part of EAGSA's effort to improve the groundwater-level monitoring network in the subbasin. This location will be transitioned into the MNM and monitored by DWR once completed. Based on the existing monitoring network, there are 28 well completions (including multi-completion wells and well clusters) at 16 distinct geographic locations throughout the subbasin that are monitored as part of an existing monitoring program. Figure 5-1 presents the locations of wells currently monitored as part in the Anderson Subbasin.

5.3.2 Representative Monitoring

GSP Regulations § 354.36 stipulates that a subset of the existing monitoring network can be defined as the representative monitoring network indicating the locations where sustainability indicators are monitored, and for which MTs, MOs, and interim milestones are defined. In this report, a well identified as being part of the representative monitoring network is referred to as a "representative monitoring point" (RMP). RMPs may also serve as the locations where measured groundwater levels serve as a proxy for monitoring other sustainability indicators. Pursuant to GSP Regulations § 354.36(b), use of groundwater levels as a proxy is justified if:

- Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.
- MOs established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.

A subset of these wells in the existing groundwater-level monitoring well network was selected to serve as RMPs for the Anderson Subbasin GSP. Table 5-1 lists information for the existing groundwater-level monitoring wells, including location type, period of record, total well depth, and whether the well has been retained as an RMP. The representative monitoring network incorporates 14 of the 28 wells or well completions (in the case of multi-level wells or well clusters) in the existing monitoring network. Wells or well completions have been omitted for the following reasons:

- Well was deemed redundant because there is a nearby well with similar construction details.
- Location is an ACID pumping well with nearby dedicated observation well(s).
- Well is not considered applicable to monitoring of potential beneficial groundwater users.
- Where well clusters or multi-completion wells exist, the shallowest well completion was deemed applicable to most beneficial users in the subbasin and was selected as the RMP for that geographic location. Selection of one completion per cluster is considered appropriate because the principal aquifer is a large leaky aquifer system in which the water table reflects subbasin conditions. The position of the water table is also more applicable to assessment of groundwater in storage and groundwater/surface-water interaction, as compared with groundwater conditions at greater depths.

Table 5-1. Anderson Subbasin Existing Groundwater Level Monitoring Wells

Well Name	Location Type	Period of Record	Well Depth (feet bgs)	RMP	Reason for Omission from RMP Network
30N/04W-05K01	Industrial Well	1976–Present	300	X	
30N/05W-02Q01	Residential Well	1978–Present	180	X	
30N/06W-03M01	Observation Well	2016–Present	130		Well is near the western subbasin boundary and not in proximity to private well users.
30N/04W-10H04	Observation Well	2003–Present	62	X	
30N/04W-10H05	Observation Well	2003–Present	161		Part of a well cluster where the shallow well has been selected as the RMP for this location.

Table 5-1. Anderson Subbasin Existing Groundwater Level Monitoring Wells

Well Name	Location Type	Period of Record	Well Depth (feet bgs)	RMP	Reason for Omission from RMP Network
30N/03W-18B01	Observation Well	2003–Present	55	X	
30N/03W-18B02	Observation Well	2003–Present	164		Part of a well cluster where the shallow well has been selected as the RMP for this location.
30N/04W-23G01	Industrial Well	1971–Present	345	X	
30N/04W-22F02	Observation well	2015–Present	113	X	
30N/04W-22F03	Observation well	2015–Present	202		Part of a well cluster where the shallow well has been selected as the RMP for this location.
30N/04W-22F04	Observation well	2015–Present	540		Part of a well cluster where the shallow well has been selected as the RMP for this location.
30N/04W-23M01	Observation well	2003–Present	114	X	
30N/04W-23M02	Observation well	2003–Present	201		Part of a well cluster where the shallow well has been selected as the RMP for this location.
30N/04W-23M03	Irrigation well	2003–Present	465		ACID pumping well in proximity to monitoring well cluster.
30N/04W-25D03	Observation well	2003–Present	122	X	
30N/04W-25D04	Observation well	2003–Present	201		Part of a well cluster where the shallow well has been selected as the RMP for this location.
30N/03W-30Q02	Observation well	2003–Present	103	X	
30N/03W-32P03	Observation well	2003–Present	101	X	
29N/04W-02M02	Irrigation well	2013–Present	270		ACID pumping well in proximity to monitoring well cluster.
29N/04W-03R02	Observation well	2010–Present	917		Part of a well cluster where the shallow well has been selected as the RMP for this location.
29N/04W-03R03	Observation well	2010–Present	696		Part of a well cluster where the shallow well has been selected as the RMP for this location.
29N/04W-03R04	Observation well	2010–Present	438		Part of a well cluster where the shallow well has been selected as the RMP for this location.
29N/04W-03R05	Observation well	2010–Present	254		Part of a well cluster where the shallow well has been selected as the RMP for this location.

Table 5-1. Anderson Subbasin Existing Groundwater Level Monitoring Wells

Well Name	Location Type	Period of Record	Well Depth (feet bgs)	RMP	Reason for Omission from RMP Network
29N/04W-03R06	Observation well	2010–Present	76	X	
29N/04W-02P01	Other	1970–Present	425		Less than 0.5 mile from the 29N/04W-03R0X well cluster. Well has a large screening interval that is covered by the nearby well cluster.
29N/05W-11A02	Irrigation well	1970–Present	360	X	
29N/05W-09L01	Residential well	1978–Present	140	X	
30N/06W-35L01	Residential well	2016–Present	180	X	

Note:

All well locations listed are monitored by DWR, except 30N/06W-05M01, which is monitored by Shasta County and 30N/06W-35L01, which is monitored by USGS.

5.3.3 Spatial Density

DWR's BMP for *Monitoring Networks and Identification of Data Gaps* (DWR, 2016c) references several studies that recommend a monitoring well density ranging from 0.2 to 10 wells per 100 square miles (Heath, 1976; Sophocleous, 1983; Hopkins, 1994). The Anderson Subbasin is approximately 154 square miles and contains 14 RMPs, which equates to 9.1 wells per 100 square miles. Based on the referenced recommended range of well densities, the density of wells included in the RMP network is adequate for tracking groundwater conditions to assess SMCs.

5.3.4 Monitoring Frequency

Wells that are included in the existing well network will be monitored at least semiannually, typically in the spring and fall, to ensure short-term, seasonal, and long-term groundwater trends can be analyzed at these locations. Groundwater elevation data from the full monitoring network will be used to assess horizontal and vertical conditions. Measurements from the RMPs will be compared to the SMCs discussed in Chapter 6 Sustainable Management Criteria to assess whether significant and unreasonable conditions are present.

5.3.5 Monitoring Protocols

To establish a set of monitoring protocols, standard operating procedures as outlined in the USGS *Groundwater Technical Procedures* (Cunningham and Schalk, 2011) document will be adopted by local agencies to define the monitoring protocols for the Anderson Subbasin groundwater-level monitoring network.

5.3.6 Data Gaps

Although there is adequate density of monitoring wells to assess groundwater-level SMCs, data gaps related to the groundwater-level monitoring network are identified as follows:

- As listed in Table 5-1, 9 of the 28 well completions in the groundwater-level monitoring network are residential, irrigation, industrial, or unknown well types. Including such well types in the network could result in lack of reliable access to static (nonpumping) groundwater-level measurements. DWR's BMP for *Monitoring Networks and Identification of Data Gaps* (DWR, 2016c) indicates that such well types can be used temporarily until either dedicated monitoring wells can be installed or an existing well can be identified that meets the criterion of being a dedicated monitoring well.

- There are a limited number of shallow monitoring wells near GDEs to assess impacts on these beneficial users.
- As shown on Figure 5-1, relatively large areas of the Anderson Subbasin lack groundwater-level monitoring wells, particularly in the northern and central portions of the subbasin.
- There is a lack of well completion information (screen intervals) for some wells.

According to U.S. Census American Community Survey 5-Year Data (2013 through 2017), household incomes are low enough to classify nearly 100 percent of the populated urban areas in the Anderson Subbasin as either a DAC or SDAC (Figures 1-2 through 1-4). Additionally, the EAGSA, according to its MOU, is not authorized to impose fees, charges, assessments, taxes, or other exactions related to groundwater management, extraction, monitoring, and implementation of SGMA or GSPs on any GSA member or the landowners within the political boundaries of GSA members (see § 6[C][2] of the MOU in Appendix B). Although resources are limited, the EAGSA is committed to the implementation of this GSP, including investment of resources for filling data gaps to improve the understanding of groundwater conditions within the subbasin and facilitate analysis of SMCs. The EAGSA members will equally share the SGMA-related cost burden with existing resources and pursue additional grant and technical support services (TSS) funding, as applicable.

5.4 Groundwater Storage Monitoring Network

Groundwater storage is monitored by proxy through the measurement of groundwater levels. Therefore, RMPs included in the groundwater-level network will also be used to address monitoring requirements for the sustainability indicator associated with reduction of groundwater storage. Additional information regarding proxy monitoring for groundwater storage is presented in Chapter 6 Sustainable Management Criteria.

5.5 Interconnected Surface-water Monitoring Network

Monitoring requirements associated with depletions of interconnected surface water are also monitored by proxy through the measurement of groundwater levels. Therefore, RMPs included in the groundwater-level network will also be used to address monitoring requirements for the sustainability indicator associated with reduction of depletions of interconnected surface water. Additional information regarding proxy monitoring of depletions of interconnected surface water is presented in Chapter 6 Sustainable Management Criteria. Although data gaps associated with groundwater-level monitoring are identified in Section 5.3.6, these are not considered applicable to the depletions of interconnected surface-water sustainability indicator network.

5.6 Groundwater Quality Monitoring Network

5.6.1 Existing Monitoring

Section 2.6 presents existing groundwater quality monitoring programs including the SWRCB DDW program, DWR and USGS's GAMA programs (i.e., groundwater quality assessment and supply well trend studies), various environmental compliance monitoring efforts, and other local groundwater quality monitoring programs. Although there are locations within the subbasin that are actively sampled as part of environmental monitoring programs, these wells are constructed to evaluate very local-scale (as opposed to subbasin-scale) groundwater quality associated with sites regulated by DTSC, EPA, or SWRCB. As such, environmental monitoring wells are not included in the EAGSA's groundwater quality network under SGMA. Figure 5-2 presents the locations of the existing groundwater quality monitoring network in the Anderson Subbasin. For the purposes of this GSP, wells that have been sampled within the 2010 through 2019 timeframe are considered to be part of an existing groundwater quality monitoring program.

5.6.2 Representative Monitoring

A subset of wells in the existing monitoring well network was selected to serve as RMPs for groundwater quality in the Anderson Subbasin. Table 5-2 presents information regarding the existing groundwater quality monitoring wells such as monitoring entity, well type and depth, period of record, and whether the well has been retained as an RMP. In general, RMPs include most of the existing monitoring network; however, some wells were omitted because they have been sampled fewer than three times throughout the period of record and are considered to have insufficient data with which to reliably characterize groundwater quality conditions.

Table 5-2. Anderson Subbasin Existing Groundwater Quality Monitoring Wells

Well Name	Monitoring Entity	Period of Record	Well Type	Well Depth (feet bgs)	RMP	Reason for Omission from RMP Network
4510001-025	SWRCB-DDW	2003–2020	Municipal	--	X	
4500254-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4510001-013	SWRCB-DDW	2001–2018	Municipal	--	X	
4500082-001	SWRCB-DDW	1999–2020	Municipal	--	X	
4400723-001	SWRCB-DDW	1986–2018	Municipal	--	X	
4500054-004	SWRCB-DDW	2007–2020	Municipal	--	X	
4500344-001	SWRCB-DDW	2018–2020	Municipal	--	X	
4500007-001	SWRCB-DDW	1979–2020	Municipal	--	X	
4500193-002	SWRCB-DDW	2002–2020	Municipal	--	X	
4500107-002	SWRCB-DDW	1998–2020	Municipal	--	X	
4500194-002	SWRCB-DDW	2002–2020	Municipal	--	X	
4500246-003	SWRCB-DDW	2005–2020	Municipal	--	X	
4500337-001	SWRCB-DDW	2008–2020	Municipal	--	X	
4500035-001	SWRCB-DDW	2001–2020	Municipal	--	X	
4510007-005	SWRCB-DDW	1992–2020	Municipal	--	X	
4500041-002	SWRCB-DDW	2003–2020	Municipal	--	X	
4500200-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4500066-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4510007-004	SWRCB-DDW	1988–2020	Municipal	--	X	
4510007-003	SWRCB-DDW	1986–2020	Municipal	--	X	
4510001-002	SWRCB-DDW	1991–2020	Municipal	--	X	
4500214-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4510016-003	SWRCB-DDW	1994–2020	Municipal	--	X	

Table 5-2. Anderson Subbasin Existing Groundwater Quality Monitoring Wells

Well Name	Monitoring Entity	Period of Record	Well Type	Well Depth (feet bgs)	RMP	Reason for Omission from RMP Network
4510001-014	SWRCB-DDW	2000–2020	Municipal	--	X	
4500191-003	SWRCB-DDW	1994–2020	Municipal	--	X	
4510016-004	SWRCB-DDW	1999–2020	Municipal	--	X	
4510001-010	SWRCB-DDW	1984–2020	Municipal	--	X	
4500107-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4510007-001	SWRCB-DDW	1984–2020	Municipal	--	X	
4510016-005	SWRCB-DDW	1999–2020	Municipal	--	X	
4500213-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4500093-002	SWRCB-DDW	2004–2020	Municipal	--	X	
4500107-003	SWRCB-DDW	2002–2020	Municipal	--	X	
4500247-002	SWRCB-DDW	2017–2020	Municipal	--	X	
4500007-002	SWRCB-DDW	1990–2020	Municipal	--	X	
4500037-001	SWRCB-DDW	1992–2020	Municipal	--	X	
4500062-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4500037-002	SWRCB-DDW	1992–2020	Municipal	--	X	
5200535-001	SWRCB-DDW	2007–2020	Municipal	--	X	
4500041-001	SWRCB-DDW	2001–2020	Municipal	--	X	
4500104-001	SWRCB-DDW	1980–2020	Municipal	--	X	
4510005-013	SWRCB-DDW	1988–2014	Municipal	--	X	
4510001-006	SWRCB-DDW	1984–2017	Municipal	--	X	
4510001-001	SWRCB-DDW	1988–2020	Municipal	--	X	
4500247-001	SWRCB-DDW	1987–2017	Municipal	--	X	
4500093-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4500246-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4500315-002	SWRCB-DDW	2017–2020	Municipal	--	X	
4510001-031	SWRCB-DDW	2005–2020	Municipal	--	X	
4500054-003	SWRCB-DDW	2004–2016	Municipal	--	X	
4510005-010	SWRCB-DDW	1989–2020	Municipal	--	X	
4500191-004	SWRCB-DDW	1994–2018	Municipal	--	X	
4510007-002	SWRCB-DDW	1985–2020	Municipal	--	X	
4510005-009	SWRCB-DDW	1989–2019	Municipal	--	X	
4500191-009	SWRCB-DDW	2018–2020	Municipal	--	**X**	
4500191-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4500315-001	SWRCB-DDW	2002-2018	Municipal	--	X	
4500204-002	SWRCB-DDW	1998–2020	Municipal	--	X	
4500066-002	SWRCB-DDW	2002–2018	Municipal	--	X	
4510005-006	SWRCB-DDW	1988–2020	Municipal	--	X	

Table 5-2. Anderson Subbasin Existing Groundwater Quality Monitoring Wells

Well Name	Monitoring Entity	Period of Record	Well Type	Well Depth (feet bgs)	RMP	Reason for Omission from RMP Network
4510001-012	SWRCB-DDW	1990–2020	Municipal	--	X	
4500204-001	SWRCB-DDW	1987–2020	Municipal	--	X	
30N04W22F004M	DWR	2015–2015	Unknown	540		A
29N04W03R005M	DWR	2010–2015	Unknown	254		A
29N04W03R004M	DWR	2010–2015	Unknown	438		A
4510005-012	SWRCB-DDW	1989–2020	Municipal	--	X	
4500140-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4500153-001	SWRCB-DDW	1987–2020	Municipal	--	X	
4500295-001	SWRCB-DDW	2001–2011	Municipal	--	X	
4500241-001	SWRCB-DDW	2001–2020	Municipal	--	X	
4500208-001	SWRCB-DDW	1993–2020	Municipal	--	X	
29N04W03R006M	DWR	2010–2015	Unknown	76		A
29N04W03R002M	DWR	2010–2015	Unknown	917		A
29N04W03R003M	DWR	2010–2015	Unknown	696		A
S9_REDBLS_RED08	USGS	2019–2019	Municipal	157		A
S9_REDBLS_RED05	USGS	2019–2019	Municipal	255		A
S9_REDBLS_RED07	USGS	2019–2019	Municipal	80		A
RED-05	USGS	2007–2018	Municipal	492		A
S9_REDBLS_RED12	USGS	2019–2019	Municipal	178		A
S9_REDBLS_RED19	USGS	2019–2019	Municipal	80		A
S9_REDBLS_RED04	USGS	2019–2019	Municipal	111		A
USGS-402300122170001	USGS	2007–2018	Unknown	--		A
4500302-001	SWRCB-DDW	2002–2020	Municipal	--	X	
4500261-001	SWRCB-DDW	2006–2010	Municipal	--	X	
4500074-001	SWRCB-DDW	1987–2018	Municipal	--	X	
4500258-001	SWRCB-DDW	1987–2017	Municipal	--	X	

Notes:

-- = information not available
A = Fewer than three historical sample records

5.6.3 Spatial Density

As shown in Table 5-2, 72 of the 86 groundwater quality sampling locations are included as RMPs for the Anderson Subbasin. Based on the well density guidance presented in Section 5.3.3, this equates to 48 wells per 100 square miles included in the groundwater quality RMP network. The density of wells included in the RMP network is adequate for tracking groundwater quality conditions to assess SMCs, based on well density criteria ranging from 0.2 to 10 wells per 100 square miles (Heath, 1976; Sophocleous, 1983; and Hopkins, 1994). As discussed in the next section, groundwater quality sampling frequency varies by well. This means that the number of RMPs sampled in a given year will vary; however, a significant number of RMPs in the subbasin is providing adequate coverage to assess potential changes to the geographic location of areas of affected groundwater quality.

5.6.4 Monitoring Frequency

The monitoring frequency for each groundwater quality RMP is specified by the water system-specific monitoring program based on local groundwater quality conditions. As part of the SWRCB groundwater quality program, sampling frequency for specific analytes varies by water system with up to a 9-year sampling interval. As such, sampling at RMPs is expected to vary year to year, and the spatial coverage of sampled RMPs will not be the same in any given year.

5.6.5 Monitoring Protocols

Groundwater quality samples at RMPs are collected by the water systems or monitoring entity in accordance with their system-specific monitoring programs.

5.6.6 Data Gaps

The primary data gaps for the Anderson Subbasin are similar to those described for the groundwater-level monitoring network. These include the following:

- Relatively large areas of the Anderson Subbasin lack groundwater quality RMPs, particularly in the northern, central, and western portions of the subbasin (Figure 5-2).
- The GAMA database lacks well completion information (total depth and screen intervals) for many wells identified as RMPs (Table 5-2).

As previously described, there is limited ability to fund improvements to the monitoring networks in the Anderson Subbasin. The EAGSA will look for opportunities to fill data gaps as funding resources become available.

5.7 Subsidence Monitoring Network

5.7.1 Existing Monitoring

As discussed in Section 3.2.6, land subsidence monitoring in the Anderson Subbasin consists of periodic surveying of GPS monuments (DWR, 2018) and analysis of satellite-based (e.g., InSAR) data processing (TreAltamira, 2020). The GPS surveys provide point measurements of vertical land movement (upwards or downwards) over time; however, there is not an established survey frequency for the subbasin. As such, GPS surveys are not considered to represent an existing monitoring program. DWR is coordinating with independent contractors to make InSAR datasets available to GSAs annually; therefore, these data are considered to be the existing monitoring program for the subbasin.

5.7.2 Representative Monitoring

The representative land subsidence monitoring network for the Anderson Subbasin is the InSAR data made available by DWR.

5.7.3 Spatial Density

The InSAR dataset includes estimates of vertical land displacement as a continuous grid across the entire subbasin (i.e., the dataset includes estimates of vertical land displacement approximately every 300 feet [100 meters] across the subbasin).

5.7.4 Monitoring Frequency

DWR will make InSAR datasets available to GSAs annually.

5.7.5 Monitoring Protocols

InSAR data acquisition and analysis protocols will be consistent with those in *InSAR Land Surveying and Mapping Services in Support of the DWR SGMA Program, Technical Report* (TreAltamira, 2020).

5.7.6 Data Gaps

No data gaps are associated with the land subsidence network in the Anderson Subbasin.

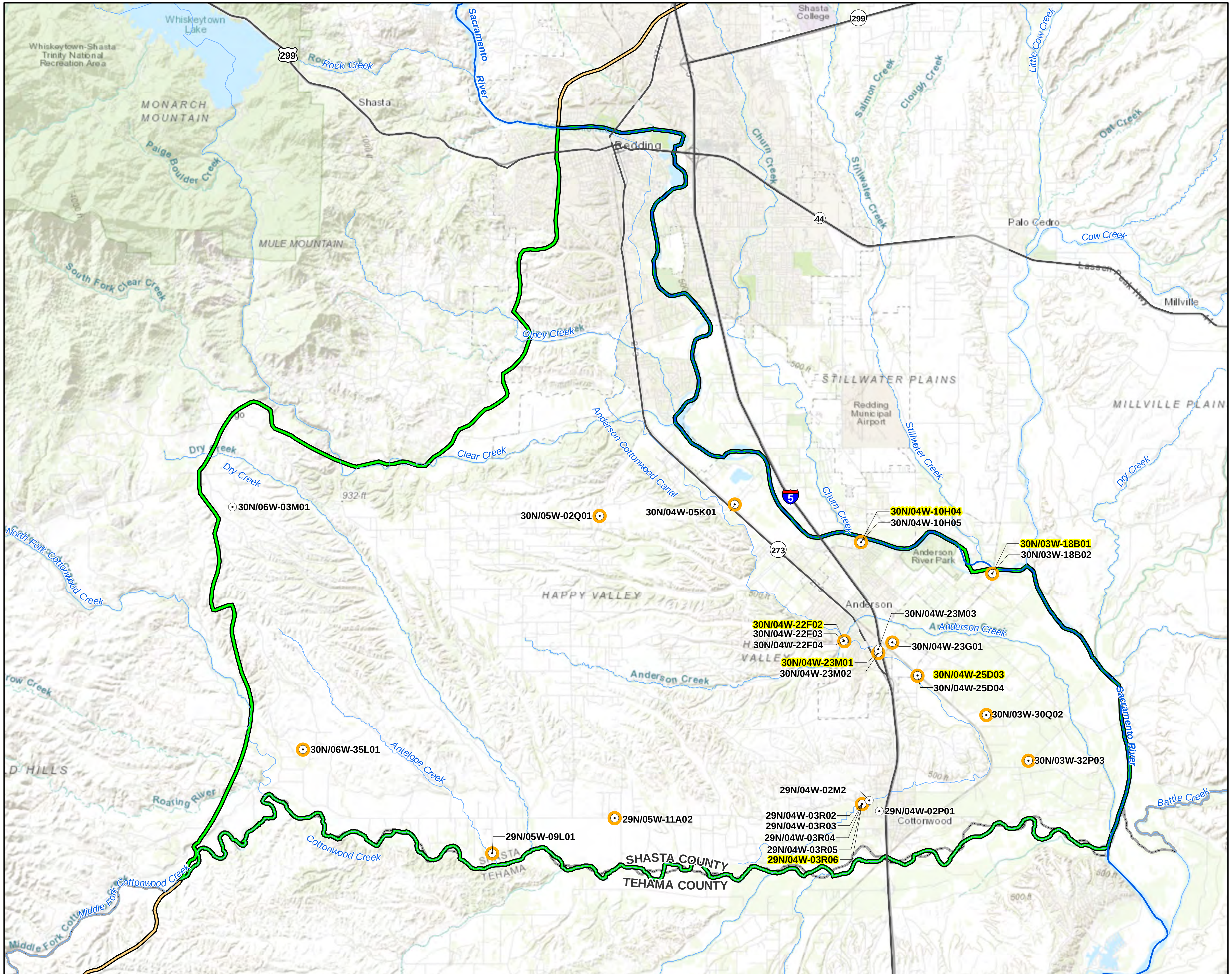
5.8 Data Management System and Reporting

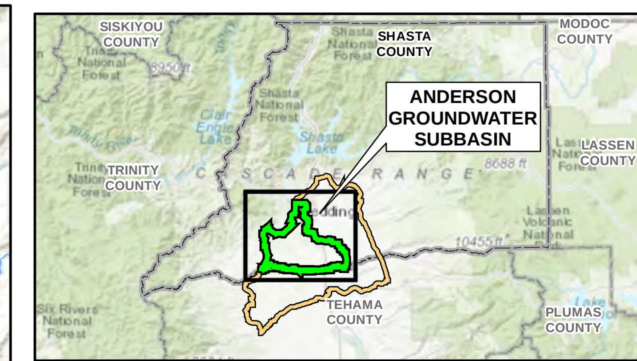
The EAGSA has developed a Data Management System (DMS) that is used to store, review, and upload data collected as part of the GSP development and implementation. The DMS adheres to the following GSP regulations:

- Article 3, Section § 352.6: Each Agency shall develop and maintain a DMS that is capable of storing and reporting information relevant to the development or implementation of the Plan and monitoring of the Subbasin.
- Article 5, Section § 354.40: Monitoring data shall be stored in the DMS developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.

The EAGSA DMS uses cloud-based software as a service through ArcGIS Online. The ArcGIS Online service platform employs the use of databases, maps, and document storage. The EAGSA uses ArcGIS Online to store information about groundwater pumping, surface-water supply, and well and water-level data. The EAGSA also leverages ArcGIS Online to source data from California GIS servers that store data for wells, subbasins, and water-level elevation.

The EAGSA also includes a publicly accessible web-map hosted on the ArcGIS Online platform; accessed at https://eagsa-redding.hub.arcgis.com/. This web-map gives interested parties access to technical information used in the development of the GSP, and includes public well data and analysis such as water level contour maps, as well as various local administrative boundaries. This web-map will be regularly updated as new information is made available to the EAGSA.





LEGEND

- EXISTING MONITORING LOCATION
- REPRESENTATIVE MONITORING POINT
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

YELLOW HIGHLIGHTED WELL NAME INDICATES REPRESENTATIVE MONITORING POINT IN WELL CLUSTER.

DATA SOURCES: DWR, 2019a; DWR, 2019b

DWR = DEPARTMENT OF WATER RESOURCES

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 5-1
GROUNDWATER-LEVEL MONITORING NETWORK
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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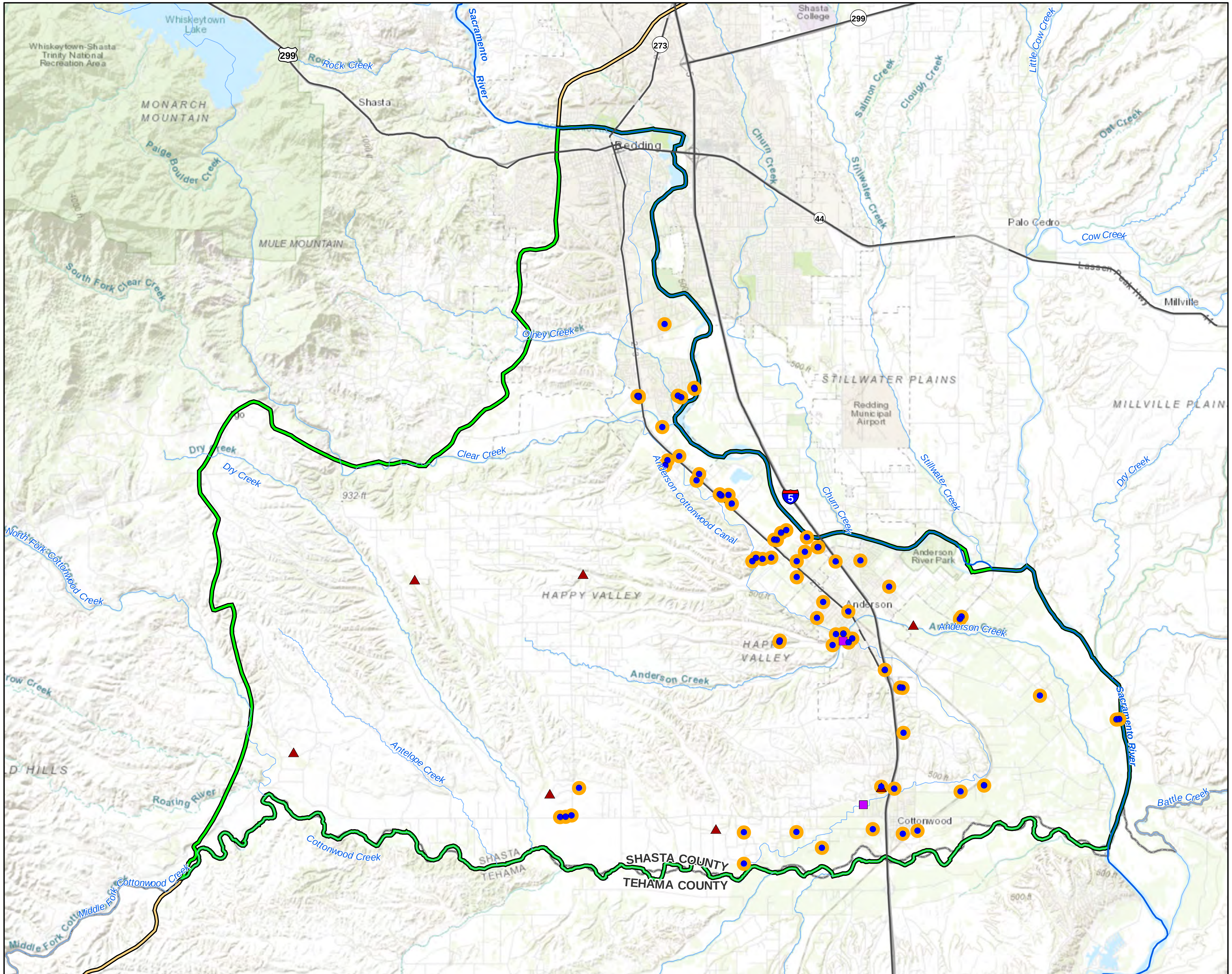

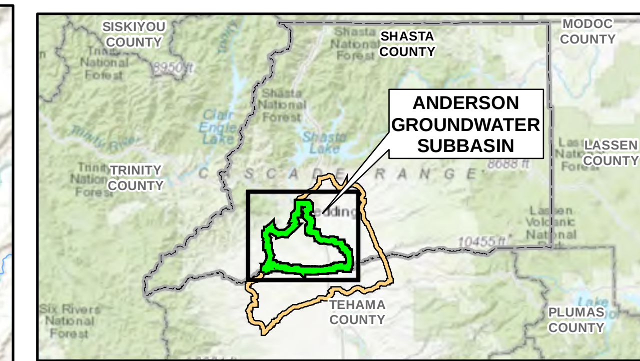

LEGEND

GROUNDWATER QUALITY NETWORK SOURCE

- SWRCB – DDW
- GAMA – DWR
- GAMA – USGS
- REPRESENTATIVE MONITORING POINT
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

DATA SOURCE: SWRCB, 2020b

DDW = DIVISION OF DRINKING WATER

DWR = CALIFORNIA DEPARTMENT OF WATER RESOURCES

GAMA = GROUNDWATER AMBIENT MONITORING AND ASSESSMENT PROGRAM

SWRCB = STATE WATER RESOURCES CONTROL BOARD

USGS = UNITED STATES GEOLOGICAL SURVEY

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 5-2
GROUNDWATER QUALITY WELL NETWORK
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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6. Sustainable Management Criteria

Sustainable management of groundwater, as defined under SGMA, refers to "the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results." This chapter describes the SMCs applicable to the Anderson Subbasin and satisfies the requirements of GSP regulations § 354 Subarticle 3 (Sustainable Management Criteria).

When establishing SMCs for the Anderson Subbasin, the EAGSA generally adhered to the following process:

- Assessment of each sustainability indicator to evaluate whether it is applicable to the Anderson Subbasin. Pursuant to GSP regulation § 354.26(d) "An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators."
- Analysis of available data to assess the current conditions within the Anderson Subbasin for the applicable sustainability indicators (see Chapter 3 for additional details).
- Development of a sustainability goal that describes the desired conditions for the Anderson Subbasin and how to achieve or maintain this condition (see Section 6.2 for additional details).
- Development of a description of what conditions would be considered to negatively affect beneficial uses and users relative to each sustainability indicator (see Section 6.3 for additional details).
- Development of qualitative descriptions and quantitative criteria to identify when those conditions are present or are likely for each sustainability indicator (see Section 6.3 for additional details).
- Development of strategies to address changing conditions in the subbasin and to maintain sustainability during the GSP planning and implementation horizon (see Chapter 7 for additional details).

6.1 Sustainability Indicators

SGMA defines a sustainability indicator as "any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x)." Following are the six sustainability indicators defined by SGMA:

- Seawater intrusion
- Chronic lowering of groundwater levels
- Reduction of groundwater storage
- Depletions of interconnected surface water
- Degraded water quality, including the migration of contaminant plumes that impair water supplies
- Land subsidence that substantially interferes with surface land uses

Each of the applicable sustainability indicators is further described in Section 6.3.

6.2 Sustainability Goal

Pursuant to GSP regulation § 354.24, a sustainability goal describes the plan for sustainable management of a basin that "culminates in the absence of undesirable results within 20 years of the applicable statutory deadline." Components of the sustainability goal include the following:

- A description of the goal, including information from the basin setting used to establish the sustainability goal
- A discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield
- An explanation of how the sustainability goal is likely to be achieved within 20 years of plan implementation and is likely to be maintained through the planning and implementation horizon

6.2.1 Sustainability Goal Description

The sustainability goal for the Anderson Subbasin was developed by the EAGSA with consideration of past, current, and projected subbasin conditions, and potential impacts on beneficial uses and users. The sustainability goal is as follows:

> *The Sustainability Goal for the Anderson Subbasin is to maintain a locally managed, economically viable, sustainable groundwater resource for existing and future beneficial use in Shasta County by continuing existing management and operation to avoid undesirable results.*

6.2.2 Discussion of Measures to Operate within the Sustainable Yield

As discussed in Chapter 4 Water Budgets, the Anderson Subbasin is currently operating within the sustainable yield and is projected to continue to operate within the sustainable yield under Future Baseline conditions. Therefore, additional measures, beyond those already being implemented by local water agencies, are not required. Chapter 7 describes potential projects and management actions that may be considered by the EAGSA to maintain sustainability in the future, if unforeseen changing conditions occur.

6.2.3 Achievement of the Sustainability Goal by 2042

As will be described in the following section, the historical, current, and projected Future Baseline simulations indicate that the Anderson Subbasin has been operated sustainably and is projected to continue to be sustainable during this GSP's implementation period. No significant and unreasonable conditions for any of the sustainability indicators are currently observed in the subbasin, and no significant and unreasonable conditions are projected to occur in the future.

6.3 Sustainable Management Criteria

The following sections provide details related to qualitative and quantitative SMCs for each sustainability indicator and fulfill the requirements of GSP regulations § 354 Subarticle 3. Table 6-1 summarizes SMCs for each sustainability indicator. Figure 6-1 presents a graphical overview of the components of SMCs, as they relate to chronic lowering of groundwater levels. The column on the left represents a hypothetical well for which SMCs are being established, and the blue line represents the hypothetical groundwater levels over time for the well, beginning with the SGMA effective year (WY 2015) moving forward for the first 20 years of GSP implementation. The lighter blue line (Example 1) represents a basin that has potentially not been sustainably managed. Groundwater levels are projected to decline through the first 5 years of implementation. The darker blue line (Example 2) represents groundwater levels for a sustainably managed basin (such as the RAGB). Groundwater levels vary seasonally, but there is no long-term decline. These hypothetical hydrographs are presented to help illustrate the SMC terms, as follows:

- The MO (the dashed green, horizontal line on Figure 6-1) represents the "desired condition" for the basin.
- The MT (the solid red, horizontal line on Figure 6-1) refers to a numeric value for each sustainability indicator used to define undesirable results. In other words, the MT is a threshold established at each RMP below which conditions are considered significant and unreasonable at that location. As discussed further in this chapter, a single violation of an MT does not necessarily indicate that undesirable results are present. In other words, the example hydrograph on Figure 6-1 that shows groundwater levels declining below the MT during the first 5 years of GSP implementation would not necessarily indicate an undesirable result.
- The margin of operational flexibility is not part of the SGMA-defined SMCs; however, this component is an important consideration for local water purveyors. The margin of operational flexibility represents the difference between the MO and the MT. This margin allows local water purveyors to pump more groundwater periodically to meet local water demands, while still operating the basin sustainably. The basin would not become unsustainable unless groundwater levels at one or more RMPs declined below the MT for a set period of time, as defined by the GSA.
- Interim milestones (the orange circles on Figure 6-1) refer to target values representing measurable groundwater conditions, in increments of 5 years, set by a GSA as a goal to reach the MO within the implementation period of the GSP. In the case of a sustainably managed basin, interim milestones are not required because the groundwater levels would be at or near the MO. In the case of the unsustainably managed basin, consecutive interim milestones are set so that the GSA can demonstrate that the basin is on track to reach sustainability during the first 20 years of implementation. As discussed in the following sections, the Anderson Subbasin is currently sustainable with groundwater levels at or near the MO; therefore, interim milestones are not required.
- Significant and unreasonable conditions (the hatched magenta region below the MT line on Figure 6-1) for a given sustainability indicator describe the conditions at which negative impacts on beneficial users are anticipated at this well. If a groundwater level at a given RMP were to exist below the MT for a set period of time, as defined by the GSA, then, by definition, significant and unreasonable conditions would exist.
- Undesirable results (the hatched magenta region below the MT line on Figure 6-1) describe the conditions at which a particular sustainability indicator would become significant and unreasonable. Undesirable results are defined based on a combination of MT violations for a set period of time, as defined by the GSA. For example, if groundwater levels at a number of the RMPs were to exist below the MTs for a set period of time, as defined by the GSA, then, by definition, significant and unreasonable conditions would exist. Under SGMA, the avoidance of undesirable results is how a GSA demonstrates that a basin is operating sustainably.

Table 6-1. Summary of Sustainable Management Criteria for the Anderson Subbasin

Sustainability Indicator	Measurable Objective	Minimum Threshold	Measurement	Undesirable Result
Seawater Intrusion	Sustainability indicator is not applicable to the Anderson Subbasin.			
Chronic Lowering of Groundwater Levels	Average WY 2015 through WY 2018 groundwater elevation at RMPs.	Lower of either the measured historical minimum groundwater elevation or the projected minimum groundwater elevation under the Increased Groundwater Use Scenario.	Measured at RMP network.	Condition that would occur when 25% of the same RMPs exceed the MT for three consecutive spring measurements.
Reduction of Groundwater Storage	Sustainability indicator uses groundwater levels as a proxy, SMCs are the same as the SMCs for chronic lowering of groundwater levels.			
Depletions of Interconnected Surface Water	Sustainability indicator uses groundwater levels as a proxy, SMCs are the same as the SMCs for chronic lowering of groundwater levels.			
Degraded Water Quality	No change to the number or distribution of MCL/SMCL exceedances at RMPs through 2018.	Zero new exceedances of MCL/SMCL at a given RMP for any chemical with an MCL or SMCL.	Groundwater quality data for RMPs downloaded annually from the SWRCB GAMA information system.	Condition that would occur when 25% of the same RMPs exceed the MT for two consecutive sampling events.
Land Subsidence	Level of accuracy of the InSAR datasets provided by DWR, 0.71 inch (0.06 foot) over a 5-year period (2015 to 2020).	6 inches of groundwater-pumping-induced land subsidence over a 5-year period.	Annual InSAR grid of vertical land displacement data (approximately 300- by 400-foot grid cells).	Condition that would occur when there is an average of 6 inches of groundwater-pumping-induced land subsidence over a 5-year period, averaged over the Anderson Subbasin.

To fulfill the requirements of GSP regulation § 354 Subarticle 3, the discussion of each applicable sustainability indicator in the following subsections is generally as follows:

- Description of the sustainability indicator
- Description of significant and unreasonable conditions
- Justification for proxy monitoring (if applicable)
- Description of the MO
- Description of the MT, including:
  - Information relied upon to establish the MT
  - Description of how the MTs may affect beneficial uses and users
  - Description of how the MT for a given sustainability indicator avoids undesirable results for other sustainability indicators
  - Description of how the MT may affect the ability of adjacent basins to operate sustainably
  - Description of how federal, State, or local standards relate to the MT
  - Description of how the MT will be measured
- Description of undesirable results, including:
  - Definition of how undesirable results will be identified
  - Description of what factors may cause undesirable results
  - Description of the potential effects of undesirable results on beneficial users

6.3.1 Seawater Intrusion

The Anderson Subbasin is not vulnerable to seawater intrusion, given its distance from the Pacific Ocean and associated bays and estuaries. Therefore, pursuant to GSP regulation § 354.26(d), SMCs are not applicable to this sustainability indicator.

6.3.2 Chronic Lowering of Groundwater Levels

The BMP for SMCs (DWR, 2017) defines chronic lowering of groundwater levels as a rate of decline that "indicates a significant and unreasonable depletion of supply if continued over the planning and implementation horizon." The BMP further specifies that "overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods." Figure 6-2 presents an example of two hydrographs, one in a hypothetical basin being managed sustainably and one for a hypothetical basin that could possibly be considered unsustainable, depending on how the GSA defines undesirable results. In both examples, groundwater levels rise and fall seasonally during each year. In general, groundwater levels are higher in the winter and spring (because there is more precipitation and streamflow and less groundwater pumping) and lower in the summer and fall (because there is less precipitation and more groundwater pumping). During above- or below-normal WYs (that is, average WYs), groundwater levels generally recover to or very near the previous year's spring levels. During dry or critically dry WYs, groundwater levels may decline over multiple years. In the case of a sustainably managed basin, once climatic conditions return to wet or normal conditions, groundwater levels recover to pre-drought levels. In the case of a potentially unsustainably managed basin, groundwater levels either will not recover as quickly or may continue to decline.

6.3.2.1 Description of Significant and Unreasonable Conditions

Significant and unreasonable conditions for chronic lowering of groundwater levels were defined by the EAGSA with consideration of local beneficial users. Because the Anderson Subbasin is, and has historically been, managed sustainably, the EAGSA cannot evaluate the historical dataset to identify a set of conditions or a specific timeframe that would be considered significant and unreasonable. As will be discussed further in this chapter, the EAGSA used the best available science, including numerical modeling, to evaluate potential future conditions that would be considered significant and unreasonable due to inferred impacts to beneficial users. The description of significant and unreasonable conditions is as follows:

> *Chronic lowering of groundwater levels that would cause significant and unreasonable reduction in the long-term capacity of domestic, agricultural, industrial, or municipal wells due to wells being dewatered or experiencing significantly higher lift, or reduction in beneficial environmental uses during the planning and implementation horizon of this GSP.*

6.3.2.2 Measurable Objectives

Appendix D contains period-of-record hydrographs of measured groundwater elevations for wells in the Anderson Subbasin. These data show that, in general, groundwater levels rise and fall seasonally due to wetter climatic conditions in the winter/spring and drier climatic conditions and increased groundwater pumping in the summer/fall. Groundwater levels for some wells decline over several years during drought periods, such as during WYs 1976–1977 and WYs 2013–2015. However, groundwater levels recover to pre-drought elevations during wetter climatic periods. The hydrographs in Appendix D show that, in general, groundwater levels during recent years are similar to groundwater levels 30 to 50 years ago. The lack of long-term decline in groundwater levels means that the Anderson Subbasin has been managed sustainably during historical and current periods. Because of the sustainable nature of the subbasin, the MO for chronic lowering of groundwater levels has been defined by the EAGSA as the average measured groundwater level during the current period (WYs 2015 through 2018) at each RMP. The beginning of the "current period" has been selected by the EAGSA as 2015, which is the effective date of SGMA. WY 2018 is the latest date associated with data used to develop this GSP. The MOs for the RMP network are presented graphically on hydrographs included on Figures 6-3 and 6-4a through 6-4d and the values are provided in Table 6-2.

6.3.2.3 Minimum Thresholds

The MTs for chronic lowering of groundwater levels were selected as the lower of either the historical minimum measured groundwater elevation or the minimum projected groundwater elevation under the Increased Groundwater Use Scenario at each RMP. The following sections describe the MTs for chronic lowering of groundwater levels pursuant to GSP regulation § 354.28.

Table 6-2. Chronic Lowering of Groundwater Levels Sustainable Management Criteria

RMP Name	Ground Surface Elevation (feet NAVD88)	Minimum Measured Nonpumping Groundwater Elevation (feet NAVD88)	Minimum Projected Groundwater Elevation (feet NAVD88)	Minimum Threshold (feet NAVD88)	Measurable Objective (feet NAVD88)
30N/04W-05K01	457.59	404.19	397.62	397.62	410.88
30N/05W-02Q01	712.61	602.61	550.76	550.76	606.33
30N/04W-10H04	418.80	395.40	393.72	393.72	396.83
30N/03W-18B01	400.12	381.09	380.19	380.19	383.30
30N/04W-23G01	452.55	382.15	383.96	382.15	394.25
30N/04W-22F02	447.86	391.86	385.70	385.70	396.68
30N/04W-23M01	472.33	393.52	385.30	385.30	397.94
30N/04W-25D03	472.47	387.29	384.28	384.28	392.51
30N/03W-30Q02	445.09	385.32	385.40	385.32	391.87
30N/03W-32P03	434.07	378.74	382.25	378.74	386.26
29N/04W-03R06	457.84	415.81	402.79	402.79	424.03
29N/05W-11A02	514.54	449.14	443.00	443.00	454.79
29N/05W-09L01	517.55	482.85	481.27	481.27	486.88
30N/06W-35L01	678.00	609.00	578.58	578.58	617.63

Information and Criteria Relied Upon to Establish the Minimum Thresholds

MTs for chronic lowering of groundwater levels were established through analysis of historical and projected groundwater elevations in the Anderson Subbasin and consideration of beneficial uses and users. Figure 6-3 presents a map of the RMP network within the subbasin and hydrographs for select wells. A complete set of hydrographs for the RMP network is included on Figures 6-4a through 6-4d. The hydrograph for each RMP includes the measured groundwater elevations dating back to WY 1998 (circles), the minimum historical measured groundwater elevation (black dashed line), the EAGSA Model projected groundwater elevations for the Future Baseline (solid blue line) and Increased Groundwater Use Scenario (solid green line), the MO (dashed orange line), and the MT (solid red line). As described above, groundwater levels (both measured and simulated) fluctuate annually as a result of seasonal climatic variability and increased groundwater use during drier periods. Seasonal fluctuations generally result in higher groundwater elevations in the winter and spring and lower groundwater levels during the summer and fall. Groundwater elevations typically recover from spring of one year to spring of the following year; however, there have been carryover declines in groundwater levels during multi-year droughts (such as WYs 2013 through 2015). Although there may have been localized, temporary effects on private wells during drought periods, there have not been widespread, persistent impacts related to chronic lowering of groundwater levels (i.e., overdraft) in the subbasin. This means that the subbasin has been and is currently being managed sustainably. As previously discussed, the Future Baseline simulation incorporates the EAGSA's best estimate of projected water and land use and climate change through WY 2071. Additional details regarding the Future Baseline simulation can be found in Appendix F.

As shown on the hydrographs presented on Figures 6-3 and 6-4a through 6-4d, the simulated Future Baseline groundwater elevations are similar to those observed during the historical and current periods. This means that the subbasin is projected to continue to be managed sustainably in the future. Because of the similarity in groundwater elevations between the historical and projected periods and because there have not been significant and unreasonable conditions related to chronic lowering of groundwater levels in the past, the EAGSA determined that additional information was needed to inform selection of MTs that would provide an adequate margin of operational flexibility.

As described in Chapter 4 Water Budgets, and in more detail in Appendix F, the Increased Groundwater Use Scenario was developed to account for hypothetical increased groundwater pumping due to unforeseen conditions. Examples of such conditions could include severe curtailment of surface water allocations beyond those experienced in the past, unforeseen population growth beyond the projected rates, or more severe or prolonged drought conditions than those included in the GCMs. The projected groundwater elevations from the Increased Groundwater Use Scenario are included in the RMP network hydrographs shown on Figures 6-3 and 6-4a through 6-4d as solid green lines. The projected groundwater elevations for the Increased Groundwater Use Scenario generally mimic the pattern of those for the Future Baseline Scenario. That is, there are generally smaller seasonal and multi-year fluctuations in RMPs near streams (such as 30N/04W-10H04) and larger fluctuations at RMPs near pumping centers (such as 30N/04W-22F02). The EAGSA selected the MT for the chronic lowering of groundwater levels sustainability indicator as the lower of either the historical measured minimum groundwater elevation or the projected minimum groundwater elevation from the Increased Groundwater Use Scenario. The MTs for the RMP network are presented graphically on hydrographs included on Figures 6-3 and 6-4a through 6-4d and values are provided in Table 6-2. The MTs were selected with consideration of potential impacts on beneficial users (discussed further in the next section), margin of operational flexibility, unforeseen future conditions, and stakeholder feedback. Although the MTs are based on the best available science and data, the SGMA process allows for review and revision to the SMCs, if warranted, during GSP implementation, notably during the 5-year GSP assessment updates.

How Minimum Thresholds May Affect the Interests of Beneficial Uses and Users of Groundwater or Land Uses and Property Interests

Beneficial users of groundwater in the Anderson Subbasin include the following:

- Water purveyors that use groundwater as public supply
- Small water systems that use groundwater as public supply
- Private domestic, agricultural, and industrial groundwater users
- Ecological users

The MTs for chronic lowering of groundwater levels were compared to the range of public and private well depths in the Anderson Subbasin to evaluate whether the selected MTs are reasonably protective of these beneficial users. This check was done to ensure that the MTs maintain operability for a substantial percentage of private and public wells. The proposed MTs for chronic lowering of groundwater levels do not necessarily protect all wells, because it is impractical to manage a groundwater basin in a manner that fully protects the shallowest wells. The first step in evaluation of potential effects of the selected MTs on public, private, and industrial groundwater users was to evaluate the distribution of these well types in the Anderson Subbasin. The statewide well completion dataset (CNRA, 2020) was queried to identify well locations within the subbasin that have total well depth information. An additional safety factor of 10 feet was included to ensure there is sufficient water column above the bottom of a given well to maintain operability.

The distribution of public and private wells was then compared to the October 2069 projected groundwater elevations from the Increased Groundwater Use Scenario. This was considered to be an appropriate comparison for the following reasons:

- As shown in Table 6-2, the MTs for the majority of RMPs are based on the minimum projected groundwater elevation from the Increased Groundwater Use Scenario.
- The minimum projected groundwater elevation for a majority of the RMPs occurs in October 2069.
- For RMPs where the minimum projected groundwater elevation did not occur in October 2069, the difference between the minimum projected groundwater elevation and the October 2069 groundwater elevation was generally less than 1.5 feet (that is, at these RMPs, the October 2069 groundwater elevation was less than 1.5 feet higher than the minimum projected groundwater elevation).

The comparison showed that if groundwater levels consistent with those projected in October 2069 under the Increased Groundwater Scenario were to occur, then:

- 78 percent of domestic wells in the Anderson Subbasin would have at least 10 feet of water in them.
- 92 percent of industrial, irrigation, or agricultural wells in the Anderson Subbasin would have at least 10 feet of water in them.
- 100 percent of public supply wells in the Anderson Subbasin would have at least 10 feet of water in them.

Many wells included in the statewide dataset are located within water purveyor service areas, and many wells have relatively old (pre-1960) construction dates. These observations, coupled with a lack of well abandonment/destruction information, result in uncertainty in the reliability of the reported number or location of private and public wells for the purpose of assessing potential impacts on these wells. Although there is uncertainty in the well construction dataset, these are the best available data with which to evaluate potential effects of MTs on groundwater pumpers in the subbasin at this time. Additionally, MTs will be re-assessed at a minimum frequency of 5 years during GSP implementation to determine if they are still appropriate given the new monitoring data that will be collected between 5-year assessments.

An assessment of potential effects of the MTs on ecological beneficial users was performed by comparing potential impacts on the extent of GDEs overlying areas of groundwater within 30 feet bgs. Figure 6-5 presents a comparison of the extent of shallow groundwater (depth to water less than or equal to 30 feet bgs) between spring 2018 and a dry month during the projection period under the Increased Groundwater Use Scenario (fall 2069). The latter condition was selected as a conservative estimate of potential depth to water under a multi-year drought and substantially higher than current groundwater pumping within the basin (i.e., a "worst-case" scenario). As shown on Figure 6-5, the lateral extents of groundwater within 30 feet of ground surface in the south/southeastern of the subbasin where most GDE communities thrive are less in fall 2069 under the Increased Groundwater Use Scenario as compared to spring 2018. The total GDE acreage within the 30-feet-to-groundwater zone is approximately 3 percent less (approximately 3,880 acres in fall 2069 compared to 4,000 acres in spring 2018). Therefore, the selected MTs are considered protective of ecological beneficial users.

Relationship between the Minimum Thresholds for Each Sustainability Indicator

In accordance with GSP regulations § 354.28(b)(2), Table 6-3 is a matrix that includes descriptions regarding the relationships between sustainability indicators and how the MTs for a given sustainability indicator avoid undesirable results for the other sustainability indicators. For example, to assess how the MTs for chronic lowering of groundwater levels avoid undesirable results for degraded water quality, one would go to the first column ("Chronic Lowering of Groundwater Levels") and read down to the fourth column ("Degraded Water Quality"). The turquoise-shaded cell describes the relationship between the two sustainability indicators.

How Minimum Thresholds Have Been Selected to Avoid Causing Undesirable Results in Adjacent Basins

As shown on Figure 2-1, the Anderson Subbasin is bordered by the Bowman Subbasin to the south, the Enterprise Subbasin to the east/northeast, and the Millville Subbasin to the east. The SMCs for both the Enterprise and Anderson Subbasins were developed by the EAGSA using the same approach; therefore, the SMCs in one subbasin will not affect the sustainability of the other subbasin. The Bowman and Millville Subbasins are designated as a very low-priority basins and are not required to develop a GSP under SGMA (DWR, 2020c). The Sacramento River drains the RAGB; therefore, the water table in the Millville Subbasin would not be expected to be substantially hydraulically connected to the Anderson Subbasin (that is, shallow groundwater from the Millville Subbasin would be expected to discharge to the Sacramento River rather than flowing into the Anderson Subbasin). Similarly, Cottonwood Creek represents a groundwater discharge area between the Anderson and Bowman Subbasins. Some amount of groundwater at depth could flow between adjacent subbasins in response to deeper groundwater pumping. Because the selected MTs are below the historical minimum groundwater elevations at some RMPs, lowering of groundwater levels in the Anderson Subbasin could increase groundwater flow exchange between adjacent subbasins. However, if undesirable results are avoided in the Anderson Subbasin, then significant and unreasonable groundwater conditions in the Bowman and Millville Subbasins will be avoided, and groundwater users therein should be able to continue operating sustainably. The EAGSA will monitor conditions, particularly at RMPs near the subbasin boundary, and coordinate with GSAs of adjacent subbasins as appropriate during GSP implementation.

How State, Federal, or Local Standards Relate to the Chronic Lowering of Groundwater Levels

There are no State, federal, or local standards related to groundwater levels applicable in this subbasin.

Table 6-3. Description of Relationship Between Minimum Thresholds for Each Sustainability Indicator

Sustainability Indicator	Chronic Lowering of Groundwater Levels	Reduction of Groundwater Storage	Depletions of Interconnected Surface Water	Degraded Water Quality	Land Subsidence
Chronic Lowering of Groundwater Levels		Groundwater levels and the estimated groundwater in storage are inter-related, as discussed in Section 6.3.3. The MTs for chronic lowering of groundwater levels are being used as a proxy for reduction in groundwater storage. As such, avoidance of undesirable results for chronic lowering of groundwater levels will avoid undesirable results for reduction in groundwater storage.	The MTs for chronic lowering of groundwater levels are being used as a proxy for depletions of interconnected surface water. As such, avoidance of undesirable results for chronic lowering of groundwater levels will avoid undesirable results for depletions of interconnected surface water.	The MTs for chronic lowering of groundwater levels are established below historical measured minimum levels for some RMPs. If these MTs are violated, there might be changes in groundwater flow directions in the subbasin that could induce migration of existing areas of groundwater-quality impairments into currently unimpaired areas.	Based on available information, there have not been issues related to groundwater-pumping-induced subsidence in the subbasin. Some of the MTs for chronic lowering of groundwater levels are below the historical minimum levels. If groundwater levels lower than historical minimums are reached, there is a possibility that land subsidence might occur; however, the subsurface materials are not susceptible to compaction and subsidence due to dewatering because there are no extensive clay aquitards in the subbasin.
Reduction of Groundwater Storage	Groundwater levels and the estimated groundwater in storage are inter-related, as discussed in Section 6.3.3. The MTs for chronic lowering of groundwater levels are being used as a proxy for reduction in groundwater storage. As such, avoidance of undesirable results for chronic lowering of groundwater levels will avoid undesirable results for reduction in groundwater storage		The MTs for chronic lowering of groundwater levels are being used as a proxy for depletion of interconnected surface water. Avoidance of undesirable results for chronic lowering of groundwater levels will avoid undesirable results for reduction in depletions of interconnected surface water.	The MTs for chronic lowering of groundwater levels are being used as a proxy for reduction in groundwater storage. If these MTs are violated, there may be changes in groundwater flow directions in the subbasin that could induce migration of existing areas of groundwater-quality impairments into currently unimpaired areas.	The MTs for chronic lowering of groundwater levels are being used as a proxy for reduction in groundwater storage. The MTs for chronic lowering of groundwater levels are protective against groundwater-pumping-induced land subsidence because they tend to discourage groundwater levels from being lowered much beyond historical minimum levels. There has also never been obvious undesirable results related to groundwater-pumping-induced land subsidence in the RAGB.
Depletions of Interconnected Surface Water	The MTs for chronic lowering of groundwater levels are being used as a proxy for depletions of interconnected surface water. As such, avoidance of undesirable results for chronic lowering of groundwater levels will avoid undesirable results for depletions of interconnected surface water.	The MTs for chronic lowering of groundwater levels are being used as a proxy for depletion of interconnected surface water. Avoidance of undesirable results for chronic lowering of groundwater levels will avoid undesirable results for reduction in depletions of interconnected surface water.		The MTs for chronic lowering of groundwater levels are being used as a proxy for depletions of interconnected surface water. If these MTs are violated, there may be changes in groundwater flow directions in the subbasin that could induce migration of existing areas of groundwater-quality impairments into currently unimpaired areas.	The MTs for chronic lowering of groundwater levels are being used as a proxy for depletions of interconnected surface water. The MTs for chronic lowering of groundwater levels are protective against groundwater-pumping-induced land subsidence because they tend to discourage groundwater levels from being lowered much beyond historical minimum levels. There has also never been obvious undesirable results related to groundwater-pumping-induced land subsidence in the RAGB.
Degraded Water Quality	The MTs for chronic lowering of groundwater levels are established below historical measured minimum levels for some RMPs. If these MTs are violated, there might be changes in groundwater flow directions in the subbasin that could induce migration of existing areas of groundwater quality impairments into currently unimpaired areas.	The MTs for chronic lowering of groundwater levels are being used as a proxy for reduction in groundwater storage. If these MTs are violated, there may be changes in groundwater flow directions in the subbasin that could induce migration of existing areas of groundwater quality impairments into currently unimpaired areas.	The MTs for chronic lowering of groundwater levels are being used as a proxy for depletions of interconnected surface water. If these MTs are violated, there may be changes in groundwater flow directions in the subbasin that could induce migration of existing areas of groundwater-quality impairments into currently unimpaired areas.		The MTs for land subsidence are set at levels that should not change groundwater flow directions in the subbasin enough to induce migration of existing areas of degraded groundwater quality into currently unimpaired areas.

Table 6-3. Description of Relationship Between Minimum Thresholds for Each Sustainability Indicator

Sustainability Indicator	Chronic Lowering of Groundwater Levels	Reduction of Groundwater Storage	Depletions of Interconnected Surface Water	Degraded Water Quality	Land Subsidence
Land Subsidence	Based on available information, there have not been issues related to groundwater-pumping-induced subsidence in the subbasin. Some of the MTs for chronic lowering of groundwater levels are below the historical minimum levels. If groundwater levels lower than historical minimums are reached, there is a possibility that land subsidence might occur; however, the subsurface materials are not susceptible to compaction and subsidence due to dewatering because there are no extensive clay aquitards in the subbasin.	The MTs for chronic lowering of groundwater levels are being used as a proxy for reduction in groundwater storage. The MTs for chronic lowering of groundwater levels are protective against groundwater-pumping-induced land subsidence because they tend to discourage groundwater levels from being lowered much beyond historical minimum levels. There has also never been obvious undesirable results related to groundwater-pumping-induced land subsidence in the RAGB.	The MTs for chronic lowering of groundwater levels are being used as a proxy for depletions of interconnected surface water. The MTs for chronic lowering of groundwater levels are protective against groundwater-pumping-induced land subsidence because they tend to discourage groundwater levels from being lowered much beyond historical minimum levels. There has also never been obvious undesirable results related to groundwater-pumping-induced land subsidence in the RAGB.	The MTs for land subsidence are set at levels that should not change groundwater flow directions in the subbasin enough to induce migration of existing areas of degraded groundwater quality into currently unimpaired areas.	

Notes:

The sustainability indicator for seawater intrusion is not shown because it is not applicable to the Anderson Subbasin.

The SMCs for all applicable sustainability indicators will be reviewed periodically by the EAGSA. The SMCs may be adjusted based on information and data collected during GSP implementation. If undesirable results occur for any applicable sustainability indicator, the EAGSA may take additional actions as described in Chapter 7.

Light blue cells describe the relationship between the chronic lowering of groundwater levels and reduction in groundwater storage sustainability indicators.

Orange cells describe the relationship between the chronic lowering of groundwater levels and depletion of interconnected surface-water sustainability indicators.

Turquoise cells describe the relationship between the chronic lowering of groundwater levels and degraded water quality sustainability indicators.

Bright yellow cells describe the relationship between the chronic lowering of groundwater levels and land subsidence sustainability indicators.

Purple cells describe the relationship between the reduction in groundwater storage and depletion of interconnected surface-water sustainability indicators.

Pink cells describe the relationship between the reduction in groundwater storage and degraded water quality sustainability indicators.

Gray cells describe the relationship between the reduction in groundwater storage and land subsidence sustainability indicators.

Medium blue cells describe the relationship between the depletion of interconnected surface water and degraded water quality sustainability indicators.

Light yellow cells describe the relationship between the depletion of interconnected surface water and land subsidence sustainability indicators.

Green cells describe the relationship between the degraded water quality and land subsidence sustainability indicators.

How the Minimum Threshold Will Be Quantitatively Measured

The process for evaluation of chronic lowering of groundwater-level MTs is as follows:

- Groundwater levels will be collected from all wells in the monitoring network at least twice per year, during seasonal high and seasonal low conditions. Spring groundwater-level measurements will be used to evaluate MTs at the RMPs.
- The spring groundwater elevations will be evaluated to assess whether MTs were violated. If there are violations of the MTs, then:
  - The number of RMPs with violations will be noted.
  - The location of RMPs with violations will be noted.

The data from the previous years will be evaluated to determine whether there were violations of the MTs at the RMPs during consecutive previous years.

6.3.2.4 Undesirable Results

Description of Undesirable Results

Undesirable results for chronic lowering of groundwater levels in the Anderson Subbasin are defined as:

> *Chronic lowering of groundwater levels that would cause significant and unreasonable reduction in the long-term capacity of domestic, agricultural, industrial, or municipal wells due to wells being dewatered or experiencing significantly higher lift, or reduction in beneficial environmental uses during the planning and implementation horizon of this GSP.* ***Undesirable results would occur when 25 percent of the same RMPs exceed the MT for three consecutive spring groundwater-level measurements, excluding drought years.***

As discussed above, the BMP for SMCs and California Water Code Chapter 2 Definitions (10721) states that: "*Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.*" The analyses in this GSP demonstrate that undesirable results are not expected to occur during reasonably anticipated future drought years, based on data from recent historical droughts and numerical modeling. MT exceedances that occur due to any future droughts that are more severe than the reasonably anticipated future ones do not constitute an undesirable result because historical data indicate that recharge during subsequent normal and wet years will offset any reductions during the drought.

Identification of Undesirable Results

There are fourteen RMPs in the Anderson Subbasin; therefore, undesirable results could potentially occur when four of the RMPs violate the MTs. The analysis of spring groundwater levels against the MTs described above will provide the necessary information to determine whether undesirable results are present for a given year. If there are four RMPs with MT violations, the EAGSA will assess if there were violations of the MTs at those same RMPs during the previous 2 years. If one or more of these RMPs did not violate the MT in one or both of the previous years, it will be concluded that undesirable results are not present. If all four of the RMPs violated the MT during both of the previous 2 years, the current year would represent the third consecutive MT violation, and it would be concluded that undesirable results are present. The EAGSA would perform further investigation and implementation of management actions described in Chapter 7 after the second consecutive year of MT violations in an attempt to avoid undesirable results. Tables 6-4a and 6-4b present examples of combinations of MT violations that do and do not result in the determination that undesirable results are present. In the first example (Table 6-4a), although 25 percent or more of the RMPs (at least four RMPs) violate MTs during each year, it is not the same set of RMPs that violate MTs for all 3 consecutive years; therefore, undesirable results are not present. In the second example (Table 6-4b), the same four RMPs violate the MTs for 3 consecutive years; therefore, this combination meets the criteria for the determination that undesirable results are present.

Table 6-4a. Example of Determination of No Undesirable Results

RMP Name	Violation of Minimum Threshold?		
	Year 1	**Year 2**	**Year 3**
30N/04W-05K01			
30N/05W-02Q01	Yes	Yes	
30N/04W-10H04			
30N/03W-18B01		Yes	Yes
30N/04W-23G01	Yes	Yes	Yes
30N/04W-22F02			
30N/04W-23M01			
30N/04W-25D03	Yes		Yes
30N/03W-30Q02			
30N/03W-32P03			
29N/04W-03R06	Yes		
29N/05W-11A02		Yes	
29N/05W-09L01			
30N/06W-35L01			Yes

Table 6-4b. Example of Determination of Undesirable Results Present

RMP Name	Violation of Minimum Threshold?		
	Year 1	**Year 2**	**Year 3**
30N/04W-05K01			
30N/05W-02Q01			
30N/04W-10H04	Yes	Yes	Yes
30N/03W-18B01			
30N/04W-23G01			

Table 6-4b. Example of Determination of Undesirable Results Present

RMP Name	Violation of Minimum Threshold?		
	Year 1	Year 2	Year 3
30N/04W-22F02			
30N/04W-23M01	Yes	Yes	Yes
30N/04W-25D03			
30N/03W-30Q02			
30N/03W-32P03			
29N/04W-03R06			
29N/05W-11A02	Yes	Yes	Yes
29N/05W-09L01			
30N/06W-35L01	Yes	Yes	Yes

Potential Causes of Undesirable Results

Significant and unreasonable lowering of groundwater levels in the Anderson Subbasin is highly unlikely. However, if such conditions were to occur, they would more likely result from increased groundwater pumping due to unforeseen factors, such as unexpected population growth, substantial changes in land use, greater-than-anticipated surface-water curtailments, or climatic conditions more severe than those considered in the Future Baseline and Increased Groundwater Use Scenarios.

Effects on Beneficial Users

If undesirable results from chronic lowering of groundwater levels were to occur, beneficial users could potentially experience reduced well yields, increased pumping costs, financial burden to construct new or modify existing wells, or reduction in crop and/or GDE health. In the event that private well owners experience these conditions, such information could be reported to the DWR Household Water Supply Shortage Reporting System.[13] The EAGSA will consider this information when reviewing SMCs during development of the 5-year GSP updates.

6.3.3 Reduction of Groundwater Storage

As described in Chapters 3 and 4, useable groundwater under SGMA in the Anderson Subbasin is water that exists underground in the principal aquifer in the pore spaces between soil grains (similar to water-filled pore space in a sponge). Groundwater storage is the thickness of the principal aquifer (i.e., the depth to bedrock forming the bottom of the principal aquifer minus the depth to the water table) times the area of the principal aquifer times the specific yield of the aquifer. The specific yield is a parameter related to how much groundwater can drain by gravity from the principal aquifer. A specific yield of 10 percent has been estimated for the principal aquifer of the Anderson Subbasin (see Appendix F for additional details). The change in groundwater storage is the difference between the groundwater inflow to the principal aquifer (such as groundwater recharge from precipitation or groundwater recharge from

[13] https://mydrywell.water.ca.gov/report/

streams) and the groundwater outflow from the principal aquifer (such as groundwater discharge to streams or groundwater pumping) during a specified period.

Figure 6-6 presents example graphs of groundwater in storage over time for a sustainably managed basin and a potentially unsustainably managed basin. In the example of a sustainably managed basin, groundwater in storage varies from year to year, decreases during multiple dry years (droughts), but fully recovers to pre-drought volumes when wetter climatic conditions resume. The overall long-term volume of groundwater in storage over timeframes of decades does not change much; therefore, the basin is sustainable. In the example of a potentially unsustainably managed basin, groundwater in storage also varies from year to year, but continues to decrease over the long term due to over pumping (i.e., overdraft).

6.3.3.1 Description of Significant and Unreasonable Conditions

Significant and unreasonable conditions for reduction in groundwater storage were determined by the EAGSA with consideration of local beneficial users. The description of significant and unreasonable conditions is as follows:

> *Reduction in groundwater storage that would cause significant and unreasonable reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses during the planning and implementation horizon of this GSP.*

6.3.3.2 Justification for Use of Groundwater Levels as a Proxy

GSP regulations § 354.28(d) state that "an Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence." Figure 6-7 provides a simplified graphical representation of the correlation between groundwater levels and groundwater in storage. In the left illustration on Figure 6-7, the inflows to the groundwater system are equal to the outflows; therefore, there is no change in the water level in the aquifer (or "bucket"). In the middle illustration, the inflows to the aquifer are greater than the outflows; therefore, the volume of water in storage increases, and the water level rises. In the right illustration, the inflows to the aquifer are less than the outflows; therefore, the volume of water in storage decreases, and the water level decreases. This figure illustrates the concept that if there were reductions in groundwater storage, the decrease would be reflected in declining groundwater levels measured at RMPs. Additionally, the volume of groundwater in storage cannot be directly measured. Rather, the volume of groundwater in storage is estimated based on the interpretation of the water table elevation across the subbasin, the interpretation of the depth of the bottom of the subbasin, and the specific yield as discussed in Section 6.3.3. Because the estimated groundwater in storage is dependent on interpretation of the water table elevation, the EAGSA is using the MTs established for chronic lowering of groundwater levels as a proxy for the reduction in groundwater storage sustainability indicator.

Similar to the SMCs for chronic lowering of groundwater levels, reduction in groundwater storage was evaluated using historical estimates and future projections from the EAGSA Model. Figure 4-10 presents plots of the estimated total groundwater in storage within the subbasin (solid blue lines), the annual change in groundwater storage (yellow bars), and the cumulative change in groundwater storage (dashed red lines) over time. The top chart presents estimates from the EAGSA Model for the historical and current periods (WYs 1999 through 2018) and the Future Baseline simulation for the projection period (WYs 2019 through 2071). The estimated groundwater in storage in the Anderson Subbasin during WY 2015 (SGMA effective year) is approximately 6,300 TAF. The annual changes in groundwater storage (yellow bars) show a roughly equal distribution of increases and decreases (positive and negative values) during the historical, current, and projection periods, indicating a long-term balance in groundwater storage.

Although there is a decrease in the cumulative change in storage during the prolonged drought beginning in approximately 2050, having groundwater outflows exceed groundwater inflows during droughts is normal and not itself an indicator of overdraft conditions, as defined in California Water Code § 10721 (x)(1). As shown on Figure 4-10, the estimated volume of groundwater in storage at WY 2071 (the end of the projection period) is also approximately 6,300 TAF. This suggests that given the EAGSA's best estimate of future water supply and demand, there is essentially no projected change in groundwater storage beyond the SGMA effective year (WY 2015).

As described in Section 6.3.3, the MTs for chronic lowering of groundwater levels were informed by the Increased Groundwater Use Scenario. In the Anderson Subbasin, the EAGSA Model simulated groundwater pumping for the Increased Groundwater Use Scenario increased by a factor of 4 over the historical and current baseline pumping rates and by a factor of 2.5 over the Future Baseline simulation pumping rates. The bottom chart on Figure 4-10 presents the estimated changes in groundwater storage over time for the Increased Groundwater Use Scenario. Similar to the Future Baseline simulation, there is a roughly equal distribution of annual increases and decreases in groundwater storage; however, the magnitude of the changes is slightly larger. The estimated groundwater in storage at WY 2071 is approximately 6,200 TAF, which represents less than a 2 percent reduction in total groundwater storage from the SGMA effective year (6,300 TAF in WY 2015). Because this is a small reduction in groundwater storage, the MTs established for chronic lowering of groundwater levels (using the Increased Groundwater Use Scenario) are considered to be applicable to the reduction in groundwater storage sustainability indicator.

6.3.3.3 Measurable Objectives

Because groundwater levels are being used as a proxy, the MOs for reduction in groundwater storage are the same as those for chronic lowering of groundwater levels (Table 6-2).

6.3.3.4 Minimum Thresholds

Because groundwater levels are being used as a proxy, the MTs for reduction in groundwater storage are the same as those for chronic lowering of groundwater levels, the lower of either the historical minimum measured groundwater elevation or the minimum projected groundwater elevation under the Increased Groundwater Use Scenario at each RMP (Table 6-2). Additionally, supporting information associated with the MTs (such as how MTs have been selected to avoid undesirable results in adjacent subbasins and how State, federal, or local standards apply to the MTs) are the same as those described for chronic lowering of groundwater levels.

6.3.3.5 Undesirable Results

Undesirable results for reduction in groundwater storage in the Anderson Subbasin are defined as:

> *Significant and unreasonable reduction in groundwater storage is that which would cause reduction in the long-term viability of domestic, agricultural, municipal, or environmental uses during the planning & implementation horizon of this GSP.* ***Using groundwater-levels as a proxy, undesirable results occur when 25 percent of the same RMPs exceed the chronic lowering of groundwater level MTs for three consecutive spring measurements, excluding drought years.***

Because groundwater levels serve as a proxy for the reduction in groundwater storage sustainability indicator, the identification of undesirable results, potential causes of undesirable results, and effects on beneficial users are the same as those described for the chronic lowering of groundwater levels sustainability indicator (Section 6.3.3).

6.3.4 Depletions of Interconnected Surface Water

As discussed in Chapter 3, surface water that is in hydraulic communication with the groundwater flow systems is referred to as interconnected surface water. If the water table beneath a stream is higher than the streambed elevation, the stream is considered to be an interconnected surface-water body (see Figure 3-16). If the water table is lower than the streambed elevation, the stream is considered to be a disconnected surface-water body. SGMA only applied to streams that are hydraulically connected to groundwater. Additionally, the EAGSA does not have authority to manage reservoir releases and is not required to manage surface waters.

6.3.4.1 Description of Significant and Unreasonable Conditions

Significant and unreasonable conditions for depletion of interconnected surface water were determined by the EAGSA with consideration of local beneficial users. The description of significant and unreasonable conditions is as follows:

> *Significant and unreasonable depletions of interconnected surface water are those which result in adverse effects on beneficial uses and users of interconnected surface water, such as inadequate supply for water rights holders or decreased GDE acreage, within the Anderson Subbasin and reduced surface water outflow from the Subbasin such that downstream beneficial users in the northern Sacramento Valley are impacted during the planning and implementation horizon of this GSP.*

6.3.4.2 Justification for Use of Groundwater Levels as a Proxy

GSP regulations § 354.28(c)(6) specify that the MT for the depletion of interconnected surface water sustainability indicator "shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results." Depletions of interconnected surface water due to groundwater pumping cannot be directly measured; thus, computer models are used to estimate depletions of interconnected surface water due to groundwater pumping.

Figures 6-8 and 6-9 present maps of the estimated distribution of interconnected surface water for streams in the Anderson Subbasin. These maps were generated using the EAGSA Model for seasonal high and low groundwater conditions, assumed to be April and October, respectively. All of the simulated April water-table elevations in WYs 1999 through 2018 were averaged to develop a seasonal high-water-table distribution, and all of the simulated October water-table elevations over that same time period were averaged to develop a seasonal low-water-table distribution. The average water-table elevations were then compared to the stream bottom elevations estimated from available topographic information (USGS, 2019b; USGS, 2018; COR, 2019b) to evaluate where modeled streams and the water table were in direct connection (that is, the water table at a given point is above the stream bottom elevation). Portions of the streams that are symbolized as blue lines represent interconnected surface water, whereas portions of the streams that are symbolized as orange lines are streams that are not interconnected (that is, the water table is below the bottom of the stream bed). As shown on Figures 6-8 and 6-9, the entire lengths of the Sacramento River and Cottonwood Creek are interconnected under both seasonal high and seasonal low-water-table conditions. This represents approximately 50 river miles of interconnected surface water. Given this length of stream, it is not practical to estimate depletions of interconnected surface water with observational data, because it would require significantly more infrastructure than is present. Furthermore, the use of field measurements would include uncertainties related to the accuracy of streamflow measurements and the fact that only total stream depletions could be estimated. It would not be possible to directly quantify depletions of interconnected surface water solely due to groundwater pumping using observational data without the aid of computer modeling.

Because of the inability to quantify depletions of interconnected surface water due to groundwater pumping through direct field measurements, the EAGSA is using the SMCs established for chronic lowering of groundwater levels as a proxy. To confirm whether this approach is appropriate, the post-2015 (SGMA effective year) surface-water depletions due to groundwater pumping from the Increased Groundwater Use Scenario were computed and evaluated to assess whether significant and unreasonable conditions would likely result. Evaluation of whether the chronic lowering of groundwater level SMCs would be protective of depletions of interconnected surface water sustainability indicator focused on the Sacramento River and Cottonwood Creek. This is because these are the major, perennial streams in the subbasin that are interconnected along the entire stream length during portions of the year. The analysis was performed as follows:

- The EAGSA Model was run without any groundwater pumping. The simulation was then processed to extract monthly total streamflows at the stream exit points from the subbasin for the simulation period (WY 1999 through WY 2071). Because multiple hydrologic processes are simultaneously simulated in the EAGSA Model, turning off groundwater pumping in the model increases estimated streamflows through a combination of hydrologic responses. In general, groundwater levels are higher (that is, closer to the land surface) in the absence of groundwater pumping. Higher groundwater levels lead to increased streamflows by increasing the volume of rejected recharge (precipitation that does not infiltrate runs off to streams), increasing groundwater discharge to streams, decreasing groundwater recharge from streams, and increasing evapotranspiration of shallow groundwater rather than evapotranspiration of precipitation (which increases runoff to streams).
- A second EAGSA Model run was conducted that included the historical groundwater pumping. This simulation was then processed to extract monthly total streamflows at the same stream exit points from the subbasin for the simulation period. Similar to the description of the interrelationship between multiple hydrologic processes included in the EAGSA Model in the bullet above, the presence of groundwater pumping in the model decreases modeled streamflows through a combination of hydrologic responses. In general, groundwater levels are lower (that is, deeper) when groundwater pumping occurs. Lower groundwater levels lead to decreased streamflows by decreasing the volume of rejected recharge (more precipitation would infiltrate rather than running off to streams), decreasing groundwater discharge to streams, increasing groundwater recharge from streams, and increasing evapotranspiration of precipitation rather than evapotranspiration of shallow groundwater (which would further reduce runoff to streams).
- The monthly simulated streamflow for the nonpumping simulation were subtracted from the simulation that included groundwater pumping to compute the stream depletion due to groundwater pumping for the historical period.
- The monthly simulated streamflow for a third simulation, the Increased Groundwater Use Scenario, and the same process was used to extract monthly total streamflows at the same exit points.
- The monthly simulated streamflows for the nonpumping simulation were subtracted from the streamflows from the Increased Groundwater Use Scenario to compute the stream depletion that could potentially occur due to the multiple interconnected hydrologic processes if groundwater pumping in the subbasin were increased 2.5 to 4 times beyond the “best estimate” of future conditions.
- The data were then rolled up to the average annual values and summarized in Table 6-5.

Table 6-5. Estimated Depletion of Interconnected Surface Water Due to Groundwater Pumping

Description	Sacramento River Streamflow at Confluence with Cottonwood Creek (cfs)	Cottonwood Creek Streamflow at Confluence with Sacramento River (cfs)
Average Annual Depletion of Interconnected Surface Water Due to Groundwater Pumping[a] Prior to SGMA Effective Date (WY 1999 through WY 2014)	38	14
Average Annual Depletion of Interconnected Surface Water Due to Groundwater Pumping[a] in the Increased Groundwater Use Scenario (WY 2015 through WY 2071)	217	89
Average Annual Depletion of Interconnected Surface Water Due to Increased Groundwater Use Scenario beyond that Prior to SGMA Effective Date	179	75
Average Annual Simulated Streamflow under the Increased Groundwater Use Scenario (WY 2015 through WY 2071)	10,130	1,050
Interconnected Surface Water Depletion as a Percentage of Streamflow Due to Increased Groundwater Use Scenario beyond that Prior to SGMA Effective Date	1.8%	7.1%
Measured Streamflow Minimum/Average/Maximum (1999 through 2018)	3,730 11,900 92,600	16 863 32,900

[a]Streamflow depletions are the result of multiple interrelated hydrologic processes that together affect the total estimated streamflow. Additional details regarding the EAGSA Model are presented in Appendix F.

Note:

Measured streamflow sources:

Data source for Sacramento River: USGS Station 113377100, Sacramento River above Bend Bridge near Red Bluff, CA (https://waterdata.usgs.gov/usa/nwis/uv?site_no=11377100)

Data source for Cow Creek: USGS Station 11376000, Cottonwood Creek near Cottonwood, CA (https://waterdata.usgs.gov/ca/nwis/uv?site_no=11376000)

The first row in Table 6-5 represents the average annual depletion of interconnected surface water because of groundwater pumping prior to the SGMA effective year. As discussed in the first bullet above, these streamflow depletions are due to the interrelated hydrologic processes that together affect total streamflows. Additionally, as previously discussed, the EAGSA is not responsible for improving depletions of interconnected surface water that occurred prior to SGMA becoming effective in 2015. The second row in Table 6-5 presents the projected average annual depletion of interconnected surface water because of greater-than-reasonably-anticipated groundwater pumping conditions under the Increased Groundwater Use Scenario. The third row presents the difference between the first two rows. This difference represents the average annual depletion of interconnected surface water beyond that which occurred prior to the SGMA effective year if future groundwater pumping in the subbasin were to increase 2.5 to 4 times beyond that which is anticipated. The remaining three rows in Table 6-5 provide information regarding the average annual simulated streamflow, the estimated average annual projected depletion of interconnected surface water beyond that at the time of SGMA effective year as a percentage of simulated streamflow, and the range of measured streamflow for the Sacramento River and Cottonwood Creek.

Using the information in Table 6-5, the EAGSA evaluated whether the estimated depletions of interconnected surface water would result in significant and unreasonable conditions for beneficial users of surface water. This evaluation resulted in the following conclusions:

- Water purveyors that use surface water as supply and other surface water rights holders are not anticipated to be unreasonably affected by the estimated depletions in interconnected surface water. The SWRCB electronic water rights information management system[14] includes total point of direct diversion rights of approximately 580 cfs for the Sacramento River and 3.9 cfs for Cottonwood Creek. If the magnitude of depletion of interconnected surface waters estimated under the Increased Groundwater Use Scenario were to occur, the average annual remaining instream flow is sufficient to meet the point of direct diversion water rights.
- Downstream surface water users are not anticipated to be unreasonably affected should the magnitude of depletions of interconnected surface water occur given that the reduction in Sacramento River flow exiting the subbasin would likely be within the measurement error of its stream gauge.
- Ecological users are not anticipated to be unreasonably affected should the magnitude of depletions of interconnected surface water included in Table 6-5 occur. As shown on Figure 6-5, the GDE acreage overlying areas of shallow groundwater is approximately 3 percent smaller as projected under the extreme low groundwater conditions in the Increased Groundwater Use Scenario (fall 2069) compared to seasonal high groundwater conditions during the current period (WY 2018). Additionally, because the estimated depletion of interconnected surface water in the Sacramento River is projected to be within the measurement error of its stream gauge, aquatic species (such as salmon) would not be affected.

Groundwater and surface water are interconnected in the Anderson Subbasin as shown on Figures 6-8 and 6-9 and as indicated by the approximate 200 to 230 TAF of average annual projected groundwater discharge to streams estimated for the Increased Groundwater Use Scenario and historical conditions, respectively (Chapter 4, Appendix F). Furthermore, the Increased Groundwater Use Scenario was used to establish the MTs for chronic lowering of groundwater levels and to estimate depletions of interconnected surface water described above. Because the projected depletions of interconnected surface water under the Increased Groundwater Use Scenario are not anticipated to create significant and unreasonable conditions for beneficial users of surface water, use of the MTs for chronic lowering of groundwater levels as a proxy for depletions of interconnected surface water is considered appropriate. As described in Section 6.3.3, some of the MTs for chronic lowering of groundwater levels are based on the historical minimum measured groundwater level, rather than the projected minimum groundwater level under the Increased Groundwater Use Scenario. Pursuant to GSP regulation § 356.4(f), the EAGSA will periodically review the SMCs and update them, as appropriate.

6.3.4.3 Measurable Objectives

Because groundwater levels are being used as a proxy, the MOs for depletions of interconnected surface water are the same as those for chronic lowering of groundwater levels (Table 6-2).

6.3.4.4 Minimum Thresholds

Because groundwater levels are being used as a proxy, the MTs for depletions of interconnected surface water are the same as those for chronic lowering of groundwater levels, the lower of either the historical

[14] https://ciwqs.waterboards.ca.gov/ciwqs/ewrims/EWMenuPublic.jsp

minimum measured groundwater elevation or the minimum projected groundwater elevation under the Increased Groundwater Use Scenario at each RMP (Table 6-2). Additionally, supporting information associated with the MTs (such as how MTs have been selected to avoid undesirable results in adjacent subbasins and how State, federal, or local standards apply to the MTs) are the same as those described for chronic lowering of groundwater levels.

6.3.4.5 Undesirable Results

Undesirable results for depletions of interconnected surface water in the Anderson Subbasin are defined as:

> *Significant and unreasonable depletions of interconnected surface water are those which result in adverse effects on beneficial uses and users of interconnected surface water, such as inadequate supply for water rights holders or decreased GDE acreage, within the Anderson Subbasin and reduced surface water outflow from the Subbasin such that downstream beneficial users in the northern Sacramento Valley are impacted during the planning and implementation horizon of this GSP.* ***Using groundwater-levels as a proxy, undesirable results occur when 25 percent of the same RMPs exceed the chronic lowering of groundwater level MTs for three consecutive spring measurements, excluding drought years.***

Although groundwater levels are being used as a proxy for this sustainability indicator, the drought year exception included in California Water Code Chapter 2 (referenced in Section 6.3.2.4 above) is not applicable to depletions of interconnected surface water.

6.3.5 Degraded Water Quality

Groundwater quality in California is regulated by a number of federal, State, and local agencies including, but not limited to, EPA, CalEPA, DTSC, and RWQCB. These entities are charged with enforcing federal and State water quality regulations, including both drinking water and agricultural uses. Although, degraded groundwater quality is one of the SGMA sustainability indicators, the emphasis on the SGMA legislation is sustainable management of groundwater quantity. As such, GSAs are not responsible for remediating (that is, cleaning up) areas of historically impaired groundwater that fall under the jurisdiction of other regulatory agencies. Rather, GSAs are responsible for identifying areas of impaired groundwater and ensuring that management of water resources within a subbasin do not further degrade groundwater quality beyond conditions that were present as of the SGMA effective year (WY 2015). For example, if there is a contaminant plume emanating from a leaky tank at a gas station, a GSA is not responsible for cleaning up the plume, because other agencies regulate this activity. The GSA is responsible for ensuring that groundwater management, such as increased pumping in a certain area, does not induce movement of the existing plume into areas of clean groundwater.

6.3.5.1 Description of Significant and Unreasonable Conditions

Significant and unreasonable conditions for degraded water quality were determined by the EAGSA with consideration of local beneficial users. The description of significant and unreasonable conditions is as follows:

> *Significant and unreasonable conditions for degraded water quality is an impact stemming from SGMA-related groundwater management activities, such as groundwater extraction/recharge, that causes reduction in groundwater quality for beneficial users during the GSP planning and implementation horizon.*

6.3.5.2 Measurable Objectives

As described in Chapter 8 Plan Implementation, there are 72 water quality RMPs in the Anderson Subbasin. The groundwater quality data for these locations (SWRCB, 2020b) were evaluated to determine which chemical constituents exceeded State or federal drinking water standards (that is, MCLs or SMCLs) through the current period (prior to 2018). The SMC for degraded water quality focus on drinking water standards, as agricultural groundwater use is limited in the subbasin. Table 6-6 summarizes this information, including the location name, the chemical constituents that exceeded the drinking water standard through 2018, the number of times that a drinking water standard was exceeded, and whether or not the exceedances are considered an existing impairment. The EAGSA has established the MOs for degraded water quality in the Anderson Subbasin as the existing distribution of groundwater impairments (i.e., no change from current conditions).

6.3.5.3 Minimum Thresholds

The MTs for degraded water quality are zero ***additional*** exceedances for any chemical that has an established MCL or SMCL at the RMPs. The following sections describe the MTs for degraded water quality pursuant to § 354.28, Minimum Thresholds.

Information and Criteria Relied Upon to Establish the Minimum Thresholds

Pursuant to GSP regulations § 354.28(c)(4), "The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin." MTs for degraded water quality were established through analysis of historical groundwater quality data for RMPs (public supply wells, see Chapter 6) in the Anderson Subbasin. The process for establishing MTs is as follows:

- The GAMA groundwater quality dataset was downloaded for the RMPs (SWRCB, 2020b).
- The groundwater quality data through the current period (that is, through 2018) were compared to the applicable MCL or SMCL to determine which chemicals exceeded the enforceable legal limit.
- Chemicals with repeated exceedances prior to 2018 are considered existing groundwater quality impairments and were established as chemicals of concern (COCs) for the Anderson Subbasin. If there is continued violation of the MCL or SMCL at these locations, this would not be considered a violation of the MT. However, if a new chemical exceeds the MCL or SMCL at these locations, this would be considered a violation of the MT.
- Chemicals with a limited number of exceedances at a given RMP were further evaluated. Exceedances are not considered existing impairments if:
  - Subsequent samples do not exceed the MCL or SMCL.
  - The exceedance is an outlier with respect to the longer sampling history at the RMP (that is, both previous and subsequent samples did not exceed the MCL or SMCL).

Table 6-6. Number of Violations of Drinking Water Standards through 2018

Location Name	Arsenic[a]	Iron[b]	Manganese[b]	Foaming Agents[b]	Perchlorate[a]	Uranium[a]	Existing Impairment?	Rational for Exclusion as Existing Impairment
4400723-001		1					Yes	
4500007-001		1					No	The iron exceedance occurred in 1979; six subsequent samples for iron at this well did not exceed the SMCL.
4500037-001			1				Yes	
4500054-003		1	1				Yes	
4500066-001		3	1				Yes	
4500066-002		3	3				Yes	
4500093-002		1					Yes	
4500107-002		1	1				Yes	
4500107-003		1					No	The iron exceedance occurred in 2014; three subsequent samples for iron at this well did not exceed the SMCL.
4500140-001		1					Yes	
4500191-001			1				Yes	
4500191-004				2			No	Only two samples from this location have been analyzed for foaming agents. The samples were collected in 1994 and 1997 and are not considered representative of current conditions.
4500191-009		1					Yes	
4500241-001		1					Yes	
4500246-001					1		No	The perchlorate exceedance occurred in 2008; ten subsequent samples for perchlorate at this well did not exceed the MCL.
4500315-002		1	1				Yes	
4500344-001		1					Yes	

Table 6-6. Number of Violations of Drinking Water Standards through 2018

Location Name	Arsenic[a]	Iron[b]	Manganese[b]	Foaming Agents[b]	Perchlorate[a]	Uranium[a]	Existing Impairment?	Rational for Exclusion as Existing Impairment
4510001-014			1				No	The manganese exceedance occurred in 2001; two subsequent samples for manganese at this well did not exceed the SMCL.
4510005-009		1					No	The iron exceedance occurred in 1991; two subsequent samples for iron at this well did not exceed the SMCL.
4510005-012		1	2			1	Yes	Uranium is not considered an existing groundwater-quality impairment at this location. The uranium exceedance occurred in 1989; three subsequent samples for uranium at this well did not exceed the MCL.
4510007-003	1						Yes	
4510016-003			5				Yes	
4510016-005		2	5				Yes	

[a]Primary federal or California MCL:
Arsenic = 10 µg/L
Perchlorate = 6 µg/L
Uranium = 20 pCi/L

[b]Secondary federal MCL:
Foaming agents = 0.5 mg/L
Iron = 300 µg/L
Manganese = 50 µg/L

Notes:

mg/L = milligrams per liter
pCi/L = picocuries per liter

Table 6-7 summarizes the identified COCs and the MTs for degraded water quality, whereas Figure 6-10 presents the distribution of RMPs considered to have existing groundwater impairments (symbolized as orange dots on the figure). A future groundwater quality sample would be considered a violation of the MT if there is an exceedance for a new chemical (that did not previously exceed the MCL or SMCL) at an RMP with other existing impairments or if a chemical exceeds the MCL or SMCL at an RMP that has not been identified as having existing impairments. For example, RMP 4510016-003 has been identified as having existing exceedances of manganese. If future groundwater-quality samples from this RMP exceed the SMCL for manganese, this would not be considered an MT violation. If future groundwater-quality samples from this RMP exceed the MCL for arsenic, this would be considered a violation of the MT, because arsenic samples did not exceed the MCL at this well prior to the end of the current period.

Table 6-7. Degraded Water Quality Minimum Thresholds

COC	Number of RMPs Identified as Having Existing Impairments for COC	Minimum Threshold
Arsenic	1	Zero additional RMPs shall exceed the arsenic MCL of 0.01 mg/L.
Iron	13	Zero additional RMPs shall exceed the iron SMCL of 0.30 mg/L.
Manganese	9	Zero additional RMPs shall exceed the manganese SMCL of 0.05 mg/L.
Other Chemicals	0	Zero additional RMPs shall exceed the MCL or SMCL for any chemical that has an established limit.

How Minimum Thresholds May Affect the Interests of Beneficial Uses and Users of Groundwater or Land Uses and Property Interests

Beneficial users of groundwater in the Anderson Subbasin include the following:

- Water purveyors that use groundwater as supply
- Small water systems that use groundwater as supply
- Private domestic, agricultural, and industrial groundwater users
- Ecological users

As discussed in Chapter 3, groundwater quality in the Anderson Subbasin is generally very good. Localized areas of impairments associated with environmental contamination sites (such as gas stations) are being cleaned up and regulated by federal, State, or local agencies. As shown in Table 6-6, contaminants associated with these sites (such as fuel-related compounds) have not been identified in any of the RMPs at concentrations exceeding the MCLs. If these future groundwater samples from RMPs exceed the MCL for such chemicals, this would be considered a violation of the MT and may lead to additional actions by the EAGSA, as described in Chapter 7. With the exception of foaming agents and perchlorate, the other chemicals listed in Table 6-6 are naturally occurring (that is, a function of the rock or sediment type that makes up the aquifer). Beneficial users of groundwater in the subbasin have been managing these chemicals (such as through blending of water) and will continue to do so in the future. If water quality trends show that undesirable results are likely, the EAGSA might take additional actions, as described in Chapter 7. Additionally, the EAGSA will periodically re-evaluate the MOs and MTs and will revise as necessary. For example, if legal limits are established for new chemicals or if existing limits for a given chemical are changed, the EAGSA will assess and update the MOs and MTs to incorporate the new regulatory information.

Relationship between the Minimum Thresholds for Each Sustainability Indicator

In accordance with GSP regulations § 354.28(b)(2), Table 6-3 includes descriptions regarding the relationship(s) between sustainability indicators and how the MTs for a given sustainability indicator avoid undesirable results for the other sustainability indicators.

How Minimum Thresholds Have Been Selected to Avoid Causing Undesirable Results in Adjacent Basins

As shown on Figure 2-1, the Anderson Subbasin is bordered by the Bowman Subbasin to the south, the Enterprise Subbasin to the east/northeast, and the Millville Subbasin to the east. The SMCs for the Enterprise and Anderson Subbasins were both developed by the EAGSA using the same approach; therefore, the SMCs in one subbasin will not affect the sustainability of the other subbasin. The Bowman and Millville Subbasins are designated as very low-priority basins and are not required to develop a GSP under SGMA (DWR, 2020c). The Sacramento River drains the RAGB; therefore, the water table in the Millville Subbasin would not be expected to be substantially hydraulically connected to the Anderson Subbasin (that is, shallow groundwater [and groundwater plumes] from the Millville Subbasin would be expected to discharge to the Sacramento River rather than flowing into the Anderson Subbasin). Similarly, Cottonwood Creek represents a groundwater discharge area between the Anderson and Bowman Subbasins. Some amount of groundwater at depth could flow between adjacent subbasins in response to deeper groundwater pumping. Because the selected MTs are below the historical minimum groundwater elevations at some RMPs, lowering of groundwater levels in the Anderson Subbasin could increase groundwater flow exchange between adjacent subbasins. However, if undesirable results are avoided in the Anderson Subbasin, then significant and unreasonable groundwater conditions in the Bowman and Millville Subbasins will be avoided, and groundwater users therein should be able to continue operating sustainably. The EAGSA will monitor conditions, particularly at RMPs near the subbasin boundary, and coordinate with GSAs of adjacent subbasins as appropriate during GSP implementation.

How State, Federal, or Local Standards Relate to Degraded Water Quality

The MTs for degraded water quality are based on the lower of either the California or federal MCL or SMCL. If regulatory limits are changed or if new regulatory limits are established in the future, the EAGSA will revise the MOs and MTs accordingly.

6.3.5.4 Undesirable Results

Description of Undesirable Results

Undesirable results for degraded water quality in the Anderson Subbasin are defined as:

> *The undesirable result for degraded water quality is an impact stemming from SGMA-related groundwater management activities, such as groundwater extraction/recharge, that causes significant & unreasonable degradation of groundwater quality for beneficial users during the GSP planning and implementation horizon.* ***Undesirable results would occur when 25 percent of the same RMPs violate the MTs for two consecutive sampling events****.*

Identification of Undesirable Results

There are 72 RMPs in the Anderson Subbasin; therefore, undesirable results may occur when 18 of the RMPs violate the MTs. The process of evaluating the presence of undesirable results will be as follows.

- The EAGSA will download the annual groundwater-quality dataset from the GAMA website.
- The groundwater quality data for the RMPs will be compared to the MCLs or SMCLs.
- If there are exceedances of the MCLs or SMCLs, the location and chemical will be compared to Table 6-6 to assess whether the exceedances are new (new chemical or new RMP).
- If the exceedances occur for chemicals identified as an existing impairment in Table 6-6, the EAGSA will conclude that undesirable results are not present.
- If the exceedance is for a chemical or well not identified in Table 6-6, the EAGSA will further evaluate whether the previous sample violated the MT (that is, if a given sample is the first or second MT violation).
  - If it is determined that this is the first MT violation, the chemical or well will be flagged for further evaluation following the next sampling event.
  - If it is determined that this is the second consecutive MT violation, the EAGSA will evaluate whether there are such violations at the same other 17 RMPs.
  - If the same 18 RMPs violate MTs for two consecutive sampling events, the EAGSA will conclude that undesirable results are present, and additional actions will be taken, as described in Chapter 7.

Potential Causes of Undesirable Results

Significant and unreasonable degradation of groundwater quality in the Anderson Subbasin could potentially result from changes in the rates or locations of groundwater pumping in the subbasin. For example, if the rate of groundwater pumping increases in an area where groundwater pumping did not previously occur (or occurred at lower rates), the direction of groundwater flow in that portion of the subbasin could change, and areas of nearby degraded groundwater could potentially be pulled into areas of unimpaired groundwater. Changes in groundwater flow direction (and direction of groundwater contaminant movement) could also result from changes in locations of groundwater recharge. For example, if an unlined, large surface-water impoundment is constructed, this could result in mounding of groundwater beneath the pond and could change local groundwater flow directions.

Effects on Beneficial Users

If undesirable results related to degraded water quality were to occur, this could result in the need for new or changing treatment of drinking water supplies, negative impacts on agriculture, or reduction in GDE health.

6.3.6 Land Subsidence

Land subsidence is the gradual settling or sinking of the ground surface due to removal or displacement of underground materials.[15] Land subsidence can be caused by multiple factors including, but not limited to, oil and gas removal, dissolution of limestone causing sinkholes, collapse of underground mines, earthquake activity, or groundwater overdraft. Of the multiple potential causes of land subsidence, SGMA legislation is only concerned with land subsidence associated with groundwater pumping. As described in Chapter 3, the removal of groundwater from an aquifer by excessive pumping can result in the grains

[15] https://www.usgs.gov/mission-areas/water-resources/science/land-subsidence?qt-science_center_objects=0#qt-science_center_objects

settling and compacting, because water is irreversibly removed from between the grains. Finer-grained materials (such as silt and clay) are particularly susceptible. If there are extensive layers of silt or clay that become dewatered, these layers will compress, becoming thinner, and cause settlement of the soils above them and ultimately the land surface. As discussed in Chapter 3, land subsidence due to groundwater pumping in the Anderson Subbasin is highly unlikely because groundwater levels are, and are projected to continue to be, similar to those observed during the past several decades and because there are no extensive layers of clay or silt in the subbasin. Although the likelihood of land subsidence in the subbasin is very low, the following sections describe the SMCs being established to account for unforeseen future conditions.

6.3.6.1 Description of Significant and Unreasonable Conditions

Significant and unreasonable conditions for land subsidence were determined by the EAGSA with consideration of local beneficial users. The description of significant and unreasonable conditions is as follows:

> *Significant and unreasonable land subsidence due to groundwater extraction that results in negative impacts to public and private infrastructure.*

6.3.6.2 Measurable Objectives

As discussed in Chapter 3, no measurable land subsidence due to groundwater pumping in the Anderson Subbasin has occurred in the past. Additionally, the aquifer materials beneath the subbasin are not considered to be susceptible to land subsidence because there are no extensive silt or clay layers. According to an independent evaluation of the InSAR datasets made available to GSAs by DWR, "InSAR data accurately models change in ground elevation to an accuracy tested to be 18 [millimeters] mm at 95% confidence" (Towill, 2021). As such, the EAGSA has established the MOs for land subsidence as the combined level of accuracy for the InSAR datasets provided by DWR, which is 18 mm (0.71 inch [0.06 foot]).

6.3.6.3 Minimum Thresholds

The MT for land subsidence is 6 inches (0.5 foot) of groundwater-pumping-induced land subsidence as reported for an individual InSAR total vertical displacement grid cell (the InSAR grid resolution is 300 by 400 feet). The following sections describe the MTs for land subsidence pursuant to § 354.28, Minimum Thresholds.

Information and Criteria Relied Upon to Establish the Minimum Thresholds

MTs for land subsidence were established through analysis of historical vertical land displacement data in the Anderson Subbasin and consideration of potential impacts on beneficial land uses. The susceptibility of local beneficial users (such as buildings, canals, and transportation networks) is not well understood. As such, the EAGSA has established the MTs at 6 inches (0.5 foot) over a 5-year period. Should additional information regarding the sensitivity of local infrastructure become available during GSP implementation, the MT will be reassessed.

How Minimum Thresholds May Affect the Interests of Beneficial Uses and Users of Groundwater or Land Uses and Property Interests

Available data suggest that land subsidence is not currently affecting local infrastructure or land uses, and projected future water use is not likely to exceed the MTs. Therefore, the MTs are considered protective of beneficial users.

Relationship between the Minimum Thresholds for Each Sustainability Indicator

In accordance with GSP regulations § 354.28(b)(2), Table 6-3 includes descriptions regarding the relationships between sustainability indicators and how the MTs for a given sustainability indicator avoid undesirable results for the other sustainability indicators.

How Minimum Thresholds Have Been Selected to Avoid Causing Undesirable Results in Adjacent Basins

As shown on Figure 2-1, the Anderson Subbasin is bordered by the Bowman Subbasin to the south, the Enterprise Subbasin to the east/northeast, and the Millville Subbasin to the east. The SMCs for both the Enterprise and Anderson Subbasins were both developed by the EAGSA using the same approach; therefore, the SMCs in one subbasin will not affect the sustainability of the other subbasin. The Bowman and Millville Subbasins are designated as very low-priority basins and are not required to develop a GSP under SGMA (DWR, 2020c). If undesirable results are avoided in the Anderson Subbasin, then significant and unreasonable groundwater conditions in the Bowman and Millville Subbasins will be avoided, and groundwater users therein should be able to continue operating sustainably. The EAGSA will monitor conditions, particularly at RMPs near the subbasin boundary, and coordinate with GSAs of adjacent subbasins as appropriate during GSP implementation.

How State, Federal, or Local Standards Relate to Land Subsidence

There are no State, federal, or local standards related to land subsidence.

6.3.6.4 Undesirable Results

Description of Undesirable Results

The undesirable result is land subsidence resulting from groundwater extraction that causes significant and unreasonable negative impacts on public and private infrastructure during the planning and implementation period of this GSP. *An undesirable result occurs when the MT of 6 inches (0.5 foot) over 5 years averaged across the Anderson Subbasin is exceeded.*

Identification of Undesirable Results

The EAGSA will evaluate whether potential undesirable results related to land subsidence exist or are likely as part of annual GSP reporting. The process for evaluating monitoring data relative to the MT is as follows:

- The EAGSA will download the InSAR total vertical displacement GIS dataset provided by DWR for each WY.
- The data will be clipped using mapping software to the lateral extent of the Anderson Subbasin boundary.
- The total vertical displacement data will be averaged across the entire subbasin.
- If the subbasin-wide average total vertical displacement for the WY is less than 0.71 inch (0.06 foot), the EAGSA will conclude that undesirable results are not present and are not likely to occur.

- If the subbasin-wide average total vertical displacement for the WY is greater than 0.71 inch (0.06 foot), the EAGSA will conclude that undesirable results might be present or could potentially occur if the data from the current WY is a continuation of an existing land subsidence trend or the start of a new land subsidence trend.
  - The EAGSA will evaluate total vertical displacement data for the previous 4 WYs to determine if there has been 6 inches (0.5 foot) or more of land subsidence during the 5-year period (that is, a violation of the MT). If this is the case, the EAGSA will conclude that undesirable results are present and will take additional actions as described in Chapter 7.
  - If there has not been more than 6 inches (0.5 foot) of subsidence during the previous 5-year period, the EAGSA will conclude that undesirable results are not present but could potentially occur in the future if the trend continues. The EAGSA might take voluntary actions, as described in Chapter 7, and will continue to assess the future land subsidence trends in the following WYs.

Potential Causes of Undesirable Results

Undesirable results related to land subsidence might occur if there is a significant and unforeseen increase in groundwater pumping in the subbasin.

Effects on Beneficial Users

If undesirable results related to land subsidence were to occur, there potentially could be impacts on infrastructure and local property interests including, but not limited to, the following:

- Water conveyance and water disposal infrastructure that relies on gravity flow is no longer operable (e.g., canals, pipelines, and septic systems)
- Damage to structural foundations
- Damage to transportation networks (e.g., roads, bridges, and railways)
- Damage to wells

These could have adverse effects on property values or public safety and could result in expenditures to mitigate these issues.

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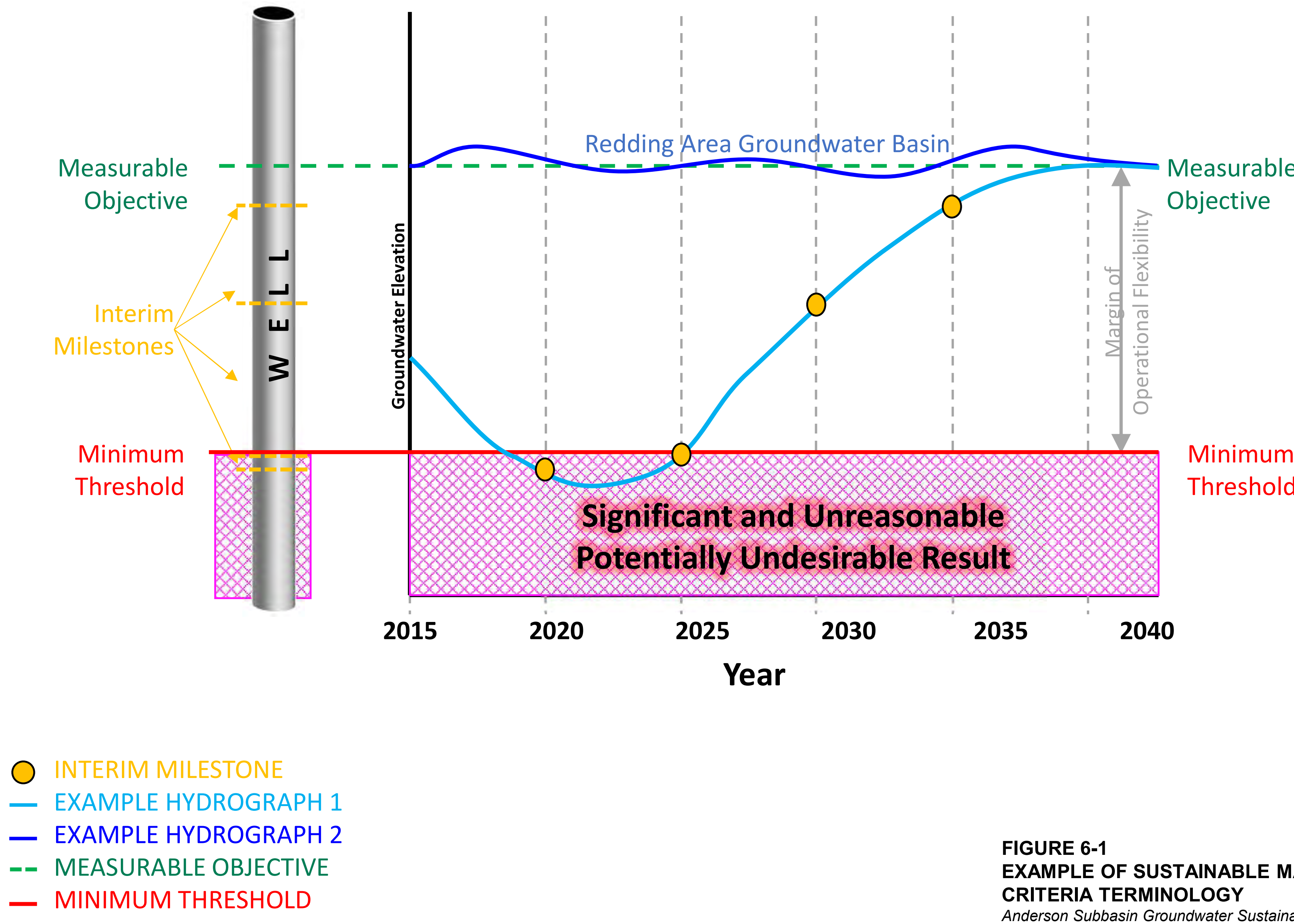

FIGURE 6-1
EXAMPLE OF SUSTAINABLE MANAGEMENT CRITERIA TERMINOLOGY
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

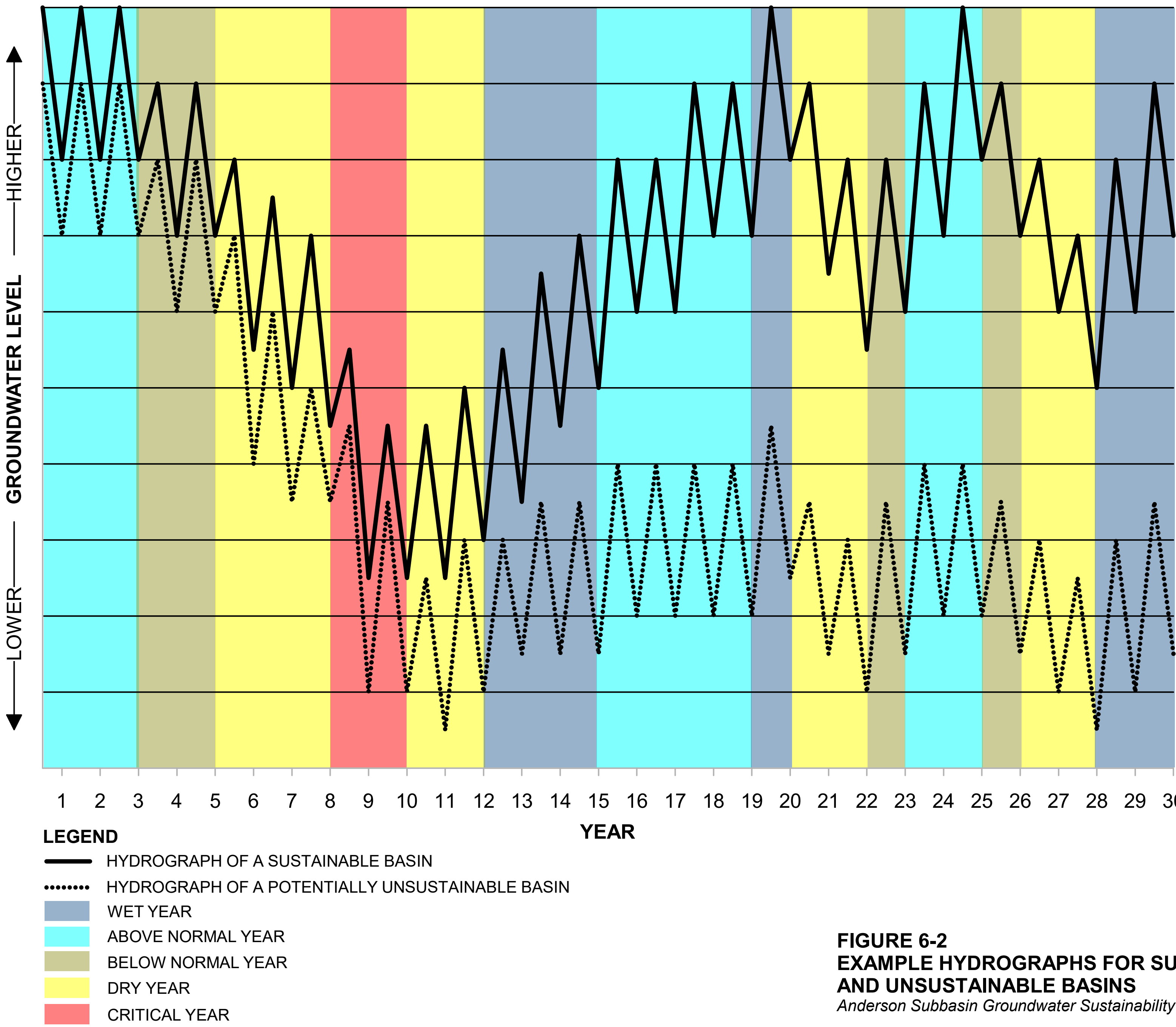

FIGURE 6-2
EXAMPLE HYDROGRAPHS FOR SUSTAINABLE AND UNSUSTAINABLE BASINS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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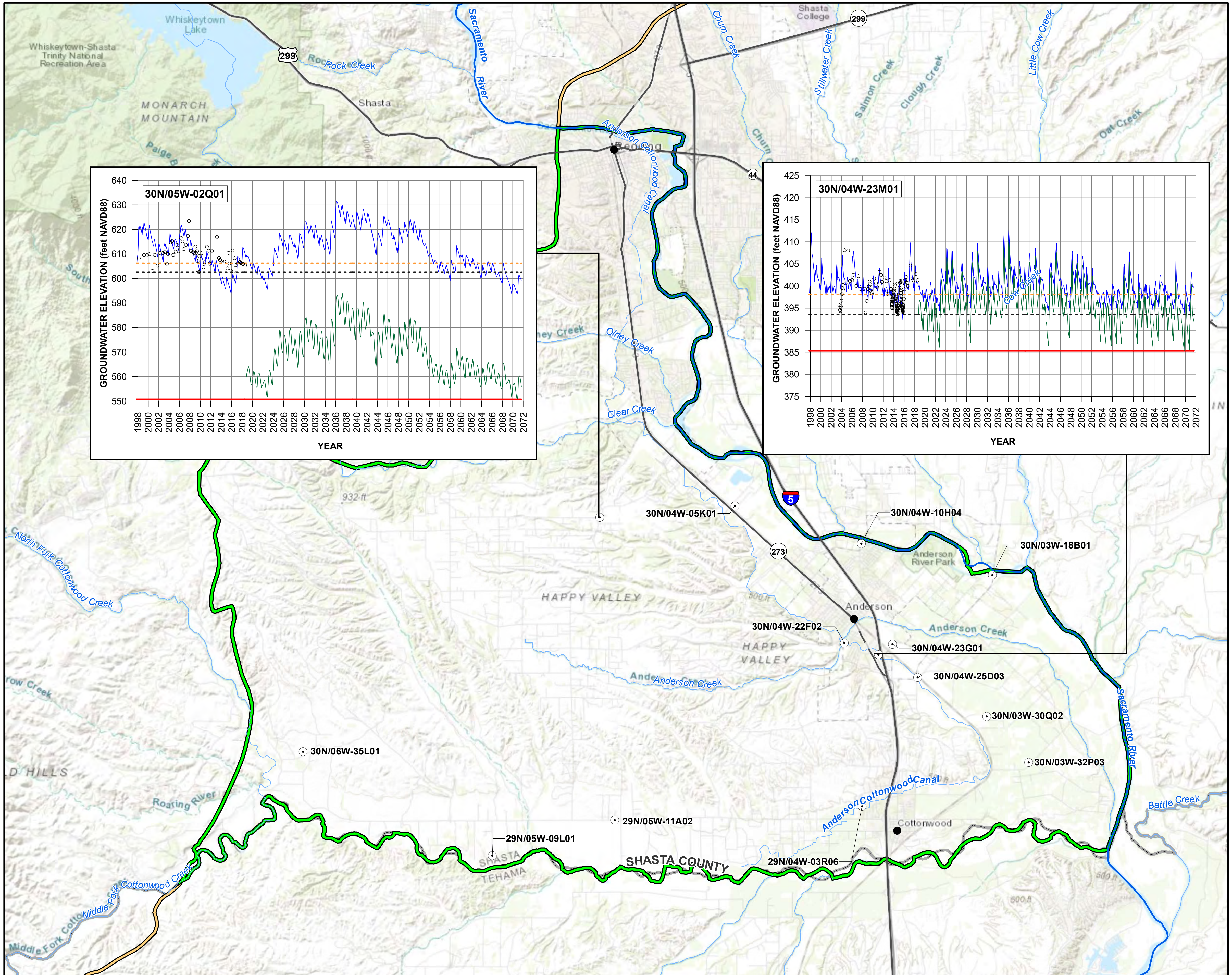

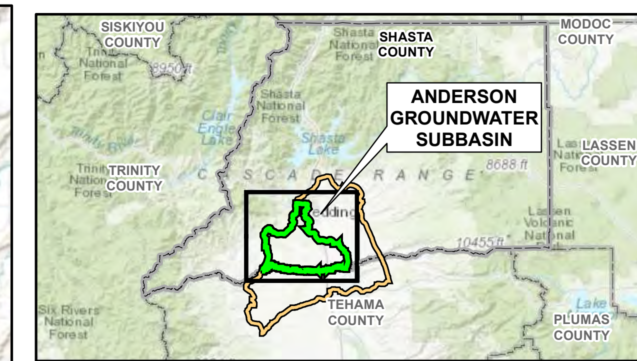

MAP LEGEND

- REPRESENTATIVE MONITORING POINT
- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

GRAPH LEGEND

- MEASURED GROUNDWATER ELEVATION
- HISTORICAL MINIMUM MEASURED GROUNDWATER ELEVATION
- HISTORICAL AND FUTURE BASELINE SIMULATED GROUNDWATER ELEVATION
- INCREASED GROUNDWATER USE SCENARIO SIMULATED GROUNDWATER ELEVATION
- MEASURABLE OBJECTIVE
- MINIMUM THRESHOLD

NOTES:

DATA SOURCES: DWR, 2019a; DWR, 2019b

MEASURED GROUNDWATER LEVELS IDENTIFIED AS PUMPING OR RECENTLY PUMPED ARE OMITTED FROM HYDROGRAPHS.

MINIMUM HISTORICAL MEASURED GROUNDWATER ELEVATIONS COULD HAVE OCCURRED PRIOR TO 1998 IN SOME INSTANCES.

DWR = DEPARTMENT OF WATER RESOURCES.

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988.

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

FIGURE 6-3
REPRESENTATIVE MONITORING NETWORK SELECT HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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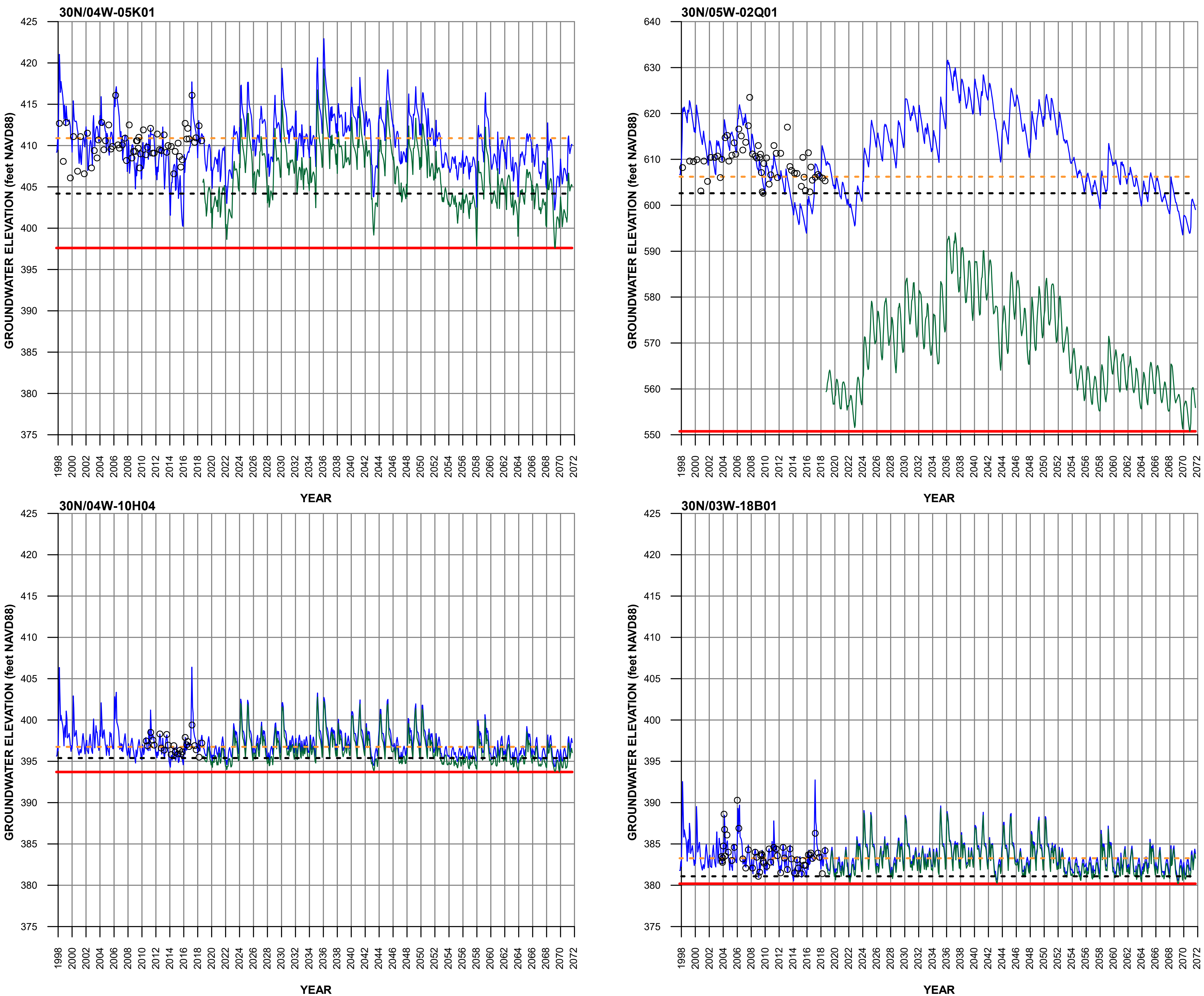


LEGEND

- MEASURED GROUNDWATER ELEVATION
- HISTORICAL AND FUTURE BASELINE SIMULATED GROUNDWATER ELEVATION
- INCREASED GROUNDWATER USE SCENARIO SIMULATED GROUNDWATER ELEVATION
- HISTORICAL MINIMUM MEASURED GROUNDWATER ELEVATION
- MEASURABLE OBJECTIVE
- MINIMUM THRESHOLD

NOTES:

DATA SOURCES: DWR, 2019a; DWR, 2019b

MEASURED GROUNDWATER LEVELS IDENTIFIED AS PUMPING OR RECENTLY PUMPED ARE OMITTED FROM HYDROGRAPHS.

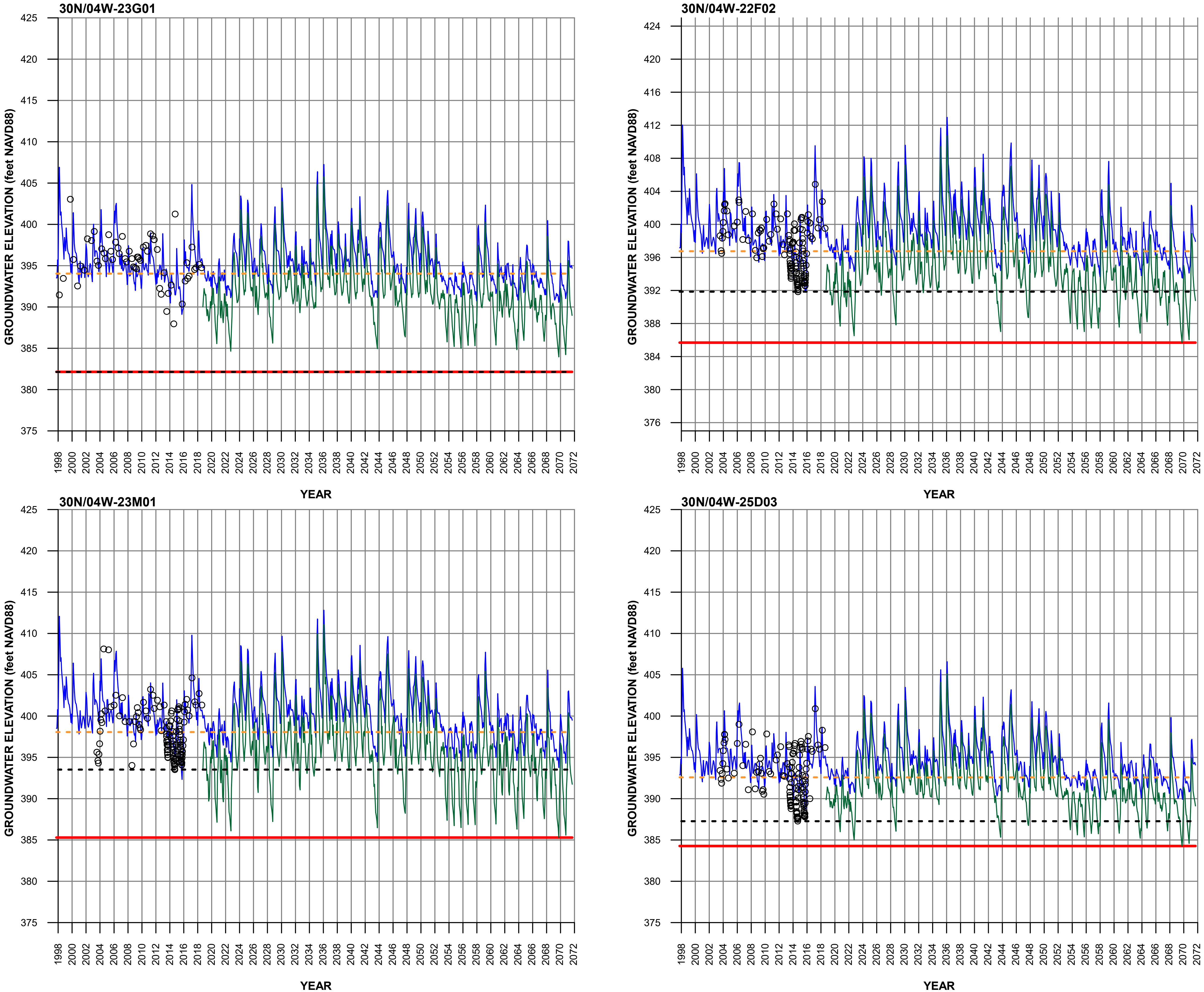
MINIMUM HISTORICAL MEASURED GROUNDWATER ELEVATIONS COULD HAVE OCCURRED PRIOR TO 1998 IN SOME INSTANCES.

DWR = DEPARTMENT OF WATER RESOURCES.

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988.

FIGURE 6-4a
REPRESENTATIVE MONITORING NETWORK HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs



LEGEND

- MEASURED GROUNDWATER ELEVATION
- HISTORICAL AND FUTURE BASELINE SIMULATED GROUNDWATER ELEVATION
- INCREASED GROUNDWATER USE SCENARIO SIMULATED GROUNDWATER ELEVATION
- HISTORICAL MINIMUM MEASURED GROUNDWATER ELEVATION
- MEASURABLE OBJECTIVE
- MINIMUM THRESHOLD

NOTES:

DATA SOURCES: DWR, 2019a; DWR, 2019b

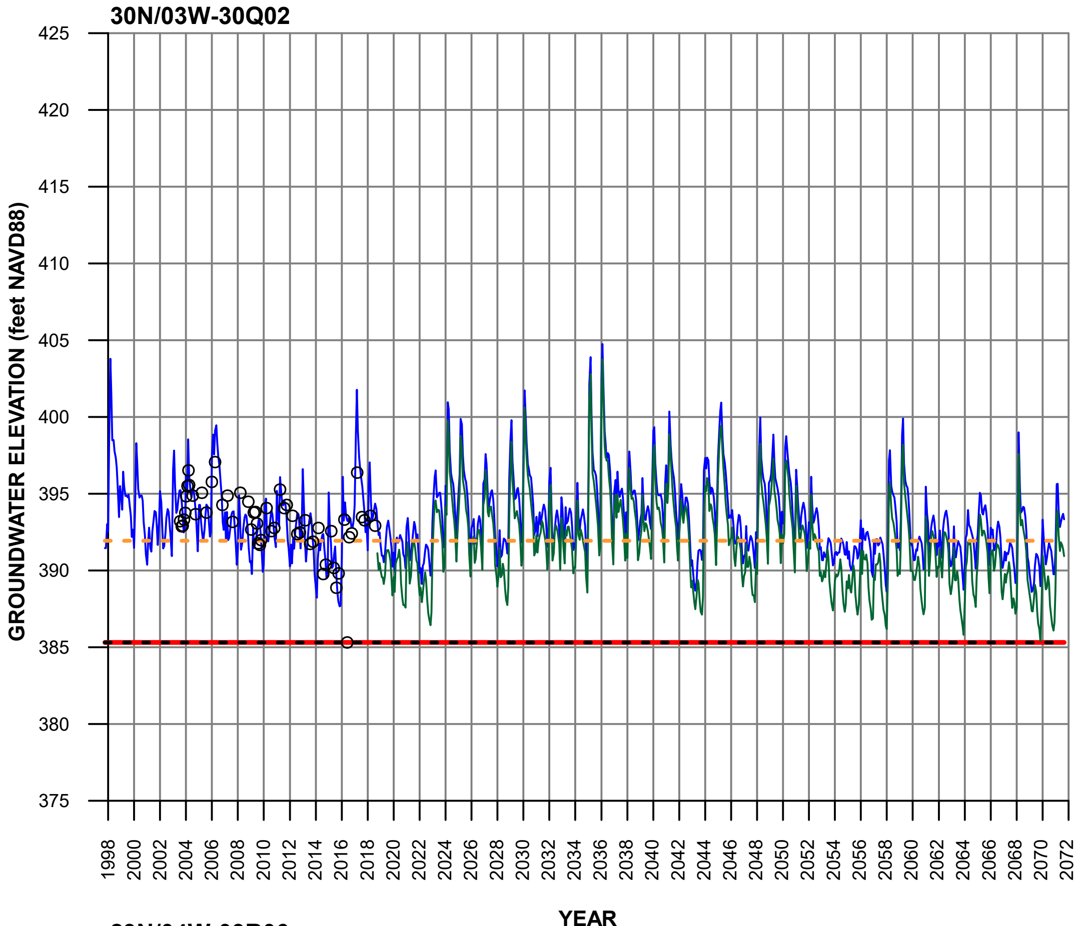
MEASURED GROUNDWATER LEVELS IDENTIFIED AS PUMPING OR RECENTLY PUMPED ARE OMITTED FROM HYDROGRAPHS.

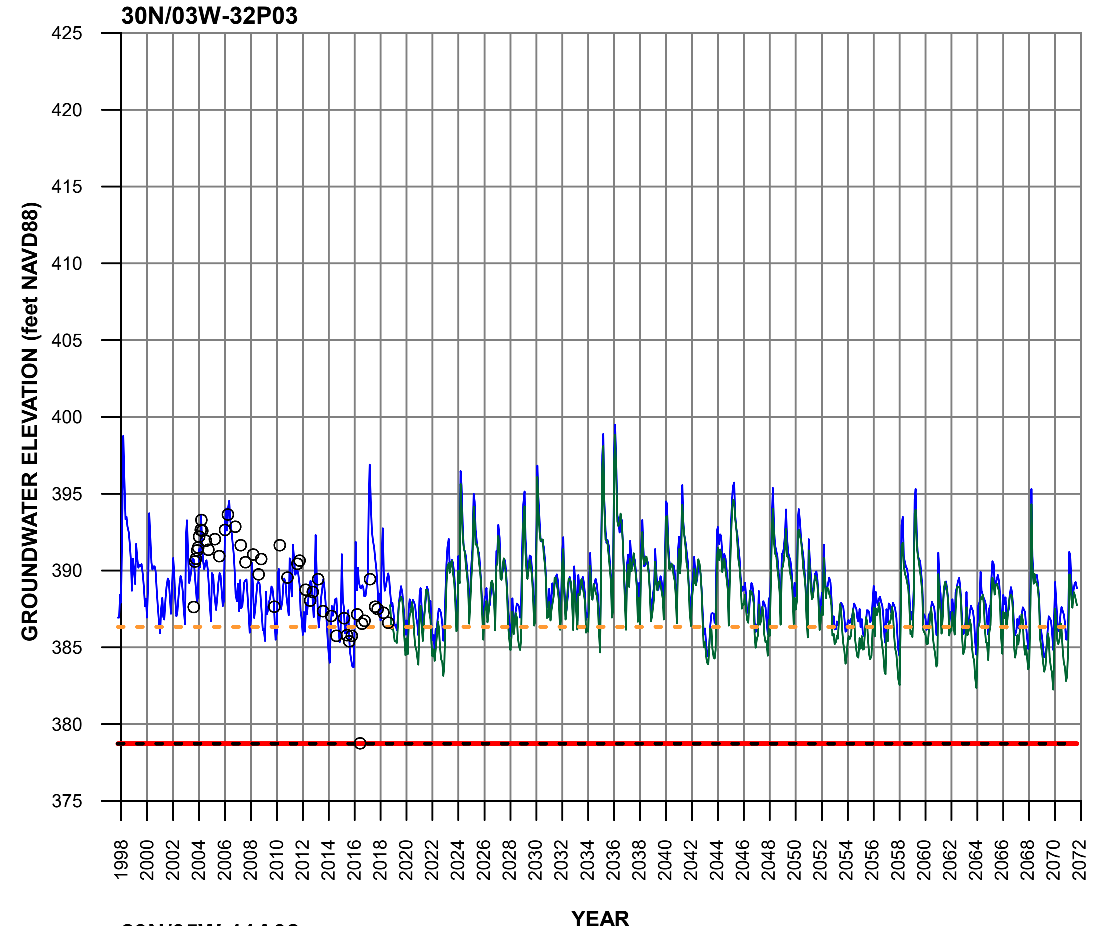
MINIMUM HISTORICAL MEASURED GROUNDWATER ELEVATIONS COULD HAVE OCCURRED PRIOR TO 1998 IN SOME INSTANCES.

DWR = DEPARTMENT OF WATER RESOURCES.

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988.

FIGURE 6-4b
REPRESENTATIVE MONITORING NETWORK HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan





LEGEND

- MEASURED GROUNDWATER ELEVATION
- HISTORICAL AND FUTURE BASELINE SIMULATED GROUNDWATER ELEVATION
- INCREASED GROUNDWATER USE SCENARIO SIMULATED GROUNDWATER ELEVATION
- HISTORICAL MINIMUM MEASURED GROUNDWATER ELEVATION
- MEASURABLE OBJECTIVE
- MINIMUM THRESHOLD

NOTES:

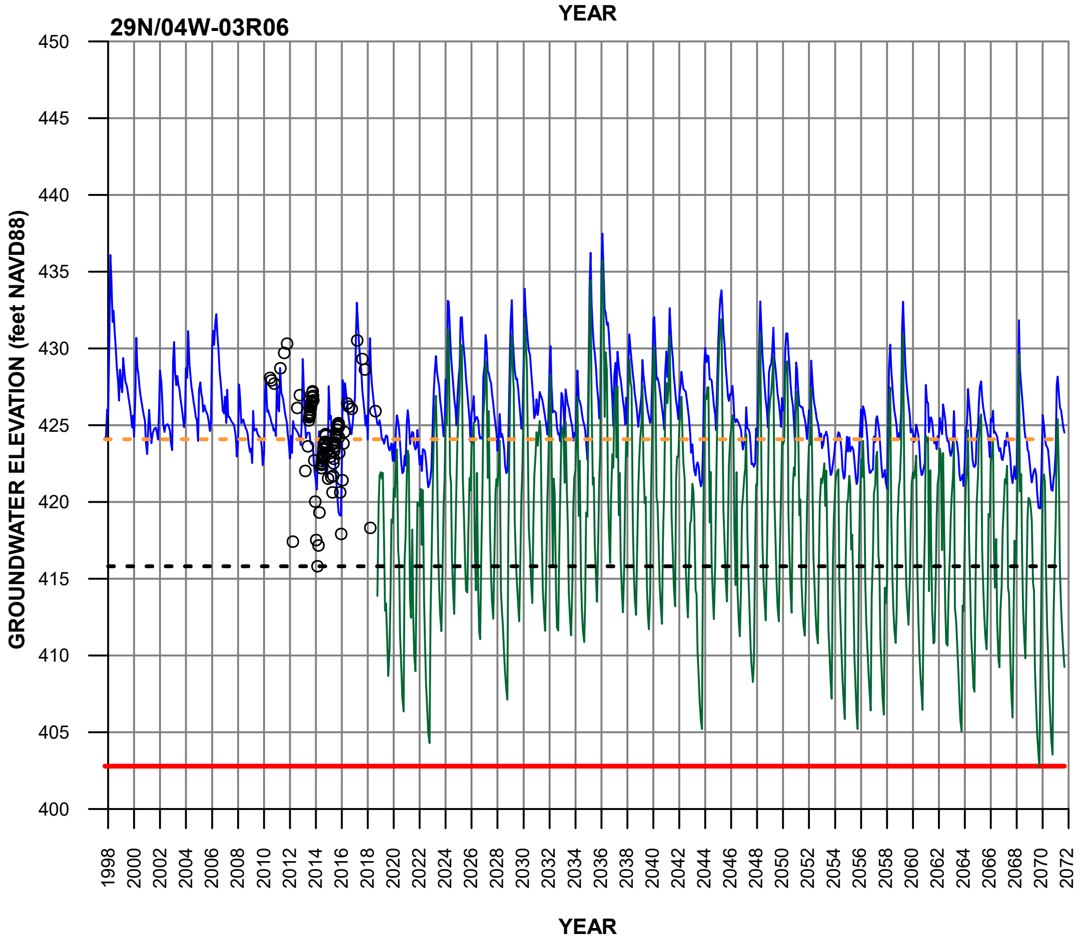
DATA SOURCES: DWR, 2019a; DWR, 2019b

MEASURED GROUNDWATER LEVELS IDENTIFIED AS PUMPING OR RECENTLY PUMPED ARE OMITTED FROM HYDROGRAPHS.

MINIMUM HISTORICAL MEASURED GROUNDWATER ELEVATIONS COULD HAVE OCCURRED PRIOR TO 1998 IN SOME INSTANCES.

DWR = DEPARTMENT OF WATER RESOURCES.

NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988.



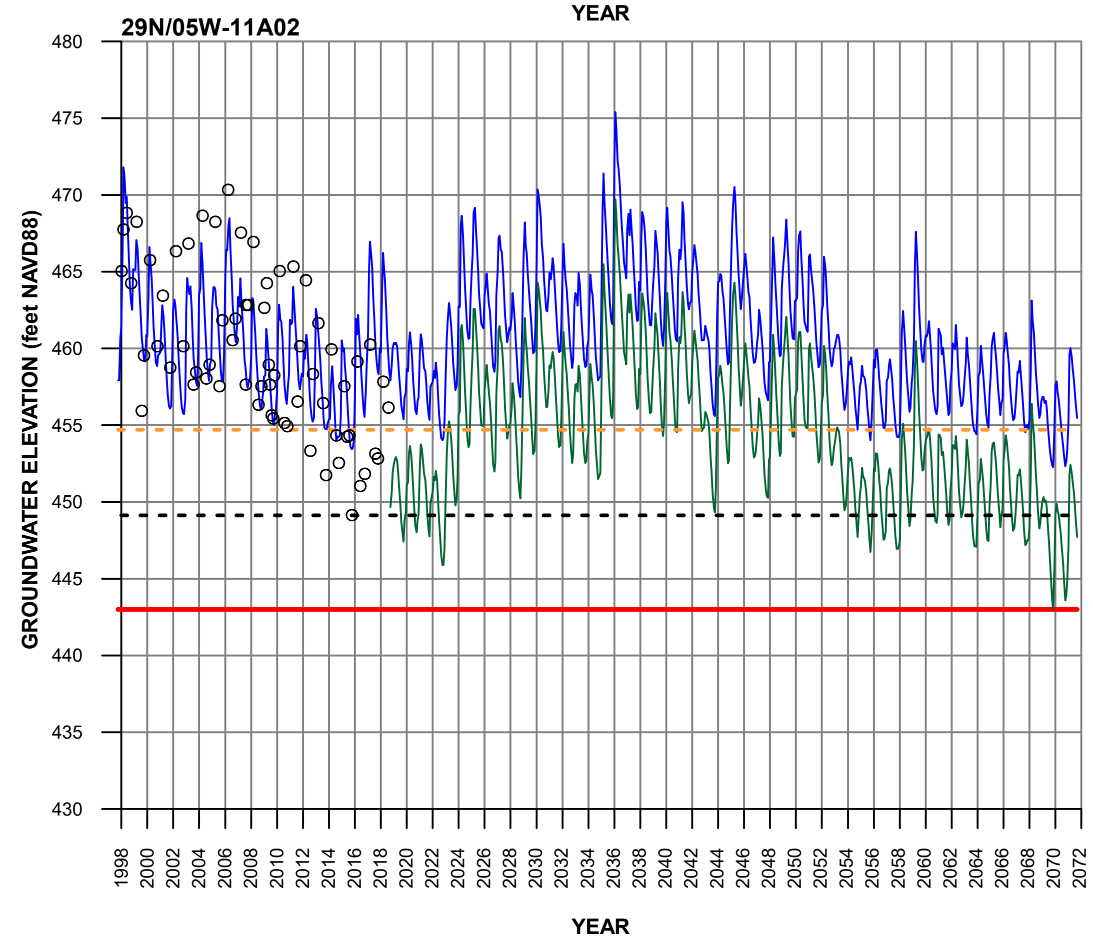
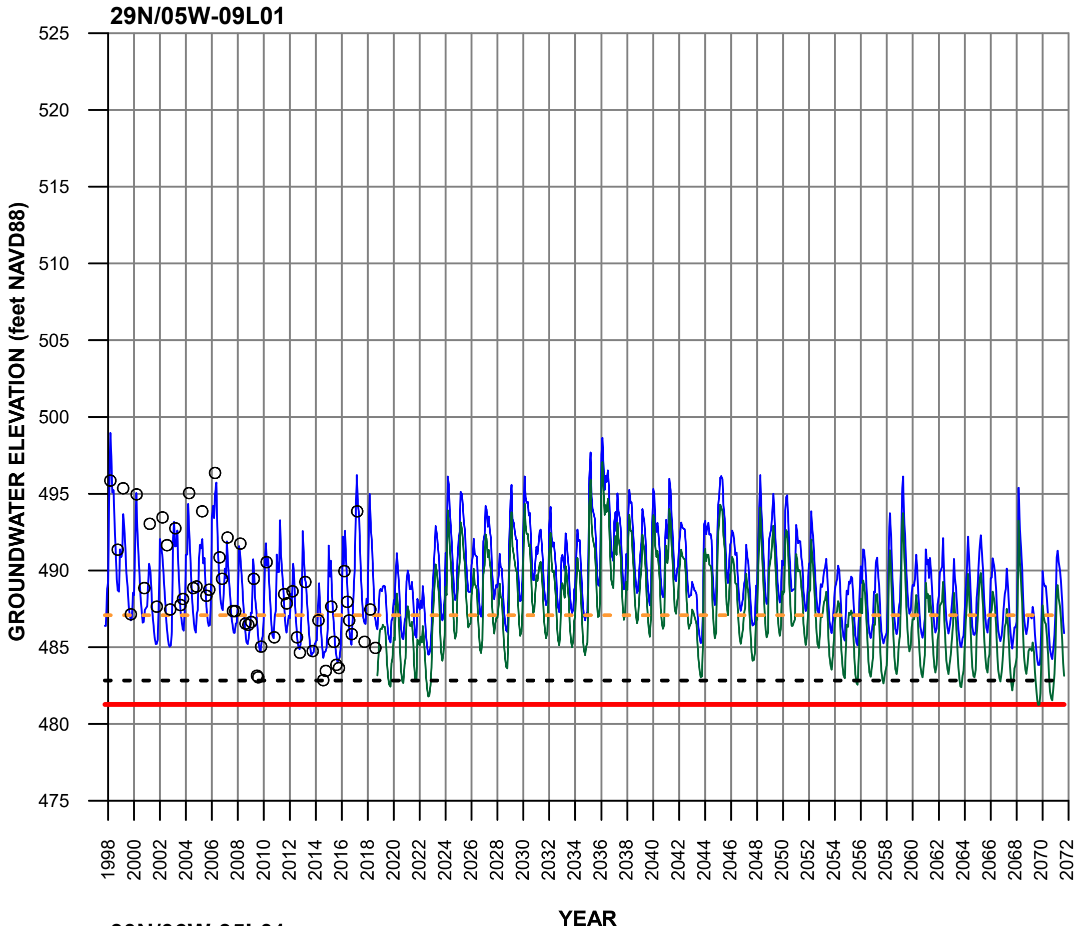
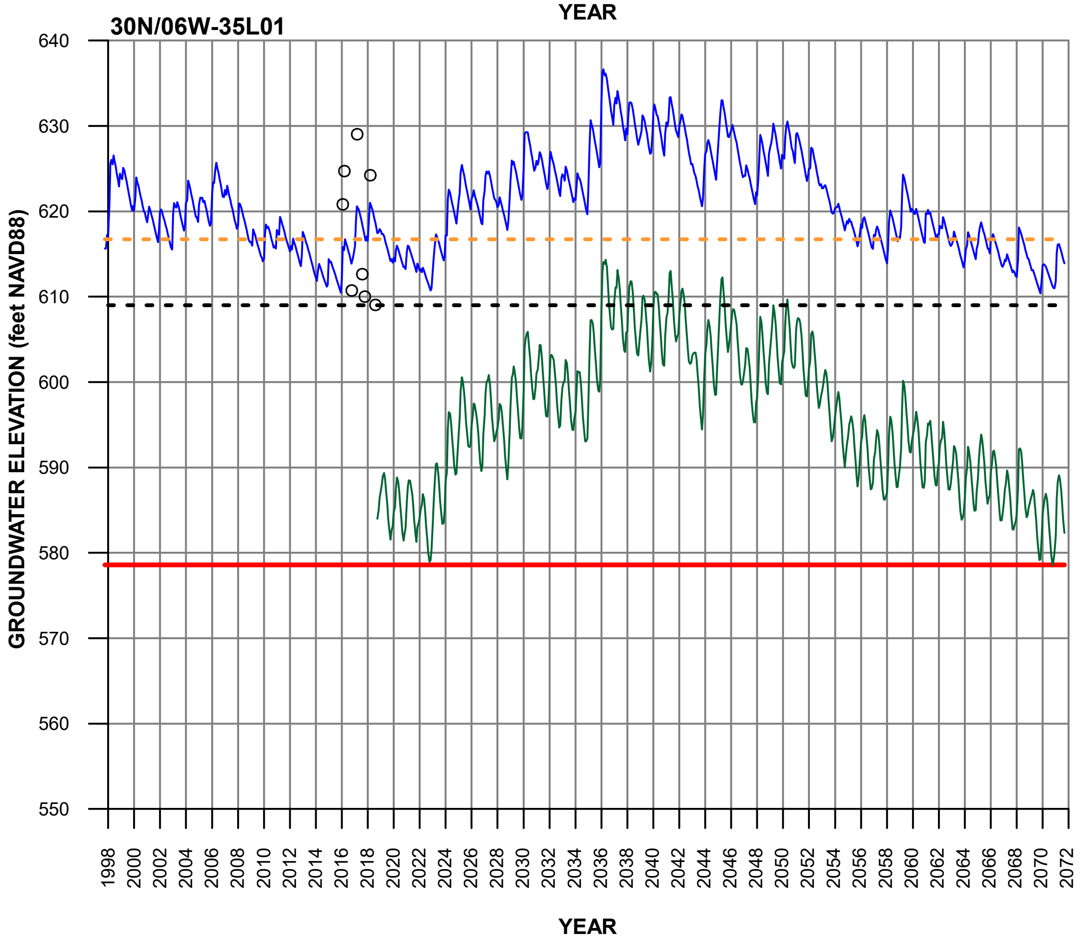


FIGURE 6-4c
REPRESENTATIVE MONITORING NETWORK HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs





LEGEND

- MEASURED GROUNDWATER ELEVATION
- HISTORICAL AND FUTURE BASELINE SIMULATED GROUNDWATER ELEVATION
- INCREASED GROUNDWATER USE SCENARIO SIMULATED GROUNDWATER ELEVATION
- HISTORICAL MINIMUM MEASURED GROUNDWATER ELEVATION
- MEASURABLE OBJECTIVE
- MINIMUM THRESHOLD

NOTES:

DATA SOURCES: DWR, 2019a; DWR, 2019b

MEASURED GROUNDWATER LEVELS IDENTIFIED AS PUMPING OR RECENTLY PUMPED ARE OMITTED FROM HYDROGRAPHS.

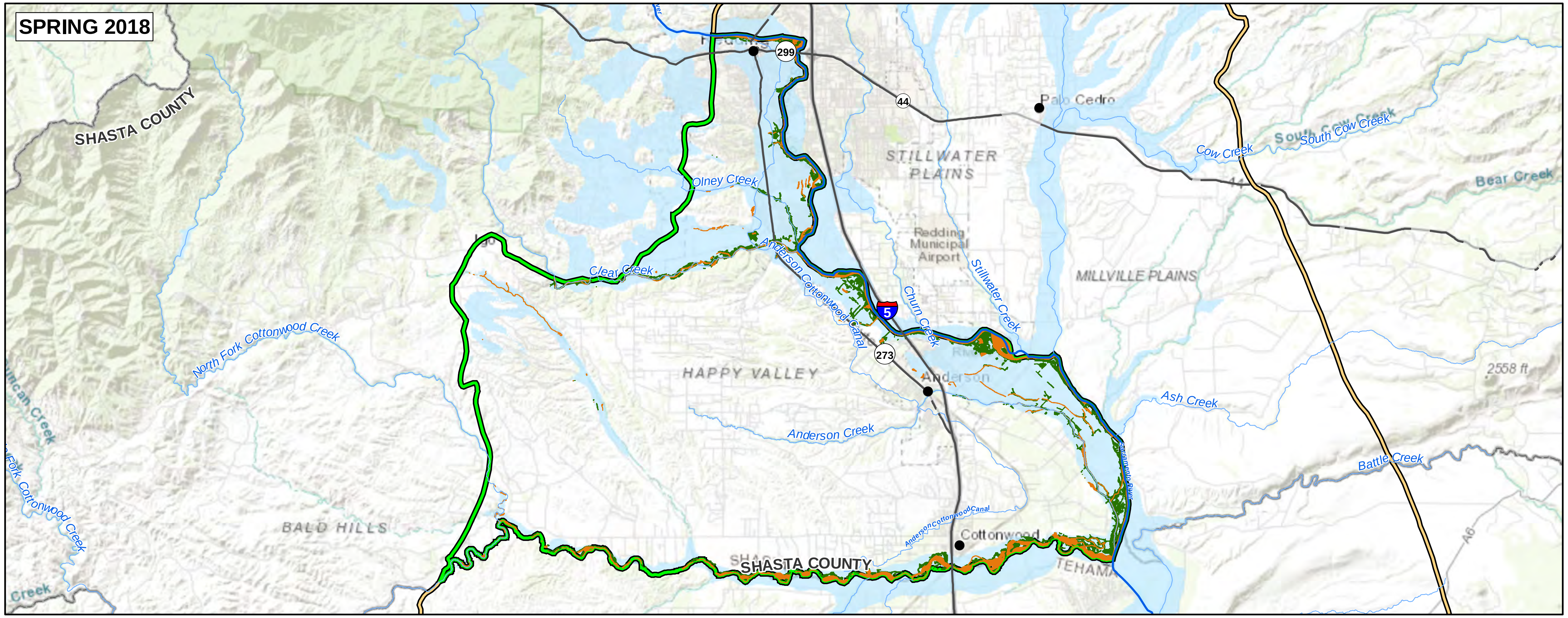
MINIMUM HISTORICAL MEASURED GROUNDWATER ELEVATIONS COULD HAVE OCCURRED PRIOR TO 1998 IN SOME INSTANCES.

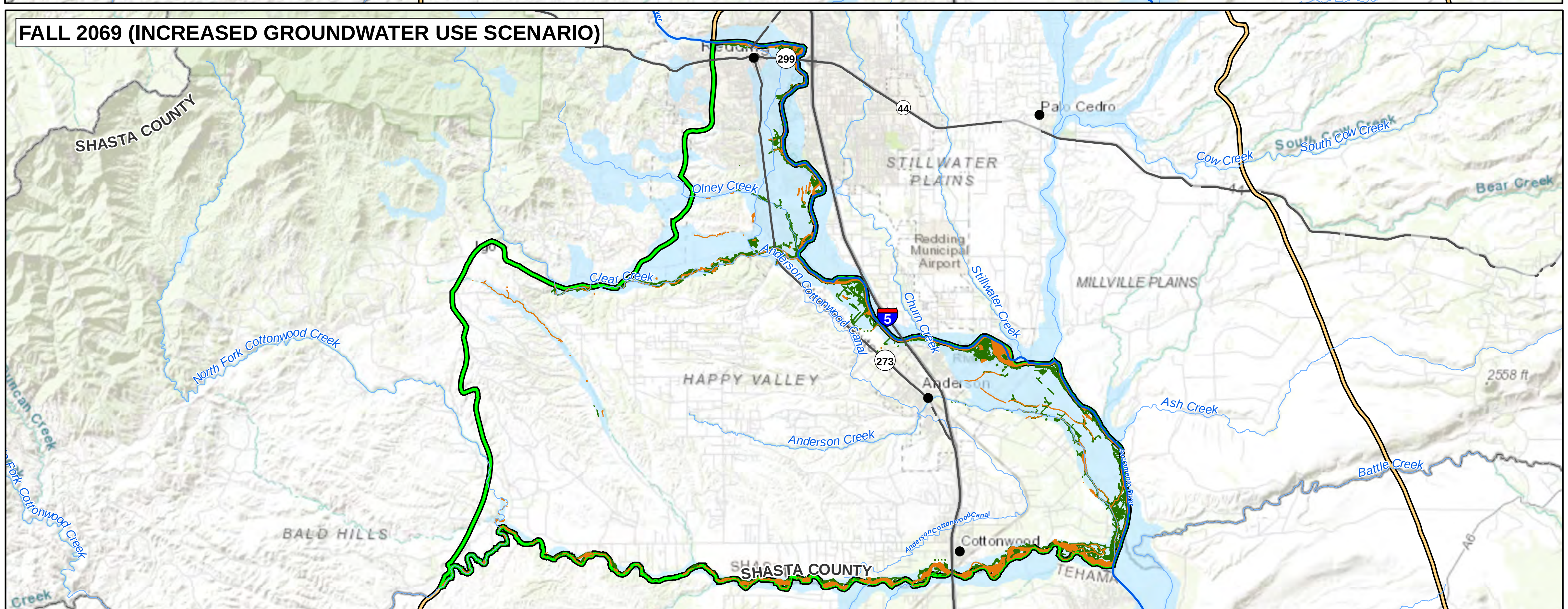
DWR = DEPARTMENT OF WATER RESOURCES.

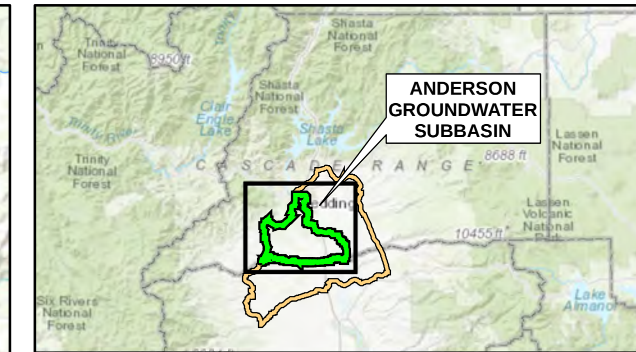
NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988.

FIGURE 6-4d
REPRESENTATIVE MONITORING NETWORK HYDROGRAPHS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs







LEGEND

- CITY
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN
- GROUNDWATER LEVELS WITHIN 30 FEET OF GROUND SURFACE (feet BGS)

GROUNDWATER-DEPENDENT ECOSYSTEMS

- NATURAL COMMUNITIES COMMONLY ASSOCIATED WITH GROUNDWATER VEGETATION
- NATURAL COMMUNITIES COMMONLY ASSOCIATED WITH GROUNDWATER WETLANDS

NOTES:

DATA SOURCES:

HTTPS://GIS.WATER.CA.GOV/APP/NCDATASETVIEWER/#. ACCESSED MARCH 2020 (DWR, 2020c)

BGS = BELOW GROUND SURFACE

DWR = DEPARTMENT OF WATER RESOURCES

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 3.5 7 Miles

FIGURE 6-5
COMPARISON OF THE EXTENT OF SHALLOW GROUNDWATER AND GROUNDWATER-DEPENDENT ECOSYSTEMS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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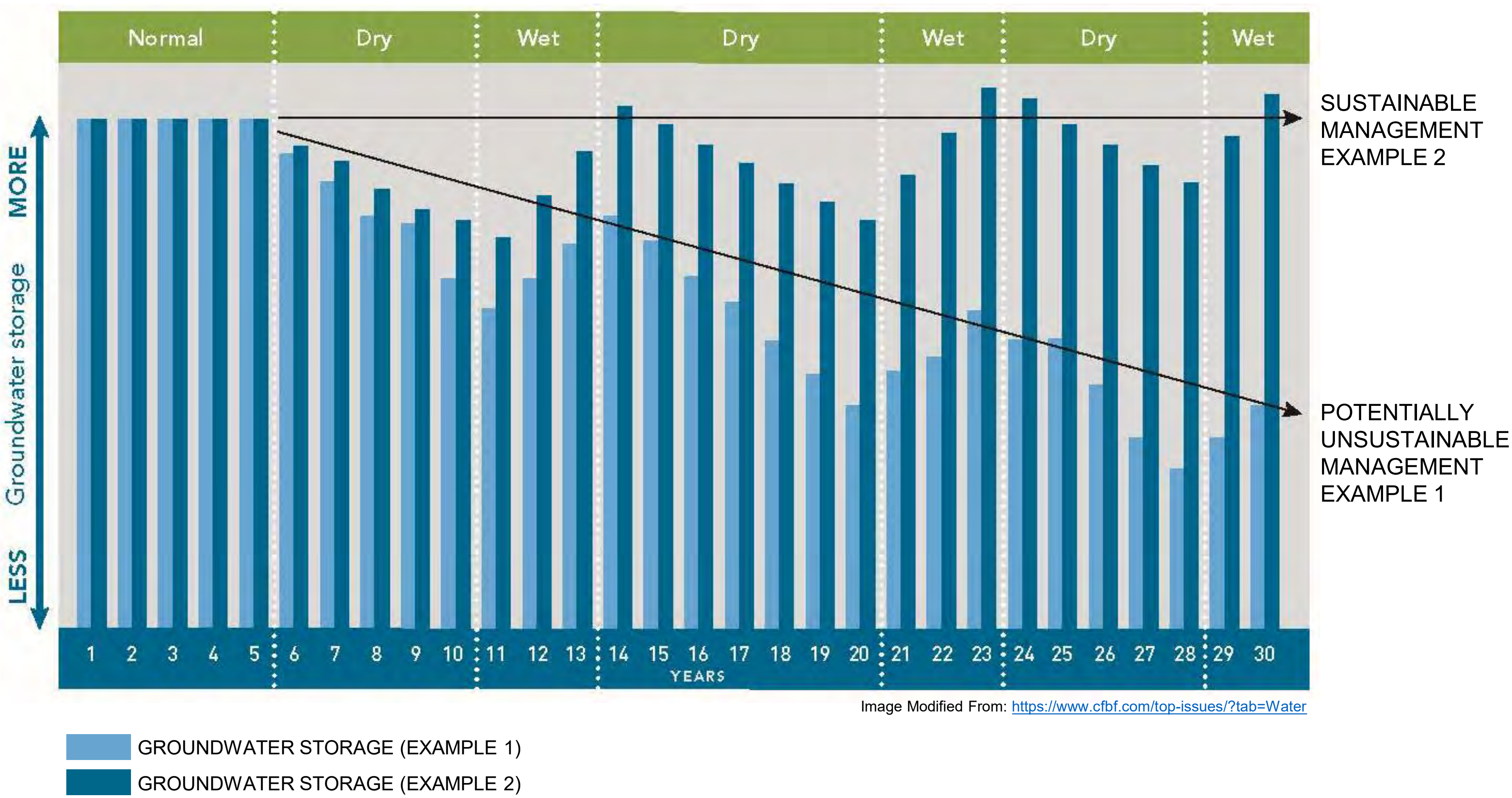


Image Modified From: https://www.cfbf.com/top-issues/?tab=Water

FIGURE 6-6
EXAMPLES OF GROUNDWATER IN STORAGE VERSUS TIME FOR A SUSTAINABLE AND UNSUSTAINABLE BASIN
Anderson Subbasin Groundwater Sustainability Plan

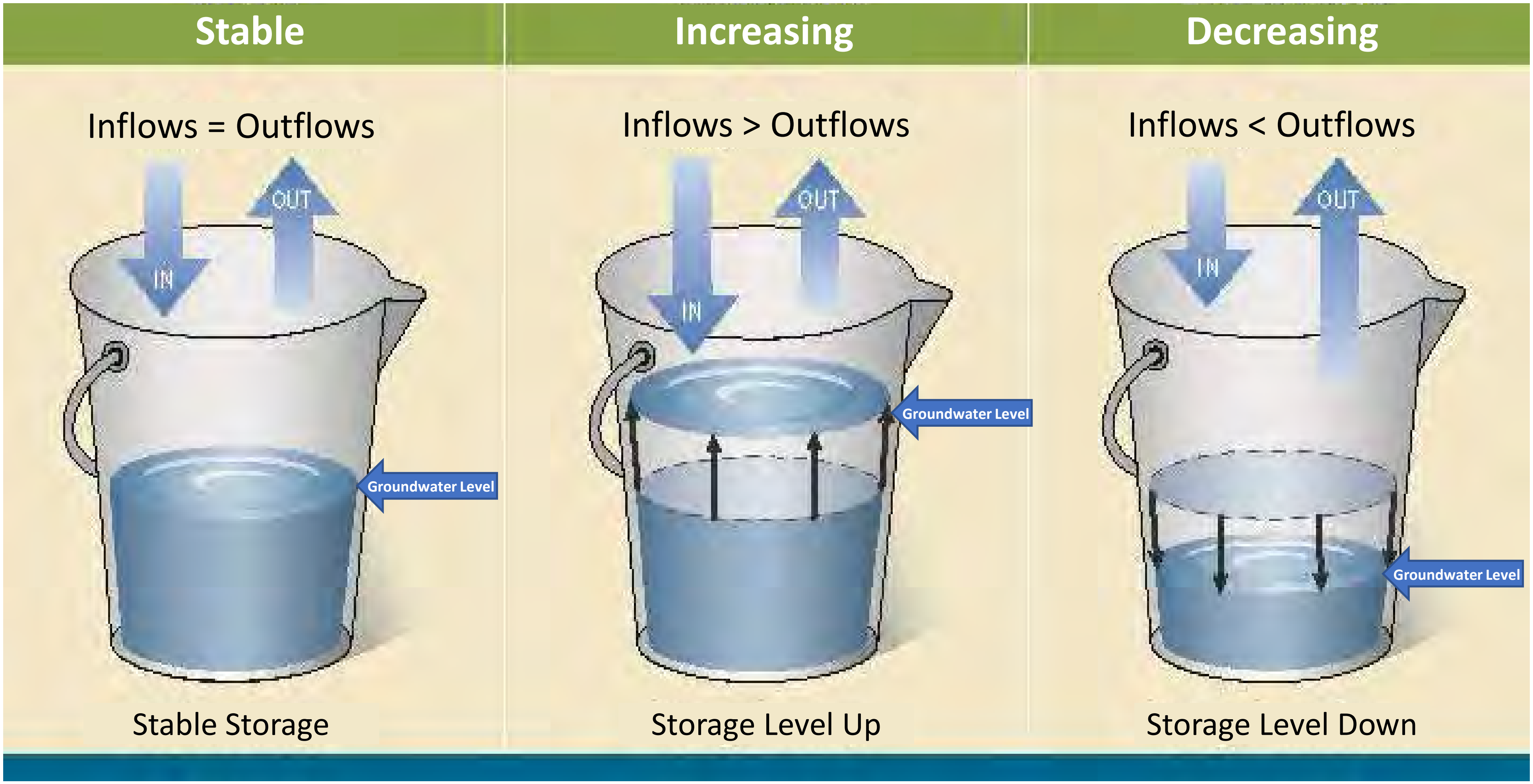
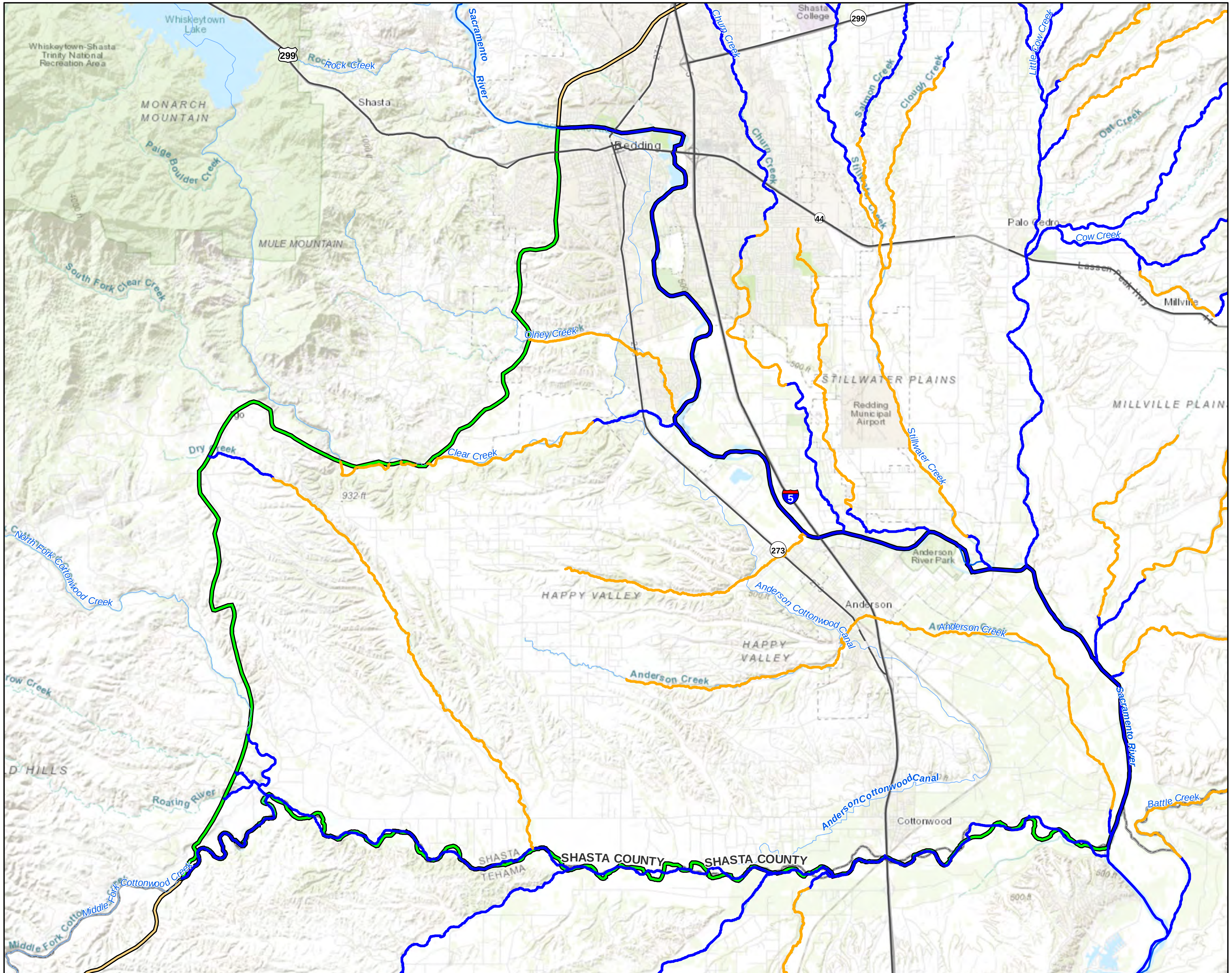
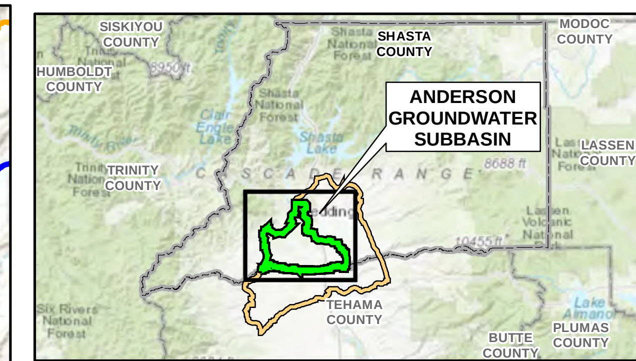


Image Modified from: https://www.cfbf.com/top-issues/?tab=Water

FIGURE 6-7
EXAMPLE OF THE RELATIONSHIP BETWEEN GROUNDWATER LEVELS AND GROUNDWATER IN STORAGE
Anderson Subbasin Groundwater Sustainability Plan





LEGEND

- INTERCONNECTED STREAM REACH
- NOT INTERCONNECTED STREAM REACH
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTE:

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

0 2 4 Miles

N

FIGURE 6-8
EXTENT OF INTERCONNECTED SURFACE WATER IN THE ANDERSON SUBBASIN UNDER AVERAGE SEASONAL HIGH GROUNDWATER CONDITIONS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

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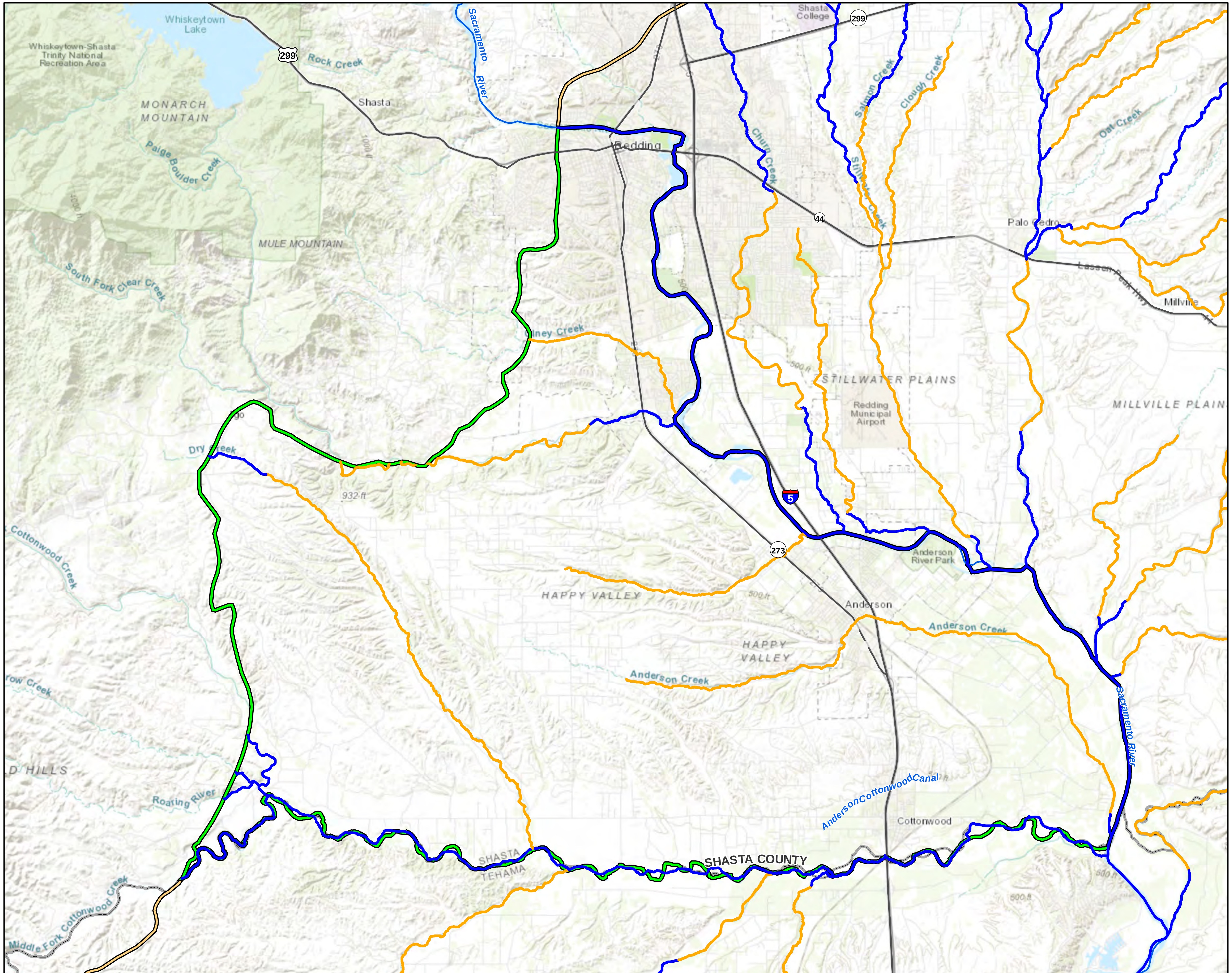
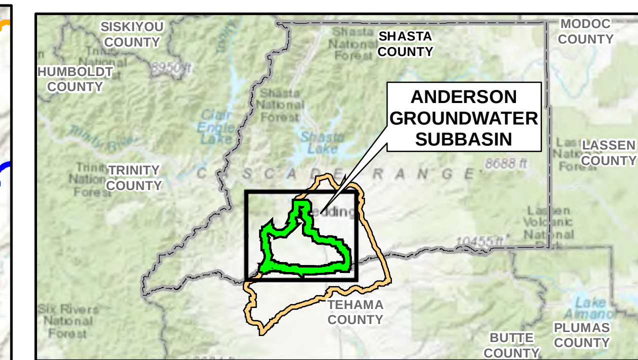




LEGEND

- INTERCONNECTED STREAM REACH
- NOT INTERCONNECTED STREAM REACH
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTE:

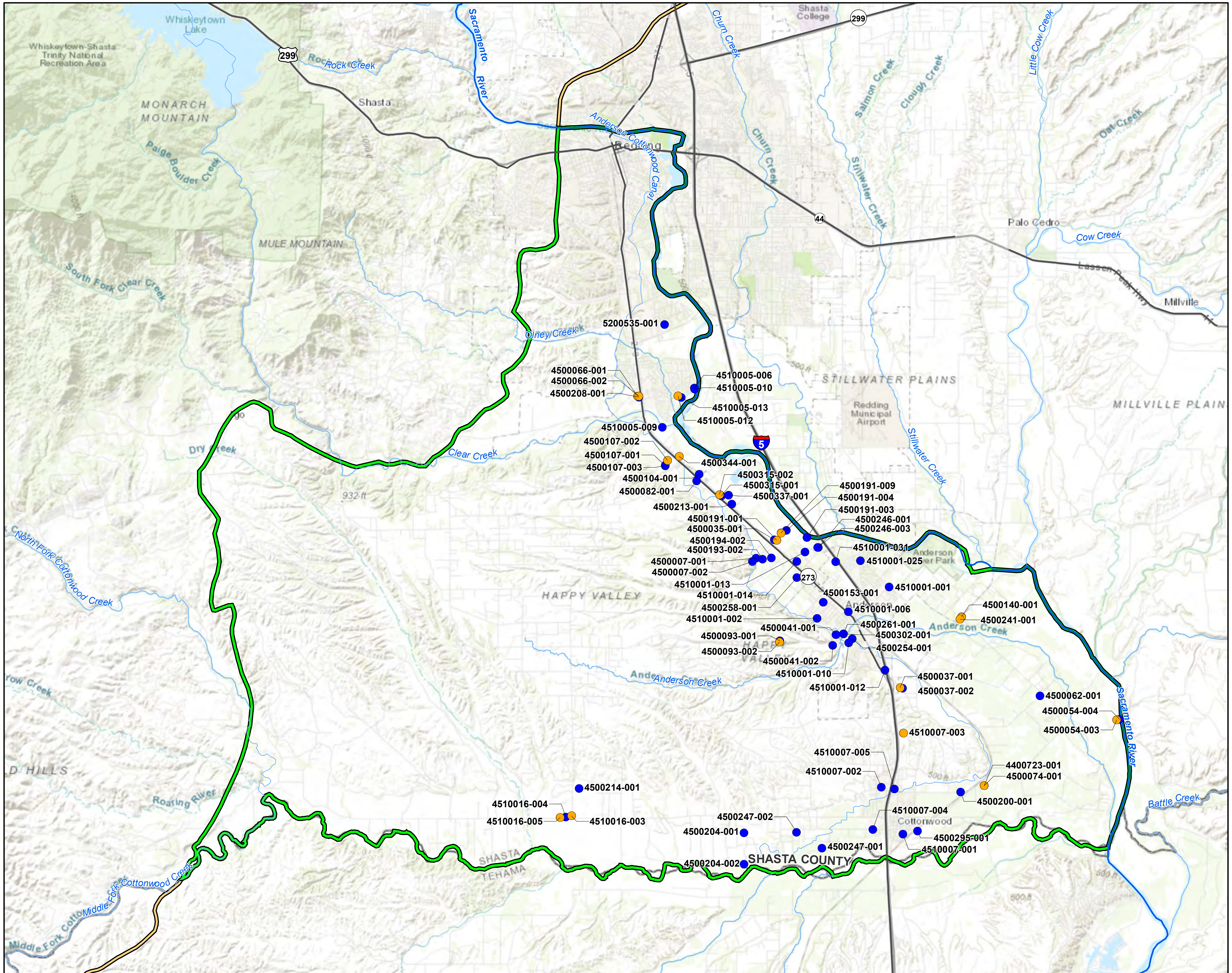
SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

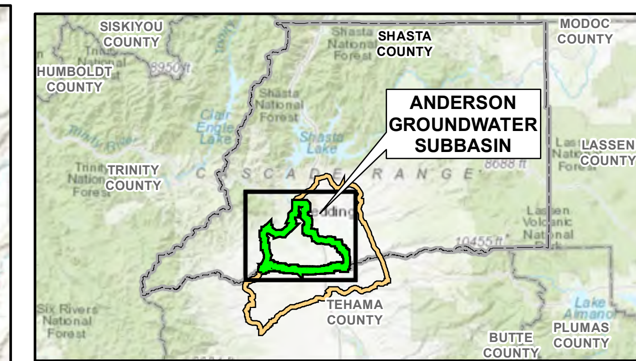
0 2 4 Miles

N

FIGURE 6-9
EXTENT OF INTERCONNECTED SURFACE WATER IN THE ANDERSON SUBBASIN UNDER AVERAGE SEASONAL LOW GROUNDWATER CONDITIONS
Anderson Subbasin Groundwater Sustainability Plan

Jacobs





LEGEND

- REPRESENTATIVE MONITORING POINT WITH EXISTING GROUNDWATER QUALITY IMPAIRMENT
- REPRESENTATIVE MONITORING POINT
- SACRAMENTO RIVER
- RIVER/STREAM
- INTERSTATE/HIGHWAY
- COUNTY BOUNDARY LINE
- ANDERSON GROUNDWATER SUBBASIN (5-006.03 PLAN AREA)
- REDDING AREA GROUNDWATER BASIN

NOTES:

DATA SOURCE: SWRCB, 2019a

SGMA = SUSTAINABLE GROUNDWATER MANAGEMENT ACT

SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

FIGURE 6-10
DEGRADED WATER QUALITY REPRESENTATIVE MONITORING NETWORK
Anderson Subbasin Groundwater Sustainability Plan

Jacobs

7. Projects and Management Actions

Pursuant to GSP regulations § 354.42 and § 354.44, this chapter describes projects and management actions the EAGSA has determined will maintain sustainable groundwater conditions in the Enterprise and Anderson Subbasins and will help the GSA respond to changing conditions in the subbasins to avoid undesirable results. For the purposes of this GSP, projects are defined as activities that support sustainable groundwater management and require new infrastructure. Management actions also support groundwater sustainability but do not require new infrastructure. This chapter is the same for both the Enterprise Subbasin GSP and the Anderson Subbasin GSP because the projects and management actions described will benefit both subbasins and, ultimately, the RAGB.

Undesirable results are currently not present in the Enterprise and Anderson Subbasins and are not anticipated to occur based on the Future Baseline Scenario (the EAGSA's best estimate of future conditions); therefore, projects and management actions to achieve sustainability or to mitigate overdraft conditions (§ 354.44 (b)(2)) are not required at this time. Evidence of current sustainable groundwater conditions, as described in more detail in Chapter 6, includes the following:

- Current groundwater levels in the subbasins are generally similar to groundwater levels observed over the past several decades. There are no long-term trends of declining groundwater levels, and groundwater levels recover following drought periods. Additionally, projected groundwater levels under the Future Baseline Scenario are similar to current and historical conditions (see hydrographs in Appendix D).
- Projected groundwater in storage under the Future Baseline Scenario is similar to historical and current conditions. Additionally, the volume of groundwater in storage at the end of the simulation period for the Increased Groundwater Use Scenario is only 2 percent less than the estimated volume at the time that SGMA became effective (2015). Projected groundwater in storage under both the Future Baseline and Increased Groundwater Use Scenarios is not indicative of overdraft conditions (Figure 4-10).
- Projected depletions of interconnected surface water under the Increased Groundwater Use Scenario are not projected to result in undesirable results. Projected surface-water flows are sufficient to meet the demands of beneficial users in the subbasins. Additionally, the projected Sacramento River outflow from the subbasins is similar to current and historical streamflows.
- Groundwater quality in the subbasins is good and appropriate for beneficial uses in the subbasins. Changes in the distribution of local areas of groundwater impairments are not anticipated in the future (that is, the Future Baseline Scenario does not indicate significant changes in groundwater flow directions).
- The subbasins have not experienced groundwater-pumping-induced land subsidence in the past, and subsurface lithology in the subbasins is not susceptible to land subsidence (that is, there are no extensive layers of compressible materials, such as clays).

Projects and management actions described in this chapter are divided into two categories: (1) ongoing projects and management actions that are part of EAGSA member agency continued operations that have contributed to sustainable groundwater management of the subbasins and (2) potential projects and management actions that might be implemented to respond to unanticipated changing conditions in the subbasins and help avoid undesirable results. The projects and management actions described in this chapter represent the EAGSA's current range of available strategies to maintain sustainability in the subbasins. Additional projects and management actions might be incorporated into this set of strategies during GSP implementation, either through GSP amendments or through the annual reporting process.

7.1 Ongoing Projects and Management Actions to Maintain Sustainability

Descriptions of the following projects and management actions currently being implemented by member agencies to maintain sustainability in the subbasins are based on various WMPs produced by members of the EAGSA:

- COA UWMP (COA, 2017)
- ACID GWMP (ACID, 2006)
- BVWD UWMP (BVWD, 2015)
- COR UWMP (COR, 2016a)
- CCCSD WMP (CCCSD, 2015)

The EAGSA is committed to maintaining sustainability in the Enterprise and Anderson Subbasins; therefore, management actions that have been successful in the past will continue to be implemented in the future. GSP regulations § 354.44 (b) provide a list of required information associated with each project or management action included in the GSPs. Much of this information is the same for ongoing management actions as follows:

- **§ 354.44 (b)(1)(A)** "A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management actions, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred."
  - The projects and management actions described in Sections 7.1.1 through 7.1.3 are part of past and ongoing operations of EAGSA member agencies. As such, the management actions are already being implemented and will continue to be implemented in the future (that is, there is no termination date).
- **§ 354.44 (b)(1)(B)** "The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken."
  - The EAGSA will provide notice on management actions via the agency web-hub and through email notification to the interested parties distribution list. Individual member agencies may provide supplementary information on their individual agency websites, through mail inserts with billing statements, or via media outreach.
- **§ 354.44 (b)(3)** "A summary of the permitting and regulatory process required for each project and management action."
  - Because the management actions described in Sections 7.1.1 through 7.1.3 are part of past and ongoing operations, no additional permitting is required.
- **§ 354.44 (b)(4)** "The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits."
  - The projects and management actions described in Sections 7.1.1 through 7.1.3 are part of past and ongoing operations of EAGSA member agencies. As such, the management actions are already being implemented and will continue to be implemented in the future (that is, there is no termination date).
- **§ 354.44 (b)(7)** "A description of the legal authority required for each project and management action, and the basis for that authority within the Agency."
  - The projects and management actions described in Sections 7.1.1 through 7.1.3 are part of past and ongoing operations of EAGSA member agencies. As such, legal authority of individual member agencies to implement the actions has been established.

- **§ 354.44 (b)(8)** "A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs."
  - Because the projects and management actions described in Sections 7.1.1 through 7.1.3 are ongoing, the implementation costs are already incorporated into the operating budgets of the individual management agencies. There is no additional cost to the EAGSA.

7.1.1 Water Conservation and Demand Management

7.1.1.1 § 354.44 (b)(6) Description

Some portion of the water supply provided to customers in the Anderson and Enterprise Subbasins is sourced from groundwater production. Some member agencies such as COA and CSA #8 - Palo Cedro are solely dependent on groundwater; whereas ACID, COR, CCCSD, and BVWD obtain water from both surface-water and groundwater supplies. In times of water supply scarcity, surface-water deliveries are reduced substantially, resulting in significant increases in groundwater production from the subbasins. Therefore, the ongoing conservation measures discussed in this section focus primarily on reduction in overall water use, with the intent being that these actions reduce overall water demand, which leads to less groundwater pumping and helps promote sustainability within the groundwater subbasins.

EAGSA member agencies have established programs and protocols to promote water conservation and water use efficiency. Specific demand management strategies vary slightly among member agencies. In general, the first management action taken by all member agencies is education and public outreach. This includes posting information regarding current climatic and water supply conditions to the individual agency websites. For example, when drought conditions have been judged to be present by State and federal government agencies, EAGSA member agencies post the drought notifications to their websites for customer information purposes. Agencies might provide additional information such as indoor and outdoor water conservation tips, recommendations for drought-tolerant landscaping, recommendation for replacing inefficient irrigation systems with more efficient automated drip and micro-sprayer irrigation systems, and recommendations for retrofitting existing plumbing fixtures with higher-efficiency fixtures. Member agencies might provide such information to customers via targeted mailings, newsletters or inserts with billing statements, or via newscasts. Along with education, EAGSA member agencies request that customers engage in voluntary water rationing. This includes implementing water conservation measures such as turning off faucets when washing dishes, only running appliances when they are full, fixing slow leaks in plumbing systems, and reducing shower durations. Most member agencies provide customer assistance with water conservation tips and offer water use audits and leak detection assistance. All of these actions lead to reduced overall water demand, and in times of water scarcity, reduce the volume of groundwater pumping from the subbasins, leading to more sustainable conditions. Reductions in groundwater pumping lead to higher groundwater levels, a greater volume of groundwater in storage, and reduced depletion of interconnected surface-water flows.

As discussed in Chapter 4, many of the EAGSA member agencies rely heavily on CVP surface-water supplies to meet customer water demands. During Critically Dry WYs when CVP allotments are severely curtailed, local purveyors have a need for larger water demand reductions. Depending on the member agency, this is accomplished through mandatory rationing, implementing tiered billing rates based on water use (to incentivize water conservation), or a combination of the two. Examples of mandatory rationing include (but are not limited to) restrictions on hard surface cleaning (such as sidewalks or decks), residential car washing, emptying and refilling of swimming pools, use of water in decorative features (fountains), and daily landscape irrigation (that is, limiting the number of days per week that customers can irrigate). As the need for water demand reductions increases, the severity of mandatory rationing measures proportionally increases and, in some cases, can include restrictions on new service connections, prohibition on outdoor irrigation, denial of permits for construction water use, and restrictions on use of water for dust control. To enforce mandatory rationing, EAGSA member agencies might institute fines for violating demand management strategies or terminate services.

In addition to demand management strategies aimed at reducing customer water consumption, many EAGSA member agencies also employ systemwide metering to help identify and repair system losses.

7.1.1.2 § 354.44 (b)(1) Relevant Measurable Objectives

Reduction in total water use within the Enterprise and Anderson Subbasins will lead to a reduction in the need for expanded groundwater pumping and benefit the measurable objectives for the following:

- Groundwater levels – Less groundwater pumping will result in higher groundwater levels.
- Groundwater storage – Less groundwater pumping will result in higher groundwater levels and, therefore, a larger volume of groundwater in storage.
- Interconnected surface water – Less groundwater pumping will result in higher groundwater levels and reduced depletions of interconnected surface water.
- Land subsidence – Less groundwater pumping will result in higher groundwater levels and a reduced potential for groundwater-pumping-induced land subsidence.

7.1.1.3 § 354.44 (b)(5) Expected Benefits and Benefit Evaluation

By reducing water demand, particularly during periods of surface-water shortages, the need to increase groundwater pumping is offset. Reduced groundwater pumping, depending on the geographic location, results in benefits such as higher groundwater levels (which might reduce costs of groundwater pumping through decreased lift), increased groundwater in storage, reduced depletions of interconnected surface water, and decreased potential for groundwater-pumping-induced land subsidence.

The benefits of water conservation and demand management will be evaluated through ongoing data collection in the subbasins. These include evaluation of groundwater levels at wells included in the groundwater elevation monitoring network, assessment of streamflow at stream gauges in the subbasins, and evaluation of land subsidence through the InSAR datasets made available by DWR. The ability to make a direct correlation between water conservation measures and groundwater levels is unlikely because this is one of several activities that will be present in the subbasins during GSP implementation.

7.1.2 Water Supply Flexibility

7.1.2.1 § 354.44 (b)(6) Description

As described in Chapter 4, EAGSA member agencies obtain water supplies through (1) surface-water supplies only, (2) groundwater supplies only, or (3) a combination of the two. Purveyors with access to multiple sources of water have the flexibility to conjunctively manage supplies to meet customer needs. For example, during shortage years (when CVP surface-water allocations are reduced), several agencies own groundwater pumping wells that can be used to help offset surface-water curtailments. In subsequent years when surface water supplies are more readily available, these purveyors can reduce the proportion of groundwater pumping used to meet demand and allow groundwater levels in aquifers to recover from prior periods of higher pumping. These strategies lead to a lower overall demand on the groundwater system and more reliable long-term supply. In addition to conjunctive water management, some EAGSA member agencies have entered into in-basin water transfer agreements. In-basin water transfers are an important water management tool for the subbasins and are used to augment supply and partially offset the impacts of drought, regulatory requirements, and other water shortages. When such transfers are executed, the receiving water purveyor increases their surface water diversions while the transferring agency reduces diversions by an equal amount. Another potential mechanism for member agencies to share water supplies is through interties between water systems. Currently, water system interties are contractually restricted to emergency use.

7.1.2.2 § 354.44 (b)(1) Relevant Measurable Objectives

Maintaining flexibility in water supplies within the subbasins will benefit the measurable objectives for all relevant sustainability indicators, as follows:

- Groundwater levels – Use of in-basin water transfers provides access to surface water for purveyors whose allotments have been reduced. This can help to maintain higher groundwater levels through a reduced need for affected purveyors to pump groundwater. Conjunctive water management (pumping groundwater in times of reduced surface-water supplies) might lead to localized areas of reduced groundwater levels; however, these reduced groundwater levels can be allowed to recover during subsequent periods of increased surface-water availability and reduced levels of required pumping.
- Groundwater storage – Less groundwater pumping will result in higher groundwater levels and, therefore, a larger volume of groundwater in storage.
- Interconnected surface water – Less groundwater pumping will result in higher groundwater levels and reduced changes to historical and current groundwater/surface-water interaction.
- Water quality – Maintaining existing patterns of groundwater pumping will result in maintaining existing groundwater flow directions, therefore reducing the potential to induce migration of localized groundwater impairments into unimpaired portions of the subbasins.
- Land subsidence – Less groundwater pumping will result in higher groundwater levels and a reduced potential for groundwater-pumping-induced land subsidence.

7.1.2.3 § 354.44 (b)(5) Expected Benefits and Benefit Evaluation

By exercising flexibility in water supplies, the need to increase groundwater pumping is offset. Reduced groundwater pumping, depending on the geographic location, results in benefits such as higher groundwater levels (which might reduce costs of groundwater pumping through decreased lift), increased groundwater in storage, reduced depletions of interconnected surface water, and decreased potential for groundwater-pumping-induced land subsidence.

The benefits of flexible water supplies will be evaluated through ongoing data collection in the subbasins. These include evaluation of groundwater levels at wells included in the groundwater elevation monitoring network, assessment of streamflow at stream gauges in the subbasins, and evaluation of land subsidence through the InSAR datasets made available by DWR.

7.1.3 Storm Water Resources Plans

7.1.3.1 § 354.44 (b)(6) Description

Several EAGSA member agencies have established storm water resources plans. The COR Public Works Department website[16] describes the plan as follows:

> *The Storm Water Resources Plan (SWRP) provides a watershed-based approach to storm water management, seeking to replicate natural hydrology and watershed processes. This*

[16] https://www.cityofredding.org/departments/public-works/environmental-management/storm-water-management

improved management will be accomplished through the identification, benefit quantification, and prioritization of the following types of projects within the SWRP study area: green infrastructure, rainwater capture projects, and storm water treatment facilities. All projects selected will result in water supply, water quality, flood control, community, and/or environmental benefits to the City, therefore reducing demand on water supply, reducing pollutants of concern in water bodies, and/or restoring ecosystems.

SWRPs include projects such as use of low-impact design in construction (such as porous pavement), construction of detention ponds to promote infiltration of and natural filtration of surface-water runoff, and riparian habitat restoration. Other positive stormwater-related management actions include activities such as educational signage on walking trails, expanding public educational campaigns to disseminate best practices for activities such as auto cleaning, pet care, and landscaping, and providing a mechanism for the reporting of illicit discharges. These projects and management actions are aimed at increasing groundwater recharge by enhancing opportunities for infiltration, increasing groundwater levels, and reducing depletions of interconnected surface water through riparian habitat restoration, and improving water quality through enhancing natural filtration.

7.1.3.2 § 354.44 (b)(1) Relevant Measurable Objectives

Implementation of SWRPs within the subbasins will benefit the measurable objectives for all relevant sustainability indicators, as follows.

- Groundwater levels – Enhanced infiltration of surface water and precipitation will lead to higher groundwater levels.
- Groundwater storage – Enhanced infiltration of surface water and precipitation will lead to higher groundwater levels and, therefore, a larger volume of groundwater in storage.
- Interconnected surface water – Enhanced infiltration of surface water and precipitation will lead to higher groundwater levels and reduced changes to historical and current groundwater/surface-water interaction. Riparian restoration and improved surface-water quality might result in improved GDE health in the subbasins.
- Water quality – Use of detention basins to filter surface water will improve water quality in the subbasins. Enhanced groundwater recharge through expansion of infiltration of surface water and precipitation will help to maintain existing groundwater flow directions and, therefore, migration directions of localized areas of impaired groundwater.
- Land subsidence – Enhanced infiltration of surface water and precipitation might lead to higher groundwater levels and a reduced potential for groundwater-pumping-induced land subsidence.

7.1.3.3 § 354.44 (b)(5) Expected Benefits and Benefit Evaluation

Increasing opportunities for groundwater recharge via enhanced infiltration and restoring riparian habitat (potentially eradicating water consumption by invasive species) might result in benefits such as higher groundwater levels (which might reduce costs of groundwater pumping through decreased lift), increased groundwater in storage, reduced depletions of interconnected surface water, improved water quality, and decreased potential for groundwater-pumping-induced land subsidence.

The benefits of SWRP implementation will be evaluated through ongoing data collection in the subbasins. These include evaluation of groundwater levels at wells included in the groundwater elevation monitoring network, assessment of streamflow at stream gauges in the subbasins, and evaluation of land subsidence through the InSAR datasets made available by DWR.

7.2 Potential Future Projects and Management Actions to Respond to Changing Conditions

As described in Chapter 6, the first step that the EAGSA plans to take to respond to potential changing conditions in the subbasins is to initiate an investigation to assess whether the observed trend is the result of SGMA-related groundwater management activities. For example, if water quality RMPs begin exceeding the SMC, the EAGSA would investigate whether:

- There have been new groundwater pumping wells installed that are resulting in changes in groundwater flow directions (therefore COC migration)
- There has been an increase in pumping rates of existing wells that are resulting in changes in groundwater flow directions (therefore COC migration)
- There are other climatic conditions that have changed groundwater flow patterns (therefore COC migration)
- The observed trend is related to non-SGMA activities, such as a contaminant release

For SMCs with a multi-year component to the definition of undesirable results, the investigation would occur mid-way through the period. For example, the definition of undesirable results for chronic lowering of groundwater levels is exceedance of the MTs at 25 percent of the same RMPs for three consecutive spring measurements. In this case, the investigation would be initiated after the second consecutive spring. If the results of the investigation conclude that the trends are due to SGMA-related groundwater management activities, the EAGSA might consider additional projects or management activities in the future to respond to changing conditions in the subbasins.

Potential future projects and management actions that might be considered should groundwater conditions change in the subbasins and trends suggest that sustainable management of the groundwater resource is threatened are discussed below. These projects are natural expansions of water management strategies discussed in Section 7.1 that are currently being successfully implemented in the Anderson and Enterprise Subbasins in times of water scarcity. The following subsections describe how the ongoing projects and management actions might be expanded to a larger scale or frequency to achieve greater benefits with respect to reducing overall water demand, thereby increasing the likelihood that sustainable conditions can be maintained. Similar to the description of ongoing projects and management actions described in Section 7.1, many of the requirements of GSP regulations § 354.44(b) are the same for expansion of ongoing management actions described below as follows:

- **§ 354.44 (b)(1)** "A description of the measurable objective that is expected to benefit from the project or management action."
  - The objective of expansion of existing projects and management actions focuses on a combination of reducing the need for additional groundwater pumping and increasing groundwater recharge. These objectives will benefit the measurable objectives for:
    - Groundwater levels – Less groundwater pumping and more groundwater recharge will result in higher groundwater levels.
    - Groundwater storage – Less groundwater pumping and increased groundwater recharge will result in higher groundwater levels and, therefore, a larger volume of groundwater in storage.
    - Interconnected surface water – Less groundwater pumping and increased groundwater will result in higher groundwater levels and reduced depletions of interconnected surface water.

- Water quality – Maintaining current groundwater flow directions within the subbasins will minimize the potential for migration of areas of local impairments into unimpaired portions of the subbasins.
- Land subsidence – Less groundwater pumping and increased groundwater recharge will result in higher groundwater levels and a reduced potential for groundwater-pumping-induced land subsidence.

▪ **§ 354.44 (b)(1)(A)** "A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management actions, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred."

– The management actions described in Sections 7.2.1 through 7.2.3 are potential expansions of ongoing operations of EAGSA member agencies. These projects and management actions might be needed in the future if an investigation into changing conditions in the subbasin concludes that (1) such trends toward undesirable results are the result of SGMA-related groundwater management activities and (2) current projects and management actions are not sufficient to reverse the trend(s).

– These more aggressive management actions would be terminated once SMCs suggest that subbasin conditions have returned to long-term sustainable conditions.

▪ **§ 354.44 (b)(1)(B)** "The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken."

– The EAGSA will provide notice on projects or management actions via the agency web-hub and through email notification to the interested parties distribution list. Individual member agencies might provide supplementary information on their individual agency websites, through mail inserts with billing statements, or via media outreach.

▪ **§ 354.44 (b)(3)** "A summary of the permitting and regulatory process required for each project and management action."

– The projects and management actions described in Sections 7.2.1 through 7.2.3 are conceptual in nature. If the EAGSA deems that these projects and management actions are needed to maintain sustainability, the necessary permitting and regulatory processes required for project or management action development and implementation would be evaluated at that time.

▪ **§ 354.44 (b)(4)** "The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits."

– The projects and management actions described in Sections 7.2.1 through 7.2.3 are conceptual in nature. If the EAGSA deems that these projects and management actions are needed to maintain sustainability, the schedule for project or management action development and implementation would be evaluated at that time.

▪ **§ 354.44 (b)(7)** "A description of the legal authority required for each project and management action, and the basis for that authority within the Agency."

– The projects and management actions described in Sections 7.2.1 through 7.2.3 are expansions of past and ongoing operations of EAGSA member agencies. As such, legal authority of individual member agencies to implement the actions has been established. If the EAGSA deems that these projects and management actions are needed to maintain sustainability, the legal authority specific to the expanded project or management action details would be evaluated at that time.

- **§ 354.44 (b)(8)** "A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs."
  - The projects and management actions described in Sections 7.2.1 through 7.2.3 are conceptual in nature. If the EAGSA deems that these projects and management actions are needed to maintain sustainability, the details for project or management action development and implementation, including costs and plans to meet those costs, would be established at that time.

7.2.1 Water Conservation and Demand Management

7.2.1.1 § 354.44 (b)(6) Description

As discussed in Section 7.1.1, water conservation measures currently being implemented in the Enterprise and Anderson Subbasins during drought conditions are educational in nature, providing information to customers of ways to reduce their overall water use. In some districts, further measures are implemented such as voluntary or mandatory water rationing, imposing tiered pricing of water, and charging a penalty fee if water use targets are exceeded, or mandating that landscape watering can only be performed on certain days of the week. The potential expansion of these efforts would add the offering of financial incentives to incentivize increased water use efficiency. This might include providing rebates to defray the cost of retrofitting plumbing fixtures, replacing low-efficiency irrigation systems or appliances with higher-efficiency technology, or paying customers to remove lawns and other water-intensive landscaping with low-water-use alternatives such as drought-tolerant plants, or by purchasing water-efficient plumbing fixtures in bulk and providing them directly to customers.

7.2.1.2 § 354.44 (b)(5) Expected Benefits and Benefit Evaluation

The results of providing financial incentives for improved water use efficiency would be a reduction of total water demand. An overall reduction in water demand would offset the quantity of groundwater being pumped. Reduced groundwater pumping, depending on the geographic location, would lead to higher groundwater levels, a greater volume of groundwater in storage in the aquifer system, reduction in depletion of interconnected surface water, and decreased potential for groundwater-pumping-induced land subsidence. All of these beneficial changes in basin conditions would result in the subbasins being managed more sustainably.

The benefits of expanded water conservation and demand management will be evaluated through ongoing data collection in the subbasins. These include evaluation of groundwater levels at wells included in the groundwater elevation monitoring network, assessment of streamflow at stream gauges in the subbasins, and evaluation of land subsidence through the InSAR datasets made available by DWR. The ability to make a direct correlation between water conservation measures and groundwater levels is unlikely because this is one of several activities that will be present in the subbasins during GSP implementation.

7.2.2 Water Supply Flexibility

7.2.2.1 § 354.44 (b)(6) Description

As discussed in Section 7.1.2, EAGSA member agencies with access to both surface-water and groundwater supplies currently manage their water supplies conjunctively. In times of water supply scarcity, groundwater is used to augment reduced surface-water supplies. During wetter periods, groundwater pumping is reduced to allow groundwater levels to recover. Several EAGSA members have also conducted in-basin water transfers to address drought impacts. Although water system interties between some water purveyors exist, they are contractually restricted to emergency use. Expansion of the water flexibility program envisioned herein would consist of modifying the current restrictions on the use of system interties to encourage more flexible collaborative use of in-basin water supplies between local purveyors. This approach would enhance sustainability of the Enterprise and Anderson Subbasins by making surface water available to local water purveyors with more junior water rights or who are reliant on groundwater resources only. Expanding opportunities for in-basin water transfers or consideration of changing the status of existing (or new) system interties from emergency use only to allow for more flexibility in transfers between water purveyors during non-emergency conditions would offset the need for increased groundwater pumping.

Another element of this program would be the redistribution of groundwater pumping to offset potential locally depressed groundwater levels in specific areas of the basin or to mitigate changes in groundwater flow directions that are inducing the migration of poorer-quality groundwater into areas of better-quality groundwater. This potential management action would need to be implemented in close consultation with the water suppliers in the affected area. If the necessary conveyance capacity exists in the existing distribution network, then this could be a relatively low-cost action. However, if modifications to the distribution network are needed to move the necessary water volumes from areas of expanded pumping to areas of customer demand, the costs could increase substantially.

7.2.2.2 § 354.44 (b)(5) Expected Benefits and Benefit Evaluation

By exercising flexibility in water supplies, the need to increase groundwater pumping is offset. Reduced groundwater pumping, depending on the geographic location, results in benefits such as higher groundwater levels (which might reduce costs of groundwater pumping through decreased lift), increased groundwater in storage, reduced depletions of interconnected surface water, and decreased potential for groundwater-pumping-induced land subsidence. Additionally, the ability to redistribute groundwater pumping will benefit water quality by minimizing the potential to induce migration of degraded groundwater into unimpaired areas of the subbasins.

The benefits of flexible water supplies will be evaluated through ongoing data collection in the subbasins. These include evaluation of groundwater levels at wells included in the groundwater elevation monitoring network, assessment of streamflow at stream gauges in the subbasins, evaluation of groundwater quality datasets from GAMA, and evaluation of land subsidence through the InSAR datasets made available by DWR.

7.2.3 Stormwater Management

7.2.3.1 § 354.44 (b)(6) Description

Several stormwater-related activities are currently being implemented as outlined in the COR and COA SWRPs. These activities are focused on projects such as use of low-impact design in construction (such as porous pavement), construction of detention ponds to promote infiltration of and natural filtration of surface-water runoff, and riparian habitat restoration. The scale of the implementation of stormwater management strategies under this potential expansion of the program would be significantly increased, thereby achieving much larger benefits to the groundwater aquifer systems in the Enterprise and Anderson Subbasins. Expansion of existing stormwater programs would be centered around opportunities for enhanced groundwater recharge through existing or new infrastructure. The Enterprise and Anderson Subbasins have irrigation infrastructure that could be used during nongrowing periods to spread excess surface-water runoff (such as winter flood flows) into unlined canal structures or irrigation laterals, as well as in fields not currently in production. This increase in groundwater recharge would increase groundwater levels and the volume in storage in the aquifer system, potentially mitigating any adverse trends in sustainability indicators. The cost for such a project would be negligible because existing infrastructure would be used. Specific areas to be used and the routing of available water to the target recharge locations could be determined in the future if actions are required to maintain subbasin sustainability.

7.2.3.2 § 354.44 (b)(5) Expected Benefits and Benefit Evaluation

Increasing opportunities for groundwater recharge via enhanced infiltration might result in benefits such as higher groundwater levels (which might reduce costs of groundwater pumping through decreased lift), increased groundwater in storage, reduced depletions of interconnected surface water, improved water quality, and decreased potential for groundwater-pumping-induced land subsidence.

The benefits of expansion of the SWRPs will be evaluated through ongoing data collection in the subbasins. These include evaluation of groundwater levels at wells included in the groundwater elevation monitoring network, assessment of streamflow at stream gauges in the subbasins, and evaluation of land subsidence through the InSAR datasets made available by DWR.

As described in Chapter 6 and in the introduction to this chapter, the Enterprise and Anderson Subbasins are currently being sustainably managed; therefore, there is not a current need for projects and management actions to bring the subbasins to a sustainable condition. If there is a need to implement additional projects and management actions during GSP implementation, they would be fully developed to address the requirements of GSP regulations § 354.44 (b) (including interbasin coordination with GSAs of adjacent subbasins) at that time.

8. Plan Implementation

This chapter serves as a roadmap that describes how the GSP for the Anderson Subbasin will be implemented. Although it is understood that the implementation plan should address activities that are anticipated to occur during the 20-year GSP implementation period from 2022 through 2042, this chapter focuses on the activities anticipated to occur during the first 5 years after GSP adoption. Much will be learned during the first 5 years of GSP implementation, so the implementation activities described in this chapter will be updated in the 5-year GSP assessment report in 2027. Implementing this GSP will involve the following high-level activities:

- GSP implementation program management
- Monitoring, reporting, and outreach
- Address data gaps
- Implement projects and management actions
- Pursue work agreements and funding opportunities
- Update the EAGSA Model

The implementation plan in this chapter is based on the current understanding of subbasin conditions and current assessment of the need for projects and management actions, as discussed in Chapter 7. As described in Chapter 6, the Anderson Subbasin is currently sustainable and is projected to continue to be managed sustainably. The EAGSA will implement the GSP components, as outlined in the following sections, and will enact management actions to maintain sustainability if unforeseen significant and unreasonable conditions arise. Given the sustainable nature of the subbasin, GSP implementation costs are anticipated to be relatively low, as compared to higher-priority basins that require projects and management actions to achieve sustainability. During the initial 5-year GSP implementation, the EAGSA will conduct a review of financing options, as is discussed in the following sections.

8.1 GSP Implementation Program Management

GSP implementation program management includes administration of all activities required to comply with GSP regulations. These activities are as follows:

- General GSA administration and oversight of ongoing groundwater monitoring and reporting
- Joint coordination among GSA members and with GSAs in adjacent basins, as needed
- Oversight of consultants or contractors that may be retained to execute certain activities on behalf of the GSA
- Public outreach and notification, including maintenance of the EAGSA website and hosting annual public workshops
- EAGSA Management Committee and Board meetings; the Management Committee intends to meet quarterly to effectively implement the GSP and provide annual updates to the EAGSA Board
- Implementation of projects and management actions, if necessary

8.2 Monitoring, Reporting, and Outreach

8.2.1 Monitoring

Following adoption of the Anderson Subbasin GSP, the EAGSA will continue to coordinate with entities executing monitoring programs, as described in Chapter 5. Data from the monitoring programs will be routinely evaluated to assess hydrologic conditions relative to the SMCs. These data will be maintained in the DMS and used to develop the annual reports that will be submitted to DWR.

8.2.1.1 Groundwater Level Monitoring

Table 5-1 lists information for the existing groundwater-level monitoring wells. As discussed in Chapter 5, groundwater levels are measured at least semi-annually at these wells as part of the CASGEM program. The majority of the CASGEM wells in the Anderson Subbasin are currently and will continue to be monitored by DWR. After GSP submittal, the data will be transitioned from the CASGEM program into the MNM. Shasta County is the monitoring and reporting entity for CASGEM well Columbia. Additionally, one new multi-completion monitoring well will have been constructed in the Anderson Subbasin by fall 2021 and will be added to the MNM. The EAGSA will coordinate with DWR with the goal of having DWR incorporate the new multi-completion well into its ongoing monitoring program. The EAGSA will download the data annually to prepare summary tables, figures, and evaluation of data relative to SMCs.

8.2.1.2 Groundwater Storage Monitoring

Changes in groundwater storage will be monitored by proxy through the measurement of groundwater levels. Therefore, no additional monitoring of groundwater storage is planned for this subbasin.

8.2.1.3 Interconnected Surface Water Monitoring

Depletions of interconnected surface water will be monitored by proxy through the measurement of groundwater levels. Therefore, no additional monitoring to address depletions of interconnected surface water is planned for this subbasin.

8.2.1.4 Water Quality Monitoring

Table 5-2 lists the locations of the existing groundwater quality monitoring network in the Anderson Subbasin. These wells are included in the existing SWRCB DDW program, where the monitoring frequency for each groundwater sampling location varies based on local groundwater quality conditions. Sample frequency for specific analytes for a given location may range from annually up to every 9 years. As such, sampling at existing monitoring wells is expected to vary year by year; thus, the spatial coverage of sampled wells may not be the same in any given year. Data will be downloaded annually from the GAMA website for evaluation of groundwater quality in the Anderson Subbasin relative to the SMCs. Data will be maintained in the EAGSA's DMS.

8.2.1.5 Land Subsidence Monitoring

As discussed in Chapter 5, DWR will continue to make InSAR datasets available to GSAs annually for the evaluation of potential land subsidence due to groundwater pumping. The EAGSA will download these data annually for evaluation of SMCs. InSAR data covering the Anderson Subbasin will be maintained in the DMS.

8.2.2 Reporting

GSP regulations § 353.4 describes the reporting provisions to be followed. The EAGSA will submit applicable reports and data electronically to DWR via an online reporting system following the format provided by DWR. Materials submitted to DWR will be accompanied by a transmittal letter signed by the plan manager or other duly authorized representative of the GSA.

8.2.2.1 Annual Reports

GSP regulations § 356.2 requires GSAs to submit annual reports to DWR on April 1st of each year following adoption of the GSP. The annual report will include the following elements:

- General information, including an executive summary and a location map depicting the subbasin.
- A detailed description of groundwater levels from monitoring wells identified in the monitoring network. The discussion of groundwater levels will be accompanied by groundwater elevation contour maps for the seasonal high and seasonal low groundwater conditions and hydrographs (graphs of groundwater elevations over time) from at least January 2015 to the current reporting year.
- Groundwater extraction by EAGSA member agencies for the preceding WY and a map that illustrates the general locations and volumes of groundwater extractions.
- Surface water supply used or available for use by EAGSA member agencies for the preceding WY.
- Total water use summarized by water use sector and water source type for EAGSA member agencies.
- Maps of the change in groundwater storage and a graph depicting WY type, groundwater use, the annual change in groundwater storage, and the cumulative change in groundwater in storage for the subbasin from January 2015 to the current reporting year.
- Comparison of monitoring data to the SMC at each RMP.
- A description of progress toward implementing the GSP, including achieving interim milestones and implementation of projects and management actions, as applicable.

8.2.2.2 Five-year GSP Assessment Reports

GSP regulations § 356.4 requires GSAs to update and submit to DWR an amended GSP at least every 5 years. The first 5-year GSP assessment report will be provided to DWR in 2027. This assessment will describe whether the GSP implementation has resulted in meeting the sustainability goal for the subbasin and also will include the following elements:

- A description of current groundwater conditions for each applicable sustainability indicator relative to SMCs.
- A description of the implementation of projects or management actions, if applicable.
- Elements of the GSP that have been reconsidered and revised, such as an evaluation of the basin setting based on new information or changes in water use.
- A description of the monitoring network in the subbasin along with an analysis of data collected, identification of data gaps, and actions needed to improve the monitoring network. If data gaps are identified, then the EAGSA will assess funding opportunities for gathering the information.
- A description of significant new information that has been made available since GSP adoption or the last 5-year assessment. The description will include whether new information warrants changes to the GSP (such as revising MOs, MTs, or description of undesirable results).
- A description of relevant actions taken by the GSA, including a summary of regulations or ordinances related to the GSP, if applicable.
- Information describing any enforcement or legal actions taken by the GSA, if applicable.
- A description of completed or proposed GSP amendments.
- Where appropriate, a summary of coordination that occurred among entities within the Anderson Subbasin and adjacent subbasins.
- Other information the GSA deems appropriate.

8.2.3 Outreach

The EAGSA will continue public outreach and provide opportunities for engagement during GSP implementation. The EAGSA website will be maintained as the primary communication tool for SGMA-related content, monitoring data, reports, and meeting information. The goal of this tool is to make the GSP process as accessible to the public as possible. Given the high percentage of DACs and SDACs in the Anderson Subbasin, it will be important to make the GSP-related information readily available to individuals from their home computers or computers available at the local library. The philosophy is to share and exchange information with local tribes, DACs, SDACs, and other interested members of the public, without the burden of obtaining transportation to public meetings, taking time off work for attendance, and potentially acquiring and paying for childcare while participating in public outreach activities. The ability to be heard and participate in this public process will be rewarding to the public, allowing them to feel more connected to the local management of groundwater resources in their subbasin.

Additionally, announcements for GSA Board meetings and other GSP-related meetings and workshops will continue to be distributed via email to recipients included in the interested parties list, which will be maintained and updated as needed during GSP implementation. The EAGSA intends to host annual public workshops to present findings from each annual report. This will be done to provide an opportunity for the public to become or stay apprised of local groundwater conditions and GSP activities.

The EAGSA will continue to foster working relationships with local, State, and federal regulatory agencies as well as with non-governmental organizations. These relationships will focus on collaboration on furthering the understanding and management of the groundwater resources within the subbasin. As discussed above, the EAGSA will coordinate with DWR on groundwater-level and subsidence monitoring and with SWRCB on groundwater quality monitoring. Additionally, environmental organizations and California Department of Fish and Wildlife will be encouraged to participate in public meetings to discuss opportunities to improve the understanding of GDEs and potential depletions of interconnected surface water.

8.3 Address Data Gaps

Although the spatial density of wells in the monitoring network meets density recommendations indicated in DWR's BMP for *Monitoring Networks and Identification of Data Gaps* (DWR, 2016c), a few data gaps have been identified for the Anderson Subbasin. The following subsections describe the plans for improving the existing monitoring networks for each of the five applicable sustainability indicators, as needed.

8.3.1 Groundwater-level Data Gaps

As discussed in Chapter 5, data gaps associated with groundwater levels in the Anderson Subbasin include the following:

- As listed in Table 5-1, 9 of the 28 well completions in the groundwater-level monitoring network are residential, irrigation, industrial, or unknown well types. Including such well types in the network could result in lack of reliable access to measure static (nonpumping) groundwater levels. DWR's BMP for *Monitoring Networks and Identification of Data Gaps* (DWR, 2016c) indicates that such well types can be used temporarily until either dedicated monitoring wells can be installed or an existing well can be identified that meets the criterion of being a dedicated monitoring well.
- There is a limited number of shallow monitoring wells near GDEs to assess impacts on these beneficial users.

- As shown on Figure 5-1, relatively large areas of the Anderson Subbasin lack groundwater-level monitoring wells, particularly in the northern and central portions of the subbasin.
- Some wells lack well completion information (e.g., screen intervals).

As described in Chapter 5, there is limited ability to fund improvements to the monitoring networks in the Anderson Subbasin. The EAGSA will look for opportunities to fill data gaps as funding resources become available (such as through the DWR Technical Support Services grants). Such activities may include installation of new monitoring wells, video logging of wells with unknown or uncertain well construction, or expansion of the monitoring network by seeking permission to monitor additional private wells in the areas listed above.

8.3.2 Groundwater Storage Data Gaps

Changes in groundwater storage will be monitored by proxy through the measurement of groundwater levels. Therefore, no additional data gaps beyond those identified for groundwater levels in the Anderson Subbasin (see Section 8.3.1) have been identified for monitoring changes in groundwater storage.

8.3.3 Interconnected Surface-water Data Gaps

Depletions of interconnected surface water will also be monitored by proxy through the measurement of groundwater levels. Therefore, no additional data gaps beyond those identified for groundwater levels in the Anderson Subbasin (see Section 8.3.1) have been identified for monitoring depletions of interconnected surface water.

8.3.4 Water Quality Data Gaps

As discussed in Chapter 5, data gaps associated with water quality in the Anderson Subbasin include the following:

- Relatively large areas of the Anderson Subbasin lack groundwater quality RMPs, particularly in the northern, central, and western portions of the subbasin (Figure 5-2).
- The GAMA database lacks well completion information (total depth and screen intervals) for many wells identified as RMPs (Table 5-2).

As described in Chapter 5, there is limited ability to fund improvements to the monitoring networks in the Anderson Subbasin. The EAGSA will look for opportunities to fill data gaps as funding resources become available (such as through the DWR Technical Support Services grants). Such activities may include video logging of wells with unknown or uncertain well construction or incorporation of USGS or DWR GAMA wells into the network if routine sample frequencies are established.

8.3.5 Land Subsidence Data Gaps

As discussed in Chapter 5, potential land subsidence will be evaluated through InSAR data made available by DWR. As such, no data gaps associated with land subsidence monitoring are identified.

8.4 Implement Projects and Management Actions

As discussed in Chapter 7, the Anderson Subbasin is and will continue to be managed sustainably. Local agencies implement a variety of actions, particularly during dry and critically dry WYs, to conjunctively manage local water resources. Local entities will continue these management actions during GSP implementation, as appropriate. The need for new projects and management actions will be assessed as part of the 5-year GSP review process.

8.5 Pursuing Work Agreements and Funding Opportunities

As previously discussed, the Anderson Subbasin is, and is projected to continue to be, managed sustainably. Because the subbasin is sustainable, the primary objective of the EAGSA is to implement a cost-effective strategy that results in achieving compliance with GSP regulations while maintaining sustainability. Given the sustainable nature of the subbasin, GSP implementation costs are largely related to administration, monitoring, and reporting. Although GSP implementation costs are relatively low, as compared to higher-priority basins that require projects and management actions to achieve sustainability, the ability of the EAGSA to raise funds beyond those already in the member agencies operating budgets is limited by constraints in its MOU and the high percentage of DACs and SDACs in the subbasin. As such, the EAGSA will coordinate with federal and State agencies to the extent practicable to offset as much of the SGMA-related costs as possible. To bridge the gap between GSP submission in 2022 and the first 5-year assessment report, the EAGSA members will share the SGMA-related cost burden with existing resources and pursue additional grant and TSS funding, as applicable.

8.6 Update the EAGSA Model

The intent of the EAGSA Model is to serve as a numerical representation of the HCM and to provide detailed water budgets for each 5-year assessment. As discussed in Chapters 4 and 6, the EAGSA Model is a key tool for the development of water budgets and evaluating the effects of implementing potential future management actions, if needed, on sustainability. Therefore, the EAGSA Model will need to be updated periodically during GSP implementation. The current version of the model simulates historical monthly hydrologic conditions from WYs 1999 through 2018 and future monthly hydrologic conditions from WYs 2019 through 2071. The following model-related activities will be needed during GSP implementation:

- Update modeling software as new versions and/or platforms become available.
- Replace projected model input values (e.g., precipitation, ET, groundwater pumping, stream inflows, reservoir releases, and diversions) with measured values.
- Update projected precipitation and ET_0 using appropriate GCMs that become available during GSP implementation.
- Incorporate monitoring data (i.e., groundwater levels and streamflows) that will have become available since the last model update into the model calibration process.
- Evaluate projects and management actions, as needed.
- Provide updated historical, current, and projected water budgets to include in each 5-year assessment report.

Additional modeling activities might be needed, depending on issues that could arise during GSP implementation.

8.7 Estimate of GSP Implementation Costs

The EAGSA members will share the SGMA-related cost burden with existing resources and pursue additional grant and TSS funding, as applicable. GSP implementation will incur ongoing costs to fund the following high-level activities:

- GSP implementation program management
- Monitoring, reporting, and outreach
- Address data gaps
- Pursue work agreements and funding opportunities
- Update the EAGSA Model

As described in Section 8.4, because the subbasin is and is anticipated to continue to be managed sustainably, the EAGSA does not anticipate the need to implement projects and management actions beyond those already in place. Because new projects and management actions are not planned for the first 5 years of GSP implementation, development of associated costs and schedules for projects and management actions are not warranted.

Table 8-1 lists approximated combined costs for the initial 5 years of GSP implementation for both the Enterprise and Anderson Subbasins. Costs from envisioned activities have been estimated over a 5-year period and then averaged (divided by 5) to approximate annual costs, which will be shared among the six EAGSA member agencies. It is likely that costs will not be the same from year-to-year and will depend on actual activities and funding opportunities available during each of the 5 years.

Table 8-1. Approximated EAGSA Combined Implementation Costs for Enterprise and Anderson Subbasins

High-level Activity	Approximated Average Annual Cost (thousands)[a]	Approximated Average Annual Cost Range (thousands)[b]	Assumption
GSP Implementation Program Management	$31	$24 to $55	
▪ General Administration	$14	$11 to $25	Includes administration, oversight, coordination, notification, and general GSP implementation.
▪ EAGSA Management Committee Meetings	$10	$10 to $23	Preparation and participation of six member agencies four times per year.
▪ EAGSA Board Meetings	$5	$4 to $9	Preparation and participation of six member agencies two times per year (including one public workshop).
Monitoring, Reporting, and Outreach	$52	$40 to $92	
▪ Monitoring	$2	$2 to $4	Other entities will continue measuring groundwater levels, sampling groundwater quality, and processing InSAR imagery. The EAGSA will download and process the monitoring data annually, which will be managed in the DMS.
▪ Annual Reporting	$27	$20 to $47	Assess monitoring data against SMCs; prepare draft and final tables, graphics, text; update the DMS; upload final annual report.

Table 8-1. Approximated EAGSA Combined Implementation Costs for Enterprise and Anderson Subbasins

High-level Activity	Approximated Average Annual Cost (thousands)[a]	Approximated Average Annual Cost Range (thousands)[b]	Assumption
▪ 5-Year Assessment Reporting[c]	$17	$13 to $30	Assess whether new data warrant changes in SMCs; prepare draft and final reports; upload final 5-year assessment report.
▪ Outreach	$6	$5 to $11	One public meeting per year to discuss findings of annual report; COR hosts and updates EAGSA website.
Address Data Gaps	$10	$8 to $18	
▪ Address Data Gaps	$10	$8 to $18	Identifying existing candidate wells to add to monitoring network; video logging wells with unknown well construction; developing well access agreements.
Pursue Work Agreements and Funding Opportunities	$9	$7 to $16	
▪ Pursue Work Agreements	$3	$2 to $5	Coordinating with DWR, USGS, and others on data collection.
▪ Pursue/Develop Grant Applications	$6	$5 to $11	Periodic grant and TSS applications, as applicable.
Update the EAGSA Model[c,d]	$17	$13 to $30	
▪ Update the Historical Version of the EAGSA Model	$8	$6 to $14	Compile and update climate, hydrological, land use, and water use data; prepare historical and current water budgets.
▪ Update the Projection Version of the EAGSA Model	$2	$2 to $4	Compile and update global climate models and future hydrological, land use, and water use data; prepare projected water budgets.
▪ Prepare Model Update Reports	$7	$5 to $12	Draft and final versions will be prepared.
Total Average Annual Cost	$119	$92 to $2114	
Approximated 5-Year Cost	$595	$460 to $1,055	

[a] Values are rounded to the nearest $1,000.

[b] Range computed as -25% to +75% of individual activities and then rounded to the nearest $1,000.

[c] This activity would occur once every 5 years, but total costs are divided by 5 to approximate annual average costs.

[d] It is anticipated that the EAGSA Model update during the first 5-year GSP assessment will represent the largest effort and that subsequent updates will require a lower level of effort.

Table 8-1. Approximated EAGSA Combined Implementation Costs for Enterprise and Anderson Subbasins

High-level Activity	Approximated Average Annual Cost (thousands)[a]	Approximated Average Annual Cost Range (thousands)[b]	Assumption

Values in this table are approximated combined costs for the initial 5 years of GSP implementation for both the Enterprise and Anderson Subbasins.

Estimates in Table 8-1 will be refined as efficiencies are gained from optimizing and prioritizing activities and as the SGMA program evolves. As described in Section 8.4, to bridge the gap between GSP submission in 2022 and the first 5-year assessment report, the EAGSA members will share the SGMA-related cost burden with existing resources and pursue additional grant and TSS funding, as applicable.

8.8 Schedule for GSP Implementation

Exhibit 8-1 illustrates the general timeline of major activities during GSP implementation from 2022 through 2042. Because the subbasin has been managed and is anticipated to continue to be managed sustainably, existing projects and management actions would only be implemented on an as-needed basis by local water managers. Therefore, the timing of projects and management actions are not included in the schedule.

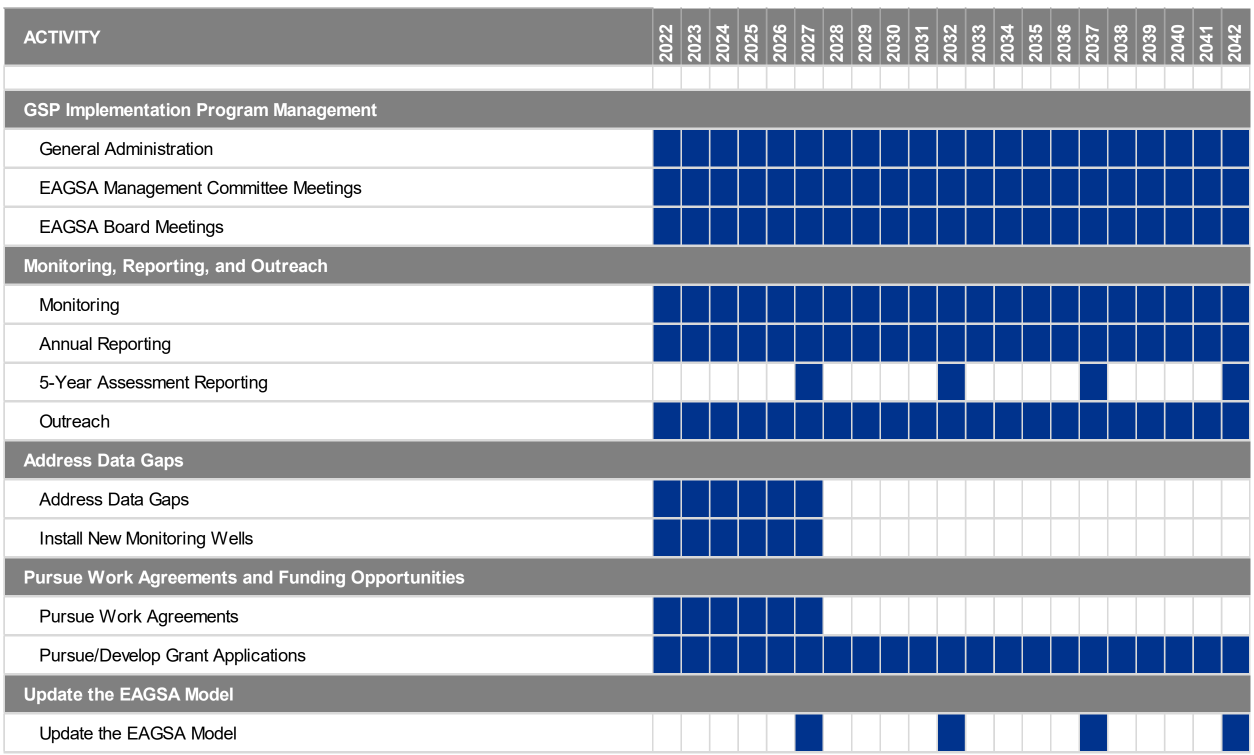


Exhibit 8-1. GSP Implementation Schedule

9. References

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Appendix A
DWR Preparation Checklist for GSP Submittal

Article 5. Plan Contents for the Anderson Subbasin

				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
§ 354.			**Introduction to Plan Contents**					
			This Article describes the required contents of Plans submitted to the Department for evaluation, including administrative information, a description of the basin setting, sustainable management criteria, description of the monitoring network, and projects and management actions.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
SubArticle 1.			**Administrative Information**					
§ 354.2.			**Introduction to Administrative Information**					
			This Subarticle describes information in the Plan relating to administrative and other general information about the Agency that has adopted the Plan and the area covered by the Plan.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.4.			**General Information**					
			Each Plan shall include the following general information:					
(a)			An executive summary written in plain language that provides an overview of the Plan and description of groundwater conditions in the basin.	3:12				
(b)			A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.	245:251				
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10733.2 and 10733.4, Water Code.					
§ 354.6.			**Agency Information**					
			When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:					
(a)			The name and mailing address of the Agency.	27	1.3			
(b)			The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan.	27:28	1.3.1			
(c)			The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.	27	1.3			
(d)			The legal authority of the Agency, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agency, demonstrating that the Agency has the legal authority to implement the Plan.	28	1.3.2			
(e)			An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.	241:244	8.7		8-1	
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.8, 10727.2, and 10733.2, Water Code.					
§ 354.8.			**Description of Plan Area**					
			Each Plan shall include a description of the geographic areas covered, including the following information:					

Article 5. Plan Contents for the Anderson Subbasin

				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(a)			One or more maps of the basin that depict the following, as applicable:					
	(1)		The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.	54	2	2-1		
	(2)		Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.	54	2.1			
	(3)		Jurisdictional boundaries of federal or state land (including the identity of the agency with jurisdiction over that land), tribal land, cities, counties, agencies with water management responsibilities, and areas covered by relevant general plans.	54:55	2.2	2-2, 2-3		
	(4)		Existing land use designations and the identification of water use sector and water source type.	55:58	2.3	2-4, 2-5	2-1	
	(5)		The density of wells per square mile, by dasymetric or similar mapping techniques, showing the general distribution of agricultural, industrial, and domestic water supply wells in the basin, including de minimis extractors, and the location and extent of communities dependent upon groundwater, utilizing data provided by the Department, as specified in Section 353.2, or the best available information.	28:59	2.4	2-6a:2-8b	2-2	
(b)			A written description of the Plan area, including a summary of the jurisdictional areas and other features depicted on the map.	54:55	2.2	2-1:2-2		
(c)			Identification of existing water resource monitoring and management programs, and description of any such programs the Agency plans to incorporate in its monitoring network or in development of its Plan. The Agency may coordinate with existing water resource monitoring and management programs to incorporate and adopt that program as part of the Plan.	59:65	2.5:2.9, 2.11:2.12			
(d)			A description of how existing water resource monitoring or management programs may limit operational flexibility in the basin, and how the Plan has been developed to adapt to those limits.	61	2.10			
(e)			A description of conjunctive use programs in the basin.	68	2.14			
(f)			A plain language description of the land use elements or topic categories of applicable general plans that includes the following:					
	(1)		A summary of general plans and other land use plans governing the basin.	68:71	2.15			
	(2)		A general description of how implementation of existing land use plans may change water demands within the basin or affect the ability of the Agency to achieve sustainable groundwater management over the planning and implementation horizon, and how the Plan addresses those potential effects	71	2.15.6			
	(3)		A general description of how implementation of the Plan may affect the water supply assumptions of relevant land use plans over the planning and implementation horizon.	71	2.15.7			
	(4)		A summary of the process for permitting new or replacement wells in the basin, including adopted standards in local well ordinances, zoning codes, and policies contained in adopted land use plans.	70:71	2.15.4			
	(5)		To the extent known, the Agency may include information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management.	71	2.15.5			
(g)			A description of any of the additional Plan elements included in Water Code Section 10727.4 that the Agency determines to be appropriate.	71:72	2.16			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10720.3, 10727.2, 10727.4, 10733, and 10733.2, Water Code.					
§ 354.10.			**Notice and Communication**					
			Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:					
(a)			A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.	29:33	1.5.1:1.5.2			

Article 5. Plan Contents for the Anderson Subbasin

				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
(b)			A list of public meetings at which the Plan was discussed or considered by the Agency.	35:36	1.5.6		1-3:1-4	
(c)			Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.	37:41, 349:390	1.5.7, C-4		1-5	
(d)			A communication section of the Plan that includes the following:					
	(1)		An explanation of the Agency's decision-making process.	37, 42	1.5.8			
	(2)		Identification of opportunities for public engagement and a discussion of how public input and response will be used.	43	1.5.9			
	(3)		A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin.	43:46	1.5.10	1-2:1-4		
	(4)		The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.	47:49	1.5.12:1.5.13			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.8, 10728.4, and 10733.2, Water Code					
SubArticle 2.			**Basin Setting**					
§ 354.12.			**Introduction to Basin Setting**					
			This Subarticle describes the information about the physical setting and characteristics of the basin and current conditions of the basin that shall be part of each Plan, including the identification of data gaps and levels of uncertainty, which comprise the basin setting that serves as the basis for defining and assessing reasonable sustainable management criteria and projects and management actions. Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.14.			**Hydrogeologic Conceptual Model**					
(a)			Each Plan shall include a descriptive hydrogeologic conceptual model of the basin based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems in the basin.	88:98	3.1			
(b)			The hydrogeologic conceptual model shall be summarized in a written description that includes the following:					
	(1)		The regional geologic and structural setting of the basin including the immediate surrounding area, as necessary for geologic consistency.	91	3.1.4			
	(2)		Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.	94	3.1.6.1			
	(3)		The definable bottom of the basin.	94	3.1.6.2	3-9		
	(4)		Principal aquifers and aquitards, including the following information:					
		(A)	Formation names, if defined.	94:95	3.1.6.3	3-7:3-8		
		(B)	Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.	95:96	3.1.6.4			
		(C)	Structural properties of the basin that restrict groundwater flow within the principal aquifers, including information regarding stratigraphic changes, truncation of units, or other features.	94	3.1.5.3			
		(D)	General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.	104:106	3.2.5	3-19:3-21		
		(E)	Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.	56:57, 94	2.3.1, 3.1.6.3			

Article 5. Plan Contents for the Anderson Subbasin

				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(5)		Identification of data gaps and uncertainty within the hydrogeologic conceptual model	N/A				The current understanding of the hydrogeologic conceptual model of Anderson Subbasin is adequate to meet the needs of the GSP.
(c)			The hydrogeologic conceptual model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin.	121:122		3-7:3-8		
(d)			Physical characteristics of the basin shall be represented on one or more maps that depict the following:					
	(1)		Topographic information derived from the U.S. Geological Survey or another reliable source.	114		3-1		
	(2)		Surficial geology derived from a qualified map including the locations of cross-sections required by this Section.	119:120		3-6a:3-6b		
	(3)		Soil characteristics as described by the appropriate Natural Resources Conservation Service soil survey or other applicable studies.	118		3-5		
	(4)		Delineation of existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas, including significant active springs, seeps, and wetlands within or adjacent to the basin.	124		3-10		
	(5)		Surface water bodies that are significant to the management of the basin.	117		3-4		
	(6)		The source and point of delivery for imported water supplies.	90, 117	3.1.3	3-4		
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10733, and 10733.2, Water Code.					
§ 354.16.			**Groundwater Conditions**					
			Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:	98:107	3.2			
(a)			Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:	98:103, 403:450	3.2.1	3-12:3-15f, Appendix D		
	(1)		Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin.	126:127		3-12:3-13		
	(2)		Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.	128:134, 403:450		3-14:3-15f, Appendix D		
(b)			A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating 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.	137		3-18		
(c)			Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.	N/A				The Anderson Subbasin is not susceptible to seawater intrusion given its distance from the Pacific Ocean.
(d)			Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.	104:106, 451:2057	3.2.5, Appendix E	3-19:3-21		
(e)			The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	107, 141	3.2.6	3-22		
(f)			Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	103	3.2.2	3-16:3-17		
(g)			Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.	97:98	3.1.6.6	3-11		

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				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10727.4, and 10733.2, Water Code.					
§ 354.18.			**Water Budget**					
(a)			Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.	142:157	4	4-1:4-10	4-1:4-6	
(b)			The water budget shall quantify the following, either through direct measurements or estimates based on data:					
	(1)		Total surface water entering and leaving a basin by water source type.	149:151	4.5.2	4-5,4-8	4-4	
	(2)		Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.	151:153	4.5.3	4-6,4-9	4-5	
	(3)		Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.	151:153	4.5.3	4-6,4-9	4-5	
	(4)		The change in the annual volume of groundwater in storage between seasonal high conditions.	153	4.5.3	4-10	4-5	
	(5)		If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.	N/A				Overdraft conditions are not currently present in the Anderson Subbasin and are not projected to occur in the future based on reasonable estimates of future water supply and demand as well as climate change.
	(6)		The water year type associated with the annual supply, demand, and change in groundwater stored.	153:156	4.6		4-6	
	(7)		An estimate of sustainable yield for the basin.	156:157	4.7			
(c)			Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:					
	(1)		Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.	144, 145:153	4.1, 4.3:4.5	4-3:4-5	4-4:4-9	
	(2)		Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:					
		(A)	A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.	153:156	4.6		4-6	
		(B)	A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.	144, 145:153	4.1, 4.3:4.5	4-3:4-5	4-4:4-9	
		(C)	A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.	156:157	4.7			
	(3)		Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:					

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		(A)	Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.	144, 145:153	4.1, 4.3:4.5	4-3:4-5	4-4:4-9	
		(B)	Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.	144, 145:153	4.1, 4.3:4.5	4-3:4-5	4-4:4-9	
		(C)	Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.	144, 145:153	4.1, 4.3:4.5	4-3:4-5	4-4:4-9	
(d)			The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:					
	(1)		Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.	144:147	4.2.1, 4.4.1	4-2	4-2	
	(2)		Current water budget information for temperature, water year type, evapotranspiration, and land use.	144:147	4.2.1, 4.4.1	4-2	4-2	
	(3)		Projected water budget information for population, population growth, climate change, and sea level rise.	145, 146:147	4.2.2, 4.4.2	4-3	4-2	
(e)			Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.	2048:2297	Appendix F			
(f)			The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.	2048:2297	Appendix F			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10723.2, 10727.2, 10727.6, 10729, and 10733.2, Water Code.					
§ 354.20.			**Management Areas**					
(a)			Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the Plan. Management areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin.	N/A				The EAGSA has not designated management areas for the Anderson Subbasin
(b)			A basin that includes one or more management areas shall describe the following in the Plan:					
	(1)		The reason for the creation of each management area.	N/A				The EAGSA has not designated management areas for the Anderson Subbasin
	(2)		The minimum thresholds and measurable objectives established for each management area, and an explanation of the rationale for selecting those values, if different from the basin at large.	N/A				The EAGSA has not designated management areas for the Anderson Subbasin
	(3)		The level of monitoring and analysis appropriate for each management area.	N/A				The EAGSA has not designated management areas for the Anderson Subbasin

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				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(4)		An explanation of how the management area can operate under different minimum thresholds and measurable objectives without causing undesirable results outside the management area, if applicable.	N/A				The EAGSA has not designated management areas for the Anderson Subbasin
(c)			If a Plan includes one or more management areas, the Plan shall include descriptions, maps, and other information required by this Subarticle sufficient to describe conditions in those areas.	N/A				The EAGSA has not designated management areas for the Anderson Subbasin
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10733.2 and 10733.4, Water Code.					
SubArticle 3.			**Sustainable Management Criteria**					
§ 354.22.			**Introduction to Sustainable Management Criteria**					
			This Subarticle describes criteria by which an Agency defines conditions in its Plan that constitute sustainable groundwater management for the basin, including the process by which the Agency shall characterize undesirable results, and establish minimum thresholds and measurable objectives for each applicable sustainability indicator.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.24.			**Sustainability Goal**					
			Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.	27, 88:107, 181	1.2, 3, 6.2			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10727, 10727.2, 10733.2, and 10733.8, Water Code.					
§ 354.26.			**Undesirable Results**					
(a)			Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.	182:183, 192:194, 196, 201, 206:207, 209:210	6.3, 6.3.2.4, 6.3.3.5, 6.3.4.5, 6.3.5.4, 6.3.6.4		6-1, 6-4a:6-4b	
(b)			The description of undesirable results shall include the following:					
	(1)		The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.	194, 207, 210	6.3.2.4, 6.3.5.4, 6.3.6.4			
	(2)		The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.	192:194, 196, 201, 206:207, 209:210	6.3.2.4, 6.3.3.5, 6.3.4.5, 6.3.5.4, 6.3.6.4		6-4a:6-4b	
	(3)		Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.	194, 207, 210	6.3.2.4, 6.3.5.4, 6.3.6.4			
(c)			The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.	193:194, 207, 209:210	6.3.2.4, 6.3.5.4, 6.3.6.4			
(d)			An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.	184	6.3.1			

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				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10721, 10723.2, 10727.2, 10733.2, and 10733.8, Water Code.					
§ 354.28.			**Minimum Thresholds**					
(a)			Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.	182:183, 185:192, 196, 200:201, 202:206, 208:209	6.3, 6.3.2.3, 6.3.3.4, 6.3.4.4, 6.3.5.3, 6.3.6.3		6-1:6-3, 6-7	
(b)			The description of minimum thresholds shall include the following:					
	(1)		The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.	187, 195:196, 197:200, 202:206, 208	6.3.2.3, 6.3.3.2, 6.3.4.2, 6.3.5.3, 6.3.6.3	6-3:6-4d	6-5, 6-6	
	(2)		The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.	189, 206, 209	6.3.2.3, 6.3.5.3, 6.3.6.3		6-3	
	(3)		How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.	189, 206, 209	6.3.2.3, 6.3.5.3, 6.3.6.3			
	(4)		How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.	188:189, 202-206, 208	6.3.2.3, 6.3.5.3, 6.3.6.3			
	(5)		How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.	189, 205:206, 209	6.3.2.3, 6.3.5.3, 6.3.6.3			
	(6)		How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.	192, 207, 209:210	6.3.2.3, 6.3.5.4, 6.3.6.4			
(c)			Minimum thresholds for each sustainability indicator shall be defined as follows:					
	(1)		Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:					
		(A)	The rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin.	187	6.3.2.3	6-3:6-4d		
		(B)	Potential effects on other sustainability indicators.	189	6.3.2.3		6-3	
	(2)		Reduction of Groundwater Storage. The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.	N/A				Pursuant to §354.28(d), the EAGSA has proposed the use of the sustainable management criteria for chronic lowering of groundwater levels as a proxy for reduction of groundwater storage.
	(3)		Seawater Intrusion. The minimum threshold for seawater intrusion shall be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results. Minimum thresholds for seawater intrusion shall be supported by the following:	184	6.3.1			
		(A)	Maps and cross-sections of the chloride concentration isocontour that defines the minimum threshold and measurable objective for each principal aquifer.	N/A				The Anderson Subbasin is not vulnerable to seawater intrusion, given its distance from the Pacific Ocean and associated bays and estuaries. Therefore, pursuant to GSP regulation § 354.26(d), SMCs are not applicable to this sustainability indicator.

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		(B)	A description of how the seawater intrusion minimum threshold considers the effects of current and projected sea levels.	N/A				The Anderson Subbasin is not vulnerable to seawater intrusion, given its distance from the Pacific Ocean and associated bays and estuaries. Therefore, pursuant to GSP regulation § 354.26(d), SMCs are not applicable to this sustainability indicator.
	(4)		Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.	202:206	6.3.5.3		6-7	
	(5)		Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:	208:210	6.3.6.3			
		(A)	Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects.	208	6.3.6.3			
		(B)	Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.	141			3-22	
	(6)		Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:	N/A				Pursuant to §354.28(d), the EAGSA has proposed the use of the sustainable management criteria for chronic lowering of groundwater levels as a proxy for depletions of interconnected surface water.
		(A)	The location, quantity, and timing of depletions of interconnected surface water.	197:200	6.3.4.2		6-5	
		(B)	A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph.	197:200, 2048:2297	6.3.4.2, Appendix F		6-5	
(d)			An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.	195:196, 197:200	6.3.3.2, 6.3.4.2		6-5	
(e)			An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.	184	6.3.1			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10733, 10733.2, and 10733.8, Water Code.					
§ 354.30.			**Measurable Objectives**					
(a)			Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.	185, 196, 200, 202, 208	6.3.2.2, 6.3.3.3, 6.3.4.3, 6.3.5.2, 6.3.6.2	6-3:6-4d	6-2, 6-3, 6-6	
(b)			Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.	185, 196, 200, 202, 208	6.3.2.2, 6.3.3.3, 6.3.4.3, 6.3.5.2, 6.3.6.2		6-2, 6-6	

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(c)			Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.	185, 196, 200, 202, 208	6.3.2.2, 6.3.3.3, 6.3.4.3, 6.3.5.2, 6.3.6.2	6-3:6-4d	6-2, 6-6	
(d)			An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.	195:196, 197:200	6.3.3.2, 6.3.4.2			
(e)			Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.	181	6.2.3			
(f)			Each Plan may include measurable objectives and interim milestones for additional Plan elements described in Water Code Section 10727.4 where the Agency determines such measures are appropriate for sustainable groundwater management in the basin.	N/A				The EAGSA has not included measurable objectives for additional plan elements.
(g)			An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.	N/A				The Anderson Subbasin is and is projected to be sustainable; therefore, the EAGSA has determined that there is not a current need to set measurable objectives to improve conditions within the subbasin.
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10727.4, and 10733.2, Water Code.					
SubArticle 4.			**Monitoring Networks**					
§ 354.32.			**Introduction to Monitoring Networks**					
			This Subarticle describes the monitoring network that shall be developed for each basin, including monitoring objectives, monitoring protocols, and data reporting requirements. The monitoring network shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.	168:177	5	5-1, 5-2, 6-3, 6-10	5-1, 5-2	
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					
§ 354.34.			**Monitoring Network**					
(a)			Each Agency shall develop a monitoring network capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan implementation.	168:177	5	5-1, 5-2, 6-3, 6-10	5-1, 5-2	
(b)			Each Plan shall include a description of the monitoring network objectives for the basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:					
	(1)		Demonstrate progress toward achieving measurable objectives described in the Plan.	156:157, 181	4.7, 6.2.2, 6.2.3			The Anderson Subbasin is and is projected to be sustainable; therefore, the EAGSA has determined that there is not a current demonstrate progress towards achieving measurable objectives. The current monitoring network is adequate for evaluating measurable objectives.
	(2)		Monitor impacts to the beneficial uses or users of groundwater.	168:177	5	5-1, 5-2, 6-3, 6-10	5-1, 5-2	

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	(3)		Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.	168:177	5	5-1, 5-2, 6-3, 6-10	5-1, 5-2	
	(4)		Quantify annual changes in water budget components.	168:177	5	5-1, 5-2, 6-3, 6-10	5-1, 5-2	
(c)			Each monitoring network shall be designed to accomplish the following for each sustainability indicator:					
	(1)		Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods:	168:172	5.3	5-1, 6-3	5-1	
		(A)	A sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.	171	5.3.3	5-1, 6-3	5-1,	
		(B)	Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.	171	5.3.4			
	(2)		Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.	N/A				Pursuant to §354.28(d), the EAGSA has proposed the use of the sustainable management criteria for chronic lowering of groundwater levels as a proxy for reduction of groundwater storage.
	(3)		Seawater Intrusion. Monitor seawater intrusion using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated.	N/A				Pursuant to §354.28(d), the EAGSA has proposed the use of the sustainable management criteria for chronic lowering of groundwater levels as a proxy for depletions of interconnected surface water.
	(4)		Degraded Water Quality. Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.	172:176	5.6	5-2, 6-10	5-2	
	(5)		Land Subsidence. Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method.	176:177	5.7			
	(6)		Depletions of Interconnected Surface Water. Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions. The monitoring network shall be able to characterize the following:	N/A				Pursuant to §354.28(d), the EAGSA has proposed the use of the sustainable management criteria for chronic lowering of groundwater levels as a proxy for depletions of interconnected surface water.
		(A)	Flow conditions including surface water discharge, surface water head, and baseflow contribution.	N/A				See not associated with (6)
		(B)	Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.	N/A				See not associated with (6)
		(C)	Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.	N/A				See not associated with (6)
		(D)	Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.	N/A				See not associated with (6)
(d)			The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.	N/A				The EAGSA has not designated management areas for the Anderson Subbasin
(e)			A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.	168:169, 172:173, 176	5.3.1, 5.6.1, 5.7.1			
(f)			The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:					

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				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
	(1)		Amount of current and projected groundwater use.	171, 175:176, 177	5.3.3, 5.3.4, 5.6.3, 5.6.4, 5.7.3, 5.7.4			
	(2)		Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.	171, 175:176, 177	5.3.3, 5.3.4, 5.6.3, 5.6.4, 5.7.3, 5.7.4			
	(3)		Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.	171, 175:176, 177	5.3.3, 5.3.4, 5.6.3, 5.6.4, 5.7.3, 5.7.4			
	(4)		Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.	171, 175:176, 177	5.3.3, 5.3.4, 5.6.3, 5.6.4, 5.7.3, 5.7.4			
(g)			Each Plan shall describe the following information about the monitoring network:					
	(1)		Scientific rationale for the monitoring site selection process.	168:168, 172:176	5.3.1, 5.3.2, 5.6.1, 5.6.2, 5.7.1, 5.7.2	5-1, 5-2	5-1, 5-2	
	(2)		Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.	171:172, 176	5.3.6, 5.6.6			
	(3)		For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.	186, 205, 208	6.3.2.2, 6.3.2.3, 6.3.5.2, 6.3.5.3, 6.3.6.2, 6.3.6.3		6-2, 6-7	
(h)			The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.	169-171, 173:175	5.3, 5.6	5-1, 5-2	5-1, 5-2	
(i)			The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.	171, 176, 177	5.3.5, 5.6.5, 5.7.5			
(j)			An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.	168	5.2			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10727.4, 10728, 10733, 10733.2, and 10733.8, Water Code					
§ 354.36.			**Representative Monitoring**					
			Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:					
(a)			Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.	169, 173, 176	5.3.2, 5.6.2, 5.7.2	5-1, 5-2	5-1, 5-2	
(b)			(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:					
	(1)		Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.	195:196, 197:200	6.3.3.2, 6.3.4.2			
	(2)		Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.	195:196, 197:200	6.3.3.2, 6.3.4.2			
(c)			The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.	169, 173, 176	5.3.2, 5.6.2, 5.7.2	5-1, 5-2	5-1, 5-2	

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				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2 and 10733.2, Water Code					
§ 354.38.			**Assessment and Improvement of Monitoring Network**					
(a)			Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.	171:172, 176	5.3.6, 5.6.6			
(b)			Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.	171:172, 176	5.3.6, 5.6.6			
(c)			If the monitoring network contains data gaps, the Plan shall include a description of the following:					
	(1)		The location and reason for data gaps in the monitoring network.	171:172, 176	5.3.6, 5.6.6			
	(2)		Local issues and circumstances that limit or prevent monitoring.	171:172, 176	5.3.6, 5.6.6			
(d)			Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.	239:240	8.3			
(e)			Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:					
	(1)		Minimum threshold exceedances.	192:193, 207, 209:210	6.3.2.4, 6.3.5.4, 6.3.6.4			
	(2)		Highly variable spatial or temporal conditions.	192:193, 207, 209:210	6.3.2.4, 6.3.5.4, 6.3.6.4			
	(3)		Adverse impacts to beneficial uses and users of groundwater.	192:193, 207, 209:210	6.3.2.4, 6.3.5.4, 6.3.6.4			
	(4)		The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.	192:193, 207, 209:210	6.3.2.4, 6.3.5.4, 6.3.6.4			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10723.2, 10727.2, 10728.2, 10733, 10733.2, and 10733.8, Water Code					
§ 354.40.			**Reporting Monitoring Data to the Department**					
			Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.	177	5.8			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10728, 10728.2, 10733.2, and 10733.8, Water Code.					
SubArticle 5.			**Projects and Management Actions**					
§ 354.42.			**Introduction to Projects and Management Actions**					
			This Subarticle describes the criteria for projects and management actions to be included in a Plan to meet the sustainability goal for the basin in a manner that can be maintained over the planning and implementation horizon.					
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Section 10733.2, Water Code.					

Article 5. Plan Contents for the Anderson Subbasin

				GSP Document References				
				Page Numbers of Plan	Or Section Numbers	Or Figure Numbers	Or Table Numbers	Notes
§ 354.44.			**Projects and Management Actions**					
(a)			Each Plan shall include a description of the projects and management actions the Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.	225:235	7			
(b)			Each Plan shall include a description of the projects and management actions that include the following:					
	(1)		A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent. The Plan shall include the following:					
		(A)	A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management actions, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.	226, 232	7.1, 7.2			
		(B)	The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.	226, 232	7.1, 7.2			
	(2)		If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.	225:235	7			Overdraft conditions are not present in the Anderson Subbasin and are not projected to occur in the future. The EAGSA has included descriptions of projects and management actions to address changing conditions in the subbasin.
	(3)		A summary of the permitting and regulatory process required for each project and management action.	226, 232	7.1, 7.2			
	(4)		The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.	226, 232	7.1, 7.2			
	(5)		An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.	228, 229, 230, 233, 234, 235	7.1.1.3, 7.1.2.3, 7.1.3.3, 7.2.1.2, 7.2.2.2, 7.2.3.2			
	(6)		An explanation of how the project or management action will be accomplished. If the projects or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall be included.	227:228, 228:229, 229:230, 233, 233:234, 234:235	7.1.1.1, 7.1.2.1, 7.1.3.1, 7.2.1.1, 7.2.2.1, 7.2.3.1			
	(7)		A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.	226, 232	7.1, 7.2			
	(8)		A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.	227, 233	7.1, 7.2			
	(9)		A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.	225:235	7			
(c)			Projects and management actions shall be supported by best available information and best available science.	225:235	7			
(d)			An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.	225:235	7			
			Note: Authority cited: Section 10733.2, Water Code.					
			Reference: Sections 10727.2, 10727.4, and 10733.2, Water Code.					

Appendix B
Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING FORMING THE ENTERPRISE-ANDERSON GROUNDWATER SUSTAINABILITY AGENCY

THIS MEMORANDUM OF UNDERSTANDING ("MOU") is made and entered into as of May 5, 2017, between the City of Anderson ("Anderson"), the Anderson-Cottonwood Irrigation District ("ACID"), Bella Vista Water District ("BVWD"), the Clear Creek Community Services District ("CCCSD"), the City of Redding ("Redding") and the County of Shasta ("County"), each a "Member" and collectively the "Members;" and

WHEREAS, on September 16, 2014, Governor Brown signed three bills (SB 1168, SB 1319, and AB 1739) into law creating the Sustainable Groundwater Management Act of 2014 ("SGMA") codified at Water Code section 10720 et seq.; and

WHEREAS, SGMA requires the formation of a Groundwater Sustainability Agency ("GSA") that will be responsible for implementing provisions of SGMA as to medium and high priority groundwater basins, as identified by the State of California Department of Water Resources ("DWR"); and

WHEREAS, under SGMA, each GSA is responsible for assuming its regulatory role by July 1, 2017, and for submitting a Groundwater Sustainability Plan ("GSP") to the California State Water Resources Control Board ("SWRCB") by either January 31, 2020, or January 31, 2022, depending on criteria specified in SGMA; and

WHEREAS, the Enterprise Sub-basin (DWR Basin No. 5-6.04) and the Anderson Sub-basin (DWR Basin No. 5-6.03) have been delineated by the DWR and identified as medium priority basins thereby making both subject to the provisions of SGMA; and

WHEREAS, Water Code Section 10723.6 authorizes a combination of local agencies overlying a groundwater basin to elect to become a Groundwater Sustainability Agency ("GSA") by using a memorandum of agreement.

NOW THEREFORE, incorporating the above recitals herein and all exhibits attached, it is mutually understood and agreed as follows:

SECTION 1. ESTABLISHMENT.

Pursuant to the authority set forth in Water Code Section 10723, the Members hereby establish the Enterprise-Anderson Groundwater Sustainability Agency ("EAGSA") to manage the Enterprise Sub-basin and the Anderson Sub-basin as depicted in Exhibit A.

SECTION 2. PURPOSE.

A. The purposes of this MOU are as follows:

1. Comply with SGMA;

2. Ensure the continued sustainability of the Anderson and Enterprise Subbasins; and

3. Develop, adopt, implement and manage a GSP for the sustainable management of groundwater within the Enterprise and Anderson Sub-basins of the Redding Area Groundwater Basin while keeping the complexity and costs as low as practicable.

B. The Members intend to maintain complete control and autonomy over the surface water and groundwater resources within their respective jurisdictions. Nothing herein is intended, nor shall be construed to affect, impair, or alter the surface water rights and groundwater rights of any Member or the rights of any landowner or customer of any Member.

C. Each Member agrees to exercise its powers under any authority it may have consistent with SGMA, the GSP, and in a manner that does not significantly interfere with any other Member's or the EAGSA's ability to successfully comply with SGMA and to achieve and maintain the sustainability goals of the GSP.

SECTION 3. GOVERNANCE AND ORGANIZATION.

A. **Governing Board:** The EAGSA shall be governed by a Board of Directors who shall serve without compensation or term of office and shall be appointed and/or removed by the legislative body of each Member. The EAGSA Board of Directors shall be composed as follows:

1. One (1) Anderson Council Member
2. One (1) ACID Board Member
3. One (1) CCCSD Board Member
4. One (1) Redding Council Member.
5. One (1) BVWD Board Member.
6. One (1) County Supervisor

B. **Alternative Directors:** Each of the Members may designate one (1) Alternate Director who shall serve only when the Director is absent or when it is anticipated that the Director may have a conflict of interest. Each such Alternate Director must be a member of the legislative body of the Member agency that he or she represents.

C. **Committees:** The Board of Directors of the EAGSA may appoint committees of its members or of staff as it deems necessary. The following Committees are hereby established:

1. **Management Committee:** Comprised of one staff representative from each Member. The Management Committee shall take direction from the Board of Directors, recommend agenda items, recommend proposed action for the Board of Directors and approve staff reports to the Board of Directors.

2. **Technical Advisory Committee:** ("TAC"): Established by the Management Committee. The TAC shall advise the Management Committee on technical matters related to development and implementation of the GSP.

D. **Support Staff:** Member agencies may provide support staff to the GSA on an as-needed basis.

1. Each Director shall have recourse to its Member's legal counsel.

2. In the event that legal counsel is required for any meeting of the Board of Directors and, for purposes of answering questions relating to compliance with the Ralph M. Brown Act (Gov. Code ' 54950 et seq.), the City of Redding shall supply said legal counsel without cost to the other Members.

3. Each Member's designated legal counsel may attend any meeting of the Board of Directors, including any items agendized for closed session.

E. The City of Redding shall serve as fiscal agent and shall, upon approval of the Board of Directors, have authority to enter into any contract necessary to assist the Members in accomplishing the purposes set forth in Section 2 of this MOU. The City of Redding shall be entitled to its reasonable costs solely attributable to contract administration and directly related support. All Members shall pay an equal, pro-rata share within thirty (30) calendar days of invoice by the City of Redding. Each contract entered into by the City of Redding in accordance with this MOU shall state that:

1. Any changes in the scope of work shall require the advance approval of the Board of Directors;

2. The contract may be terminated with or without cause through majority action of the Board of Directors except that any vote to terminate with cause is subject to override by action of the City Council of the City of Redding should it determine, in its sole discretion, that said determination by the Board of Directors would cause City to be in breach of its contract;